

Satellite-based Decision Support Tool for Surface PM_{2.5} Estimates in California

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Introduction

- Fine particulate matter less than 2.5 micrometers in aerodynamic diameter, known as PM_{2.5}, imposes significant adverse impacts to public health.
- A decision-support tool is needed, in order to inform public of the air quality and assist public health sectors, air agencies and other stakeholders during events such as wildfires.
- As a member of the NASA Health and Air Quality Applied Sciences Team (HAQAST), San Jose State University collaborates with NASA USRA and California Department of Public to develop a decision support tool based on NASA MODIS satellite data and EPA ground monitors.

Method and dataset

- In this study, we will present an approach that fuses satellite data (NASA MODIS aerosol optical depth) with ground monitors, to examine PM_{2.5} fields in California at **daily, 3-km resolution**.

- All data and tools developed from this NASA project is publicly available and hosted online by SJSU.

- **Satellite data:** The NASA Aqua MODIS satellite data provide one observation per day at local time around 1:30 pm. Columnar aerosol optical depth (AOD) concentrations are retrieved from the MODIS data.

- **PM_{2.5} – AOD regression:** A relationship between columnar AOD and surface PM_{2.5} concentration is derived based on two models – a regression model, and a surfacing model. Sensitivity tests are conducted to evaluate the derived PM_{2.5} against non-FRM monitors (led by Mohammad Al-Hamdan)

- **A review paper** compares publicly available PM_{2.5} datasets over the continental U.S., led by Minghui Diao (SJSU) and Tracey Holloway (U Wisconsin).

Results

Part 1. Publicly available satellite-derived PM_{2.5} data and tools hosted by SJSU.

1. A Visualization Tool for Viewing Community-Scale PM_{2.5} in the Bay Area in California

<https://www.cloud-research.org/haqast-project>

2. Daily Real-Time PM_{2.5} Fields for entire California. Download netcdf or maps.

<http://www.met.sjsu.edu/weather/HAQAST/product2.html>

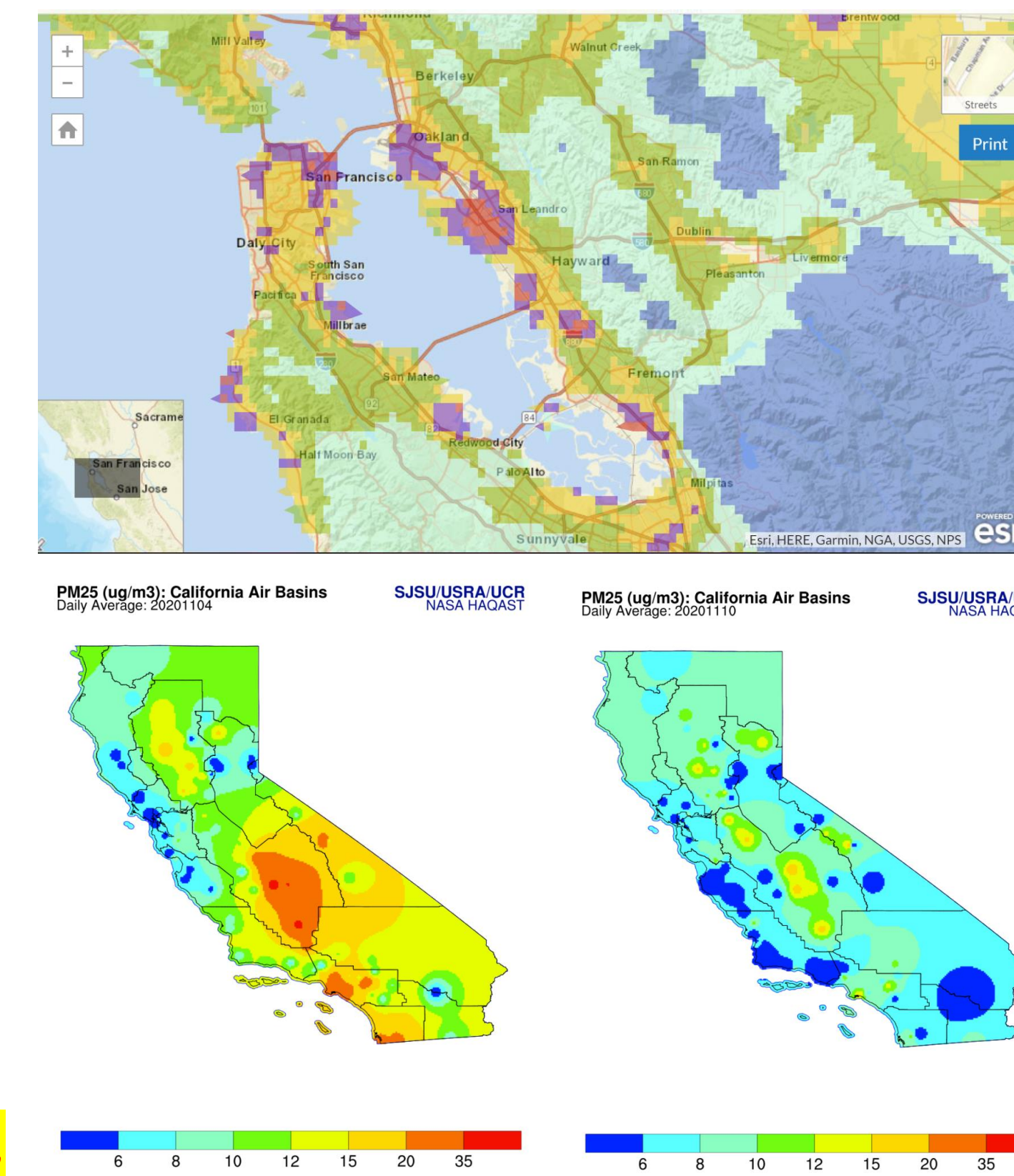
3. Daily PM_{2.5} Fields for entire California (2006 – 2017). Download csv files.

