NOAA Technical Report NOS CO-OPS 067

EXTREME WATER LEVELS OF THE UNITED STATES 1893-2010

Sewell Park, Miami, Florida after Hurricane Andrew. ***Photo courtesy of NOAA Central Library.***

Silver Spring, Maryland
September, 2013

noaa National Oceanic and Atmospheric Administration

U.S. DEPARTMENT OF COMMERCE
National Ocean Service
Center for Operational Oceanographic Products and Services

Center for Operational Oceanographic Products and Services

National Ocean Service
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

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EXTREME WATER LEVELS OF THE UNITED STATES 1893-2010

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September, 2013

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LIST OF ACRONYMS

BFE	Base Flood Elevation
CO-OPS	Center for Operational Oceanographic Products and Services
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
GEV	Generalized Extreme Value
GPD	Generalized Pareto Distribution
HWM	High Water Mark
MHHW	Mean Higher High Water
MHW	Mean High Water
MLLW	Mean Lower Low Water
MLW	Mean Low Water
MSL	Mean Sea Level
MTDE	Modified Tidal Datum Epoch
NAVD88	North American Vertical Datum of 1988
NCAR	National Center for Atmospheric Research
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NTDE	National Tidal Datum Epoch
NWLON	National Water Level Observation Network
POT	Peaks over threshold
SWEL	Stillwater Elevation
USGS	United States Geological Survey

EXECUTIVE SUMMARY

Extreme monthly highest and lowest water levels at 112 long-term stations of the National Water Level Observation Network (NWLON) operated by the Center for Operational Oceanographic Products and Services (CO-OPS) are analyzed to quantify probabilities of exceedance and the return periods of extreme events. All data through 2010 are used from stations on the U.S. Atlantic and Pacific coasts, the Gulf of Mexico, Hawaii, Alaska, and islands in the Pacific and Atlantic Oceans. Since there are statistically significant trends in the data, the values are linearly detrended using the mean sea level trend (or the mean high or low water trend in a few cases) prior to analysis. A set of the annual maxima and annual minima are then derived for each station.

The Generalized Extreme Value (GEV) approach was chosen to characterize the distribution of extreme values of a long-term water level time series. A GEV distribution is fitted to each station's annual maxima or minima by solving for the location, scale, and shape parameters. The solution defines an exceedance probability curve and its 95% confidence interval as a function of the return period, which is the average length of time between exceedances of a given extreme water level.

The shapes of the derived GEV curves show large variations at the longer return periods depending on whether the GEV shape parameter is positive (the curve rises sharply) or negative (the curve flattens out). A positive shape parameter indicates a distribution with a higher probability of a rare event in the extreme tail of the distribution. A GEV curve with a positive shape parameter also has much wider 95% confidence intervals than one with a negative shape parameter. The stations with occasional large hurricane storm tides in the data generally have positive shape parameters. Stations on coasts that do not experience hurricanes generally have GEV curves which flatten out at longer return periods and have narrow 95% confidence intervals at the longer return periods.

In the Appendices, the GEV exceedance levels for each station are displayed as a set of plots showing their relationship with the observed annual maxima or minima versus return period, with the tidal and geodetic datums as a stick diagram relative to mean sea level, and with the observed monthly highest and lowest water levels versus time. Extreme events which exceeded the 0.01 exceedance probability level, which can be considered as a 100-year event, are identified. The monthly data are also separated into sets of the highest and the lowest water levels for each month of the year. A GEV analysis is then performed on each of the 24 subsets to show how the likelihood of exceedance changes seasonally.

Hurricane Sandy struck the coast of New Jersey in October 2012. Its peak water level at The Battery was over a meter higher than any previously recorded water level. Levels reached at Bridgeport and Sandy Hook (before the station was destroyed) were also far above previous records. As a result, the GEV exceedance probability levels for high water levels at these three stations were recalculated and the results are discussed in Appendix VIII.

I. Introduction

A. What can be learned from extreme water levels recorded over the past century?

For almost 160 years, coastal water levels in the United States have been measured by continuously-recording instrumentation deployed by the U.S. Coast and Geodetic Survey and its successor agencies. Today, this task is carried out by the Center for Operational Oceanographic Products and Services (CO-OPS) of the National Ocean Service (NOS). The primary reasons that coastal water levels began to be recorded were to derive the harmonic tidal constituents at a particular location for making tide predictions and to collect a sufficient number of observed high and low waters to establish tidal datums for navigational charts, for geodetic surveys, and for legally delineating shorelines and marine boundaries.

Over the years, human "computers" and later electronic computers produced quality-controlled tabulations of hourly (and later six-minute) water levels, and the times and heights of high and low waters. Monthly means were derived from these data sets, including the monthly means of the hourly data (i.e., the monthly mean sea level) and a set of mean tide levels from the high and low waters tabulated for each day, such as the monthly mean high water and mean low water, among others. Also tabulated were the highest and lowest observed water levels for each month, which will form the basis for this NOAA Technical Report.

The establishment of a tidal datum at a primary station requires a 19-year period of observation, known as a tidal datum epoch, to capture the variation caused by the precession of the lunar node (Gill and Schultz, 2001). At other (secondary or tertiary) stations, that are near a primary station and have similar tidal curves, only a year or less of observation is required to establish their tidal datums by a comparison of simultaneous observations (Center for Operational Oceanographic Products and Services, 2003).

Once enough data were collected at a location for tidal prediction and for the establishment of tidal datums, it might be expected that further recording of water levels at a particular location would no longer be required. Fortunately, historical observations were continued at a limited number of primary stations around the nation's coasts in recognition that major changes to harbor configurations and depths, whether natural or man-made, could affect the tides. Therefore, once a 19-year tidal datum epoch was complete and official U.S. tidal datums were established, data continued to be collected at primary stations for the calculation of the next tidal datum epoch.

Originally, the nation-wide network of long-term continuous water level stations (now called the National Water Level Observation Network (NWLON)) was quite small, but has since grown to approximately 210 stations, including, since 1970, stations on the Great Lakes previously operated by the Army Corps of Engineers. Today, these stations provide data for many operational purposes beyond tide predictions and datums. Real-time data collection supports

safe and efficient use of our ports, tsunami warning networks, storm surge modeling, and inundation frequency and duration information.

Over time, it became known that in some parts of the world, particularly in Scandinavia, there are rapid vertical land motions leading to changes in relative sea level that are noticeable over decades or centuries (Marmer, 1951). Sure enough, after several decades of data were collected, it became clear that many U.S. coastal areas had long-term relative sea level trends that are statistically significant (non-zero), due to a combination of vertical land motion and absolute sea level rise (Zervas, 2009). As a result of these long periods of data collection and the tabulation of monthly highest and lowest water levels, records of the most extreme water levels at each station can be placed in a historical context of the more routine highest/lowest water levels observed in most other months.

Many of the analyses, applications, and products that employ the CO-OPS historical water level database are based only on the more recently collected data from the long-term stations. The most commonly-produced analysis that uses a station's entire historical record is the calculation of the mean sea level trend, which is derived from the monthly mean sea levels, often condensed by researchers into a set of annual means. There have also been a few studies that have used entire sets of monthly tide levels to calculate changing tidal ranges in coastal regions ((Flick et al., 2003); Zervas in (Coastal Services Center, 2003)). Bromirski et al. (2003) used the entire series of hourly water levels at San Francisco since 1858, in order to estimate changes in "storminess" from its detided residual time series. A similar study (Zhang et al., 2000) employed ten east coast stations from Portland, ME to Mayport, FL. So far, there have been no comprehensive publications presenting the entire record of monthly highest and lowest water levels at long-term U.S. coastal stations and performing statistical analyses on these data sets.

B. What types of extreme value analysis are carried out in this report?

The monthly highest and lowest water levels were derived from a much greater amount of data (i.e., from six-minute or hourly water levels or even earlier from the direct measurement of analog tide curves recorded on paper). Tsunamis and high-frequency harbor seiches were always excluded from CO-OPS high and low water tabulations by smoothing. The data to be examined are a sampling from a distribution of extreme values from (nearly) equal-length time periods (i.e., monthly maxima and minima). The distribution of extreme values can be fitted by any number of probability distribution formulae. This procedure has been carried out by many researchers and the distribution that fits best is often chosen as the correct distribution and used to estimate extreme value return periods for times greater than the length of the observations. Although many of these distributions were chosen empirically, the theoretically-expected distribution of extremes should follow the Generalized Extreme Value (GEV) distribution (Katz et al., 2002). This is the distribution chosen for this report.

The three GEV parameters (location, scale, and shape) are fitted to the maxima or minima data employing a maximum likelihood estimate (Gilleland and Katz, 2006; Gilleland et al., 2005). Maximum likelihood is a statistical method of solving for the set of model parameters that are the most likely to have produced the observed data. The extRemes package of the R statistical analysis software, developed by the Weather and Climate Impact Assessment Science Program at the National Center for Atmospheric Research (NCAR) (Gilleland et al., 2013; Stephenson and Gilleland, 2005) is used to calculate the GEV parameters.

The analysis is carried out for long-term NWLON stations utilizing all available data through the end of 2010. Since the long-term relative sea level trend at each station can make a substantial difference in how high or low a storm event can reach, depending on whether the event occurred near the beginning, middle, or end of the series, a linear trend is first subtracted from the monthly highest and lowest values. A set of annual highest and lowest values is then produced from the years that have at least four months of data. Years with less than a full year of data are evaluated and dropped if they have a known extreme event missing based on inter-station comparisons.

Once a GEV probability distribution is fitted to the data using a maximum likelihood estimation, a set of plots for each station is produced to clearly demonstrate the results for various practical applications. Exceedance probability level curves are first plotted relative to a range of return periods from 1 year to 200 years. The GEV parameter most important for characterizing the upper tail of the distribution, which includes the most extreme events, is the shape parameter. It is plotted for all stations by region to show similarities and differences between stations.

The levels for the 99%, 50%, 10%, and 1% annual exceedance probabilities are then compared by region to indicate variations of the levels that can be reached and to also identify stations that may have questionable results due to shorter records and/or missing storms. Another set of plots displays each station's stick diagram showing the tidal datums, a geodetic datum (if available), and several high water and low water exceedance probability levels relative to the mean sea level datum (MSL). A third set of plots shows each station's monthly highest or lowest levels before detrending and a set of the calculated exceedance probability levels for several return periods which follow the station's mean sea level trend.

Subsequently, an additional group of GEV analyses are carried out using each station's highest or lowest levels for each of the twelve individual months of the year. These results indicate which months and seasons are most and least likely to have the most extreme storm tide events. The seasonal cycles of the exceedance probability levels for several return periods are plotted for several regionally-representative stations.

C. What applications can use the results of this analysis?

The results presented in this NOAA Technical Report have many practical applications to assist a broad range of users in decision-making and problem solving. Each extreme high or low water event in the historical record can be categorized by its probability of occurrence and return period. Events occurring in the near future will be able to be easily categorized as soon as the water level crosses an exceedance probability threshold. Extreme low waters will be able to be recognized in real time and appropriate navigational warnings could be disseminated to prevent possible ship groundings.

Knowledge of exceedance probability levels will be extremely helpful for coastal planners and managers in their evaluation and assessments of hazards. These levels are critical for most coastal construction projects such as housing, commercial buildings, ports, roads, bridges, sewer/water treatment infrastructure, and storm drainage systems. It is also vitally important for the development of storm surge protection structures and floodplain management.

The Federal Emergency Management Agency (FEMA) bases its coastal flood maps (National Research Council, 2009) on an assessment of the 1% annual probability of inundation level which it calls the Base Flood Elevation (BFE). Their maps also include a zone of 0.2% annual probability of inundation which corresponds to a 1-in-500-year inundation event. The exceedance probability levels calculated in this report are based only on the levels recorded by water level gauges; these levels do not include wave effects which also contribute to the BFEs calculated by FEMA. Water levels measured by gauges correspond more closely to what FEMA defines as the stillwater elevation (SWEL). Although FEMA's definition does not include the wave setup effect, water levels recorded by gauges can include a limited amount of wave setup based on their degree of exposure to ocean waves. FEMA's flood insurance studies (FIS), which are the basis of its flood insurance rate maps (FIRM), employ a number of approaches including extensive numerical modeling with a variety of additional physical effects, but the calculation and/or modeling of SWELs is the underlying basis for flood zoning (Crowell et al., 2007).

Exceedance probability levels are important not just for man-made structures but also for natural ecosystems (Scavia et al., 2002). State and local agencies responsible for management of floodplains and natural coastal landscapes require precise knowledge of land elevations and their relationships to the probability of frequent or infrequent inundation. Coastal marsh ecosystem restoration projects can use this information in their decisions about what types of vegetation will flourish at various land elevations. Beach replenishment and coastal dune restoration projects also require information about exceedance probabilities. These types of projects, which can create or restore a healthy ecosystem, also provide benefits to adjacent developed areas by providing a storm surge and wave buffer.

Once exceedance probability levels are derived, they can be used to project the likelihood of inundation at a location into the future since they are tied to the local tidal datums. They can be raised or lowered by projecting the calculated mean sea level trend into the future. Alternatively,

various scenarios for estimating an acceleration in the rate of global or regional sea level rise, such as those recommended by the Corps of Engineers (Moritz et al., 2012) or by NOAA for the National Climate Assessment (Parris et al., 2012), can be incorporated in projecting future exceedance probability levels (Flick et al., 2013). The implicit underlying assumption would be that there would be no change in storm frequencies in the future.

II. Theory and Methods of Extreme Value Analysis

A. GEV Formulae and Classification

Many different statistical distributions have been employed to describe the frequency of occurrence of extreme values in a time series. Data are either a series of maximum values occurring in equal time blocks such as days, months, or years or all the values above a chosen extreme threshold. A number of different analytical functions are fitted to the data and the best-fitting function is often chosen to represent the extreme value distribution. The US Geological Survey (USGS), for example, has chosen the Log-Pearson Type III probability distribution function as the basis for its calculation of river flood frequencies based on empirical evidence that it give the best results, where the data used are the logarithm of the annual maximum stream flows (Stedinger and Griffis, 2008; Water Resources Council Hydrology Committee., 1981).

The use of one specific family of probability distribution functions for extreme values can be mathematically justified on a theoretical basis (Coles, 2001). For block maxima data, the Generalized Extreme Value (GEV) functions are the appropriate distributions to use, whereas for peaks-over-threshold (POT) values, the Generalized Pareto Distribution (GPD) functions are preferred. The GEV distribution is completely described by three parameters, known as the location, scale, and shape parameters. The GPD is also completely described by three parameters: the chosen threshold, the scale parameter (which is threshold-dependent), and the shape parameter (which is not). The GEV and GPD are related distributions; either distribution's parameters can be expressed in terms of the other distribution's parameters and they both have the identical shape parameter.

In this report, the GEV distribution function will be applied to block maxima and block minima data. This approach is chosen because CO-OPS has a complete database of the monthly highest and lowest water levels for many long-term water level stations. The GPD approach would require using the high/low waters or the hourly data; however, the digitized record is incomplete for many long-term stations. The daily high /low water data (e.g., two high waters and two low waters per day at semidiurnal tidal stations) are in the digitized database only since the mid-1970s. There are nearly complete long-term digitized hourly data for some of the long-term stations in the database, but not for others. Leaving out any of the most extreme events early in the historical record can have a large effect on the results for the longer return periods. The GPD approach also requires selection of a different threshold for each station. A complete GPD analysis of these stations, however, would be a useful follow-up study to this report.

The GEV cumulative distribution function F as a function of a parameter x, such as the water level height, can be written as

$F(x; \mu, \sigma, \xi) = \exp \{ - [1 + \xi(x-\mu)/\sigma]^{-1/\xi} \}$ for $- \infty < x \leq \mu - (\sigma/\xi)$, when $\xi < 0$ (Weibull)

$F(x; \mu, \sigma) = \exp \{ - \exp [- (x-\mu)/\sigma] \}$ for $- \infty < x < + \infty$, when $\xi = 0$ (Gumbel)

$F(x; \mu, \sigma, \xi) = \exp \{ - [1 + \xi(x-\mu)/\sigma]^{-1/\xi} \}$ for $\mu - (\sigma/ \xi) \leq x < + \infty$, when $\xi > 0$ (Fréchet)

where μ, σ, and ξ are the location, scale, and shape parameters of the distribution. The probability distribution functions (shown in Figure 1) can be derived by taking the derivative of F with respect to x. For $\xi < 0$, the distribution is called the Weibull distribution; for $\xi = 0$, it is called the Gumbel distribution; and for $\xi > 0$, it is called the Fréchet distribution. The Weibull distribution has the smaller probability of including a value much larger than μ; in fact, it goes to zero above x = 5 in the example in Figure 1. The Gumbel distribution, extends from $-\infty$ to $+\infty$, and is sometimes known as a light-tailed distribution. The Fréchet distribution, which is zero below x = -5 in the example in Figure 1 and extends to $+\infty$, is sometimes known as a heavy-tailed distribution because it has a higher probability of a value much larger than μ occurring.

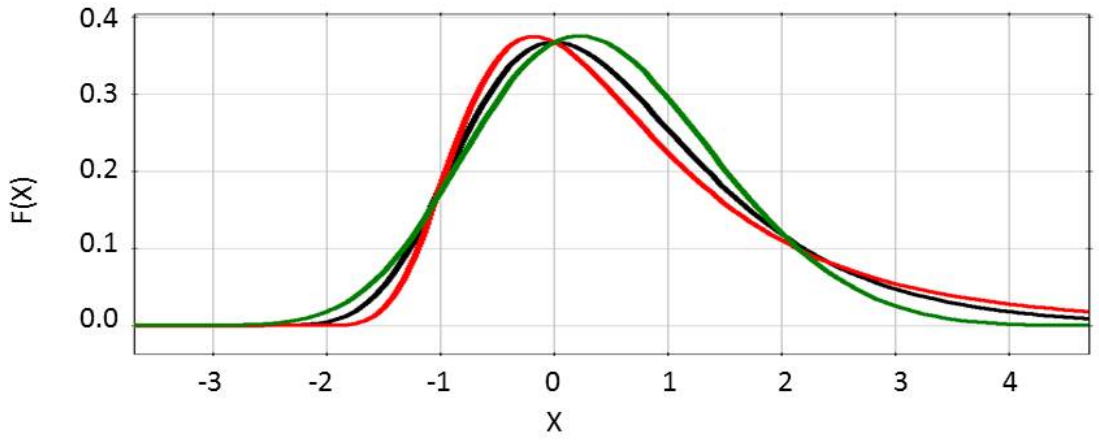

Figure 1. Generalized Extreme Value (GEV) probability distribution functions with a location parameter of 0 and a scale parameter of 1. The shape parameters are -0.2 for the green curve (Weibull distribution), 0 for the black curve (Gumbel distribution), and 0.2 for the red curve (Fréchet distribution).

B. Approach to Deriving GEV Parameters and the Analysis Software Employed

Preliminary plots of monthly highest and lowest water levels show that there is an obvious long-term linear trend in the data at most stations. This linear trend is very close to the corresponding long-term trend in the station's mean sea level. In this report, mean sea level trends, based on data up to 2006 (Zervas, 2009), are adopted as the baseline rate of change affecting the monthly highest and lowest water levels. At a few of the stations, a different rate and an offset were calculated before and after an earthquake; monthly highest and lowest levels are assumed to also follow these abrupt changes in mean sea level. At four stations, it is evident that the monthly highest and lowest water levels have differing baseline rates of change. Significantly different rates for mean high and low waters have been calculated at these stations (Zervas in (Coastal Services Center, 2003)), reflecting continual increases in their tidal range, possibly due to the hydrodynamic response of these harbors to the deepening of their navigational channels. At

these stations, updated rates for mean high and low waters are calculated for this report and used as the baseline rates of change for the monthly highest and lowest water levels.

Since the basis of the extreme value theory is that each observed level will be assigned a calculated probability of exceedance, which should be independent of when it appears in the series, the monthly highest and lowest water levels are first detrended to remove the time dependence of the values before the GEV analysis is carried out. This is accomplished by removing a line with the mean sea level trend crossing zero at the mid-point of the National Tidal Datum Epoch of 1983-2001 which is 1992.5. Some of the stations in Louisiana, Texas, and Alaska, which have larger rates of sea level change, are on more recent 5-year modified tidal datum epochs (MTDE); for these stations, the line removed crosses zero at the mid-point of these 5-year periods. An alternate approach would be to solve for the mean trend as an additional non-stationary parameter in the analysis of extreme water levels (Menendez and Woodworth, 2010).

There will be two types of GEV analysis in this report: one of the annual extreme values for each station, and then twenty four separate analyses using the high and low extreme values for each individual month for each station. The annual extreme values are derived for each year having at least four months of data. Then a review of each annual extreme value data set is carried out to see if, for partial years, there are values that are definitely not the annual extreme value, due to a regular seasonal cycle at the station; these annual extremes are removed. The years with less than four months of extreme values are also examined to determine if one of those months clearly had the extreme event of that year; if so, that value is added back to the annual extreme value data set.

The GEV analyses will be carried out using the extRemes package of the R statistical analysis software (Gilleland et al., 2005) developed by the Weather and Climate Impact Assessment Science Program of the National Center for Atmospheric Research (NCAR). The solution is the maximum-likelihood estimate (MLE) derived by an iterative process. The results of each analysis are the three extreme value distribution parameters (μ, σ, ξ) for location, scale, and shape. From these parameters, the extRemes package can compute levels on the exceedance probability curve for any set of requested return periods. Exceedance probability levels are calculated for a range of return periods from 1 year to 200 years. An upper and lower 95% confidence level is also calculated for each return period using the profile-likelihood method. The 95% confidence intervals are not symmetric about the exceedance curve.

III. Water Level Data

A. Selection of Stations

The 112 NWLON long-term water level stations analyzed in this report are listed in Table 1 which gives the station number, latitude, longitude, first year of data, last year of data, year range, station name, and state or territory. Some of the stations analyzed are not presently in operation. These stations and their last year of data are Johnston Atoll (2003), Chuuk (1995), Seavey Island (2001), Port Jefferson (1992), Colonial Beach (2003), Gloucester Point (2003), Portsmouth (1987), Miami Beach (1981), Eugene Island (1974), Port Mansfield (1997), Padre Island (1994), Newport Beach (1993), and Rincon Island (1990).

All the stations had over 30 years of data except for Rincon Island and Nikiski, which had 27 and 26 years, respectively. Their analysis results were judged to be good when compared to neighboring stations so they are included in this report. Two additional stations were initially part of the analysis, Apalachicola (8728690) and Panama City (8729108), but their results were judged to be problematic, despite using 43 and 38 years of data, respectively. These two stations are therefore not included in this report.

Occasionally, various circumstances required the permanent or temporary relocation of an NWLON station. If the old and new stations are in the same vicinity and their levels can be connected to some common tidal bench marks, the old station's series can be continued at the new location assuming no difference in vertical land motion or long-term oceanographic variability between the two sites. It is also implicitly assumed that storm surge amplitudes at the two stations are essentially equivalent.

At the stations listed in Table 2, data from two or more locations were combined to form longer time series. Sometimes, the two stations were operated in tandem for a period to confirm the similarity of their tidal signals. In other cases, such as when a pier was destroyed in a storm, collecting a period of overlapping data was not possible. All of the stations that were combined were placed on a common datum on the basis of a direct leveling connection to common bench marks except for the Willets Point / Kings Point, NY series. These two stations were simultaneously in operation from November 1998 to December 2000 and had nearly identical hourly time series, so it was decided to combine them, making the assumption that there is no mean sea level or tidal difference between them.

The monthly highest and lowest data to be analyzed were the values above the mean higher high water (MHHW) datum for the highest monthly water levels and the values below the mean lower low water (MLLW) datum for the lowest monthly water levels, except at Port Mansfield (8778490). Port Mansfield is located on a coastal lagoon of the Texas coast and has very weak tides; thus it is not possible to establish any tidal datums other than MSL. Therefore, Port Mansfield's monthly highest and lowest water levels relative to MSL were used in the GEV analysis.

The MHHW and MLLW datums at most of the stations are the values officially established by CO-OPS for the National Tidal Datum Epoch (NTDE), a 19-year period during which the tidal cycle caused by the precession of the moon's node is averaged out (Gill and Schultz, 2001). The present-day NTDE is 1983-2001. At Eugene Island (8764311), no data were collected during the 1983-2001 epoch, so the MHHW and MLLW datums used in this report are from the previous 1960-1978 NTDE.

At a limited number of stations in Louisiana, Texas, and Alaska with large mean sea level trends, CO-OPS has introduced 5-year modified tidal datum epochs (MTDE) by adjusting the tidal datums to the height of MSL averaged over a more recent 5-year period. Sabine Pass, Galveston Pier 21, Galveston Pleasure Pier, Freeport, Anchorage, and Unalaska are on the 1997-2001 MDTE. Grand Isle, Rockport, Juneau, Skagway, Yakutat, Seldovia, Nikiski, and Kodiak Island are on the 2002-2006 MTDE.

Table 1. Long-Term Water Level Stations
Some series are a combination of data from two station numbers.
Some stations have separate pre- and post-earthquake trends calculated.

Station Number	Latitude	Longitude	First Year	Last Year	MSL Trend (mm/yr) +/- 95% Conf. Int.		Station Name	State or Territory
1611400	21.955	-159.357	1954	2010	1.53	0.59	Nawiliwili	Hawaii
1612340	21.307	-157.867	1905	2010	1.50	0.25	Honolulu	Hawaii
1612480	21.437	-157.793	1957	2010	1.31	0.72	Mokuoloe	Hawaii
1615680	20.898	-156.472	1951	2010	2.32	0.53	Kahului	Hawaii
1617760	19.73	-155.057	1946	2010	3.27	0.35	Hilo	Hawaii
1619000	16.738	-169.53	1947	2003	0.75	0.56	Johnston Atoll	Pacific Ocean
1619910	28.212	-177.36	1947	2010	0.70	0.54	Midway Atoll	Pacific Ocean
1630000	13.442	144.653	1948	2010	-1.05 / 8.58	1.72 / 8.93	Guam*	Marianas Is.
1770000	-14.28	-170.69	1948	2010	2.07	0.90	Pago Pago	American Samoa
1820000	8.737	167.738	1946	2010	1.43	0.81	Kwajalein	Marshall Is.
1840000	7.447	151.847	1953	1995	0.60	1.78	Chuuk	Caroline Is.
1890000	19.29	166.618	1950	2010	1.91	0.59	Wake Island	Pacific Ocean
2695535 2695540	32.373	-64.703	1932	2010	2.04	0.47	Bermuda	Atlantic Ocean
8410140	44.903	-66.985	1929	2010	2.00	0.21	Eastport	Maine
8413320	44.392	-68.205	1947	2010	2.04	0.26	Bar Harbor	Maine
8418150	43.657	-70.247	1912	2010	1.82	0.17	Portland	Maine
8419870	43.08	-70.742	1926	2001	1.76	0.30	Seavey Island	Maine
8443970	42.355	-71.052	1921	2010	2.63	0.18	Boston	Massachusetts
8447930	41.523	-70.672	1932	2010	2.61	0.20	Woods Hole	Massachusetts
8449130	41.285	-70.097	1965	2010	2.95	0.46	Nantucket Island	Massachusetts
8452660	41.505	-71.327	1930	2010	2.58	0.19	Newport	Rhode Island
8454000	41.807	-71.402	1938	2010	1.95	0.28	Providence	Rhode Island
8461490	41.355	-72.087	1938	2010	2.25	0.25	New London	Connecticut
8467150	41.173	-73.182	1964	2010	2.56	0.58	Bridgeport	Connecticut

Table 1. Long-Term Water Level Stations
Some series are a combination of data from two station numbers.
Some stations have separate pre- and post-earthquake trends calculated.

Station Number	Latitude	Longitude	First Year	Last Year	MSL Trend (mm/yr) +/- 95% Conf. Int.		Station Name	State or Territory
8510560	41.048	-71.96	1947	2010	2.78	0.32	Montauk	New York
8514560	40.95	-73.077	1957	1992	2.44	0.76	Port Jefferson	New York
8516990 8516945	40.81	-73.765	1931	2010	2.35	0.24	Willets Point / Kings Point	New York
8518750	40.7	-74.015	1893	2010	2.77	0.09	The Battery	New York
8531680	40.467	-74.01	1932	2010	3.90	0.25	Sandy Hook	New Jersey
8534720	39.355	-74.418	1911	2010	3.99	0.18	Atlantic City	New Jersey
8536110	38.968	-74.96	1965	2010	4.06	0.74	Cape May	New Jersey
8505530 8545240	39.933	-75.142	1900	2010	2.79	0.21	Philadelphia	Pennsylvania
8557380	38.782	-75.12	1919	2010	3.20	0.28	Lewes	Delaware
8571890 8571892	38.573	-76.068	1943	2010	3.48	0.39	Cambridge	Maryland
8574680	39.267	-76.578	1902	2010	3.08	0.15	Baltimore	Maryland
8575512	38.983	-76.48	1928	2010	3.44	0.23	Annapolis	Maryland
8577330	38.317	-76.452	1937	2010	3.41	0.29	Solomons Island	Maryland
8594900	38.873	-77.022	1931	2010	3.16	0.35	Washington	D. C.
8632200	37.167	-75.988	1951	2010	3.48	0.42	Kiptopeke	Virginia
8635150	38.252	-76.96	1972	2003	4.78	1.21	Colonial Beach	Virginia
8635750	37.995	-76.465	1974	2010	4.97	1.04	Lewisetta	Virginia
8637624	37.247	-76.5	1950	2003	3.81	0.47	Gloucester Point	Virginia
8638610	36.947	-76.33	1927	2010	4.44	0.27	Sewells Point	Virginia
8638660	36.822	-76.293	1935	1987	3.76	0.45	Portsmouth	Virginia
8638863	36.967	-76.113	1975	2010	6.05	1.14	Ches. Bay Br. Tnl.	Virginia
8656495 8656483	34.72	-76.67	1953	2010	2.57	0.44	Beaufort	North Carolina
8658120	34.227	-77.953	1935	2010	2.07	0.40	Wilmington	North Carolina
8661000 8661070	33.655	-78.918	1957	2010	4.09	0.76	Springmaid Pier	South Carolina
8665530	32.782	-79.925	1921	2010	3.15	0.25	Charleston	South Carolina
8670870	32.033	-80.902	1935	2010	2.98	0.33	Fort Pulaski	Georgia
8720030	30.672	-81.465	1897	2010	2.02	0.20	Fernandina Beach	Florida
8720220 8720218	30.397	-81.43	1928	2010	2.40	0.31	Mayport	Florida
8723170	25.768	-80.132	1931	1981	2.39	0.43	Miami Beach	Florida
8723970	24.712	-81.105	1971	2010	2.78	0.60	Vaca Key	Florida
8724580	24.553	-81.808	1913	2010	2.24	0.16	Key West	Florida
8725110	26.13	-81.807	1965	2010	2,02	0.60	Naples	Florida
8725520	26.647	-81.872	1965	2010	2.40	0.65	Fort Myers	Florida
8726520	27.76	-82.627	1947	2010	2.36	0.29	St. Petersburg	Florida
8726724	27.978	-82.832	1973	2010	2.43	0.80	Clearwater Beach	Florida
8727520	29.135	-83.032	1914	2010	1.80	0.19	Cedar Key	Florida
8729840	30.403	-87.212	1923	2010	2.10	0.26	Pensacola	Florida
8735180	30.25	-88.075	1966	2010	2.98	0.87	Dauphin Island	Alabama
8761720 8761724	29.263	-89.957	1947	2010	9.24	0.59	Grand Isle	Louisiana

Table 1. Long-Term Water Level Stations
Some series are a combination of data from two station numbers.
Some stations have separate pre- and post-earthquake trends calculated.

Station Number	Latitude	Longitude	First Year	Last Year	MSL Trend (mm/yr) +/- 95% Conf. Int.		Station Name	State or Territory
8764311	29.372	-91.385	1939	1974	9.65	1.24	Eugene Island	Louisiana
8770590 8770570	29.73	-93.87	1958	2010	5.66	1.07	Sabine Pass	Texas
8771450	29.31	-94.793	1908	2010	6.39	0.28	Galveston Pier 21	Texas
8771510	29.285	-94.788	1957	2010	6.84	0.81	Galves. Pleasure Pier	Texas
8772440	28.948	-95.308	1954	2008	4.35	1.12	Freeport	Texas
8774770	28.022	-97.047	1948	2010	5.16	0.67	Rockport	Texas
8778490	26.565	-97.43	1964	1994	1.93	0.97	Port Mansfield	Texas
8779750	26.068	-97.152	1958	1994	3.48	0.75	Padre Island	Texas
8779770	26.06	-97.215	1944	2010	3.64	0.44	Port Isabel	Texas
9410170	32.713	-117.173	1906	2010	2.06	0.20	San Diego	California
9410230	32.867	-117.258	1924	2010	2.07	0.29	La Jolla	California
9410580	33.603	-117.883	1955	1993	2.22	1.04	Newport Beach	California
9410660	33.72	-118.272	1923	2010	0.83	0.27	Los Angeles	California
9410840	34.008	-118.5	1933	2010	1.46	0.40	Santa Monica	California
9411270	34.348	-119.443	1962	1990	3.22	1.66	Rincon Island	California
9412110	35.177	-120.76	1945	2010	0.79	0.48	Port San Luis	California
9413450	36.605	-121.888	1973	2010	1.34	1.35	Monterey	California
9414290	37.807	-122.465	1897	2010	2.01	0.21	San Francisco	California
9414750	37.772	-122.298	1939	2010	0.82	0.51	Alameda	California
9415020	37.997	-122.975	1975	2010	2.10	1.52	Point Reyes	California
9419750	41.745	-124.183	1933	2010	-0.65	0.36	Crescent City	California
9432780	43.345	-124.322	1970	2010	1.29	1.15	Charleston	Oregon
9435380	44.625	-124.043	1967	2010	2.72	1.03	South Beach	Oregon
9439040	46.208	-123.767	1925	2010	-0.31	0.40	Astoria	Oregon
9440910	46.708	-123.965	1968	2010	1.60	1.38	Toke Point	Washington
9443090	48.368	-124.617	1934	2010	-1.63	0.36	Neah Bay	Washington
9444090	48.125	-123.44	1975	2010	0.19	1.39	Port Angeles	Washington
9444900	48.112	-122.758	1972	2010	1.98	1.15	Port Townsend	Washington
9447130	47.605	-122.338	1898	2010	2.06	0.17	Seattle	Washington
9449424	48.863	-122.758	1973	2010	0.82	1.20	Cherry Point	Washington
9449880	48.547	-123.01	1934	2010	1.13	0.33	Friday Harbor	Washington
9450460	55.333	-131.625	1918	2010	-0.19	0.27	Ketchikan	Alaska
9451600	57.052	-135.342	1938	2010	-2.05	0.32	Sitka	Alaska
9452210	58.298	-134.412	1936	2010	-12.92	0.43	Juneau	Alaska
9452400	59.45	-135.327	1944	2010	-17.12	0.65	Skagway	Alaska
9453220	59.548	-139.735	1940	2010	-4.81 / -11.54	0.89 / 1.39	Yakutat*	Alaska
9454050	60.558	-145.753	1964	2010	12.04 / 2.57	3.72 / 1.38	Cordova*	Alaska
9454240	61.125	-146.362	1973	2010	6.76 / -4.92	17.13 / 1.55	Valdez*	Alaska
9455090	60.12	-149.427	1964	2010	-1.74	0.91	Seward	Alaska
9455500	59.44	-151.72	1964	2010	-9.45	1.10	Seldovia	Alaska
9455760	60.683	-151.398	1971	2010	-9.80	1.50	Nikiski	Alaska
9455920	61.238	-149.89	1964	2010	0.88	1.54	Anchorage	Alaska

Table 1. Long-Term Water Level Stations Some series are a combination of data from two station numbers. Some stations have separate pre- and post-earthquake trends calculated.								
Station Number	Latitude	Longitude	First Year	Last Year	MSL Trend (mm/yr) +/- 95% Conf. Int.		Station Name	State or Territory
9457292 **9457283**	57.732	-152.512	1966	2010	-10.42	1.33	Kodiak Island	Alaska
9459450	55.337	-160.502	1972	2010	0.92	1.32	Sand Point	Alaska
9461380	51.863	-176.632	1943	2010	2.45 / -2.75	3.61 / 0.54	Adak Island*	Alaska
9462611 **9462620**	53.88	-166.537	1934	2010	-0.57 / -5.72	2.16 / 0.67	Unalaska*	Alaska
9751639	18.335	-64.92	1975	2010	1.20	0.96	Charlotte Amalie	Virgin Islands
9755371	18.458	-66.117	1962	2010	1.65	0.52	San Juan	Puerto Rico
9759110	17.972	-67.047	1955	2010	1.35	0.37	Magueyes Island	Puerto Rico

*Guam has separate trends calculated before and after 8/93. Yakutat, Cordova, and Valdez have separate trends calculated before and after 2/79. Adak Island and Unalaska have separate trends calculated before and after 3/57.

Table 2. Combined Water Level Stations		
Station Number	**Station Name**	**Data Periods**
2695535	Bermuda Biological Station	1932-1992
2695540	Bermuda Esso Pier	1988-2010
8419870	Seavey Island, Navy Yard	1926-1969
	Seavey Island, Berth 2	1973-2001
8443970	Boston, Commonwealth Pier #5	1921-1939
	Boston, Appraisers Wharf	1939-2010
8516990	Willets Point	1931-2000
8516945	Kings Point	1998-2010
8518750	Fort Hamilton	1893-1933
	The Battery	1920-2010
8534720	Atlantic City, Million Dollar Pier	1911-1920
	Atlantic City, Steel Pier	1922-1985
	Ventnor City	1985-1991
	Atlantic City, Steel Pier	1991-2010
8545530	Philadelphia, Chestnut Street Pier	1900-1920
	Philadelphia, Pier 9 North	1922-1962
	Philadelphia, Pier 11 North	1962-1989
8545240	Philadelphia, USCG Station	1989-2010
8557380	Lewes, Fort Miles	1919-1939
	Lewes	1947-2010
8571890	Cambridge, Yacht Basin	1943-1980
8571892	Cambridge, Marine Terminal	1980-2010
8575512	Annapolis, Naval Academy	1928-1970
	Annapolis, Naval Station	1970-1978
	Annapolis, Naval Academy	1978-2010
8656495	Morehead City	1953-1962
8656483	Beaufort	1964-2010
8661000	Myrtle Beach	1957-1977

Table 2. Combined Water Level Stations		
Station Number	**Station Name**	**Data Periods**
8661070	Springmaid Pier	1977-2010
8720220	Mayport	1928-2000
8720218	Bar Pilots Dock	2001-2010
8724580	Key West, Curry's Wharf	1913-1926
	Key West, Naval Base	1926-2010
8761720	Grand Isle, Bayou Rigaud	1947-1980
8761724	Grand Isle, East Point	1980-2010
8770590	Sabine Pass	1958-1985
8770570	Sabine Pass North	1985-2010
9410170	San Diego, Quarantine Station	1906-1926
	San Diego, Municipal Pier #1	1926-2010
9412110	Avila Beach	1945-1970
	Port San Luis	1971-2010
9414290	San Francisco, Presidio	1897-1927
	San Francisco, Presidio (Crissy Field)	1927-2010
9457283	Kodiak, St. Pauls Harbor	1964-1984
9457292	Kodiak Harbor, Womens Bay	1984-2010
9462611	Dutch Harbor	1934-1955
9462620	Unalaska	1955-2010
9755371	San Juan, Naval Base	1962-1975
	San Juan, USCG Base	1977-2010

B. Data Quality Control, Missing Extreme Storms, and High Water Marks

Extensive quality control was carried out on the monthly highest and lowest water level data sets to correct errors in the database and to ensure that the data was as comprehensive and complete as possible. This was accomplished by careful comparisons of the extreme event levels recorded at one station with those recorded at nearby stations. In the process, it was important to distinguish between water levels measured by a gauge and water levels that were inferred because of missing data or placed in the data set from other sources such as a nearby high water mark (HWM) leveled to the tidal bench marks. It was also important to indicate which extreme events that could have been recorded are missing due to the destruction of the station or malfunctioning of the instrument. In some cases, the peak water level of an extreme event was not recorded, so as an attempt to include the event, the last recorded level was included in the data set. Table 3 is a listing of the monthly highest and lowest water levels not directly recorded instrumentally.

Table 3. Inferred Extremes, High Water Marks, Missing Extreme Storm Tides, and Last Recorded Levels				
Station Number	**High Water Event**		**Low Water Event**	
	Date	**Comment**	**Date**	**Comment**
1615680 Kahului	7/18/1951	Inferred		
1619910 Midway	1/11/1958	Inferred		
1630000 Guam			10/24/1972	Inferred
8418150 Portland			1/2/1999	Inferred
8443970 Boston	8/31/1954	Inferred	12/10/1977	Inferred
8447930 Woods Hole	9/21/1938	High Water Mark		
	9/14/1944	Inferred		
	8/31/1954	Inferred		
8452660 Newport	9/21/1938	High Water Mark		
	9/14/1944	High Water Mark		
	11/7/1953	Inferred		
	8/31/1954	Inferred		
8454000 Providence	9/21/1938	High Water Mark	2/21/1989	Inferred
	9/14/1944	Inferred		
8461490 New London	9/21/1938	High Water Mark		
	9/14/1944	Inferred		
	8/31/1954	Inferred		
	11/30/1963	Inferred		
8514560 Montauk	9/12/1960	Inferred	12/30/1962	Inferred
	3/6/1962	Inferred		
8516945 Kings Pt./Willets Pt.	11/9/1932	Inferred	1/6/1959	Inferred
	11/17/1935	High Water Mark	2/25/1967	Inferred
	9/21/1938	High Water Mark	2/2/1976	Inferred
	9/14/1944	Missing Event	1/10/1978	Inferred
	11/25/1950	Inferred		
	8/31/1954	Inferred		
8518750 The Battery	2/20/1927	Inferred		
	9/21/1938	Inferred		
	9/14/1944	Inferred		
	11/7/1953	Inferred		
	4/13/1961	Inferred		
	12/11/1992	Inferred		
8531680 Sandy Hook	11/10/1932	Inferred		
	11/25/1950	Inferred		
	11/7/1953	Inferred		
	9/12/1960	Inferred		
8534720 Atlantic City			1/31/1966	Inferred
8536110 Cape May	2/26/1979	Inferred		
8545240 Philadelphia	8/24/1933	High Water Mark	1/25/1945	Inferred
	11/25/1950	Inferred	12/2/1946	Inferred
			12/31/1962	Inferred
8571892 Cambridge			1/17/1982	Inferred
8574680 Baltimore	8/4/1915	Inferred	1/24/1908	Inferred
	11/16/1926	Inferred	3/29/1919	Inferred
	9/20/1928	Inferred	9/18/1936	Inferred
	8/23/1933	High Water Mark	12/31/1962	Inferred
	11/25/1950	Inferred		
	9/1/1952	Inferred		
8575512 Annapolis	8/23/1933	High Water Mark	12/31/1962	Inferred
	10/15/1954	Inferred		
8577330 Solomons Island	6/22/1972	Inferred	12/31/1962	Inferred
	9/19/2003	Last Recorded Level	2/26/1967	Inferred

Table 3. Inferred Extremes, High Water Marks, Missing Extreme Storm Tides, and Last Recorded Levels				
Station Number	**High Water Event**		**Low Water Event**	
	Date	**Comment**	**Date**	**Comment**
			1/2/1977	Inferred
8594900 Washington	8/23/1933	High Water Mark	12/31/1962	Inferred
8632200 Kiptopeke	10/6/1957	Inferred		
8635150 Colonial Beach	11/4/1985	Last Recorded Level		
	9/18/2003	Last Recorded Level		
8637624 Gloucester Point	9/18/2003	Last Recorded Level		
8638610 Sewells Point	8/23/1933	High Water Mark		
8638660 Portsmouth	9/27/1956	Inferred		
8661070 Springmaid Pier	9/21/1989	Missing Event	12/1/1963	Inferred
8665530 Charleston	9/18/1928	Inferred	11/30/1963	Inferred
	8/11/1940	High Water Mark	2/25/1967	Inferred
8670870 Fort Pulaski			3/21/1936	Inferred
			3/3/1942	Inferred
8720030 Fernandina Beach	10/2/1898	High Water Mark		
8720218 Mayport	9/9/1964	Inferred		
8723170 Miami Beach	11/4/1935	Inferred		
	9/17/1947	Inferred		
	10/18/1950	Inferred		
8725110 Naples	8/13/2004	Missing Event		
8726520 St. Petersburg			9/18/1947	Last Recorded Level
8727520 Cedar Key	8/31/1985	Last Recorded Level	9/18/1947	Inferred
			9/8/1965	Inferred
8729840 Pensacola	9/20/1926	High Water Mark		
	8/31/1950	Last Recorded Level		
	8/18/1969	Inferred		
	9/12/1979	Last Recorded Level		
	9/16/2004	Last Recorded Level		
	9/12/1979	Missing Event		
8761724 Grand Isle	9/19/1947	Inferred		
	10/3/1964	Inferred		
8764311 Eugene Island	9/23/1956	Inferred		
	6/27/1957	Inferred		
	9/11/1961	High Water Mark		
8770570 Sabine Pass	2/14/1969	Inferred	1/6/1962	Inferred
	9/24/2005	Last Recorded Level	2/25/1965	Inferred
8771450 Galveston Pier 21	8/17/1915	High Water Mark	1/25/1938	Inferred
	9/15/1919	High Water Mark	1/6/1962	Inferred
	8/13/1932	Inferred	1/13/1964	Inferred
	7/25/1934	Inferred		
	9/23/1941	Inferred		
	8/29/1942	Inferred		
	9/17/1963	Inferred		
	9/13/2008	Last Recorded Level		
8772440 Freeport	9/11/1961	Missing Event	1/19/1955	Inferred
	9/6/1973	Inferred		
8774770 Rockport	9/20/1967	Last Recorded Level		
8778490 Port Mansfield	9/20/1967	Last Recorded Level		
	8/10/1980	Missing Event		
8779750 Padre Island	9/11/1961	High Water Mark		
	9/20/1967	High Water Mark		
8779770 Port Isabel	9/20/1967	High Water Mark		
9443090 Neah Bay	11/30/1951	Inferred		

C. Detrending of Monthly Highest and Lowest Water Levels

The monthly mean highest and lowest water levels at most stations clearly include an underlying linear trend which reflects the direction of the MSL trend of the station. Where the MSL trend is positive, the highest and lowest water levels are also rising; when the MSL trend is negative, the highest and lowest water levels are also falling. This is because the daily high and low tide levels are also following the MSL trend and many of the monthly highest and lowest water levels are simply the highest and lowest predicted tide of the month, if there is no meteorological event occurring. The presence of the underlying trend affects the level reached by each event in the record. If an event occurs early or late in the time series, it will reach higher or lower than if it had occurred in the middle of the series. In order to evaluate the probability of occurrence of each level with a GEV analysis, all the times series are first detrended. An alternative approach is to allow for a trend in the data and parameterize the GEV analysis to also solve for the value of that trend (Menendez and Woodworth, 2010).

In this report, the time series are detrended with the trends listed in Table 1. For most of the stations, the data are detrended to the time origin (or zero time) of 1992.5, which is the mid-point of the present-day NTDE. For the stations on a 5-year MTDE, the data are detrended to the time origin of 1999.5 or 2004.5, depending on which 5-year MTDE is in use for each station (1997-2001 or 2002-2006). The Eugene Island data are on the 1960-1978 NTDE, so its data are detrended to the time origin of 1969.5.

There are four long-term stations which have been determined to have had significantly increasing tidal ranges over their period of record (Zervas in (Coastal Services Center, 2003)). At these stations (Philadelphia, Beaufort, Wilmington, and Anchorage), the monthly highest water level follows the MHW linear trend and the monthly lowest water level follows the MLW linear trend. The reason that MHW and MLW trends are used instead of MHHW and MLLW trends, is because MHHWs and MLLWs were not tabulated for east coast stations by CO-OPS until the 1970s. The MHW and MLW trends were recalculated with data up to 2011 (Table 4), and used to detrend the monthly highest and lowest values for these four stations.

Table 4. Mean High Water and Mean Low Water Trends for data up to 2011

Station Number	Station Name	MHW Trend (mm/yr)	MLW Trend (mm/yr)
8545240	Philadelphia	4.41 +/- 0.24	0.95 +/- 0.23
8656483	Beaufort	3.77 +/- 0.41	1.54 +/- 0.44
8658120	Wilmington	3.94 +/- 0.35	-0.91 +/- 0.45
9455920	Anchorage	1.38 +/- 0.94	-5.19 +/- 1.40

Three earthquakes which occurred in March 1957 in the Aleutian Islands, March 1964 in southern Alaska, and August 1993 near Guam resulted in discernible offsets and/or changes in

trend at nearby water level stations (Zervas, 2009). At Guam, separate mean sea level trends are calculated before and after August 1993 event. At Seward and Kodiak Island, there are large offsets (> 1 meter) at the time of the March 1964 earthquake; since such a large change in the surrounding bathymetry near these stations could have affected the tides and the local response to storm surges, it was decided not the include any pre-1964 data in the GEV analyses for those two stations. At Adak Island and Unalaska, separate trends were calculated before and after the March 1957 earthquake.

At three Alaskan stations (Yakutat, Cordova, and Valdez), there appears to have been a change in trend between the start and the end of their time series, but it is not clear if the change has been gradual over recent decades (perhaps due to the melting of glaciers) or if it is related to one or more of the nearby large earthquakes that have occurred over the past 50 years. To remove the time-dependent effect of the changing mean sea level on monthly highest or lowest levels, it doesn't make a great difference whether a single theoretical curve or two linear segments are removed. It was decided to remove two separate trends calculated before and after an earthquake in February 1979.

At Freeport (8772440), there is an unexplained datum shift in January 1972 in the monthly mean sea level series (Zervas, 2009), so the monthly highest and lowest values for Freeport were detrended incorporating the apparent datum shift with the same linear trend before and after January 1972.

D. Generation of Monthly and Annual Extreme Data Sets

The detrended monthly and annual highest and lowest water levels comprise the data sets that are used for the GEV analyses in this report. Each station's GEV annual exceedance probability curve is derived by a maximum likelihood estimate using the extRemes package of the R statistical analysis software. Therefore, annual extreme values are first obtained from the detrended monthly extremes data set; however, if a year has less than four months of monthly values, no annual maxima or minima are supplied to the station's annual extremes data set.

Three exceptions are made for years in which there are less than four months of data, where a monthly extreme is clearly the extreme value for the year: the February 1972 high water level for Montauk, the March 1993 high water level for Clearwater Beach, and the January 1997 low water level for Cherry Point. In three other instances, there are four or more months of data, but the annual maxima or minima is clearly in one of the missing months; therefore, that year is deleted from that station's annual extremes data set. These years are: 1979 for the annual highest water level for Anchorage, 1975 for the annual lowest water level for Apalachicola, and 1966 for the annual lowest water level for Kodiak Island.

The monthly highest and lowest water levels are also used to produce a set of twenty four GEV analyses, two for each month, to show how the high and low water exceedance probability levels

can vary month by month, over the course of a year. To do this, the monthly highest and lowest water levels are separated into twenty four data sets, one each for the high and the low extreme values recorded in each month of the year.

IV. Analysis and Discussion

A. Annual GEV Curves and Shape Parameters

The result of a GEV analysis consists of the three parameters for location, scale, and shape, including the standard error of each parameter. The 95% confidence intervals are obtained by multiplying the standard errors by 1.96. The GEV parameters are listed in Appendix I and II for all the stations. Table A in Appendix I gives the parameters for annual highest water levels and Table B in Appendix II gives the parameters for annual lowest water levels.

The location parameter is a measure, roughly comparable to a mean or a median, of how far above MHHW or below MLLW the annual highest or lowest water levels tend to be. The scale parameter is a measure, generally comparable to the standard deviation of a normal distribution, of how variable the annual highest or lowest water levels can be from year to year. The shape parameter, which is non-dimensional, represents how skewed the GEV distribution is, and is important in quantifying the occurrence of values far more extreme than the location parameter. An extreme value far exceeding the location parameter (i.e., in the upper tail of the distribution) is statistically more likely when the shape parameter is positive and less likely when the shape parameter is negative.

The GEV parameters define a curve of annual exceedance probability levels customarily shown with 95% confidence intervals as a function of the return period, also known as the average recurrence interval. By calculating these levels for a range of exceedance probabilities from 99% to 0.5% (equivalent to return periods of 1.01 to 200 years), the exceedance probability curves are generated and plotted in Appendix I and II for the highest and lowest annual extreme water levels. The return periods of 1.01, 2, 10, and 100 years, corresponding to exceedance probabilities of 99%, 50%, 10%, and 1%, are labeled on the plots. The 10% and 1% annual exceedance probability levels are the levels that are exceeded on average 10 times and 1 time, respectively, per century. The 50% annual exceedance probability level is actually the median of the annual water level maxima or minima, i.e., in half of the years the annual maximum or minimum is higher and in the other half the annual maximum or minimum is lower. The 99% annual exceedance probability defines the level that is not exceeded in only one year out of every 100 years on average. That does not mean that it cannot be exceeded multiple times in other years.

The data values used in the derivation of the curves (i.e., the annual extreme water levels), are also plotted on the figures in Appendix I and II as dots in their Weibull plotting positions as a function of the return period in years (Water Resources Council Hydrology Committee., 1981), which is defined as

$$(N+1) / r$$

where N is the number of annual extreme values and r is the integer ranking of the level from most extreme (r = 1) to least extreme (r = N). There are other theoretical plotting positions that are sometimes used, which plot the most extreme values (r = 1, 2, 3, …) somewhat further to the right at longer return periods. The plotting positions chosen for the figures have no bearing on the calculation of the GEV curves. The discussion below of the stations' shape parameters in Figures 2 to 7 can be best understood by referring to the exceedance probability curves in Appendix I and II to see the effect of differing shape parameters at the longer return periods (Gilleland and Katz, 2006).

The East Coast high water shape parameters (Figure 2) are mostly positive (Fréchet distributions—see Section II.A) although most of their 95% confidence intervals also include zero (Gumbel distributions). The most extreme events in the Gulf of Maine (Eastport to Boston) are winter storms; for the rest of the East Coast, the extreme events are a mix of winter storms and hurricanes, with the most extreme event more likely to be a hurricane. The few stations with slightly negative shape parameters (Weibull distributions) have 95% confidence intervals which also overlap zero (Gumbel distributions), and generally have a shorter period of record for the GEV calculation than neighboring stations. Therefore, they may not include an older extreme event that might have been recorded if the station had been in operation at the time and which could have made its shape parameter positive. Washington has the most positive shape parameter because its record of extremes is greatly influenced by several large river floods, unlike any of the records at other stations.

The West Coast high water shape parameters (Figure 3) are mostly negative with only a few of the 95% confidence intervals at the stations with short periods of record also including zero. The most negative shape parameter is at Nikiski, but it also has a wide 95% confidence interval due to its short period of record.

The high water shape parameters for the Pacific Islands and Bermuda in Figure 4 vary from negative values for islands which haven't had any large storm surges, to near zero for islands which have had only a few large storm surges. Only Wake Island has a statistically significant positive shape factor, because of a greater number of hurricane strikes. At the Gulf Coast and Caribbean stations, shape parameters are positive with 95% confidence intervals which don't include zero, due to their high frequency of hurricane strikes. Two stations, Apalachicola (8726890) and Panama City (8729108) that were initially included in the analysis, however, had very large shape factors with wide 95% confidence intervals (0.60 +/- 0.29 at Apalachicola and 0.78 +/- 0.43 at Panama City). This resulted in exceedance probability curves rising so steeply that their 1% exceedance probability levels were far above those of the neighboring stations of Cedar Key and Pensacola, which have much longer periods of record. It seems that the iterative maximum likelihood estimate of the GEV parameters at those two stations may have converged to an incorrect solution. This is probably due to more frequent hurricane landfalls on this section of the gulf coast over the past 35-45 years compared to the early and mid-20th century.

In contrast to the high water shape parameters, which are regionally variable and depend greatly on the probability of hurricanes and large winter storm surges, low water shape parameters (Figures 5 to 7) are mostly negative implying a comparatively smaller likelihood of an extremely low water level far below the usual monthly or annual lowest water levels. A number of East Coast low water shape parameters are close to zero with the 95% confidence intervals including zero due to a slightly increased likelihood of an extremely negative storm surge than on the other U.S. coasts or islands. The positive value at Port Jefferson has very wide 95% confidence intervals and may be due to an inadequately short period of record.

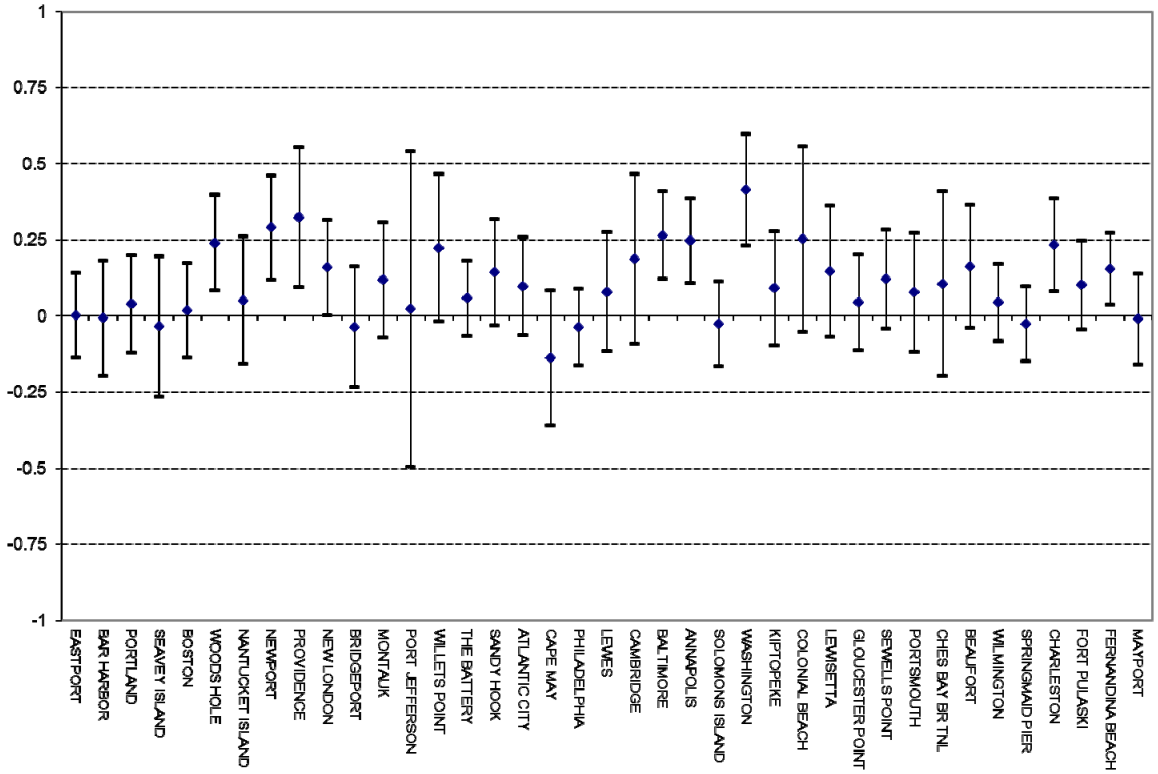

Figure 2. High water GEV shape parameters for East Coast stations.

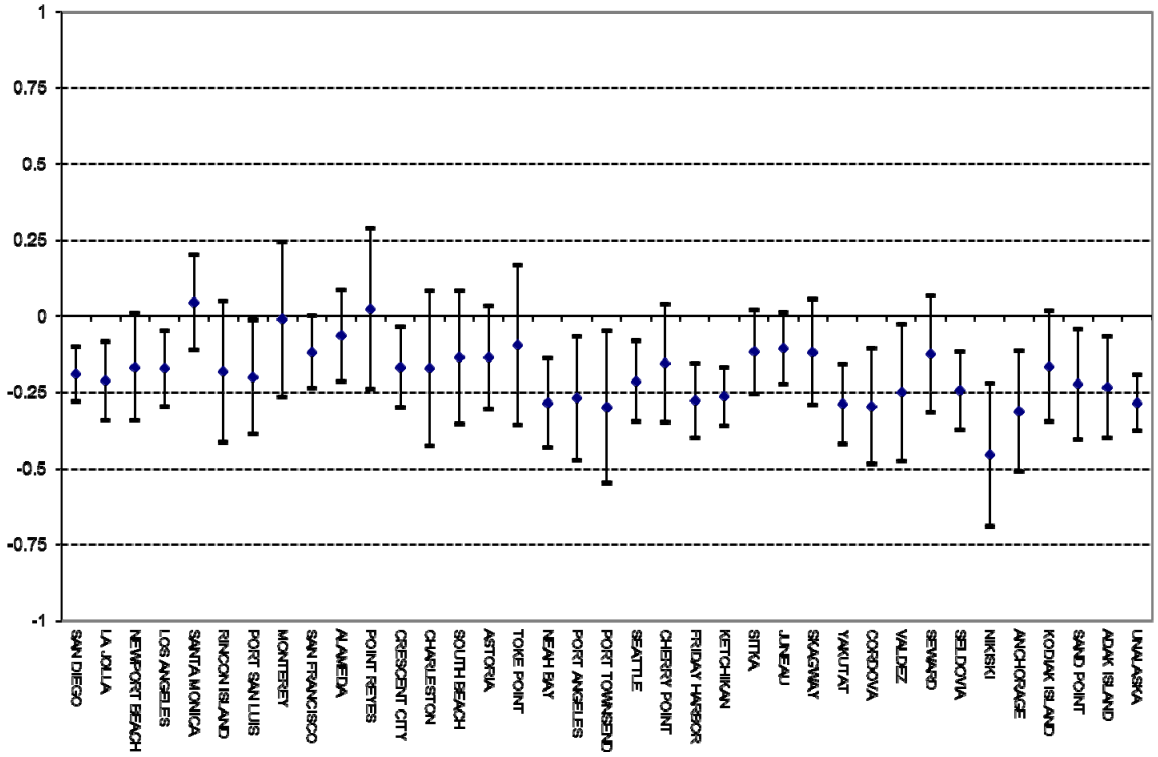

Figure 3. High water GEV shape parameters for West Coast stations.

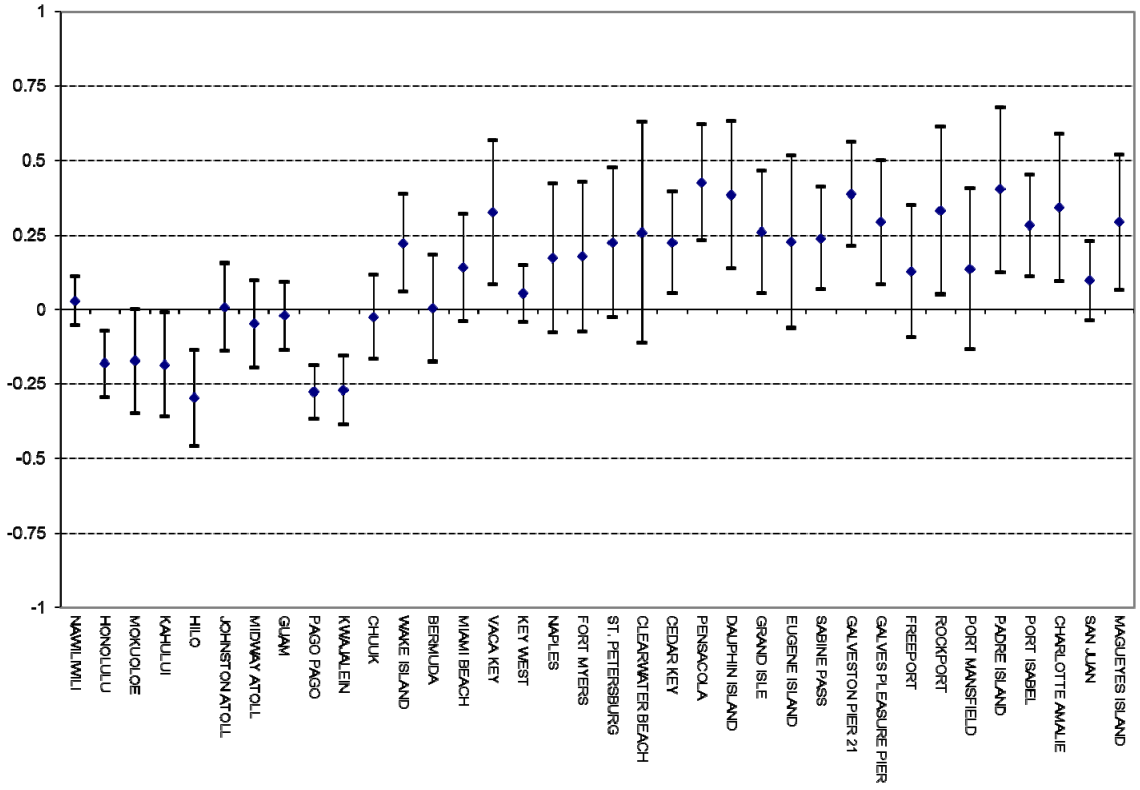

Figure 4. Low water GEV shape parameters for East Coast stations.

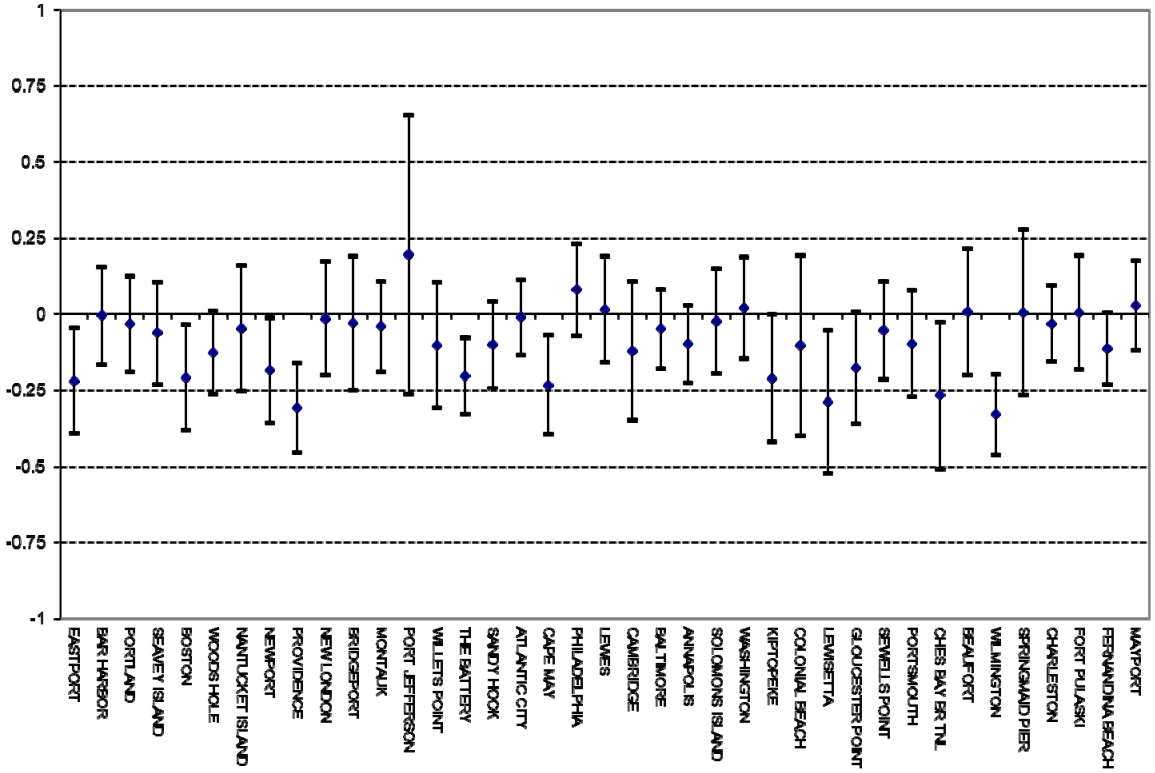

Figure 5. High water GEV shape parameters for island and Gulf Coast stations.

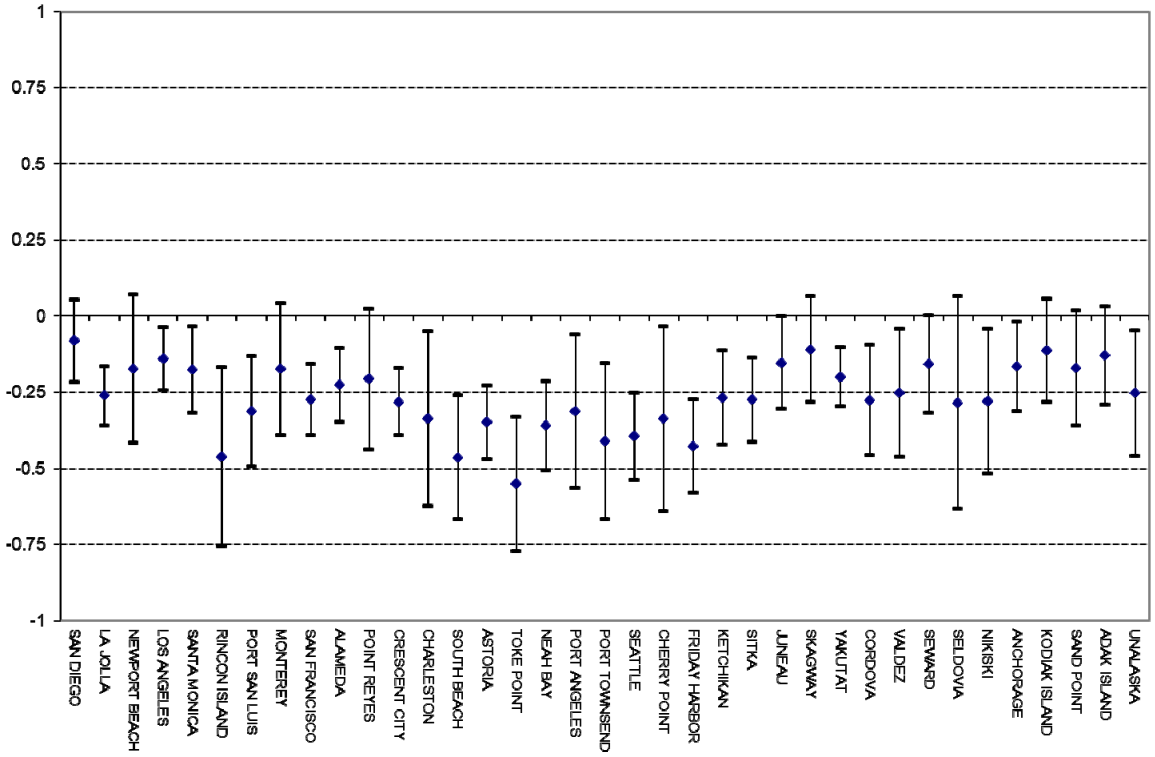

Figure 6. Low water GEV shape parameters for West Coast stations.

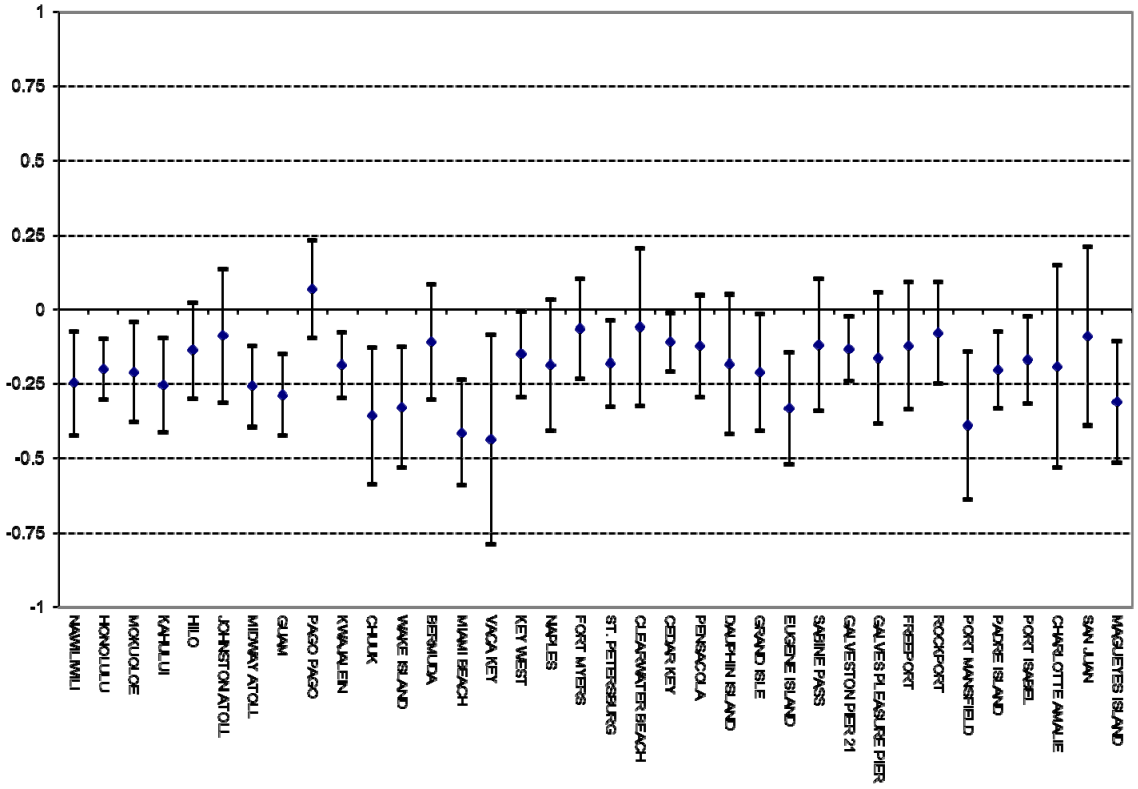

Figure 7. Low water GEV shape parameters for the island and Gulf Coast stations.

B. GEV Stick Diagrams

The exceedance probability levels for return periods of 1.01, 2, 10, and 100 years in the plots of the annual exceedance probability curves in Appendix I and II (which are listed in Tables C and D in Appendix III), are shown for inter-station and regional comparison in Figures 8 to 13. These levels above MHHW and below MLLW are independent of time, and follow the mean sea level trend, or, in four cases, follow the mean high and low water trends for the stations which have had increasing tidal ranges.

Another way of visualizing the exceedance probability levels for each station is to expand the traditional CO-OPS stick diagrams which are used to show the levels of the tidal datums relative to each other, to the station's bench marks, and to a national geodetic datum, if there is a good leveling connection from the national network to a station's bench mark network. In Appendix III, a set of stick diagrams show the high and low 1%, 10%, 50%, and 99% exceedance probability levels, and the tidal datums of MHHW, MHW, MLW, and MLLW relative to MSL for each station. The position of the North American Vertical Datum of 1988 (NAVD88) relative to MSL is also shown, if it is available.

The relationships between tidal datums and between the tidal datums and NAVD88 are defined for the 19-year NTDE (1983-2001), or for a 5-year MTDE for the stations with high rates of change in Louisiana, Texas, and Alaska. Therefore, the stick diagrams in Appendix III, can be considered as the representative of a particular time, i.e., the mid-year of the tidal datum epoch used for the datums (1992 for most stations, or either 1999 or 2004 for the stations on a 5-year MTDE). If one wanted to project the stick diagram levels forward or backward in time relative to the MSL datum (for example, to the present year), one would use the mean sea level trend (or the mean high and low water trends, as the case may be) to calculate the amount to raise or lower the exceedance probability levels to obtain future or past positions.

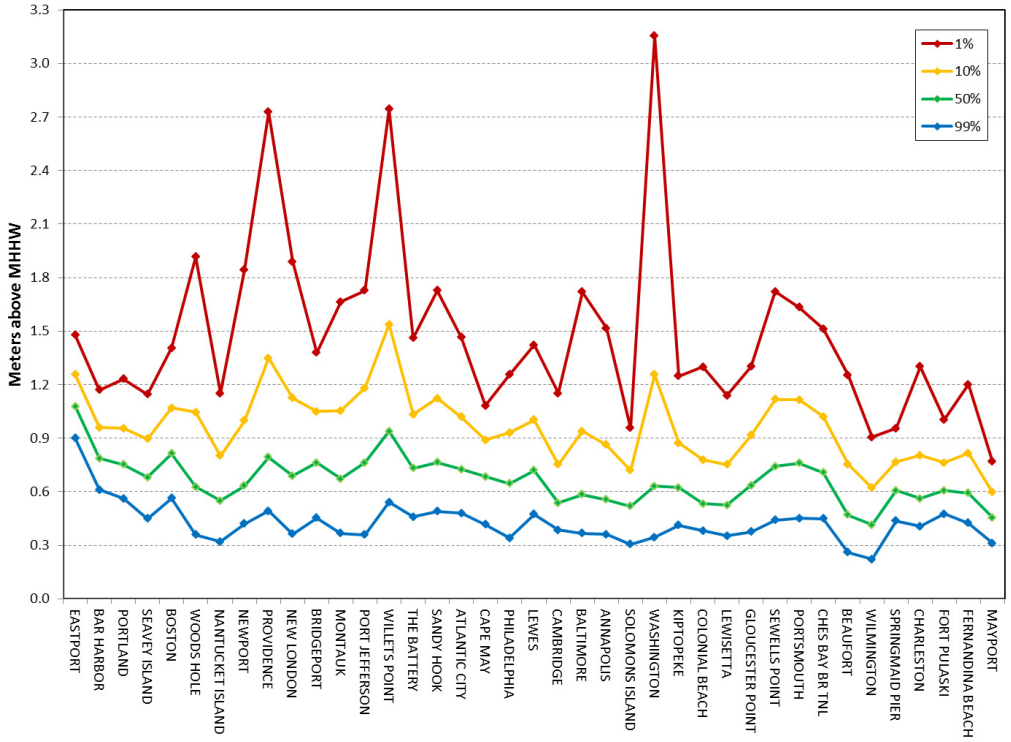

Figure 8. High water exceedance probability levels for East Coast stations.

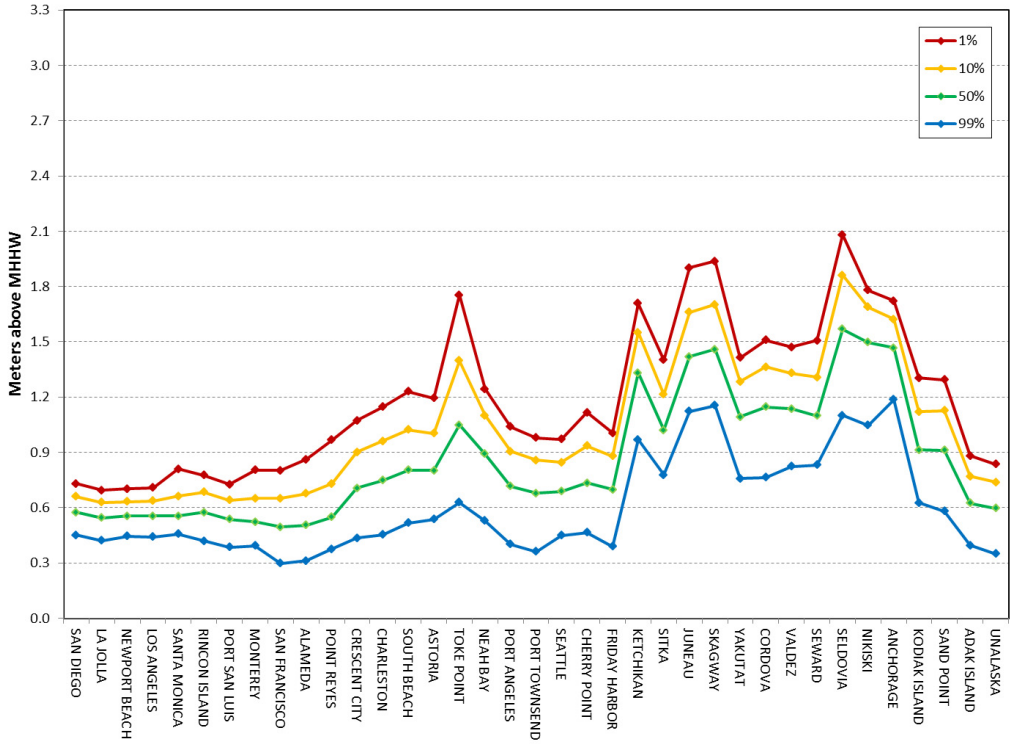

Figure 9. High water exceedance probability levels for West Coast stations.

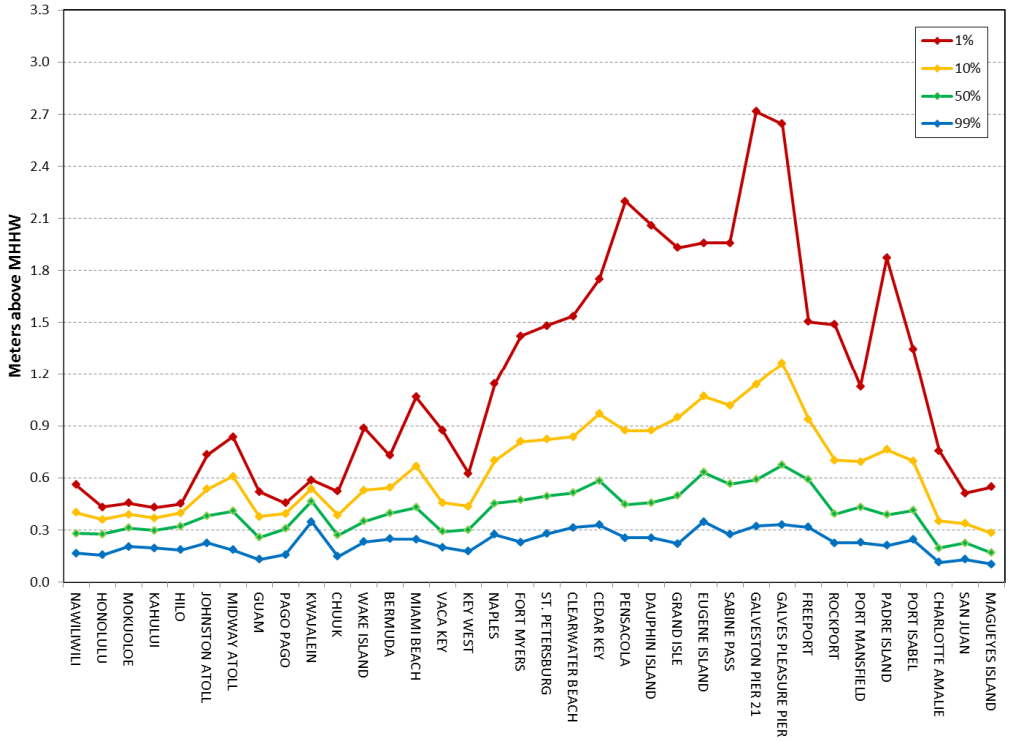

Figure 10. High water exceedance probability levels for island and Gulf Coast stations.

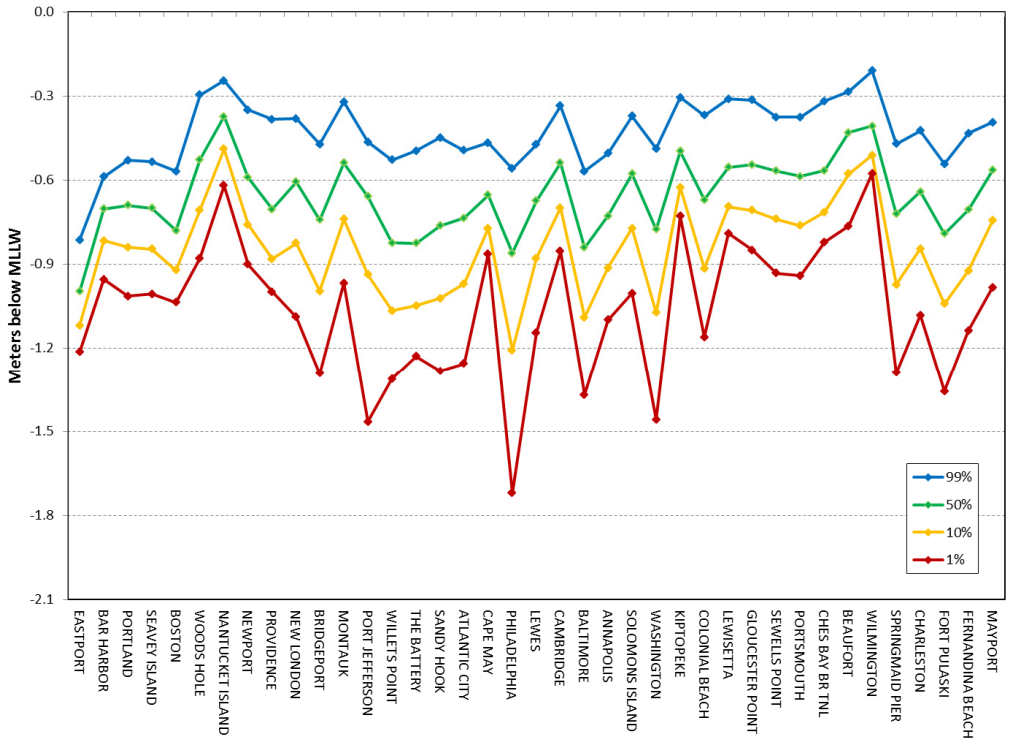

Figure 11. Low water exceedance probability levels for East Coast stations.

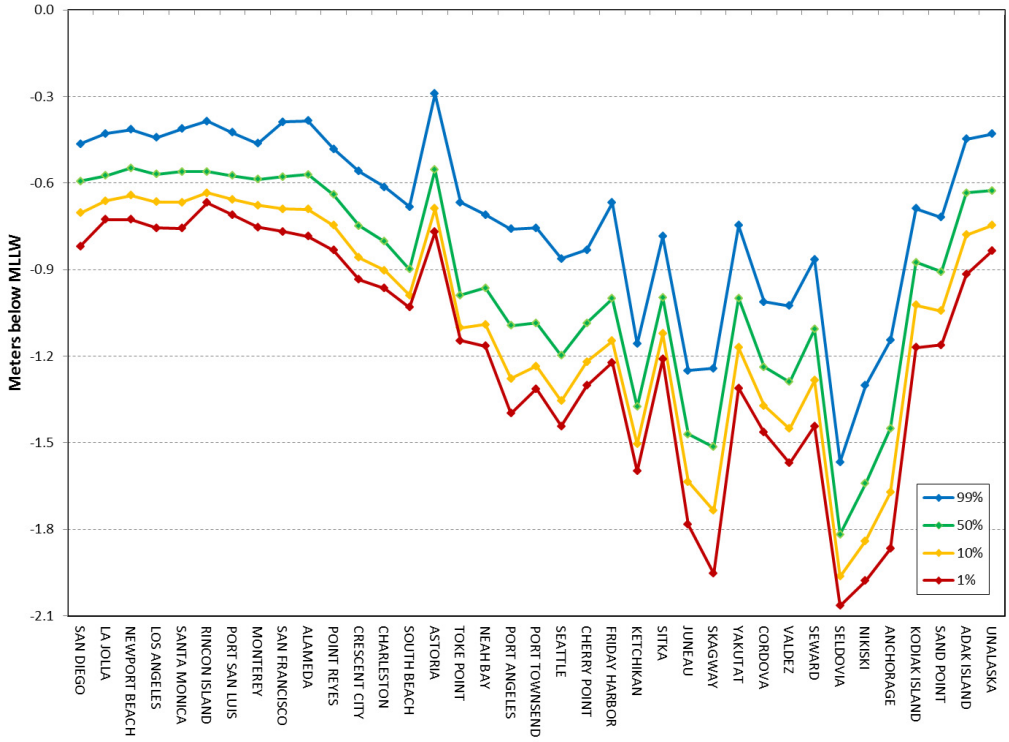

Figure 12. Low water exceedance probability levels for West Coast stations.

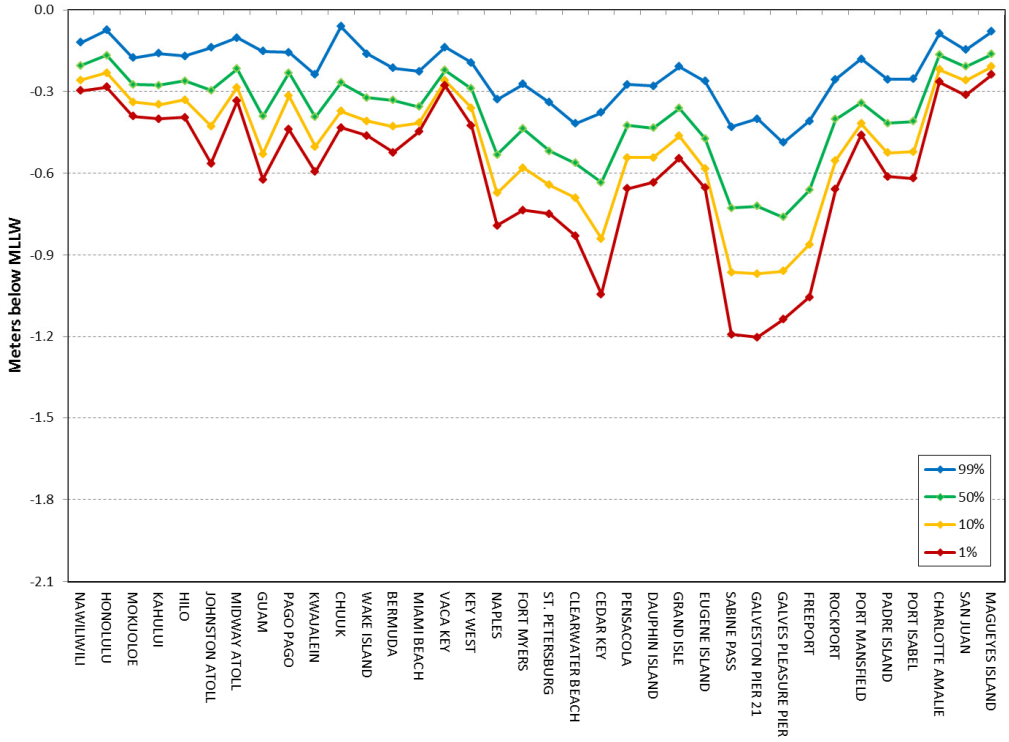

Figure 13. Low water exceedance probability levels for island and Gulf Coast stations.

C. Comparison of 1% Annual Exceedance Probability Levels between Stations

The high water 1% exceedance probability level, or the level that is expected to be exceeded once in 100 years on average, is a level often considered as a minimum height below which there is an unacceptable risk of inundation for man-made structures. This is incorporated into FEMA's approach to flood insurance practices (Crowell et al., 2007). Coastal flood insurance studies (FIS) define a set of stillwater elevations (SWELs) for coastal regions as the water level that has a 1% annual chance of exceedance. This water level is defined to exclude waves, and wave effects such as set-up and run-up. The wave heights and wave effects are then modeled to a much finer spatial scale and added to the SWELs to obtain base flood elevations (BFEs), which are the basis for the zoning on FEMA's flood insurance rate maps. The high water 1% exceedance probability levels derived in this report should roughly correspond to SWELs at locations with limited exposure to ocean waves.

The 1% GEV exceedance probability levels are shown for regional and inter-station comparisons in Figures 14 to 19 along with their 95% confidence intervals. The confidence intervals were calculated with the profile-likelihood method which allows for asymmetric confidence intervals since extreme value data places tighter restrictions on the lower bounds than on the upper bounds. This asymmetry is especially obvious on the confidence intervals of GEV curves with positive shape factors (Frechet distributions).

For the East Coast high water levels (Figure 14), Washington has the highest 1% exceedance probability level and the widest confidence interval due to several occurrences of large river floods in its record. Providence, at the north end of Naragansett Bay, and Kings Point/Willets Point, at the west end of Long Island Sound, also have very high 1% exceedance probability levels based on the extreme storm surges caused by hurricanes in 1938 and 1954. A few stations, such as Nantucket Island, Bridgeport, Solomons Island, and Mayport, have lower 1% exceedance probability levels than their neighbors, which could be either due to the period of record missing an extreme event or due to their specific geographical locations.

On the West Coast (Figure 15), high water 1% exceedance probability levels have much tighter 95% confidence intervals than on the East Coast due to the absence of hurricane strikes and because the narrowness of the continental shelf limits the wind-driven component of surge heights produced by winter storms. The levels are low from San Diego to Friday Harbor except at the Toke Point station. Toke Point is in Willapa Bay in Washington and the bay's entrance is very shallow without a dredged channel. Therefore, breaking waves at the entrance during large storm events may induce a substantial wave set-up effect causing higher water levels in the bay than on the open coast. In Alaska, the 1% levels are highest at Ketchikan, Juneau, Skagway, and the Cook Inlet stations of Seldovia, Nikiski, and Anchorage which have the greatest tidal ranges. The 1% levels are low at Unalaska and Adak Island in the Aleutian Islands.

The high water 1% exceedance levels at the island stations (Figure 16) are generally low because they are surrounded by deep water which limits the wind-driven component of storm surges. Along the Gulf Coast however, extremely large storm surges occur as hurricane-force winds interact with the wide shallow continental shelf waters. The 1% exceedance levels are highest at Galveston Pier 21 and Galveston Pleasure Pier with wide 95% confidence intervals.

The low water 1% exceedance probability levels (Figures 17 to 19) also vary greatly depending on station location. The river stations of Philadelphia and Washington show the lowest 1% levels. Port Jefferson has a large 95% confidence interval probably due to an inadequately short period of record. Nantucket Island, which is located mid-way between the coast and the continental slope, and the river station of Wilmington have lesser low water extremes. The Alaska stations with large tidal ranges such as Ketchikan, Juneau, Skagway, Seldovia, Nikiski, and Anchorage have much lower 1% exceedance probability levels than those for the rest of the west coast. The river station of Astoria has lesser low water extremes than its neighboring stations on the open coast. The Gulf Coast stations have lower 1% exceedance probability levels than the island stations with the lowest values along the northeastern part of the Texas coastline.

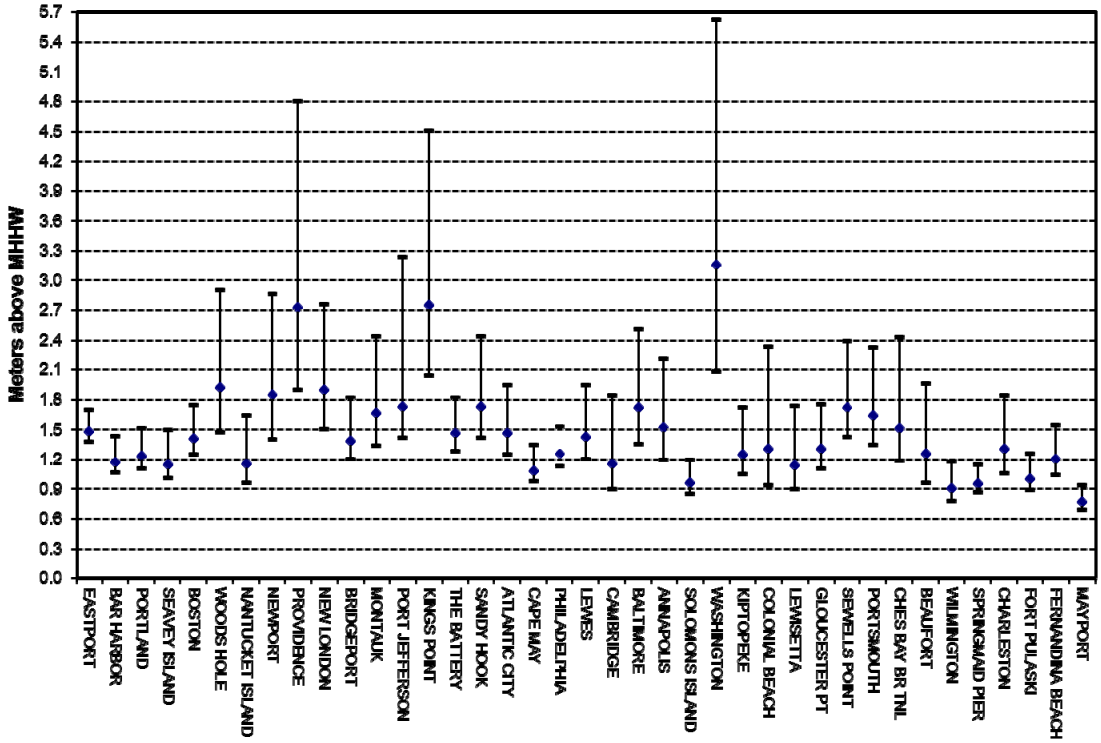

Figure 14. 1% high water exceedance probability levels with 95% confidence intervals for East Coast stations.

