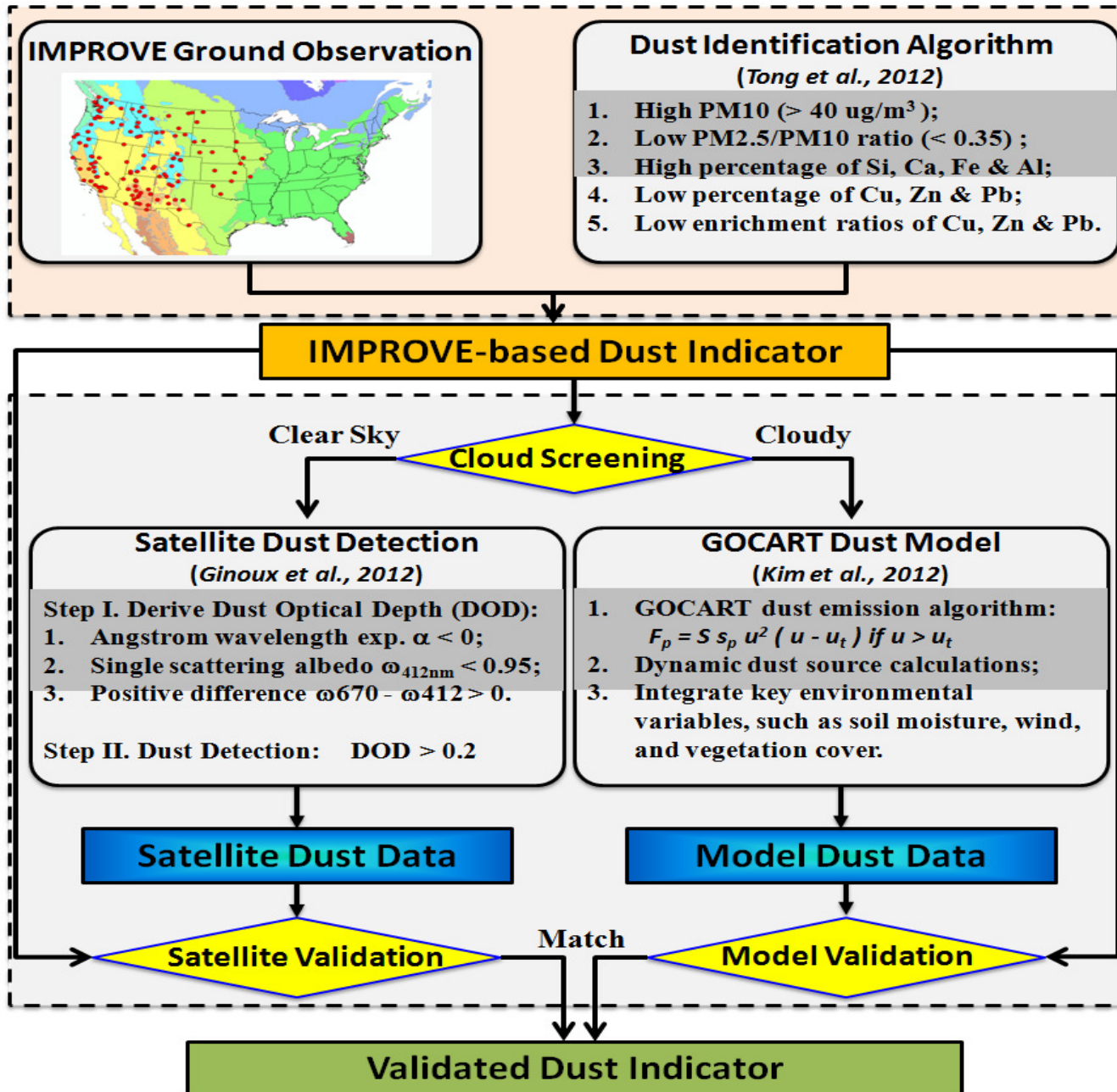# NCA Dust Indicator

PI: Daniel Tong;
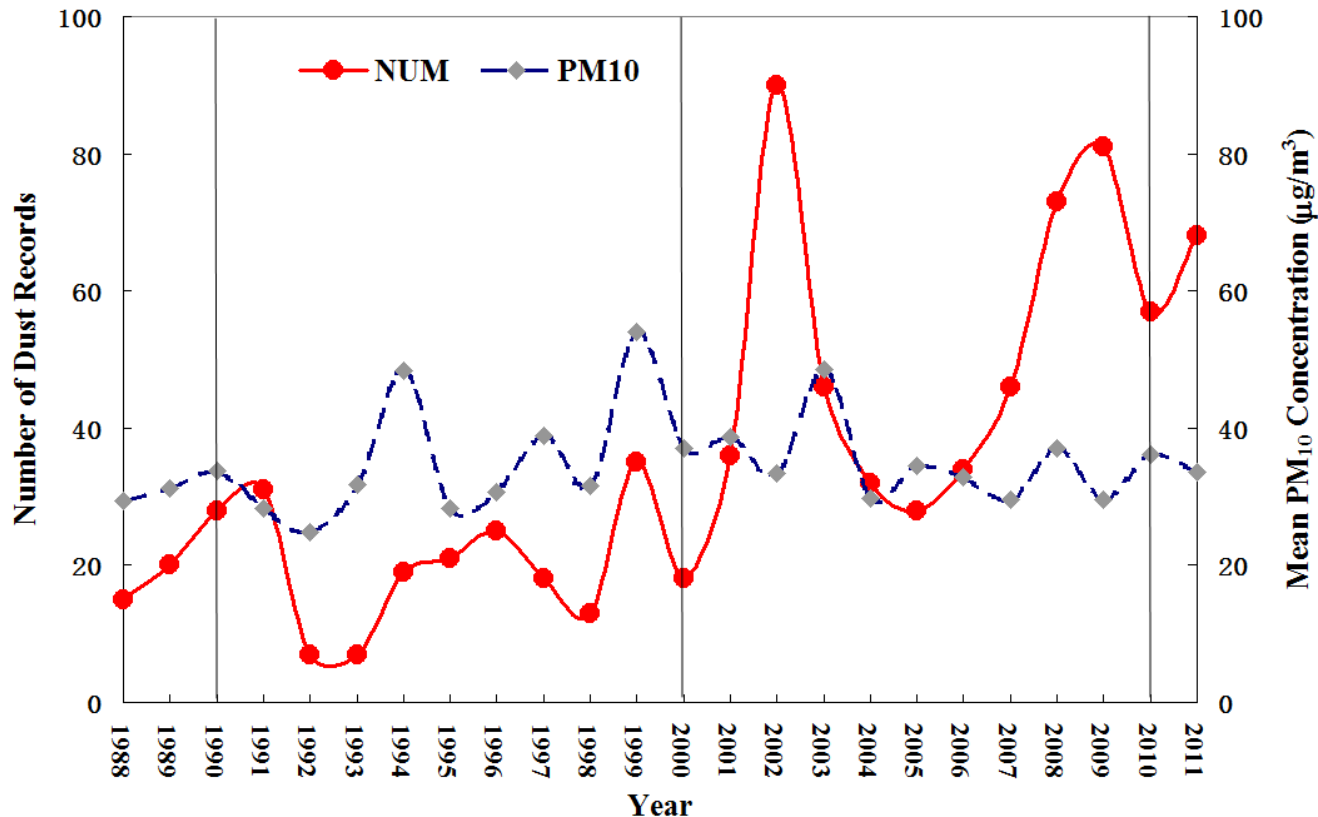**Co-Is: Dongchul Kim, Julian Wang, Thomas Gill & Huiyan Yang**

◆ **Create a climate-quality indicator of local wind-blown dust storms originated within the U.S.**

◆ **Validate the dust records using satellite retrievals and model prediction.**

◆ **Assess long-term variability and trends in dust indicator at regional and national levels.**

Methodology

IMPROVE Ground Observation

Dust Identification Algorithm
(*Tong et al., 2012*)

1. High PM10 (> 40 ug/m^3);
2. Low PM2.5/PM10 ratio (< 0.35);
3. High percentage of Si, Ca, Fe & Al;
4. Low percentage of Cu, Zn & Pb;
5. Low enrichment ratios of Cu, Zn & Pb.

