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(MERLE J. et T. DELCROIX)



# Double Seasonal Tilt of the Thermocline in the Tropical Atlantic Ocean

In the tropics, the depth of the thermocline is one of the features most indicative of the response of the ocean to wind forcing. Using a data set consisting of all available XBT (expendable bathythermograph), MBT (mechanical bathythermograph) and Nansen bottle observations recorded prior to 1978, we investigated the annual variability of the depth of the thermocline (defined as the 20°C isotherm) throughout the tropical Atlantic between 16°S and 30°N.

Monthly mean temperatures are calculated at standard depths in areas of 4° longitude by 2° latitude, and the depth of the 20°C isotherm is linearly interpolated. Maps of the amplitude (Figure 1A) and phase (Figure 1B) of the annual component of the 20°C isotherm depth variation are computed from a Fourier analysis of the monthly mean data.

Two regions of large amplitudes are: (1) 3°-8°N and west of 20°W (denoted as the northwest equatorial region) and (2) along the equator and in the eastern Atlantic near Africa (called the eastern equatorial region) (Figure 1A). The annual cycles of these two regions are not in phase (Figure 1B). The thermocline reaches its maximum depth from February to April in the eastern equatorial region, from October to December in the northwest equatorial region and again from April to June north of the line 5°-10°N. Thus, a six to eight month

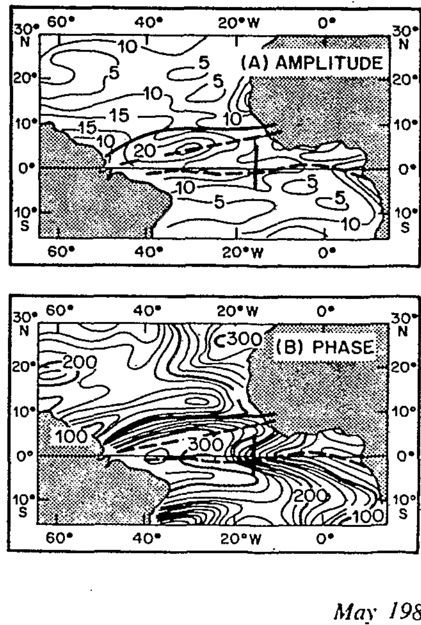


FIGURE 1 *(Merle and Delcroix)*
*(A) Amplitude (in meters) and (B) phase (in Julian Days) of the annual component of the 20°C isotherm depth variation. Thick dashed lines represent the tilt axis of the thermocline and thin dashed lines denote the axis of maximum amplitude.*

hase difference separates the two events. his produces an annual movement of the ermocline with a double tilt: one in an equa-al plane with a pivot point around 15°W d the other along a pivot line approximately rallel to the equator and situated between 3°-N (Figure 1A). The zonal tilt of the thermo-ne along the equator was already known Merle, 1980) and confirmed by equatorial odels (Cane and Sarachik, 1980; Philander d Pacanowski, 1981). The meridional north atorial tilt of the thermocline is a new fact.

The meridional annual oscillation of the rmocline is situated approximately under mean annual position of the Intertropical nvergence Zone (ITCZ). The ITCZ position ries throughout the year over a large latitudi-l band, extending roughly from the equator 10°-15°N, and occurs over the ocean where maximum amplitude and phase changes in the depth of the thermocline are observed (Figure 1). The curl of the wind stress changes sign north and south of the ITCZ. Thus, the annual vertical displacement of the thermocline associated with the latitudinal migration of the ITCZ is related to the change in the sign of the curl of the wind stress. Calculations of Ekman pumping (not presented here) confirm this result. Theory (Busalacchi and Picaut, 1983) also provides an amazing similarity with our results for both phase and amplitude.

*References*

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