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Improving the Surface Currents from the Merging of Altimetry and Sea Surface Temperature Image in the South Indian Ocean

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Accurate knowledge of ocean surface currents is crucial for a gamut of applications. In this study, the way in which merging altimeters composited two-dimensional sea surface height (SSH, 1/4°) with remote sensing combined sea surface temperature (SST, 9km) image improves the surface current estimates is investigated. Based on the surface quasigeostrophic (SQG) theory, we reconstruct the surface current by resolving the large scale motions, the mesoscale dynamics, and the oceanic smaller processes. Its feasibility is validated using the altimeter-derived geostrophic current (GC) and drogued drifters in the South Indian Ocean (SIO) during 2011–2015. Results of the two cases show that the effective resolution of the reconstructed surface current (RSC) has improved to 30 km after merging the high-resolution SST information, compared to 70 km of the GC. Moreover, the RSC outperforms the altimeter-derived GC in reproducing the practical dynamical processes. Over the analyzed period, compared with 841 drifters, the statistical results indicate that the RSC reduces the reconstruction errors of zonal velocity, meridional velocity, and velocity phase by about 14.6%, 45.7%, 27.0% in the SIO relative to the GC, respectively. Our method particularly improves the meridional velocity and velocity phase along the Antarctic Circumpolar Current, Agulhas Retroflection, Greater Agulhas System, and South Equatorial Current. In addition, the lower Lagrangian separation distance and higher skill score of the RSC given by Lagrangian analysis also demonstrate that the proposed method is more promising to provide essential information on ocean surface currents applications, such as water property transports, search and rescue, etc.