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Emission location dependent ozone depletion potentials for very short-lived halogenated species

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We present trajectory-based estimates of Ozone Depletion Potentials (ODPs) for very short-lived halogenated source gases as a function of surface emission location. The ODPs are determined by the fraction of source gas and its degradation products which reach the stratosphere, depending primarily on tropospheric transport and chemistry, and the effect of the resulting reactive halogen in the stratosphere, which is determined by stratospheric transport and chemistry, in particular by stratospheric residence time. Reflecting the different timescales and physico-chemical processes in the troposphere and stratosphere, the estimates are based on calculation of separate ensembles of trajectories for the troposphere and stratosphere. A methodology is described by which information from the two ensembles can be combined to give the ODPs.

The ODP estimates for a species with a fixed 20 d lifetime, representing a compound like n-propyl bromide, are presented as an example. The estimated ODPs show strong geographical and seasonal variation, particularly within the tropics. The values of the ODPs are sensitive to the inclusion of a convective parametrization in the trajectory calculations, but the relative spatial and seasonal variation is not. The results imply that ODPs are largest for emissions from South and South-East Asia during Northern Hemisphere summer and from the Western Pacific during Northern Hemisphere winter. Large ODPs are also estimated for emissions throughout the tropics with non-negligible values also extending into northern mid-latitudes, particularly in the summer. These first estimates, whilst made under some simplifying assumptions, show larger ODPs for certain emission regions, particularly South Asia in NH Summer, than have typically been reported by previous studies for emissions distributed over land in within broad latitudinal bands.

Keywords: ozone, troposphere-stratosphere-transport, short lived species, boundary layer emissions