

Increases in Tropospheric Chlorine from Dichloromethane, a Gas Not Controlled by the Montreal Protocol

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Global measurements of dichloromethane (CH_2Cl_2) indicate that its atmospheric mean surface mole fraction has increased by nearly a factor of 2 since the early 2000s at remote sites throughout the globe. The result has implications for stratospheric ozone, climate, and policy because dichloromethane, while it contains chlorine (Cl) that adds to ozone-depleting halogen in the stratosphere, is not controlled by the Montreal Protocol. Short-lived chlorinated gases like dichloromethane that are emitted predominantly from human activities historically have not been controlled by the Montreal Protocol because their past contributions to ozone depletion were relatively small and constant over time. The increases in chlorine being delivered to the stratosphere from dichloromethane are significant because approximately 80% of the CH_2Cl_2 measured at the surface reaches the stratosphere; we estimate that in recent years the increase in Cl from CH_2Cl_2 has been comparable to the increase in Cl from the sum of all HCFCs. Hence, continued increases in dichloromethane have the potential to significantly slow down the decline in stratospheric chlorine brought about by the Montreal Protocol. Although dichloromethane is used typically as a cleaning agent and solvent, and as a feedstock in the industrial production of other chemicals, use magnitudes are not documented well enough to understand the cause of the recent atmospheric increase. Our data reveal that the increase coincides with a change in the atmospheric distribution of dichloromethane that suggests increased sources from lower latitudes in the northern hemisphere (green lines in figure) and at high altitude-mid-latitude sites. These results suggest that a reconsideration of allowable use magnitudes might be appropriate for short-lived substances to ensure that their impacts remain small in the future and not appreciably offset the benefits to stratospheric ozone provided by the Montreal Protocol.

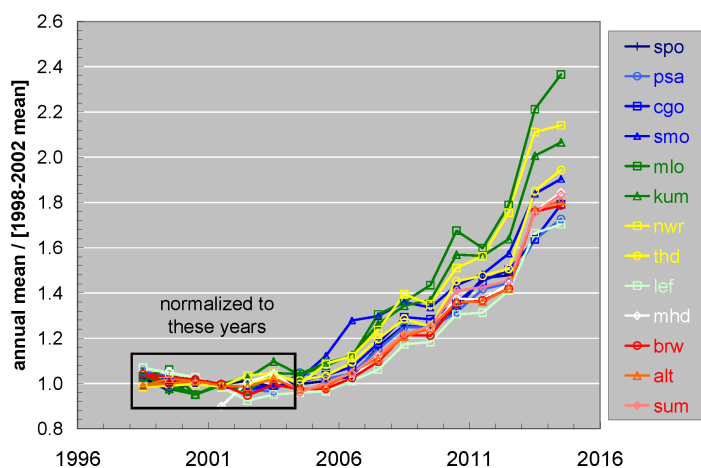


Figure 1. Atmospheric increases observed for dichloromethane at remote sites in both hemispheres normalized to mean mole fractions measured during 1998-2002 (indicated by region encompassed by the box). Different colored lines correspond to different sites, with blue from sites in the southern hemisphere, green from tropical northern hemisphere sites (NH), yellow and white from mid-latitude NH, and red from the Arctic.