Atmosphere-based Estimates of Non-CO_2 Greenhouse Gas Emissions for the U.S. Derived from $^{14}CO_2$

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The small radiocarbon fraction of atmospheric CO_2 (~1:10^{12} ^{14}C:C) has proven to be an ideal tracer for the fossil fuel derived component of observed CO_2 (Cff) over large industrialized land areas. High-precision $^{14}CO_2$ measurements are being made in air sampled from a network of tall towers and airborne profiling sites around the U.S. together with measurements of more than 20 other anthropogenic trace gases including CO, CH_4, N_2O, SF_6, and halo- and hydro-carbons. Pairing Cff with boundary-layer concentration enhancements of these gases allows us to determine apparent emissions ratios for each gas with respect to Cff. When combined with model-derived spatial footprints and inventory-based fossil fuel emissions, absolute emission rates for the correlate gases can be derived, following simple scaling methods we have outlined previously [Miller et al. 2012, J. Geophys. Res., doi:10.1029/2011JD017048]. Here we present emission magnitudes derived for select gases in regions of significant urban and industrial activity around the U.S. based on measurements in California, Texas, the mid-west, south-east and north-east. Statistically significant and coherent spatial and seasonal patterns in emissions ratios and absolute emissions are determined for many gases based on measurements over multiple years. We believe this approach provides reliable 'top down', observationally-based emissions estimates for these gases, many of which influence climate, air quality and stratospheric ozone.

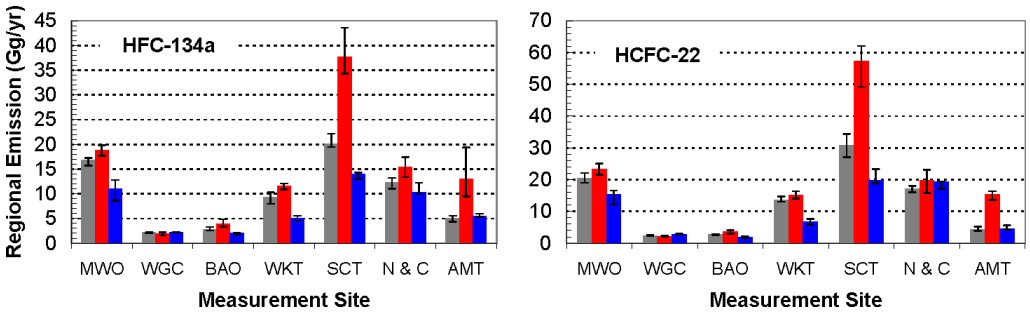

Figure 1. Regional emissions of HFC-134a and HCFC-22 derived at different locations in the U.S. during 2010 based on measured covariations in these halocarbons and the fossil-fuel component of CO_2 (Cff). Absolute emission magnitudes are derived from the measured halocarbon-to-Cff covariations and site-specific fossil-fuel emissions derived from computed sensitivities (over space and time) of collected samples to the VULCAN fossil-fuel emission inventory (Gurney et al., 2009). Measurement locations are listed west to east: MWO = Southern California; WGC = mid-California; BAO = Front range, Colorado; LEF = Wisconsin; WKT = Texas; SCT = South Carolina; N&C = average of results from New Jersey and New Hampshire; AMT = Maine. Estimates are derived for summer (May through September; red bars), winter (November through February; blue bars), and year-round (gray bars).