<http://www.met.sjsu.edu/weather/HAQAST/product1.html>

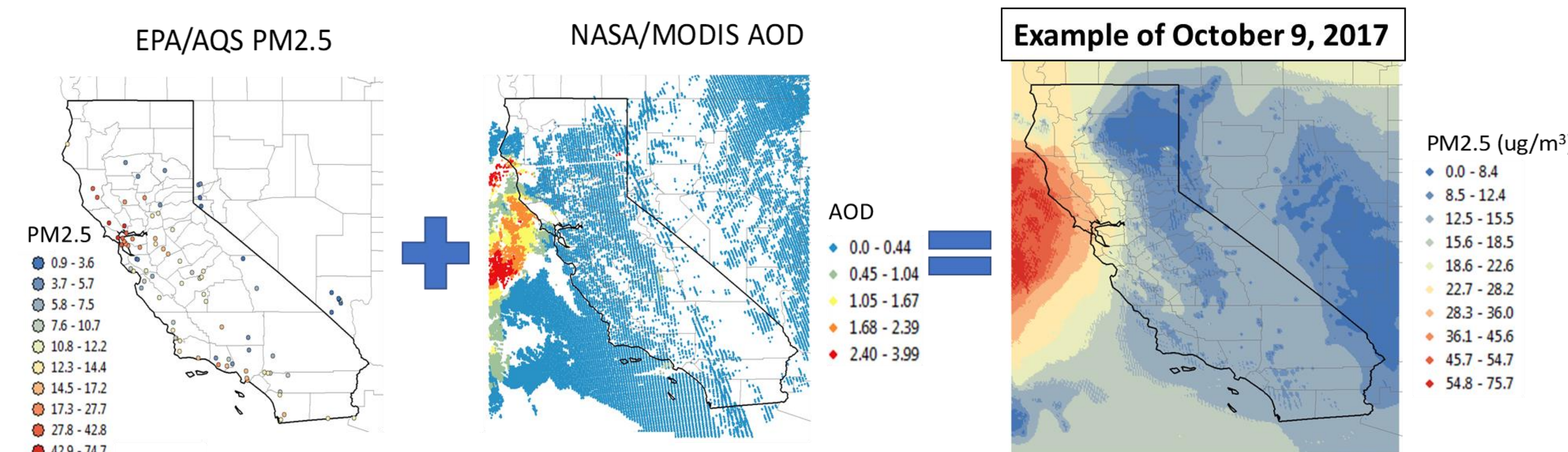
4. Daily Real-Time PM_{2.5} Fields (East San Jose, CA). Download netcdf or maps.

