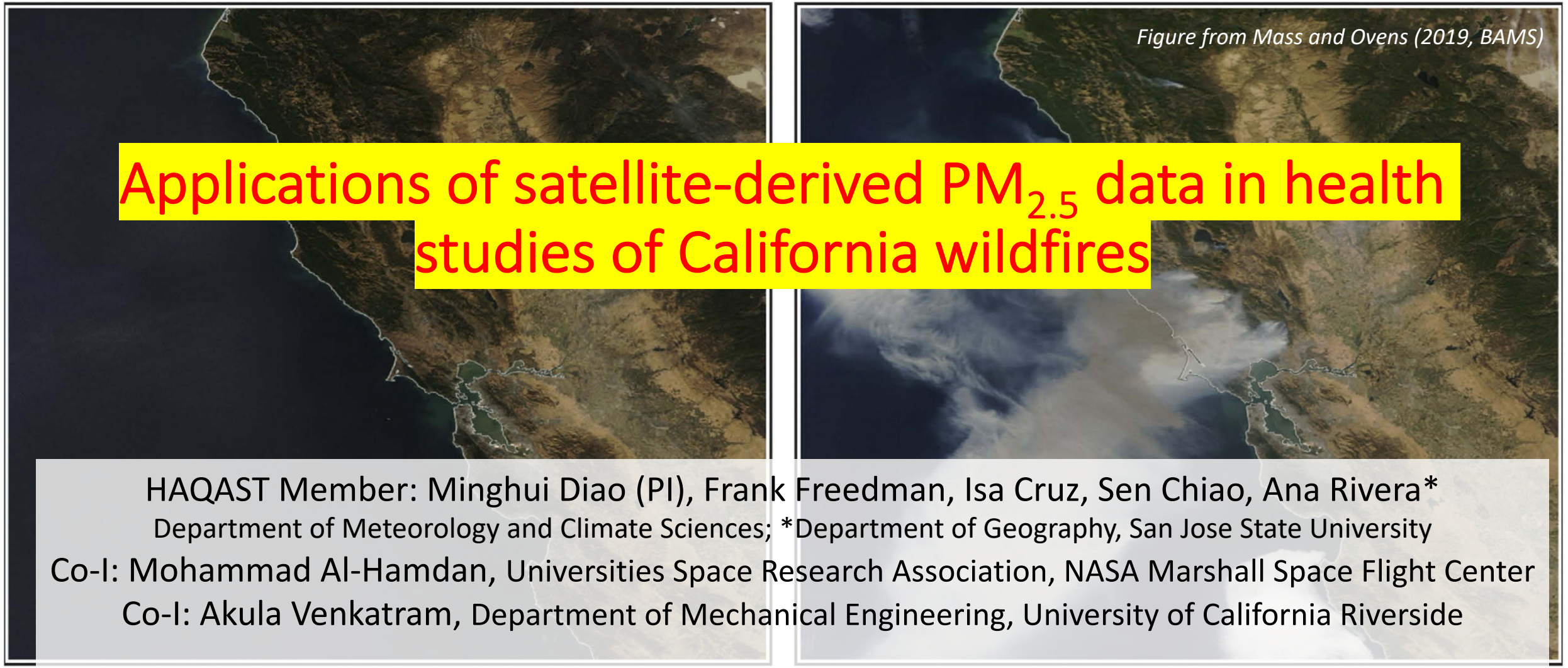



# Applications of satellite-derived $PM_{2.5}$ data in health studies of California wildfires

HAQAST Member: Minghui Diao (PI), Frank Freedman, Isa Cruz, Sen Chiao, Ana Rivera*
Department of Meteorology and Climate Sciences; *Department of Geography, San Jose State University
Co-I: Mohammad Al-Hamdan, Universities Space Research Association, NASA Marshall Space Flight Center
Co-I: Akula Venkatram, Department of Mechanical Engineering, University of California Riverside

