A Picture of Atmospheric Carbonyl Sulfide: Strong Ties to Photosynthesis

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Global Monitoring Division - **ESRL-GMD**
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A publication authored by NOAA/ESRL and Cooperative Institute for Research in Environmental Sciences (CIRES) scientists titled "On the global distribution, seasonality, and budget of atmospheric carbonyl sulfide (COS) and some similarities to CO2" (Montzka et al., 2007) appeared recently in the Journal of Geophysical Research. This study dramatically improves our understanding of the atmospheric distribution and seasonality of carbonyl sulfide, a trace gas that accounts for a large fraction of the sulfur in the Junge stratospheric aerosol layer. The study also breaks new ground by suggesting that carbonyl sulfide may provide an important new tool for understanding the uptake of CO2 by terrestrial ecosystems.

Background:

COS is the most abundant, long-lived, sulfur-containing trace gas in the atmosphere. It accounts for a large fraction of sulfur in the stratospheric aerosol layer during periods of minimal volcanic activity. This aerosol layer influences climate through its direct interaction with radiation and through its influence on stratospheric ozone levels. Though many measurements of COS had been reported previously, reconciliation of these data with known sources and sinks was not possible. By expanding analysis capabilities in the NOAA/ESRL global flask sampling network to include measurements of COS, NOAA scientists were able to develop, for the first time, a coherent picture of the factors influencing atmospheric COS on hemispheric scales. While this is a major breakthrough by itself, because it allows for a better understanding of atmospheric COS, the scientists also discovered that the distribution and variations of atmospheric COS are closely related to those observed for CO2. This similarity arises because both COS and CO2 are removed from the atmosphere primarily by vegetation undergoing active photosynthesis.

Significance:

An improved understanding of COS sources and sinks is important for understanding variations and burdens of aerosols and ozone in the stratosphere. This is particularly important for COS now, because industry is considering enhanced use of COS as a replacement for CH3Br in crop fumigation and because COS is a byproduct of sulfur-rich coal combustion. Secondly, because of the similarities discovered between COS and CO2, COS shows promise for substantially improving our understanding of rates of photosynthesis separate from respiration. As evidence of this, multiple groups the world over (US, Israel, UK, Germany) are investigating the details of COS interactions with vegetation. Independent measures of photosynthesis rates are not readily available currently, but are crucial for improving our understanding of the factors underlying the uptake and release of carbon from the terrestrial biosphere and, therefore, the future evolution of atmospheric CO2.

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Citation: Montzka, S.A., P. Calvert, B.D. Hall, J.W. Elkins, T.J. Conway, P.P Tans, and C.Sweeney (2007), On the global distribution, seasonality, and budget of atmospheric carbonyl sulfide (COS) and some similarities to CO2, J. Geophys. Res., 112, D09302, doi:10.1029/2006JD007665.

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