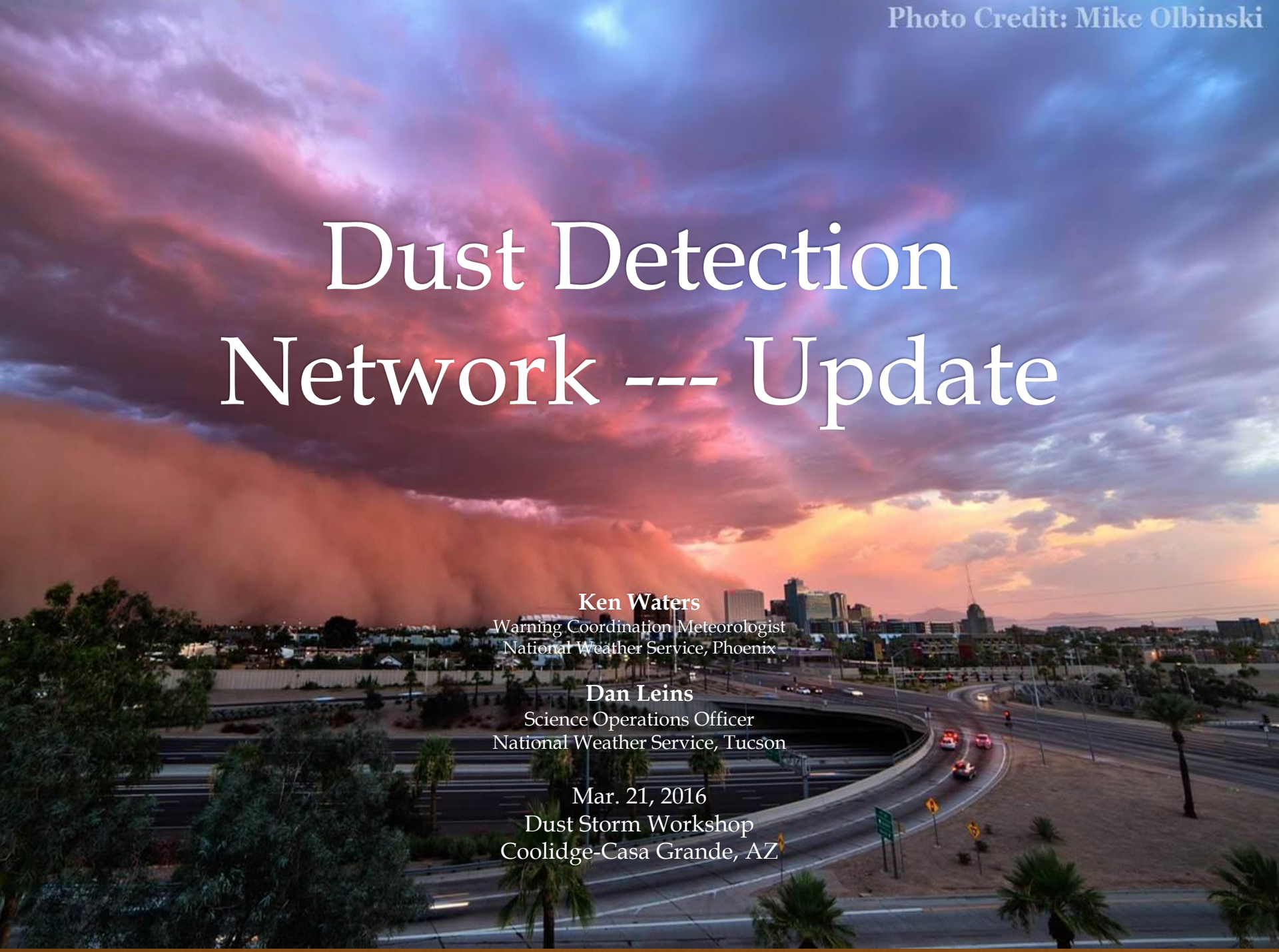


Dust Detection Network --- Update

Ken Waters
Warning Coordination Meteorologist
National Weather Service, Phoenix

Dan Leins
Science Operations Officer
National Weather Service, Tucson

Mar. 21, 2016
Dust Storm Workshop
Coolidge-Casa Grande, AZ

Dust Storm Classification: #1

- Commonly seen types in Arizona:
  - (1) Large-scale monsoonal "haboob" dust storms
    - Typically June-August
    - Caused by strong outflow winds out of decaying severe thunderstorms that radiate outward from the storm
    - Threat area: primarily southern half of AZ, southeastern CA, southwest NM
    - Fetch (track) as long as 300 miles!
    - Movement typically 40 mph
    - Visibility often zero
    - Most extreme examples can be 5,000 – 8,000 feet in height

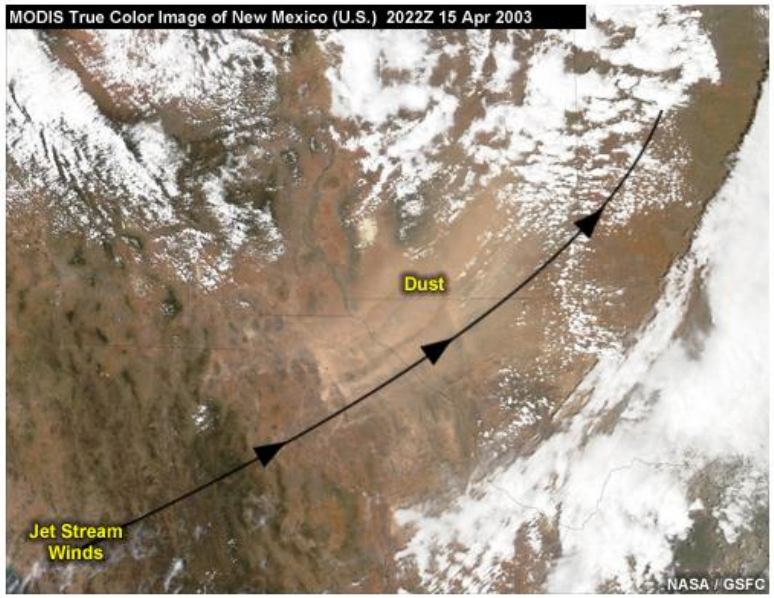
Source: http://www.goes-r.gov/users/comet/EUMETSAT/at_dust/print_3.htm

Dust Storm Classification: #2

- Commonly seen types in Arizona:
  - Synoptic (e.g. large frontal/pressure systems)
    - Most typical January-April
    - Widespread high winds of 25-50 mph
    - Caused by strong pressure gradient associated with winter cold front systems (can be pre-frontal or post-frontal)
    - Typically widespread lower visibilities (1-5 miles)
    - Threat area is region-wide but especially northern regions such as NE AZ [Navajo country and along I-40]

American Southwest Example

Postfrontal dust storms are also common across the American southwest. This MODIS true colour image shows one that originated in northern Mexico and western Texas. A jet maximum had rounded the base of an upper-level trough, transporting momentum and therefore strong winds to the surface.



