HAQAST High-Resolution Tiger Team: Imperial Valley
(Investigation topics)

1. MAIAC AOD spatial patterns for high-wind, high PM cases (F. Freedman)

2. Assessing particulate sources using IVAN w dispersion models (A. Venkatram)

3. Contribution of IVAN monitors to Random Forest PM2.5 prediction model (Yang Liu)

http://sites.bu.edu/haqast-highrestt/research/aim-3/

Study Design

- PM2.5 fields from random forest modeling constructed w/ and w/out IVAN PM2.5 measurements as input.

- MAIAC AOD utilized as random forest input variable. Gap-filling procedure applied to ensure spatiotemporally continuous AOD inputs.

- Other independent predictors: 1) land-use variables, 2) meteorological variables, 3) PM2.5-ancillary variables.
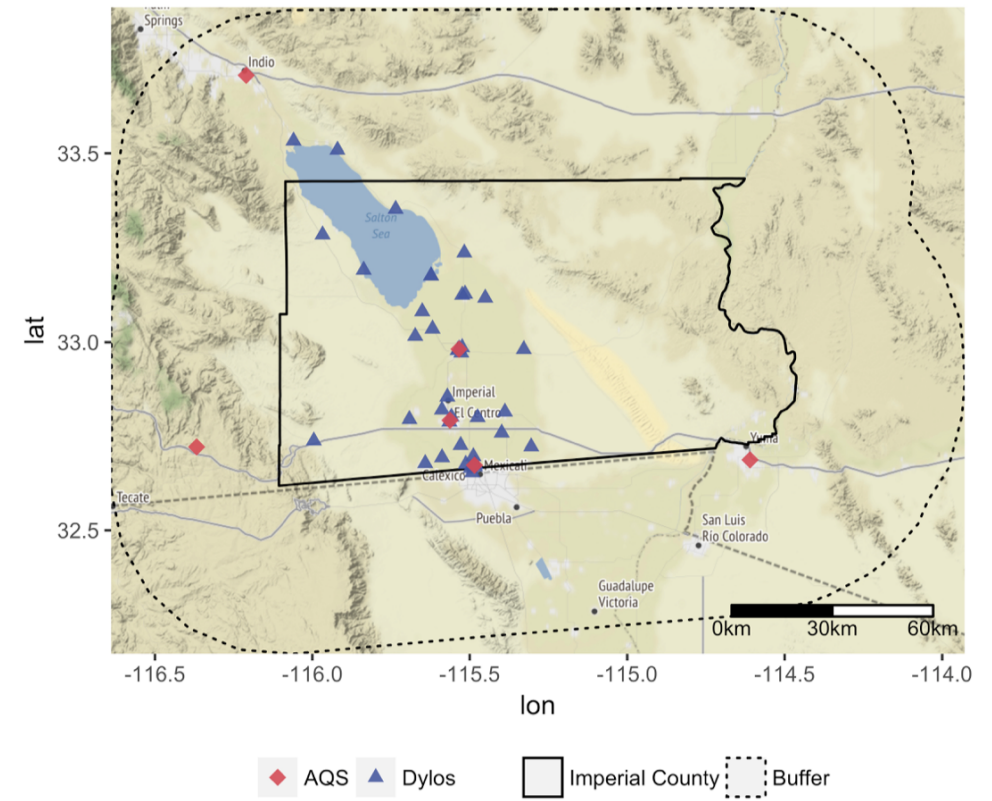
- **Study domain**
  - Imperial County, CA with a 50-km buffer
  - 6 EPA AQS stations
  - 39 IVAN sensors

