An Evaluation of the Capability of HIRDLS to Measure Thin Ozone Filaments During Tropopause Folding Events in the Extra-tropical UTLS Using Co-Located Ozonesonde and Lidar Measurements

Below: coincident ozone profiles measured with HIRDLS (V004, to be released, v2.04.19 internally) and with WOUDC ozonesondes during UTLS lamina events.

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Abstract: Stratosphere-troposphere exchange and a related poleward transport of extra-tropical upper tropospheric air into the lower atmosphere appear to occur frequently along fast moving tropopause folding events. Folding events are especially prevalent in Northern Hemisphere late winter and early spring. The High Resolution Dynamic Limb Sounder (HIRDLS) on board the Aura satellite has a demonstrated ability to measure ozone with approximately 1 km vertical resolution into the upper troposphere / lower stratosphere (UTLS) region often to better than 200 km. It is the first satellite instrument with sufficient vertical resolution to attempt to observe many such events in the UTLS. HIRDLS measurements of ozone and temperature during folding events show the typical features of low ozone pockets above relatively ozone rich layers. Presented here are measurements of HIRDLS ozone profiles on multiple such events compared with coincident WOUDC ozonesonde profiles and Table Mountain lidar ozone profiles. We use these co-located measurements to provide an assessment of the ability of HIRDLS to detect these events.

Below: HIRDLS V004 ozone profiles compared with coincident lidar profiles from Table Mountain Facility [TMF].

Frequency of Lamina Occurrence

To the left are coincident ozone profiles during lamina events. Profiles are compared from World Ozone and Ultra Violet Data Center (WOUDC) sites in the NH at mid and high latitudes spanning range 38°-79°N, and from the ground based lidar station at Table Mountain Facility [TMF, 34.9°N]. The coincidence criteria used are temporal and spatial separation of less than 500 km and 12 hrs respectively. The black dots are the coincident lamina profiles for the three stations above-right, and the HIRDLS Team

Shown at right is the statistical difference of the lumped set of coincident lamina profiles for the three stations above-right, and the Legionsowo and Walkrau island stations, in terms of partial pressure (top), volume mixing ratio (middle) and percent difference (bottom). The solid line with individual station statistics, a 10% accuracy to pressures of about 200 hPa are indicated. At far right are scatter plots of all profile data-points in terms of partial pressure (top) and volume mixing ratio (bottom) are shown. Correlations between the two datasets are very high, at 0.97 for VMR and 0.79 for partial pressure.

Ozone [V004] - Accuracy As A Function Of Latitude

Shown above is the accuracy of HIRDLS ozone, V004, as determined statistically by a average of the differences between HIRDLS and ozonesonde ozone values for W. WOUDC sites spanning latitudes range 45 degrees S to 79 degrees N. Numbered in blue and black in the upper right of each panel is the number of HIRDLS and sondes profiles, respectively, of which the dataset is comprised.

A/L coincidences  Lamina cases only