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Influences of submesoscale eddies on synoptic and mesoscale dynamics in the Japan Sea

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ABSTRACT

The Japan Sea is connected to other seas by five narrow and shallow straits with a minimal depth of the order of 100 meters or less, resulting in limited water exchange thereby isolating the water and aquatic ecosystem. The modeling and observational studies on quantifying the dynamics in the Japan Sea are still undergoing (e.g., Hirose *et al*., 2007), whereas effects of submesoscale dynamics on the mean structure, eddies, and material dispersal in the Japan Sea have not been extensively investigated yet. In the present study, we conduct a detailed oceanic downscaling numerical experiment using ROMS in a double nested configuration at horizontal resolutions of 3 km (ROMS-L1) and 1 km (ROMS-L20, bounded by the assimilative JCOPE2 reanalysis (Miyazawa *et al*., 2009).

The L1 and L2 models are compared to the observed data to show a good agreement with an appropriate parameter choice. Our models sufficiently reproduce the overall frontal structure and associated major currents in the Japan Sea consisting of the Liman Cold Current along the Russian coast and the Tsushima Warm Current along the Japanese coast. Surface normalized relative vorticity fields demonstrate that both the mesoscale and submesoscale eddies are apparently enhanced, as the model grid resolution is finer. In summer and fall, mesoscale eddies are evident in L1 and L2. In contrast in winter and spring, submesoscale eddies are significantly energized in the whole Japan Sea particularly in L2 due to the surface cooling that preconditions symmetric instability (e.g., Thomas *et al*., 2012). The enhancement of EKE appears around Tsushima strait and along the Korean Peninsula in L1, while EKE in L2 is extensively increased in the most part of the southern Japan Sea. On the other hand, SSH variance as a proxy of mesoscale variability is more realistically distributed in L2 than L1, suggesting a potential importance of influences of submesoscale eddies on the mesoscale dynamics.