A Lamina-based Approach for Interpreting Variability in Ozonesonde Vertical Profiles

K. Minschwaner[1], G. Manney[2,1], I. Petropavlovskikh[3,4], B. Johnson[4] and A. Jordan[3,4]

[1]New Mexico Institute of Mining and Technology, Socorro, NM 87801; 575-835-5226, E-mail: kenneth.minschwaner@nmt.edu
[2]NorthWest Research Associates, Boulder, CO 80301
[3]Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, CO 80309
[4]NOAA Earth System Research Laboratory, Global Monitoring Division (GMD), Boulder, CO 80305

An improved understanding of ozone variability in the upper troposphere/lower stratosphere (UTLS) is critical for evaluating the impact of ozone transport on regional air quality and assessing ozone radiative forcing of climate. Ozonesonde measurements can play a key role in characterizing day-to-day, seasonal, and long-term changes in UTLS ozone at a given location, but interpretation of these changes is complicated by possible influences from a wide range of chemical and dynamical processes. A major component of the variability in ozonesonde vertical profiles is associated with laminar features (0.2 to ~2 km thickness) that can be traced to dynamical or chemical phenomena occurring far from the measurement site. We use an analysis package (RIO SOL - Robust Identification of Observed Signatures of Ozone Laminae) applied to the ESRL/GMD ozonesonde dataset from Boulder, Colorado. Laminae statistics from RIO SOL include the distributions of widths and amplitudes, frequencies of occurrence as functions of altitude, and classification of ozone features associated with gravity wave activity (Figure 1). The generating mechanisms associated with non-gravity wave laminae are examined using parcel back-trajectories tagged to UTLS ozone features identified by RIO SOL.

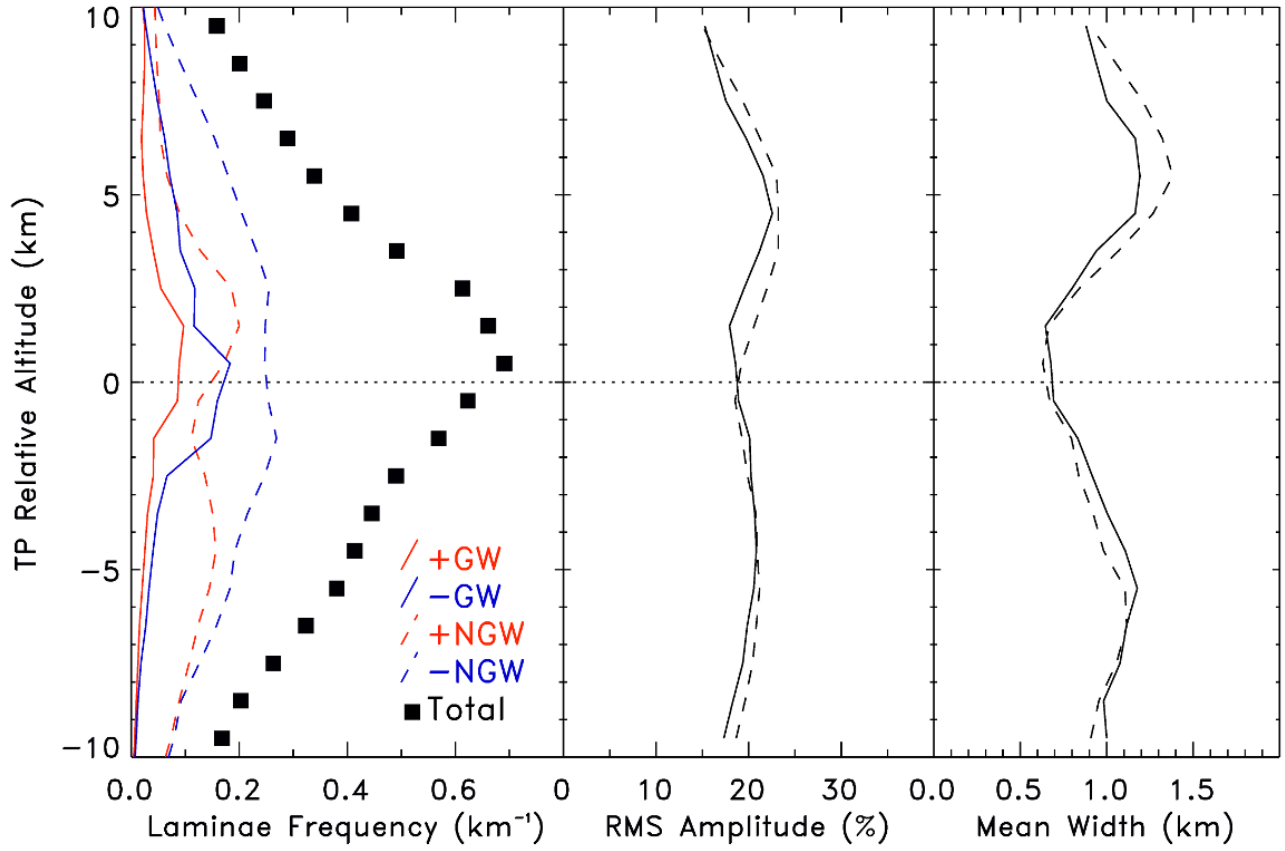

Figure 1. Vertical profiles of ozone laminae characteristics in altitude coordinates relative to the WMO tropopause (TP). Left panel shows laminae frequency as the number of laminae detected per sounding within 1-km wide altitude bins. Black squares are for all laminae types and signs. Solid lines show frequencies of gravity wave (GW) laminae, dashed lines indicate non-gravity wave (NGW) laminae, and red and blue indicate positive and negative anomalies, respectively. The middle and right panels show vertical profiles of laminae mean amplitudes and mean widths, respectively.