Satellite-aided Regional Dust Forecasting for Valley Fever Surveillance, Highway Safety and Air Quality Management

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NOAA ARL/National Air Quality Forecast Capability (NAQFC)
NASA Health and Air Quality Applied Science Team (HAQAST)

Arizona Dust Workshop, Coolidge, AZ
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Project Team

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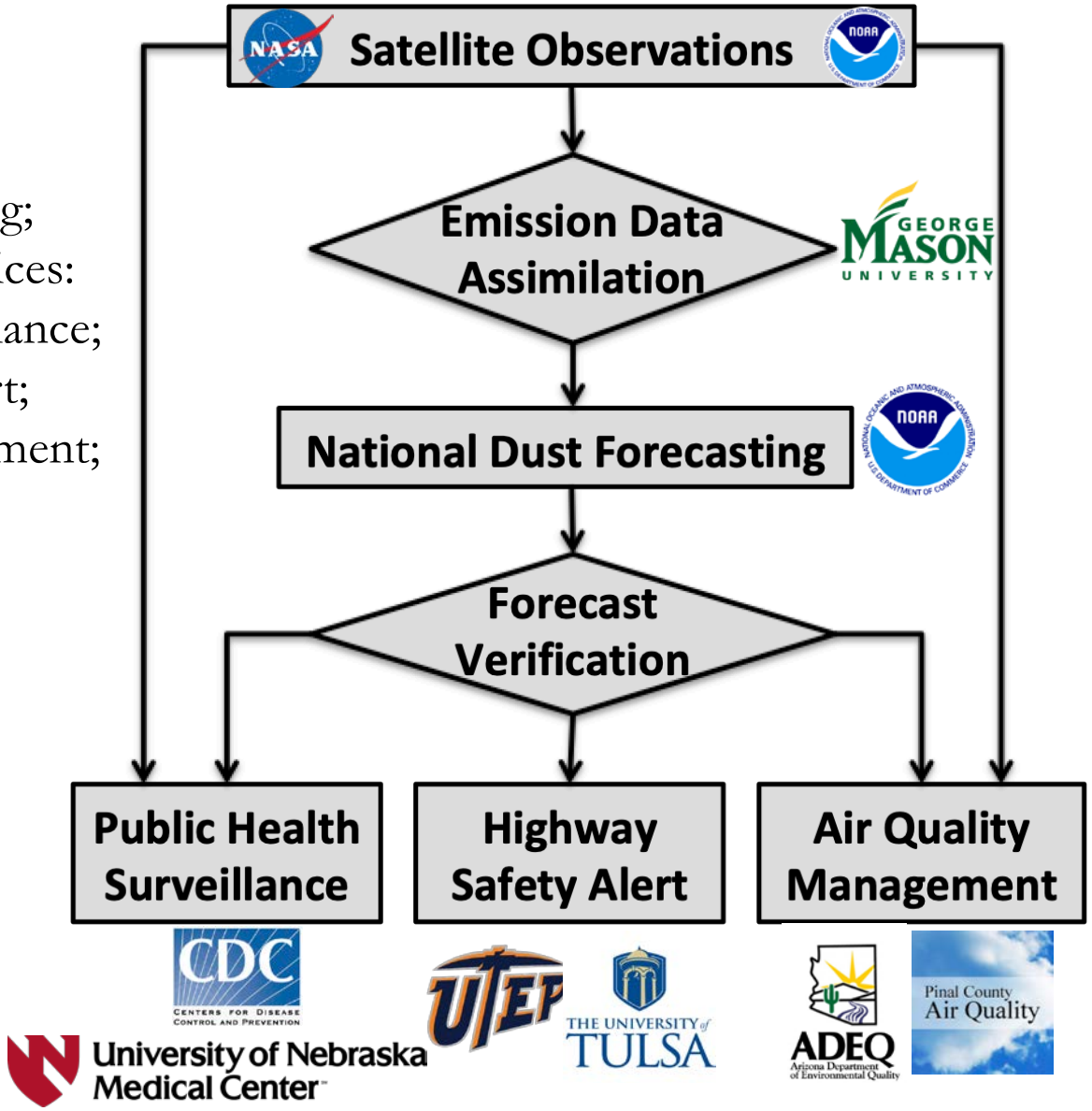
Julian Wang, NOAA

Project Overview

Project Goals:

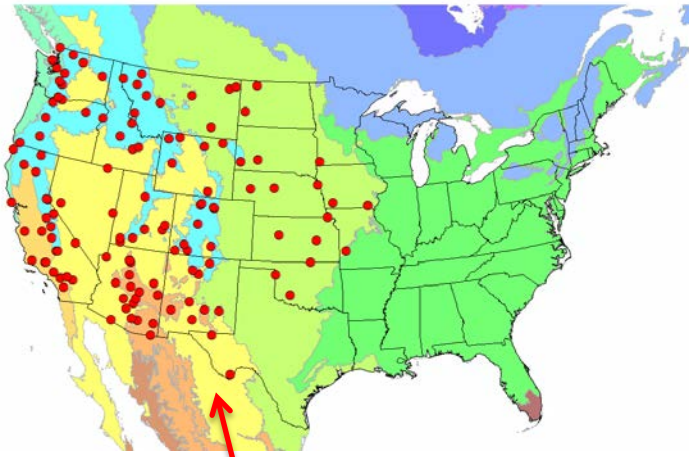
1. Improve dust forecasting;
2. Support three dust services:
   a) Valley fever surveillance;
   b) Highway safety alert;
   c) Air quality management;



