Evaluating Planetary Boundary Layer Depths in CarbonTracker for a Region Around the Moody Tall Tower in Texas

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The difficulty of modeling atmospheric transport and mixing processes introduces significant uncertainties in the fluxes estimated with inverse carbon transport models. Of particular importance for a correct estimation of carbon fluxes is the simulation of vertical transport and mixing within the planetary boundary layer (PBL) and between the PBL and the free troposphere. An important diagnostic for vertical transport and mixing is the PBL depth, the height above the surface up to which surface fluxes of heat, moisture, momentum, and trace gases such as carbon dioxide (CO_2) are transported and mixed on a diurnal time scale. Despite its importance, there is large uncertainty in how well current transport models simulate PBL depths and how biases in PBL depths translate to uncertainties in CO_2 fluxes. The diurnal and seasonal cycle of CO_2 concentrations near the surface and in the PBL is strongly dependent on vertical mixing within the PBL, and if we are to have confidence in inverse modeling estimates of continental CO_2 fluxes, then the transport models driving the inverse models must also be capable of predicting the variation in PBL depth and structure. In this poster, we evaluate the performance of the atmospheric transport model TM5 that drives global carbon inverse models in its simulation of regional scale PBL depths for a case study (around the Moody tall tower in Texas) that coincided with a large amount of available data, including data from ceilometer, wind profilers, and radiosonde sounding. Simulations with the Weather Research and Forecasting (WRF) model are also performed to investigate the spatial PBL depth variability and to illustrate the challenges of evaluating simulated PBL depths with local scale observations.

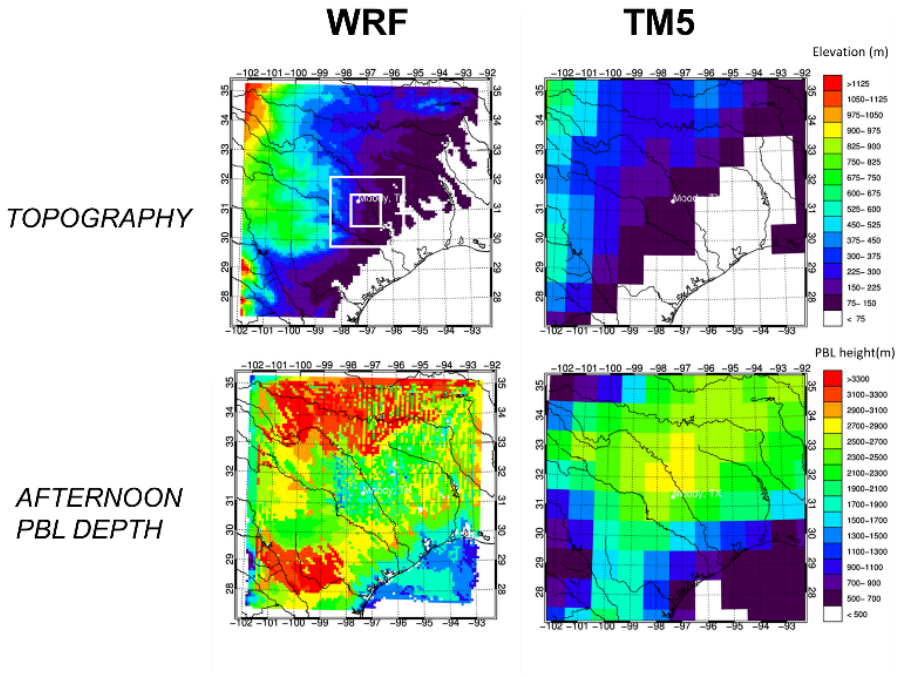

Figure 1. Comparison of topography and afternoon PBL depth between WRF (left column) and TM5 (right column). For a particular case study (3 August 2006), large differences in the spatial PBL depth variability between WRF and TM5 are observed for a 10x10 degree domain. However, for the location around the Moody, TX, tall tower, the PBL depth compares well.