Title: Baroclinic control of Southerm Ocean eddy upwelling near topography

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Abstract:
In the Southern Ocean, mesoscale eddies contribute to the upwelling of deep waters along isopycnals, helping to close the upper branch of the meridional overturning circulation. These eddies are not uniformly distributed along the path of the Antarctic Circumpolar Current but have `hotspots' of eddy kinetic energy (EKE) downstream of topographic features, thought to be associated with enhanced eddy-driven upwelling and cross-jet exchanges.
We present a modeling study of an idealized Southern Ocean jet interacting with topography, in which we examine the cross-jet transport due to transient eddies in a southward-shoaling isopycnal layer. We find that a topographic feature can enhance and localise eddy upwelling, but that this eddy-driven isopycnal transport systematically occurs in regions of EKE growth through baroclinic instability (diagnosed by the energy conversion via eddy form stress), located upstream of regions of maximum EKE. The impact that topography has on the location and magnitude of upwelling is due to how it influences the growth of baroclinic instability, while eddies created by barotropic instability do not influence the upwelling.
In most cases, zonal EKE growth outperforms popular metrics (such as EKE and/or isopycnal slope) as a simple, first-order indicator of eddy upwelling, but future parameterizations should consider metrics specific to the baroclinic instability energy pathway.