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Cross-frontal eddy transfer between well-mixed and stratified waters

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The role of baroclinic eddies in controlling the cross-front exchange between well mixed and stratified waters in the coastal ocean is examined here. This cross-front exchange in shallow seas is compared with that in the open ocean, which at a steady state is constrained by the surface diabatic forcing. In contrast, in shallow seas, the front separates stratified waters and well-mixed waters, where tidal mixing is important throughout the water column. Given the differences in diabatic forcing, we wish to explore how the eddy-driven exchange is different in the coastal and open ocean environments. A series of idealised high-resolution numerical experiments have been conducted in order to explore how the cross-front eddy exchange operates when there are well-mixed turbulent waters and the stratified interior. The experiments have been conducted in an idealised domain using a cartesian co-ordinate model (POLCOMS) initialized to a two-layers system and forced by coastal-trapped Kelvin waves, leading to an enhanced near-coast tidal mixing.

Model results show that for the steady state, there is an eddy exchange across the front in the form of two overturning cells involving eddy shoreward fluxes of water from the surface and the bottom together with a compensating offshore flux of intermediate waters. The vertical structure reveals that the eddies transporting tracers from the stratified region are quickly destroyed once they enter the well-mixed region. The relative strength of each of these overturning cells is controlled by the imposed surface diabatic forcing and bottom mixing, in agreement with the water-mass transformation theory of Walin (1982). In particular, the inclusion of the tidal mixing within the entire water column leads to a lateral diabatic eddy transfer all along the front, rather than being confined within a surface diabatic layer as in the open ocean . This eddy transfer might eventually be parameterized in the transformed Eulerian mean framework

through an extension of the Karsten, Jones and Marshall (2002) theory.

References:

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