A Principal Oscillation Pattern Analysis of the intraseasonal oscillation in a ECHAM2 T21 perpetual january experiment

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Procedure

With the POP (Principal Oscillation Pattern) method we are investigating the intraseasonal fluctuations of the equatorial troposphere for a 1800 days perpetual January simulation, carried out with the T21 General Circulation Model ECHAM2 of MPI Hamburg.

The POP analysis is applied to the 200 mb velocity potential anomalies along the equator.
The Hovmoller diagram (not shown here) for the complete time series of the field, clearly indicates the existence of eastward propagating waves, originated in the Indonesian region and travelling with a mean velocity of about $15 - 20\ ms^{-1}$.

Since we are intersted in time scale of few weeks, the time series has been, before the POP analysis, filtered to supress signals with periods longer than 90 days and shorter than 15 days. Moreover, in order to remove small-scale noise and to reduce the dimension of the system, an EOF (Empirical Orthogonal Function) expansion has been performed on the filtered time series. The expansion has been truncated after 10 terms and the truncated series retains more than 95% of the filtered variance.

Results

Five pairs of complex patterns have been obtained. Two pairs are dominant explaining the 46% and the 21% of the total variance respectively, and in the following only these ones will be considered. the remaining three pairs explain less than 10% of the variance.

The orthogonal patterns of the first pair are shown in fig. 1. Their spatial scales correspond to zonal wave number 1, with a phase shift of the order of 90° corresponding to an eastward propagating disturbance, with a period of about 22 days and an e-folding time of about 52 days.

In fig. 2 are illustrated the patterns of the second pair. They exibit a period of about 31 days, e-folding time of 33 days and a zonal wave number 2 structure, with a phase shift of about 90°. This mode propagates also eastward, but it is mostly active in the Indian Ocean.

A cross-spectral analysis of the complex POP coefficients has been performed and, for the both pairs, the spectra (not shown here) exibits an approximately equal distribution of the variance, a constant phase difference of −90°, and a significant coherence throughout the period range between about 20 and 60 days.

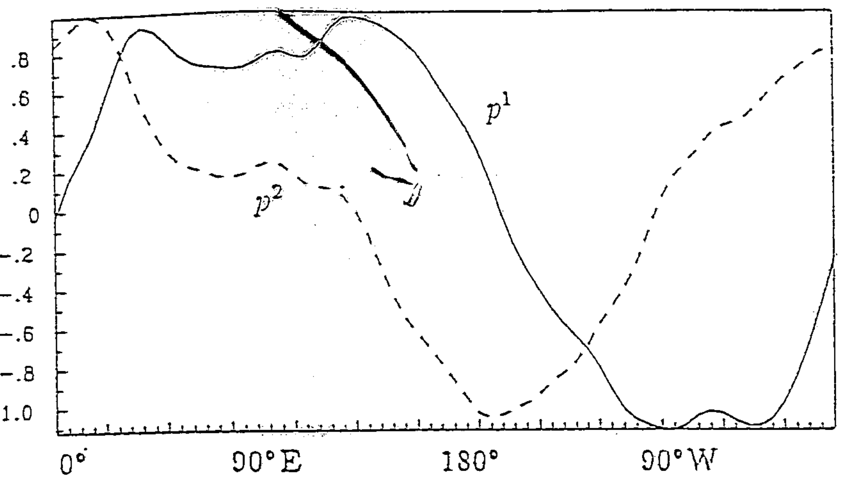

Figure 1: Spatial structure of the first POP pair. Characteristic time: period $T = 22$ days, e-folding time $\tau = 52$ days.
The POP cycle is $p^1 \rightarrow -p^2 \rightarrow -p^1 \rightarrow p^2$

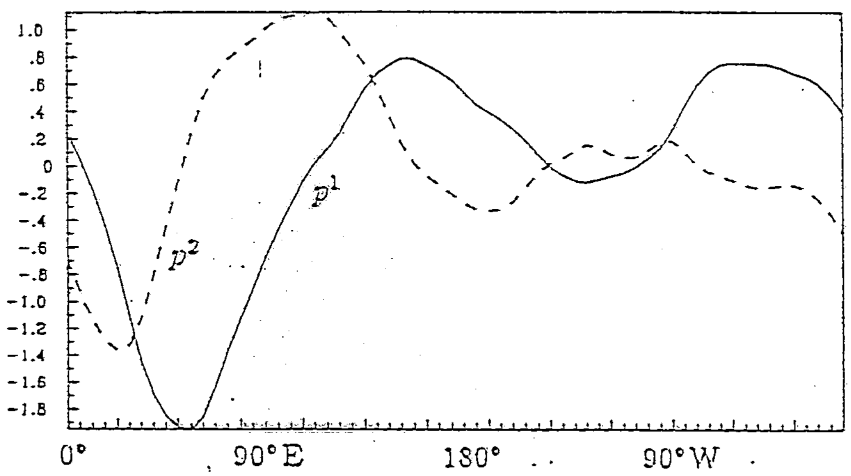

Figure 2: Spatial structure of the second pair. Characteristic time: period $T = 31$ days, e-folding time $\tau = 33$ days. The POP cycle is $p^1 \rightarrow -p^2 \rightarrow -p^1 \rightarrow p^2$

References

von Storch. H. et al.. Principal Oscillation Pattern Analysis of the 30- to 60-Day Oscillation in General Circulation Model Equatorial Troposphere; J. Geophys. Res. 93, D9, 11.022-11.036