Abstract View

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Equatorial Waves in the Presence of Air-Sea Heat Exchange

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ABSTRACT

Changes in propagation of free linear waves on the equatorial β-plane associated with air-sea heat exchange are in investigated here. By using a mixed-layer model, with the waves considered as perturbations on a specified basic state, the usual separability problems are avoided and the sea surface temperature is carried as a prognostic variable. The heat exchange is limited to that associated with turbulent fluxes, and a simplified air-sea transfer function allows analytic solutions of the various equatorial modes.

The problem is reduced to the classical solutions for a single vertical mode with the air-sea heat flux and mixed layer entrainment feedback effects cast in terms of three adjustments scales: an atmospheric adjustment length scale and two oceanic adjustment time scales, one for the response to surface fluxes and one for the response to entrainment. In order for the feedback to have any effect, both surface fluxes and entrainment must be included.

Propagation speeds of the equatorial waves are affected significantly by the presence of feedback. For an assumed easterly wind, the Kelvin wave speed is decreased by as much as 15% and the Rossby wave speeds are increased by as much as 50%, depending on the magnitude of the feedback parameters. In addition, the feedback increases (decrease) the wave-related SST amplitude for downwind (upwind) propagating waves over that for the no-feedback case. This is not a positive feedback, because the dissipative nature of the feedback causes the solutions to decay.