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Vortex interaction with a buoyancy-driven coastal current in a rotating fluid

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The extent to which the front of a buoyancy-driven coastal current acts as a barrier to material flux between the shelf and slope regions has been investigated. This work pertains to one important aspect of shelf/slope exchange, namely the interaction of a slope vortex with a shelfbreak current. A series of idealized laboratory experiments have been performed to examine the processes that govern such an interaction. A buoyant current was generated over a continental shelf in a rotating tank, while a self-propagating baroclinic vortex moving towards the current front was also generated. The nonlinear three-dimensional interaction between the vortex and the current has been studied while varying a key parameter: the ratio of the absolute values of the current velocity and the vortex azimuthal velocity, denoted by ϵ. Two main regimes were observed: strong interaction for $\epsilon \ll 1$ and weak interaction for $\epsilon \gg 1$. The largest exchange flux took place for strong interaction ($\epsilon \ll 1$). Measurements of the offshore transport were conducted as well as the identification of the most onshore trajectory, formerly belonging to the current, that was deviated offshore by the vortex. In this way the active part of the current was quantified. There was a marked similarity between the experimental velocity fields and trajectories of satellite-tracked drifting buoys deployed in the North Atlantic, where two floats from the outer edge of a current front moved off-shelf, while the inner part of the current was not affected by the interaction.