On the Use of Prognostic Meteorological Data in Dispersion Modeling

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Motivation

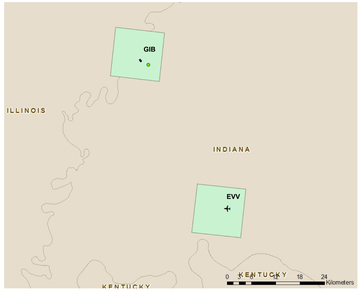
EPA is currently in the process of evaluating and updating the *Guideline on Air Quality Models* (i.e., Appendix W). As a part of this process, the meteorological inputs to dispersion models are being examined. As stated in Appendix W, the meteorological data used is 'dependent on: (1) the proximity of the meteorological monitoring site, (2) the complexity of the terrain, (3) the exposure of the meteorological monitoring site, and (4) the period of time during which data are collected.' Currently, these data include either National Weather Service (NWS) AWOS/ASOS data or site-specific meteorological monitoring.

However, there are myriad issues with using these data; NWS sites may not be representative of the location and site-specific monitoring may not be financially feasible. One possible solution is using prognostic meteorological data, given advancements in computational efficiency and model resolution. Using prognostic meteorological data (e.g., WRF) to inform dispersion models may provide more representative data compared to NWS data and is potentially more cost-effective than site-specific monitoring.

In order to generate dispersion model inputs from prognostic meteorological models, the Mesoscale Model Interface (MMIF) tool was developed. This tool will generate the inputs necessary to run various dispersion models such as AERMOD and SCICHEM. Here, we present a comparison of site-specific, NWS, and prognostic data in dispersion applications.

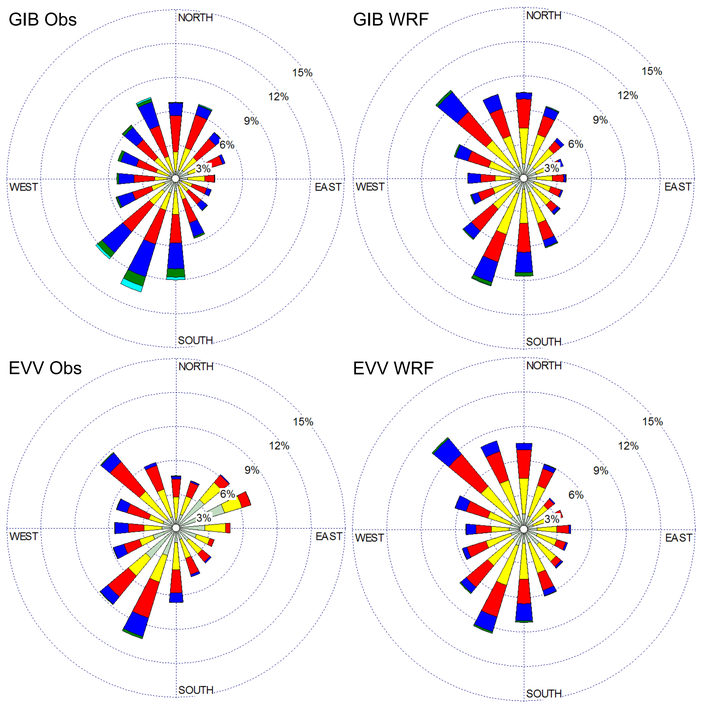
Study Setup

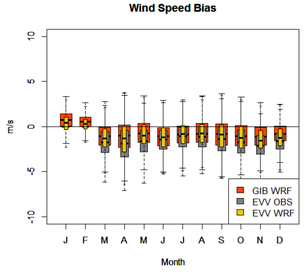
In order to examine the representativeness of the prognostic meteorological data, a comparison with both site-specific meteorology and local NWS data is presented. A facility in Gibson, IN (GIB; Frost, 2014) made site-specific meteorological observations in 2010. The closest NWS observations were located at Evansville Regional Airport (EVV). A 12-km annual WRF run for 2010 was processed through MMIF to generate AERMOD-ready inputs. AERMOD was then run for each set of meteorological data and the results compared.

