The surface reflection of the internal wave field emitted by a localized submerged stratified turbulent source

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Abstract

The surface manifestation of the internal waves (IWs) radiated by stratified wake of a towed sphere is examined using implicit Large Eddy Simulation. Six simulations are performed at values of sphere-based Reynolds number, *Re*=5×10ˆ3 and 10ˆ5, and Froude number, *Fr*=4, 16 and 64, have been performed. An idealized linear stratification extends through the entire computational domain which is chosen to be sufficiently deep and wide to enable the full surface reflection of the radiated waves. The wave-emitting wake is located at a fixed distance of nine sphere diameters below the surface. Extending to a non-dimensional time of $Nt \approx 300$, where N is the buoyancy frequency, the IW field's horizontal wavelength and wave period, are computed at the sea surface through wavelet transforms of the corresponding horizontal divergence signals. The mean observable horizontal wavelength decays with a -1 power law in time indicating that wave dispersion is the dominant process in the far field, as predicted by a *Re/Fr*-independent linear propagation model. This finding suggests that the most energetic waves observed at the free surface originate from the early-time wake and its adjustment to buoyancy ; questions remain as to how efficient later-time strongly stratified turbulence may be in radiating energetic IWs. The local enrichment ratio of model surfactants scales linear with IW steepness and exceeds an empirically proposed remote visibility threshold. Finally, Lagrangian drifts of the ocean tracer particles produce a local divergence in lateral mass transport, immediately above the wake centerline, an effect that intensifies strongly with increasing *Fr*.

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