Updates on Soil Microorganism Detection and Dust Forecasting over the Southwest U.S.

Daniel Tong and Patrick Gillevet

George Mason University, Fairfax, VA

Co-authors:

Ling Ren, Yunyao Li, Janak Joshi, Siqi Ma, Masoumeh Sikaroodi, Zack Chester (GMU);

Tom Gill (UTEP), Scott Van Pelt (USDA), William Sprigg (Sci. Policy.)

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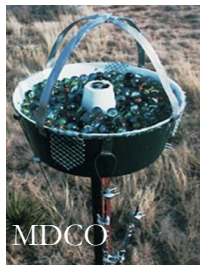
Arizona Dust Workshop, March 24, 2021, Virtual

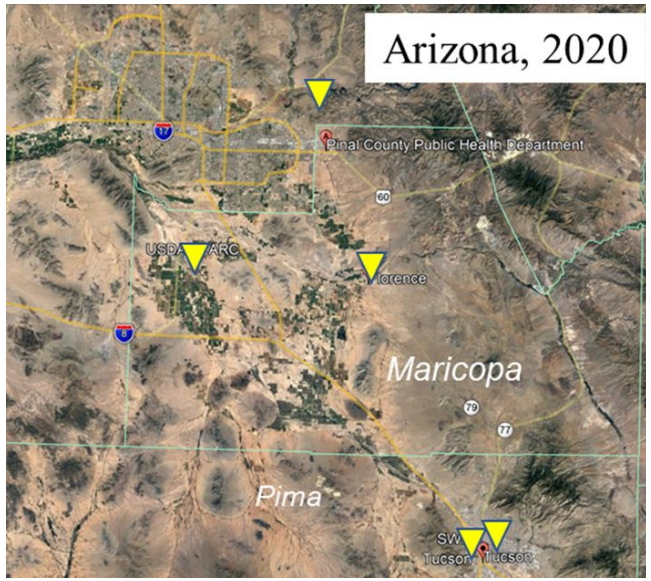
Monitoring and Detecting Dust-Associated Microorganisms in Arizona, US

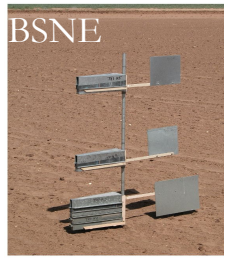
Project Objectives

1) Develop laboratory methods to detect microorganisms in soil and dust; 2) Compare the low-cost dust collectors; 3) Evaluate the feasibility of a large-scale and cost-effective monitoring on potential pathogens, including *Coccidioides*.

