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Variational analysis of high-frequency radar surface currents using DIVA

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DIVA (Data-Interpolating Variational Analysis) is a tool that allows one to interpolate observations on a regular grid in an optimal way. It is commonly applied to in situ observations such as temperature, salinity or nutrient concentration to obtain gridded climatologies. It takes the coastline and bathymetry, ocean currents and the spatial connectivity of water bodies into account to interpolate these tracers, also considering uncertainties on observations. For vector quantities, like ocean surface currents, addition a new set of constraints must be taken into consideration based on the relationship between the components. We have extended DIVA to include additional dynamic constraints relevant to surface currents, including imposing a zero normal velocity at the coastline, imposing a low horizontal divergence of the surface currents, temporal coherence and a simplified dynamics based on the Coriolis force and possibly including a surface pressure gradient.

The impact of these constraints is evaluated by cross-validation using the HF (High-Frequency) radar surface current observations in the Ibiza Channel from the Balearic Islands Coastal Ocean Observing and Forecasting System (SOCIB). A small fraction of the radial current observations are set aside to validate the velocity reconstruction. The remaining radial currents from the two radar sites are combined to derive total surface currents using DIVA and then compared to the cross-validation data set. The benefit of the dynamic constraints is assessed relative to a naive variational interpolation ignoring these dynamical constraints. Best results have been obtained when the Coriolis force and the surface pressure gradient are included together.