Origins of Filaments in Boulder Ozonesonde Data

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Ozonesonde data launched in June-July 2014 from Boulder, Colorado are analyzed to determine the origins of laminae observed in the upper troposphere/lower stratosphere (UTLS). We use NASA Global Monitoring and Assimilation Office's GEOS-5 data assimilation system products, including Modern-Era Retrospective analysis for Research and Applications (MERRA), interpolated to Boulder, Colorado (40°N, 105°W) to assess incidence of upper tropospheric jets that influence UTLS ozone distribution. Our tools include back trajectory analysis coupled with 4D satellite ozone profile data, including those from NASA's V3.3 Aura Microwave Limb Sounder (MLS) and Ozone Monitoring Instrument (OMI). Filaments causing laminae in ozone profiles observed at Boulder are tracked to origins in either stratospheric or tropospheric intrusions using reverse domain-filling trajectory methods (RDF). The RDF captures many of the filament features, but it only captures the effects of large scale differential transport. A case where RDF misses a feature in the 340-350K altitude is likely related to ozone stratification caused by the gravity waves. In addition, satellite observations indicate that air from the tropical tropopause layer (TTL) can be transported into regions with multiple tropopauses over the middle latitudes in the vicinity of the subtropical jets. Detailed studies of several ozone profiles collected over Boulder in June/July 2014 help with determining techniques for future analysis of a larger dataset that goes back to 1980s. 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.

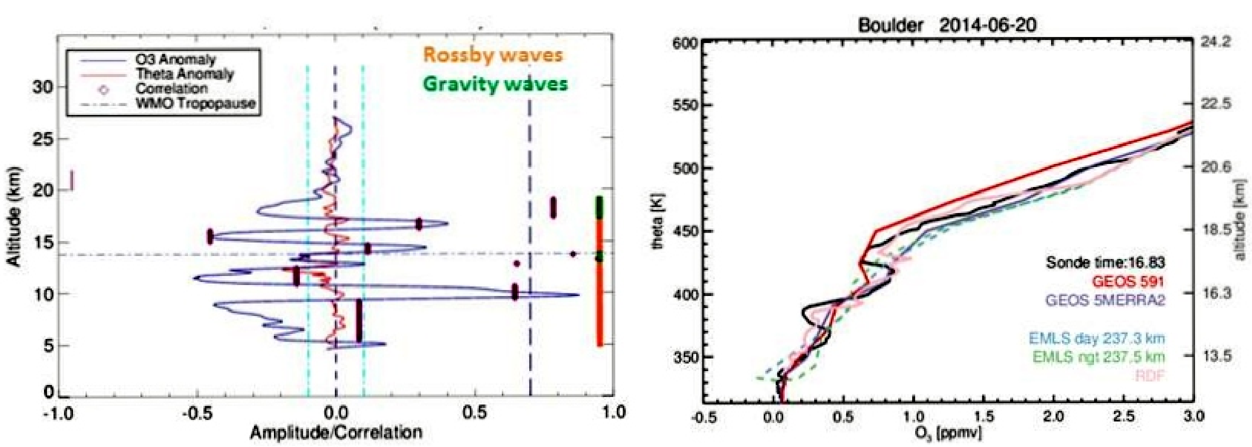

Figure 1. Left panel shows analyses of the ozone and potential temperature lamination (dark blue and red respectively) as recorded by sonde launched on June 20, 2014. Vertical solid bars indicate periods of correlation in measurements (dark red), significance (dashed lines), the impact of STE transport (orange) and gravity waves (green). Panel on the right shows ozone vertical distribution from ozone-sonde (black), GEOS-591 analysis (red), GEOS 5 MERRA2 analysis (purple), MLS ozone profile from Boulder overpass during the day (blue) and night (green), and RDF profile (pink). MERRA analysis indicates formation of a double tropopause over Boulder around 3 UTC on June 19th, which then persists for several days.