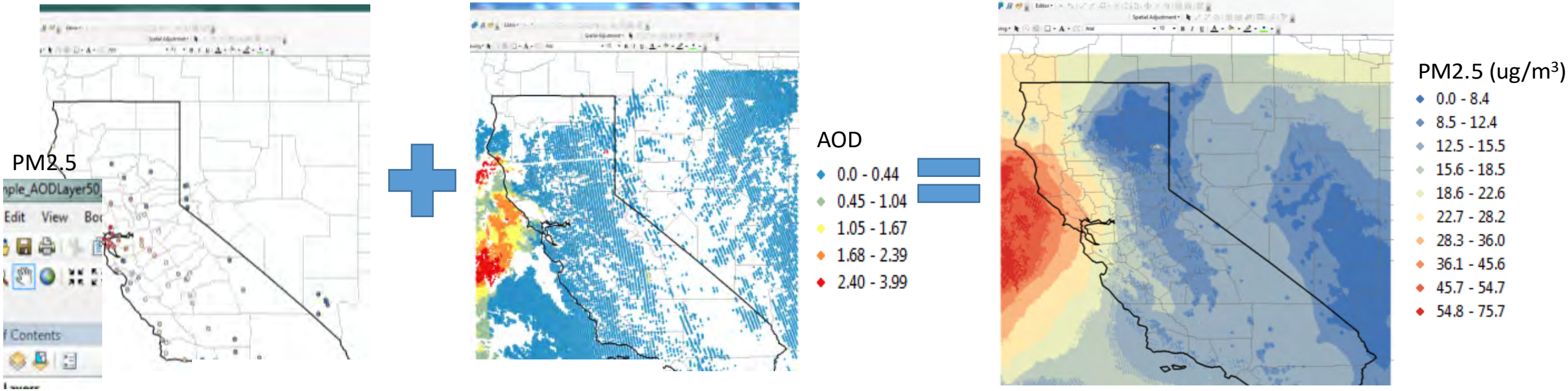
Stakeholder Contact: Saffet Tanrikulu (Bay Area Air Quality Management District)
Cynthia Garcia (California Air Resource Board)
Sang-Mi Lee (South Coast Air Quality Management District)
Collaborators: Robert Chatfield and Meytar Sorek-Hamer (NASA ARC)

***HAQAST-6 meeting, July 10, 2019, Pasadena, CA***

# Tiger Team 2 project on California wildfire in Oct-Nov 2017

EPA/AQS PM2.5

NASA/MODIS AOD




**Example of October 9, 2017**

We used spatial/geostatistical surfacing algorithms, which combine data from 3-km, daily NASA Aqua MODIS satellite AOD data (Dark Target product) and EPA ground monitors to provide daily estimates of PM2.5 on a 3-km grid (surface). The surfacing and regression algorithms were explained in Al-Hamdan et al. (2009, *JAWMA*).


***Figures prepared by:***
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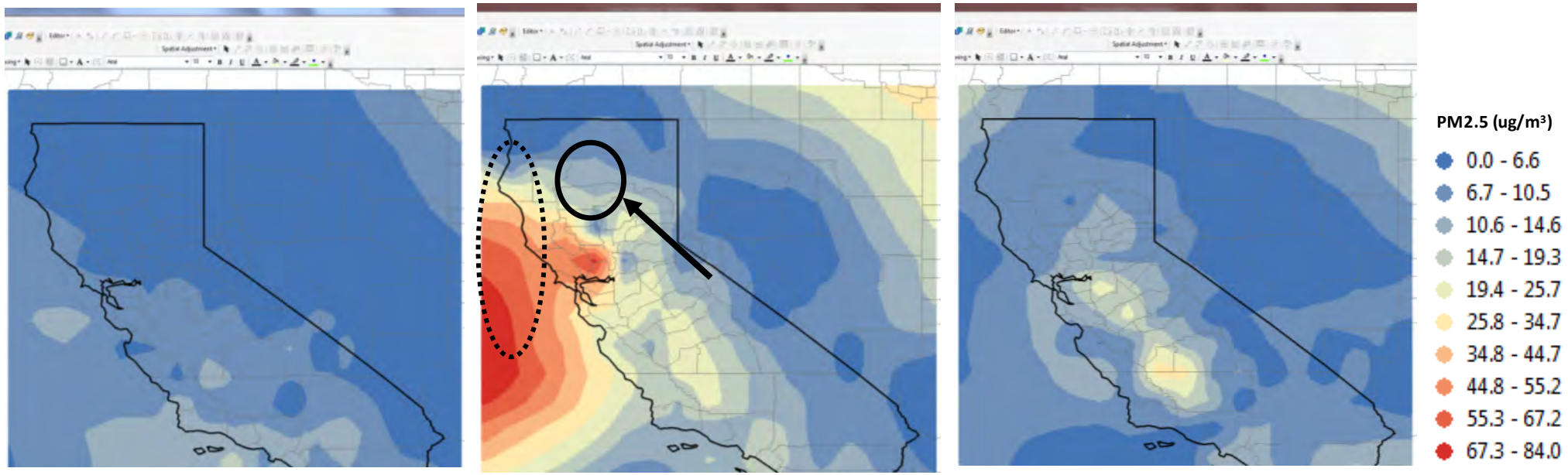
# Evolution of the surface $PM_{2.5}$ concentrations

