An Environmental Data Web Service Based on Near-Road Dispersion Modeling to Support the Los Angeles Pediatric Research Integrating Sensor Monitoring Systems (PRISMS) Informatics Center

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Introduction

- The Biomedical REAl-Time Health Evaluation (BREATHE) platform **integrates sensor data, local and regional environmental data, clinical data, and information from patient-reported activities** into a real-time system that can help children avoid asthma incidents. BREATHE is the focus of the Los Angeles PRISMS Informatics Center.
- As exposure to traffic-related air pollutants is associated with acute asthma exacerbation, obtaining real-time near-road exposure information is crucial for predicting asthma incidents.

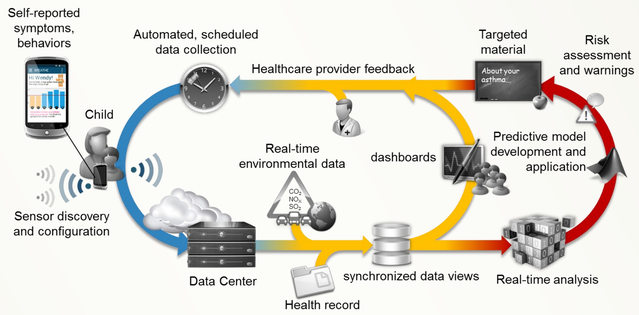


Figure 1. The BREATHE platform.

Purpose

Build a real-time web service for the BREATHE platform that collects regional air quality data and estimates near-road exposure.

Method

- Background concentrations are estimated using **inverse distance weighting**, based on air quality system (AQS) monitoring data.
- **Traffic-contributed concentrations** are modeled using the **Research LINE source dispersion model (RLINE)**.
- The BREATHE environmental data service was built in Python using Flask library. The system consists of:
  - ⇒ Web service: Takes user inputs (date and location) and interacts with the Data and Model services.
  - ⇒ Data service: Retrieves information from downloaded air quality and weather data.
  - ⇒ Model Service: Runs the Meteorological Data Preprocessor for AERMOD (AERMET) and RLINE models.

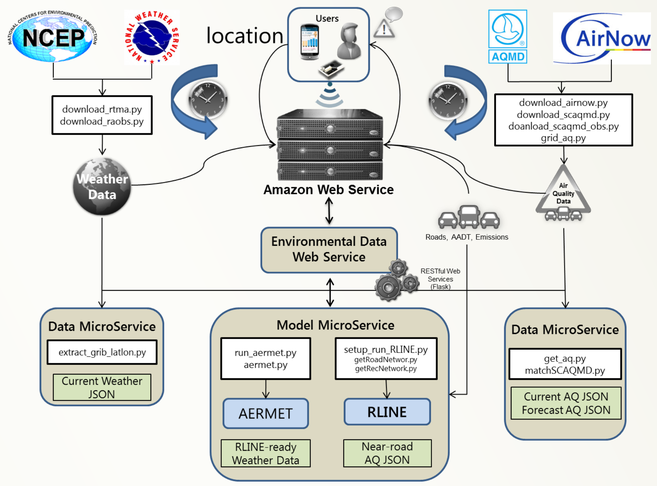
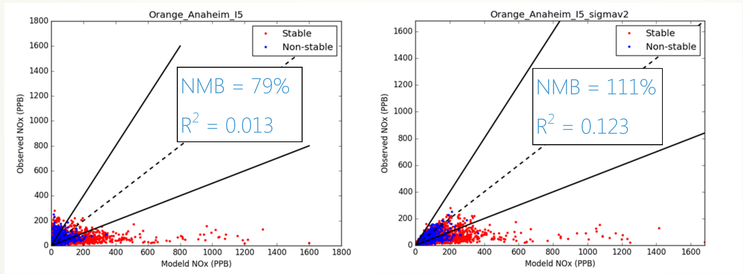


Figure 2. Diagram of the web-based environmental data service.

Model Evaluation

- The initial model evaluation (Figures 3a and 3b) shows an over-prediction for NO_X.
- Increasing sigmav (i.e., the minimum lateral turbulent wind component, which controls the weight of the meander plume) improved the performance (Figures 3c and 3d).



(3a) sigmav = 0.2, no background *(3b) sigmav = 0.2, with background*

(3c) sigmav = 1, no background *(3d) sigmav = 1, with background*

Figure 3. Model evaluation results at the Anaheim near-road monitor at Interstate 5. NMB stands for normalized mean bias.

Results

- After receiving the user location, the web service returns JavaScript Object Notation (JSON) objects with NO_X, NO_2, and $PM_{2.5}$ concentrations in 14 seconds.
- The concentration gradients from roadways are captured by the system.

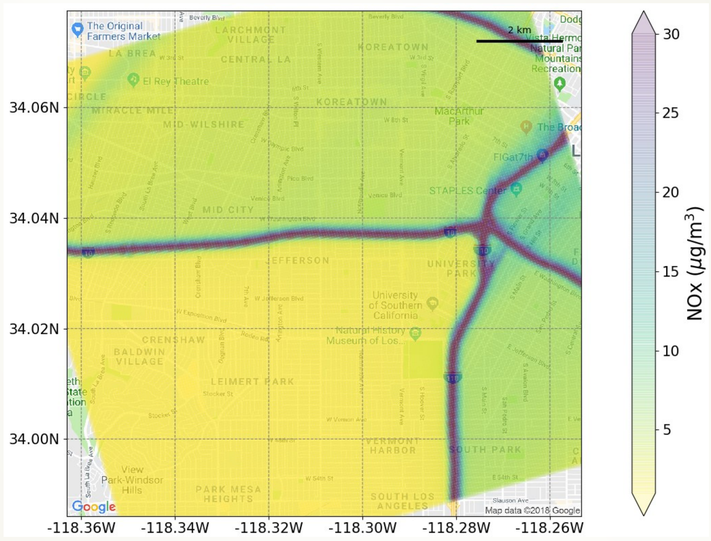


Figure 4. NO_x concentration map produced by the model MicroService system using RLINE.

Summary

- A real-time web service for BREATHE was implemented. It reports near-road NO_X, NO_2 and $PM_{2.5}$ concentrations in Los Angeles, California.
- Increasing sigmav for RLINE addresses the over-prediction under stable conditions.
- The model evaluation against near-road monitors shows reasonable model performance.

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