Phoenix, AZ

# ΛΟΟΤ

5<sup>th</sup> Annual Regional Dust Workshop

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

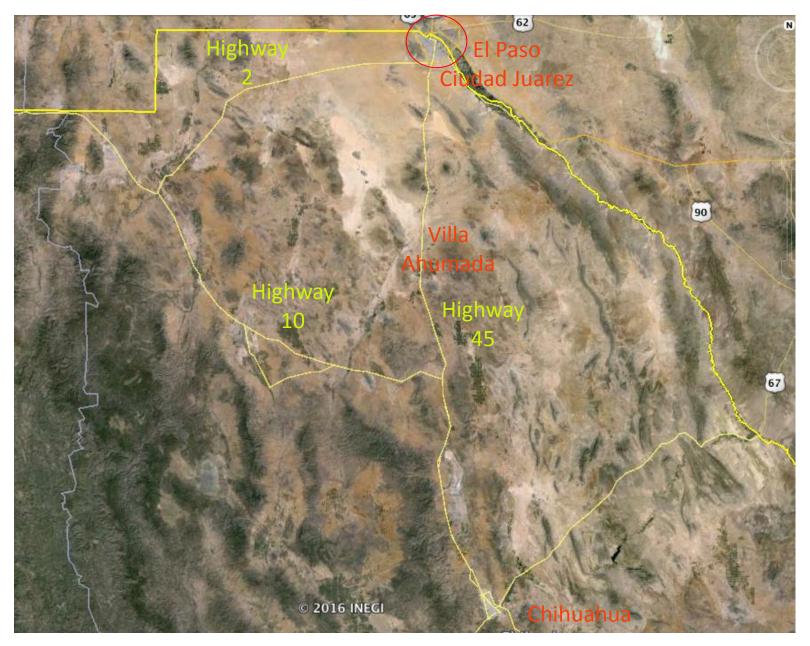
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> > **CA Modelos Ambientales**

UAC

Universidad Autónoma de Ciudad Juárez

### **Problem and location**



## **Problem and location**

#### Dust and sand storms wreak havoc!

#### Potential to cause loss of lives

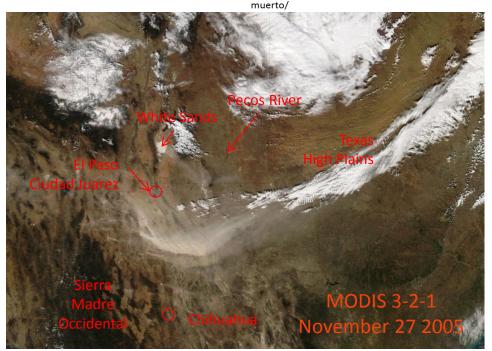
Inicio » Chihuahua » Tolvaneras provocan choque múltiple en carretera a Juárez; un muerto

#### 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/tolvanerasprovocan-choque-multipleen-carretera-a-juarez-un-



#### Disrupt traffic, cause accidents



#### Vientos 'borran' la carretera en tramo Juárez-Ahumada

#### f 🔰 😡 M 🎯 🕂



#### 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 fenômeno 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-lacarretera-en-tramo-juarez-ahumada-/

# **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.

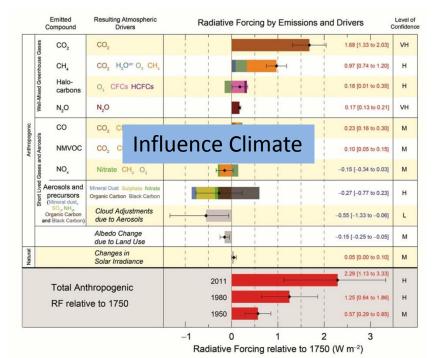
- Climatic change
- Influence cloud nucleation
- Glacier mass budget alteration
- Ocean productivity
- Nutrient dispersion
- Radiative forcing
- Soil erosions
- Air pollution
- Animal suffocation
- Asthma and allergies incidence
- Pollutant and disease transport
- Transport disruption
- Etc.,



