# A MODEL OF THE EQUATORIAL SEA SURFACE TEMPERATURE FIELD AND ASSOCIATED CIRCULATION DYNAMICS

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# ABSTRACT

A linear, continuosly stratified analytical model of the equatorial ocean is developed and used to simulate the major features of the equatorial sea surface temperature (SST) field and current system. The model is bounded by meridional barriers to flow in the east and west and is forced by an idealized southeast trade wind field. The steady state response is studied, although the model is time periodic and capable of simulating the annual cycle or a more general time dependence. The surface heat flux forcing is set to zero so that the contribution of the equatorial upwelling field in maintaining the cool equatorial surface water can be studied.

Most of the observed features of the equatorial SST field and current system are simulated. The model generates cool SST anomalies on the equator in the center of the basin. The cool water core is located to the south of the equator in the eastern part of the basin, with the coldest water along the eastern boundary. The latitudinal and longitudinal scales of the model SST anomaly agree with observations. The latitudinal scales are established by a linear combination of the equatorial deformation radii of all model baroclinic modes and not just one or two modes. The frontal structure associated with the model cool water tongue also agrees with observations. The northern front is strong and crosses the equator near the eastern boundary. The front to the south is weaker. Both fronts weaken monotonically westward into the basin. A southerly wind

that crosses the equator along the eastern boundary is necessary for proper simulation of the equatorial SST field.

The model current structure is familiar. The Equatorial Undercurrent is geostrophic and symmetric about the equator in the center of the basin. It is situated between a surface westward flow and deep westward flow. The eastward volume transport associated with the Undercurrent moves southward in the eastern part of the basin and at some depths, the Equatorial and Coastal Undercurrents are continuous. Boundary effects in the eastern region force the Equatorial Undercurrent to bifurcate at a distance of approximately 100 km. from the coast. The southerly core is continuous with the model generated Coastal Undercurrent. The Equatorial Undercurrent becomes shallower towards the east, due to the different forcing dynamics of zonal and meridional winds. All current magnitudes agree reasonably well with observational estimates.

The solution techniques are the standard separation of variables but in order to incorporate a heat flux surface boundary condition, special methods are employed. We have termed these "inverse methods" as we need to eventually solve for a boundary condition (the SST anomaly field). The methods are quite complex and so are demonstrated on a much simpler, one-dimensional diffusion problem before they are used to solve the equatorial problem.