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Ozone Destruction in the Upper Troposphere/Lower Stratosphere from Short-Lived Halogens and Climate Impacts

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Halogens released from very short-lived substances (VSLS) can deplete ozone in the upper-troposphere and lower stratosphere where the perturbation can exert a large climate impact. In addition to the known ozone loss from natural biogenic bromine VSLS, such as bromoform (CHBr3), using a global atmospheric model we show that anthropogenic chlorine VSLS such as dichloromethane (CH2Cl2) – not regulated by the Montreal Protocol – also contribute. Although this impact is small compared to bromine VSLS at present, CH2Cl2 has industrial sources and observations show its atmospheric loading is increasing rapidly. We estimate a significant radiative effect of the bromine and chlorine VSLS-driven lower stratospheric ozone destruction of -0.11 Wm-2. The largest impact comes from ozone loss at high latitudes, where column ozone decreases due to VSLS are up to 6%. The trend in anthropogenic chlorine VSLS could cause a significant radiative forcing, especially if augmented by any trend in natural bromine VSLS. We also used the model to study the impact of iodine-containing VSLS such as methyl iodide (CH3I). Of the three halogens iodine has the largest leverage to destroy lower stratospheric ozone, but current limits based on IO observations indicate only a minor impact at present.