Emission Data Assimilation for Air Quality Forecasting

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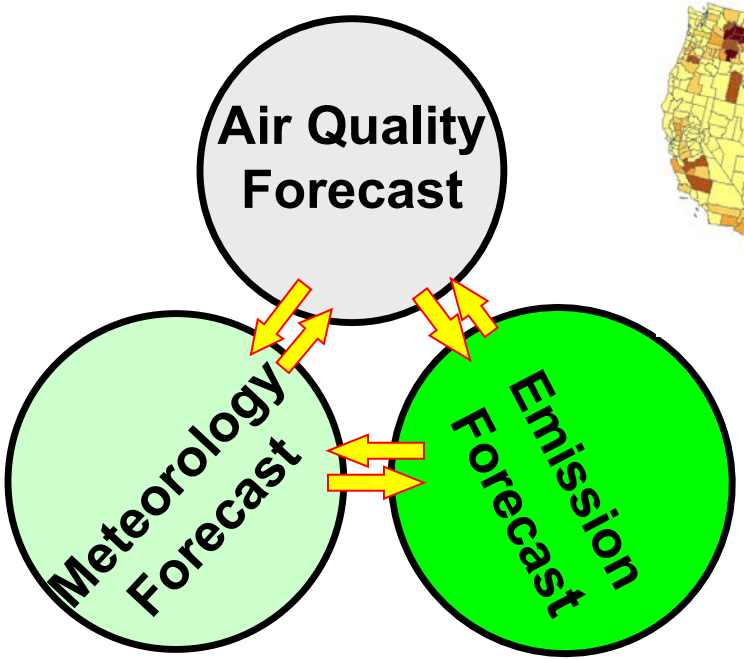
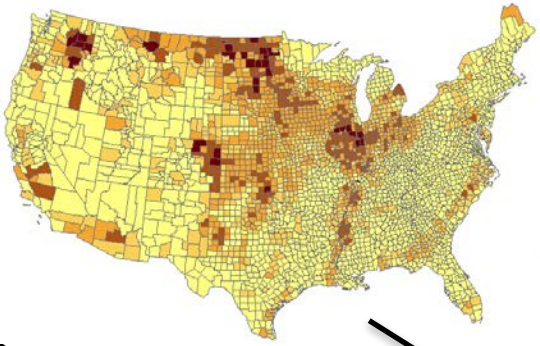
Emission Data Assimilation

Emission data assimilation (EDA): Assimilate satellite observations to reduce emission uncertainty (temporal trends, spatial distribution, source strength, etc).



(Source: Tong et al., 2012)

Raw Emission



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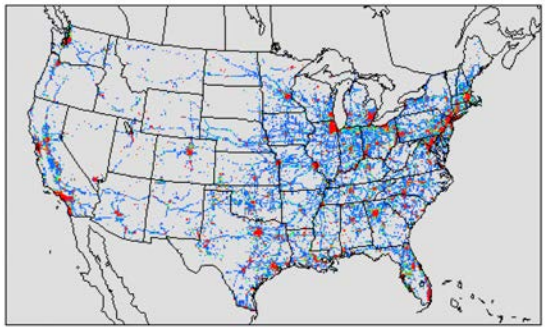
Satellite Observations