<http://www.met.sjsu.edu/weather/HAQAST/dispersion1.html>

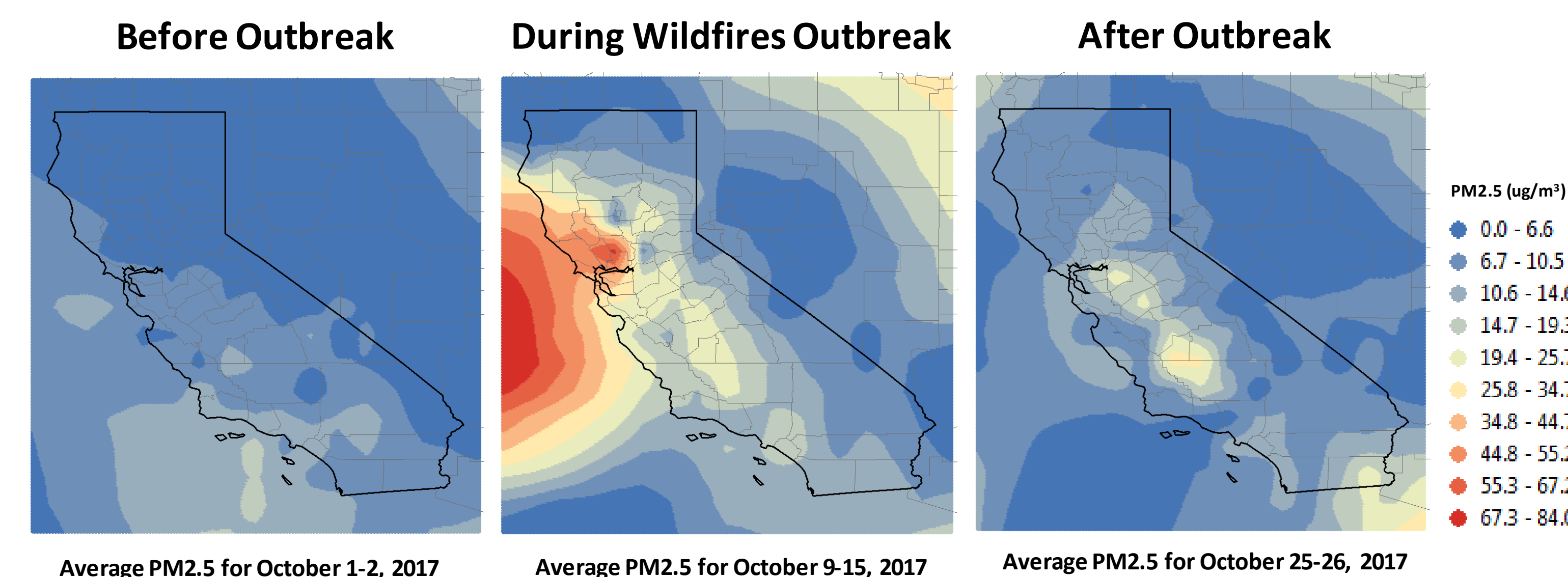
All free for download. Available in both maps and tables.



Part 2. Application of satellite data in analysis of California wildfire 2017.