Source: http://www.goes-r.gov/users/comet/EUMETSAT/at_dust/print_3.htm

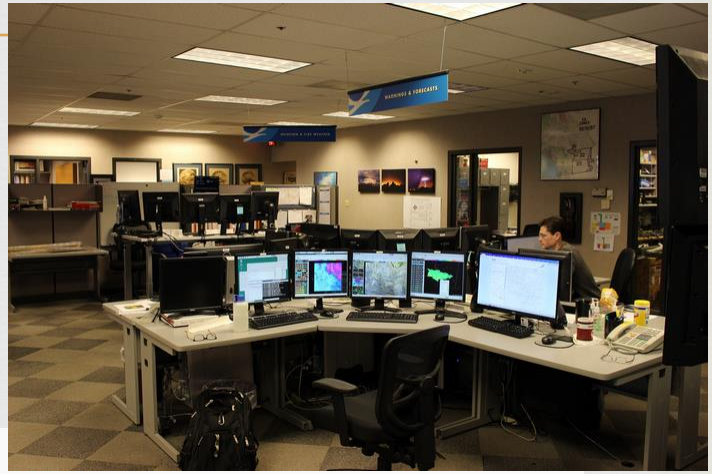
Dust Storm Classification: #3

-

nd-i--north-
e0-ae4a-

Dust Storm Warning and Dissemination Process

- Warnings/Advisories:
  - Dust Storm Warnings issued by NWS offices using AWIPS
    - Typically from 30 to 90 minutes in duration
    - Issued by "public zones" --- no capability to issue targeted warnings based on the threat
    - Based on forecast methodologies but also **more on observations from volunteer spotters**
  - Blowing Dust Advisories
    - Typically from 1 hour to 10 hours in duration
    - Not used for situations where extremely low visibility (< 1/8 mile) is expected
    - Similar to a "Watch" where we can indicate conditions may be likely for blowing dust over a large area



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WWUS75 KTWC
 042344 NPWTWC

URGENT - WEATHER MESSAGE
NATIONAL WEATHER SERVICE TUCSON AZ 444 PM MST MON JUL 4 2011
AZZ502-504>506-050745- /O.NEW.KTWC.DS.W.0003.110706T2300Z-110707T0100Z/
TOHONO O'ODHAM NATION-TUCSON METRO AREA-
SOUTH CENTRAL PINAL COUNTY-SOUTHEAST PINAL COUNTY- INCLUDING THE CITIES OF...MARANA...PICACHO PEAK
STATE PARK 444 PM MST MON JUL 4 2011

...DUST STORM WARNING IN EFFECT FROM 4 PM TO 6 PM MST WEDNESDAY...

THE NATIONAL WEATHER SERVICE IN TUCSON HAS ISSUED A DUST STORM WARNING...WHICH IS IN EFFECT FROM
 4 PM TO 6 PM MST WEDNESDAY.

* TIMING...STRONG OUTFLOW WINDS FROM THUNDERSTORMS MOVING THROUGH EASTERN PIMA COUNTY WILL
CONTINUE WEST INTO THE TOHONO OODHAM NATION AND NORTHWEST THROUGH PINAL COUNTY.

* WINDS...EAST GUSTS OF 30 TO 50 MPH.

* VISIBILITY...WILL BRIEFLY BE DOWN TO LESS THAN ONE-QUARTER OF A MILE.

* IMPACTS...MOTORISTS SHOULD BE PREPARED TO QUICKLY CHANGING CONDITIONS IN BLOWING DUST.
PRECAUTIONARY/PREPAREDNESS ACTIONS...
A DUST STORM WARNING MEANS SEVERELY LIMITED VISIBILITIES ARE EXPECTED WITH BLOWING DUST.
BLOWING DUST CAN QUICKLY REDUCE VISIBILITY...CAUSING ACCIDENTS THAT MAY INVOLVE CHAIN
COLLISIONS AND MULTIPLE PILEUPS. IF DENSE DUST IS OBSERVED BLOWING ACROSS OR APPROACHING
A ROADWAY...PULL YOUR VEHICLE OFF THE PAVEMENT AS FAR AS POSSIBLE TO STOP. TURN OFF THE
LIGHTS...SET THE EMERGENCY BRAKE...AND TAKE YOUR FOOT OFF OF THE BRAKE PEDAL TO ENSURE
BRAKE LIGHTS ARE NOT ILLUMINATED.

STAY TUNED TO NOAA WEATHER RADIO...COMMERCIAL RADIO OR TELEVISION STATIONS...OR YOUR
CABLE TELEVISION PROVIDER FOR LATER STATEMENTS CONCERNING THIS DUST STORM.

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Dust Storm Warning and Dissemination Process

- Dissemination
  - Emergency Alert System [EAS]
    - Goes to media, emergency managers, and other partners
  - Internet sites (NWS, weather partners, etc.)

