

On the Relation Between Atmospheric Carbonyl Sulfide and Carbon Dioxide

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CMDL measurements of carbonyl sulfide (COS) at ground-based sampling stations across the globe show large seasonal variations that are strongly related to those observed for CO₂. Specifically, the amplitude of seasonal variation observed for COS at eight Northern Hemisphere (NH) sites are strongly correlated ($r^2 \geq 0.9$) to those observed for CO₂. The eight NH sites at which COS measurements were made during recent years include coastal sites in the arctic (Barrow, Alaska, and Alert, Canada), midlatitudes (California), and on Hawaii (Kumukahi), continental United States' sites (Wisconsin and Massachusetts), and high-altitude sites (Mauna Loa, HI, and Niwot Ridge, CO). This correlation (Figure 1) mostly likely arises because a major loss process for both gases is a reaction with carbonic anhydrase in photosynthesizing plants. But whereas CO₂ is respired by vegetation and other organisms, COS is not similarly produced. This important point may help explain why the spring-summer drawn-down observed for COS during this time of year is about eight times larger than that for CO₂ at these NH sites. Given our understanding of interactions between trace gases and vegetation, the observations suggest that COS measurements could provide constraints on our understanding of CO₂ uptake by plants independent of the influence of respiration. Sources and non-vegetative sinks of COS are also considered, and constraints to their influence on COS seasonality in the Northern Hemisphere may possibly be derived, for example, from measurements at Southern Hemispheric sites.

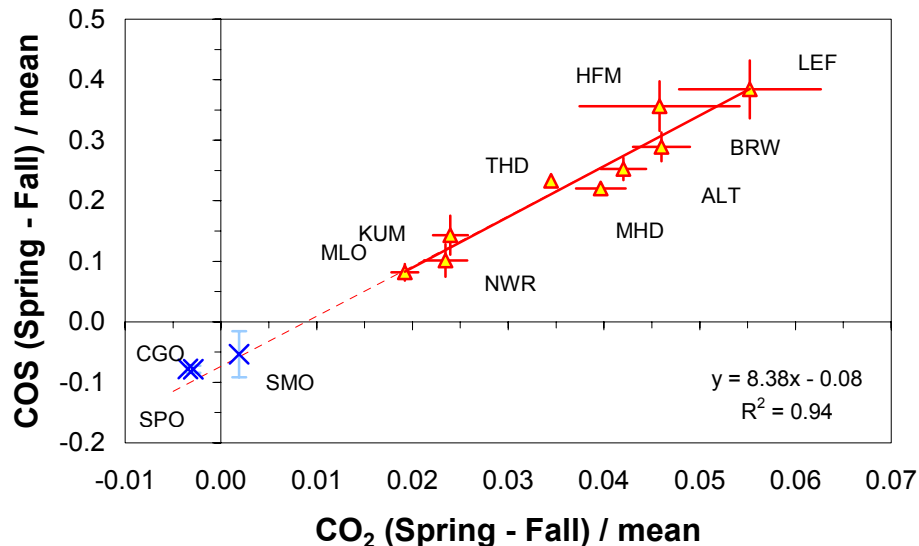


Figure 1. Relative seasonal variation amplitudes measured for COS and CO₂ at different sites in both hemispheres (red = NH, blue = SH; note that the linear regression was calculated only with the NH data). CO₂ seasonality at THD (Trinidad Head, CA, 41°N, 124°W, 120-m above sea level (asl)) courtesy of T. Lueker, SIO; CO₂ data from HFM (Harvard Forest, Massachusetts, 42.6°N, 72°W, 340-m above sea level) courtesy of S. Wofsy. CO₂ data from all other sites courtesy of the CMDL Carbon Cycle Group. Relative seasonal changes were calculated as mean residuals to 12-month running means after normalizing the residual to the running annual mean.