Aerosol Properties and Surface Albedo Ground Truth from the Mobile SURFRAD Platform deployed at DISCOVER-AQ, Central Valley California

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1. Introduction

On going, high quality surface radiation and aerosol observations are necessary for addressing air quality, climate change, and renewable energy. These long-term records give rise to questions that can be addressed through regional scale studies.

A mobile SURFRAD platform has been built and tested to address regional scale research to augment our long-term SURFRAD network. The first mobile SURFRAD platform was funded by NOAA GOES-R Cal/Val Activities for validating NOAA GOES-R Aerosol and Radiation Products.

- **Aerosol Properties**
  - Aerosol Optical Depth (AOD)
  - Aerosol Absorption (SSA)
  - Aerosol Size (Å)
- **Spectral surface albedo**
- Shortwave Radiation
- Long-wave Radiation
- Land Surface Temperature
- Green Vegetation Fraction
- Normalized Vegetation Index

As part of these activities the mobile SURFRAD platform was deployed during DISCOVER-AQ, Central Valley, CA, Jan-Feb, 2013.

2. What is DISCOVER-AQ?

DISCOVER-AQ is a NASA funded Air Quality campaign; PI(s) are James Crawford and Ken Pickering.

Deriving **I**nformation of **S**urface **C**onditions from Column and **V**ertically **R**esolved Observations Relevant to **A**ir **Q**uality through aircraft and ground-based measurements.
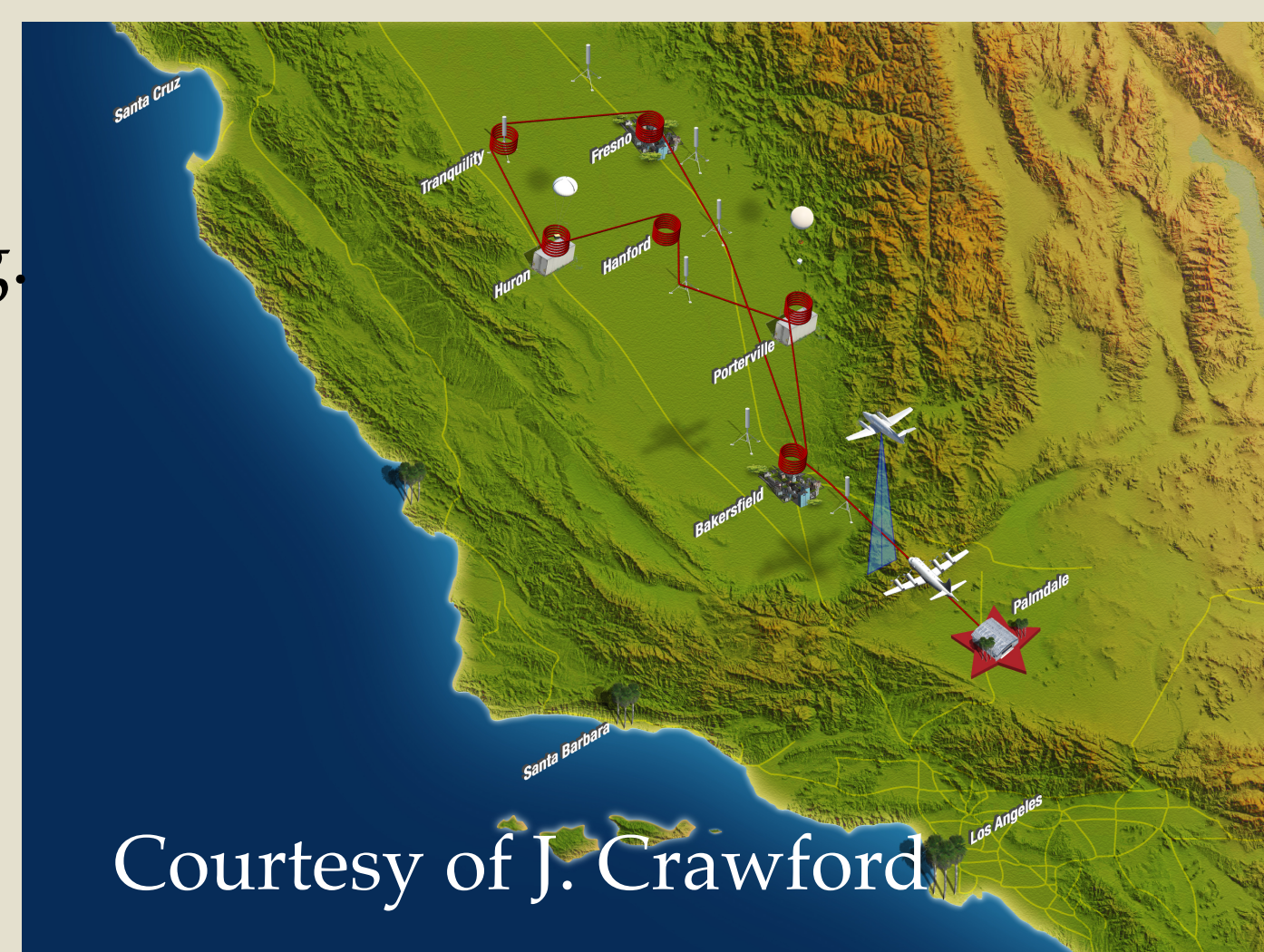
Courtesy of J. Crawford

