The Role of Convection in Tropical Ozone Variability Inferred from Profiles at NOAA's SHADOZ Stations (1998–2017)

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The tropical free troposphere (FT) and tropopause transition layer (TTL) are critical regions in changing atmospheric composition because of feedbacks among temperature (i.e., radiative forcing), dynamics, and key species like water vapor and ozone. Because of these sensitivities, quantifying ozone variability and trends in the FT and TTL over the past several decades remains an on-going subject of interest. Here we use the reprocessed SHADOZ (Southern Hemisphere Additional Ozonesondes; *Thompson et al.,* 2017; *Sterling et al.,* 2018; *Witte et al.,* 2017; 2018) ozonesonde dataset to analyze variability in FT and TTL ozone at ten tropical stations with an emphasis on those that NOAA has overseen since 1998: Am. Samoa; Fiji; San Cristóbal, Galapagos; San Pedro, Costa Rica. Ozone vertical structure in the FT and TTL suggests convective influence (CI) with clear transitions in frequency 3–4 times/yr as shown in the two examples below. Standard metrics (e.g., seasonal mean mixing ratio), augmented by laminar wave-identification of wave impact (Gravity Wave Index [GWI], *Thompson et al.,* 2011) and SOM (Self-Organizing Maps; *Stauffer et al.*, 2018), are used to quantify the role of CI in seasonal, intraseasonal and interannual variability in FT and TTL ozone. We find an inverse relationship between CI, quantified by the GWI, in the TTL and FT ozone column amount. A standard Multi-variate Linear Regression Model (MLR) that includes convectively-related oscillations, e.g. El Niño Southern Oscillation (ENSO), Indian Ocean Dipole, Madden-Julian Oscillation, is applied to monthly mean ozone. Of these, the most significant is the ENSO impact. CI needs to be taken into account when computing trends. Statistics for the NOAA (Pacific) stations are compared to those for Atlantic SHADOZ stations.

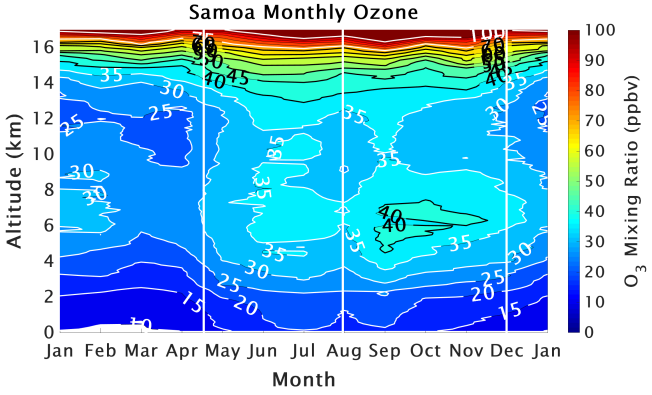

Figure 1. Mean monthly ozone mixing ratios (in ppbv) from the surface to 17 km at the American Samoa SHADOZ station. White lines indicate transition periods in the seasonal cycle of tropospheric and upper tropospheric/lower stratospheric ozone.

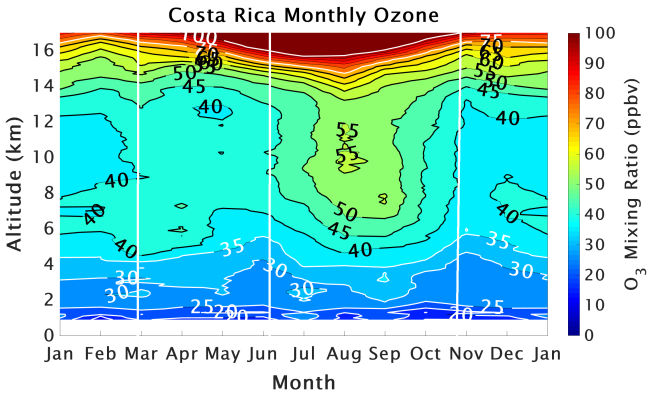

Figure 2. Mean monthly ozone mixing ratios (in ppbv) from the surface to 17 km at the Costa Rica SHADOZ station. White lines indicate transition periods in the seasonal cycle of tropospheric and upper tropospheric/lower stratospheric ozone.