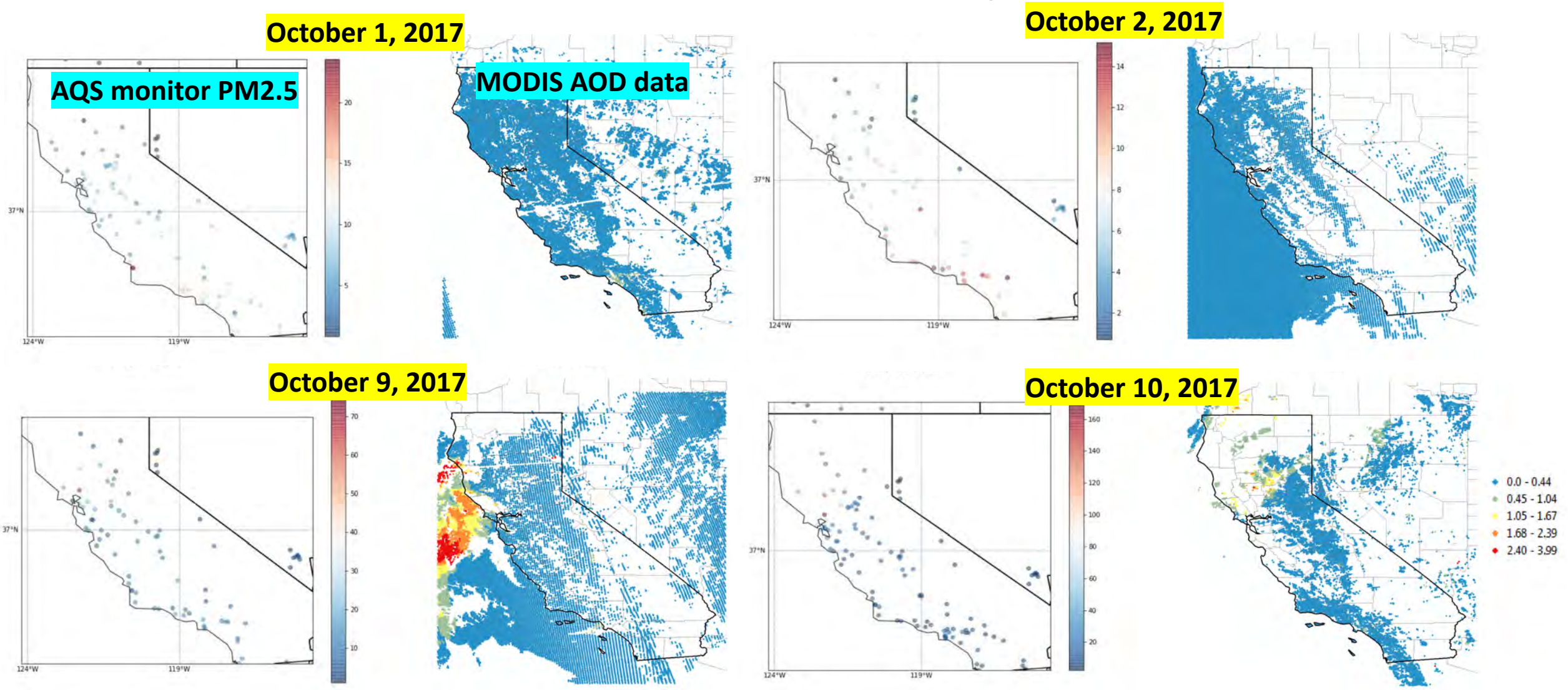
**Before Outbreak** | **During Wildfires Outbreak** | **After Outbreak**




