Linking Asthma Exacerbation and Air Pollution Data

A Step Toward Public Health And Environmental Data Integration

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INTRODUCTION

Reducing exposure that triggers asthma such as air pollutants can reduce symptoms and the need for medication. Systems that monitor asthma, however, are generally not integrated with those that track environmental hazards related to asthma. This lack of integration hinders public health awareness and responsiveness to those environmental triggers. This project developed a system to augment sparse ground station measurements of PM 2.5 with remotely sensed satellite data from NASA, to provide a statewide spatial and time-series profile of environmental air quality. Statewide daily incidence data for acute asthma exacerbations are collected and analyzed to determine the correlation of air quality variation with asthma exacerbation incidence throughout the state over time. The goal is to utilize these readily available measures of air quality to provide a real-time risk assessment tool for asthma exacerbation that could easily be expanded nationwide for Environmental Public Health Tracking (EPHT).

METHOD AND RESULT

Air Quality

NASA MODIS satellite data of aerosol optical depth measurements provide an estimate of PM 2.5. A B-Spline surface model combines the point ground monitor data (EPA AQS) with satellite data (NASA MODIS) to provide daily estimates of PM 2.5 levels statewide at a 10 km resolution.

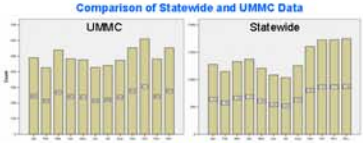
Terra Spacecraft with MODIS and Other Instruments

Ground Monitoring Stations

Asthma Exacerbations

- Statewide daily hospital visits for asthma collected by the Mississippi Department Health from 112 hospitals throughout the state
- Real-time asthma data collected by the Emergency Department of the University of Mississippi Medical Center.

Comparison of Statewide and UMMC Data

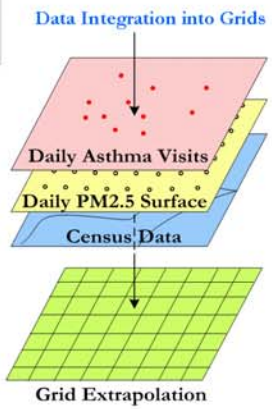


Predictors of Asthma

	B	S.E.	Wald	Sig.	Exp(B)	95.0% C.I.for EXP(B) Lower	Upper
Age (<15=1, 15 or older=0)	1.882	.056	1022.274	.000	6.565	5.950	7.367
Gender (M=0, F=1	.166	.057	8.466	.004	1.181	1.056	1.321
Race (WHO, AA=1, Other=2)	.790	.056	192.175	.000	2.204	1.965	2.473
Constant	-.508	.064	63.106	.000	.602		

Model Approach

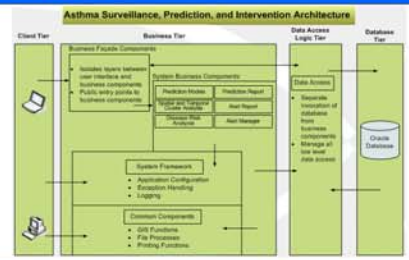
The spatio-temporal variation in air quality and asthma cases is resolved to a level of 10 x 10 km^2 grids and includes the relevant demographic data for each grid. A Poisson regression model is used to correlation between air quality data, demographic variables, and asthma incidence.



METHOD AND RESULT

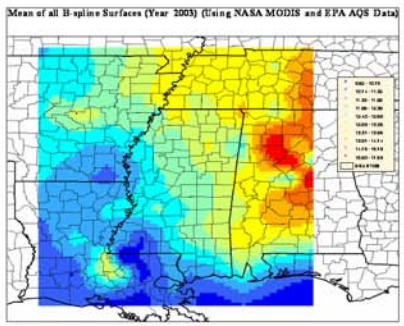
System Architecture

System was designed with multi-tier architecture which includes: Client, Business, Data access logic, and Database tiers. Business tier includes the façade component and business core components (prediction model, alert manager, spatial scan analysis model, etc.). Data access logic tier separates the invocation of the database call from the business models.



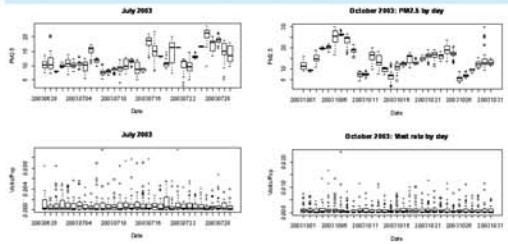
Surface Model PM 2.5

A B-Spline surfacing algorithm generates daily PM 2.5 estimations covering 6084 grids in the study area using daily MODIS AOD data and daily AQS PM 2.5 ground data



Asthma and PM 2.5 Analysis

Daily boxplots for observed asthma visits, modeled PM 2.5 for July and October 2003, illustrate a variation by days across the grid cells. Poisson regression results suggest significant association between visits and local demographics, illustrating the importance of adjusting for demographics when assessing the impact of local PM 2.5 values. Analyses incorporating both demographics and daily PM 2.5 predictions are underway to estimate and map the impact of the modeled values on asthma visits.



CONCLUSION

- Correlation between asthma visits and B-Spline estimated PM 2.5 is not consistent throughout the year at grid level
- This application approach is intended to explore other variables of interest and at different spatial and temporal scales
- Health and environmental data have been successfully integrated into an existing syndromic surveillance system developed at UMMC (GeoMedStat)