  - Wireless Emergency Alerts [WEA]
    - New program established in 2012
      - Includes Tornado warnings, Flash Flood warnings
    - Very strong public reach as most smartphones are alerted
    - One drawback: because of use of public zones it often has an overreach
    - Consumer guide at http://transition.fcc.gov/cgb/consumerfacts/wea.pdf

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                                              OUR FOOT OFF OF THE BRAKE PEDAL TO ENSURE


                                              RADIO OR TELEVISION STATIONS...OR YOUR
                                              S CONCERNING THIS DUST STORM.
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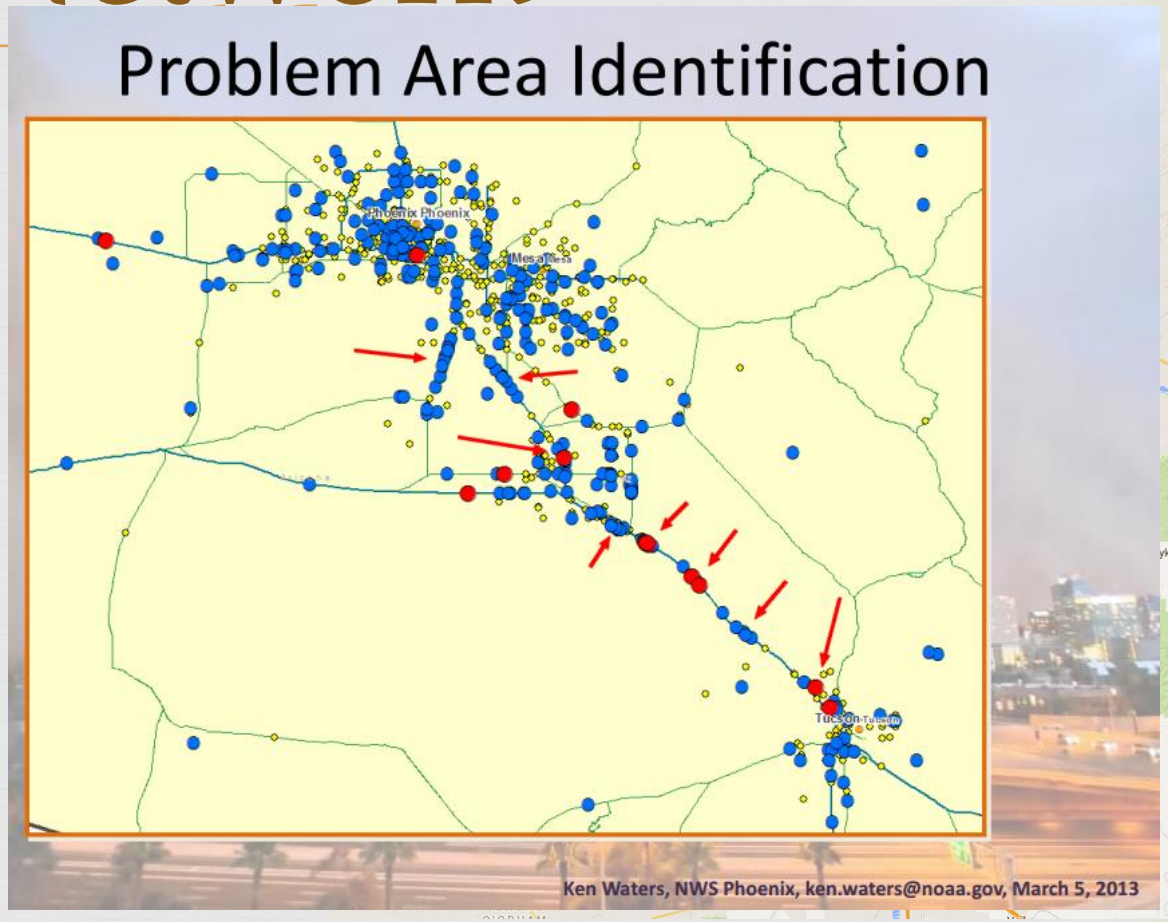
Dust Storm Detection Network

- Motivation
  - Paucity of real-time observations along common dust storm corridor in Pinal County
  - GIS study (http://www.wrh.noaa.gov/psr/dust/2013/presentations/Waters_Accident_Analysis.pdf) showed common accident locations



Dust Storm Detection Network

Mission:

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GOALS:

1) Inexpensive
2) Use new technologies newly available
3) Designed to be a discrete [dust or no dust?] indicator rather than a precise scientific measurement
4) Use available Internet and power thus minimizing infrastructure cost
5) Careful placement to be typically "upwind" from highways like I-8 and I-10

Dust Storm Detection Network

Two Primary Functions

Allow regular monitoring of particulate values for each of the sensors; prepare graphs to view the data.

