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Ozone and Climate Impacts of Hydrofluorocarbons

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Hydrofluorocarbons (HFCs) are second-generation replacements for the chlorofluorocarbons (CFCs), halons and other substances that caused the 'ozone hole'. Atmospheric concentrations of HFCs are projected to increase dramatically in the coming decades. Previously, NASA GSFC 2D model simulations showed that HFCs contribute to ozone depletion, due to changing stratospheric temperatures and enhancement of the overturning circulation. Simulations with the Goddard Earth Observing System Chemistry-Climate Model (GEOSCCM), a three-dimensional, fully coupled ocean-atmosphere model with interactive stratospheric chemistry, are used to confirm the ozone impacts of HFCs in a projected 2050 atmosphere. Annual mean differences in ozone, age-of-air and stratospheric temperature are examined.

Recent estimates suggest that, by the mid-21st century, the radiative forcing by HFCs could be as large as 20% that of CO_2. GEOSCCM simulations provide the first quantitative estimates of the contribution of HFCs to future climate change. Specifically, these simulations identify the HFC contributions to future changes in meteorology and sea surface temperatures, variability in the tropical Pacific El Niño/Southern Oscillation region, sea ice, the Hadley circulation and interannual atmospheric variability. GEOSCCM sensitivity simulations contrast the climate impacts of HFCs with those of CO_2 and CFC-11. Limited future HFC emissions simulations demonstrate the relative ozone and climate benefits of restricting HFC emissions in the coming decades.