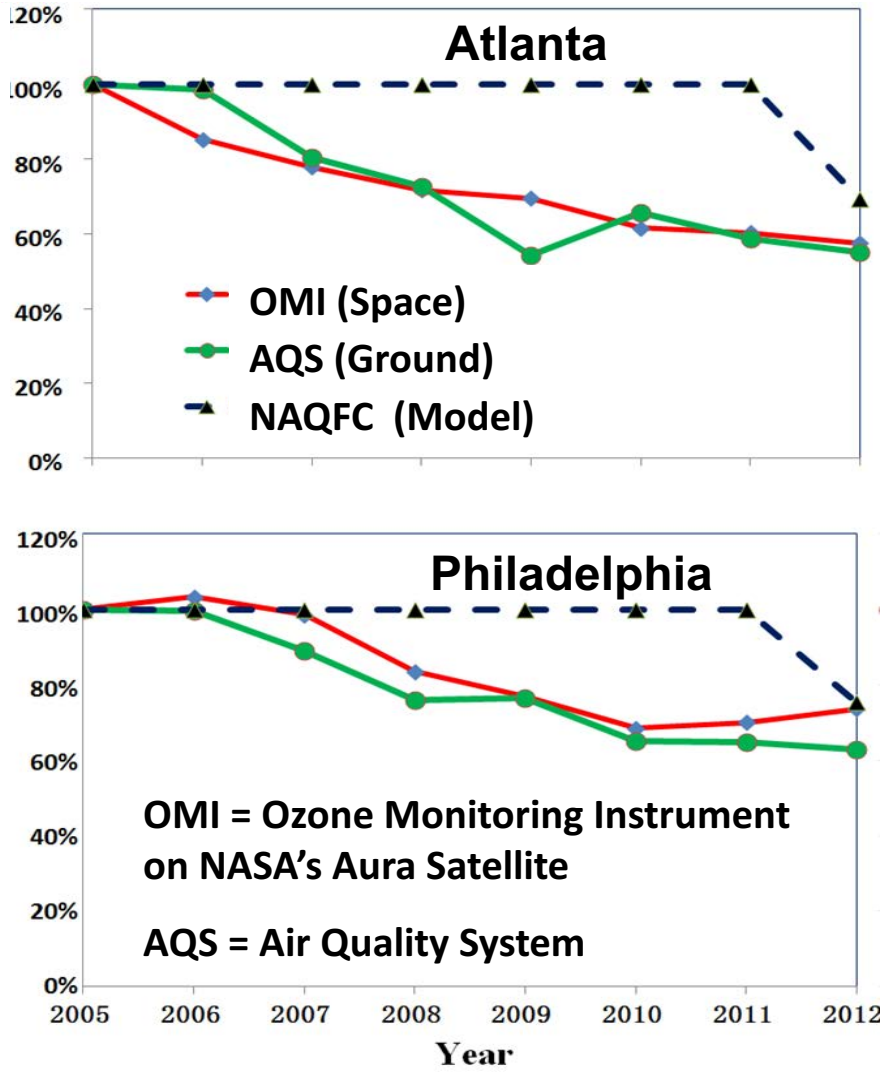
Satellite Adjusted Emission



EDA provides rapid emission refresh for air quality forecasting.

