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Gross surface fluxes of carbonyl sulfide and carbon dioxide inferred from simultaneous assimilation of boundary layer observations

J. E. Campbell (1), G. R. Carmichael (2), N. J. Blake (3), S. A. Vay (4), Y. H. Choi (4), T. Chai (2), Y. Tang (2), M. C. Mena (1), J. L. Schnoor (1), C. O. Stanier (2)

(1) Civil and Environmental Engineering, University of Iowa, USA, (2) Chemical and Biochemical Engineering, University of Iowa, USA, (3) Chemistry, University of California, Irvine, USA, (4) Langley Research Center, NASA, USA

(cae@engineering.uiowa.edu / +01-319-3510175)

Inversion studies statistically combine trace gas observations and atmospheric models to infer fluxes between the atmosphere and the Earth's surface. The covariance between carbon dioxide and carbon monoxide has been shown to provide a powerful tool for improving the accuracy of these inverted fluxes. However, this approach is not as useful for studies of the growing season when the biosphere fluxes are in question. It has been hypothesized that the close relationship of plant uptake of carbonyl sulfide and carbon dioxide could be exploited to estimate regional uptake of these gases. Here we demonstrate how boundary layer observations of carbonyl sulfide and carbon dioxide can be exploited in a four dimensional variational data assimilation framework to obtain improved surface flux estimates during the growing season over North America. We use aircraft observations from the NASA INTEX-A experiment along with the STEM regional atmospheric transport model. In the future, simultaneous observations of carbonyl sulfide and carbon dioxide could provide a great benefit to unraveling the processes associated with the surface fluxes of both gases.