Development of a high-accuracy dynamic dilution system for generating ambient level carbonyl sulfide standard gas

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We developed a high accuracy dynamic dilution system for generating reference gas standard for long-term observation of atmospheric carbonyl sulfide (COS).
COS has recently received increased attention as a potential tracer for carbon cycle because COS is irreversibly taken up by photosynthesis of plant vegetation unlike carbon dioxide. This unique feature of COS gives us the possibility to estimate gross primary production (GPP) from local to global scale based on atmospheric observation. Especially for the estimation of global GPP trend, accurate and precise determination of COS is required to detect its inter-annual variability, estimated to be within only a few ppt in a pristine air. However, long-term atmospheric measurements of COS have been very limited. A lack of reliable standard gas of COS at ambient level (ca. 500 ppt) is one of the major reasons.
In this study, we developed the dynamic dilution system which can generate COS reference gas at atmospheric mole fraction level accurately. The system uses gravimetrically-prepared standard gas containing ~5 ppm COS, which is known to be relatively stable. The parent gas is diluted more than 2000 times with pure nitrogen using thermal mass flow controllers with rigorous pressure control. The mass flow rates of the parent gas and dilutant are measured with high-precision flow meters, and the flow ratios are used to calculate mole fractions of COS in the diluted gas. In this presentation, we will show the detail system configuration and results from experiments for evaluating dilution performance including repeatability, reproducibility, and linearity as well as for validating dilution accuracy. These results demonstrated that the developed dilution system is capable of dynamically generate reference gas standards of COS at the atmospheric level accurately, which allows to detect long-term trends in atmospheric COS.

Keywords: Standard gas, Dynamic dilution, Carbon cycle, Carbonyl sulfide

