Combining satellite data and CMAQ model to map $PM_{2.5}$ exposure over the Northeast U.S.A.

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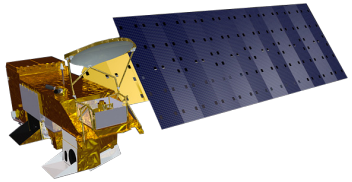
Using satellite products and models to inform air quality planning and health accountability



Satellite observations

CMAQ SIP (2011) from NYSDEC

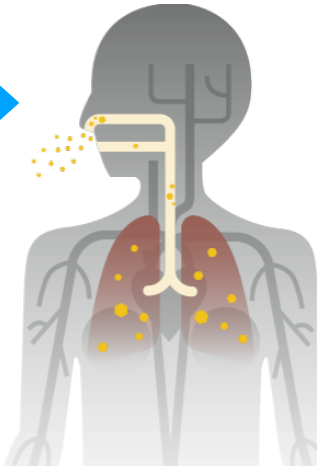
Ground-based observations

Hospital admission data from NYSDOH

Aerosol Optical Depth (AOD)

$$AOD_{satellite} \times \frac{PM_{2.5\_CMAQ}}{AOD_{CMAQ}} = PM_{2.5\_satellite}$$

Fine Particulate Matter ($PM_{2.5}$)

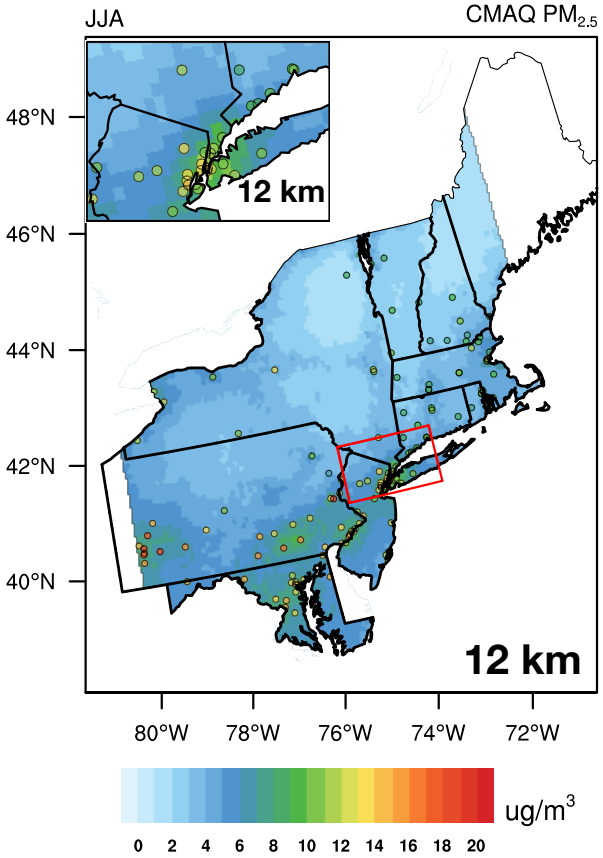


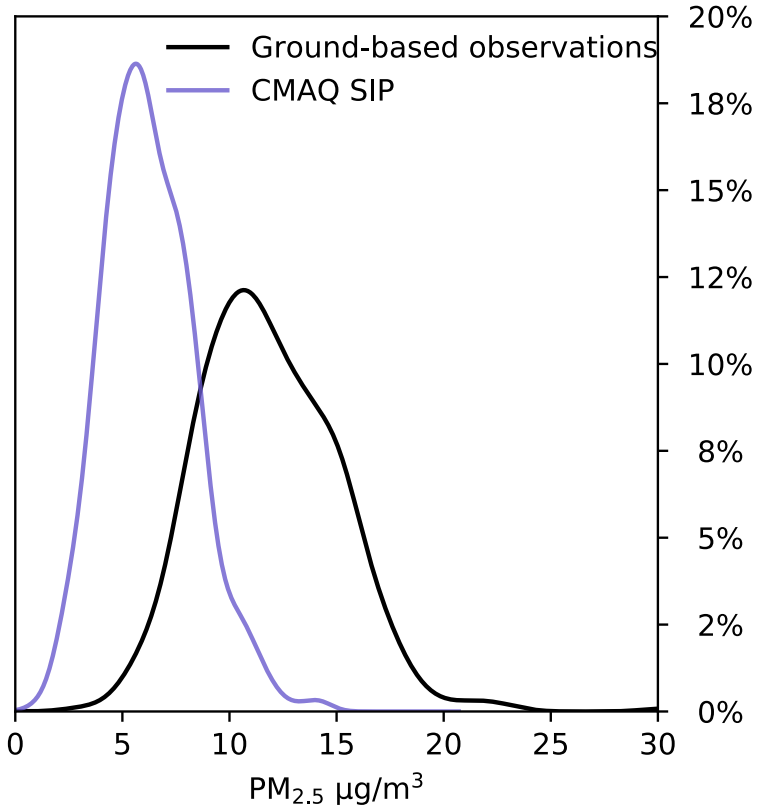
Target I: Evaluate the value and uncertainties of satellite-based approaches for $PM_{2.5}$ exposure mapping.

