

Enhancing EPHT with Satellite Driven Particle Exposure Modeling and Epidemiology

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- Reasonably strong association between satellite AOD and PM_{2.5}
- Limited coverage of current PM health indicators in Tracking Network
- High computational cost of HBM estimates

- Extend the spatial coverage of the PM_{2.5} indicators in Tracking Network with satellite data
- Provide timely estimates of county average PM_{2.5} health indicators
- Evaluate satellite PM_{2.5} estimates as a alternative exposure data source in environmental epidemiologic studies and using independent ground sampling

Project Components

□ A: integration of Earth science data (Year 1)

- Spatially and temporally match various data sources to a defined master grid in study domain
- □ B: PM_{2.5} exposure modeling (Year 2)
 - Develop spatial statistical models to estimate PM_{2.5} concentrations and compare with existing Tracking datasets and independent field measurements
- C: PM_{2.5} health effects modeling (Year 3)
 - Associate model estimated PM_{2.5} concentrations with cardiorespiratory ED visits in an epidemiological model, and compare effects with conventional methods

Project Timeline

Task	Year 1				Year 2				Year 3			
UTECHNOLOGETA.	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Component A:			-	-		8	÷	÷		1		
Develop master grid (Emory)		-	1	1		÷	:	:		÷	:	:
MISR/GOES/NARR collection (Emory)		-		- 11-0 -		2	:	:		1	÷	:
MODIS/OMI/land use/EPA collection (MSFC)				-			:			÷	:	
Data integration into master grid (Emory & MSFC)			1	-		2	÷	-		÷	-	
Sampling filter preparation (Emory)		:	i.	2 .	Re al	÷	÷	:		÷	:	:
Component B:		-	-	-		-		-		-	-	
AOD data validation (Emory)		1	-	-			÷	1			:	
Pilot test for sampling (Emory)		1	:	:	13	•	-	-		5	:	:
Final satellite data generation (MSFC)		ł.	÷	:			-	-		1	:	
HBM PM data preparation in domain (CDC)		-		-				ē.		÷	÷	:
Generate satellite PM estimates (Emory)		:	÷	÷		i	-			÷	:	:
Satellite PM comparison with HBM (CDC)		-	-	3		-	-		4	1	:	2
Begin prospective validation sampling (Emory)		1	-	1	0.40	-		-		÷	:	:
Component C:												
Final satellite PM generation and analysis (Emory)			1					1		1	_	
Sample analysis, start epi modeling (Emory)		1				1	1	1		1	.	
Sampling and epi results comparison (Emory)			1				1			1		-
Assessment of benefits to Tracking (CDC)												
Data delivery preparation (All)		1	1	1		1	1	1		-	1	1
Final report preparation (All)		1	1	1		1	ł	1			-	-

Study Domains



Health study domain:
20-county Metro
Atlanta area (150 x 150 km²)

- Determined by health data availability
- Exposure modeling domain: 600 x 600 km²
 - Eliminate boundary effect of spatial models

First stage GAM: temporal variables

$$Y_{(t,site)} \sim \mu_1 + f_t(t) + f_{AOD}(t _ AOD) + f_{cloud}(cloud) + OMI _ type + \sum_k f_{met _k}(met _k)$$

Second stage GAM: temporal variables

$$\begin{split} Y_{(site)} = \overline{Y_{(t,site)} - \hat{Y}_{(t,site)}} &\sim \mu_2 + f_{AOD}(AOD_{site}) + f(population) \\ &\quad + f_{x,y}(x,y) + f(land \ use \ variables) \end{split}$$

Final prediction

$$[PM2.5]_{t,site} = \hat{Y}_{t,site} + \hat{Y}_{site} = \hat{Y}_{t,site} + \overline{Y}_{t,site} - \hat{Y}_{t,site}$$

Year 1 Objective: Data Integration

- Satellite data: MISR (AOD, 2000 -), MODIS (AOD, cloud cover, 2000 -), GOES (AOD, 2001 -), OMI (aerosol type, 2005 -)
- PM data: EPA AQS & IMPROVE (~ 90 sites, daily concentration), HBM results (12 km gridded daily)
- Meteorology: NARR (wind, PBL, RH, etc.)
- Land use: NLCD or MODIS land use data
- Health outcome: geocoded ED visits in 20-county metro Atlanta area

Action Plan for Year 1

- Master grid for integration: 12 km CMAQ grid
- MODIS/OMI data processing (MSFC/USRA):
 - Extract Terra & Aqua AOD separately with QA flags
 - Extract 1 km MODIS cloud cover data
 - Re-grid AOD and cloud cover data
 - Extract and re-grid OMI aerosol type data
- Land use data processing (MSFC/USRA & CDC)
 - Compare NLCD data with MODIS land use at small scale
- MSFC/USRA will complete (1) processing MODIS aerosol/cloud data, OMI and NLCD data, (2) mapping of EPA / IMPROVE data, and deliver to Emory by end of year 1.

Action Plan for Year 1 cont'd

MISR / GOES data processing (Emory)

- Extract MISR AOD based on QA flags and re-grid
- Extract GOES AOD based on NOAA criteria and re-grid
- NARR data processing (Emory)
 - Download raw data from NCDC
 - Extract surface / profile meteorological variables
- Emory will (1) complete MISR / GOES / NARR data processing by end of year 1, and (2) start field experiment preparation at end of year 1
- Team will decide the value of MODIS land use at end of year 1