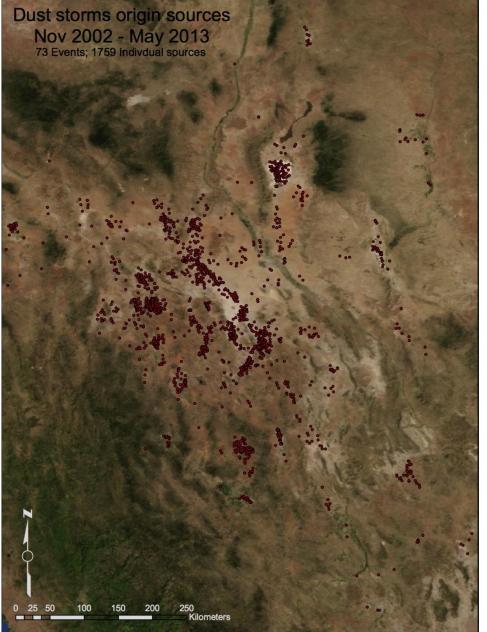
#### Health Hazards



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



## Where and what are the sources?



### OBJECTIVES

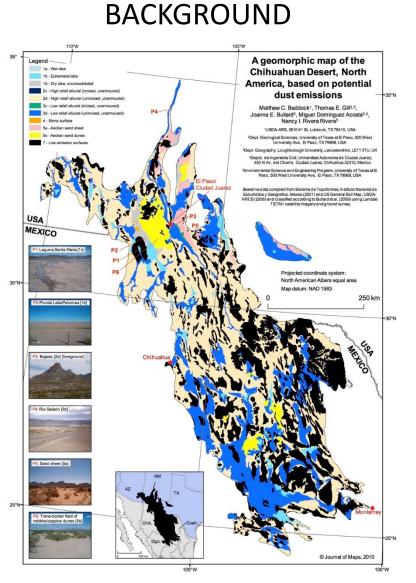
- Identify the prevalent sources of aeolian erosion in the central and northern Chihuahuan Desert
- Characterize the those sources according to their geomorphological setting and land cover
- Generate a robust database that would account for most of the source areas of dust storms



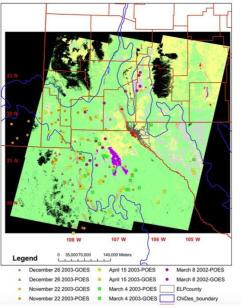


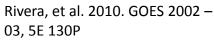


## Where and what are the sources?



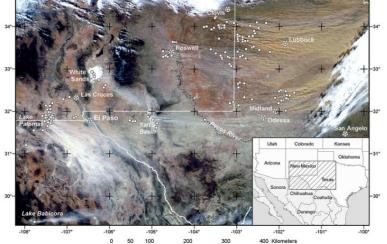
Baddock, et al. 2011 MODIS 2001 - 09, 26E, ?P





50°H

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



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

#### Obvious!

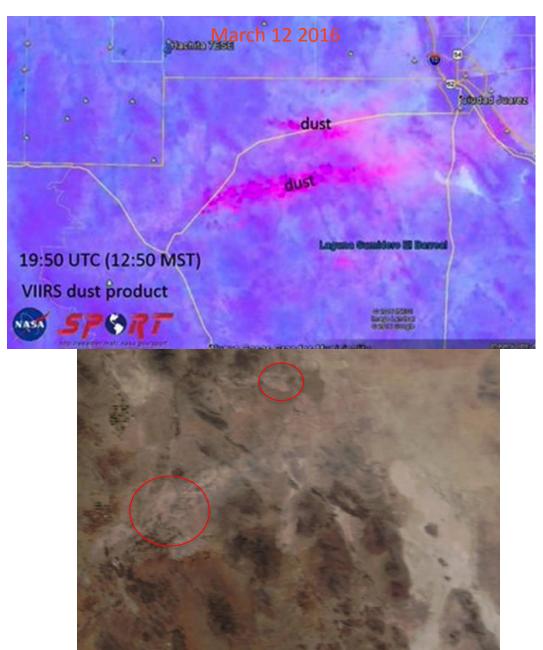
There area NATURAL and ANTHROPOGENIC sources as well as natural and anthropogenic conditional and triggering factors.

