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Recent increases in global HFC-23 emissions and early trends in other HFCs

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Hydrofluorocarbons (HFCs) generally have high global warming potentials and are used as substitutes for ozone-depleting gases. Trifluoromethane (HFC-23) is an unintended by-product of chlorodifluoromethane (HCFC-22) production and has the longest lifetime (270 yr) and largest 100-yr global warming potential (14,800) of all the most commonly produced HFCs. Firn-air and ambient air measurements of HFC-23 from three firn sampling excursions to Antarctica between 2001 and 2009 are used to construct a consistent atmospheric history for this chemical in the Southern Hemisphere. The results show continued increases in the atmospheric abundance of HFC-23 and they imply substantial increases in HFC-23 global emissions since 2003. The increases in HFC-23 emissions are coincident with rapidly increasing HCFC-22 production in developing countries and are observed despite efforts in recent years to limit emissions of HFC-23 through the Kyoto Protocol's Clean Development Mechanism. These results will be considered along with new observations of additional HFCs from archived air, firn air, and ongoing flask-air measurements. Summed together, atmospheric increases observed for HCFCs and HFCs accounted for $\sim$9% of the increase in total direct radiative forcing from anthropogenic gases during 2003-2008, an addition that was slightly larger than that attributable to N2O global mixing ratio increases over this same period.