Long-Term Evolution of Strongly Nonlinear Internal Solitary Waves in a Rotating Channel.

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Abstract:

The evolution of internal solitary waves (ISWs) propagating in a rotating channel is studied numerically in the framework of a fully-nonlinear, nonhydrostatic numerical model. The aim of modelling efforts was the investigation of strongly-nonlinear effects, which are beyond the applicability of weakly nonlinear theories. Results reveal that small-amplitude waves and sufficiently strong ISWs evolve differently under the action of the rotation. At the first stage of evolution an initially two-dimensional ISW transforms according to the scenario described by the rotation modified Kadomtsev-Petviashvili equation, namely, it starts to evolve into a Kelvin wave (with exponential decay of the wave amplitude across the channel) with front curved backwards. This transition is accompanied by a permanent radiation of secondary Poincaré waves attached to the leading wave. However, in a strongly-nonlinear limit not all the energy is transmitted to secondary radiated waves. Part of it returns to the leading wave as a result of nonlinear interactions with secondary Kelvin waves generated in the course of time. This leads to the formation of a slowly attenuating quasi-stationary system of leading Kelvin waves, capable of propagating for several hundreds hours as a localized wave packet.