Dust sources in northern Chihuahua impacting Federal Highways 45, 2 and 10 functionality during dust storm events

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CA Modelos Ambientales

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Problem and location

Problem and location

Dust and sand storms wreak havoc!

Potential to cause loss of lives

Disrupt traffic, cause accidents

Inicio » Chihuahua » Tolvaneras provocan choque múltiple en carretera a Juárez; un muerto
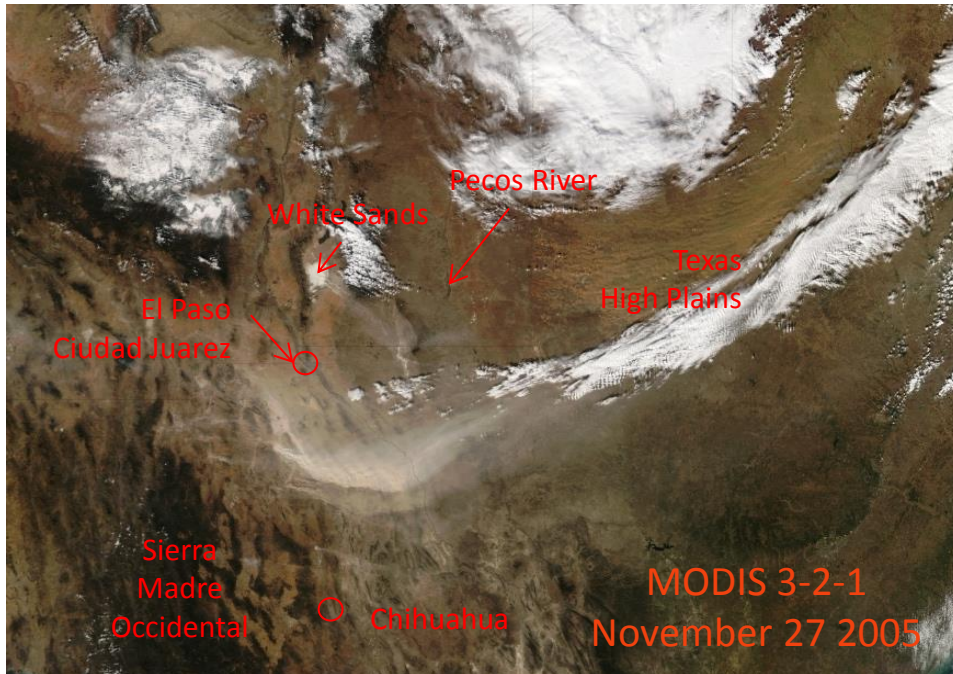
Tolvaneras provocan choque múltiple en carretera a Juárez; un muerto

Redacción La Policiaca

30 November, 2010 2:00 am

Chihuahua.- Un choque registrado en el kilómetro 258 del tramo carretero Juárez-Villa Ahumada, dejó como resultado a una persona sin vida. De acuerdo al reporte de lo acontecido el percance se presentó a causa de las tolvaneras.

http://www.lapoliciaca.com/nota-roja/tolvaneras-provocan-choque-multipleen-carretera-a-juarez-un-muerto/

Vientos 'borran' la carretera en tramo Juárez-Ahumada

f Y ⊙ M ⊛ +

Ever Chávez

22-02-2016 15:11 Por: Redacción

Ciudad Juárez.- Una fuerte 'tormenta' de arena' se registró en el tramo carretero Juárez-Ahumada lo que complicó la visibilidad a los conductores.

Este fenómeno se da después de que Protección Civil del Municipio emitiera una alerta roja de fuertes vientos para Juárez con rachas superiores a los 60 kilómetros por hora, asimismo en Chihuahua capital también se anunciaron fuertes torbellinos durante el día.

Las autoridades exhortan a tener precaución, en especial a los conductores que viajen a la altura de Samalayuca, ya que la arena de las Dunas puede imposibilitar completamente la visibilidad.

Se pide mantener las luces encendidas y circular despacio para evitar accidentes; en caso de requerirse es mejor detenerse en el acotamiento y esperar a que mejoren las condiciones.

http://netnoticias.mx/2016-02-22-6c850982/vientos-borran-la-carretera-en-tramo-juarez-ahumada-/

Pecos River

White Sands

Texas High Plains

El Paso Ciudad Juarez

Sierra Madre Occidental

Chihuahua

MODIS 3-2-1 November 27 2005

Problem and location

They have other major impacts!

Potential Hazatds

Goudie and Middleton 2006
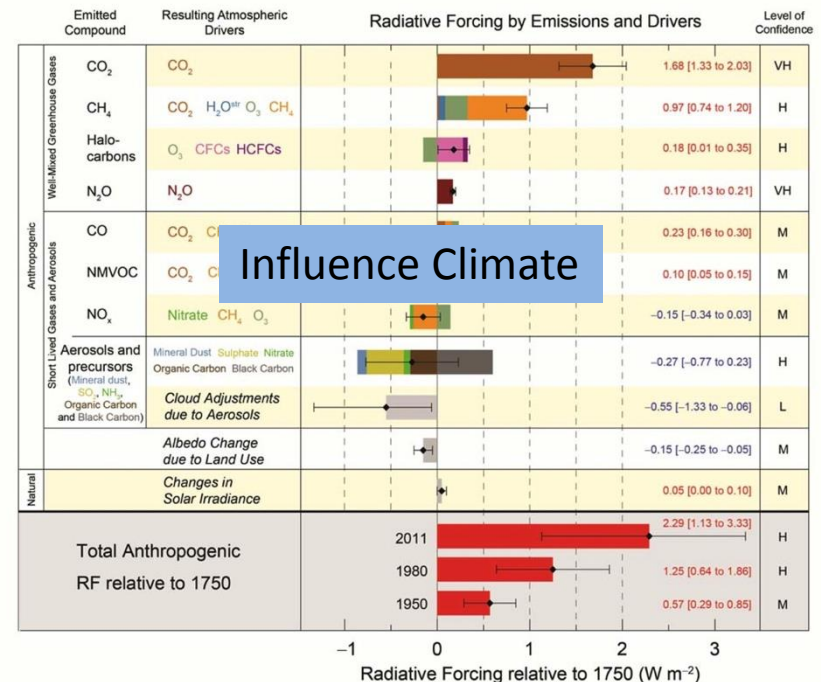
List about 50 potential hazards related to dust storms.

