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Mesoscale vortices, ageostrophic motions and vertical mixing in the ocean

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We investigate the role played by wind-forced eddies in the vertical transport and mixing at the ocean mesoscale with a high-resolution primitive-equation model. Both idealized and realistic configurations are implemented.
With a detailed analysis of the vertical velocity field in the idealized experiments we find that in the vortex cores and inside intense vorticity filaments, the motion is strongly ageostrophic, and vertical velocities associated with the vortices can reach magnitudes and levels of spatial complexity akin to those reported for frontal regions.
Mesoscale anticyclones appear as "islands" of increased penetration of wind energy into the ocean interior, and they represent the maxima of available potential energy.
The wind energy injected at the surface is transferred at depth through the generation and subsequent straining effect of Vortex Rossby Waves (VRWs), whose time-scale is of the order of few days, and through near-inertial internal oscillations trapped inside anticyclonic vortices, on time scales of few hours to few days depending on the latitude.
In the realistic configurations (Labrador Sea and South China Sea), we show that the temporal resolution of the wind forcing contributes to the strength of the near-inertial component. We evaluate the response of the ocean circulation in the under three different forcing conditions: NCEP/QUICKSCATT blended monthly, daily and six-hourly mean winds.
While the surface circulation does not display significant differences, the vertical velocity field shows high sensitivity to the frequency of the wind forcing. We analyze the physical mechanism responsible for those changes and the details of the interplay between the near-inertial and mesoscale eddy fields under the various forcing fields, quantifying the impact of those changes on the vertical mixing.