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Evidence of QBO-generated 5-year oscillation in stratospheric NCEP data

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An analysis is presented of the stratospheric zonal wind and temperature variations supplied by the National Center for Environmental Prediction (NCEP). The derived zonal-mean variations are employed. Stimulated by modeling studies, the data are separated into the hemispherically symmetric and anti-symmetric components, and spectral analysis is applied to study the 12-month annual oscillation (AO) and the Quasi-biennial Oscillation (QBO). For data samples that cover as much as 40 years, the zonal wind results reveal a pronounced 5-year modulation of the symmetric AO in the lower stratosphere, which is confined to equatorial latitudes. This modulation is also seen in the temperature variations but extends to high latitudes, qualitatively consistent with published model results. A comparison between different time intervals of the data indicates that the signature of the 5-year oscillation is larger when the QBO of 30 months is more pronounced. Thus there is circumstantial evidence that this particular QBO period is involved in generating the oscillation as was shown in a modeling study (Mayr et al., JATP, 2000). In agreement with the model, the spectral analysis also reveals a weak anti-symmetric 5-year oscillation in the zonal wind data, which could interact with the large anti-symmetric AO to produce the modulation of the symmetric AO. The 30-month QBO is well suited to be synchronized by, and phase-locked to, the equatorial Semi-annual Oscillation (SAO), and this may explain why this QBO periodicity and its 5-year spin-off are observed to persist for several cycles.