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CHANGE RECORD

When the quality of the products changes, the QuID is updated and the SQO is updated. A line is added to this table and the version of the SQO document is the same than that of the REFERENCE QUID. The third column specifies which sections or sub-sections have been updated.

Issue	Date	§	Description of Change	Authors	Validated By
2.0	28/05/20	All	Creation of the document for the 4 datasets (radar_total, radar_radial, drifter,drifter_filt)	E. Reyes,L. Corgnati, C. Mantovani, P. Rotllán-García, A Rubio, J. Mader, H Etienne, T. Carval, N. Verbrugge	Validated by PQ leader
2.1	04/09/2020	All	Addition of “argo” dataset	T. Carval	S. Tarot
2.2	31/08/2022	Executive summary + § on drifter_filt removed	Drifter_filt removal, additional MO_TS_DC files on MED, datasets renaming	N. Verbrugge	S. Tarot
2.3	31/05/2023	Executive summary §3 and §4	Add drifters without drogue Update of argo and drifters figures	N. Verbrugge, T. Carval	S. Tarot

Contents

Executive summary

This document provides a description of the information related to the assessment of the spatio-temporal coverage of the five datasets within the INSITU_GLO_PHY_UV_DISCRETE_NRT_013_048 product from the Copernicus Marine Service distribution, which is available in near real time through different services from mairineinsitu.eu.

- **SURFACE WATER VELOCITY from High Frequency Radars (cmems_obs-ins_glo_phy-cur_nrt_radar-total_irr dataset)**
  The SURFACE WATER VELOCITY consists in maps of near-surface zonal and meridional velocities measured by High Frequency radars (HF radars, as acronym HFR). These variables are distributed along with their standard deviation, Geometrical Dilution of Precision (GDOP), quality flags and metadata.
- **RADIAL VELOCITIES from High Frequency Radars (cmems_obs-ins_glo_phy-cur_nrt_radar-radial_irr dataset)**
  The RADIAL VELOCITIES consist in maps of the zonal and meridional components of the radial ocean surface currents provided on a regular grid in the area covered by the individual radar stations. These variables are distributed along with their standard deviation, quality flags and metadata.

To control both spatial and temporal availability of the surface water velocity maps for each HFR total platform and for the radial velocities from each HFR radial platform, we use:

- the **spatial data coverage** of each HFR platform (Figure 1 and Figure 4), showing the area where there was good (QCflag=1) or probably good (QCflag=2) data for at least the 80% of the time for the last hour available of the last daily file (archived in the folder /latest).
- the 80/80 coverage metric (Roarty, et al. 2012), showing the temporal and spatial data coverage (Figure 2 and
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- Figure 5) provided by each individual HFR platform (total or radial) over the last month (as available in the folder /monthly).
- At the HFR network level, the temporal availability is shown by the **number of HFR platforms** available over the last month (Figure 3 and Figure 6). This metric is computed from the index_latest.txt file available in the folder of each dataset.

- **NEAR_SURFACE WATER VELOCITY from cmems_obs-ins_glo_phy-cur_nrt_drifter_irr dataset**

  For GL_TS_DC files (global region): the Coriolis data Centre delivers every Monday **1-hour (3-hours before the 25th of March 2018)** 15 m depth velocities measurements from drifters.

  Most of the drifters are of SVP type (or derived) and are part of the DBCP's Global Drifter Program which transmits the data in real-time to the (Global Telecommunication system-GTS). Their drogue is centred at 15 meters depth (note: a small number of buoys, not SVP type, can measure other depths: 0 and 50m). These data are first collected on the GTS, then analysed and pre-processed (estimations of the velocities, outliers detection, position on land, drogue loss,…) by the Marine meteorological Center of Météo-France (CMM) in the frame of the French project Coriolis, dedicated to operational oceanography in situ observation management. Drifters with and without their drogue are distributed.

  Other operational qualification is also done by Coriolis in a second stage (position, date, spike, Real Time Quality Control (RTQC) (ref:EuroGOOS 2010). Drogued data provide

velocity information at the drogue center depth (15m for most of them). SVP drifter's velocity is not the perfect measurement of the water column averaged over the drogue depth. The water can sink, or the drifter can slip due to wind influence on the surface float. Hence the resulting drifter velocity is the addition of the 15 meters depth large-scale current, the upper-ocean wind-driven flow, the influence of tides and Stokes Drift and other forces on the drogue and the surface body of the drifter, and the slip.