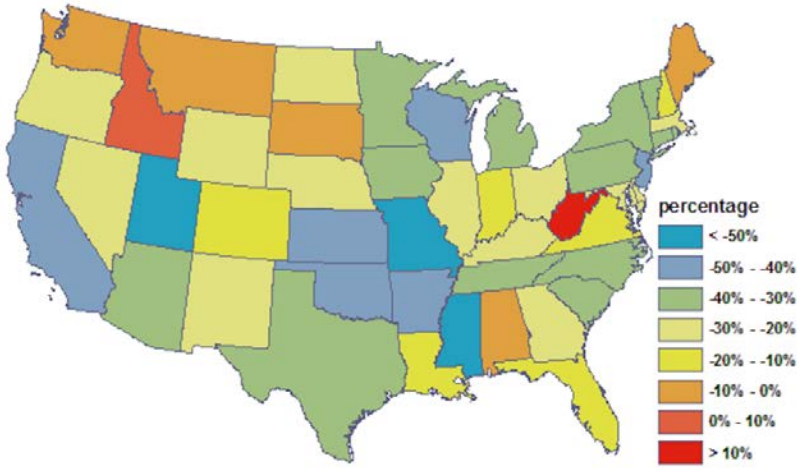
NO_x Emissions During Great Recession

Comparison to 2005 values

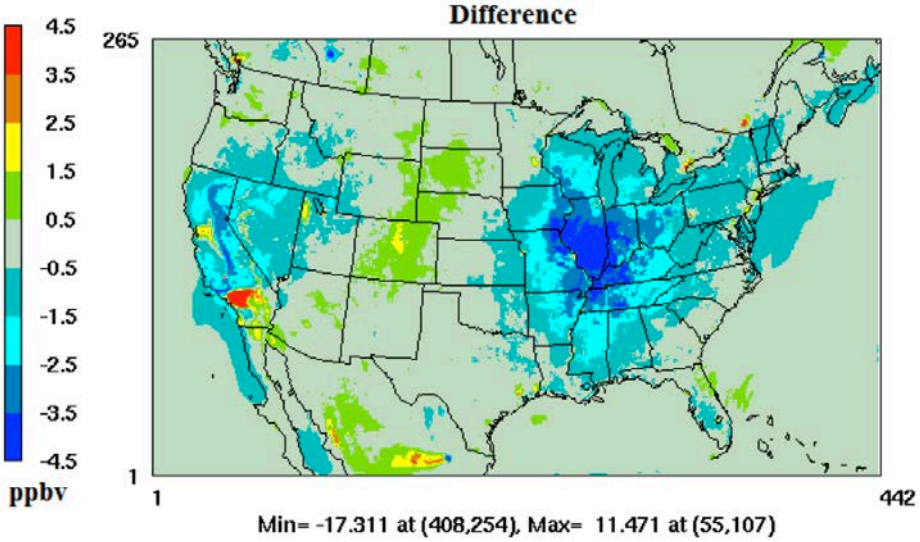


(Source: Tong et al., 2015; 2016)

State-level NOx Adjustment



Satellite-adjusted – EPA Project.

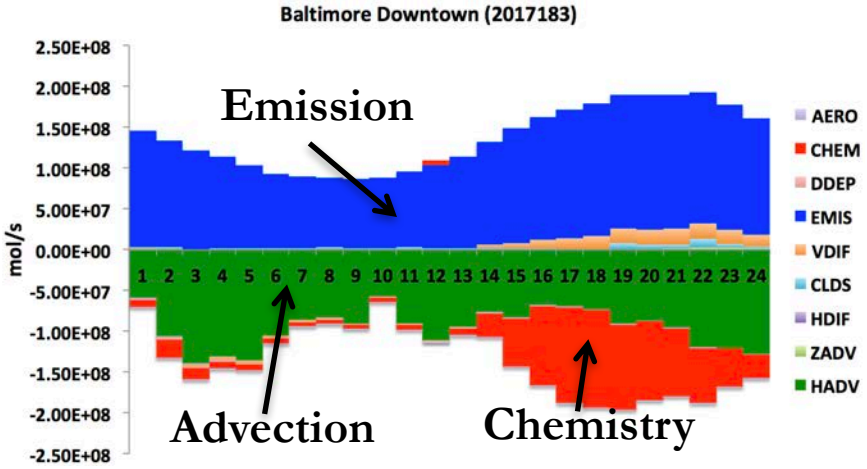


Surface Ozone Change

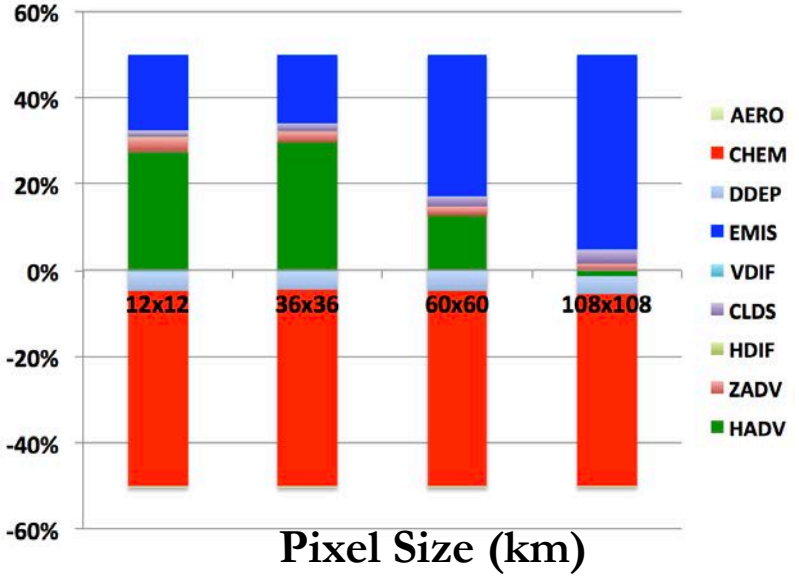
Process-aware Emission Adjustment

Can satellite data be used to adjust emission pixel by pixel?

