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Direct and Remote Effects of Topography on the Dynamics of Mesoscale Eddies

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This study is focused on the equilibration of baroclinic instability which commonly develops in large-scale stratified oceanic flows, resulting in an active field of mesoscale eddies: large pockets of ocean which have different thermal, directional and density characteristics than the surrounding ocean water. In particular, we investigate how the transport characteristics of these instability-driven mesoscale flows are effected by (i) variation in topography, (ii) the orientation of the large-scale current, and (iii) structure of the basic velocity. In order to accomplish this, we simulate a zonal flow in a large-scale ocean basin using the Massachusetts Institute of Technology general circulation model (MITgcm). We then compare the lateral transport of these simulations with our analytic model, which is based on balancing the growth rate of the baroclinic instability derived from linear theory with that of a numerically derived secondary instability.

Additionally, two flow regimes are considered; the first is an “remote” scenario in which the current is spatially separated from the ocean floor and therefore any effects of topography on the flow are fundamentally eddy-induced. The second case is a “direct” one in which the current is in direct contact with the ocean bottom resulting in heightened sensitivity of the flow to these same topographic variations.