Separated in environmental and human related consequences.

- Climatic change
- Influence cloud nucleation
- Glacier mass budget alteration
- Ocean productivity
- Nutrient dispersion
- Radiative forcing
- Soil erosions
- Air pollution
- Animal suffocation
- Asthma and allergies incidence
- Pollutant and disease transport
- Transport disruption
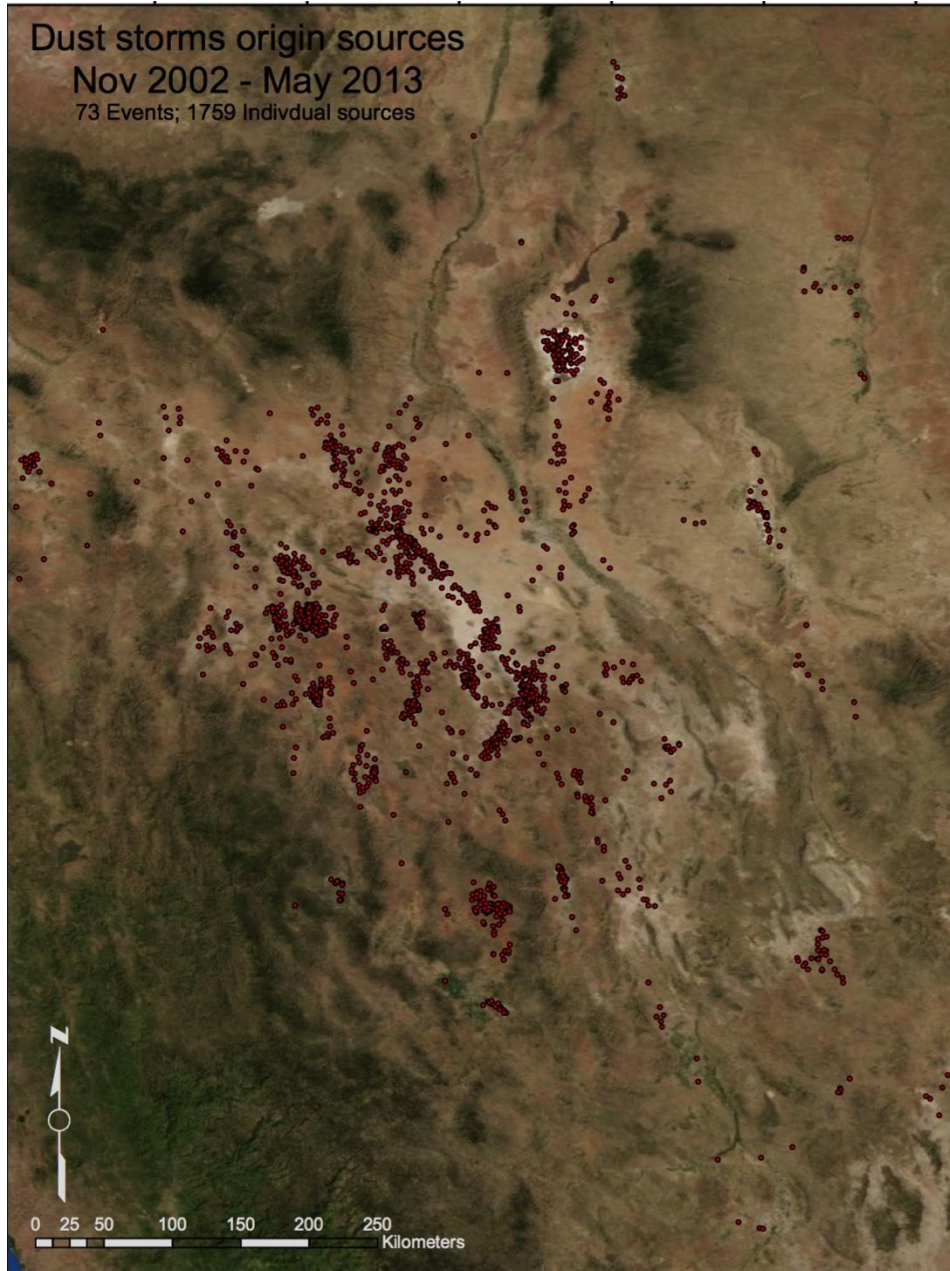- Etc.,

Health Hazards

Ciudad Juárez

El Paso, TX

PM-10: 655.4 ug/m3
PM-2.5: 94.2 ug/m3
@ 16:00 hrs

NOM-025-SSA1-1993
150 µg/m3, en 24 horas una vez al año

Web camera TCEQ: Ranger Peak El Paso, TX.
March 26 2010; left 8:30 and right 18:00 hrs.

Influence Climate

Where and what are the sources?

Dust storms origin sources
Nov 2002 - May 2013
73 Events; 1759 Indivdual sources

0 25 50   100   150   200   250
Kilometers

OBJECTIVES

• Identify the prevalent sources of aeolian erosion in the central and northern Chihuahuan Desert

• Characterize the those sources according to their geomorphological setting and land cover

