Geophysical Research Abstracts, Vol. 8, 05427, 2006
SRef-ID: 1607-7962/gra/EGU06-A-05427

Well-calibrated, flux-tower based, continuous CO2 mixing ratio measurements suitable for atmospheric inversions: The virtual tall towers approach

Davis, KJ (1), Butler, MP(1), Ricciuto, DR(1), Wang, W(1), Bakwin, PS(2)

(1) The Pennsylvania State University, USA [davis@met.psu.edu], (2) National Oceanographic and Atmospheric Administration, USA [pbakwin@comcast.net]

Study of the terrestrial carbon cycle via atmospheric inversions is data limited. One approach being used to increase the density of carbon dioxide mixing ratio data is the addition of well-calibrated CO2 instruments to eddy-covariance flux towers. Interpretation of these data is complicated by the fact that the data is collected close to the biological sources and sinks of CO2 at the surface. We present a method for 1) subsampling such a data stream and 2) applying a micrometeorological correction such that the daytime data are very close to the mean mixing ratio within the daytime convective boundary layer. This approach has become known as the "virtual tall towers" approach, given the fact that the daytime data available via this approach are similar to the data that would be available from a tall tower. We evaluate and calibrate the approach with multiple years of data from the 447m tall WLEF tower. We show that the approach is capable of providing mixing ratio values with random and systematic differences from the daytime boundary layer mean of 0.2 ppm or less on a monthly basis. We also show that subsampling data for well-mixed atmospheric conditions reduces the systematic errors to no more than about 2 ppm for a monthly mean value, and is more than sufficient for clearly detecting the synoptic and seasonal cycles of CO2 in the continental boundary layer. Further, we discuss the method for applying a factor that adjusts surface layer mixing ratio measurements to be approximately equal to the mid boundary layer values, and calibrate this correction using WLEF measurements. We describe the sources of uncertainty in the correction, and make recommendations for future work to reduce those uncertainties.