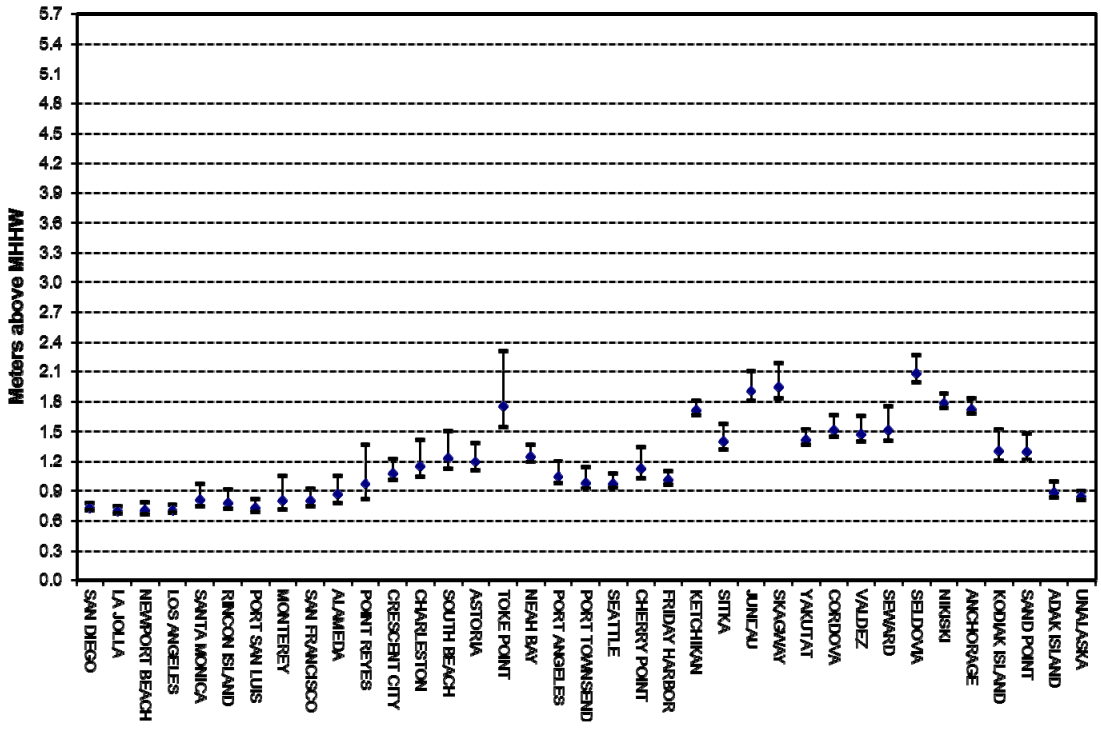

Figure 15. 1% high water exceedance probability levels with 95% confidence intervals for West Coast stations.

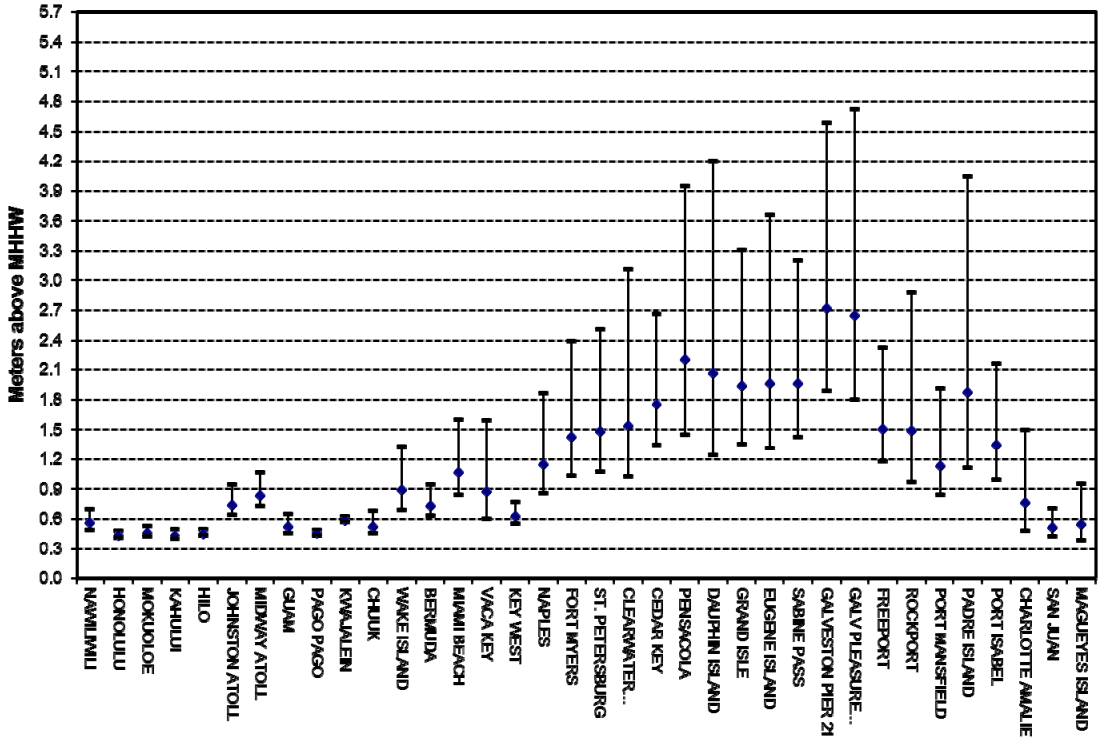

Figure 16. 1% high water exceedance probability levels with 95% confidence intervals for island and Gulf Coast stations.

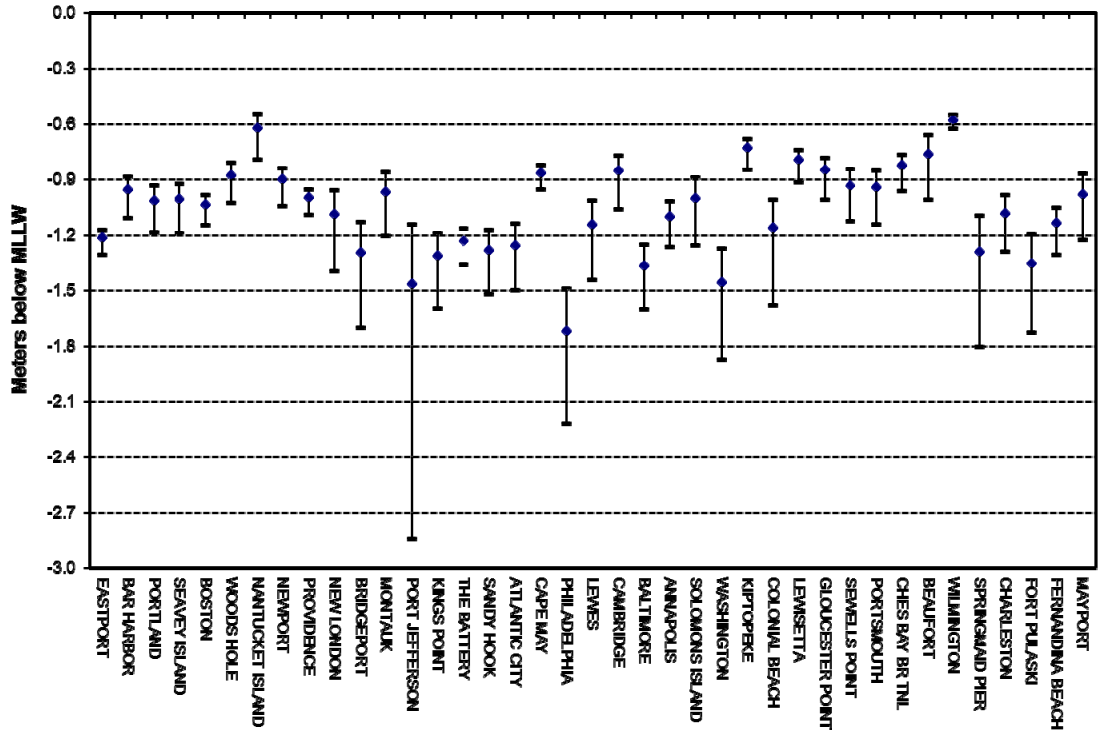

Figure 17. 1% low water exceedance probability levels with 95% confidence intervals for East Coast stations.

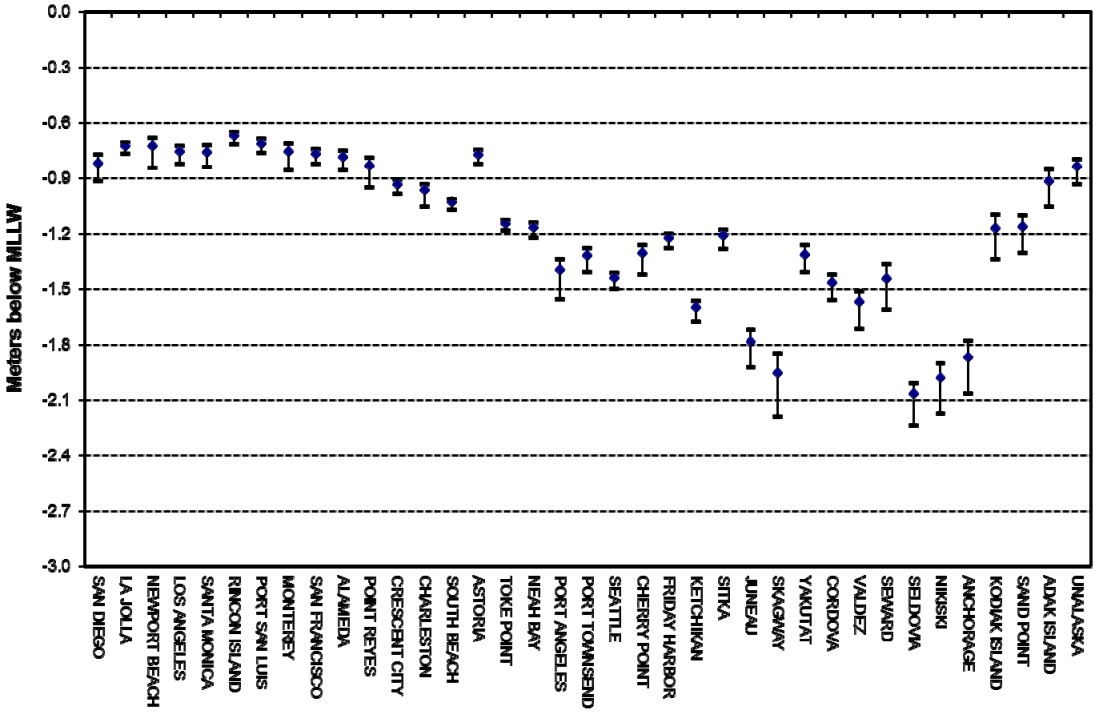

Figure 18. 1% low water exceedance probability levels with 95% confidence intervals for West Coast stations.

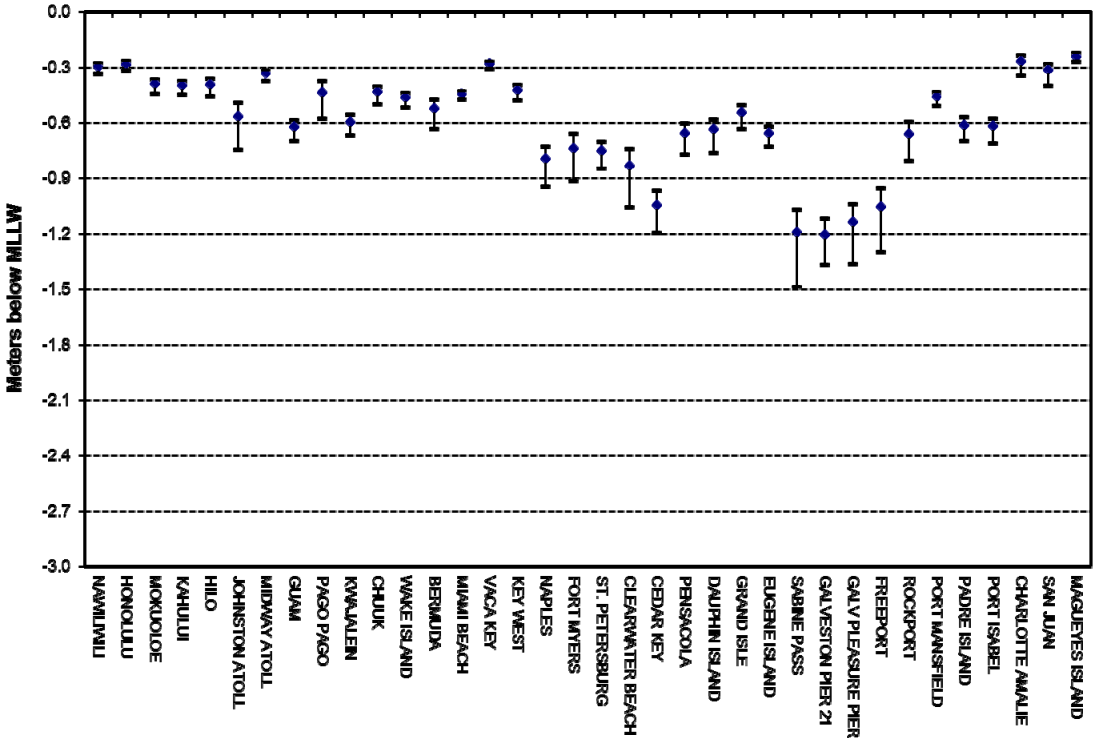

Figure 19. 1% low water exceedance probability levels with 95% confidence intervals for island and Gulf Coast stations.

D. GEV Data and Trend Plots

The exceedance probability levels shown in Figures 8 to 13 were derived from the detrended annual extreme values relative to MHHW and MLLW. The original observed monthly highest and lowest data can now be displayed with the calculated exceedance probability levels superimposed, if the exceedance levels are adjusted for their time dependence, i.e., rising or falling with MHHW or MLLW. MHHW and MLLW will follow mean sea level trend, except at the four stations previously mentioned which have differing high and low trends because of their increasing tidal range. The effect of the trend on the exceedance probability levels is obtained by adjusting the levels according to the amount of time before or after the time origin (or zero time) of the station, which is 1992.5 for the stations on the 1983-2001 NDTE, and 1999.5 or 2004.5 for the stations on a 5-year MTDE. For example, the levels at mid-2012 would be obtained by adding 20 years multiplied by the mean sea level trend to the exceedance probability levels that are on the 1983-2001 datum. These plots for all the stations are displayed in Appendix IV and V.

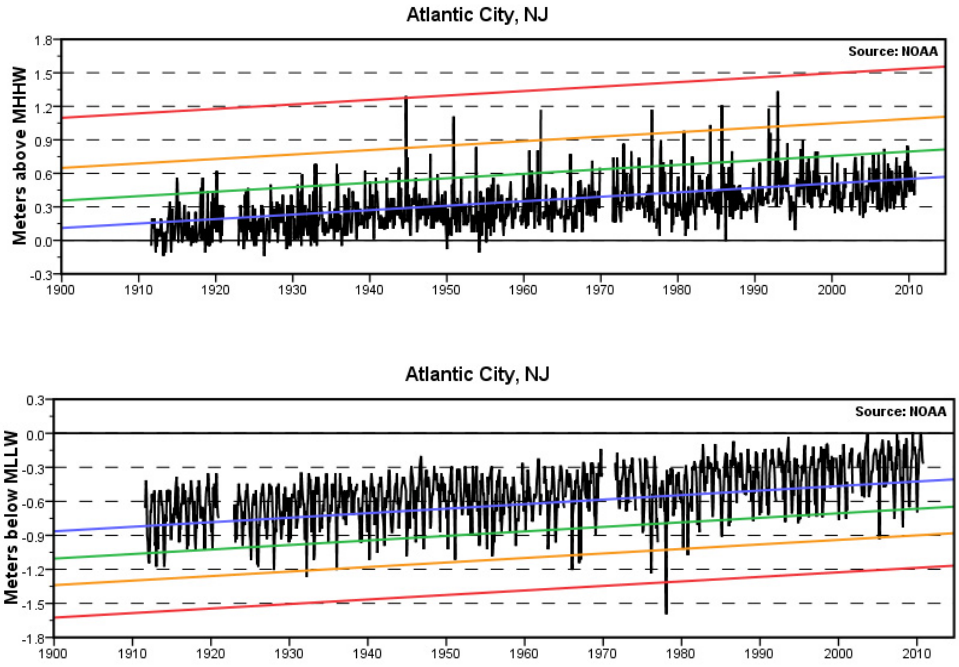

Figure 20. Monthly highest and lowest water levels for Atlantic City relative to MHHW and MLLW, respectively. Red, orange, green and blue lines are the 1%, 10%, 50%, and 99% annual exceedance probability levels. Atlantic City datums are for the 1983-2001 NDTE.

The plots in Figures 20 and 21 show examples of the monthly highest and lowest water levels and where the exceedance probability levels were at the time they occurred. This is useful in showing how a fixed level will undergo a long-term change in its exceedance probability. For stations with a positive trend like Atlantic City (Figure 20), the high water probability of exceedance at a fixed level increases over time and thus, the return period gets shorter; the low water probability of exceedance at a fixed level diminishes over time and thus, the return period

lengthens. For stations with a negative trend like Juneau (Figure 21), the high water probability of exceedance at a fixed level diminishes over time and thus, the return period lengthens; the low water probability of exceedance at a fixed level increases over time and thus, the return period gets shorter.

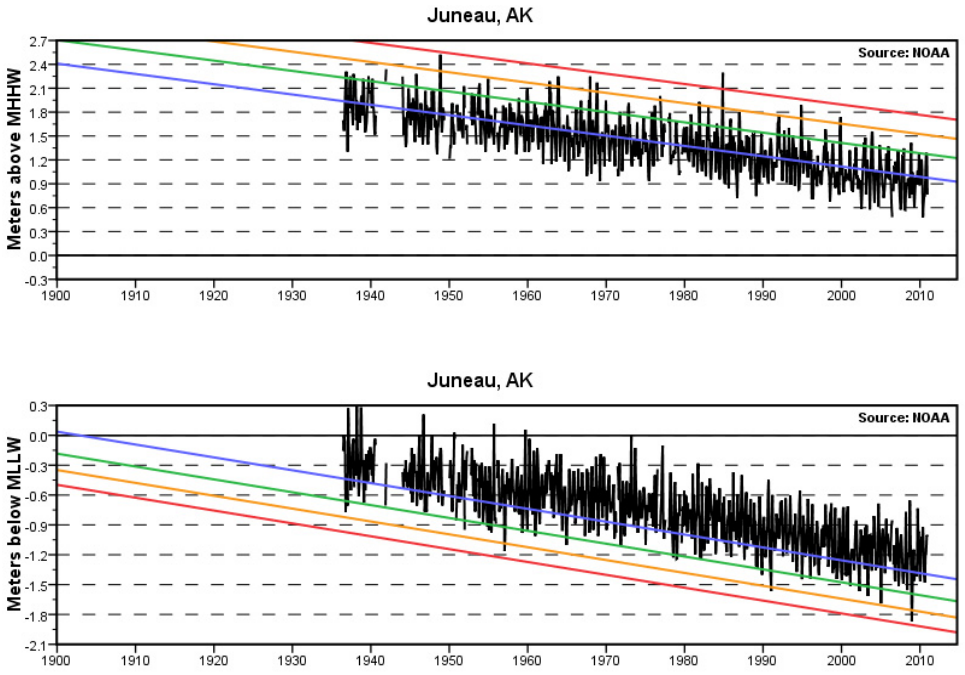

Figure 21. Monthly highest and lowest water levels for Juneau relative to MHHW and MLLW, respectively. Red, orange, green and blue lines are the 1%, 10%, 50%, and 99% annual exceedance probability levels. Juneau datums are for the modified 2002-2006 MTDE.

Therefore, in comparing two historical storm tides, it is important to consider where the exceedance probability levels were at the times that the different events occurred. For example, a storm tide today may not have exceeded today's 1% exceedance probability level, but a somewhat lower storm tide a long time ago may have exceeded the 1% exceedance probability level given its position at that time. This provides a way of evaluating the relative magnitudes of each station's extreme events independent of where mean sea level was when they occurred.

Table 5 is list of the high and low water events that exceeded the calculated 1% exceedance probability levels at each station. Due to changing mean sea levels, these events are not necessarily the highest or lowest levels ever recorded at each station. Furthermore, although these events can be considered to have an average return period of 100 years, it is possible that there is more than one such event in a station's record, even if the record is shorter than 100 years. It is also possible that there are no 100-year events in the record of a station with over 100 years of data. Many of the 100-year extreme values were caused by large-scale weather events and exceeded the 1% annual exceedance probability level at multiple stations; thus, they were probably the 100-year event for a broad coastal region.

Table 5. High and low water events which exceeded the 1% Annual Exceedance Probability Level					
Station Number	**Station Name**	**Date of High Water Event**		**Date of Low Water Event**	
1611400	Nawiliwili	9/11/1992			
1612340	Honolulu	12/20/1968	9/11/1992	4/30/1911	
1612480	Mokuoloe	1/8/1974		6/10/1968	
1615680	Kahului	12/20/1968		6/20/1955	
1617760	Hilo	1/20/1981		6/10/1972	5/3/1973
1619000	Johnston Atoll	1/13/1958			
1619910	Midway Atoll	1/11/1958		4/6/1969	5/5/1969
1630000	Guam	8/28/1992		12/21/1968	10/24/1972
1770000	Pago Pago	9/4/1960		2/6/1966 3/27/1998 5/26/1998	2/27/1998 4/27/1998
1820000	Kwajalein	2/28/2006	9/8/2010	12/2/1982	9/16/1997
1840000	Chuuk	11/26/1988		1/7/1970	
1890000	Wake Island	10/28/1992	8/31/2006		
2695540	Bermuda				
8410140	Eastport	4/6/1977	1/10/1997		
8413320	Bar Harbor			12/31/1963	
8418150	Portland	1/9/1978	2/7/1978		
8419870	Seavey Island	2/7/1978		2/12/2001	
8443970	Boston	2/7/1978			
8447930	Woods Hole	9/21/1938	8/31/1954	2/2/1976	
8449130	Nantucket Island	10/30/1991			
8452660	Newport	9/21/1938	8/31/1954		
8454000	Providence	9/21/1938		1/6/1959	
8461490	New London	9/21/1938	8/31/1954	2/2/1976	
8467150	Bridgeport	12/11/1992		2/2/1976	
8510560	Montauk	8/31/1954		2/2/1976	
8514560	Port Jefferson				
8516945	Kings/Willets Point	9/21/1938			
8518750	The Battery	11/7/1953	9/12/1960		
8531680	Sandy Hook			2/2/1976	1/10/1978
8534720	Atlantic City	9/14/1944			
8536110	Cape May				
8545240	Philadelphia	8/24/1933	11/25/1950	12/31/1962	
8557380	Lewes	3/6/1962		1/10/1978	
8571892	Cambridge	9/19/2003			
8574680	Baltimore	8/23/1933	9/19/2003	4/4/1975	
8575512	Annapolis	8/23/1933	9/19/2003	4/5/1975	
8577330	Solomons Island	8/13/1955		12/31/1962	
8594900	Washington			2/26/1967	

Table 5. High and low water events which exceeded the 1% Annual Exceedance Probability Level					
Station Number	**Station Name**	**Date of High Water Event**		**Date of Low Water Event**	
8632200	Kiptopeke	3/7/1962			
8635150	Colonial Beach				
8635750	Lewisetta	9/19/2003	9/1/2006		
8637624	Gloucester Point	9/18/2003			
8638610	Sewells Point	8/23/1933		1/31/1966	
8638660	Portsmouth	9/18/1936		1/31/1966	
8638863	Ches. Bay Brdg. Tnl.				
8656483	Beaufort			3/8/2004	
8658120	Wilmington	10/15/1954		2/3/1940	2/12/1981
8661070	Springmaid Pier	1/1/1987			
8665530	Charleston	8/11/1940	9/21/1989	3/13/1993	
8670870	Fort Pulaski	8/11/1940	10/15/1947		
8720030	Fernandina Beach	10/2/1898 9/9/1964	10/19/1944	1/24/1940	3/13/1993
8720218	Mayport	10/19/1944	9/9/1964	3/13/1993	
8723170	Miami Beach	10/18/1950	9/8/1965	3/18/1980	
8723970	Vaca Key	10/24/2005			
8724580	Key West	10/18/1944 10/24/2005	9/8/1965	2/4/1970	
8725110	Naples				
8725520	Fort Myers			9/8/1965	
8726520	St. Petersburg			1/3/2008	
8726724	Clearwater Beach				
8727520	Cedar Key			9/18/1947	
8729840	Pensacola	9/20/1926			
8735180	Dauphin Island				
8761724	Grand Isle	9/9/1965			
8764311	Eugene Island			1/13/1964	
8770570	Sabine Pass	9/13/2008			
8771450	Galveston Pier 21	8/17/1915	9/13/2008	1/25/1938	2/28/1984
8771510	Galv. Pleasure Pier	9/13/2008			
8772440	Freeport				
8774770	Rockport			2/29/1984	
8778490	Point Mansfield	9/20/1967			
8779750	Padre Island			12/13/1989	
8779770	Port Isabel	9/20/1967	8/9/1980	12/13/1989	
9410170	San Diego	12/17/1914 1/27/1983	12/20/1968	12/17/1933	12/17/1937
9410230	La Jolla	8/8/1983	11/13/1997	12/17/1933	
9410580	Newport Beach	1/28/1983			

Table 5. High and low water events which exceeded the 1% Annual Exceedance Probability Level					
Station Number	**Station Name**	**Date of High Water Event**		**Date of Low Water Event**	
9410660	Los Angeles	1/27/1983	1/10/2005	12/26/1932	12/17/1933
9410840	Santa Monica	11/30/1982		12/17/1933	
9411270	Rincon Island				
9412110	Port San Luis				
9413450	Monterey				
9414290	San Francisco	1/27/1983	12/3/1983	12/25/2007	1/11/2009
9414750	Alameda	1/27/1983	12/3/1983	12/25/2007	1/11/2009
9415020	Point Reyes				
9419750	Crescent City	1/29/1983		5/18/2003	
9432780	Charleston				
9435380	South Beach	12/11/1969		5/18/2003	
9439040	Astoria			1/16/1930	
9440910	Toke Point			12/19/1983	
9443090	Neah Bay	11/30/1951		11/26/2007	
9444090	Port Angeles	1/2/2003			
9444900	Port Townsend				
9447130	Seattle	12/15/1977	1/27/1983	6/20/1951	12/12/1985
9449424	Cherry Point	12/16/1982			
9449880	Friday Harbor	12/16/1982		12/12/1985	
9450460	Ketchikan	12/2/1967		12/14/2008	
9451600	Sitka	11/2/1948		1/1/1991	12/14/2008
9452210	Juneau	11/22/1984		12/14/2008	
9452400	Skagway	11/22/1984			
9453220	Yakutat	11/2/1948	12/31/1963	12/14/2008	
9454050	Cordova	11/11/1981		12/14/2008	
9454240	Valdez			12/14/2008	
9455090	Seward	1/1/1987		12/14/2008	
9455500	Seldovia	11/5/2002			
9455760	Nikiski	11/6/2002			
9455920	Anchorage	11/5/2002		12/25/1999	
9457292	Kodiak Island	11/5/2002		12/14/2008	
9459450	Sand Point	12/31/1986		12/13/2008	
9461380	Adak Island	12/28/1966		11/11/1950	
9462620	Unalaska	1/14/1938			
9751639	Charlotte Amalie	9/18/1989	9/16/1995		
9755371	San Juan	9/18/1989			
9759110	Magueyes Island	8/31/1979			

E. Monthly GEV Variation

The annual GEV results discussed so far give the annual likelihood of the occurrence of extreme water levels; however, these events are usually caused by some combination of meteorological and tidal forcing both of which can have a varying probability of occurrence over the course of a year. To investigate this seasonal dependence on the probability of extreme water levels, the monthly highest and lowest water level data can be divided up into twenty four subsets, one for the highest and one for the lowest water levels recorded in each individual month of the year. Then twenty four GEV analyses are carried out on the monthly extreme levels for each station. Each analysis will produce a set of location, scale, and shape parameters from which exceedance probability curves can be calculated. The 99%, 50%, 10% and 1% high and low exceedance probability levels for each month are listed in Table E in Appendix VI and Table F in Appendix VII.

Figures 20 to 25 are plots of the high and low exceedance probability levels by month for twelve stations which are representative of regional differences. For the high water exceedance probability levels (Figures 20-22), at some stations (e.g., Honolulu) there is very little seasonal dependence. At other representative stations such as Guam, Charleston, St. Petersburg, Galveston, and San Juan, where winter storms are rare and hurricanes or typhoons are common, exceedance probabilities are elevated in one or more of the summer months. At locations where winter storms are frequent and hurricanes are uncommon or nonexistent such as Boston, The Battery, San Francisco, Seattle, Sitka, and Unalaska, exceedance probabilities are more elevated in the winter months.

For the low water exceedance probability levels (Figures 23-25), there is only a small seasonal dependence at stations such as Honolulu and San Juan where they appear to follow the mean sea level seasonal cycle. At Guam, the exceedance probability levels are lowest during winter months, which are the months when extreme low water levels in the western tropical Pacific can occur during an El Niño event. At Boston, The Battery, Charleston, St. Petersburg, and Galveston the lowest extreme probability levels are also during the winter months, but are due to cold season storminess in the Atlantic and Gulf of Mexico. St. Petersburg also has a lowered 1% exceedance probability level during September, which is due to a few strong hurricanes which, having crossed southern Florida, deliver intense offshore winds to Florida's west coast. The west coast stations of San Francisco, Seattle, and Sitka have lower exceedance probability levels in summer and winter relative to the levels in March and September. This seasonality is due to a variation in tidal forcing over the course of a year which, for almost all U.S. coastal regions, gives higher amplitude spring tides during the solstices and lower amplitude spring tides during the equinoxes (Merrifield et al., 2007). There are other parts of the global ocean that have higher amplitude spring tides during the equinoxes (March and September) than during the solstices (June and December).

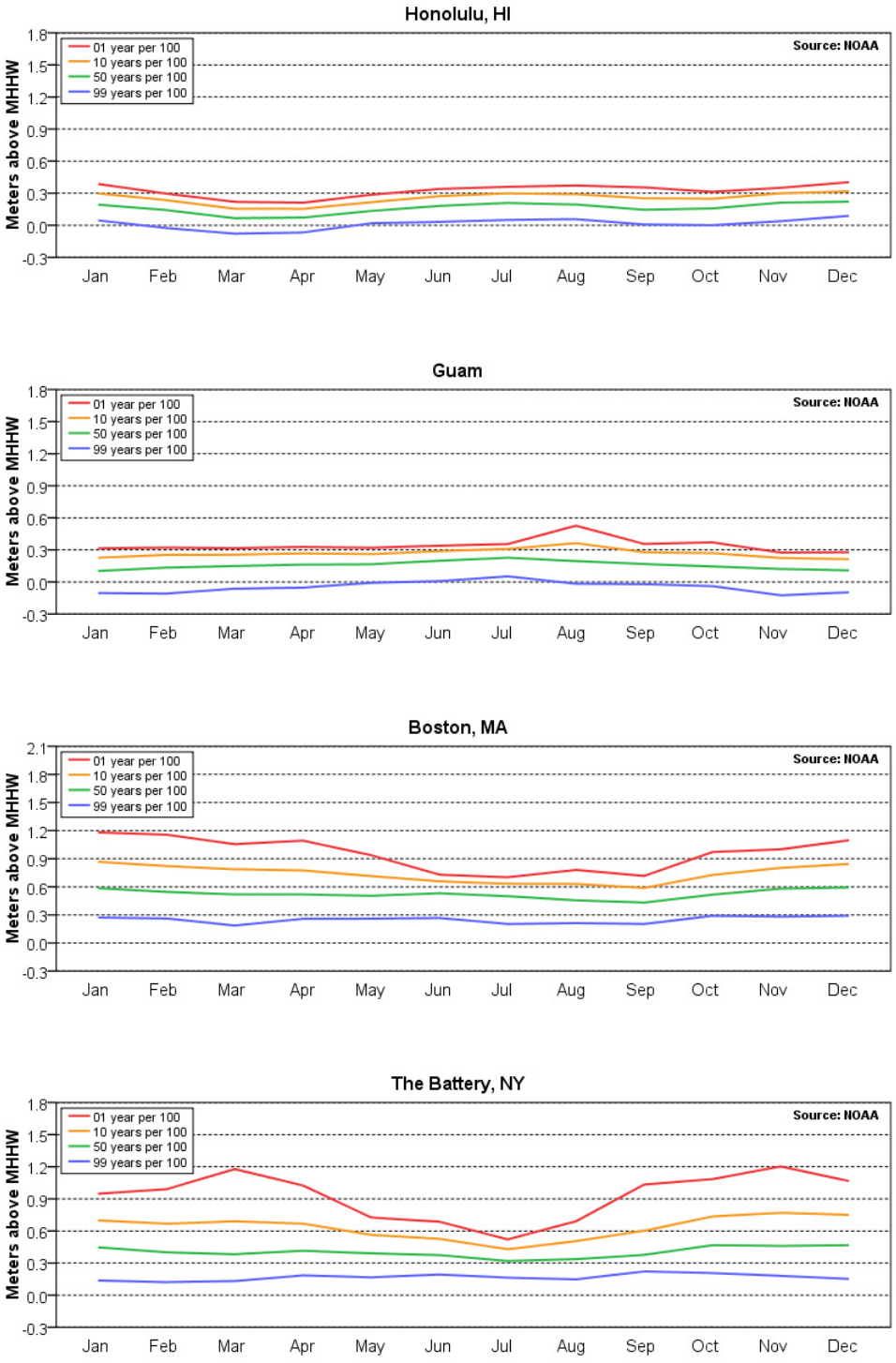

Figure 22. Seasonal varation of 99%, 50%, 10%, and 1% high water exceedance probability levels above MHHW for Honolulu, Guam, Boston, and The Battery.

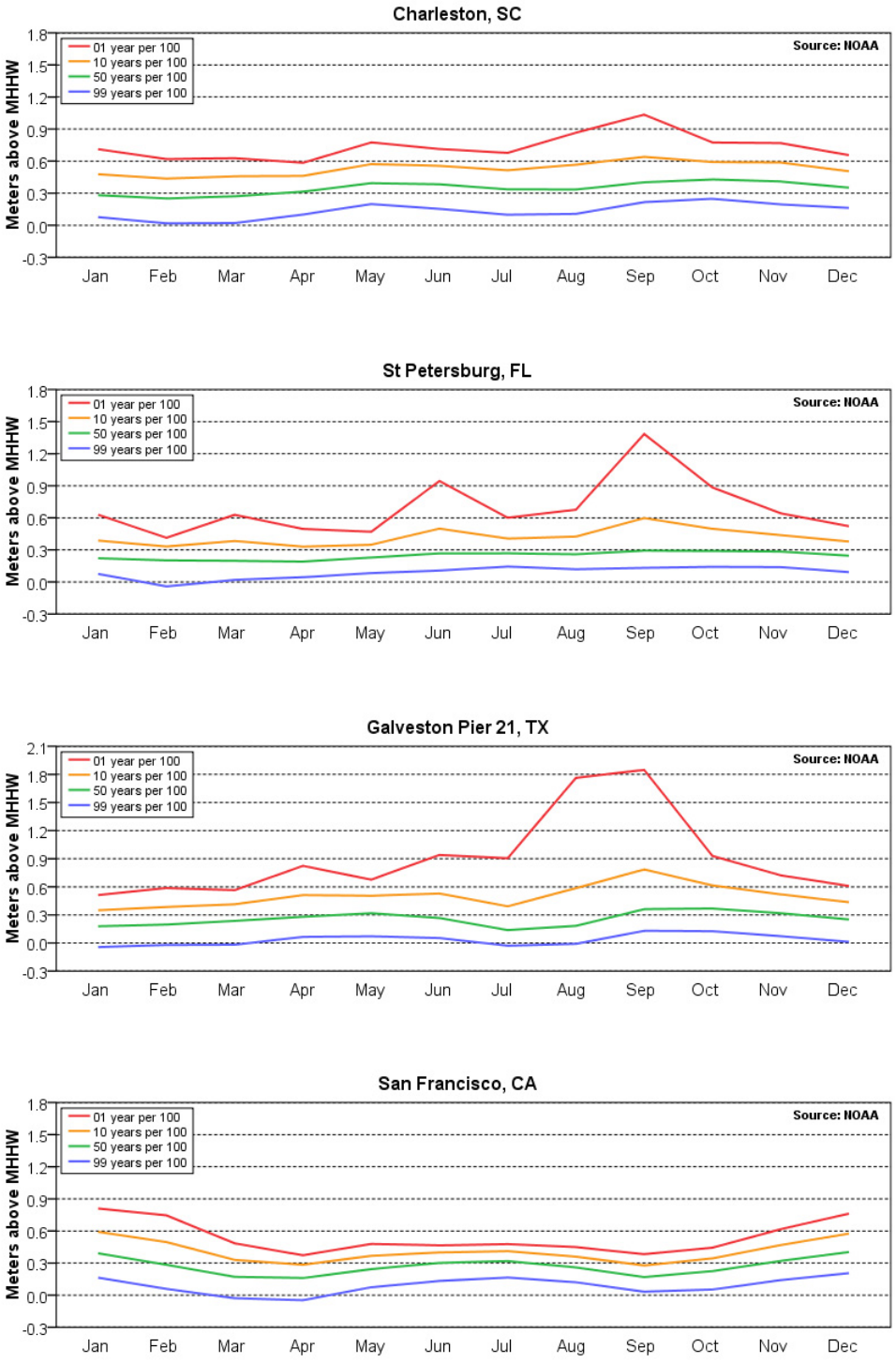

Figure 23. Seasonal varation of 99%, 50%, 10%, and 1% high water exceedance probability levels above MHHW for Charleston, St. Petersburg, Galveston Pier 21, and San Francisco.

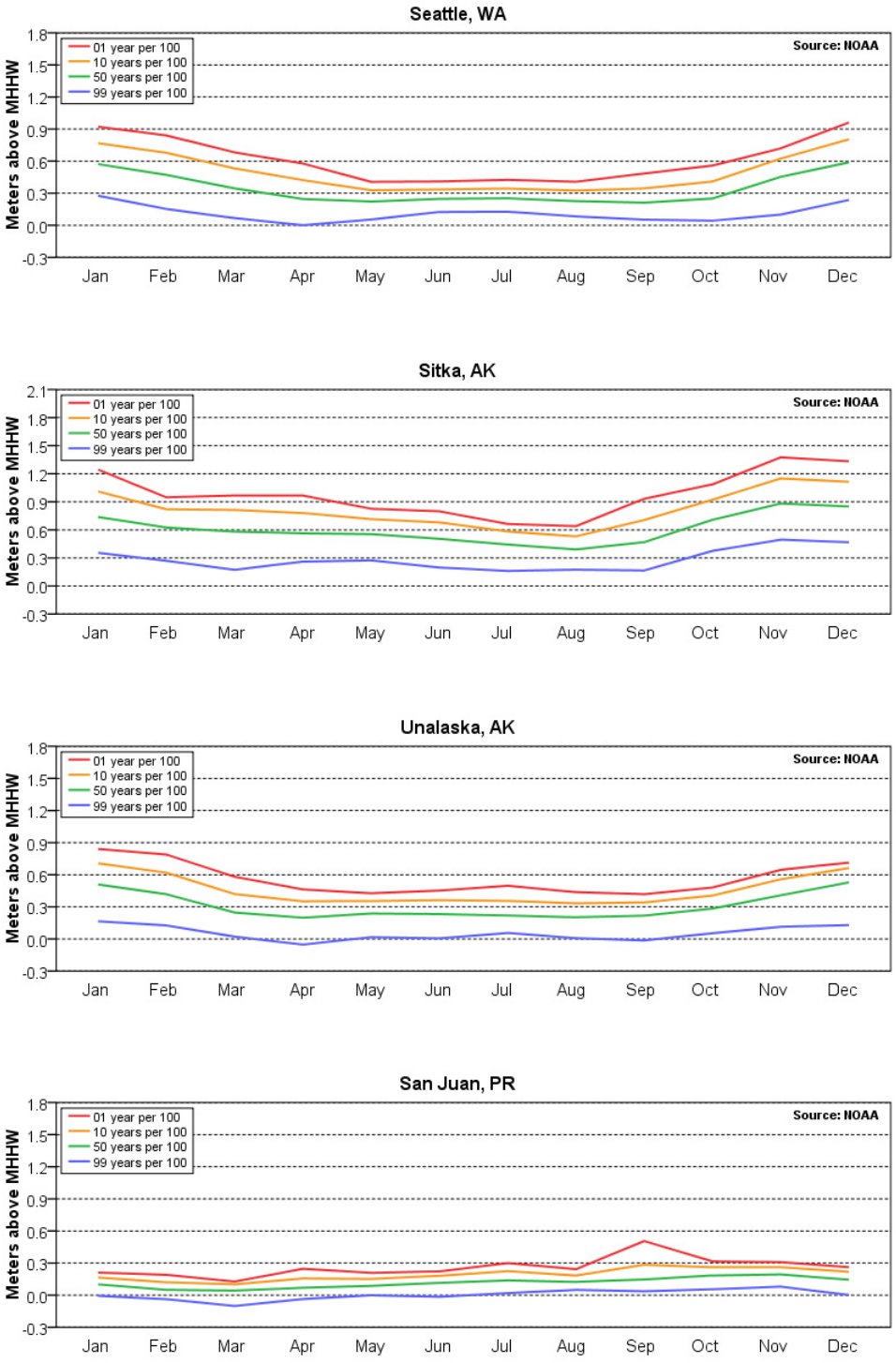

Figure 24. Seasonal varation of 99%, 50%, 10%, and 1% high water exceedance probability levels above MHHW for Seattle, Sitka, Unalaska, and San Juan.

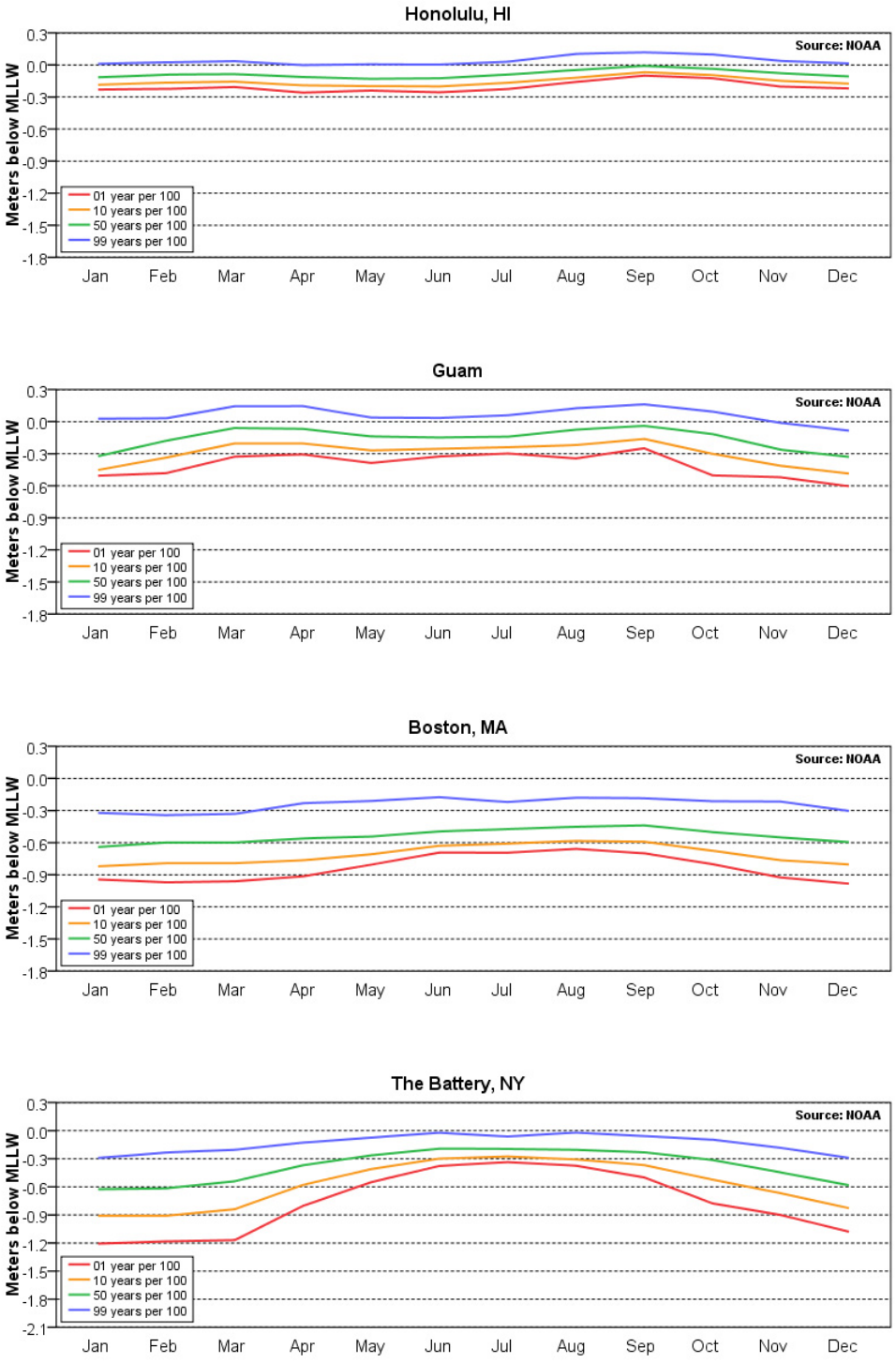

Figure 25. Seasonal varation of 99%, 50%, 10%, and 1% low water exceedance probability levels below MLLW for Honolulu, Guam, Boston, and The Battery.

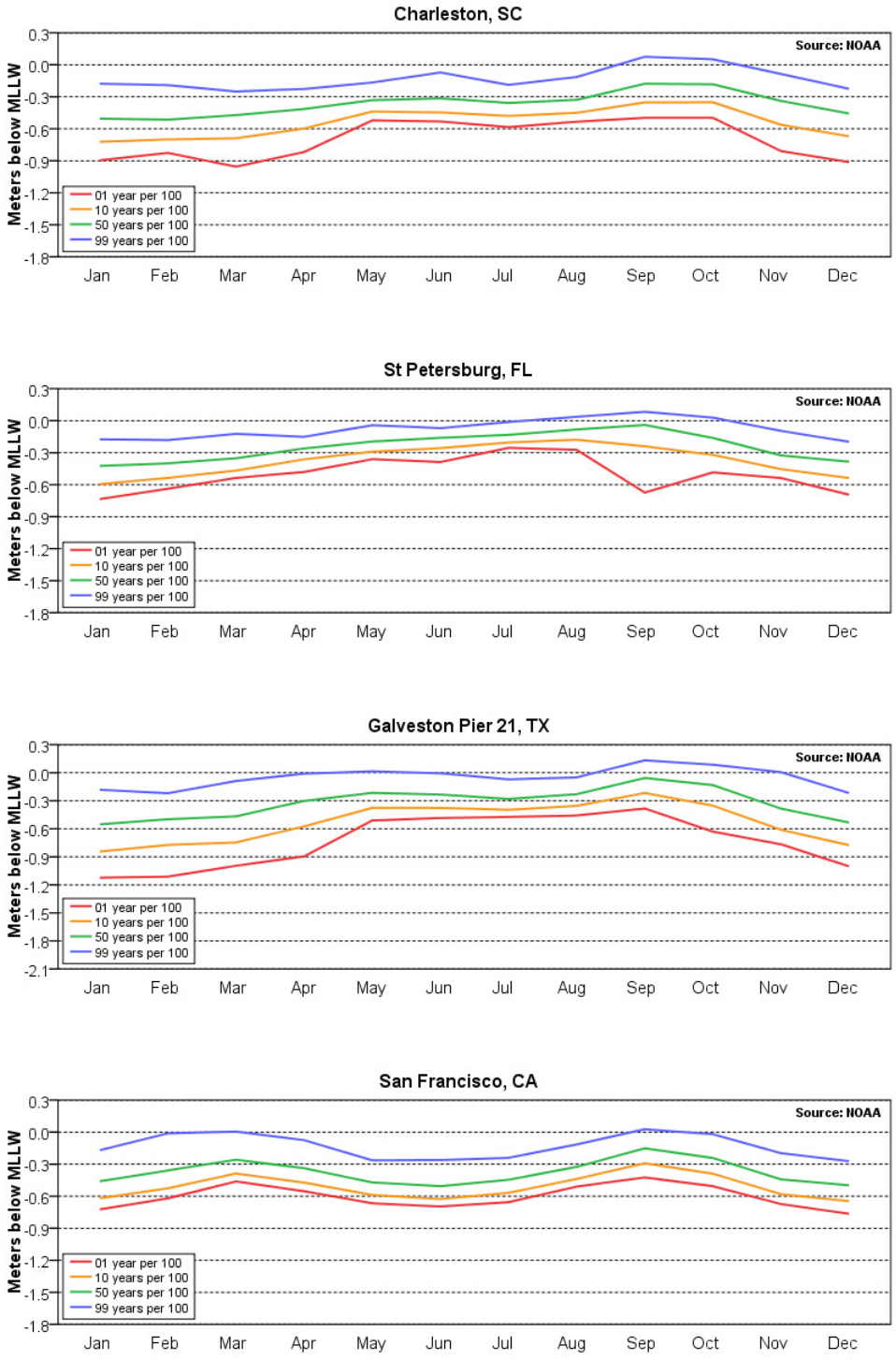

Figure 26. Seasonal varation of 99%, 50%, 10%, and 1% low water exceedance probability levels below MLLW for Charleston, St. Petersburg, Galveston Pier 21, and San Francisco.

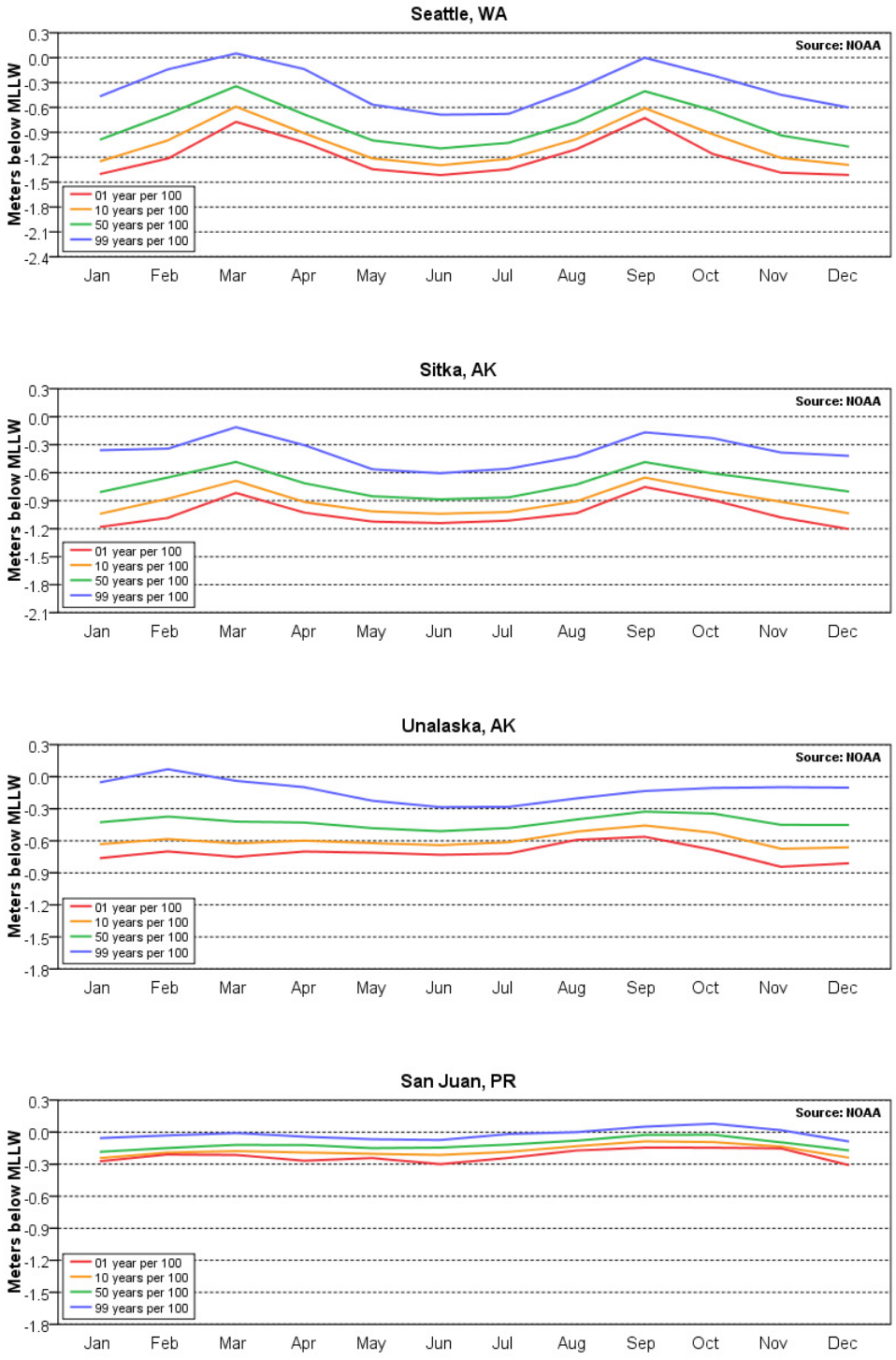

Figure 27. Seasonal varation of 99%, 50%, 10%, and 1% low water exceedance probability levels below MLLW for Seattle, Sitka, Unalaska, and San Juan.

V. Summary and Conclusion

The goal of this investigation was to quantify the likelihood of storm tide inundation along the U.S. coastline with a focus on the least common, most extreme events. This study made use of a valuable data set consisting of the highest and lowest monthly water levels recorded at 112 long-term U.S. water level stations. Ten of the stations had over 100 years of data. Using the data up to 2010, all of the stations had over 30 years of data except for two west coast stations, where good results were obtained with 26 and 27 years of data (Rincon Island and Nikiski, respectively).

After extensive quality control checking of the data, sets of monthly highest and lowest water levels were obtained for each station. The data were then detrended using the mean sea level trends calculated with data up to 2006 (Zervas, 2009), except at four stations where separate mean high and low water trends were used for detrending, due to the stations' increasing tidal ranges over their periods of record. A set of annual highest and lowest water levels were then generated. The GEV analysis method was chosen as the appropriate statistical model for extreme data values. The extRemes package of the R statistical software environment was used to calculate the GEV parameters for each station's high and low water extreme values.

The results of the GEV analyses were presented in tables and figures to display them for discussion and for practical applications. The high and low water exceedance probability curves and their 95% confidence intervals were plotted along with the detrended annual extreme values from which they were derived. The shape parameters, which have a great influence on the behavior of the exceedance curves at longer return periods, were compared by regions to show similarities and differences between neighboring stations.

The high and low water 99%, 50%, 10%, and 1% exceedance probability levels were displayed in plots by region and were used to construct stick diagrams for each station showing the relationship of these levels to MSL, the other tidal datums, and to the NAVD88 geodetic datum, if it was available. Station-to-station comparisons were also made of the 1% GEV exceedance probability levels and their 95% confidence intervals which may be comparable to the SWELs used by FEMA in flood insurance studies as the basis for their flood insurance rate maps.

The original data were then plotted along with the calculated exceedance probability levels which rise or fall in conjunction with a station's MSL. The extreme events which exceeded the 1% exceedance probability level and which can be considered as the events with a 100-year return period, are identified in a table. Finally, a set of twenty four GEV exceedance probability analyses were carried out for each station using the high and low water values for each month of the year in order to demonstrate seasonal variability in the likelihood of the occurrence of extreme events.

The width of the 95% confidence intervals calculated for the exceedance probability curves vary greatly with the return period, the years of data available for analysis, and with the GEV shape

parameter which characterizes the distribution of the extreme values. Although at longer return periods, the confidence intervals always get wider, the stations with negative shape parameters have quite narrow confidence intervals up to and beyond the 100-year return periods. At stations with positive shape parameters, however, the confidence intervals can be very wide at the 100-year return period. The continued collection of more years of data, and the future recalculation of the GEV exceedance probability parameters should gradually narrow the widths of the confidence intervals.

The results of this investigation should have many potential uses. Knowledge of the positions of the exceedance probability levels will allow the level reached by any future storm event to be immediately put in a historical context. In conjunction with numerical operational forecast models, predicted storm tides, when accompanied with a station's exceedance probability levels, can be used to prepare for the impacts of an approaching storm system.

The exceedance probability levels will also be useful in the planning and construction of man-made infrastructure in coastal regions of the United States. The likelihood of fixed levels being inundated over the design lifetime of a structure needs to be quantified for the planning and construction of roads, bridges, buildings, ports, and drainage systems. The exceedance probability levels should also prove useful in the management and restoration of natural ecosystems such as marshlands, reefs, beaches, and barrier islands.

Exceedance levels can also be projected into the future by raising or lowering the levels according to either the historical linear trends or by taking into account non-linear future scenarios for global and/or regional sea level rise. With continually changing sea levels, the probability of exceedance at a fixed elevation will also undergo a continuous change each year.

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Appendix I.

Annual GEV Exceedance Probability Curves for High Waters

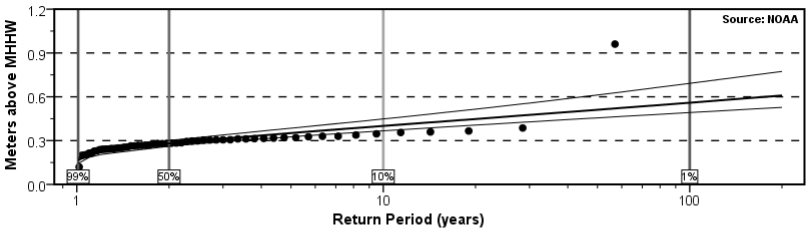
Note: Black dots indicate the annual highest water levels shown in the Weibull plotting positions. Thicker black line is the GEV exceedance probability curve and the thinner black lines indicate the upper and lower 95% confidence intervals. The vertical red, orange, green, and blue lines are the return periods of the 1%, 10%, 50%, and 99% annual probabilities of exceedance. The zero value on the vertical axis represents the elevation of the MHHW datum for the National Tidal Datum Epoch (1983-2001) or the special 5-year Modified Tidal Datum Epoch, as appropriate.

Table A. High Water Level GEV Location, Scale, and Shape Parameters							
Station Number	Station Name	Location Parameter (meters)	+/- 95% Confidence Interval	Scale Parameter (meters)	+/- 95% Confidence Interval	Shape Parameter	+/- 95% Confidence Interval
1611400	Nawiliwili	0.258	0.017	0.062	0.011	0.028	0.082
1612340	Honolulu	0.255	0.012	0.056	0.008	-0.182	0.112
1612480	Mokuoloe	0.293	0.016	0.051	0.011	-0.174	0.174
1615680	Kahului	0.280	0.014	0.048	0.010	-0.186	0.174
1617760	Hilo	0.301	0.016	0.060	0.012	-0.298	0.162
1619000	Johnston Atoll	0.350	0.024	0.082	0.017	0.007	0.146
1619910	Midway Atoll	0.366	0.031	0.114	0.021	-0.050	0.146
1630000	Guam	0.233	0.018	0.066	0.012	-0.022	0.115
1770000	Pago Pago	0.284	0.018	0.066	0.011	-0.278	0.091
1820000	Kwajalein	0.448	0.014	0.053	0.009	-0.272	0.115
1840000	Chuuk	0.246	0.021	0.064	0.015	-0.026	0.142
1890000	Wake Island	0.322	0.020	0.071	0.015	0.222	0.163
2695540	Bermuda	0.367	0.021	0.078	0.015	0.005	0.179
8410140	Eastport	1.044	0.023	0.094	0.016	0.000	0.139
8413320	Bar Harbor	0.754	0.026	0.092	0.019	-0.008	0.189
8418150	Portland	0.714	0.023	0.103	0.017	0.038	0.159
8419870	Seavey Island	0.637	0.037	0.120	0.027	-0.035	0.231
8443970	Boston	0.764	0.031	0.133	0.023	0.019	0.156
8447930	Woods Hole	0.565	0.040	0.161	0.032	0.240	0.157
8449130	Nantucket Island	0.504	0.041	0.125	0.030	0.052	0.210
8452660	Newport	0.582	0.032	0.131	0.027	0.290	0.170
8454000	Providence	0.720	0.054	0.190	0.046	0.323	0.230
8461490	New London	0.618	0.048	0.188	0.037	0.158	0.158
8467150	Bridgeport	0.704	0.052	0.160	0.037	-0.037	0.198
8510560	Montauk	0.608	0.048	0.173	0.037	0.118	0.190
8514560	Port Jefferson	0.683	0.097	0.216	0.079	0.022	0.517
8516990	Kings Point / Willets Point	0.848	0.063	0.236	0.051	0.224	0.240
8518750	The Battery	0.676	0.030	0.149	0.022	0.058	0.124
8531680	Sandy Hook	0.706	0.039	0.157	0.030	0.142	0.175
8534720	Atlantic City	0.674	0.031	0.137	0.023	0.097	0.162
8536110	Cape May	0.638	0.043	0.130	0.031	-0.138	0.222
8545240	Philadelphia	0.589	0.033	0.158	0.023	-0.038	0.125
8557380	Lewes	0.669	0.036	0.136	0.027	0.079	0.195
8571892	Cambridge	0.503	0.029	0.089	0.024	0.187	0.279
8574680	Baltimore	0.533	0.028	0.132	0.023	0.264	0.143
8575512	Annapolis	0.510	0.028	0.118	0.023	0.247	0.140
8577330	Solomons Island	0.478	0.028	0.110	0.020	-0.026	0.139
8594900	Washington	0.557	0.046	0.188	0.042	0.413	0.182
8632200	Kiptopeke	0.579	0.033	0.117	0.025	0.090	0.186

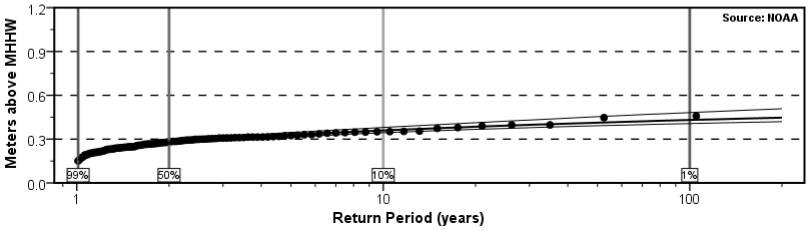
Table A. High Water Level GEV Location, Scale, and Shape Parameters							
Station Number	Station Name	Location Parameter (meters)	+/- 95% Confidence Interval	Scale Parameter (meters)	+/- 95% Confidence Interval	Shape Parameter	+/- 95% Confidence Interval
8635150	Colonial Beach	0.498	0.035	0.093	0.029	0.251	0.304
8635750	Lewisetta	0.488	0.035	0.099	0.027	0.146	0.215
8637624	Gloucester Point	0.582	0.042	0.141	0.030	0.044	0.158
8638610	Sewells Point	0.678	0.041	0.170	0.031	0.120	0.163
8638660	Portsmouth	0.697	0.052	0.170	0.038	0.076	0.196
8638863	Ches. Bay Bridge Tunnel	0.653	0.055	0.145	0.042	0.105	0.302
8656483	Beaufort	0.424	0.037	0.121	0.029	0.163	0.203
8658120	Wilmington	0.375	0.026	0.104	0.018	0.045	0.127
8661070	Springmaid Pier	0.574	0.027	0.088	0.018	-0.026	0.122
8665530	Charleston	0.526	0.022	0.094	0.017	0.234	0.153
8670870	Fort Pulaski	0.579	0.018	0.072	0.014	0.101	0.147
8720030	Fernandina Beach	0.556	0.021	0.096	0.016	0.154	0.118
8720220	Mayport	0.428	0.018	0.076	0.013	-0.010	0.148
8723170	Miami Beach	0.391	0.033	0.105	0.025	0.140	0.181
8723970	Vaca Key	0.268	0.020	0.057	0.017	0.325	0.242
8724580	Key West	0.276	0.014	0.067	0.010	0.053	0.096
8725110	Naples	0.414	0.034	0.104	0.027	0.172	0.249
8725520	Fort Myers	0.418	0.047	0.141	0.037	0.177	0.250
8726520	St. Petersburg	0.445	0.037	0.129	0.030	0.224	0.252
8726724	Clearwater Beach	0.467	0.048	0.122	0.040	0.257	0.370
8727520	Cedar Key	0.524	0.036	0.152	0.029	0.224	0.171
8729840	Pensacola	0.397	0.030	0.126	0.027	0.426	0.194
8735180	Dauphin Island	0.404	0.046	0.131	0.041	0.385	0.248
8761724	Grand Isle	0.433	0.047	0.168	0.039	0.261	0.206
8764311	Eugene Island	0.567	0.066	0.171	0.053	0.228	0.289
8770570	Sabine Pass	0.498	0.053	0.175	0.042	0.238	0.172
8771450	Galveston Pier 21	0.522	0.038	0.172	0.034	0.386	0.175
8771510	Galveston Pleasure Pier	0.592	0.066	0.212	0.055	0.292	0.208
8772440	Freeport	0.532	0.047	0.155	0.036	0.128	0.222
8774770	Rockport	0.351	0.033	0.105	0.028	0.331	0.282
8778490	Port Mansfield	0.388	0.046	0.116	0.035	0.135	0.270
8779750	Padre Island	0.341	0.043	0.115	0.038	0.401	0.277
8779770	Port Isabel	0.373	0.027	0.103	0.023	0.282	0.170
9410170	San Diego	0.554	0.012	0.058	0.008	-0.190	0.090
9410230	La Jolla	0.525	0.014	0.058	0.009	-0.213	0.129
9410580	Newport Beach	0.536	0.018	0.052	0.012	-0.167	0.176
9410660	Los Angeles	0.536	0.012	0.054	0.009	-0.172	0.123
9410840	Santa Monica	0.536	0.014	0.054	0.010	0.045	0.156
9411270	Rincon Island	0.548	0.030	0.073	0.021	-0.182	0.233
9412110	Port San Luis	0.512	0.020	0.071	0.014	-0.200	0.188
9413450	Monterey	0.499	0.025	0.068	0.018	-0.011	0.255

Table A. High Water Level GEV Location, Scale, and Shape Parameters							
Station Number	Station Name	Location Parameter (meters)	+/- 95% Confidence Interval	Scale Parameter (meters)	+/- 95% Confidence Interval	Shape Parameter	+/- 95% Confidence Interval
9414290	San Francisco	0.460	0.020	0.096	0.014	-0.118	0.119
9414750	Alameda	0.470	0.025	0.098	0.018	-0.064	0.151
9415020	Point Reyes	0.515	0.034	0.093	0.025	0.024	0.265
9419750	Crescent City	0.660	0.032	0.129	0.022	-0.167	0.133
9432780	Charleston	0.698	0.049	0.140	0.035	-0.170	0.253
9435380	South Beach	0.753	0.046	0.139	0.033	-0.135	0.218
9439040	Astoria	0.755	0.031	0.128	0.022	-0.135	0.169
9440910	Toke Point	0.973	0.074	0.209	0.054	-0.094	0.262
9443090	Neah Bay	0.835	0.039	0.160	0.028	-0.285	0.146
9444090	Port Angeles	0.668	0.051	0.141	0.035	-0.269	0.203
9444900	Port Townsend	0.631	0.049	0.139	0.036	-0.298	0.250
9447130	Seattle	0.649	0.023	0.110	0.016	-0.214	0.132
9449424	Cherry Point	0.689	0.045	0.130	0.031	-0.154	0.193
9449880	Friday Harbor	0.650	0.033	0.137	0.023	-0.277	0.123
9450460	Ketchikan	1.275	0.036	0.162	0.024	-0.263	0.096
9451600	Sitka	0.978	0.030	0.119	0.021	-0.117	0.139
9452210	Juneau	1.366	0.037	0.147	0.025	-0.106	0.117
9452400	Skagway	1.405	0.040	0.150	0.029	-0.118	0.173
9453220	Yakutat	1.041	0.038	0.147	0.026	-0.289	0.131
9454050	Cordova	1.088	0.053	0.167	0.038	-0.295	0.189
9454240	Valdez	1.086	0.051	0.141	0.036	-0.251	0.226
9455090	Seward	1.052	0.043	0.130	0.030	-0.125	0.191
9455500	Seldovia	1.494	0.066	0.213	0.045	-0.245	0.129
9455760	Nikiski	1.438	0.074	0.177	0.054	-0.455	0.234
9455920	Anchorage	1.425	0.041	0.122	0.029	-0.312	0.198
9457292	Kodiak Island	0.864	0.045	0.136	0.031	-0.165	0.181
9459450	Sand Point	0.858	0.053	0.152	0.037	-0.224	0.182
9461380	Adak Island	0.587	0.028	0.105	0.020	-0.234	0.166
9462620	Unalaska	0.558	0.027	0.109	0.018	-0.285	0.092
9751639	Charlotte Amalie	0.175	0.019	0.052	0.016	0.343	0.248
9755371	San Juan	0.204	0.016	0.053	0.012	0.097	0.133
9759110	Magueyes Island	0.152	0.012	0.041	0.010	0.291	0.228

Nawiliwili, HI



Honolulu, HI



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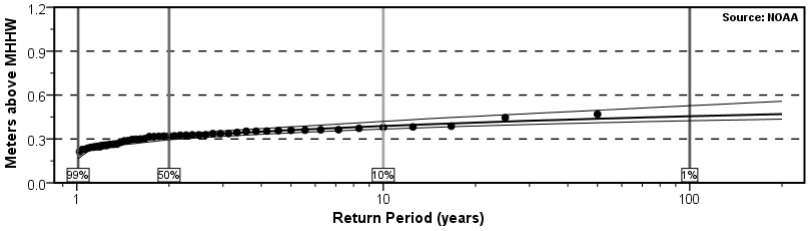

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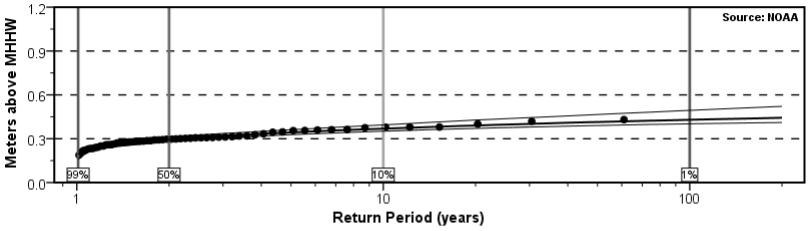

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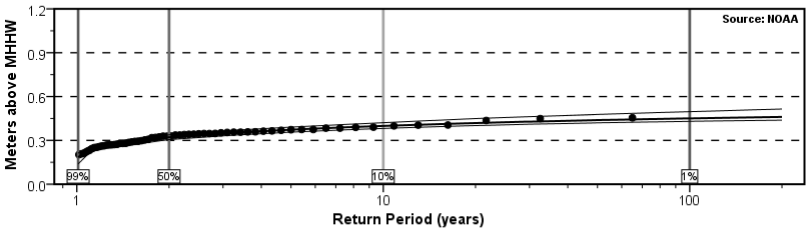
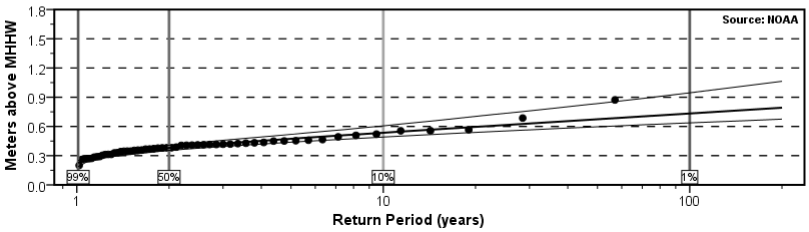
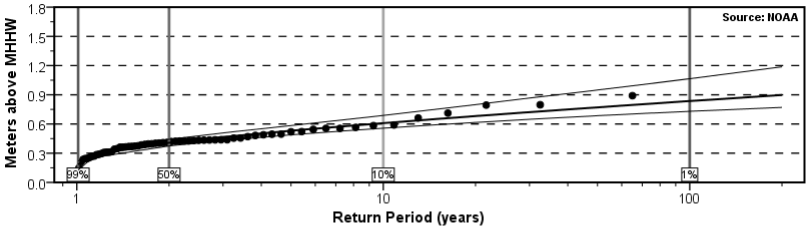


Johnston Atoll



Midway Atoll



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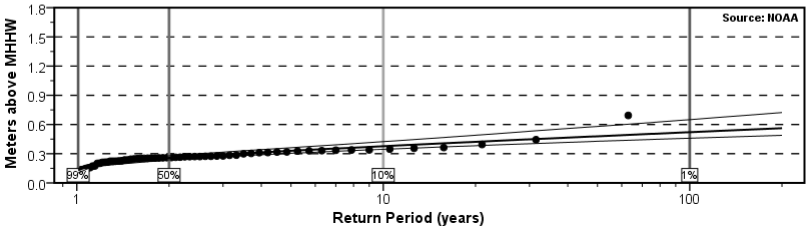

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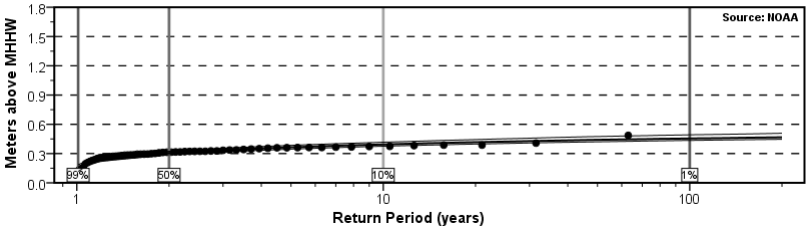
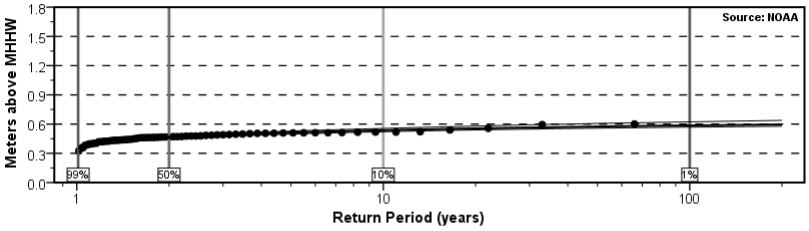


Kwajalein



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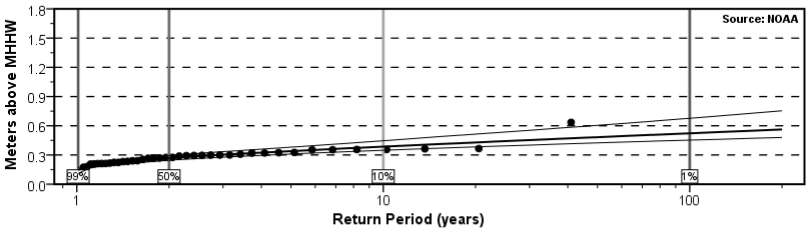
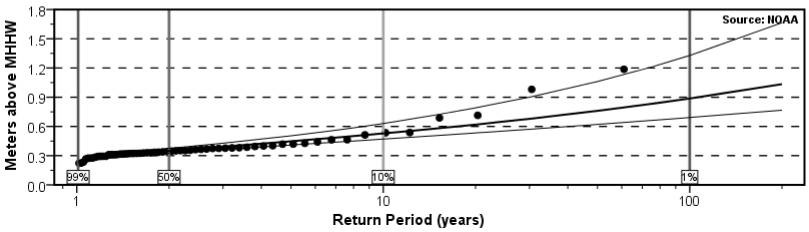


Wake Island



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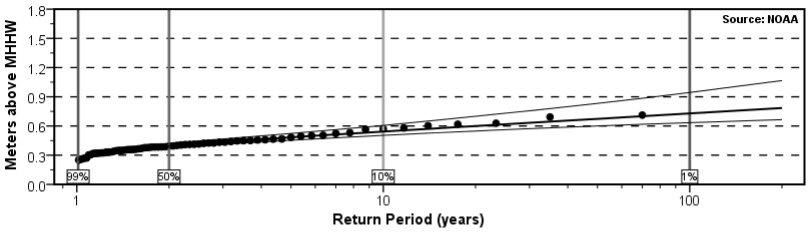
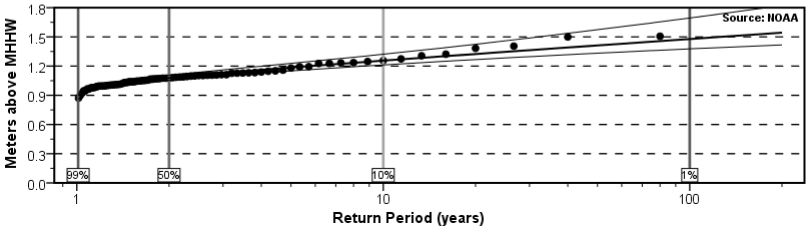
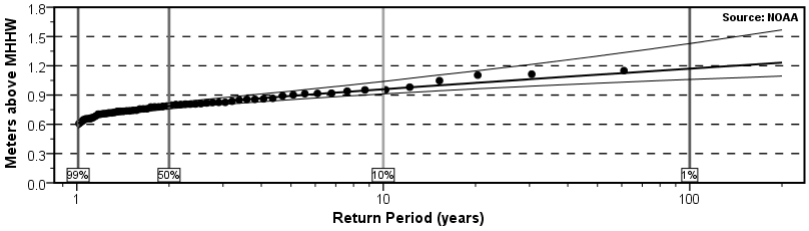


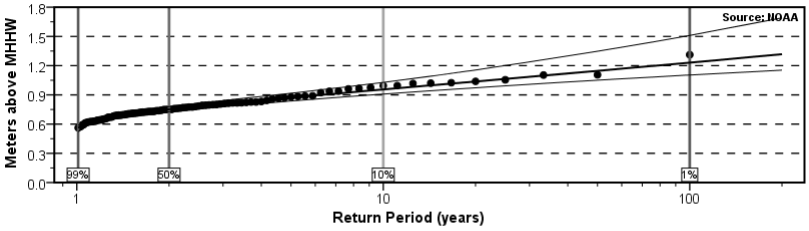
Eastport, ME



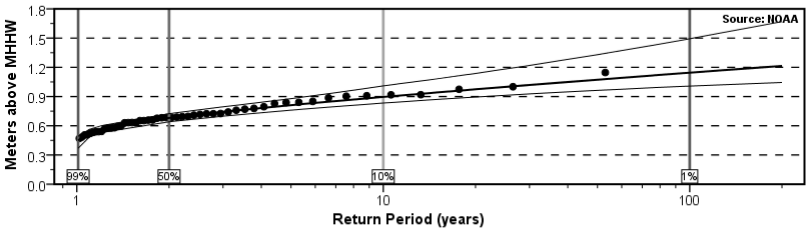
Bar Harbor, ME



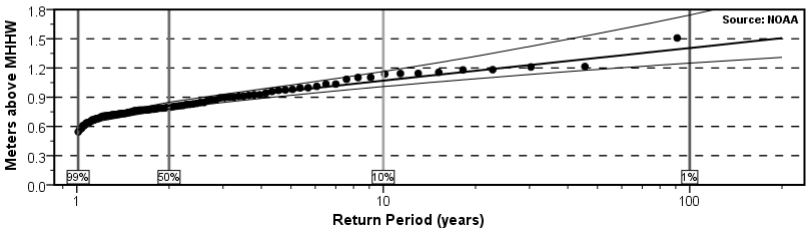
Portland, ME



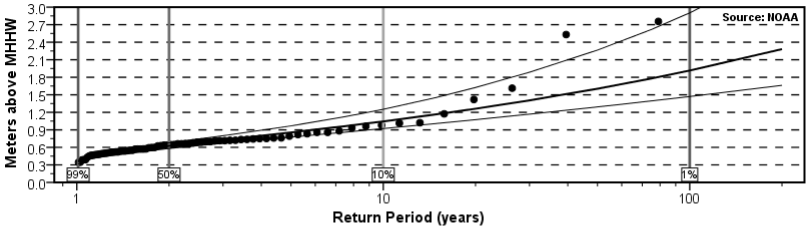
Seavey Island, ME



Boston, MA



Woods Hole, MA



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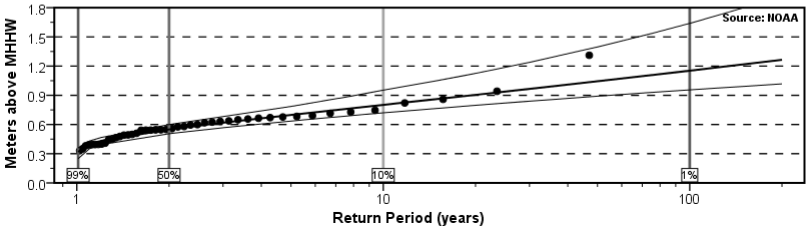
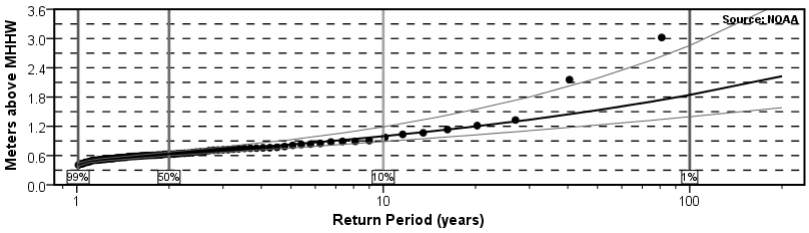


Newport, RI



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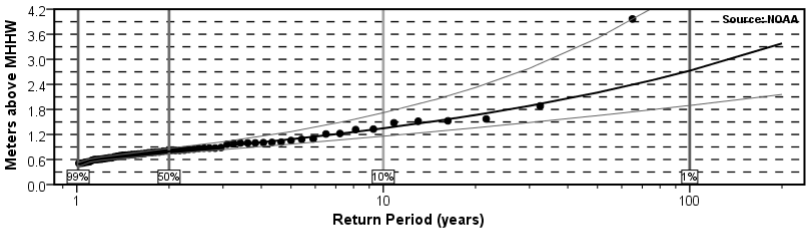
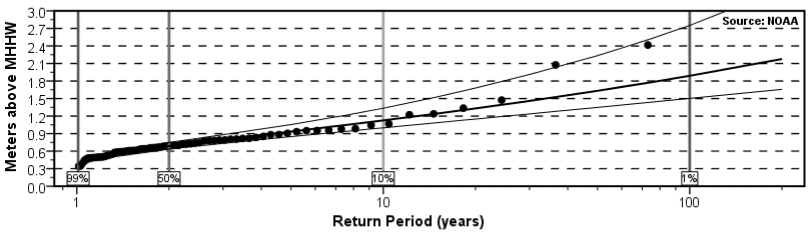
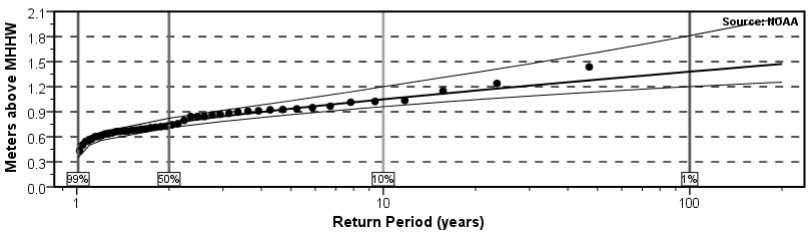


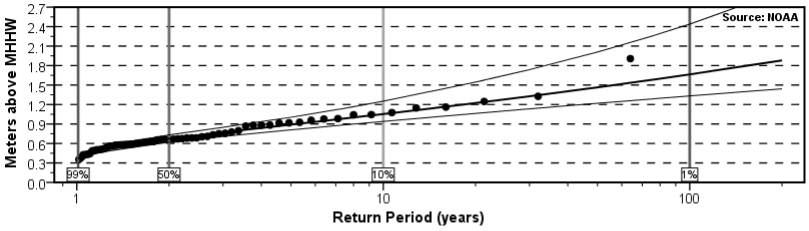
New London, CT



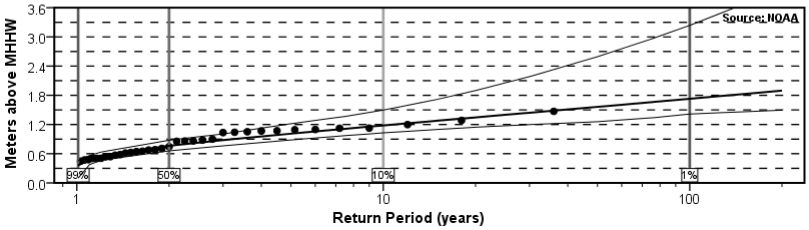
Bridgeport, CT



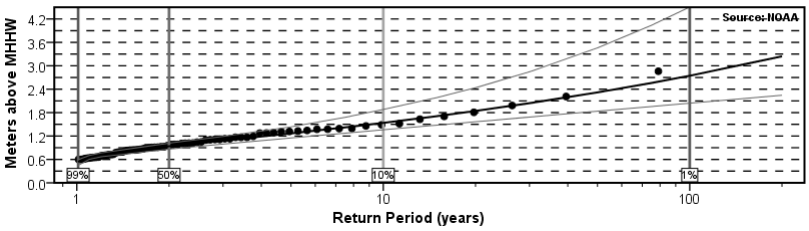
Montauk, NY



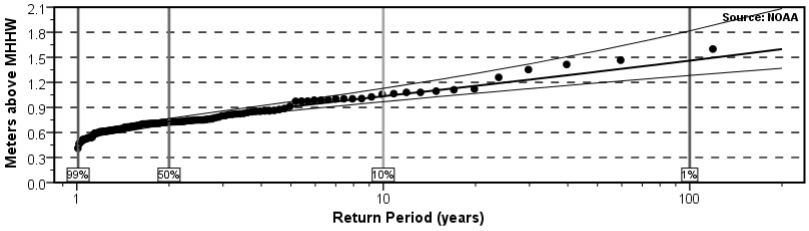
Port Jefferson, NY



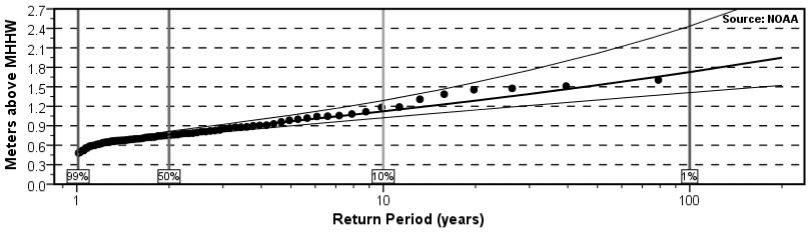
Kings Point / Willets Point, NY



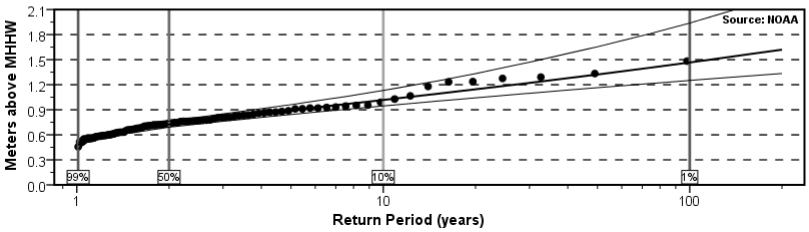
The Battery, NY



Sandy Hook, NJ



Atlantic City, NJ



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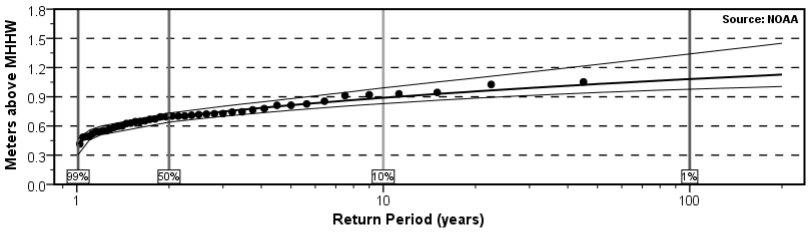
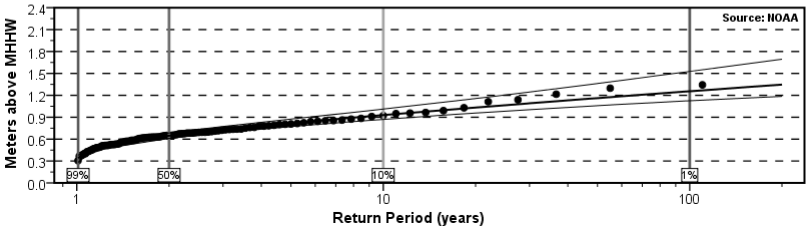
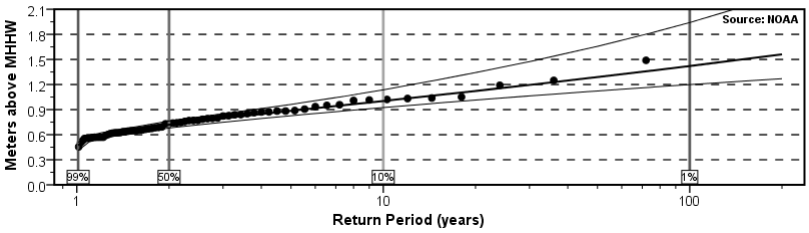