Target II: Conduct multi-pollutant health impact analysis for the past decade over New York State. (Mike He, Columbia School of Public Health)

CMAQ SIP modeled $PM_{2.5}$ is biased low in summer

CMAQ SIP $PM_{2.5}$



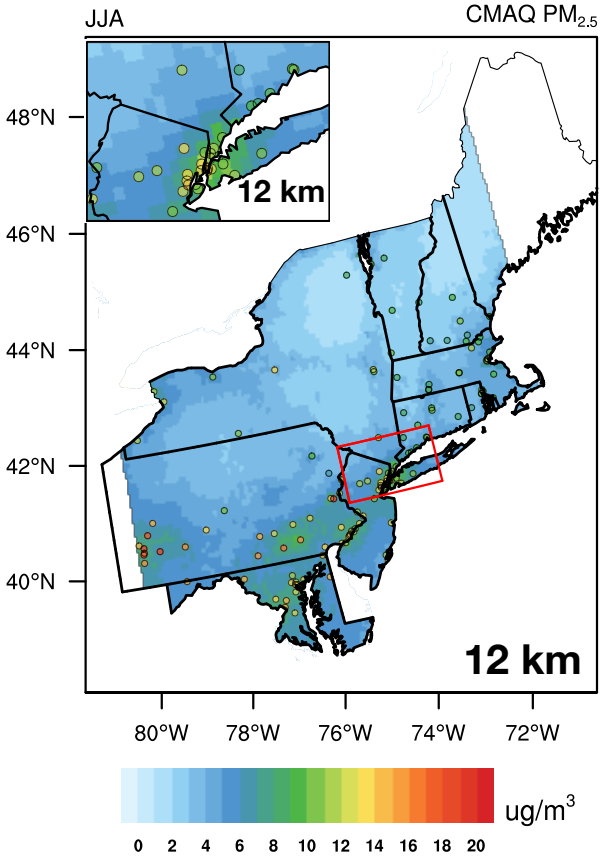


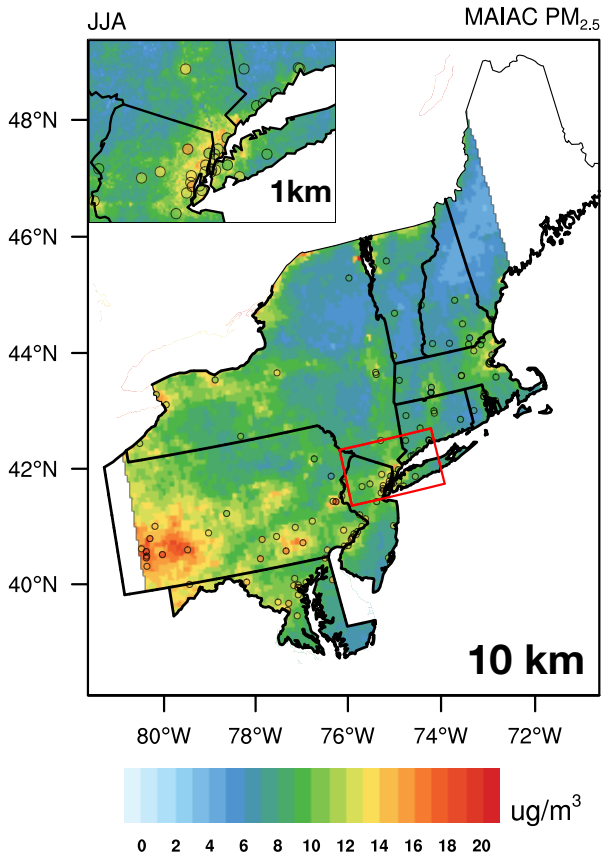
Summer 2011