3. What are the Key Science Questions?

- How do column aerosol properties (satellite/ground/aircraft) correlate to in-situ PM2.5 or PM10 measurements?
- How do column aerosol properties compare to particulate forecasts, e.g. NOAA WRF-CHEM?
- How are these correlations influenced by humidity, boundary layer height, transport, aerosol origin/type?
- How do assumptions about the ground surface albedo affect satellite retrievals of aerosol optical depth?
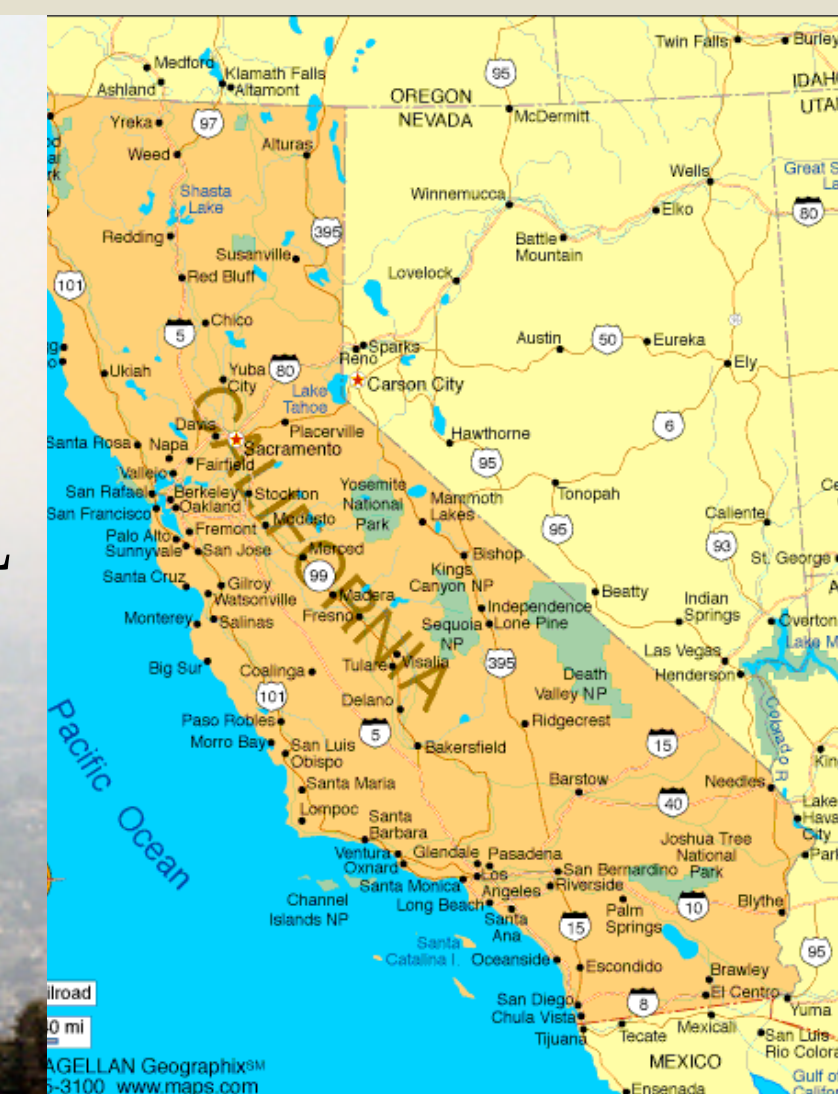
4. Motivation

a. Why the Central Valley?

