

Comparison of the zonal wind in the tropical stratosphere among several reanalysis datasets

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The small Coriolis parameter at low latitudes invalidates the quasi-geostrophic theory that is so useful in explaining the large-scale circulation of the extratropical atmosphere. Another consequence of the small Coriolis parameter is that satellite temperature observations are of limited use in inferring winds at low latitudes. Thus, it is much harder in the tropics to diagnose the detailed dynamics from available observations, leading to more reliance on indirect theoretical and modelling approaches to study the general circulation. This paper reports on a project to compare the representation of the monthly-mean zonal wind in the equatorial stratosphere among major global atmospheric reanalysis datasets.

The degree of disagreement among the reanalysis is characterized by the standard deviation of the monthly-mean zonal wind. At each level there is a tendency for the agreement to be best near the longitude of Singapore, suggesting that the Singapore observations act as a strong constraint on all the reanalysis. The worst agreement tends to be over the data-poor eastern Pacific region. At the 10-20 hPa level, all the analyses show that the eddy component in the monthly mean zonal wind near the equator is dominated by zonal wavenumber 1 and 2 quasi-stationary planetary waves propagating from mid-latitudes. The agreement among the reanalysis near the equator is significantly better when there are mean easterlies than when there are mean westerlies associated with the QBO. At 70-30 hPa, the eddy components of zonal wind are not strongly affected by the phase of the QBO. Our measures of the quality of the reanalysis show systematic improvement over the 1979-2012 period considered. A sudden drop in the standard deviation among the reanalysis is found in 1998 particularly at 50 hPa, which is due to new available satellite data. The magnitude of the differences among the reanalysis declines significantly over the record, although the geographical pattern of differences is nearly constant.

Key words: Reanalysis, tropical stratosphere, Quasi-biennial oscillation