COPERNICUS
MARINE ENVIRONMENT MONITORING SERVICE

QUALITY INFORMATION DOCUMENT

SYNTHESIS QUALITY OVERVIEW DOCUMENT (SQO)

Associated to extended quality information document (QUID): CMEMS-INS-QUID-013_030-036

QUID Version: 2.3
Associated to Product ID:
INSITU_GLO_PHYBGCWAV_DISCRETE_MYNRT_013_030
INSITU_ARC_PHYBGCWAV_DISCRETE_MYNRT_013_031
INSITU_BAL_PHYBGCWAV_DISCRETE_MYNRT_013_032
INSITU_IBI_PHYBGCWAV_DISCRETE_MYNRT_013_033
INSITU_BLK_PHYBGCWAV_DISCRETE_MYNRT_013_034
INSITU_MED_PHYBGCWAV_DISCRETE_MYNRT_013_035
INSITU_NWS_PHYBGCWAV_DISCRETE_MYNRT_013_036

Issue: 2.3

Contributors to SQO: H. Wehde, K. V. Schuckmann, S. Pouliquen, A. Grouazel, T Bartolome, J Tintore, M. De Alfonso Alonso-Munoyerro, T. Carval, V. Racapé and the In Situ TAC team

SQO approval date by the CMEMS PQ coordination team: 12/01/2024

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	18/09/2020	All	Creation of the document	Marta de Alfonso	
2.2	25/08/2022		New names for products/datasets Update template	Ludovic Drouineau	S. Tarot
2.2	24/04/2023		Correction of the figures	Ludovic Drouineau	S. Tarot
2.3	30/08/2023	All	Update document	Ludovic Drouineau	S. Tarot

Contents

Executive summary 3

1. Temperature and salinity (T&S) observations 4
2. Biogeochemical observations (BGC) 5
3. Wave observations 6
4. Sea level observations 7
5. Ocean currents observations 8
6. Meteorological and miscellaneous observations 9

References 10

Executive summary

The INSITU_*_PHYBGCWAV_DISCRETE_MYNRT_013_030-036 products are based on in situ observations collected in real-time and revisited in delayed mode by data providers and the In Situ TAC 7 regions.

The data validation is carried out by automatic quality control tests both in real time and delayed mode (Copernicus Marine In Situ Team, 2020). Moreover, data is visualized by experts to detect spikes and anomalous behaviour of the sensors and additionally, comparison with other sources is performed to detect possible wrong data.

It is important to note that this product is providing data from global, regional, national or institutional observing systems. They are responsible for the data transmission and the equipment maintenance.

The temporal coverage ranges from the beginning of the 20th century to now. It is presented with histograms. The metric is the platform-day (one platform, one day, one or many observations = +1) for temperature and salinity (T&S) observations and platform-month (one platform, one month, one or many observations = +1) for the rest of variables. The results show a continuous increase along the years and especially in the last two decades.

The spatial coverage is presented through maps with the distribution of observations on the current year (2023) for all the variables. For underway data, measuring T&S and Oxygen, the coverage is rather homogeneous, while for fixed platforms like buoys, HF radars or tide gauges, measuring the rest of variables, the coverage is diverse with most of the stations concentrated in the Northern Hemisphere and more specifically in the coast of Europe and North America.

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 remarkable events please refer to the reference quid document CMEMS-INS-QUID-013_030-036.

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). The results presented in this report and derived estimated accuracy numbers (EAN) are representative of average error levels over large areas of the ocean. These numbers might be used as a mean error in one given point of the area, but in order to refine error estimates locally, the reader is invited to use complementary information from reference QUIDs (error maps for instance, when available).

1. Temperature and salinity (T&S) observations

T&S observations are reported as vertical profiles, underway data and time series. Compared to 2021, the total number of vertical profiles increased by 4% in 2022; the total number of underway data increased by 8.6% in 2022. During the 1970-1999 period, fixed buoys and vessels were the main observation platform type. In the 2000-2023 period, drifting buoys and Argo floats complemented significantly the T&S observation networks (see figure 1 – top panel). The spatial distribution is shown in Figure 1 (bottom panel). The coverage for the underway data is homogeneous all over the oceans. Although small in absolute number, sea-mammal profiles significantly increased the spatial coverage in Northern and Southern latitudes. Moorings and fixed buoys are mostly concentrated in the Northern Hemisphere (coast of Europe and North America), Australia and around the Equator for the open ocean stations.