• Generate a robust database that would account for most of the source areas of dust storms
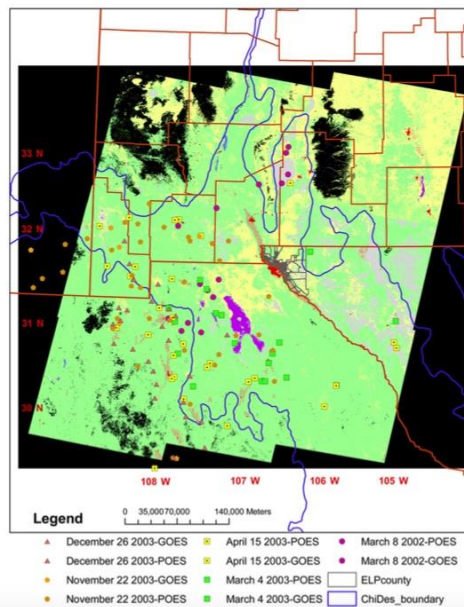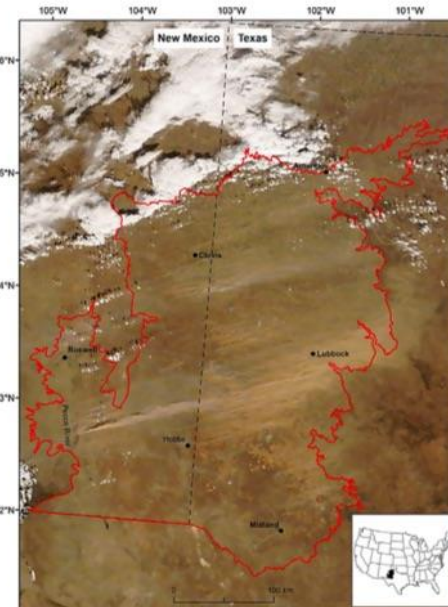
Where and what are the sources?
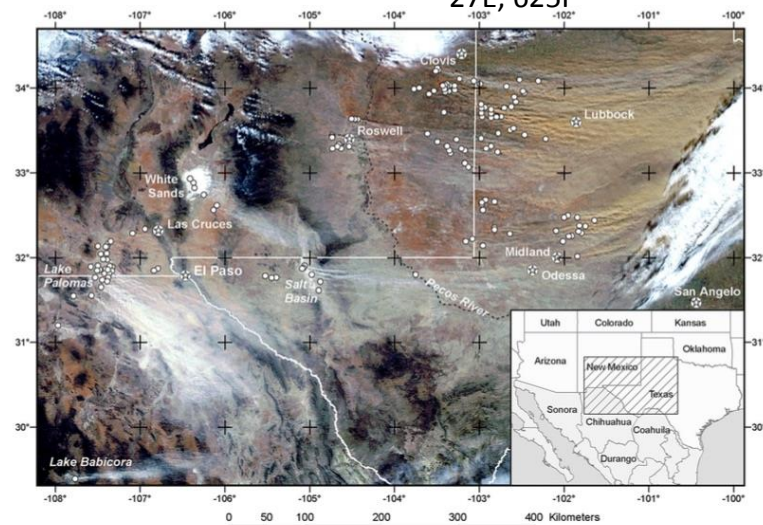
BACKGROUND
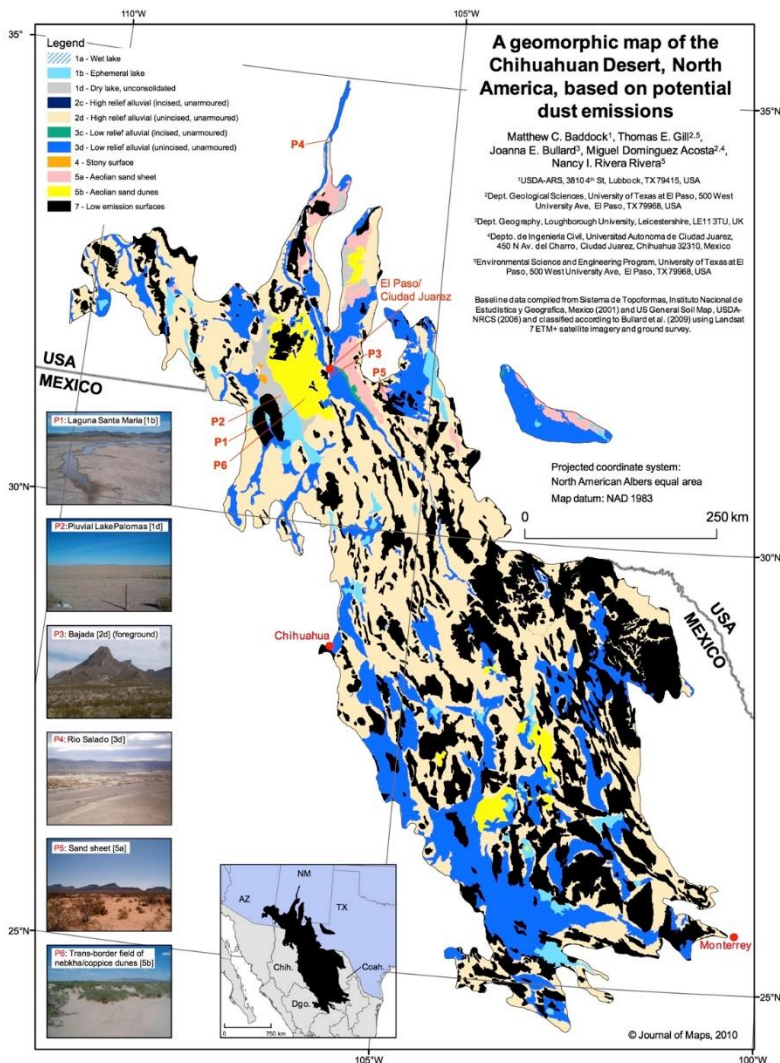
Baddock, et al. 2011 MODIS 2001 - 09, 26E, ?P

Rivera, et al. 2010. GOES 2002 – 03, 5E 130P

Lee, et al. 2011 MODIS 2001 -09, 27E, 625P
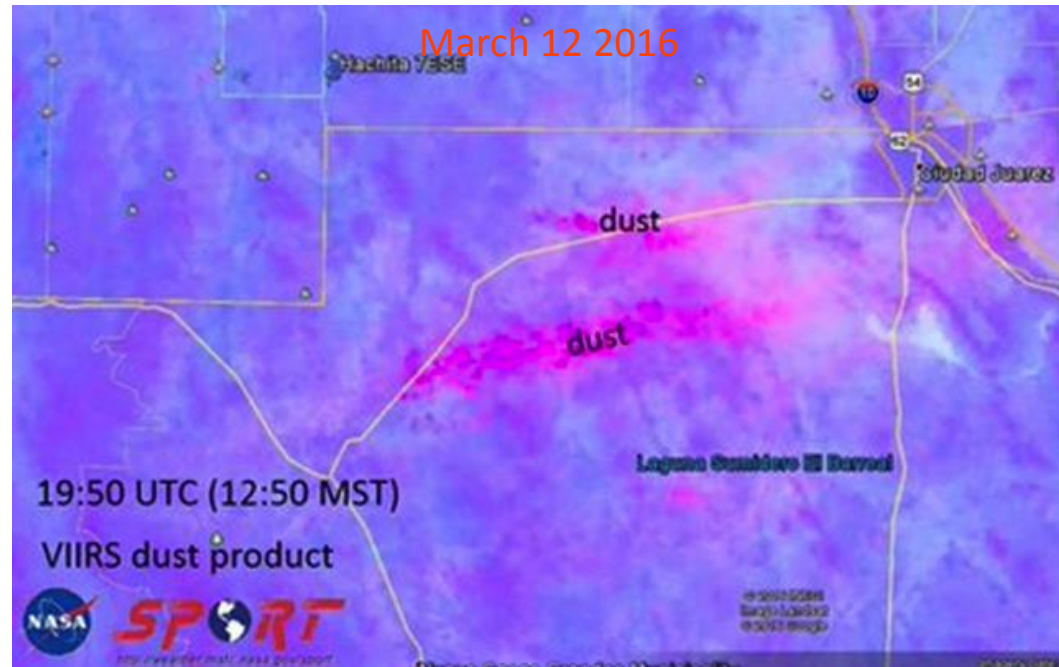

