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

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Project Information

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Co-Investigators/Collaborators

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Stakeholders:

Jonny Malloy, ADEQ
Matthew Roach, ADHS
David Hadwiger, NM DOT
Scott Van Pelt, USDA ARS
Scott DiBiase, Pinal County AQCD
Beth Gorman, Pima County DEQ
Andy Edman, NWS
Jeff McQueen, NWS
Dale Griffin, USGS
Mariana Casual, Pinal County DoH
Alexander Baklanov, WMO
Andrea Sealy, WMO Pan-America
Michael Lewis, US Army ERDC
Brooke Doman, NM DoH
TuSimple (Autonomous Trucking)

Satellite-aided Dust Forecasting
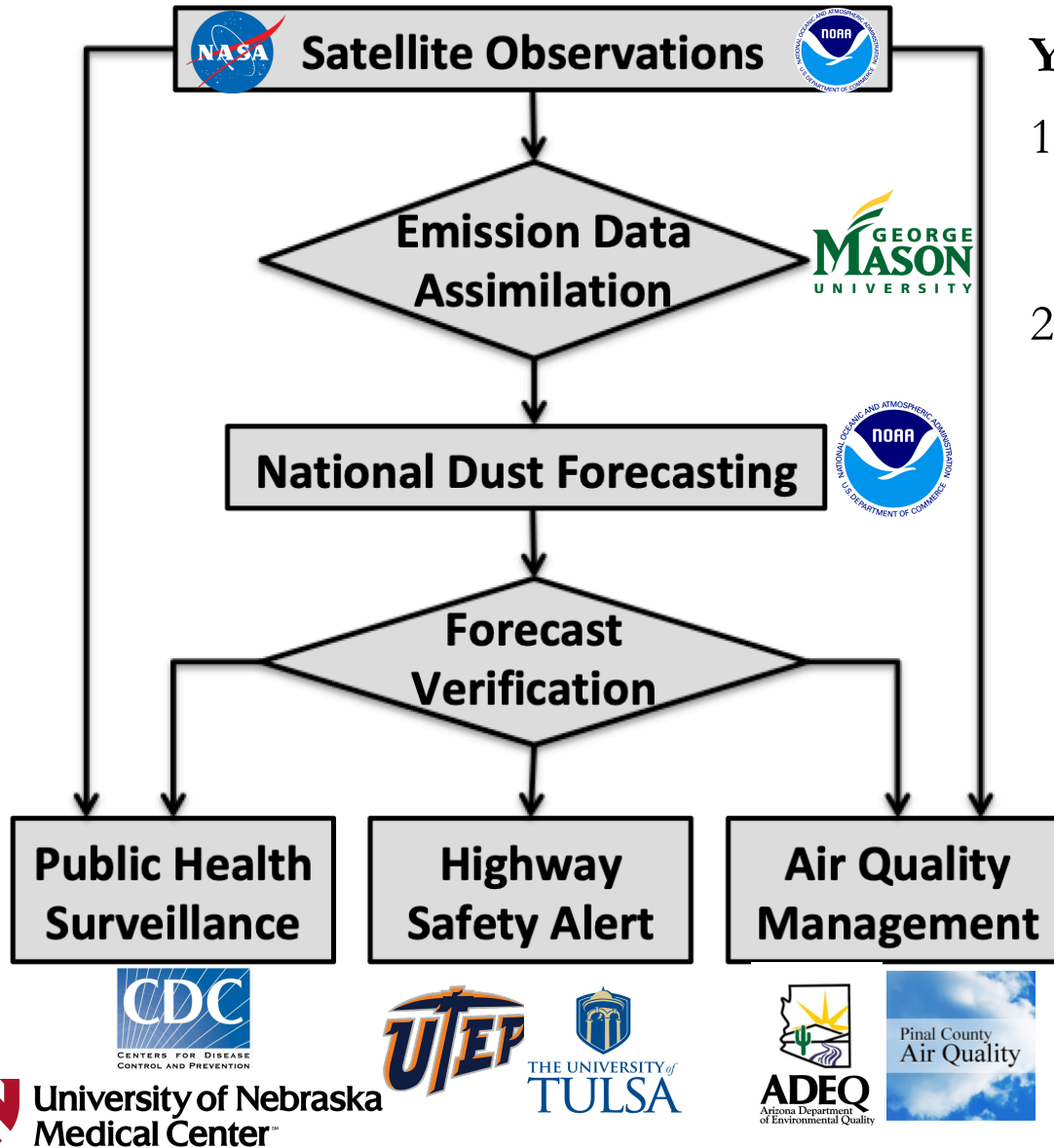
Year 1 Milestones:

