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Gridding of high-frequency radar velocities using the Data-Interpolation Variational Analysis in n dimensions (*DIVAnd*)

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The main goal of this work is to present the design and the implementation of a procedure for the reconstruction of surface velocity fields in different coastal regions of Europe, by applying advanced spatio-temporal interpolation techniques on high-frequency radar (HFR) radial velocities.

The method allows us to take additional constraints such as the boundary constraint (impermeability of the coastline), low divergence, or Coriolis effect. The procedure is applied to different coastal regions and the files obtained from the EMODnet Physics Thredds server. The follows steps:

- Specification of the region of interest (rectangular bounding box, in the form), based on the coverage of the different radials.
- Preparation of a high-resolution bathymetry for the region.
- Setting of the period of interest (initial and final dates).
- Setting of the analysis parameters: correlation length (longitude, latitude and possibly time), noise-to-signal ratio, relative importance of the constraint (divergence, boundary, Coriolis).
- Specification of the metadata in the netCDF files.
- Run of the interpolation.
- Writing the netCDF files storing the results.

This procedure was applied to the Gulf of Manfredonia (Adriatic coast of Italy), the Gulf of Trieste (north of the Adriatic Sea), the Gulf of Naples (south-western coast of Italy) and the Gran Canaria island (Atlantic Ocean).

The different parameters are optimised using a cross-validation technique:

- The radial velocities from one of the antennas are discarded.
- The velocity field is reconstructed using the radial velocities from the remaining sites.
- The velocity field is interpolated at the location of the discarded measurements and projected on the radial direction.

- The RMS difference between the original (discarded) radial and the radial obtained in the previous step is computed.

The outputs (gridded fields) are provided as netCDF files following the Climate and Forecast (CF) conventions and the recommendation of the EuroGOOS HFR Task Team.

For the validation and intercomparison, different approaches are used: in the Gulf of Manfredonia, high-resolution satellite images of chlorophyll concentrations are used to derive the currents with the outputs of the HFR gridded fields; for the Gran Canaria system, we compared the velocity with the outputs of the IBI model (*Atlantic-iberian Biscay Irish- Ocean Physics Analysis And Forecast*, product IBI_ANALYSISFORECAST_PHY_005_001), provided by the Copernicus Marine Environment Monitoring Service.