

FINE GRID METEOROLOGICAL SIMULATIONS
FOR AIR QUALITY APPLICATIONS
USING MM5 AND WRF

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In order to evaluate the current state of the science for inter-regional transport/diffusion and to identify what model attributes are most effective for improving prediction skill over the past 10-15 years (e.g., finer resolution, better physics, four-dimensional data assimilation (FDDA)), the CAPTEX-83 Episode 1 on 18-19 September 1983 was chosen to evaluate MM5 and its transport and dispersion skill on inter-regional scales. Use of the MM5 results in the Second-Order Closure Integrated Puff (SCIPUFF) dispersion model made it possible to verify predicted surface tracer concentrations against observed surface concentrations collected during the CAPTEX-83 study. Specific conclusions from this study are as follows. (1) A model configuration reflecting capabilities of the late 1980s (70-km horizontal grid, 15 layers, older sub-grid physics, and no FDDA) was shown to produce large errors in the simulated meteorology that severely degraded the accuracy of the surface tracer concentrations predicted by SCIPUFF. (2) Improving the horizontal and vertical resolution of the mesoscale model to 12 km and 32 layers led to some modest improvements in the MM5 performance, but the further addition of more advanced physics produced much greater reductions of simulation errors. (3) Use of FDDA, along with 12-km resolution and improved physics, produced the overall best performance of all. (4) Further reduction of horizontal grid size to 4 km had a detrimental effect on meteorological and plume dispersion solutions due to misrepresentation by the MM5's explicit moist physics of the extensive convection associated with a cold front crossing the lower Great Lakes.

Penn State has begun new work on improving the fine grid (4-km) CAPTEX simulations using MM5 and WRF. The primary goal of this new Coordinating Research Council (CRC) project is to investigate the role of model physics and numerics on the accuracy of the winds and cloud / precipitation fields simulated at $\Delta x = 4$ km during CAPTEX'83. As a result, we will gain better understanding as to how these fields may be improved in MM5 and WRF for application in three-dimensional air quality models. Various sensitivity studies will be performed in both models to provide us further insight into how to optimally configure a mesoscale model (MM5, WRF) so that its 4-km domain solution may be improved.