5.065 Estimation of sulfuryl fluoride emissions at regional and global scales by inverse modeling using AGAGE measurements.

Early Career Scientist

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Abstract:

Sulfuryl fluoride (SO_2F_2) is used increasingly as a fumigant to replace methyl bromide (CH_3Br), which was regulated under the Montreal Protocol (1986). Mühle et al. (2009) showed that SO_2F_2 had been accumulating in the global atmosphere with a growth rate of 5±1% per year from 1978 to 2007. They also demonstrated, using the 2D AGAGE box model, that SO_2F_2 has a total atmospheric lifetime of 36±11 years mainly driven by the oceanic uptake. In addition, the global warming potential of SO_2F_2 has been estimated to be ≈4780 for a 100-year time horizon (Papadimitriou et al., 2008), which is similar to the CFC-11 (CCl_3F) GWP. Thus it is a potent greenhouse gas and its emissions are expected to continue to increase in the future. Therefore, it is important that we improve our knowledge of past and current SO_2F_2 emissions and chemistry in the atmosphere. The focus of this work is to estimate SO_2F_2 surface emissions both at regional and global scales from 1978 to 2015. We use the 3D chemical transport model MOZART-4 with a 1.9° × 2.5° horizontal resolution to which we have added the main processes involved in SO_2F_2 atmospheric chemistry. We perform inverse modeling to improve the estimate of the SO_2F_2 emissions via the CELS (Combined Eulerian and Lagrangian Sensitivity) approach. This method uses the Eulerian MOZART-4 model and the lagrangian NAME model together with the AGAGE (Advanced Global Atmospheric Gases Experiment) measurements at Mace Head (Ireland), Trinidad Head (California), Gosan (South Korea), Shandiangzi (China), Cape Grim (Australia), Cape Matatula (Samoa), Ragged Point (Barbados), Jungfraujoch (Switzerland), Monte Cimone (Italy) and Ny-Alesund (Svalbard), along with air archives going back to 1978. Results will be compared to the global industrial estimates and provide a much better understanding of the SO_2F_2 emissions at regional and global scales over the last decade.