

Euro-Argo ERIC – Copernicus Marine Service

Memorandum of Understanding

This Memorandum of Understanding serves as the initial document for collaboration between Mercator Ocean International in charge of the implementation of the Copernicus Marine Service and Euro-Argo ERIC, both of which are legal entities who seek to better formalise their relations to enhance their collaboration on *in situ* ocean observations in Europe.

Rationale

Euro-Argo ERIC provides *in situ* ocean observations to a wide range of users with an interest in the ocean's state and its evolution, both from a physical and biogeochemical point of view. It contributes to 25% of the Argo international programme.

The Copernicus Marine Service integrates *in situ* observations into coherent products and services and needs to aggregate data provided by the *in situ* observing system operators.

Euro-Argo ERIC

The international Argo programme is an essential component of the global ocean observing system required to monitor and forecast the oceans and the evolution of our climate. Argo is the first-ever global, *in situ* ocean observing network in the history of oceanography, providing an essential complement to satellite systems. About 4000 floats are now globally measuring ocean properties between the surface and 2000m depth, delivering key data used in operational centres to produce standardised products. Argo provides thousands of daily measurements of ocean physics and is progressively becoming the main source of *in situ* biogeochemical (BGC) observations in the open seas, while extending towards the abyss.

The Euro-Argo ERIC (European Research Infrastructure Consortium) organises and federates 12 European countries aiming at maintaining 25% of the global Argo network. Euro-Argo partners also operate one of the two Argo Global Data Assembly Centres and several regional Argo data centres.

Setting up a long-term observation of the deep oceans is vital to understand how much, and how fast, the earth will warm due to increased greenhouse gas concentrations. Long-term observation of ocean biogeochemistry helps to understand the evolution of the marine ecosystem and the impact of climate change. The new "Global, Full-Depth and Multidisciplinary" Argo design (Roemmich et al., 2019) is now being implemented in Europe, with two main objectives: 1/ to sustain the existing global array and 2/ extend its capabilities to deeper depths and to biogeochemistry through the Deep Argo and BGC Argo missions. In addition, Euro-Argo is also enhancing Argo monitoring in polar regions and European marginal seas.

Copernicus Marine Service

The Copernicus Marine Service provides operational, regular and systematic reference information on the physical (blue) and biogeochemical (green) ocean and sea-ice (white) state for the global ocean

and the European regional seas. This capacity encompasses the description of the current situation (analysis), the prediction of the situation 10 days ahead (forecast), and the provision of consistent retrospective data records (reprocessing (in situ and satellite) and reanalysis). More than thirty thousand expert downstream services and users are connected to the service that responds to public and private user needs and policies related to all marine and maritime sectors: maritime safety, coastal environment monitoring, trade and marine navigation, fishery, aquaculture, marine renewable energy, marine conservation and biodiversity, ocean health, climate and climate adaptation, recreation, education, science and innovation.

The Copernicus Marine Service production structure is organised in two layers: (1) processing of space and *in situ* observations and delivery of derived products and (2) processing of models for forecasts, hind-cast and reanalyses, fed by products derived from space and in-situ observations.

The first layer is undertaken by Thematic Assembly Centres (TACs) organized according to consistent parameters – or sets of parameters. The Copernicus Marine Service includes 7 TACs handling space observations (Sea Level, Ocean Colour, Sea Surface Temperature, Sea Ice, Winds, Waves, and Multi-Observation Integration), and one TAC dedicated to *in situ* observations. The second layer is undertaken by Monitoring and Forecasting Centres (MFCs), structured according to regional domains (6 European regional seas) and global ocean.

The service provides, to several thousands of users, pioneering solutions, operational and scientifically assessed, to monitor the global ocean with a focus on the European seas. The products delivered by the Copernicus Marine Service are open and free of charge, and compliant with European regulations. They are accessible through a European one-stop-shop - the Copernicus Marine Service web-portal - which includes a structured information catalogue monitored to ensure that it complies with its operational obligations to users.

Relations between the Euro-Argo ERIC and the Copernicus Marine Service

Observations are a fundamental pillar of the Copernicus Marine Service value-added chain that goes from observation to information and users. In particular, *in situ* observations play a critical role within the Copernicus Marine Service: the Argo array of profiling floats has especially a major impact on the quality of the global and regional analyses and forecasts and allows to validate satellite observations (Sentinel missions). The Argo time-series over the past two decades have also enabled the Copernicus Marine Service to produce a number of Ocean Monitoring Indicators (OMIs), informing on physical and biogeochemical states of the ocean. With regards to implementation of the new phase of Argo, and the extension to the deep and the BGC missions as well as towards high latitudes, it has been shown that Deep Argo measurements were key in improving the products. Argo Biogeochemical parameters are under study, e.g., through the Copernicus Marine Service “service evolution” projects. The development of the global *in situ* Argo BGC array constitutes a strong priority for the Copernicus Marine Service, because the lack of *in situ* BGC data currently limits its ability to monitor and forecast the state of the “green” ocean. BGC Argo data are also invaluable to validate Sentinel-3 ocean colour observations.

Copernicus Marine Service and Euro-Argo ERIC collaboration items

Mercator Ocean International - in charge of the implementation of the Copernicus Marine Service - and the Euro-Argo ERIC recognize a common interest in *in situ* data for different applications and

users, and that there are several areas of development and operational activities that will benefit from cooperation between them. This Memorandum of Understanding formulates an initial number of areas and activities of cooperation, while this list can be updated over time in mutual agreement:

- The two entities will exchange and coordinate activities to maximize and ease the use of existing and new types of Argo data (e.g., deep and biogeochemical observations) by the Copernicus Marine Service.
- They will regularly review the quality and availability of Euro-Argo products and agree on recommendations as to their improvement.
- Mercator Ocean International and Euro-Argo ERIC will also report on achievements and future needs in terms of observations (spatial and temporal coverage) in order to enhance the range and quality of operational products offered by the Copernicus Marine Service.
- They will develop joint advocacy activities towards funding agencies for promoting the need for a sustained and consolidated European contribution to the full-depth, multidisciplinary and global Argo array.

Progress on these collaborative activities will be monitored through regular meetings between key representatives of both entities. Initially, the meetings will be organized yearly - with notice at least one month before each meeting - with the possibility to increase the frequency based on requirements from both sides. They will also provide opportunities for possibly updating this initial MoU.

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