Analyzing Gross Primary Production and Respiration of Terrestrial Ecosystems Using a Global Carbon Cycle Model that Includes Carbonyl Sulfide

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Carbonly sulfide (COS), an analog of CO_2, is emerging as a useful tracer of carbon cycle processes. Previous studies have shown that COS is taken up by leaves and that the rate of its uptake is closely linked to the rate of gross primary production (GPP). It has been suggested that COS uptake could be used as a direct measure of photosynthesis by terrestrial ecosystems on regional and continental scales. COS concentrations are being monitored in the background atmosphere at 13 sites and profiles of the lower atmosphere are being made at a number of continental sites. In addition, a number of atmospheric chemistry campaigns have measured COS and CO_2 concentrations. To help interpret these measurements, we have incorporated the biochemical and biophysical mechanisms controlling COS exchange into a land surface model (SIB) and we have used this new parameterization to simulate global COS and CO_2 fluxes and transported these together with other known sources and sinks in a chemical transport model (PCTM). Because the new terrestrial sink was larger and differently located than that used in previous studies (Kettle et al., 2002), we used an inversion approach to adjust the ocean flux to obtain a reasonable match to the annual mean concentration from the Arctic to the South Pole. The model exhibits reasonable skill in simulating observations of the seasonal cycle (Fig. 1a) and vertical profiles of COS and CO_2 concentration over North America (Fig. 1b) and in the tropics (not shown). Also shown is a profile simulated with and earlier parameterization of the terrestrial sink used by Kettle et al., (JGR, 107(D22), 4658, doi:10.1029/2002JD002187, 2002).

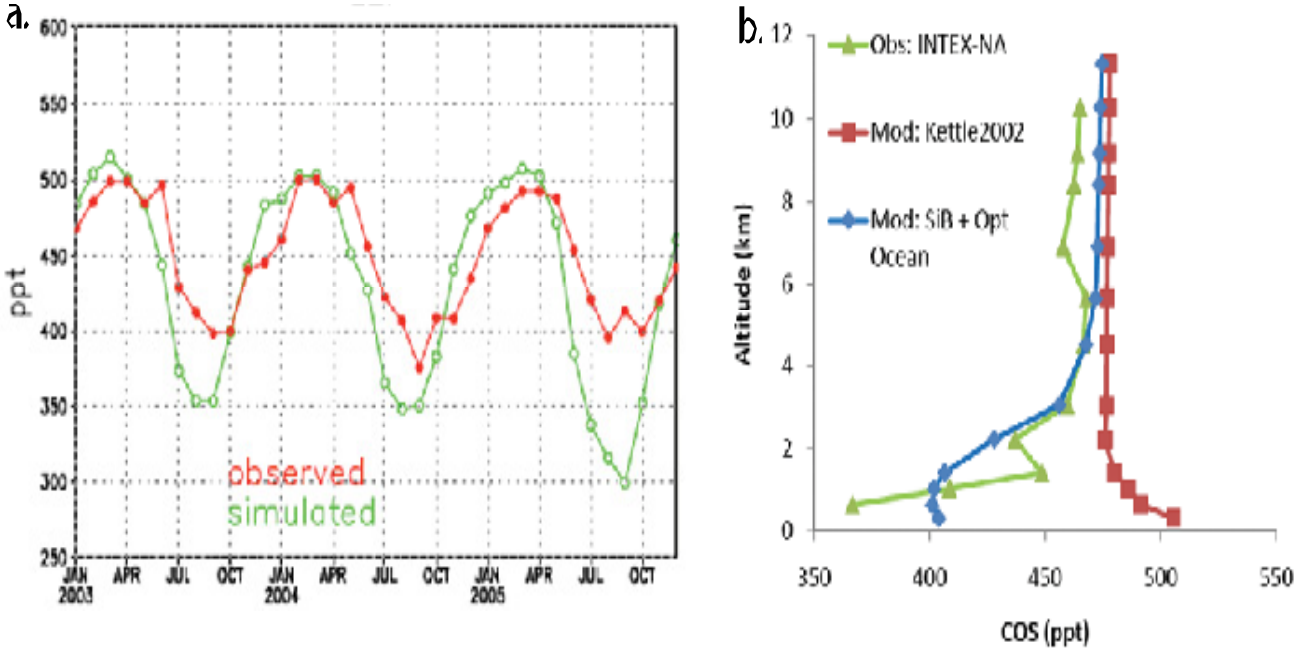

Figure 1. Seasonal cycle of observed and simulated COS at the WLF tower (left) and vertical profiles sampled by INTEX-NA (right) over Indiana and Illinois in July 2004 (mean monthly profile simulated vs mean of profiles sampled).