Geophysical Research Abstracts
Vol. 21, EGU2019-3564, 2019
EGU General Assembly 2019

On shelf-ocean exchange by shelfbreak eddies

Olivier Marchal
Woods Hole Oceanographic Institution, Woods Hole, United States (omarchal@whoi.edu)

Dynamical processes at the shelbreak determine the exchange of material and energy between the continental shelf and the continental slope. These processes are of paramount importance to a variety of oceanographic phenomena, such as the maintenance of the freshwater balance of the shelf region, the fate of pollutants discharged into the coastal zone, and the offshore export of dissolved substances and solid particles from the shelf. The shelfbreak is often the site of significant gradients of temperature and salinity in the cross-isobath direction, reflecting the different properties of shelf and slope waters. If the resultant density gradient is large enough, an along-isobath current in approximate thermal wind balance can be observed at the shelf edge. The presence of such a current suggests that dynamical conditions at the shelf edge are not particularly favourable to material transport between the shelf and slope regions, i.e., motions that are conducive to material transport across the shelfbreak would be primarily ageostrophic.

In this presentation, the Lagrangian motion in the eddy field produced by an unstable retrograde jet along the shelfbreak jet is studied from idealized numerical experiments with a primitive-equation model. The jet is initially in thermal wind balance with a cross-isobath density gradient and is not subject to any atmospheric forcing. Over the course of the model integration, the jet becomes unstable and produces a quasi-stationary eddy field over a 2-month period. During this period, the cross-slope flow at the shelfbreak is characterized by along-slope correlation scales of O(10 km) and temporal correlation scales of a few days. The cross-slope dispersion of parcels originating from near the surface or mid-depth is found to increase with time as t^b, where $1 < b < 2$. This mixed diffusive-ballistic regime appears to reflect the combined effects of (i) the short length scales of velocity correlation at the shelfbreak and (ii) the seaward excursion of monopolar and dipolar vortices. Cross-slope dispersion is greater offshore of the front than inshore of the front, as offshore parcels are both subducted onshore below density surfaces and translated offshore with eddies. Nonetheless, the exchange of parcels across the jet remains very limited on the monthly time scale. Parcels originating from the bottom experience upward displacements of a few tens of meters and seaward displacements of O(100 km), suggesting that the eddy activity engendered by an unstable along-slope jet provides another mechanism for bottom boundary layer detachment near the shelf edge.