Undrogued data provide velocity information at the surface and can be contaminated by direct wind effect on the buoy (not linked to ocean current).

For MO_TS_DC files (Mediterranean region only): additional data are distributed in the Mediterranean Sea from OGS database and comes from various institutions and countries. Many drifters distributed are considered to be without drogue (CODE, CARTHE,…). These measurements can be considered as surface observations. For these buoys, the tests on the drogue loss are not activated. These tests are done for SVP drifters only (see description of the quality flags and tests in the CMEMS-INS-PUM-013_048 document of the product).

To control both spatial and temporal availability of the drifters, we use:

- a map (Figure 7) showing the trajectories of the active drifting buoys for the last 30 days (but to be use carefully: see the note in Figure 7)
- the **number of drifters' platforms** available over the last month (Figure 8). This metric is computed from the index_latest.txt file available in the folder of each dataset.

- **SEA WATER VELOCITY from cmems_obs-ins_glo_phy-cur_nrt_argo_irr dataset**

The Argo current product generated by Copernicus In Situ TAC (Ollitraut and Rannou, 2013) is derived from the original trajectory data from Argo GDAC (Global Data Assembly Center) available at:

- *Argo float data and metadata from Global Data Assembly Centre (Argo GDAC). https://doi.org/10.17882/42182*

The ocean current product contains a NetCDF file for each Argo float. It is updated daily in real time by automated processes. For each cycle it contains the surface and deep current variables.

Validation consists of monitoring the number of platforms from Marine In Situ KPI dashboard (http://www.marineinsitu.eu/monitoring) and regular inspection a global Argo current speed map and individual float current graphics.

➔ For additional information regarding the in-depth validation of this product, the calculation of the assessment metrics presented in this product and other detailed information in quality and noticeable events please refer to the reference Quality Information Document (QuID) CMEMS-INS-QUID-013_048

Important notice:
The contents of this document are an assessment based on the best set of observations available for evaluation at the time the operational system was validated. The validation methodology was defined and agreed within Copernicus Marine Service, inheriting the long experience of MyOcean and MERSEA series of projects (Hernandez et al., 2018) but also the HFR EU node and the HFR-related activities in the CMEMS-INCREASE and H2020 – JERICO-Next research projects (HFR data). The estimated accuracy numbers (EAN) given in this document mainly come from literature. Other results illustrate the data coverages in time and space. The reader is invited to use complementary information from reference QUID (error maps for instance, when available).

1. SURFACE WATER VELOCITY - High Frequency Radar (obs-ins_glo_phy-cur_nrt_radar-total_irr dataset)

Coverage area and spatial resolution of the SURFACE WATER VELOCITY depend respectively on HFR operating frequency and available bandwidth (Rubio et al. 2017). Moreover, data coverage is not always regular. Spatial and temporal data gaps may occur at the outer edge, as well as inside the measurement domain due to several environmental and electromagnetic causes: (e.g. lack of Bragg scattering ocean waves or severe ocean wave conditions, low salinity environments, the occurrence of radio interference).

The figures below show examples of snapshots from the dashboard and the monitoring services from marineinsitu.eu where the user can access to near real-time information for assessing the spatio-temporal coverage of the HFR surface current data, for each individual platform and for the whole network. A brief description of the figure, along with clear instructions on how to find this information is provided (code to make it on your own is available at http://www.marineinsitu.eu/material/).

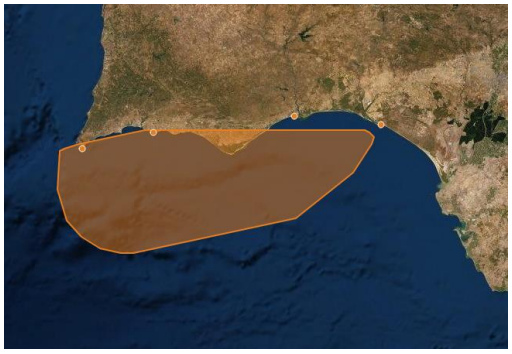


Figure 1: *map showing the spatial coverage of each HFR total platform (e.g. HFR-South) considering all those grid points with a temporal availability higher than 80% for the last available hour (of the latest daily file from the /latest).*

Availability: visit the dashboard, select the platform High Frequency Radars (HF) and the total coverage will be displayed on the map for every platform (or for every regional network in the case of US HFR platforms).