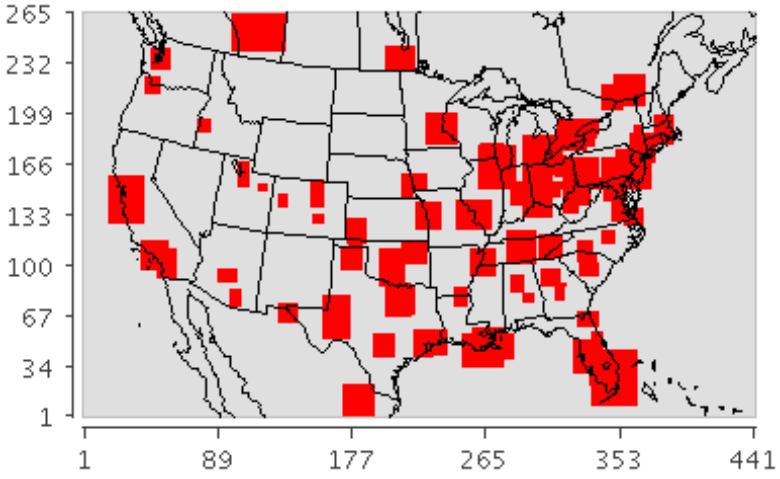
Processes contribution to NOx (Urban)



Contribution vs Pixel Size (Rural)



Emission Adjustment with Chemical Regimes



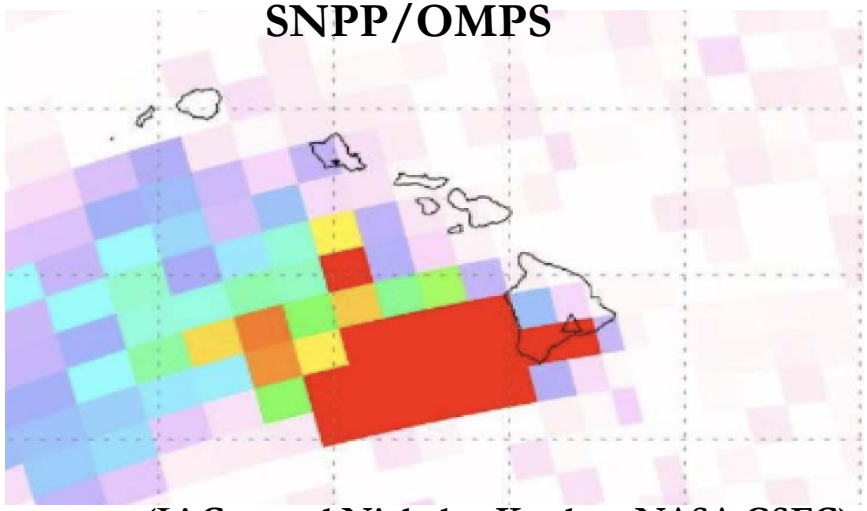
1) Emission contribution >= 75%;
2) Transport <= 25%;

Applications of Hi-Res satellite data need to consider chemical budget when adjusting emissions.