#### NOT so obvious!

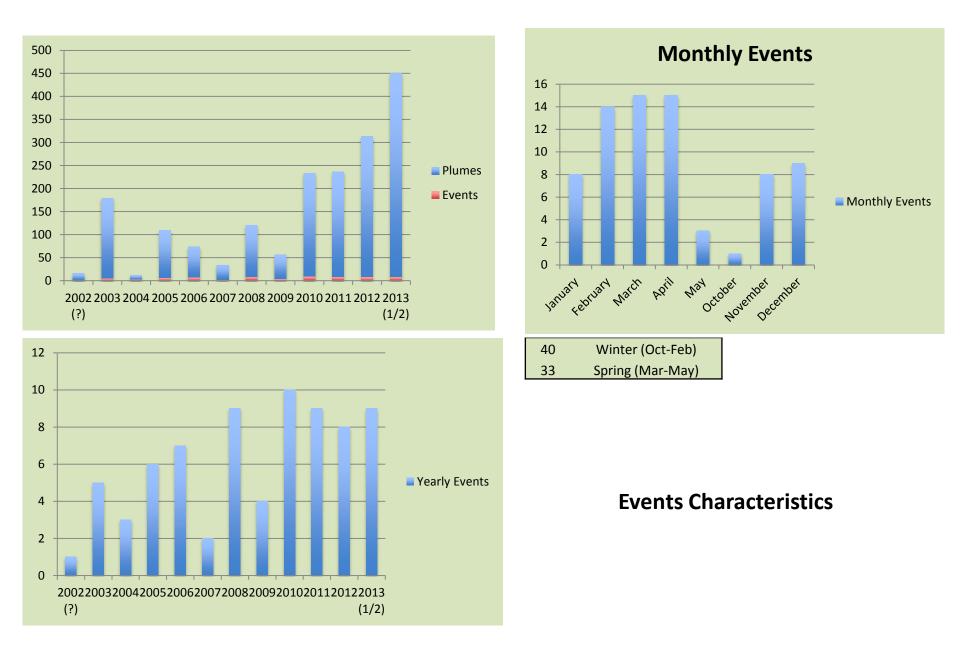
- Areas areas area geomorphically generated/conditioned and naturally and/or anthropogenically affected.
- Some areas are complex. e.g. several geomorphic classes plus anthropogenic activity in a small spatial location.
- Technical data: climatology/meteorology of dust events.

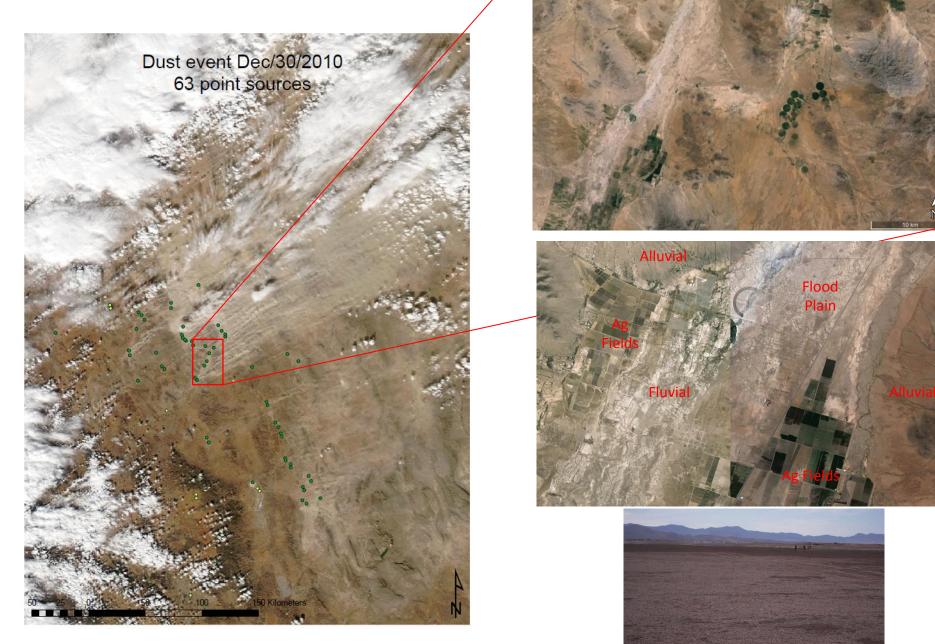
Geomorphology/land cover/sediment classes of sources.

