Abstract View

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Weak Interactions of Equatorial Waves in a One-Layer Model. Part II: Applications

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ABSTRACT

There are pairs of resonant triads with two common components. Analytic solutions describing the evolution of a system with such a *double resonant triad* are presented and compared with the resonant three-wave problem. Both solutions for constant energies (and shifted frequencies) and for maximum energy exchange (and unshifted frequencies) are discussed. The latter problem is integrable; a subclass of solutions can be written in terms of those of the one-triad system.

Unlike problems of mid-latitude quasi-geostrophic flow and internal gravity waves in a vertical plane, there are resonant triads of equatorial waves with the same speed which have a finite interaction coefficient. This includes the case of second-harmonic resonance or, more generally, a chain of resonant harmonies (a finite number of them in the case of Rossby waves, but an infinite number for inertia–gravity modes). Some analytic and numerical solutions describing the evolution of different chains of resonant harmonies are presented and compared with the (resonant) three-wave problem. Both solutions for constant energies (and shifted frequencies) and for maximum energy exchange (and unshifted frequencies) are presented. The evolution of a chain of resonant harmonies with more than five components is aperiodic, chaotic and unstable.

The derivation of the equations of long-short wave resonances and Korteweg-deVries is straightforward from the evolution equations in phase-space, i.e., there is no need of the usual and cumbersome perturbation expansion in physical space. These equations govern the interaction of a packet of Rossby and inertia–gravity waves with a long Rossby mode of the same group velocity and the self-interaction of long Rossby waves, respectively.

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