



Tropopause height–500 hPa height coupling: meridional variability along a circle of latitude

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In an endeavor to understand the coupled behavior between the thermal tropopause height and the 500 hPa height along a circle of latitude, the Empirical Orthogonal Functions (EOF) method is applied to the variables at seven upper-air stations located approximately along 20°S in order to obtain the normal modes of oscillation for the mean climatic year, consisting in an average for each day within the period January 1973 – December 2006. The stations used in this research are Bulawayo (67964) ($\phi=-20.14^{\circ}\text{S}$, $\lambda=28.61^{\circ}\text{E}$), Campo Grande (83612) ($\phi=-20.45^{\circ}\text{S}$, $\lambda=54.65^{\circ}\text{W}$), Trindade (83650) ($\phi=-20.50^{\circ}\text{S}$, $\lambda=29.30^{\circ}\text{W}$), Noumea (91592) ($\phi=-22.26^{\circ}\text{S}$, $\lambda=166.44^{\circ}\text{E}$), Townsville (94294) ($\phi=-19.25^{\circ}\text{S}$, $\lambda=146.75^{\circ}\text{E}$), Port Hedland (94312) ($\phi=-20.36^{\circ}\text{S}$, $\lambda=118.62^{\circ}\text{E}$), and Mount Isa (94332) ($\phi=-20.68^{\circ}\text{S}$, $\lambda=139.47^{\circ}\text{E}$).

Up to three tropopauses were found for most of the stations, single tropopause events being the most frequent by far (90% from the total number of cases, on average). Following this, the study is carried out using only single tropopause events. Mean values are calculated and Fourier analyzed for tropopause as well as for 500 hPa heights at each station, and anomalies are obtained as the departures from the composition of those harmonics accounting more than 10% of the total explained variance. A matrix containing the time series for the height anomalies at each station is built, and the datasets at each station are standardized in order to make the results comparable. This matrix is used to carry out the EOF analysis.

The noteworthy features of the results can be summarized as follows. The first EOF

accounts almost 19% of the total explained variance. On the one hand, standardized tropopause heights over those stations located close to the so-called “warm pool” over the maritime continent (Indonesia and Pacific Islands) are the highest ones, while standardized 500 hPa heights reach the minimum values. This fact reveals a warming between the level of 500 hPa and the level of the tropopause, probably due to the release of large amounts of latent heat from convection. By contrast, stations located in South America present the inverse behavior, i.e. standardized tropopause heights lower than standardized 500 hPa heights. This EOF is characterized by a semiannual behavior, with maxima in summer and winter (Southern Hemisphere, SH).

As to the second EOF (11% of the total explained variance), standardized tropopause heights and standardized 500 hPa heights behave in a similar fashion near the “warm pool”, while over the westernmost stations the former variable is lower than the latter. For this EOF a quarterly behavior is present, with maxima in late summer, early winter and early spring (SH).