Collaborative Oceanography and Monitoring for Protected Areas and Species (COMPASS)

Deliverable T5.2.1

Hindcasts of Hydrodynamic Conditions

June 2021

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1. Overview

The COMPASS hydrodynamic hindcasts consist of 2016-2020 daily fields of different physical parameters relevant to the distribution of marine species that can be directly obtained from the hydrodynamic models used under the COMPASS project. Detailed information about the selected parameters is provided in Section 2.

A hydrodynamic model is a computational system that, after being provided with information describing the ocean seafloor, atmospheric forcing, boundary conditions and the initial state of the region of interest, can simulate the dynamics of the ocean circulation, sea surface elevation and distribution of salinity, temperature and density. Two hydrodynamic models have been used under the COMPASS project:

(a) The ROMS-based North-East Atlantic model (NEA-ROMS) developed by the Marine Institute Ireland (Dabrowski et al., 2014; Dabrowski et al., 2016).
(b) The FVCOM-based West Scotland Coastal Ocean Modelling System (WeStCOMS) developed by the Scottish Association for Marine Science (Aleynik et al., 2016).

The latter model (WeStCOMS) is nested within the former (NEA-ROMS) and receives boundary information from it. This model system has been described in previous COMPASS deliverables D.T5.4.1.1 and D.T5.4.2.2.

Separate sets of hydrodynamic hindcasts have been produced for each of these models. In general, the advantage of the NEA-ROMS model relies on its wider coverage, but the WeStCOMS model should be preferred when focus is on the waters neighbouring the complex Scottish coastline, with innumerable islands and lochs that are not well resolved by the large-scale NEA-ROMS model.

The grids used by these two models are greatly different in terms of structure and resolution. For the sake of consistency, data from these models have been linearly interpolated from their native grids to a common, regular, 0.01°-resolution, non-rotated grid covering from 53°N 11°W to 59°N 2.8°W (Fig. 1). This is the same approach used to produce the habitat data layers (see COMPASS deliverable D.T5.4.1). It is important to notice that this interpolation step involves a loss of resolution in some areas, in particular, in the waters near the complex coastline of Scotland which are properly resolved by the native grid of the WeStCOMS model with its fine triangular mesh. Users concerned with this loss of resolution are encouraged to download the data from the native product, which is freely accessible through the THREDDS server at the Scottish Association for Marine Science (https://thredds.sams.ac.uk/thredds/catalog/SCOATS.html).

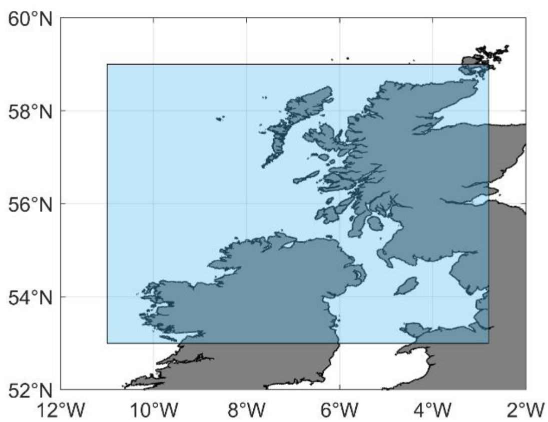

Figure 1. Domain covered by the 0.01° COMPASS regular grid on which hydrodynamic hindcasts are provided.

2. Ocean variables

2.1. Potential temperature

The potential temperature (°C) is the temperature that a water parcel would attain if adiabatically moved to a reference pressure level, usually the surface. The NEA-ROMS model directly provides potential temperature as an output, but the FVCOM-based WeStCOMS model provides *in situ* temperature instead. Therefore, the TEOS-10 Thermodynamic Equations of Seawater (IOC et al., 2010) have been used to convert WeStCOMS *in situ* temperature to potential temperature. Potential temperature is provided as daily instantaneous values at noon at the surface, 10-meters depth, 30-meters depth and bottom.

