The s=0 Atmospheric Oscillations in 35-Year MERRA Zonal Wind and Temperature

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The zonal mean atmospheric state, a snapshot of Earth's dynamics and thermal structure at a particular time, can oscillate with time at a wide range of frequency modes. These oscillations are also referred to as the "standing" wave with zero zonal wavenumber (s=0), because they are part of the wave solutions in these cases such as the mixed Rossby-gravity (MRG) waves. The s=0 oscillations can be categorized into those directly driven by solar forcings (e.g., diurnal, 11-year solar cycle) and those driven by internal variabilities (Madden-Julian oscillation quasi-biennial oscillation, El Niño-southern oscillation). Estimation of the 11 year solar signal from atmospheric variables is often difficult to obtain because of its small amplitude under other large-amplitude s=0 oscillations. Analyzing 35 years of MERRA reanalysis data, we are able to extract the 11-year oscillation by bandpassing the signal from the time series. However, the internal atmospheric oscillations at 8 and 20 year periods may have a considerable impact on the significance of the extracted solar signal. Some of the false solar-cycle signals can be removed by comparing the 11-year oscillation with the long-term TSI measurement. Generally speaking, the extracted 11-year temperature and zonal wind amplitudes from MERRA show a consistent distribution pattern with the ERA as reported in Gray et al. [2010] for the stratosphere and upper troposphere. In the lower mesosphere and upper stratosphere, however, the results from these reanalysis data reveal quite different patterns.