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MODELLMÄßIGE UNTERSUCHUNG DER NIEDERFREQUENTEN VARIABILITÄT IM ÄQUATORIALEN PAZIFIK

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The equatorial Pacific exhibits the most important interannual climate variation known as El Niño. During El Niño events anomalous warm surface waters appear for several months over the entire equatorial zone, causing disastrous economic consequences for the fishing and guano industries along the South American coast. The occurance of El Niño has been empirically related to the equatorial wind anomaly fields (Wyrtki, 1975), to the Southern Oscillation (Rasmusson and Carpenter, 1982; Wright, 1977) and to North American weather patterns (Horel and Wallace, 1981).

The physical mechanism behind the El Niño phenomenon is not yet fully understood. Several simple models have been proposed. But it is generally believed that more sophisticated models like oceanic and atmospheric general circulation models are necessary to describe this coupled ocean-atmosphere phenomenon more realistically.

In order to investigate the oceanic part of the interaction loop a primitive equation ocean model for the equatorial Pacific was forced with 32 years of observed winds. The model uses the full set of equations with the exception that the horizontal diffusion is omitted and salinity effects are neglected. A variable grid is applied with higher resolution (50 km) near the equator and the coasts. Vertically there are 13 levels, most of which are placed within the thermocline. Bottom topography is not included. The time step is two hours. The model is forced at the surface with 32 years (1947-1978) of observed wind stress (Barnett, 1983) and a heat flux which is parameterized according to Haney (1971) with a constant forcing temperature of 26°C and a relaxation time of about 30 days.

The period of forcing data used is characterized by pronounced interannual signals, associated with warm as well as with cold events. The heavy line in Fig. 1a represents the observed SST anomalies near the dateline on the equator. It is seen that the most prominent warm events occured during the years 1957, 1965, 1969 and 1972, whereas the years 1955, 1973 and 1975 must be classified as "cold years". It is also seen that the model response (thin line in Fig. 1a) is in remarkable agreement with the data. The model reproduces not only the observed warm events associated with the El Niños, but also the pronounced cold events. Fig. 1b shows that most of the observed variance occurs within the frequency range of 2-8 cycles per 16 years with a maximum at 3 cycles per 16 years. The computed variance spectrum compares rather well. In the range of highest variance the coherence between observed and simulated time series is above the 99% confidence level (Fig. 1c), while the phase angles vanish (Fig. 1d). Generally the time and space structure of the equatorial model response to observed winds is in good agreement with observations.

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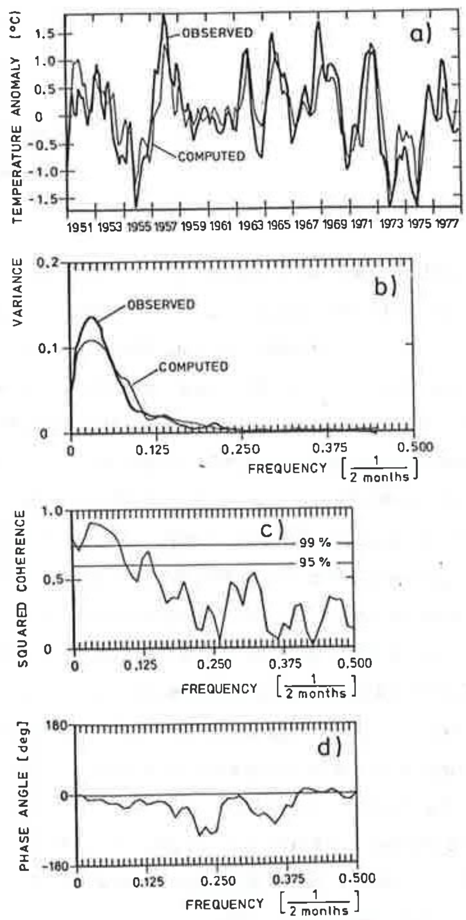

Fig. 1. Time series of observed (heavy line) and computed (thin line) SST anomaly near the date line on the equator (a), variance spectra (b), coherence spectrum (c) and phase spectrum (d) of the two time series (From Latif, 1985).