Abstract View

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An Attempt to Verify Some Theories of El Niño

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ABSTRACT

Numerous hypotheses have been proposed to explain interannual changes in equatorial water temperatures. It is shown that many of these hypotheses can be tested by expressing them in terms of a statistical-dynamical model based on the heat balance equation. The ability of the resulting model to account for variance in a 20-year record of observed water temperature provides a hitherto unavailable, quantitative measure of the hypothesis consistency.

Field data were used in conjunction with the models to show that the following general conclusions are consistent with available observations: 1) The advective terms (both horizontal and vertical) in the heat balance equation account for 30–50% of the variance in records of interannual changes in near-equatorial SST. 2) The advective changes are closely related to significant changes in the trade wind field, particularly those occurring near the equator and just west of the dateline, as well as major changes in sea level across the entire Pacific Basin.

Specific hypotheses about interannual changes in water temperature were tested. The following conclusions were found to be consistent with the available data: 1) Eastward advection of heat by the North Equatorial Countercurrent is far more important (29% of the variance) to the heat balance of the eastern tropical Pacific than local heating or consequences of long-term variations in the Northeast Trades. 2) At Talara, Peru, 48% of the SST variance was predictable one month in advance using basin-wide fluctuations in sea level as predictors. This suggests the importance to the heat balance off Peru of eastward advection of heat by currents or wave phenomena. Of less importance (14%) was trans-equatorial flow across the Galapagos front. Upwelling induced by *local* changes in the wind stress was not important, on the interannual time scale, in the estimate of SST. 3) Temperature changes in the central equatorial Pacific (Christmas Island) were consistent with the mechanisms of local upwelling at the equator (25%) and advection from the east (33%).

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