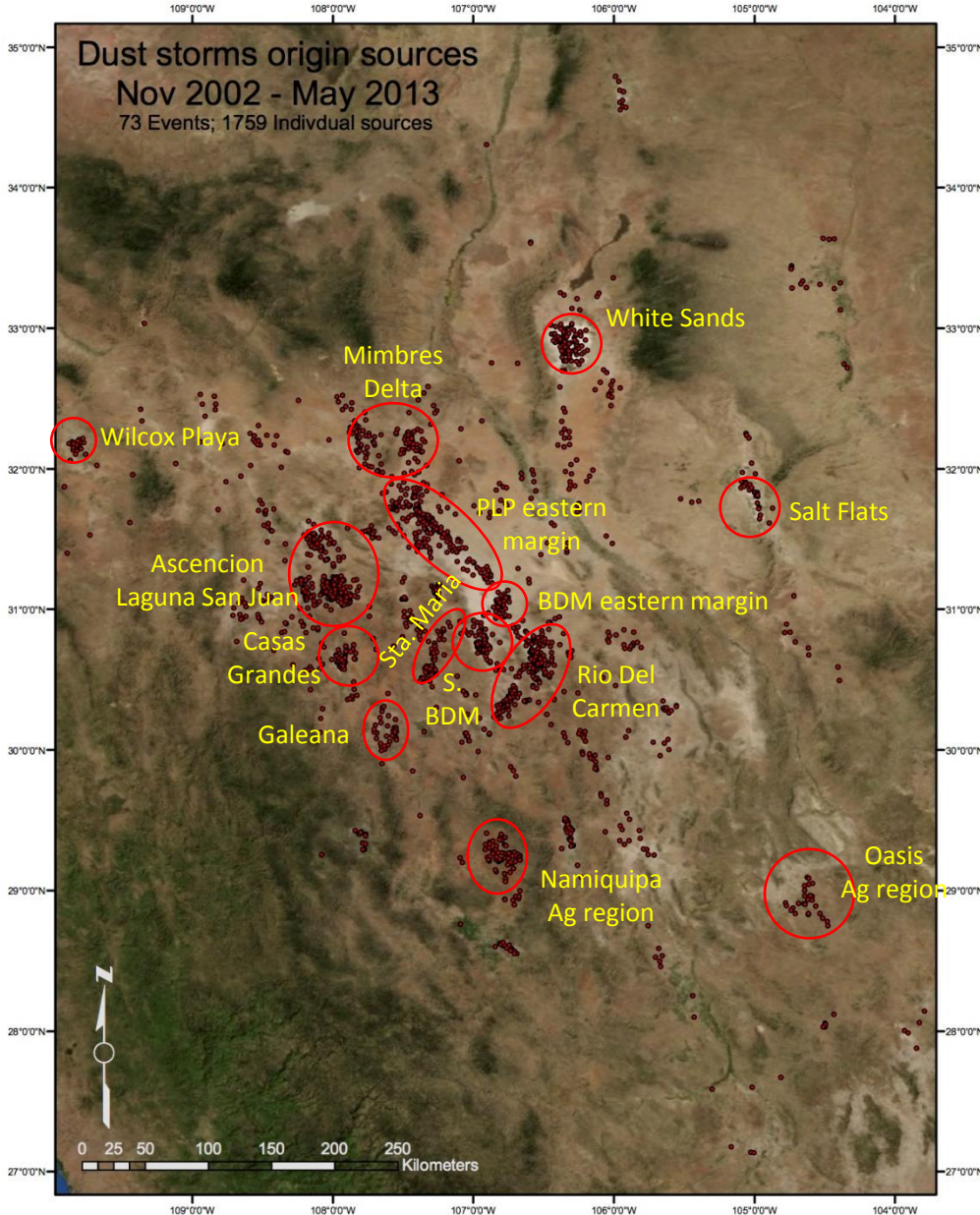Lee, et al. 2009 MODIS 2003, 1E, 146P

What have we learned?

Obvious!

There area NATURAL and ANTHROPOGENIC sources
as well as natural and anthropogenic conditional and triggering factors.

NOT so obvious!