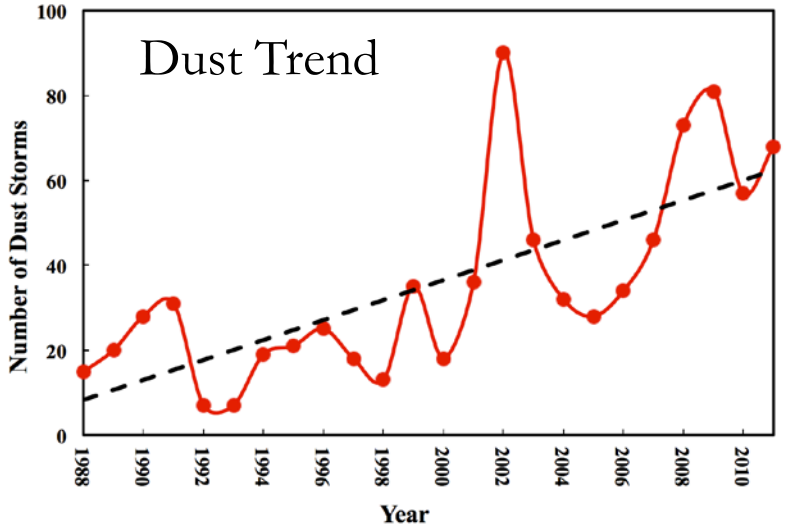
Trend of Dust Storms

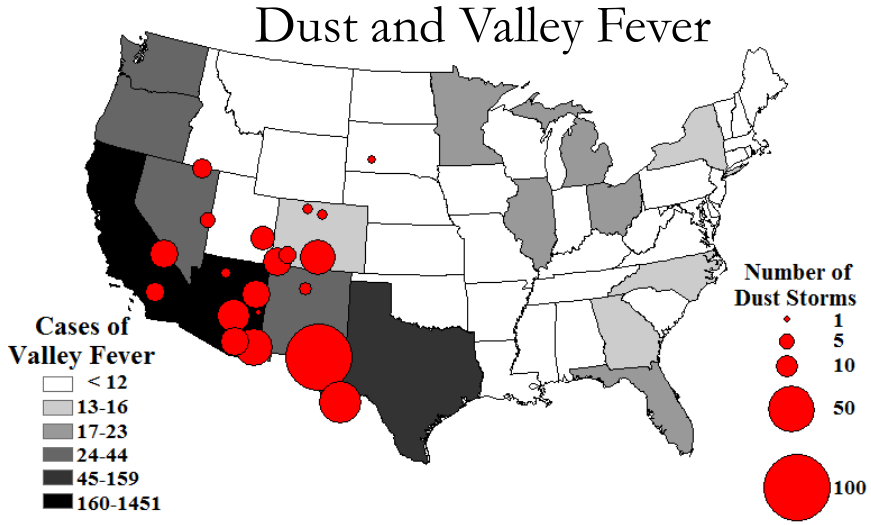
(Source: Tong et al., GRL, 2017)