Monitor conditions in real-time and issue alerts in the event dust storm conditions are detected.

Dust Storm Detection Network

- Motivation
  - Take advantage of new low-cost technologies (e.g., Internet of Things [IoT])
    - Arduino
    - Raspberry Pi
    - Air particulate sensors

Installation

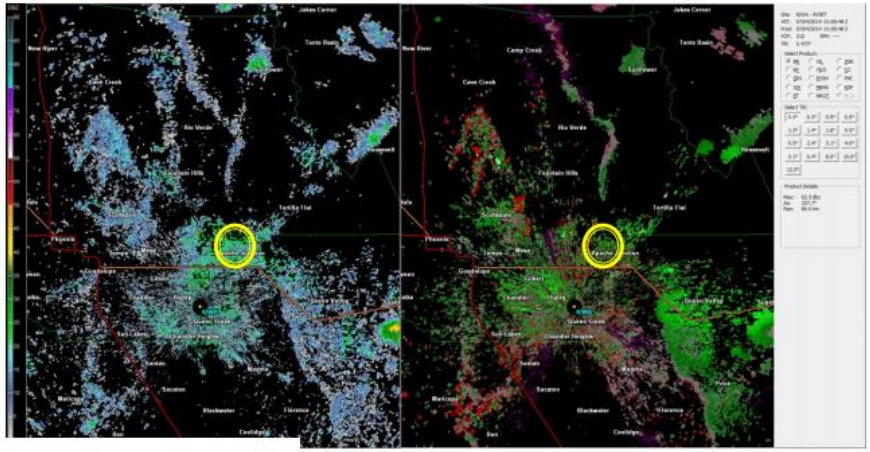
- Find sites with available power + Internet access [either Ethernet or WiFi]
- Prefer fairly secure location not likely to be tampered with
- Mechanically secure the box so that high winds will not disrupt it

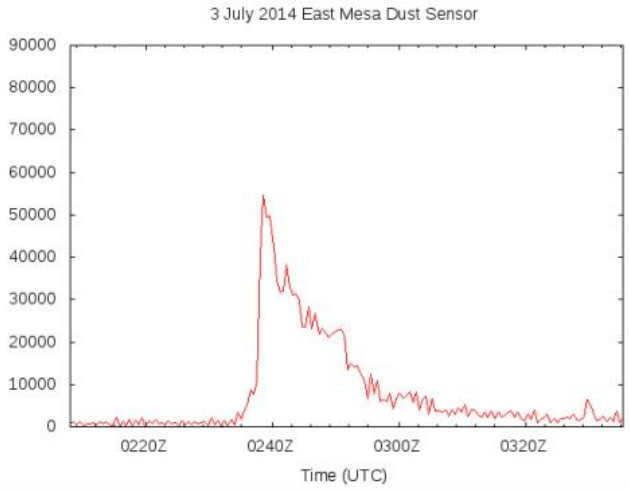
Dust Storm Detection Network

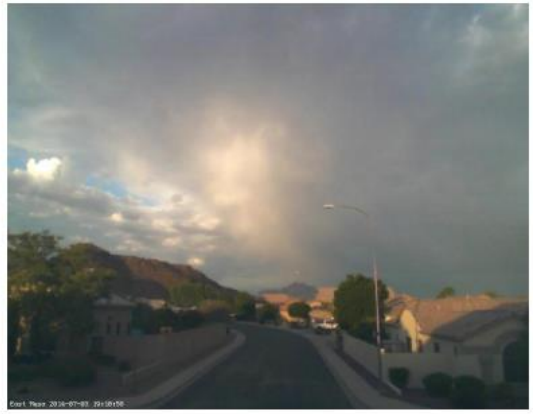
- History
  - 2013: home-grov experimentation collecting particulate data captured first fe dust storm even
  - 2014: Haboob event captured

