Observational Constraints on U.S. Emissions of Climate-Active and Ozone-Depleting Trace Gases from NOAA Air Sampling Networks

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Precise measurements of trace gases in air sampled in the remote global atmosphere and in the continental U.S. air shed provide an opportunity to estimate U.S. emissions of ozone-depleting and greenhouse gases independent of inventory-based approaches. We have analyzed samples collected approximately weekly at two continental U.S. sites during the past 13 years. We also have shorter records (up to 6 years) from the analyses of flask samples collected daily at 5-10 tall tower sites and biweekly from aircraft (as vertical profiles) at 15-20 sites. Here we explore how emissions of ozone-depleting gases such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) have changed over time relative to emissions of hydrofluorocarbons (HFCs) used as substitutes. Results from surface sites sampled weekly since 1997 indicate a substantial increase in emissions of HFC-134a relative to HCFC-22 during this period as HFC use increased across the U.S. While some of these changes are captured by the U.S. EPA inventory emissions of these gases, others are not. When additional higher frequency data from tall towers and the more broadly distributed aircraft data are considered, emission ratios more representative of the entire U.S. are derived. Only with results from these additional sampling programs are we able to detect spatial and seasonal emission variations that are qualitatively consistent with expected geographical and seasonal use patterns of these refrigerants and, additionally, some new substitute HFCs (HFC-125 and HFC-143a).

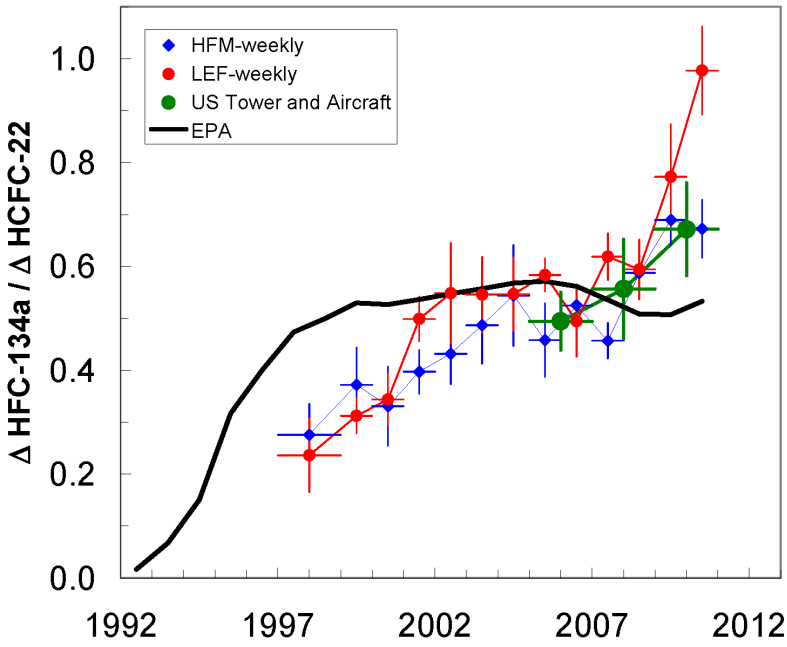

Figure 1. Emission ratios of HFC-134a relative to HCFC-22 estimated from inventory techniques (U.S. EPA, black line) and atmospheric data (NOAA, colored lines). Emission ratios derived from atmospheric data are based on the correlation slope of measured mixing ratio enhancements above background of HFC-134a relative to those measured for HCFC-22. Results from weekly surface sampling at a site in Wisconsin (LEF, red symbols) and Massachusetts (HFM, blue symbols) are compared to the aggregated results from multiple sites sampled by aircraft and tall towers (green symbols).