- Areas areas area geomorphically generated/conditioned and naturally and/or anthropogenically affected.
- Some areas are complex. e.g. several geomorphic classes plus anthropogenic activity in a small spatial location.
- Technical data:
climatology/meteorology of dust events.
Geomorphology/land cover/sediment classes of sources.
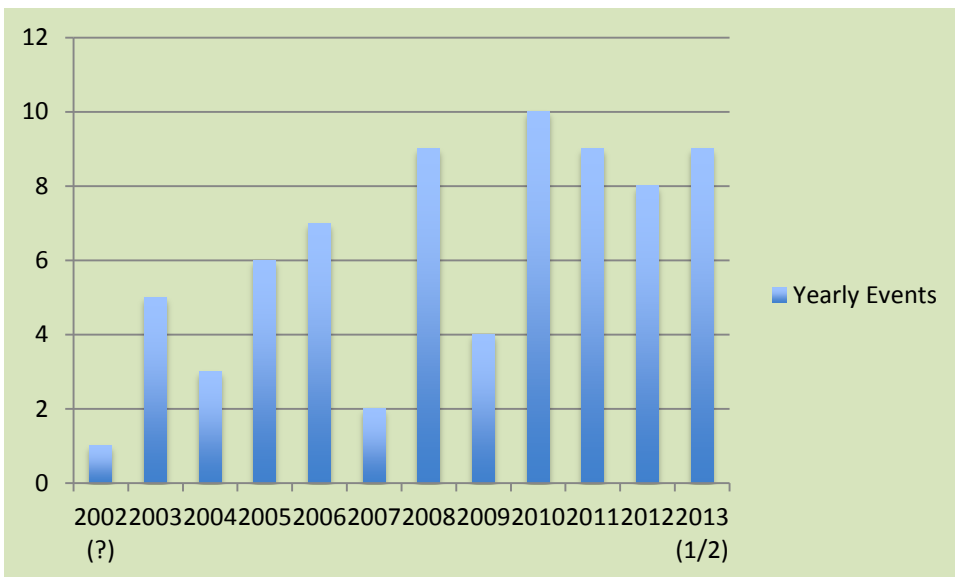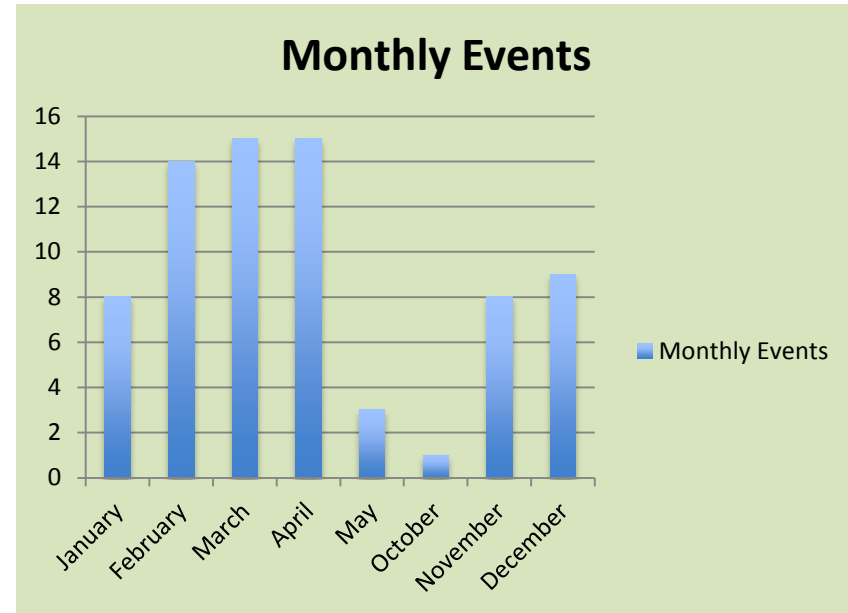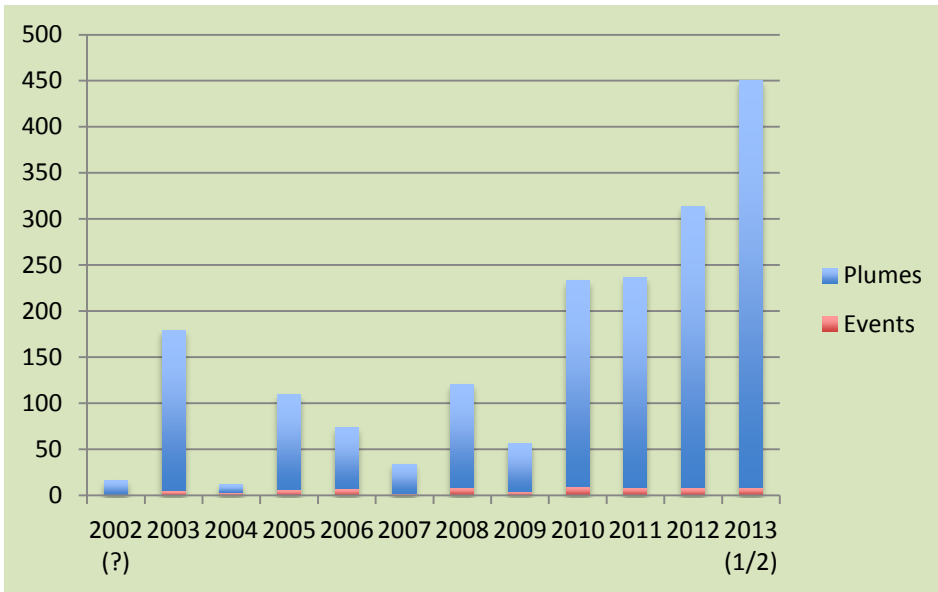Chemical and mineralogical makeup.

March 12 2016

dust

dust

19:50 UTC (12:50 MST)

VIIRS dust product

NASA SPORT

What have we learned?

Dust storms origin sources
Nov 2002 - May 2013
73 Events; 1759 Indivdual sources

Map labels: White Sands, Mimbres Delta, Wilcox Playa, PLP eastern margin, Salt Flats, Ascencion, Laguna San Juan, Sta. Maria, BDM eastern margin, Casas Grandes, S. BDM, Rio Del Carmen, Galeana, Namiquipa Ag region, Oasis Ag region

Geomorphic Classes (14 Total)	Counting	% (of 1759)	Merged %
Aeolian Sand Sheet	1	0.06	
Alluvial Deposits	571	32.46	33.37
Fluvio/Alluvial Deposits	16	0.91	
Deltaic Deposits	197	11.20	
Dune Field/Coppice	83	4.72	
Ephemeral Lake	20	1.14	
Flood Plain	321	18.25	
Fluvial Deposits	2	0.11	
Lacustrine Margin/Aeolian Deposits	13	0.74	
Lacustrine Margin/Alluvial Deposits	2	0.11	1.99
Lacustrine Margin/Sandy Shoreline	20	1.14	
Mountain/Bedrock	1	0.06	
Playa	409	23.25	
Playa/Gypsum Sand Dunes	103	5.86	

Land Cover (13 Total)	Counting	% (of 1759)	Merged %
Aeolian Sandy Soils	14	0.80	
Aeolian Sandy Soils/Coppice	78	4.43	
Agricultural Fields	345	19.61	
Anthropogenically Disturbed	66	3.75	
Barren Flat Soil Surfaces	361	20.52	
Barren Flat Soil Surfaces (Playa) and Sandy Soil (Dunes)	103	5.86	
Desert Pavement/Rangeland	8	0.45	
Efflorescent Soils/Sandy Beach	15	0.85	
Lake Margin/Barren Flat Surface	20	1.14	
Rangeland	697	39.62	42.18
Rangeland/Barren Flat Surfaces (Laguna San Juan)	45	2.56	
Riverbed	2	0.11	
Sandy Beach	5	0.28	

General Geomorphic Classes	Counting	Percentage
Aeolian	84	4.78
Alluvial	587	33.37
Fluvial (incl. deltas)	520	29.56
Lacustrine (incl. playas)	464	26.38
Mountain/Bedrock	1	0.06
White Sands	103	5.86

What have we learned?

