Rapid Emission Updates With Satellite Observations

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NASA ACCP Air Quality Virtual Workshop
March 16-18, 2020
Emission and Chemical Data Assimilation

**Chemical Data Assimilation (CDA):** Use satellite observations to improve chemical fields, including initial concentrations.

**Emission Data Assimilation (EDA):** Assimilate satellite observations to reduce emission uncertainties;

EDA provides rapid emission refresh for air quality forecasting.

(Source: Tong et al., 2012)
Ensemble Wildfire Forecasting: Camp Fire

(Ralph Kahn, NASA)

- FRP (MODIS/VIIRS): wildfire emissions and plume rise modeling;
- MISR plume height, MODIS/VIIRS AOD, TROPOMI CO/NO\textsubscript{2} for model validation;

Emissions differ 10x;
- Predicted surface PM2.5 differ 1000x;
- Thick smoke $\Rightarrow$ biased FRP/emission/plume rise
2020 “GigaFire”, Ozone and PM$_{2.5}$ Exceedance

(Yunyao Li)

- Wildfire NO$_x$ emissions (and VOCs) are highly uncertain;
- More challenging to predict O$_3$ exceedance than PM$_{2.5}$;
- When there is a big fire, it rules!
Predicting Dust Storms

Dust Trend

(Tong et al., 2017)

Albedo-based Dust Source Map

(Barry Baker, GMU/NOAA)

Satellite products used:

Source: MODIS/VIIRS NDVI, BRDF/Albedo;
Validation: MODIS/VIIRS AOD, Dust Mask
Concluding Thoughts

- Air quality improves, extreme events increase;
- Some pressing needs in forecasting air quality extreme events:

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| Wildfire Forecasting    | **High-opacity retrievals;**  
|                         | **Plume height** (more often, better vertical resolution);  
|                         | **Burning stage** (emission factors; hygroscopicity etc).  
|                         | **Data Latency;**                                                          |
| Dust Forecasting        | **Observing time** (NA dust peaks in late afternoon; Fatal dust accidents at 5PM);  
|                         | **Dust source detection;**  
|                         | **Aerosol type** (dust mask);  
|                         | **Better dust retrievals with cloud;**                                      |