Ground Network



MODIS Dust



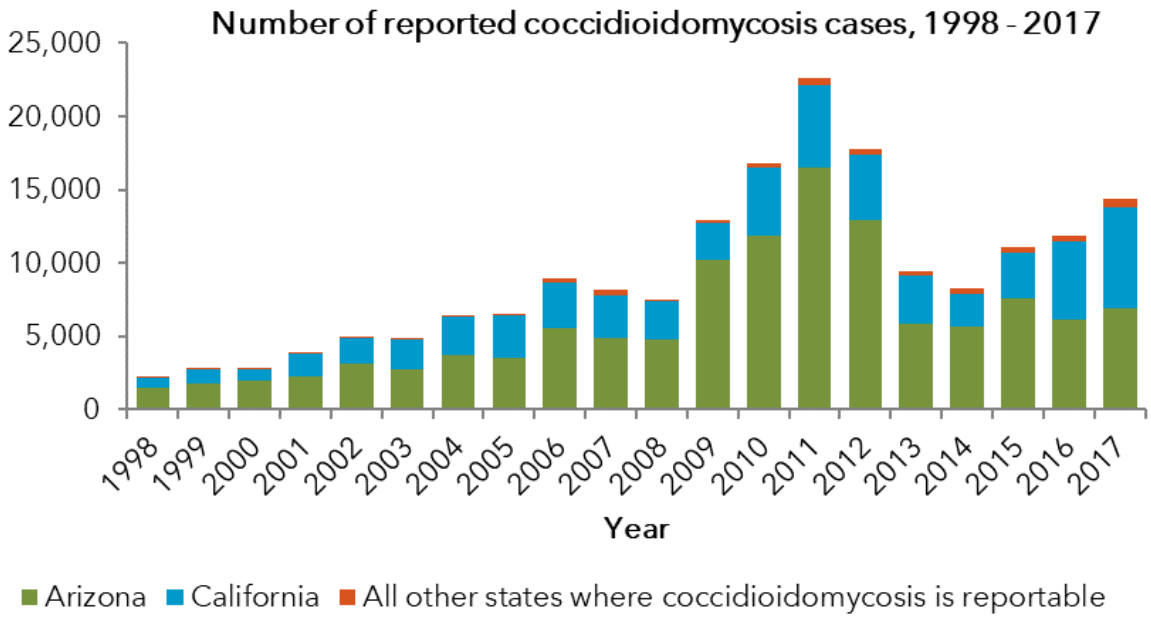


20 Large Storms per year in 1990s → 48 Storms in 2000s;

Burden of Disease

(Contributed by Orion McCotter and Jesse Bell)

- Rates in the United States have increased dramatically
- ~10,000-20,000 cases reported to public health annually
- >95% of cases are from Arizona and California

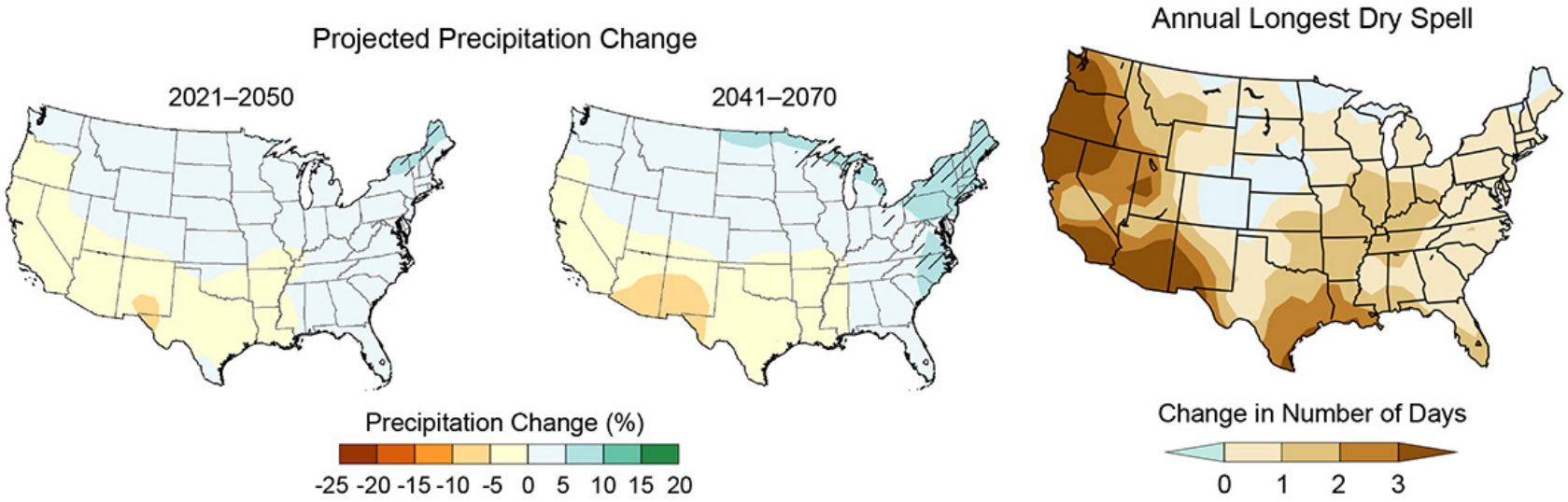


More reading: McCotter, O. Z. et al, 2019. Update on the epidemiology of coccidioidomycosis in the united states. *Medical Mycology, 57* (Supplement_1), S30-S40.

Drought, Dust and Valley Fever

(Contributed by Orion McCotter and Jesse Bell)

- Droughts tend to relate with an increase in Valley fever incidence
  - Drier soil omens higher Valley fever incidence in proceeding years
  - Southwestern U.S. is dry, and becoming drier and drier, supported by widespread perception and climate model projections
  - Droughts produce conditions that lead to dust storms
- Dust trends may increase the Valley fever incidence
  - Dust storms have become more frequent in past decades in the SW U.S.
  - The incidence was found positively related to dust number or frequency of dust storms in Arizona

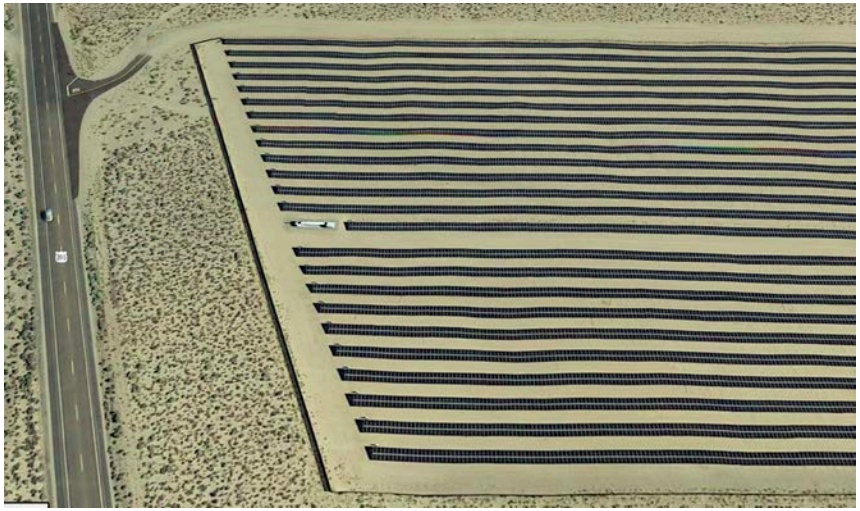


(Cook et al., 2015; Coopersmith et al., 2017; Tong et al., 2017; Gorris et al., 2018)

