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Eastward Propagation at the Equator During the 1982-83 El Niño Inferred From Sea Surface Salinity

The SURTROPAC Group (ORSTOM Nouméa, New Caledonia) has been operating a ship-of-opportunity program since 1969 to collect surface temperature and salinity data in the tropical Pacific Ocean. Since 1979, thanks to a French-U.S. agreement, the same ships have been observing, through expendable bathythermographs, the thermal structure from the surface to 400 m. Data from such a network can be incorporated in a global description of the oceanic climate. During the strong 1982-83 El Niño event, it was seen that several physical parameters propagated eastward along the equator; that is, wind, surface temperature, and rainfall through outgoing long-wave radiation (OLR) anomalies (Gill and Rasmusson, 1983); deepening isotherms (Donguy et al., 1984); and sea level (Lukas et al., 1984). Model simulation of the 1982-83 sea level shows such eastward propagation (Busalacchi and Cane, 1985). Sea surface salinity (SSS) is also an indication of eastward propagation.

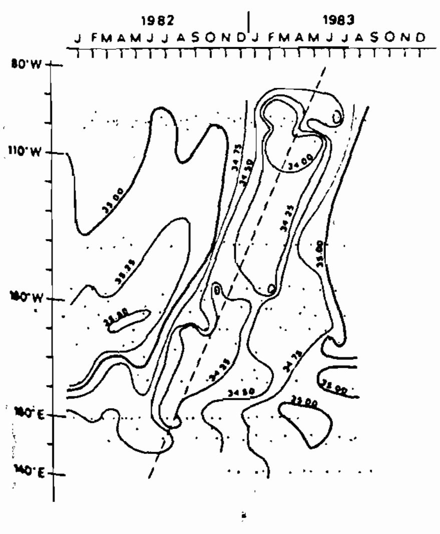

FIGURE 1 (*Donguy and Eldin*)
Sea surface salinity along the equator during 1982-83 (1°N-1°S, 130°E-80°W).

According to Donguy and Dessier (1983), in the western equatorial Pacific there is no clear seasonal variation of the surface salinity. Rather, there are primarily interannual fluctuations associated with El Niño. These fluctuations are mainly caused by changes in the location of the wind convergence zone (Donguy and Morliere, 1983). In the central Pacific, where the wind convergence zone remains steadily at 10°N, data analysis shows that there are no important changes in the surface salinity.

However, in 1982-83, surface conditions changed. Not only did the low surface salinity that is characteristic of El Niño occur in the equatorial western Pacific during the second part of the year, but, unlike events in previous cases, this feature seemed to propagate eastward (Figure 1), starting at 150°E in July 1982 and reaching 95°W in April 1983, with an estimated phase speed of 0.3 m s^{-1}.

For Figure 2, we used the same space-time diagram as in Figure 1. The central position of negative OLR anomalies (Rasmusson et al., 1983; Gill and Rasmusson, 1983) and the monthly percentage frequency of occurrence of highly reflective clouds (HRC) on the equator (Garcia, 1983) are plotted. HRC has been correlated with rainfall (Kilonsky and Ramage, 1976). Comparison of Figure 1 with Figure 2 shows a close relationship between rainfall and salinity during the 1982-83 El Niño event.

Figure 3 shows rainfall data observed at two equatorial islands (Sadler and Kilonsky, 1983), Tarawa (1°20'N, 173°E) and Christmas Island (2°N, 157°W) (data averaged for two stations). At each island, a rainfall maximum is separated by a time lag that is consistent with the eastward propagation of low salinity (Figure 1).

Along the equator, during the 1982-83 El Niño, there was eastward propagation of several climatic and oceanographic parameters as follows:

Parameter	Phase speed (m s^{-1})
Wind	0.6
Sea level	0.7
Isotherms	0.7
SST	0.4
Rainfall	0.3
SSS	0.3

All of these propagations are comparable. Examination of the surface salinity emphasizes the probability of the existence of the eastward propagation of an ocean-atmosphere coupled system during the 1982-83 El Niño along the equator from the west to the east Pacific.

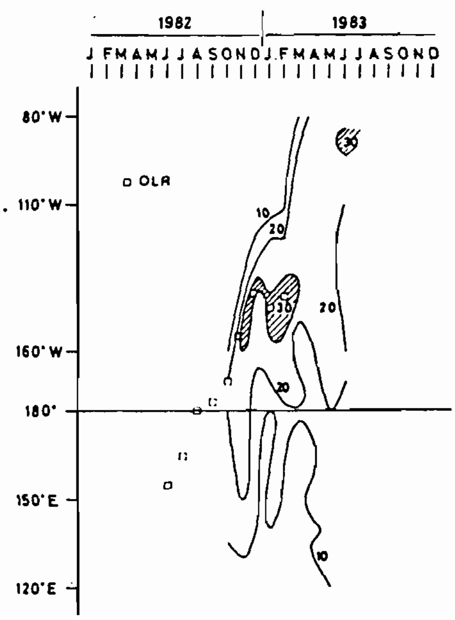

FIGURE 2 (*Donguy and Eldin*)
Monthly percentage frequency of occurrence of highly reflective clouds during 1982-83 on the equator. Squares are the central positions of the negative outgoing long-wave radiation.

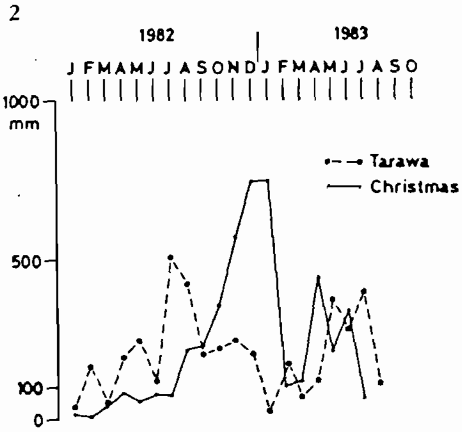

FIGURE 3 (*Donguy and Eldin*)
Rainfall in millimeters during 1982-83 at Tarawa and Christmas Island.

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