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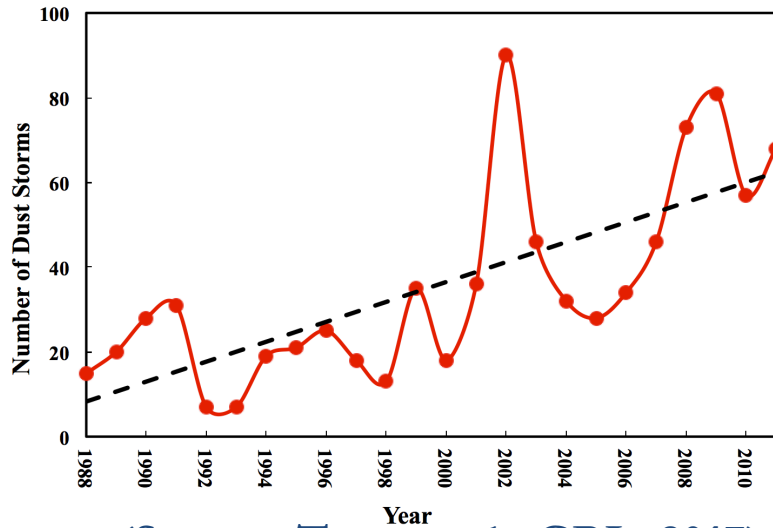   b) Highway safety alert;
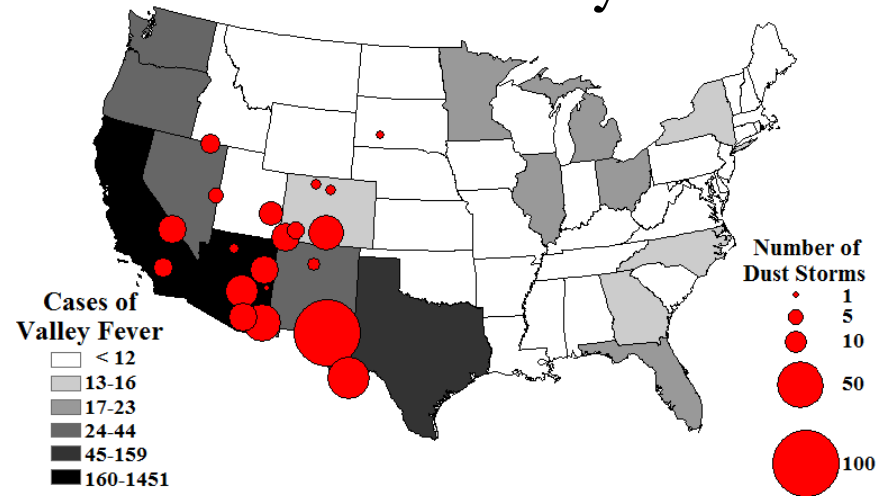   c) Air quality management.

Rising Dust and Impacts on America
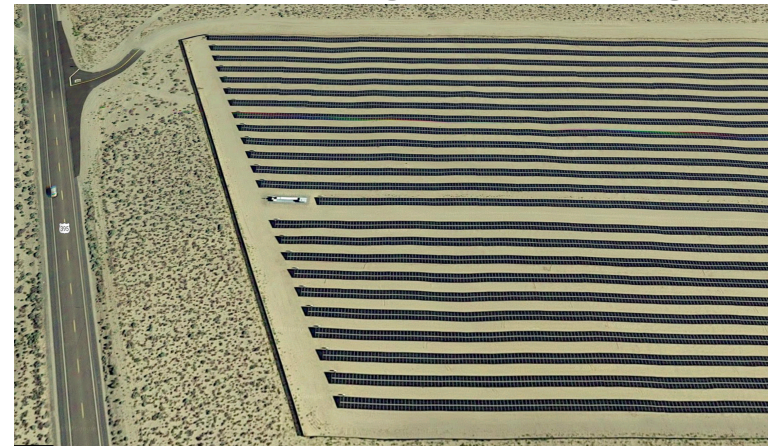
Dust Trend