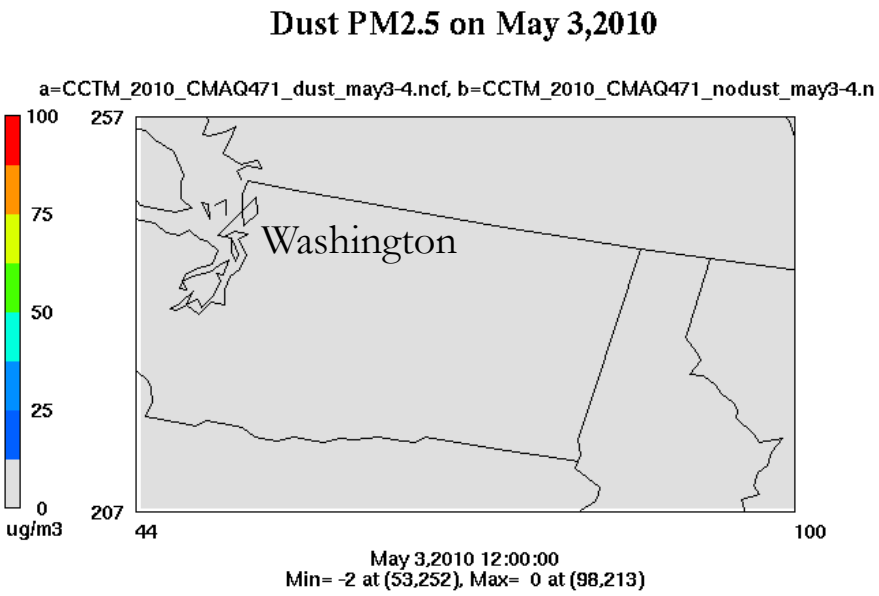
Highway Safety, Solar Power, Agriculture…

- Highway traffic accidents caused by visibility loss and high wind

- Dust deposition reduces power generation efficiency of solar farms

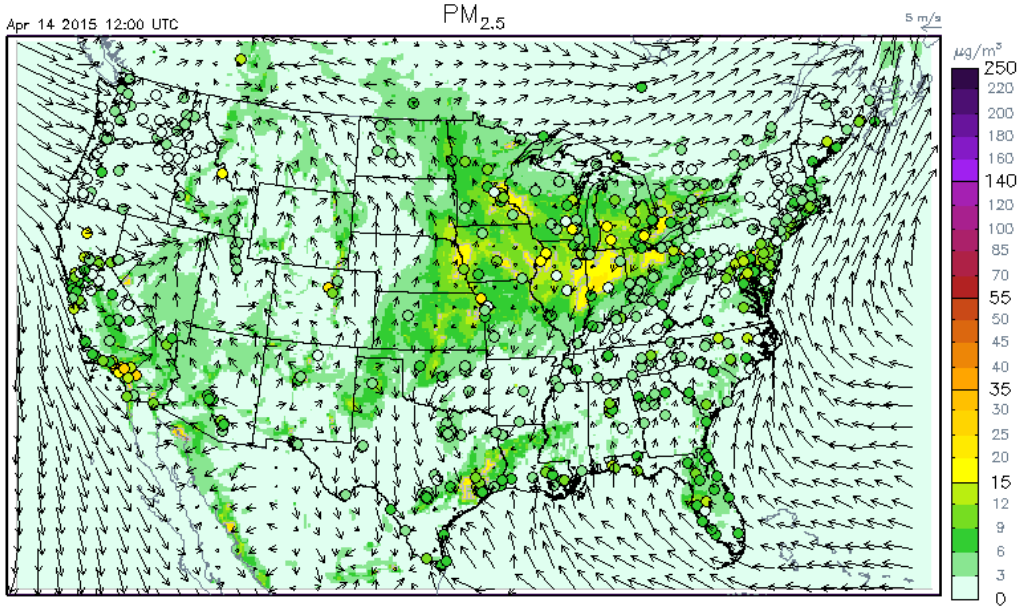


NOAA Real-time Dust Forecasting (CMAQ)



