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Solar cycle and ENSO Variability of the Tropical Stratosphere: Comparisons and Implications

L. Hood and B. Soukharev
lon@lpl.arizona.edu

Multiple regression and correlative time series analyses of available long-term remote sensing data sets are applied to estimate the solar cycle and ENSO components of interannual ozone, temperature, and zonal wind variability in the tropical and subtropical stratosphere. For all three quantities, the solar cycle response coefficients do not change appreciably when an ENSO term is added to the regression model. This is because the ENSO signal in the data is relatively weak due to the presence of other sources of interannual variability, especially an irregular QBO. The ENSO ozone regression coefficient has significant negative values in the tropical lower stratosphere (15 - 50 hPa) and significant positive values in the equatorial middle stratosphere (5 - 10 hPa). In contrast, the solar ozone regression coefficient has significant positive values in the tropical lower stratosphere and insignificant values in the equatorial middle stratosphere. Similar vertical structures are found for the respective temperature regression coefficients using the ERA-40 data set. The ENSO regression coefficient in TOMS/SBUV total ozone data (representative of the lower stratosphere) is statistically significant mainly over the tropical eastern Pacific (90W - 180W) while the corresponding solar regression coefficient is significant at all longitudes. As will be shown, these characteristics are consistent with those expected for changes in the tropical upwelling rate (positive in the eastern Pacific during El-Niño events and negative at all longitudes approaching solar maxima). Implications for the origin of the solar cycle upwelling rate changes will be discussed.