Geophysical Research Abstracts
Vol. 13, EGU2011-10825, 2011
EGU General Assembly 2011
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Relative trends of stratospheric ozone in the mid-latitudes

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We examine the long-term evolution of stratospheric ozone at different regions in the mid-latitudes together with a subtropical station in this study. The analysis is performed by comparing the collocated profiles of lidar ozone at the northern mid-latitude (Haute-Provence Observatory - 43.93°N, 5.71°E, Hohenpeissenberg - 47.8°N, 11°E, Tsukuba - 36°N, 140°E and Table Mountain Facility - 34.5°N, 117.7°W), subtropics (Mauna Loa Observatory - 19.5°N, 155.6°W) and southern mid-latitude (Lauder - 45°S, 169.7°E) stations with ozonesondes and space-borne observations (SBUV(/2), SAGE II, HALOE, UARS MLS and Aura MLS) extracted around the stations in 1985-2010. A detailed statistical study on the relative differences of the compared measurements is performed to check any specific drifts with time. On average, all measurements show their best agreement with the respective lidar in 20-45 km, where the differences are within +/-5%. The drifts are estimated from the time series of the monthly averaged relative differences of the long-term datasets (more than 10 years of observations) and are generally within +/-1%/year in 20-45 km at all stations except at Tsukuba, where relatively higher drifts are found. Below 20 km, HALOE exhibits slightly larger trends at all stations and SAGE II at Tsukuba, Mauna Loa Observatory and Lauder. To find out the drifts in the reference data, we compared all datasets with the average of the available observations in each day. The relative differences found from this comparison are very small and the average deviations stay within +/-2% in 20-45 km at all stations during the compared period. Below 20 km also, it does not exceed +/-5% for most of the measurements at different stations. The estimated drifts are less than +/-0.5%/year at 20-45 km at various stations. Below 19 km drifts are relatively higher at Tsukuba, Table Mountain Facility and Mauna Loa Observatory. The higher tropopause and its influence on the analysis at these regions are to be investigated.