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Remote Recoil and Wave Capture: Wave–vortex Interactions in Atmosphere-Ocean Models

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In a recent paper (J. Fluid Mech 492, 207) we described a fundamentally new wave–mean or wave–vortex interaction effect able to force persistent, cumulative change in mean flows in the absence of wave breaking or other kinds of wave dissipation. It is associated with the refraction of nondissipating waves by inhomogeneous mean (vortical) flows. The simplest relevant case is that of a narrow beam of sound waves, or shallow-water gravity waves, weakly refracted by a single vortex in two dimensions. An effective recoil force arises. This accords with expectation from a naive photon analogy or 'pseudomomentum rule' EXCEPT that it acts not where the waves refract, but at the vortex core, even if the core is spatially separated from the refracting beam of waves. Strong refraction brings further phenomena including catastrophic 'wave capture', a nontrivial variant of classical critical-layer absorption; see the more detailed presentation on this by Buehler in this Minisymposium. One implication is that there are missing forces not yet accounted for in atmospheric climate and weather-prediction models. Connections with the 'pseudomomentum rule' and the 'wave momentum myth' are discussed.

View the extended summary