Toward a Combined Data-fusion Atmospheric Inversion System at Continental Scale: Structure of Flux Errors and Atmospheric Regional Variability Over North America

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Current efforts for the development of regional networks of CO_2 mixing ratios on continental surfaces aim at constraining regional carbon balances for mitigation and adaptation policies. The design of these networks remains unclear for both constraining the regional balance and capturing the spatial patterns in the surface fluxes. The Mid Continent Intensive (MCI) experiment offers a unique tower deployment over the U.S. Upper Midwest, with 8 surface towers located in a 700 x 700 km domain measuring *in situ* CO_2 atmospheric mixing ratios continuously. We used our mesoscale inversion system to perform sensitivity experiments, tower removal tests, and cross validations to investigate the robustness of the regional carbon balance and the flux spatial patterns to the network design. We also investigated the impact of our initial assumptions, in particular the spatial structures in the prior flux errors, affecting both our corrections of the regional biases and smaller scale flux signals. Finally, we compared our results to recent findings using eddy-flux observations and land vegetation modeling. The converging estimates around few hundreds of kilometers at the weekly time scale indicate clearly that spatial coherence is present in regional CO_2 flux errors, even though a more rigorous quantification is still limited by the lack of observations at finer scales.

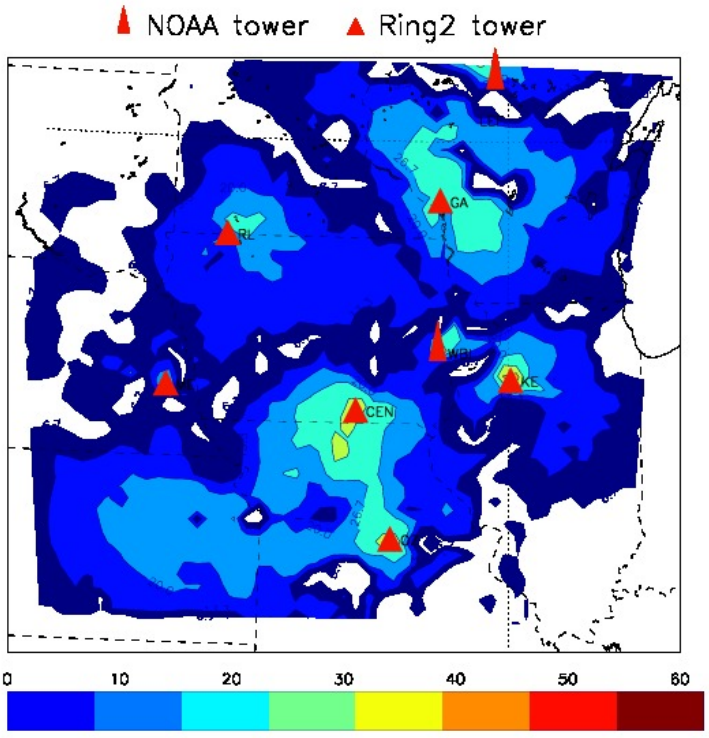

Figure 1. Error reduction in % for June to December 2007 using the MCI tower network at 20 km resolution, assuming prior flux error spatial correlations based on ecosystems and distances between pixels.