Geophysical Research Abstracts
Vol. 19, EGU2017-19292, 2017
EGU General Assembly 2017

Nonlinear effects of internal wave focusing by a horizontally oscillating torus

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Nonlinear breaking of internal tides leads to mixing of the abyssal ocean and therefore, plays an important role in large-scale ocean circulation. The localized zones representing hot spots for incipient overturning may occure close to curved topographies owing to the concentration of energy due to wave focusing (Buijsman et al. 2014, Peliz et al. 2009). In the laboratory, we generate the focusing internal waves by an oscillating torus in a linearly stratified fluid. Ermanyuk et al. (2017) showed experimentally that in a linear regime the wave amplitude amplifies in the focal zone and increases linearly with increasing oscillation amplitude. Here we investigate weakly nonlinear and nonlinear effects of focusing internal waves. LIF and PIV techniques are used to measure the isopycnal displacement and the velocity, respectively. The nonlinear effects are investigated in terms of wave slopes as a function of newly developed focusing number Fo, which includes the geometric effect of focusing and the variation in energy with the propagation angle. The data obtained for different sizes tori predict the wave breaking for the critical value of Fo = 0.22. Below this value, nonlinear effects in the focal zone arise in the generation of higher harmonics and the vertical mean flow, while above the critical number the generation of new fundamental internal waves in the focal zone is observed (Shmakova et al. in preparation).