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Reconstructing the atmospheric concentration and emissions of CF_4, C_2F_6 and C_3F_8 prior to direct atmospheric measurements, using air from polar firn and ice

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Perfluorocarbons are very potent and long-lived greenhouse gases in the atmosphere, released predominantly during aluminium production, electronic chip manufacture and refrigeration. Mühle et al. (2010) presented records of the concentration and inferred emissions of CF_4 (PFC-14), C_2F_6 (PFC-116) and C_3F_8 (PFC-218) from the 1970s up to 2008, using measurements from the Cape Grim Air Archive and a suite of tanks with old Northern Hemisphere air, and the AGAGE in situ network. Mühle et al. (2010) also estimated pre-industrial concentrations of these compounds from a small number of polar firn and ice core samples.

Here we present measurements of air from polar firn at four sites (DSSW20K, EDML, NEEM and South Pole) and from air bubbles trapped in ice at two sites (DE08 and DE08-2), along with recent atmospheric measurements to give a continuous record of concentration from preindustrial levels up to the present. We estimate global emissions (with uncertainties) consistent with the concentration records. The uncertainty analysis takes into account uncertainties in characterisation of the age of air in firn and ice by the use of two different (independently-calibrated) firn models (the CSIRO and LGGE-GIPSA firn models).

References

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