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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.

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# Executive summary

The quality of the INSITU\_GLO\_UV\_NRT\_OBSERVATIONS\_013\_048 product from the CMEMS distribution is assessed through the horizontal and vertical data coverage along time for the following variables/datasets:

This document provides a description of the information related to the assessment of the spatio-temporal coverage of the 4 datasets within this data product that is available in near real time through different services (i.e. dashboard, monitoring) from [mairineinsitu.eu.](marineinsitu.eu)

* **SURFACE WATER VELOCITY from High Frequency Radars (“radar\_total” dataset)**

In the case of the radar\_total data set, 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 standard deviation of near-surface zonal and meridional velocities, Geometrical Dilution of Precision (GDOP), quality flags and metadata.

This assessment complements the synthesis quality overview (SQO) document: CMEMS-INS-SQO-013-044 which includes further details of the historical performance of the best radar\_total datasets that is updated every 6 months.

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

* the **spatial data coverage of each HFR** total platform, showing the area where there was surface current data for at least the 80% during the last hour. To compute this metric, we first calculate the temporal data coverage of each radar total grid point flagged with good or probably good data (QCflag=1 or 2, respectively) in near-real time for the last hour available of the last daily file (archived in the folder /latest). Finally, only those points with a percentage of data availability higher than 80% are considered.
* the **80/80 coverage metric** as suggested by Roarty, et al. 2012, showing the temporal and spatial coverage of surface currents provided by each individual HF radar total platform over the last month (as available in the folder /monthly)**.** To compute this metric, we define a spatial area of reference which consist in all the grid points with at least one time step of available good data (i.e. QCflag=1) for the target period. Then the % of time steps where the spatial coverage is equal or higher than 80% of the reference area is computed, considering only good (i.e. QCflag=1) and probably good data (i.e. QCflag=2). This metric allows to check if the system has reached the goal of providing surface currents over the 80% of the area during 80% of the time (point of intersection of the lines with 80% temporal and 80% spatial coverages).

To provide a global view of the HFR network performance in terms of data availability, the information to be considered is:

* the **number of HFR total platforms** available over the last month as an indicative of the uptimes of all platforms included in the network that are providing surface current data and that are available in the radar\_total dataset. This metric is computed from the index\_last.txt files available in the folder of the dataset
* the **number of HFR surface current files** available in the different folders (historical, latest, monthly) as an indicative of the temporal data availability along different periods for the entire network. This metric is computed from the information included in the different index files of the dataset.
* **RADIAL VELOCITIES from High Frequency Radars (“radar\_radial” dataset)**

In the case of the radar\_radial data set, the RADIAL VELOCITIES consist in maps of the zonal and meridional components of the radial ocean currents on a regular grid in the area covered by the individual radar stations. These variables are distributed along with standard deviation of near-surface zonal and meridional components of the radial velocities at the surface, quality flags and metadata.

~~This assessment complements the synthesis quality overview (SQO) document: CMEMS-INS-SQO-013-044 which includes further details of the historical performance of the best radar\_radial datasets that is updated every 6 months.~~

Same as for radar\_total, to control both spatial and temporal availability of the RADIAL VELOCITY maps, we use:

* the **spatial data coverage of each HFR radial site** separately, showing the area where there was radial velocity data for at least the 80% for the last hour available of the last daily file (archived in the folder /latest).
* the **80/80 coverage metric**, showing the temporal and spatial coverage of radial velocities provided by each individual HFR radial site over the last month (as available in the folder /monthly)**.**

In both cases, the computation is the same as for surface currents (described before)

At the network level, the temporal availability of radial velocities is shown by:

* the **number of HFR radial platforms** over the last month showing the uptimes of the HFR radial sites which provide data in near real-time.
* the **number of HFR radial velocity files** available in the different folders (historical, latest, monthly).
* **NEAR\_SURFACE WATER VELOCITY From “drifter” dataset**

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). 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 Meteo-France (CMM) in the frame of the French project Coriolis, dedicated to operational oceanography in situ observation management. Only the drifters that have kept their drogue are distributed.

Other operational qualification is also done by Coriolis in a second stage (position, date, spike, … - Real Time Quality Control (RTQC): EuroGOOS DATA-MEQ working group (2010). Recommendations for in-situ data Near Real Time Quality Control. https://doi.org/10.13155/36230) before the final dissemination of the data to CMEMS project in CMEMS file.

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.

* **SEA WATER VELOCITY at 15m from “drifter\_filt” dataset**

🡺 **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 CMEMS, 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).

# Variable/dataset SURFACE WATER VELOCITY from High Frequency Radars (“radar\_total” dataset

Coverage area and spatial resolution 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](http://www.marineinsitu.eu/dashboard/) and the [monitoring](http://www.marineinsitu.eu/monitoring/) services from [marineinsitu.eu](http://www.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 at your own is also included if available).

