

# Submesoscale stirring of the Kuroshio in the East China Sea

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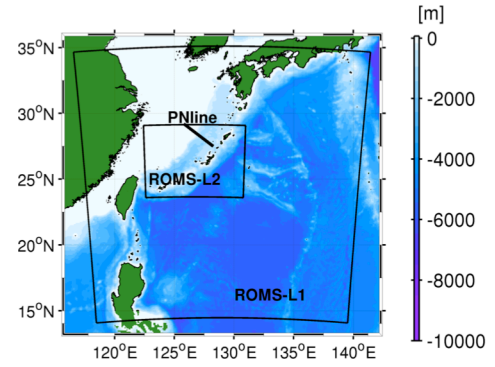
**Key words:** JCOPE2-ROMS downscaling, Kuroshio, submesoscale eddies, Ryukyu Islands

## Abstract

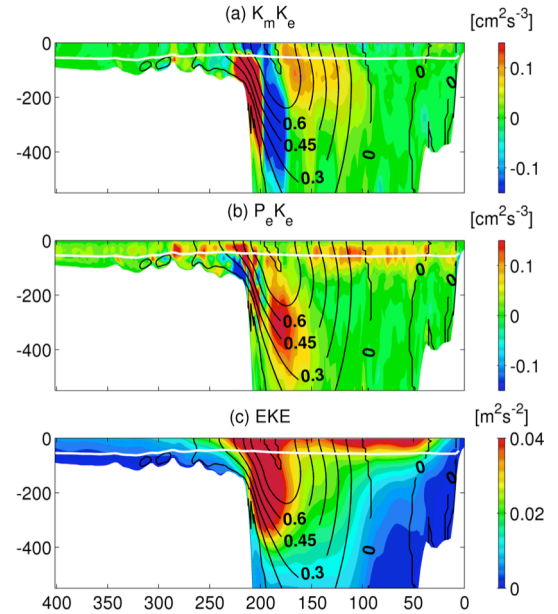
A synoptic regional downscaling experiment on Kuroshio off Ryukyu Islands, Japan, exhibits the evident predominance of submesoscale anticyclonic eddies over cyclones in the narrow strip between Kuroshio and the islands (Uchiyama *et al.*, 2013). In order to investigate the mechanism of the anticyclone dominance over cyclones with an attention to topographic effects of the islands, we carry out a detailed oceanic downscaling experiment in a double nested configuration forced by JCOPE2 and GPV-MSM with a horizontal resolution of 1 km (Fig. 1). A preliminary, accompanying experiment is then conducted to directly investigate the island topography effects around the Ryukyu Islands by removing all the island topography above  $z > -1000$  m. If the islands are removed, the submesoscale negative vorticity on the eastern side of the Kuroshio is markedly attenuated as compared to the baseline case with islands (Kamidaira *et al.*, 2014).

An energy conversion analysis relevant to eddy kinetic energy demonstrates that the dominance of negative vorticity between Kuroshio and the Ryukyu Islands is induced by a combination of the lateral shear instability and the baroclinic instability in the upper ocean, leading to eddy shedding on the shelf break and subsequent development of eddies confined in the narrow strip between the continental shelf slope of the East China Sea and the Okinawan ridge (Fig. 2). We further examine the heat transport due to eddying currents and focus on the divergent component of the eddy heat flux (EHF). The diagnostic EHF analysis suggests that the dominance of the negative vorticity is substantial in emergence of more energetic submesoscale anti-cyclonic eddies that lead to promoting lateral material exchange between Kuroshio and

the islands.



**Figure 1:** Geographical configuration of the double nested JCOPE2-ROMS downscaling model for the Ryukyu Islands fringing the East China Sea.



**Figure 2:** Cross-sectional plots of (a) barotropic conversion rate,  $K_m K_e$ , (b) baroclinic conversion rate,  $P_e K_e$ , and (c) eddy kinetic energy, EKE, along the SSE-NNW transect off the Okinawa main island normal to the Kuroshio. The abscissa is the distance from the main island, contours are the stream-wise velocity in m/s of the Kuroshio.