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Do longer tropospheric lifetimes related to low OH in the Western Pacific lead to enhanced transport of sulfur and halogens to the stratosphere?

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Intense vertical transport of air from the troposphere to the stratosphere occurs in the maritime continent-west Pacific in boreal winter (Fueglistaler et al., 2004). Convective uplift injects tropospheric air masses into the TTL, where strong radiative heating fosters further vertical transport to the stratosphere and the upper branch of the Brewer Dobson Circulation.

Based on observations of very low tropospheric ozone made during the TransBrom-Cruise (Ridder et al., 2012), Rex et al. (2011) has hypothesized that tropospheric air in the western Pacific region should be rather depleted in OH – the main tropospheric oxidant – leading to significantly longer lifetimes of compounds carrying halogens (VSLS) and sulfur (SO_2) in these air masses.

We investigate this hypothesis and its possible impact on SO_2 and VSLS transport to the stratosphere by looking at aircraft measurements made during the SCOUT-O_3 field experiment in Darwin, Australia, in November and December 2005. Trajectory calculations show that tropospheric ozone mixing ratios below 15 ppb encountered during several flights are typically found in clean Pacific air masses that are also relatively low in CO. A slightly negative correlation between CO and SO_2 in these air masses may indeed be caused by a longer lifetime due to low OH. However, the tropospheric SO_2 concentrations observed during SCOUT-O_3 are too low to represent a significant sulfur source to the stratosphere. Samples of several VSLS made in the TTL are also analyzed for a possible signature of enhanced tropospheric lifetimes.

Fueglistaler, S., et al.: Tropical troposphere-to-stratosphere transport inferred from trajectory calculations, J. Geophys. Res., 109, 10.1029/2003jd004069, 2004.

Rex, M., et al.: Is There a Hole in the Global OH Shield Over the Tropical Western Pacific Warm Pool?, NDACC symposium, Reunion Island, 2011.

Ridder, T., et al.: Ship-borne FTIR measurements of CO and O_3 in the Western Pacific from 43° N to 35° S: an evaluation of the sources, Atmos. Chem. Phys., 12, 815-828, 10.5194/acp-12-815-2012, 2012.