Soil and Dust Collection

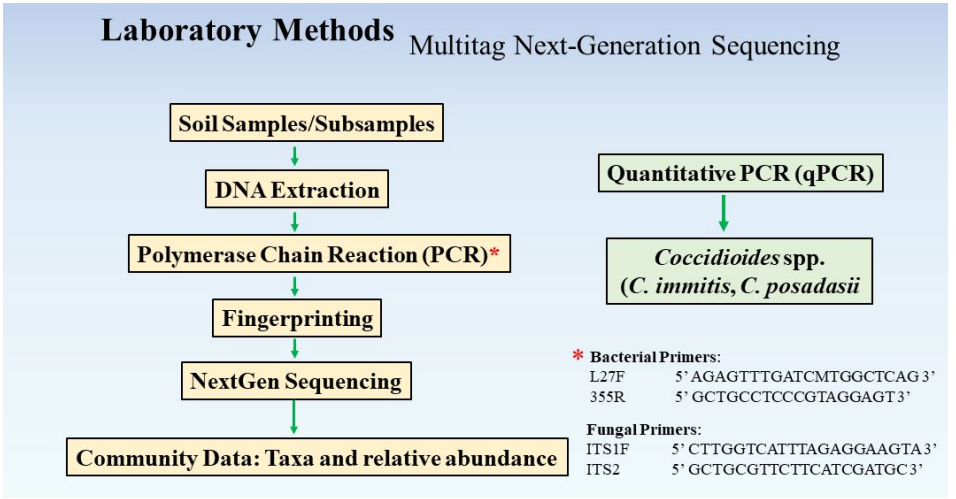






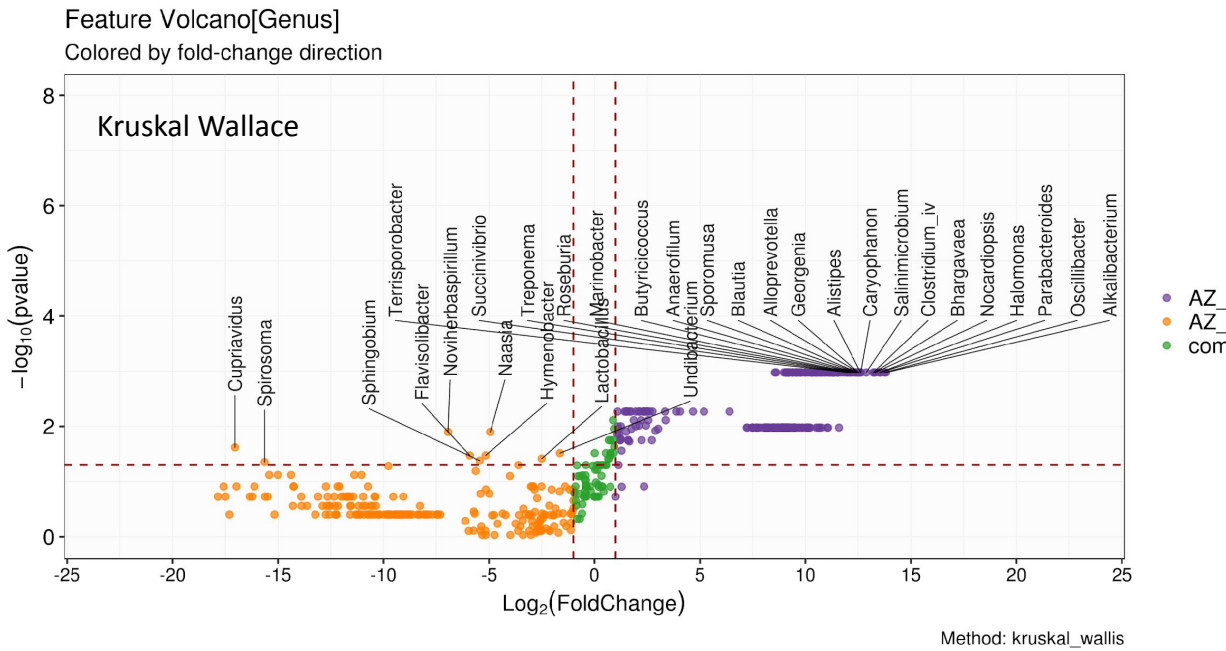
PurpleAir

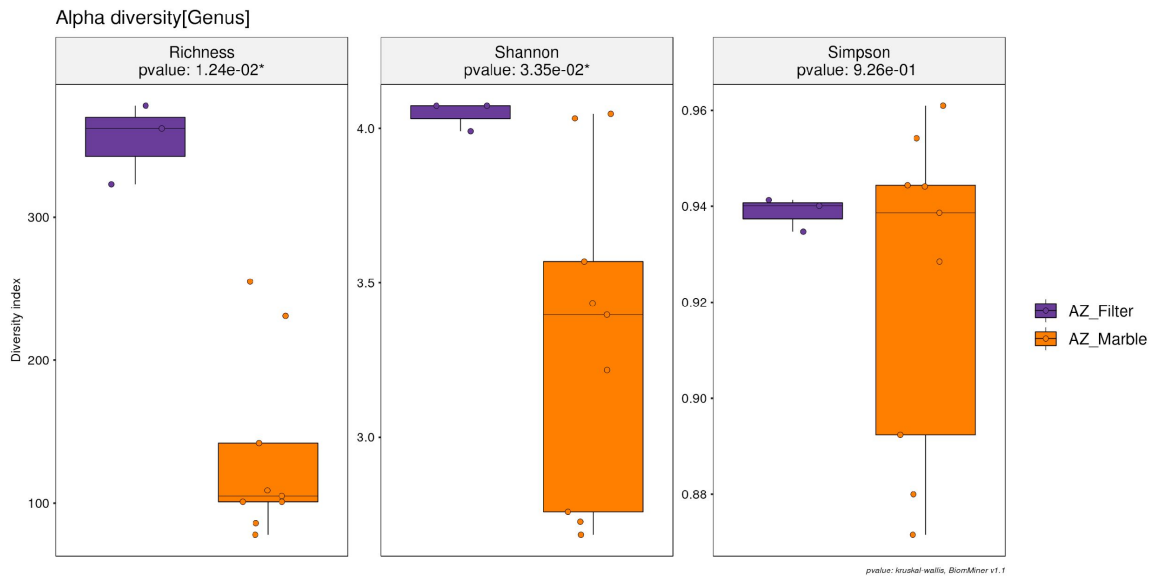
Laboratory Analysis



Potential Fungal Pathogens	Relative Abundance	
	Soil	Dust
Alternaria alternata	<1~27%	1~44%
Cryptococcus albidus	<1~3%	<1~24%)
Scopulariopsis brevicaulis	<1~3%	ND
Thyrostroma carpophilum	<1 ~53%	<1~4%)
Cladosporium pseudocladosporioides	<1 ~10%	<1~37%
Phoma fungicola	<1 ~52%	<1~75%

