

Long-term oscillations observed globally in the middle atmosphere using COSMIC GPSRO and SABER/TIMED measurements

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Abstract:

Temperature observations from GPS Radio Occultation measurements from COSMIC and SABER instrument on the TIMED spacecraft are used to investigate the global structures of long-period oscillations like semi-annual oscillation (SAO), annual oscillation (AO) and quasi-biennial oscillations (QBO). The SABER data from 2002 to 2015 and COSMIC GPS RO from 2006 to 2015 are utilized for the present study. SABER measurements provide altitude range of 20 to 100 km, while GPS RO data were taken in between 10 to 60 km altitude range. To investigate the dominant long-period oscillations using monthly temperature datasets, Lomb Scargle Periodogram, Harmonic, and Wavelet analysis are utilized. Dominant AO amplitudes are observed in northern hemisphere in stratosphere and in upper mesosphere heights, AO amplitudes are more in southern hemisphere. SAO and QBO are observed in the mesosphere with a double peak structure near mesopause region. The maximum SAO and QBO amplitudes of nearly 2-4 K is found at equator near 25, 75, and 85 km altitude levels representing the Stratospheric QBO (SQBO), Mesospheric SAO (MSAO) and Mesospheric QBO (MQBO) which can be more in SH than NH. Observed SQBO and MQBO are in out of phase. Similarly, AO amplitudes are maximum in the mid latitude regions in the mesosphere which are twice that of SAO amplitudes. The QBO peak is observed within about 15 degrees of the equator, and the amplitudes reaches maximum at 25 km. Morphologically, SAO, AO and QBO amplitudes derived from SABER and GPS RO measurements are in qualitatively good agreement as function of latitude, and altitude wise. The analysis reveals that there is evidence for long-period oscillations in NH and SH. Downward propagation of wave is observed at more heights with time, although upward propagations are sometimes observed.

Key words: COSMIC-GPSRO, SABER, Long period oscillations, Middle Atmosphere Dynamics.