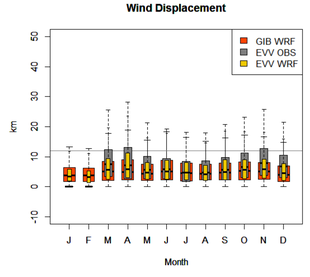


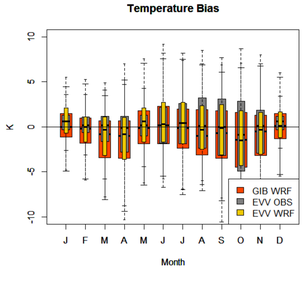
The location of the facility and airport, along with the WRF cells used for the MMIF extraction (green) is shown on the left. A satellite image of the facility and nearby monitors is shown on the right.

Meteorological Comparison





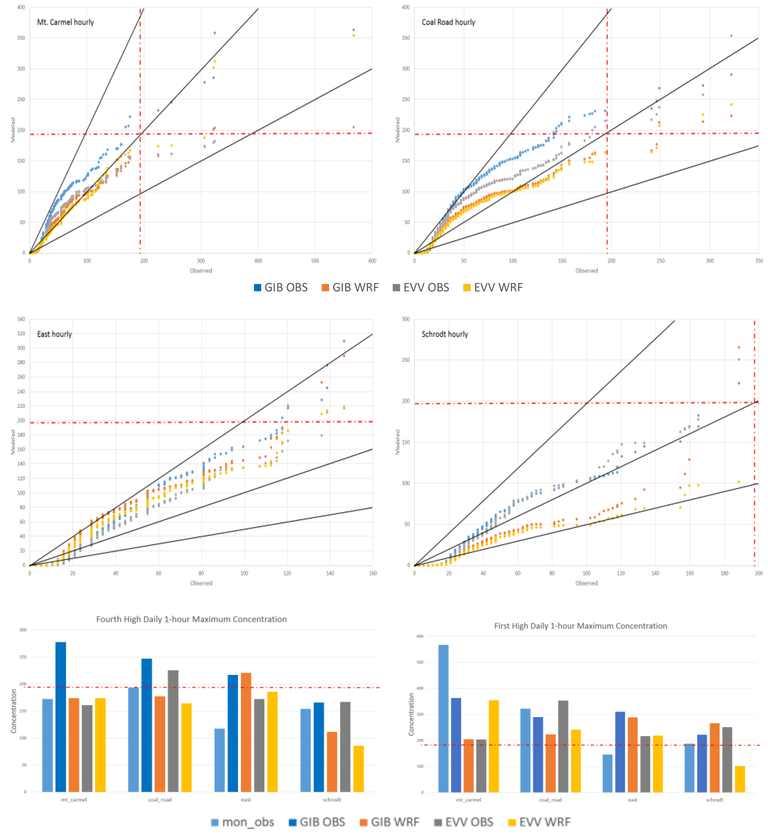




Statistical Evaluation:

Temperature, wind speed and direction from MMIF processed data at the Evansville airport (EVV) and Gibson, IN (GIB) facility, as well as NWS data (OBS), were compared to the site-specific meteorological data at the Gibson facility. Overall, the variability between the three sets of data was less than the variability when compared to the site-specific meteorological data. This similarity indicates the dispersion modeling results when using prognostic data may compare favorably to those using NWS data.

Dispersion Modeling Results



AERMOD Evaluation:

AERMOD (version 14134) simulations were performed for the facility for the following meteorological scenarios: site-specific observations (GIB_OBS), 12 km WRF for the facility's grid cell (GIB_WRF), Evansville NWS observations (EVV_OBS) and WRF for Evansville (EVV_WRF). QQ-plots of the hourly observations vs. hourly modeled concentrations and comparisons of the 1st and 4th daily highest daily 1-hour maximum concentrations show that MMIF concentrations tend to under predict compared to concentrations derived from observed meteorology but generally show good agreement with monitored concentrations.

Future Work

Currently, evaluations are ongoing that examine the use of multiple years of prognostic meteorological data compared with multiple years of NWS data. These evaluations will allow a better understanding of the representativeness and limitations of using prognostic meteorological data in dispersion models.

WRF Model simulations were performed under EPA guidance by Lara Reynolds and Kathy Brehme of CSC.
MMIF extractions were performed under EPA guidance by Darrell Ensley of CSC.
Frost, K. D., AERMOD Performance Evaluation for Three Coal-fired Electrical Generating Units in Southwest Indiana, *J. Air Waste Manage. Assoc.*, 64:3, 280-290, DOI: 10.1080/10962247.2013.858651
The authors wish to think Kali Frost of the Indiana Dept. of Environmental Management for the Gibson AERMOD inputs.
The views expressed here are those of the individual authors and do not necessarily reflect the views and policies of the EPA.