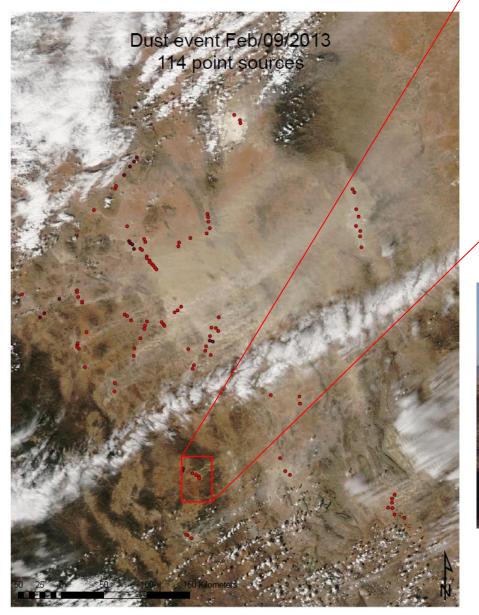
Chemical and mineralogical makeup.



	109°00"W	108°0'0'W	107°0'0'W	106°0'0"W	105°0'0''W	104°0'0'W	Geomorphic Classes (14 Total)	Counting	% (of 1759	Merged %
35°0'0"N•	Dust storms	origin sou	irces			-35"0'0"N	Aeolian Sand Sheet		L 0.0	5
	Nov 2002	2 - May 201	13	1			Alluvial Deposits	57	32.4	5 22.27
	73 Events; 175	9 Indivdual source	es	2 and and a		Y	Fluvio/Alluvial Deposits	1	5 0.9	33.37
	COMPANY OF THE OWNER	and the		No No		100	Deltaic Deposits	19	7 11.2	D
34*0'0"N•				al de		-34*0'0"N	Dune Field/Coppice	8	3 4.7	2
	a series	12. C. 10	m 2	1 1 200			Ephemeral Lake	2	) 1.14	1
			1	12.9		3C	Flood Plain	32	18.2	5
33*0'0"N•				White Sa	ands	-33"0'0"N	Fluvial Deposits		2 0.1	1
33-00 N		- Mimb	res			-33'00'N	Lacustrine Margin/Aeolian Deposits	1	3 0.74	1
		Delta			2	Part -	Lacustrine Margin/Alluvial Deposits		2 0.1	1 1.99
						mark .	Lacustrine Margin/Sandy Shoreline	2	) 1.14	1
32°0'0"N•	WIICOX Playa			000 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		-32"0'0"N	Mountain/Bedrock		L 0.0	5
	S C BB C I			≱° astern °°			Playa	40	23.2	5
	6 · ·	a prover a	mai	rein		als	Playa/Gypsum Sand Dunes	10	3 5.8	5
	Ascencio			the states	· ····································	Derreand	Land Cover (13 Total)		unting % (of 1	759) Merged %
31*0'0"N•	Laguna San J	Juan	So (	BDM eastern r	nargin	-31*0'0'N	Aeolian Sandy Soils			0.80
	· · · · · · · · · · · · · · · · · · ·	Casas 🕢 🖉	1 1 1	1. 8°		Also -	Aeolian Sandy Soils/Coppice			4.43
	Gr	andes		Rio Del	1364:	See 1	Agricultural Fields			9.61
			BDM	Carmen	- ISA	A CONTRACT	Anthropogenically Disturbed		66	3.75
2010/0751	S AND A SAME	Galeana	.8 %	88	10- m 4		Barren Flat Soil Surfaces		361 2	0.52
30 0 0 11		v.			the states	-30 UUN	Barren Flat Soil Surfaces (Playa) and Sandy Soil (D	unes)	103	5.86
		Salar Salar	100		ALL ALL	R. Carl	Desert Pavement/Rangeland		8	0.45
		900	° Car		1 Parts	Second Co	Efflorescent Soils/Sandy Beach			0.85
		•	8 300	80	$\square$	Oasis	Lake Margin/Barren Flat Surface			1.14
29°0'0"N•				Namiquipa		g regior-29707N	Rangeland			9.62 42.18
				Ag region	··· 3		Rangeland/Barren Flat Surfaces (Laguna San Juan)			2.56 42.18
			1.1.4	i i i i i i i i i i i i i i i i i i i			Riverbed			0.11
			A Color		A YOR	1 22	Sandy Beach		5	0.28
28°0'0"N•	1 4				1	-28"0'0"N	General Geomorphic Classes	Count	ng Percentag	•
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		1 au la la			· · ·		Alluvial		87 33.3	7
		and the second second		A STATE OF A	SALASS IN	344 \$	Fluvial (incl. deltas)	ļ	20 29.5	6
2710101	0 25 50 100	150 200 250 K	liometers	A AN AN	1° % ( 0)		Lacustrine (incl. playas)	4	64 26.3	8
21 00 1				A STATEMENT AND A	105"0'0"W	2/ 00N	Mountain/Bedrock		1 0.0	6
	109°0'0'W	108°0'0"W	107°0'0'W	106°0'0"W		104°0'0"W				









