CAN CARBONYL SULFIDE PROVIDE CONSTRAINTS TO GROSS TERRESTRIAL PHOTOSYNTHESIS?

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The atmospheric burden of carbon dioxide (CO_2) increases at variable rates from year to year in part because of variability in carbon uptake and release by the terrestrial biosphere. Improving our understanding of this interaction and the factors that influence it are crucial for developing a predictive understanding of atmospheric CO_2 in the future. Unfortunately, the tools available for studying independently the response of respiration and photosynthesis to changes in climate are limited.

We have suggested recently that carbonyl sulfide may help in this regard (Montzka *et al*., 2007). Uptake by vegetation represents the main loss mechanism for atmospheric carbonyl sulfide (COS). COS undergoes rapid hydrolysis by carbonic anhydrase and rubisco, the same enzymes involved in the initial stages of carbon assimilation by vegetation. The influence of this uptake is readily observed in the spatial and temporal distribution of atmospheric COS in the Northern Hemisphere (see Figure). COS is unique, however, because it is not emitted in large quantities from vegetation as is CO_2 during respiration. This critical fact suggests that large-scale features observed for COS may be responding primarily to spatial and temporal variations in terrestrial photosynthesis. Although this hypothesis is supported by the measurement data obtained to date, the influence of non-vegetative COS fluxes is poorly constrained. Here we investigate the observations we have made over the past 8 years to assess the relationships between COS and CO_2 as a function of time and space, and the extent to which non-vegetative processes influence atmospheric COS over North America.

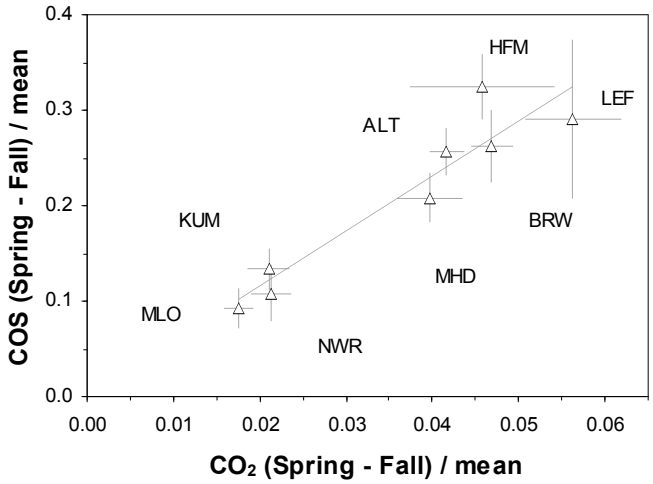

Figure Caption: The relative seasonal amplitudes of carbonyl sulfide (COS) and carbon dioxide (CO_2) are strongly correlated in observations obtained from surface sites in the Northern Hemisphere (MLO=19N, KUM=19N, NWR=40N, HFM=43N, LEF=46N, MHD=53N, BWR=71N, ALT=83N). Furthermore, the relative amplitudes of COS seasonal variations are ~6 times larger than observed for CO_2.

Montzka, S.A., P. Calvert, B. Hall, J.W. Elkins, P. Tans, and C. Sweeney (2007), On the global distribution, seasonality, and budget of atmospheric carbonyl sulfide (COS) and some similarities to CO_2, *J. Geophys. Res.*, 112, D09302, doi:10.1029/2006JD07665.