Arizona Filter versus Marble for Bacterial Genera





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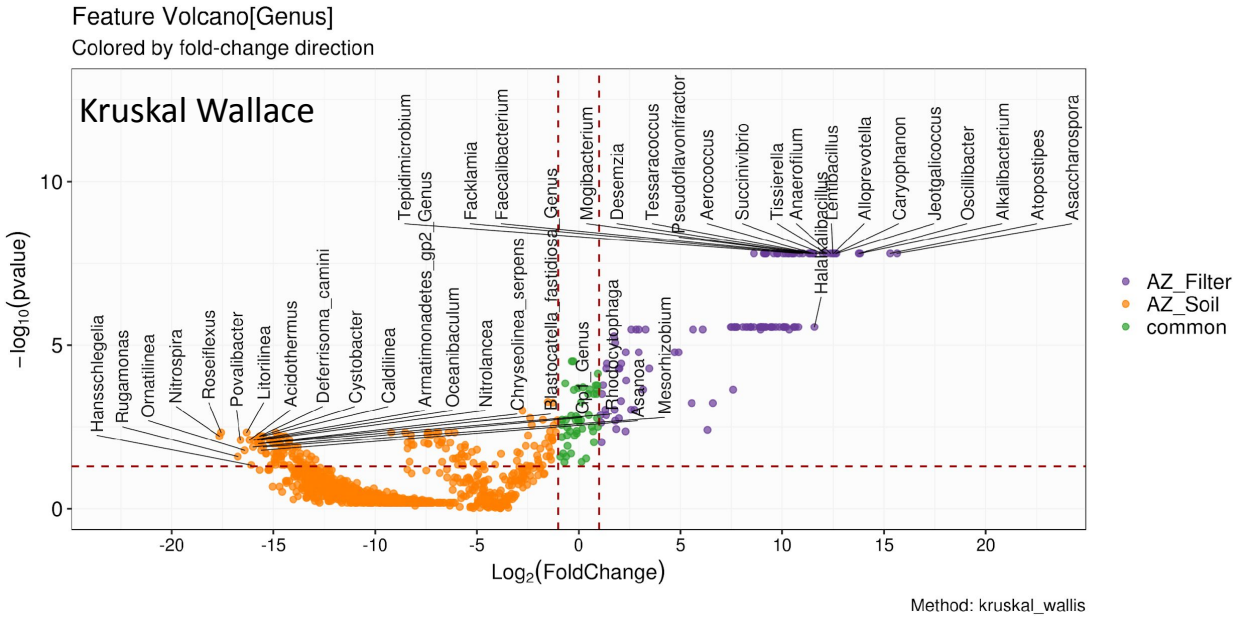
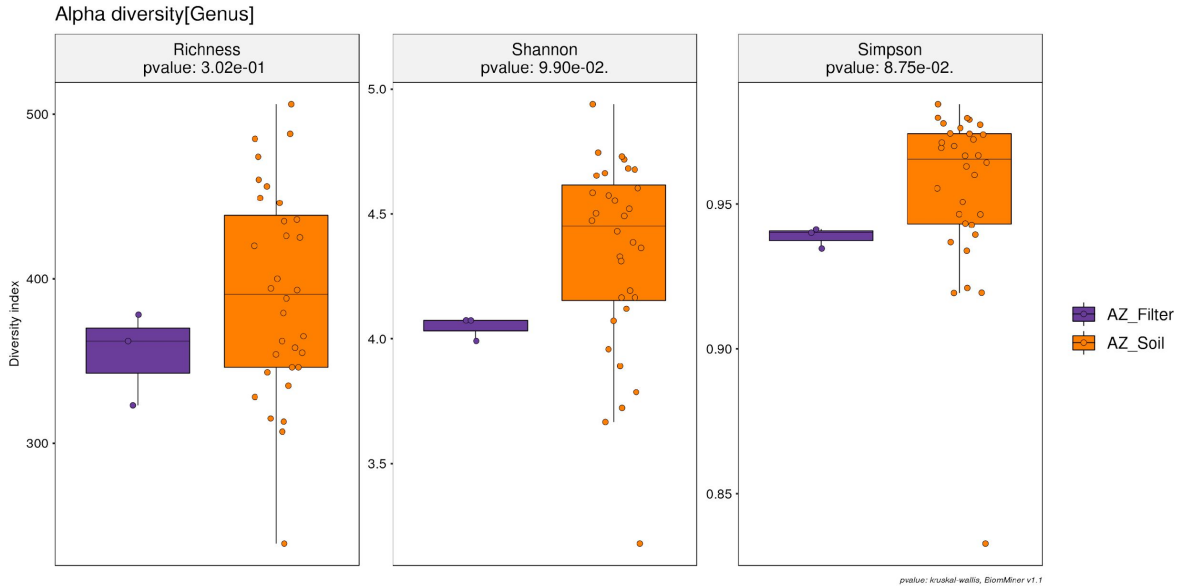
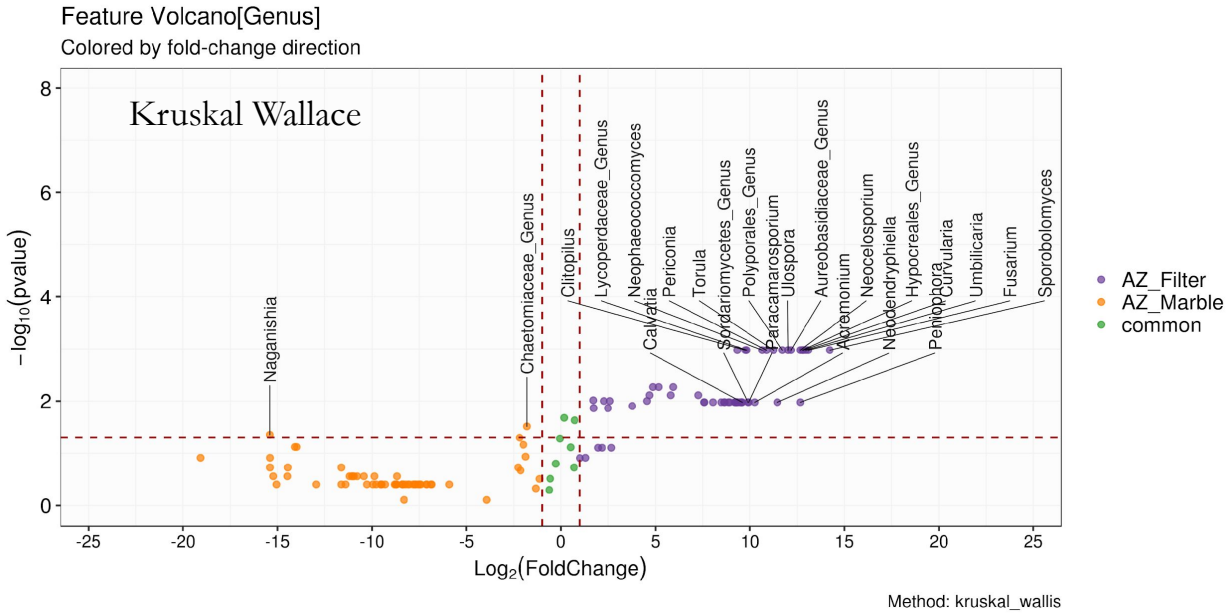
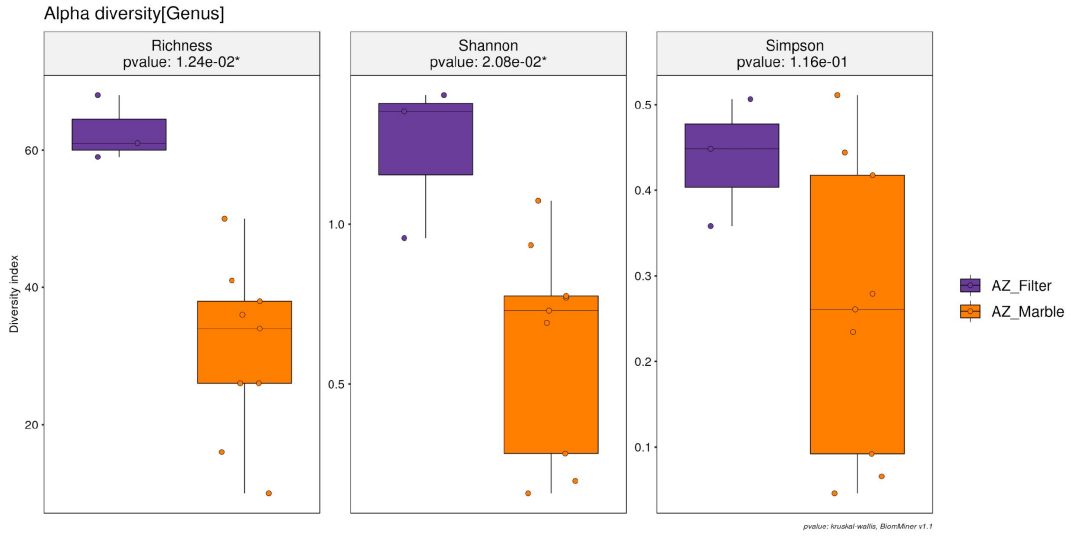




