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Emission estimates of several long lived ozone depleting substances and greenhouse gases from top-down modeling

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Halons are a class of bromine containing haloalkanes which have been used since the early 1950s in fire fighting and explosion protection applications because of their highly inert chemical nature. This means that they generally do not break down in the troposphere but enter the stratosphere where they photodissociate and the resulting bromine acts as a catalyst in the destruction of ozone. These gases are entirely anthropogenic in origin and their production has been restricted since 1994 under the Montreal Protocol.

Hydrofluorocarbons (HFCs) are a second stage replacement for chlorofluorocarbons (CFCs) and contain no chlorine or bromine, however there are concerns over the high global warming potentials that some have. SF5CF3 has grown rapidly in the atmosphere since the 1960s and has one of the highest global mean radiative forcings of any molecule discovered in the atmosphere. It is thought to be a by-product of fluorochemical production or of SF6 breakdown in high voltage equipment.

Time series for the four main halons: H-1211, H-1301, H-2402 and H-1202, as well as the CFC replacement, HFC-227ea and the long-lived greenhouse gas SF5CF3 ¬are reported. For the halons and SF5CF3 the measurements were derived from background air flask samples from Cape Grim, Tasmania, dating back to 1978. For HFC-227ea the measurements were from firn air samples taken as part of the NEEM drilling project, Greenland.

We report that concentrations of H-1211 and H-1301 have stopped growing in recent years, while H-2402 and, in particular, H-1202 have shown a significant decline. HFC-227ea has grown rapidly since its introduction in the early 1990s and is still rising, though the emissions derived from the model are significantly lower than those derived from the EDGAR emissions database. SF5CF3 is shown to have increased rapidly since the 1970s but has stopped growing since 2005 in contrast to SF6.

Using a two-dimensional atmospheric chemical transfer model a 'top down' approach has been taken to determine annual emissions of these gases. Annual emissions are input to the model and the modelled output is compared to the atmospheric time series. Modelled emissions are then adjusted to fit the measured data.