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Generation of submesoscale frontal eddies in the Agulhas current

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Abstract

This study addresses the dynamics of the Agulhas inshore front in the submesoscale range upstream of 26◦ E. Submesoscale frontal eddies are observed in the vicinity of Port Elizabeth (26◦ E) from satellite images and in observations collected from underwater gliders. Using a submesoscale-resolving numerical model (dx ∼ 0.75 km), we are able to simulate similar submesoscale eddies. Barotropic instability is confirmed as the generation mechanism by a one-dimensional linear stability analysis and an eddy kinetic energy budget. Kinetic energy is transferred from the mean flow to the eddies through the mean horizontal shear, which is a signature of barotropic instability. When the Agulhas Current is in a nonmeandering state, submesoscale eddy generation is a recurrent process which locally drives the front's variability. Along the front, the spatial variability of barotropic instability is shaped by the background strain. A large strain aligned with the frontal axis intensifies the frontal shear upstream of 28◦ E while a weakening of the strain allows for barotropic instability to be triggered downstream. Although an intermittent process, the barotropic instability shows a dominant period of variability comparable with the variability of the Agulhas Current and Undercurrent.