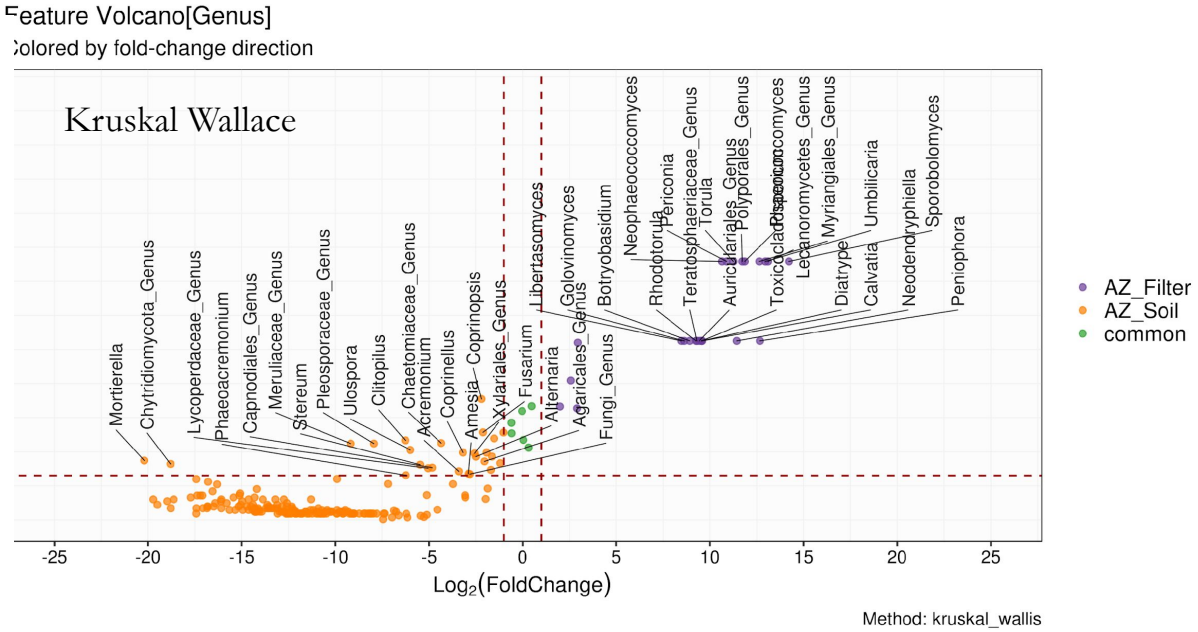
Collection device yields very different Bacterial communities

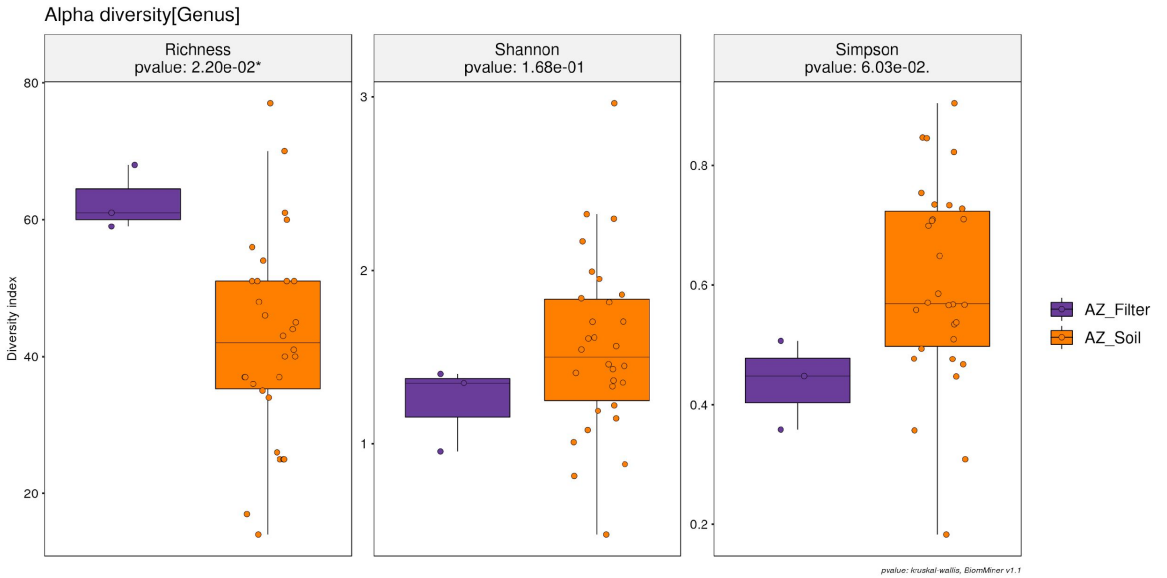
Arizona Filter versus Marble for Fungal Genera





Arizona Filter versus Soil for Fungal Genera





Collection device yields very different Fungal communities

Summary of Soil Microorganism Detection

- Each collection devise selects for different community
- Same for both Fungal and Bacterial communities
- All collectors differ from soil
- Is this observation dependent on particle size selection?
- Are there similar biases for Coccidioides?
- Capture common pathogens

