Temporal Variability of Sulfur Hexafluoride and Trifluoromethyl Sulfur Pentafluoride Concentrations in the Atmosphere

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Sulfur hexafluoride (SF_6) is a greenhouse gas formed through anthropogenic processes such as the manufacture of high voltage equipment. Recently trifluoromethyl sulfur pentafluoride (SF_5CF_3) has been tied to SF_6 because of their parallel trend of increase in the atmosphere. The purpose of this project was to study the variability of SF_5CF_3 using gas chromatography to confirm its use as a tracer. The main question was whether SF_5CF_3 has a unique rate of increase, meaning that it has different sources than SF_6; or whether it correlates with SF_6, in which case it could be a by-product of SF_6 production. Dichlorodifluoromethane (referred to as F12) was also studied to serve as a basis for the accuracy of the measurements made in Palisades, New York; an ideal location to study the compounds' local sources. SF_5CF_3 did not correlate significantly with SF_6, F12 or any atmospheric variable studied, whereas SF_6 was seen to correlate with relative humidity and atmospheric CO2 concentration. Compared to historical data, our SF_6 or F12 values were not as high; for F12 this was expected since it was recently discontinued, and for SF_6 it could be due to the short sampling period. SF_5CF_3 also did not exhibit as much variability, which can be explained by the atmospheric mixing ratio of SF_5CF_3 (Busenberg and Plummer, 2008) which appears to have leveled after 2000, due to increased awareness of its potency as a greenhouse gas. The effect of wind direction was also studied: very high SF_6 values were observed from highly urbanized areas in NE and SW as well as Manhattan. Both SF_6 and SF_5CF_3 peaked with winds from N, indicating Dutchess County where IBM produces plasma in semiconductor etching. These results have proved that the atmospheric variability of SF_5CF_3 is easily documented and that the compounds may have a complex relationship with their sources, which merits further research.

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