12:30 p.m, May 3,2010

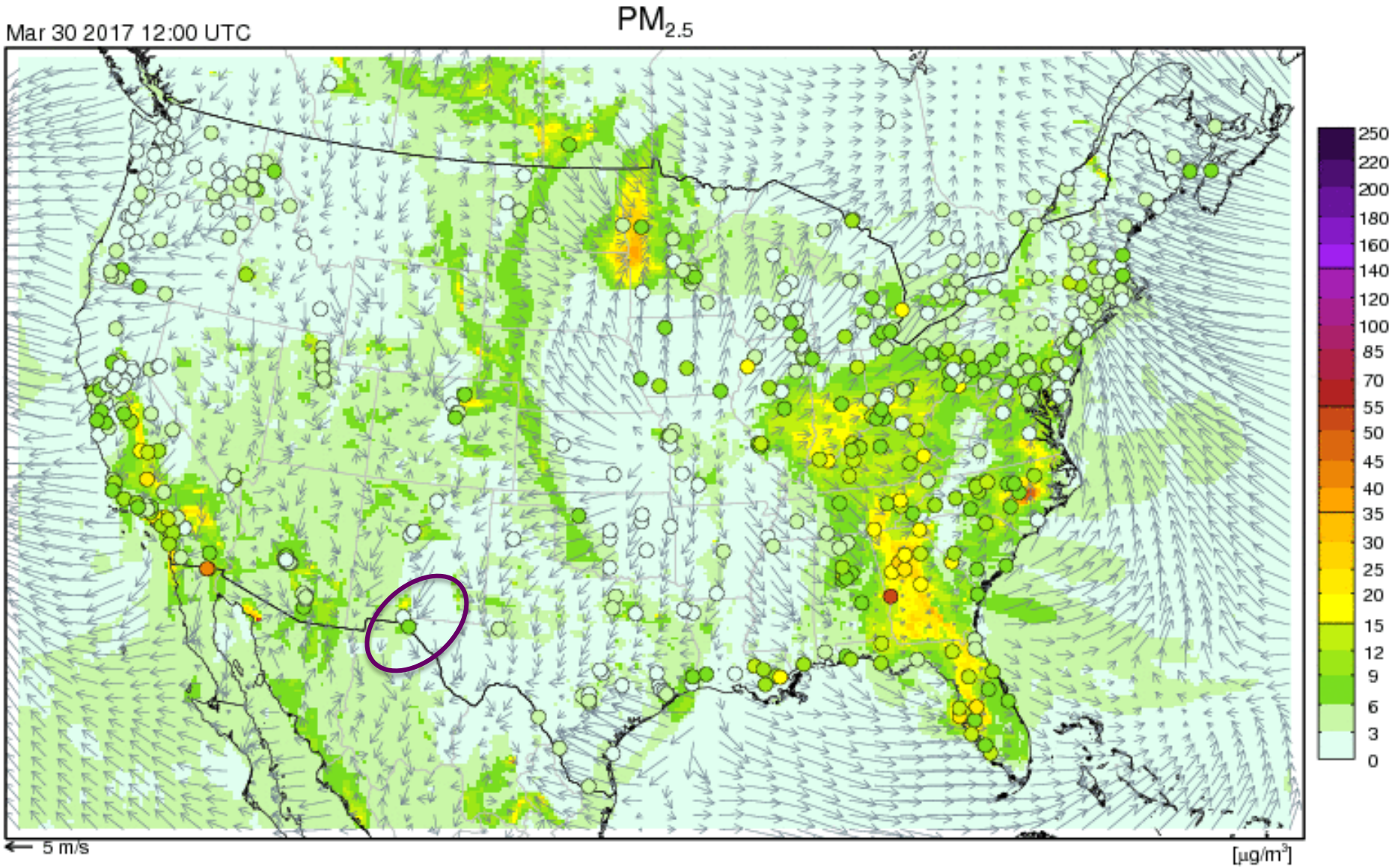
--http://earthobservatory.nasa.gov/NaturalHazards



(Courtesy of Huyncheol Kim)

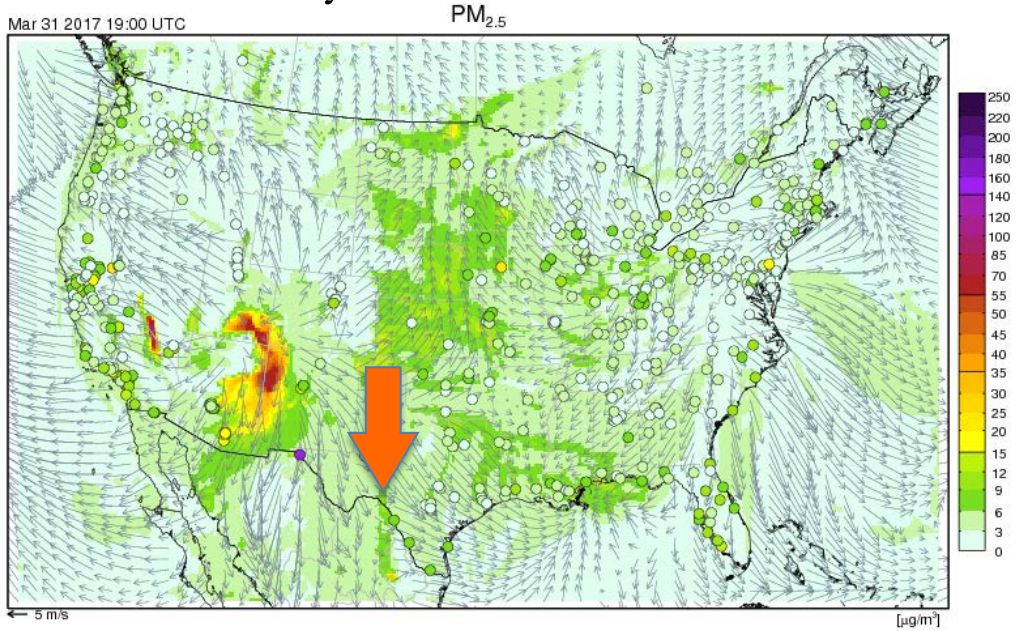
Dust storm killed two people on I-80.

