INTERNAL KELVIN WAVES FRONTOGENESIS ON THE EQUATORIAL THERMOCLINE

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Some theoretical studies which have been applied to El Nino, use the model of equatorial internal Kelvin waves (IKW) frontogenesis.

Fedorov et al. [1] using the nonlinear shallow-water equations for a single-layer fluid on the equatorial beta plane lying on a deep motionless layer (3/2 approximation) simulated the steepening and breaking IKW on the equatorial thermocline. Novotraysov [2] and Novotraysov et al. [3] with using asymptotic methods find that: (a) a distance to wave breaking depends on hydrologic structure of the equatorial water; (b) the quadratic nonlinearity produces the spectral exponent \( \omega^{-3} \) physically caused by kinetic energy transfer to higher frequencies.

IKW frontogenesis is simulated using nonlinear, fully three-dimensional, primitive equations, finite difference model POM [4] for different cases of stratification. The simplest model of the equatorial ocean on beta plane with the depth 4500 meters and the typical thermal stratification is considered. The initial conditions are chosen to correspond to the first mode of the linear bell-shaped Kelvin wave stretched in the direction of the equator.

The influence of thermal stratification parameters: the location and the width of the thermocline and the maximum of buoyancy frequency on the steepening and breaking of waves is studied. It was found that dominants of nonlinear transformation of Kelvin wave are by both the presence of a shallow thermocline or a strong stratification and the increasing of buoyancy frequency maximum. Furthermore, the propagating of nonlinear IKW fist mode results in generation of the second mode. It was found that the energy of second wave mode depends on the width of thermocline. The numerical results showed that the 3/2 approximation is very crude approximation at the simulated of IKW frontogenesis. This process depends significantly on both initial distribution of velocity field and parameters of the thermocline.

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REFERENCES