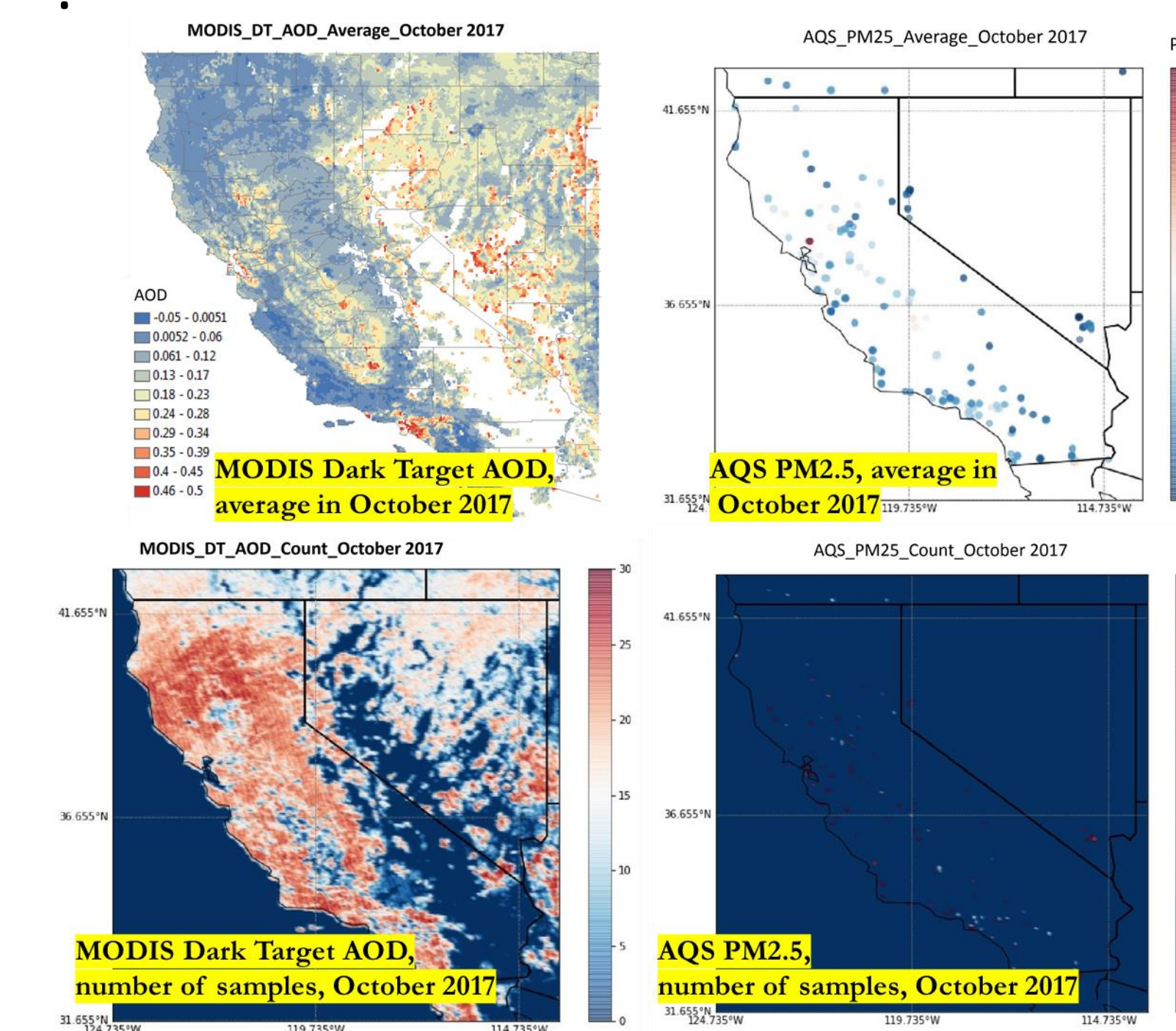


We used spatial/geostatistical surfacing algorithms, which combine data from 3-km, daily NASA Aqua MODIS satellite AOD data (Dark Target product) and EPA ground monitors to provide daily estimates of PM_{2.5} on a 3-km grid (surface). The surfacing and regression algorithms were explained in Al-Hamdan et al. (2009, JAWMA).