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

Dust and Valley Fever

Highway Accidents

Solar Energy Farming

Economic Costs: $3B - $20B per year

Detecting Cocci Fungus in the Air

(Source: hi-q.net)

Molecular detection of airborne *Coccidioides* in Tucson, Arizona

Nancy A. Chow[1,*], Dale W. Griffin[2], Bridget M. Barker[3,4,5], Vladimir N. Loparev[6], and Anastasia P. Litvintseva[1,*]

[1]Mycotic Diseases Branch, Centers for Disease Control and Prevention, Atlanta, Georgia

[2]US Geological Survey, Coastal and Marine Science Center, St. Petersburg, Florida

[3]Division of Pathogen Genomics, Translational Genomics Research Institute, Flagstaff, Arizona

[4]Center for Microbial Genetics and Genomics, Northern Arizona University, Flagstaff, Arizona

[5]Valley Fever Center for Excellence, University of Arizona, Tucson, Arizona

[6]Biotechnology Core Facility Branch, Centers for Disease Control and Prevention, Atlanta, GA

Large-volume air sampler

Can low-cost samplers be used to detect Cocci in the air?

Low-Cost Air Samplers

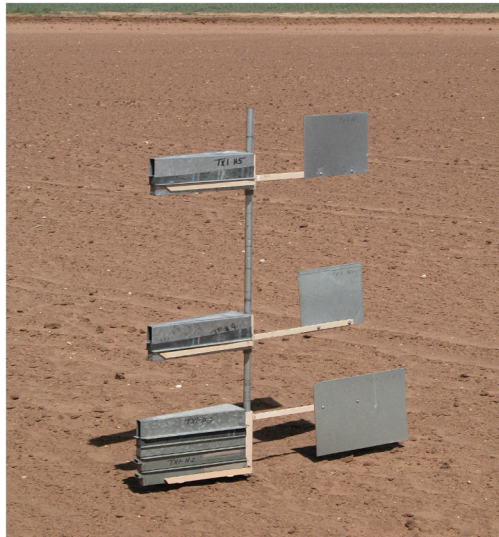**Marble Dust Collector (MDCO)**

PurpleAir Air Quality Sensor

Big Spring Number Eight (BSNE)

Aspirated Air Sampler

(Contributed by Scott Van Pelt)

Site Deployment - Maricopa

Installing Samplers with Graduate Students Zack Chester (GMU) and Iyasu Eibidingel (UTEP).

Installed Marble Collector (near) and Aspirated Sampler (far).
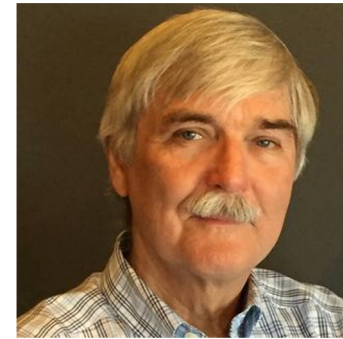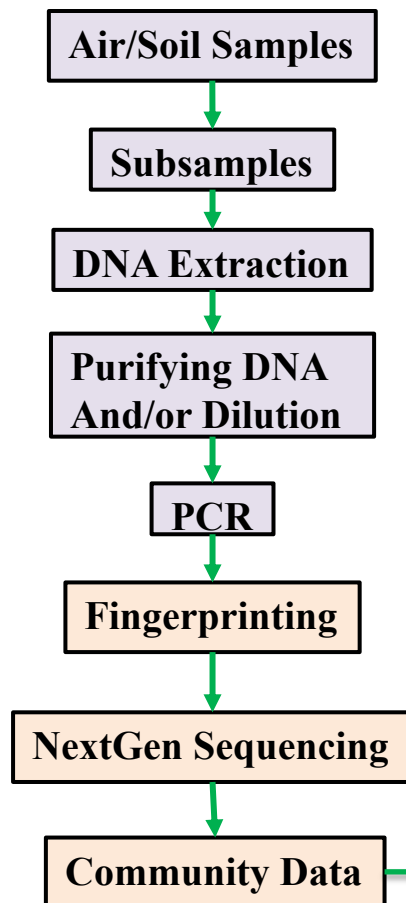
Laboratory Analysis