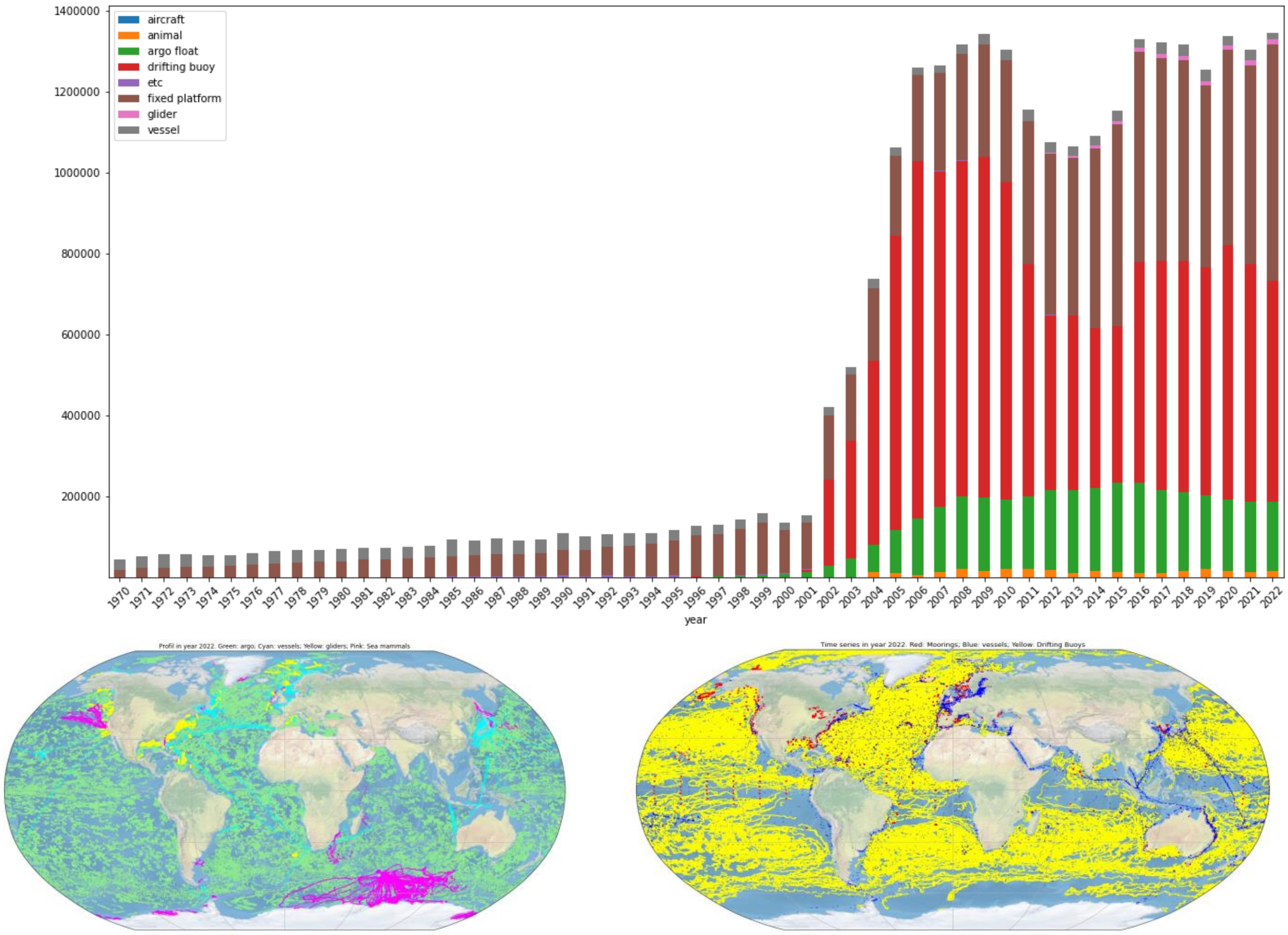


Figure 1: Observations per platform-day: one platform – one day – one or many observations = +1 (top panel). (bottom left panel) Profiles in year 2022: green: Argo, cyan: vessels, yellow: gliders, pink: sea mammals. (bottom right panel) Time series for 2022. Red: Moorings, yellow: drifting buoys, blue: vessels

2. Biogeochemical observations (BGC)

The In Situ TAC aggregates and provides to users a large panel of BGC variables together with useful metadata information on the platforms. The main parameters available in the MYNRT In Situ TAC products are dissolved oxygen concentration, nutrients (nitrate, silicate and phosphate), chlorophyll, fluorescence and pH. Due to the recent nature of In Situ TAC BGC quality control activity, the present document is focused on the dissolved oxygen concentration, noted "oxygen" hereafter and nutrients. It will be progressively updated with other BGC parameters.

