Global study of the quasi-biennial oscillation by the pseudo-2D wavelet transform

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The quasi-biennial oscillation (the quasi-regular change of the zonal winds direction in the lower tropical stratosphere) is a phenomenon affecting global climate. It can be detected over different areas at various atmospheric levels and the use of a spatially oriented method is essential to describe the oscillation's structure in all aspects. To analyze the quasi-biennial oscillation in this study, we have applied the pseudo-2D wavelet transform (p2D-WT) - a technique designed to describe frequency characteristics globally over an analyzed area. We analyzed two types of data at several pressure levels; (1) the HadAT radiosonde dataset and (2) two sets of reanalyzed data (ERA-40 and NCEP/NCAR). The study includes an analysis of time series of air temperature, u and v wind velocities and ozone mass mixing ratios at pressure levels up to 10 hPa, as well as temperature and height of the tropopause. The datasets cover the second half of the 20th century. The results provide a detailed description of the oscillations' spatial distribution, together with mutual comparison of the two reanalyzed datasets. The analysis is supplemented by a study of different approaches to evaluate statistical significance of the resulting wavelet power spectra.

Study of the quasi-biennial oscillation shows that the cycle is detected over extensive regions. Those are mostly equatorial areas. Nevertheless, the results differ significantly for some regions that are identified in the NCEP/NCAR and ERA-40 reanalysis. That indicates that a study utilizing a reanalyzed dataset should compare the results with an analysis of another type of reanalysis and the result should not be interpreted without careful discussion.