NAQFC Dust Forecast (Surface $PM_{2.5}$)

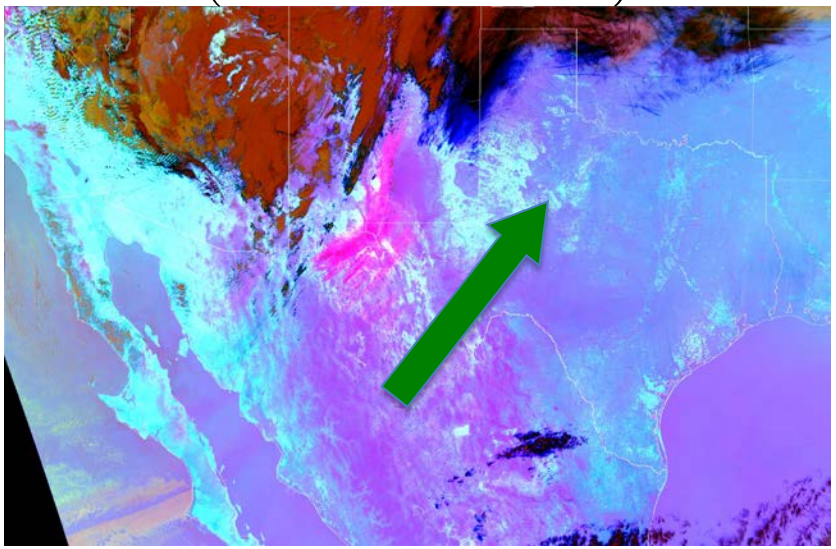


Why Did the Model Fail?

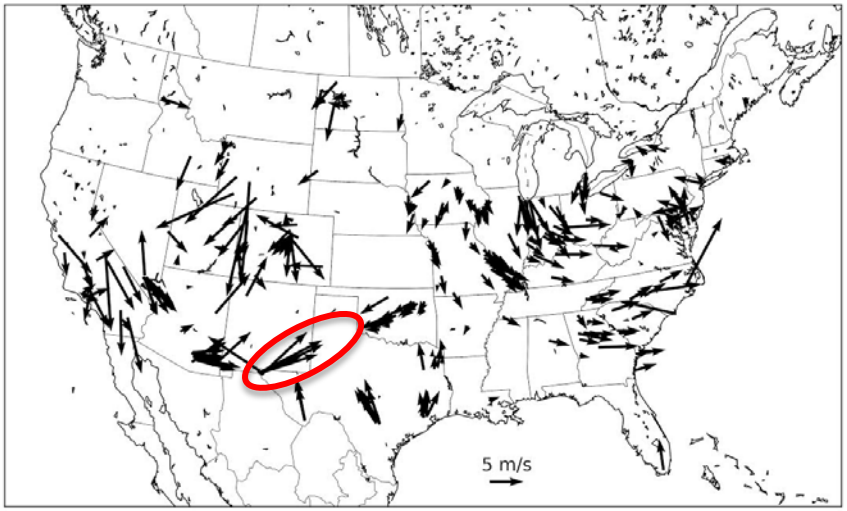
Northerly wind in El Paso, TX



Southwesterly Dust Plume
(Suomi-NPP VIIRS)