(Contributed by Ling Ren)

- Multitag sequencing of bacterial and fungal communities

- Quantitative PCR (qPCR) on *Coccidioides*

DNA extraction

NextGen Sequencing

```
Air/Soil Samples
      ↓
   Subsamples
      ↓
  DNA Extraction
      ↓
Purifying DNA
And/or Dilution
      ↓
     PCR
      ↓
  Fingerprinting
      ↓
NextGen Sequencing
      ↓
 Community Data ──→ Cocci Positive Samples
                          ↓
                   In-depth Sequencing
                          ↓
                        qPCR
```
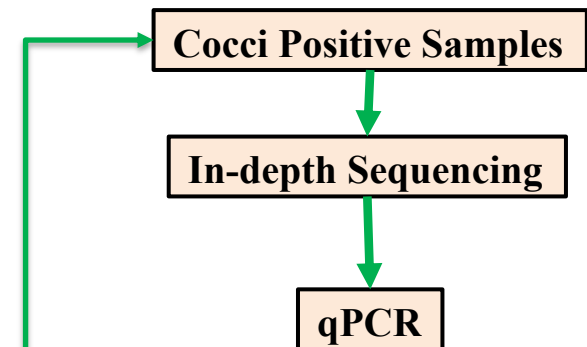

Patrick M. Gillevet
GMU MicroBiome Analysis Center

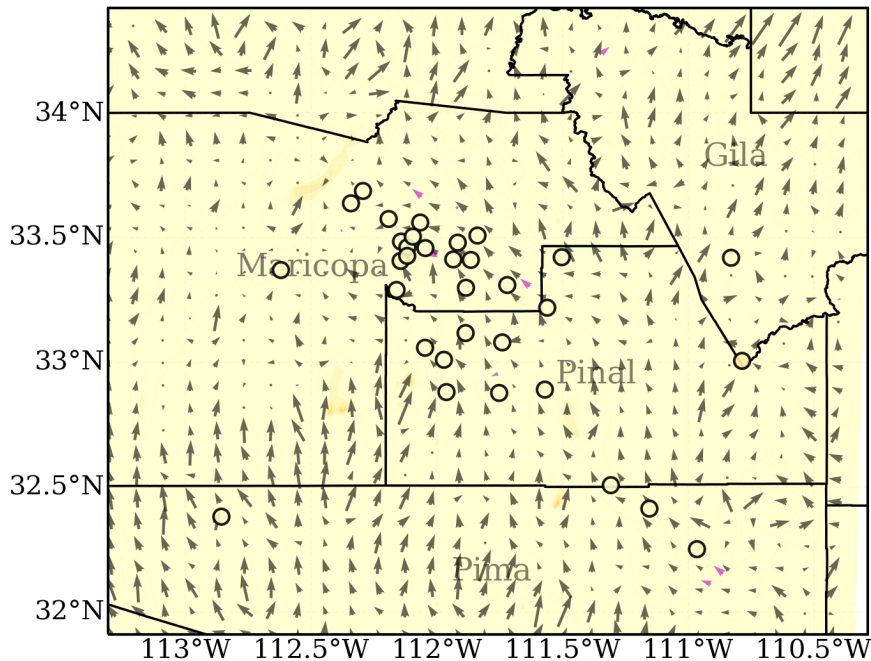Thanks to CDC and
GMU Institute of a
Sustainable Earth!