Acknowledgements

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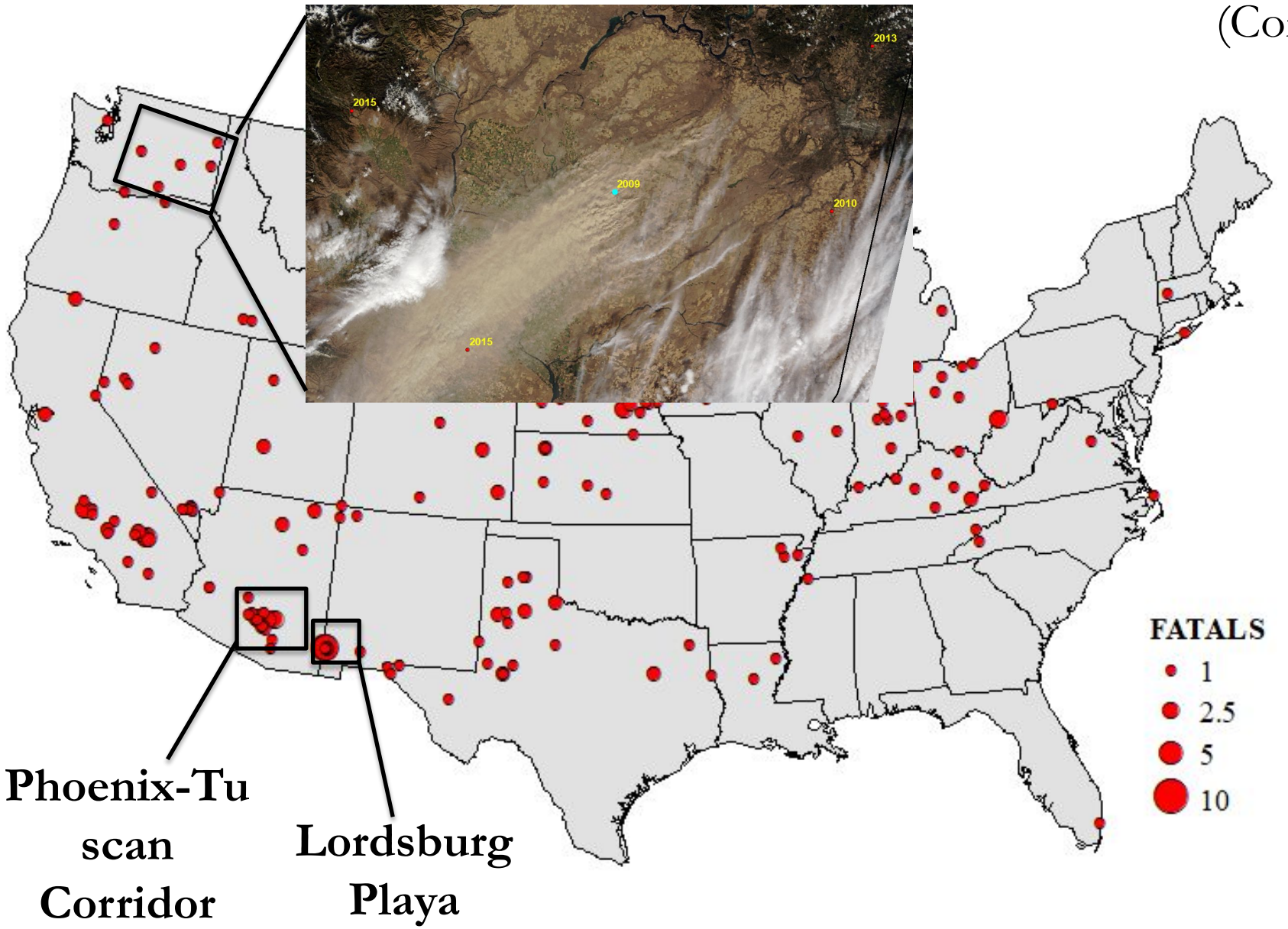
Marcos Mendez, UTEP
Iyasu G. Eibedingil, UTEP

How Many People Were Killed by Dust Storms?

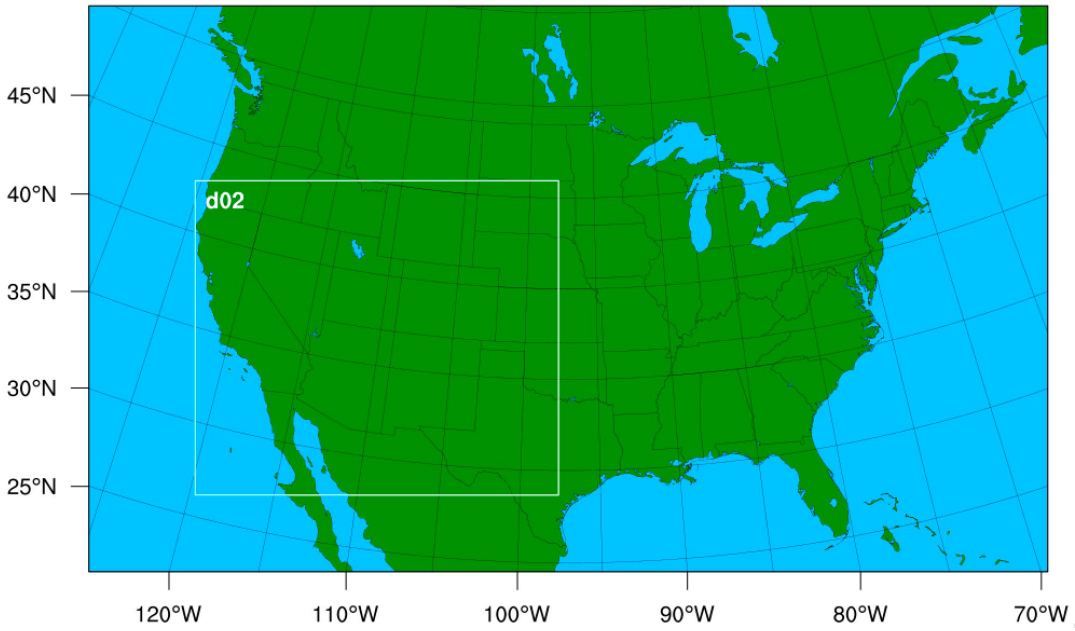
(Contributed by Irene Feng)



- 14-33 dust fatalities each year (2007-2017);
- 30% of top-ranking fatal accidents in Arizona;
- 60% of deadliest accidents along I-10.

Dust Storm and Air Quality Prediction

- Outer domain (12km): CONUS;
- Inner domain (3km): Southwest.