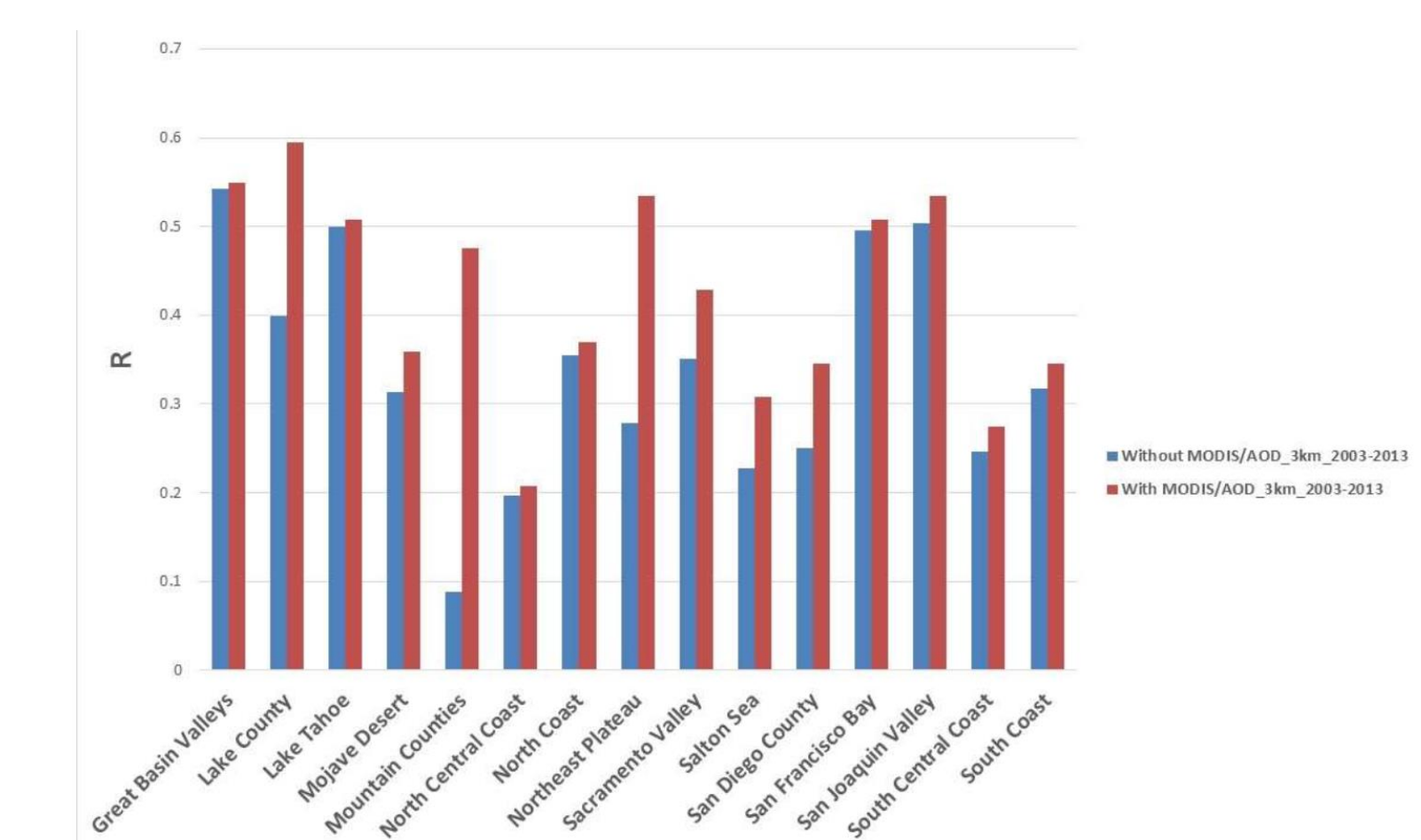


Using the daily, 3-km PM_{2.5} surface concentration derived from NASA satellites and ground monitors, we can track the evolution of wildfire emissions before and after the Northern California wildfire outbreak during October 9 – 15, 2017.

Part 3. Advantages of fusing satellite and ground monitor PM_{2.5} data.



1. Satellite data can help to fill in missing gaps in ground monitor data, especially for rural areas.
2. Satellite data can be “trained” to represent the ground monitor data more accurately by improving the regression model of aerosol optical depth (AOD) – PM_{2.5}.
3. The figure on the bottom shows R values for the comparison between satellite-informed PM_{2.5} and the PM_{2.5} reported by non-FRM monitors. Comparing PM_{2.5} data with or without satellite information, the evaluation shows the improvement/value added to the multiple regression model (R improvement) by including the MODIS/AOD in the multiple regression model.



Conclusions and future work

- As a key deliverable of our NASA project, the SJSU/USRA team have developed a method that fuses satellite AOD information with EPA ground monitor data, to derive surface PM_{2.5} data for California.

- This PM_{2.5} data set in California is available on daily, 3-km resolution, and is currently updated at near real-time (within 24 hours of the satellite swath time). This data set is free for download on the website hosted by SJSU: <http://www.met.sjsu.edu/weather/HAQAST/home.html>

- These satellite-informed PM_{2.5} surface data in California have been shared with several stakeholders, including California Department of Public Health, CARB, BAAQMD, etc. This decision-support tool can be used to evaluate near real-time wildfire emissions in California during the wildfire season.

- For future work, we aim to advance this decision support tool into higher resolution – 1 km scale for the entire state of California. The information will be updated within 24 hours of the satellite swath, and be shared with stakeholders and the public for air pollution alert and advice.

Acknowledgments

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