Geophysical Research Abstracts,
Vol. 11, EGU2009-5578, 2009
EGU General Assembly 2009

The contribution of Kelvin waves in the forcing of the QBO and SAO derived from SABER and ECMWF temperatures

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The quasi-biennial oscillation (QBO) of the zonal mean zonal wind is one of the most important processes in the dynamics of the middle atmosphere in the tropics. The phase descent of alternating tropical easterlies and westerlies is driven by atmospheric waves of both global scale (equatorial wave modes like Kelvin or Rossby-gravity waves), as well as mesoscale gravity waves. However, the relative distribution of the different types of waves to the forcing of the QBO winds is highly uncertain. This is the case because until recently there were no high resolution long-term global measurements in the stratosphere. With the new satellite instruments SABER and HIRDLS, as well as the COSMIC GPS receivers, this situation now has changed. At higher altitudes, in the upper stratosphere and in the mesosphere, one of the most prominent processes in the dynamics of the tropics is the semi-annual oscillation (SAO) of the zonal mean zonal wind. We estimate momentum fluxes and the contribution of zonal wind forcing by Kelvin waves based on space-time spectra determined from both SABER temperature measurements as well as ECMWF temperatures. Peak values of total Kelvin wave zonal wind forcing are about 0.2 m/s/day. Global distributions are shown and the results are compared to the total wave forcing required to balance the background atmosphere. It is found that there is good agreement between SABER and ECMWF results. During some periods Kelvin wave forcing is sufficient to explain almost the whole total wave forcing required for the momentum balance of the QBO, while in other periods the contribution of Kelvin waves is comparably low. Also the contribution of Kelvin wave wind forcing to the forcing of the SAO in the upper stratosphere and in the mesosphere is low.