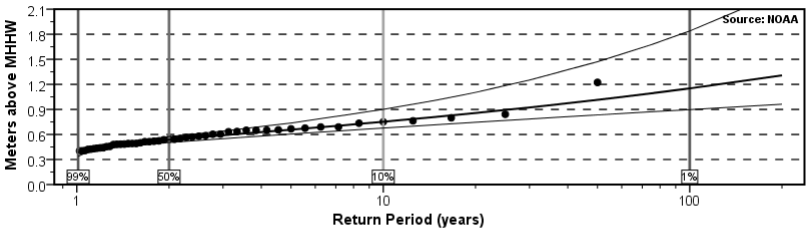
Philadelphia, PA



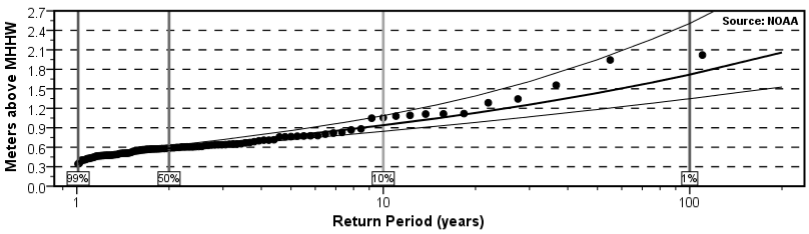
Lewes, DE



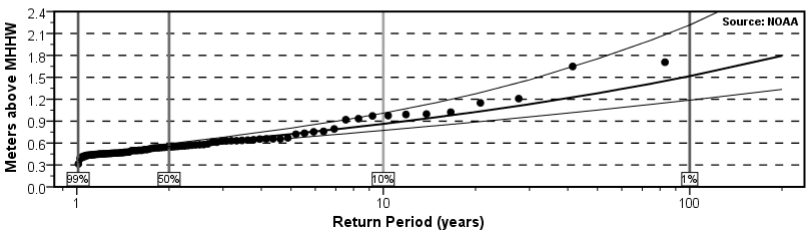
Cambridge, MD



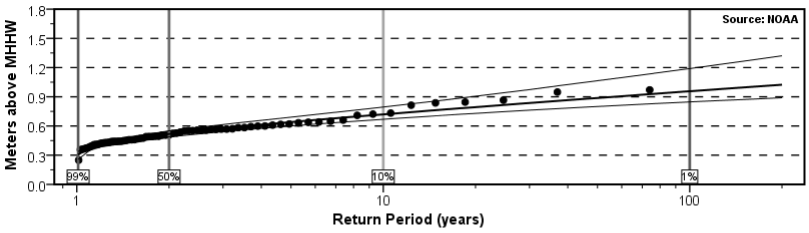
Baltimore, MD



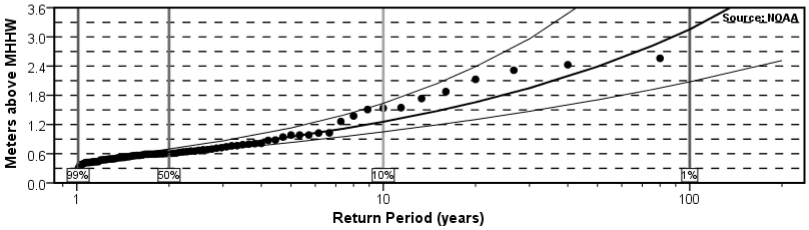
Annapolis, MD



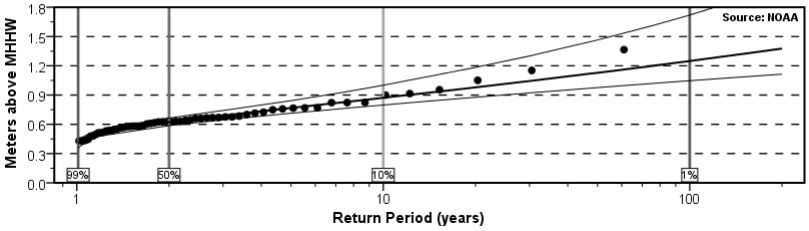
Solomons Island, MD



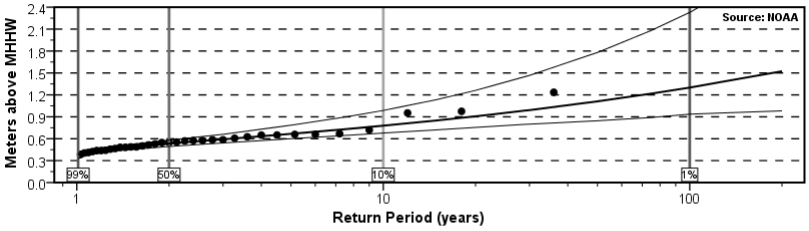
Washington, DC



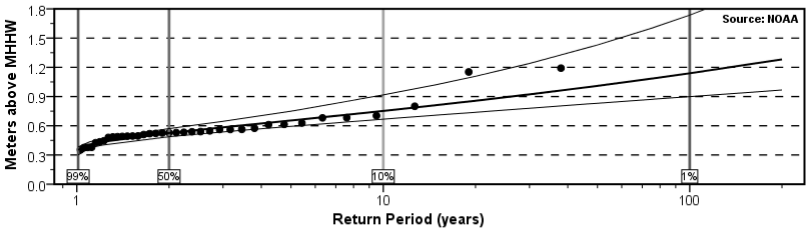
Kiptopeke, VA



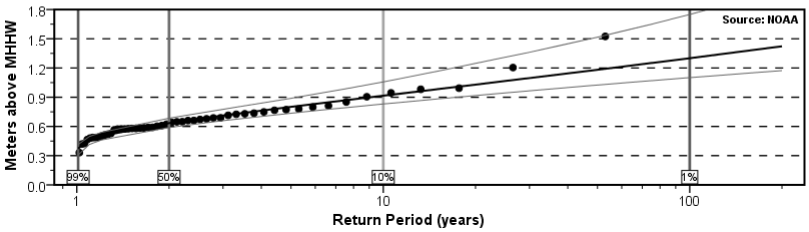
Colonial Beach, VA



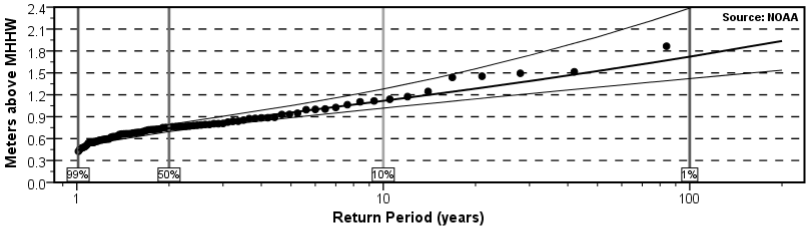
Lewisetta, VA



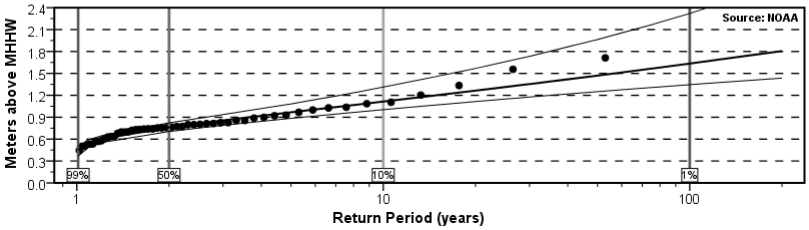
Gloucester Point, VA



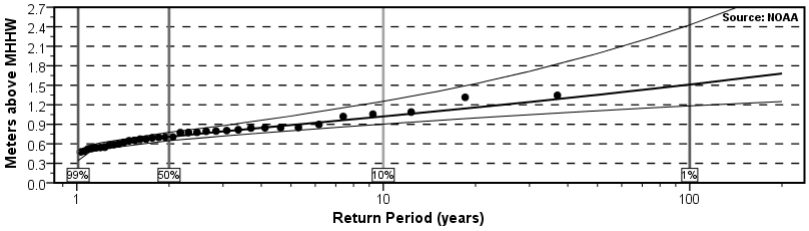
Sewells Point, VA



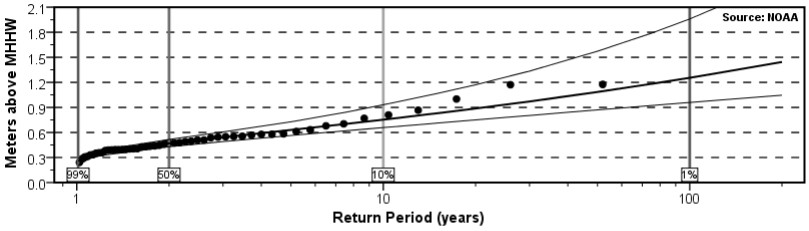
Portsmouth, VA



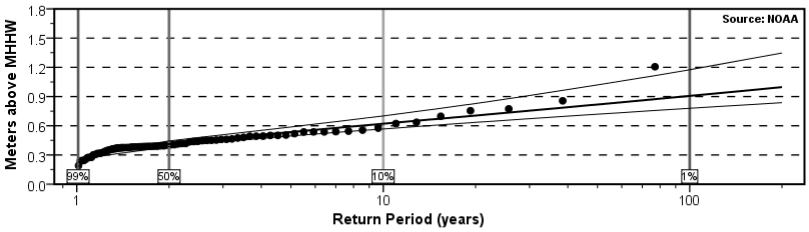
Chesapeake Bay Bridge Tunnel, VA



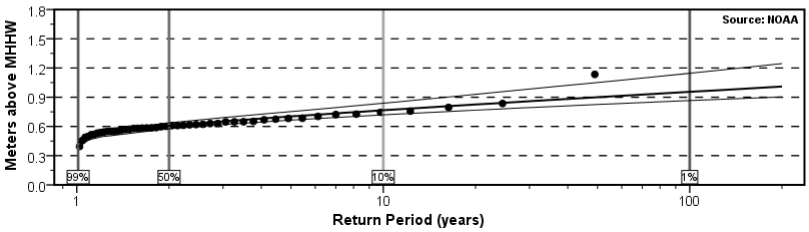
Beaufort, NC



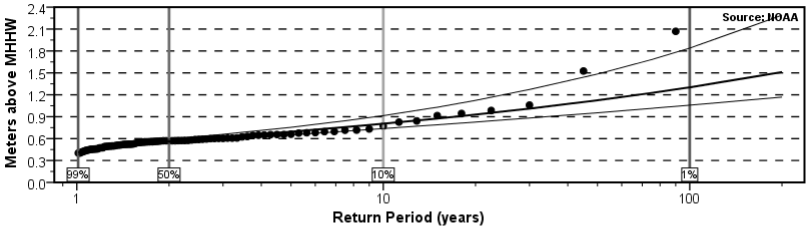
Wilmington, NC



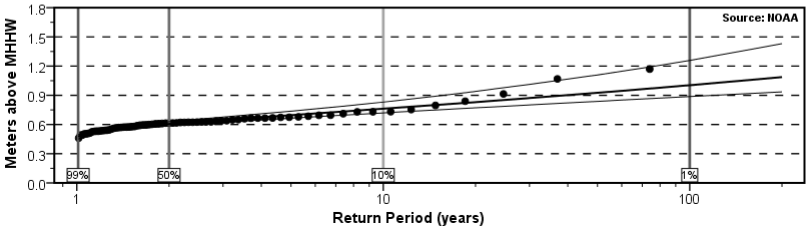
Springmaid Pier, SC



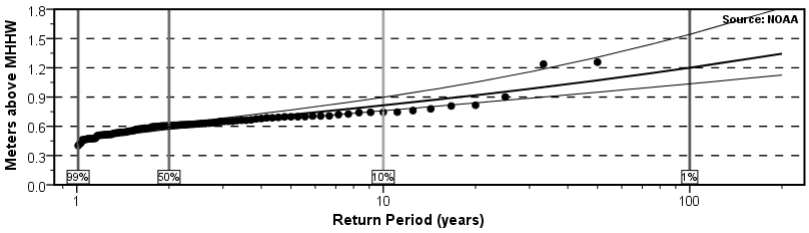
Charleston, SC



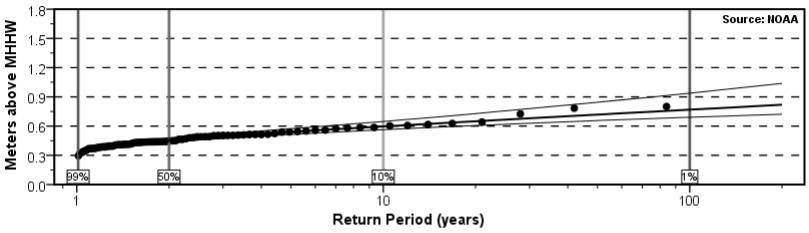
Fort Pulaski, GA



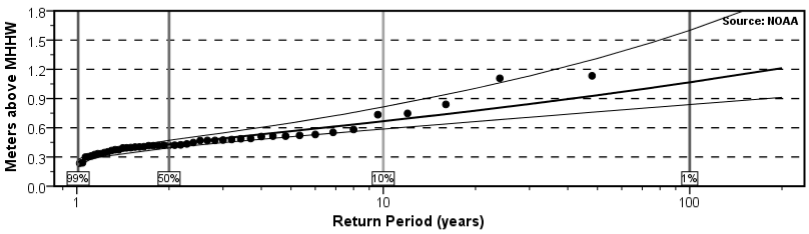
Fernandina Beach, FL



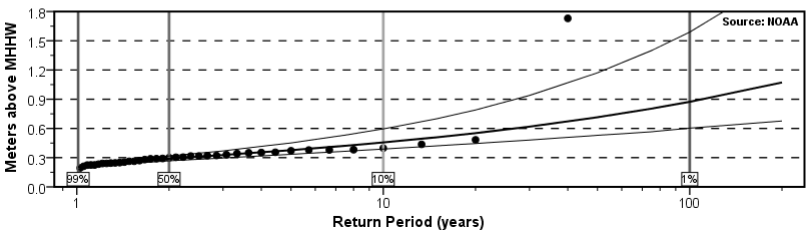
Bar Pilots Dock / Mayport, FL



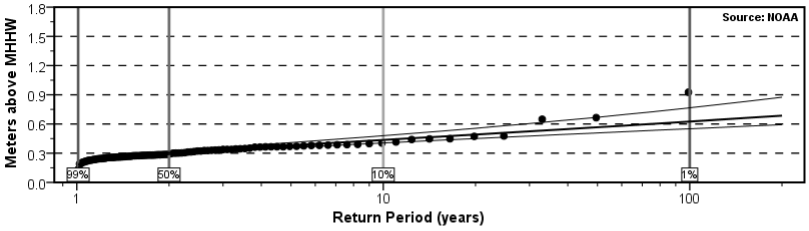
Miami Beach, FL



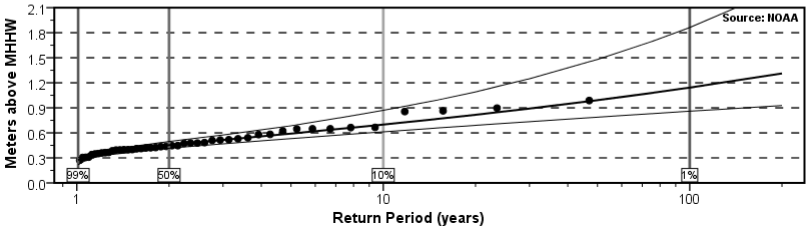
Vaca Key, FL



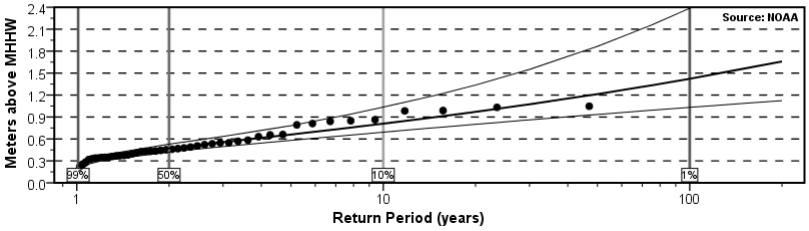
Key West, FL



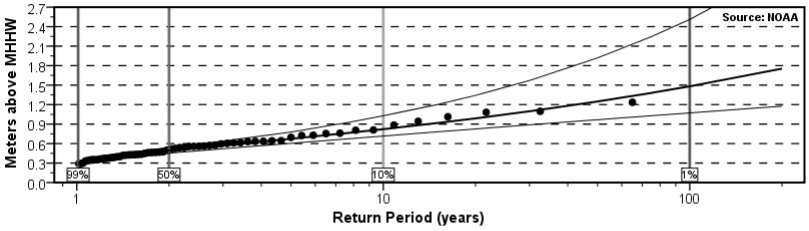
Naples, FL



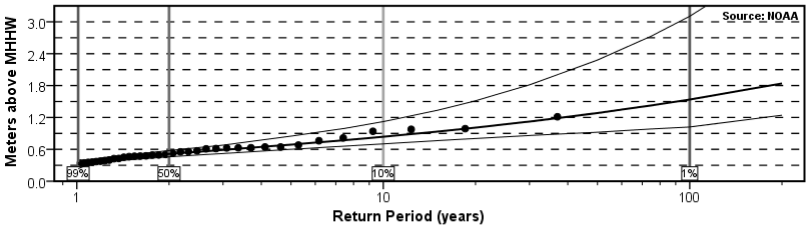
Fort Myers, FL



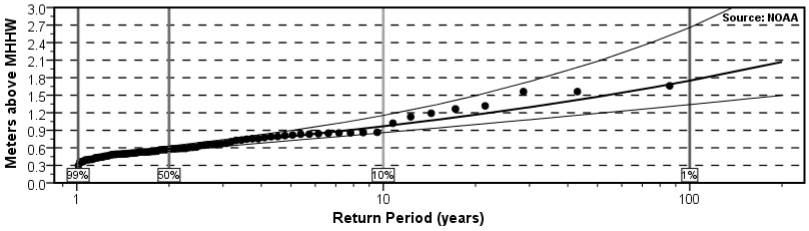
St Petersburg, FL



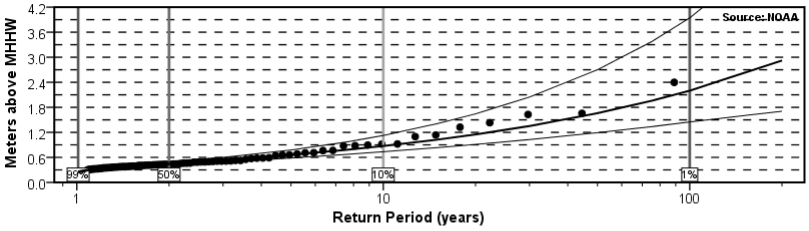
Clearwater Beach, FL



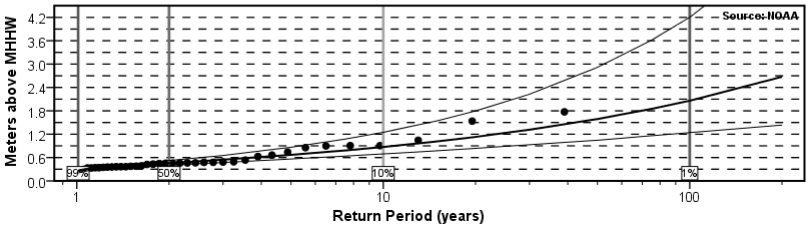
Cedar Key, FL



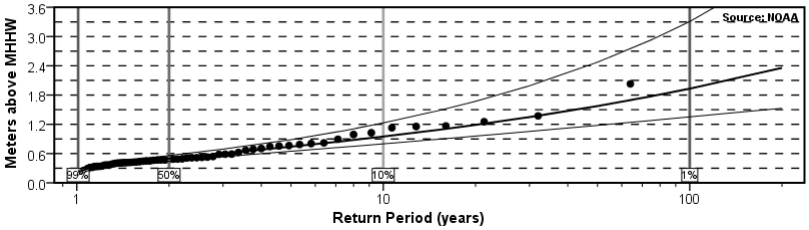
Pensacola, FL



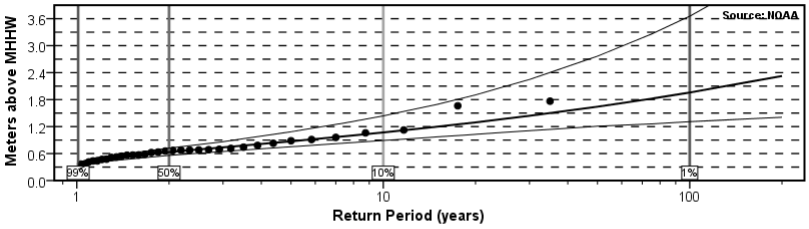
Dauphin Island, AL



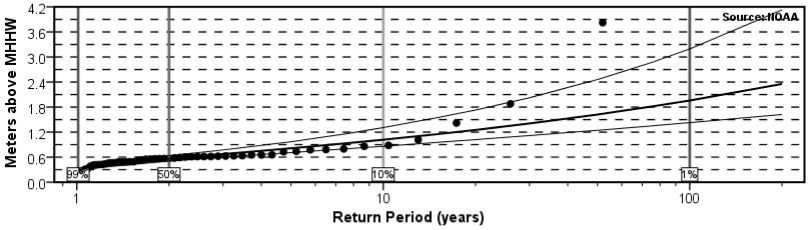
Grand Isle, LA



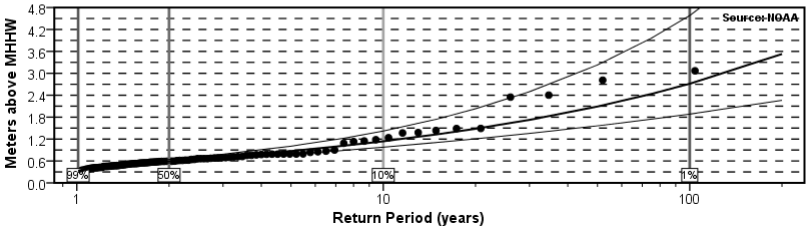
Eugene Island, LA

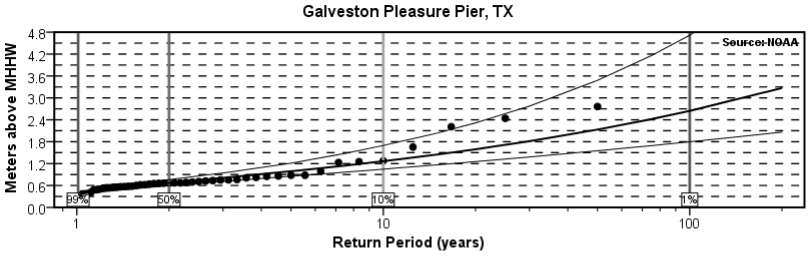


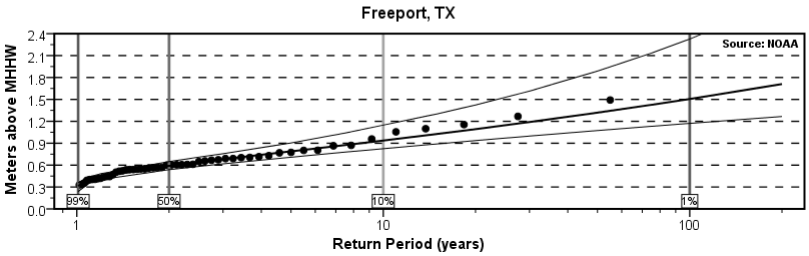
Sabine Pass, TX

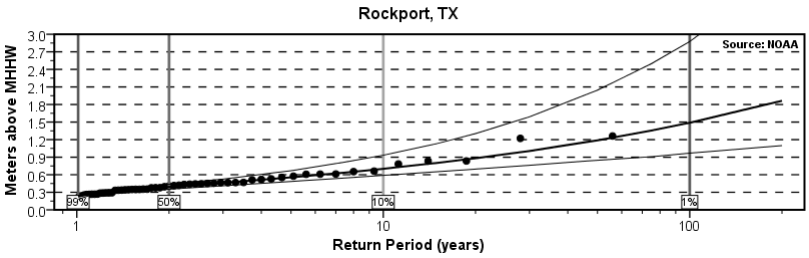


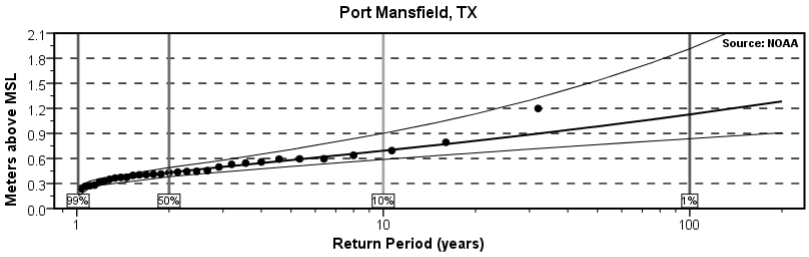
Galveston Pier 21, TX

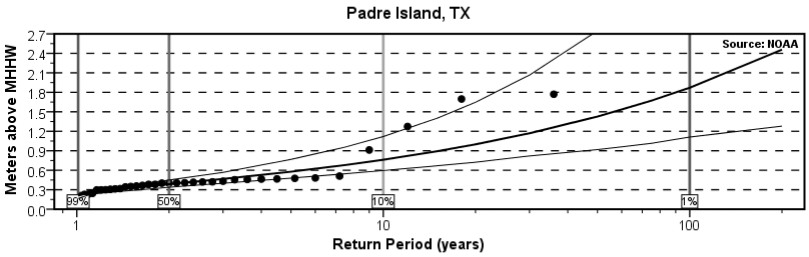


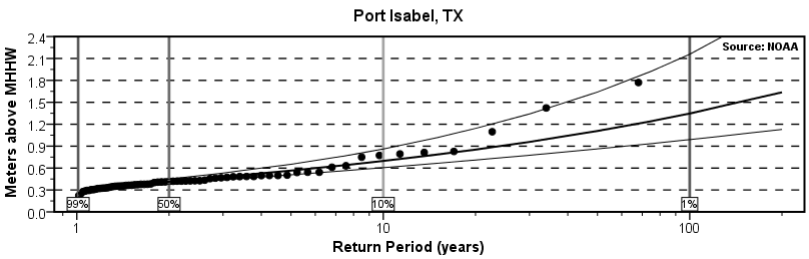

Galveston Pleasure Pier, TX
Meters above MHHW
Source: NOAA
99%
50%
10%
1%
Return Period (years)


Freeport, TX
Meters above MHHW
Source: NOAA
99%
50%
10%
1%
Return Period (years)

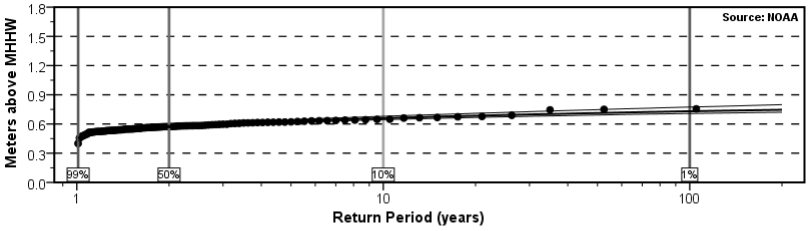

Rockport, TX
Meters above MHHW
Source: NOAA
99%
50%
10%
1%
Return Period (years)


Port Mansfield, TX
Meters above MSL
Source: NOAA
99%
50%
10%
1%
Return Period (years)

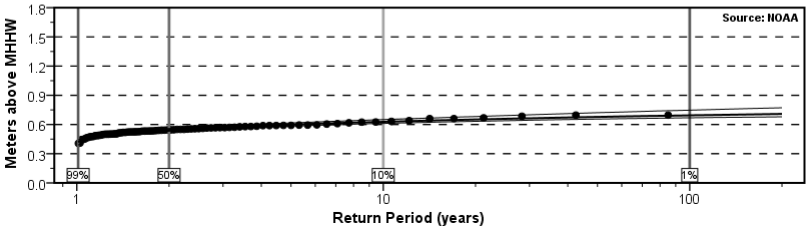

Padre Island, TX
Meters above MHHW
Source: NOAA
99%
50%
10%
1%
Return Period (years)


Port Isabel, TX
Meters above MHHW
Source: NOAA
99%
50%
10%
1%
Return Period (years)

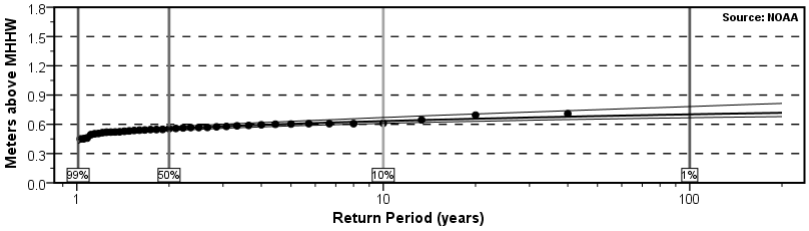
San Diego, CA



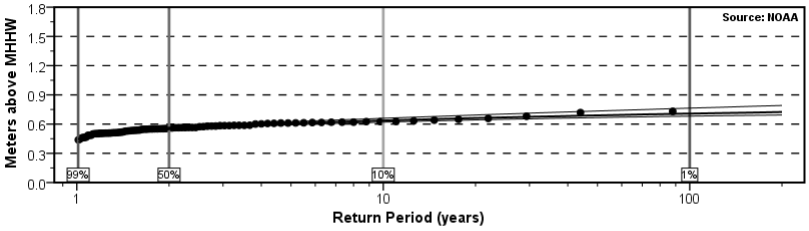
La Jolla, CA



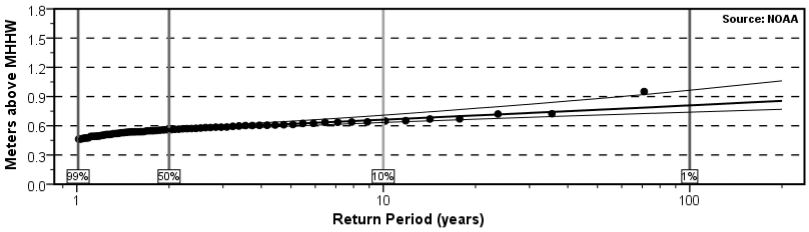
Newport Beach, CA



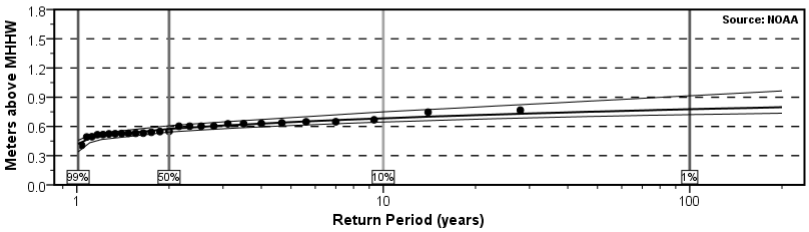
Los Angeles, CA



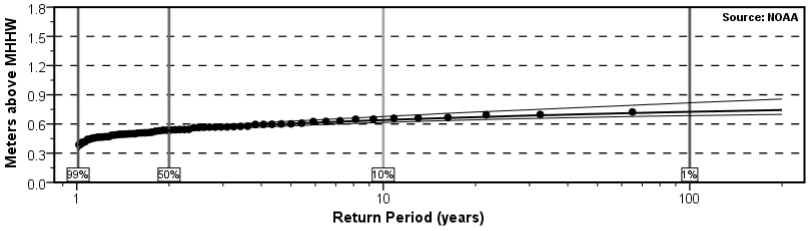
Santa Monica, CA



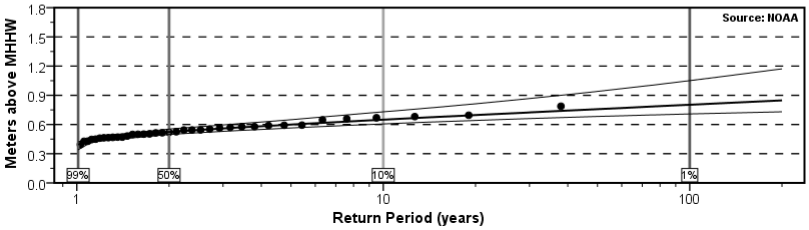
Rincon Island, CA



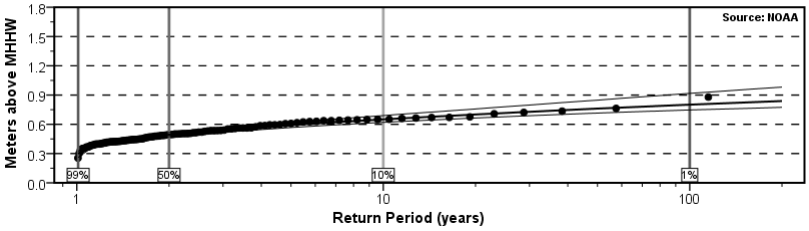
Port San Luis, CA



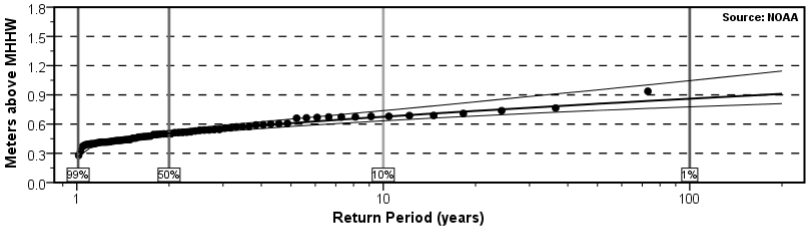
Monterey, CA



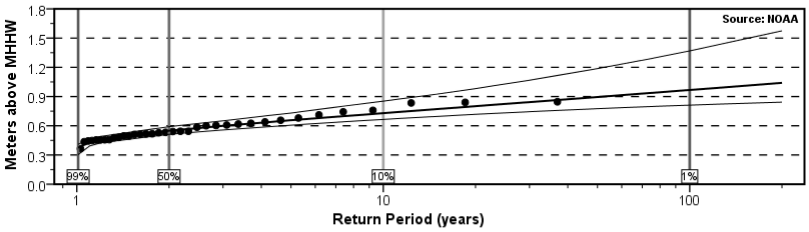
San Francisco, CA



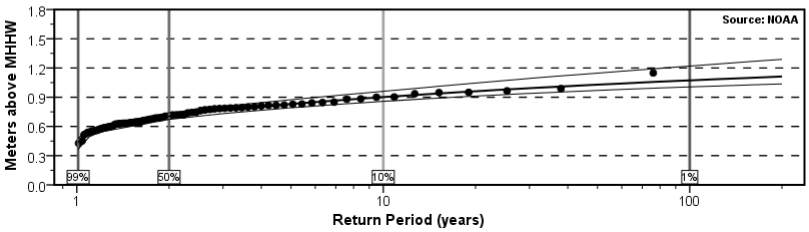
Alameda, CA



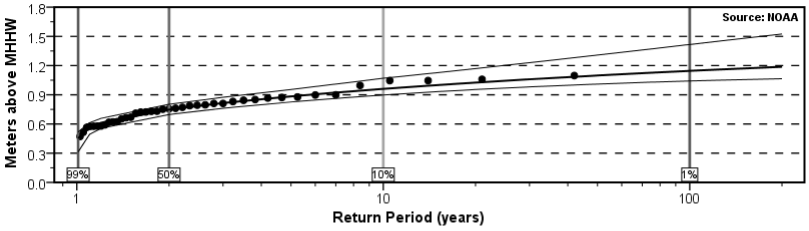
Point Reyes, CA



Crescent City, CA



Charleston, OR



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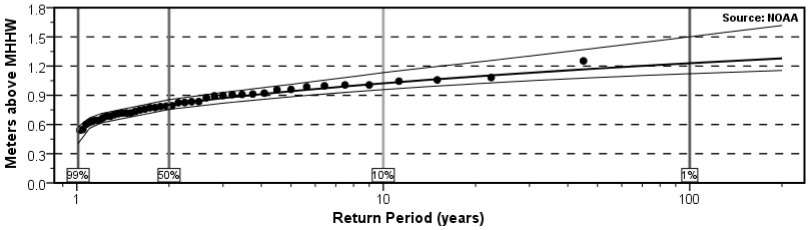

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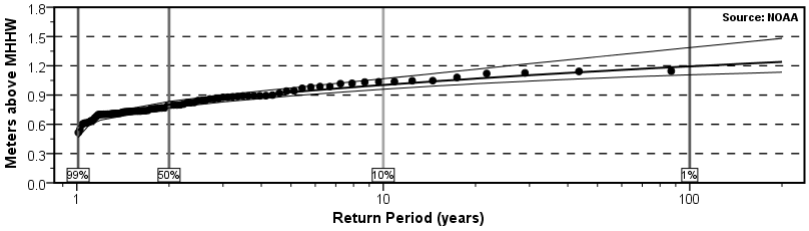

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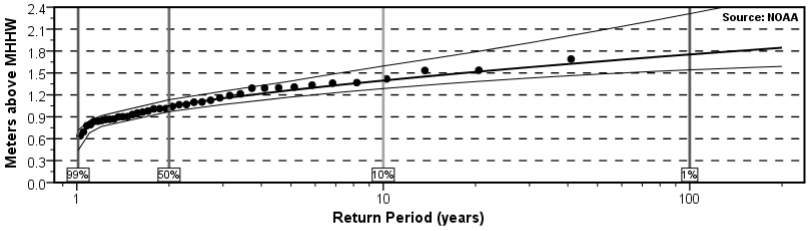

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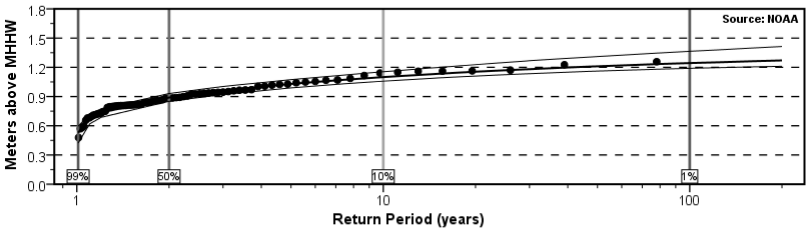

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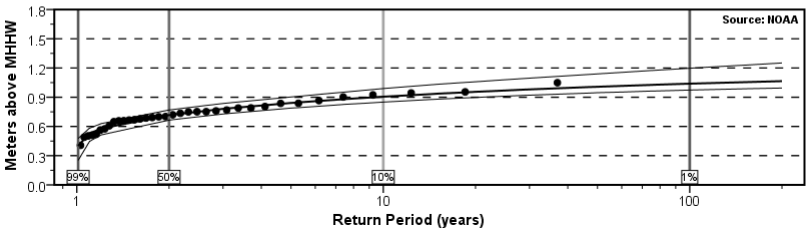

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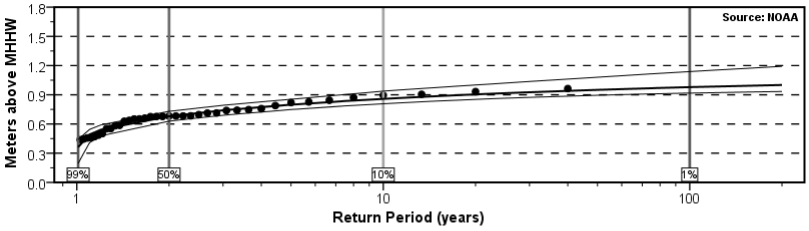

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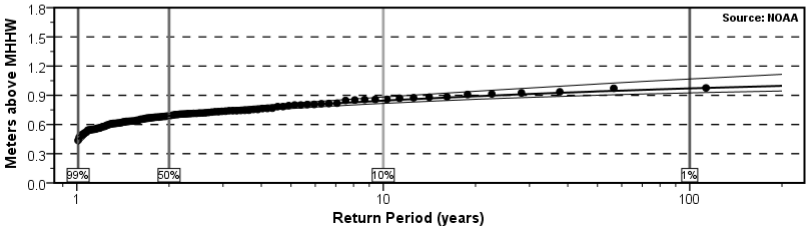
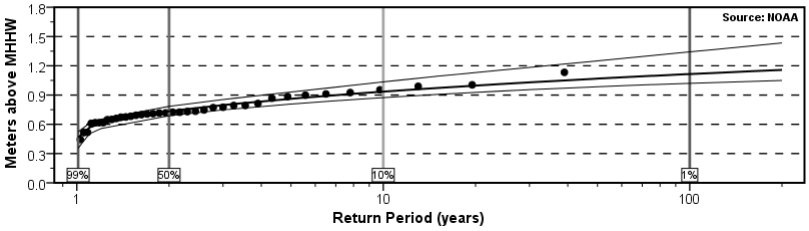
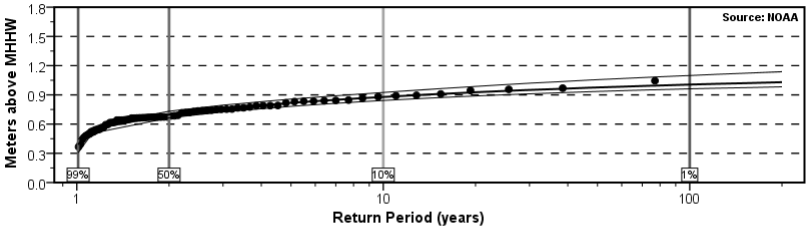


Cherry Point, WA



Friday Harbor, WA



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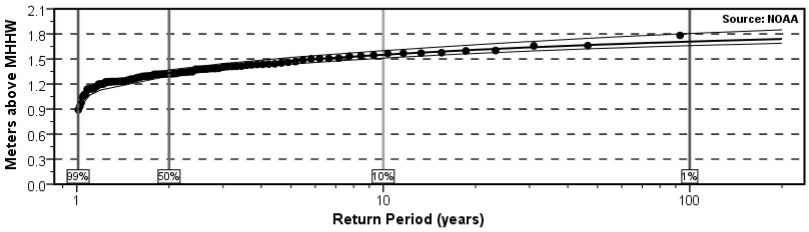

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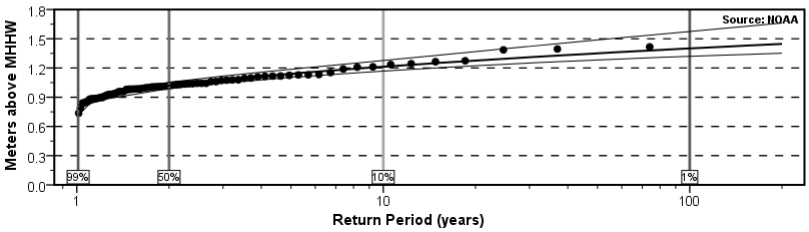

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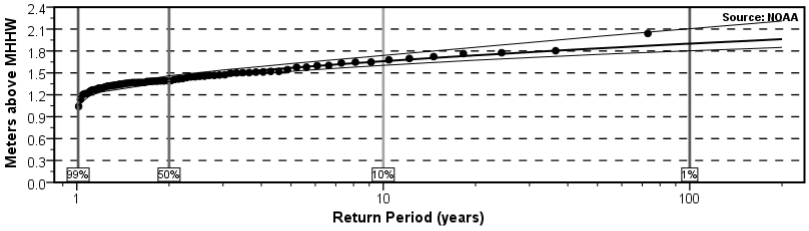

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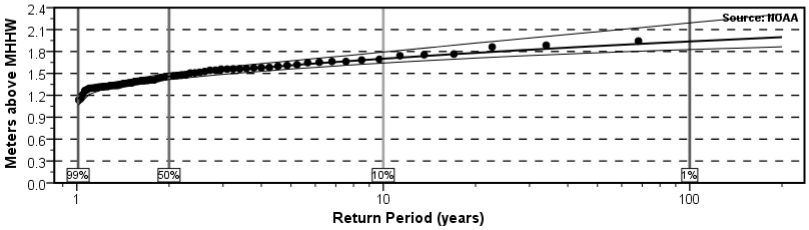

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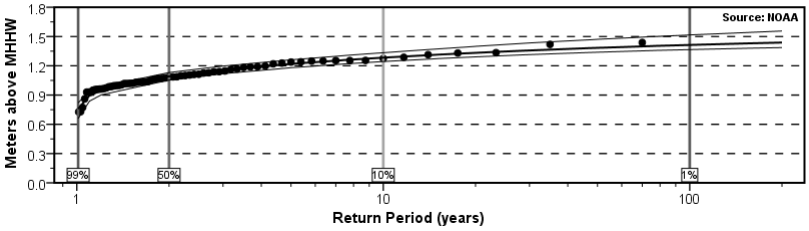
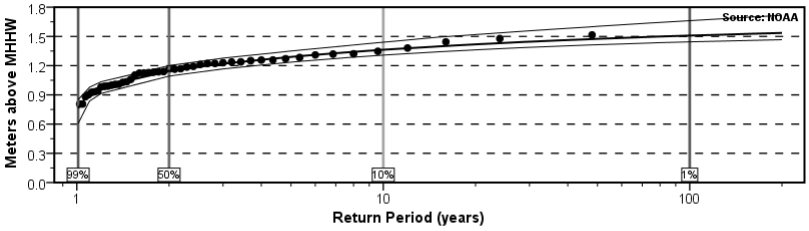
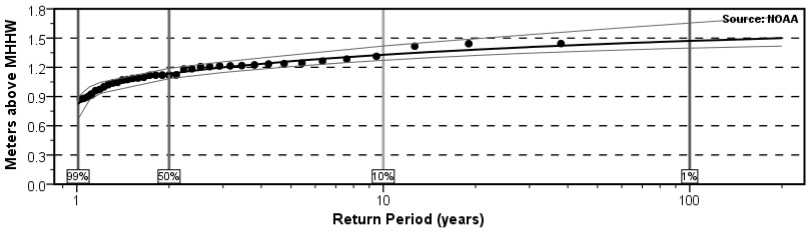


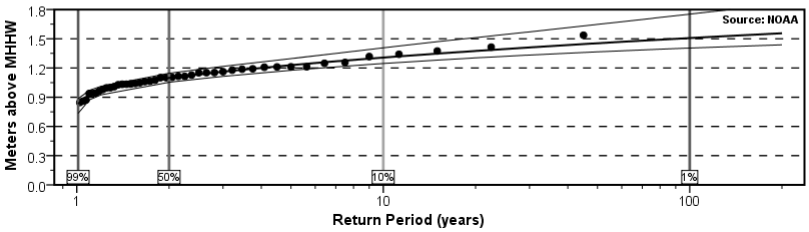
Cordova, AK



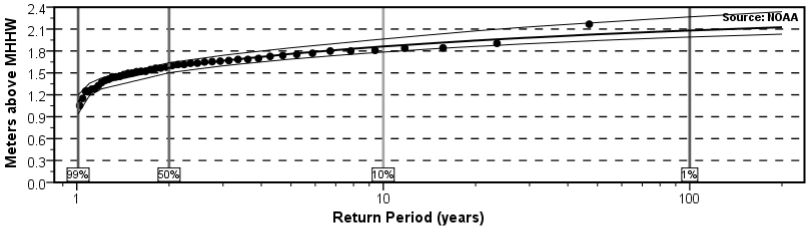
Valdez, AK



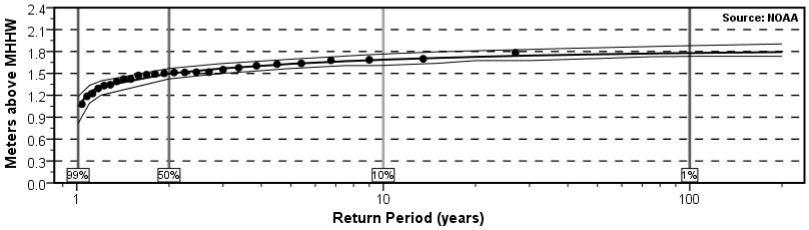
Seward, AK



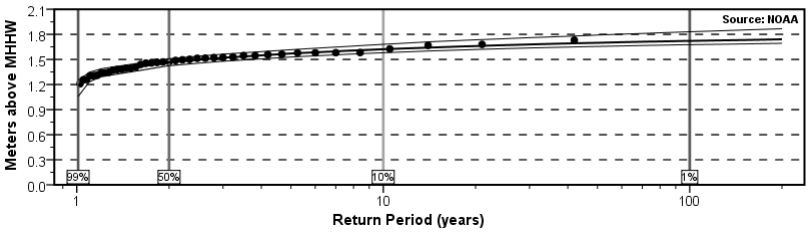
Seldovia, AK



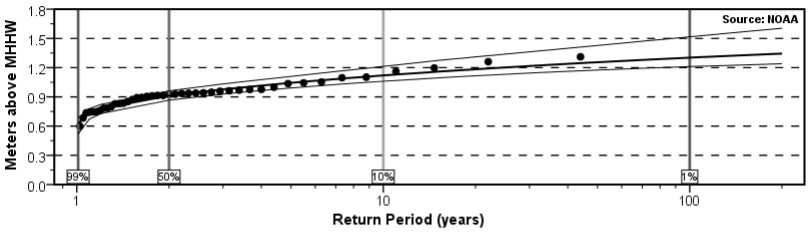
Nikiski, AK



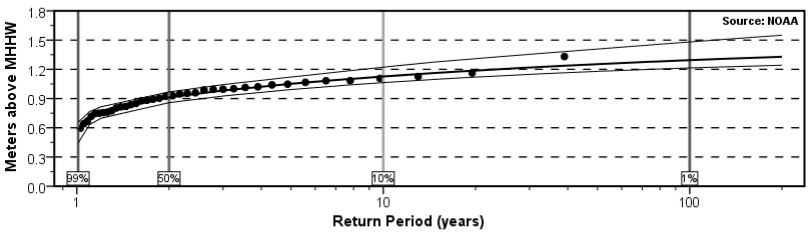
Anchorage, AK



Kodiak Island, AK



Sand Point, AK



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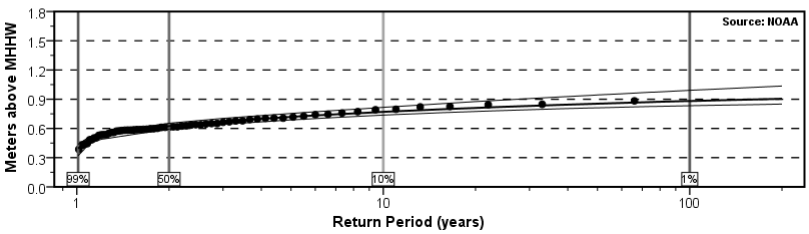
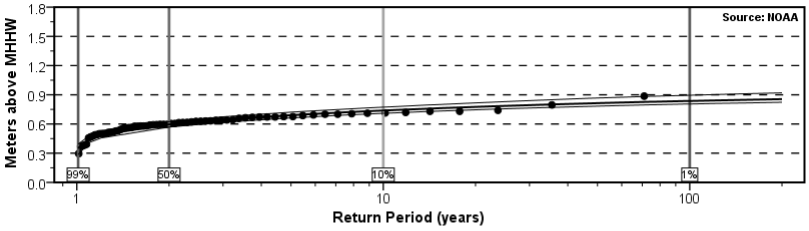
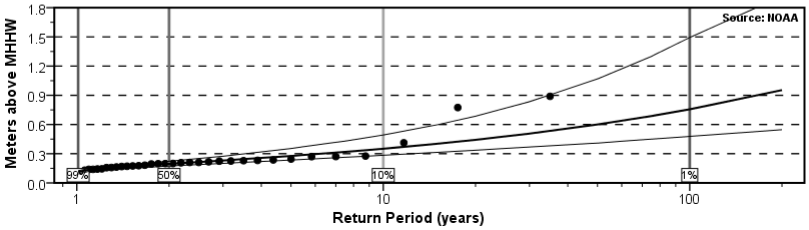


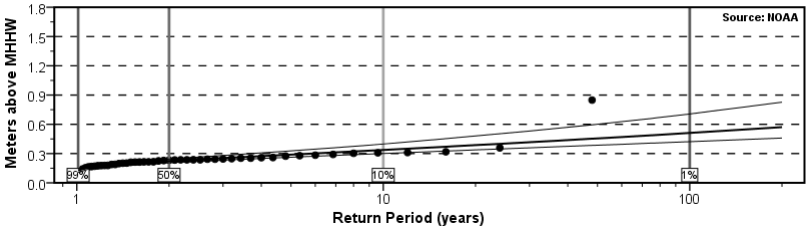
Unalaska, AK



Charlotte Amalie, VI



San Juan, PR



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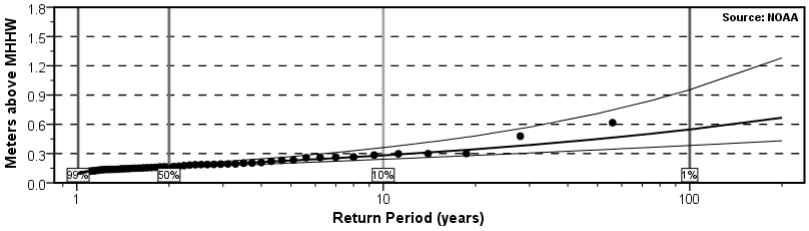


Appendix II.

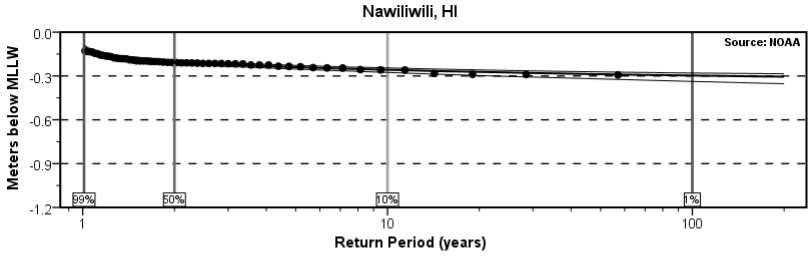
Annual GEV Exceedance Probability Curves for Low Waters

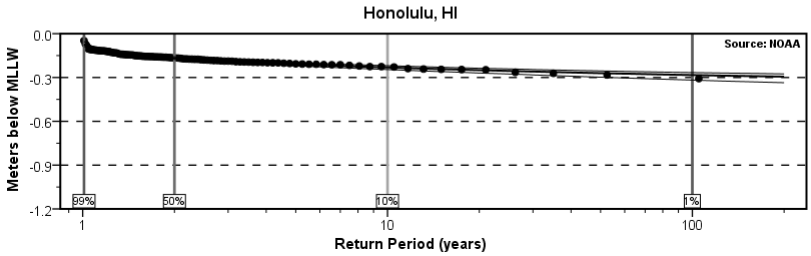
Note: Black dots indicate the annual lowest water levels shown in the Weibull plotting positions. Thicker black line is the GEV exceedance probability curve and the thinner black lines indicate the upper and lower 95% confidence intervals. The vertical red, orange, green, and blue lines are the return periods of the 1%, 10%, 50%, and 99% annual probabilities of exceedance. The zero value on the vertical axis represents the elevation of the MLLW datum for the National Tidal Datum Epoch (1983-2001) or the special 5-year Modified Tidal Datum Epoch, as appropriate.

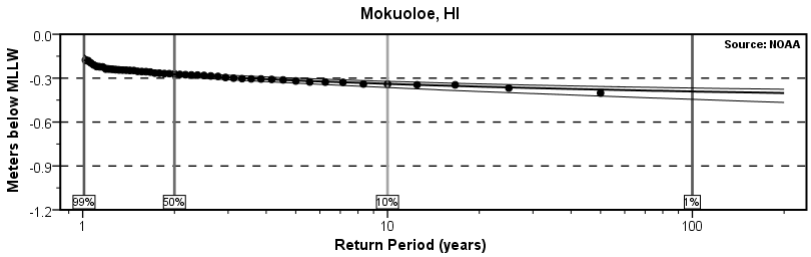
Table B. Low Water Level GEV Location, Scale, and Shape Parameters							
Station Number	Station Name	Location Parameter (meters)	+/- 95% Confidence Interval	Scale Parameter (meters)	+/- 95% Confidence Interval	Shape Parameter	+/- 95% Confidence Interval
1611400	Nawiliwili	-0.191	0.011	0.039	0.008	-0.248	0.174
1612340	Honolulu	-0.152	0.009	0.044	0.006	-0.200	0.102
1612480	Mokuoloe	-0.258	0.014	0.045	0.010	-0.211	0.167
1615680	Kahului	-0.259	0.015	0.052	0.010	-0.254	0.159
1617760	Hilo	-0.245	0.012	0.044	0.008	-0.137	0.161
1619000	Johnston Atoll	-0.267	0.024	0.078	0.017	-0.088	0.224
1619910	Midway Atoll	-0.198	0.014	0.051	0.010	-0.259	0.137
1630000	Guam	-0.354	0.029	0.105	0.020	-0.288	0.136
1770000	Pago Pago	-0.216	0.011	0.041	0.008	0.067	0.164
1820000	Kwajalein	-0.368	0.019	0.073	0.013	-0.187	0.110
1840000	Chuuk	-0.237	0.030	0.087	0.023	-0.358	0.230
1890000	Wake Island	-0.299	0.020	0.069	0.014	-0.328	0.203
2695540	Bermuda	-0.311	0.016	0.059	0.011	-0.109	0.192
8410140	Eastport	-0.968	0.021	0.085	0.015	-0.219	0.174
8413320	Bar Harbor	-0.681	0.017	0.060	0.012	-0.005	0.159
8418150	Portland	-0.660	0.019	0.083	0.013	-0.032	0.157
8419870	Seavey Island	-0.670	0.025	0.084	0.018	-0.062	0.168
8443970	Boston	-0.746	0.023	0.098	0.017	-0.208	0.173
8447930	Woods Hole	-0.487	0.028	0.113	0.019	-0.127	0.137
8449130	Nantucket Island	-0.349	0.021	0.065	0.015	-0.047	0.207
8452660	Newport	-0.550	0.028	0.113	0.020	-0.185	0.172
8454000	Providence	-0.656	0.037	0.139	0.027	-0.307	0.147
8461490	New London	-0.564	0.031	0.118	0.023	-0.014	0.188
8467150	Bridgeport	-0.692	0.046	0.140	0.034	-0.030	0.220
8510560	Montauk	-0.498	0.031	0.112	0.022	-0.041	0.149
8514560	Port Jefferson	-0.615	0.049	0.114	0.040	0.196	0.459
8516990	Kings Point / Willets Point	-0.771	0.038	0.147	0.028	-0.101	0.206
8518750	The Battery	-0.771	0.031	0.154	0.022	-0.204	0.126
8531680	Sandy Hook	-0.708	0.039	0.157	0.027	-0.101	0.142
8534720	Atlantic City	-0.689	0.028	0.126	0.020	-0.010	0.124
8536110	Cape May	-0.624	0.027	0.085	0.019	-0.233	0.162
8545240	Philadelphia	-0.799	0.036	0.166	0.027	0.079	0.152
8557380	Lewes	-0.635	0.028	0.107	0.021	0.016	0.174
8571892	Cambridge	-0.503	0.032	0.100	0.023	-0.121	0.228
8574680	Baltimore	-0.791	0.029	0.140	0.021	-0.048	0.130
8575512	Annapolis	-0.689	0.026	0.111	0.018	-0.098	0.127
8577330	Solomons Island	-0.539	0.028	0.107	0.020	-0.024	0.172
8594900	Washington	-0.720	0.038	0.154	0.028	0.019	0.167
8632200	Kiptopeke	-0.466	0.026	0.089	0.019	-0.211	0.209

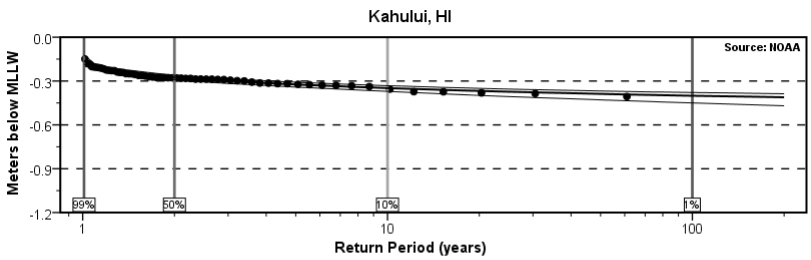
Table B. Low Water Level GEV Location, Scale, and Shape Parameters							
Station Number	Station Name	Location Parameter (meters)	+/- 95% Confidence Interval	Scale Parameter (meters)	+/- 95% Confidence Interval	Shape Parameter	+/- 95% Confidence Interval
8635150	Colonial Beach	-0.617	0.057	0.149	0.042	-0.104	0.296
8635750	Lewisetta	-0.517	0.039	0.107	0.028	-0.288	0.234
8637624	Gloucester Point	-0.506	0.033	0.109	0.023	-0.176	0.183
8638610	Sewells Point	-0.532	0.024	0.098	0.017	-0.053	0.161
8638660	Portsmouth	-0.549	0.032	0.106	0.022	-0.097	0.175
8638863	Ches. Bay Bridge Tunnel	-0.528	0.041	0.111	0.029	-0.268	0.241
8656483	Beaufort	-0.403	0.024	0.077	0.017	0.007	0.207
8658120	Wilmington	-0.378	0.021	0.084	0.014	-0.330	0.132
8661070	Springmaid Pier	-0.673	0.044	0.133	0.033	0.005	0.273
8665530	Charleston	-0.601	0.026	0.112	0.018	-0.031	0.124
8670870	Fort Pulaski	-0.744	0.034	0.132	0.025	0.004	0.187
8720030	Fernandina Beach	-0.657	0.029	0.134	0.020	-0.113	0.118
8720220	Mayport	-0.531	0.022	0.092	0.016	0.029	0.148
8723170	Miami Beach	-0.338	0.016	0.053	0.012	-0.414	0.178
8723970	Vaca Key	-0.211	0.013	0.034	0.010	-0.437	0.352
8724580	Key West	-0.273	0.010	0.046	0.007	-0.151	0.144
8725110	Naples	-0.498	0.031	0.095	0.022	-0.187	0.221
8725520	Fort Myers	-0.406	0.026	0.083	0.018	-0.065	0.168
8726520	St. Petersburg	-0.488	0.023	0.084	0.015	-0.182	0.144
8726724	Clearwater Beach	-0.536	0.028	0.073	0.020	-0.060	0.265
8727520	Cedar Key	-0.588	0.029	0.127	0.020	-0.110	0.097
8729840	Pensacola	-0.398	0.018	0.074	0.013	-0.123	0.170
8735180	Dauphin Island	-0.408	0.026	0.073	0.018	-0.185	0.234
8761724	Grand Isle	-0.336	0.020	0.071	0.014	-0.211	0.196
8764311	Eugene Island	-0.442	0.033	0.090	0.023	-0.333	0.188
8770570	Sabine Pass	-0.675	0.046	0.146	0.033	-0.119	0.222
8771450	Galveston Pier 21	-0.665	0.033	0.156	0.023	-0.133	0.108
8771510	Galveston Pleasure Pier	-0.714	0.041	0.131	0.029	-0.164	0.220
8772440	Freeport	-0.617	0.038	0.124	0.027	-0.122	0.214
8774770	Rockport	-0.376	0.022	0.074	0.015	-0.080	0.170
8778490	Port Mansfield	-0.318	0.026	0.066	0.019	-0.389	0.248
8779750	Padre Island	-0.390	0.027	0.075	0.017	-0.203	0.129
8779770	Port Isabel	-0.383	0.020	0.074	0.014	-0.169	0.146
9410170	San Diego	-0.570	0.014	0.065	0.010	-0.082	0.135
9410230	La Jolla	-0.551	0.015	0.065	0.010	-0.262	0.097
9410580	Newport Beach	-0.525	0.022	0.063	0.016	-0.173	0.244
9410660	Los Angeles	-0.547	0.014	0.061	0.009	-0.141	0.103
9410840	Santa Monica	-0.536	0.018	0.071	0.013	-0.177	0.142
9411270	Rincon Island	-0.538	0.029	0.069	0.022	-0.462	0.293
9412110	Port San Luis	-0.552	0.018	0.065	0.013	-0.313	0.180
9413450	Monterey	-0.566	0.021	0.059	0.015	-0.175	0.217

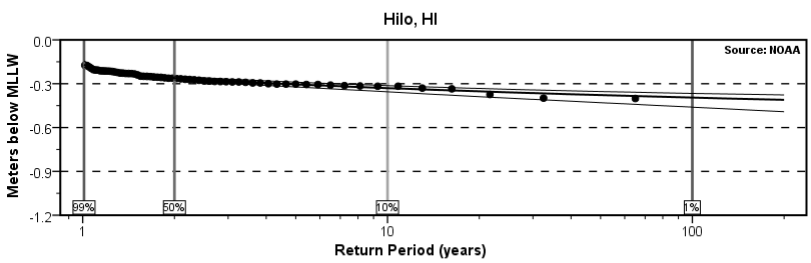
Table B. Low Water Level GEV Location, Scale, and Shape Parameters							
Station Number	Station Name	Location Parameter (meters)	+/- 95% Confidence Interval	Scale Parameter (meters)	+/- 95% Confidence Interval	Shape Parameter	+/- 95% Confidence Interval
9414290	San Francisco	-0.548	0.017	0.084	0.012	-0.274	0.116
9414750	Alameda	-0.540	0.021	0.085	0.014	-0.226	0.121
9415020	Point Reyes	-0.614	0.027	0.074	0.019	-0.207	0.230
9419750	Crescent City	-0.719	0.020	0.084	0.014	-0.282	0.110
9432780	Charleston	-0.775	0.028	0.081	0.022	-0.337	0.286
9435380	South Beach	-0.870	0.027	0.085	0.021	-0.465	0.204
9439040	Astoria	-0.516	0.026	0.111	0.018	-0.349	0.121
9440910	Toke Point	-0.950	0.040	0.118	0.031	-0.552	0.220
9443090	Neah Bay	-0.927	0.026	0.106	0.019	-0.360	0.145
9444090	Port Angeles	-1.044	0.053	0.145	0.039	-0.313	0.251
9444900	Port Townsend	-1.039	0.047	0.133	0.036	-0.412	0.256
9447130	Seattle	-1.151	0.028	0.137	0.022	-0.396	0.144
9449424	Cherry Point	-1.048	0.040	0.108	0.031	-0.337	0.304
9449880	Friday Harbor	-0.955	0.033	0.133	0.025	-0.428	0.153
9450460	Ketchikan	-1.341	0.022	0.097	0.016	-0.268	0.153
9451600	Sitka	-0.964	0.024	0.095	0.017	-0.275	0.138
9452210	Juneau	-1.433	0.027	0.106	0.019	-0.153	0.153
9452400	Skagway	-1.466	0.036	0.135	0.026	-0.109	0.174
9453220	Yakutat	-0.957	0.030	0.118	0.020	-0.200	0.097
9454050	Cordova	-1.203	0.032	0.100	0.022	-0.276	0.183
9454240	Valdez	-1.247	0.042	0.119	0.030	-0.253	0.211
9455090	Seward	-1.065	0.037	0.116	0.026	-0.158	0.160
9455500	Seldovia	-1.780	0.039	0.111	0.031	-0.285	0.348
9455760	Nikiski	-1.589	0.064	0.151	0.044	-0.280	0.237
9455920	Anchorage	-1.399	0.048	0.146	0.032	-0.165	0.147
9457292	Kodiak Island	-0.842	0.030	0.092	0.021	-0.114	0.170
9459450	Sand Point	-0.876	0.031	0.090	0.022	-0.172	0.188
9461380	Adak Island	-0.602	0.025	0.091	0.017	-0.131	0.161
9462620	Unalaska	-0.595	0.024	0.089	0.017	-0.254	0.206
9751639	Charlotte Amalie	-0.152	0.015	0.037	0.011	-0.191	0.340
9755371	San Juan	-0.197	0.011	0.031	0.008	-0.090	0.300
9759110	Magueyes Island	-0.150	0.011	0.036	0.008	-0.310	0.204

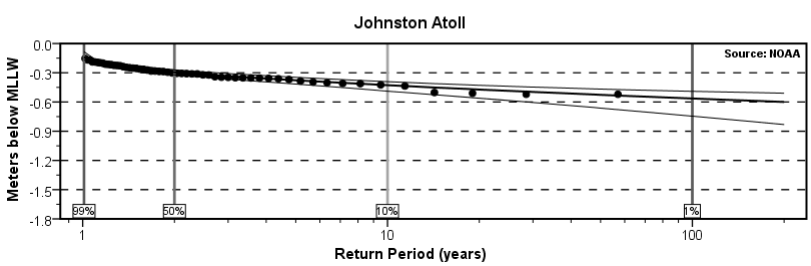

Nawiliwili, HI
Source: NOAA
Meters below MLLW
0.0
-0.3
-0.6
-0.9
-1.2
99%
50%
10%
1%
1
10
100
Return Period (years)


Honolulu, HI
Source: NOAA
Meters below MLLW
0.0
-0.3
-0.6
-0.9
-1.2
99%
50%
10%
1%
1
10
100
Return Period (years)

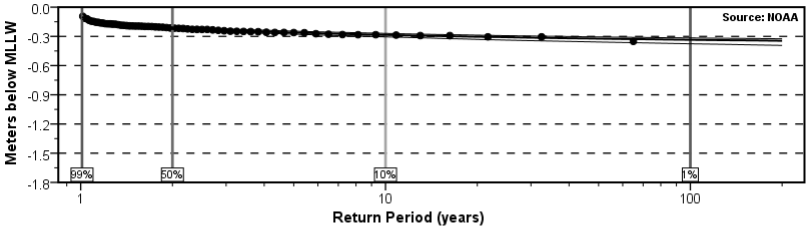

Mokuoloe, HI
Source: NOAA
Meters below MLLW
0.0
-0.3
-0.6
-0.9
-1.2
99%
50%
10%
1%
1
10
100
Return Period (years)


Kahului, HI
Source: NOAA
Meters below MLLW
0.0
-0.3
-0.6
-0.9
-1.2
99%
50%
10%
1%
1
10
100
Return Period (years)

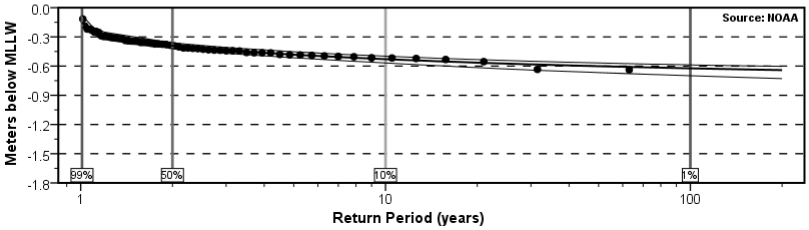

Hilo, HI
Source: NOAA
Meters below MLLW
0.0
-0.3
-0.6
-0.9
-1.2
99%
50%
10%
1%
1
10
100
Return Period (years)


Johnston Atoll
Source: NOAA
Meters below MLLW
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
99%
50%
10%
1%
1
10
100
Return Period (years)

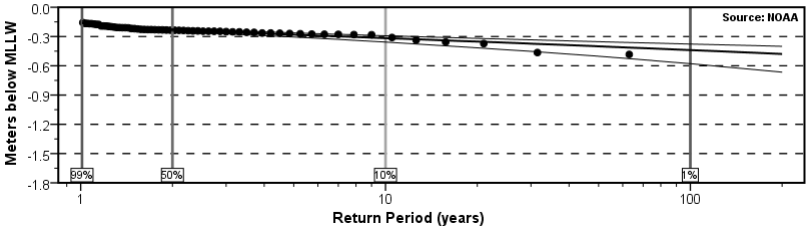
Midway Atoll



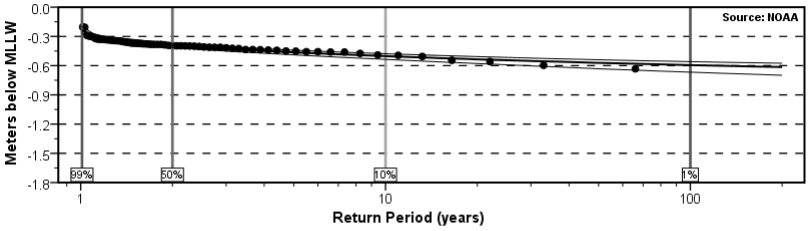
Guam



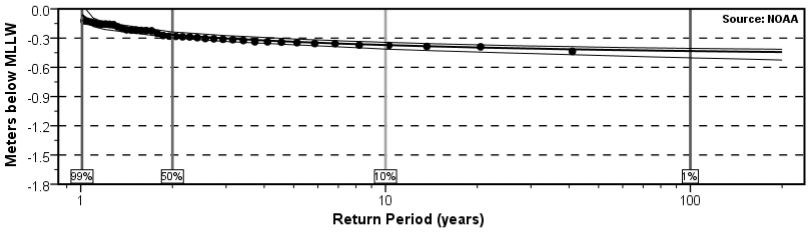
Pago Pago



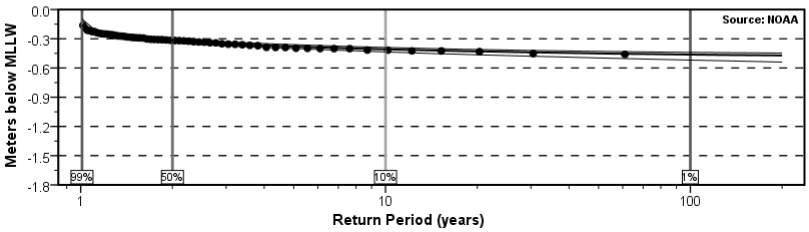
Kwajalein



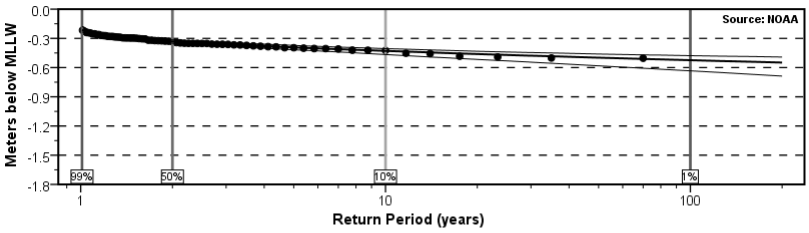
Chuuk



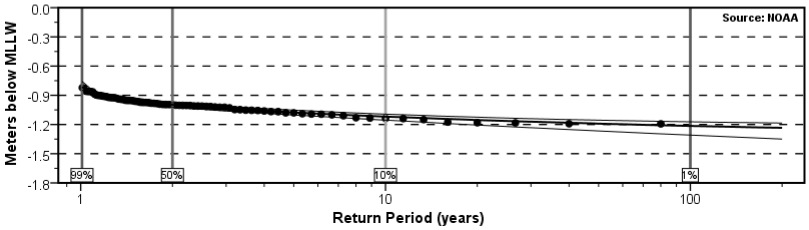
Wake Island



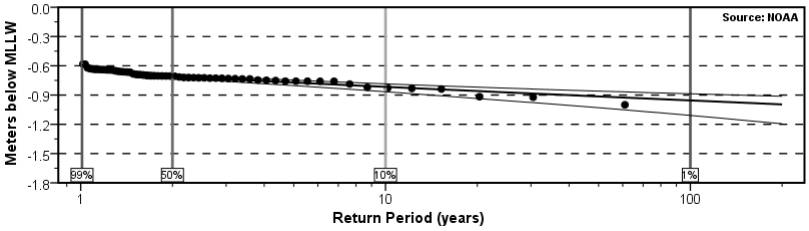
Bermuda



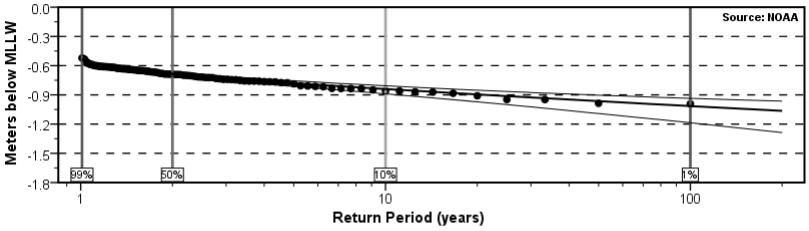
Eastport, ME



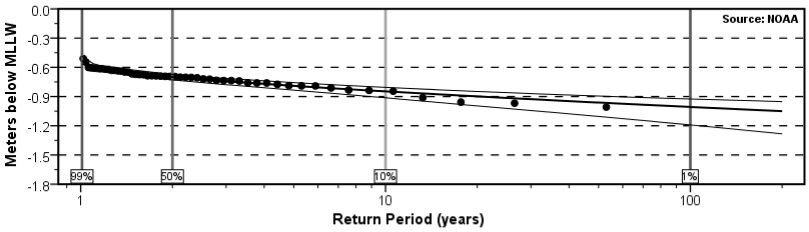
Bar Harbor, ME



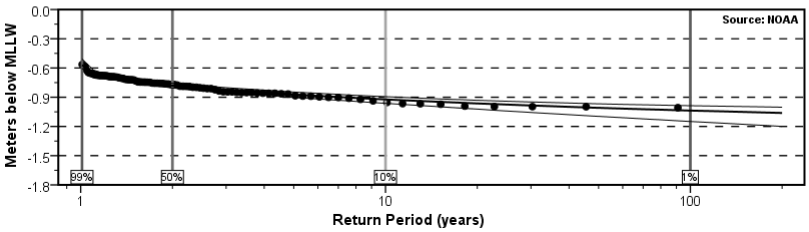
Portland, ME

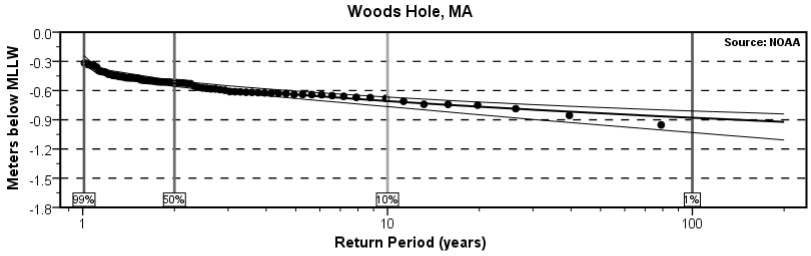


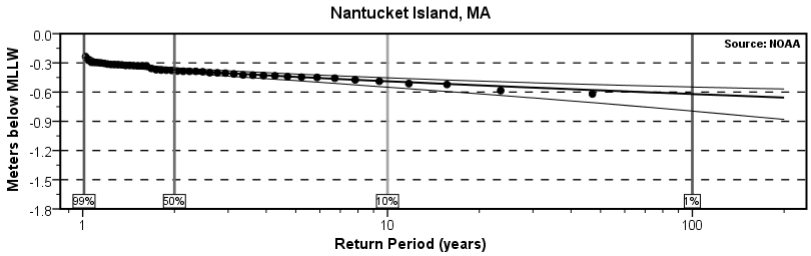
Seavey Island, ME

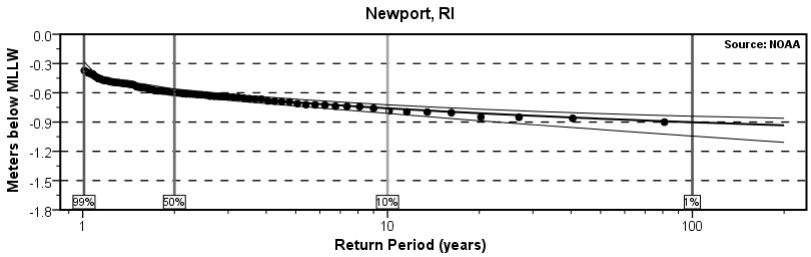


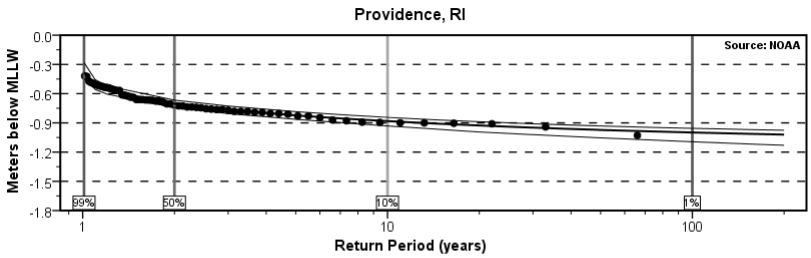
Boston, MA

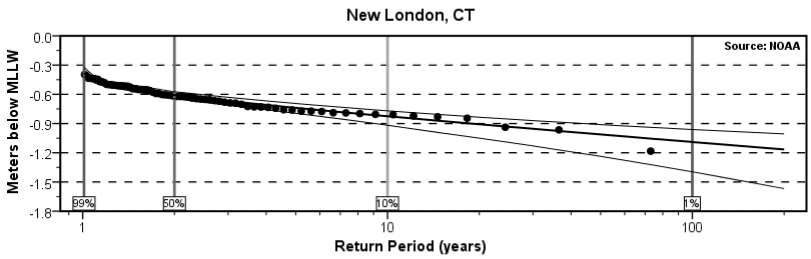


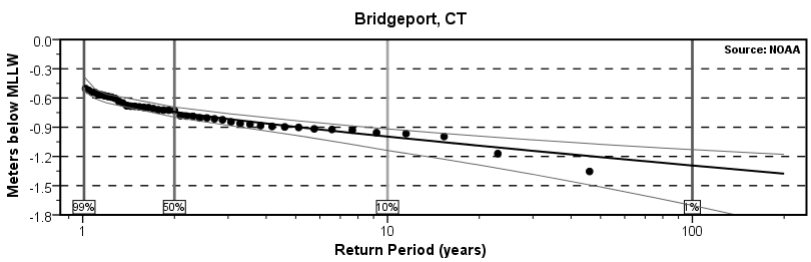

Woods Hole, MA
Source: NOAA
Meters below MLLW
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
99%
50%
10%
1%
1
10
100
Return Period (years)


Nantucket Island, MA
Source: NOAA
Meters below MLLW
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
99%
50%
10%
1%
1
10
100
Return Period (years)

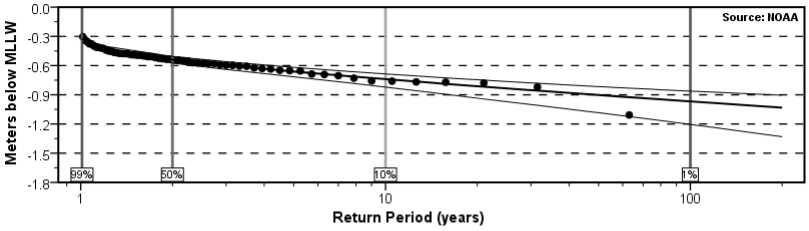

Newport, RI
Source: NOAA
Meters below MLLW
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
99%
50%
10%
1%
1
10
100
Return Period (years)


Providence, RI
Source: NOAA
Meters below MLLW
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
99%
50%
10%
1%
1
10
100
Return Period (years)

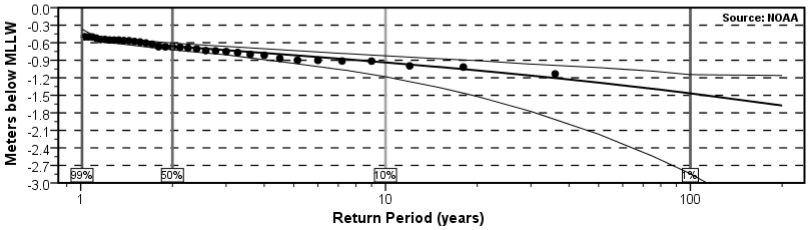

New London, CT
Source: NOAA
Meters below MLLW
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
99%
50%
10%
1%
1
10
100
Return Period (years)


Bridgeport, CT
Source: NOAA
Meters below MLLW
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
99%
50%
10%
1%
1
10
100
Return Period (years)

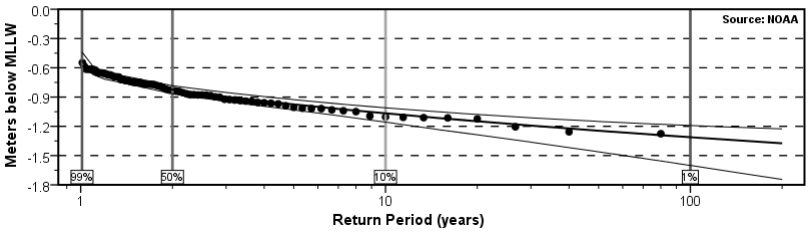
Montauk, NY



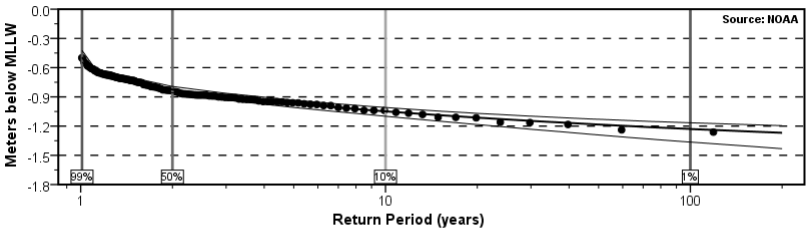
Port Jefferson, NY



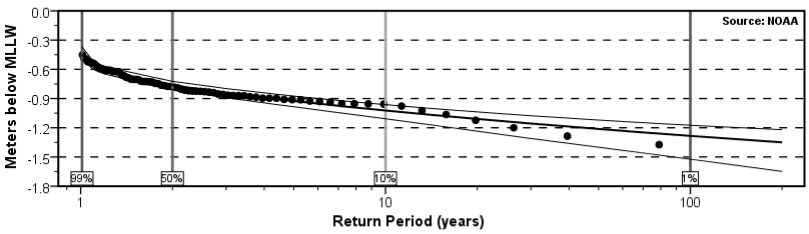
Kings Point / Willets Point, NY



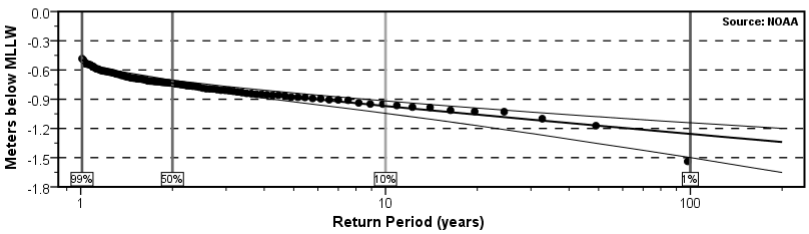
The Battery, NY



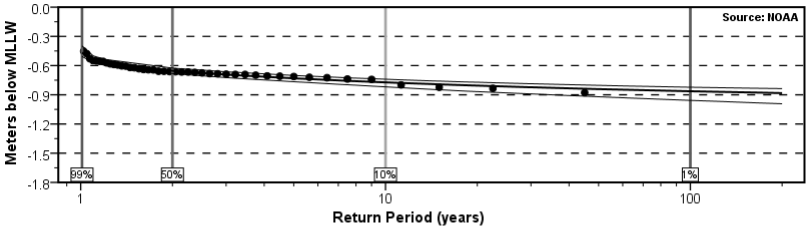
Sandy Hook, NJ



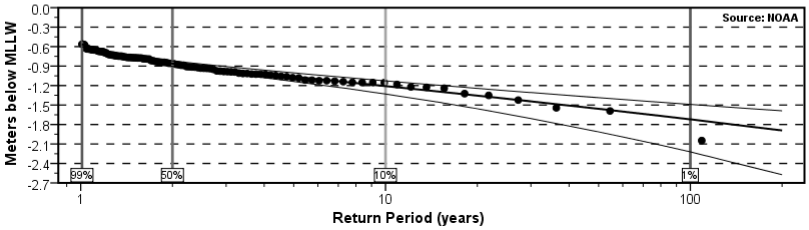
Atlantic City, NJ



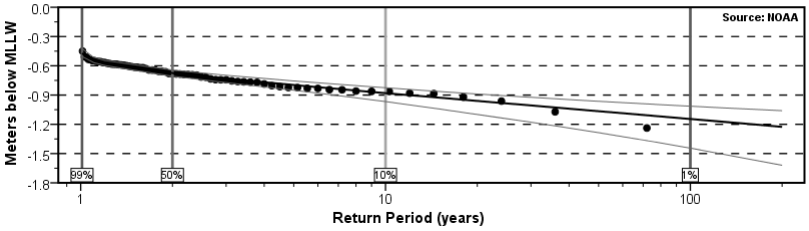
Cape May, NJ



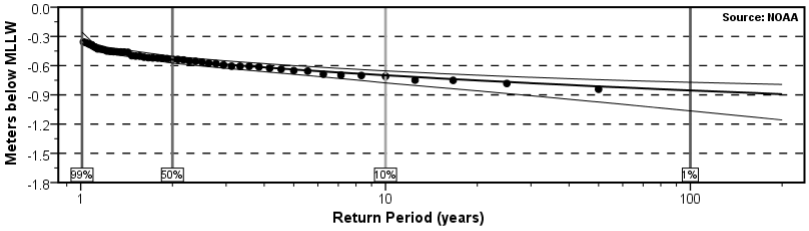
Philadelphia, PA



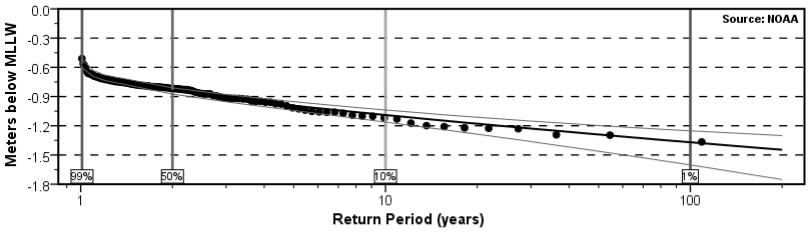
Lewes, DE



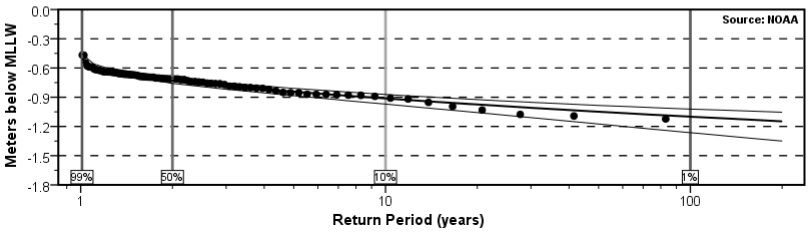
Cambridge, MD



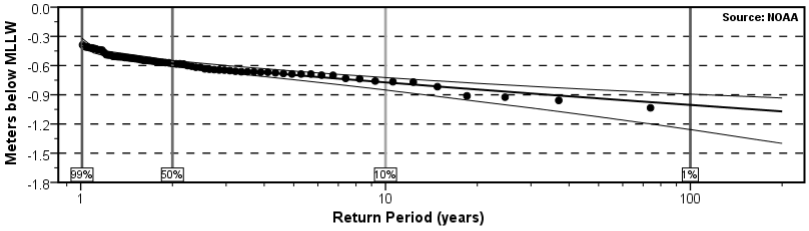
Baltimore, MD



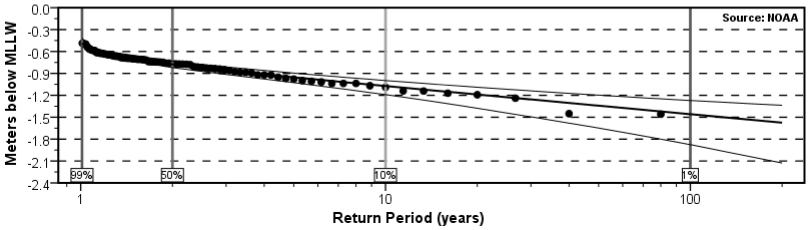
Annapolis, MD



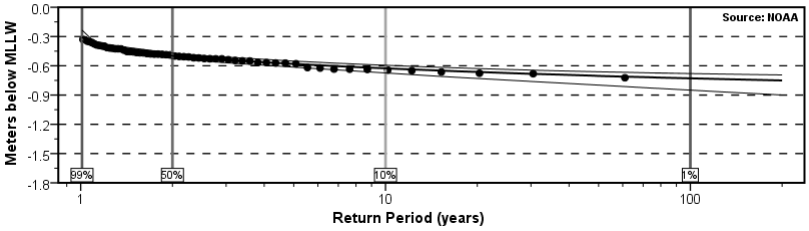
Solomons Island, MD



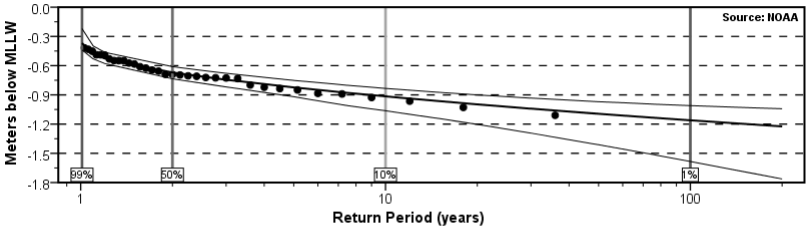
Washington, DC



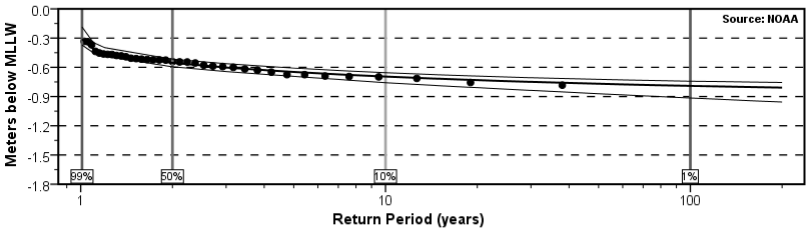
Kiptopeke, VA



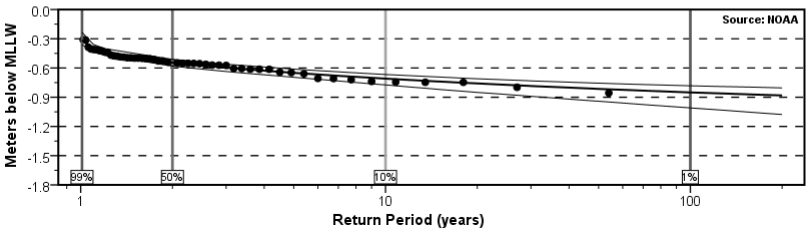
Colonial Beach, VA



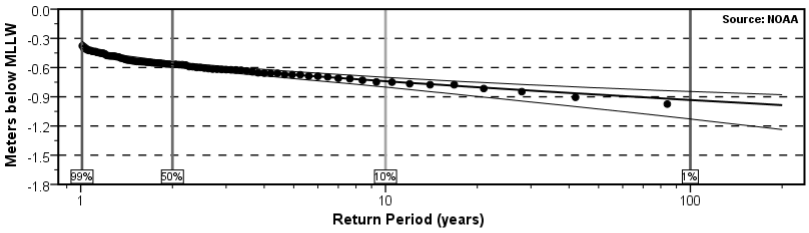
Lewisetta, VA



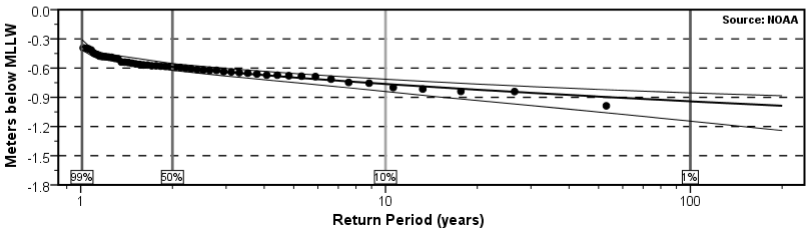
Gloucester Point, VA



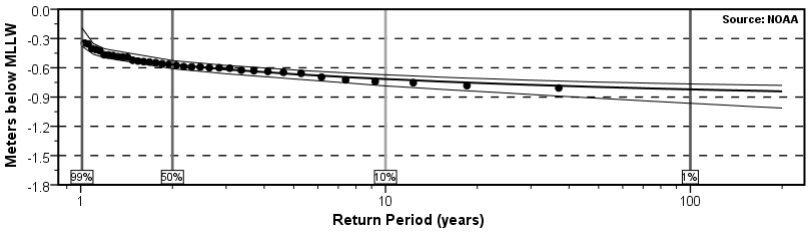
Sewells Point, VA



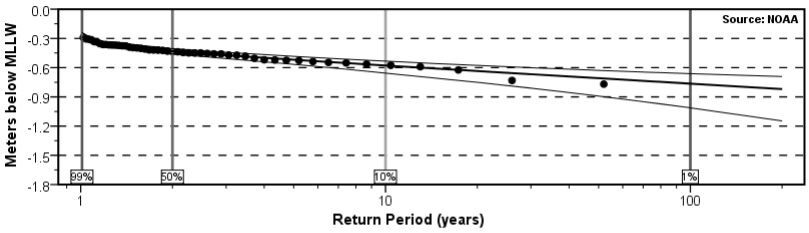
Portsmouth, VA



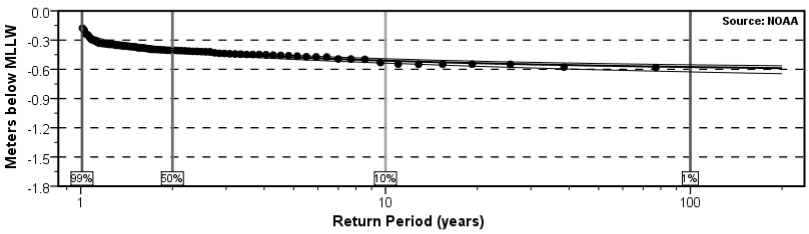
Chesapeake Bay Bridge Tunnel, VA



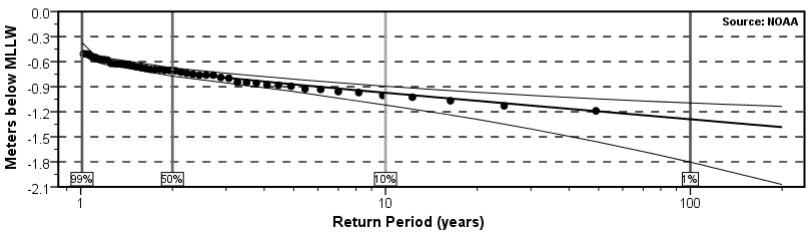
Beaufort, NC



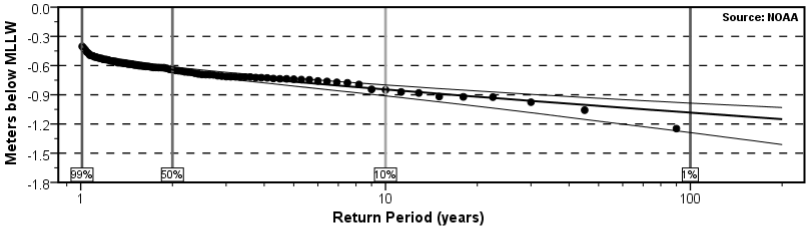
Wilmington, NC



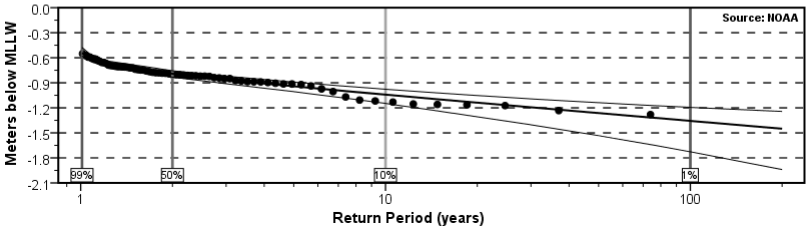
Springmaid Pier, SC



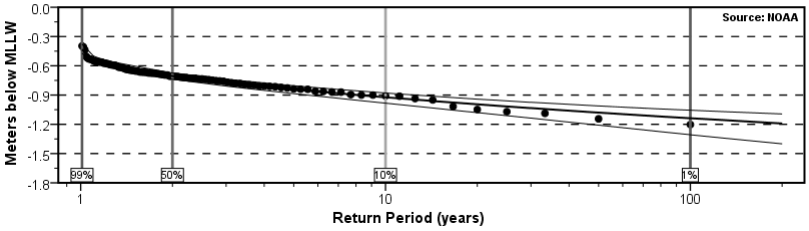
Charleston, SC



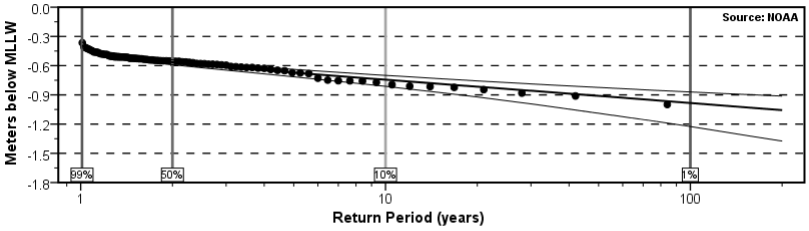
Fort Pulaski, GA



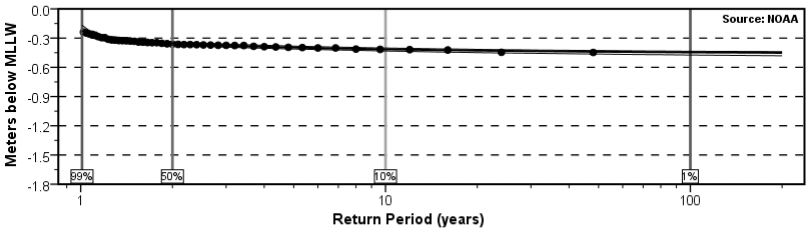
Fernandina Beach, FL



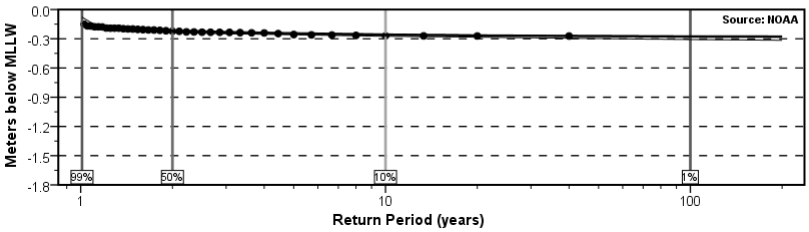
Bar Pilots Dock / Mayport, FL

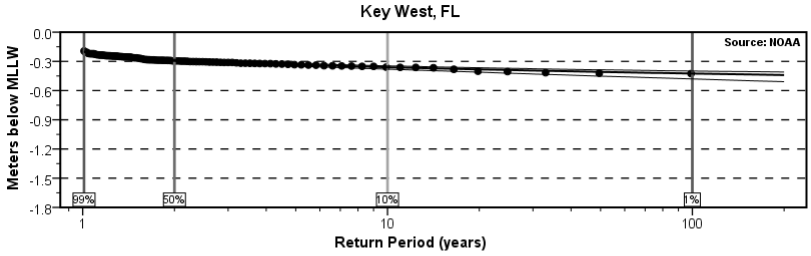


Miami Beach, FL



Vaca Key, FL




Key West, FL
Source: NOAA
Meters below MLLW
0.0
-0.3
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-0.9
-1.2
-1.5
-1.8
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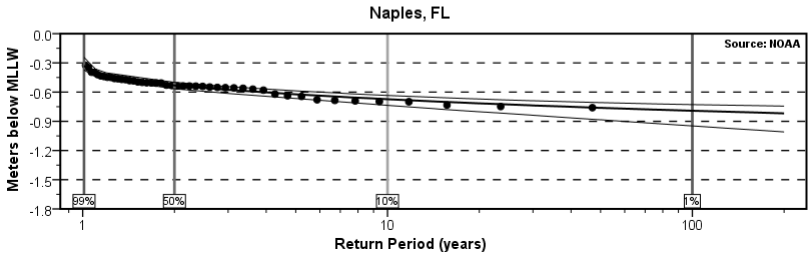
10
100
Return Period (years)


