The Global Chloromethane Cycle

Plenary Lecture

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Chloromethane (CH_3Cl, often named methyl chloride) is an important provider of chlorine to the stratosphere. It accounts for ~16% of the ozone-depleting halogens delivered to the stratosphere **[1]** and is predicted to grow in importance as the chlorine contribution to the stratosphere from anthropogenic chlorofluorocarbons decline. Today CH_3Cl originates mainly from natural sources with only a minor fraction considered to be of anthropogenic origin. However, until as recently as 2000 most of the CH_3Cl input to the atmosphere was considered to originate from the oceans, but investigations in recent years have clearly demonstrated that natural terrestrial sources such as biomass burning, wood-rotting fungi, salt marshes, tropical vegetation and soil organic matter degradation must dominate the atmospheric budgets of CH_3Cl **[2]**.

Anthropogenic CH_3Cl release to the atmosphere comes from the combustion of coal and biomass with minor emissions from cattle and humans. In addition, it has been reported that emissions from industrial sources might be much higher than previously assumed **[3]**.

The dominant sink for atmospheric CH_3Cl results from the reaction with photochemically-produced hydroxyl radicals **[1]**. Furthermore, in the marine boundary layer the reaction of CH_3Cl with chlorine radicals represents another sink. Microbial CH_3Cl degradation in soils may be a relevant additional global sink **[4]** but its impact on the global CH_3Cl budget is still highly uncertain. Moreover, small proportions of tropospheric CH_3Cl are lost to the stratosphere and to cold polar oceans though oceans in total are a net source **[1]**.

In summary many uncertainties still exist regarding strengths of both sources and sinks, as well as the mechanisms of formation and degradation of CH_3Cl. A better understanding of the atmospheric budget of CH_3Cl is therefore required for reliable prediction of future ozone depletion.

A potentially powerful tool in the investigation of the budget of volatile compounds in the atmosphere is the use of stable isotope ratios **[5].** Stable isotope analysis, when used in combination with CH_3Cl flux measurements, has the potential to better constrain the atmospheric CH_3Cl budget as suggested by **[6, 7]**. The isotopic composition of tropospheric CH_3Cl depends on the isotopic source signatures and the kinetic isotope effects (KIE) of the sinks.

In this presentation recent advances in our understanding of the origin and fate of CH_3Cl in the environment/atmosphere with particular emphasis on the applications of stable isotope techniques/tools including hydrogen, carbon and chlorine will be discussed.

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References

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