

INTERANNUAL VARIABILITY OF TROPOSPHERIC MOISTURE AND TEMPERATURE AND RELATIONSHIPS TO ENSO USING COSMIC-1 GNSS-RO OBSERVATIONS

B. R. Johnston (1), W. Randel (2), and J. J. Braun (3)

(1,2,3) University Corporation for Atmospheric Research - COSMIC Program Office

(1) National Oceanic and Atmospheric Administration - Atlantic Oceanographic & Meteorological Laboratory

(2) National Center for Atmospheric Research - Atmospheric Chemi

Interannual variability of tropospheric moisture and temperature are key aspects of Earth's climate. In this study, monthly mean specific humidity (q) and temperature (T) variability is analyzed using 12 years of COSMIC-1 (C1) radio occultation retrievals between 60°N - 60°S , with a focus on the tropics. Tropical interannual variability is dominated by El Niño-Southern Oscillation (ENSO). Systematic increases and decreases in zonal mean q and T are observed during the 2009-10 and 2015-16 El Niño events and 2007-08 and 2010-11 La Niña events, respectively. ENSO patterns in q and T are isolated using linear regression, and anomaly magnitudes increase with altitude, reaching a maximum in the upper troposphere. Upper troposphere q anomalies expand from the tropics into the midlatitude lower stratosphere, and the T vertical structure is consistent with a moist adiabatic response. C1 results are compared with a free-running simulation from NCAR's Whole Atmosphere Community Climate Model (WACCM), forced by observed sea surface temperatures, to evaluate model behavior in an idealized setting. WACCM ENSO variations in q and T generally show consistent behavior to the C1 observations, with somewhat smaller magnitudes. Case studies are conducted for major ENSO events during the study period. The spatial variability of q is closely aligned with outgoing longwave radiation (OLR, a proxy for deep convection) anomalies. For example, mid-tropospheric q increases over 100% and OLR decreases over 50 W m^{-2} over the central Pacific during the 2015-16 El Niño, and substantial regional q and T anomalies are observed throughout the tropics and midlatitudes for each event.