Each year the American Lung Association identifies the 10 most polluted cities year-round for O_3 and particulates:

Most Polluted U.S. Cities in 2011:

1. Bakersfield-Delano, CA
2. Los Angeles-Riverside, CA
   Phoenix, AZ
3. Porterville, CA
4. Hanford, CA
5. Fresno, CA
6. Pittsburgh, PA
7. Birmingham, AL
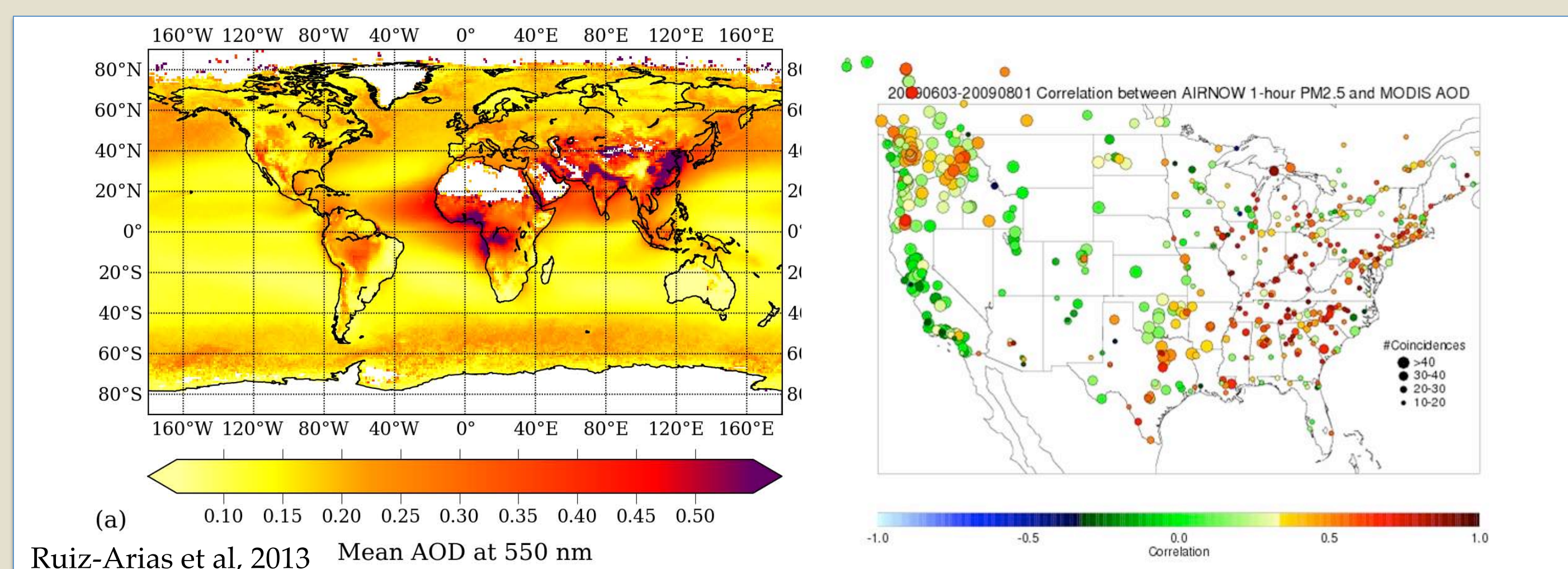8. Cincinnati, OH
9. Louisville, KY
10. Modesto, CA