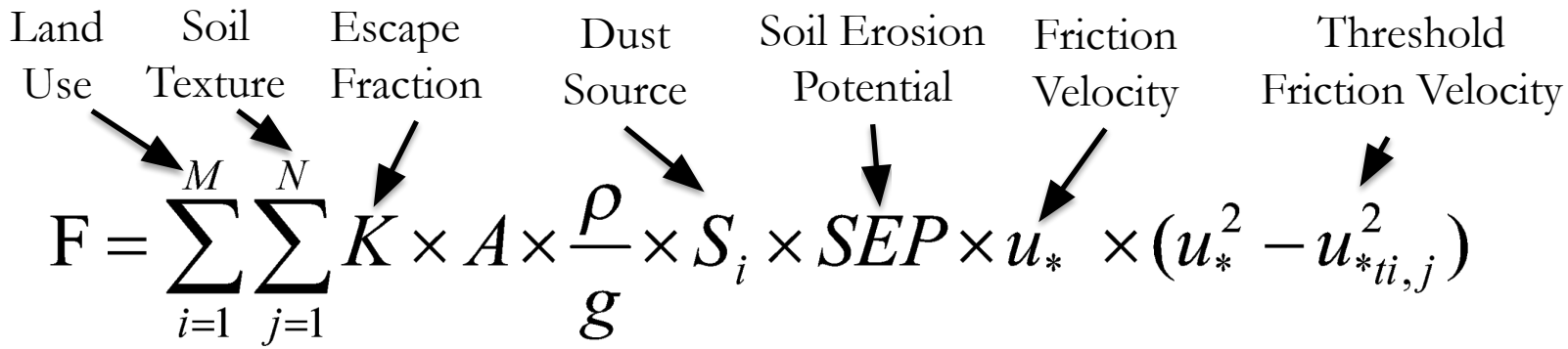


- Emission: EPA NEI2016 + Biogenic + Dust + Wildfires
- Meteorology: WRF4.1
- Full chemistry (CMAQv5.3.1) – capable of predicting general air quality (O_3, NO_x, CO, VOCs, PM);
- Satellite-aided prediction of extreme events: Dust Storms and Wildfires.

FENGSHA Dust Emission Model

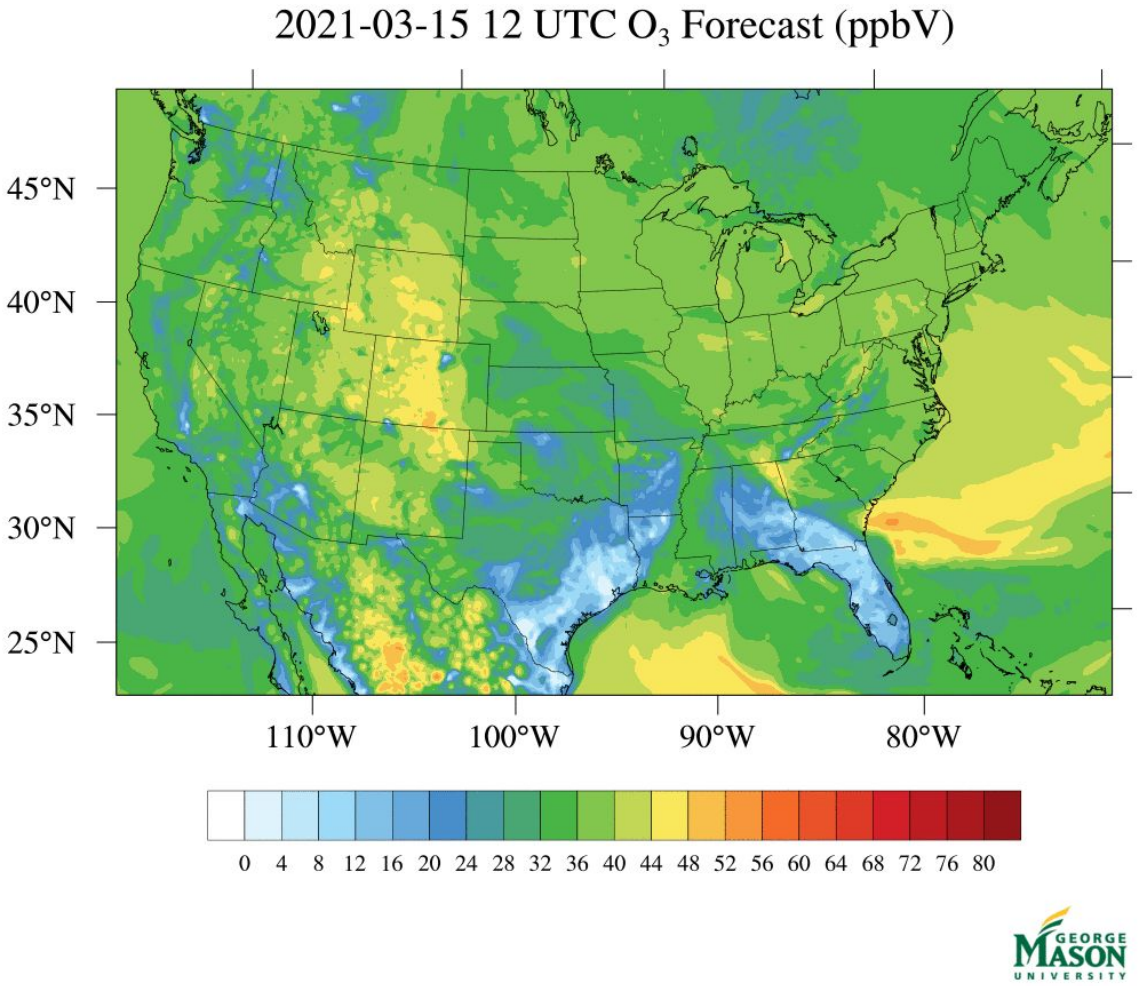
(Contributed by Janak Joshi)