Naples, FL
Source: NOAA
Meters below MLLW
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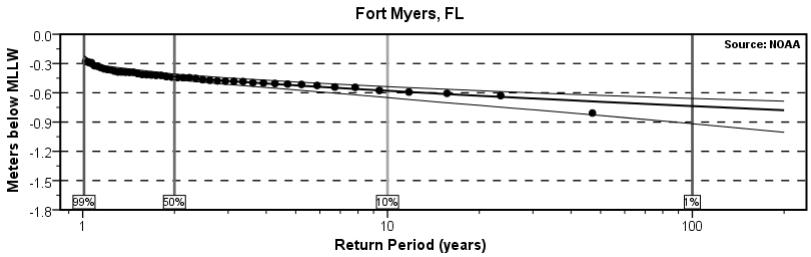
10
100
Return Period (years)


Fort Myers, FL
Source: NOAA
Meters below MLLW
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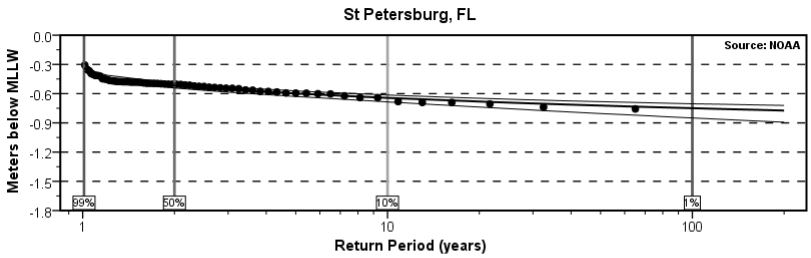
10
100
Return Period (years)


St Petersburg, FL
Source: NOAA
Meters below MLLW
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-0.3
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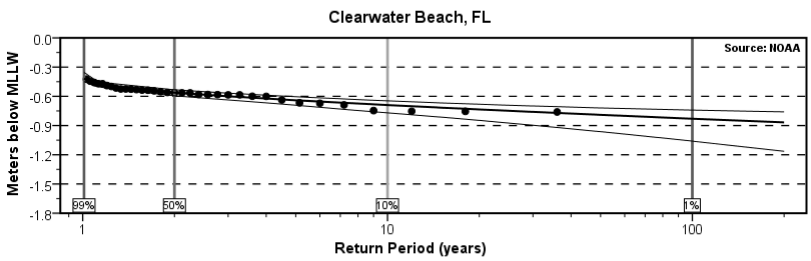
-1.8
99%
50%
10%
1%
1
10
100
Return Period (years)


Clearwater Beach, FL
Source: NOAA
Meters below MLLW
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99%
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1%
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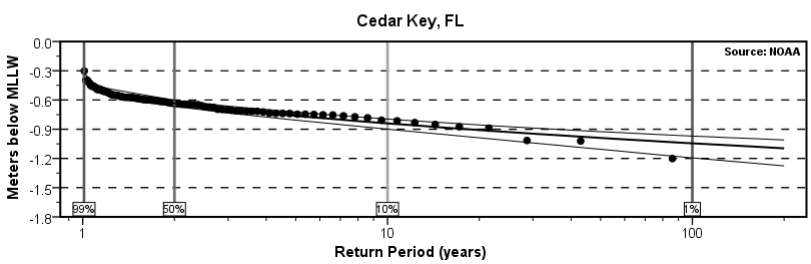
10
100
Return Period (years)


Cedar Key, FL
Source: NOAA
Meters below MLLW
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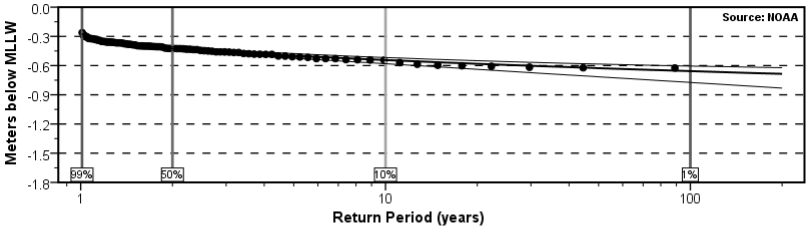
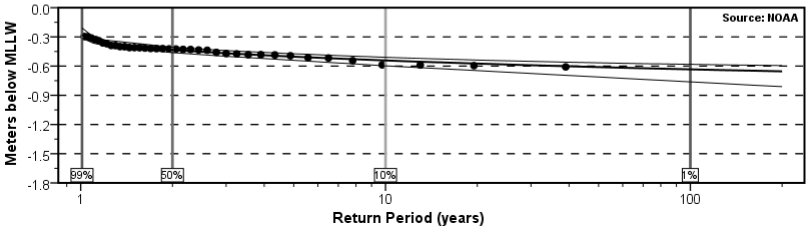
99%
50%
10%
1%
1
10
100
Return Period (years)

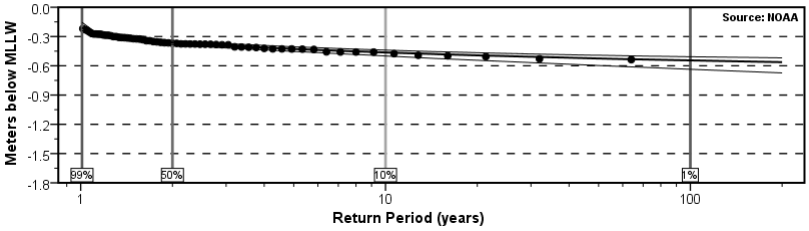
Pensacola, FL



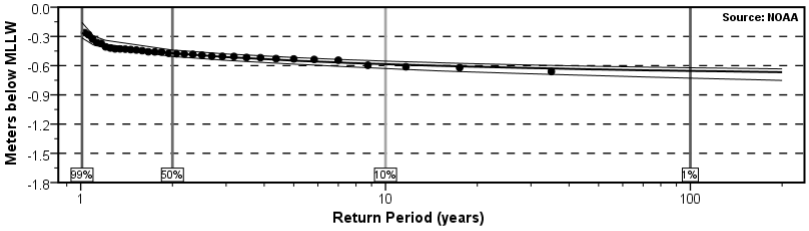
Dauphin Island, AL



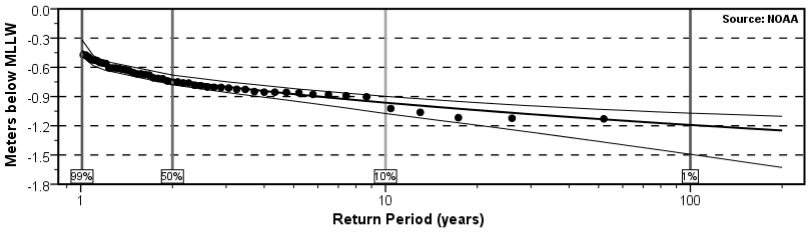
Grand Isle, LA



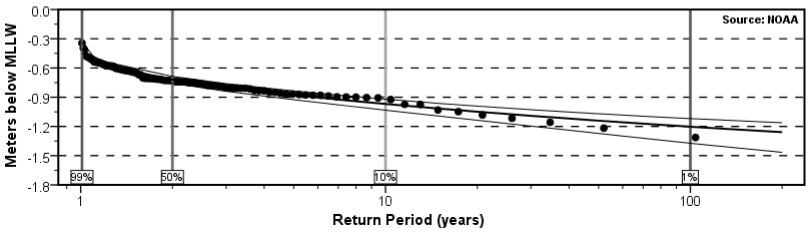
Eugene Island, LA



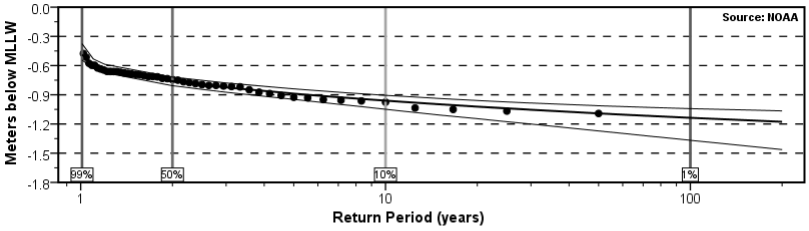
Sabine Pass, TX



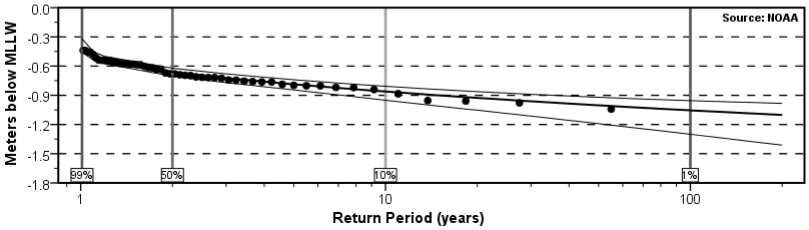
Galveston Pier 21, TX



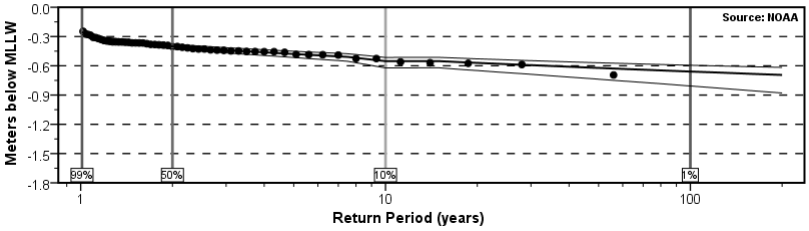
Galveston Pleasure Pier, TX



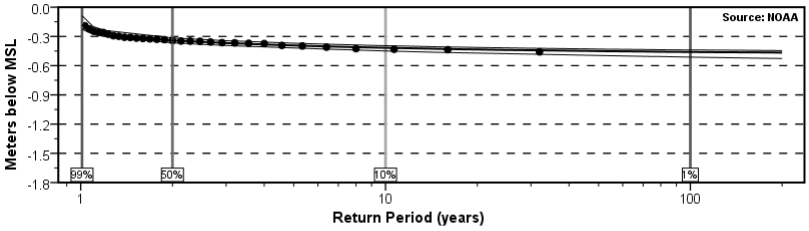
Freeport, TX



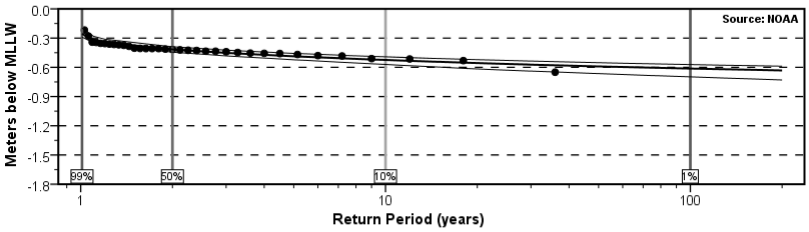
Rockport, TX



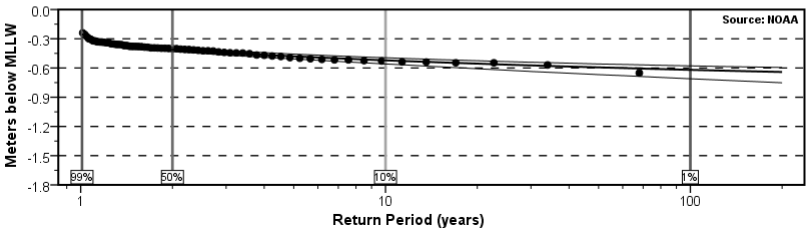
Port Mansfield, TX



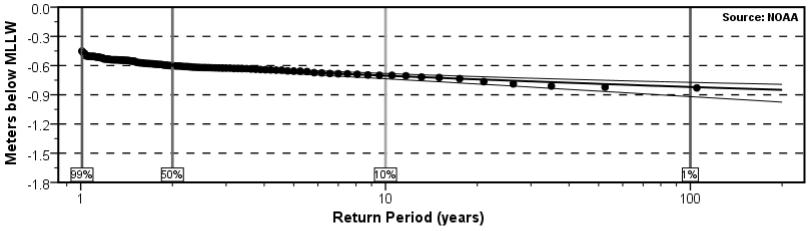
Padre Island, TX



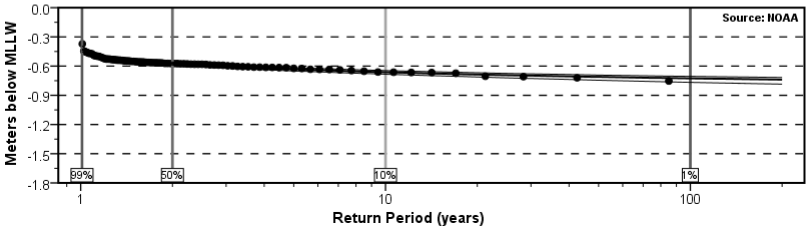
Port Isabel, TX



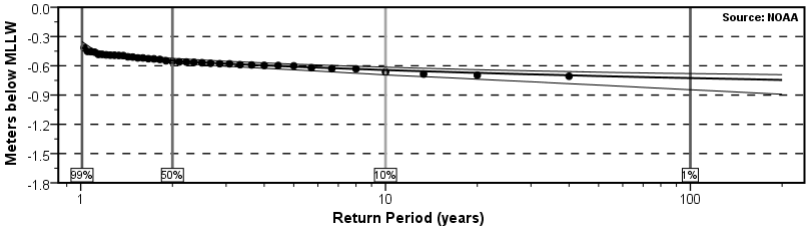
San Diego, CA



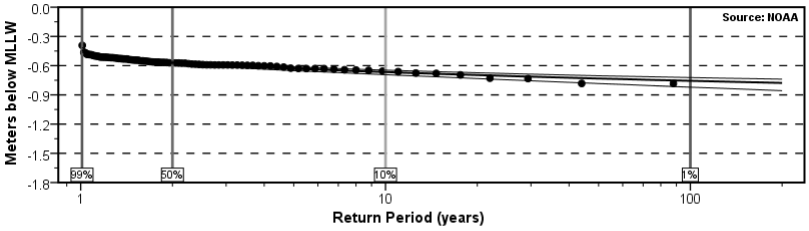
La Jolla, CA



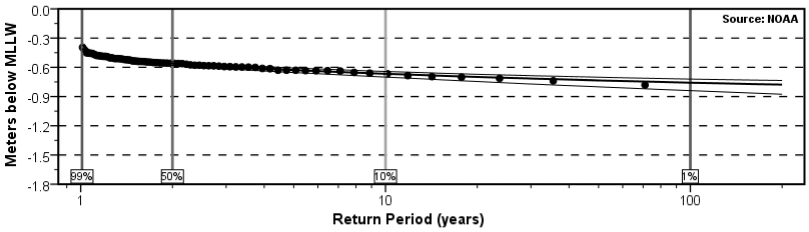
Newport Beach, CA



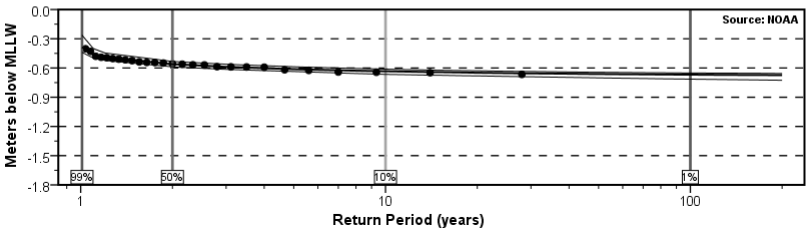
Los Angeles, CA

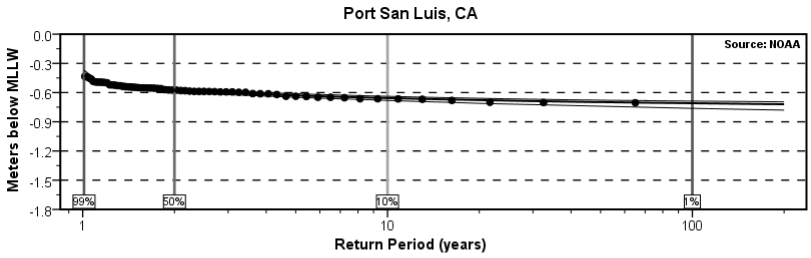


Santa Monica, CA



Rincon Island, CA




Port San Luis, CA
Source: NOAA
Meters below MLLW
0.0
-0.3
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-0.9
-1.2
-1.5
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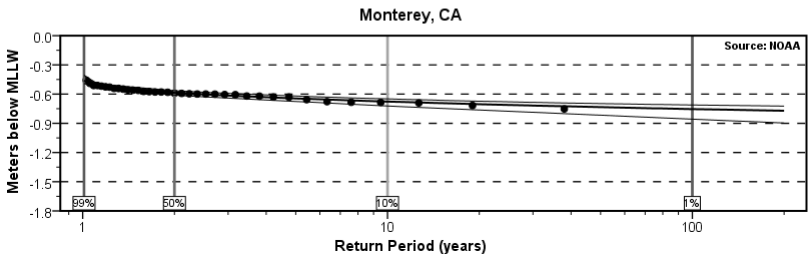
99%
50%
10%
1%
1
10
100
Return Period (years)


Monterey, CA
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Meters below MLLW
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99%
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10%
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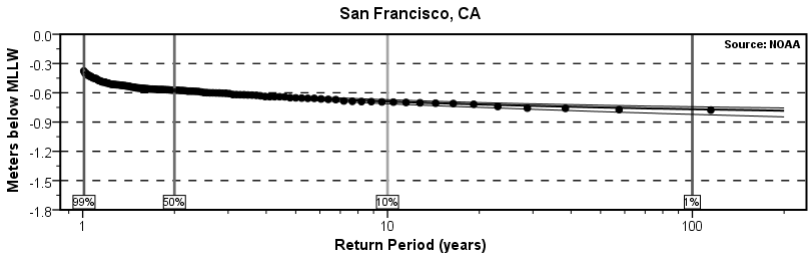
10
100
Return Period (years)


San Francisco, CA
Source: NOAA
Meters below MLLW
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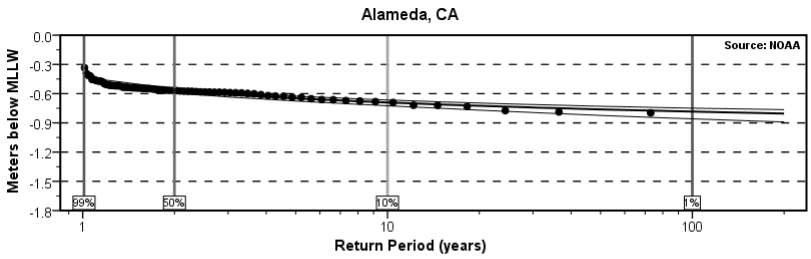
1
10
100
Return Period (years)


Alameda, CA
Source: NOAA
Meters below MLLW
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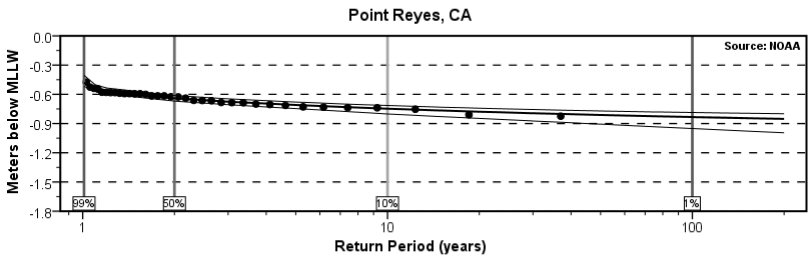
10
100
Return Period (years)


Point Reyes, CA
Source: NOAA
Meters below MLLW
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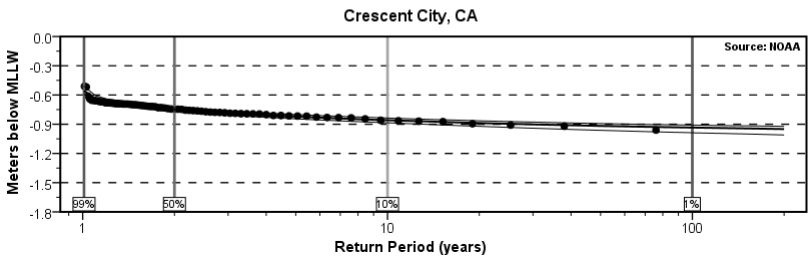
1%
1
10
100
Return Period (years)


Crescent City, CA
Source: NOAA
Meters below MLLW
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-0.3
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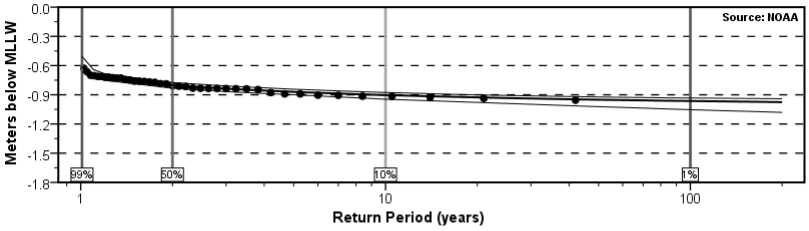
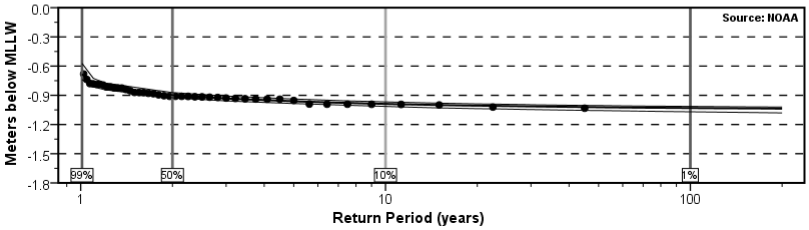
-1.5
-1.8
99%
50%
10%
1%
1
10
100
Return Period (years)

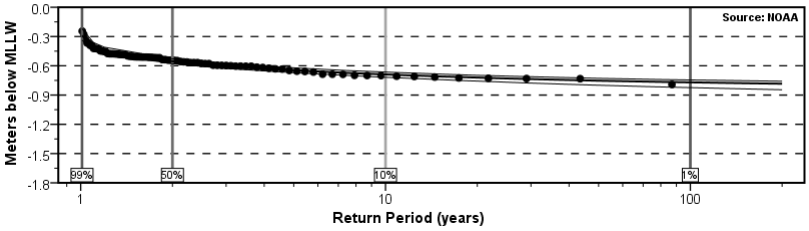
Charleston, OR



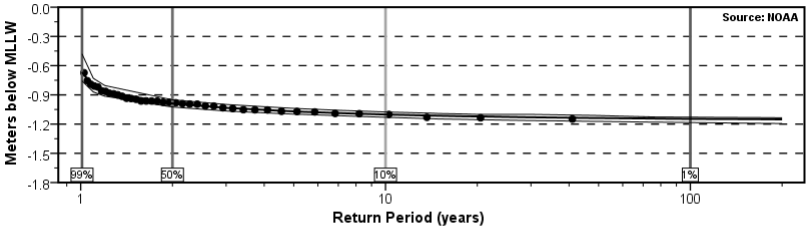
South Beach, OR



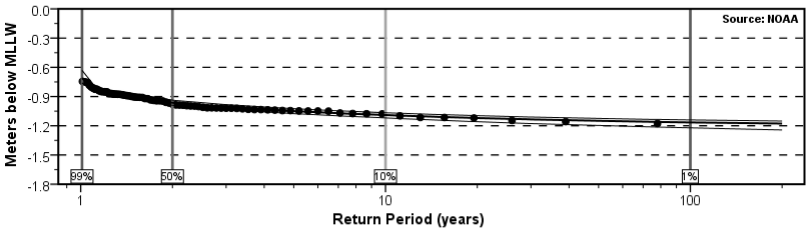
Astoria, OR



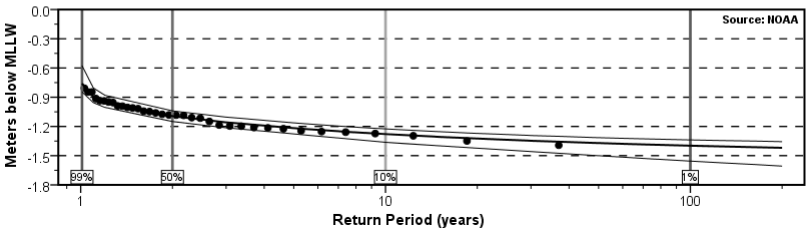
Toke Point, WA



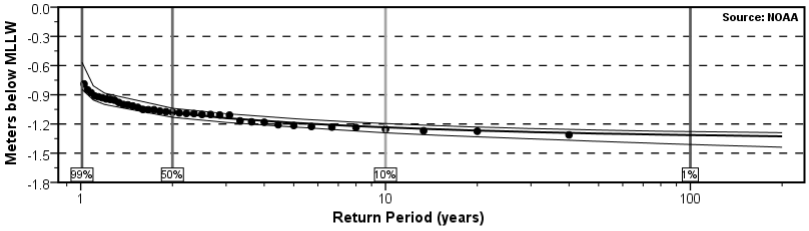
Neah Bay, WA



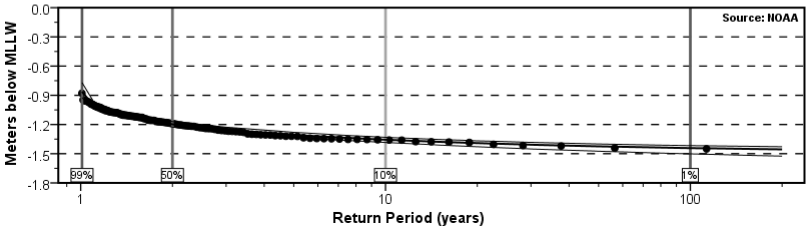
Port Angeles, WA



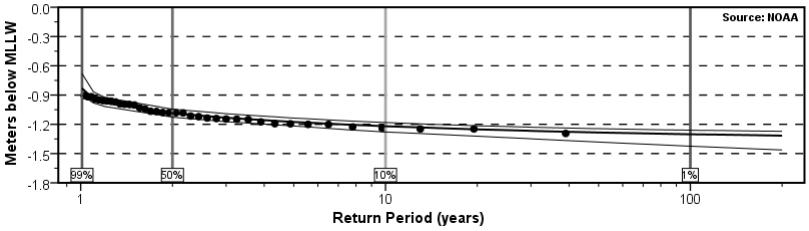
Port Townsend, WA



Seattle, WA



Cherry Point, WA



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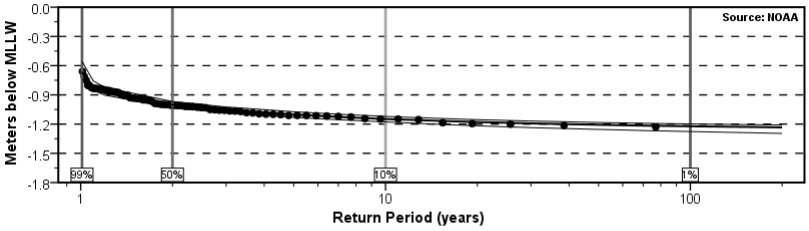

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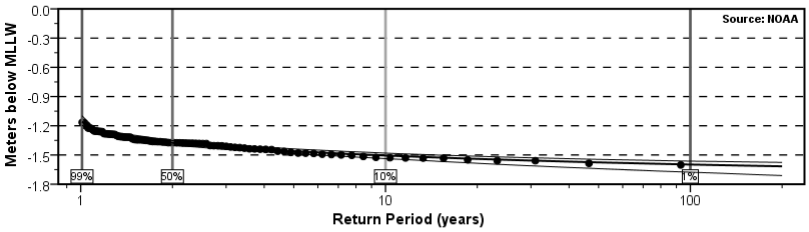

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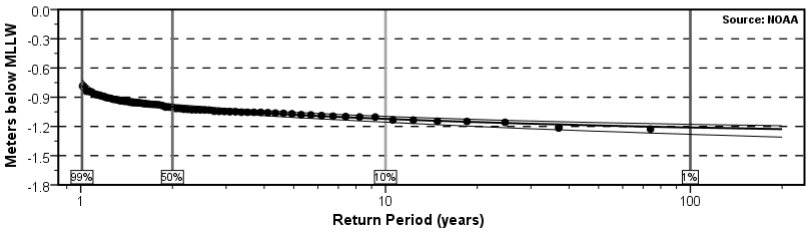

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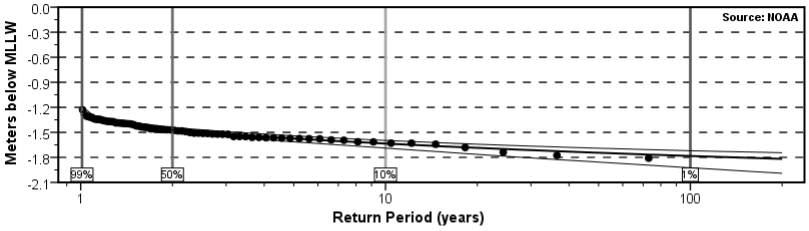

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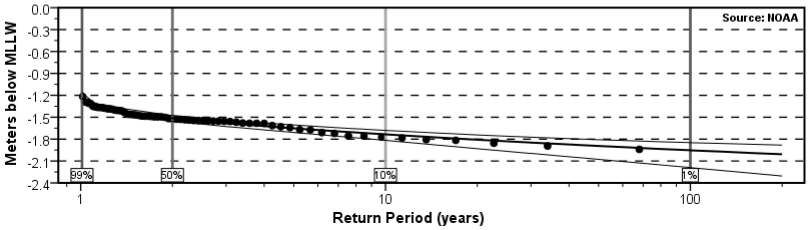

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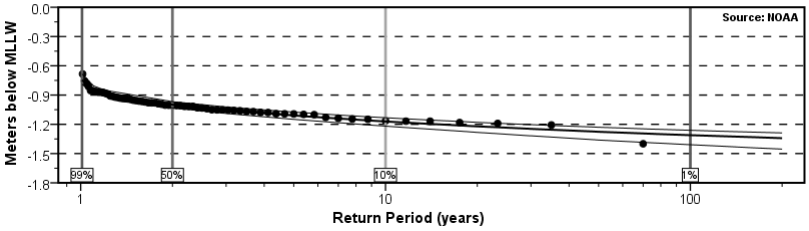

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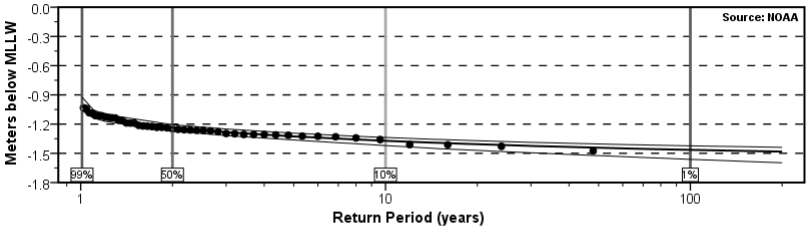

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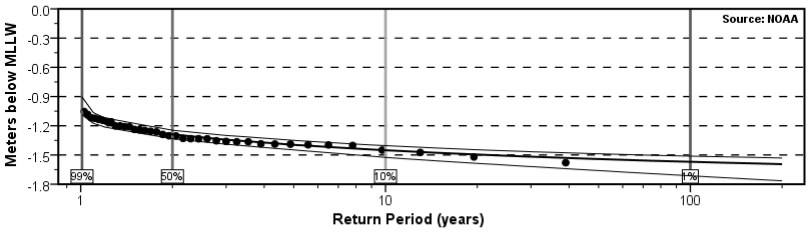

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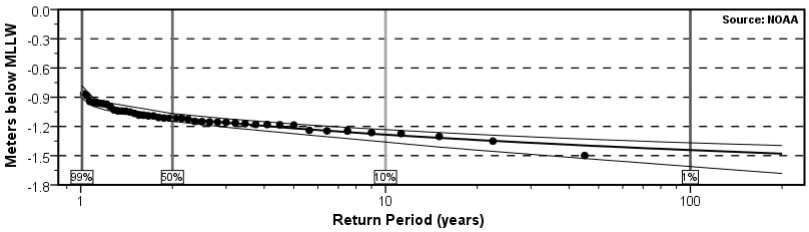

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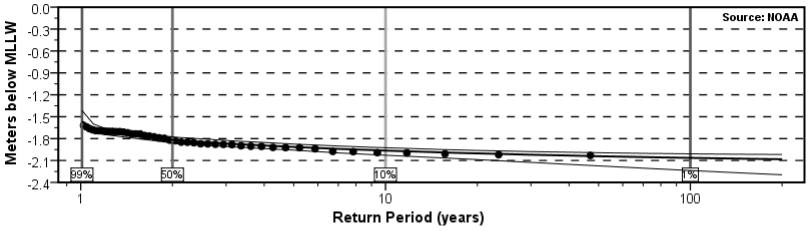

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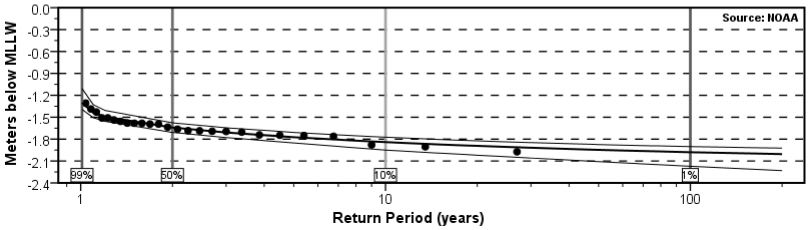

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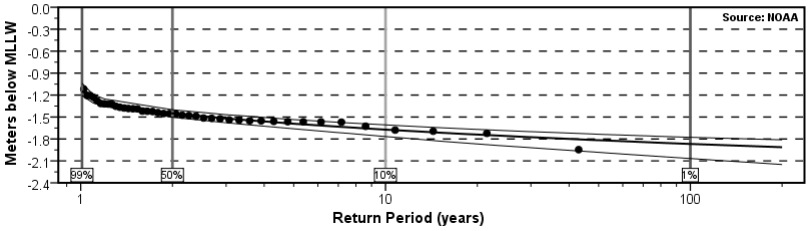
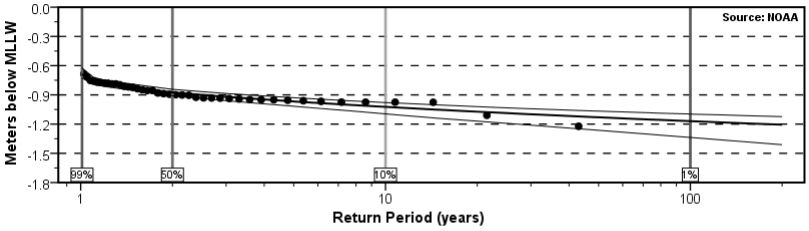
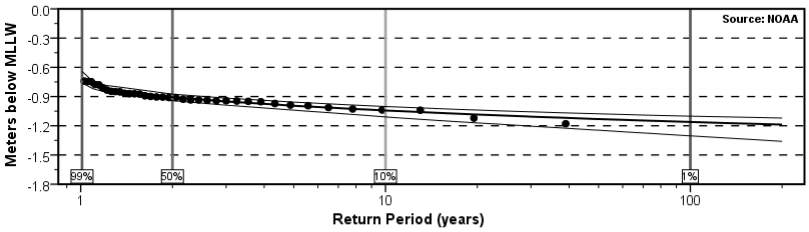


Kodiak Island, AK



Sand Point, AK



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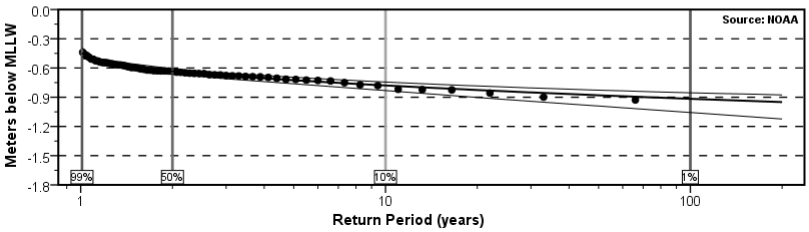
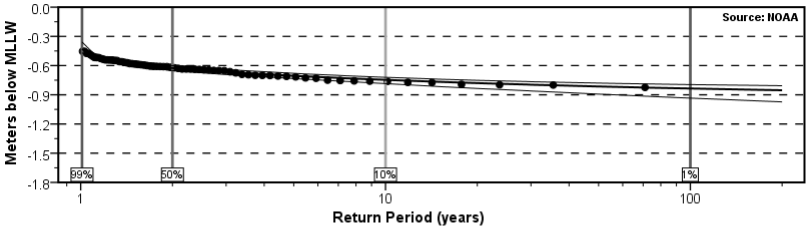


Unalaska, AK



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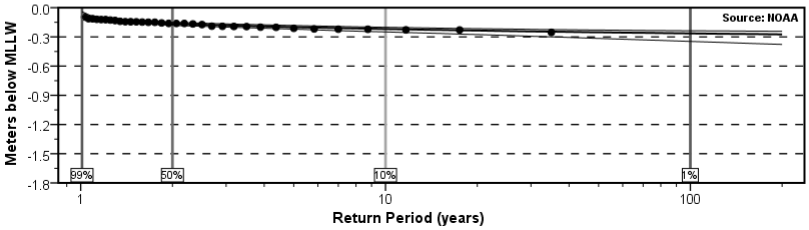
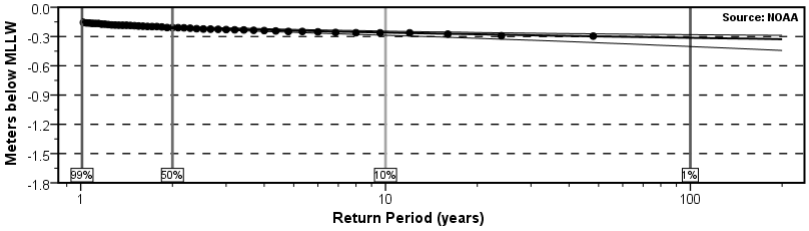


San Juan, PR



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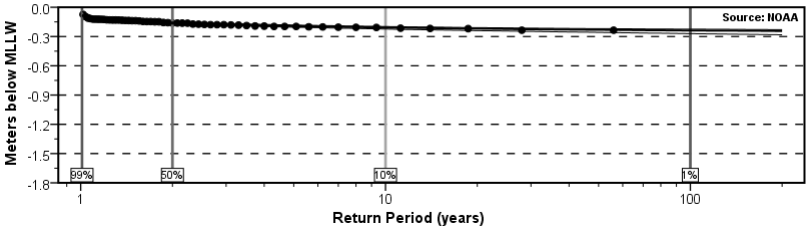


Appendix III.

Stick Diagrams of the Annual GEV Exceedance Proabiltiy Levels Relative to Tidal and Geodetic Datums

Note: Red, orange, green, and blue symbols indicate the 1%, 10%, 50%, and 99% high and low annual GEV exceedance probability levels relative to MSL. Black symbols indicate the MHHW, MHW, MLW, and MLLW tidal datums and the geodetic datum NAVD88, if available. The zero value on the vertical axis represents the elevation of the MSL datum for the National Tidal Datum Epoch (1983-2001) or the special 5-year Modified Tidal Datum Epoch, as appropriate.

Table C. High Water Level 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels (meters above MHHW)													
Station Number	**Station Name**	**0.99 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**	**0.50 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**	**0.10 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**	**0.01 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**
161140	Nawiliwili	0.165	0.182	0.142	0.280	0.300	0.262	0.400	0.448	0.367	0.559	0.692	0.492
161234	Honolulu	0.156	0.174	0.131	0.275	0.288	0.263	0.359	0.380	0.344	0.431	0.482	0.407
161248	Mokuoloe	0.203	0.225	0.166	0.311	0.328	0.295	0.388	0.420	0.368	0.455	0.527	0.424
161568	Kahului	0.194	0.214	0.161	0.297	0.312	0.283	0.369	0.395	0.352	0.430	0.494	0.402
161776	Hilo	0.185	0.212	0.139	0.321	0.338	0.305	0.399	0.421	0.382	0.451	0.497	0.430
161900	Johnston Atoll	0.225	0.250	0.187	0.380	0.408	0.355	0.536	0.606	0.491	0.733	0.945	0.637
161991	Midway Atoll	0.184	0.220	0.128	0.407	0.442	0.375	0.609	0.688	0.557	0.836	1.066	0.730
163000	Guam	0.131	0.150	0.102	0.257	0.277	0.238	0.377	0.424	0.345	0.521	0.650	0.459
177000	Pago Pago	0.158	0.185	0.117	0.307	0.325	0.289	0.394	0.417	0.375	0.455	0.492	0.435
182000	Kwajalein	0.347	0.369	0.313	0.466	0.480	0.452	0.537	0.556	0.522	0.587	0.623	0.569
184000	Chuuk	0.147	0.169	0.110	0.270	0.295	0.247	0.386	0.446	0.349	0.523	0.677	0.453
189000	Wake Island	0.231	0.246	0.208	0.349	0.374	0.327	0.528	0.630	0.470	0.887	1.328	0.692
269554	Bermuda	0.248	0.271	0.210	0.396	0.420	0.373	0.543	0.606	0.504	0.729	0.944	0.634
841014	Eastport	0.900	0.925	0.861	1.078	1.105	1.054	1.256	1.322	1.212	1.478	1.694	1.377
841332	Bar Harbor	0.611	0.640	0.561	0.787	0.818	0.759	0.960	1.039	0.912	1.171	1.428	1.060
841815	Portland	0.562	0.587	0.522	0.752	0.779	0.727	0.956	1.028	0.908	1.231	1.510	1.104
841987	Seavey Island	0.449	0.492	0.369	0.681	0.724	0.641	0.896	1.009	0.833	1.145	1.493	1.007
844397	Boston	0.563	0.597	0.509	0.813	0.849	0.780	1.071	1.164	1.009	1.405	1.744	1.250
844793	Woods Hole	0.359	0.389	0.313	0.626	0.678	0.582	1.045	1.252	0.922	1.915	2.902	1.470
844913	Nantucket Is.	0.320	0.360	0.250	0.550	0.599	0.506	0.802	0.953	0.720	1.153	1.639	0.956
845266	Newport	0.420	0.443	0.385	0.632	0.675	0.596	0.997	1.189	0.887	1.844	2.857	1.396
845400	Providence	0.491	0.529	0.428	0.794	0.866	0.733	1.348	1.720	1.159	2.727	4.803	1.894
846149	New London	0.362	0.404	0.298	0.689	0.749	0.635	1.126	1.335	1.000	1.890	2.752	1.502
846715	Bridgeport	0.453	0.510	0.350	0.762	0.822	0.708	1.049	1.200	0.961	1.380	1.811	1.201
851056	Montauk	0.366	0.410	0.292	0.672	0.732	0.620	1.053	1.252	0.940	1.664	2.439	1.332
851456	Port Jefferson	0.359	0.459	0.098	0.763	0.877	0.659	1.181	1.496	1.028	1.728	3.237	1.416
851694	Kings Point	0.542	0.595	0.449	0.938	1.018	0.866	1.538	1.882	1.360	2.745	4.506	2.041
851875	The Battery	0.459	0.490	0.414	0.732	0.767	0.699	1.034	1.128	0.968	1.460	1.817	1.283
853168	Sandy Hook	0.490	0.526	0.432	0.765	0.814	0.722	1.123	1.289	1.023	1.727	2.435	1.411
853472	Atlantic City	0.480	0.511	0.432	0.725	0.763	0.691	1.018	1.131	0.946	1.466	1.938	1.251
853611	Cape May	0.416	0.472	0.307	0.685	0.733	0.639	0.890	0.992	0.830	1.082	1.340	0.978
854524	Philadelphia	0.340	0.380	0.282	0.646	0.684	0.611	0.929	1.012	0.870	1.256	1.527	1.125
855738	Lewes	0.474	0.510	0.412	0.720	0.763	0.680	1.003	1.137	0.924	1.421	1.941	1.199
857189	Cambridge	0.384	0.409	0.337	0.537	0.574	0.504	0.752	0.900	0.677	1.152	1.839	0.898
857468	Baltimore	0.367	0.388	0.336	0.584	0.620	0.552	0.939	1.087	0.846	1.719	2.508	1.347
857551	Annapolis	0.360	0.381	0.329	0.555	0.591	0.523	0.863	1.009	0.773	1.516	2.216	1.187
857733	Solomons Is.	0.306	0.337	0.257	0.519	0.551	0.489	0.720	0.795	0.669	0.957	1.190	0.848
859490	Washington	0.344	0.372	0.300	0.632	0.697	0.578	1.257	1.635	1.049	3.154	5.621	2.076
863220	Kiptopeke	0.412	0.444	0.359	0.623	0.664	0.587	0.872	1.001	0.798	1.248	1.720	1.047

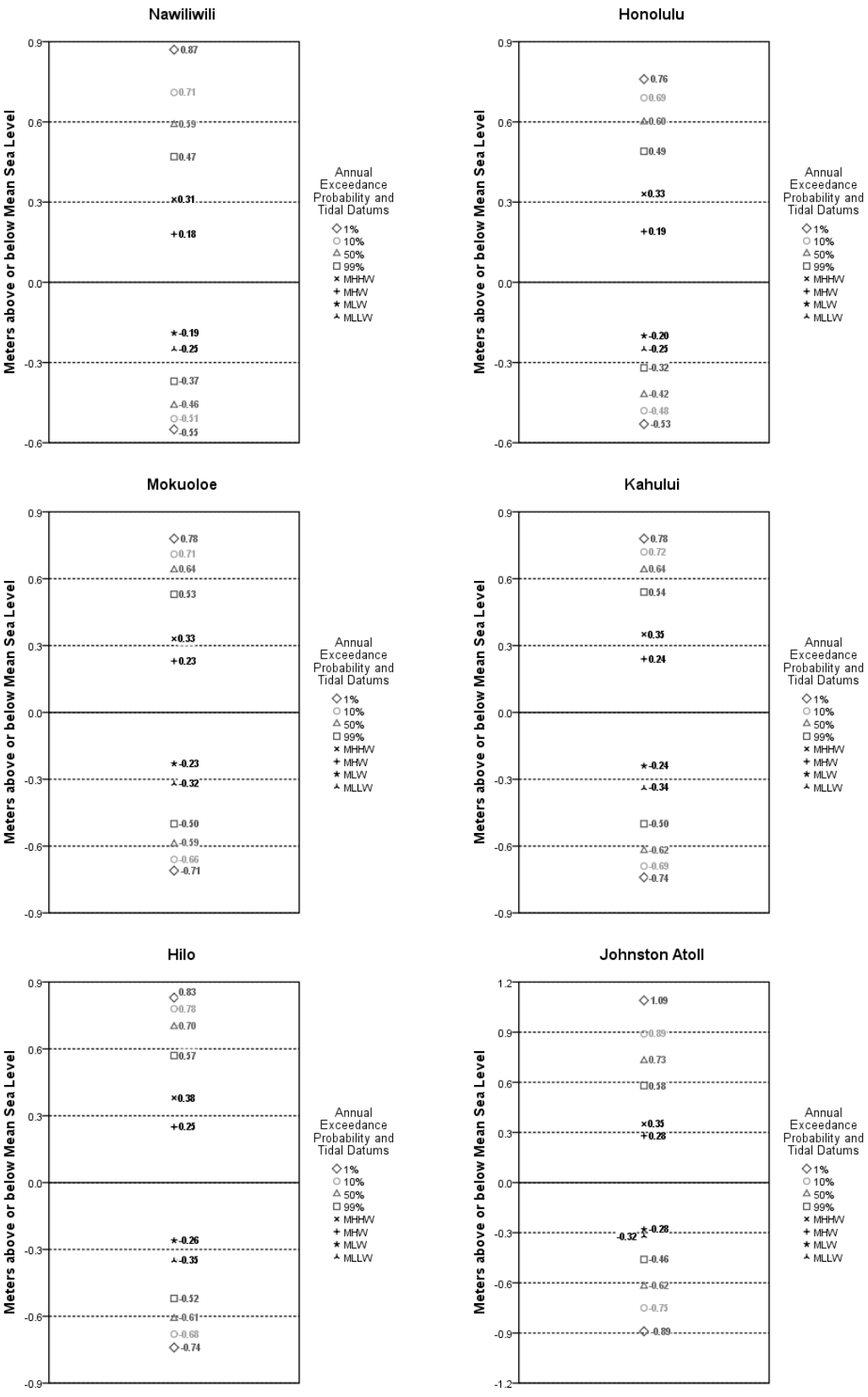
Table C. High Water Level 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels (meters above MHHW)													
Station Number	**Station Name**	**0.99 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**	**0.50 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**	**0.10 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**	**0.01 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**
863515	Colonial Beach	0.380	0.406	0.328	0.533	0.581	0.494	0.778	0.987	0.677	1.300	2.329	0.936
863575	Lewisetta	0.353	0.382	0.301	0.526	0.571	0.487	0.753	0.917	0.668	1.139	1.736	0.899
863762	Gloucester Pt.	0.374	0.415	0.307	0.635	0.685	0.589	0.916	1.057	0.830	1.301	1.749	1.101
863861	Sewells Point	0.441	0.480	0.381	0.742	0.792	0.697	1.117	1.279	1.018	1.722	2.387	1.422
863866	Portsmouth	0.452	0.501	0.367	0.760	0.824	0.704	1.115	1.313	1.004	1.634	2.321	1.346
863886	CBBT	0.448	0.498	0.344	0.708	0.777	0.648	1.022	1.254	0.904	1.511	2.429	1.183
865648	Beaufort	0.260	0.291	0.205	0.470	0.517	0.429	0.753	0.931	0.658	1.254	1.959	0.959
865812	Wilmington	0.221	0.247	0.183	0.413	0.443	0.385	0.621	0.701	0.568	0.906	1.175	0.779
866107	Springmaid Pier	0.436	0.465	0.392	0.606	0.637	0.577	0.766	0.838	0.719	0.955	1.146	0.866
866553	Charleston	0.405	0.423	0.380	0.562	0.590	0.537	0.804	0.915	0.737	1.302	1.839	1.058
867087	Fort Pulaski	0.477	0.494	0.450	0.606	0.629	0.586	0.762	0.830	0.719	1.004	1.258	0.887
872003	Fernandina	0.425	0.444	0.400	0.593	0.618	0.569	0.815	0.897	0.760	1.201	1.542	1.036
872021	Mayport	0.311	0.332	0.279	0.456	0.477	0.436	0.597	0.648	0.563	0.769	0.938	0.691
872317	Miami Beach	0.247	0.275	0.200	0.430	0.471	0.394	0.667	0.814	0.587	1.067	1.600	0.838
872397	Vaca Key	0.199	0.212	0.177	0.290	0.318	0.267	0.456	0.595	0.388	0.874	1.589	0.603
872458	Key West	0.177	0.192	0.158	0.301	0.318	0.285	0.436	0.480	0.405	0.625	0.766	0.551
872511	Naples	0.274	0.303	0.218	0.453	0.497	0.416	0.699	0.870	0.612	1.142	1.862	0.859
872552	Fort Myers	0.229	0.266	0.155	0.472	0.529	0.423	0.809	1.036	0.693	1.423	2.387	1.032
872652	St. Petersburg	0.278	0.309	0.220	0.494	0.542	0.452	0.822	1.028	0.716	1.482	2.511	1.072
872672	Clearwater Bch.	0.313	0.348	0.235	0.513	0.577	0.460	0.837	1.122	0.704	1.538	3.105	1.021
872752	Cedar Key	0.328	0.357	0.281	0.582	0.629	0.542	0.969	1.154	0.859	1.749	2.658	1.340
872984	Pensacola	0.255	0.273	0.226	0.447	0.489	0.412	0.873	1.125	0.736	2.199	3.944	1.449
873518	Dauphin Island	0.253	0.281	0.203	0.456	0.523	0.404	0.872	1.248	0.693	2.060	4.204	1.240
876172	Grand Isle	0.221	0.256	0.160	0.498	0.560	0.445	0.949	1.229	0.800	1.931	3.306	1.353
876431	Eugene Island	0.346	0.395	0.248	0.633	0.721	0.561	1.070	1.439	0.891	1.958	3.656	1.309
877057	Sabine Pass	0.274	0.313	0.215	0.565	0.634	0.506	1.018	1.309	0.862	1.958	3.194	1.426
877145	Galves. Pier 21	0.323	0.347	0.285	0.590	0.641	0.545	1.140	1.420	0.978	2.715	4.581	1.884
877151	Glv. Pleasure	0.331	0.377	0.256	0.674	0.763	0.600	1.265	1.697	1.048	2.644	4.716	1.796
877244	Freeport	0.316	0.358	0.239	0.590	0.649	0.538	0.937	1.148	0.825	1.506	2.327	1.172
877477	Rockport	0.225	0.247	0.181	0.392	0.436	0.354	0.702	0.934	0.589	1.488	2.876	0.969
877849	Port Mansfield	0.228	0.266	0.151	0.431	0.491	0.382	0.693	0.901	0.588	1.127	1.913	0.836
877975	Padre Island	0.210	0.235	0.165	0.387	0.449	0.338	0.762	1.120	0.595	1.871	4.039	1.112
877977	Port Isabel	0.244	0.264	0.214	0.413	0.449	0.382	0.698	0.861	0.606	1.347	2.158	0.989
941017	San Diego	0.452	0.469	0.428	0.575	0.587	0.562	0.660	0.679	0.644	0.731	0.774	0.708
941023	La Jolla	0.421	0.441	0.389	0.545	0.560	0.532	0.628	0.650	0.612	0.694	0.748	0.669
941058	Newport Beach	0.446	0.469	0.404	0.554	0.574	0.536	0.633	0.670	0.610	0.702	0.782	0.667
941066	Los Angeles	0.442	0.460	0.415	0.556	0.569	0.543	0.637	0.659	0.620	0.708	0.763	0.682
941084	Santa Monica	0.457	0.471	0.435	0.556	0.572	0.540	0.663	0.708	0.634	0.809	0.965	0.740
941127	Rincon Island	0.419	0.458	0.340	0.574	0.608	0.543	0.684	0.750	0.645	0.777	0.915	0.722
941211	Port San Luis	0.385	0.414	0.334	0.537	0.558	0.517	0.640	0.677	0.616	0.725	0.818	0.686
941345	Monterey	0.394	0.420	0.341	0.524	0.553	0.497	0.650	0.730	0.606	0.803	1.050	0.708

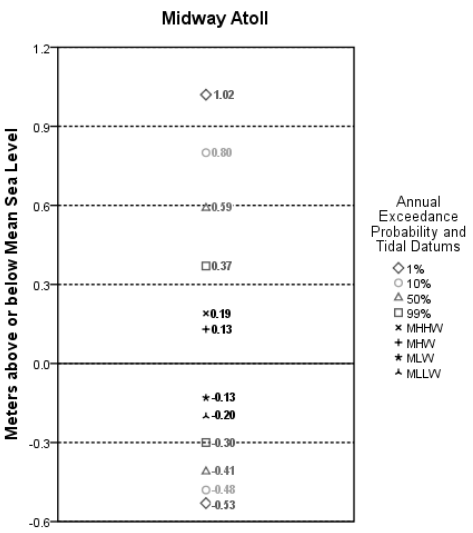
Table C. High Water Level 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels (meters above MHHW)													
Station Number	**Station Name**	**0.99 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**	**0.50 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**	**0.10 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**	**0.01 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**
941429	San Francisco	0.298	0.325	0.260	0.495	0.516	0.474	0.650	0.690	0.620	0.802	0.917	0.747
941475	Alameda	0.312	0.343	0.264	0.505	0.534	0.479	0.675	0.738	0.634	0.861	1.046	0.777
941502	Point Reyes	0.375	0.409	0.304	0.549	0.591	0.512	0.730	0.852	0.665	0.967	1.369	0.812
941975	Crescent City	0.435	0.480	0.366	0.705	0.740	0.672	0.901	0.961	0.858	1.073	1.220	1.006
943278	Charleston	0.453	0.519	0.315	0.748	0.802	0.697	0.961	1.070	0.898	1.146	1.416	1.042
943538	South Beach	0.517	0.577	0.406	0.803	0.855	0.755	1.023	1.133	0.959	1.230	1.501	1.122
943904	Astoria	0.537	0.580	0.466	0.801	0.835	0.769	1.004	1.068	0.960	1.194	1.387	1.107
944091	Toke Point	0.629	0.718	0.441	1.048	1.133	0.971	1.397	1.595	1.287	1.753	2.311	1.543
944309	Neah Bay	0.529	0.595	0.422	0.890	0.931	0.851	1.100	1.154	1.058	1.244	1.365	1.189
944409	Port Angeles	0.401	0.477	0.252	0.717	0.770	0.665	0.905	0.989	0.850	1.039	1.197	0.973
944490	Port Townsend	0.362	0.441	0.196	0.679	0.730	0.629	0.858	0.938	0.808	0.978	1.138	0.918
944713	Seattle	0.450	0.486	0.395	0.688	0.712	0.664	0.845	0.882	0.817	0.971	1.068	0.925
944942	Cherry Point	0.465	0.523	0.356	0.735	0.785	0.688	0.935	1.035	0.874	1.116	1.342	1.021
944988	Friday Harbor	0.390	0.445	0.306	0.698	0.732	0.664	0.879	0.925	0.842	1.006	1.099	0.962
945046	Ketchikan	0.970	1.027	0.887	1.332	1.369	1.296	1.551	1.599	1.510	1.708	1.805	1.660
945160	Sitka	0.778	0.817	0.717	1.020	1.054	0.989	1.213	1.277	1.168	1.401	1.575	1.320
945221	Juneau	1.123	1.169	1.054	1.419	1.460	1.381	1.660	1.739	1.604	1.901	2.105	1.803
945240	Skagway	1.154	1.206	1.064	1.459	1.504	1.417	1.702	1.791	1.642	1.938	2.191	1.827
945322	Yakutat	0.759	0.820	0.661	1.092	1.130	1.054	1.283	1.334	1.243	1.414	1.516	1.366
945405	Cordova	0.765	0.850	0.607	1.146	1.201	1.093	1.363	1.441	1.308	1.509	1.662	1.444
945424	Valdez	0.823	0.898	0.670	1.136	1.190	1.084	1.329	1.419	1.272	1.471	1.655	1.397
945509	Seward	0.832	0.885	0.735	1.098	1.146	1.054	1.307	1.407	1.246	1.508	1.753	1.405
945550	Seldovia	1.100	1.197	0.939	1.569	1.638	1.501	1.862	1.963	1.786	2.081	2.267	1.991
945576	Nikiski	1.048	1.184	0.815	1.498	1.568	1.425	1.687	1.766	1.609	1.779	1.879	1.733
945592	Anchorage	1.186	1.253	1.058	1.467	1.509	1.425	1.621	1.681	1.580	1.722	1.831	1.677
945729	Kodiak Island	0.627	0.686	0.520	0.913	0.962	0.866	1.120	1.213	1.061	1.303	1.517	1.211
945945	Sand Point	0.581	0.656	0.443	0.912	0.968	0.857	1.127	1.223	1.064	1.294	1.481	1.214
946138	Adak Island	0.395	0.438	0.320	0.624	0.653	0.595	0.770	0.816	0.737	0.882	0.991	0.833
946262	Unalaska	0.350	0.394	0.286	0.596	0.624	0.569	0.739	0.773	0.710	0.837	0.895	0.806
975163	Charlotte Amali	0.114	0.126	0.092	0.196	0.223	0.174	0.351	0.492	0.284	0.756	1.494	0.478
975537	San Juan	0.129	0.144	0.107	0.224	0.244	0.206	0.337	0.398	0.301	0.511	0.706	0.422
975911	Magueyes Is.	0.102	0.110	0.086	0.168	0.184	0.154	0.282	0.361	0.241	0.547	0.954	0.383

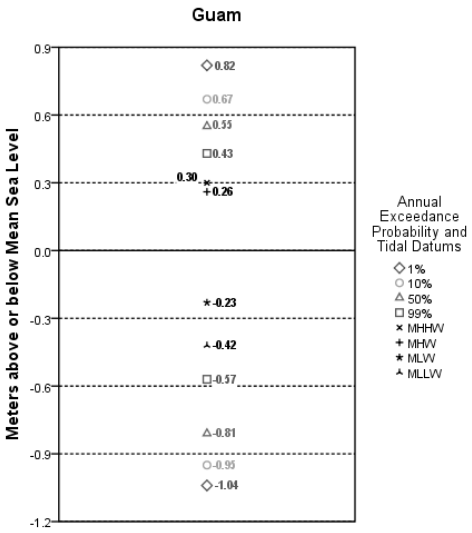
Table D. Low Water Level 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels (meters below MLLW)													
Station Number	**Station Name**	**0.99 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**	**0.50 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**	**0.10 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**	**0.01 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**
1611400	Nawiliwili	-0.119	-0.137	-0.089	-0.205	-0.217	-0.193	-0.258	-0.276	-0.245	-0.297	-0.337	-0.280
1612340	Honolulu	-0.074	-0.087	-0.054	-0.167	-0.177	-0.158	-0.231	-0.246	-0.219	-0.283	-0.318	-0.266
1612480	Mokuoloe	-0.176	-0.196	-0.142	-0.274	-0.289	-0.259	-0.339	-0.364	-0.322	-0.391	-0.445	-0.367
1615680	Kahului	-0.161	-0.183	-0.122	-0.277	-0.292	-0.262	-0.348	-0.371	-0.332	-0.401	-0.450	-0.379
1617760	Hilo	-0.170	-0.186	-0.144	-0.261	-0.274	-0.248	-0.330	-0.355	-0.313	-0.395	-0.461	-0.366
1619000	Johnston At.	-0.139	-0.169	-0.084	-0.296	-0.323	-0.271	-0.427	-0.489	-0.391	-0.564	-0.745	-0.491
1619910	Midway Atoll	-0.102	-0.124	-0.068	-0.216	-0.230	-0.202	-0.285	-0.305	-0.270	-0.335	-0.376	-0.316
1630000	Guam	-0.152	-0.198	-0.076	-0.391	-0.420	-0.362	-0.529	-0.568	-0.498	-0.623	-0.699	-0.588
1770000	Pago Pago	-0.156	-0.167	-0.138	-0.231	-0.245	-0.219	-0.316	-0.357	-0.292	-0.439	-0.579	-0.377
1820000	Kwajalein	-0.238	-0.264	-0.198	-0.394	-0.414	-0.374	-0.503	-0.536	-0.478	-0.594	-0.667	-0.559
1840000	Chuuk	-0.061	-0.115	0.044	-0.267	-0.298	-0.237	-0.371	-0.413	-0.344	-0.433	-0.503	-0.406
1890000	Wake Island	-0.162	-0.197	-0.097	-0.322	-0.343	-0.303	-0.408	-0.435	-0.389	-0.462	-0.519	-0.439
2695540	Bermuda	-0.213	-0.234	-0.177	-0.332	-0.350	-0.316	-0.429	-0.466	-0.405	-0.524	-0.634	-0.478
8410140	Eastport	-0.814	-0.847	-0.757	-0.998	-1.021	-0.976	-1.119	-1.155	-1.094	-1.214	-1.309	-1.173
8413320	Bar Harbor	-0.589	-0.607	-0.559	-0.703	-0.723	-0.685	-0.816	-0.866	-0.785	-0.955	-1.109	-0.887
8418150	Portland	-0.530	-0.553	-0.495	-0.691	-0.712	-0.671	-0.840	-0.889	-0.807	-1.015	-1.186	-0.936
8419870	Seavey Is.	-0.535	-0.564	-0.485	-0.701	-0.729	-0.674	-0.847	-0.913	-0.806	-1.007	-1.191	-0.926
8443970	Boston	-0.569	-0.605	-0.508	-0.781	-0.806	-0.757	-0.923	-0.963	-0.894	-1.037	-1.149	-0.987
8447930	Woods Hole	-0.297	-0.334	-0.240	-0.527	-0.558	-0.498	-0.707	-0.764	-0.667	-0.879	-1.031	-0.810
8449130	Nantucket Is.	-0.245	-0.269	-0.201	-0.373	-0.398	-0.351	-0.489	-0.550	-0.454	-0.620	-0.795	-0.548
8452660	Newport	-0.350	-0.392	-0.280	-0.590	-0.621	-0.561	-0.759	-0.811	-0.723	-0.902	-1.044	-0.840
8454000	Providence	-0.384	-0.448	-0.281	-0.704	-0.742	-0.666	-0.882	-0.931	-0.844	-0.999	-1.094	-0.956
8461490	New London	-0.382	-0.418	-0.323	-0.607	-0.643	-0.574	-0.825	-0.917	-0.769	-1.090	-1.395	-0.961
8467150	Bridgeport	-0.473	-0.525	-0.380	-0.743	-0.797	-0.693	-0.996	-1.139	-0.917	-1.293	-1.703	-1.130
8510560	Montauk	-0.321	-0.357	-0.266	-0.539	-0.574	-0.506	-0.739	-0.821	-0.686	-0.968	-1.204	-0.862
8514560	Prt. Jefferson	-0.465	-0.503	-0.370	-0.658	-0.722	-0.606	-0.937	-1.183	-0.825	-1.466	-2.841	-1.146
8516945	Kings Point	-0.528	-0.580	-0.440	-0.824	-0.867	-0.784	-1.067	-1.157	-1.010	-1.312	-1.601	-1.192
8518750	The Battery	-0.496	-0.544	-0.424	-0.825	-0.858	-0.793	-1.048	-1.099	-1.009	-1.230	-1.364	-1.166
8531680	Sandy Hook	-0.449	-0.498	-0.372	-0.764	-0.807	-0.723	-1.023	-1.108	-0.963	-1.284	-1.523	-1.174
8534720	Atlantic City	-0.495	-0.527	-0.450	-0.736	-0.768	-0.706	-0.970	-1.044	-0.917	-1.256	-1.499	-1.142
8536110	Cape May	-0.467	-0.507	-0.397	-0.653	-0.682	-0.625	-0.773	-0.819	-0.741	-0.864	-0.957	-0.822
8545240	Philadelphia	-0.560	-0.597	-0.505	-0.861	-0.903	-0.822	-1.208	-1.330	-1.128	-1.720	-2.221	-1.490
8557380	Lewes	-0.473	-0.504	-0.423	-0.674	-0.707	-0.644	-0.880	-0.967	-0.826	-1.145	-1.444	-1.015
8571892	Cambridge	-0.335	-0.376	-0.257	-0.538	-0.574	-0.505	-0.699	-0.777	-0.654	-0.854	-1.064	-0.771
8574680	Baltimore	-0.568	-0.604	-0.514	-0.842	-0.875	-0.811	-1.090	-1.163	-1.038	-1.369	-1.602	-1.253
8575512	Annapolis	-0.505	-0.538	-0.455	-0.729	-0.758	-0.701	-0.913	-0.971	-0.871	-1.100	-1.264	-1.022
8577330	Solomons Is.	-0.372	-0.404	-0.320	-0.578	-0.610	-0.548	-0.773	-0.851	-0.724	-1.004	-1.257	-0.894
8594900	Washington	-0.489	-0.530	-0.421	-0.776	-0.821	-0.735	-1.073	-1.191	-0.998	-1.458	-1.876	-1.271
8632200	Kiptopeke	-0.305	-0.344	-0.234	-0.498	-0.526	-0.471	-0.626	-0.674	-0.595	-0.729	-0.850	-0.680
8635150	Colonial Bch.	-0.370	-0.439	-0.220	-0.670	-0.736	-0.610	-0.915	-1.063	-0.834	-1.161	-1.583	-1.011
8635750	Lewisetta	-0.311	-0.371	-0.186	-0.554	-0.595	-0.515	-0.695	-0.758	-0.655	-0.791	-0.915	-0.742

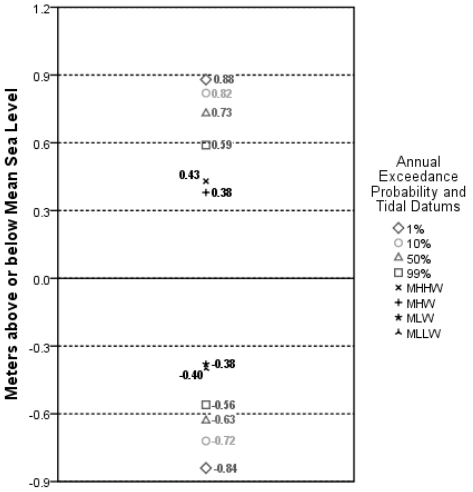
Table D. Low Water Level 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels (meters below MLLW)													
Station Number	**Station Name**	**0.99 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**	**0.50 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**	**0.10 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**	**0.01 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**
8637624	Gloucester	-0.315	-0.359	-0.234	-0.545	-0.580	-0.511	-0.709	-0.774	-0.666	-0.850	-1.010	-0.782
8638610	Sewells Point	-0.376	-0.405	-0.329	-0.567	-0.595	-0.542	-0.740	-0.801	-0.700	-0.933	-1.128	-0.846
8638660	Portsmouth	-0.375	-0.414	-0.309	-0.587	-0.623	-0.554	-0.763	-0.840	-0.714	-0.942	-1.145	-0.854
8638863	CBBT	-0.319	-0.380	-0.191	-0.567	-0.610	-0.526	-0.715	-0.786	-0.672	-0.821	-0.964	-0.766
8656483	Beaufort	-0.285	-0.310	-0.239	-0.431	-0.459	-0.405	-0.578	-0.657	-0.533	-0.764	-1.013	-0.662
8658120	Wilmington	-0.211	-0.247	-0.153	-0.407	-0.428	-0.386	-0.511	-0.536	-0.491	-0.577	-0.626	-0.554
8661070	Springmaid	-0.471	-0.519	-0.372	-0.722	-0.774	-0.675	-0.973	-1.120	-0.894	-1.290	-1.803	-1.095
8665530	Charleston	-0.425	-0.455	-0.381	-0.642	-0.671	-0.614	-0.845	-0.911	-0.799	-1.083	-1.288	-0.985
8670870	Fort Pulaski	-0.543	-0.581	-0.477	-0.792	-0.833	-0.755	-1.042	-1.148	-0.977	-1.357	-1.727	-1.195
8720030	Fernandina	-0.434	-0.472	-0.378	-0.705	-0.737	-0.675	-0.923	-0.983	-0.879	-1.138	-1.307	-1.056
8720218	Mayport	-0.394	-0.417	-0.357	-0.565	-0.591	-0.541	-0.745	-0.813	-0.700	-0.983	-1.225	-0.870
8723170	Miami Beach	-0.225	-0.257	-0.167	-0.356	-0.372	-0.340	-0.415	-0.432	-0.402	-0.447	-0.474	-0.435
8723970	Vaca Key	-0.137	-0.162	-0.078	-0.222	-0.236	-0.210	-0.260	-0.274	-0.250	-0.278	-0.308	-0.269
8724580	Key West	-0.194	-0.209	-0.171	-0.289	-0.300	-0.278	-0.360	-0.380	-0.346	-0.425	-0.481	-0.399
8725110	Naples	-0.330	-0.372	-0.243	-0.532	-0.566	-0.500	-0.673	-0.736	-0.634	-0.792	-0.947	-0.728
8725520	Fort Myers	-0.272	-0.303	-0.221	-0.436	-0.466	-0.408	-0.580	-0.649	-0.537	-0.736	-0.917	-0.658
8726520	S. Petersburg	-0.340	-0.372	-0.289	-0.518	-0.542	-0.495	-0.643	-0.685	-0.614	-0.750	-0.850	-0.704
8726724	Clearwater	-0.418	-0.449	-0.354	-0.562	-0.594	-0.533	-0.690	-0.770	-0.646	-0.830	-1.060	-0.741
8727520	Cedar Key	-0.377	-0.414	-0.325	-0.633	-0.665	-0.603	-0.840	-0.899	-0.796	-1.045	-1.194	-0.970
8729840	Pensacola	-0.274	-0.298	-0.234	-0.424	-0.444	-0.406	-0.543	-0.581	-0.517	-0.657	-0.773	-0.605
8735180	Dauphin Is.	-0.279	-0.314	-0.208	-0.434	-0.462	-0.407	-0.542	-0.597	-0.509	-0.634	-0.762	-0.582
8761724	Grand Isle	-0.208	-0.238	-0.155	-0.361	-0.383	-0.341	-0.463	-0.499	-0.439	-0.545	-0.636	-0.507
8764311	Eugene Is.	-0.262	-0.315	-0.157	-0.473	-0.506	-0.440	-0.585	-0.629	-0.553	-0.654	-0.729	-0.622
8770570	Sabine Pass	-0.430	-0.489	-0.319	-0.728	-0.779	-0.680	-0.963	-1.074	-0.898	-1.192	-1.493	-1.070
8771450	Galv. Pier 21	-0.400	-0.445	-0.336	-0.721	-0.757	-0.687	-0.969	-1.033	-0.920	-1.203	-1.373	-1.119
8771510	Glv. Pleasure	-0.487	-0.543	-0.375	-0.761	-0.807	-0.718	-0.960	-1.049	-0.906	-1.137	-1.367	-1.042
8772440	Freeport	-0.408	-0.457	-0.317	-0.661	-0.704	-0.622	-0.862	-0.951	-0.807	-1.055	-1.300	-0.955
8774770	Rockport	-0.256	-0.282	-0.212	-0.402	-0.427	-0.379	-0.553	-0.622	-0.515	-0.659	-0.807	-0.595
8778490	Pt. Mansfield	-0.181	-0.226	-0.087	-0.341	-0.366	-0.315	-0.417	-0.450	-0.395	-0.459	-0.512	-0.439
8779750	Padre Island	-0.256	-0.291	-0.196	-0.416	-0.444	-0.389	-0.525	-0.571	-0.492	-0.613	-0.698	-0.572
8779770	Port Isabel	-0.253	-0.281	-0.210	-0.409	-0.430	-0.389	-0.521	-0.558	-0.495	-0.619	-0.710	-0.578
9410170	San Diego	-0.464	-0.482	-0.437	-0.593	-0.609	-0.578	-0.704	-0.735	-0.681	-0.820	-0.919	-0.773
9410230	La Jolla	-0.428	-0.452	-0.394	-0.574	-0.590	-0.559	-0.662	-0.683	-0.646	-0.726	-0.767	-0.706
9410580	Newport Bc.	-0.414	-0.444	-0.352	-0.548	-0.573	-0.525	-0.643	-0.693	-0.615	-0.726	-0.845	-0.680
9410660	Los Angeles	-0.443	-0.461	-0.416	-0.569	-0.585	-0.555	-0.666	-0.693	-0.646	-0.756	-0.821	-0.723
9410840	Sta. Monica	-0.412	-0.437	-0.371	-0.561	-0.580	-0.542	-0.667	-0.700	-0.643	-0.758	-0.839	-0.720
9411270	Rincon Is.	-0.385	-0.440	-0.263	-0.561	-0.588	-0.532	-0.634	-0.666	-0.612	-0.668	-0.715	-0.651
9412110	Port San Luis	-0.425	-0.455	-0.370	-0.574	-0.592	-0.556	-0.657	-0.680	-0.639	-0.710	-0.762	-0.688
9413450	Monterey	-0.462	-0.490	-0.406	-0.587	-0.611	-0.566	-0.677	-0.722	-0.649	-0.754	-0.857	-0.712
9414290	S. Francisco	-0.388	-0.417	-0.345	-0.578	-0.595	-0.561	-0.690	-0.713	-0.671	-0.769	-0.822	-0.743
9414750	Alameda	-0.384	-0.416	-0.335	-0.570	-0.593	-0.548	-0.691	-0.724	-0.665	-0.784	-0.859	-0.749

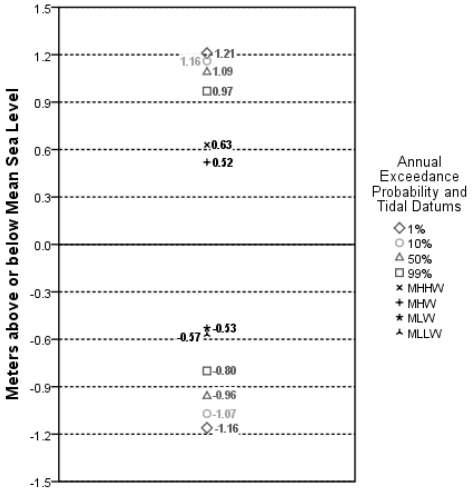
Table D. Low Water Level 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels (meters below MLLW)													
Station Number	**Station Name**	**0.99 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**	**0.50 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**	**0.10 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**	**0.01 Exc. Prob.**	**+95% Conf. Int.**	**-95% Conf. Int.**
9415020	Point Reyes	-0.481	-0.518	-0.405	-0.640	-0.670	-0.613	-0.747	-0.802	-0.715	-0.833	-0.951	-0.787
9419750	Crescent City	-0.559	-0.592	-0.509	-0.748	-0.769	-0.728	-0.859	-0.886	-0.837	-0.935	-0.988	-0.909
9432780	Charleston	-0.613	-0.663	-0.505	-0.803	-0.833	-0.774	-0.903	-0.945	-0.876	-0.964	-1.053	-0.933
9435380	South Beach	-0.682	-0.738	-0.572	-0.899	-0.925	-0.872	-0.988	-1.014	-0.968	-1.031	-1.070	-1.015
9439040	Astoria	-0.291	-0.338	-0.219	-0.554	-0.579	-0.528	-0.689	-0.718	-0.665	-0.770	-0.824	-0.745
9440910	Toke Point	-0.667	-0.758	-0.480	-0.989	-1.025	-0.950	-1.101	-1.130	-1.076	-1.146	-1.184	-1.129
9443090	Neah Bay	-0.711	-0.760	-0.632	-0.963	-0.989	-0.937	-1.091	-1.120	-1.066	-1.165	-1.221	-1.140
9444090	Port Angeles	-0.759	-0.846	-0.576	-1.094	-1.149	-1.040	-1.278	-1.363	-1.225	-1.398	-1.556	-1.338
9444900	P. Townsend	-0.756	-0.846	-0.566	-1.085	-1.131	-1.038	-1.235	-1.291	-1.196	-1.314	-1.410	-1.278
9447130	Seattle	-0.862	-0.923	-0.770	-1.198	-1.226	-1.170	-1.356	-1.384	-1.331	-1.442	-1.502	-1.416
9449424	Cherry Point	-0.831	-0.903	-0.680	-1.086	-1.127	-1.045	-1.219	-1.278	-1.182	-1.302	-1.424	-1.260
9449880	Friday Hbr.	-0.669	-0.737	-0.556	-1.000	-1.032	-0.968	-1.147	-1.178	-1.121	-1.222	-1.277	-1.198
9450460	Ketchikan	-1.157	-1.195	-1.097	-1.375	-1.398	-1.352	-1.505	-1.537	-1.481	-1.598	-1.677	-1.563
9451600	Sitka	-0.784	-0.823	-0.723	-0.997	-1.022	-0.973	-1.123	-1.156	-1.097	-1.211	-1.281	-1.179
9452210	Juneau	-1.250	-1.287	-1.189	-1.470	-1.500	-1.442	-1.635	-1.689	-1.597	-1.783	-1.924	-1.720
9452400	Skagway	-1.242	-1.289	-1.163	-1.515	-1.555	-1.477	-1.735	-1.818	-1.681	-1.953	-2.190	-1.849
9453220	Yakutat	-0.747	-0.789	-0.684	-0.999	-1.031	-0.968	-1.170	-1.219	-1.132	-1.311	-1.409	-1.262
9454050	Cordova	-1.012	-1.062	-0.922	-1.238	-1.271	-1.206	-1.371	-1.420	-1.337	-1.464	-1.562	-1.423
9454240	Valdez	-1.025	-1.088	-0.904	-1.289	-1.333	-1.246	-1.451	-1.525	-1.404	-1.570	-1.714	-1.512
9455090	Seward	-0.865	-0.914	-0.782	-1.106	-1.147	-1.068	-1.284	-1.360	-1.233	-1.443	-1.612	-1.368
9455500	Seldovia	-1.566	-1.634	-1.415	-1.818	-1.860	-1.777	-1.964	-2.028	-1.925	-2.065	-2.237	-2.009
9455760	Nikiski	-1.302	-1.394	-1.108	-1.642	-1.708	-1.577	-1.841	-1.951	-1.774	-1.979	-2.172	-1.902
9455920	Anchorage	-1.145	-1.207	-1.040	-1.450	-1.503	-1.401	-1.672	-1.767	-1.608	-1.868	-2.067	-1.777
9457292	Kodiak Island	-0.689	-0.726	-0.625	-0.875	-0.909	-0.843	-1.024	-1.095	-0.979	-1.170	-1.337	-1.097
9459450	Sand Point	-0.718	-0.760	-0.642	-0.907	-0.942	-0.875	-1.043	-1.109	-1.002	-1.161	-1.303	-1.101
9461380	Adak Island	-0.448	-0.481	-0.395	-0.635	-0.662	-0.609	-0.779	-0.832	-0.744	-0.916	-1.056	-0.854
9462620	Unalaska	-0.430	-0.469	-0.358	-0.626	-0.651	-0.602	-0.747	-0.785	-0.721	-0.836	-0.934	-0.795
9751639	CharlotteAm	-0.087	-0.107	-0.042	-0.165	-0.181	-0.150	-0.219	-0.249	-0.202	-0.264	-0.346	-0.237
9755371	San Juan	-0.146	-0.159	-0.118	-0.208	-0.220	-0.197	-0.260	-0.287	-0.244	-0.313	-0.402	-0.281
9759110	Magueyes Is.	-0.079	-0.097	-0.045	-0.162	-0.173	-0.151	-0.208	-0.223	-0.197	-0.238	-0.270	-0.225

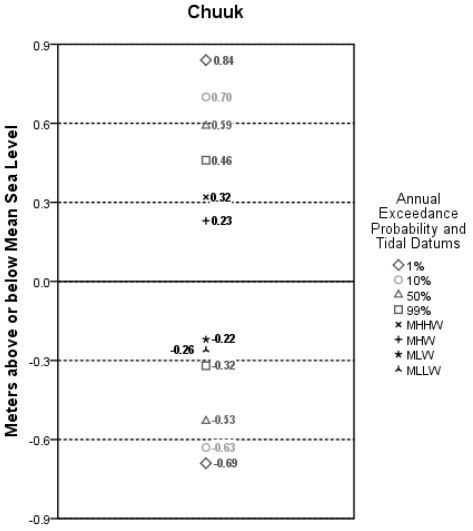

Nawiliwili
Meters above or below Mean Sea Level
0.9
0.6
0.3
0.0
-0.3
-0.6
0.87
0.71
0.59
0.47
0.31
0.18
-0.19
-0.25
-0.37
-0.46
-0.51
-0.55
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
Honolulu
Meters above or below Mean Sea Level
0.9
0.6
0.3
0.0
-0.3
-0.6
0.76
0.69
0.60
0.49
0.33
0.19
-0.20
-0.25
-0.32
-0.42
-0.48
-0.53
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
Mokuoloe
Meters above or below Mean Sea Level
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
0.78
0.71
0.64
0.53
0.33
0.23
-0.23
-0.32
-0.50
-0.59
-0.66
-0.71
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
Kahului
Meters above or below Mean Sea Level
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
0.78
0.72
0.64
0.54
0.35
0.24
-0.24
-0.34
-0.50
-0.62
-0.69
-0.74
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
Hilo
Meters above or below Mean Sea Level
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
0.83
0.78
0.70
0.57
0.38
0.25
-0.26
-0.35
-0.52
-0.61
-0.68
-0.74
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
Johnston Atoll
Meters above or below Mean Sea Level
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
1.09
0.89
0.73
0.58
0.35
0.28
-0.28
-0.32
-0.46
-0.62
-0.75
-0.89
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW

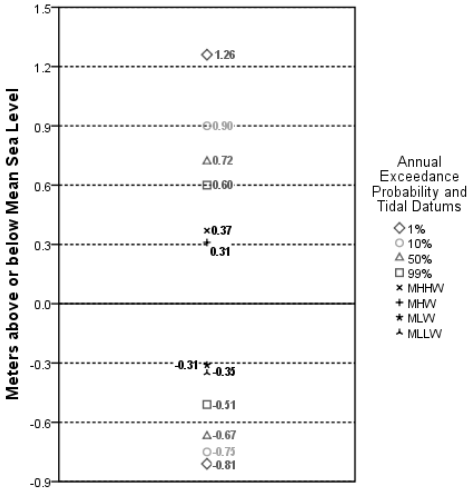

Midway Atoll
Meters above or below Mean Sea Level
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
1.02
0.80
0.59
0.37
0.19
0.13
-0.13
-0.20
-0.30
-0.41
-0.48
-0.53
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW

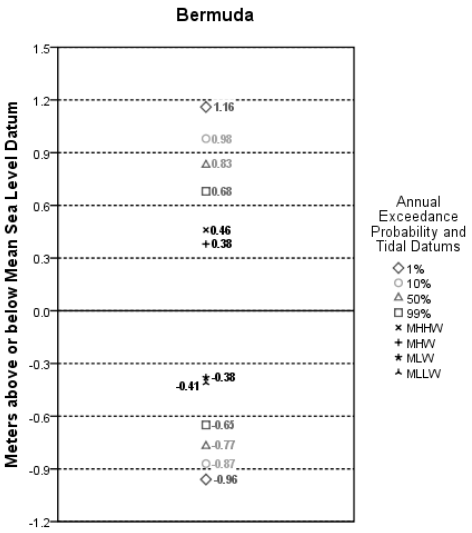

Guam
Meters above or below Mean Sea Level
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
0.82
0.67
0.55
0.43
0.30
0.26
-0.23
-0.42
-0.57
-0.81
-0.95
-1.04
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW

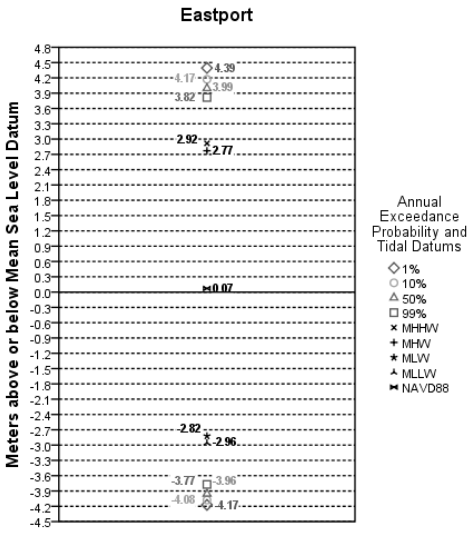

Pago Pago
Meters above or below Mean Sea Level
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
0.88
0.82
0.73
0.59
0.43
0.38
-0.38
-0.40
-0.56
-0.63
-0.72
-0.84
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW

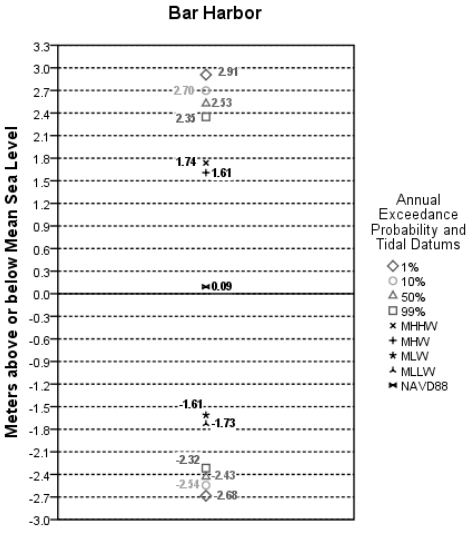

Kwajalein
Meters above or below Mean Sea Level
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
1.21
1.16
1.09
0.97
0.63
0.52
-0.53
-0.57
-0.80
-0.96
-1.07
-1.16
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW

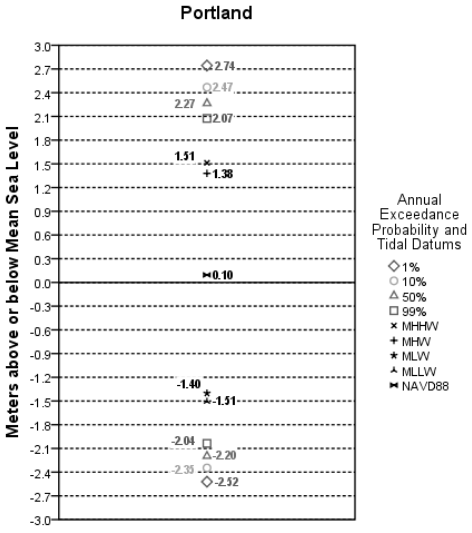

Chuuk
Meters above or below Mean Sea Level
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
0.84
0.70
0.59
0.46
0.32
0.23
-0.22
-0.26
-0.32
-0.53
-0.63
-0.69
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW

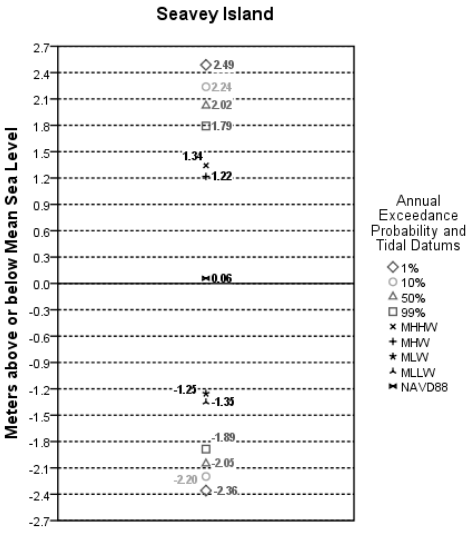

Wake Island
Meters above or below Mean Sea Level
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
1.26
0.90
0.72
0.60
0.37
0.31
-0.31
-0.35
-0.51
-0.67
-0.75
-0.81
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW

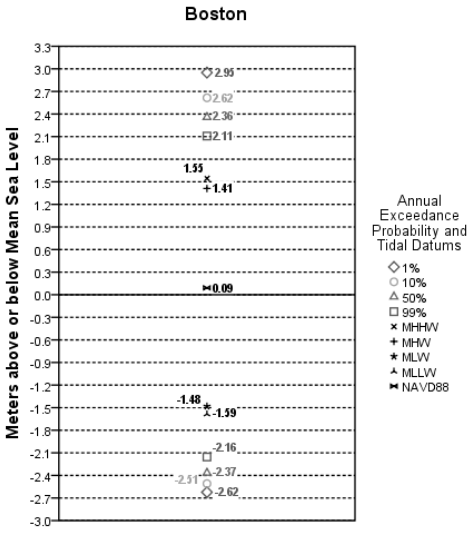

Bermuda
Meters above or below Mean Sea Level Datum
1.16
0.98
0.83
0.68
0.46
0.38
-0.38
-0.41
-0.63
-0.77
-0.87
-0.96
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW

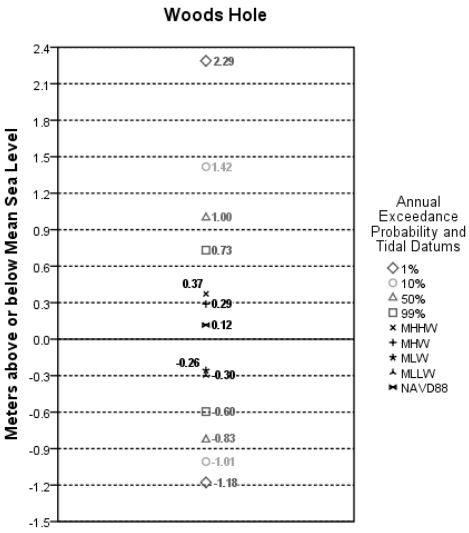

Eastport
Meters above or below Mean Sea Level Datum
4.39
4.17
3.99
3.82
2.92
2.77
0.07
-2.82
-2.96
-3.77
-3.96
-4.08
-4.17
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

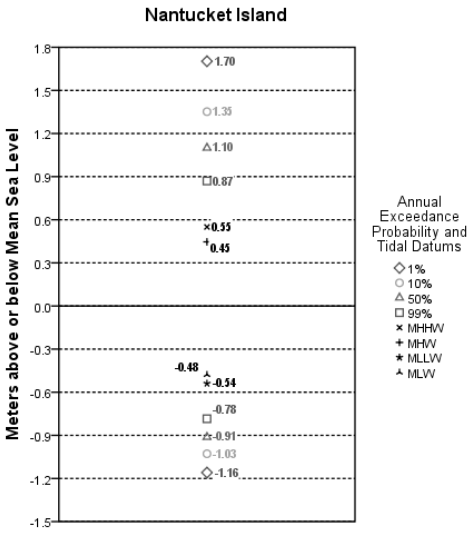

Bar Harbor
Meters above or below Mean Sea Level
2.91
2.70
2.53
2.35
1.74
1.61
0.09
-1.61
-1.73
-2.32
-2.43
-2.51
-2.68
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

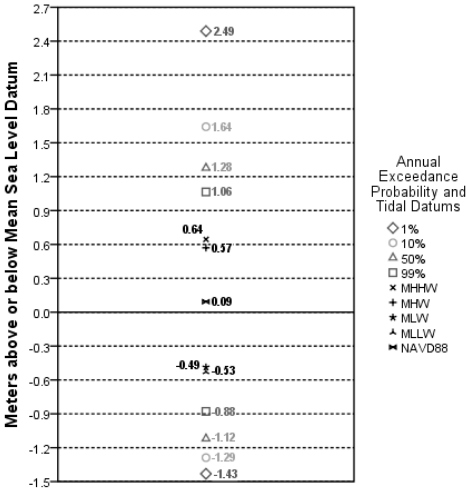

Portland
Meters above or below Mean Sea Level
2.74
2.47
2.27
2.07
1.51
1.38
0.10
-1.40
-1.51
-2.04
-2.20
-2.35
-2.52
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

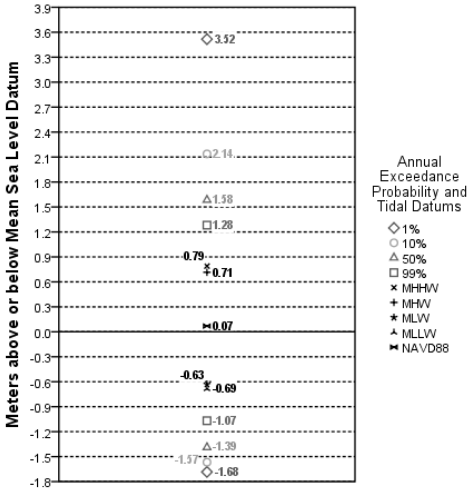

Seavey Island
Meters above or below Mean Sea Level
2.49
2.24
2.02
1.79
1.34
1.22
0.06
-1.25
-1.35
-1.89
-2.05
-2.20
-2.36
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

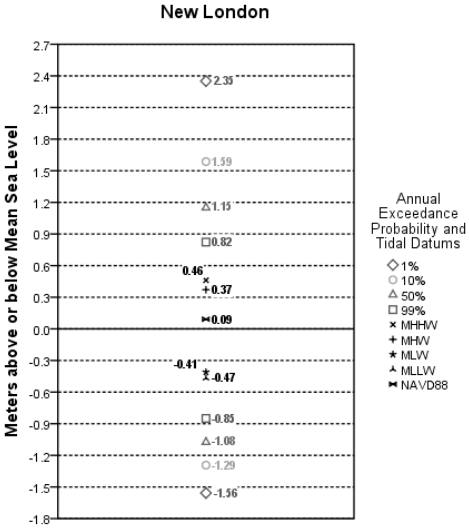

Boston
Meters above or below Mean Sea Level
2.95
2.62
2.36
2.11
1.55
1.41
0.09
-1.48
-1.59
-2.16
-2.37
-2.51
-2.62
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

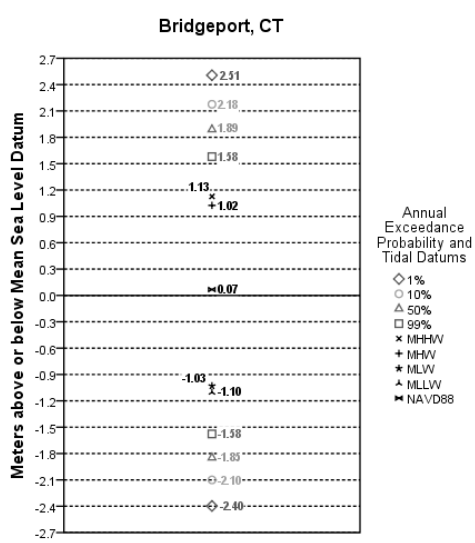

Woods Hole
Meters above or below Mean Sea Level
2.29
1.42
1.00
0.73
0.37
0.29
0.12
-0.26
-0.30
-0.60
-0.83
-1.01
-1.18
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88


