## Integrating SWOT data into a deep learning model for real-time high-resolution prediction of ocean surface currents

New high-resolution data from the SWOT (Surface Water and Ocean Topography) satellite provides new opportunities for learning high-resolution ocean surface currents in real-time using deep learning methods. The high resolution (~1km) and wide swath (~120km) of SWOT allows reliable estimation of sub-mesoscale eddies, missed by nadir satellite altimeters. However, due to the long revisit time (21 days), interpolation methods are required to predict ocean surface currents in real time. Recent advances in computer vision allow us to predict ocean surface currents, by fusing information from multiple sources of satellite imagery such as sea surface temperature and nadir satellite altimetry. The potential of SWOT in increasing the accuracy of ocean surface current predictions has been demonstrated using simulated data. We expand upon previous work by training a model which uses real SWOT satellite data in combination with nadir altimetry and sea surface temperature to learn ocean surface currents. Our convolutional neural network inputs a time series of past SST images, as well as SWOT and nadir altimetry, and outputs a time series of future SSH fields and ocean surface currents. The model is trained using SWOT satellite altimetry as ground truth data, in addition to nadir satellite altimetry. We predict ocean surface currents by applying a correction to the geostrophic currents derived by altimetry. In particular, we train and evaluate our model in the Mediterranean Sea, in the Atlantic Ocean and in the Pacific Ocean. Our evaluation metrics are angle and magnitude differences between our model predictions and measurements from drifters. SWOT data allows us to increase the resolution of our predictions up to 1/60° and reveals small-scale structures, whose signatures are also visible in high-resolution SST data. The model learns to fusion high-resolution information visible in the SST with sparse altimetric observations to reconstruct sea surface height and ocean surface currents. Although the data from SWOT is noisy, our model learns to make smooth generalised predictions due to training on large quantities of historical data. High-resolution prediction of ocean surface currents has many potential applications, including optimising ship routes, understanding climate dynamics and tracking of pollutants. We outline a potential application by illustrating how our model can be used to increase efficiency in cleaning plastic pollution in the Pacific Ocean.

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