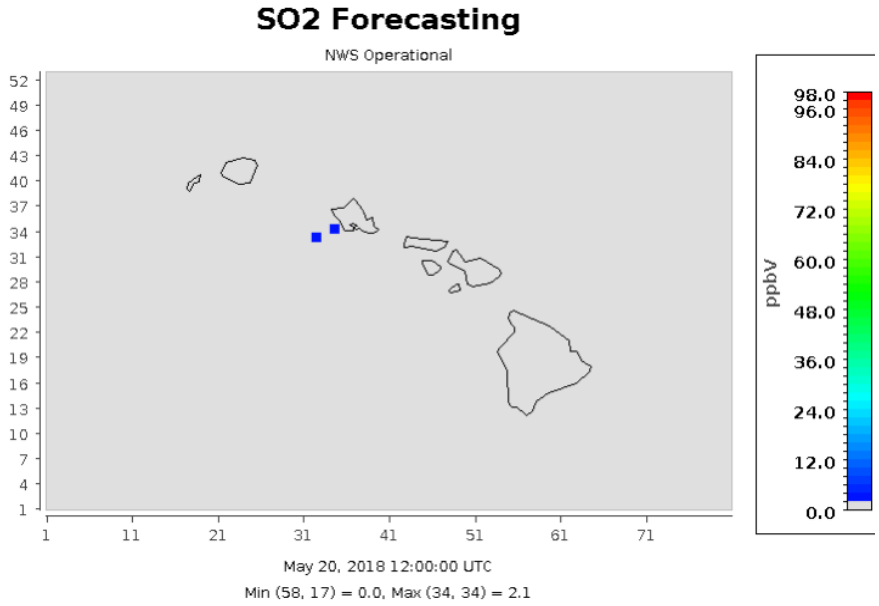
SO_2 Emission from Kilauea Eruption

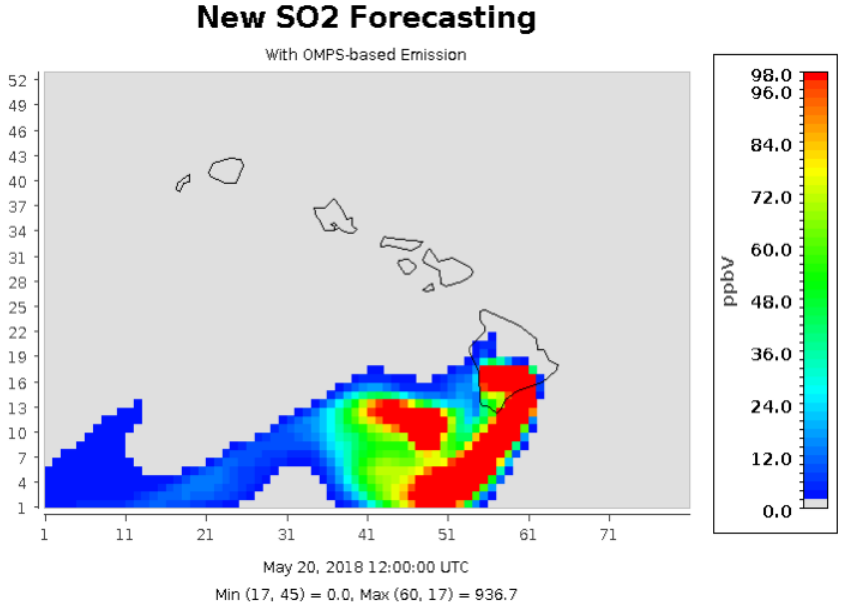
(REUTERS/Terray Sylvester)