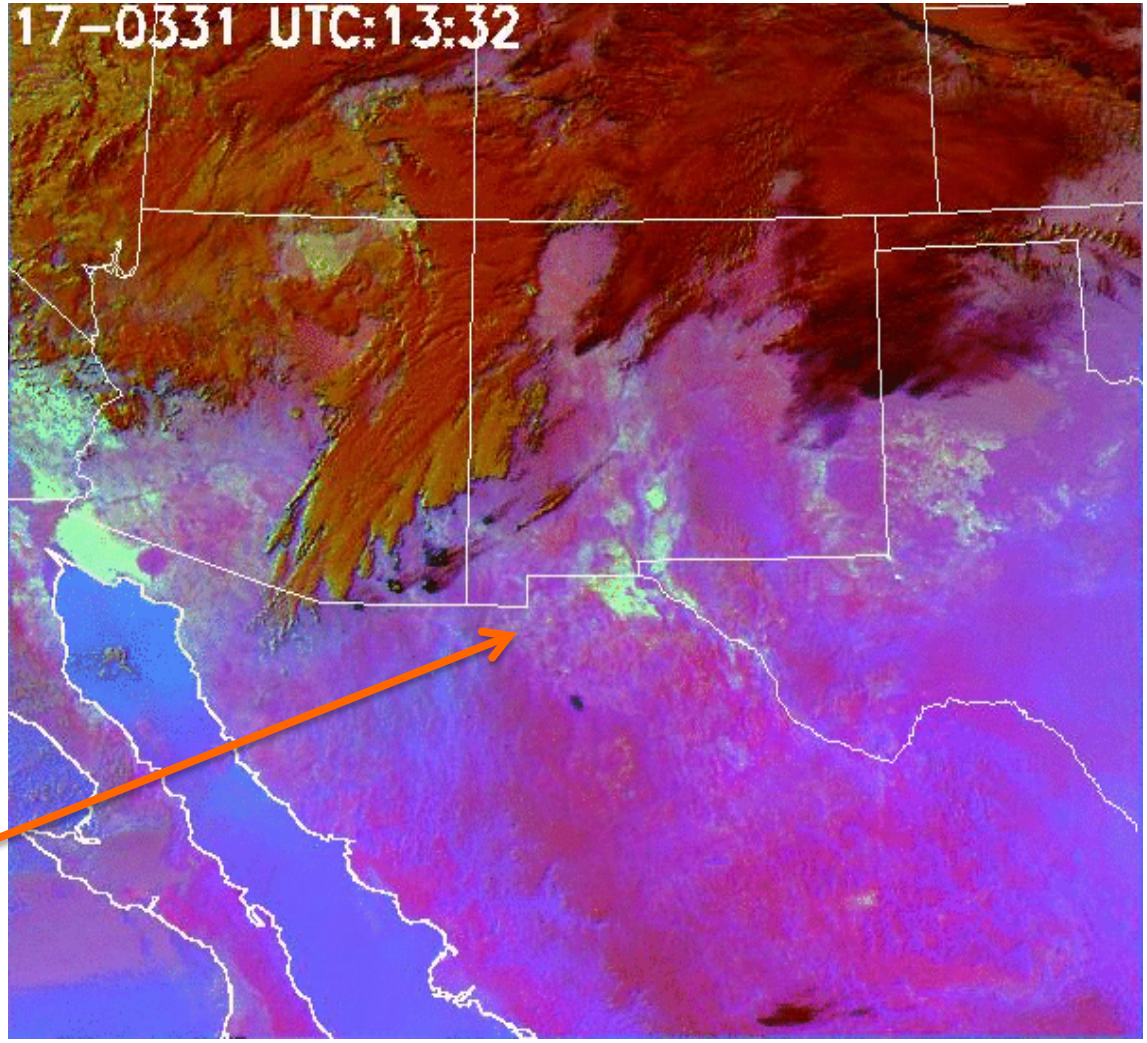
Ground observations consistent with satellite data



March 31 2017 Afternoon 19 UTC

New Satellite Dust Detection Capability
(GOES-16 ABI Dust Mask)

Red 12 µm – 10.8 µm
Green 10.8 µm – 8.7 µm
Blue 10.8 µm

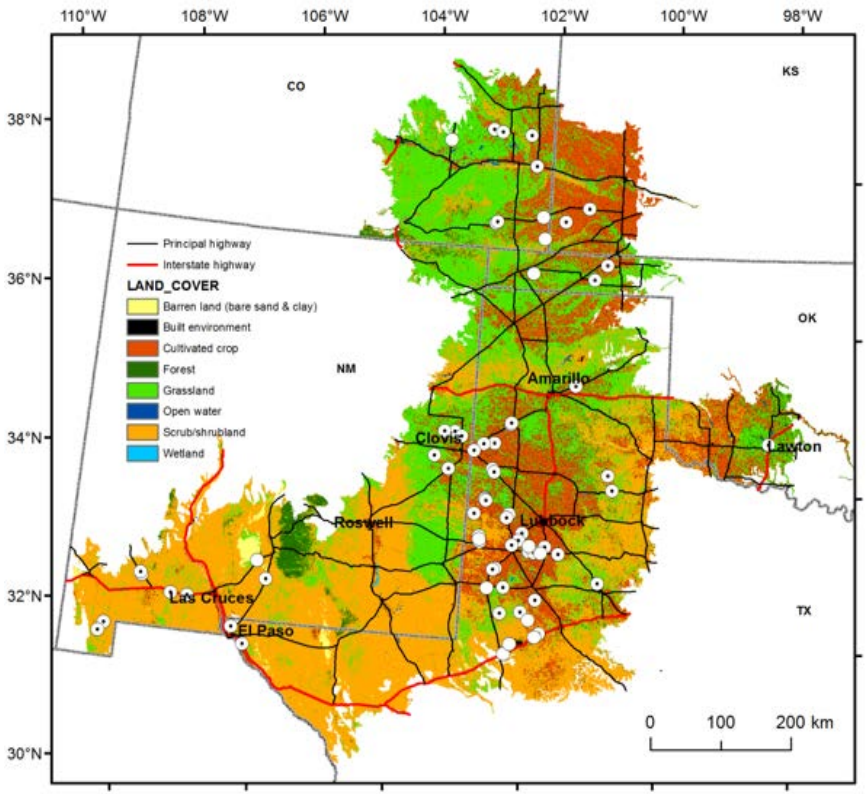


Dust appears as pinkish magenta plume that forms near Mexico/New Mexico border. Cold ground appears as static pink that changes to shades of bluish green when warm