Monthly Events

Events Characteristics

| 40 | Winter (Oct-Feb) |
| 33 | Spring (Mar-May) |

What have we learned?

Dust event Dec/30/2010
63 point sources

50   25   0   50   100   150 Kilometers

Alluvial

Flood Plain

Ag Fields

Fluvial

Alluvial

Ag Fields

10 km

What have we learned?

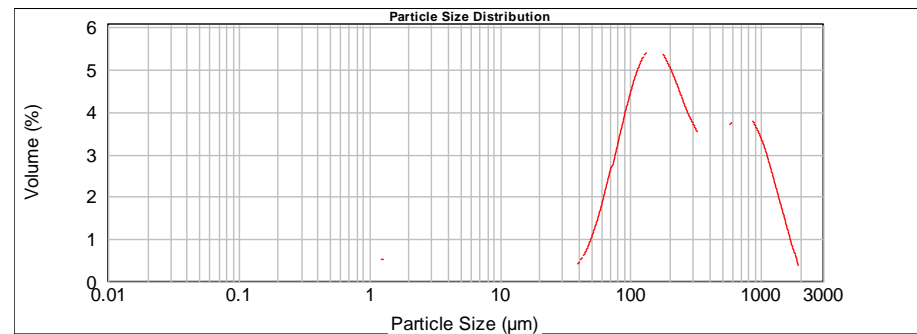Dust event Feb/09/2013
114 point sources
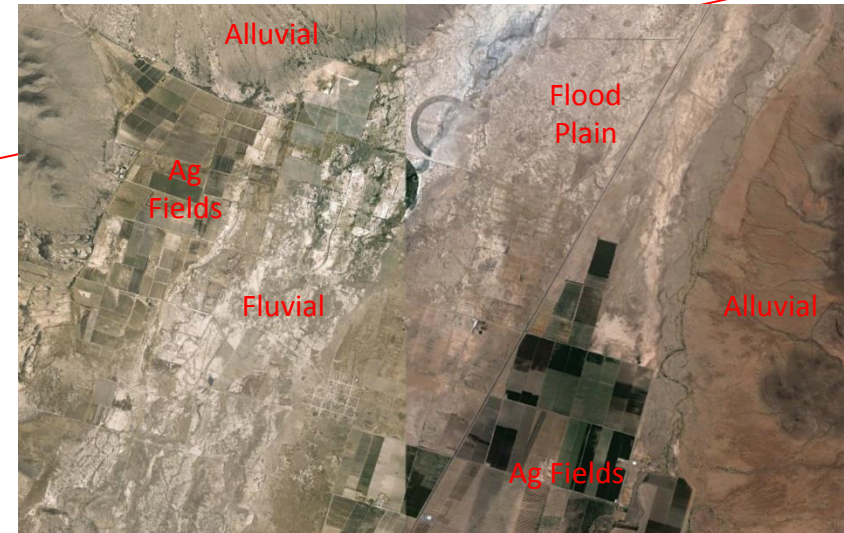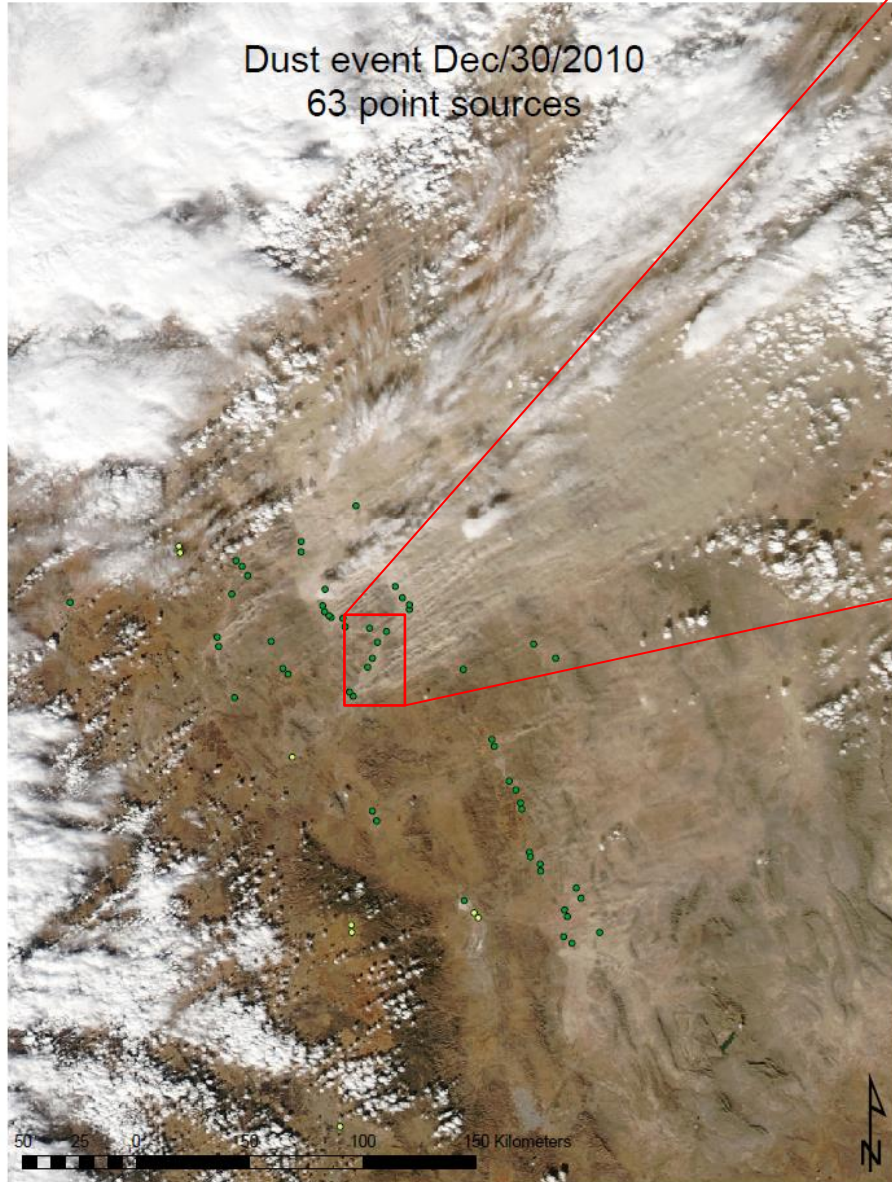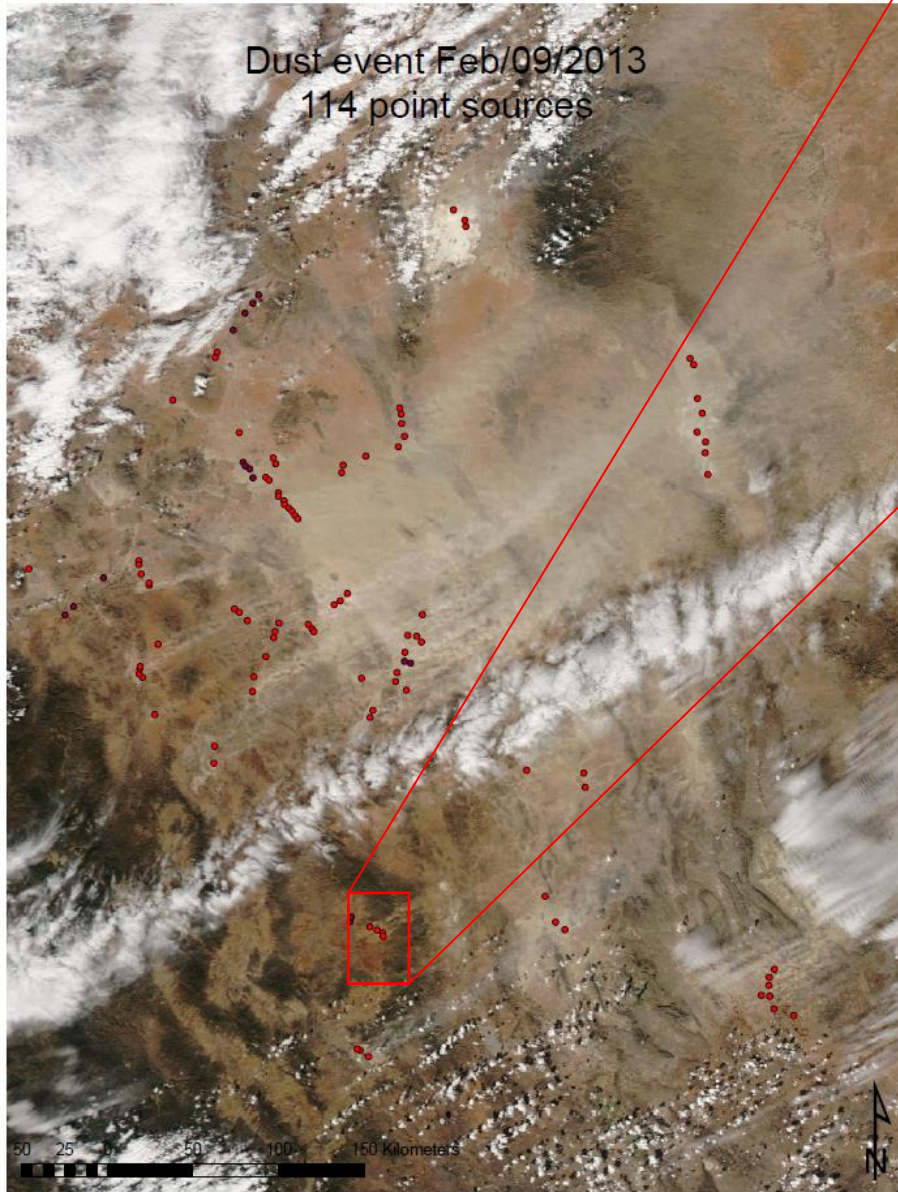
What have we learned?