IMPROVE-based Dust Indicator

Clear Sky **Cloud Screening** Cloudy

Satellite Dust Detection
(*Ginoux et al., 2012*)

Step I. Derive Dust Optical Depth (DOD):
1. Angstrom wavelength exp. $\alpha < 0$;
2. Single scattering albedo $\omega_{412nm} < 0.95$;
3. Positive difference $\omega 670 - \omega 412 > 0$.

Step II. Dust Detection: DOD > 0.2

GOCART Dust Model
(*Kim et al., 2012*)

1. GOCART dust emission algorithm:
   $F_p = S\, s_p\, u^2\, (\, u - u_t\,)\ if\ u > u_t$
2. Dynamic dust source calculations;
3. Integrate key environmental variables, such as soil moisture, wind, and vegetation cover.

Satellite Dust Data

Model Dust Data

Satellite Validation Match **Model Validation**

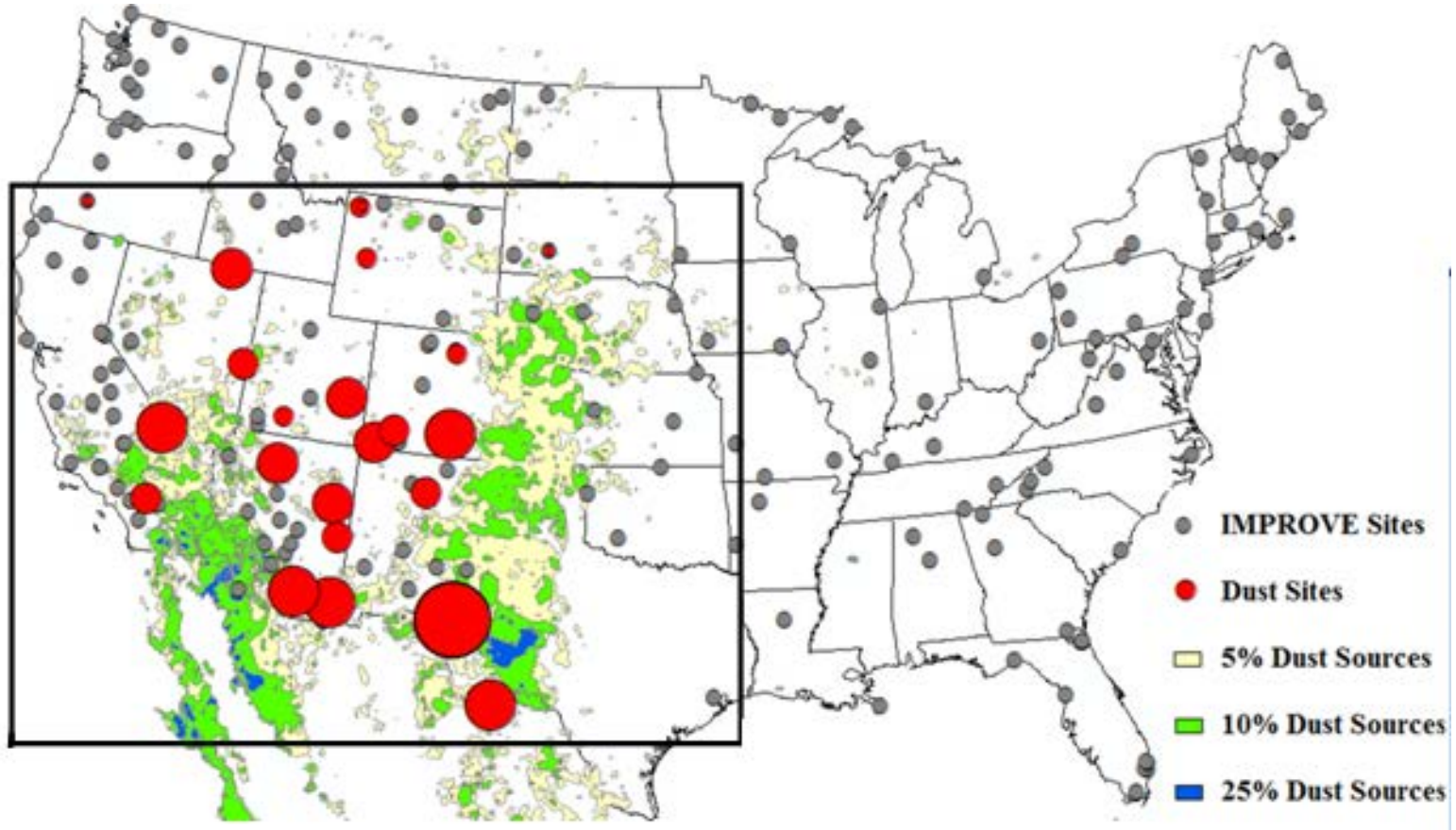**Validated Dust Indicator**

Major Findings

◆ **Dust storms became more frequent in United States;**

The number of dust storms has more than doubled.
Aerosol loading by dust storms increased.

Major Findings

◆ **Consistent spatial patterns detected by satellite and ground observations.**

Legend:
- IMPROVE Sites
- Dust Sites
- 5% Dust Sources
- 10% Dust Sources
- 25% Dust Sources

Dust-active regions:
10 states in four Deserts and Colorado Plateau

Major Findings

◆ **Dust intensification mostly in spring;**

◆ **The dusty season came later in the spring, due likely to earlier snow melting with warming.**
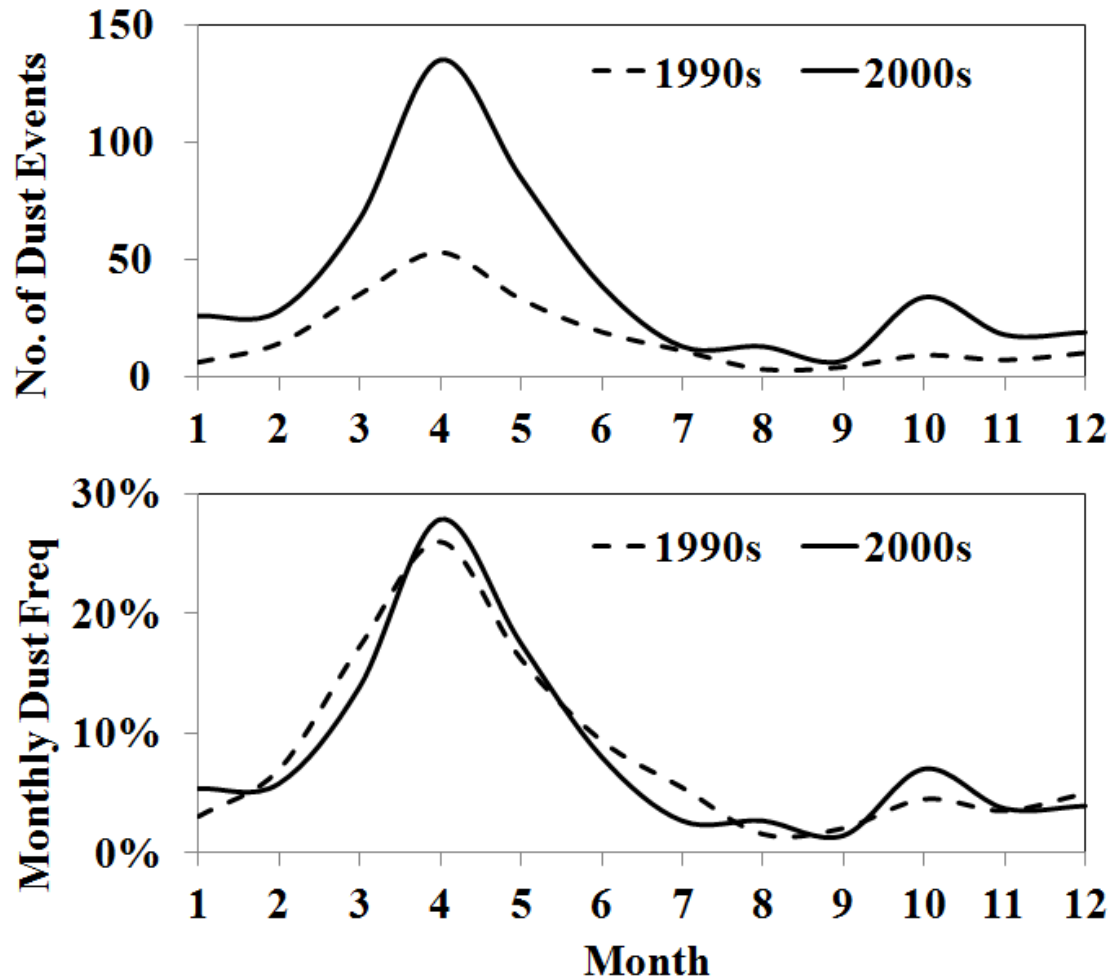
Major Findings