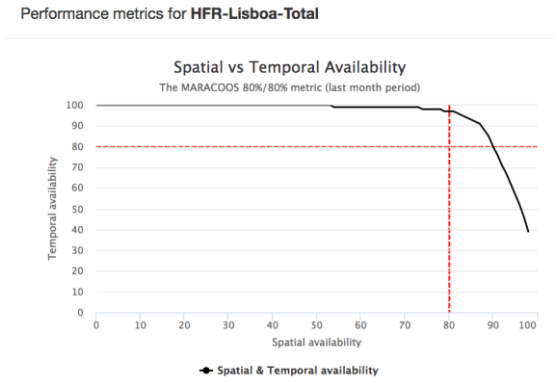


Figure 2: *temporal and spatial coverage available in near real-time for each HFR total platform. The point of intersection of the two red dashed lines shows the 80/80 metric (e.g. HFR-Lisboa is performing well providing surface currents over 90% of the time in an area corresponding to 80% of the total grid).*

The historical performance along the years of operations is available in the CMEMS-INS-SQO-013_044, biannually updated.

Availability: visit the dashboard, select the platform High Frequency Radars (HF), click over the spatial coverage of each HFR platform and select the “Stats” button.

At the network level:

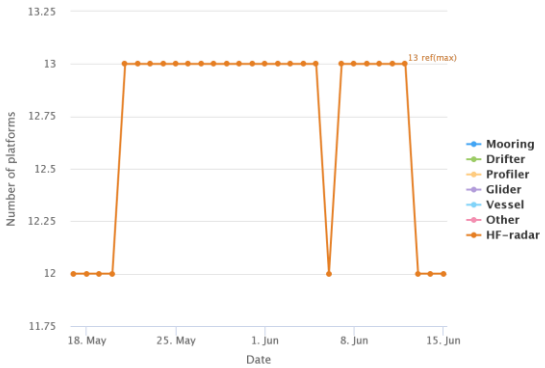


Figure 3: *number of platforms providing HFR total over the last month, updated in NRT.*

Availability: visit the monitoring service, click on “Detailed view” and select:

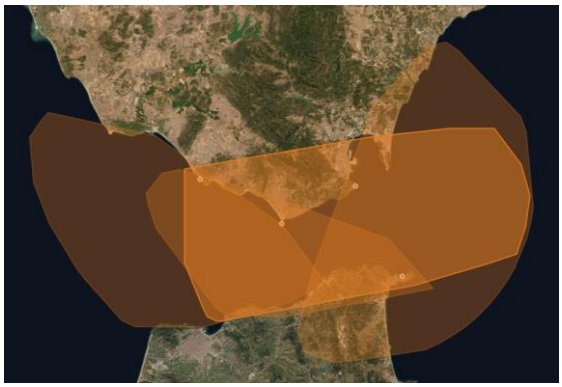
- ***Region*** = Global
- ***Type*** = Near Real Time
- ***Product***: INSITU_GLO_PHY_UV_DISCRETE_NRT_013_048
- ***Dataset*** = radar_total
- ***KPI*** = Number of platforms (e.g., 12 HFR total platforms were providing surface currents at the date of the edition of this document).

Finally, the figure will be displayed and able to be saved in different formats (i.e. PNG, JPEG, PDF, SVG).

2. RADIAL VELOCITY - High Frequency Radar

(obs-ins_glo_phy-cur_nrt_radar-radial_irr)

The assessment of the spatio-temporal coverage of the RADIAL VELOCITIES (variable/dataset) for each HFR radial site and for the whole network is provided by means of similar figures as in the case of the HFR surface currents.



Performance metrics for **HFR-TirLig-TINO**

Figure 4: *Map showing the spatial coverage of each HFR radial site (e.g,. HFR-Gibraltar-CARN, TARI, CEUT, CAMA) area considering all those grid points with a temporal availability higher than 80% for the last available hour (of the latest daily file available).*

Availability: visit the dashboard, select the platform High Frequency Radars (HF) and click on the orange points (i.e. representing each one of the HFR radial sites contributing to the HFR total platform). The coverage map could be displayed or hidden following the options provided.

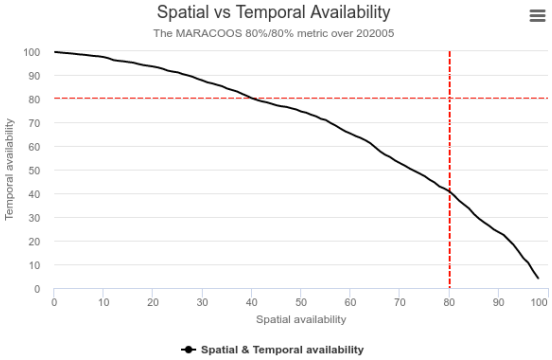


Figure 5: *Temporal and spatial coverage available in near real-time for each one of the HFR radial sites (e.g. HFR-TirLig-TINO). The point of intersection of the two red dashed lines shows the 80/80 metric.*

Availability: visit the dashboard, select the platform High Frequency Radars (HF), click on the orange dots and select the “Stats” button.