Mix of sediments: erosional agents
and eroding dust generators.
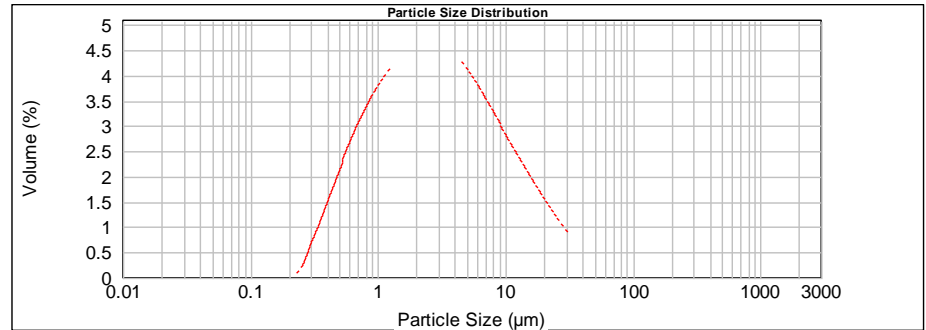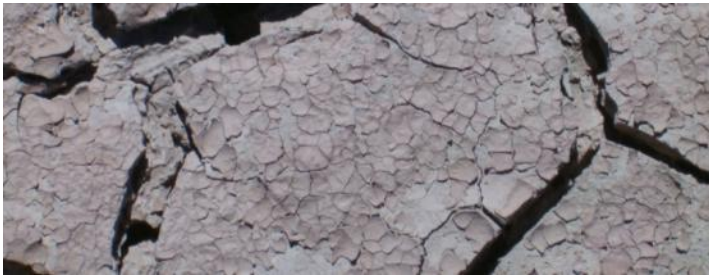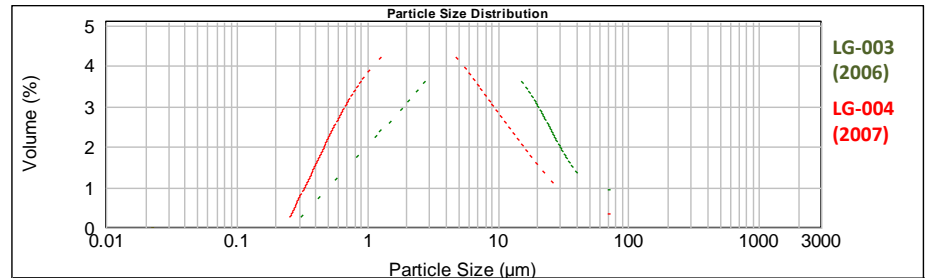Presence of other significant eroding
mechanisms
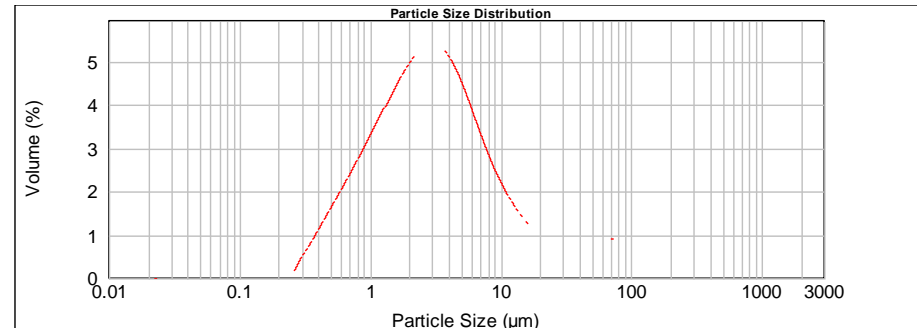
SELP-002