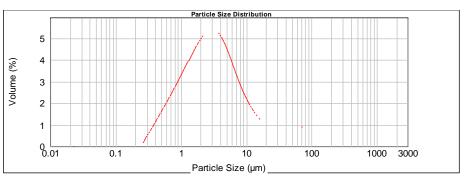


Mix of sediments: erosional agents and eroding dust generators. Presence of other significant eroding mechanisms

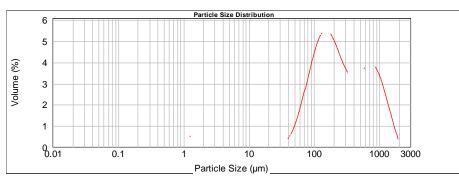








SELP-002

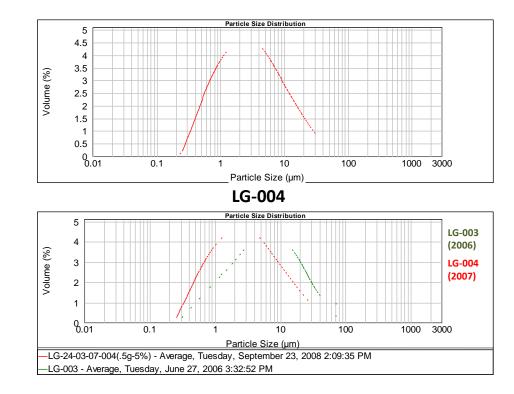


SELP-010









Inundation areas that act as sediment recharge areas.

Presence of easily erodible crusts: flakes (clay) and efflorescent salts. Potential chemical hazards.

Lack of roughness elements.

Large, elongated and mountain flanked erosional surfaces.

Heavy presence of anthropogenic disruption (agriculture and roads).









White sands Lordsburg Playa Laguna Palomas Undiferentiated area of PLPB Salt flats Los Moscos Laguna Guzman **Bolson de los Muertos** Laguna El Fresnal (Pluvial Lake Palomas) Laguna Santa Maria

Resetting control

**Rio Santa Maria** 

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.