Dust Forecasting along Deadliest 10-Miles

(Contributed by Joshi Janak)
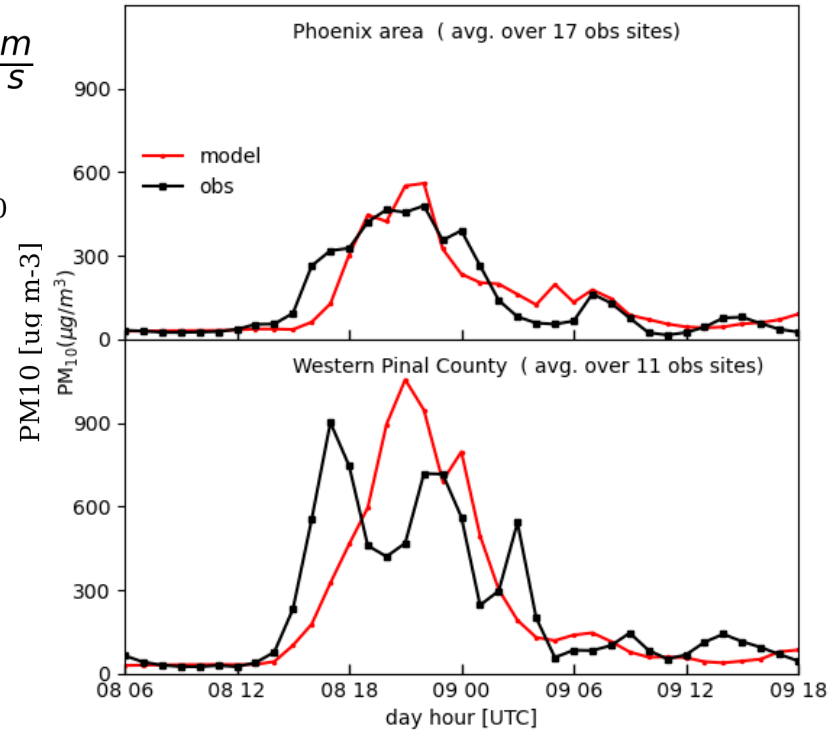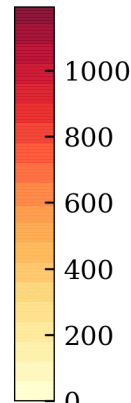
Satellite Products used/planned:

- MODIS NDVI;
- MODIS Black-sky Albedo;
- LandSat land use data;
- MODIS AOD;

Lordsburg Playa

Lordsburg Playa, NM

(Contributed by Scott Van Pelt)

We investigated several possible source areas using a PI-SWERL to generate and quantify dust from the surfaces

At least 55 people have perished in dust reduced visibility related crashes

Summary of Team Achievements

- **Publications:** Eight Journal papers, Three in review; New "Dust and Health Review" under WHO & WMO.
- **Presentations:** 21 Presentations; 4 AGU/AMS sessions organized on GeoHealth and Air Quality;
- **Stakeholder meetings:** 7 In-person; 20 Virtual;
- **Media/Outreach:** 10+ interviews, including NPR, NBC, Forbes, TV stations, etc.

Stakeholder Meetings

(William Sprigg, Outreach)

Arizona Dust Workshop

USDA Arid Land Center

New Mexico Health Department

Pinal County Health Dept.

Milestones and Future Plan

Tasks	Months after Start					
	6	12	18	24	30	36
Task 1. Using NASA data to improve NAQFC dust forecasting						
a. Update dust map with MODIS land and aerosol products	■	■				
c. Use MODIS albedo to adjust surface roughness;		■	■	■		
d. Test new system in NAQFC with NASA observations (6);		■	■	■	■	■
e. Transition improved dust forecasts to NAQFC (8 or 9);		■	■	■	■	■
Task 2. Public health application: Valley fever surveillance						
a. Analyze long-term dust and incidence data;		■	■			
b. Test early warning system with NAQFC dust forecasts (6);				■	■	
c. Transition the early warning products (7-8);					■	
Task 3. Highway Accident Prevention						
b. Test/evaluate the integrated system at NMDOT sites (5);				■	■	
c. Deploy roadside dust alert capability (6);				■		
d. Transition the early warning products to NMDOT (8 or 9);				■	■	■
Task 4. Air Quality Management						
a. Support air quality forecasting and early warning (7);		■	■	■	■	■
c. System transition and user training workshop (9);					■	■