Figure 2 (top left) represents oxygen profiles yearly distribution and Figure 2 (bottom left) the oxygen observations spatial distribution. Both figures show that most of the dissolved oxygen profiles included in the MYNRT products have been measured by CTD-O2 during the last century and covered the global Ocean. This trend has progressively evolved over the last two decades with the implementation of the ARGO-O2 network (PF). The spatial coverage of the profiling floats remains nevertheless insufficient.

Figure 2 (top right) represents the yearly distribution of nutrient stations and Figure 2 (bottom right) the spatial distribution of nutrient observations. Nutrient measurements are essentially (if not exclusively) chemical (BO), but it is possible to find them in CTD (CT) instrument files to keep information with CTD-O2 observations. BGC-ARGO (PF) and GLIDER (GL) network measure nitrate only

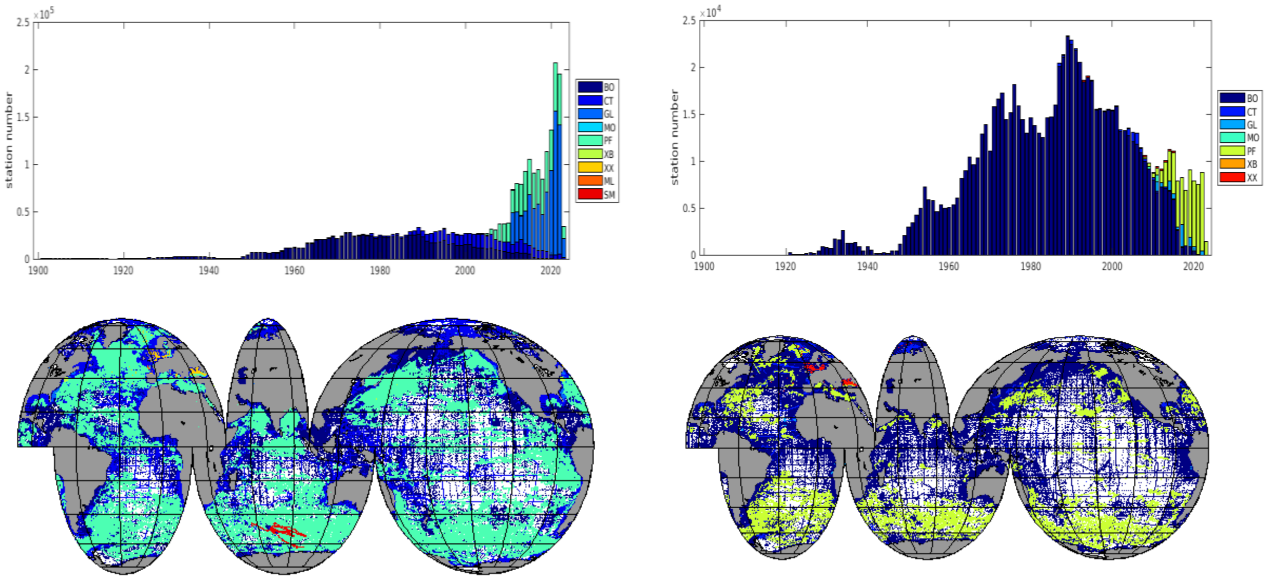


Figure 2: Temporal (top left) and spatial (bottom left) distribution of stations including at least one good data (QC 1 & 2) of oxygen per instrument type. Nutrient station yearly distribution per instrument file type (top right panel) and nutrient observation spatial distribution per instrument file type (bottom right panel).

3. Wave observations

The temporal coverage of the wave observations is shown in Figure 3 (top panel) with the evolution of the number of platforms from 1970 to 2023 differentiating between wave height, period, direction, and wave spectra. The spatial coverage is presented through a map (Figure 3 - bottom panel) with the distribution of wave platforms coloured showing the number of years with data coverage and distinguishing between active and non-active platforms. Both for scalar (height and period) and directional waves, it is clear the increase in the number of platforms collected along the period, specially in the last two decades. For wave spectra the coverage is null until the 90's decade and increases significantly in the last decade. Regarding the spatial coverage, most of the stations providing waves are concentrated in the Northern Hemisphere and close to the coast, specially in North America and Europe with platforms also around Australia. In the European Seas there are differences between the regions with high coverage in all of them except in the Southern Black Sea, the Arctic and the Southern and Eastern Mediterranean.

