The Impact of Very-Short Lived Chlorine Compounds on Trends in Stratospheric Ozone

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The successful implementation of the Montreal Protocol has led to a decrease in the atmospheric abundance of long-lived, well mixed ozone depleting substances and a slow-down in the destruction of the stratospheric ozone by anthropogenic halogens. However, the rise in compounds not regulated by the Montreal Protocol, such as chlorinated very short lived (VSL) substances, has led to a slower than expected recovery of the ozone layer. We quantify the recovery of stratospheric ozone using a multiple linear regression model that includes the effect on ozone of halogens, total solar irradiance, stratospheric aerosol optical depth, the quasi-biennial oscillation of tropospheric winds, and the El Niño Southern Oscillation. The analysis is restricted to the extra-polar region because this is where the vast majority of the world’s population resides. We’ll provide a brief overview of the abundance of VSL chlorine reaching the stratosphere based on various in-situ measurements in the tropical tropopause region, and we’ll relate these in-situ observations to ground-based observations of stratospheric inorganic chlorine gases. Next, we will quantify the effect of chlorinated VSL substances on the recovery of the ozone layer over the coming decades. We’ll conclude by assessing the implications of the latest understanding of VSL halogens with the response of the thickness of the ozone layer to future abundances of CO2, CH4, and N2O.