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On 3D internal wave beams and induced large-scale mean flows[1]

T.R. AKYLAS, MIT, TAKESHI KATAOKA, Kobe University, Japan — A theoretical model is developed for the 3D propagation of internal gravity wave beams in a uniformly stratified Boussinesq fluid, assuming that variations in the along-beam and transverse directions are of long lengthscale in comparison with the beam width. This situation applies, for instance, to the far-field behavior of a wave beam generated by a horizontal line source with weak transverse dependence. In the 2D case, where only along-beam variations are present, it is known that nonlinear effects are minor, even for beams with finite steepness. By contrast, in 3D, nonlinear interactions can cause transfer of energy to a circulating horizontal mean flow far from the vicinity of the beam. For a small-steepness beam, this process is described by two coupled equations, which govern the 3D beam evolution along with the induced mean flow. This asymptotic model is applied to the experimental setup of Bordes et al. (2012) and qualitative agreement with their observations is found.

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T.R. Akylas
MIT

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