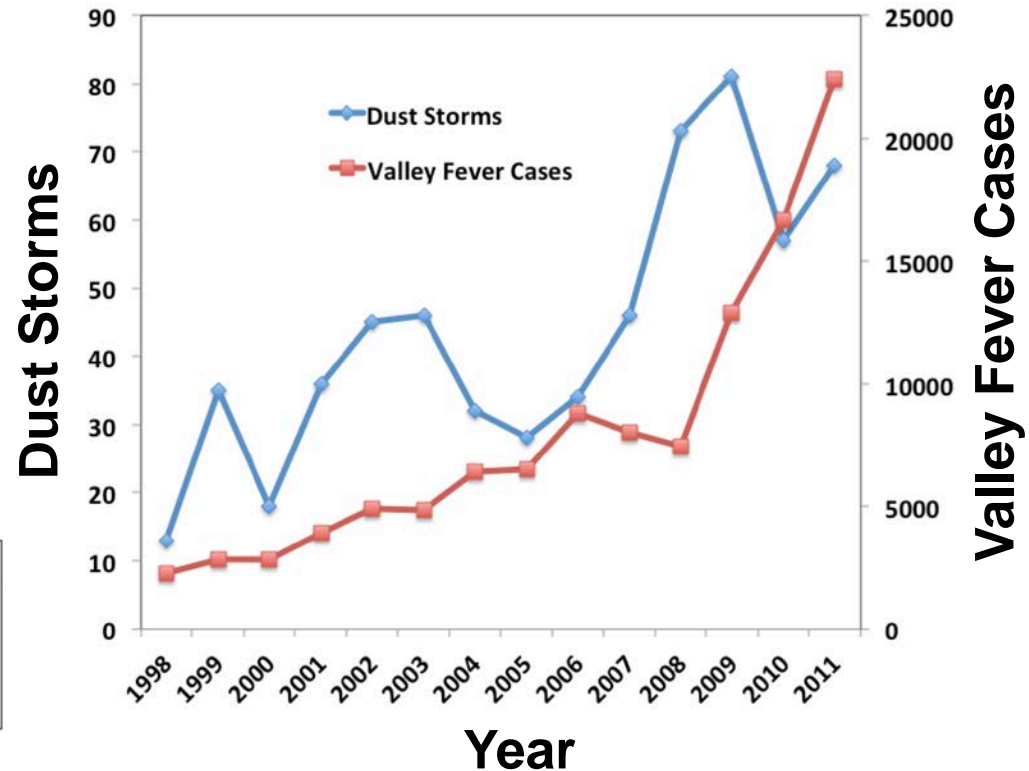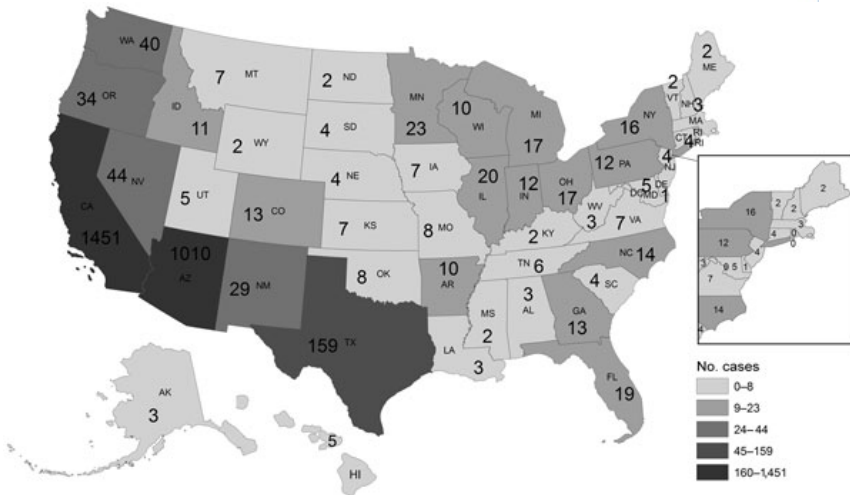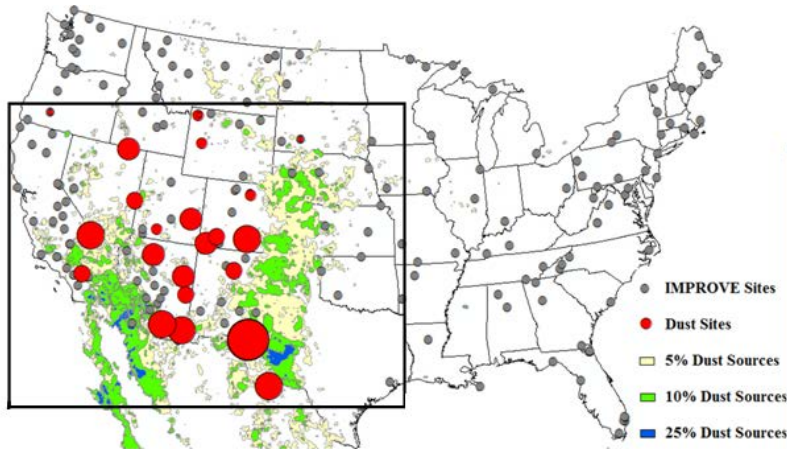◆ **Mechanism behind the dust increasing trend is unclear;**
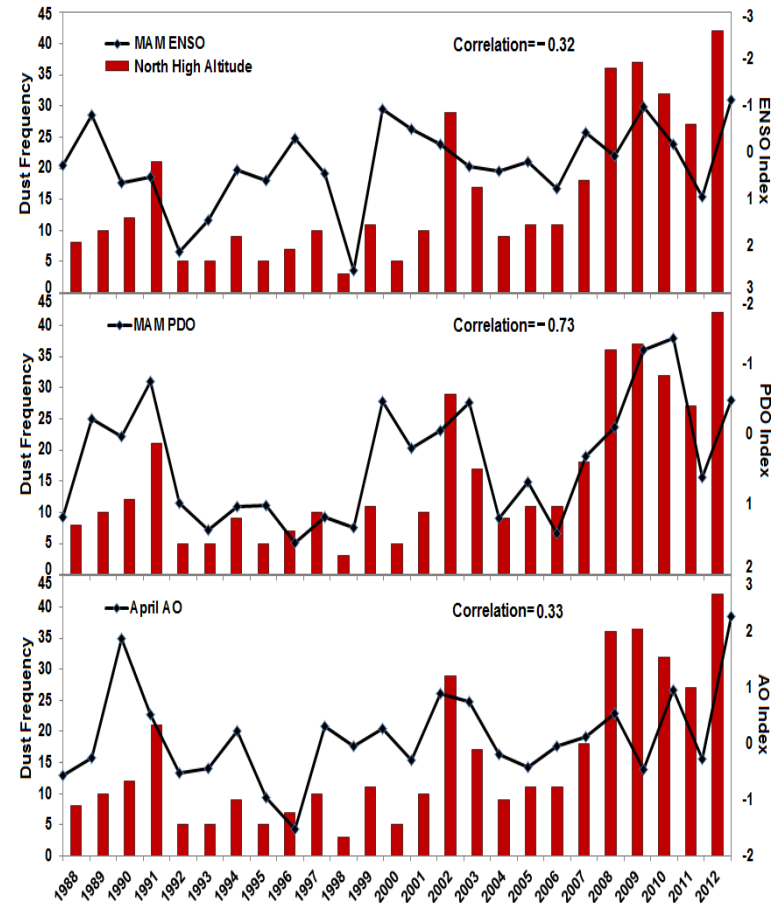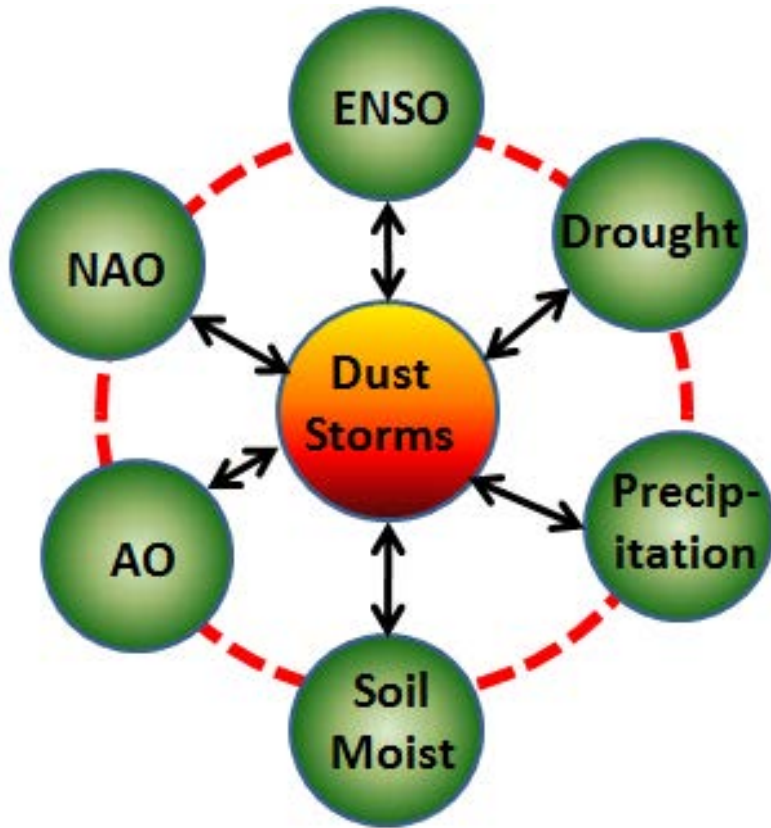
✓ **Is the increasing trend an early indicator to another "Dust Bowl"?**

Dust Trend and Valley Fever

◆ **The dust trend is correlated with the Valley Fever incidences;**

✓**Will the dust trend lead to a valley fever outbreak?**

Users and Data Dissemination

◆ Soil Conservation: USDA and International Soil Conservation Society.

◆ Environmental Management: US EPA, Clark County Department of Air Quality, Maricopa Association of Governments, Bay Area Air Quality Management District, Texas Commission of Environmental Quality.

◆ Public Health: CDC (Valley Fever) and Southwestern States (early contact)

◆ Research Community: NASA GOCART / NU-WRF, NOAA NAQFC and HYSPLIT, EPA CMAQ;

◆ Peer-Reviewed Journal Publications: Two journal papers published; Three more to be submitted.

NCA Dust Data User Workshop

◆ **Time: June 9-10, 2015**
◆ **Location: The ESSIC Building, College Park, MD**
◆ **Participants: NCA Dust Indicator Team, and data users from EPA, USDA, NOAA, State and local environmental agencies.**

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