- **Study period**
  - 09/01/2016 – 11/30/2017

Random Forest PM2.5 Prediction Models
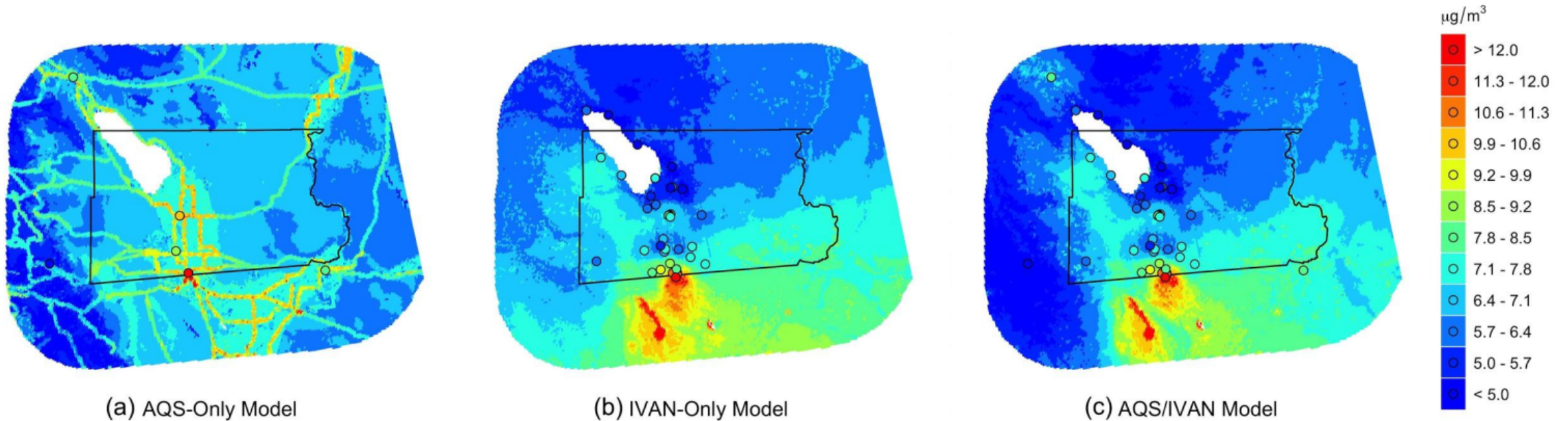
Independent variables

MAIAC AOD	Gap-filled AOD	PM2.5-ancillary variables	PM2.5 convolutional layer
Land-use variables	DEM		PM10-PM2.5 ratio
	Population	Meteorological variables	2-meter temperature
	NDVI		2-meter specific humidity
	Nearest road distance		Planetary boundary layer height
	0 - 10 cm soil moisture		Sensible heat net flux
	Land surface temperature		Frictional velocity
	Percentage of grassland		10-meter wind direction
	Percentage of water body		10-meter wind speed

Model Performance

Model	N	Overall CV R^2	Spatial CV R^2	Temporal CV R^2	RMSE
AQS Only	1617	0.53	0.25	0.55	3.77 µg/m^3
IVAN Only	11965	0.75	0.64	0.70	3.71 µg/m^3
AQS/IVAN	12902	0.73	0.63	0.70	3.72 µg/m^3

- Limited PM2.5 measurements from AQS can't fully train our random forest model.

- IVAN had a significantly larger sample to train the machine learning model.

- The combined model prediction accuracy is reduced slightly, indicating that the uncertainties between two types of observations had a negative effect.

Contribution of IVAN Measurements

(a) AQS-Only Model (b) IVAN-Only Model (c) AQS/IVAN Model

µg/m³
> 12.0
11.3 - 12.0
10.6 - 11.3
9.9 - 10.6
9.2 - 9.9
8.5 - 9.2
7.8 - 8.5
7.1 - 7.8
6.4 - 7.1
5.7 - 6.4
5.0 - 5.7
< 5.0

- Road networks and land-use types were significantly emphasized in AQS-only model.
- The PM2.5 distribution derived from IVAN measurements showed a more reasonable pattern.
- PM2.5 predictions from the IVAN-only and AQS/IVAN model had a similar distribution since the IVAN measurements dominated the training sample.
- Compared to IVAN-only model, the additional AQS measurements in AQS/IVAN model led to obvious changes in PM2.5 distribution.