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IN SOUTH AMERICA DURING THE QUATERNARY:  
PAST - PRESENT - FUTURE

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THE INFLUENCE OF THE "EL NIÑO" PHENOMENON ON THE  
ENHANCEMENT OR ANNIHILATION OF CABO FRIO UPWELLING,  
IN THE BRAZILIAN COAST OF THE STATE OF RIO DE JANEIRO

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The seasonal cycle of cold waters in Cabo Frio region (State of Rio de Janeiro, Brazil) is controlled by three distinct factors: the local topography of the coastline, the situation of the Brazilian Stream axis and the wind pattern. The first two factors may be considered as ancillary whereas the latter is determinant. The water surface temperature is minimum when the winds are NE and increases when the winds turn to SW. During spring and summer, the dominant wind pattern is NE. In autumn and winter, the wind pattern is disturbed by the passage of successive northward waves, in the middle and upper troposphere, and, in surface, by the corresponding frontal systems which are associated to SW, S and SE winds.

The alternating presence of cold waters in Cabo Frio region produces an important decrease in rain precipitation and, hence, a dry microclimate. This latter also yields the Araruama and Vermelha lagoons hypersalinity.

Periodically, it may occur, in the East Pacific, an increase of ocean's temperature around the equatorial region. This occasional presence of hot waters along the coast of Ecuador and Peru is called the "El Niño" Phenomenon.

During the year of 1983, an intense "El Niño" Phenomenon which occurred in the coast of Peru, resulted in a strong subtropical jet current in the troposphere. This jet current extended from Pacific East Coast to the South of Brazil, obstructing the arrival of frontal systems. The blockage started

in South Brazil, moved northward and became stationary during July-August over the Rio de Janeiro region. As the obstruction was situated South of Cabo Frio, the SW, S and SE winds were blocked of the region and, as a result, the NE winds become almost permanent, producing an enhanced upwelling (Fig. 1d).

During 1976, also a "El Niño" year, it was possible to observe an inversed situation: from March to August, the waters became anomalously hot due to the absence of NE winds (Fig. 1c). The "El Niño" Phenomenon was weaker than in 1983, then the subtropical jet current was situated northward. This may explain why the NE winds didn't reach the Cabo Frio region.

During 1972, also a "El Niño" year, it was possible to observe, from March to September, many periods of cold waters (Fig.1b) due to the anomalously high frequency of NE winds.

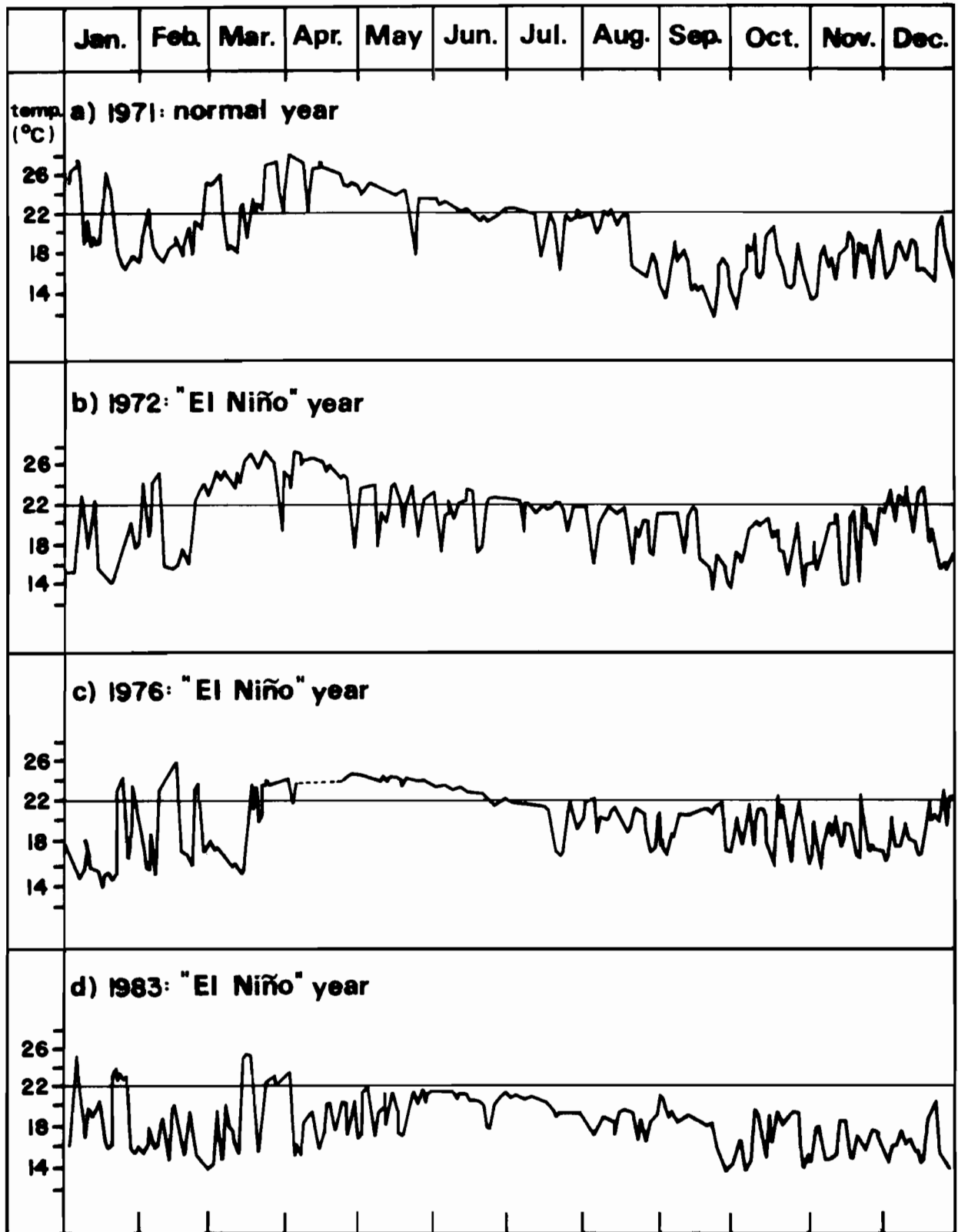
Therefore we may state that there is a teleconnection between the enhancement or the disappearance of the upwelling in Cabo Frio region with the occasional presence of warm waters along the coast of Ecuador and Peru.

We have already shown (3) that inversions in the direction of dominant swell have occurred along the coast of Espírito Santo State during the Holocene. Archeological studies (4) have shown that the southern part of Santa Helena Cape (Ecuador) has been subjected to alternancies of wet and dry periods. These indications suggest that it must occurred periods of "El Niño"-like conditions. In this way, if there were any extended periods of enhancement or decline of the Cabo Frio upwelling it would have resulted in changes in the salinity of Araruama and Vermelha lagoons and, consequently in the local ecosystems and sedimentary environments.

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