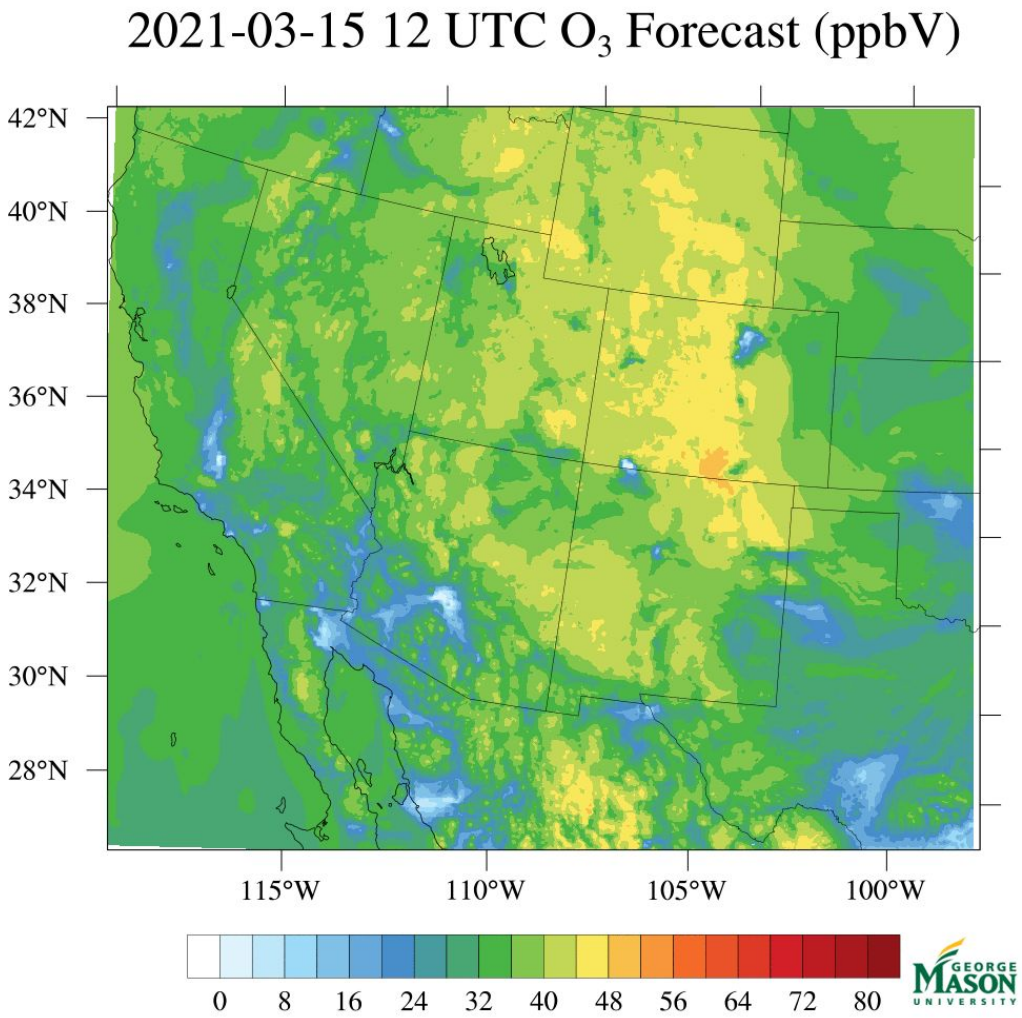
- FENGSHA ("Windblown Dust" in Mandarin), initially developed at EPA based on measurements by Dale Gillette;
- FENGSHA emission algorithm :



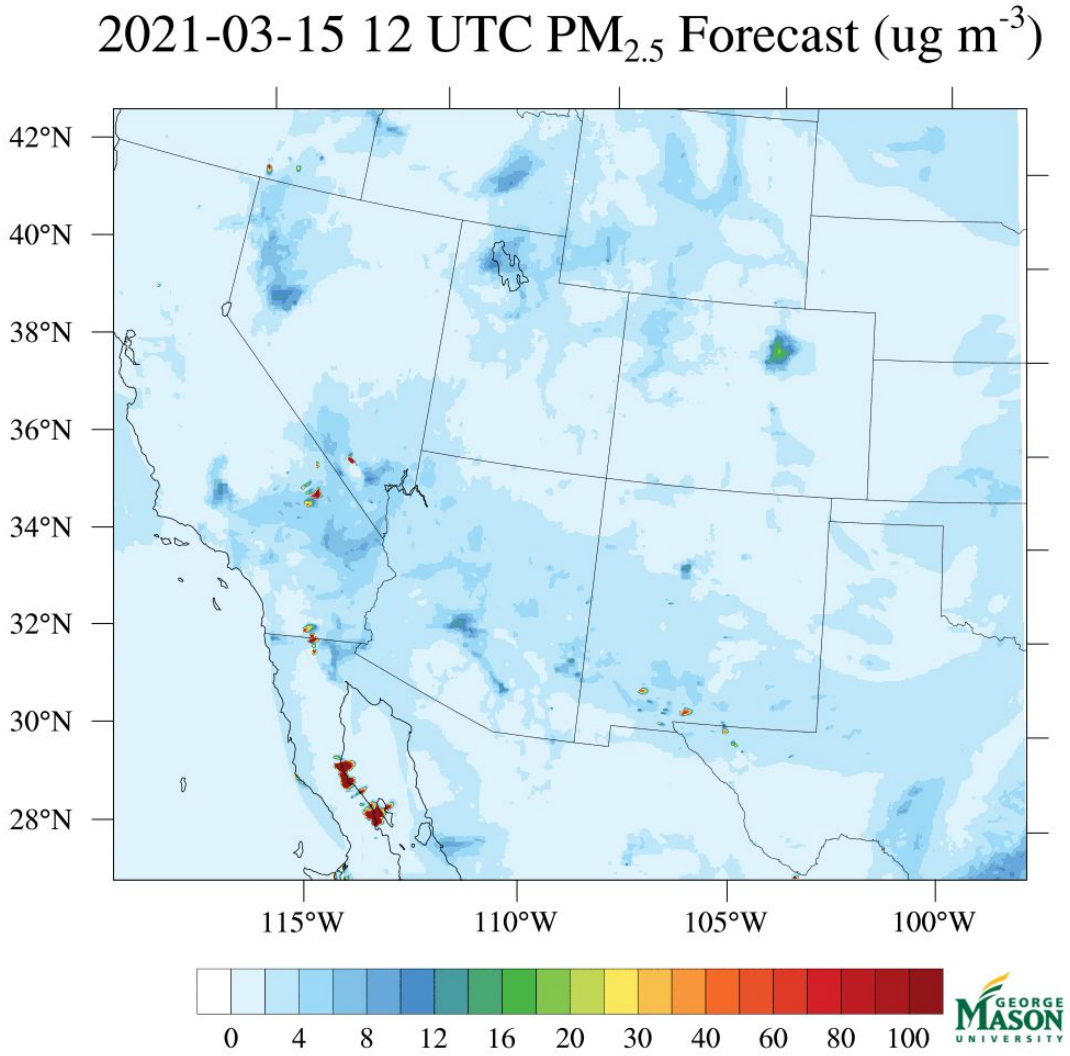
- Threshold friction velocity is further controlled by soil moisture and surface roughness.
- Special treatments for the Southwest domain:
  - Cropland updated with GMU/USDA CropScape dataset (30m);
  - Dust sources adjusted based on vegetation cover (MODIS NDVI);
  - Soil texture data from soilGrids (250m);
  - Roughness effect based on Darmenova et al. (2009).