At the network level:

Figure 6: *Number of platforms providing HFR radial over the last month, updated in NRT.*

- **Availability:** visit the monitoring service, click on “Detailed view” and select:
- ***Region*** = Global
- ***Type*** = Near Real Time
- ***Product***: INSITU_GLO_PHY_UV_DISCRETE_NRT_013_048
- ***Dataset*** = radar_radial
- ***KPI*** = Number of platforms (e.g., 20 HFR radial sites were providing radial velocities at the date of the edition of this document).

Finally, the figure will be displayed and able to be saved in different formats (i.e. PNG, JPEG, PDF, SVG).

3. NEAR SURFACE SEA WATER VELOCITY - Drifter (obs-ins_glo_phy-cur_nrt_drifter_irr)

Table 1 summarizes the accuracy of the measurements that can be expected from the drifters. This is the best accuracy that a user can expect for the data:

Dataset	Reference	Current (m/s)
drifter	Poulain et al. (2012, doi:10.1175/JPO-D-11-0159.1)	0,01

Table 1: Accuracy of the drifter measurements expected from literature.

In some regions and time periods, the number of measurements can be critically low due to the drifter launch time schedule and their geographical locations (as in high latitudes) (Figure 7). The number of drifters has continuously increased from 2003 and reaches a number around 1700 in the last 4 years. From May 2022 to May 2023, the number of platforms oscillates between 1300 to 1700 (Figure 8). The spatial repartition of the measurement is sparse or null in high latitudes. Less data is also available in the Mediterranean Sea and particularly in coastal areas.

Figure 7: *map showing the trajectories of the active drifting buoys for the last 30 days.*

- **Availability:** visit the dashboard, select the platform Drifters (DB) and the trajectories of the active surface drifters will be displayed on the map. Further information about the drifter and data provider is given when clicking in the trajectory.

- **Note:** please, be aware that the drifter dataset (DC data) is built from DB data (i.e. displayed), but additional tests are added and the trajectories could differ.

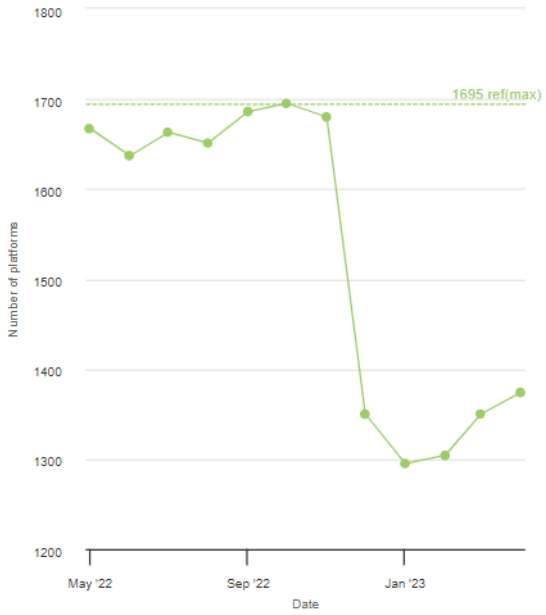


Figure 8: *number of drifter platforms providing surface currents over the last month, updated in NRT.*

Availability: visit the monitoring service, click on "Detailed view" and select:
- ***Region*** = Global
- ***Type*** = Near Real Time
- ***Product***: INSITU_GLO_PHY_UV_DISCRETE_NRT_013_048
- ***Dataset*** = drifter
- ***KPI*** = Number of platforms (e.g 1374 drifters were active at the global level at the date of the edition of this document).

Finally, the figure will be displayed and able to be saved in different formats (i.e. PNG, JPEG, PDF, SVG).

-**Note:** the delivery of this dataset is once per week.

4. SEA WATER VELOCITY - ARGO (obs-ins_glo_phy-cur_nrt_argo_irr)

The Argo current product generated by Copernicus In Situ TAC (Ollitraut and Rannou, 2013) is derived from the original trajectory data from Argo GDAC (Global Data Assembly Center). The positions measured during the surface drift are used to estimate the velocities at the surface and at the level of the Argo parking pressure (around 1000 dbar).

