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Experimental and numerical study of the resonant feature of internal gravity waves in the case of ‘dead water’ phenomenon

Karim Medjdoub¹, Imre M. Jánosi², and Miklós Vincze³

¹Doctoral school of environmental sciences, ELTE Eötvös Loránd University, Budapest, Hungary (karim26@caesar.elte.hu)

²Department of Physics of Complex Systems, ELTE Eötvös Loránd University, Budapest, Hungary (imre.janosi@ttk.elte.hu)

³MTA-ELTE Theoretical Physics Research Group, ELTE Eötvös Loránd University, Budapest, Hungary (mvincze@general.elte.hu)

‘Dead water’ phenomenon, which is essentially a ship-wave in a stratified fluid is studied experimentally in a laboratory tank. Interfacial waves are excited by a moving ship model in a quasi-two-layer fluid, which leads to the development of a drag force that reaches the maximum at the largest wave amplitude in a critical ‘resonant’ towing speed, whose value depends on the structure of the vertical density profile. We utilize five ships of different lengths but of the same width and wet depth. The experimental analysis focuses on the variability of the interfacial wave amplitudes and wavelengths as a function of towing speed in different stratifications. Data evaluation is based on linear two- and three-layer theories of freely propagating interfacial waves and lee waves. We observe that although the internal waves have considerable amplitude, linear theory still gives a surprisingly adequate description of subcritical to supercritical transition and the associated amplification of internal waves.

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