**October 1 – 2 2017** | **October 9 – 15 2017** | **October 25 – 26 2017**

1. NASA satellites and ground monitors combined to provide daily estimates of $PM_{2.5}$ before and after the Northern California Wildfires outbreak of October 9-15, 2017.
2. Sensitivity tests on parameters and weighting functions used in the surfacing model.

# Evolution of the AQS surface $PM_{2.5}$ and MODIS AOD



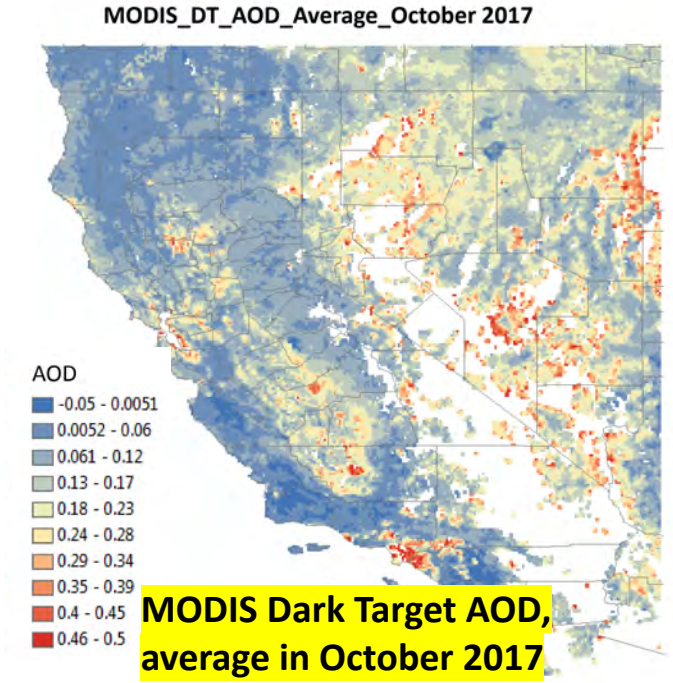

Challenges: (1) Large spatial and temporal variabilities; (2) Missing data in satellite AOD

# Monthly average and number of samples for satellite and AQS ground monitors

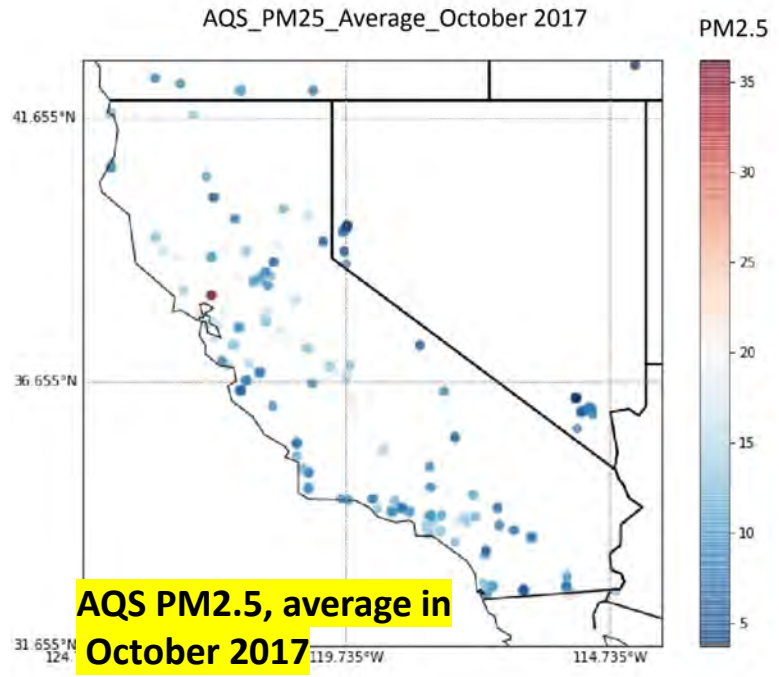
1. Monthly averages can help to fill in gaps of missing satellite AOD data