The Argo dataset is regularly validated by a specialist with:

- A global current speed map ;
- A graph of current speed per float; and
- File counts and KPIs continuously updated on http://www.marineinsitu.eu/monitoring

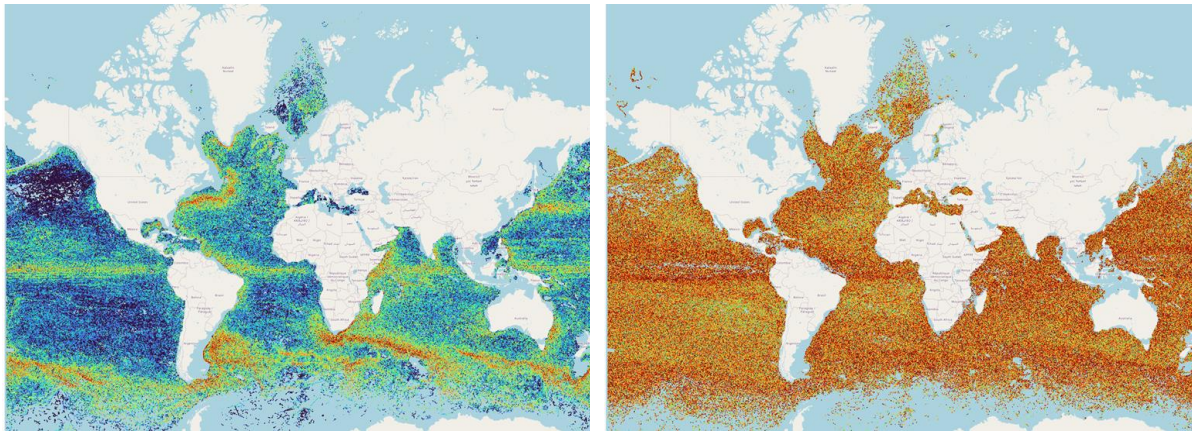


Figure 9: Density map of Argo each dot represents the ocean current from one cycle (typically 10 days for deep currents and a few hours at the surface) from one float. (left panel) deep current observations, (right panel) surface current observations. Colour scale from dark blue dot: 0 meter/second, to red dot: 2 m/s.

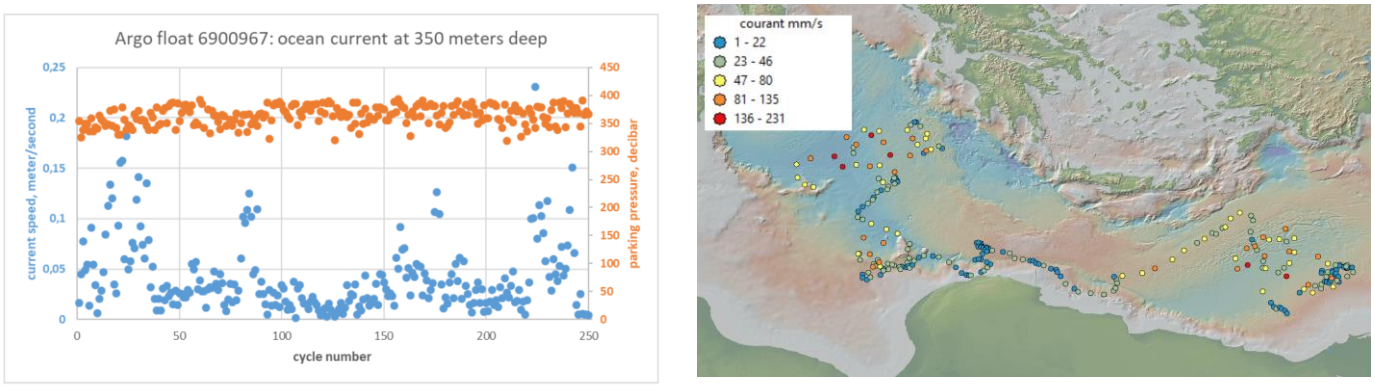


Figure 10: Argo current from float 6900967 around 350 m depth: 250 values from 1 millimeter/second to 231 mm/s.

References

Hernandez, F., et al., 2018: Measuring performances, skill and accuracy in operational oceanography: New challenges and approaches. In "New Frontiers in Operational Oceanography", E. Chassignet, A. Pascual, J. Tintoré, and J. Verron, Eds. GODAE OceanView, 759-796, doi:10.17125/gov2018.ch29.

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