

# Variability and Trends in Free Tropospheric and Lower Stratospheric Ozone in the Tropics from SHADOZ

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The tropical free troposphere (FT) and lower stratosphere (LS) are recognized as critical regions in changing atmospheric composition. This is because of feedbacks among temperature (i.e., radiative forcing), dynamics and key species like water vapor and ozone. Recently, because of these complex sensitivities, LS ozone trends have been the subject of much interest. In particular the question has been raised about whether or not perceived losses of LS ozone, as determined by models, are correct whereas other analyses claim that LS ozone is increasing over the past 20 years. Some studies focus on changes on FT ozone where satellite products are highly uncertain and models seem to disagree with one another. In this study we use the reprocessed 1998-2017 SHADOZ (Southern Hemisphere Additional Ozonesondes) ozonesonde data (more than 7000 profiles) to analyze interannual variability and trends in FT and LS ozone in the tropics and subtropics. Tropical ozonesonde data are geographically isolated but their superior vertical resolution is ideal for studying ozone structure up to 35 km. We use a wave-identification method to examine impacts of convection on the TTL (tropopause transition layer) and a Linear Regression Model that accounts for solar and seasonal cycles, QBO and ENSO for trends. For SHADOZ stations with short records or multi-year gaps, comparisons between the first 2-3 and most recent 2-3 years are presented. Results vary according to location of site and segment of the profile. For example, in the FT ENSO and pollution signatures in ozone may be pronounced whereas the LS displays details of QBO impact on ozone. Variations and changes observed in the SHADOZ record constitute an independent benchmark for researchers using models and satellite data to establish credible interpretations of global tropical ozone oscillations and trends

Key words: ozone, TTL, lower stratosphere, SHADOZ, ENSO