2. Spatial patterns of satellite AOD are generally similar to ground monitor PM2.5 in monthly averages.

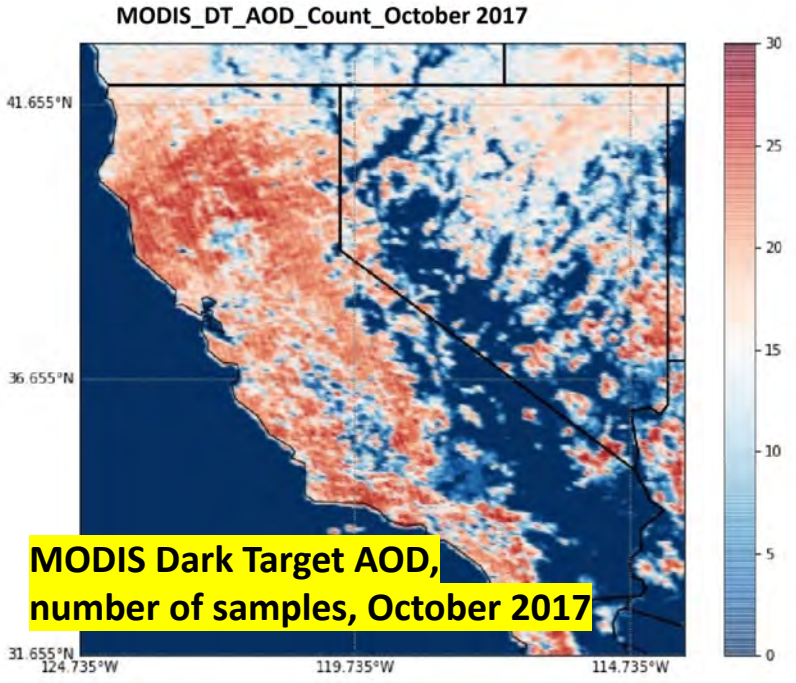
3. More comparisons are needed: an ongoing team effort of a manuscript for this Tiger Team 2