b. Why provide Ground Truth for satellite aerosol products?
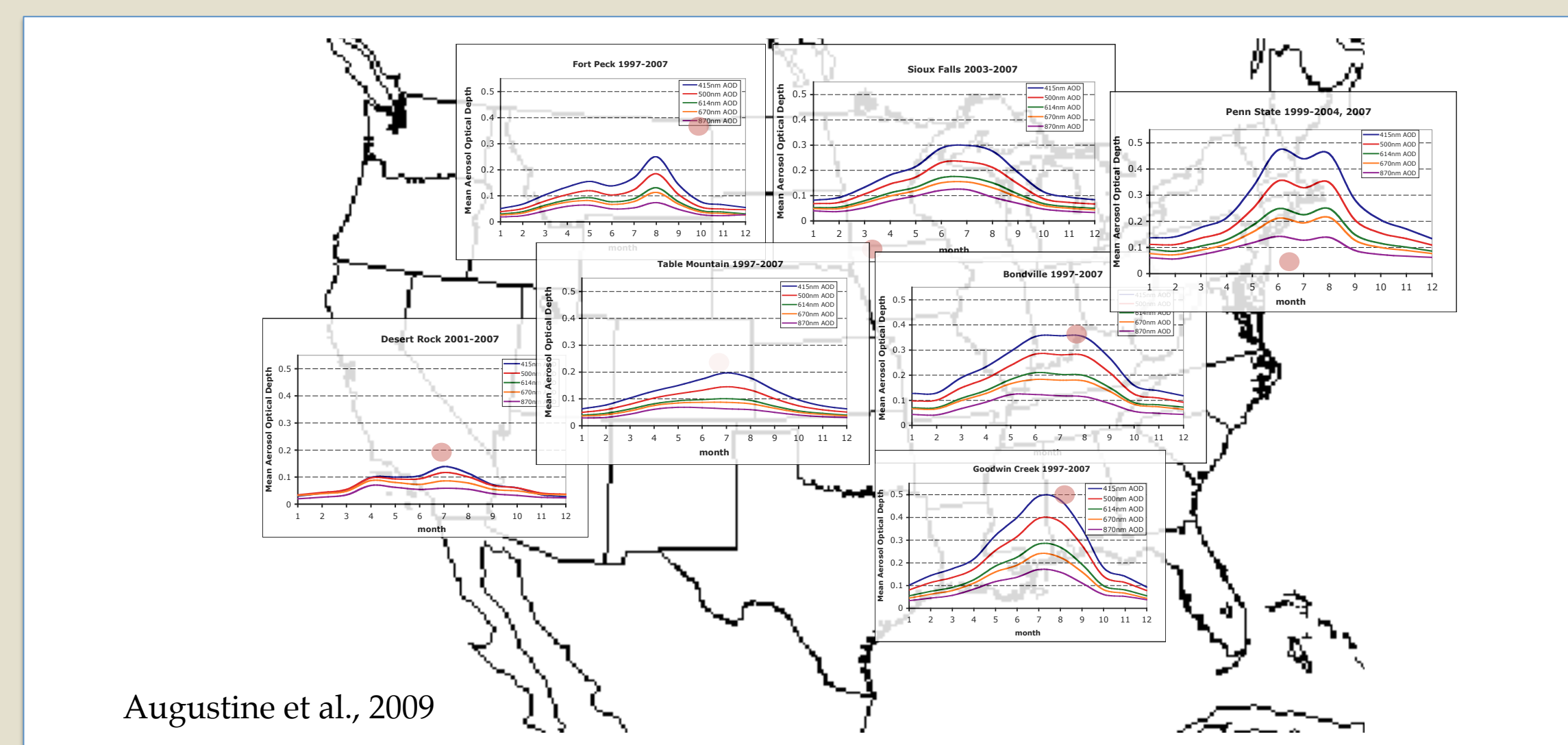
Augustine et al., 2009

Main message: SURFRAD AOD ground-truth measures higher AOD in the eastern than the western U.S. Satellite AOD shows the opposite. **Why?**

Ruiz-Arias et al, 2013   Mean AOD at 550 nm

(a)   0.10 0.15 0.20 0.25 0.30 0.35 0.40 0.45 0.50

2009603-20090801 Correlation between AIRNOW 1-hour PM2.5 and MODIS AOD

-1.0   -0.5   0.0   0.5   1.0
Correlation

Main message: Correlations between PM2.5 and AOD vary widely but are worst in the West? **Why?** (Right Graph Credit: NOAA STAR IDEA Team)
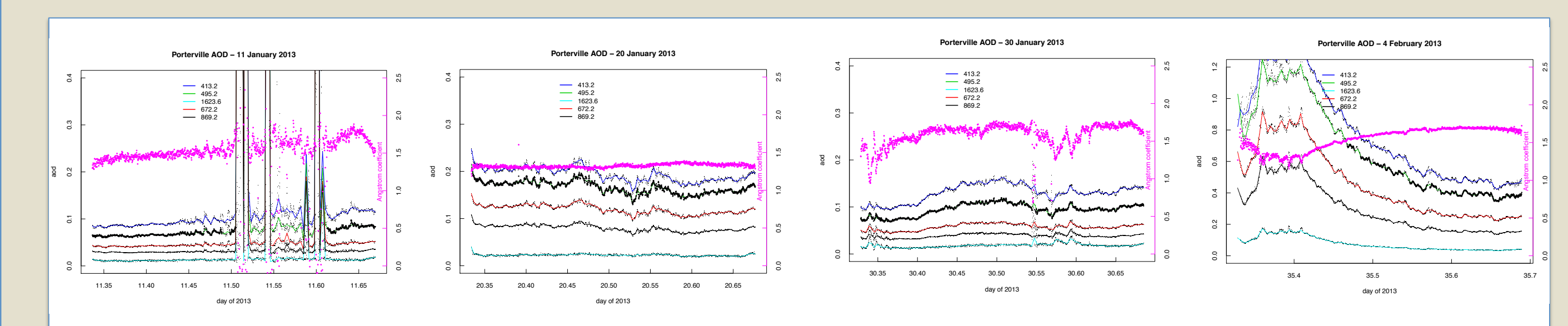
5. Preliminary Results

