ON THE ORIGIN OF THE PROLONGED WARMING OF THE TROPICAL PACIFIC DURING THE 1990S

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Whereas interannual El Niño variability can be explained in terms of strictly tropical processes, longer-term fluctuations such as the prolonged warming that occurred during the 1990s probably involve interactions between the tropics and middle latitudes.

The 1991-1995 episode of warm surface waters in the central and eastern tropical Pacific is the subject of much debate. The time of onset of the warm event was predicted and El Niño dynamics were associated with the 1991 - 1992 interval. However, the additional 3-year period of warm water was unexpected and the ocean dynamics were not representative of El Niño. Furthermore, the delayed-oscillator hypothesis about the onset and destruction of an El Niño, which successfully explained the two El Niños during the 1980s, failed to have the same impact in the 1990s.

If we accept the basic hypothesis of the ventilated thermocline theories -- that the vertical thermal structure of the ocean depends on temperature patterns at the ocean surface where subduction occurs -- then the water of the equatorial thermocline is formed in middle latitudes by increased evaporation, increased Ekman pumping, cold-air intrusions, or a combination of these ocean-atmosphere interactions. Frequency and intensity of intermediate-water formation are believed to cause variations in the strength of the meridional circulation, which would influence the amount of upwelling in the equatorial zone. The dominant equatorward trajectory of the intermediate-water mass and its associated transport are not known. Are western boundary currents and the interior of the ocean of equal importance? is the subject of this project.

Between 40°S and 40°N there are insufficient subsurface temperature measurements, and satellite-derived sea surface topography data must be assimilated to improve ocean general circulation model simulations.

Behringer has developed a system to assimilate satellite observations of variations in sea surface height as well as in situ temperature data to provide a correction to the model temperature field. Figure 1 illustrates the contribution of assimilation of T/P data to the representativeness of simulated subsurface oceanographic conditions. T/P data improved simulations of monthly mean temperatures more often than it did not.

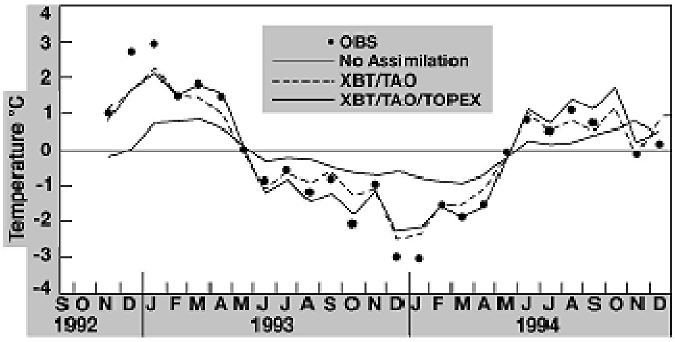

Figure 1

Monthly mean temperature difference between observed (solid dot) and the record-length mean value and between simulated and the record-length mean value. Simulations were computed without assimilation of data (thin line), with assimilation of XBT and TAO subsurface temperature data (dash line), and with assimilation of in situ data and T/P sea surface height data (thick line). A temperature difference of 0°C represents the record-length mean value.