Progress on the Use of MODIS Aerosol Optical Depth for Fine-Scale Particulate Matter Analysis: Case Studies for California

Introduction

• PM_{2.5} is the type of particulate matters (PM) with 2.5 micron or smaller aerodynamic diameter

 Epidemiological and clinical studies have found associations between exposure to PM₂₅ and adverse health effects, such as cardiorespiratory disease, lung cancer, stroke and premature births

 This study uses the observations obtained from the MODIS instrument onboard the NASA Aqua satellite, to construct regional PM concentration fields in California Dispersion modeling is used to build in fine-scale features within these regional fields.

Method and dataset

• The NASA Aqua MODIS satellite data provide one observation per day at local time around 1:30 pm. Columnar aerosol optical depth (AOD) concentrations are retrieved from the MODIS data A relationship between columnar AOD and surface PM_{25} concentration is derived based on two models – a regression model, and a surfacing model Sensitivity tests are conducted to compare and evaluate two different types of surfacing algorithms (led by Mohammad Al-Hamdan) •A dispersion model is used to inform the community-scale distributions of PM_{25} concentrations (led by Akula Venkatram and Frank Freedman) • A review study is conducted to document and compare publicly available PM_{25} datasets over the continental U.S. (led by Minghui Diao)

 $PM_{2.5}$



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Results

Part 1. Regional PM2.5. Developing relationship between columnar AOD and



Part 2. Building in fine-scale spatial features using dispersion models

Forward: Knowledge of Emissions Roadway Emissions \rightarrow Dispersion Model \rightarrow Concentration Field

Backward: Knowledge of Concentrations Monitored PM2.5 \rightarrow Dispersion Model \rightarrow Emission Configuration \rightarrow Concentration Field



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Part 4. A survey of $PM_{2.5}$ exposure data, method, and applications (Manuscript submitted to ES&T, see reference)



• Manuscript aims to provide guidance to environmental research and public health sector users on how to interpret and utilize publicly available PM_{25} exposure data sets. • Four main types of methods for generating PM_{2.5} exposure data are discussed: ground monitor only, monitor + satellite data, monitor + model, monitor + satellite data + model. Advantages and disadvantages are discussed for each data set. • Key result of comparisons between four datasets: CDC WONDER (a), CDC Tracking Network (b), and Dalhousie data (c). EPA AQS and IMPROVE fused data (d).

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4.59 3.45 0.71 0.76 4.14 3.15 0.84 0.742 4.714 3.505 0.06 Merged AQS/MODIS (0.737) 4.713 (3.501) -0.02



Reference