Two pollution events occurred during DISCOVER-AQ: Peaking on January 20 and February 3, 2013
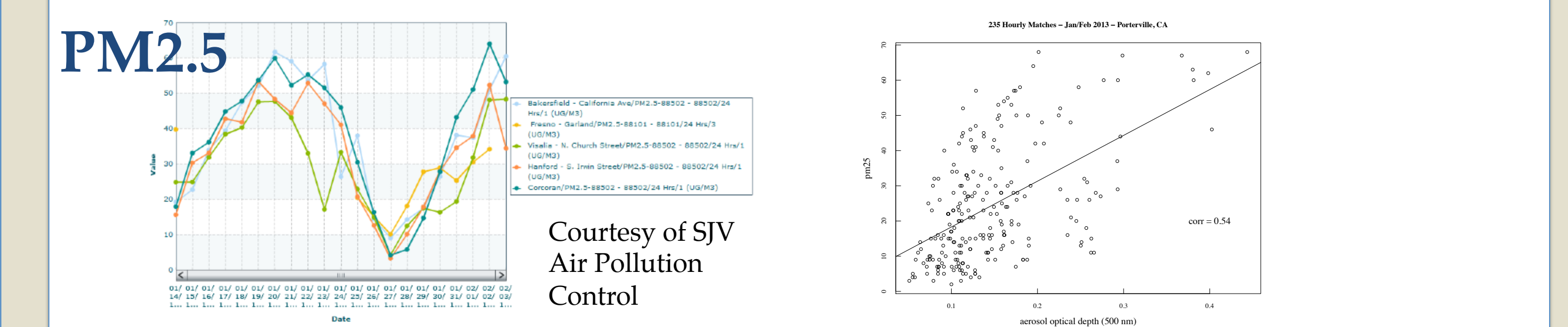
PM2.5

Courtesy of SJV Air Pollution Control

SURFRAD Aerosol Optical Depth (AOD)

- Pollution events observed in both PM2.5 and SURFRAD AOD
- Qualitative differences between the two events:
  - Event 1 has larger particles than Event 2 as indicated by the Angstrom Coefficient. Transport for Event 1 was from the south likely carrying dust particles.
  - The aerosol single scattering albedo is larger in Event 2 (likely due to higher relative humidity).

Spectral Surface Albedo
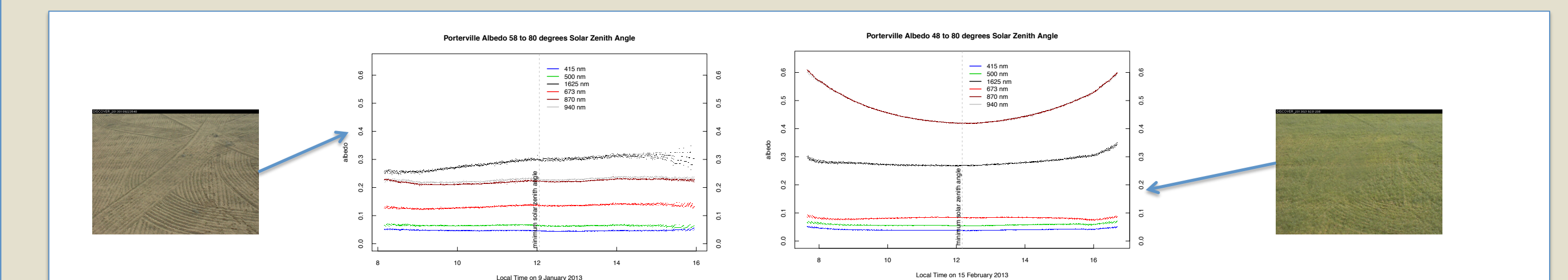
- Satellite retrievals of AOD have difficulty over different Land-types (e.g. bright surfaces). Spectral surface albedo changed during the campaign in this agricultural region.
- SURFRAD data and collocated measurements will be analyzed to elucidate the key science questions to improve air quality measurements from satellites.

6. Future mobile SURFRAD deployments

Deploy mobile SURFRAD platforms at future air quality and renewable energy campaigns:

- NASA Discover-AQ Houston and Denver, 2013 and 2014
- DOE-NOAA Solar Forecasting Project: San Luis Valley, CO, 2013
- DOE-NOAA Solar Forecasting Project: Tucson Electric, AZ, 2014