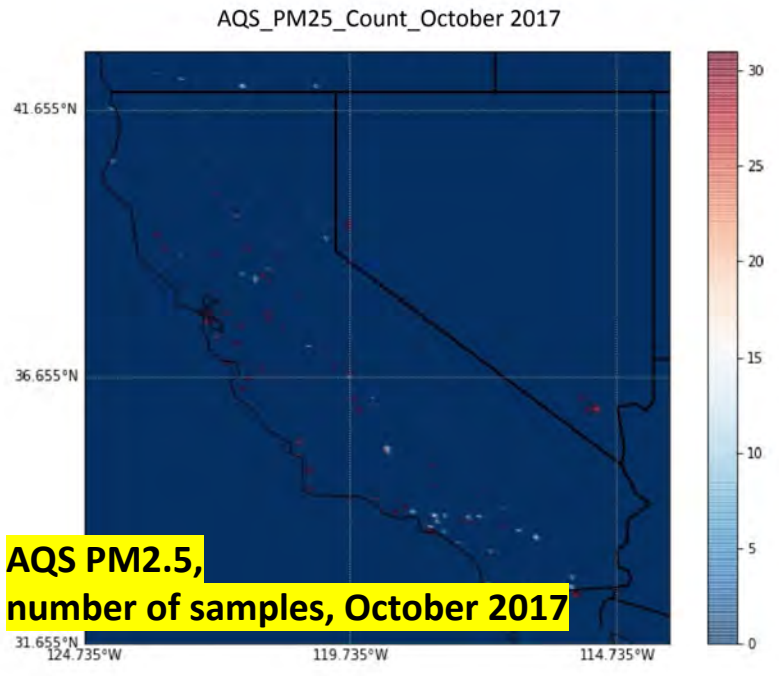

MODIS Dark Target AOD, average in October 2017




AQS PM2.5, average in October 2017

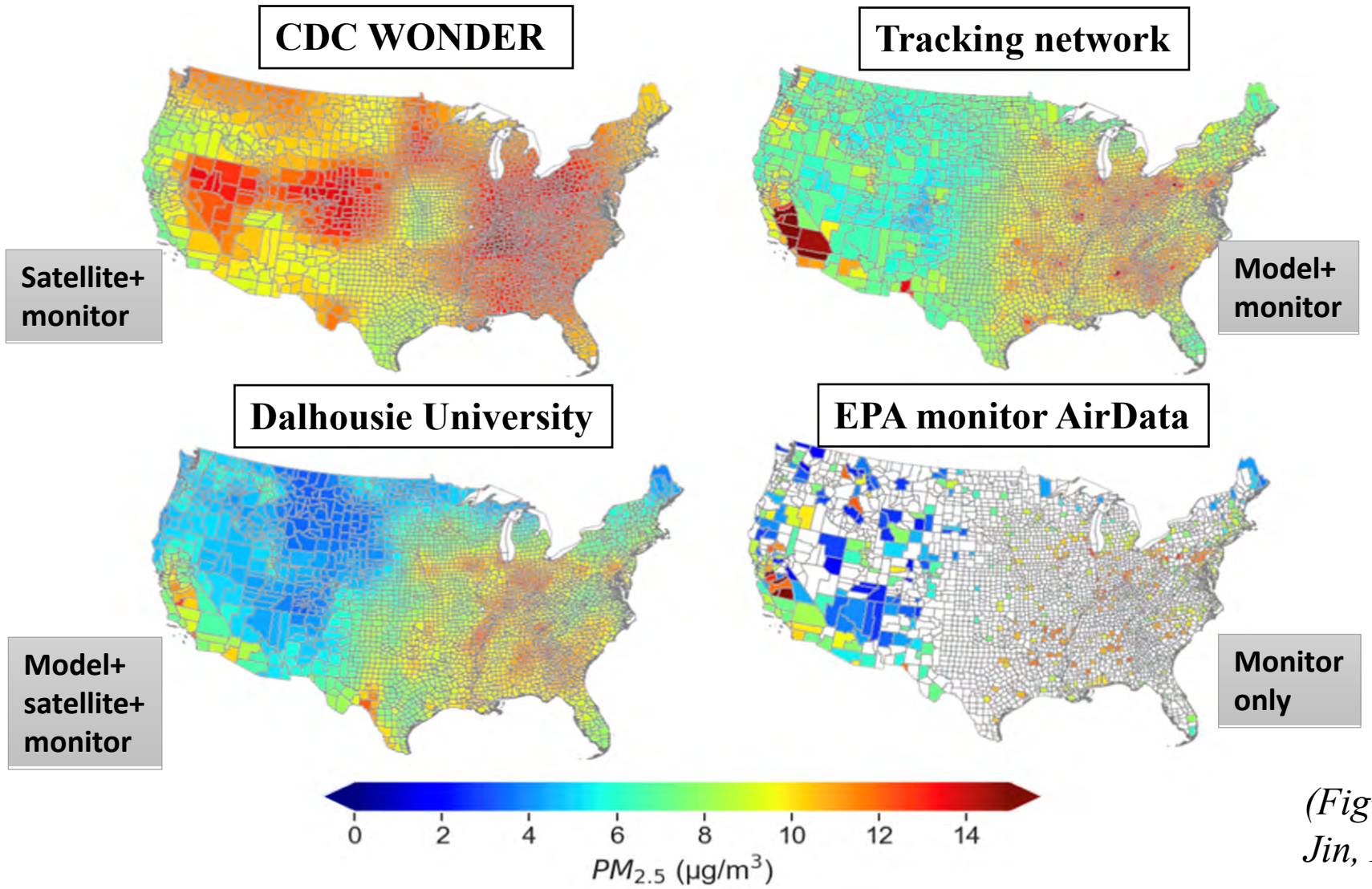



MODIS Dark Target AOD, number of samples, October 2017




AQS PM2.5, number of samples, October 2017

# Comparisons of three PM2.5 datasets in the contiguous U.S.




***A review paper for $PM_{2.5}$ exposure estimates***

(1) CDC WONDER exhibits higher $PM_{2.5}$ and a large regional maximum over the central U.S.

(2) For Southern California, EPHTN shows the highest $PM_{2.5}$ (over 14 µg/m3)

(3) Dalhousie exhibits lower $PM_{2.5}$ overall, and is more spatially homogeneous over the western U.S.

*(Figure prepared by Grace Choi, Xiaomeng Jin, Minghui Diao, and Tracey Holloway)*

Diao M., T. Holloway, S. Choi, S.M. O'Neill, M.Z. Al-Hamdan, A.van Donkelaar, R.V. Martin, X. Jin, A.M. Fiore, D.K. Henze, F. Lacey, P.L. Kinney, F. Freedman, N.K. Larkin, Y. Zou, A. Vaidyanathan. Methods, availability, and applications of $PM_{2.5}$ exposure estimates derived from ground measurements, models, and satellite datasets, *Journal of Air & Waste Management Association (JAMWA), in revision* .

# Year 3 Progress Update, PI Minghui Diao

**Core Project: Downscaling Satellite Derived PM2.5 Fields for California using Dispersion Modeling**

- 1. Satellite-derived $PM_{2.5}$ grids
  - Constructed preliminary daily AOD-derived $PM_{2.5}$ surfaces for California for 2006 - 2017;
  - System running in real-time at SJSU
  - Work ongoing to refine / improve fields.
  - ***A review paper of satellite PM2.5 fields is in revision stage (JA&WMA)*** led by Minghui Diao w HAQAST co-authors.
