Boulder Ozone Sonde Data Analyses for Multiple Tropopause Origins

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Boulder ozone profile measurements tend to feature structures with multiple layers in the troposphere, so-called laminae. These have been shown to be related to several phenomena, including stratospheric air intrusions that are transported to the location of measurements and local gravity wave perturbations (Boulder is located near the Rocky Mountain range where gravity waves are prevalent). In addition, observations indicate that air from the tropical tropopause layer can be transported into regions with multiple tropopauses over the middle latitudes in the vicinity of the subtropical jets. We use assimilation system products, including Modern-Era Retrospective analysis for Research and Applications (MERRA), interpolated to Boulder, Colorado, USA to assess incidence of upper tropospheric jets that influence UTLS ozone distribution. The proximity of the subtropical jet to Boulder results in frequent observations of multiple tropopauses. We analyze ozonesonde data launched in June-July 2014 to determine the origins of laminae observed in the upper troposphere/lower stratosphere (UTLS). Our tools include back trajectory analysis coupled with 4D satellite ozone profile data, including those from NASA's Aura Microwave Limb Sounder instrument. Filaments causing laminae in ozone profiles observed at Boulder will be tracked to origins in either stratospheric or tropospheric intrusions using reverse domain-filling trajectory methods. Detailed studies of ozone profiles collected over Boulder starting in 1978 will be presented with emphasis on May/June/July season. Ozone variability in the UTLS over Boulder is of importance for studies of local climatological ozone conditions, trends and their causes/attribution to the changes in the long-range transport.

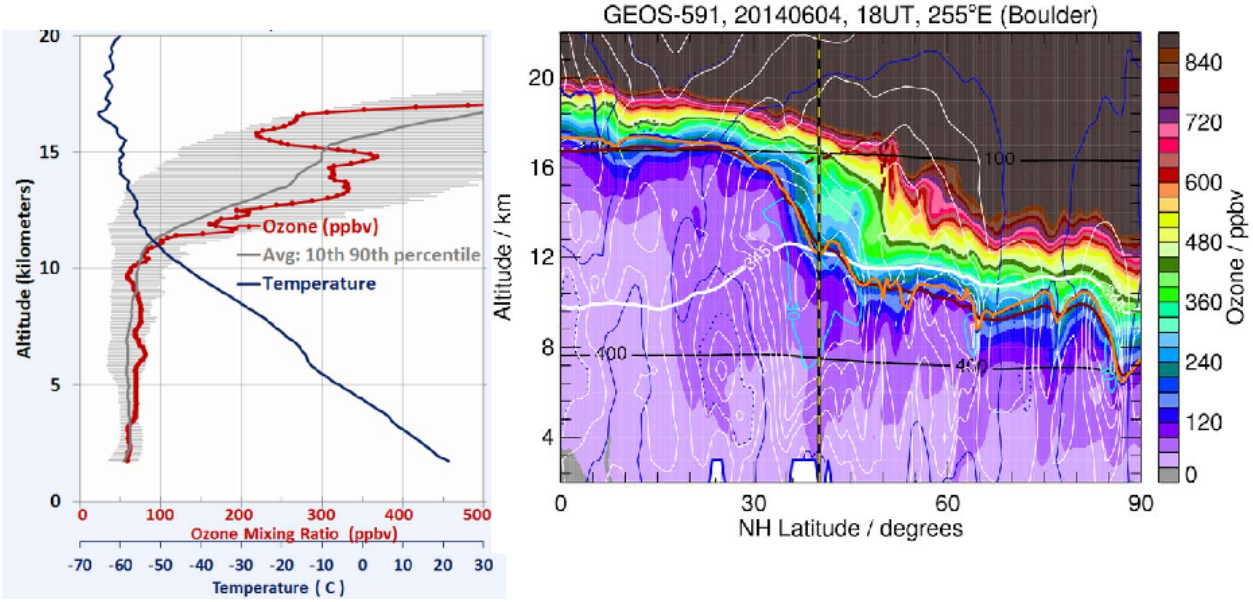

Figure 1. Left panel shows balloon launch on June 4, 2014 and climatological mean and variability for ozone-sonde data in June. Panel on the right shows ozone vertical and horizontal distribution from GEOS-591 analysis (18UT, June 4th), with overlaying the primary tropopause around 12 km (dark red line) and the secondary tropopause around 16 km (dark dashed line). MERRA analysis indicates formation of a double tropopause over Boulder around 9 UTC on June 4th, which then persists for several days.