Nantucket Island
Meters above or below Mean Sea Level
1.70
1.35
1.10
0.87
0.55
0.45
-0.48
-0.54
-0.78
-0.91
-1.03
-1.16
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLLW
MLW

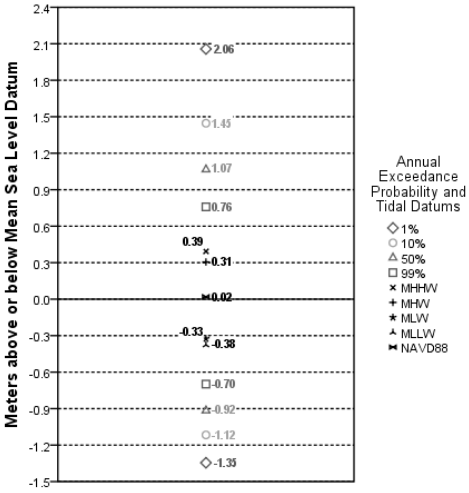

Newport, RI
Meters above or below Mean Sea Level Datum
2.49
1.64
1.28
1.06
0.64
0.57
0.09
-0.49
-0.53
-0.88
-1.12
-1.29
-1.43
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88


Providence, RI
Meters above or below Mean Sea Level Datum
3.52
2.14
1.58
1.28
0.79
0.71
0.07
-0.63
-0.69
-1.07
-1.39
-1.57
-1.68
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

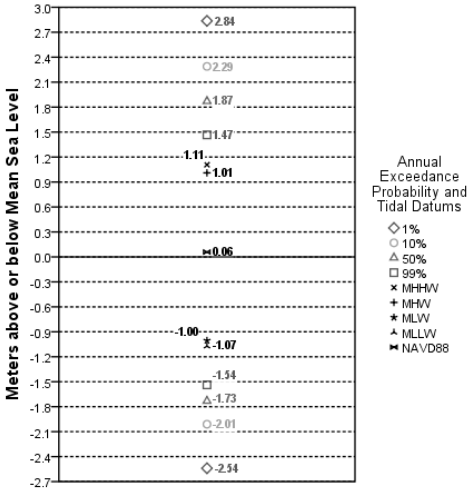

New London
Meters above or below Mean Sea Level
2.35
1.59
1.15
0.82
0.46
0.37
0.09
-0.41
-0.47
-0.85
-1.08
-1.29
-1.56
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88


Bridgeport, CT
Meters above or below Mean Sea Level Datum
2.51
2.18
1.89
1.58
1.13
1.02
0.07
-1.03
-1.10
-1.58
-1.85
-2.10
-2.40
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

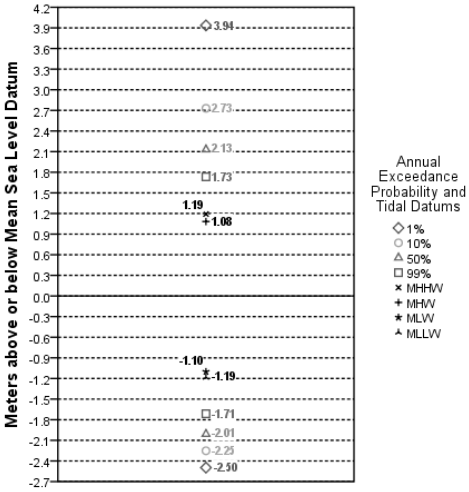
Montauk, NY



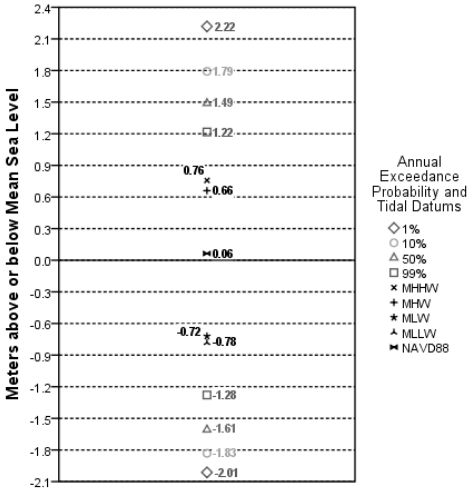
Port Jefferson



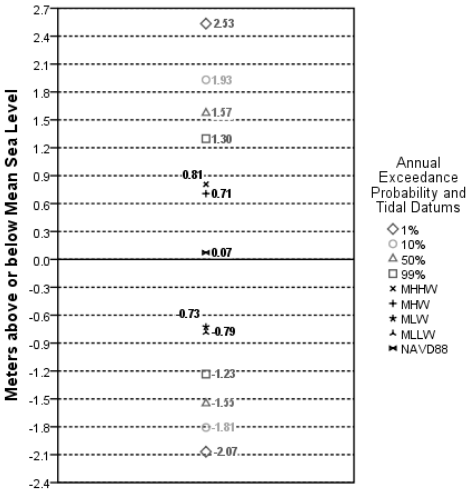
Kings Point / Willets Point, NY



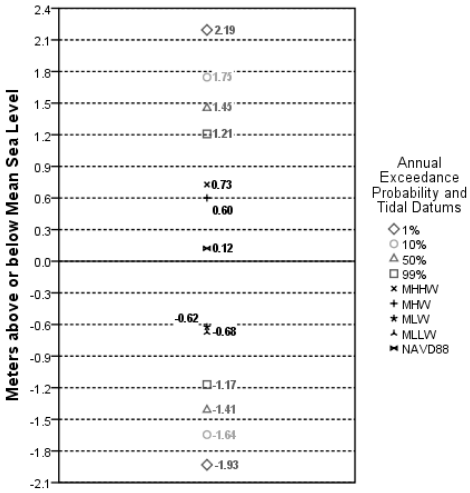
The Battery

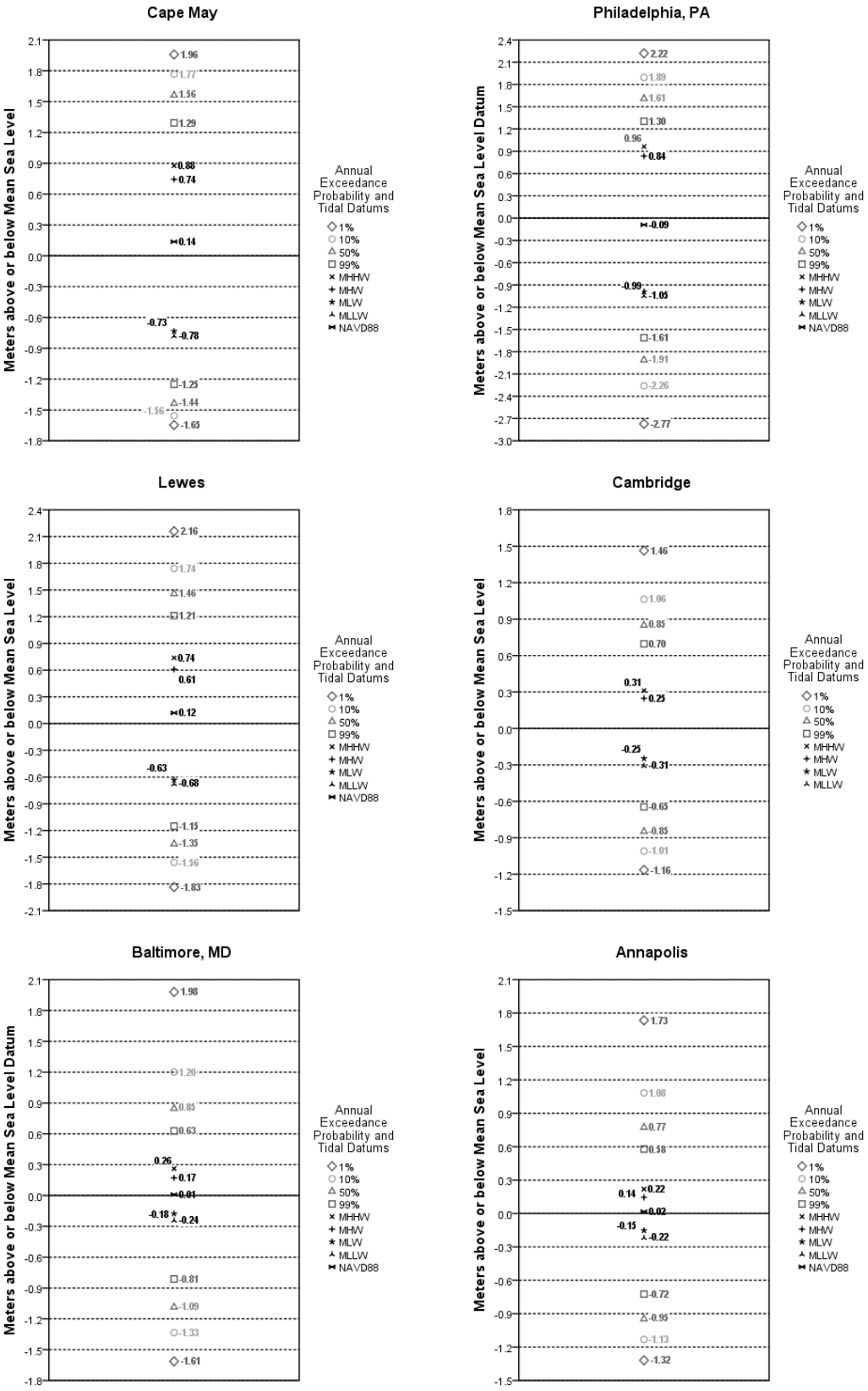


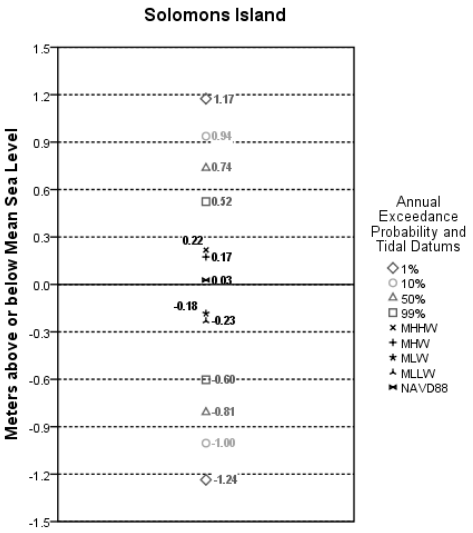
Sandy Hook

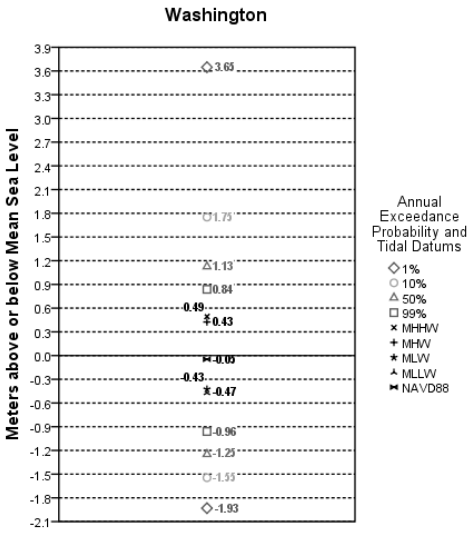


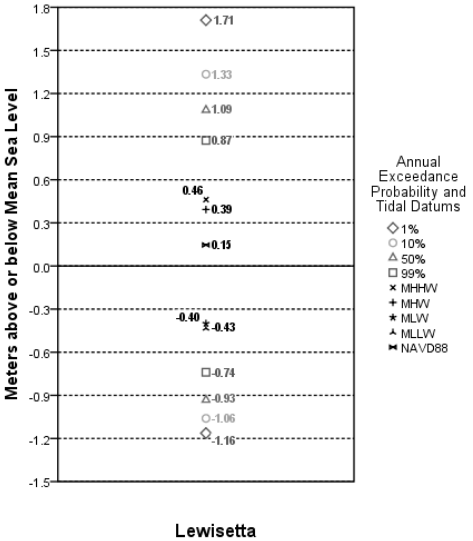
Atlantic City

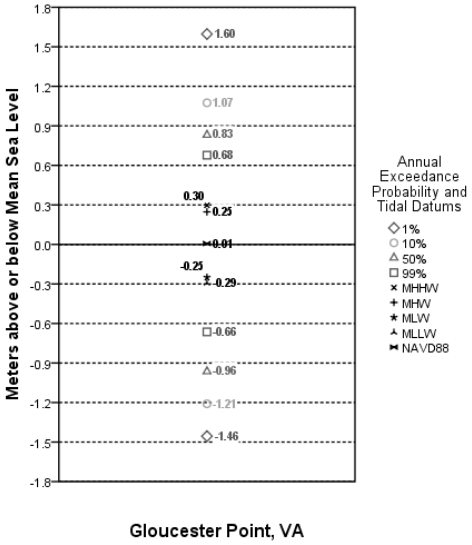


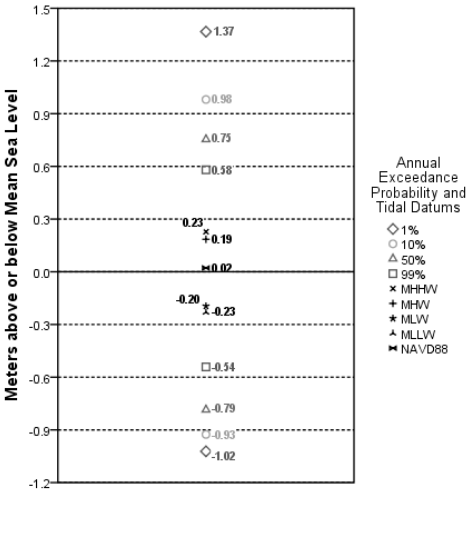

Cape May
Meters above or below Mean Sea Level
1.96
1.77
1.56
1.29
0.88
0.74
0.14
-0.73
-0.78
-1.25
-1.44
-1.56
-1.65
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88
Philadelphia, PA
Meters above or below Mean Sea Level Datum
2.22
1.89
1.61
1.30
0.96
0.84
-0.09
-0.99
-1.05
-1.61
-1.91
-2.26
-2.77
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88
Lewes
Meters above or below Mean Sea Level
2.16
1.74
1.46
1.21
0.74
0.61
0.12
-0.63
-0.68
-1.15
-1.35
-1.56
-1.83
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88
Cambridge
Meters above or below Mean Sea Level
1.46
1.06
0.85
0.70
0.31
0.25
-0.25
-0.31
-0.65
-0.85
-1.01
-1.16
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
Baltimore, MD
Meters above or below Mean Sea Level Datum
1.98
1.20
0.85
0.63
0.26
0.17
0.01
-0.18
-0.24
-0.81
-1.09
-1.33
-1.61
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88
Annapolis
Meters above or below Mean Sea Level
1.73
1.08
0.77
0.58
0.14
0.22
0.02
-0.15
-0.22
-0.72
-0.95
-1.13
-1.32
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

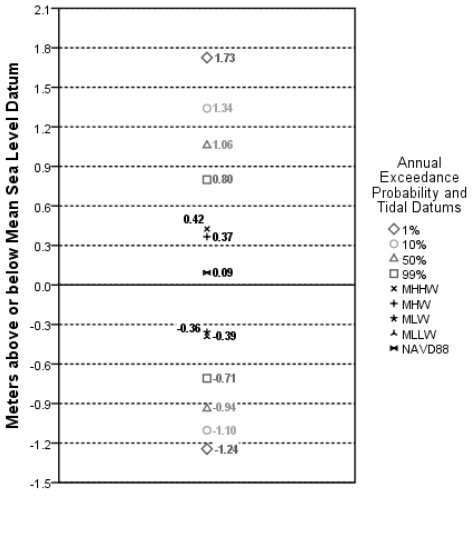

Solomons Island
Meters above or below Mean Sea Level
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
1.17
0.94
0.74
0.52
0.22
0.17
0.03
-0.18
-0.23
-0.60
-0.81
-1.00
-1.24
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

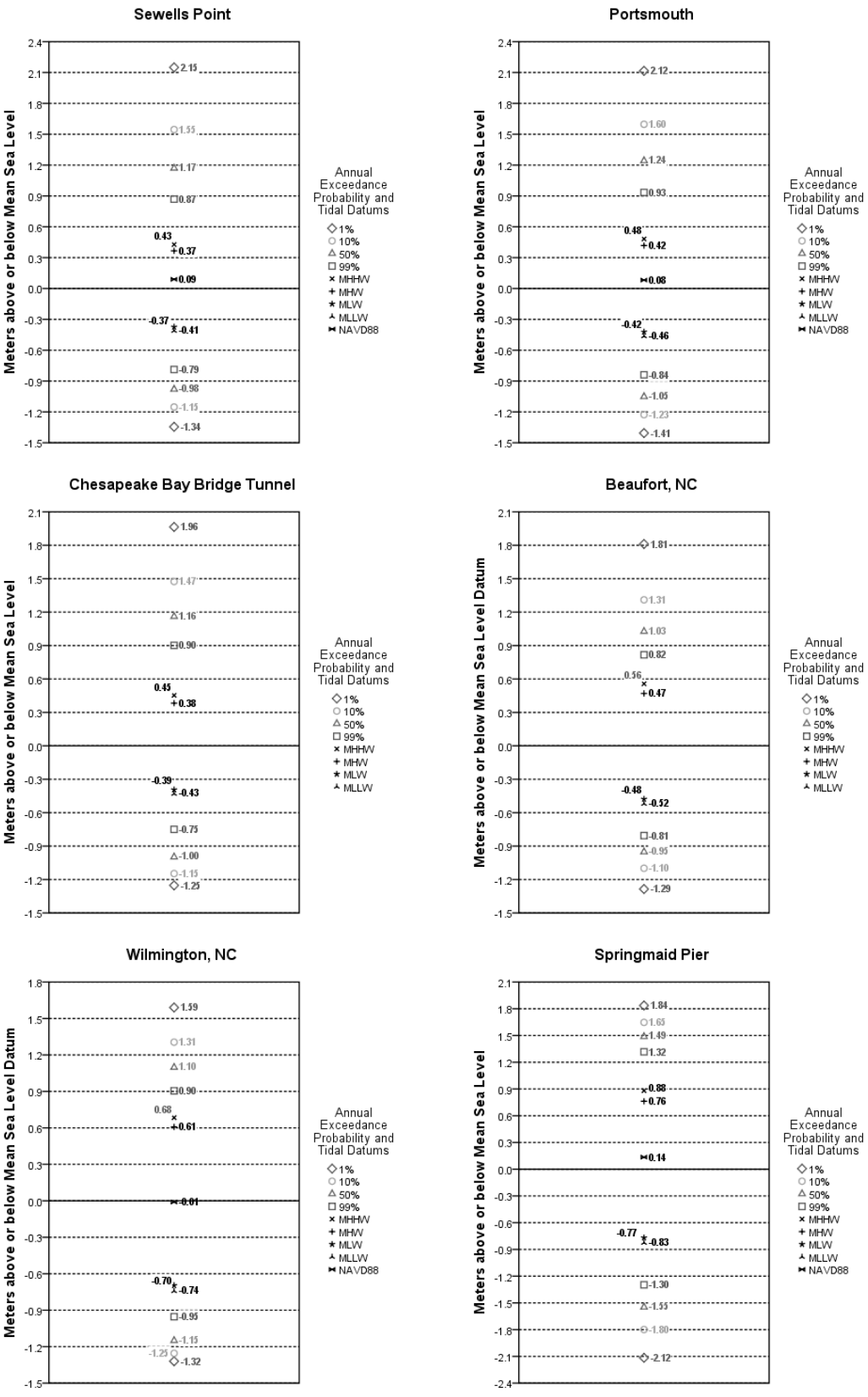

Washington
Meters above or below Mean Sea Level
3.9
3.6
3.3
3.0
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
-2.1
3.65
1.75
1.13
0.84
0.49
0.43
0.05
-0.43
-0.47
-0.96
-1.25
-1.55
-1.93
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

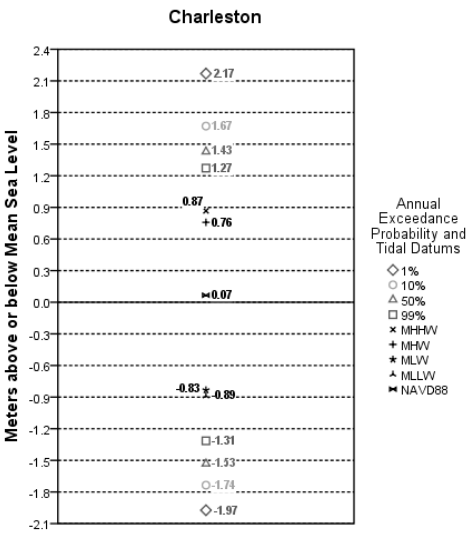

Kiptopeke
Meters above or below Mean Sea Level
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
1.71
1.33
1.09
0.87
0.46
0.39
0.15
-0.40
-0.43
-0.74
-0.93
-1.06
-1.16
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

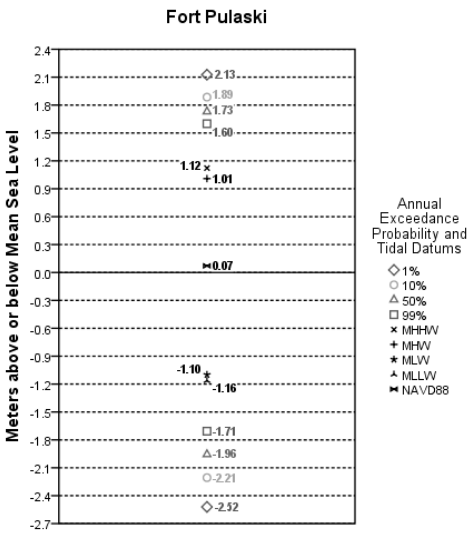

Colonial Beach
Meters above or below Mean Sea Level
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
1.60
1.07
0.83
0.68
0.30
0.25
0.01
-0.25
-0.29
-0.66
-0.96
-1.21
-1.46
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

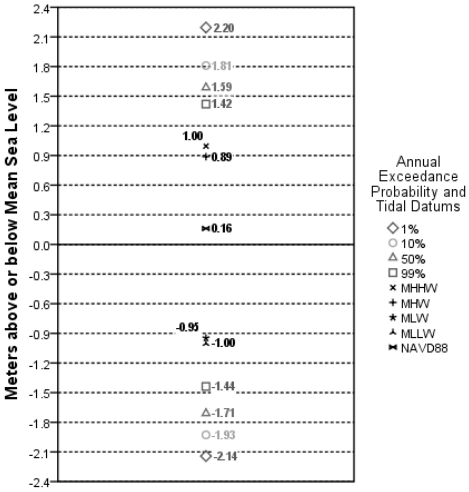

Lewisetta
Meters above or below Mean Sea Level
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
1.37
0.98
0.75
0.58
0.23
0.19
0.02
-0.20
-0.23
-0.54
-0.79
-0.93
-1.02
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

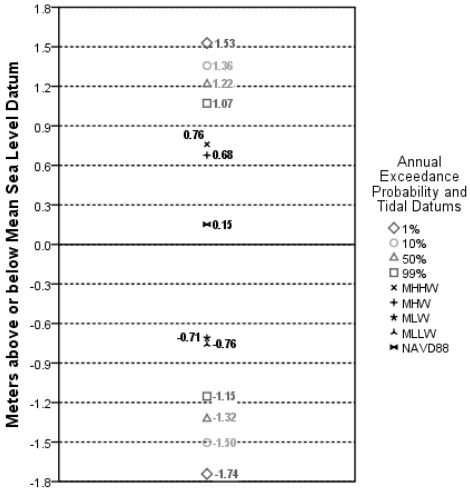

Gloucester Point, VA
Meters above or below Mean Sea Level Datum
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
1.73
1.34
1.06
0.80
0.42
0.37
0.09
-0.36
-0.39
-0.71
-0.94
-1.10
-1.24
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

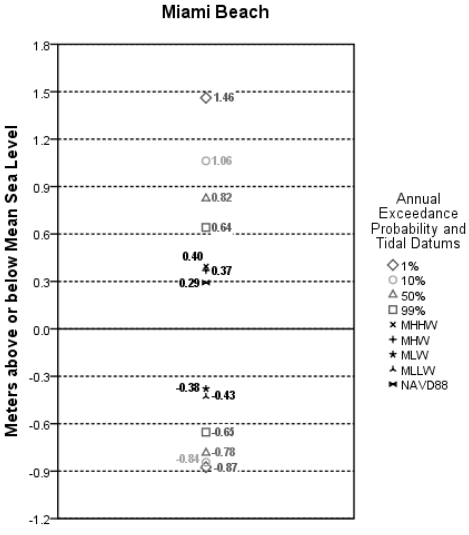

Sewells Point
Meters above or below Mean Sea Level
2.15
1.55
1.17
0.87
0.43
0.37
0.09
-0.37
-0.41
-0.79
-0.98
-1.15
-1.34
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88
Portsmouth
Meters above or below Mean Sea Level
2.12
1.60
1.24
0.93
0.48
0.42
0.08
-0.42
-0.46
-0.84
-1.05
-1.23
-1.41
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88
Chesapeake Bay Bridge Tunnel
Meters above or below Mean Sea Level
1.96
1.47
1.16
0.90
0.45
0.38
-0.39
-0.43
-0.75
-1.00
-1.15
-1.25
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
Beaufort, NC
Meters above or below Mean Sea Level Datum
1.81
1.31
1.03
0.82
0.56
0.47
-0.48
-0.52
-0.81
-0.95
-1.10
-1.29
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
Wilmington, NC
Meters above or below Mean Sea Level Datum
1.59
1.31
1.10
0.90
0.68
0.61
0.01
-0.70
-0.74
-0.95
-1.15
-1.25
-1.32
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88
Springmaid Pier
Meters above or below Mean Sea Level
1.84
1.65
1.49
1.32
0.88
0.76
0.14
-0.77
-0.83
-1.30
-1.55
-1.80
-2.12
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

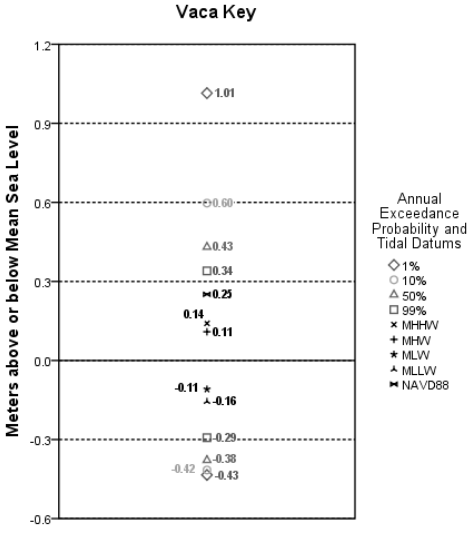

Charleston
Meters above or below Mean Sea Level
2.17
1.67
1.43
1.27
0.87
0.76
0.07
-0.83
-0.89
-1.31
-1.53
-1.74
-1.97
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

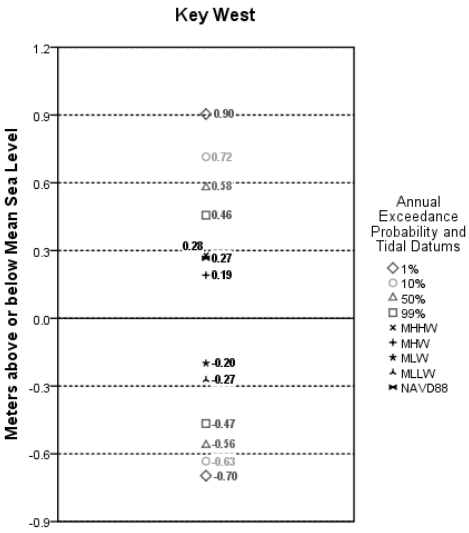

Fort Pulaski
Meters above or below Mean Sea Level
2.13
1.89
1.73
1.60
1.12
1.01
0.07
-1.10
-1.16
-1.71
-1.96
-2.21
-2.52
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

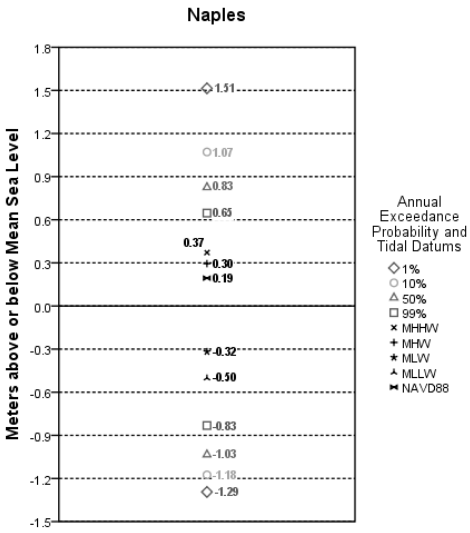

Fernandina Beach
Meters above or below Mean Sea Level
2.20
1.81
1.59
1.42
1.00
0.89
0.16
-0.95
-1.00
-1.44
-1.71
-1.93
-2.14
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

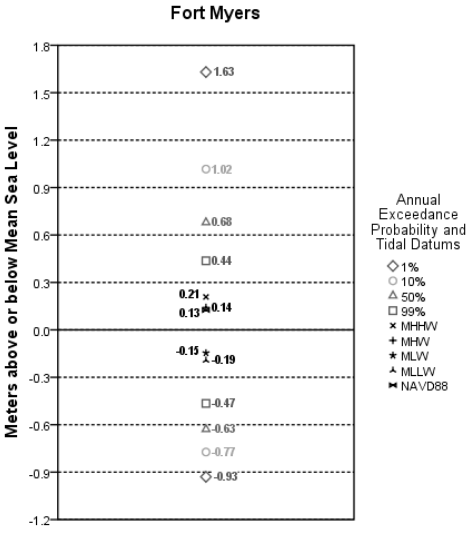

Bar Pilots Dock / Mayport, FL
Meters above or below Mean Sea Level Datum
1.53
1.36
1.22
1.07
0.76
0.68
0.15
-0.71
-0.76
-1.15
-1.32
-1.50
-1.74
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

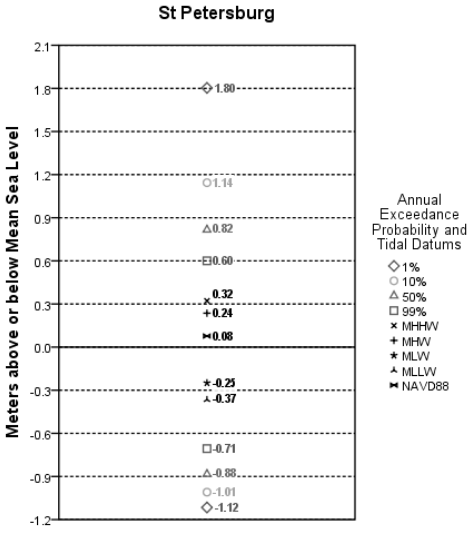

Miami Beach
Meters above or below Mean Sea Level
1.46
1.06
0.82
0.64
0.40
0.37
0.29
-0.38
-0.43
-0.63
-0.78
-0.84
-0.87
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

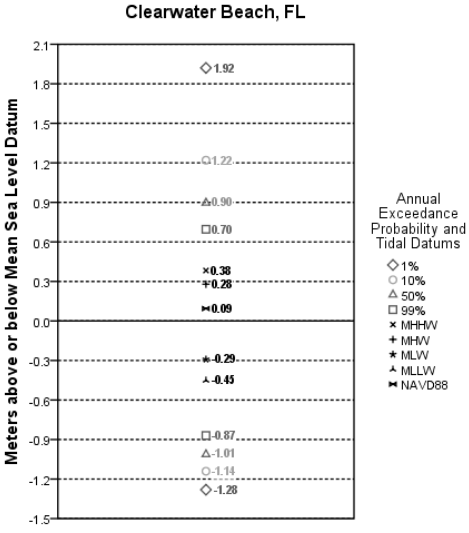

Vaca Key
Meters above or below Mean Sea Level
1.01
0.60
0.43
0.34
0.25
0.14
0.11
-0.11
-0.16
-0.29
-0.38
-0.42
-0.43
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

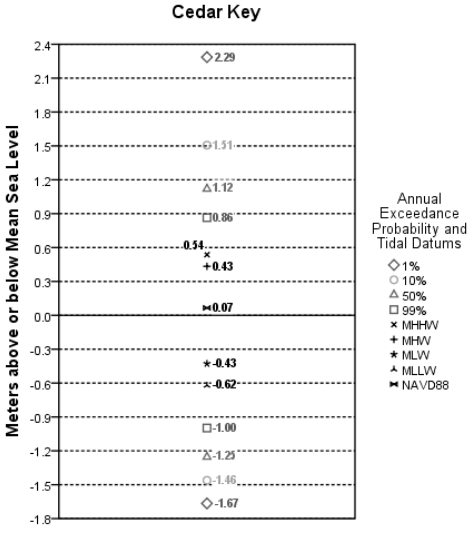

Key West
Meters above or below Mean Sea Level
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
0.90
0.72
0.58
0.46
0.28
0.27
0.19
-0.20
-0.27
-0.47
-0.56
-0.63
-0.70
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

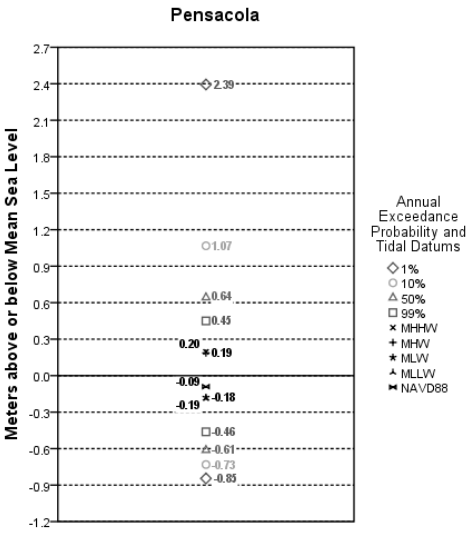

Naples
Meters above or below Mean Sea Level
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
1.51
1.07
0.83
0.65
0.37
0.30
0.19
-0.32
-0.50
-0.83
-1.03
-1.18
-1.29
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

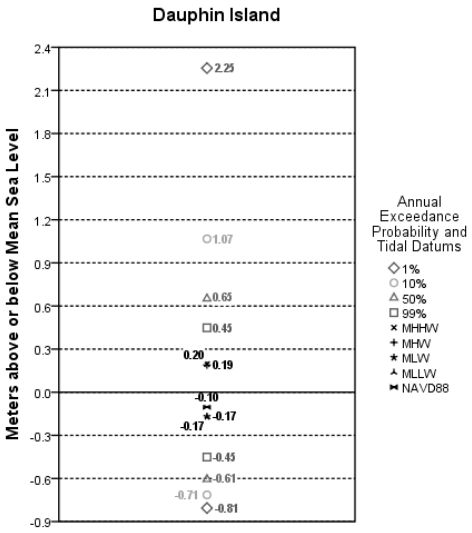

Fort Myers
Meters above or below Mean Sea Level
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
1.63
1.02
0.68
0.44
0.21
0.13
0.14
-0.15
-0.19
-0.47
-0.63
-0.77
-0.93
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

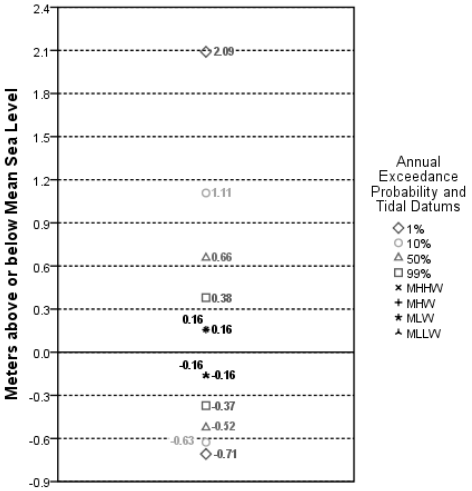

St Petersburg
Meters above or below Mean Sea Level
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
1.80
1.14
0.82
0.60
0.32
0.24
0.08
-0.25
-0.37
-0.71
-0.88
-1.01
-1.12
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

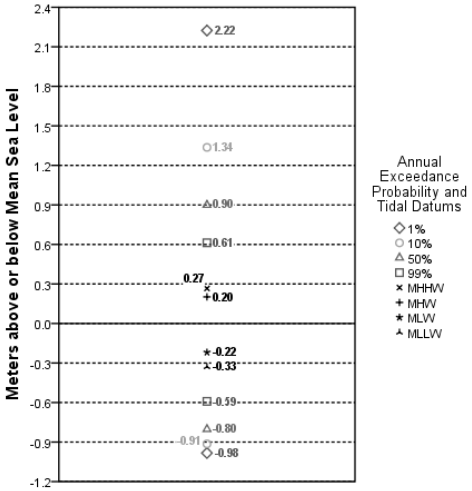

Clearwater Beach, FL
Meters above or below Mean Sea Level Datum
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
1.92
1.22
0.90
0.70
0.38
0.28
0.09
-0.29
-0.45
-0.87
-1.01
-1.14
-1.28
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

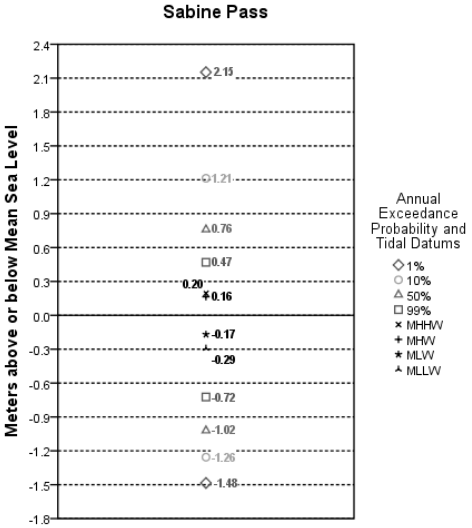

Cedar Key
Meters above or below Mean Sea Level
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
2.29
1.51
1.12
0.86
0.54
0.43
0.07
-0.43
-0.62
-1.00
-1.25
-1.46
-1.67
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

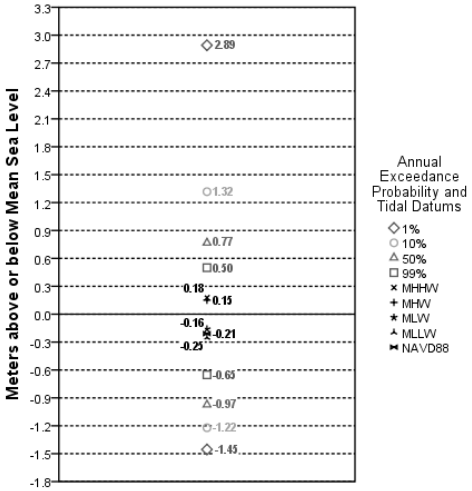

Pensacola
Meters above or below Mean Sea Level
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
2.39
1.07
0.64
0.45
0.20
0.19
-0.09
-0.18
-0.19
-0.46
-0.61
-0.73
-0.85
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

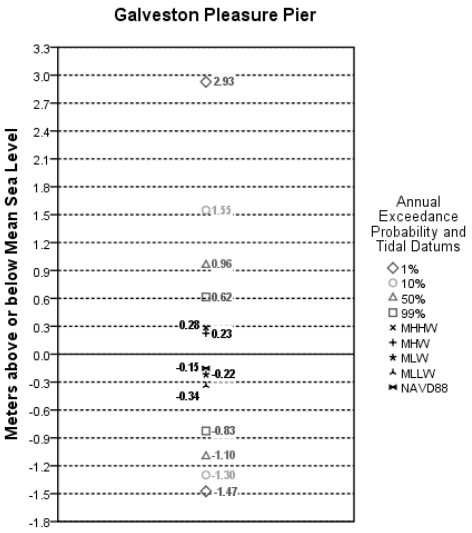

Dauphin Island
Meters above or below Mean Sea Level
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
2.25
1.07
0.65
0.45
0.29
0.19
-0.10
-0.17
-0.17
-0.45
-0.61
-0.71
-0.81
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

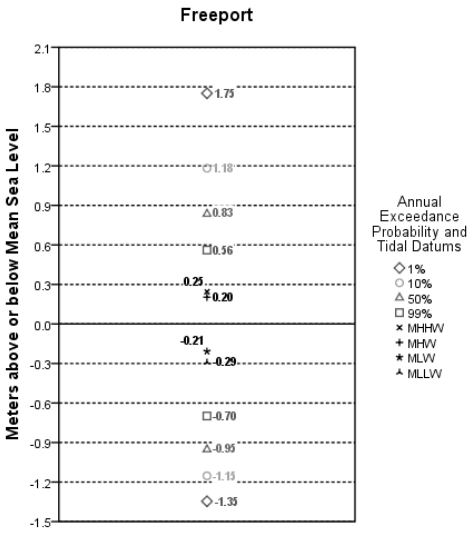

Grand Isle
Meters above or below Mean Sea Level
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
2.09
1.11
0.66
0.38
0.16
0.16
-0.16
-0.16
-0.37
-0.52
-0.63
-0.71
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW

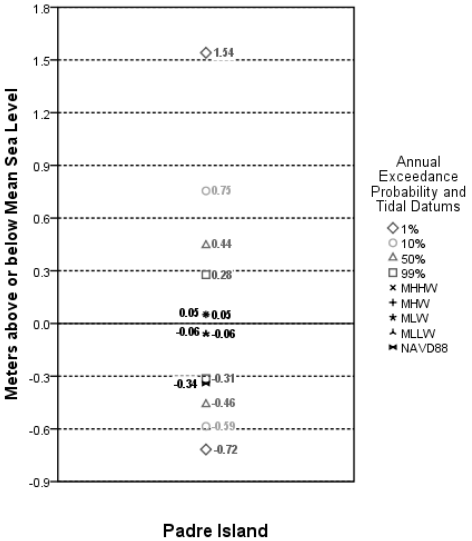

Eugene Island
Meters above or below Mean Sea Level
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
2.22
1.34
0.90
0.61
0.27
0.20
-0.22
-0.33
-0.59
-0.80
-0.91
-0.98
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW

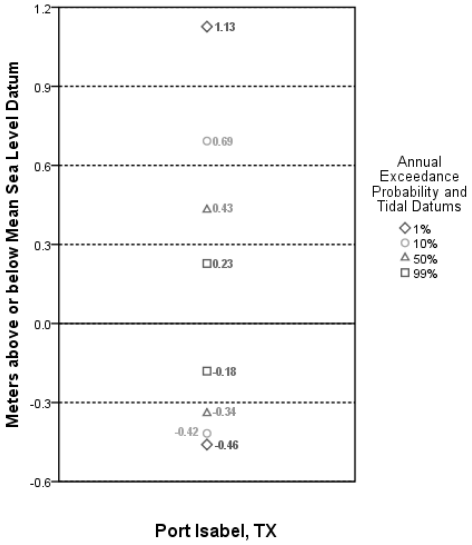

Sabine Pass
Meters above or below Mean Sea Level
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
2.15
1.21
0.76
0.47
0.20
0.16
-0.17
-0.29
-0.72
-1.02
-1.26
-1.48
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW

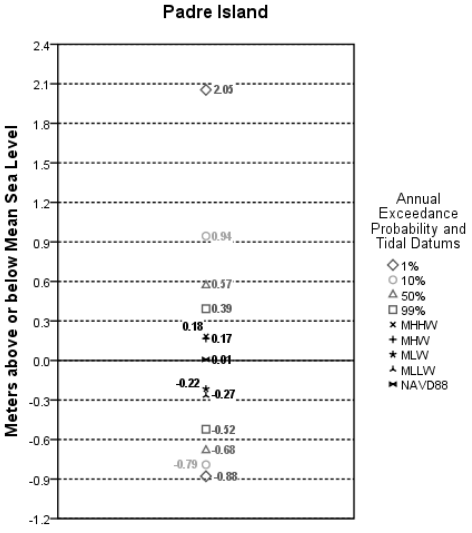

Galveston Pier 21
Meters above or below Mean Sea Level
3.3
3.0
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
2.89
1.32
0.77
0.50
0.18
0.15
-0.16
-0.21
-0.25
-0.65
-0.97
-1.22
-1.45
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

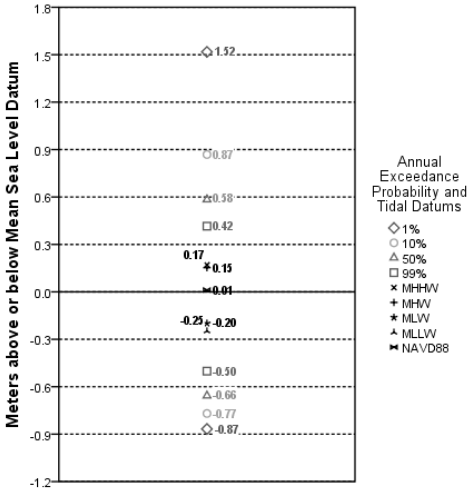

Galveston Pleasure Pier
Meters above or below Mean Sea Level
3.3
3.0
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
2.93
1.55
0.96
0.62
0.28
0.23
-0.15
-0.22
-0.34
-0.83
-1.10
-1.30
-1.47
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

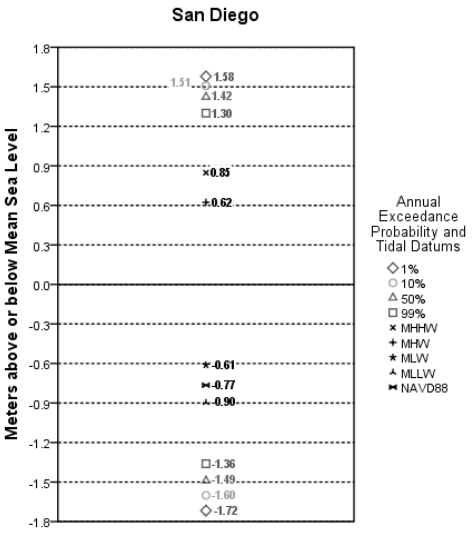

Freeport
Meters above or below Mean Sea Level
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
1.75
1.18
0.83
0.56
0.25
0.20
-0.21
-0.29
-0.70
-0.95
-1.15
-1.35
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW

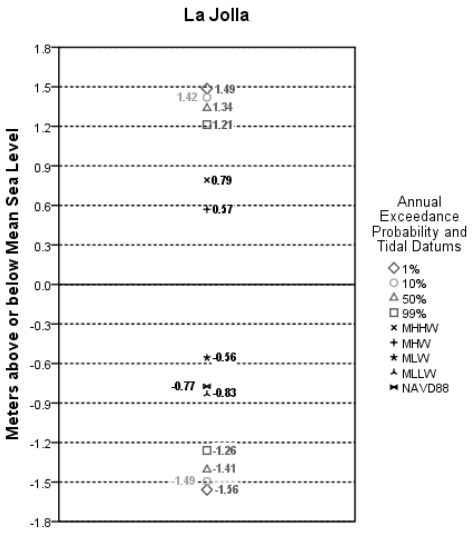

Rockport
Meters above or below Mean Sea Level
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
1.54
0.75
0.44
0.28
0.05
0.05
-0.06
-0.06
-0.31
-0.34
-0.46
-0.59
-0.72
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

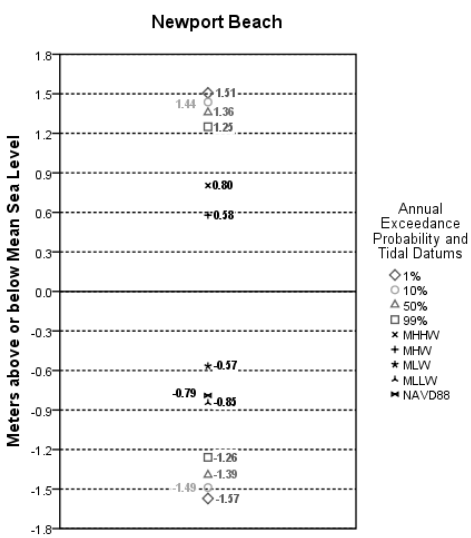

Port Mansfield, TX
Meters above or below Mean Sea Level Datum
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
1.13
0.69
0.43
0.23
-0.18
-0.34
-0.42
-0.46
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%

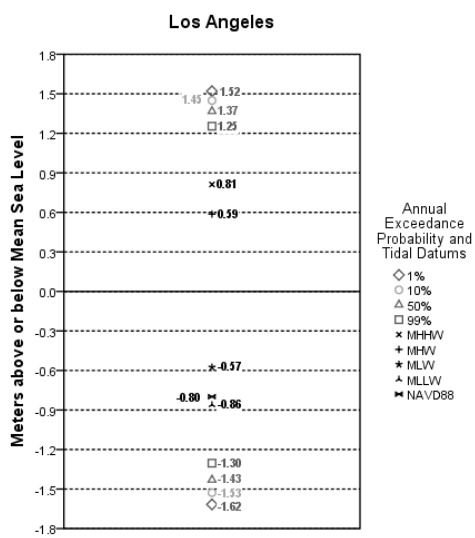

Padre Island
Meters above or below Mean Sea Level
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
2.05
0.94
0.57
0.39
0.18
0.17
0.01
-0.22
-0.27
-0.52
-0.68
-0.79
-0.88
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

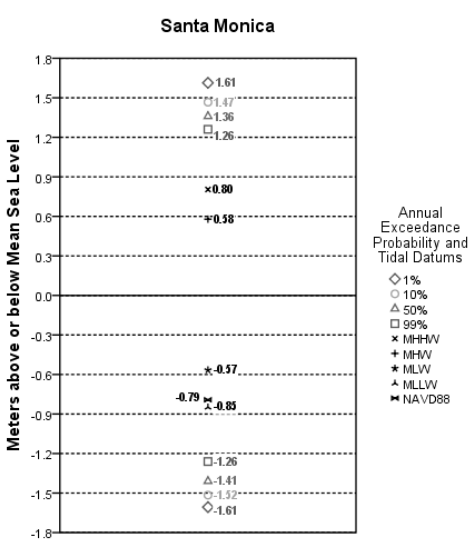

Port Isabel, TX
Meters above or below Mean Sea Level Datum
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
1.52
0.87
0.58
0.42
0.17
0.15
0.01
-0.25
-0.20
-0.50
-0.66
-0.77
-0.87
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

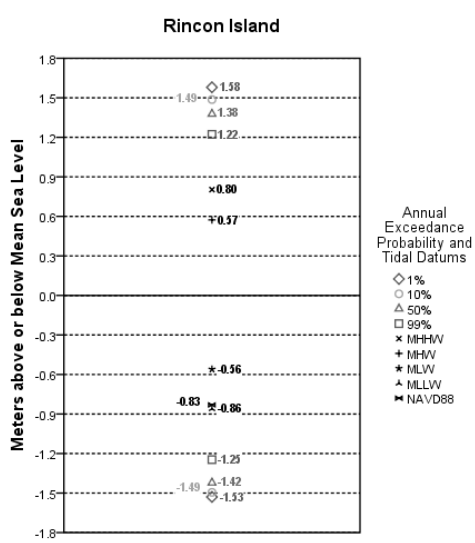

San Diego
Meters above or below Mean Sea Level
1.58
1.51
1.42
1.30
0.85
0.62
-0.61
-0.77
-0.90
-1.36
-1.49
-1.60
-1.72
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

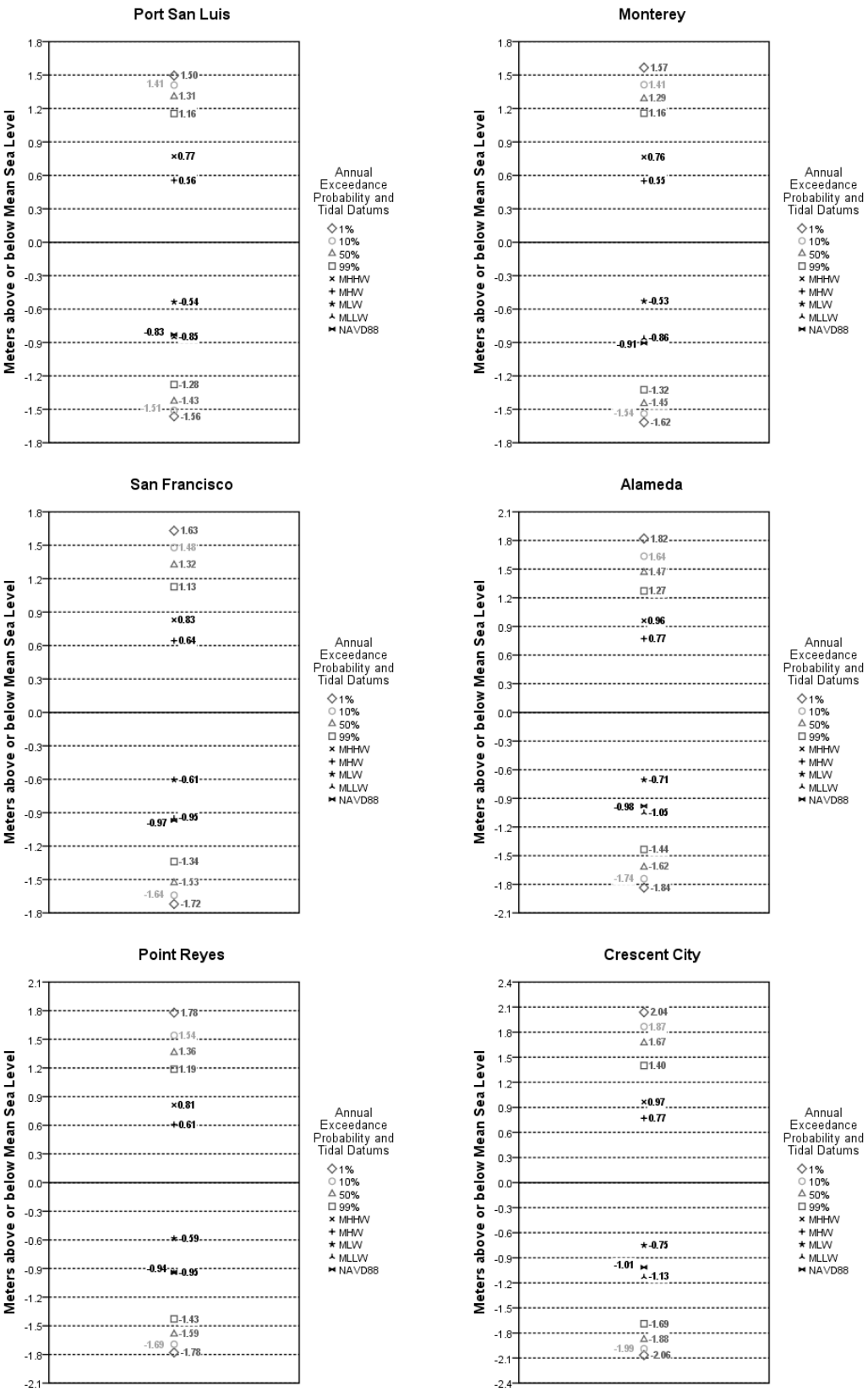

La Jolla
Meters above or below Mean Sea Level
1.49
1.42
1.34
1.21
0.79
0.57
-0.56
-0.77
-0.83
-1.26
-1.41
-1.49
-1.56
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

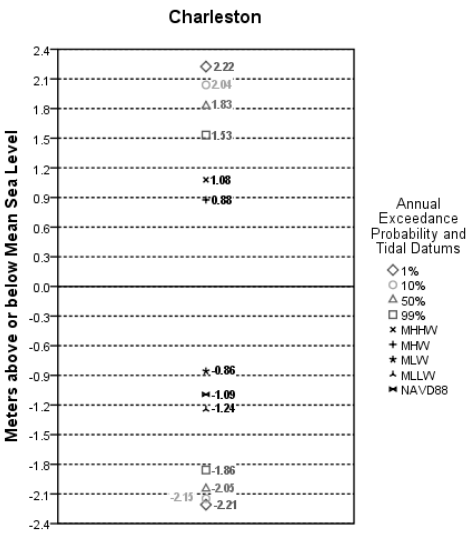

Newport Beach
Meters above or below Mean Sea Level
1.51
1.44
1.36
1.25
0.80
0.58
-0.57
-0.79
-0.85
-1.26
-1.39
-1.49
-1.57
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

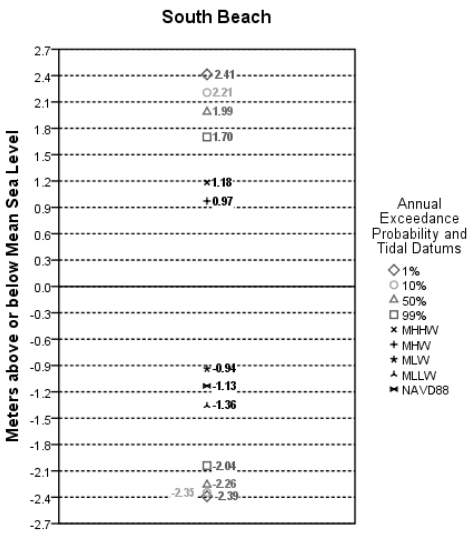

Los Angeles
Meters above or below Mean Sea Level
1.52
1.45
1.37
1.25
0.81
0.59
-0.57
-0.80
-0.86
-1.30
-1.43
-1.53
-1.62
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

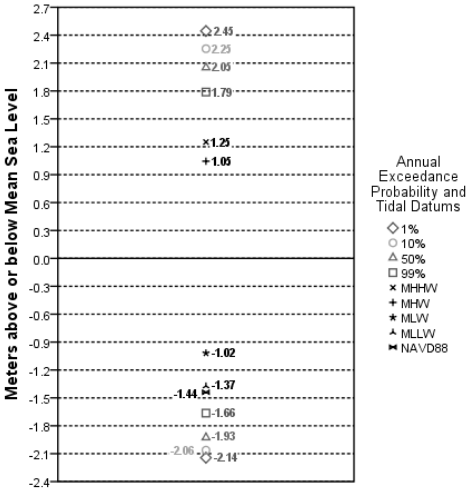

Santa Monica
Meters above or below Mean Sea Level
1.61
1.47
1.36
1.26
0.80
0.58
-0.57
-0.79
-0.85
-1.26
-1.41
-1.52
-1.61
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

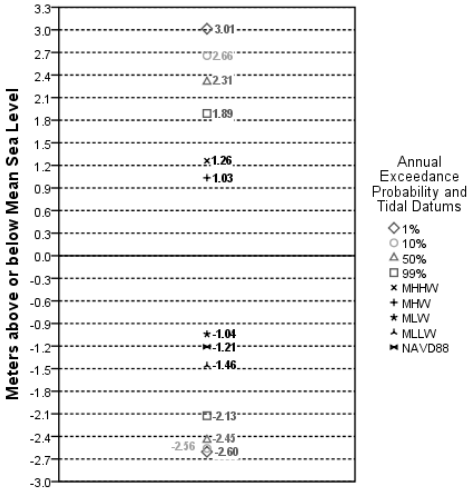

Rincon Island
Meters above or below Mean Sea Level
1.58
1.49
1.38
1.22
0.80
0.57
-0.56
-0.83
-0.86
-1.25
-1.42
-1.49
-1.53
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

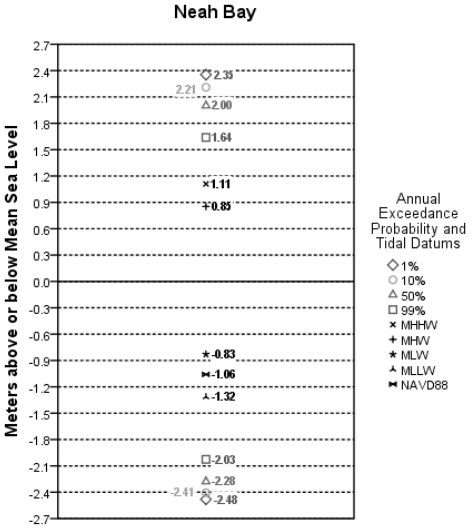

Port San Luis
Meters above or below Mean Sea Level
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
1.50
1.41
1.31
1.16
0.77
0.56
-0.54
-0.83
-0.85
-1.28
-1.43
-1.51
-1.56
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88
Monterey
Meters above or below Mean Sea Level
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
1.57
1.41
1.29
1.16
0.76
0.55
-0.53
-0.91
-0.86
-1.32
-1.45
-1.54
-1.62
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88
San Francisco
Meters above or below Mean Sea Level
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
1.63
1.48
1.32
1.13
0.83
0.64
-0.61
-0.97
-0.95
-1.34
-1.53
-1.64
-1.72
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88
Alameda
Meters above or below Mean Sea Level
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
-2.1
1.82
1.64
1.47
1.27
0.96
0.77
-0.71
-0.98
-1.05
-1.44
-1.62
-1.74
-1.84
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88
Point Reyes
Meters above or below Mean Sea Level
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
-2.1
1.78
1.54
1.36
1.19
0.81
0.61
-0.59
-0.94
-0.95
-1.43
-1.59
-1.69
-1.78
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88
Crescent City
Meters above or below Mean Sea Level
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
-2.1
-2.4
2.04
1.87
1.67
1.40
0.97
0.77
-0.75
-1.01
-1.13
-1.69
-1.88
-1.99
-2.06
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

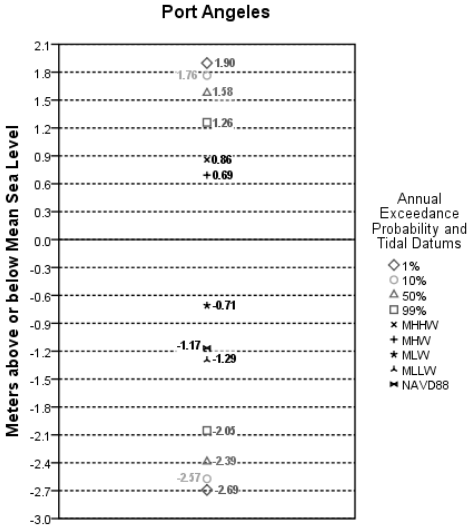

Charleston
Meters above or below Mean Sea Level
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
-2.1
-2.4
2.22
2.04
1.83
1.53
1.08
0.88
-0.86
-1.09
-1.24
-1.86
-2.05
-2.13
-2.21
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

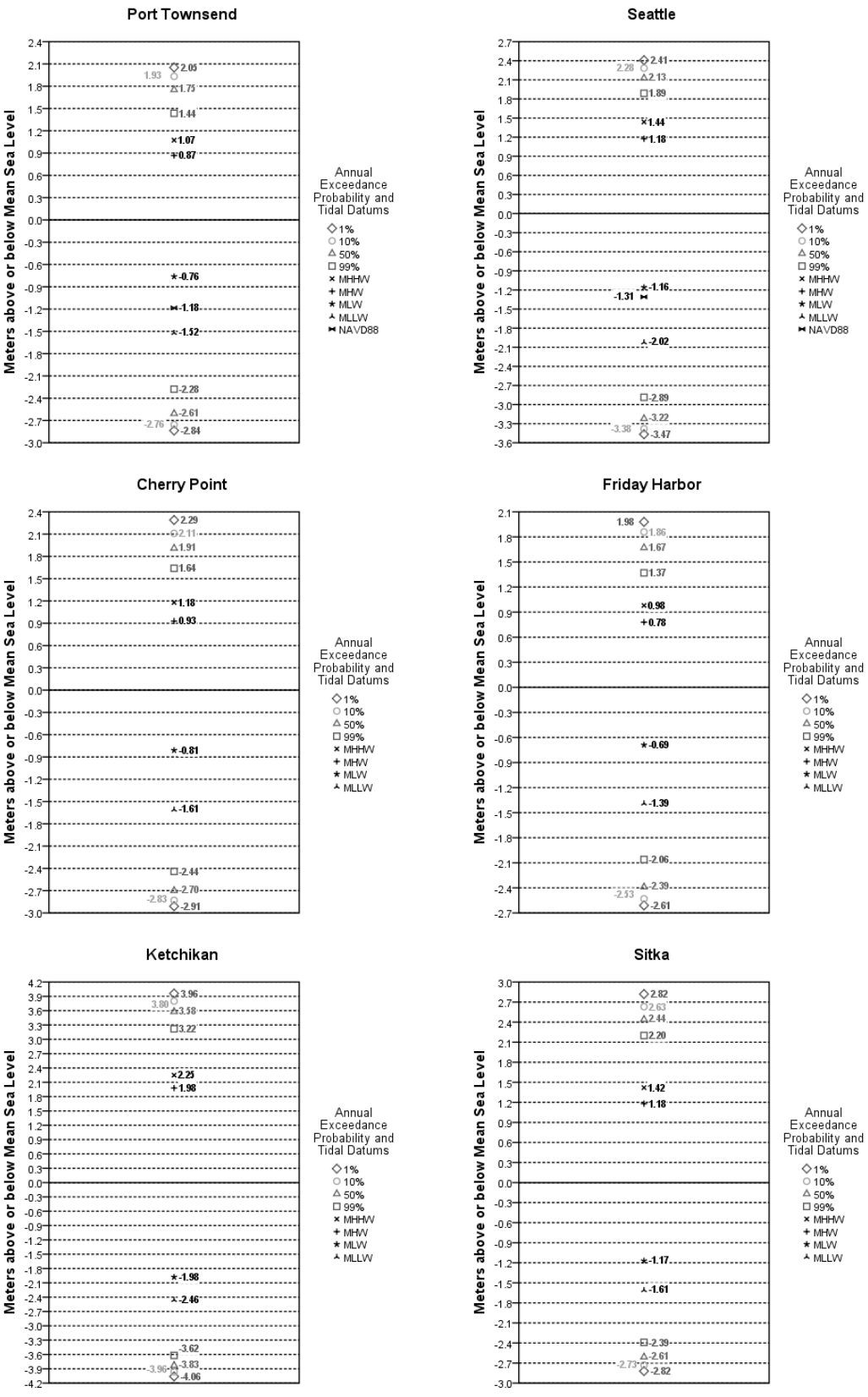

South Beach
Meters above or below Mean Sea Level
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
-2.1
-2.4
-2.7
2.41
2.21
1.99
1.70
1.18
0.97
-0.94
-1.13
-1.36
-2.04
-2.26
-2.35
-2.39
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

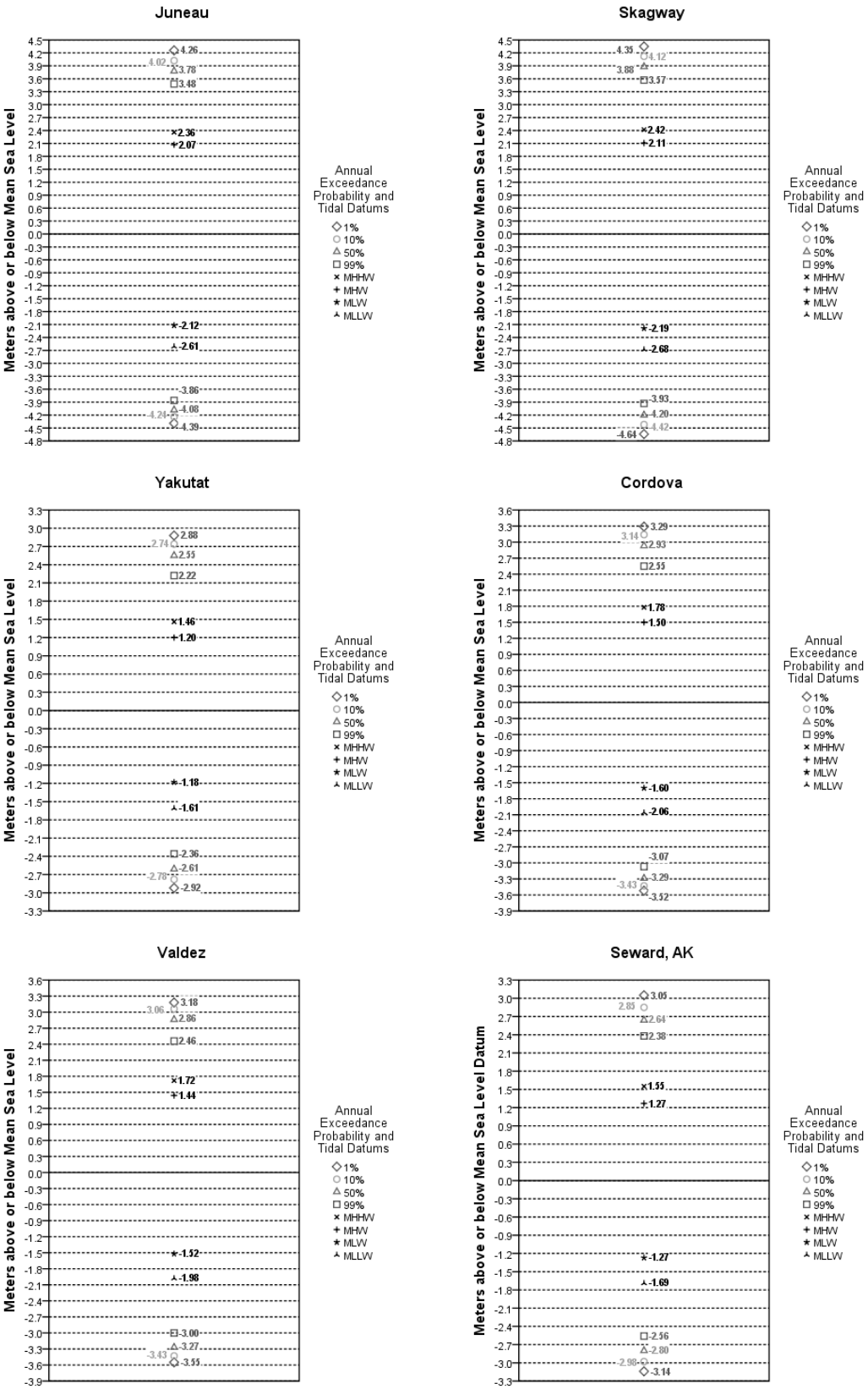

Astoria
Meters above or below Mean Sea Level
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
-2.1
-2.4
2.45
2.25
2.05
1.79
1.25
1.05
-1.02
-1.37
-1.44
-1.66
-1.93
-2.06
-2.14
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88


Toke Point
Meters above or below Mean Sea Level
3.3
3.0
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
-2.1
-2.4
-2.7
-3.0
3.01
2.66
2.31
1.89
1.26
1.03
-1.04
-1.21
-1.46
-2.13
-2.45
-2.56
-2.60
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

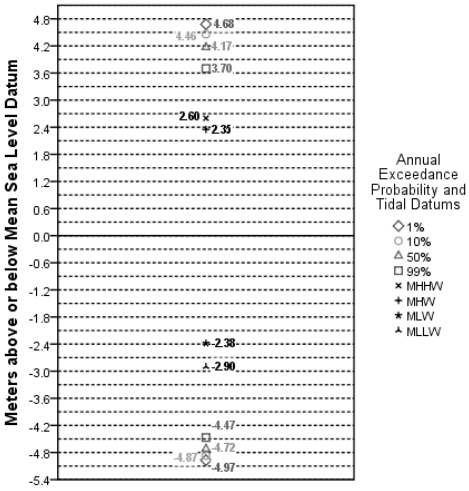

Neah Bay
Meters above or below Mean Sea Level
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
-2.1
-2.4
-2.7
2.35
2.21
2.00
1.64
1.11
0.85
-0.83
-1.06
-1.32
-2.03
-2.28
-2.41
-2.48
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88


Port Angeles
Meters above or below Mean Sea Level
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
-2.1
-2.4
-2.7
-3.0
1.90
1.76
1.58
1.26
0.86
0.69
-0.71
-1.17
-1.29
-2.05
-2.39
-2.57
-2.69
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88

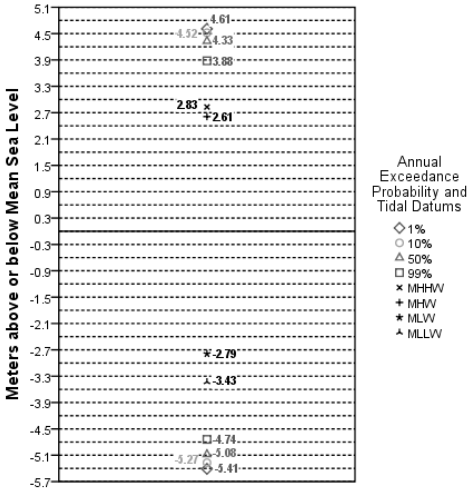

Port Townsend
Meters above or below Mean Sea Level
2.05
1.93
1.75
1.44
1.07
0.87
-0.76
-1.18
-1.52
-2.28
-2.61
-2.76
-2.84
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88
Seattle
Meters above or below Mean Sea Level
2.41
2.28
2.13
1.89
1.44
1.18
-1.16
-1.31
-2.02
-2.89
-3.22
-3.38
-3.47
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
NAVD88
Cherry Point
Meters above or below Mean Sea Level
2.29
2.11
1.91
1.64
1.18
0.93
-0.81
-1.61
-2.44
-2.70
-2.83
-2.91
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
Friday Harbor
Meters above or below Mean Sea Level
1.98
1.86
1.67
1.37
0.98
0.78
-0.69
-1.39
-2.06
-2.39
-2.33
-2.61
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
Ketchikan
Meters above or below Mean Sea Level
3.96
3.80
3.58
3.22
2.23
1.98
-1.98
-2.46
-3.62
-3.83
-3.96
-4.06
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
Sitka
Meters above or below Mean Sea Level
2.82
2.63
2.44
2.20
1.42
1.18
-1.17
-1.61
-2.39
-2.61
-2.73
-2.82
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW


Juneau
Meters above or below Mean Sea Level
4.26
4.02
3.78
3.48
2.36
2.07
-2.12
-2.61
-3.86
-4.08
-4.24
-4.39
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
Skagway
Meters above or below Mean Sea Level
4.35
4.12
3.88
3.57
2.42
2.11
-2.19
-2.68
-3.93
-4.20
-4.64
-4.42
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
Yakutat
Meters above or below Mean Sea Level
2.88
2.74
2.55
2.22
1.46
1.20
-1.18
-1.61
-2.36
-2.61
-2.78
-2.92
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
Cordova
Meters above or below Mean Sea Level
3.29
3.14
2.93
2.55
1.78
1.50
-1.60
-2.06
-3.07
-3.29
-3.43
-3.52
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
Valdez
Meters above or below Mean Sea Level
3.18
3.06
2.86
2.46
1.72
1.44
-1.52
-1.98
-3.00
-3.27
-3.43
-3.55
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW
Seward, AK
Meters above or below Mean Sea Level Datum
3.05
2.85
2.64
2.38
1.55
1.27
-1.27
-1.69
-2.56
-2.80
-2.98
-3.14
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW

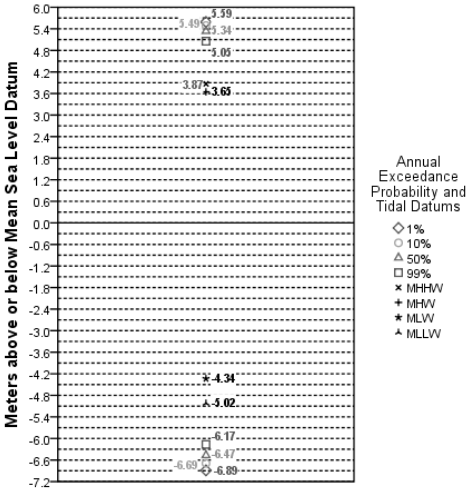
Seldovia, AK



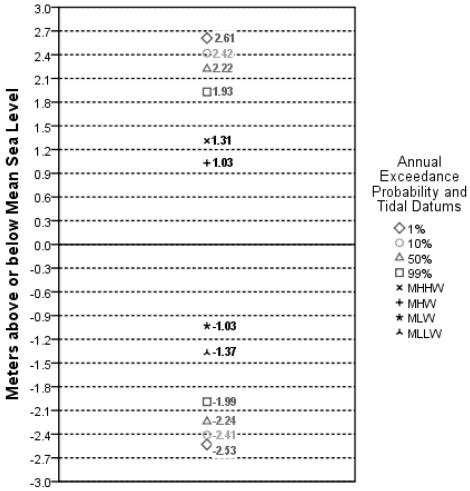
Nikiski



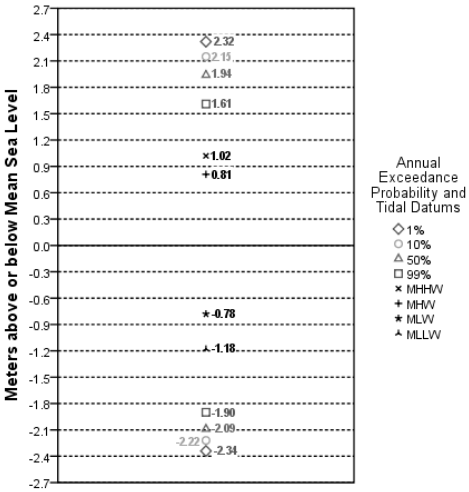
Anchorage, AK



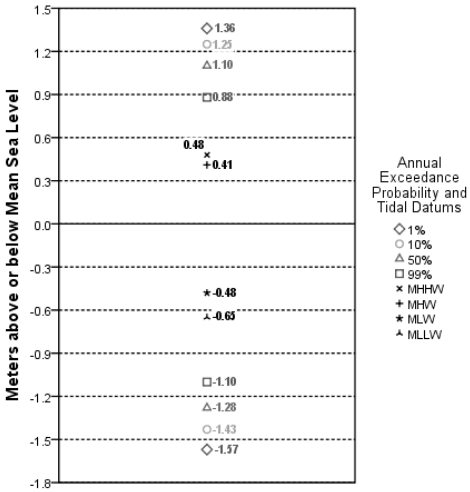
Kodiak Island

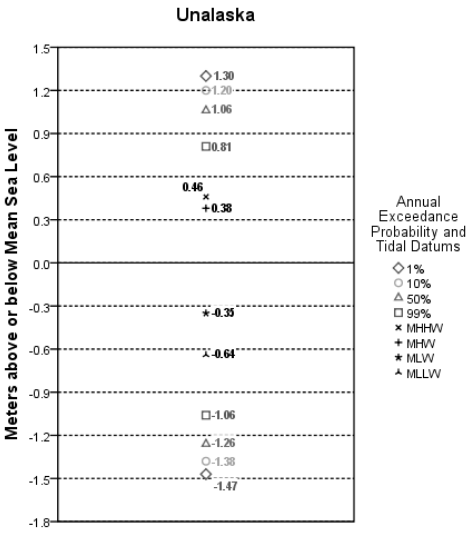


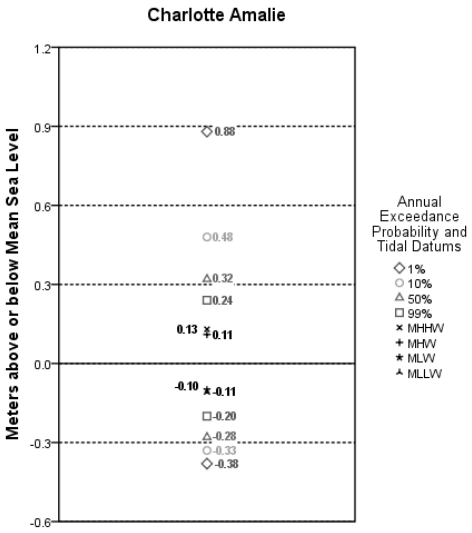
Sand Point

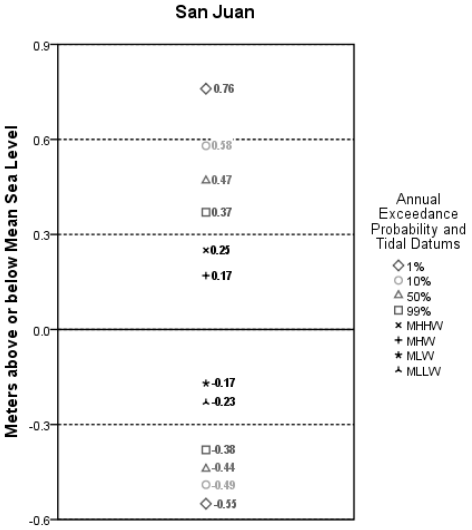


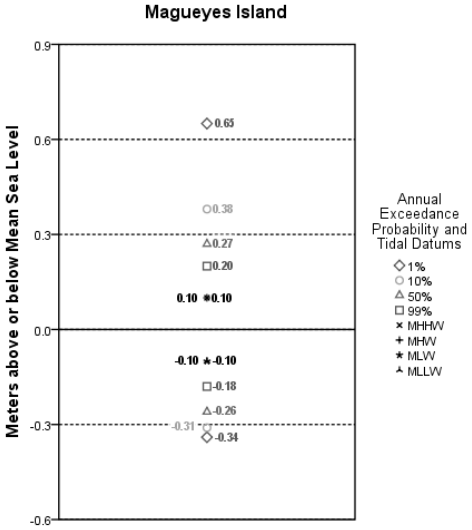
Adak Island




Unalaska
Meters above or below Mean Sea Level
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
1.30
1.20
1.06
0.81
0.46
0.38
-0.35
-0.64
-1.06
-1.26
-1.38
-1.47
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW


Charlotte Amalie
Meters above or below Mean Sea Level
1.2
0.9
0.6
0.3
0.0
-0.3
-0.6
0.88
0.48
0.32
0.24
0.13
0.11
-0.10
-0.11
-0.20
-0.28
-0.33
-0.38
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW


San Juan
Meters above or below Mean Sea Level
0.9
0.6
0.3
0.0
-0.3
-0.6
0.76
0.58
0.47
0.37
0.25
0.17
-0.17
-0.23
-0.38
-0.44
-0.49
-0.55
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW

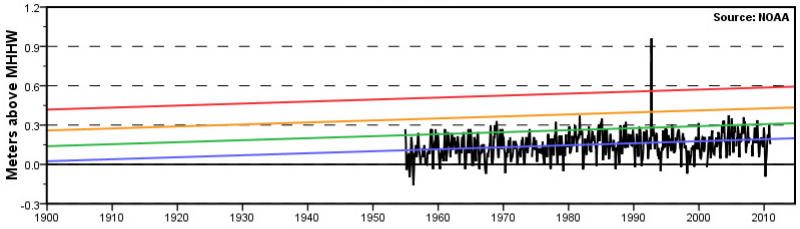

Magueyes Island
Meters above or below Mean Sea Level
0.9
0.6
0.3
0.0
-0.3
-0.6
0.65
0.38
0.27
0.20
0.10
0.10
-0.10
-0.10
-0.18
-0.26
-0.31
-0.34
Annual Exceedance Probability and Tidal Datums
1%
10%
50%
99%
MHHW
MHW
MLW
MLLW

Appendix IV.

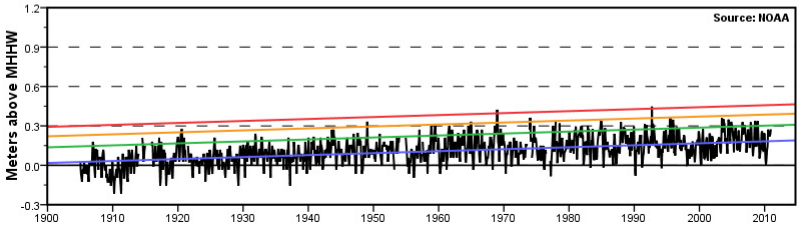
Time series of monthly highest water level and GEV exceedance probability levels

Note: Black line indicates the monthly highest water level. Red, orange, green and blue lines represent the 1%, 10%, 50%, and 99% annual probability of exceedance levels . The zero value on the vertical axis represents the elevation of the MHHW datum for the National Tidal Datum Epoch (1983-2001) or the special 5-year Modified Tidal Datum Epoch, as appropriate.

