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The generation and energetic pathways of balanced upper-ocean submesoscale turbulence

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The presence of lateral buoyancy gradients at the ocean's upper boundary plays two distinct roles in the production of submesoscale turbulence. First, the surface gradient interacts with the interior gradient of potential vorticity to generate a Charney-type baroclinic instability that preferentially injects energy at the surface. But independent of the generation mechanism, the energized surface velocity field stirs against the mean gradient to generate a forward cascade of buoyancy variance, with a surface-intensified vertical structure that is consistent with geostrophic turbulence in the presence of a boundary. Because this second mechanism is independent of the nature of the driving instability, any stirring that has some amplitude at the surface will lead to a generation of energy in surface modes. This process has implications for the pathway of eddy energy from generation to dissipation, and for the problem of reconstruction of the eddy field from satellite observations, both of which will be discussed.