Sensitivity and Uncertainty Analysis of Physical Parameterization and Initial Conditions on Meteorological Variables and CO_2 Mole Fractions

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Atmospheric transport model errors are one of the main contributors to the uncertainty affecting CO_2 inverse flux estimates, but have not been quantified thoroughly. This study aims to assess the transport errors over the Mid-Continental Intensive domain with an ensemble of simulations created with the Weather Research and Forecasting (WRF) mesoscale model using different physical parameterizations (e.g., planetary boundary layer (PBL) schemes and land surface models (LSMs), cumulus parameterizations and microphysics parameterizations). Modeled meteorological variables and atmospheric CO_2 concentrations were compared to observations (e.g., radiosondes and CO_2 mixing ratio towers) during the summer of 2008. The model-data mismatch for several meteorological variables (i.e., wind speed, wind direction and PBL height) was used to examine the spread of the ensemble and identify the model configurations that were systematically biased. Then we present a study of the sensitivity of atmospheric conditions to the choice of physical parameterization, to identify the parameterization driving the model-to-model variability in atmospheric CO_2 concentrations at the mesoscale over the MCI domain. Preliminary results show that wind speed and wind direction are influenced by choice of PBL schemes, whereas the PBL height bias is influenced by the choice of PBL scheme and LSM. Finally, our sensitivity test shows that all physical parameterizations drives the model-to-model variability in atmospheric CO_2 concentrations except for the microphysics parameterization. Future work will be to describe these transport errors in the regional atmospheric inversions using this ensemble, for the year of 2008.

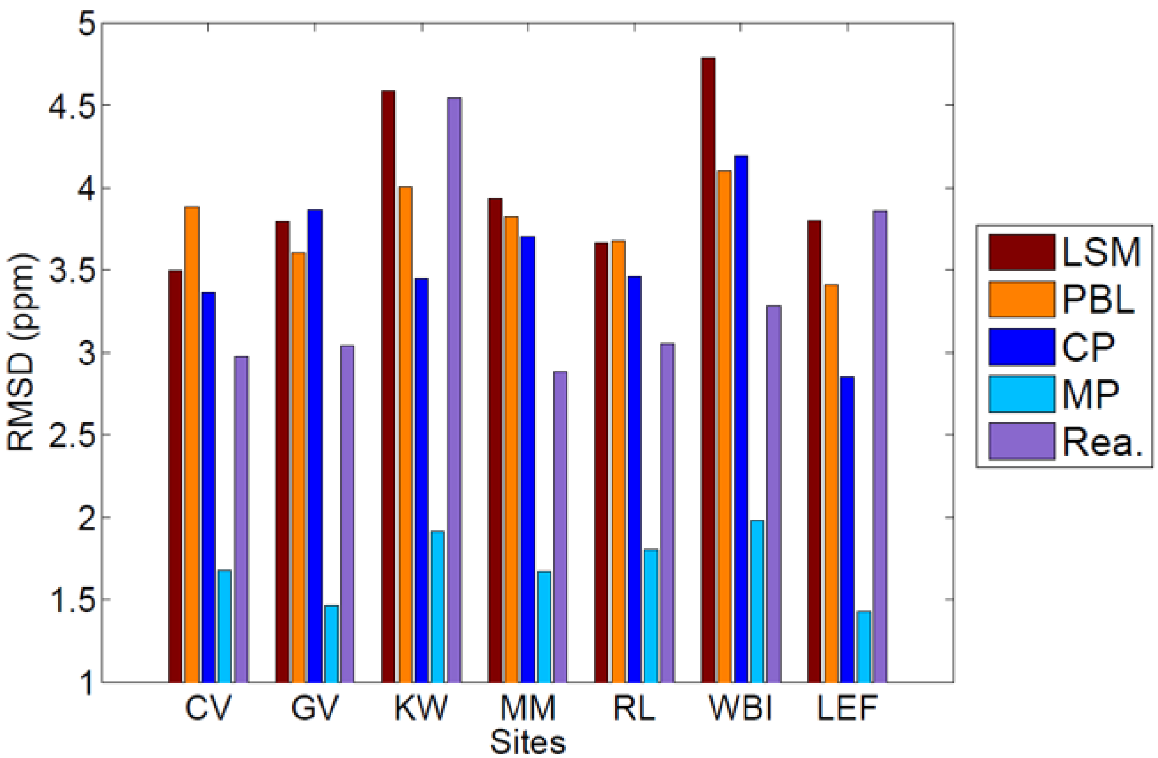

Figure 1. Root mean square difference (RMSD) of the CO_2 mixing ratio for each of the physical parameterizations (e.g., planetary boundary layer (PBL) schemes and land surface models (LSMs), cumulus parameterizations (CP) and microphysics parameterizations (MP)) and reanalysis.