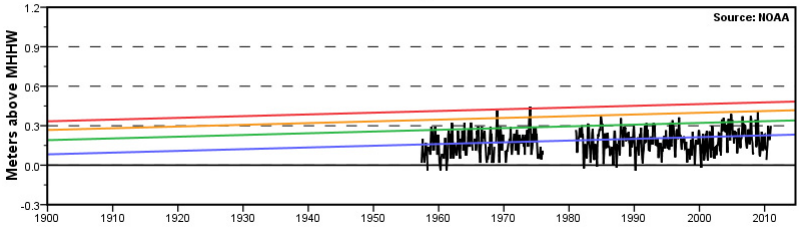
Nawiliwili, HI



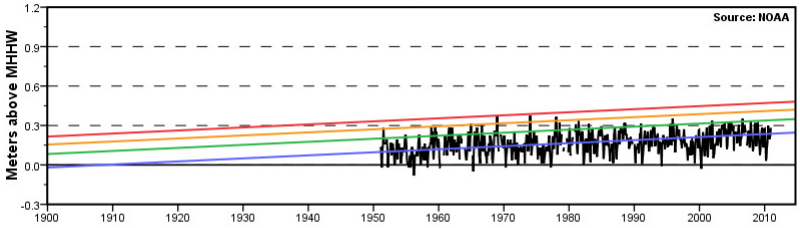
Honolulu, HI



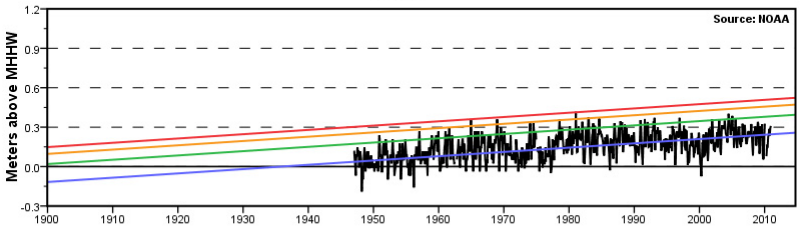
Mokuoloe, HI



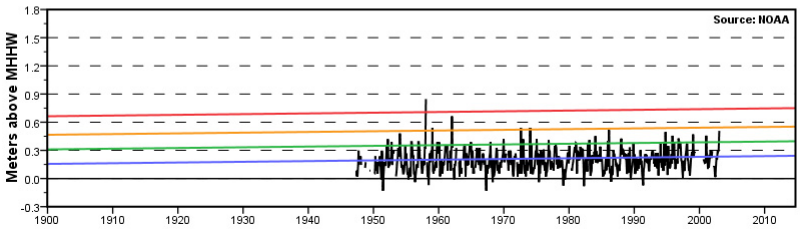
Kahului, HI



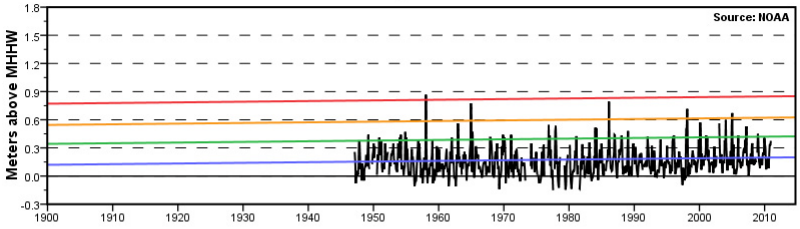
Hilo, HI



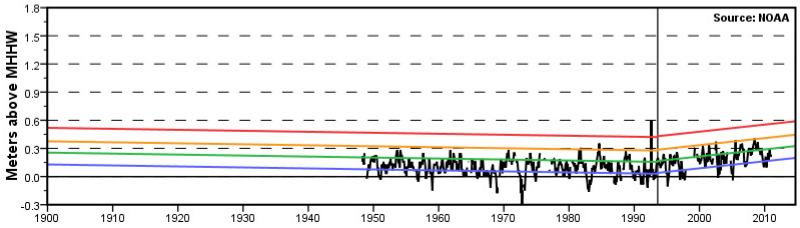
Johnston Atoll



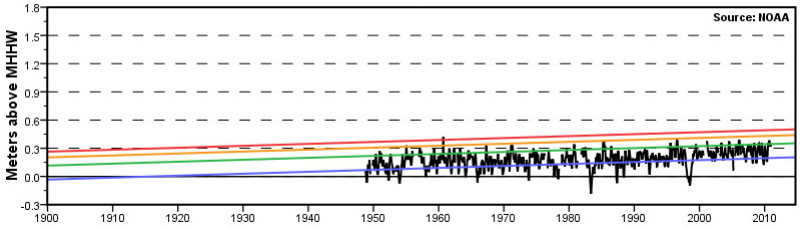
Midway Atoll



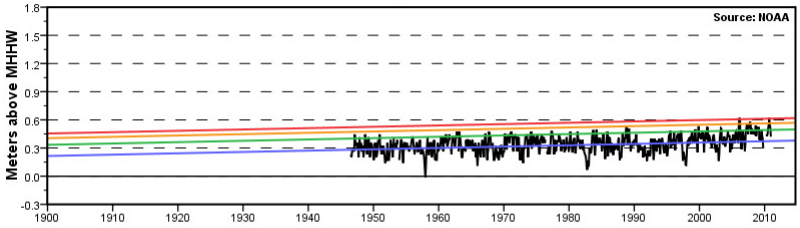
Guam



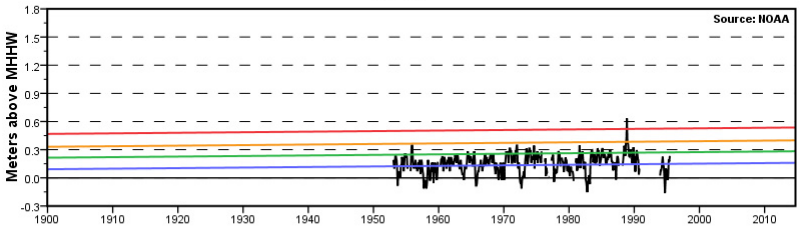
Pago Pago



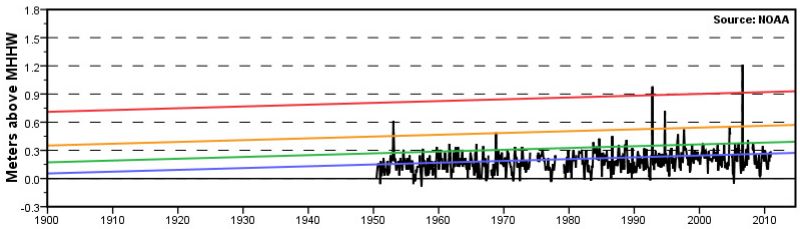
Kwajalein



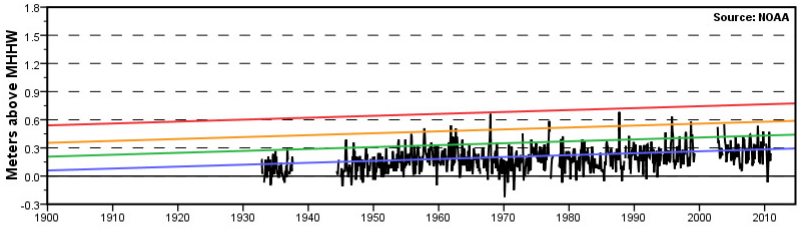
Chuuk



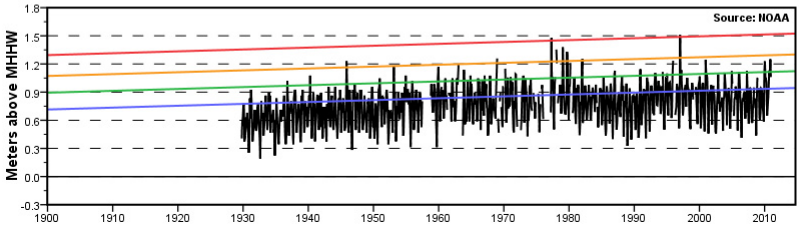
Wake Island



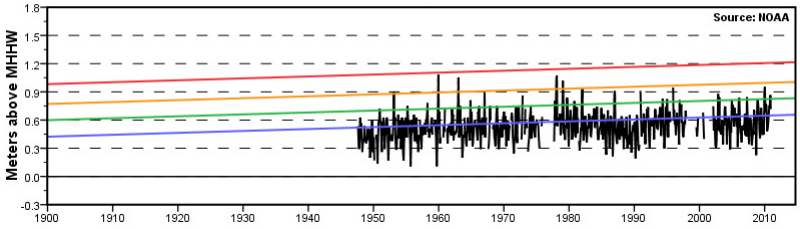
Bermuda



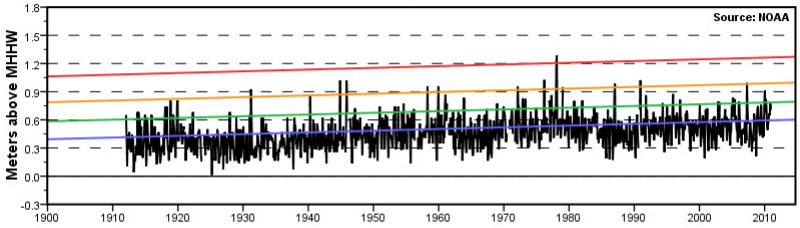
Eastport, ME



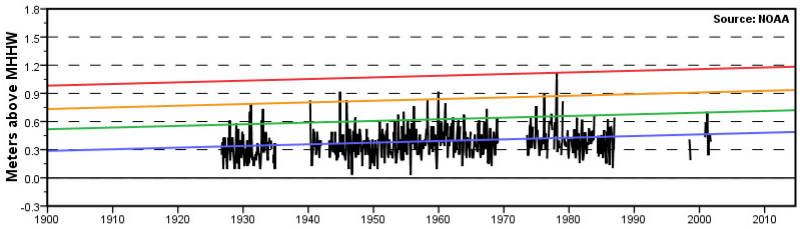
Bar Harbor, ME



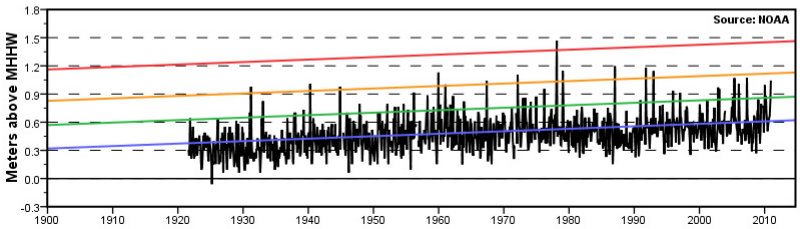
Portland, ME



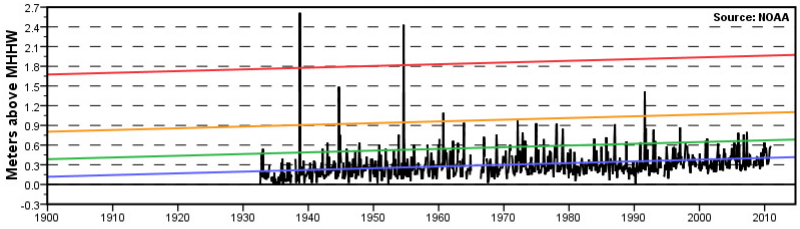
Seavey Island, ME



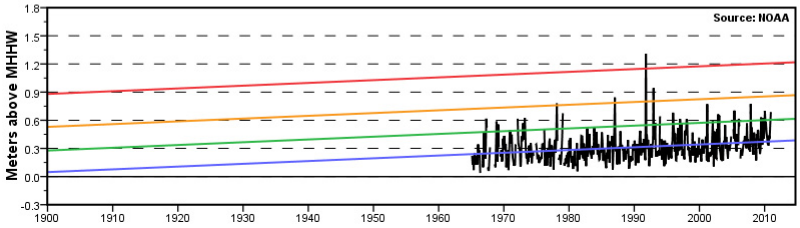
Boston, MA



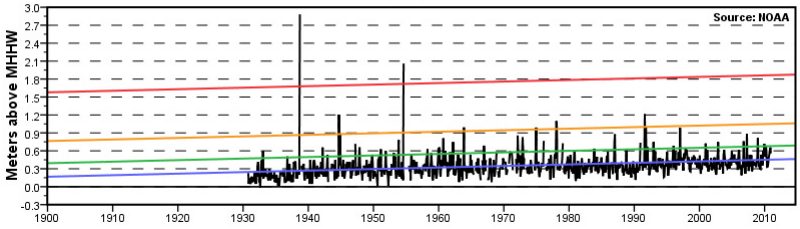
Woods Hole, MA



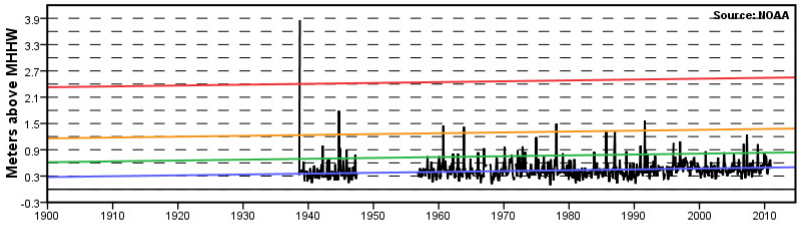
Nantucket Island, MA



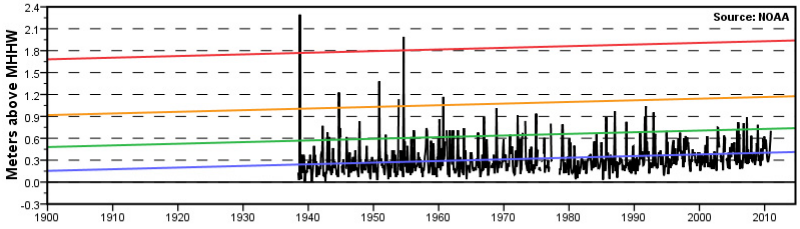
Newport, RI



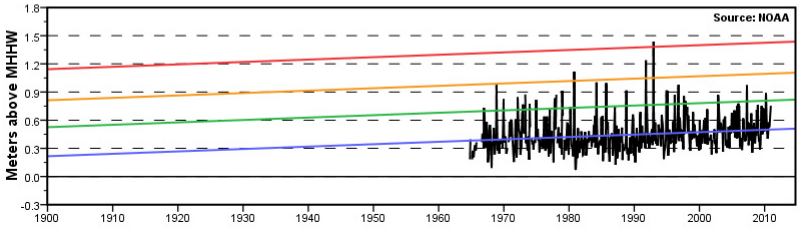
Providence, RI



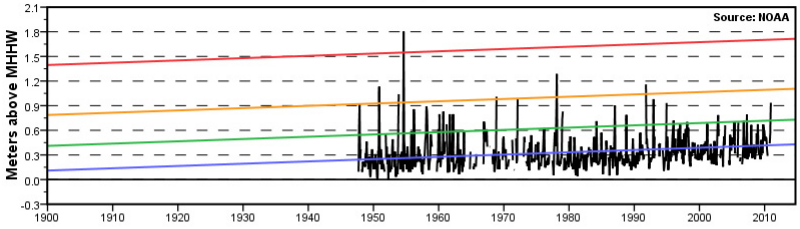
New London, CT



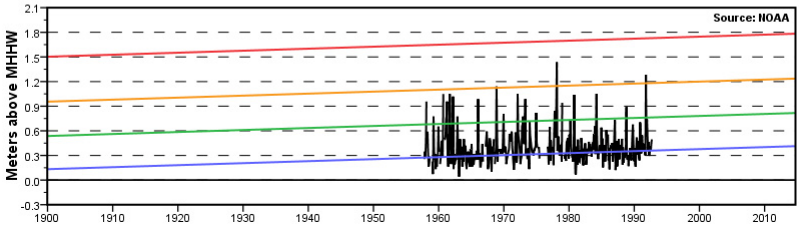
Bridgeport, CT



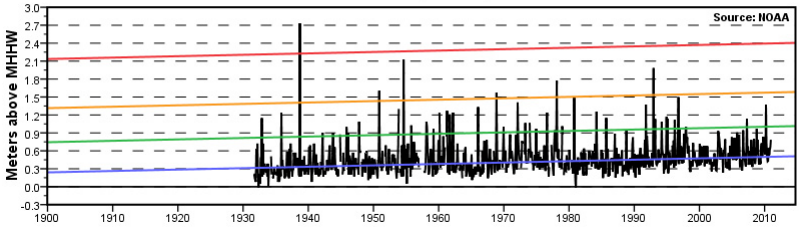
Montauk, NY



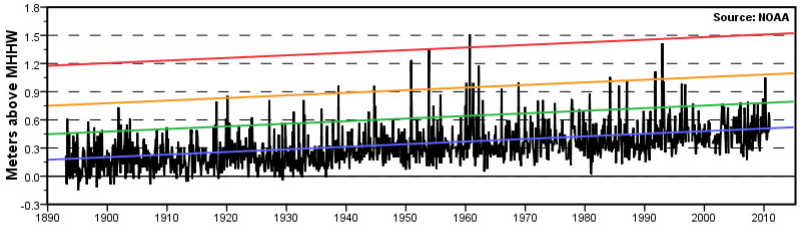
Port Jefferson, NY



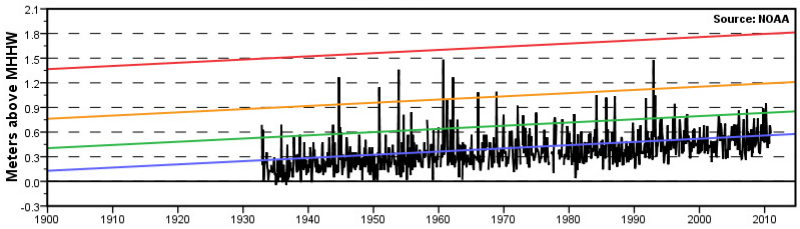
Willets Point / Kings Point, NY



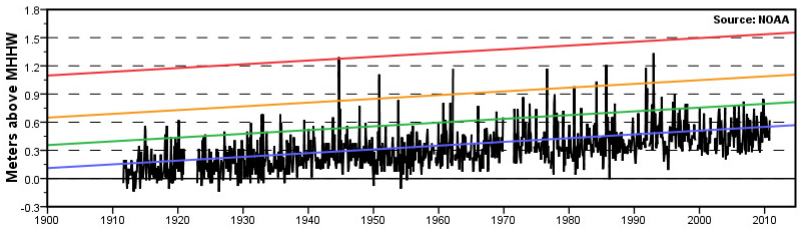
The Battery, NY



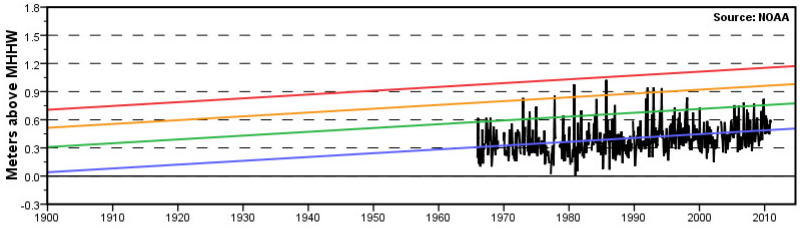
Sandy Hook, NJ



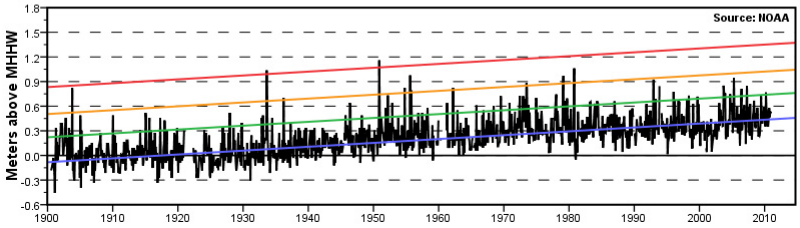
Atlantic City, NJ



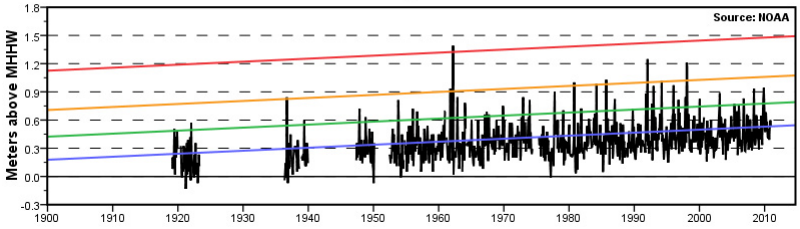
Cape May, NJ



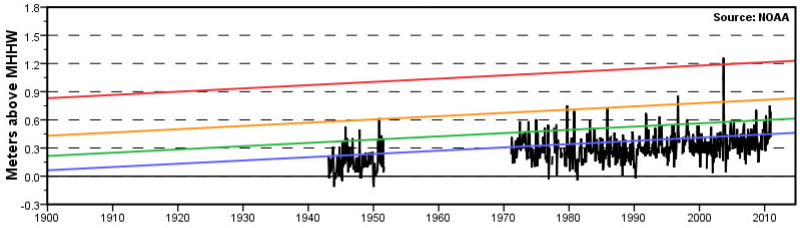
Philadelphia, PA



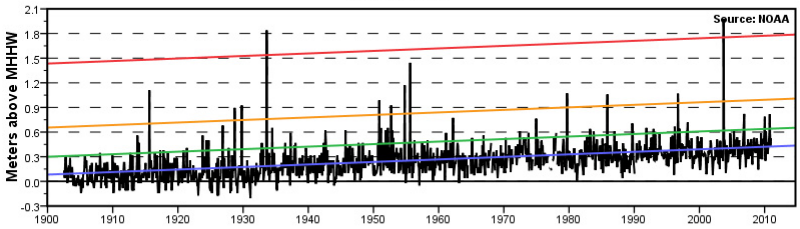
Lewes, DE



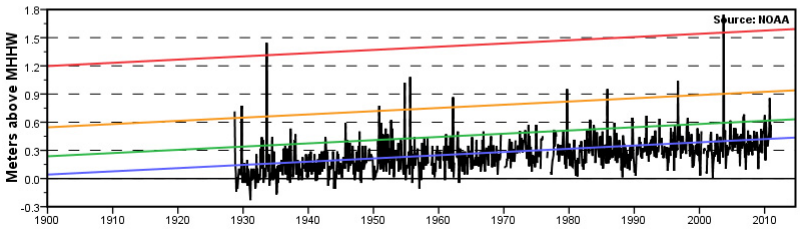
Cambridge, MD



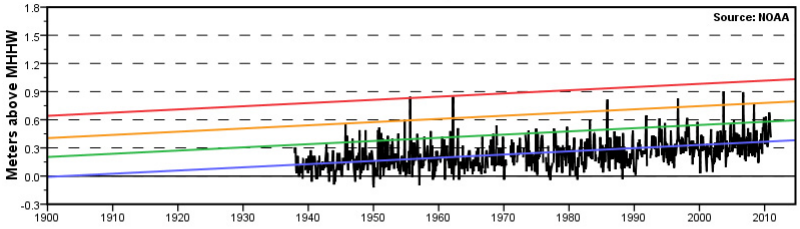
Baltimore, MD



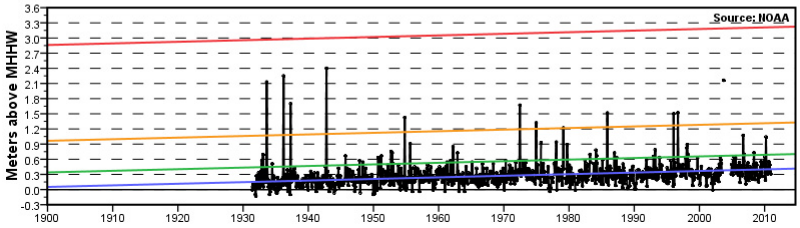
Annapolis, MD



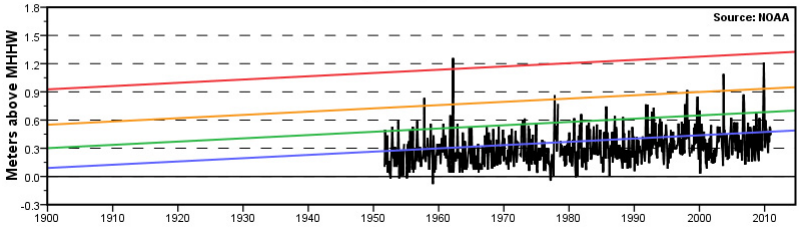
Solomons Island, MD



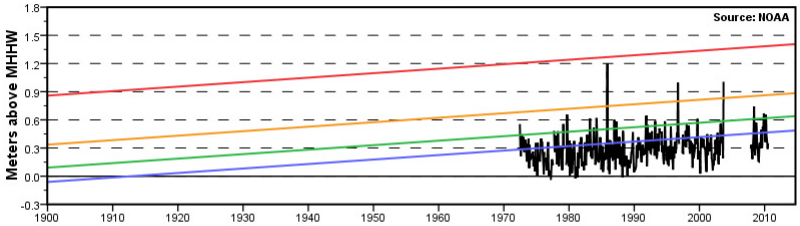
Washington, DC



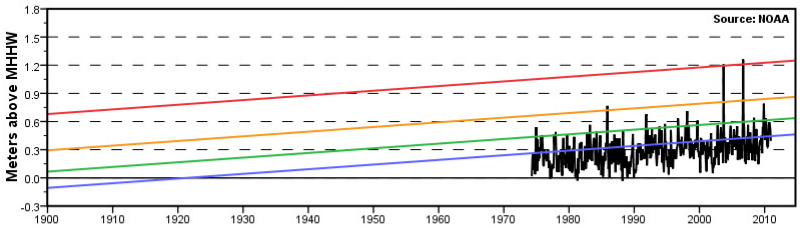
Kiptopeke, VA



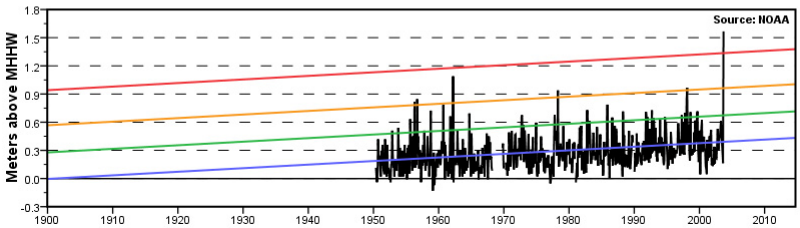
Colonial Beach, VA



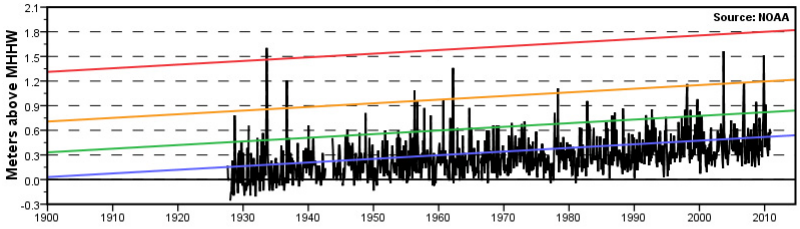
Lewisetta, VA



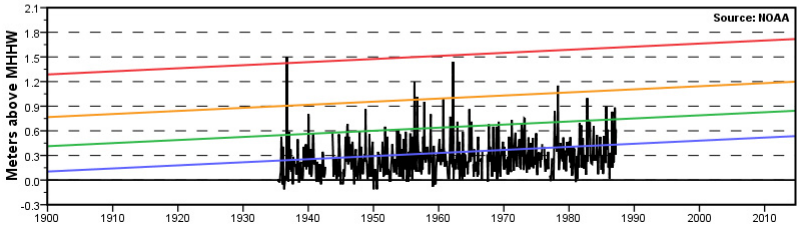
Gloucester Point, VA



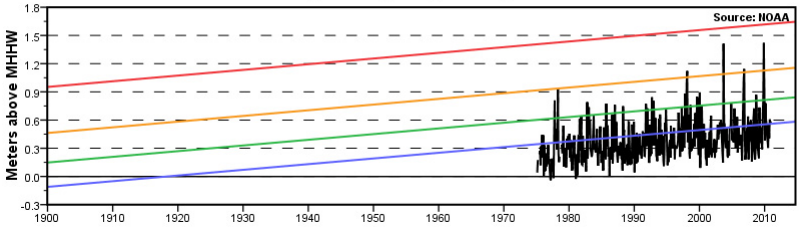
Sewells Point, VA



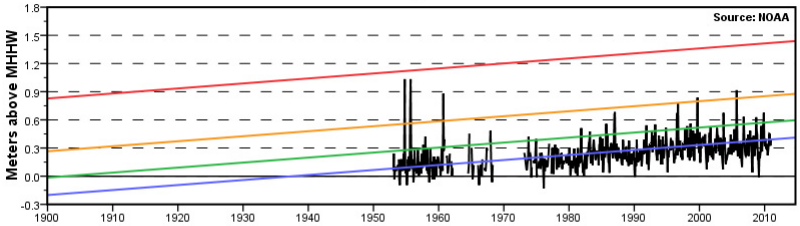
Portsmouth, VA



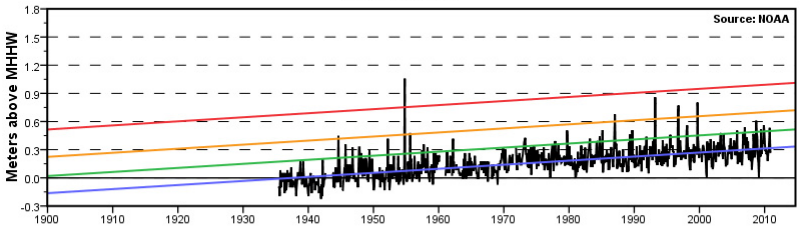
Chesapeake Bay Bridge Tunnel, VA



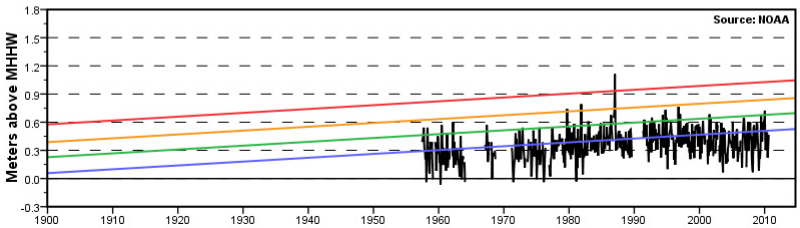
Beaufort, NC



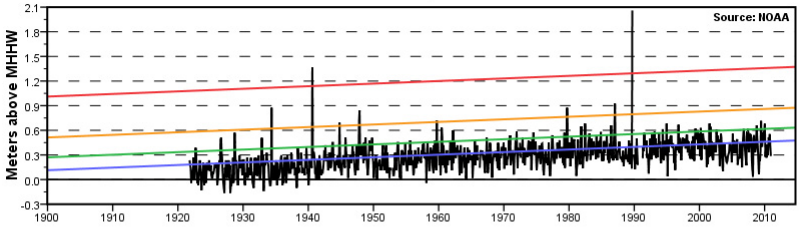
Wilmington, NC



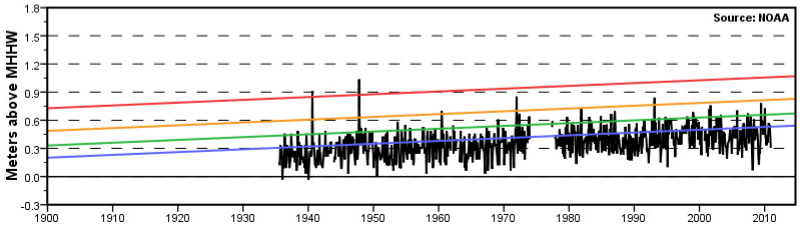
Springmaid Pier, SC



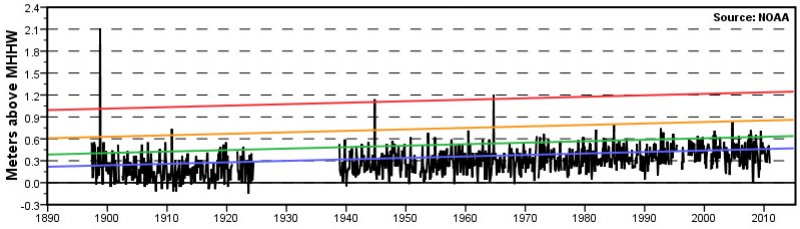
Charleston, SC



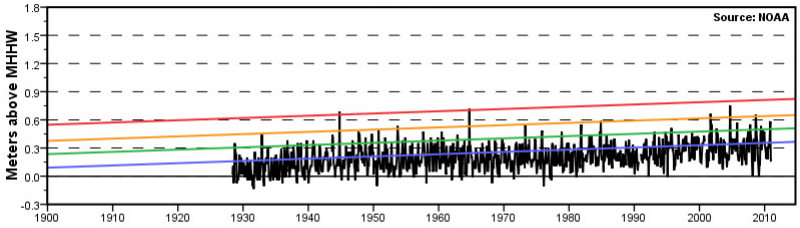
Fort Pulaski, GA



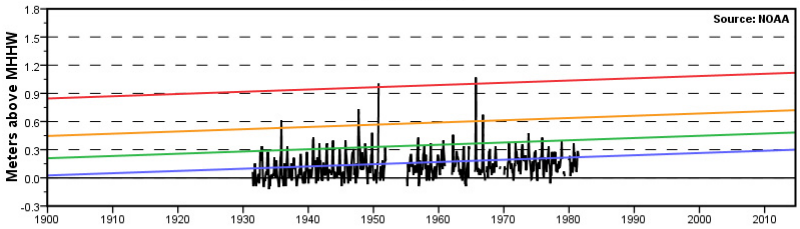
Fernandina Beach, FL



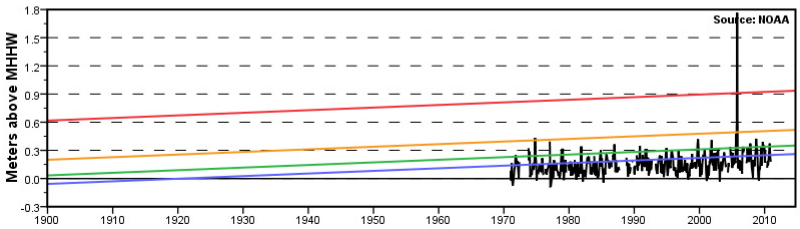
Mayport, FL



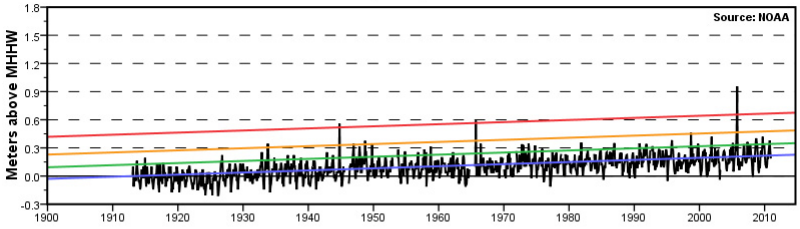
Miami Beach, FL



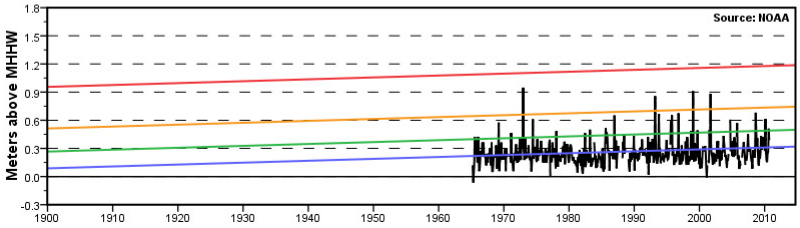
Vaca Key, FL



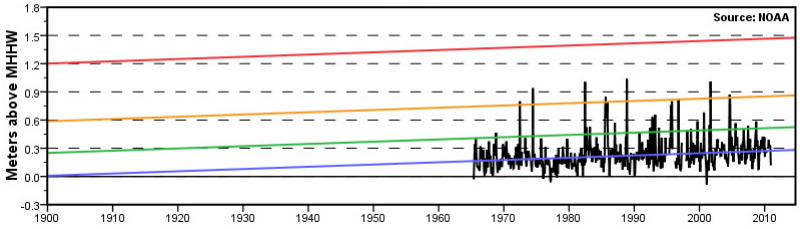
Key West, FL



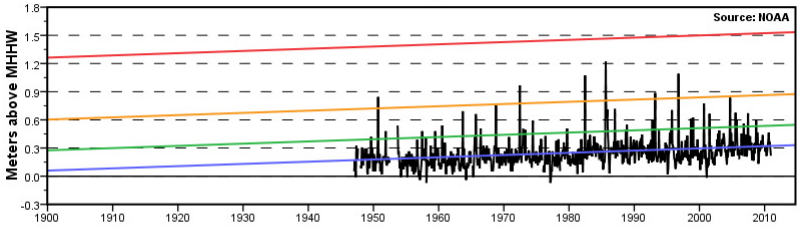
Naples, FL



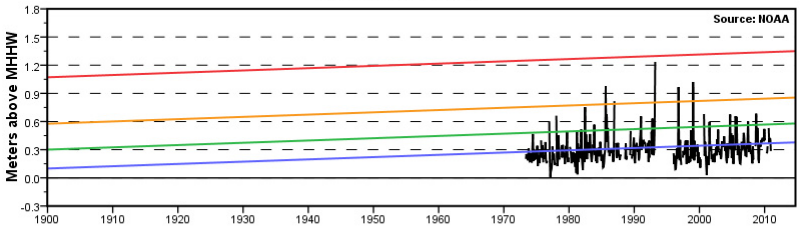
Fort Myers, FL



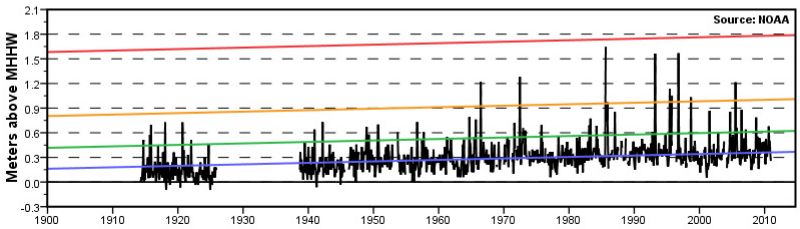
St Petersburg, FL



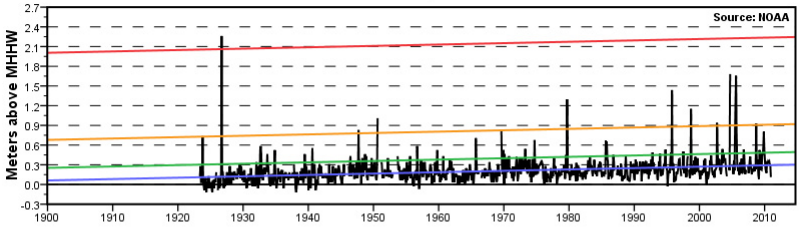
Clearwater Beach, FL



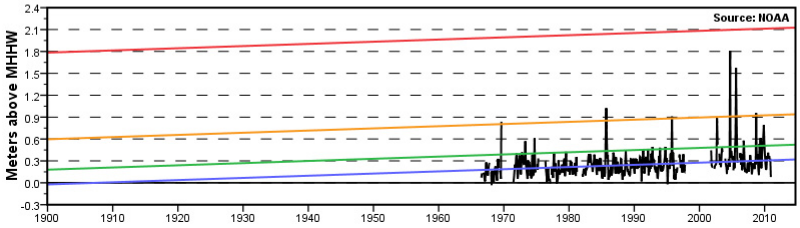
Cedar Key, FL



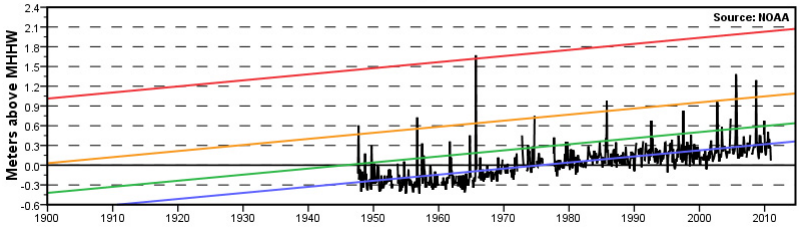
Pensacola, FL



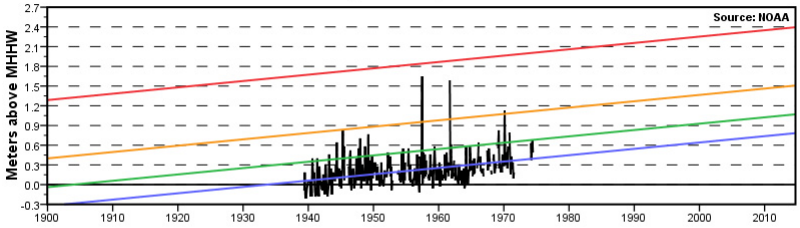
Dauphin Island, AL



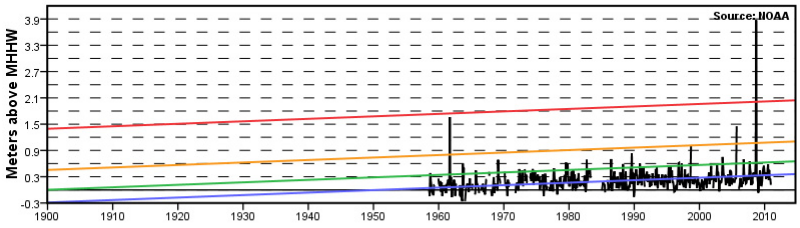
Grand Isle, LA



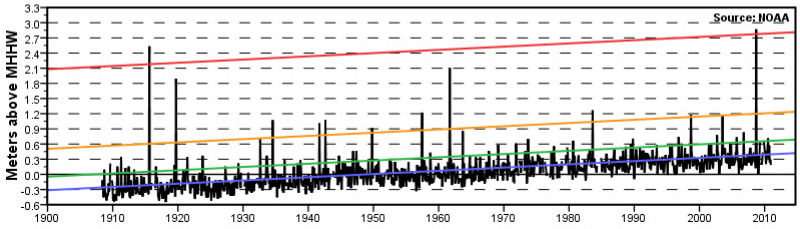
Eugene Island, LA



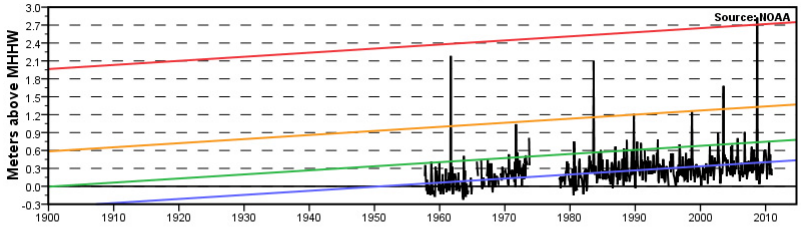
Sabine Pass, TX



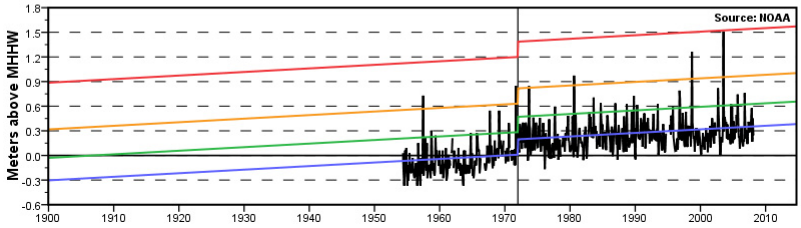
Galveston Pier 21, TX



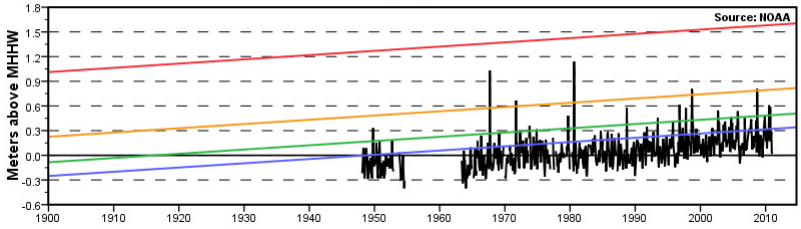
Galveston Pleasure Pier, TX



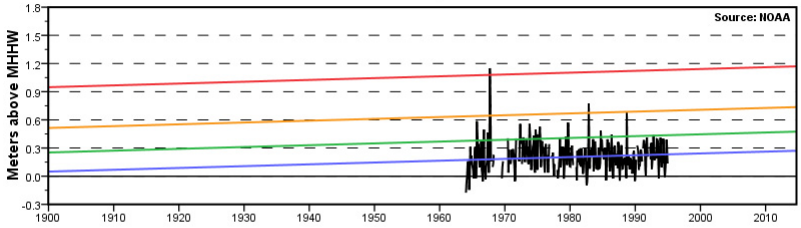
Freeport, TX



Rockport, TX



Port Mansfield, TX



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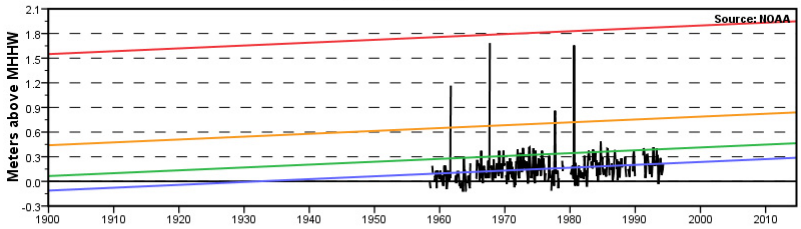
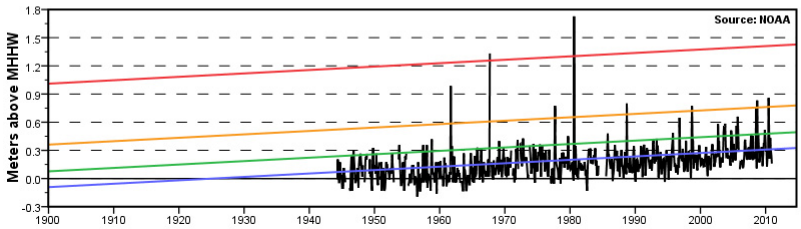
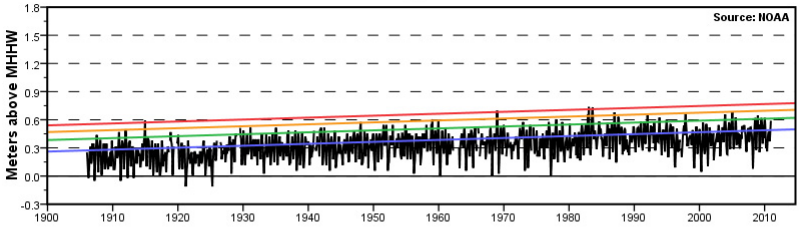


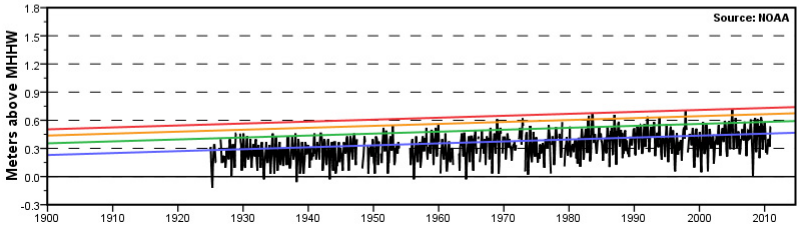
Port Isabel, TX



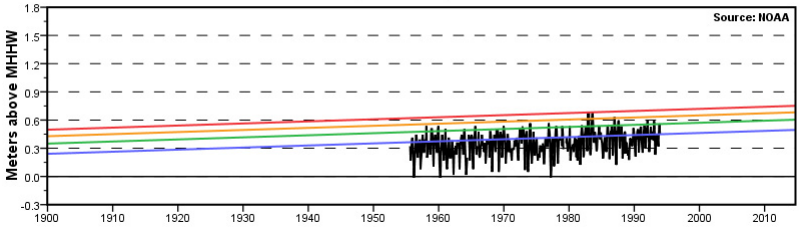
San Diego, CA



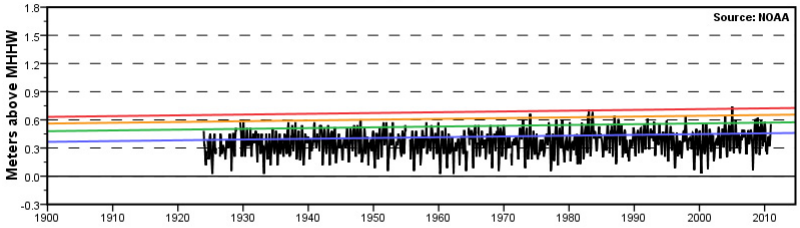
La Jolla, CA



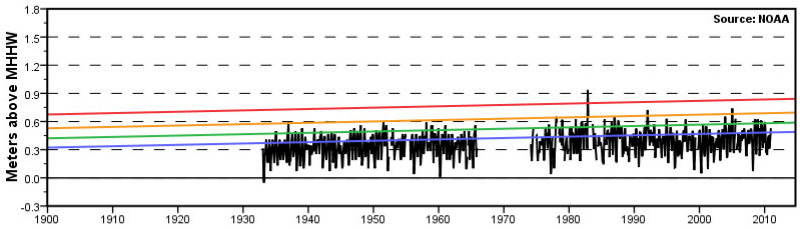
Newport Beach, CA



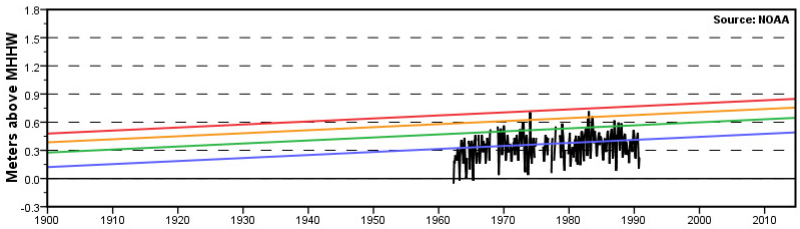
Los Angeles, CA



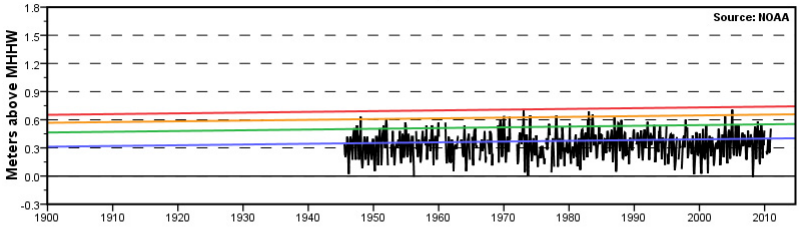
Santa Monica, CA



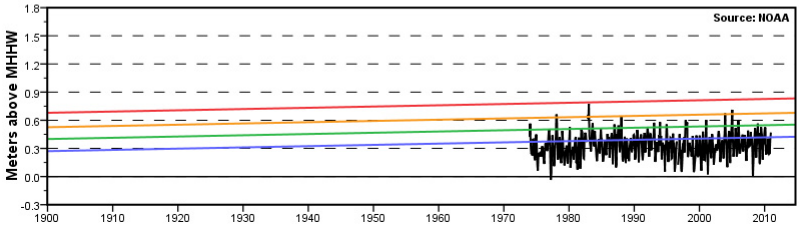
Rincon Island, CA



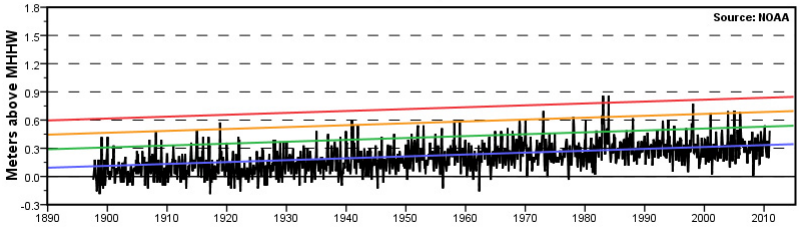
Port San Luis, CA



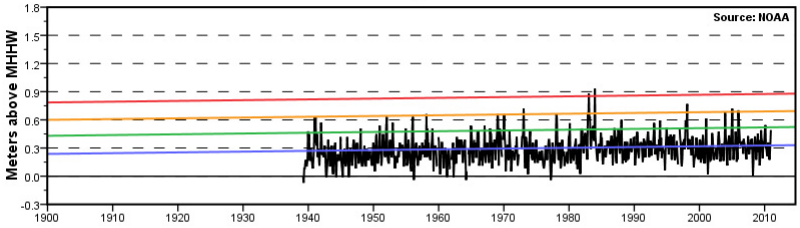
Monterey, CA



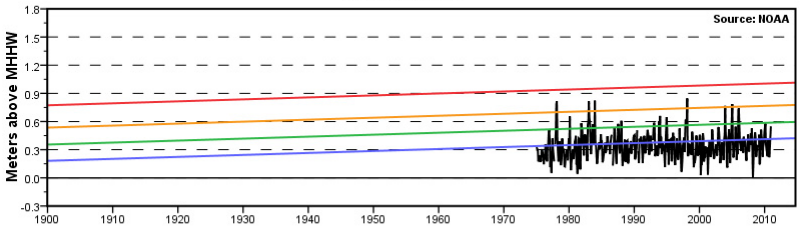
San Francisco, CA



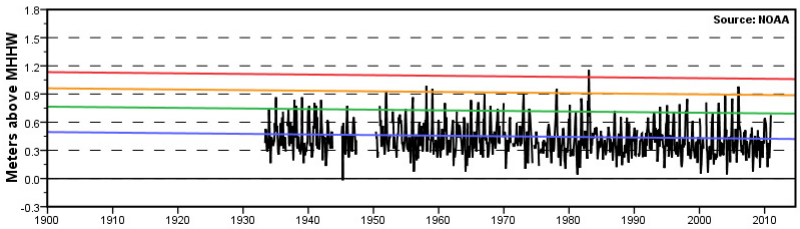
Alameda, CA



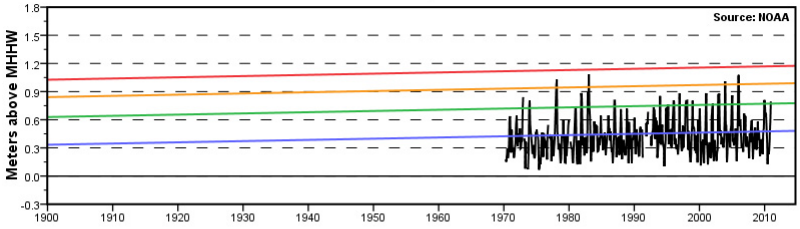
Point Reyes, CA



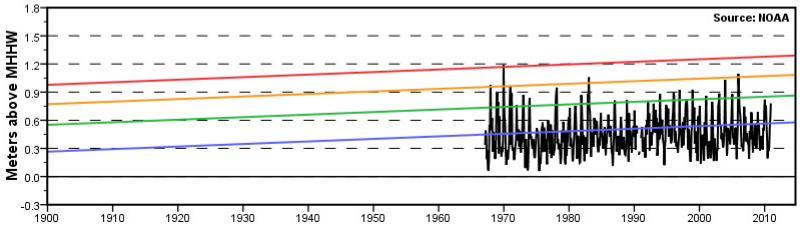
Crescent City, CA



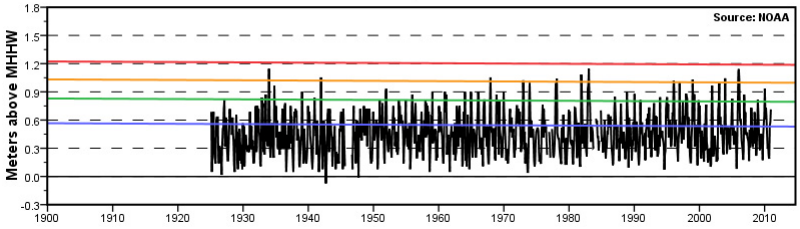
Charleston, OR



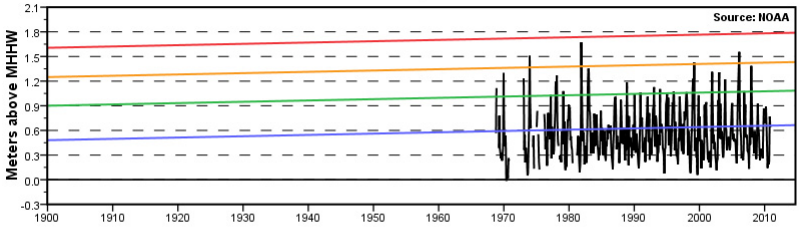
South Beach, OR



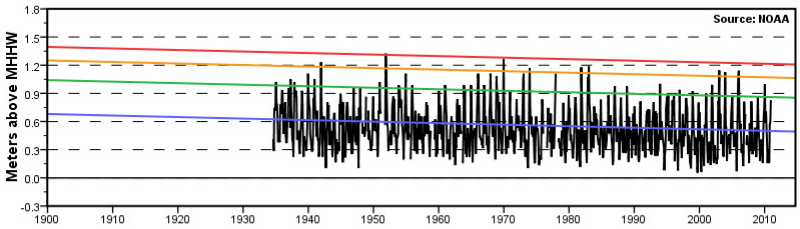
Astoria, OR



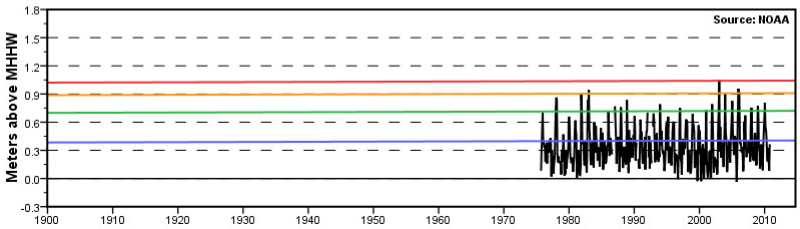
Toke Point, WA



Neah Bay, WA



Port Angeles, WA



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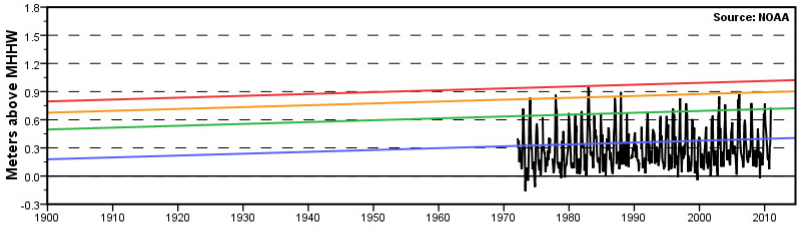
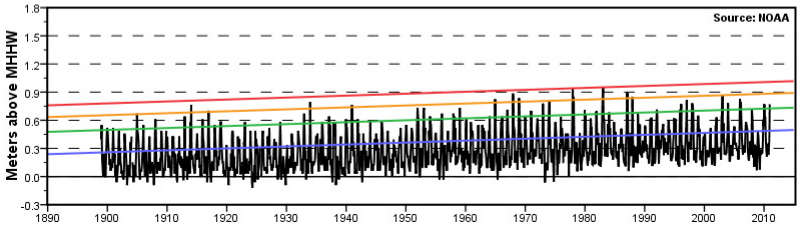
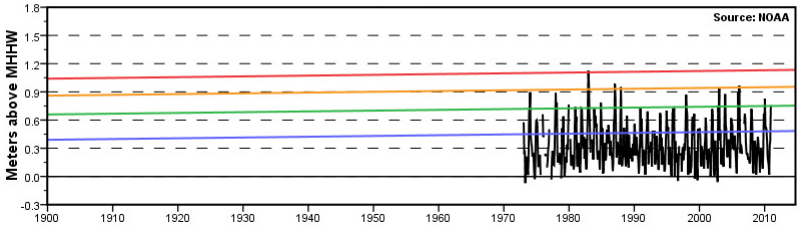


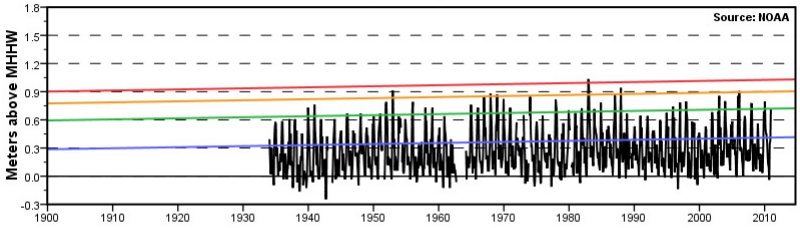
Seattle, WA



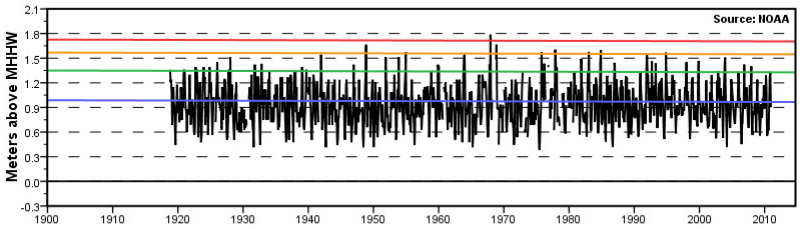
Cherry Point, WA



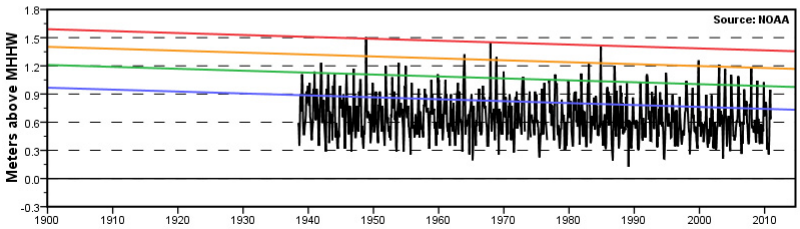
Friday Harbor, WA



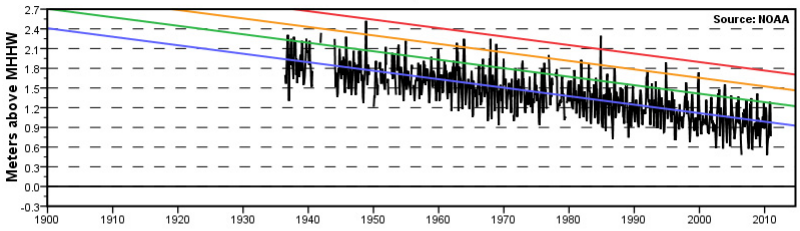
Ketchikan, AK



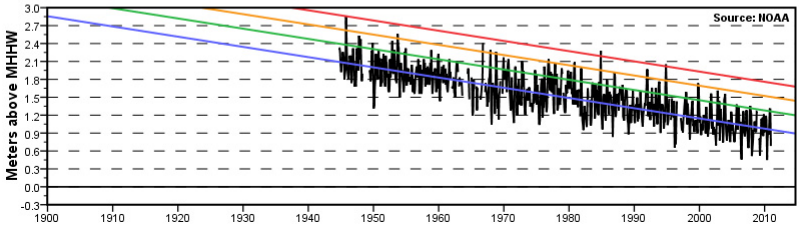
Sitka, AK



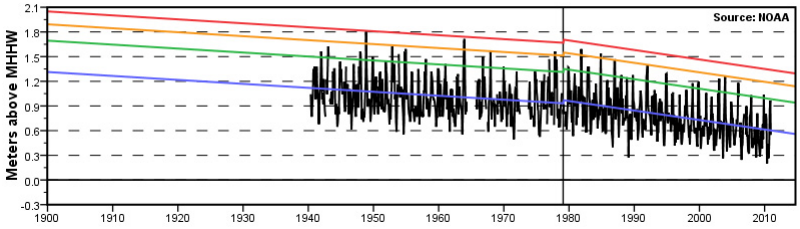
Juneau, AK



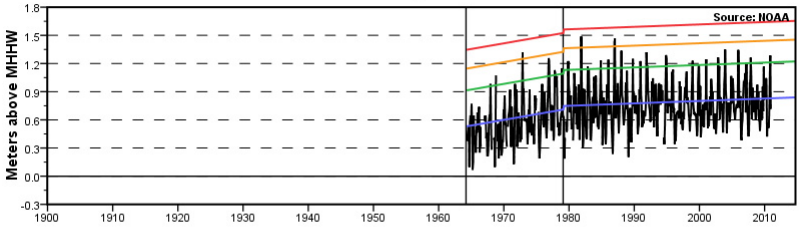
Skagway, AK



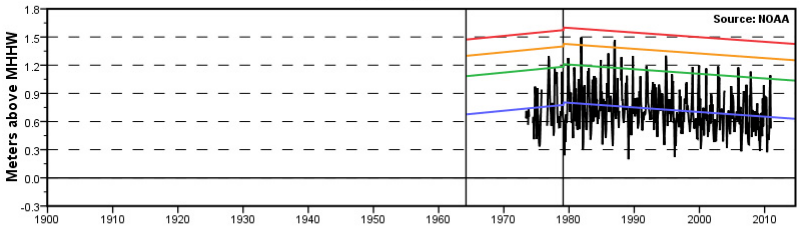
Yakutat, AK



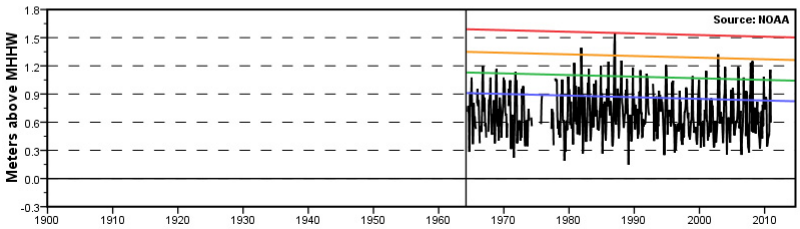
Cordova, AK



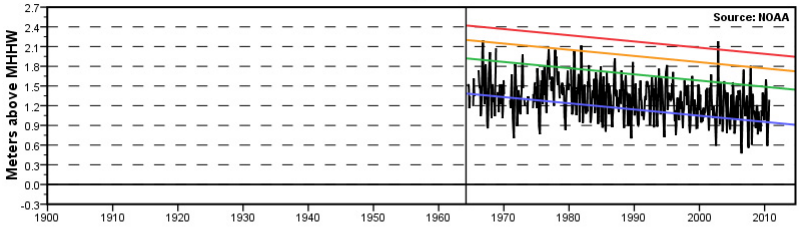
Valdez, AK



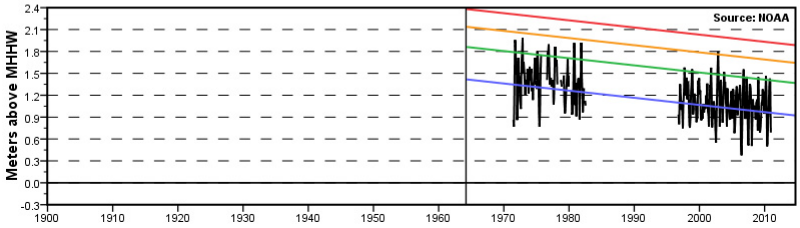
Seward, AK



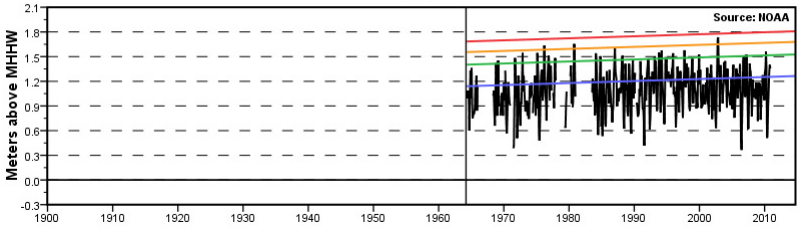
Seldovia, AK



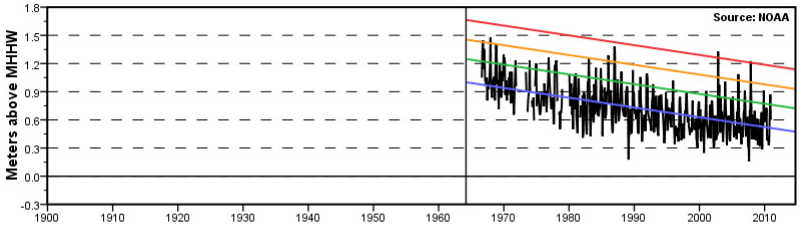
Nikiski, AK



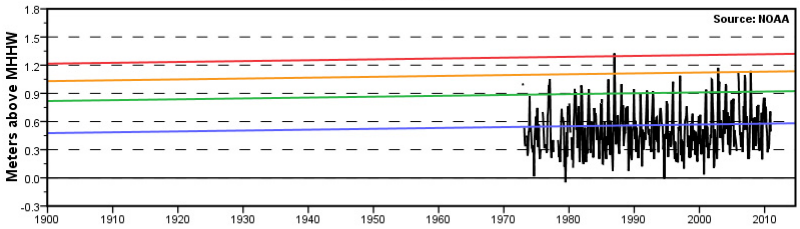
Anchorage, AK



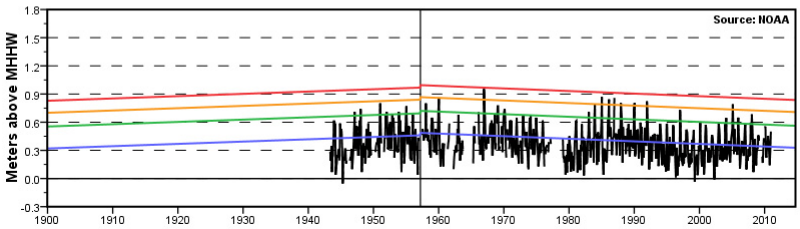
Kodiak Island, AK

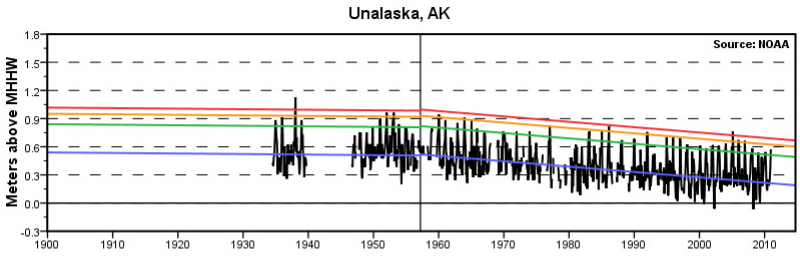


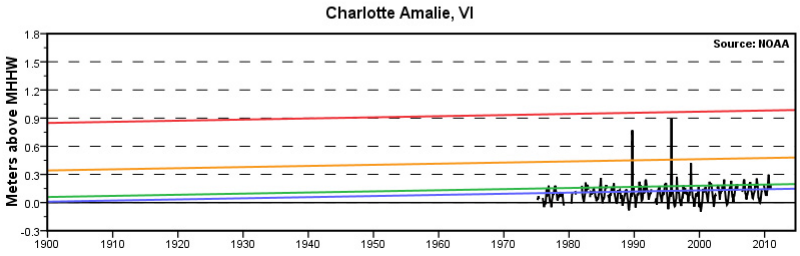
Sand Point, AK

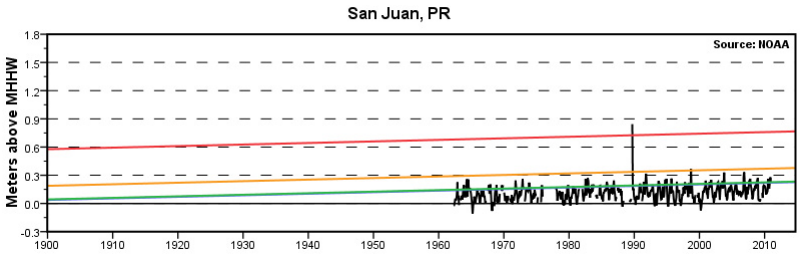


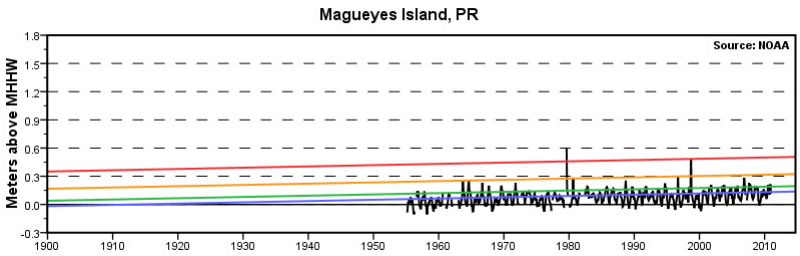
Adak Island, AK




Unalaska, AK
Source: NOAA
Meters above MHHW
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010


Charlotte Amalie, VI
Source: NOAA
Meters above MHHW
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010


San Juan, PR
Source: NOAA
Meters above MHHW
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

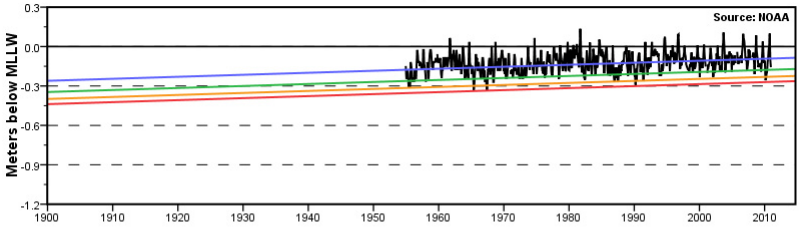

Magueyes Island, PR
Source: NOAA
Meters above MHHW
1.8
1.5
1.2
0.9
0.6
0.3
0.0
-0.3
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010

Appendix V.

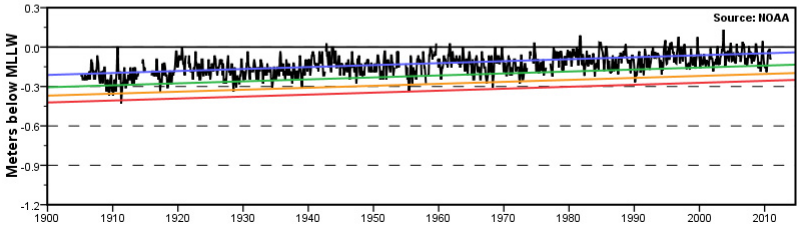
Time series of monthly lowest water level and GEV exceedance probability levels

Note: Black line indicates the monthly lowest water level. Red, orange, green and blue lines represent the 1%, 10%, 50%, and 99% annual probability of exceedance levels . The zero value on the vertical axis represents the elevation of the MLLW datum for the National Tidal Datum Epoch (1983-2001) or the special 5-year Modified Tidal Datum Epoch, as appropriate.

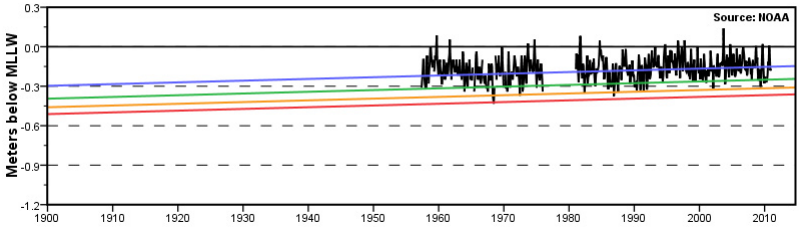
Nawiliwili, HI



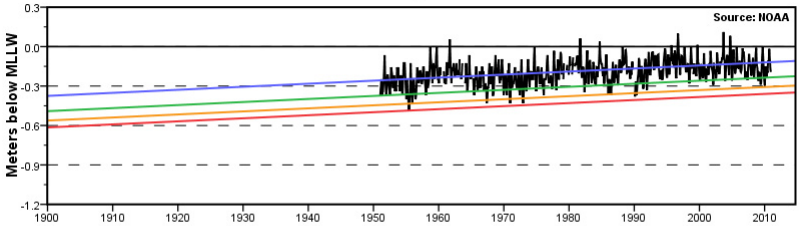
Honolulu, HI



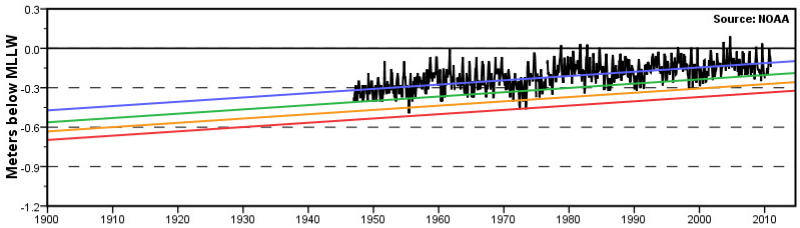
Mokuoloe, HI



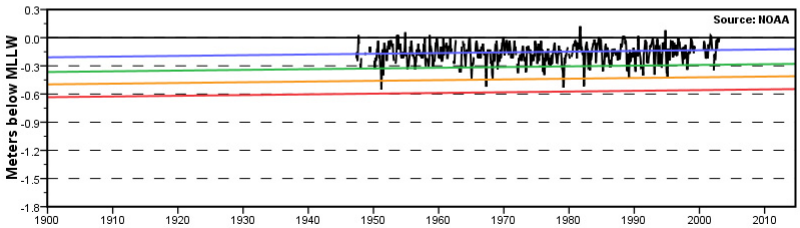
Kahului, HI

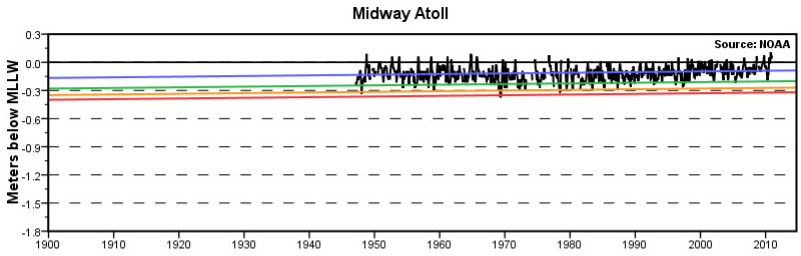


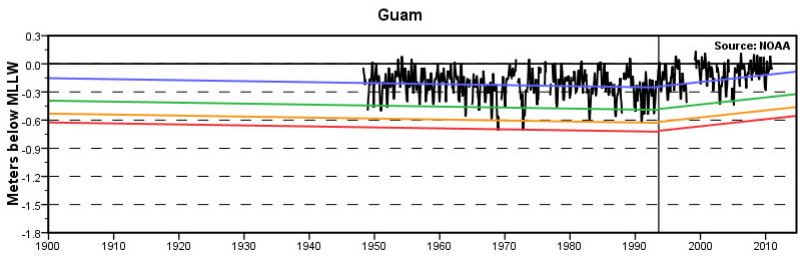
Hilo, HI



Johnston Atoll




Midway Atoll
Source: NOAA
Meters below MLLW
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
2010


Guam
Source: NOAA
Meters below MLLW
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
1900
1910
1920
1930
1940
1950
1960
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1980
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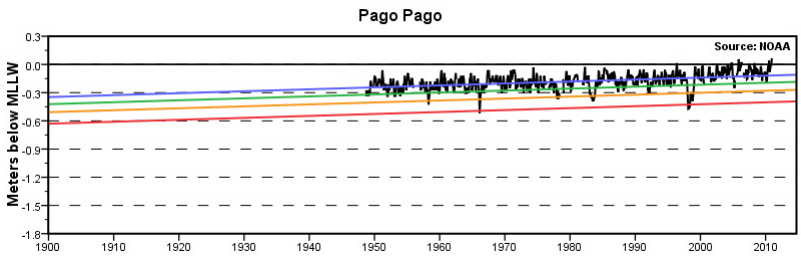
2000
2010


Pago Pago
Source: NOAA
Meters below MLLW
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
1900
1910
1920
1930
1940
1950
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2000
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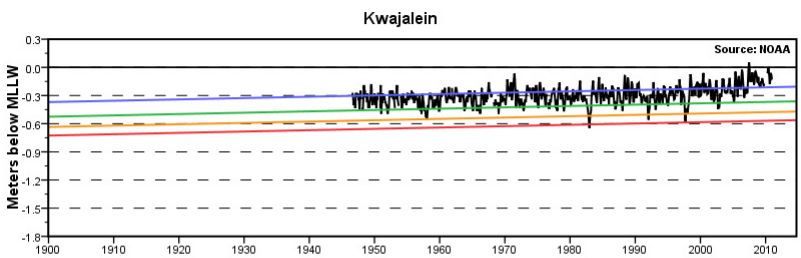
Kwajalein
Source: NOAA
Meters below MLLW
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
1900
1910
1920
1930
1940
1950
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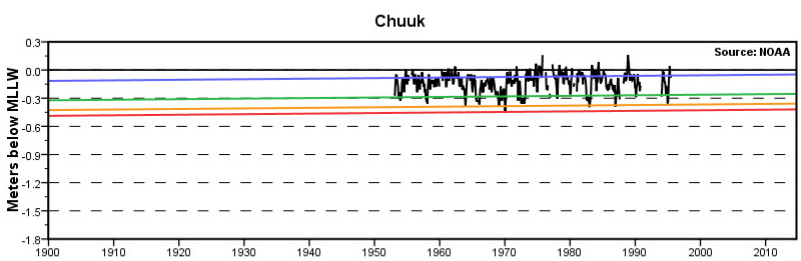
Chuuk
Source: NOAA
Meters below MLLW
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
1900
1910
1920
1930
1940
1950
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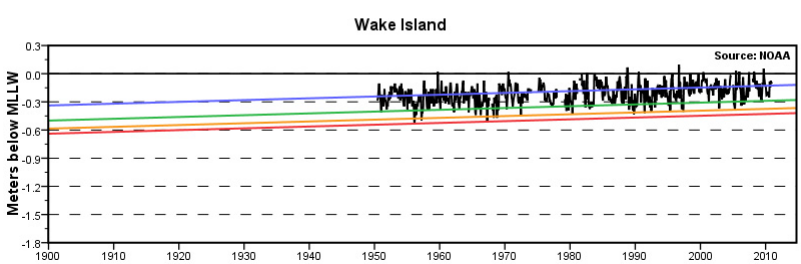
Wake Island
Source: NOAA
Meters below MLLW
0.3
0.0
-0.3
-0.6
-0.9
-1.2
-1.5
-1.8
1900
1910
1920
1930
1940
1950
1960
1970
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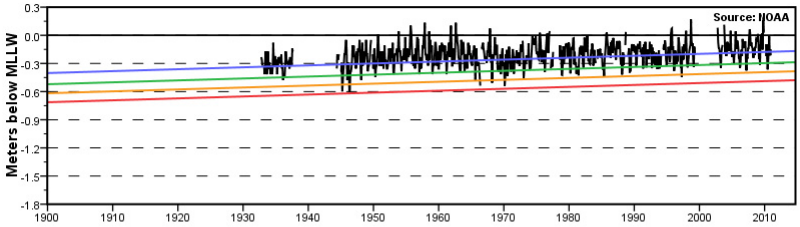
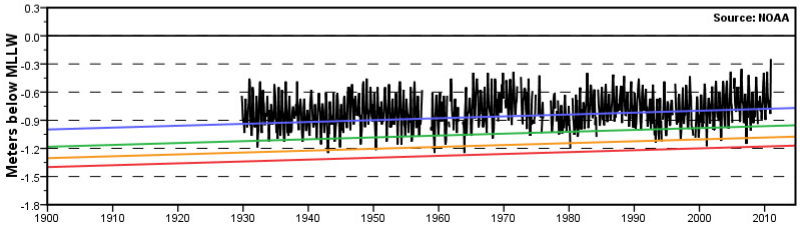
1990
2000
2010

