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Evaluation of global satellite-derived geostrophic ocean current products

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Gridded geostrophic currents derived from satellite altimetry are a cornerstone for investigating ocean surface circulation. However, their effective spatial resolution and dynamical fidelity are highly sensitive to processing choices. Here, we present a comprehensive global intercomparison of several daily, gridded (Level-4) freely available altimetry-based datasets that employ distinct gridding strategies.

Dataset performance is evaluated using a suite of complementary metrics. Spectral diagnostics, including power spectral density and eddy kinetic energy, are employed to quantify the representation of mesoscale variability across a range of spatial scales, dynamical regimes, and energy levels. In addition, a Lagrangian framework is adopted in which virtual drifters are deployed and advected along observed drifter trajectories, enabling robust statistical comparisons of transport and dispersion characteristics among the datasets. The results are consistent across metrics and highlight the strong performance of recently developed products, including neural network–based approaches such as NeurOST, and advanced multi-mission datasets, such as those provided by the Copernicus Marine Environment Monitoring Service (CMEMS) data store.

This intercomparison is conducted within the framework of ESA's Climate Change Initiative, which aims to expand ESA's portfolio of Essential Climate Variables. It supports the development of a novel Ocean Surface Heat Flux (OSHF) product, generated to address the observational gaps and limitations inherent in existing OSHF estimates.