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Kelvin waves: a comparison study between SABER and normal mode analysis of ECMWF data

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Equatorial Kelvin waves spectra are sensitive to the multi-scale variability of their source of tropical convective forcing. Moreover, Kelvin wave spectra are modified upward by changes in the background winds and stability. Recent high resolution data from observations as well as analyses are capable of resolving the slower Kelvin waves with shorter vertical wavelength near the tropical tropopause. In this presentation, results from a quantitive comparison study of stratospheric Kelvin waves in satellite data (SABER) and analysis data from the ECMWF operational archive will be shown.

Temperature data from SABER is extracted over a six year period (2007-2012) with an effective vertical resolution of 2 km. Spectral power of stratospheric Kelvin waves in SABER data is isolated by selecting symmetric and eastward spectral components in the 8-20 days range. Global data from ECMWF operational analysis is extracted for the same six years on 91 model levels (top level at 0.01 hPa) and 25 km horizontal resolution. Using three-dimensional orthogonal normal-mode expansions, the input mass and wind data from ECMWF is projected onto balanced rotational modes and unbalanced inertia-gravity modes, including spectral data for pure Kelvin waves.

The results show good agreement between Kelvin waves in SABER and ECMWF analyses data for: (i) the frequency shift of Kelvin wave variance with height and (ii) vertical wavelengths. Variability with respect to QBO will also be discussed. In a previous study, discrepancies in the upper stratosphere were found to be 60% and are found here to be 10% (8-20 day averaged value), which can be explained by the better stratosphere representation in the 91 model level version of the ECMWF operational model.

New discrepancies in Kelvin wave variance are found in the lower stratosphere at 20 km. Averaged spectral power over the 8-20 day range is found to be 35% higher in ECMWF compared to SABER data. We compared results at 20 km with additional satellite data from HIRDLS (1 km eff. resolution) and conclude preliminary that SABER data does not represent the shortest 20 day Kelvin waves as well as HIRDLS and ECMWF operational analysis.