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Application of advanced data assimilation techniques to improve atmospheric transport and dispersion predictions

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Accurate meteorological modeling is critical for obtaining realistic atmospheric transport and dispersion (T&D) predictions. There are several data assimilation (DA) techniques used to improve meteorological results. Two common philosophies are nudging and variational DA. Traditionally, nudging is used in T&D, whereas more sophisticated variational techniques are used in weather forecasting. Here, these two DA techniques are investigated in order to assess their specific impacts on T&D results and to determine if the more advanced DA techniques used in weather forecasting can be employed for T&D applications. The two methods are applied in the Weather Research and Forecasting (WRF) model for the Colorado Springs Tracer Experiment (COSTEX). First, WRF results are verified and validated against available measurements of temperature, wind speed, and wind direction. Next T&D simulations for COSTEX are performed with the Hybrid Single-Particle Lagrangian Integrated Trajectory model. Using the COSTEX tracer observations, the correlation, fractional bias, figure of merit in space, and Kolmogorov-Smirnov parameter are computed to evaluate the robustness of the T&D simulations and identify which DA technique provides the most realistic results. Overall this study provides guidance for the meteorological community as to which DA techniques provide the most value for T&D simulations.

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