July 3rd

Classic monsoon severe microburst outflow signature





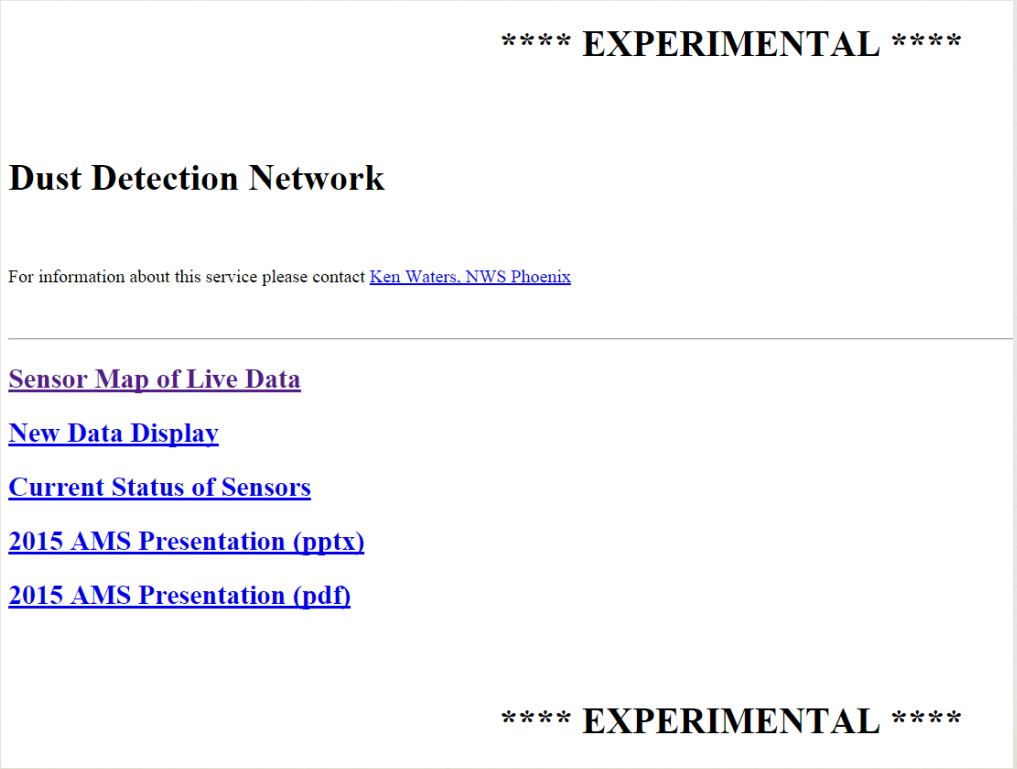


Dust Storm Detection Network

- History
  - 2013: First sensor deployed to collect data
  - 2015: Built website to store data, sensor status; began to add additional field sensors.
  - 2015: Developed valuable partnership with Pinal County Sheriff's Office to find suitable locations for sensors to be hosted.
  - 2016: Network built out to include 9 operational sensor packages

