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Trends of halon gases in polar firn air: implications for their emission distributions

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Abstract. Four halons (H-1301, H-1211, H-2402 and H-1202) have been measured in air samples collected from polar firn from Dome Concordia (Dome C), Antarctica, from Devon Island, Canada and the North Greenland Ice Core Project (NGRIP) site, Greenland. H-2402 and H-1202 are reported for the first time in firn air. The depth profiles show the concentrations of all four halons to be close to zero (i.e. below the detection limit of 0.001 ppt) at the base of the firn thus demonstrating their entirely anthropogenic origin. This is the first evidence of this for H-2402 and H-1202. A 2-D atmospheric model was run with emissions previously derived using archive air measurements from the southern hemisphere mid-latitudes to produce historical trends in atmospheric concentrations at the firn sites, which were then input into a firn diffusion model to produce concentration depth profiles for comparison with the firn measurements. This comparison provides an evaluation of the model-derived atmospheric concentration histories in both hemispheres and thus an indirect evaluation of the emission rates and distributions used in the atmospheric model. Atmospheric concentration trends produced using global emissions previously determined from measurements at Cape Grim are found to be consistent with the firn data from the southern hemisphere. Further emissions of H-1202 in recent years (late 1980s onwards) are likely to have come from latitudes mostly south of 40° N, but emissions prior to that may have come from further north. Emissions of H-1211 may also have shifted to latitudes south of 40° N during the late 1980s. Following comparison of the atmospheric model output with the firn data, modelled atmospheric trends of total organic bromine in the form of halons were derived for both polar regions.

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