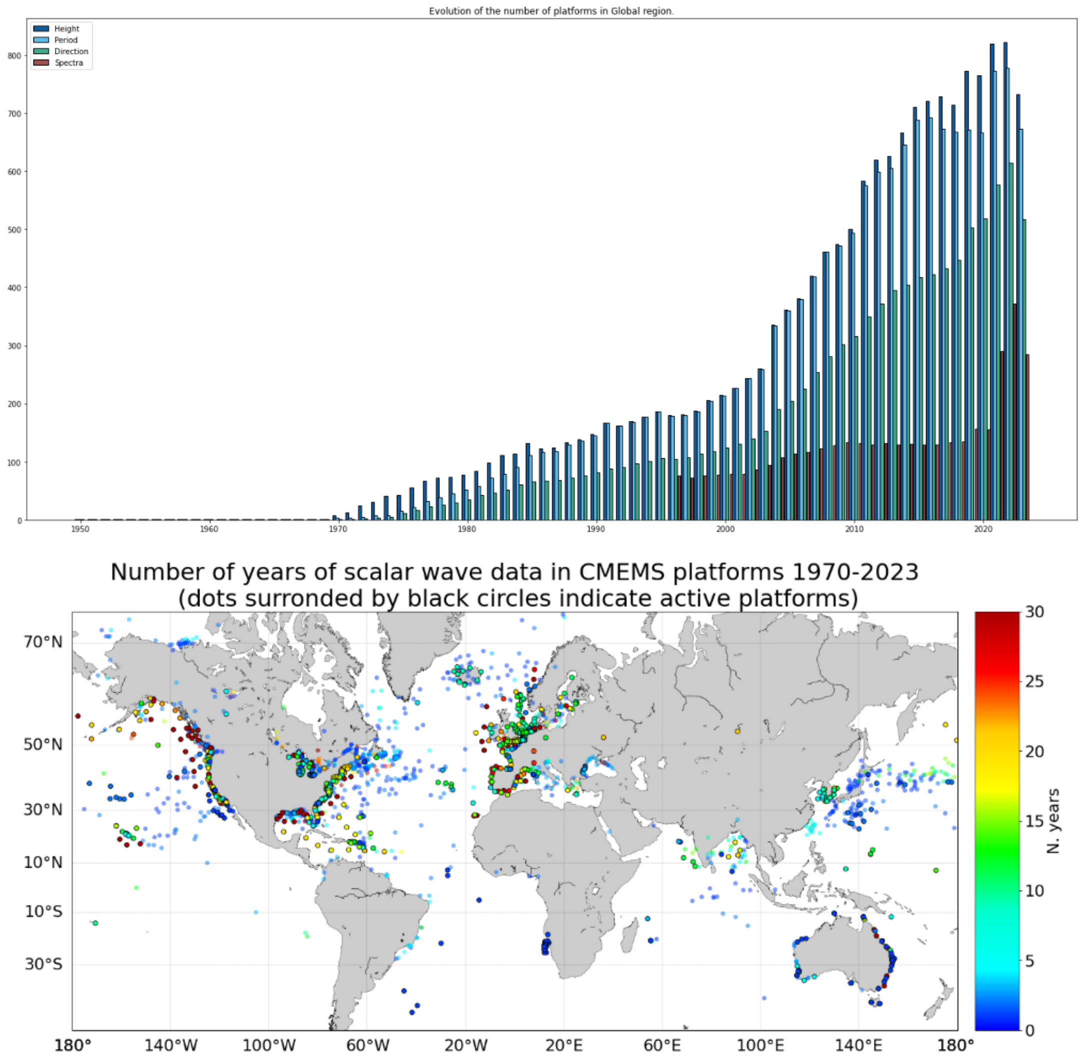


Figure 3: evolution of the number of wave platforms from 1970 to 2023 at global scale (top panel). wave data geospatial coverage at global scale, coloured by time coverage (bottom panel).