Dust Storm Detection Network Website

- URL: http://monsoonsafety.org/dust/



****** EXPERIMENTAL ******

Dust Detection Network

For information about this service please contact Ken Waters, NWS Phoenix

Sensor Map of Live Data

New Data Display

Current Status of Sensors

2015 AMS Presentation (pptx)

2015 AMS Presentation (pdf)

****** EXPERIMENTAL ******

D hoen rk

- URL: http

Graph upda
every 5 min

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show intens

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[note: **not**
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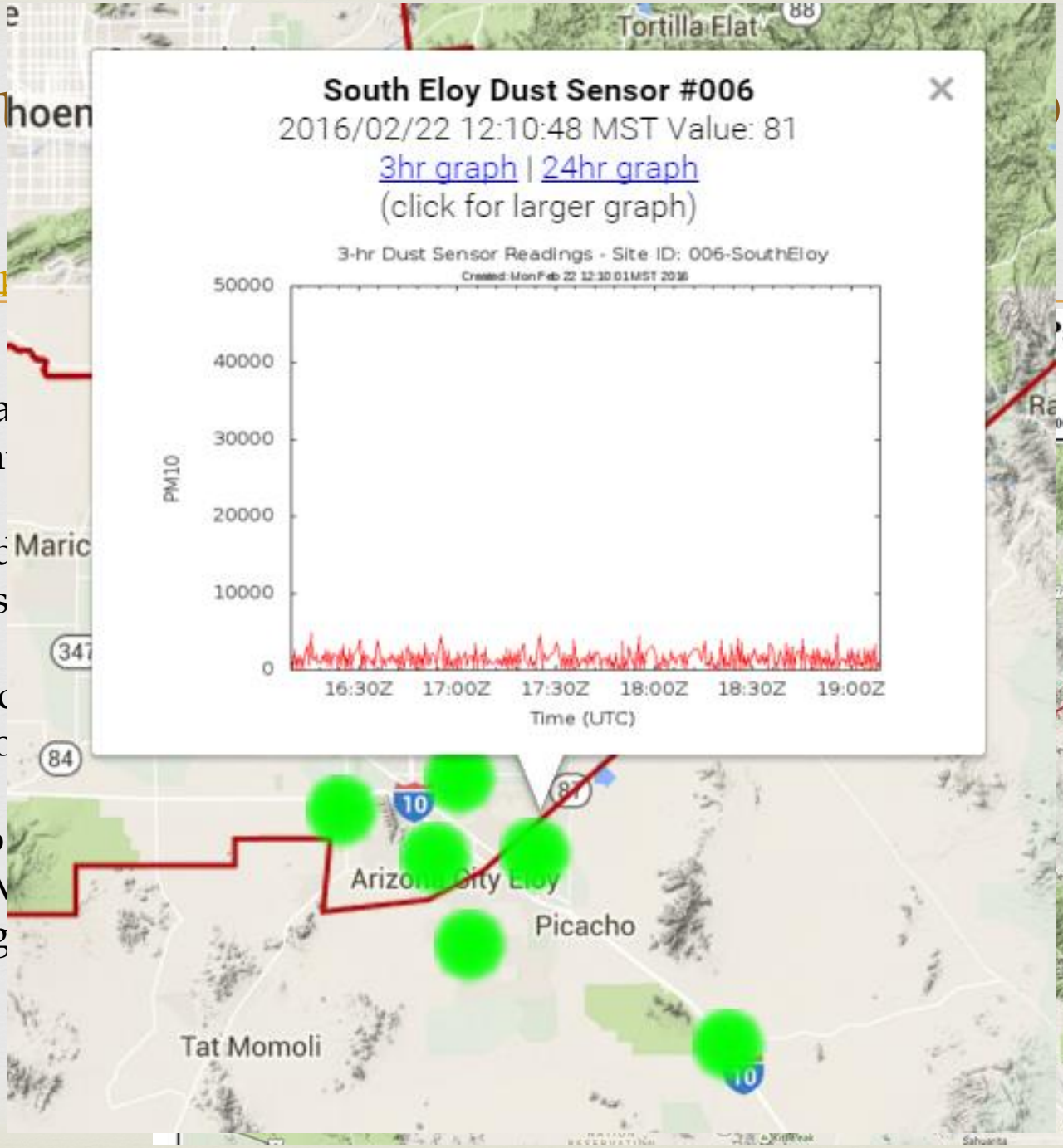
standard PM
values of µg