SELP-010

What have we learned?

LG-004

LG-003 (2006)
LG-004 (2007)

LG-24-03-07-004(.5g-5%) - Average, Tuesday, September 23, 2008 2:09:35 PM
LG-003 - Average, Tuesday, June 27, 2006 3:32:52 PM

Inundation areas that act as sediment recharge areas.
Presence of easily erodible crusts: flakes (clay) and efflorescent salts.
Potential chemical hazards.
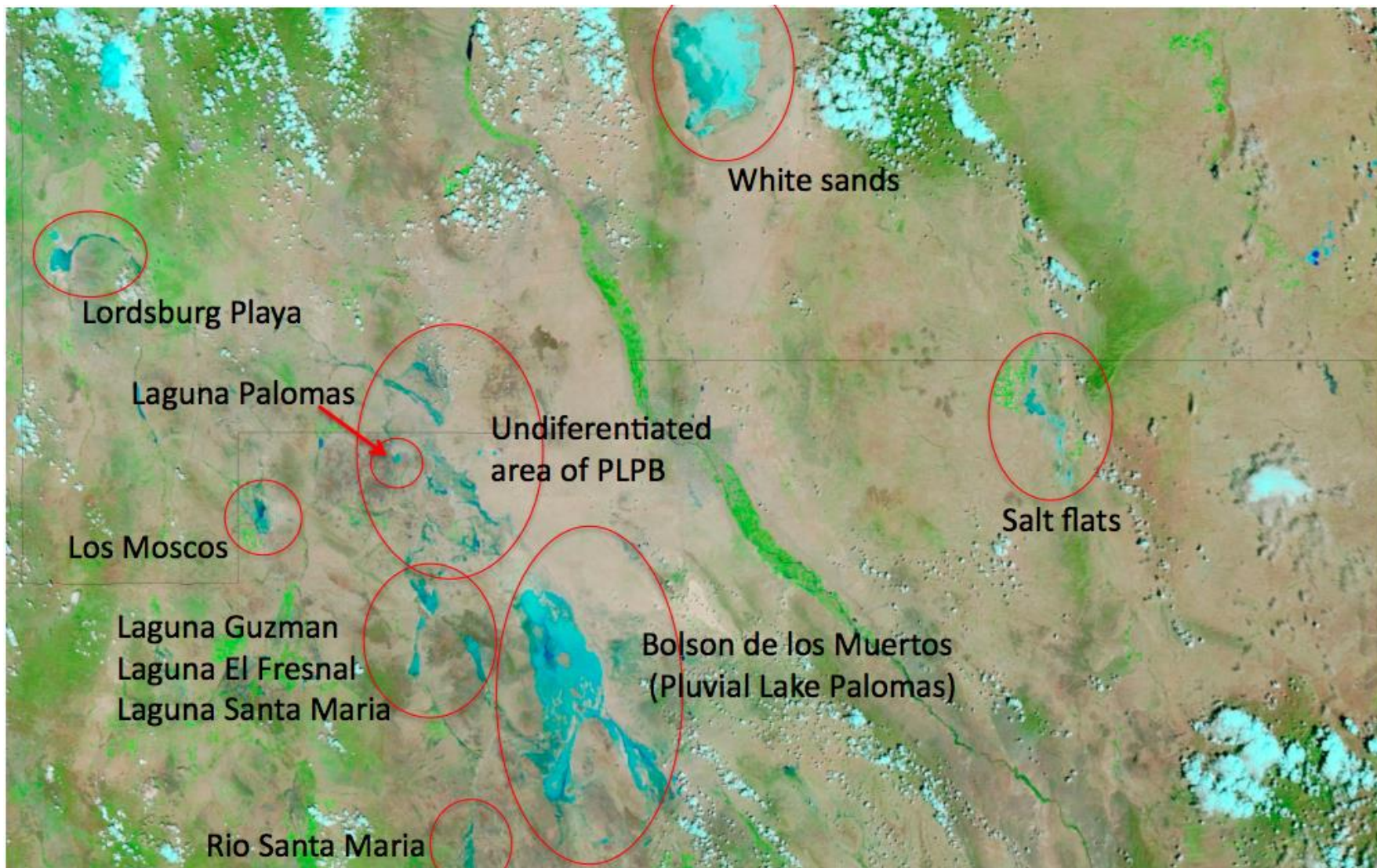
What have we learned?

Lack of roughness elements.
Large, elongated and mountain flanked erosional surfaces.
Heavy presence of anthropogenic disruption (agriculture and roads).

What have we learned?

Resetting control — Agust 07 2006 MODIS R:7 G: 2 B:1

Conclusions

- Specific geomorphic settings are identified, that form "Hot Spots". e.g. WS, BDM, North PLP, Ascension, Flood plains of the Casas Grandes, Sta. Maria and Del Carmen, etc. as well of some of the mega-agricultural fields in the region.

- Detailed point based source characterization of dust sources is achieved with a robust database both spatially and temporally.

- We are able to identify the most relevant geomorphic (alluvial, playas, flood plains and river deltas) and land cover (rangeland, barren flat surfaces, agricultural fields) classes and their sedimentological characteristics in the central and northern Chihuahuan Desert.

- Establish a base for continuing evaluation of the Chihuahuan Desert region as significant source of mineral aerosols in North America and their regional and global implications.

- Establish the need to initiate an action plan for monitoring and informing about dust storms and their potential hazards to the affected population.