(Kondragunta et al., EM, 2018)

Dust Hotspots: Relative to Highways

(Contributed by Tom Gill, Junran Li and Scott Van Pelt)



UTEP and USDA-ARS: Field studies of dust emission potential at key sites

Buffering analysis

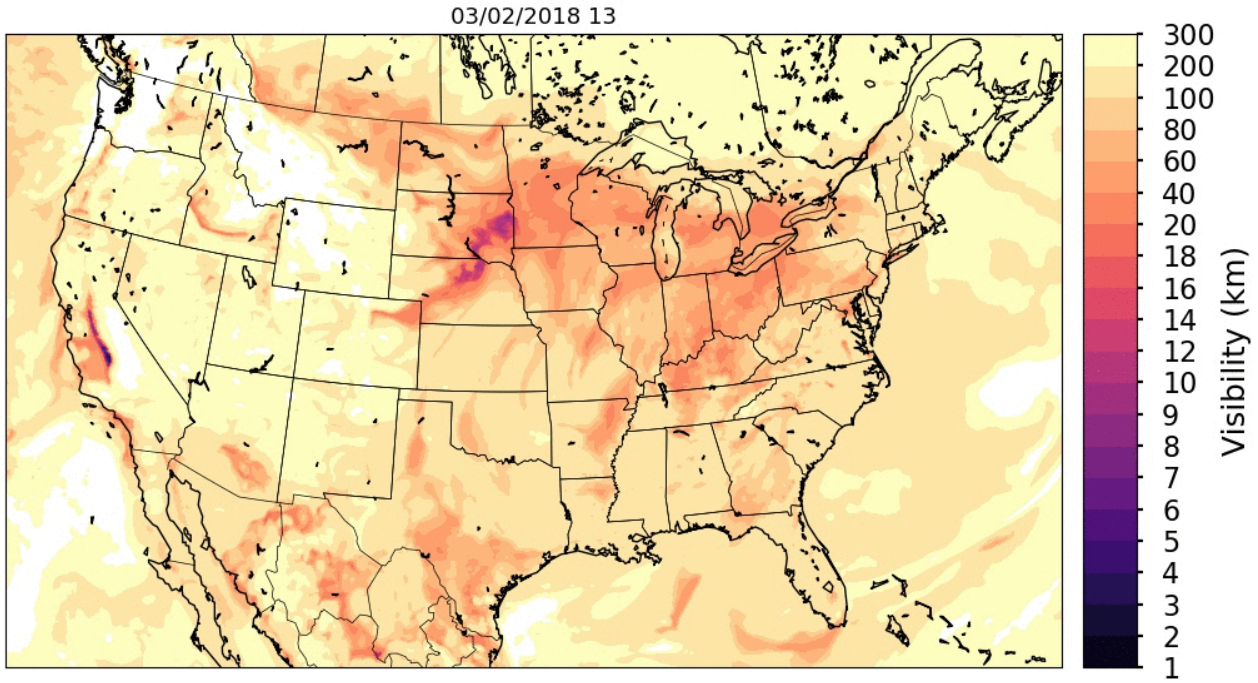
- <0.5 km
- <1.0 km
- <2 km
- <5 km
- <10 km

(Li, J. et al., Science of Total Environ., 2018)

Dust Forecasting for Highway Safety

Highway dust forecasts:

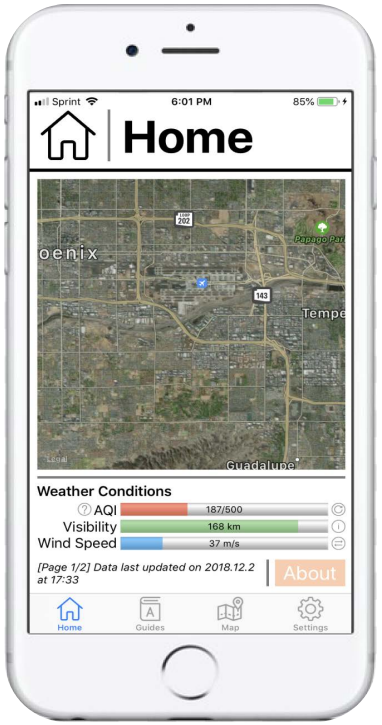
- Visibility
- High Wind
- Dust Concentration
- Inhalable Particle Concentration



(Courtesy: Barry Baker)

DustWatch App:

- Citizen Scientist Project
- Use dust forecasts
- Real-time dust alerts



(Contact Dust App. Team: dustapp2018@gmail.com)

How to Get Involved?

Collaborations welcome!

- Weather and dust forecasting;
- Dust observations, model verification;
- Using weather and dust products at your own work;
- Disseminating dust information to stakeholders and the public.

How to get involved?

- Monthly meetings with stakeholders;
- More frequent technical discussions among sub-groups (Dust forecasting/Valley fever/Air Quality & Highway);
- Meeting us at AGU 2019, NASA HAQAST (haqast.org) and more;

Contact us:

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