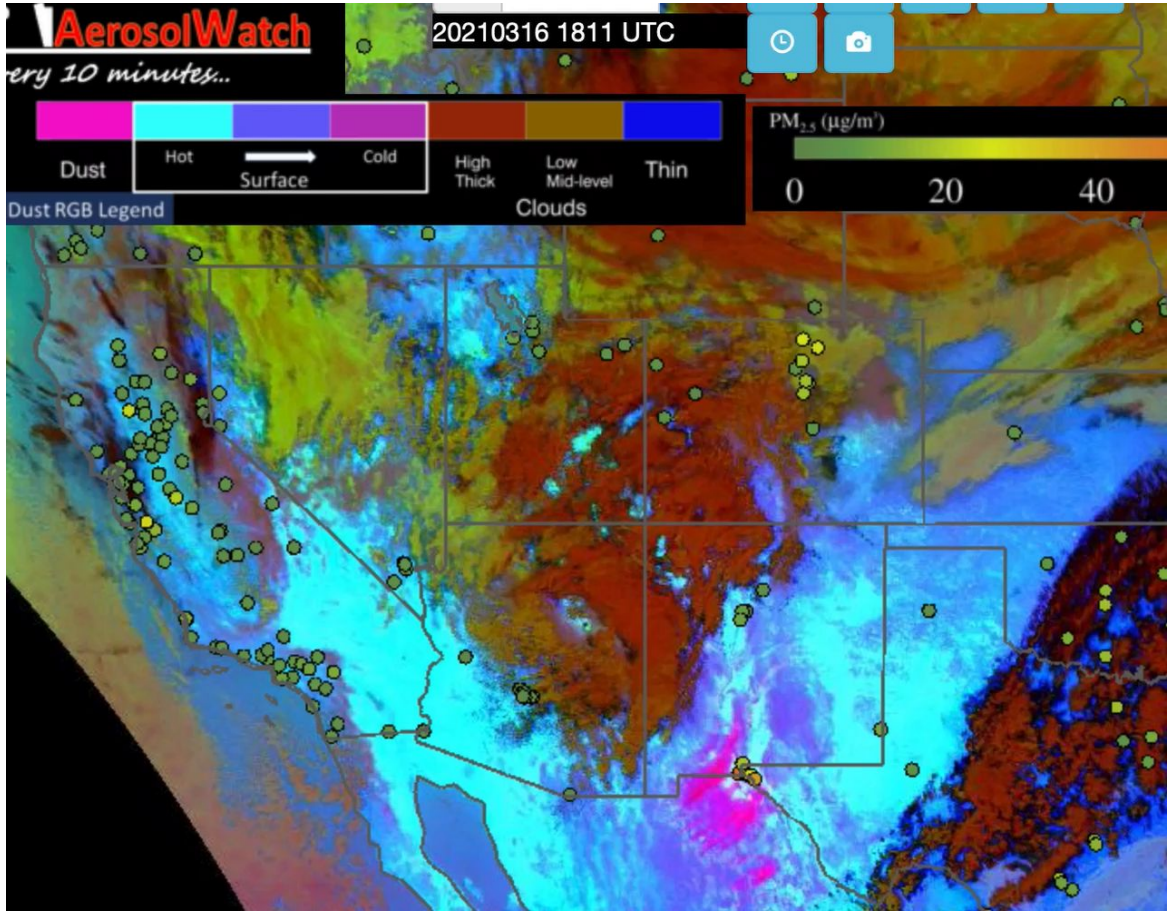
O_3 Forecasts





$PM_{2.5}$ Forecast during the March 15 Dust Storm





International Dust Summer School

(Contributed by William Sprigg)

- Inspired by the Annual Arizona Dust Workshop
  - Updated Science … in line for Potential Applications
  - For and By those who Research, Deliver Service & Set Policy
- Facilitated by the WMO Sand & Dust Storm Warning Advisory & Assessment System
- Late Summer, 2021, Virtual & Web-based, Open Registration Soon!
- Topics: Latest Research, Tools & Applications from around the world
  - Seminar format followed by panel discussion and Q & A with students
- Presented by Leaders in Science & Service: Public Health, Transportation, Environmental Quality
- Serves Global Interests—Sand & Dust Storms, Wind-Eroded Soil—With Local & Regional Implications
- Planned Annually.

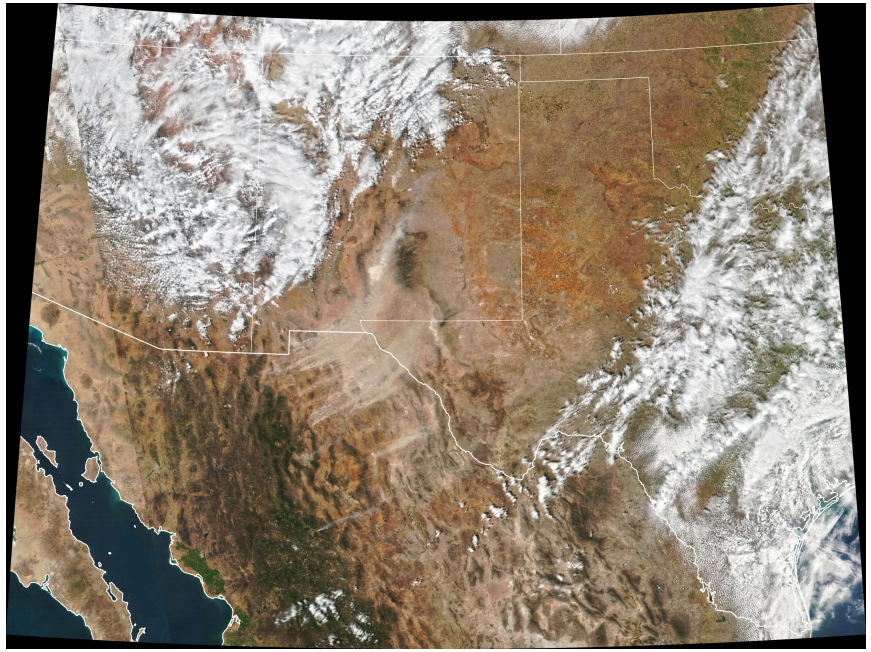


Figure complements of Dr. Tom Gill and NASA's Earth Observatory