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Ocean Circulation from the synergy of altimeter-derived and oceanic tracers observations

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Measuring the ocean surface currents at high spatio-temporal resolutions is crucial for scientific and socio-economic applications. Since the early 1990s, the synoptic and global-scale monitoring of the ocean surface currents has been provided by constellations of Radar Altimeters. The Altimeter observations enable to derive the geostrophic component of the surface currents with effective spatial-temporal resolutions O(100 km) and O(10 days), respectively. Therefore, only the largest mesoscale oceanic features can be accurately resolved. In order to enhance the altimeter system capabilities, we propose a synergistic use of high resolution, satellite-derived Sea Surface Temperature (SST), Chlorophyll concentrations (Chl) and Altimeter-derived currents. Our approach is tested in both global-scale and regional contexts.
At global scale, relying on past numerical studies, we perform a sensitivity experiment based on several gap-free SST datasets, emphasizing strengths and weaknesses in ocean currents applications. Overall, the comparison with in-situ measured currents shows that our synergistic method can improve the altimeter estimates up to 30% locally.
Then, our method is also implemented with Chl data in the Mediterranean Sea, where the most energetic variable signals are found at spatio-temporal scales up to 10 km and few days. We test the method feasibility in an Observing System Simulation Experiment relying on model outputs of the European Copernicus Marine Service. Statistical analyses based on the 2017 daily data show that our approach can improve the altimeter-derived currents accuracy up to 50% at the basin scale, also enhancing the effective spatial-temporal resolutions up to 30 km and less than 10 days, respectively. The method efficiency decreases when the surface Chl patterns are dominated by the biological activity rather than the currents advection, which mostly occurs in the mid-February to mid-March time window. Preliminary tests on the method applicability to satellite-derived data are also presented and discussed.