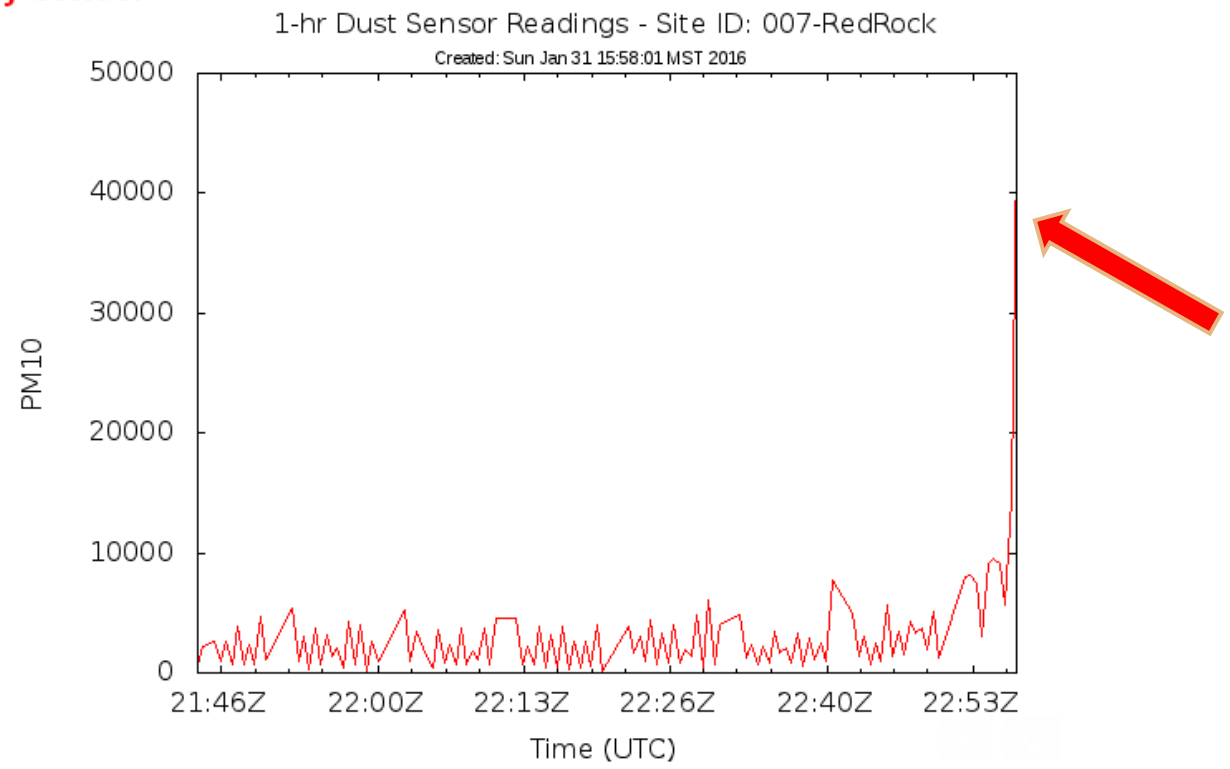
Dust Storm Detection Network Event

ALERT: Dust Sensor 007-RedRock Inbox x

Jan 31

Actual e-mail Alert on January 31st, 2016 for Red Rock/Avra Valley sensor

60 min Graph



this new prototype dust sensor network, including their graphs of PM-10 particulates (dust) on the following website: http://monsoonsafety.org/dust/dustMap.php.

Maintenance

- Minimal maintenance required so far --- although we're still learning
- Have had one deployed sensor with sudden high noise level beginning in early March
  - Did a site visit and determined that it may be due to an issue with the Raspberry Pi
  - Returned the package to NWS and ordered replacement to be tested and redeployed

Dust Detection Network

- Future:
  - Tweak alerting algorithm
  - Expand network of responders receiving the alerts
  - Possibly deploy 1-4 more carefully placed sensors
    - Goals:
      - Target known trouble spots
      - Place sensors upwind from trouble spot if possible
  - Deploy Raspberry Pi webcams (3 are in stock) to capture images on a few of the sensors

Questions?
Resources

- Ken Waters
  - Warning Coordination Meteorologist, NWS Phoenix
  - E-Mail: ken.waters@noaa.gov
  - Twitter: @wxphx
  - Office: 602-275-7002, x223

- Dan Leins
  - Science Operations Officer, NWS Tucson
  - E-Mail: daniel.leins@noaa.gov
  - Office: 520-670-5156, x224

RESOURCES:

Arizona Dust Storm Workshops:
http://www.wrh.noaa.gov/psr/dust/

Dust Detection Network:
http://monsoonsafety.org/dust/