2.2. Absolute Salinity

The Absolute Salinity (g kg^{-1}) is the mass fraction of total dissolved solids per kilogram of seawater and has been calculated from practical salinity using the TEOS-10 Thermodynamic Equations of Seawater. Again, it is provided as daily instantaneous values at noon at the surface, 10-meters depth, 30-meters depth and bottom.

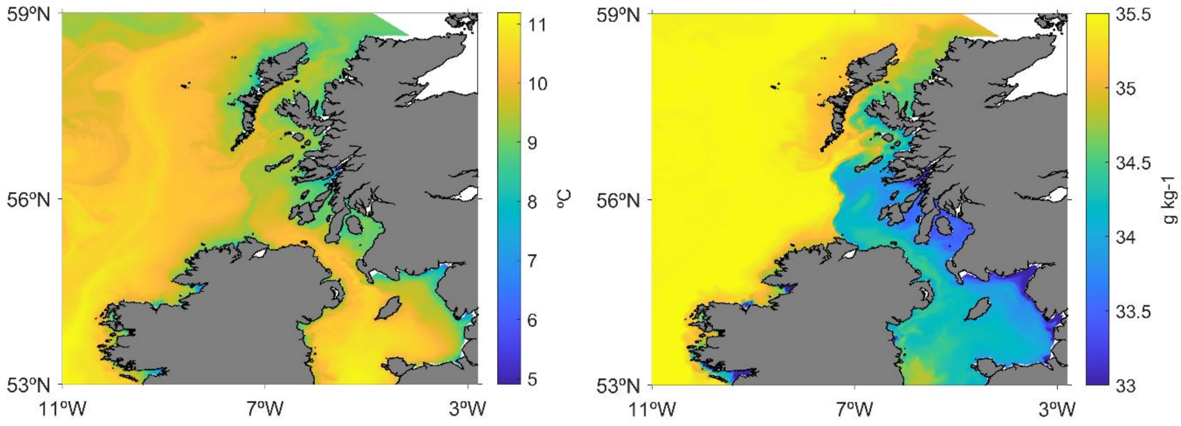

Figure 2. NEA-ROMS 01-Jan-2016 surface temperature (left) and surface salinity (right).

2.3. Mixed Layer Depth

The mixed layer depth (m) is provided as the depth at which a potential density difference of 0.03 kg m^{-3} with respect to a near-surface reference value is observed, with the near-surface reference value set at 10 meters depth (de Boyer Montégut et al., 2004). It is provided as daily instantaneous values at noon.

2.4. Residual currents

The residual currents (m s^{-1}) are provided as 25-hour averages, from midnight (12 a.m.) to midnight (12 a.m.) at the surface, 10-meters depth, 30-meters depth, bottom and vertically-integrated through the water column.

3. Data access

Daily files of hydrodynamic hindcasts are in NetCDF format and can be accessed through the THREDDS server at the Marine Institute (thredds.marine.ie/thredds/catalog.html) and the THREDDS server at the Scottish Association for Marine Science (https://thredds.sams.ac.uk/thredds/catalog/SCOATS.html).

4. References

Aleynik, D., Dale, A. C., Porter, M., Davidson, K., 2016. A high resolution hydrodynamic model system suitable for novel harmful algal bloom modelling in areas of complex coastline and topography. Harmful algae, 53, 102-117. https://dx.doi.org/10.1016/j.hal.2015.11.012

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IOC, SCOR and IAPSO, 2010: The international thermodynamic equation of seawater – 2010: Calculation and use of thermodynamic properties. Intergovernmental Oceanographic Commission, Manuals and Guides No. 56, UNESCO (English), 196 pp.

Appendix – Acronyms used

COMPASS – Collaborative Oceanography and Monitoring for Protected Areas and Species

FVCOM - Finite Volume Community Ocean Model

NEA-ROMS – The implementation of ROMS in the northeast Atlantic (as used by COMPASS)

NetCDF – Network Common Data Form

ROMS – Regional Ocean Modelling System

TEOS-10 – Thermodynamic Equation of Seawater 2010

THREDDS - Thematic Real-Time Environmental Distributed Data Services

WeStCOMS - The implementation of FVCOM in western Scotland (as used by COMPASS)