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|  | **- Description:** 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](http://www.marineinsitu.eu/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). * **Code**: visit the [training material](http://www.marineinsitu.eu/material/) and run the HFR\_plot |
|  | **- Description:** 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.  **- Code:** visit the [training material](http://www.marineinsitu.eu/material/) and run the HFR\_plot |

At the network level:

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|  | * **Description:** number of platforms providing HFR total over the last month, updated in NRT. * **Availability:** visit the [monitoring service](http://www.marineinsitu.eu/monitoring/), click on “Detailed view” and select: * Region=Global * Type= Near Real Time * Product:INSITU\_GLO\_UV\_NRT\_OBSERVATIONS\_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). |
|  | **- Description:** number of HFR surface current files available in the different folders (historical, latest, monthly)   * **Availability:** visit the [monitoring service](http://www.marineinsitu.eu/monitoring/), click on “Detailed view” and select: * Region=Global * Type= Near Real Time * Product:INSITU\_GLO\_UV\_NRT\_OBSERVATIONS\_013\_048 * dataset=radar\_total * KPI=Number of files (e.g. 382 HFR files were available in the last 30 days, 15 historical files and 146 monthly files)   Finally, the figure will be displayed and able to be saved in different formats (i.e. PNG, JPEG, PDF, SVG). |

1. **Variable/dataset RADIAL VELOCITY from High Frequency Radars (“radar\_radial” dataset)**

The assessment of the spatio-temporal coverage of the RADIAL VELOCITIES 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.

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|  | **- Description:** 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](http://www.marineinsitu.eu/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. * **Code**: visit the [training material](http://www.marineinsitu.eu/material/) and run the HFR\_plot |
|  | **- Description:** temporal and spatial coverage available in near real-time for each one of the HFR radial sites. 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).  **- Availability:** visit the dashboard, , select the platform High Frequency Radars (HF), click on the orange dots and select the “Stats” button.  **- Code:** visit the [training material](http://www.marineinsitu.eu/material/) and run the HFR\_plot |

At the network level:

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|  | * **Description:** number of platforms providing HFR radial over the last month, updated in NRT. * **Availability:** visit the [monitoring service](http://www.marineinsitu.eu/monitoring/), click on “Detailed view” and select: * Region=Global * Type= Near Real Time * Product:INSITU\_GLO\_UV\_NRT\_OBSERVATIONS\_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). |
|  | **-Description:** number of HFR radial velocity files available in the different folders (historical, latest, monthly)   * **Availability:** visit the [monitoring service](http://www.marineinsitu.eu/monitoring/), click on “Detailed view” and select: * Region=Global * Type= Near Real Time * Product:INSITU\_GLO\_UV\_NRT\_OBSERVATIONS\_013\_048 * dataset=radar\_radial * KPI=Number of files (e.g. 610 HFR radial files were available in the last 30 days, 27 historical files and 273 monthly files)   Finally, the figure will be displayed and able to be saved in different formats (i.e. PNG, JPEG, PDF, SVG). |

# Variable NEAR SURFACE SEA WATER VELOCITY from “drifter” dataset

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 (or 50) 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.

Table 3 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:

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

Table 3: 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 (Figure 2) and their geographical locations (as in high latitudes) (Figure 3). The number of drifters has continuously increased from 2003 and reaches a number around 1200 in the last 4 years. 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.

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|  | **- Description:** map showing the trajectories of the active drifting buoys for the last 30 days   * **Availability:** visit the [dashboard](http://www.marineinsitu.eu/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. * **Code**: visit the [training material](http://www.marineinsitu.eu/material/) and run the drifter for plotting the trajectories over a map. |
|  | * **Description:** number of drifter platforms providing surface currents over the last month, updated in NRT. * **Availability:** visit the [monitoring service](http://www.marineinsitu.eu/monitoring/), click on “Detailed view” and select: * Region=Global * Type= Near Real Time * Product:INSITU\_GLO\_UV\_NRT\_OBSERVATIONS\_013\_048 * dataset=drifter * KPI=Number of platforms (e.g 1240 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). |
|  | **-Description:** number of drifter files available in the different folders (historical, latest, monthly)   * **Availability:** visit the [monitoring service](http://www.marineinsitu.eu/monitoring/), click on “Detailed view” and select: * Region=Global * Type= Near Real Time * Product:INSITU\_GLO\_UV\_NRT\_OBSERVATIONS\_013\_048 * dataset=drifter * KPI=Number of files (e.g. 76021 files were available in the last 30 days, 11249 historical files and 28622 monthly files)   Finally, the figure will be displayed and able to be saved in different formats (i.e. PNG, JPEG, PDF, SVG). |
|  | Figure 2: Count of transmitting drifters per month from 01/2003 to 12/2018. |