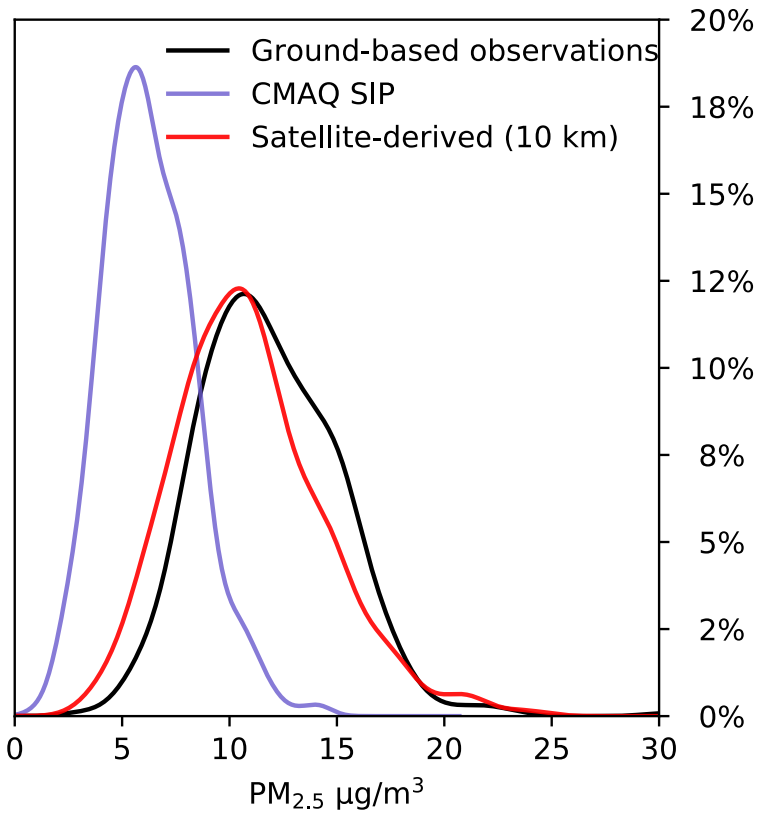
Satellite-derived $PM_{2.5}$ correct the biases of CMAQ $PM_{2.5}$

CMAQ SIP $PM_{2.5}$

Satellite-derived (MAIAC) $PM_{2.5}$







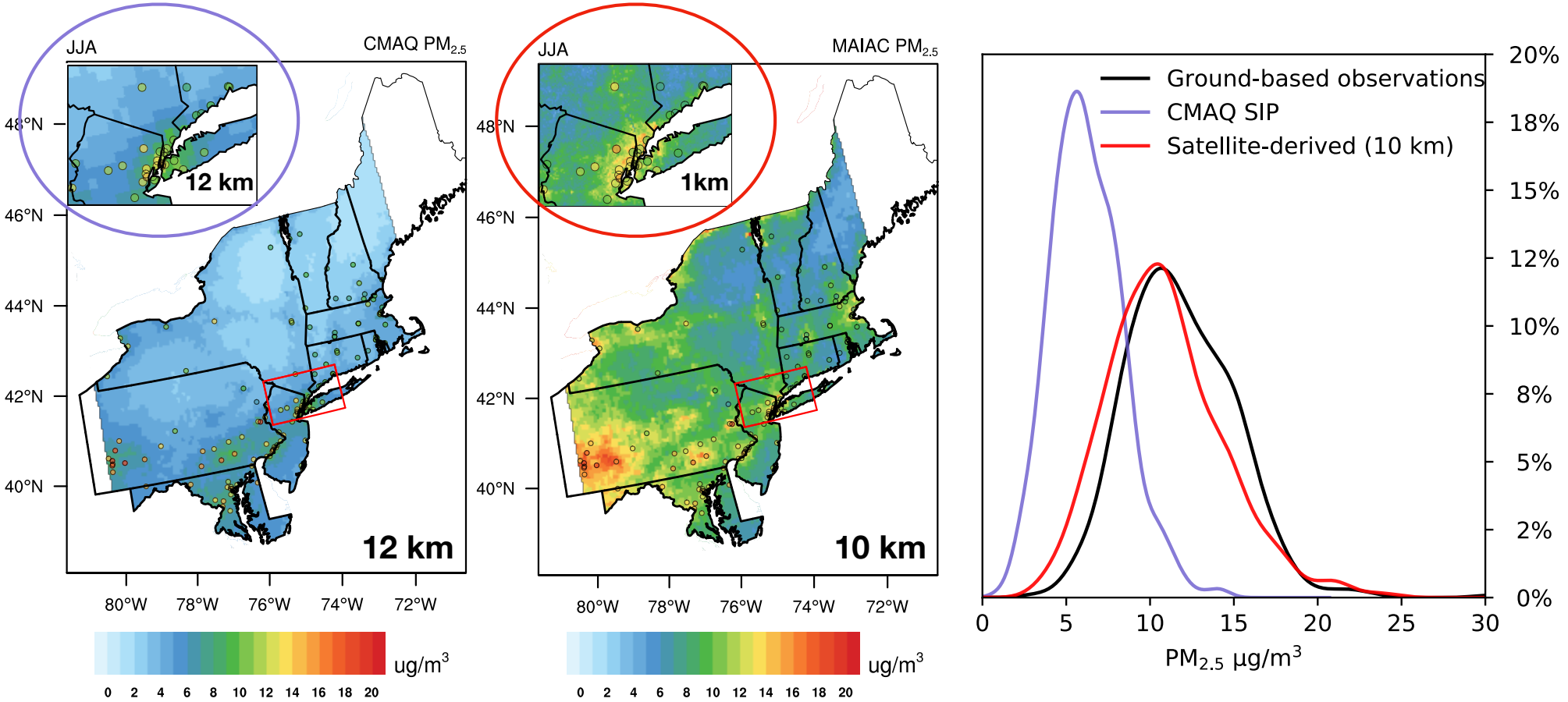
Summer 2011

$$AOD_{satellite} \times \frac{PM_{2.5\_CMAQ}}{AOD_{CMAQ}} = PM_{2.5\_satellite}$$