SNPP/OMPS

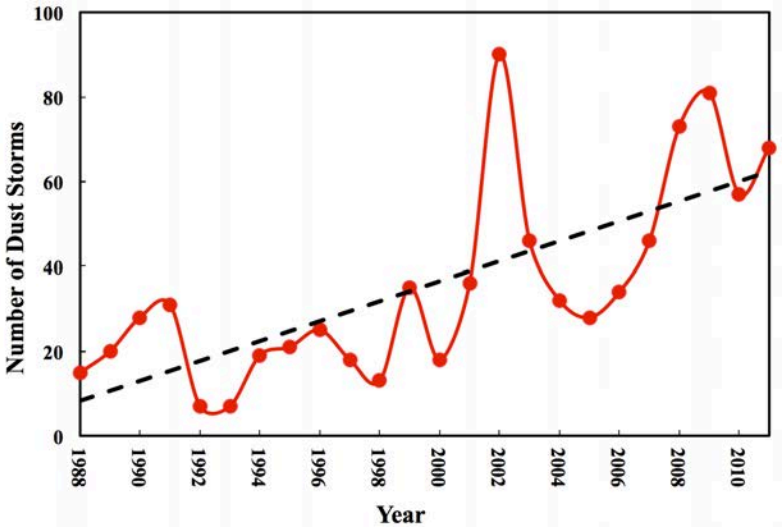


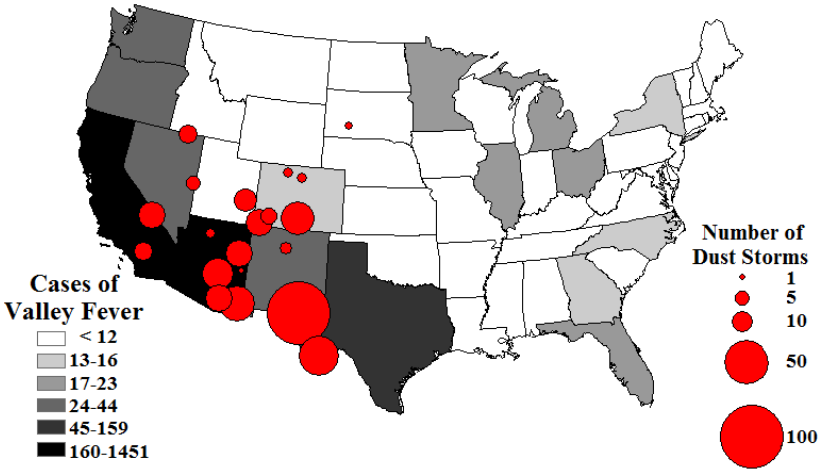
(Li Can and Nickolay Krotkov, NASA GSFC)



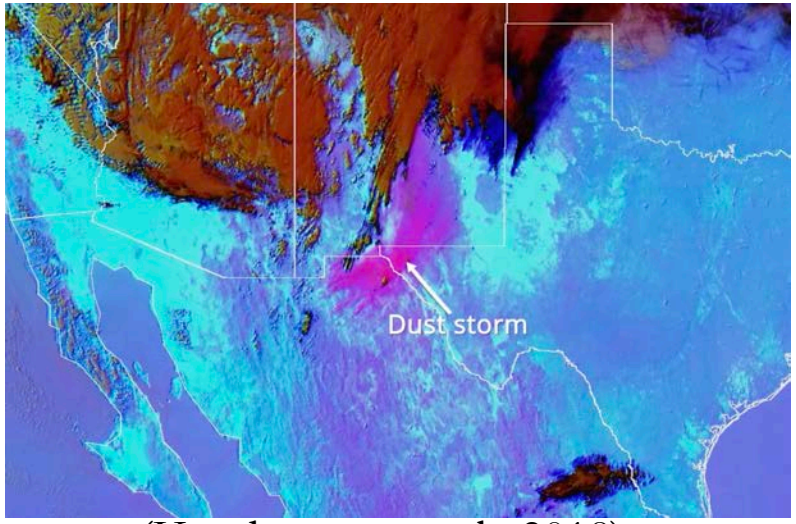


Rising Dust Storms





(Source: Tong et al., 2017)



GOES-16

(Kondragunta et al., 2018).

Fast rising dust in Southwest, economic losses of 3 billion dollars per year, approximately half from health effects.

Year 2 Progress Update, PI Tong

Emission data assimilation, air quality forecasting and reanalysis

- Ammonia Emissions from Biomass Burning
  - Fire NH_3 emissions derived from MODIS Fire Radiative Power (FRP) [Bray et al., 2018];
- Chemical data assimilation of MODIS AOD into the National Air Quality Forecast Capability (NAQFC) [Tang et al., 2017];
- High-resolution long-term North America Chemical Reanalysis;
  - Combined model prediction and observations for $PM_{2.5}$ and composition, O_3, NO_2, CO and SO_2 (12km resolution over US, 2009-2018);
- Dust storm and human health;
  - Used NASA data to link ocean changes to dust storms and Valley fever [Tong et al., 2017].
  - Tracking dust storms with GOES-16 Advanced Baseline Imager [Kondragunta et al., 2018].
- Outreach: Eight presentations; 20+ media interviews; New documentary "Dust Rising" (Lauren Swartzman).

Tiger Team Participation

- Co-Lead with Brad Pierce: NOx emissions
  - Developed rapid emission refresh application;
  - Supported chemical data assimilation work by Peirce and NOAA.
- TT Fiore: Satellite Data in SIPS.
  - Worked with NASA GIS DISC to create a recipe to derive long-term satellite NO_2 trend over your city.
- TT Duncan and West: Emission Efficacy.
  - Generated long-term air quality reanalysis data for West's health analysis.
- TT Kinney and Freeman: High Resolution
  - Developed multi-year dust observations to cross-validate high-resolution prediction.