- 2. Visualization of satellite-derived $PM_{2.5}$ grids (complete)
  - Develop visualization of MAIAC AOD and derived $PM_{2.5}$ on selected days (LA, Bay Area, Imperial Valley);
  - https://www.cloud-research.org/haqast-project
- 3. Dispersion model Downscaling
  - System running in real-time at SJSU
  - Published important developmental work: https://www.mdpi.com/1660-4601/16/7/1252
  - A ***conference paper on approach***: http://www.met.sjsu.edu/~008535124/HAQAST/articles/Freedman_CMAS2017_Technical_Abstract.pdf

**Tiger Teams**

- TT#1: Community Scale PM2.5 Exposure (complete)
  - Completed UNC PAS low-cost samplers study w Maria Castillo, Pat Kinney, Jeff Wagner. Paper in revision stage (Atmos. Environ.)
  - Imperial Valley: Published article on dispersion modeling of 2017 PM2.5 using IVAN low-cost sensors https://www.mdpi.com/1660-4601/16/7/1252
  - Imperial Valley: A paper submitted to Remote Sensing of Environment on MAIAC AOD detection of windblown dust events
  - Co-authorship on papers submitted by Yang Liu's group (Southern California & Imperial Valley)
- TT#2 led by Susan O'Neill (PI) and Minghui Diao (co-I) (on-going)
  - Developing surface PM2.5 derived from satellite data for the duration of the California wildfire in October – November 2017 (finished)
  - Developing plume injection height product from satellite (finished)
  - ***A paper in preparation*** for wildfire projects with multiple groups

**Project Websites**

http://www.met.sjsu.edu/~008535124/**HAQAST**/home.html
https://www.cloud-research.org/**haqast-project**