Satellite observations add more spatial detail

CMAQ SIP $PM_{2.5}$

Satellite-derived (MAIAC) $PM_{2.5}$

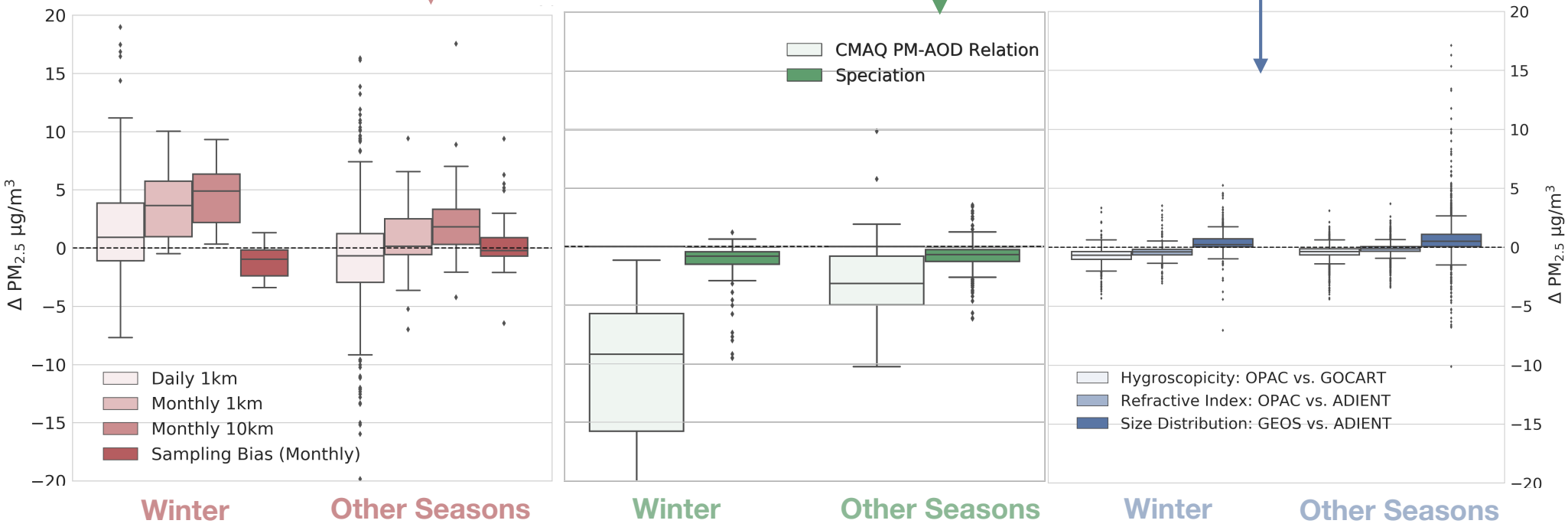


Summer 2011

$$AOD_{satellite} \times \frac{PM_{2.5\_CMAQ}}{AOD_{CMAQ}} = PM_{2.5\_satellite}$$

Satellite derived $PM_{2.5}$ products are useful, but uncertain

$$PM_{2.5\_satellite} = AOD_{satellite} \times \frac{PM_{2.5\_CMAQ}}{AOD_{CMAQ}}$$



$\Delta PM_{2.5}$ = the difference in derived $PM_{2.5}$ if:

'true' (AERONET observed) AOD is used instead of MAIAC AOD

'true' (observed) $PM_{2.5}$-AOD relationship or speciation is used instead of model

using different assumptions of aerosol properties for AOD_{CMAQ}

Take-aways and next steps

- **Satellite-derived $PM_{2.5}$ products are useful:** full coverage, finer spatial resolution and consistent with ground-based measurements.
- **But they are uncertain due to uncertainties of:** noise of satellite observations, model simulated $PM_{2.5}$-AOD relationships and assumptions of the aerosol properties.
- **Next steps:**

  1)Produce decadal satellite-derived $PM_{2.5}$ data using CMAQ simulation (from EPA RSIG) and satellite AOD (MAIAC) data.

  2)Compare multiple $PM_{2.5}$ products over New York State.

  3)Analyze how the uncertainties of $PM_{2.5}$ products affect health impact analysis.