4. Sea level observations

Sea level observations are aggregated in real-time. The evolution of the number of platforms between 1840 and 2023 is shown in Figure 4 (top panel). The number is increasing slowly until 1990. Between 1990 and 2010 the number of platforms doubled from 200 to 400 and in the last decade the increase is more intense. The spatial distribution map (Figure 4 – bottom panel) shows how the coverage is high in European Seas except in the Southern Mediterranean, Black Sea and very scarce out of Europe.

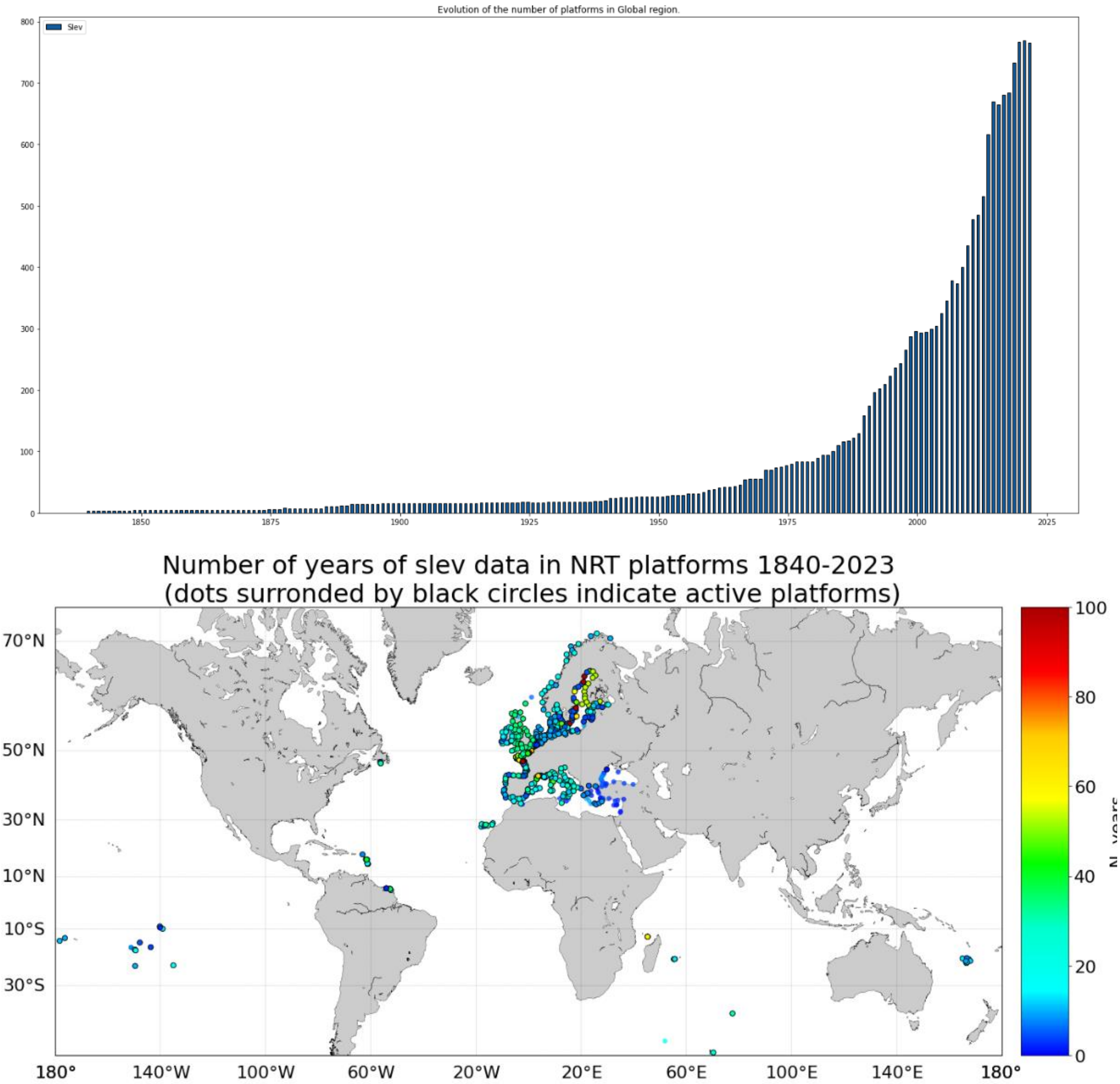
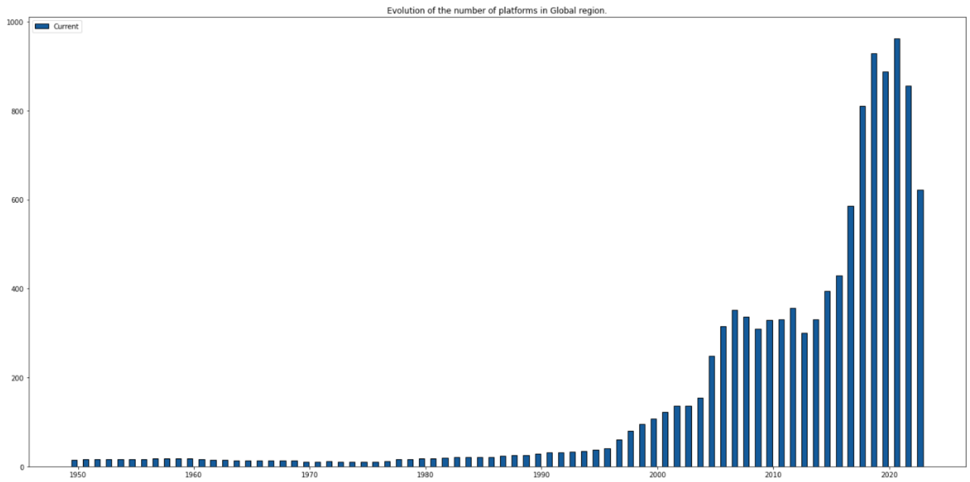


