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What can we learn from machine learning models developed for short-term forecasting of PM2.5?

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Abstract Text:

Accurate forecasting of air pollution concentrations, both short- and long-term, can provide sensitive and other groups with some warning, thus enabling them to take action to reduce exposure to unhealthy levels of air pollution. We explore how different machine algorithms perform in predicting short-term 1-3 hour forecasts of PM2.5 concentrations at 5 different sites in Oregon. We use hourly PM2.5 and meteorological observations from Oregon's air quality monitoring network for the years from 2012-2016 as the training data set, and the 2017 PM2.5 data as the validation dataset. The accuracy of the machine learning models (MLMs) is estimated using the following metrics:
(1) Comparison of the mean square errors for the MLM 1-hour predictions with the Reff model.
(2) The mean bias and mean error of the 1-, 2-, and 3-hour predictions for each site as compared to the observed concentrations.
(3) The slope and R^2 of the best-fit line between predicted vs. observed concentrations.

MLMs are traditionally treated as black boxes. We use a combination of residual analysis, sensitivity analysis, and visualizations to "peek" instead the black box. Our goal is to explore

what we can learn from the MLM performance; and to harness these insights into picking the right algorithm and building better models.

Session Selection:
Use of Machine Learning and Causal Discovery to Advance Knowledge in the Atmospheric Sciences – Methods, Limitations and Trade-offs

Submitter's E-mail Address:
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Abstract Title:
What can we learn from machine learning models developed for short-term forecasting of PM2.5?

Requested Presentation Type:
Poster Only

Previously Published?:
Yes

Previously Published Material:
The machine learning model development and comparison was presented at the EPA conference in Portland, OR in August 2018. This study builds on the previous work and begins exploring the models through sensitivity analysis and examines the residuals to get insights into what the models are missing or what are they catching? How do their predictions - and residuals - differ? We hope to develop heuristics on algorithm selection through these insights.

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