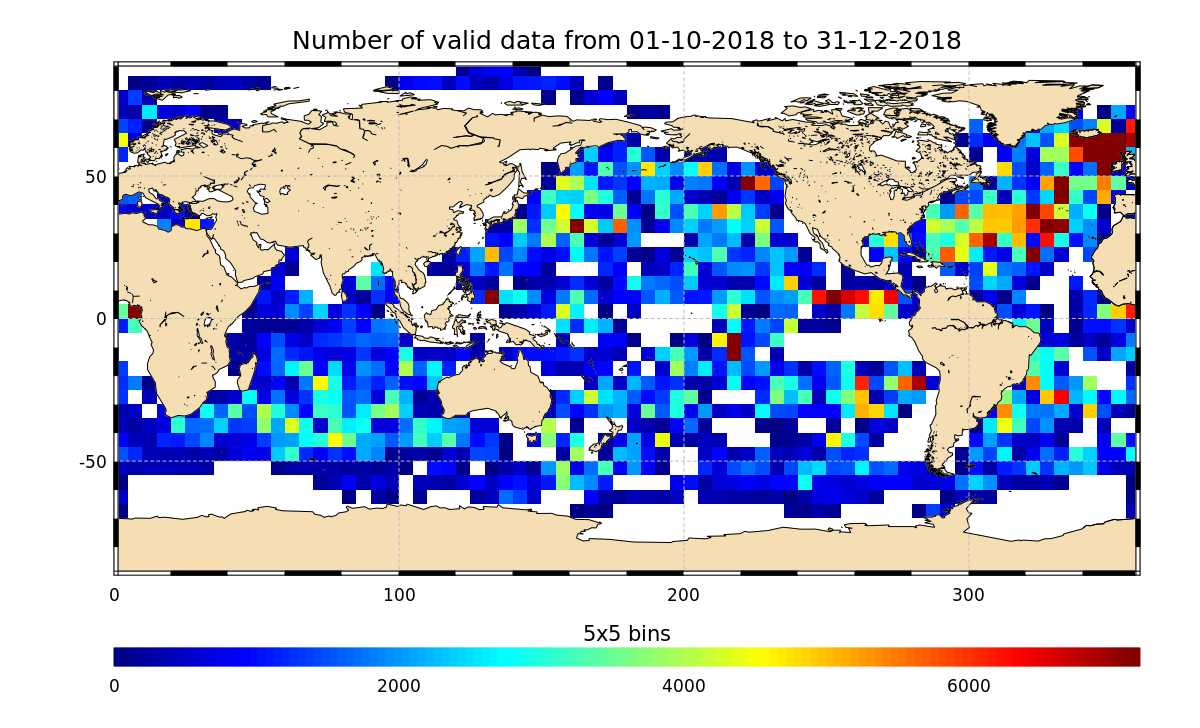


Figure 3: 5°x5° bins mean number of measurements over a 3-month period from 2019 October to December.

# Variable SEA WATER VELOCITY at 15m from “drifter\_filt” dataset

This dataset is based on the “drifter dataset” (§3). Each Tuesday, the data for the latest 30 days of the “drifter dataset” are downloaded and a 3-day low-pass filtering is applied along each drifter’s trajectory to remove inertial oscillation, tidal and high frequencies. The spatial and temporal distribution of the data is identical to the one of the “drifter dataset”.

Number of SVP drifters at 15m depth relatively to the entire raw drifter dataset

Energy spectrum for raw and filtered data. Entire dataset from march 2018 (1h data) => validate the filtering

# 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.

**Poulain, P-M, M. Menna, and E. Mauri, 2012**: Surface Geostrophic Circulation of the Mediterranean Sea Derived from Drifter and Satellite Altimeter Data.JPO, June 2012. https://doi.org/10.1175/JPO-D-11-0159.1

**Roarty, H., Smith, M. Kerfoot, J. Kohut J. and Glenn S.,** 2012 Automated quality control of High Frequency radar data, Oceans, Hampton Roads, VA, 2012, pp. 1-7. (https://ieeexplore.ieee.org/document/6404809/)

**Rubio, A., Mader, J., Corgnati, L., Mantovani, C., Griffa, A., Novellino, A., Quentin, C., Wyatt, L., Schulz-Stellenfleth, J., Horstmann, J., Lorente, P., Zambianchi, E., Hartnett, M., Fernandes, C., Zervakis, V., Gorringe, P., Melet, A., and Puillat, I**., 2017 : HF radar activity in European coastal seas: next steps towards a pan-European HF radar network, Frontiers in Marine Science, 4 (8), available at: http://dx.doi.org/10.3389/fmars.2017.00008.