Instabilities of finite-amplitude internal wave beams

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Previous studies have shown that instability of small-amplitude internal wave beams, generated by a surface tide flowing over topography, is most significant at a particular latitude where parametric subharmonic instability (PSI) excites inertial oscillations. Here we extend the discussion to the case of finite-amplitude beams using a new kind of Floquet approach. The disturbance growth rate obtained is quantified in terms of two non-dimensional parameters A and F: velocity shear divided by the buoyancy frequency and the Coriolis parameter divided by the beam frequency. If A is small, PSI is indeed the principle mode under the condition $F < 0.5$ with the maximum growth rate achieved when the equality holds. As A is increased, however, instability comes to occur even for $F > 0.5$ but the location of the maximum instability shifts towards lower F, thus totally changing its latitudinal dependence. The resulting energy spectrum is significantly Doppler shifted, and therefore distinguished from that made by PSI. These findings are useful to quantify the energy loss of internal wave beams that causes water mixing prevailing in the major generation sites of internal tides.

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