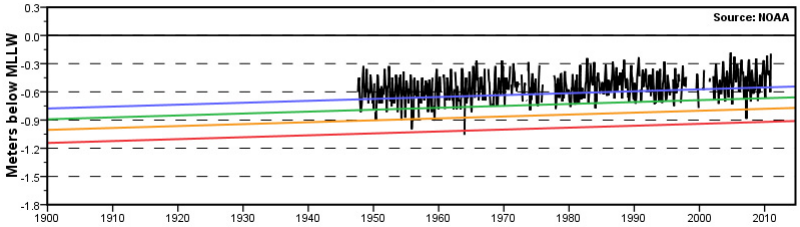
Bermuda



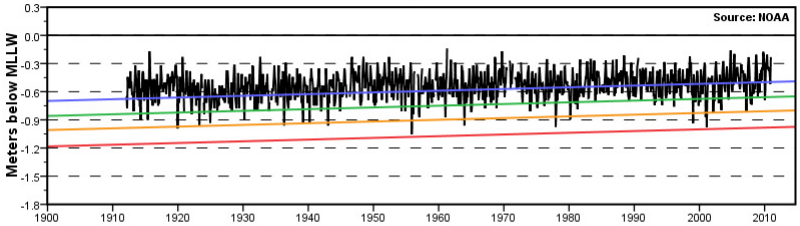
Eastport, ME



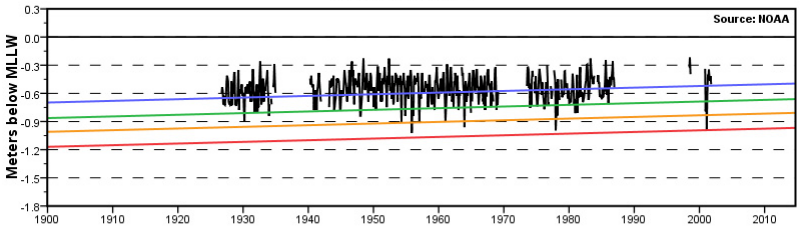
Bar Harbor, ME



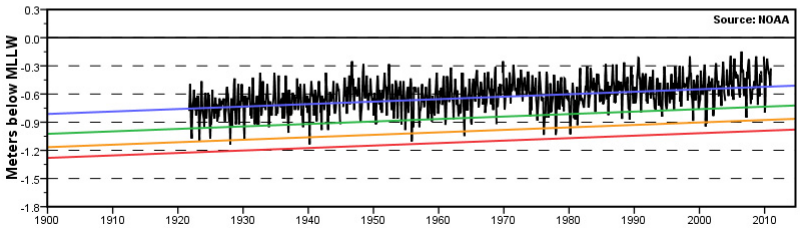
Portland, ME



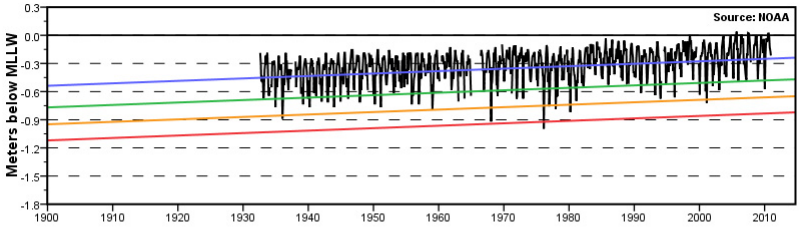
Seavey Island, ME



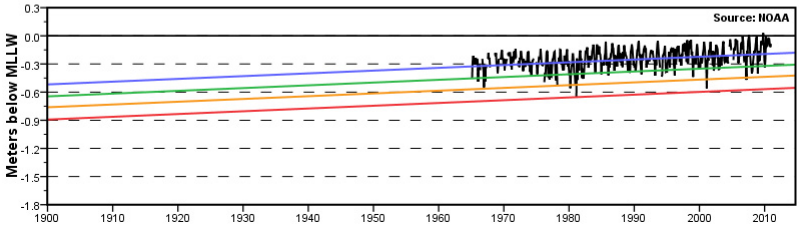
Boston, MA



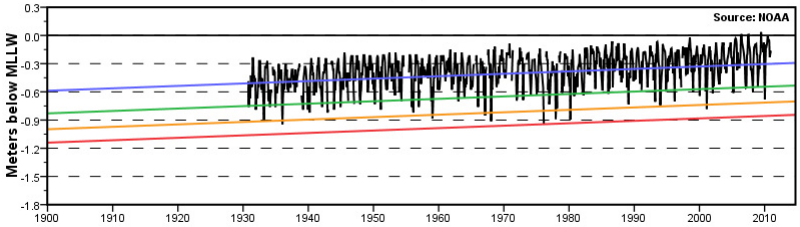
Woods Hole, MA



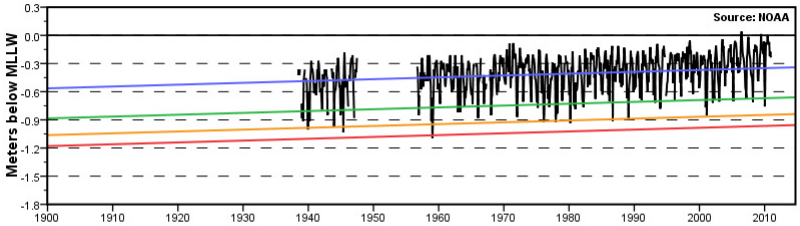
Nantucket Island, MA



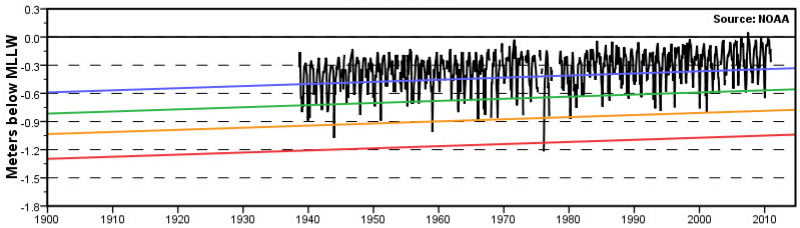
Newport, RI



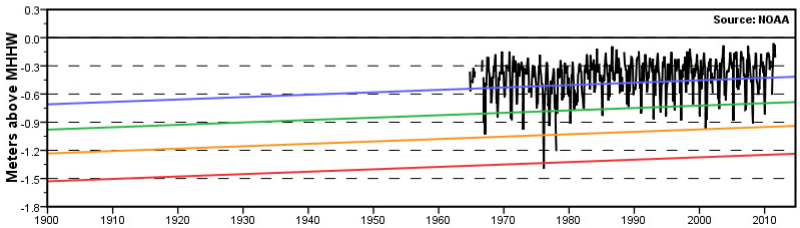
Providence, RI



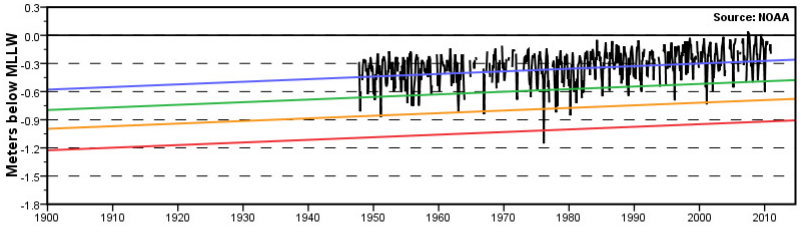
New London, CT



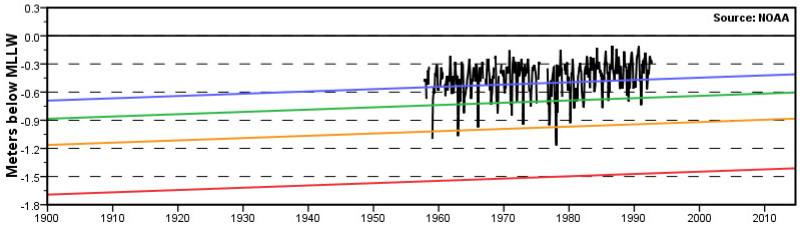
Bridgeport, CT



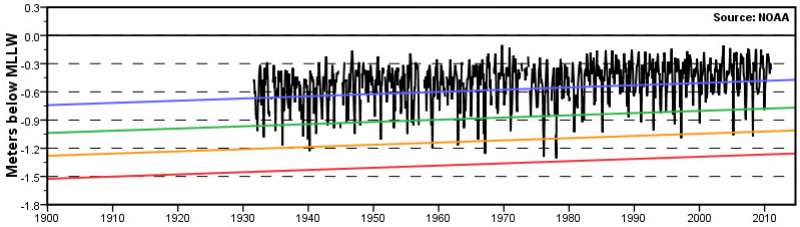
Montauk, NY



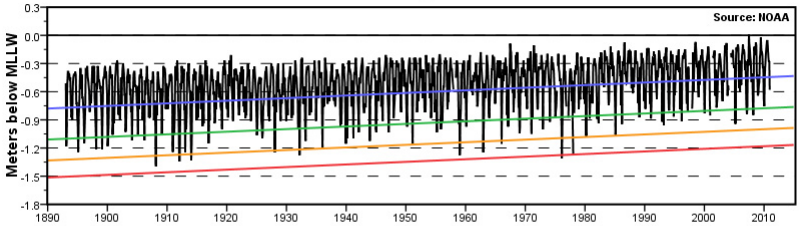
Port Jefferson, NY



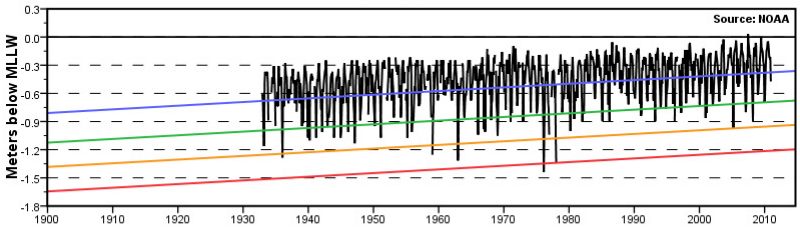
Willets Point / Kings Point, NY



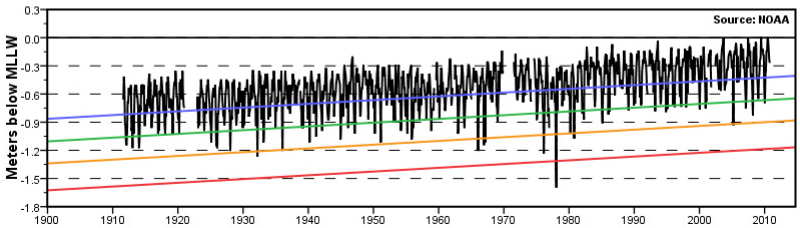
The Battery, NY



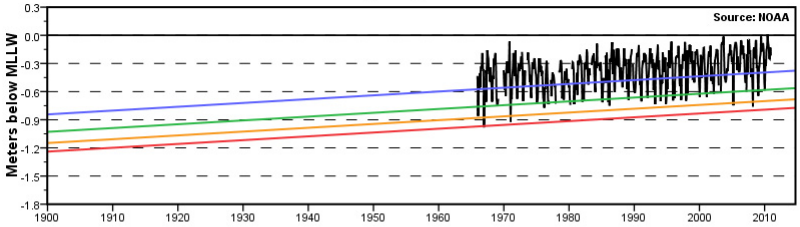
Sandy Hook, NJ



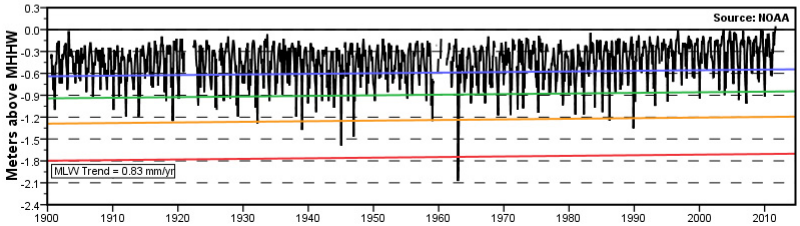
Atlantic City, NJ



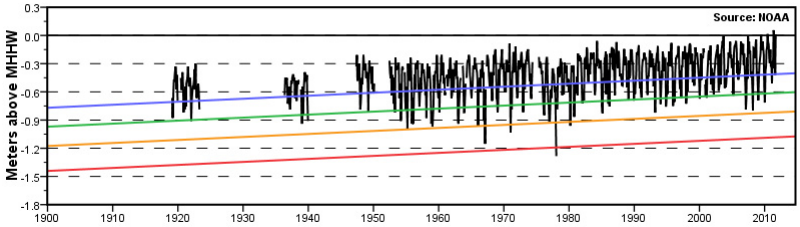
Cape May, NJ



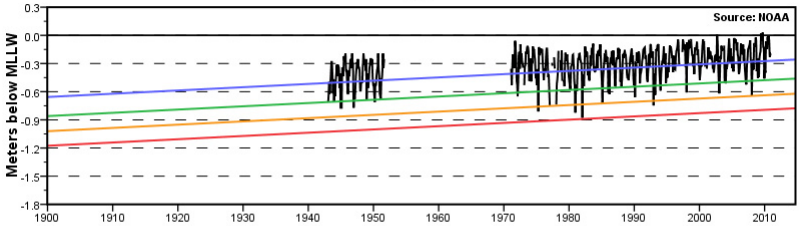
Philadelphia, PA



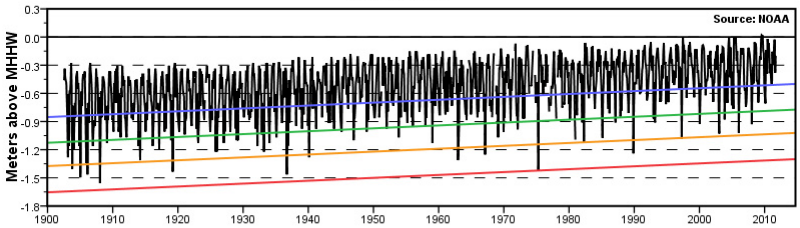
Lewes, DE



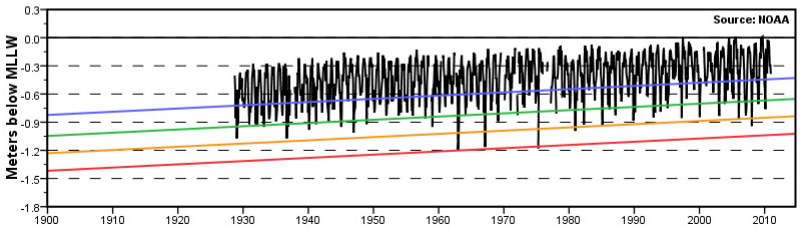
Cambridge, MD



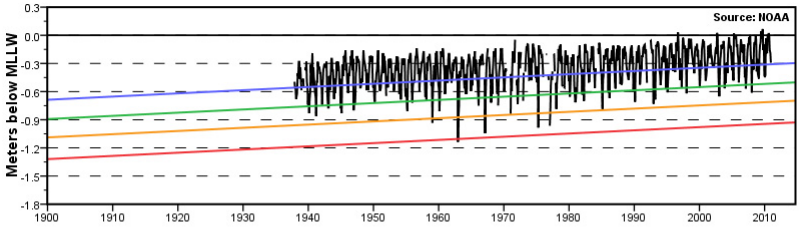
Baltimore, MD



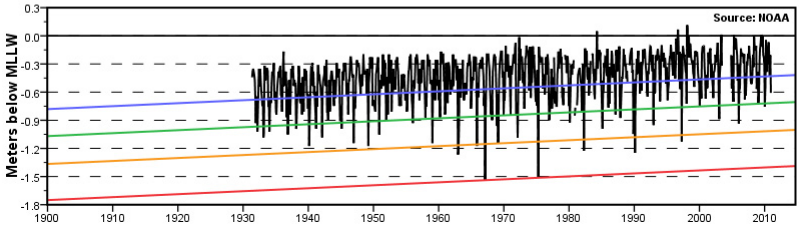
Annapolis, MD



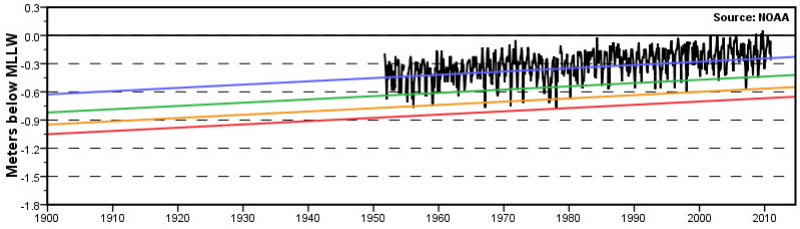
Solomons Island, MD



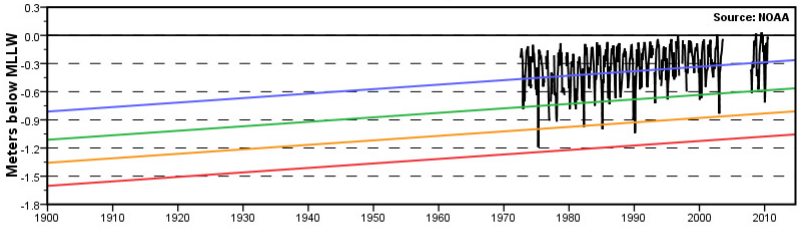
Washington, DC



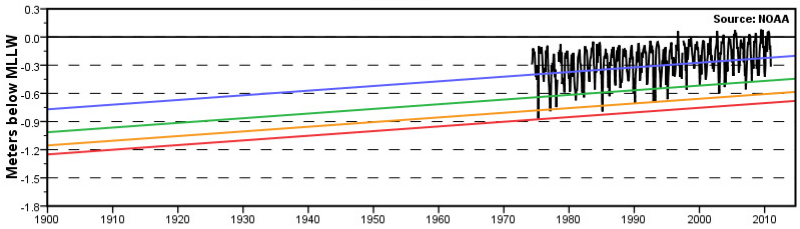
Kiptopeke, VA



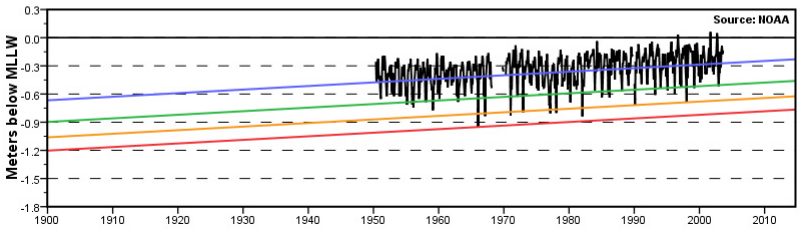
Colonial Beach, VA



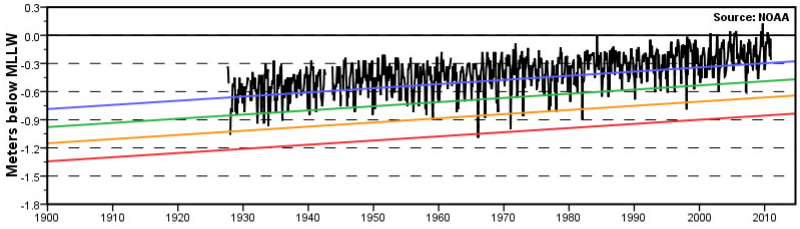
Lewisetta, VA



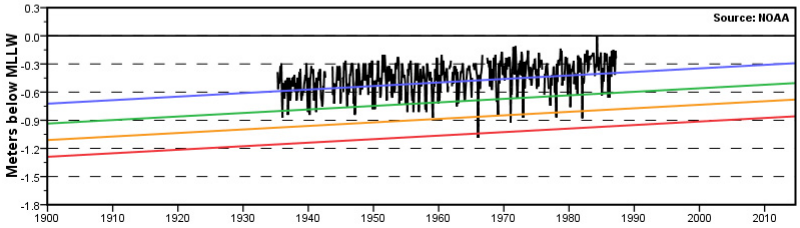
Gloucester Point, VA



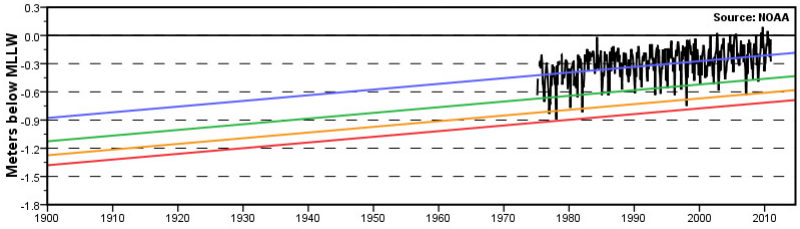
Sewells Point, VA



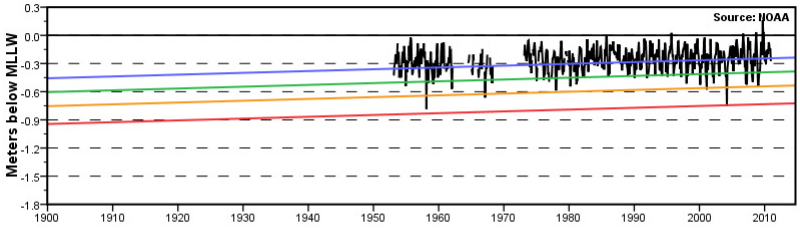
Portsmouth, VA



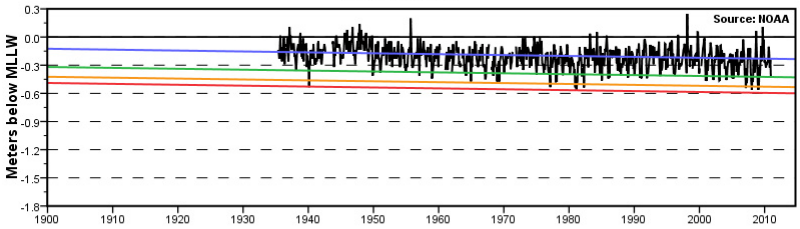
Chesapeake Bay Bridge Tunnel, VA



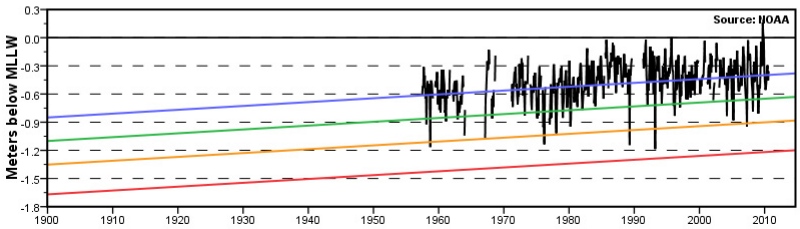
Beaufort, NC



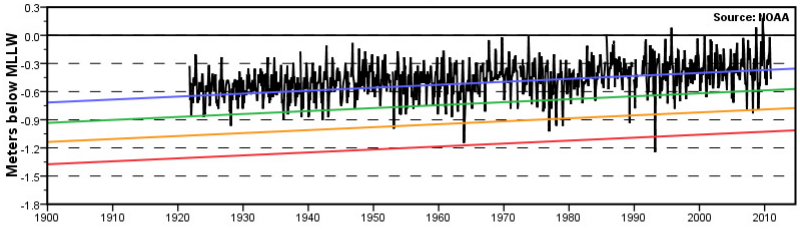
Wilmington, NC



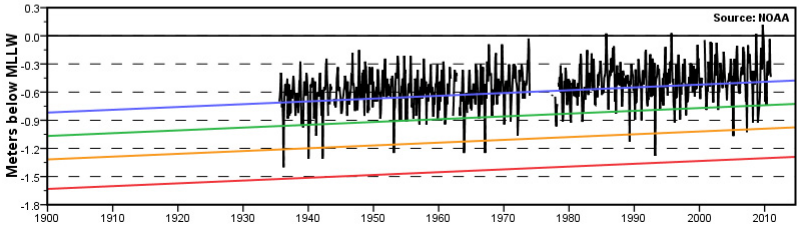
Springmaid Pier, SC



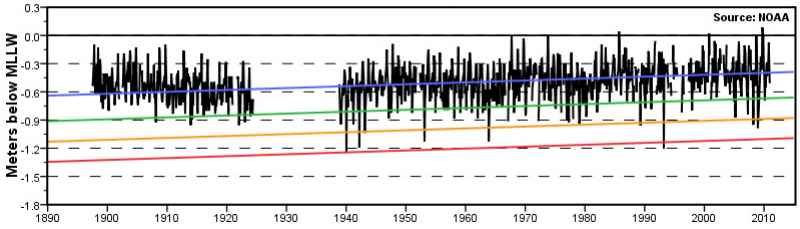
Charleston, SC



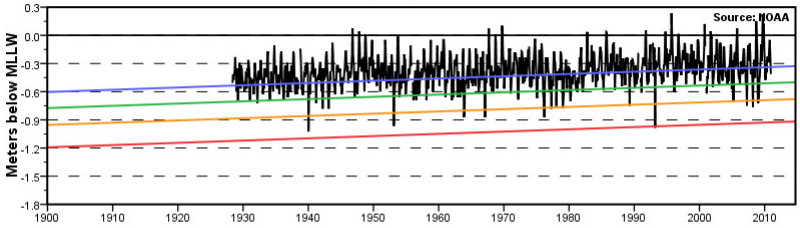
Fort Pulaski, GA



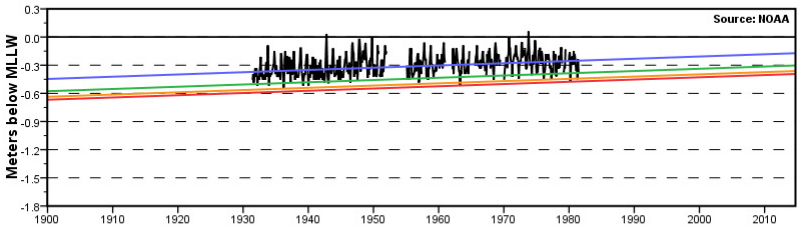
Fernandina Beach, FL



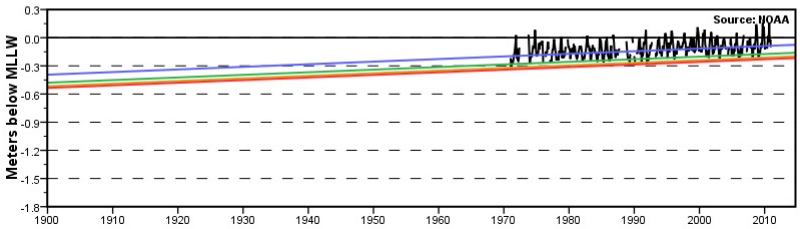
Mayport, FL



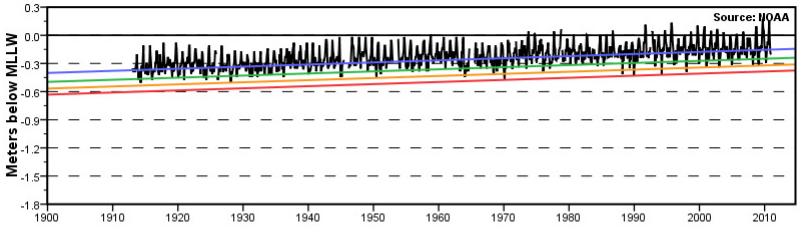
Miami Beach, FL



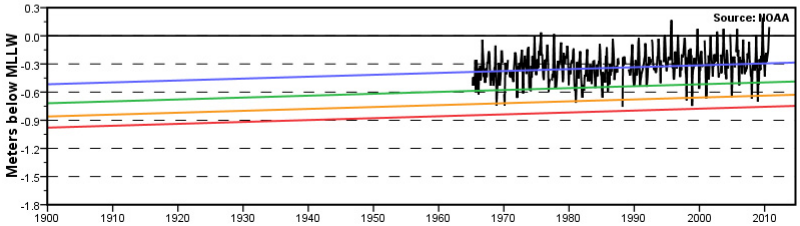
Vaca Key, FL



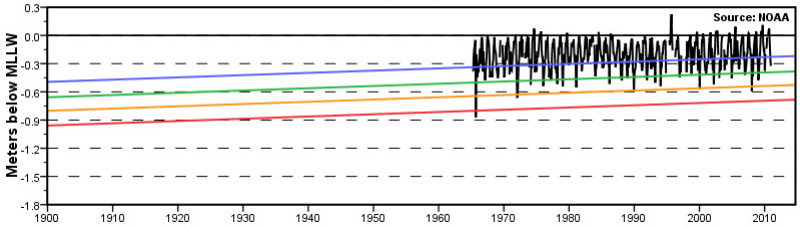
Key West, FL



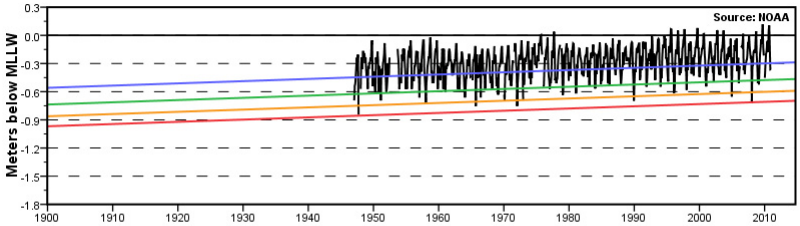
Naples, FL



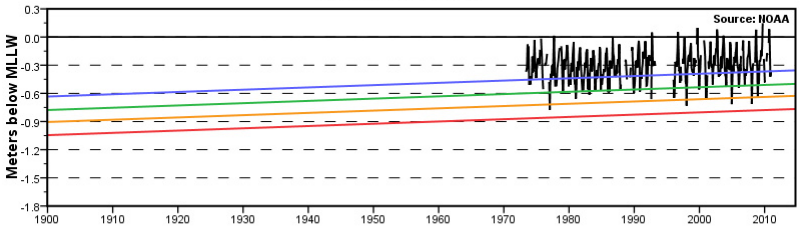
Fort Myers, FL



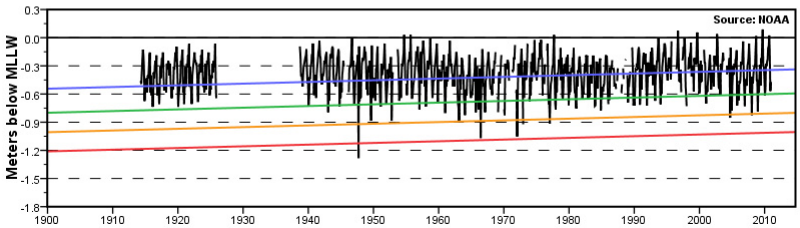
St Petersburg, FL



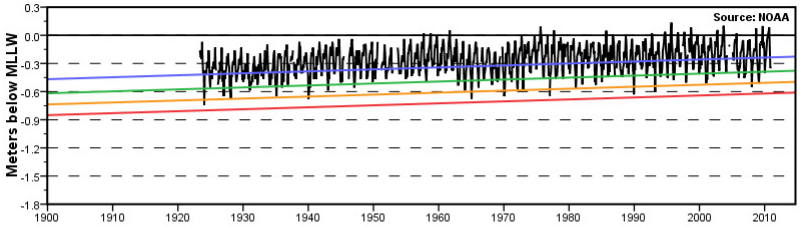
Clearwater Beach, FL



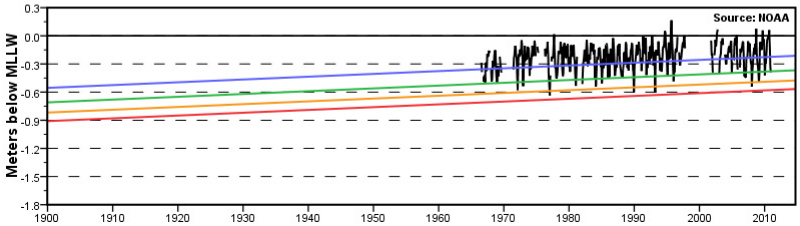
Cedar Key, FL



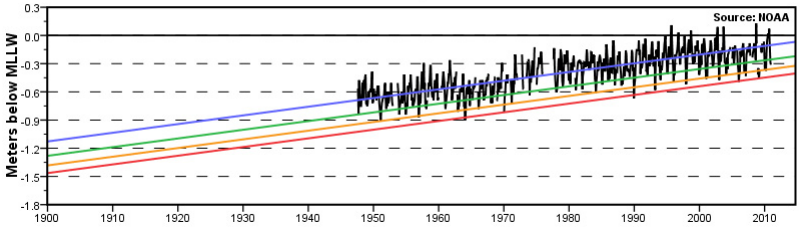
Pensacola, FL



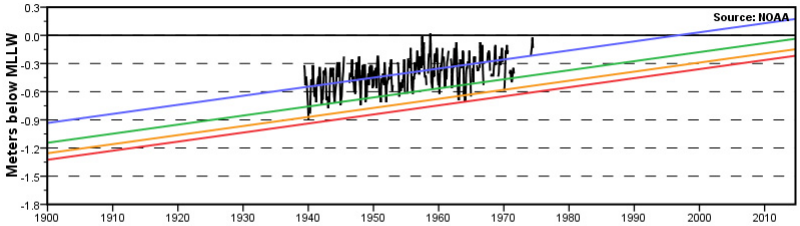
Dauphin Island, AL



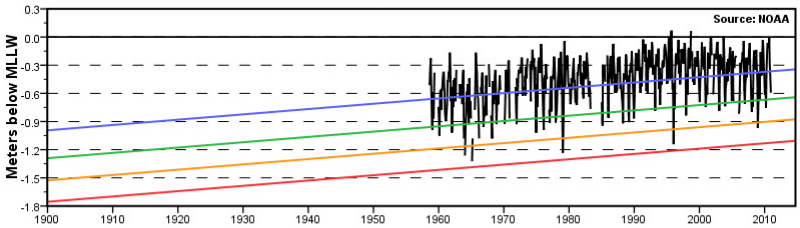
Grand Isle, LA



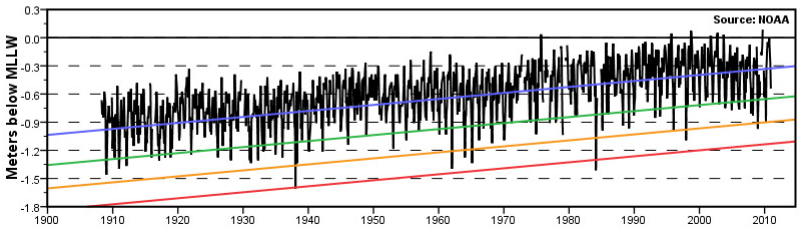
Eugene Island, LA



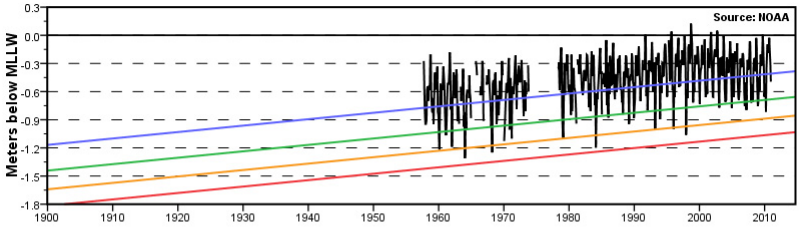
Sabine Pass, TX



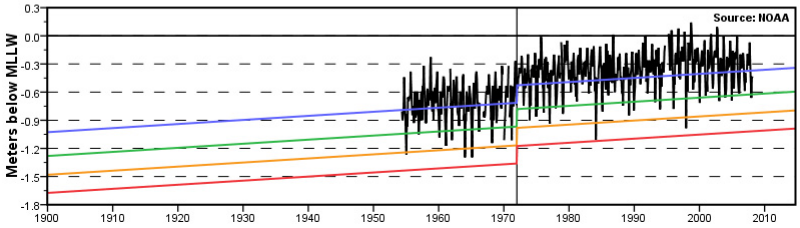
Galveston Pier 21, TX



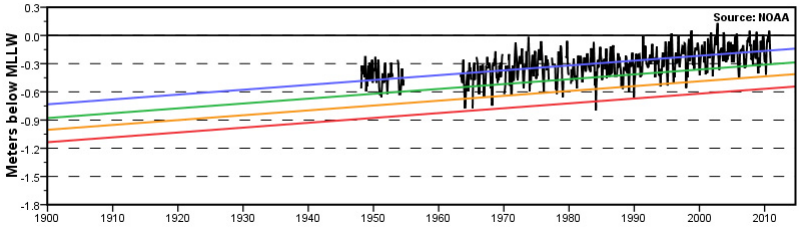
Galveston Pleasure Pier, TX



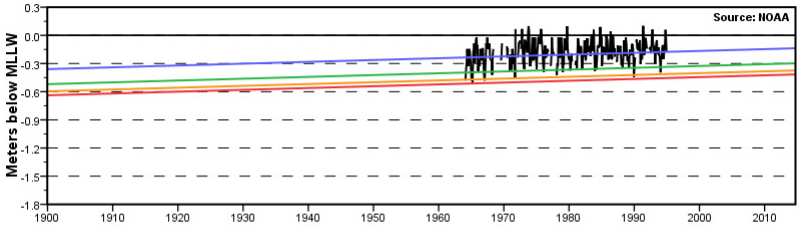
Freeport, TX



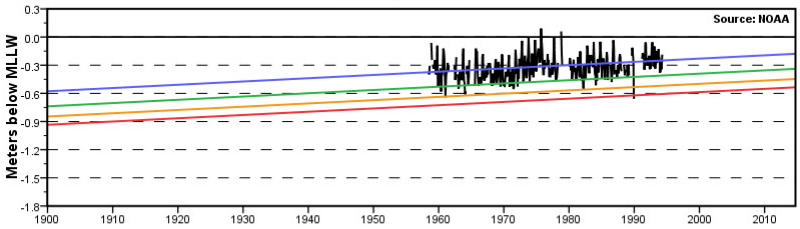
Rockport, TX



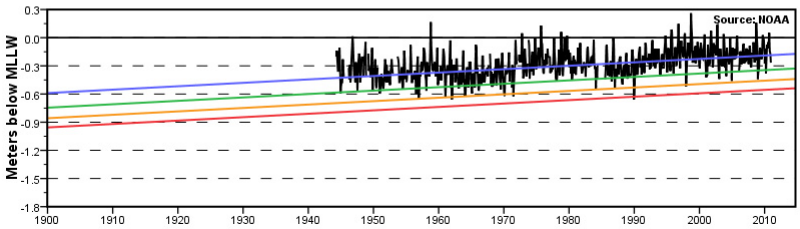
Port Mansfield, TX



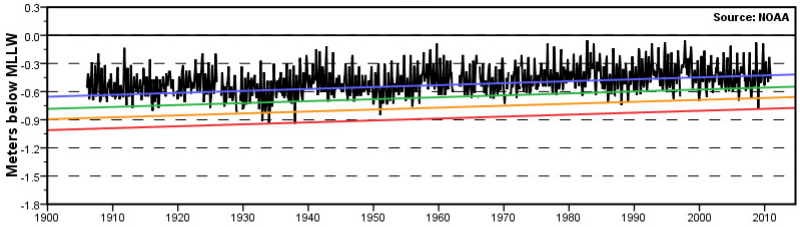
Padre Island, TX



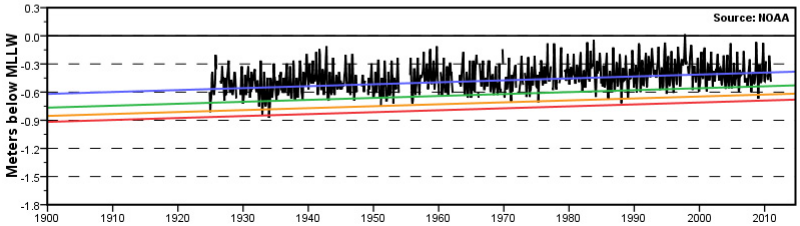
Port Isabel, TX



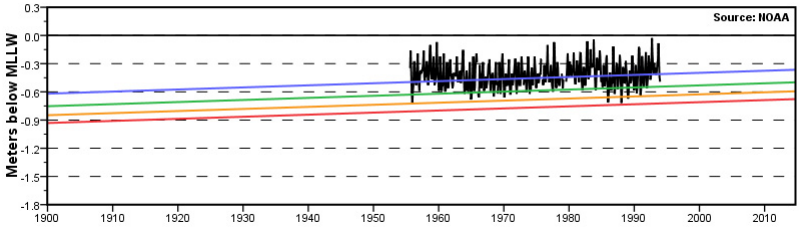
San Diego, CA



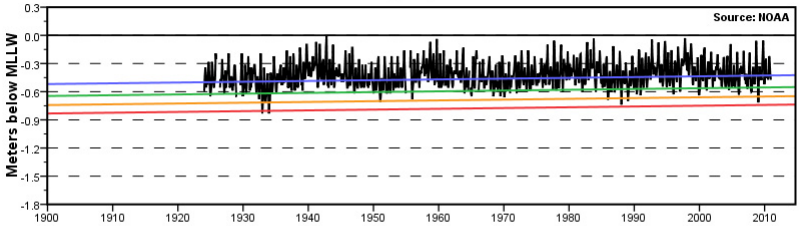
La Jolla, CA



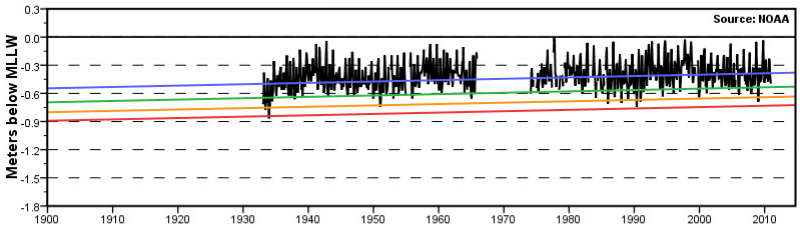
Newport Beach, CA



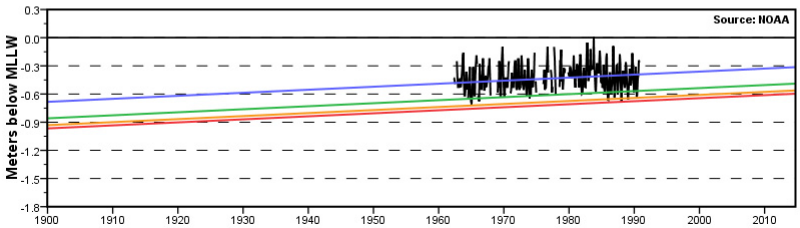
Los Angeles, CA



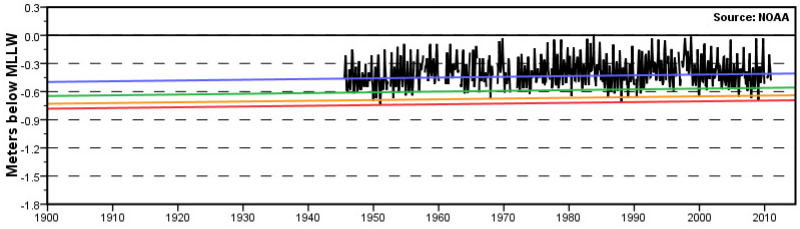
Santa Monica, CA



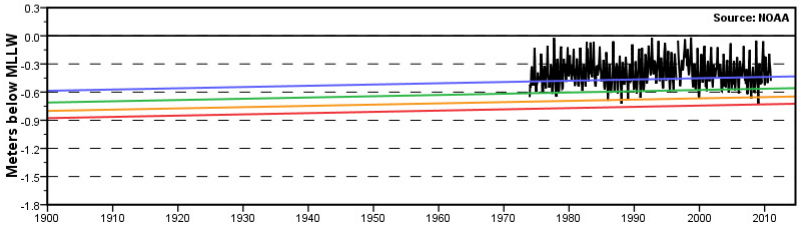
Rincon Island, CA



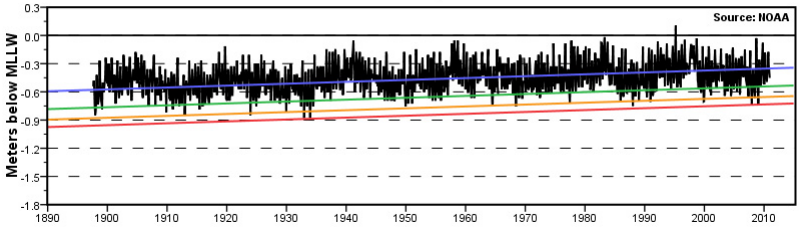
Port San Luis, CA



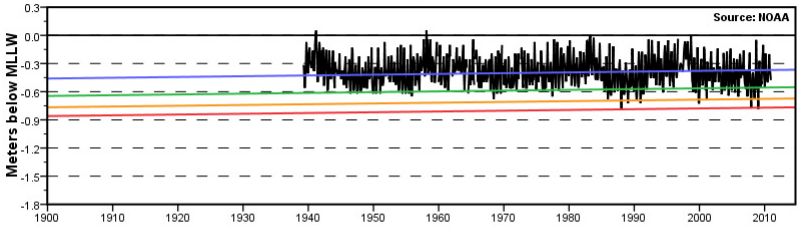
Monterey, CA



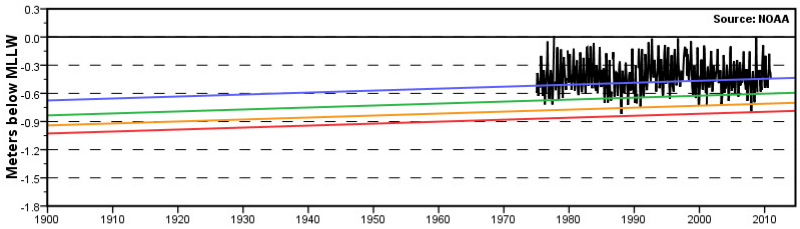
San Francisco, CA



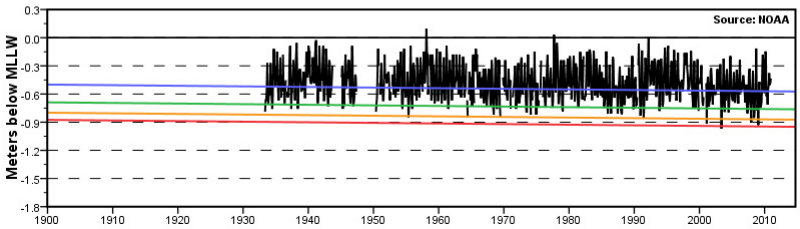
Alameda, CA



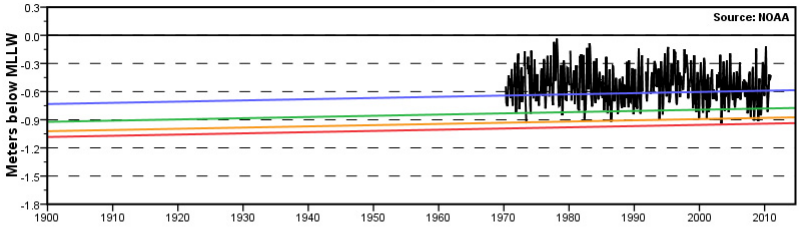
Point Reyes, CA



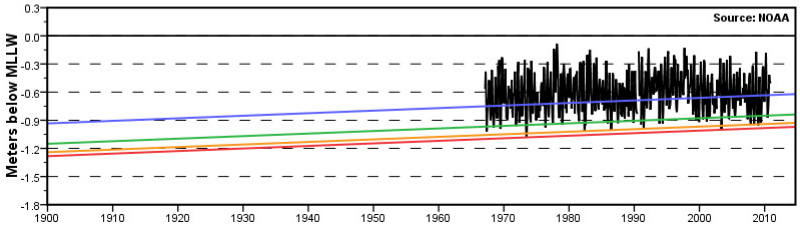
Crescent City, CA



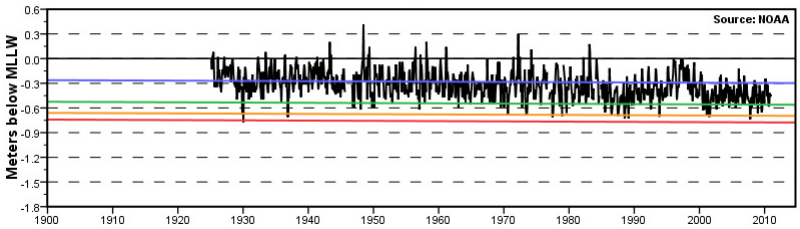
Charleston, OR



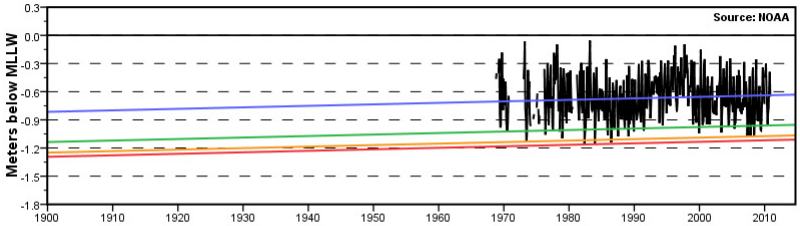
South Beach, OR



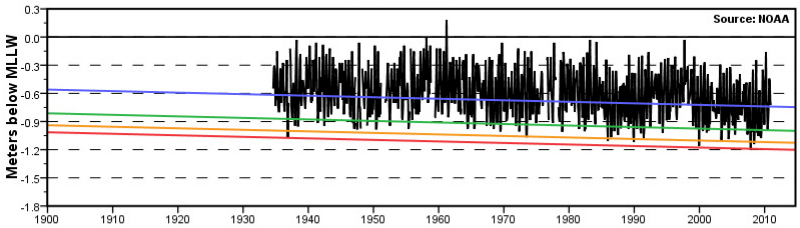
Astoria, OR



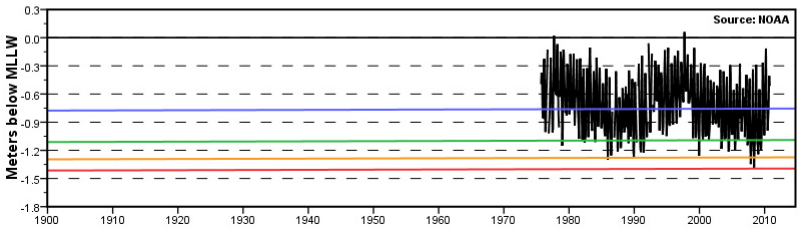
Toke Point, WA



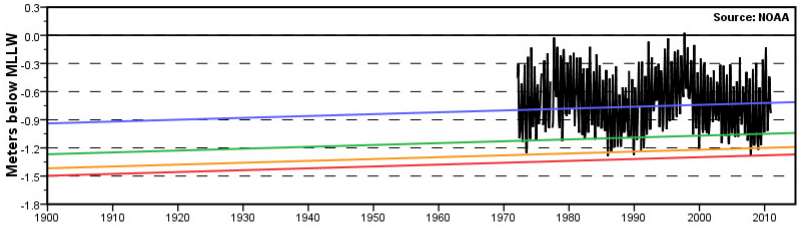
Neah Bay, WA



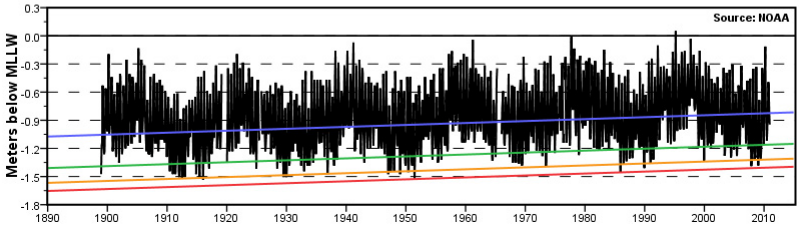
Port Angeles, WA



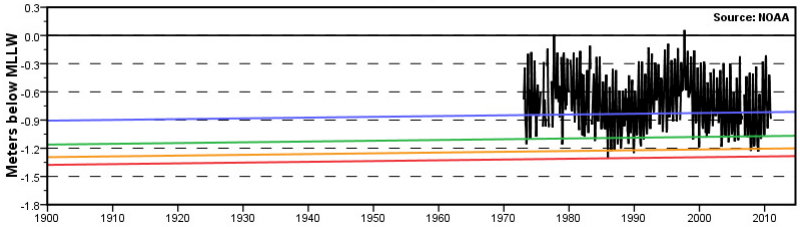
Port Townsend, WA



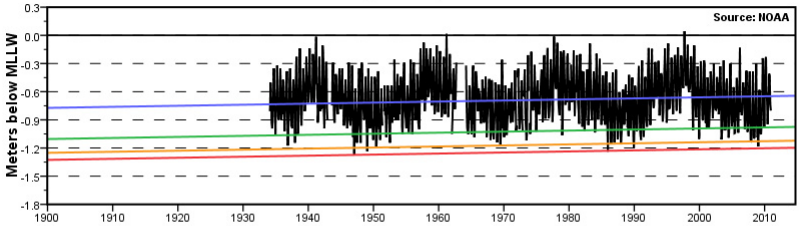
Seattle, WA



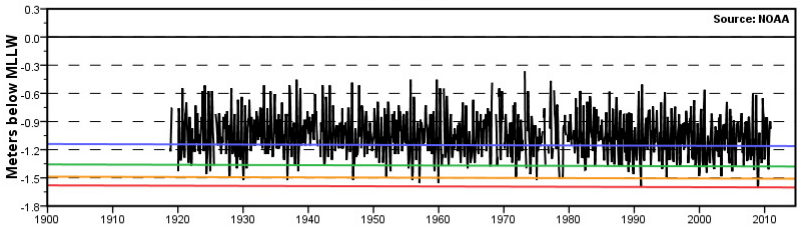
Cherry Point, WA



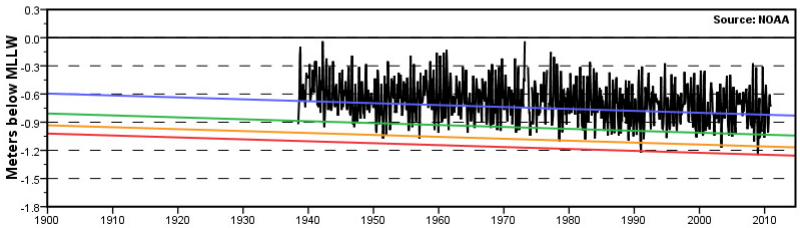
Friday Harbor, WA

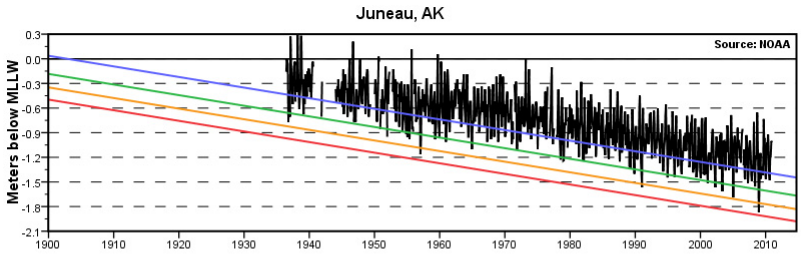


Ketchikan, AK



Sitka, AK




Juneau, AK
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-0.6
-0.9
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-1.8
-2.1
1900
1910
1920
1930
1940
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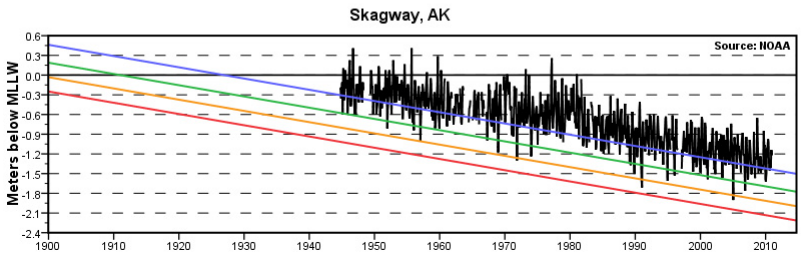
Skagway, AK
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Meters below MLLW
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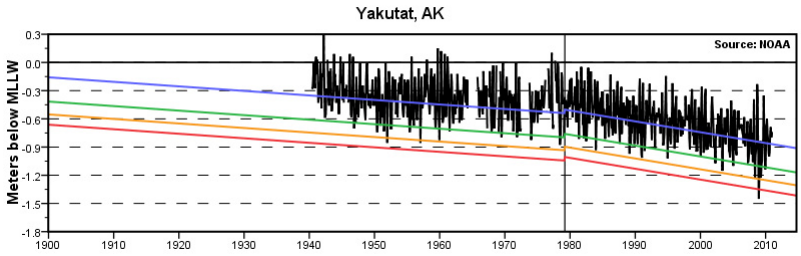
Yakutat, AK
Source: NOAA
Meters below MLLW
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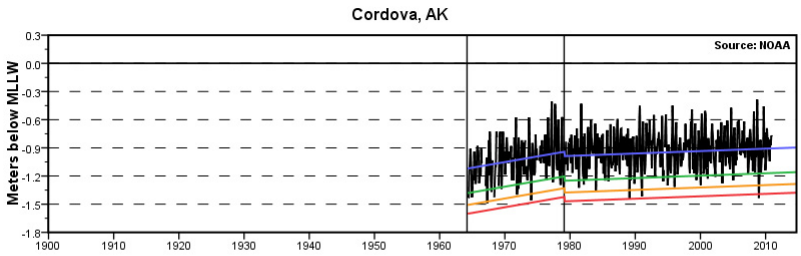
Cordova, AK
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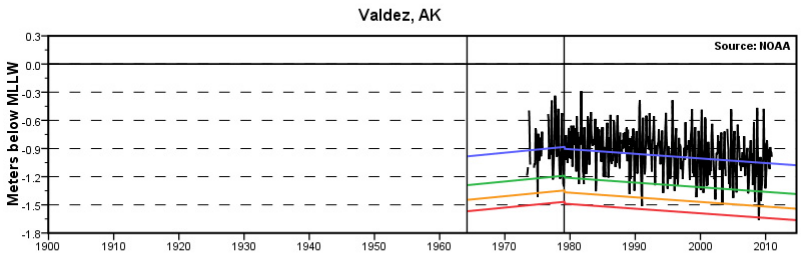
Valdez, AK
Source: NOAA
Meters below MLLW
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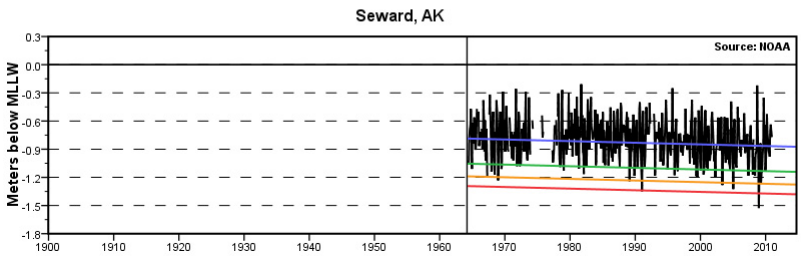
Seward, AK
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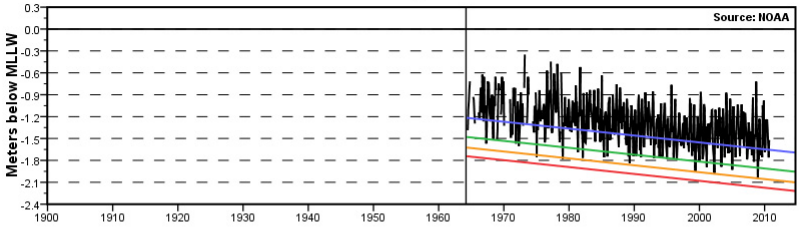
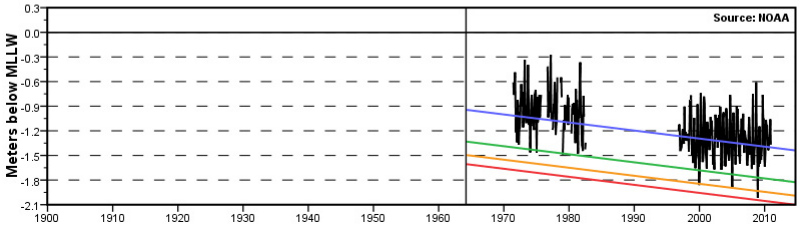
2010

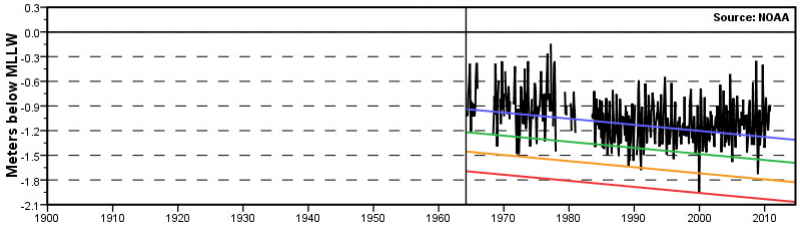
Seldovia, AK



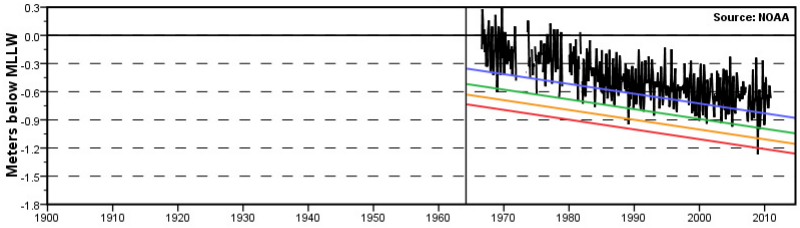
Nikiski, AK



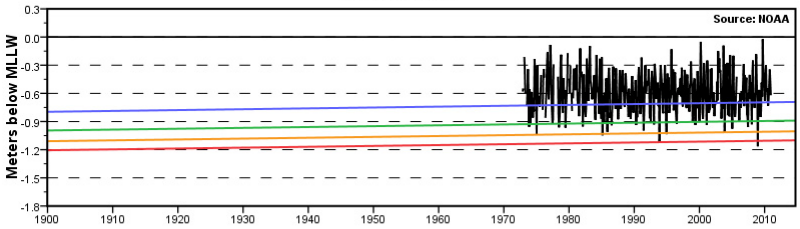
Anchorage, AK



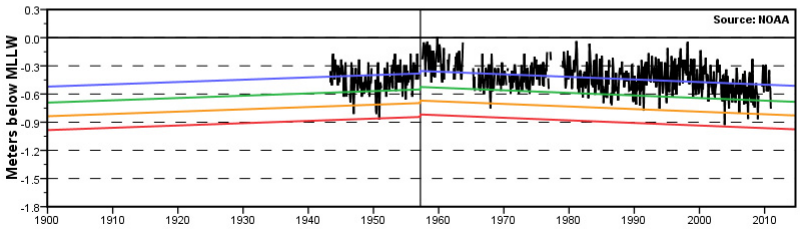
Kodiak Island, AK



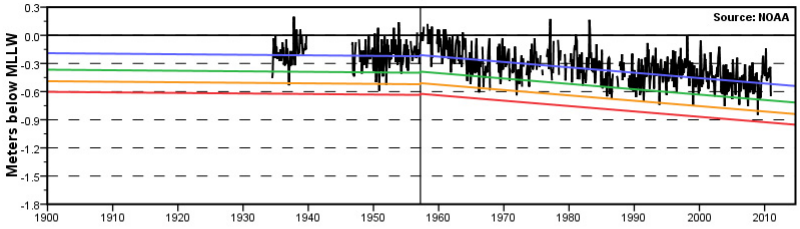
Sand Point, AK



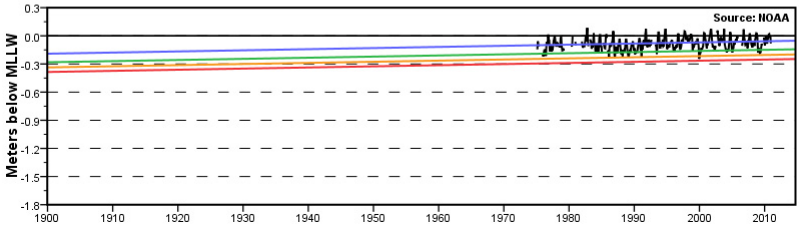
Adak Island, AK



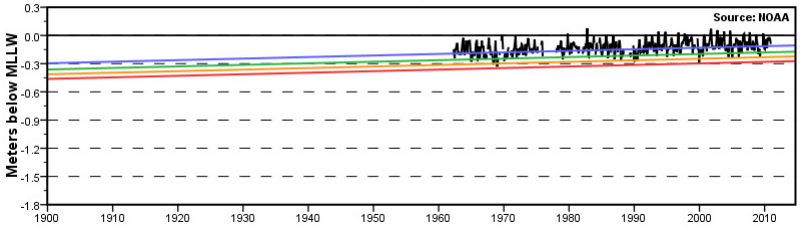
Unalaska, AK



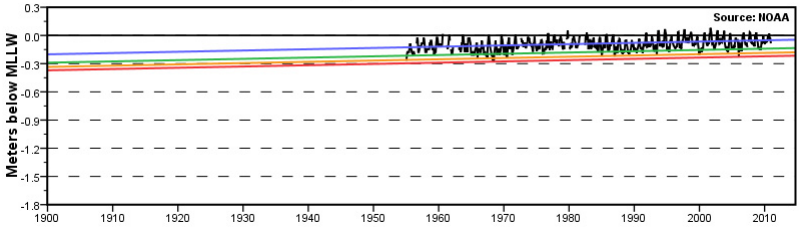
Charlotte Amalie, VI



San Juan, PR



Magueyes Island, PR



Appendix VI.

High Water GEV Exceedance Probabiility Levels by Month

Table E. High Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters above MHHW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1611400 Nawiliwili	0.99	0.040	-0.035	-0.103	-0.055	-0.006	0.060	0.050	0.011	0.034	0.025	0.031	0.089
	0.50	0.224	0.134	0.059	0.067	0.132	0.156	0.200	0.187	0.138	0.163	0.215	0.232
	0.10	0.306	0.253	0.158	0.150	0.197	0.237	0.283	0.277	0.282	0.251	0.294	0.308
	0.01	0.349	0.353	0.230	0.216	0.232	0.321	0.338	0.331	0.541	0.317	0.333	0.356
1612340 Honolulu	0.99	0.045	-0.026	-0.078	-0.067	0.019	0.031	0.050	0.057	0.007	0.001	0.038	0.088
	0.50	0.193	0.142	0.066	0.072	0.134	0.181	0.208	0.194	0.146	0.157	0.212	0.221
	0.10	0.297	0.236	0.155	0.154	0.216	0.273	0.299	0.290	0.253	0.249	0.299	0.318
	0.01	0.386	0.296	0.219	0.211	0.286	0.340	0.360	0.372	0.354	0.313	0.351	0.403
1612480 Mokuoloe	0.99	0.118	-0.004	-0.031	-0.045	0.036	0.067	0.041	0.051	0.033	0.001	0.007	0.107
	0.50	0.246	0.184	0.116	0.080	0.127	0.183	0.224	0.214	0.167	0.161	0.247	0.264
	0.10	0.342	0.276	0.196	0.165	0.237	0.278	0.290	0.302	0.254	0.248	0.342	0.359
	0.01	0.430	0.328	0.248	0.236	0.407	0.375	0.317	0.357	0.321	0.303	0.385	0.428
1615680 Kahului	0.99	0.111	-0.005	-0.021	-0.031	0.062	0.077	0.091	0.116	0.047	0.032	0.074	0.129
	0.50	0.244	0.189	0.102	0.100	0.153	0.200	0.234	0.231	0.186	0.174	0.232	0.240
	0.10	0.333	0.267	0.184	0.166	0.230	0.285	0.314	0.308	0.251	0.248	0.310	0.326
	0.01	0.405	0.304	0.251	0.206	0.309	0.355	0.367	0.370	0.287	0.292	0.356	0.408
1617760 Hilo	0.99	0.099	0.012	-0.048	-0.051	0.014	0.031	0.106	0.094	0.020	0.014	0.049	0.090
	0.50	0.262	0.202	0.118	0.113	0.159	0.193	0.234	0.243	0.187	0.192	0.252	0.265
	0.10	0.361	0.304	0.218	0.197	0.253	0.289	0.324	0.333	0.281	0.270	0.331	0.365
	0.01	0.431	0.369	0.290	0.248	0.327	0.358	0.401	0.399	0.344	0.310	0.367	0.433
1619000 Johnston Atoll	0.99	0.074	-0.032	0.013	-0.094	-0.061	-0.082	0.018	0.072	0.011	0.100	0.072	0.085
	0.50	0.306	0.214	0.140	0.160	0.121	0.109	0.146	0.172	0.197	0.240	0.283	0.273
	0.10	0.523	0.370	0.302	0.294	0.229	0.205	0.220	0.285	0.298	0.366	0.387	0.383
	0.01	0.778	0.488	0.568	0.377	0.305	0.260	0.271	0.451	0.361	0.506	0.447	0.460
1619910 Midway Atoll	0.99	0.077	-0.012	-0.032	-0.111	-0.116	-0.144	-0.141	-0.090	-0.053	-0.006	0.000	0.033
	0.50	0.302	0.217	0.173	0.073	0.076	0.079	0.060	0.087	0.143	0.179	0.227	0.255
	0.10	0.519	0.435	0.386	0.187	0.183	0.155	0.153	0.184	0.265	0.304	0.399	0.461
	0.01	0.782	0.692	0.664	0.271	0.253	0.184	0.202	0.247	0.355	0.406	0.557	0.698
1630000 Guam	0.99	-0.104	-0.108	-0.063	-0.053	-0.008	0.008	0.052	-0.016	-0.020	-0.039	-0.125	-0.096
	0.50	0.103	0.134	0.149	0.162	0.166	0.198	0.227	0.195	0.167	0.145	0.122	0.108
	0.10	0.227	0.254	0.255	0.268	0.260	0.289	0.309	0.363	0.278	0.270	0.225	0.214
	0.01	0.314	0.322	0.316	0.328	0.321	0.339	0.354	0.527	0.355	0.371	0.275	0.277
1770000 Pago Pago	0.99	0.021	0.013	-0.011	-0.064	-0.103	-0.052	0.003	0.014	0.037	0.036	-0.023	0.000
	0.50	0.200	0.202	0.195	0.205	0.209	0.222	0.238	0.236	0.199	0.200	0.212	0.209
	0.10	0.306	0.309	0.299	0.324	0.326	0.303	0.332	0.324	0.317	0.289	0.282	0.300
	0.01	0.382	0.379	0.359	0.385	0.376	0.331	0.376	0.364	0.421	0.346	0.306	0.346
1820000 Kwajalein	0.99	0.149	0.245	0.217	0.215	0.204	0.160	0.169	0.175	0.141	0.136	0.133	0.070
	0.50	0.334	0.395	0.401	0.389	0.360	0.326	0.359	0.377	0.348	0.373	0.369	0.308
	0.10	0.444	0.493	0.500	0.473	0.450	0.419	0.452	0.469	0.475	0.484	0.471	0.426
	0.01	0.520	0.572	0.565	0.520	0.511	0.480	0.505	0.517	0.570	0.544	0.521	0.495

Table E. High Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters above MHHW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1840000 Chuuk	0.99	-0.077	-0.127	-0.070	0.076	0.061	0.024	-0.049	-0.083	-0.162	-0.145	-0.079	-0.100
	0.50	0.177	0.166	0.117	0.169	0.222	0.225	0.204	0.153	0.075	0.142	0.177	0.179
	0.10	0.299	0.274	0.209	0.238	0.287	0.304	0.289	0.281	0.222	0.296	0.374	0.314
	0.01	0.368	0.320	0.262	0.300	0.317	0.338	0.321	0.363	0.331	0.393	0.559	0.389
1890000 Wake Island	0.99	0.040	0.027	-0.010	-0.070	-0.076	-0.023	0.011	0.059	0.070	0.068	0.037	0.032
	0.50	0.178	0.196	0.178	0.161	0.157	0.155	0.212	0.252	0.225	0.231	0.222	0.199
	0.10	0.312	0.321	0.282	0.284	0.257	0.273	0.319	0.463	0.387	0.413	0.321	0.305
	0.01	0.477	0.432	0.350	0.362	0.306	0.367	0.386	0.755	0.602	0.673	0.384	0.383
2695540 Bermuda	0.99	0.020	-0.073	-0.020	-0.003	-0.017	-0.015	-0.048	0.001	-0.005	0.065	0.033	0.006
	0.50	0.221	0.182	0.146	0.158	0.174	0.198	0.213	0.227	0.235	0.294	0.302	0.271
	0.10	0.355	0.291	0.305	0.271	0.291	0.307	0.336	0.376	0.425	0.464	0.461	0.461
	0.01	0.461	0.345	0.495	0.367	0.376	0.372	0.403	0.494	0.608	0.619	0.574	0.626
8410140 Eastport	0.99	0.437	0.457	0.431	0.476	0.413	0.336	0.284	0.302	0.360	0.391	0.373	0.416
	0.50	0.880	0.864	0.784	0.797	0.796	0.791	0.784	0.755	0.724	0.830	0.864	0.893
	0.10	1.186	1.090	1.023	1.061	0.980	0.983	0.943	0.960	0.984	1.024	1.116	1.152
	0.01	1.442	1.237	1.218	1.327	1.083	1.076	1.000	1.067	1.208	1.124	1.267	1.317
8413320 Bar Harbor	0.99	0.317	0.311	0.214	0.262	0.292	0.212	0.221	0.142	0.172	0.352	0.266	0.326
	0.50	0.640	0.592	0.535	0.548	0.528	0.578	0.540	0.506	0.460	0.550	0.600	0.636
	0.10	0.897	0.812	0.719	0.728	0.677	0.666	0.655	0.635	0.648	0.688	0.787	0.860
	0.01	1.145	1.023	0.844	0.862	0.790	0.690	0.703	0.687	0.794	0.805	0.911	1.057
8418150 Portland	0.99	0.266	0.242	0.169	0.232	0.236	0.232	0.222	0.217	0.174	0.241	0.245	0.233
	0.50	0.550	0.507	0.480	0.501	0.508	0.533	0.494	0.451	0.419	0.496	0.548	0.587
	0.10	0.799	0.749	0.729	0.755	0.668	0.657	0.623	0.615	0.565	0.675	0.792	0.814
	0.01	1.070	1.023	0.972	1.054	0.782	0.716	0.695	0.753	0.667	0.826	1.035	0.988
8419870 Seavey Island	0.99	0.228	0.175	0.145	0.202	0.202	0.183	0.141	0.142	0.038	0.241	0.212	0.175
	0.50	0.493	0.431	0.425	0.415	0.416	0.445	0.388	0.353	0.344	0.409	0.460	0.507
	0.10	0.722	0.668	0.694	0.646	0.581	0.564	0.512	0.524	0.439	0.556	0.684	0.730
	0.01	0.964	0.942	1.018	0.963	0.736	0.626	0.586	0.696	0.472	0.718	0.935	0.909
8443970 Boston	0.99	0.272	0.262	0.187	0.258	0.260	0.267	0.203	0.212	0.203	0.290	0.282	0.290
	0.50	0.586	0.546	0.518	0.519	0.504	0.531	0.500	0.456	0.432	0.516	0.581	0.594
	0.10	0.867	0.821	0.787	0.775	0.714	0.659	0.633	0.630	0.588	0.726	0.802	0.844
	0.01	1.180	1.156	1.055	1.092	0.937	0.730	0.701	0.781	0.716	0.971	1.000	1.097
8447930 Woods Hole	0.99	0.140	0.137	0.036	0.104	0.138	0.155	0.114	0.127	0.153	0.193	0.179	0.111
	0.50	0.387	0.307	0.331	0.296	0.254	0.279	0.254	0.235	0.282	0.377	0.393	0.426
	0.10	0.629	0.554	0.567	0.515	0.377	0.379	0.341	0.421	0.527	0.561	0.664	0.678
	0.01	0.925	1.033	0.798	0.835	0.543	0.479	0.404	0.855	1.172	0.792	1.106	0.927
8449130 Nantucket Island	0.99	0.190	0.155	0.079	0.077	0.108	0.166	0.073	0.095	0.093	0.158	0.146	0.163
	0.50	0.416	0.342	0.315	0.261	0.234	0.275	0.268	0.215	0.229	0.315	0.351	0.405
	0.10	0.618	0.540	0.521	0.470	0.405	0.380	0.333	0.321	0.367	0.503	0.533	0.614
	0.01	0.842	0.807	0.745	0.773	0.709	0.507	0.357	0.437	0.541	0.795	0.732	0.835
8452660	0.99	0.165	0.149	0.143	0.151	0.153	0.174	0.122	0.146	0.228	0.284	0.202	0.164

Table E. High Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters above MHHW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Newport	0.50	0.415	0.356	0.373	0.361	0.330	0.337	0.317	0.314	0.372	0.444	0.440	0.454
	0.10	0.665	0.590	0.581	0.551	0.458	0.447	0.409	0.540	0.581	0.616	0.693	0.685
	0.01	0.980	0.924	0.815	0.762	0.568	0.538	0.460	0.937	0.983	0.847	1.030	0.910
8454000	0.99	0.183	0.131	0.140	0.232	0.197	0.208	0.211	0.223	0.278	0.289	0.268	0.203
	0.50	0.459	0.430	0.465	0.427	0.397	0.397	0.366	0.380	0.442	0.503	0.501	0.518
Providence	0.10	0.817	0.694	0.743	0.688	0.548	0.542	0.483	0.574	0.743	0.700	0.799	0.819
	0.01	1.422	0.982	1.036	1.148	0.685	0.677	0.591	0.883	1.502	0.925	1.296	1.179
8461490	0.99	0.136	0.134	0.044	0.091	0.117	0.140	0.106	0.116	0.147	0.158	0.158	0.098
	0.50	0.373	0.321	0.362	0.314	0.275	0.252	0.206	0.224	0.270	0.373	0.408	0.474
New London	0.10	0.590	0.552	0.654	0.537	0.411	0.368	0.305	0.400	0.517	0.639	0.741	0.751
	0.01	0.835	0.917	0.987	0.817	0.556	0.519	0.428	0.788	1.199	1.064	1.318	1.000
8467150	0.99	0.152	0.114	0.116	0.217	0.215	0.246	0.193	0.189	0.249	0.248	0.203	0.121
	0.50	0.468	0.385	0.425	0.434	0.408	0.396	0.338	0.364	0.417	0.484	0.471	0.555
Bridgeport	0.10	0.690	0.656	0.714	0.648	0.544	0.505	0.468	0.541	0.605	0.796	0.718	0.910
	0.01	0.880	0.996	1.052	0.913	0.662	0.600	0.612	0.766	0.871	1.334	1.000	1.266
8510560	0.99	0.135	0.153	0.058	0.077	0.113	0.151	0.109	0.105	0.164	0.203	0.165	0.120
	0.50	0.380	0.325	0.360	0.323	0.272	0.263	0.228	0.233	0.296	0.392	0.397	0.458
Montauk	0.10	0.634	0.624	0.659	0.527	0.425	0.365	0.320	0.422	0.484	0.646	0.715	0.725
	0.01	0.968	1.323	1.032	0.738	0.609	0.480	0.406	0.794	0.834	1.088	1.279	0.985
8514560	0.99	0.130	0.089	0.104	0.188	0.177	0.197	0.163	0.167	0.237	0.220	0.181	0.062
	0.50	0.435	0.366	0.422	0.407	0.380	0.358	0.331	0.342	0.389	0.457	0.483	0.514
Port Jefferson	0.10	0.723	0.816	0.788	0.662	0.520	0.480	0.442	0.456	0.654	0.816	0.769	0.796
	0.01	1.063	1.800	1.323	1.044	0.636	0.590	0.531	0.544	1.283	1.532	1.105	1.007
8516945	0.99	0.136	0.154	0.136	0.219	0.173	0.253	0.186	0.191	0.256	0.229	0.187	0.178
	0.50	0.512	0.453	0.485	0.470	0.450	0.423	0.349	0.365	0.444	0.511	0.519	0.548
Kings Point	0.10	0.823	0.857	0.907	0.771	0.648	0.544	0.487	0.640	0.766	0.904	0.956	0.944
	0.01	1.138	1.567	1.561	1.236	0.818	0.649	0.631	1.221	1.512	1.624	1.705	1.483
8518750	0.99	0.137	0.122	0.132	0.185	0.167	0.193	0.164	0.149	0.222	0.207	0.181	0.152
	0.50	0.447	0.400	0.382	0.415	0.391	0.374	0.320	0.337	0.377	0.467	0.461	0.467
The Battery	0.10	0.699	0.668	0.690	0.669	0.564	0.527	0.429	0.505	0.602	0.735	0.769	0.751
	0.01	0.948	0.989	1.178	1.025	0.726	0.686	0.521	0.690	1.034	1.084	1.203	1.066
8531680	0.99	0.146	0.151	0.151	0.191	0.196	0.215	0.198	0.161	0.250	0.216	0.196	0.156
	0.50	0.466	0.401	0.412	0.404	0.396	0.398	0.355	0.377	0.417	0.482	0.470	0.470
Sandy Hook	0.10	0.752	0.620	0.766	0.643	0.561	0.519	0.468	0.567	0.653	0.752	0.806	0.778
	0.01	1.066	0.858	1.393	0.987	0.728	0.614	0.566	0.773	1.093	1.097	1.336	1.159
8534720	0.99	0.134	0.143	0.065	0.110	0.161	0.211	0.184	0.156	0.215	0.211	0.212	0.160
	0.50	0.456	0.392	0.380	0.381	0.378	0.402	0.344	0.374	0.402	0.469	0.461	0.453
Atlantic City	0.10	0.709	0.624	0.679	0.594	0.564	0.538	0.475	0.602	0.660	0.740	0.731	0.728
	0.01	0.953	0.894	1.035	0.798	0.760	0.655	0.605	0.905	1.126	1.101	1.101	1.050
8536110	0.99	0.160	0.116	0.045	0.098	0.170	0.220	0.211	0.184	0.222	0.172	0.159	0.098
	0.50	0.443	0.317	0.344	0.381	0.371	0.388	0.342	0.360	0.367	0.423	0.442	0.444

Table E. High Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters above MHHW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Cape May	0.10	0.689	0.520	0.622	0.571	0.571	0.532	0.449	0.490	0.576	0.704	0.620	0.717
	0.01	0.951	0.777	0.940	0.725	0.823	0.684	0.556	0.607	0.973	1.104	0.752	0.981
8545240	0.99	0.040	-0.021	0.066	0.075	0.157	0.198	0.201	0.177	0.138	0.146	0.031	0.026
	0.50	0.366	0.270	0.374	0.414	0.382	0.390	0.332	0.330	0.347	0.370	0.365	0.348
Philadelphia	0.10	0.636	0.541	0.635	0.663	0.568	0.597	0.503	0.519	0.576	0.643	0.670	0.629
	0.01	0.910	0.855	0.908	0.886	0.759	0.883	0.792	0.816	0.894	1.073	1.016	0.933
8557380	0.99	0.085	0.107	0.058	0.073	0.161	0.205	0.186	0.134	0.215	0.146	0.145	0.130
	0.50	0.451	0.366	0.388	0.383	0.375	0.378	0.331	0.366	0.393	0.480	0.462	0.436
Lewes	0.10	0.794	0.630	0.712	0.568	0.594	0.534	0.451	0.516	0.652	0.773	0.711	0.690
	0.01	1.195	0.972	1.110	0.699	0.876	0.709	0.575	0.633	1.143	1.090	0.948	0.950
8571892	0.99	-0.019	0.019	-0.056	0.005	0.123	0.158	0.122	0.125	0.154	0.148	0.101	0.034
	0.50	0.281	0.221	0.319	0.326	0.279	0.285	0.241	0.286	0.336	0.403	0.384	0.295
Cambridge	0.10	0.461	0.400	0.518	0.485	0.405	0.409	0.324	0.372	0.598	0.584	0.585	0.503
	0.01	0.590	0.594	0.643	0.577	0.531	0.559	0.393	0.426	1.100	0.740	0.758	0.707
8574680	0.99	0.019	0.023	0.047	0.127	0.149	0.176	0.168	0.198	0.199	0.218	0.156	0.058
	0.50	0.285	0.251	0.284	0.337	0.317	0.336	0.310	0.319	0.392	0.408	0.361	0.305
Baltimore	0.10	0.511	0.452	0.516	0.509	0.471	0.501	0.410	0.524	0.664	0.626	0.596	0.518
	0.01	0.751	0.673	0.798	0.682	0.645	0.717	0.495	0.991	1.171	0.944	0.941	0.746
8575512	0.99	-0.023	-0.013	0.044	0.074	0.117	0.161	0.143	0.169	0.167	0.185	0.136	0.024
	0.50	0.282	0.233	0.273	0.316	0.309	0.305	0.271	0.290	0.366	0.387	0.353	0.302
Annapolis	0.10	0.484	0.427	0.513	0.497	0.431	0.453	0.383	0.474	0.641	0.605	0.582	0.502
	0.01	0.645	0.612	0.830	0.660	0.524	0.643	0.502	0.850	1.137	0.903	0.885	0.675
8577330	0.99	-0.023	0.002	0.007	0.026	0.113	0.112	0.085	0.147	0.163	0.111	0.092	0.011
	0.50	0.251	0.196	0.263	0.295	0.273	0.267	0.216	0.275	0.346	0.384	0.333	0.253
Solomons Island	0.10	0.413	0.351	0.500	0.439	0.425	0.389	0.340	0.421	0.574	0.560	0.543	0.455
	0.01	0.527	0.503	0.772	0.529	0.607	0.507	0.484	0.635	0.944	0.697	0.771	0.662
8594900	0.99	-0.011	0.037	0.031	0.129	0.140	0.158	0.121	0.166	0.189	0.161	0.102	-0.004
	0.50	0.283	0.233	0.332	0.346	0.341	0.313	0.272	0.301	0.365	0.372	0.336	0.265
Washington	0.10	0.603	0.521	0.710	0.598	0.503	0.516	0.396	0.516	0.681	0.668	0.616	0.569
	0.01	1.046	1.079	1.320	0.971	0.664	0.862	0.522	0.982	1.456	1.213	1.049	1.006
8632200	0.99	0.024	-0.009	0.028	0.056	0.082	0.142	0.098	0.058	0.162	0.159	0.113	0.072
	0.50	0.298	0.268	0.302	0.307	0.298	0.287	0.221	0.289	0.394	0.447	0.378	0.326
Kiptopeke	0.10	0.572	0.507	0.590	0.525	0.480	0.436	0.339	0.468	0.653	0.705	0.631	0.568
	0.01	0.914	0.762	0.970	0.759	0.669	0.630	0.478	0.638	1.021	0.992	0.931	0.854
8635150	0.99	-0.049	-0.010	-0.060	-0.033	0.143	0.104	0.107	0.116	0.154	0.097	0.078	-0.003
	0.50	0.241	0.169	0.292	0.319	0.291	0.263	0.224	0.310	0.376	0.369	0.286	0.193
Colonial Beach	0.10	0.429	0.359	0.534	0.503	0.439	0.410	0.326	0.429	0.638	0.516	0.572	0.464
	0.01	0.576	0.613	0.734	0.616	0.623	0.579	0.433	0.516	1.037	0.611	1.087	0.953
8635750	0.99	-0.009	0.011	-0.054	-0.084	0.109	0.087	0.048	0.078	0.145	0.132	0.072	-0.028
	0.50	0.226	0.178	0.274	0.293	0.271	0.232	0.211	0.301	0.374	0.398	0.301	0.240
	0.10	0.400	0.383	0.480	0.449	0.412	0.351	0.324	0.420	0.657	0.544	0.556	0.467

Table E. High Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters above MHHW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Lewisetta	0.01	0.556	0.707	0.634	0.523	0.566	0.473	0.417	0.496	1.112	0.638	0.915	0.703
8637624 Gloucester Point	0.99	0.014	-0.020	0.024	0.037	0.059	0.104	0.095	0.076	0.154	0.140	0.099	0.085
	0.50	0.282	0.259	0.279	0.279	0.306	0.284	0.222	0.283	0.398	0.418	0.333	0.281
	0.10	0.537	0.514	0.544	0.598	0.487	0.438	0.340	0.509	0.723	0.668	0.556	0.507
	0.01	0.840	0.801	0.892	1.144	0.648	0.599	0.475	0.820	1.285	0.950	0.818	0.837
8638610 Sewells Point	0.99	0.006	0.014	0.047	0.072	0.087	0.087	0.057	0.072	0.167	0.199	0.102	0.077
	0.50	0.324	0.291	0.321	0.334	0.330	0.296	0.221	0.298	0.447	0.481	0.392	0.315
	0.10	0.657	0.582	0.621	0.645	0.580	0.472	0.390	0.610	0.861	0.780	0.713	0.577
	0.01	1.095	0.971	1.040	1.119	0.907	0.651	0.610	1.172	1.670	1.181	1.165	0.945
8638660 Portsmouth	0.99	0.028	0.045	0.041	0.069	0.083	0.057	0.057	0.062	0.153	0.258	0.153	0.066
	0.50	0.355	0.333	0.325	0.326	0.304	0.313	0.228	0.302	0.460	0.481	0.412	0.308
	0.10	0.694	0.581	0.684	0.644	0.552	0.459	0.351	0.573	0.859	0.813	0.644	0.590
	0.01	1.139	0.846	1.275	1.152	0.906	0.559	0.459	0.963	1.534	1.470	0.903	1.014
8638863 Ches. Bay Br. Tnl.	0.99	0.007	0.006	-0.018	0.061	0.092	0.122	0.058	0.066	0.190	0.174	0.136	0.090
	0.50	0.309	0.288	0.342	0.328	0.342	0.273	0.215	0.298	0.423	0.482	0.377	0.359
	0.10	0.682	0.608	0.548	0.650	0.569	0.451	0.341	0.554	0.734	0.761	0.732	0.632
	0.01	1.279	1.073	0.688	1.150	0.825	0.720	0.466	0.913	1.274	1.072	1.423	0.983
8656483 Beaufort	0.99	0.032	-0.085	0.034	0.036	0.128	0.082	0.060	0.061	0.158	0.175	0.138	0.098
	0.50	0.236	0.192	0.198	0.233	0.262	0.268	0.236	0.239	0.335	0.342	0.329	0.270
	0.10	0.422	0.367	0.357	0.380	0.379	0.385	0.387	0.423	0.648	0.542	0.479	0.448
	0.01	0.634	0.500	0.551	0.513	0.507	0.474	0.545	0.663	1.397	0.848	0.624	0.682
8658120 Wilmington	0.99	0.010	-0.027	0.052	0.077	0.098	0.078	0.058	0.063	0.085	0.113	0.060	0.029
	0.50	0.203	0.206	0.228	0.234	0.226	0.233	0.204	0.203	0.263	0.264	0.243	0.223
	0.10	0.371	0.377	0.427	0.373	0.350	0.346	0.313	0.343	0.447	0.469	0.387	0.358
	0.01	0.552	0.527	0.713	0.525	0.500	0.447	0.411	0.518	0.688	0.833	0.526	0.470
8661070 Springmaid Pier	0.99	0.067	-0.067	0.002	0.058	0.134	0.063	0.003	0.087	0.256	0.272	0.189	0.173
	0.50	0.344	0.272	0.315	0.328	0.424	0.416	0.395	0.358	0.427	0.441	0.460	0.382
	0.10	0.612	0.492	0.515	0.510	0.583	0.598	0.564	0.508	0.581	0.600	0.638	0.562
	0.01	0.935	0.663	0.669	0.656	0.686	0.707	0.649	0.604	0.755	0.787	0.780	0.753
8665530 Charleston	0.99	0.076	0.018	0.021	0.100	0.199	0.153	0.099	0.107	0.216	0.248	0.195	0.162
	0.50	0.282	0.251	0.271	0.315	0.394	0.384	0.336	0.334	0.402	0.428	0.409	0.352
	0.10	0.478	0.437	0.458	0.462	0.572	0.556	0.515	0.567	0.640	0.591	0.587	0.505
	0.01	0.711	0.619	0.628	0.584	0.775	0.714	0.677	0.866	1.035	0.775	0.768	0.656
8670870 Fort Pulaski	0.99	0.103	0.067	0.086	0.128	0.214	0.227	0.126	0.197	0.240	0.275	0.234	0.209
	0.50	0.328	0.307	0.340	0.396	0.466	0.447	0.400	0.390	0.453	0.451	0.440	0.382
	0.10	0.521	0.523	0.500	0.541	0.606	0.609	0.561	0.578	0.596	0.628	0.593	0.559
	0.01	0.726	0.765	0.620	0.633	0.697	0.754	0.672	0.804	0.712	0.850	0.733	0.789
8720030 Fernandina Beach	0.99	0.013	0.020	0.030	0.092	0.177	0.152	0.058	0.069	0.194	0.271	0.191	0.105
	0.50	0.267	0.238	0.255	0.305	0.379	0.365	0.302	0.301	0.430	0.488	0.433	0.361
	0.10	0.447	0.454	0.407	0.477	0.540	0.550	0.461	0.484	0.660	0.752	0.612	0.540
	0.01	0.602	0.724	0.532	0.649	0.698	0.750	0.584	0.660	0.941	1.164	0.773	0.690

Table E. High Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters above MHHW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
8720218	0.99	-0.001	-0.043	-0.016	0.022	0.110	0.049	-0.010	0.049	0.103	0.212	0.157	0.086
	0.50	0.187	0.160	0.159	0.201	0.262	0.255	0.211	0.213	0.341	0.392	0.351	0.262
Mayport	0.10	0.314	0.313	0.290	0.345	0.373	0.401	0.328	0.370	0.532	0.535	0.487	0.397
	0.01	0.415	0.454	0.410	0.485	0.472	0.524	0.402	0.559	0.720	0.674	0.601	0.525
8723170	0.99	0.018	-0.042	-0.007	0.036	0.055	0.025	0.020	0.059	0.134	0.201	0.172	0.015
	0.50	0.143	0.129	0.122	0.156	0.187	0.164	0.125	0.198	0.308	0.377	0.317	0.195
Miami Beach	0.10	0.247	0.242	0.247	0.257	0.274	0.262	0.216	0.306	0.529	0.579	0.469	0.323
	0.01	0.354	0.332	0.399	0.359	0.343	0.346	0.314	0.411	0.892	0.874	0.671	0.433
8723970	0.99	-0.025	-0.116	-0.075	-0.042	-0.024	-0.009	0.005	0.028	0.057	0.101	0.096	0.040
	0.50	0.124	0.102	0.114	0.097	0.120	0.118	0.094	0.148	0.209	0.244	0.255	0.146
Vaca Key	0.10	0.260	0.209	0.202	0.182	0.216	0.211	0.160	0.255	0.307	0.454	0.335	0.270
	0.01	0.414	0.271	0.250	0.244	0.291	0.296	0.219	0.371	0.383	0.858	0.383	0.457
8724580	0.99	-0.017	-0.077	-0.050	-0.032	0.036	0.048	0.057	0.061	0.092	0.103	0.132	0.026
	0.50	0.131	0.086	0.061	0.091	0.143	0.162	0.152	0.184	0.217	0.259	0.247	0.170
Key West	0.10	0.227	0.197	0.168	0.186	0.224	0.253	0.222	0.256	0.336	0.412	0.334	0.283
	0.01	0.301	0.288	0.294	0.275	0.300	0.340	0.284	0.306	0.476	0.602	0.414	0.394
8725110	0.99	0.057	-0.035	0.038	0.006	0.061	0.099	0.118	0.167	0.160	0.147	0.145	0.095
	0.50	0.202	0.224	0.190	0.187	0.218	0.228	0.243	0.261	0.297	0.288	0.277	0.206
Naples	0.10	0.394	0.409	0.392	0.336	0.316	0.397	0.354	0.395	0.486	0.469	0.369	0.410
	0.01	0.723	0.568	0.740	0.489	0.391	0.683	0.475	0.646	0.830	0.771	0.446	0.924
8725520	0.99	0.005	-0.083	-0.005	-0.001	0.044	0.053	0.098	0.107	0.125	0.143	0.082	0.047
	0.50	0.152	0.161	0.190	0.163	0.200	0.228	0.229	0.229	0.278	0.284	0.246	0.194
Fort Myers	0.10	0.306	0.326	0.392	0.296	0.320	0.499	0.391	0.438	0.597	0.503	0.449	0.302
	0.01	0.510	0.460	0.655	0.429	0.433	1.058	0.653	0.916	1.526	0.957	0.774	0.399
8726520	0.99	0.076	-0.041	0.019	0.044	0.083	0.107	0.143	0.119	0.132	0.142	0.139	0.093
	0.50	0.222	0.202	0.198	0.191	0.229	0.267	0.268	0.259	0.293	0.289	0.285	0.246
St. Petersburg	0.10	0.388	0.332	0.384	0.330	0.348	0.499	0.406	0.425	0.597	0.497	0.438	0.379
	0.01	0.629	0.413	0.629	0.496	0.470	0.944	0.601	0.676	1.384	0.884	0.642	0.521
8726724	0.99	0.087	-0.068	0.051	-0.011	0.088	0.107	0.157	0.151	0.177	0.126	0.132	0.130
	0.50	0.242	0.229	0.206	0.228	0.231	0.261	0.283	0.274	0.300	0.271	0.314	0.247
Clearwater Beach	0.10	0.475	0.374	0.460	0.336	0.356	0.453	0.416	0.451	0.515	0.490	0.454	0.462
	0.01	0.944	0.456	1.016	0.393	0.491	0.762	0.595	0.786	1.025	0.929	0.585	0.992
8727520	0.99	0.119	0.057	0.058	0.072	0.106	0.135	0.175	0.146	0.134	0.117	0.142	0.048
	0.50	0.268	0.267	0.291	0.288	0.287	0.296	0.311	0.320	0.367	0.321	0.346	0.292
Cedar Key	0.10	0.467	0.449	0.561	0.482	0.435	0.540	0.490	0.530	0.647	0.578	0.554	0.498
	0.01	0.812	0.642	0.964	0.697	0.581	1.028	0.795	0.854	1.082	0.998	0.820	0.712
8729840	0.99	0.000	-0.027	0.020	0.034	0.029	0.093	0.082	0.081	0.127	0.142	0.118	0.036
	0.50	0.186	0.174	0.196	0.201	0.222	0.225	0.214	0.230	0.316	0.291	0.270	0.237
Pensacola	0.10	0.316	0.322	0.372	0.349	0.353	0.385	0.378	0.463	0.700	0.513	0.420	0.388
	0.01	0.425	0.456	0.595	0.511	0.462	0.638	0.642	0.950	1.775	0.950	0.607	0.525
8735180	0.99	0.025	-0.036	0.030	0.036	0.071	0.063	0.075	0.067	0.149	0.147	0.135	-0.001

Table E. High Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters above MHHW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Dauphin Island	0.50	0.218	0.161	0.203	0.230	0.215	0.229	0.186	0.226	0.310	0.316	0.296	0.285
	0.10	0.336	0.329	0.358	0.402	0.389	0.354	0.359	0.493	0.706	0.537	0.448	0.425
	0.01	0.422	0.507	0.531	0.589	0.660	0.469	0.716	1.093	2.098	0.915	0.626	0.504
8761724	0.99	-0.042	-0.026	0.041	0.002	0.051	0.089	0.043	0.055	0.179	0.123	0.059	-0.025
	0.50	0.175	0.157	0.198	0.217	0.243	0.225	0.194	0.233	0.340	0.312	0.266	0.214
Grand Isle	0.10	0.302	0.330	0.343	0.359	0.406	0.378	0.383	0.453	0.872	0.582	0.404	0.400
	0.01	0.388	0.532	0.510	0.471	0.574	0.596	0.685	0.806	3.498	1.087	0.514	0.577
8764311	0.99	-0.021	0.035	0.010	0.131	0.073	0.064	0.060	0.041	0.119	0.073	0.113	-0.005
	0.50	0.222	0.285	0.360	0.338	0.370	0.360	0.199	0.248	0.356	0.295	0.311	0.273
Eugene Island	0.10	0.398	0.599	0.711	0.577	0.654	0.724	0.385	0.514	0.754	0.476	0.574	0.537
	0.01	0.551	1.109	1.155	0.929	0.994	1.304	0.711	0.956	1.655	0.656	1.028	0.851
8770570	0.99	-0.101	-0.048	-0.021	0.030	0.049	0.021	-0.011	-0.038	0.132	0.075	0.061	-0.048
	0.50	0.175	0.183	0.239	0.324	0.295	0.280	0.155	0.211	0.346	0.348	0.293	0.234
Sabine Pass	0.10	0.372	0.442	0.428	0.508	0.477	0.509	0.393	0.481	0.933	0.551	0.504	0.412
	0.01	0.541	0.808	0.596	0.645	0.642	0.761	0.842	0.851	3.260	0.734	0.740	0.546
8771450	0.99	-0.043	-0.021	-0.018	0.065	0.072	0.053	-0.029	-0.009	0.130	0.126	0.072	0.013
	0.50	0.179	0.196	0.236	0.281	0.318	0.267	0.137	0.183	0.361	0.368	0.318	0.251
Galveston Pier 21	0.10	0.350	0.385	0.414	0.511	0.505	0.529	0.391	0.586	0.785	0.614	0.519	0.435
	0.01	0.511	0.587	0.564	0.824	0.676	0.940	0.905	1.763	1.848	0.929	0.722	0.609
8771510	0.99	-0.050	-0.039	0.019	0.053	0.159	0.122	0.003	0.033	0.171	0.115	0.104	0.058
	0.50	0.227	0.227	0.257	0.314	0.362	0.333	0.221	0.233	0.418	0.410	0.369	0.268
Glv. Pleasure Pier	0.10	0.450	0.414	0.469	0.548	0.541	0.563	0.534	0.567	0.956	0.682	0.580	0.559
	0.01	0.672	0.575	0.702	0.810	0.735	0.883	1.125	1.320	2.595	0.997	0.787	1.086
8772440	0.99	-0.055	-0.023	0.038	0.039	0.131	0.126	0.003	0.007	0.108	0.102	0.131	0.035
	0.50	0.207	0.180	0.189	0.280	0.317	0.284	0.162	0.212	0.387	0.388	0.342	0.243
Freeport	0.10	0.384	0.386	0.354	0.459	0.486	0.485	0.421	0.472	0.745	0.611	0.514	0.460
	0.01	0.528	0.645	0.582	0.618	0.678	0.817	0.988	0.899	1.343	0.821	0.685	0.745
8774770	0.99	-0.165	-0.136	-0.143	-0.051	0.012	-0.062	-0.149	-0.118	0.012	0.032	0.027	-0.118
	0.50	0.038	0.046	0.115	0.158	0.209	0.127	0.040	0.069	0.276	0.292	0.197	0.082
Rockport	0.10	0.161	0.214	0.240	0.309	0.347	0.287	0.261	0.313	0.606	0.481	0.350	0.200
	0.01	0.250	0.407	0.309	0.442	0.463	0.453	0.591	0.728	1.137	0.646	0.521	0.283
8778490	0.99	-0.112	-0.019	0.014	0.027	0.154	-0.034	-0.092	-0.092	0.092	0.159	0.094	-0.038
	0.50	0.125	0.163	0.206	0.282	0.312	0.264	0.070	0.099	0.283	0.352	0.291	0.201
Port Mansfield	0.10	0.251	0.290	0.338	0.406	0.471	0.408	0.211	0.228	0.638	0.533	0.494	0.324
	0.01	0.329	0.396	0.447	0.478	0.670	0.488	0.361	0.335	1.533	0.745	0.757	0.397
8779750	0.99	-0.039	-0.046	-0.049	-0.006	0.071	0.009	-0.037	-0.024	0.068	0.018	0.100	0.028
	0.50	0.148	0.130	0.159	0.175	0.194	0.171	0.078	0.112	0.295	0.311	0.266	0.211
Padre Island	0.10	0.258	0.270	0.284	0.317	0.361	0.281	0.203	0.352	0.694	0.431	0.358	0.337
	0.01	0.336	0.408	0.374	0.455	0.656	0.372	0.374	0.926	1.645	0.487	0.418	0.441
8779770	0.99	-0.024	-0.028	0.012	0.038	0.067	0.033	-0.053	-0.050	0.087	0.099	0.102	0.028
	0.50	0.148	0.137	0.154	0.179	0.197	0.158	0.082	0.133	0.299	0.320	0.292	0.201

Table E. High Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters above MHHW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Port Isabel	0.10	0.287	0.279	0.256	0.310	0.324	0.321	0.256	0.361	0.609	0.473	0.396	0.326
	0.01	0.424	0.431	0.343	0.460	0.482	0.599	0.547	0.730	1.208	0.600	0.464	0.435
9410170	0.99	0.303	0.174	0.033	0.060	0.184	0.274	0.344	0.312	0.175	0.197	0.257	0.316
	0.50	0.483	0.391	0.224	0.265	0.380	0.445	0.493	0.451	0.342	0.367	0.466	0.501
San Diego	0.10	0.606	0.523	0.347	0.389	0.485	0.536	0.589	0.558	0.449	0.488	0.582	0.625
	0.01	0.708	0.620	0.442	0.478	0.552	0.594	0.664	0.658	0.531	0.594	0.658	0.726
9410230	0.99	0.256	0.116	0.012	0.027	0.166	0.247	0.311	0.315	0.120	0.148	0.231	0.278
	0.50	0.446	0.358	0.186	0.234	0.360	0.426	0.468	0.423	0.316	0.329	0.434	0.481
La Jolla	0.10	0.570	0.491	0.304	0.357	0.456	0.521	0.569	0.532	0.432	0.455	0.567	0.591
	0.01	0.668	0.577	0.401	0.444	0.511	0.581	0.646	0.672	0.514	0.561	0.673	0.661
9410580	0.99	0.272	0.130	0.017	0.046	0.167	0.268	0.322	0.325	0.119	0.203	0.265	0.250
	0.50	0.475	0.378	0.206	0.243	0.387	0.445	0.468	0.425	0.322	0.340	0.458	0.480
Newport Beach	0.10	0.598	0.518	0.331	0.359	0.465	0.517	0.571	0.543	0.445	0.447	0.582	0.588
	0.01	0.686	0.610	0.430	0.441	0.497	0.552	0.657	0.726	0.533	0.550	0.679	0.647
9410660	0.99	0.277	0.147	0.035	0.041	0.178	0.262	0.315	0.309	0.164	0.206	0.250	0.283
	0.50	0.465	0.369	0.208	0.234	0.371	0.436	0.476	0.432	0.316	0.343	0.443	0.497
Los Angeles	0.10	0.597	0.506	0.326	0.346	0.459	0.521	0.569	0.535	0.427	0.457	0.556	0.593
	0.01	0.710	0.605	0.425	0.423	0.505	0.569	0.634	0.642	0.525	0.573	0.635	0.644
9410840	0.99	0.265	0.133	0.044	0.066	0.211	0.289	0.329	0.307	0.143	0.194	0.267	0.316
	0.50	0.477	0.372	0.211	0.255	0.385	0.451	0.493	0.444	0.327	0.348	0.437	0.500
Santa Monica	0.10	0.612	0.521	0.340	0.380	0.493	0.549	0.581	0.542	0.434	0.459	0.589	0.604
	0.01	0.715	0.631	0.462	0.479	0.571	0.621	0.636	0.627	0.508	0.554	0.760	0.674
9411270	0.99	0.273	0.044	0.036	-0.011	0.239	0.279	0.343	0.265	0.085	0.170	0.273	0.194
	0.50	0.489	0.403	0.219	0.245	0.398	0.477	0.485	0.452	0.317	0.326	0.457	0.528
Rincon Island	0.10	0.656	0.513	0.323	0.363	0.505	0.560	0.589	0.581	0.451	0.458	0.583	0.621
	0.01	0.813	0.551	0.394	0.426	0.590	0.600	0.683	0.689	0.543	0.595	0.686	0.650
9412110	0.99	0.245	0.093	-0.005	0.019	0.159	0.246	0.285	0.242	0.068	0.152	0.185	0.279
	0.50	0.457	0.338	0.171	0.187	0.325	0.398	0.428	0.367	0.256	0.289	0.403	0.474
Port San Luis	0.10	0.612	0.481	0.299	0.293	0.442	0.501	0.522	0.485	0.380	0.394	0.537	0.581
	0.01	0.749	0.580	0.413	0.374	0.541	0.584	0.595	0.622	0.478	0.491	0.636	0.651
9413450	0.99	0.207	0.065	-0.023	-0.023	0.147	0.212	0.247	0.223	0.062	0.091	0.177	0.293
	0.50	0.441	0.330	0.172	0.195	0.288	0.374	0.406	0.340	0.218	0.286	0.381	0.460
Monterey	0.10	0.619	0.507	0.304	0.292	0.384	0.460	0.491	0.459	0.335	0.388	0.523	0.571
	0.01	0.782	0.649	0.411	0.343	0.463	0.514	0.544	0.611	0.444	0.449	0.642	0.660
9414290	0.99	0.164	0.060	-0.028	-0.047	0.074	0.133	0.166	0.121	0.032	0.053	0.141	0.207
	0.50	0.391	0.285	0.171	0.161	0.243	0.302	0.319	0.260	0.169	0.225	0.320	0.403
San Francisco	0.10	0.591	0.497	0.330	0.285	0.368	0.399	0.411	0.360	0.278	0.344	0.468	0.576
	0.01	0.810	0.746	0.485	0.373	0.479	0.465	0.477	0.449	0.383	0.444	0.617	0.762
9414750	0.99	0.165	0.057	-0.020	-0.016	0.114	0.144	0.176	0.139	0.050	0.040	0.125	0.207
	0.50	0.408	0.300	0.187	0.188	0.272	0.337	0.335	0.264	0.184	0.235	0.323	0.430
	0.10	0.614	0.527	0.354	0.333	0.400	0.432	0.430	0.378	0.297	0.353	0.474	0.613

Table E. High Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters above MHHW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Alameda	0.01	0.831	0.792	0.520	0.459	0.527	0.488	0.497	0.508	0.415	0.437	0.613	0.795
9415020	0.99	0.198	0.090	-0.009	-0.002	0.118	0.176	0.221	0.187	0.102	0.155	0.186	0.289
	0.50	0.453	0.341	0.232	0.201	0.276	0.356	0.388	0.316	0.216	0.293	0.393	0.483
Point Reyes	0.10	0.662	0.605	0.407	0.306	0.382	0.454	0.494	0.441	0.352	0.422	0.525	0.656
	0.01	0.873	0.958	0.562	0.371	0.466	0.515	0.573	0.592	0.560	0.574	0.625	0.846
9419750	0.99	0.252	0.119	0.018	-0.004	0.132	0.136	0.163	0.133	0.112	0.169	0.232	0.315
	0.50	0.583	0.447	0.356	0.307	0.331	0.363	0.364	0.304	0.273	0.357	0.485	0.624
Crescent City	0.10	0.837	0.707	0.574	0.498	0.462	0.484	0.464	0.412	0.398	0.504	0.680	0.811
	0.01	1.072	0.959	0.743	0.637	0.566	0.561	0.522	0.492	0.517	0.646	0.863	0.944
9432780	0.99	0.239	0.161	0.075	0.071	0.066	0.098	0.154	0.068	0.082	0.169	0.329	0.299
	0.50	0.601	0.456	0.400	0.326	0.355	0.344	0.321	0.262	0.265	0.376	0.547	0.665
Charleston	0.10	0.885	0.709	0.595	0.497	0.458	0.483	0.434	0.382	0.400	0.504	0.743	0.886
	0.01	1.156	0.977	0.734	0.635	0.499	0.577	0.525	0.471	0.522	0.599	0.965	1.044
9435380	0.99	0.289	0.191	0.104	0.129	0.098	0.115	0.128	0.082	0.104	0.188	0.317	0.362
	0.50	0.646	0.509	0.461	0.390	0.387	0.380	0.347	0.273	0.280	0.412	0.582	0.720
South Beach	0.10	0.897	0.756	0.701	0.582	0.515	0.519	0.458	0.397	0.436	0.552	0.780	0.986
	0.01	1.111	0.992	0.893	0.753	0.581	0.605	0.523	0.494	0.608	0.657	0.960	1.227
9439040	0.99	0.213	0.134	0.008	0.056	0.157	0.174	0.135	0.019	-0.026	0.074	0.186	0.283
	0.50	0.638	0.507	0.434	0.399	0.459	0.476	0.339	0.200	0.186	0.339	0.561	0.706
Astoria	0.10	0.908	0.773	0.675	0.621	0.631	0.663	0.497	0.355	0.355	0.560	0.807	0.957
	0.01	1.113	1.003	0.834	0.793	0.746	0.802	0.647	0.518	0.522	0.788	1.000	1.133
9440910	0.99	0.280	0.247	0.268	0.104	0.090	-0.003	0.134	0.010	0.060	0.173	0.387	0.311
	0.50	0.854	0.658	0.550	0.485	0.432	0.427	0.329	0.255	0.277	0.489	0.751	0.929
Toke Point	0.10	1.190	1.035	0.923	0.703	0.612	0.595	0.499	0.416	0.509	0.726	1.112	1.287
	0.01	1.423	1.464	1.560	0.848	0.721	0.670	0.681	0.543	0.822	0.942	1.561	1.532
9443090	0.99	0.334	0.213	0.049	0.072	0.170	0.154	0.132	0.090	0.033	0.123	0.376	0.355
	0.50	0.694	0.536	0.449	0.393	0.415	0.423	0.371	0.273	0.230	0.431	0.668	0.831
Neah Bay	0.10	0.966	0.754	0.686	0.647	0.574	0.582	0.494	0.403	0.417	0.624	0.917	1.064
	0.01	1.216	0.932	0.853	0.891	0.699	0.694	0.569	0.515	0.638	0.767	1.181	1.199
9444090	0.99	0.168	0.096	-0.071	-0.056	0.058	0.049	0.122	0.014	-0.053	-0.036	0.151	0.145
	0.50	0.612	0.427	0.279	0.189	0.250	0.324	0.305	0.189	0.117	0.241	0.494	0.630
Port Angeles	0.10	0.866	0.668	0.498	0.367	0.361	0.432	0.410	0.325	0.258	0.360	0.719	0.837
	0.01	1.039	0.880	0.662	0.522	0.437	0.481	0.481	0.452	0.401	0.420	0.896	0.940
9444900	0.99	0.180	0.064	-0.047	-0.124	0.010	0.075	0.047	-0.026	-0.053	-0.089	0.026	0.265
	0.50	0.539	0.419	0.293	0.165	0.162	0.189	0.163	0.129	0.076	0.207	0.475	0.593
Port Townsend	0.10	0.778	0.650	0.459	0.335	0.263	0.288	0.235	0.226	0.186	0.347	0.636	0.808
	0.01	0.969	0.830	0.555	0.452	0.344	0.393	0.289	0.300	0.303	0.424	0.702	0.977
9447130	0.99	0.276	0.153	0.067	0.001	0.054	0.125	0.127	0.084	0.052	0.043	0.100	0.237
	0.50	0.572	0.471	0.346	0.246	0.222	0.248	0.252	0.226	0.211	0.250	0.453	0.589
Seattle	0.10	0.767	0.678	0.532	0.423	0.328	0.335	0.344	0.325	0.345	0.410	0.624	0.805
	0.01	0.922	0.840	0.682	0.577	0.406	0.410	0.425	0.407	0.485	0.559	0.719	0.961

Table E. High Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters above MHHW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
9449424 Cherry Point	0.99	0.243	0.052	-0.040	-0.098	0.062	0.129	0.134	0.013	-0.054	-0.075	0.121	0.334
	0.50	0.581	0.457	0.302	0.164	0.242	0.283	0.224	0.152	0.071	0.230	0.528	0.647
	0.10	0.834	0.728	0.509	0.346	0.355	0.399	0.310	0.243	0.202	0.405	0.705	0.883
	0.01	1.065	0.946	0.658	0.498	0.440	0.505	0.411	0.313	0.373	0.525	0.793	1.098
9449880 Friday Harbor	0.99	0.164	0.099	-0.045	-0.091	0.028	0.060	0.035	-0.084	-0.143	-0.037	0.132	0.290
	0.50	0.571	0.427	0.252	0.161	0.206	0.217	0.155	0.074	0.028	0.225	0.484	0.629
	0.10	0.788	0.641	0.444	0.341	0.322	0.328	0.245	0.160	0.149	0.399	0.671	0.845
	0.01	0.924	0.809	0.592	0.497	0.413	0.423	0.328	0.216	0.252	0.537	0.788	1.009
9450460 Ketchikan	0.99	0.473	0.514	0.430	0.463	0.467	0.395	0.387	0.357	0.415	0.632	0.688	0.644
	0.50	1.017	0.906	0.935	0.916	0.854	0.808	0.746	0.708	0.833	1.078	1.182	1.076
	0.10	1.322	1.162	1.206	1.182	1.072	1.005	0.938	0.915	1.143	1.337	1.462	1.402
	0.01	1.524	1.362	1.377	1.368	1.217	1.114	1.058	1.059	1.423	1.514	1.649	1.701
9451600 Sitka	0.99	0.354	0.269	0.173	0.260	0.274	0.197	0.161	0.174	0.166	0.375	0.495	0.468
	0.50	0.737	0.625	0.581	0.564	0.553	0.504	0.443	0.390	0.469	0.707	0.881	0.850
	0.10	1.010	0.820	0.812	0.780	0.715	0.680	0.582	0.531	0.706	0.921	1.150	1.113
	0.01	1.244	0.947	0.967	0.967	0.825	0.798	0.663	0.639	0.932	1.086	1.375	1.332
9452210 Juneau	0.99	0.449	0.558	0.495	0.553	0.550	0.505	0.479	0.541	0.547	0.720	0.804	0.648
	0.50	1.048	0.968	1.013	0.989	0.967	0.923	0.910	0.876	0.994	1.213	1.298	1.166
	0.10	1.381	1.216	1.291	1.239	1.191	1.121	1.091	1.085	1.260	1.483	1.633	1.489
	0.01	1.600	1.394	1.468	1.408	1.334	1.229	1.178	1.241	1.448	1.657	1.906	1.730
9452400 Skagway	0.99	0.451	0.481	0.458	0.546	0.536	0.545	0.517	0.664	0.595	0.797	0.808	0.679
	0.50	1.016	0.972	1.015	1.012	0.986	0.986	1.025	0.978	1.085	1.319	1.330	1.154
	0.10	1.387	1.235	1.321	1.284	1.229	1.211	1.250	1.239	1.392	1.612	1.644	1.483
	0.01	1.680	1.399	1.518	1.472	1.385	1.346	1.367	1.508	1.622	1.807	1.869	1.759
9453220 Yakutat	0.99	0.378	0.270	0.281	0.296	0.265	0.259	0.207	0.203	0.239	0.431	0.538	0.480
	0.50	0.804	0.644	0.600	0.582	0.583	0.548	0.495	0.442	0.552	0.778	0.928	0.928
	0.10	1.098	0.885	0.840	0.784	0.765	0.738	0.637	0.600	0.751	1.040	1.204	1.189
	0.01	1.341	1.071	1.059	0.957	0.888	0.888	0.717	0.725	0.902	1.281	1.439	1.369
9454050 Cordova	0.99	0.382	0.229	0.253	0.217	0.317	0.274	0.211	0.244	0.253	0.488	0.459	0.568
	0.50	0.828	0.725	0.693	0.673	0.623	0.580	0.567	0.513	0.630	0.862	0.987	0.963
	0.10	1.169	0.961	0.944	0.884	0.811	0.802	0.741	0.701	0.876	1.083	1.287	1.225
	0.01	1.488	1.092	1.114	0.997	0.949	0.997	0.839	0.860	1.069	1.238	1.488	1.435
9454240 Valdez	0.99	0.360	0.157	0.248	0.164	0.271	0.291	0.288	0.323	0.335	0.503	0.470	0.488
	0.50	0.822	0.706	0.639	0.664	0.628	0.626	0.622	0.533	0.648	0.850	0.984	0.918
	0.10	1.173	0.938	0.872	0.869	0.828	0.848	0.772	0.741	0.855	1.078	1.255	1.193
	0.01	1.498	1.052	1.038	0.966	0.962	1.023	0.850	1.000	1.021	1.258	1.424	1.404
9455090 Seward	0.99	0.346	0.118	0.224	0.147	0.281	0.252	0.211	0.260	0.268	0.440	0.523	0.524
	0.50	0.798	0.669	0.570	0.585	0.588	0.572	0.560	0.464	0.603	0.813	0.918	0.928
	0.10	1.151	0.919	0.793	0.787	0.765	0.787	0.697	0.655	0.829	1.058	1.195	1.176
	0.01	1.486	1.051	0.964	0.897	0.886	0.959	0.759	0.878	1.012	1.250	1.430	1.357
9455500	0.99	0.569	0.480	0.694	0.677	0.534	0.435	0.333	0.569	0.642	0.658	0.846	0.711

Table E. High Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters above MHHW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Seldovia	0.50	1.161	1.188	1.260	1.221	1.048	0.892	0.930	1.008	1.250	1.407	1.373	1.261
	0.10	1.511	1.453	1.506	1.460	1.306	1.193	1.143	1.274	1.523	1.704	1.766	1.554
	0.01	1.755	1.567	1.630	1.582	1.457	1.431	1.229	1.464	1.663	1.839	2.124	1.736
9455760	0.99	0.440	0.610	0.651	0.619	0.281	0.279	0.239	0.556	0.719	0.698	0.705	-0.053
	0.50	1.130	1.076	1.204	1.106	0.977	0.845	0.906	1.053	1.274	1.368	1.283	1.214
Nikiski	0.10	1.384	1.341	1.426	1.311	1.142	1.090	1.091	1.227	1.513	1.595	1.617	1.386
	0.01	1.491	1.520	1.527	1.411	1.186	1.214	1.148	1.297	1.632	1.682	1.845	1.411
9455920	0.99	0.611	0.560	0.771	0.772	0.391	0.348	0.403	0.636	0.698	0.737	0.706	0.562
	0.50	1.120	1.233	1.307	1.177	0.947	0.853	0.930	1.067	1.192	1.282	1.228	1.169
Anchorage	0.10	1.409	1.495	1.549	1.363	1.155	1.112	1.137	1.291	1.431	1.552	1.520	1.436
	0.01	1.603	1.613	1.675	1.462	1.243	1.268	1.230	1.427	1.567	1.708	1.712	1.571
9457292	0.99	0.337	0.083	0.177	0.193	0.333	0.325	0.246	0.190	0.186	0.307	0.466	0.400
	0.50	0.694	0.570	0.468	0.530	0.531	0.508	0.483	0.398	0.462	0.633	0.732	0.791
Kodiak Island	0.10	0.960	0.804	0.641	0.704	0.693	0.695	0.635	0.562	0.699	0.866	0.997	1.018
	0.01	1.201	0.935	0.765	0.810	0.854	0.936	0.752	0.720	0.953	1.069	1.330	1.174
9459450	0.99	0.007	0.092	0.059	0.113	0.117	0.018	0.208	0.007	0.019	0.193	0.337	0.475
	0.50	0.818	0.568	0.406	0.388	0.423	0.413	0.376	0.264	0.369	0.550	0.701	0.805
Sand Point	0.10	1.023	0.802	0.632	0.595	0.566	0.624	0.521	0.426	0.595	0.722	0.988	1.056
	0.01	1.081	0.935	0.806	0.785	0.644	0.757	0.675	0.548	0.768	0.819	1.267	1.288
9461380	0.99	0.301	0.166	0.013	-0.077	0.059	0.016	0.076	0.061	-0.017	-0.006	0.102	0.252
	0.50	0.553	0.470	0.271	0.187	0.265	0.335	0.333	0.289	0.236	0.246	0.392	0.537
Adak Island	0.10	0.717	0.665	0.437	0.367	0.413	0.467	0.453	0.447	0.388	0.359	0.549	0.722
	0.01	0.847	0.813	0.566	0.514	0.543	0.531	0.518	0.579	0.497	0.417	0.650	0.866
9462620	0.99	0.166	0.126	0.022	-0.052	0.017	0.007	0.056	0.008	-0.013	0.054	0.114	0.129
	0.50	0.510	0.418	0.247	0.199	0.238	0.232	0.219	0.203	0.218	0.284	0.408	0.529
Unalaska	0.10	0.707	0.620	0.420	0.352	0.355	0.363	0.356	0.333	0.342	0.406	0.557	0.663
	0.01	0.840	0.789	0.581	0.463	0.427	0.452	0.498	0.437	0.419	0.481	0.646	0.714
9751639	0.99	-0.017	-0.072	-0.126	-0.071	-0.029	0.000	0.057	0.062	0.070	0.053	0.073	-0.029
	0.50	0.068	0.034	0.009	0.025	0.052	0.084	0.124	0.119	0.148	0.160	0.163	0.113
Charlotte Amalie	0.10	0.109	0.084	0.063	0.084	0.103	0.131	0.192	0.176	0.301	0.217	0.221	0.168
	0.01	0.131	0.113	0.088	0.128	0.140	0.163	0.278	0.249	0.719	0.252	0.268	0.192
9755371	0.99	-0.006	-0.038	-0.100	-0.036	-0.001	-0.015	0.020	0.050	0.037	0.056	0.080	0.003
	0.50	0.101	0.050	0.043	0.069	0.088	0.115	0.138	0.124	0.147	0.184	0.194	0.146
San Juan	0.10	0.165	0.121	0.101	0.157	0.152	0.182	0.224	0.184	0.284	0.261	0.261	0.218
	0.01	0.211	0.191	0.127	0.247	0.209	0.222	0.300	0.243	0.506	0.316	0.309	0.261
9759110	0.99	-0.021	-0.044	-0.082	-0.063	-0.019	-0.004	0.022	0.059	0.052	0.060	0.056	-0.007
	0.50	0.056	0.031	0.006	0.020	0.048	0.080	0.115	0.122	0.137	0.134	0.133	0.102
Magueyes Island	0.10	0.104	0.079	0.065	0.064	0.102	0.127	0.175	0.211	0.233	0.192	0.189	0.149
	0.01	0.140	0.117	0.112	0.090	0.156	0.160	0.223	0.378	0.369	0.248	0.238	0.172

Appendix VII.

