Using Earth Observations to Support Regional and National Environmental Health Surveillance

Yang Liu, Ph.D.
The 3rd HAQAST Meeting
November 28-29, 2017
Columbia University
The Team and Stake Holders

Team

- Yang Liu, Emory University (PI)
- Howard Chang, Emory University
- Matthew Strickland, University of Nevada, Reno
- Heather Holmes, University of Nevada, Reno

Stakeholders

- CDC’s Environmental Public Health Tracking Network
- Colorado Department of Public Health and Environment (CDPHE)
Study Objectives

- Conduct a multi-year time-series epidemiological study to evaluate the health impact of air pollution levels elevated by wildfires in Colorado.
- Conduct a national scale epidemiological study to link age-specific county-level daily counts of ED visits with satellite-driven air pollution exposure estimates to demonstrate an application of Tracking’s surveillance data.
Daily PM$_{2.5}$ Modeling During Fire Season in Colorado

Goal: Develop a satellite-based high-resolution PM$_{2.5}$ exposure model in Colorado to support epidemiologic research.

**Approach**

- MAIAC AOD downscaler
- CMAQ PM$_{2.5}$ downscaler

Ensemble Weighting function:

\[ Y_{st} = \alpha_{st} + \beta_{st} X_{st} + \gamma Z_{st} + \epsilon_{st} \]

Downscaler Model:

\[ PM_{2.5, st} = (1 - w_{ts}) Y_{st}^{\uparrow AOD} + w_{ts} Y_{st}^{\uparrow CMAQ} \]
Ten-fold Cross Validation Results

- The CV $R^2$ of the ensemble model was 0.66, better than the AOD downscaler or CMAQ downscaler alone.
- The performance of the Bayesian ensemble model is better than the previously used multi-stage model when using same parameters ($R^2 = 0.44$).
The year of 2012 had enhanced PM$_{2.5}$ compared to other years because Colorado experienced an unusually strong fire season in 2012.
Predicted Monthly Mean PM$_{2.5}$ Over Fire Events

Our model is able to capture the local scale variability in PM$_{2.5}$ concentrations due to wildfires.
Current Status

- PM exposure estimates have been aggregated to 4 km health data grid
- ED visits data from Colorado has been preprocessed and is ready for model incorporation
- Data management and epidemiologic model investigations are currently underway