Low Water GEV Exceedance Probabiility Levels by Month

Table F. Low Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters below MLLW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1611400 Nawiliwili	0.99	0.011	0.030	0.036	0.012	-0.027	-0.037	0.000	0.059	0.136	0.092	0.011	-0.010
	0.50	-0.150	-0.123	-0.102	-0.137	-0.154	-0.166	-0.121	-0.056	0.000	-0.045	-0.102	-0.141
	0.10	-0.215	-0.210	-0.197	-0.204	-0.235	-0.237	-0.195	-0.143	-0.074	-0.121	-0.174	-0.207
	0.01	-0.244	-0.268	-0.277	-0.240	-0.295	-0.282	-0.249	-0.222	-0.122	-0.170	-0.229	-0.247
1612340 Honolulu	0.99	0.010	0.024	0.035	-0.002	0.006	0.003	0.029	0.103	0.118	0.097	0.037	0.014
	0.50	-0.116	-0.091	-0.086	-0.113	-0.130	-0.124	-0.091	-0.048	-0.010	-0.037	-0.077	-0.107
	0.10	-0.186	-0.166	-0.157	-0.191	-0.199	-0.201	-0.168	-0.120	-0.068	-0.095	-0.149	-0.175
	0.01	-0.231	-0.224	-0.207	-0.259	-0.240	-0.256	-0.226	-0.159	-0.099	-0.125	-0.203	-0.220
1612480 Mokuoloe	0.99	-0.052	-0.040	0.000	-0.020	-0.064	-0.071	-0.034	0.048	0.163	0.073	-0.022	-0.068
	0.50	-0.220	-0.158	-0.102	-0.169	-0.217	-0.221	-0.183	-0.112	-0.039	-0.093	-0.168	-0.223
	0.10	-0.284	-0.243	-0.187	-0.262	-0.304	-0.313	-0.272	-0.203	-0.110	-0.150	-0.264	-0.295
	0.01	-0.311	-0.319	-0.273	-0.331	-0.362	-0.379	-0.335	-0.264	-0.138	-0.173	-0.341	-0.333
1615680 Kahului	0.99	-0.077	-0.068	0.010	-0.018	-0.093	-0.088	-0.059	0.029	0.133	0.027	-0.057	-0.091
	0.50	-0.224	-0.173	-0.136	-0.179	-0.227	-0.227	-0.188	-0.112	-0.046	-0.103	-0.176	-0.226
	0.10	-0.302	-0.261	-0.220	-0.265	-0.312	-0.316	-0.261	-0.195	-0.116	-0.173	-0.256	-0.315
	0.01	-0.350	-0.349	-0.278	-0.318	-0.375	-0.385	-0.311	-0.253	-0.149	-0.218	-0.320	-0.383
1617760 Hilo	0.99	-0.078	-0.063	0.000	-0.030	-0.092	-0.087	-0.059	0.058	0.088	0.051	-0.038	-0.094
	0.50	-0.200	-0.167	-0.147	-0.179	-0.213	-0.218	-0.179	-0.100	-0.046	-0.090	-0.164	-0.204
	0.10	-0.269	-0.242	-0.217	-0.252	-0.302	-0.309	-0.251	-0.171	-0.123	-0.166	-0.241	-0.278
	0.01	-0.314	-0.308	-0.257	-0.294	-0.381	-0.384	-0.302	-0.208	-0.175	-0.216	-0.298	-0.337
1619000 Johnston Atoll	0.99	-0.012	-0.028	-0.014	-0.012	0.016	-0.010	0.014	0.091	0.092	0.069	0.052	0.003
	0.50	-0.182	-0.211	-0.231	-0.190	-0.188	-0.174	-0.132	-0.100	-0.079	-0.071	-0.086	-0.146
	0.10	-0.308	-0.352	-0.382	-0.337	-0.305	-0.276	-0.229	-0.170	-0.193	-0.153	-0.198	-0.264
	0.01	-0.424	-0.485	-0.508	-0.485	-0.386	-0.352	-0.306	-0.198	-0.284	-0.210	-0.308	-0.378
1619910 Midway Atoll	0.99	0.034	0.021	0.039	-0.026	-0.002	-0.014	0.033	0.067	0.103	0.145	0.058	0.037
	0.50	-0.125	-0.111	-0.140	-0.153	-0.154	-0.146	-0.133	-0.045	-0.030	-0.064	-0.104	-0.118
	0.10	-0.222	-0.200	-0.220	-0.248	-0.252	-0.238	-0.226	-0.142	-0.112	-0.160	-0.189	-0.198
	0.01	-0.294	-0.275	-0.263	-0.336	-0.326	-0.315	-0.286	-0.246	-0.172	-0.211	-0.241	-0.246
1630000 Guam	0.99	0.027	0.031	0.143	0.145	0.038	0.034	0.059	0.125	0.161	0.093	-0.012	-0.085
	0.50	-0.324	-0.179	-0.060	-0.069	-0.139	-0.149	-0.141	-0.076	-0.040	-0.116	-0.263	-0.330
	0.10	-0.452	-0.337	-0.204	-0.204	-0.269	-0.254	-0.240	-0.220	-0.162	-0.301	-0.414	-0.486
	0.01	-0.506	-0.482	-0.328	-0.307	-0.387	-0.326	-0.298	-0.344	-0.250	-0.503	-0.521	-0.605
1770000 Pago Pago	0.99	-0.041	-0.031	0.006	0.017	0.012	-0.007	-0.010	-0.036	-0.019	-0.023	-0.015	0.007
	0.50	-0.175	-0.165	-0.148	-0.131	-0.135	-0.135	-0.136	-0.135	-0.131	-0.132	-0.139	-0.164
	0.10	-0.262	-0.287	-0.281	-0.261	-0.262	-0.248	-0.235	-0.224	-0.231	-0.230	-0.228	-0.241
	0.01	-0.329	-0.423	-0.421	-0.401	-0.398	-0.371	-0.331	-0.323	-0.341	-0.336	-0.305	-0.281
1820000 Kwajalein	0.99	-0.163	-0.180	-0.173	-0.102	-0.019	0.004	-0.035	-0.155	-0.150	-0.101	-0.094	-0.099
	0.50	-0.333	-0.336	-0.317	-0.266	-0.215	-0.201	-0.233	-0.274	-0.297	-0.292	-0.285	-0.297
	0.10	-0.451	-0.420	-0.402	-0.351	-0.308	-0.302	-0.317	-0.372	-0.412	-0.403	-0.411	-0.440
	0.01	-0.549	-0.472	-0.461	-0.401	-0.359	-0.359	-0.359	-0.471	-0.520	-0.480	-0.512	-0.566

Table F. Low Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters below MLLW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
1840000	0.99	0.028	0.006	0.031	0.075	0.102	0.028	0.014	0.014	0.022	0.163	0.153	0.079
	0.50	-0.210	-0.147	-0.095	-0.045	-0.047	-0.090	-0.132	-0.124	-0.116	-0.096	-0.112	-0.200
Chuuk	0.10	-0.343	-0.295	-0.195	-0.135	-0.136	-0.193	-0.254	-0.247	-0.253	-0.253	-0.254	-0.333
	0.01	-0.431	-0.474	-0.291	-0.216	-0.198	-0.305	-0.381	-0.382	-0.425	-0.365	-0.344	-0.408
1890000	0.99	-0.042	-0.039	-0.016	0.025	-0.030	0.041	0.045	0.032	0.091	0.028	0.001	0.018
	0.50	-0.228	-0.211	-0.225	-0.231	-0.225	-0.190	-0.160	-0.139	-0.137	-0.152	-0.175	-0.201
Wake Island	0.10	-0.319	-0.328	-0.339	-0.363	-0.339	-0.330	-0.282	-0.261	-0.257	-0.285	-0.296	-0.294
	0.01	-0.373	-0.425	-0.414	-0.442	-0.419	-0.430	-0.367	-0.366	-0.332	-0.403	-0.397	-0.339
2695540	0.99	-0.004	-0.060	-0.043	-0.032	-0.009	0.023	0.068	0.112	0.156	0.153	0.164	0.055
	0.50	-0.219	-0.241	-0.241	-0.233	-0.211	-0.156	-0.132	-0.104	-0.102	-0.086	-0.118	-0.163
Bermuda	0.10	-0.330	-0.361	-0.371	-0.368	-0.349	-0.285	-0.272	-0.251	-0.239	-0.207	-0.270	-0.294
	0.01	-0.399	-0.455	-0.474	-0.476	-0.463	-0.400	-0.391	-0.373	-0.324	-0.279	-0.366	-0.387
8410140	0.99	-0.336	-0.420	-0.425	-0.316	-0.346	-0.292	-0.303	-0.342	-0.372	-0.322	-0.330	-0.308
	0.50	-0.784	-0.794	-0.812	-0.788	-0.763	-0.714	-0.738	-0.732	-0.721	-0.741	-0.776	-0.769
Eastport	0.10	-1.004	-1.005	-1.028	-1.009	-1.003	-0.915	-0.914	-0.900	-0.915	-0.951	-0.982	-1.006
	0.01	-1.131	-1.145	-1.170	-1.130	-1.166	-1.026	-0.996	-0.984	-1.042	-1.074	-1.094	-1.149
8413320	0.99	-0.198	-0.355	-0.336	-0.233	-0.226	-0.180	-0.246	-0.228	-0.201	-0.135	-0.240	-0.253
	0.50	-0.613	-0.564	-0.557	-0.542	-0.511	-0.487	-0.490	-0.448	-0.427	-0.502	-0.531	-0.563
Bar Harbor	0.10	-0.731	-0.701	-0.717	-0.707	-0.692	-0.616	-0.614	-0.560	-0.576	-0.650	-0.723	-0.765
	0.01	-0.769	-0.808	-0.857	-0.809	-0.828	-0.679	-0.688	-0.626	-0.694	-0.717	-0.875	-0.923
8418150	0.99	-0.271	-0.277	-0.268	-0.165	-0.171	-0.176	-0.166	-0.122	-0.095	-0.160	-0.207	-0.236
	0.50	-0.558	-0.528	-0.529	-0.491	-0.469	-0.427	-0.416	-0.388	-0.397	-0.459	-0.480	-0.540
Portland	0.10	-0.740	-0.714	-0.708	-0.687	-0.645	-0.569	-0.549	-0.528	-0.531	-0.611	-0.681	-0.740
	0.01	-0.879	-0.880	-0.856	-0.828	-0.769	-0.665	-0.633	-0.615	-0.599	-0.701	-0.860	-0.899
8419870	0.99	-0.298	-0.347	-0.302	-0.183	-0.193	-0.193	-0.222	-0.178	-0.177	-0.190	-0.254	-0.312
	0.50	-0.592	-0.552	-0.537	-0.503	-0.489	-0.438	-0.403	-0.382	-0.388	-0.470	-0.498	-0.571
Seavey Island	0.10	-0.748	-0.735	-0.692	-0.687	-0.641	-0.539	-0.528	-0.490	-0.521	-0.623	-0.691	-0.762
	0.01	-0.846	-0.938	-0.816	-0.813	-0.732	-0.588	-0.630	-0.557	-0.622	-0.722	-0.879	-0.935
8443970	0.99	-0.322	-0.343	-0.332	-0.232	-0.211	-0.176	-0.221	-0.180	-0.185	-0.213	-0.217	-0.304
	0.50	-0.641	-0.598	-0.598	-0.561	-0.543	-0.495	-0.473	-0.451	-0.439	-0.502	-0.551	-0.595
Boston	0.10	-0.822	-0.792	-0.792	-0.765	-0.709	-0.629	-0.609	-0.584	-0.591	-0.676	-0.764	-0.803
	0.01	-0.944	-0.971	-0.962	-0.915	-0.806	-0.693	-0.694	-0.659	-0.700	-0.801	-0.926	-0.983
8447930	0.99	-0.182	-0.134	-0.139	-0.044	-0.066	-0.022	-0.015	-0.013	-0.013	-0.023	-0.086	-0.143
	0.50	-0.419	-0.364	-0.340	-0.266	-0.210	-0.151	-0.126	-0.113	-0.130	-0.206	-0.282	-0.422
Woods Hole	0.10	-0.612	-0.573	-0.552	-0.388	-0.313	-0.236	-0.197	-0.179	-0.238	-0.329	-0.451	-0.598
	0.01	-0.805	-0.808	-0.835	-0.466	-0.403	-0.303	-0.252	-0.231	-0.362	-0.427	-0.630	-0.731
8449130	0.99	-0.152	-0.113	-0.103	-0.076	-0.122	-0.077	-0.060	-0.014	-0.047	-0.023	-0.123	-0.100
	0.50	-0.318	-0.290	-0.305	-0.257	-0.241	-0.201	-0.158	-0.122	-0.128	-0.182	-0.238	-0.300
Nantucket Island	0.10	-0.407	-0.436	-0.434	-0.365	-0.321	-0.280	-0.234	-0.160	-0.189	-0.294	-0.328	-0.414
	0.01	-0.464	-0.584	-0.533	-0.442	-0.387	-0.341	-0.305	-0.175	-0.245	-0.391	-0.416	-0.491
8452660	0.99	-0.247	-0.187	-0.181	-0.122	-0.047	-0.010	-0.042	-0.055	-0.085	-0.085	-0.103	-0.173

Table F. Low Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters below MLLW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Newport	0.50	-0.468	-0.444	-0.408	-0.312	-0.240	-0.166	-0.148	-0.160	-0.200	-0.261	-0.337	-0.445
	0.10	-0.659	-0.649	-0.620	-0.445	-0.367	-0.247	-0.237	-0.248	-0.316	-0.407	-0.503	-0.639
	0.01	-0.860	-0.850	-0.865	-0.558	-0.468	-0.297	-0.329	-0.338	-0.463	-0.554	-0.646	-0.807
8454000	0.99	-0.307	-0.199	-0.153	-0.138	-0.074	0.013	-0.042	-0.111	-0.128	-0.113	-0.117	-0.225
	0.50	-0.556	-0.496	-0.501	-0.342	-0.270	-0.205	-0.186	-0.225	-0.266	-0.320	-0.396	-0.525
Providence	0.10	-0.766	-0.715	-0.733	-0.515	-0.456	-0.315	-0.283	-0.328	-0.419	-0.497	-0.593	-0.749
	0.01	-0.983	-0.909	-0.919	-0.699	-0.676	-0.379	-0.363	-0.445	-0.637	-0.684	-0.762	-0.951
8461490	0.99	-0.245	-0.152	-0.144	-0.054	-0.077	-0.017	-0.036	-0.018	-0.027	-0.044	-0.087	-0.190
	0.50	-0.476	-0.436	-0.377	-0.276	-0.216	-0.184	-0.154	-0.135	-0.148	-0.231	-0.338	-0.471
New London	0.10	-0.705	-0.688	-0.618	-0.427	-0.323	-0.267	-0.215	-0.216	-0.258	-0.375	-0.514	-0.694
	0.01	-0.991	-0.966	-0.931	-0.550	-0.422	-0.316	-0.253	-0.285	-0.382	-0.510	-0.664	-0.908
8467150	0.99	-0.331	-0.182	-0.155	-0.105	-0.151	-0.109	-0.119	-0.098	-0.082	-0.179	-0.155	-0.277
	0.50	-0.597	-0.507	-0.513	-0.387	-0.333	-0.295	-0.274	-0.247	-0.256	-0.339	-0.438	-0.529
Bridgeport	0.10	-0.846	-0.834	-0.790	-0.563	-0.434	-0.400	-0.348	-0.312	-0.368	-0.539	-0.634	-0.789
	0.01	-1.138	-1.247	-1.052	-0.695	-0.499	-0.472	-0.390	-0.344	-0.455	-0.860	-0.797	-1.126
8510560	0.99	-0.251	-0.121	-0.123	-0.044	-0.069	-0.028	-0.042	-0.025	-0.032	-0.064	-0.126	-0.164
	0.50	-0.432	-0.403	-0.373	-0.288	-0.221	-0.186	-0.154	-0.137	-0.154	-0.234	-0.305	-0.423
Montauk	0.10	-0.611	-0.665	-0.597	-0.427	-0.320	-0.275	-0.224	-0.214	-0.263	-0.386	-0.476	-0.615
	0.01	-0.833	-0.969	-0.844	-0.520	-0.397	-0.334	-0.278	-0.277	-0.383	-0.555	-0.680	-0.789
8514560	0.99	-0.355	-0.166	-0.188	-0.085	-0.165	-0.129	-0.147	-0.096	-0.099	-0.155	-0.143	-0.294
	0.50	-0.589	-0.522	-0.447	-0.411	-0.355	-0.319	-0.282	-0.263	-0.260	-0.337	-0.443	-0.494
Port Jefferson	0.10	-0.844	-0.680	-0.691	-0.588	-0.466	-0.388	-0.355	-0.360	-0.362	-0.542	-0.619	-0.758
	0.01	-1.198	-0.761	-0.977	-0.700	-0.543	-0.416	-0.402	-0.427	-0.439	-0.833	-0.742	-1.213
8516945	0.99	-0.274	-0.235	-0.205	-0.149	-0.188	-0.151	-0.168	-0.114	-0.072	-0.149	-0.158	-0.298
	0.50	-0.632	-0.585	-0.530	-0.420	-0.389	-0.343	-0.311	-0.274	-0.273	-0.374	-0.495	-0.609
Kings Point	0.10	-0.912	-0.895	-0.878	-0.634	-0.533	-0.449	-0.411	-0.369	-0.429	-0.587	-0.730	-0.860
	0.01	-1.180	-1.236	-1.350	-0.843	-0.656	-0.519	-0.493	-0.435	-0.579	-0.838	-0.928	-1.110
8518750	0.99	-0.292	-0.234	-0.205	-0.129	-0.075	-0.023	-0.063	-0.021	-0.059	-0.097	-0.184	-0.292
	0.50	-0.626	-0.616	-0.541	-0.370	-0.264	-0.193	-0.196	-0.205	-0.232	-0.314	-0.446	-0.583
The Battery	0.10	-0.909	-0.909	-0.840	-0.580	-0.411	-0.299	-0.277	-0.308	-0.368	-0.523	-0.669	-0.828
	0.01	-1.206	-1.183	-1.169	-0.804	-0.551	-0.377	-0.337	-0.375	-0.500	-0.777	-0.901	-1.079
8531680	0.99	-0.280	-0.213	-0.179	-0.103	-0.063	-0.016	-0.078	-0.043	-0.048	-0.074	-0.133	-0.264
	0.50	-0.583	-0.554	-0.499	-0.349	-0.257	-0.195	-0.188	-0.198	-0.223	-0.297	-0.414	-0.553
Sandy Hook	0.10	-0.861	-0.850	-0.825	-0.531	-0.399	-0.294	-0.270	-0.298	-0.356	-0.506	-0.632	-0.815
	0.01	-1.180	-1.169	-1.245	-0.696	-0.526	-0.358	-0.344	-0.376	-0.481	-0.750	-0.839	-1.112
8534720	0.99	-0.260	-0.198	-0.209	-0.145	-0.118	-0.042	-0.090	-0.048	-0.028	-0.082	-0.157	-0.299
	0.50	-0.574	-0.559	-0.525	-0.381	-0.293	-0.237	-0.240	-0.228	-0.250	-0.312	-0.432	-0.573
Atlantic City	0.10	-0.860	-0.823	-0.797	-0.567	-0.443	-0.343	-0.349	-0.333	-0.385	-0.528	-0.657	-0.781
	0.01	-1.183	-1.057	-1.088	-0.746	-0.603	-0.410	-0.446	-0.404	-0.481	-0.778	-0.883	-0.972
8536110	0.99	-0.263	-0.091	-0.113	-0.087	-0.114	-0.028	-0.089	-0.048	-0.032	-0.065	-0.075	-0.236
	0.50	-0.546	-0.497	-0.506	-0.370	-0.271	-0.226	-0.229	-0.211	-0.223	-0.267	-0.361	-0.498

Table F. Low Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters below MLLW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Cape May	0.10	-0.708	-0.644	-0.711	-0.549	-0.415	-0.334	-0.321	-0.303	-0.374	-0.465	-0.548	-0.678
	0.01	-0.816	-0.705	-0.836	-0.685	-0.581	-0.403	-0.393	-0.364	-0.518	-0.710	-0.694	-0.829
8545240	0.99	-0.229	-0.179	-0.067	-0.046	-0.064	-0.054	-0.047	-0.055	-0.010	-0.098	-0.169	-0.307
	0.50	-0.662	-0.647	-0.517	-0.381	-0.251	-0.215	-0.207	-0.193	-0.225	-0.322	-0.459	-0.631
Philadelphia	0.10	-1.021	-0.944	-0.876	-0.664	-0.420	-0.363	-0.300	-0.326	-0.397	-0.531	-0.724	-0.972
	0.01	-1.388	-1.169	-1.226	-0.958	-0.611	-0.533	-0.365	-0.486	-0.565	-0.774	-1.027	-1.424
8557380	0.99	-0.279	-0.187	-0.139	-0.073	-0.099	-0.028	-0.078	-0.042	-0.039	-0.074	-0.101	-0.266
	0.50	-0.548	-0.500	-0.498	-0.365	-0.261	-0.219	-0.227	-0.232	-0.209	-0.282	-0.382	-0.534
Lewes	0.10	-0.799	-0.743	-0.742	-0.543	-0.417	-0.315	-0.320	-0.323	-0.363	-0.487	-0.605	-0.725
	0.01	-1.090	-0.974	-0.940	-0.672	-0.605	-0.371	-0.390	-0.374	-0.536	-0.739	-0.822	-0.892
8571892	0.99	-0.207	-0.177	-0.158	-0.116	-0.043	0.004	-0.036	-0.049	0.031	-0.039	-0.073	-0.223
	0.50	-0.468	-0.431	-0.366	-0.289	-0.212	-0.169	-0.141	-0.141	-0.155	-0.211	-0.294	-0.399
Cambridge	0.10	-0.650	-0.579	-0.515	-0.449	-0.310	-0.257	-0.211	-0.227	-0.256	-0.354	-0.446	-0.573
	0.01	-0.801	-0.680	-0.642	-0.634	-0.377	-0.309	-0.266	-0.327	-0.320	-0.499	-0.570	-0.788
8574680	0.99	-0.337	-0.298	-0.197	-0.125	-0.054	-0.023	-0.016	-0.024	-0.055	-0.079	-0.182	-0.318
	0.50	-0.651	-0.637	-0.527	-0.418	-0.251	-0.175	-0.152	-0.169	-0.212	-0.338	-0.476	-0.602
Baltimore	0.10	-0.915	-0.908	-0.814	-0.707	-0.427	-0.344	-0.260	-0.315	-0.403	-0.579	-0.749	-0.856
	0.01	-1.188	-1.172	-1.123	-1.067	-0.622	-0.582	-0.365	-0.501	-0.702	-0.857	-1.064	-1.135
8575512	0.99	-0.223	-0.242	-0.151	-0.125	-0.037	-0.012	-0.021	-0.018	-0.025	-0.072	-0.151	-0.285
	0.50	-0.568	-0.550	-0.457	-0.353	-0.206	-0.152	-0.128	-0.143	-0.177	-0.285	-0.410	-0.518
Annapolis	0.10	-0.799	-0.782	-0.663	-0.585	-0.365	-0.286	-0.222	-0.262	-0.346	-0.438	-0.615	-0.735
	0.01	-0.984	-0.993	-0.829	-0.884	-0.552	-0.445	-0.323	-0.406	-0.584	-0.570	-0.815	-0.985
8577330	0.99	-0.229	-0.181	-0.139	-0.084	-0.046	-0.004	-0.041	-0.016	0.026	-0.057	-0.104	-0.244
	0.50	-0.462	-0.454	-0.382	-0.288	-0.184	-0.150	-0.120	-0.116	-0.123	-0.204	-0.316	-0.422
Solomons Island	0.10	-0.657	-0.670	-0.555	-0.479	-0.300	-0.255	-0.200	-0.206	-0.231	-0.330	-0.470	-0.601
	0.01	-0.859	-0.879	-0.704	-0.701	-0.420	-0.346	-0.303	-0.309	-0.328	-0.464	-0.604	-0.827
8594900	0.99	-0.145	-0.074	-0.033	-0.018	0.000	-0.034	-0.059	-0.058	-0.018	-0.049	-0.141	-0.226
	0.50	-0.553	-0.554	-0.467	-0.351	-0.246	-0.203	-0.190	-0.188	-0.209	-0.323	-0.434	-0.547
Washington	0.10	-0.828	-0.919	-0.746	-0.680	-0.446	-0.364	-0.294	-0.288	-0.371	-0.522	-0.713	-0.808
	0.01	-1.051	-1.257	-0.962	-1.089	-0.645	-0.554	-0.396	-0.381	-0.542	-0.695	-1.046	-1.070
8632200	0.99	-0.193	-0.073	-0.132	-0.036	-0.076	-0.036	-0.043	-0.053	0.002	-0.016	-0.054	-0.172
	0.50	-0.391	-0.393	-0.334	-0.285	-0.214	-0.180	-0.195	-0.170	-0.123	-0.190	-0.258	-0.371
Kiptopeke	0.10	-0.558	-0.564	-0.510	-0.403	-0.337	-0.259	-0.259	-0.239	-0.213	-0.325	-0.399	-0.515
	0.01	-0.733	-0.672	-0.699	-0.468	-0.473	-0.311	-0.290	-0.288	-0.290	-0.454	-0.517	-0.641
8635150	0.99	-0.114	-0.251	-0.143	-0.070	-0.061	-0.005	-0.044	-0.037	0.000	-0.049	-0.046	-0.221
	0.50	-0.544	-0.493	-0.431	-0.332	-0.201	-0.158	-0.129	-0.121	-0.112	-0.231	-0.373	-0.478
Colonial Beach	0.10	-0.764	-0.759	-0.611	-0.628	-0.375	-0.273	-0.234	-0.212	-0.212	-0.424	-0.619	-0.678
	0.01	-0.897	-1.134	-0.747	-1.055	-0.657	-0.377	-0.400	-0.335	-0.324	-0.684	-0.844	-0.869
8635750	0.99	-0.221	-0.151	-0.103	-0.034	-0.015	0.016	-0.028	-0.015	0.045	-0.014	-0.058	-0.207
	0.50	-0.456	-0.404	-0.355	-0.265	-0.168	-0.122	-0.103	-0.090	-0.083	-0.182	-0.290	-0.384
	0.10	-0.592	-0.604	-0.530	-0.483	-0.266	-0.202	-0.202	-0.175	-0.171	-0.323	-0.469	-0.528

Table F. Low Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters below MLLW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Lewisetta	0.01	-0.686	-0.798	-0.676	-0.739	-0.342	-0.257	-0.370	-0.295	-0.244	-0.468	-0.638	-0.669
8637624 Gloucester Point	0.99	-0.205	-0.108	-0.105	-0.058	-0.059	-0.040	-0.071	-0.054	0.029	-0.023	-0.044	-0.181
	0.50	-0.428	-0.414	-0.352	-0.291	-0.207	-0.186	-0.196	-0.174	-0.131	-0.182	-0.298	-0.397
	0.10	-0.635	-0.608	-0.533	-0.414	-0.317	-0.279	-0.277	-0.255	-0.211	-0.350	-0.417	-0.555
	0.01	-0.874	-0.755	-0.693	-0.492	-0.414	-0.352	-0.340	-0.320	-0.257	-0.574	-0.484	-0.695
8638610 Sewells Point	0.99	-0.180	-0.088	-0.087	-0.059	-0.042	0.000	-0.062	-0.050	0.026	-0.034	-0.061	-0.193
	0.50	-0.423	-0.412	-0.390	-0.300	-0.231	-0.180	-0.215	-0.200	-0.154	-0.210	-0.315	-0.411
	0.10	-0.656	-0.610	-0.577	-0.437	-0.360	-0.289	-0.312	-0.293	-0.265	-0.390	-0.508	-0.580
	0.01	-0.934	-0.754	-0.712	-0.529	-0.466	-0.369	-0.386	-0.361	-0.347	-0.621	-0.687	-0.741
8638660 Portsmouth	0.99	-0.216	-0.147	-0.114	-0.076	-0.072	-0.040	-0.106	-0.111	-0.032	-0.054	-0.069	-0.155
	0.50	-0.440	-0.412	-0.400	-0.347	-0.279	-0.223	-0.241	-0.239	-0.185	-0.219	-0.325	-0.442
	0.10	-0.689	-0.614	-0.593	-0.484	-0.401	-0.340	-0.326	-0.326	-0.283	-0.411	-0.509	-0.626
	0.01	-1.043	-0.801	-0.750	-0.565	-0.485	-0.430	-0.389	-0.397	-0.360	-0.697	-0.668	-0.768
8638863 Ches. Bay Br. Tnl.	0.99	-0.178	-0.018	-0.132	-0.029	-0.062	-0.050	-0.073	-0.050	-0.001	-0.047	-0.072	-0.268
	0.50	-0.436	-0.411	-0.386	-0.299	-0.220	-0.187	-0.205	-0.202	-0.164	-0.233	-0.304	-0.400
	0.10	-0.646	-0.589	-0.606	-0.456	-0.352	-0.270	-0.310	-0.273	-0.262	-0.396	-0.454	-0.535
	0.01	-0.854	-0.683	-0.841	-0.564	-0.489	-0.329	-0.412	-0.312	-0.333	-0.571	-0.572	-0.710
8656483 Beaufort	0.99	-0.149	-0.090	-0.078	-0.079	-0.091	-0.016	-0.020	-0.010	0.110	0.029	-0.020	-0.181
	0.50	-0.347	-0.325	-0.327	-0.279	-0.240	-0.198	-0.210	-0.189	-0.102	-0.104	-0.228	-0.335
	0.10	-0.478	-0.514	-0.515	-0.412	-0.342	-0.292	-0.282	-0.268	-0.183	-0.243	-0.334	-0.442
	0.01	-0.583	-0.699	-0.687	-0.519	-0.425	-0.350	-0.314	-0.309	-0.218	-0.428	-0.397	-0.531
8658120 Wilmington	0.99	-0.094	0.078	0.036	0.000	-0.066	-0.063	-0.009	-0.018	0.100	0.055	0.010	-0.085
	0.50	-0.331	-0.312	-0.256	-0.235	-0.215	-0.192	-0.207	-0.187	-0.122	-0.139	-0.242	-0.339
	0.10	-0.457	-0.483	-0.406	-0.388	-0.315	-0.285	-0.284	-0.275	-0.257	-0.286	-0.364	-0.460
	0.01	-0.535	-0.569	-0.497	-0.506	-0.396	-0.366	-0.318	-0.327	-0.353	-0.421	-0.434	-0.527
8661070 Springmaid Pier	0.99	-0.185	-0.231	-0.298	-0.264	-0.181	-0.002	-0.083	-0.128	0.051	-0.008	-0.048	-0.217
	0.50	-0.572	-0.567	-0.574	-0.507	-0.389	-0.374	-0.367	-0.373	-0.234	-0.248	-0.365	-0.525
	0.10	-0.798	-0.776	-0.847	-0.757	-0.531	-0.511	-0.509	-0.521	-0.503	-0.438	-0.569	-0.734
	0.01	-0.955	-0.932	-1.185	-1.083	-0.649	-0.569	-0.591	-0.627	-0.818	-0.621	-0.727	-0.904
8665530 Charleston	0.99	-0.178	-0.191	-0.250	-0.227	-0.167	-0.072	-0.189	-0.115	0.075	0.051	-0.086	-0.226
	0.50	-0.505	-0.514	-0.472	-0.415	-0.332	-0.315	-0.358	-0.329	-0.178	-0.183	-0.339	-0.457
	0.10	-0.722	-0.700	-0.689	-0.597	-0.439	-0.447	-0.479	-0.451	-0.353	-0.351	-0.563	-0.670
	0.01	-0.895	-0.826	-0.955	-0.818	-0.521	-0.531	-0.585	-0.533	-0.497	-0.497	-0.809	-0.913
8670870 Fort Pulaski	0.99	-0.275	-0.300	-0.346	-0.314	-0.246	-0.116	-0.237	-0.153	0.042	0.003	-0.100	-0.326
	0.50	-0.598	-0.638	-0.613	-0.551	-0.430	-0.409	-0.452	-0.422	-0.255	-0.256	-0.412	-0.554
	0.10	-0.848	-0.885	-0.895	-0.766	-0.568	-0.584	-0.595	-0.581	-0.450	-0.437	-0.676	-0.770
	0.01	-1.083	-1.104	-1.273	-1.008	-0.693	-0.707	-0.709	-0.693	-0.603	-0.589	-0.949	-1.026
8720030 Fernandina Beach	0.99	-0.292	-0.260	-0.232	-0.215	-0.176	-0.047	-0.213	-0.158	0.051	0.097	-0.068	-0.254
	0.50	-0.541	-0.580	-0.534	-0.487	-0.401	-0.381	-0.425	-0.407	-0.236	-0.205	-0.337	-0.497
	0.10	-0.771	-0.796	-0.785	-0.693	-0.526	-0.546	-0.574	-0.568	-0.428	-0.386	-0.569	-0.697
	0.01	-1.035	-0.971	-1.043	-0.883	-0.607	-0.641	-0.701	-0.693	-0.584	-0.515	-0.816	-0.898

Table F. Low Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters below MLLW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
8720218	0.99	-0.177	-0.171	-0.195	-0.189	-0.160	-0.071	-0.172	-0.087	0.161	0.157	0.006	-0.137
	0.50	-0.433	-0.459	-0.441	-0.396	-0.326	-0.311	-0.364	-0.319	-0.149	-0.103	-0.230	-0.375
Mayport	0.10	-0.630	-0.653	-0.647	-0.571	-0.434	-0.441	-0.486	-0.448	-0.335	-0.265	-0.431	-0.551
	0.01	-0.814	-0.810	-0.857	-0.753	-0.519	-0.525	-0.579	-0.533	-0.469	-0.386	-0.643	-0.710
8723170	0.99	-0.068	-0.072	-0.061	-0.131	-0.061	-0.013	-0.065	-0.011	0.020	0.142	0.048	-0.017
	0.50	-0.262	-0.250	-0.272	-0.290	-0.233	-0.231	-0.229	-0.185	-0.105	-0.042	-0.133	-0.227
Miami Beach	0.10	-0.355	-0.345	-0.376	-0.380	-0.315	-0.338	-0.309	-0.283	-0.205	-0.168	-0.244	-0.331
	0.01	-0.406	-0.403	-0.435	-0.439	-0.361	-0.400	-0.354	-0.349	-0.304	-0.273	-0.323	-0.392
8723970	0.99	-0.030	0.007	-0.082	-0.070	-0.031	-0.025	0.001	0.041	0.136	0.129	0.088	-0.025
	0.50	-0.168	-0.197	-0.181	-0.170	-0.150	-0.121	-0.106	-0.067	-0.016	-0.001	-0.057	-0.141
Vaca Key	0.10	-0.228	-0.254	-0.231	-0.228	-0.204	-0.188	-0.170	-0.119	-0.078	-0.071	-0.128	-0.212
	0.01	-0.259	-0.272	-0.261	-0.267	-0.233	-0.243	-0.214	-0.147	-0.108	-0.114	-0.167	-0.265
8724580	0.99	-0.096	-0.070	-0.075	-0.100	-0.067	-0.066	-0.060	0.025	0.128	0.112	0.003	-0.083
	0.50	-0.226	-0.208	-0.202	-0.213	-0.197	-0.188	-0.163	-0.085	-0.007	-0.016	-0.130	-0.215
Key West	0.10	-0.315	-0.304	-0.297	-0.283	-0.272	-0.272	-0.233	-0.154	-0.089	-0.121	-0.220	-0.304
	0.01	-0.386	-0.385	-0.381	-0.333	-0.325	-0.342	-0.291	-0.206	-0.150	-0.226	-0.294	-0.375
8725110	0.99	-0.277	-0.202	-0.162	-0.162	-0.117	-0.152	-0.130	0.050	0.148	0.014	-0.163	-0.221
	0.50	-0.451	-0.404	-0.298	-0.306	-0.332	-0.328	-0.290	-0.190	-0.053	-0.164	-0.343	-0.442
Naples	0.10	-0.607	-0.561	-0.443	-0.426	-0.435	-0.431	-0.391	-0.282	-0.233	-0.296	-0.543	-0.589
	0.01	-0.780	-0.710	-0.638	-0.548	-0.493	-0.504	-0.467	-0.322	-0.433	-0.414	-0.829	-0.706
8725520	0.99	-0.144	-0.121	-0.075	-0.067	0.020	0.042	0.069	0.097	0.152	0.048	0.017	-0.120
	0.50	-0.365	-0.337	-0.299	-0.230	-0.136	-0.061	-0.028	-0.021	-0.036	-0.153	-0.251	-0.292
Fort Myers	0.10	-0.520	-0.470	-0.439	-0.333	-0.224	-0.148	-0.079	-0.145	-0.223	-0.304	-0.360	-0.441
	0.01	-0.653	-0.569	-0.544	-0.411	-0.282	-0.237	-0.109	-0.309	-0.455	-0.442	-0.412	-0.598
8726520	0.99	-0.175	-0.181	-0.123	-0.151	-0.043	-0.070	-0.012	0.036	0.083	0.028	-0.096	-0.198
	0.50	-0.424	-0.400	-0.352	-0.260	-0.195	-0.161	-0.133	-0.083	-0.040	-0.162	-0.326	-0.384
St. Petersburg	0.10	-0.595	-0.537	-0.468	-0.362	-0.290	-0.258	-0.205	-0.179	-0.240	-0.321	-0.454	-0.538
	0.01	-0.736	-0.638	-0.537	-0.481	-0.361	-0.388	-0.255	-0.273	-0.674	-0.486	-0.538	-0.694
8726724	0.99	-0.283	-0.203	-0.180	-0.179	-0.149	-0.148	-0.061	-0.045	0.109	-0.005	-0.103	-0.283
	0.50	-0.500	-0.449	-0.359	-0.305	-0.279	-0.292	-0.262	-0.152	-0.047	-0.191	-0.389	-0.457
Clearwater Beach	0.10	-0.666	-0.580	-0.509	-0.390	-0.373	-0.347	-0.344	-0.295	-0.155	-0.347	-0.526	-0.599
	0.01	-0.821	-0.662	-0.662	-0.461	-0.457	-0.371	-0.384	-0.547	-0.243	-0.511	-0.603	-0.740
8727520	0.99	-0.246	-0.261	-0.089	-0.142	-0.098	-0.091	-0.011	0.018	0.095	0.018	-0.082	-0.220
	0.50	-0.520	-0.492	-0.410	-0.328	-0.292	-0.248	-0.196	-0.132	-0.063	-0.232	-0.431	-0.495
Cedar Key	0.10	-0.744	-0.658	-0.574	-0.460	-0.425	-0.414	-0.320	-0.292	-0.320	-0.488	-0.621	-0.695
	0.01	-0.968	-0.802	-0.671	-0.574	-0.535	-0.633	-0.419	-0.505	-0.875	-0.820	-0.743	-0.870
8729840	0.99	-0.182	-0.158	-0.094	-0.060	-0.010	-0.012	0.015	0.076	0.116	0.067	-0.057	-0.176
	0.50	-0.382	-0.341	-0.299	-0.210	-0.155	-0.132	-0.136	-0.087	-0.007	-0.109	-0.270	-0.328
Pensacola	0.10	-0.520	-0.469	-0.434	-0.320	-0.258	-0.233	-0.214	-0.166	-0.093	-0.244	-0.388	-0.450
	0.01	-0.634	-0.578	-0.540	-0.418	-0.348	-0.336	-0.261	-0.211	-0.164	-0.371	-0.466	-0.572
8735180	0.99	-0.145	-0.085	-0.055	-0.016	-0.004	-0.040	-0.056	0.024	0.112	0.049	-0.028	-0.146

Table F. Low Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters below MLLW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Dauphin Island	0.50	-0.370	-0.344	-0.281	-0.208	-0.159	-0.147	-0.162	-0.128	-0.038	-0.116	-0.244	-0.339
	0.10	-0.504	-0.472	-0.438	-0.293	-0.253	-0.230	-0.245	-0.236	-0.129	-0.253	-0.384	-0.471
	0.01	-0.599	-0.545	-0.569	-0.336	-0.321	-0.308	-0.324	-0.328	-0.194	-0.392	-0.490	-0.581
8761724	0.99	-0.089	-0.076	-0.054	0.021	0.091	0.033	0.014	0.056	0.169	0.148	0.034	-0.095
	0.50	-0.307	-0.274	-0.237	-0.166	-0.134	-0.127	-0.140	-0.087	0.023	-0.035	-0.173	-0.269
Grand Isle	0.10	-0.432	-0.403	-0.369	-0.272	-0.216	-0.226	-0.223	-0.185	-0.102	-0.186	-0.303	-0.400
	0.01	-0.517	-0.502	-0.482	-0.343	-0.250	-0.299	-0.275	-0.264	-0.234	-0.338	-0.401	-0.520
8764311	0.99	-0.256	-0.108	-0.120	-0.110	-0.006	0.092	-0.073	-0.026	0.108	0.024	-0.167	-0.210
	0.50	-0.421	-0.376	-0.330	-0.258	-0.190	-0.196	-0.197	-0.173	-0.091	-0.191	-0.361	-0.416
Eugene Island	0.10	-0.577	-0.533	-0.450	-0.402	-0.338	-0.320	-0.304	-0.272	-0.155	-0.376	-0.487	-0.534
	0.01	-0.761	-0.642	-0.532	-0.577	-0.484	-0.381	-0.418	-0.352	-0.179	-0.574	-0.585	-0.613
8770570	0.99	-0.172	-0.214	-0.043	0.034	0.022	-0.065	-0.121	-0.030	0.089	0.024	-0.086	-0.158
	0.50	-0.587	-0.519	-0.491	-0.299	-0.255	-0.265	-0.289	-0.238	-0.101	-0.168	-0.411	-0.554
Sabine Pass	0.10	-0.888	-0.795	-0.765	-0.552	-0.449	-0.398	-0.442	-0.420	-0.252	-0.420	-0.654	-0.806
	0.01	-1.152	-1.103	-0.964	-0.785	-0.614	-0.505	-0.616	-0.617	-0.398	-0.855	-0.876	-0.997
8771450	0.99	-0.182	-0.220	-0.089	-0.011	0.014	-0.007	-0.072	-0.050	0.132	0.085	0.006	-0.218
	0.50	-0.553	-0.498	-0.467	-0.302	-0.216	-0.234	-0.281	-0.230	-0.057	-0.133	-0.385	-0.533
Galveston Pier 21	0.10	-0.844	-0.773	-0.746	-0.575	-0.376	-0.377	-0.397	-0.355	-0.217	-0.352	-0.611	-0.775
	0.01	-1.123	-1.113	-0.996	-0.895	-0.511	-0.485	-0.473	-0.458	-0.383	-0.631	-0.766	-1.002
8771510	0.99	-0.199	-0.236	-0.117	-0.022	-0.071	-0.079	-0.166	-0.058	0.113	0.070	-0.065	-0.268
	0.50	-0.634	-0.547	-0.540	-0.334	-0.282	-0.301	-0.327	-0.262	-0.083	-0.140	-0.435	-0.567
Glv. Pleasure Pier	0.10	-0.877	-0.810	-0.831	-0.583	-0.435	-0.466	-0.428	-0.385	-0.207	-0.367	-0.652	-0.797
	0.01	-1.038	-1.082	-1.072	-0.826	-0.569	-0.614	-0.504	-0.473	-0.300	-0.678	-0.803	-1.012
8772440	0.99	-0.197	-0.170	-0.139	-0.002	-0.051	-0.076	-0.140	-0.053	0.127	0.141	-0.029	-0.235
	0.50	-0.530	-0.465	-0.410	-0.277	-0.246	-0.299	-0.311	-0.251	-0.070	-0.115	-0.336	-0.482
Freeport	0.10	-0.754	-0.725	-0.654	-0.469	-0.385	-0.449	-0.412	-0.383	-0.196	-0.322	-0.502	-0.705
	0.01	-0.936	-1.010	-0.928	-0.631	-0.506	-0.570	-0.483	-0.490	-0.292	-0.526	-0.607	-0.954
8774770	0.99	-0.118	-0.108	-0.014	0.008	0.040	0.009	-0.030	-0.014	0.105	0.134	0.021	-0.090
	0.50	-0.332	-0.305	-0.295	-0.182	-0.116	-0.126	-0.195	-0.187	-0.051	-0.052	-0.193	-0.295
Rockport	0.10	-0.460	-0.461	-0.462	-0.316	-0.210	-0.232	-0.294	-0.262	-0.156	-0.203	-0.297	-0.435
	0.01	-0.551	-0.611	-0.580	-0.431	-0.279	-0.333	-0.365	-0.300	-0.241	-0.353	-0.357	-0.550
8778490	0.99	-0.115	-0.080	-0.003	0.057	0.102	0.042	-0.048	-0.021	0.118	0.164	0.058	0.006
	0.50	-0.296	-0.260	-0.257	-0.152	-0.077	-0.098	-0.184	-0.162	-0.050	-0.025	-0.130	-0.233
Port Mansfield	0.10	-0.395	-0.360	-0.380	-0.256	-0.176	-0.204	-0.243	-0.213	-0.192	-0.179	-0.248	-0.357
	0.01	-0.458	-0.425	-0.450	-0.316	-0.241	-0.303	-0.273	-0.234	-0.339	-0.333	-0.336	-0.432
8779750	0.99	-0.173	-0.059	-0.089	-0.076	-0.071	-0.101	-0.129	-0.125	0.131	0.120	0.045	-0.152
	0.50	-0.349	-0.345	-0.281	-0.259	-0.253	-0.308	-0.346	-0.258	-0.138	-0.078	-0.219	-0.340
Padre Island	0.10	-0.457	-0.447	-0.410	-0.360	-0.378	-0.414	-0.431	-0.341	-0.225	-0.220	-0.365	-0.478
	0.01	-0.535	-0.488	-0.515	-0.427	-0.479	-0.477	-0.469	-0.403	-0.257	-0.343	-0.460	-0.600
8779770	0.99	-0.132	-0.096	0.000	0.002	-0.016	-0.072	-0.085	-0.044	0.207	0.216	0.085	-0.105
	0.50	-0.335	-0.300	-0.240	-0.211	-0.228	-0.269	-0.307	-0.227	-0.079	-0.044	-0.195	-0.309

Table F. Low Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters below MLLW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Port Isabel	0.10	-0.470	-0.437	-0.384	-0.324	-0.334	-0.398	-0.410	-0.319	-0.185	-0.193	-0.348	-0.460
	0.01	-0.578	-0.547	-0.486	-0.395	-0.396	-0.499	-0.466	-0.374	-0.230	-0.294	-0.446	-0.596
9410170	0.99	-0.349	-0.260	-0.130	-0.152	-0.281	-0.324	-0.253	-0.172	-0.020	0.005	-0.171	-0.300
	0.50	-0.548	-0.499	-0.389	-0.362	-0.462	-0.499	-0.465	-0.380	-0.229	-0.240	-0.418	-0.522
San Diego	0.10	-0.674	-0.618	-0.510	-0.480	-0.568	-0.599	-0.565	-0.499	-0.354	-0.375	-0.545	-0.670
	0.01	-0.769	-0.687	-0.576	-0.558	-0.642	-0.668	-0.620	-0.580	-0.442	-0.463	-0.622	-0.789
9410230	0.99	-0.335	-0.254	-0.125	-0.178	-0.257	-0.305	-0.236	-0.143	-0.006	0.000	-0.177	-0.301
	0.50	-0.527	-0.478	-0.381	-0.341	-0.457	-0.487	-0.440	-0.352	-0.212	-0.214	-0.396	-0.508
La Jolla	0.10	-0.630	-0.591	-0.484	-0.473	-0.547	-0.574	-0.536	-0.454	-0.326	-0.340	-0.512	-0.631
	0.01	-0.696	-0.656	-0.532	-0.602	-0.594	-0.623	-0.588	-0.513	-0.399	-0.429	-0.583	-0.719
9410580	0.99	-0.304	-0.212	-0.121	-0.136	-0.258	-0.240	-0.193	-0.118	0.062	-0.025	-0.155	-0.288
	0.50	-0.505	-0.450	-0.344	-0.322	-0.424	-0.474	-0.445	-0.339	-0.200	-0.200	-0.393	-0.503
Newport Beach	0.10	-0.623	-0.559	-0.478	-0.426	-0.523	-0.559	-0.531	-0.436	-0.304	-0.308	-0.488	-0.617
	0.01	-0.705	-0.617	-0.575	-0.495	-0.594	-0.594	-0.563	-0.485	-0.350	-0.387	-0.533	-0.687
9410660	0.99	-0.312	-0.216	-0.096	-0.155	-0.260	-0.306	-0.247	-0.166	0.007	0.003	-0.190	-0.291
	0.50	-0.522	-0.470	-0.364	-0.347	-0.449	-0.482	-0.454	-0.356	-0.214	-0.215	-0.404	-0.506
Los Angeles	0.10	-0.640	-0.585	-0.475	-0.443	-0.553	-0.578	-0.546	-0.470	-0.345	-0.345	-0.520	-0.641
	0.01	-0.718	-0.645	-0.529	-0.499	-0.622	-0.642	-0.594	-0.551	-0.437	-0.438	-0.595	-0.744
9410840	0.99	-0.258	-0.175	-0.065	-0.128	-0.251	-0.310	-0.246	-0.125	0.017	0.028	-0.157	-0.265
	0.50	-0.506	-0.452	-0.339	-0.335	-0.432	-0.468	-0.432	-0.327	-0.178	-0.196	-0.387	-0.496
Santa Monica	0.10	-0.633	-0.581	-0.455	-0.454	-0.564	-0.572	-0.528	-0.454	-0.311	-0.339	-0.517	-0.635
	0.01	-0.709	-0.650	-0.512	-0.534	-0.680	-0.654	-0.585	-0.549	-0.422	-0.448	-0.605	-0.735
9411270	0.99	-0.267	-0.209	-0.176	-0.107	-0.251	-0.244	-0.016	-0.158	-0.021	0.076	-0.049	-0.298
	0.50	-0.511	-0.480	-0.342	-0.317	-0.407	-0.471	-0.480	-0.309	-0.177	-0.173	-0.394	-0.512
Rincon Island	0.10	-0.620	-0.541	-0.463	-0.428	-0.524	-0.564	-0.545	-0.401	-0.286	-0.278	-0.496	-0.600
	0.01	-0.676	-0.557	-0.570	-0.497	-0.630	-0.607	-0.555	-0.467	-0.377	-0.329	-0.530	-0.642
9412110	0.99	-0.239	-0.172	-0.146	-0.085	-0.242	-0.212	-0.244	-0.114	0.004	0.014	-0.158	-0.255
	0.50	-0.501	-0.434	-0.323	-0.349	-0.453	-0.504	-0.446	-0.326	-0.166	-0.187	-0.399	-0.515
Port San Luis	0.10	-0.631	-0.544	-0.445	-0.465	-0.571	-0.573	-0.535	-0.440	-0.298	-0.327	-0.526	-0.623
	0.01	-0.707	-0.598	-0.546	-0.524	-0.649	-0.592	-0.579	-0.512	-0.423	-0.443	-0.605	-0.676
9413450	0.99	-0.234	-0.154	-0.098	-0.109	-0.239	-0.239	-0.272	-0.150	0.025	-0.010	-0.158	-0.309
	0.50	-0.517	-0.403	-0.298	-0.348	-0.477	-0.523	-0.462	-0.331	-0.152	-0.203	-0.428	-0.530
Monterey	0.10	-0.658	-0.524	-0.375	-0.457	-0.586	-0.599	-0.550	-0.423	-0.259	-0.350	-0.562	-0.636
	0.01	-0.740	-0.594	-0.409	-0.514	-0.643	-0.621	-0.598	-0.477	-0.335	-0.484	-0.640	-0.695
9414290	0.99	-0.169	-0.012	0.004	-0.075	-0.264	-0.261	-0.241	-0.116	0.027	-0.019	-0.197	-0.272
	0.50	-0.460	-0.359	-0.258	-0.338	-0.471	-0.506	-0.446	-0.325	-0.152	-0.242	-0.443	-0.498
San Francisco	0.10	-0.620	-0.526	-0.387	-0.473	-0.588	-0.627	-0.569	-0.438	-0.291	-0.389	-0.581	-0.647
	0.01	-0.724	-0.620	-0.462	-0.554	-0.666	-0.696	-0.656	-0.510	-0.424	-0.506	-0.673	-0.765
9414750	0.99	-0.136	0.047	0.033	-0.015	-0.233	-0.261	-0.209	-0.103	0.024	-0.032	-0.185	-0.274
	0.50	-0.451	-0.343	-0.240	-0.342	-0.468	-0.502	-0.458	-0.325	-0.148	-0.228	-0.435	-0.494
	0.10	-0.633	-0.534	-0.393	-0.505	-0.596	-0.617	-0.557	-0.421	-0.277	-0.376	-0.580	-0.639

Table F. Low Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters below MLLW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Alameda	0.01	-0.757	-0.645	-0.493	-0.601	-0.679	-0.681	-0.602	-0.469	-0.394	-0.511	-0.680	-0.753
9415020	0.99	-0.196	-0.106	0.030	-0.142	-0.307	-0.338	-0.303	-0.153	0.061	-0.027	-0.192	-0.303
	0.50	-0.520	-0.404	-0.325	-0.419	-0.535	-0.572	-0.507	-0.352	-0.154	-0.242	-0.471	-0.558
Point Reyes	0.10	-0.686	-0.599	-0.410	-0.571	-0.663	-0.677	-0.602	-0.453	-0.262	-0.401	-0.618	-0.703
	0.01	-0.785	-0.751	-0.433	-0.671	-0.749	-0.732	-0.653	-0.514	-0.325	-0.545	-0.708	-0.802
9419750	0.99	-0.150	-0.001	-0.033	-0.124	-0.378	-0.464	-0.398	-0.250	-0.035	-0.125	-0.145	-0.323
	0.50	-0.555	-0.420	-0.302	-0.475	-0.642	-0.679	-0.599	-0.431	-0.227	-0.398	-0.564	-0.583
Crescent City	0.10	-0.757	-0.671	-0.487	-0.662	-0.799	-0.795	-0.709	-0.567	-0.354	-0.552	-0.723	-0.750
	0.01	-0.875	-0.849	-0.638	-0.779	-0.911	-0.870	-0.778	-0.689	-0.453	-0.655	-0.793	-0.878
9432780	0.99	-0.181	-0.015	-0.049	-0.147	-0.460	-0.464	-0.365	-0.270	-0.052	-0.181	-0.134	-0.267
	0.50	-0.573	-0.419	-0.298	-0.554	-0.684	-0.724	-0.690	-0.522	-0.322	-0.473	-0.550	-0.605
Charleston	0.10	-0.778	-0.694	-0.496	-0.706	-0.844	-0.850	-0.797	-0.676	-0.458	-0.654	-0.786	-0.783
	0.01	-0.904	-0.921	-0.689	-0.770	-0.983	-0.922	-0.836	-0.788	-0.538	-0.787	-0.943	-0.893
9435380	0.99	-0.286	-0.079	-0.092	-0.146	-0.455	-0.504	-0.420	-0.370	-0.079	-0.211	-0.193	-0.304
	0.50	-0.652	-0.466	-0.329	-0.599	-0.768	-0.815	-0.788	-0.611	-0.370	-0.521	-0.608	-0.690
South Beach	0.10	-0.849	-0.743	-0.523	-0.771	-0.935	-0.949	-0.909	-0.767	-0.511	-0.726	-0.850	-0.856
	0.01	-0.973	-0.983	-0.720	-0.845	-1.040	-1.016	-0.955	-0.887	-0.590	-0.889	-1.017	-0.939
9439040	0.99	0.010	0.134	0.170	0.105	0.097	0.204	-0.038	-0.208	-0.133	-0.137	-0.073	-0.057
	0.50	-0.335	-0.265	-0.204	-0.231	-0.268	-0.275	-0.417	-0.455	-0.384	-0.386	-0.402	-0.373
Astoria	0.10	-0.551	-0.503	-0.384	-0.403	-0.464	-0.539	-0.613	-0.593	-0.504	-0.544	-0.584	-0.549
	0.01	-0.713	-0.671	-0.486	-0.505	-0.588	-0.710	-0.732	-0.684	-0.571	-0.663	-0.703	-0.665
9440910	0.99	-0.182	-0.097	-0.019	-0.124	-0.428	-0.539	-0.457	-0.336	-0.064	-0.250	-0.223	-0.252
	0.50	-0.713	-0.516	-0.375	-0.627	-0.801	-0.882	-0.867	-0.700	-0.422	-0.542	-0.597	-0.759
Toke Point	0.10	-0.916	-0.837	-0.597	-0.832	-1.017	-1.038	-1.009	-0.869	-0.601	-0.796	-0.898	-1.007
	0.01	-1.005	-1.137	-0.763	-0.928	-1.164	-1.120	-1.065	-0.961	-0.706	-1.070	-1.197	-1.149
9443090	0.99	-0.287	-0.107	0.016	-0.084	-0.421	-0.512	-0.550	-0.326	-0.050	-0.146	-0.258	-0.399
	0.50	-0.714	-0.525	-0.310	-0.565	-0.806	-0.899	-0.851	-0.632	-0.366	-0.517	-0.666	-0.762
Neah Bay	0.10	-0.935	-0.789	-0.512	-0.768	-0.996	-1.036	-0.989	-0.803	-0.519	-0.777	-0.944	-0.985
	0.01	-1.069	-0.990	-0.660	-0.866	-1.105	-1.091	-1.063	-0.915	-0.607	-0.998	-1.171	-1.149
9444090	0.99	-0.448	-0.044	-0.008	-0.065	-0.498	-0.506	-0.453	-0.258	0.078	-0.189	-0.346	-0.393
	0.50	-0.877	-0.593	-0.282	-0.620	-0.859	-1.025	-0.953	-0.683	-0.332	-0.545	-0.733	-0.985
Port Angeles	0.10	-1.106	-0.928	-0.503	-0.832	-1.137	-1.192	-1.122	-0.869	-0.522	-0.834	-1.085	-1.205
	0.01	-1.250	-1.172	-0.721	-0.925	-1.397	-1.252	-1.186	-0.962	-0.625	-1.121	-1.481	-1.297
9444900	0.99	-0.441	-0.074	0.016	-0.059	-0.437	-0.516	-0.543	-0.301	0.051	-0.195	-0.335	-0.408
	0.50	-0.889	-0.591	-0.293	-0.627	-0.887	-1.016	-0.928	-0.671	-0.354	-0.560	-0.767	-0.986
Port Townsend	0.10	-1.118	-0.919	-0.510	-0.837	-1.101	-1.173	-1.097	-0.851	-0.530	-0.830	-1.083	-1.195
	0.01	-1.256	-1.168	-0.694	-0.925	-1.221	-1.228	-1.182	-0.953	-0.619	-1.075	-1.364	-1.281
9447130	0.99	-0.466	-0.141	0.051	-0.138	-0.566	-0.687	-0.678	-0.373	-0.001	-0.214	-0.448	-0.602
	0.50	-0.989	-0.681	-0.344	-0.683	-0.996	-1.093	-1.027	-0.776	-0.405	-0.635	-0.937	-1.072
Seattle	0.10	-1.251	-0.997	-0.590	-0.912	-1.214	-1.297	-1.220	-0.981	-0.608	-0.923	-1.208	-1.294
	0.01	-1.403	-1.216	-0.774	-1.021	-1.343	-1.416	-1.346	-1.104	-0.728	-1.161	-1.386	-1.414

Table F. Low Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters below MLLW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
9449424 Cherry Point	0.99	-0.452	-0.085	-0.037	-0.141	-0.542	-0.539	-0.495	-0.248	0.066	-0.189	-0.321	-0.471
	0.50	-0.919	-0.642	-0.326	-0.645	-0.868	-0.964	-0.885	-0.600	-0.312	-0.557	-0.770	-1.019
	0.10	-1.129	-0.967	-0.552	-0.856	-1.087	-1.138	-1.037	-0.790	-0.489	-0.811	-1.067	-1.210
	0.01	-1.238	-1.190	-0.769	-0.958	-1.264	-1.221	-1.105	-0.909	-0.586	-1.021	-1.303	-1.287
9449880 Friday Harbor	0.99	-0.345	-0.062	0.077	-0.139	-0.412	-0.519	-0.497	-0.215	0.048	-0.146	-0.298	-0.459
	0.50	-0.830	-0.579	-0.319	-0.555	-0.825	-0.903	-0.814	-0.600	-0.326	-0.497	-0.745	-0.896
	0.10	-1.067	-0.862	-0.511	-0.768	-1.022	-1.069	-0.984	-0.752	-0.505	-0.737	-0.992	-1.099
	0.01	-1.202	-1.044	-0.619	-0.895	-1.133	-1.151	-1.091	-0.820	-0.605	-0.936	-1.153	-1.209
9450460 Ketchikan	0.99	-0.613	-0.554	-0.400	-0.486	-0.702	-0.705	-0.739	-0.670	-0.367	-0.531	-0.626	-0.647
	0.50	-1.161	-1.033	-0.841	-1.028	-1.149	-1.151	-1.171	-1.110	-0.904	-1.009	-1.069	-1.147
	0.10	-1.426	-1.289	-1.118	-1.272	-1.355	-1.338	-1.371	-1.310	-1.102	-1.275	-1.336	-1.418
	0.01	-1.575	-1.450	-1.325	-1.399	-1.466	-1.429	-1.480	-1.415	-1.186	-1.450	-1.527	-1.592
9451600 Sitka	0.99	-0.359	-0.343	-0.112	-0.305	-0.563	-0.606	-0.558	-0.425	-0.168	-0.230	-0.385	-0.420
	0.50	-0.809	-0.652	-0.485	-0.713	-0.852	-0.886	-0.865	-0.726	-0.487	-0.608	-0.702	-0.802
	0.10	-1.041	-0.879	-0.687	-0.913	-1.015	-1.040	-1.021	-0.906	-0.652	-0.790	-0.912	-1.035
	0.01	-1.182	-1.084	-0.817	-1.027	-1.124	-1.141	-1.113	-1.033	-0.753	-0.893	-1.080	-1.204
9452210 Juneau	0.99	-0.743	-0.667	-0.438	-0.554	-0.737	-0.667	-0.708	-0.664	-0.374	-0.635	-0.628	-0.724
	0.50	-1.256	-1.156	-0.978	-1.197	-1.229	-1.166	-1.167	-1.140	-0.936	-1.080	-1.176	-1.221
	0.10	-1.547	-1.433	-1.235	-1.458	-1.471	-1.377	-1.394	-1.353	-1.165	-1.369	-1.452	-1.529
	0.01	-1.744	-1.617	-1.378	-1.580	-1.610	-1.479	-1.524	-1.463	-1.272	-1.594	-1.614	-1.757
9452400 Skagway	0.99	-0.629	-0.570	-0.385	-0.493	-0.578	-0.549	-0.558	-0.638	-0.324	-0.599	-0.644	-0.727
	0.50	-1.291	-1.237	-1.019	-1.208	-1.217	-1.125	-1.131	-1.129	-0.970	-1.133	-1.183	-1.271
	0.10	-1.658	-1.507	-1.323	-1.499	-1.460	-1.347	-1.365	-1.360	-1.199	-1.404	-1.538	-1.590
	0.01	-1.897	-1.633	-1.494	-1.636	-1.566	-1.446	-1.474	-1.486	-1.292	-1.565	-1.818	-1.811
9453220 Yakutat	0.99	-0.316	-0.315	-0.114	-0.328	-0.557	-0.582	-0.537	-0.374	-0.123	-0.204	-0.362	-0.424
	0.50	-0.815	-0.679	-0.520	-0.738	-0.845	-0.873	-0.849	-0.722	-0.482	-0.591	-0.686	-0.774
	0.10	-1.052	-0.918	-0.714	-0.973	-1.034	-1.026	-0.992	-0.914	-0.656	-0.772	-0.922	-1.056
	0.01	-1.183	-1.107	-0.821	-1.131	-1.183	-1.121	-1.069	-1.039	-0.754	-0.870	-1.132	-1.335
9454050 Cordova	0.99	-0.639	-0.557	-0.441	-0.538	-0.593	-0.602	-0.648	-0.521	-0.309	-0.518	-0.545	-0.695
	0.50	-1.081	-0.933	-0.779	-0.986	-1.066	-1.033	-1.000	-0.917	-0.694	-0.839	-0.898	-1.005
	0.10	-1.298	-1.182	-0.981	-1.209	-1.242	-1.194	-1.175	-1.082	-0.867	-1.002	-1.145	-1.254
	0.01	-1.423	-1.378	-1.124	-1.339	-1.317	-1.263	-1.276	-1.161	-0.957	-1.100	-1.353	-1.500
9454240 Valdez	0.99	-0.567	-0.573	-0.402	-0.579	-0.688	-0.698	-0.667	-0.491	-0.260	-0.513	-0.544	-0.745
	0.50	-1.074	-0.912	-0.748	-1.015	-1.105	-1.026	-1.028	-0.914	-0.642	-0.799	-0.894	-1.026
	0.10	-1.362	-1.189	-0.986	-1.262	-1.322	-1.225	-1.219	-1.112	-0.843	-0.988	-1.153	-1.312
	0.01	-1.556	-1.467	-1.185	-1.426	-1.455	-1.369	-1.338	-1.220	-0.966	-1.138	-1.385	-1.680
9455090 Seward	0.99	-0.375	-0.387	-0.277	-0.454	-0.553	-0.582	-0.614	-0.475	-0.169	-0.325	-0.415	-0.549
	0.50	-0.917	-0.763	-0.629	-0.827	-0.959	-0.954	-0.904	-0.780	-0.498	-0.660	-0.748	-0.885
	0.10	-1.186	-1.023	-0.829	-1.088	-1.148	-1.120	-1.077	-0.953	-0.696	-0.832	-1.011	-1.161
	0.01	-1.342	-1.241	-0.962	-1.309	-1.250	-1.205	-1.200	-1.071	-0.838	-0.936	-1.266	-1.440
9455500	0.99	-0.771	-0.935	-0.559	-0.795	-0.960	-0.903	-0.957	-0.831	-0.653	-0.780	-0.841	-0.956

Table F. Low Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels by Month (meters below MLLW)													
Station Number and Name	**Exc. Prob.**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Seldovia	0.50	-1.556	-1.436	-1.300	-1.554	-1.559	-1.481	-1.488	-1.465	-1.204	-1.392	-1.374	-1.454
	0.10	-1.880	-1.753	-1.623	-1.857	-1.841	-1.710	-1.733	-1.682	-1.510	-1.632	-1.745	-1.756
	0.01	-2.033	-1.994	-1.785	-1.997	-1.995	-1.814	-1.863	-1.766	-1.711	-1.740	-2.058	-1.973
9455760	0.99	-0.779	-0.638	-0.416	-0.918	-0.952	-0.805	-0.807	-0.541	-0.470	-0.675	-0.846	-1.045
	0.50	-1.536	-1.337	-1.104	-1.330	-1.407	-1.365	-1.367	-1.242	-0.933	-1.182	-1.227	-1.382
Nikiski	0.10	-1.783	-1.599	-1.436	-1.578	-1.634	-1.566	-1.551	-1.455	-1.159	-1.379	-1.506	-1.683
	0.01	-1.875	-1.710	-1.622	-1.755	-1.765	-1.648	-1.619	-1.527	-1.288	-1.466	-1.754	-2.017
9455920	0.99	-0.841	-0.815	-0.326	-0.748	-0.846	-0.900	-0.806	-0.632	-0.230	-0.533	-0.664	-0.838
	0.50	-1.278	-1.107	-1.011	-1.155	-1.292	-1.237	-1.176	-1.047	-0.797	-0.981	-1.101	-1.285
Anchorage	0.10	-1.562	-1.376	-1.280	-1.457	-1.478	-1.428	-1.404	-1.322	-1.034	-1.222	-1.400	-1.605
	0.01	-1.784	-1.685	-1.402	-1.730	-1.568	-1.555	-1.571	-1.539	-1.147	-1.375	-1.647	-1.884
9457292	0.99	-0.271	-0.234	-0.172	-0.298	-0.387	-0.427	-0.339	-0.247	-0.045	-0.206	-0.349	-0.337
	0.50	-0.724	-0.574	-0.460	-0.630	-0.744	-0.731	-0.691	-0.588	-0.355	-0.512	-0.615	-0.716
Kodiak Island	0.10	-0.902	-0.830	-0.656	-0.823	-0.887	-0.871	-0.850	-0.735	-0.531	-0.679	-0.820	-0.964
	0.01	-0.982	-1.065	-0.816	-0.954	-0.952	-0.945	-0.933	-0.809	-0.650	-0.785	-1.012	-1.159
9459450	0.99	-0.062	-0.085	-0.014	-0.255	-0.446	-0.492	-0.400	-0.220	-0.028	-0.098	-0.216	-0.326
	0.50	-0.639	-0.481	-0.432	-0.572	-0.743	-0.772	-0.743	-0.619	-0.337	-0.488	-0.591	-0.649
Sand Point	0.10	-0.898	-0.813	-0.644	-0.787	-0.871	-0.915	-0.877	-0.773	-0.547	-0.638	-0.879	-0.903
	0.01	-1.034	-1.157	-0.770	-0.963	-0.936	-1.000	-0.937	-0.841	-0.720	-0.703	-1.147	-1.146
9461380	0.99	-0.081	-0.009	-0.051	-0.153	-0.266	-0.354	-0.288	-0.186	-0.137	-0.092	-0.168	-0.171
	0.50	-0.459	-0.359	-0.371	-0.451	-0.507	-0.538	-0.513	-0.397	-0.317	-0.397	-0.486	-0.508
Adak Island	0.10	-0.598	-0.583	-0.546	-0.612	-0.660	-0.684	-0.638	-0.524	-0.446	-0.557	-0.707	-0.712
	0.01	-0.657	-0.754	-0.660	-0.715	-0.777	-0.826	-0.720	-0.615	-0.557	-0.656	-0.892	-0.858
9462620	0.99	-0.054	0.070	-0.039	-0.098	-0.225	-0.285	-0.282	-0.203	-0.134	-0.105	-0.099	-0.102
	0.50	-0.427	-0.373	-0.420	-0.429	-0.482	-0.510	-0.481	-0.400	-0.327	-0.345	-0.451	-0.452
Unalaska	0.10	-0.632	-0.583	-0.623	-0.599	-0.622	-0.641	-0.613	-0.514	-0.457	-0.524	-0.674	-0.661
	0.01	-0.763	-0.699	-0.751	-0.701	-0.712	-0.732	-0.720	-0.591	-0.563	-0.685	-0.843	-0.810
9751639	0.99	-0.044	-0.023	-0.002	-0.021	-0.024	-0.026	0.012	0.021	0.061	0.109	0.019	-0.020
	0.50	-0.143	-0.138	-0.105	-0.099	-0.111	-0.113	-0.086	-0.055	-0.003	0.013	-0.053	-0.113
Charlotte Amalie	0.10	-0.197	-0.198	-0.171	-0.159	-0.164	-0.167	-0.132	-0.098	-0.056	-0.041	-0.101	-0.183
	0.01	-0.231	-0.234	-0.223	-0.214	-0.204	-0.206	-0.157	-0.128	-0.109	-0.076	-0.139	-0.247
9755371	0.99	-0.056	-0.031	-0.009	-0.042	-0.066	-0.074	-0.018	-0.001	0.051	0.079	0.018	-0.088
	0.50	-0.185	-0.148	-0.120	-0.121	-0.150	-0.145	-0.116	-0.080	-0.026	-0.025	-0.095	-0.171
San Juan	0.10	-0.243	-0.191	-0.178	-0.191	-0.203	-0.214	-0.185	-0.132	-0.086	-0.093	-0.136	-0.239
	0.01	-0.273	-0.209	-0.214	-0.268	-0.243	-0.300	-0.242	-0.172	-0.145	-0.146	-0.152	-0.310
9759110	0.99	-0.047	-0.034	-0.011	-0.049	-0.031	-0.034	0.022	0.051	0.072	0.068	0.029	-0.037
	0.50	-0.131	-0.119	-0.105	-0.111	-0.132	-0.118	-0.071	-0.035	-0.003	-0.011	-0.064	-0.117
Magueyes Island	0.10	-0.186	-0.159	-0.159	-0.168	-0.179	-0.179	-0.130	-0.086	-0.058	-0.072	-0.115	-0.170
	0.01	-0.230	-0.182	-0.197	-0.232	-0.204	-0.233	-0.175	-0.121	-0.106	-0.128	-0.147	-0.213

Appendix VIII.

Effect of Hurricanes Irene and Sandy on High Water Exceedance Probability Levels for Bridgeport, The Battery, and Sandy Hook

In late October 2012, Hurricane Sandy struck the coast of New Jersey. The storm's large area, direction of motion relative to the coastline, strong winds, and low barometric pressure caused a large storm surge along the Mid-Atlantic coast from Cape Cod to Cape Hatteras. At most long-term NWLON stations, the peak water levels were high, but not the historically highest levels, with the exception of two stations in New York Harbor (The Battery and Sandy Hook) and at Bridgeport on Long Island Sound.

At Bridgeport, the level reached by Sandy was 0.304 meters above the previous historic record, from a December 1992 winter storm. At The Battery, Sandy reached a level of 1.228 meters above the previous record from Hurricane Donna in 1960. At Sandy Hook, the gauge stopped recording at 23:36 on October 29, after reaching a level of 0.959 meters above the previous historic record, also from Donna in 1960. Because these new maxima are so far above the previous maxima, they cause a significant change in the shapes of any calculated exceedance probability curves especially at the longer return periods. Therefore, in this Appendix, the high water GEV parameters for these three stations are recalculated with the inclusion of the highest levels for 2011 and 2012, which were the peak levels reached by Hurricane Irene and Hurricane Sandy at all three stations.

Since the Sandy Hook station malfunctioned before reaching its peak during Hurricane Sandy, a couple of nearby high water marks (HWMs) leveled by the USGS to the NAVD88 geodetic datum were considered. The marks are about 0.5 kilometers north and south of the station and reached levels of 11.57 and 11.06 feet above NAVD88, respectively (McCallum et al., 2013). The average of the two HWMs is equivalent to 3.449 meters above NAVD88 which is 2.714 meters above MHHW. This peak level at Sandy Hook is 0.274 meters above the last recorded level received from the gauge before it was destroyed and, therefore, is 1.233 meters above the level reached by Hurricane Donna in 1960.

In Table G, the location, scale, and shape parameters of the high water level GEV solutions are shown as a comparison between the results with and without the 2011 and 2012 maxima. The locations parameters are negligibly higher and the scale parameters are slightly higher with the additional two years. The most significant change is the increase in the shape parameters which indicate how steeply the exceedance probability levels rise as the return period lengthens. At The Battery and Sandy Hook, the shape parameters become more positive and at Bridgeport the shape parameter changes from a negative value (Weibull distribution) to a positive value (Fréchet distribution).

Table G. Comparison of High Water Level GEV Location, Scale, and Shape Parameters							
Station Number	Station Name	Location Parameter (meters)	+/- 95% Confidence Interval	Scale Parameter (meters)	+/- 95% Confidence Interval	Shape Parameter	+/- 95% Confidence Interval
Through 2010							
8467150	Bridgeport	0.704	0.052	0.160	0.037	-0.037	0.198
8518750	The Battery	0.676	0.030	0.149	0.022	0.058	0.124
8531680	Sandy Hook	0.706	0.039	0.157	0.030	0.142	0.175
Through 2012 (including Irene and Sandy)							
8467150	Bridgeport	0.709	0.055	0.172	0.040	0.072	0.201
8518750	The Battery	0.676	0.031	0.155	0.023	0.142	0.117
8531680	Sandy Hook	0.709	0.041	0.167	0.033	0.226	0.173

Table H is a comparison of the 0.99, 0.50, 0.10 and 0.01 GEV exceedance probability levels for the three stations with and without the high water maxima for 2011 and 2012. The exceedance probability curves are also plotted versus return period in Figures 28, 29, and 30 for the three stations. The shorter return period sections of the curves (0.99 and 0.50 exceedance probabilities) are negligibly higher with the two additional years. The 0.10 exceedance probability levels are slightly higher and the 0.01 exceedance probability levels are substantially higher, primarily due the level reached by Hurricane Sandy, which steepens the curves and widens the confidence intervals at the longer return periods.

Table H. Comparison of High Water 0.99, 0.50, 0.10, and 0.01 GEV Exceedance Probability Levels (meters above MHHW)													
Station Number	Station Name	0.99 Exc. Prob.	+95% Conf. Int.	-95% Conf. Int.	0.50 Exc. Prob.	+95% Conf. Int.	-95% Conf. Int.	0.10 Exc. Prob.	+95% Conf. Int.	-95% Conf. Int.	0.01 Exc. Prob.	+95% Conf. Int.	-95% Conf. Int.
Through 2010													
846715	Bridgeport	0.453	0.510	0.350	0.762	0.822	0.708	1.049	1.200	0.961	1.380	1.811	1.201
851875	The Battery	0.459	0.490	0.414	0.732	0.767	0.699	1.034	1.128	0.968	1.460	1.817	1.283
853168	Sandy Hook	0.490	0.526	0.432	0.765	0.814	0.722	1.123	1.289	1.023	1.727	2.435	1.411
Through 2012 (including Irene and Sandy)													
846715	Bridgeport	0.459	0.511	0.367	0.773	0.840	0.714	1.130	1.340	1.015	1.650	2.362	1.352
851875	The Battery	0.463	0.491	0.425	0.735	0.772	0.700	1.087	1.204	1.006	1.681	2.173	1.434
853168	Sandy Hook	0.493	0.526	0.441	0.773	0.826	0.727	1.199	1.410	1.075	2.058	3.077	1.605

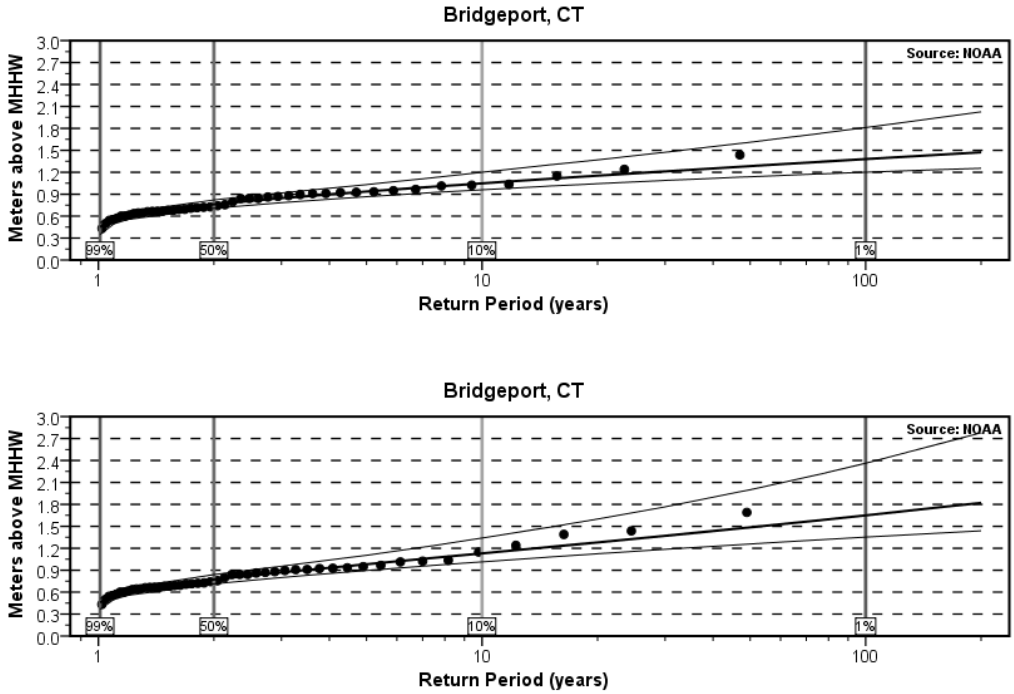


Figure 28. High water GEV exceedance probability curves with 95% confidence intervals at Bridgeport before (top) and after (bottom) inclusion of the 2011 and 2012 maxima.

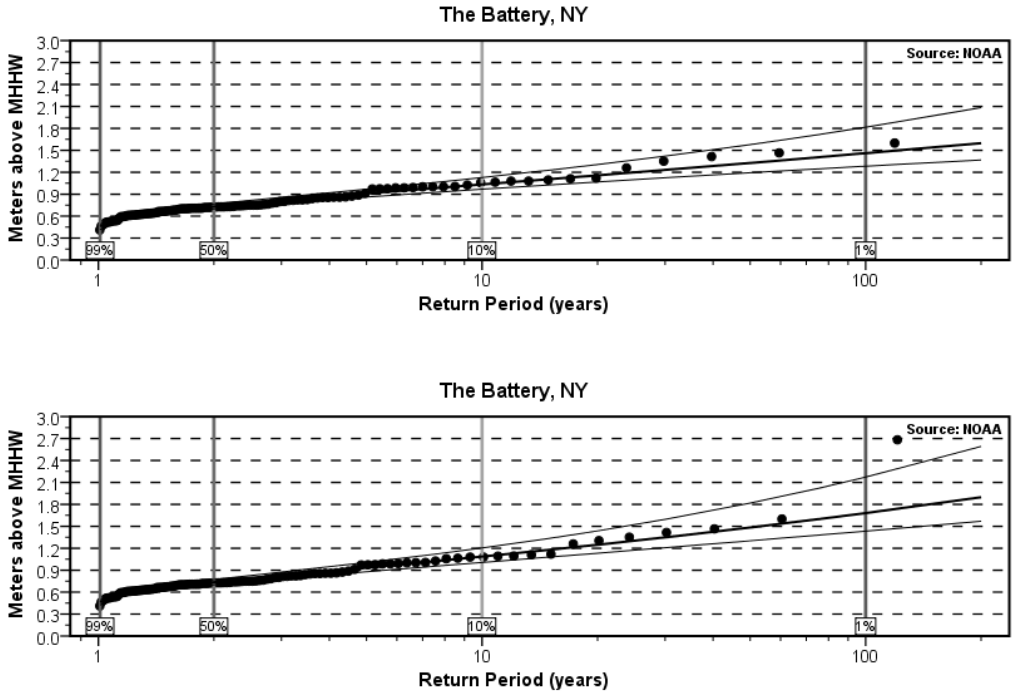


Figure 29. High water GEV exceedance probability curves with 95% confidence intervals at The Battery before (top) and after (bottom) inclusion of the 2011 and 2012 maxima.

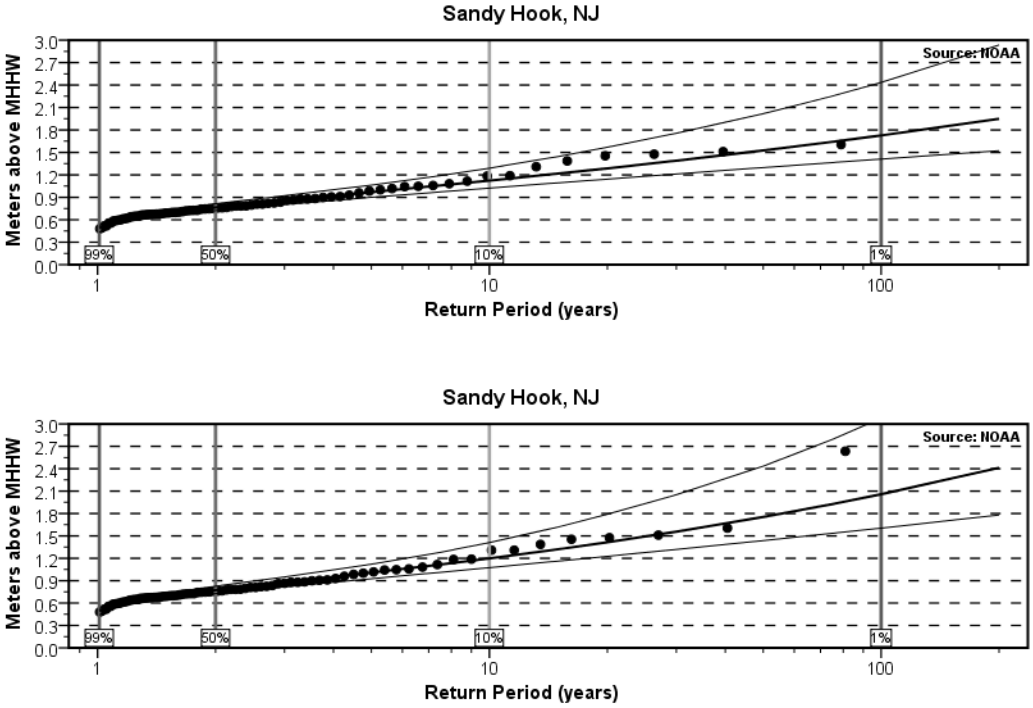


Figure 30. High water GEV exceedance probability curves with 95% confidence intervals at Sandy Hook before (top) and after (bottom) inclusion of the 2011 and 2012 maxima.

The station stick diagrams were discussed in Section IV.B and plotted in Appendix III showing the positions of the 99%, 50%, 10% and 1% annual GEV exceedance probability levels relative to MSL and the tidal datums. The effect of the recalculation of the high water exceedance probability levels for Bridgeport, The Battery, and Sandy Hook are displayed in Figures 31, 32, 33, showing the increased high levels obtained by including the peaks from Hurricane Irene in 2011 and Hurricane Sandy in 2012.

A consequence of the recalculation of the high water GEV curves for these three stations is that Hurricane Sandy now becomes the only historically recorded event exceeding the 1% annual exceedance probability level at all three stations. In Table 5 in Section IV.D, the level reached by the winter storm on 12/11/1992 at Bridgeport no longer exceeds the 1% annual exceedance probability level. At The Battery, the winter storm on 11/7/1953 and Hurricane Donna on 9/12/1960 also no longer exceed the 1% annual exceedance probability level.

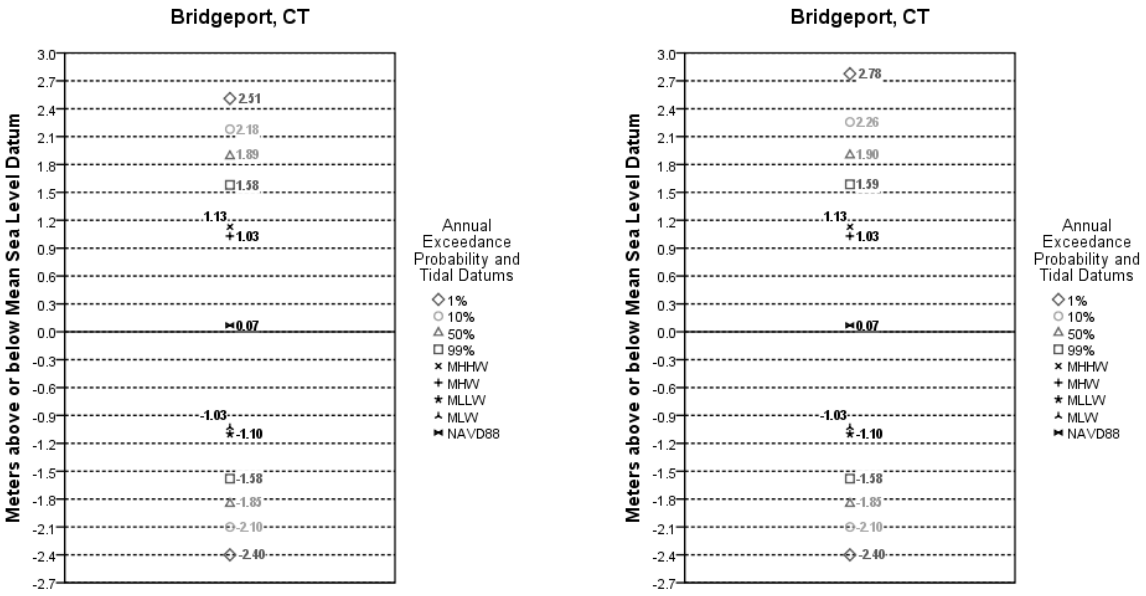


Figure 31. Stick diagrams for Bridgeport showing the GEV annual exceedance probability levels before (left) and after (right) inclusion of the 2011 and 2012 maxima.

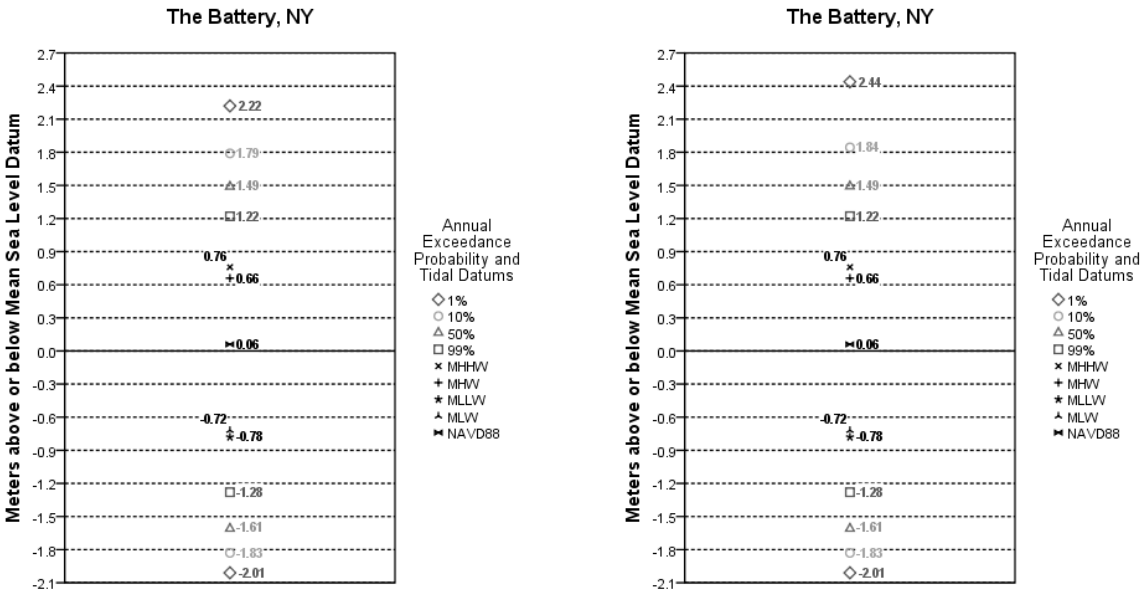


Figure 32. Stick diagrams for The Battery showing the GEV annual exceedance probability levels before (left) and after (right) inclusion of the 2011 and 2012 maxima.

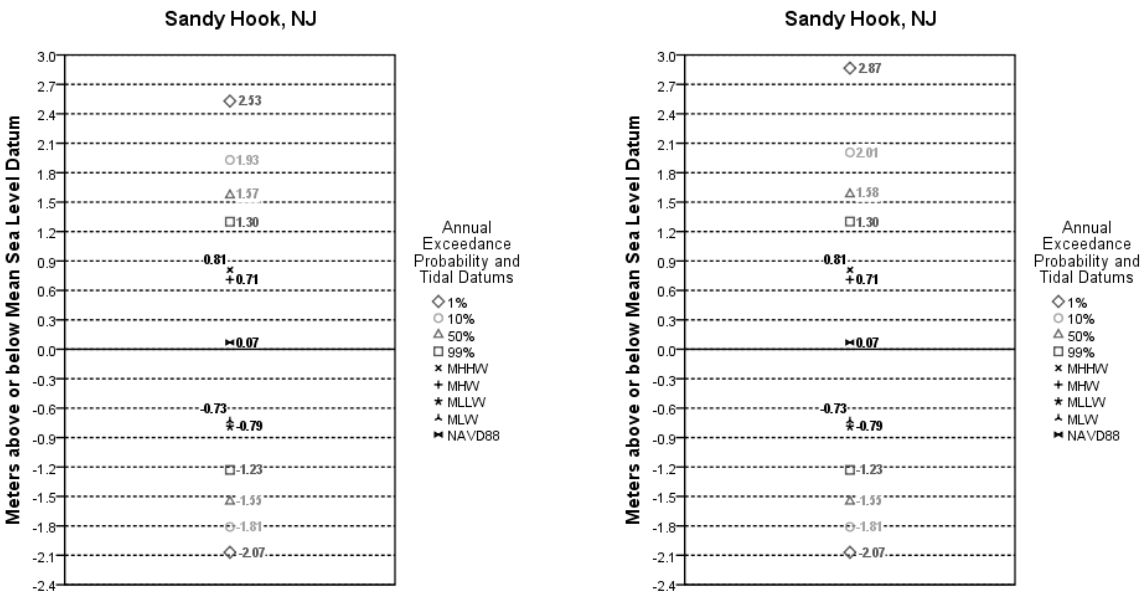


Figure 33. Stick diagrams for Sandy Hook showing the GEV annual exceedance probability levels before (left) and after (right) inclusion of the 2011 and 2012 maxima.