Figure 4: evolution of number of sea level platforms between 1840 and 2022 at global scale (top panel) and geospatial coverage at global scale, coloured by time coverage (bottom panel).

5. Ocean currents observations

Ocean currents data are aggregated from platforms such as HF-radars (HFRs) or ADCP mounted on vessels or fixed sites. They are reported as 7 variables. The number of platform was quite low until end of 20th century (less than 200 platforms) and then significantly increased to more 800 in 2020 (see Figure 5 - top panel).

A focus on HF radars: The last inventory shows that there are 72 HFRs currently deployed and active in various coastal areas of the European seas (Figure 5 – bottom panel). The EU HFR Node is now managing data from 12 HFR networks (built by 35 radar sites) and is expected to manage 20 networks (for a total of 50 radar sites) by end 2020. From these 12 networks, 10 are sending data in NRT since 2019, and 4 have provided time series of historical data before 2019. HF radars are distributed among the different Regional Ocean Observing Systems (ROOS) areas coordinated by the European Global Ocean Observing System (EuroGOOS): 56% in MONGOOS (Mediterranean Operational Network for the Global Ocean Observing System), 32% in IBI-ROOS (Ireland-Biscay-Iberia Regional Operational Oceanographic System) and 5% in NOOS (north West European Shelf Operational Oceanographic System) (Last update of the inventory, March 2020 as shown in Figure 5 – bottom panel).



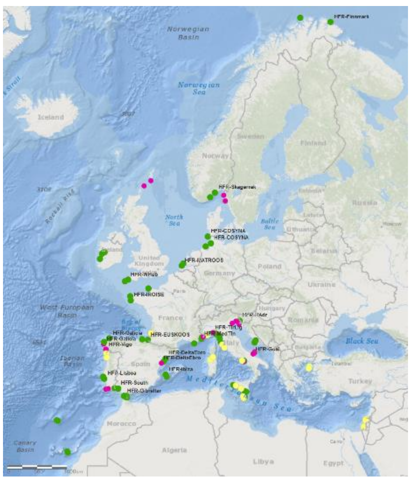


Figure 5: yearly distribution of new platforms reporting ocean current data (top panel). distribution of HFR systems in Europe. The operational systems are plotted in green, future installations in yellow and past deployments in magenta. Source: http://eurogoos.eu/high-frequency-radar-task-team/ (bottom panel)

6. Meteorological and miscellaneous observations

The In Situ TAC has no specific commitment to manage in situ meteorological and non ocean observations. However, when such parameters are reported along ocean in situ parameters, they are preserved in the NetCDF files, with no additional quality control. Meteorological and miscellaneous observations include wind, air temperature, humidity, precipitation, atmospheric pressure, river flows.

As an example, Figure 6 (top panel) shows the evolution of the number of platforms between 1970 and 2023. It shows a clear increase from the mid of the 2000 decade. Figure 6 (bottom panel) shows the distribution of the platforms providing wind data at global scale. Most of them are concentrated in the European and North American coasts and around the Equator for open ocean platforms.

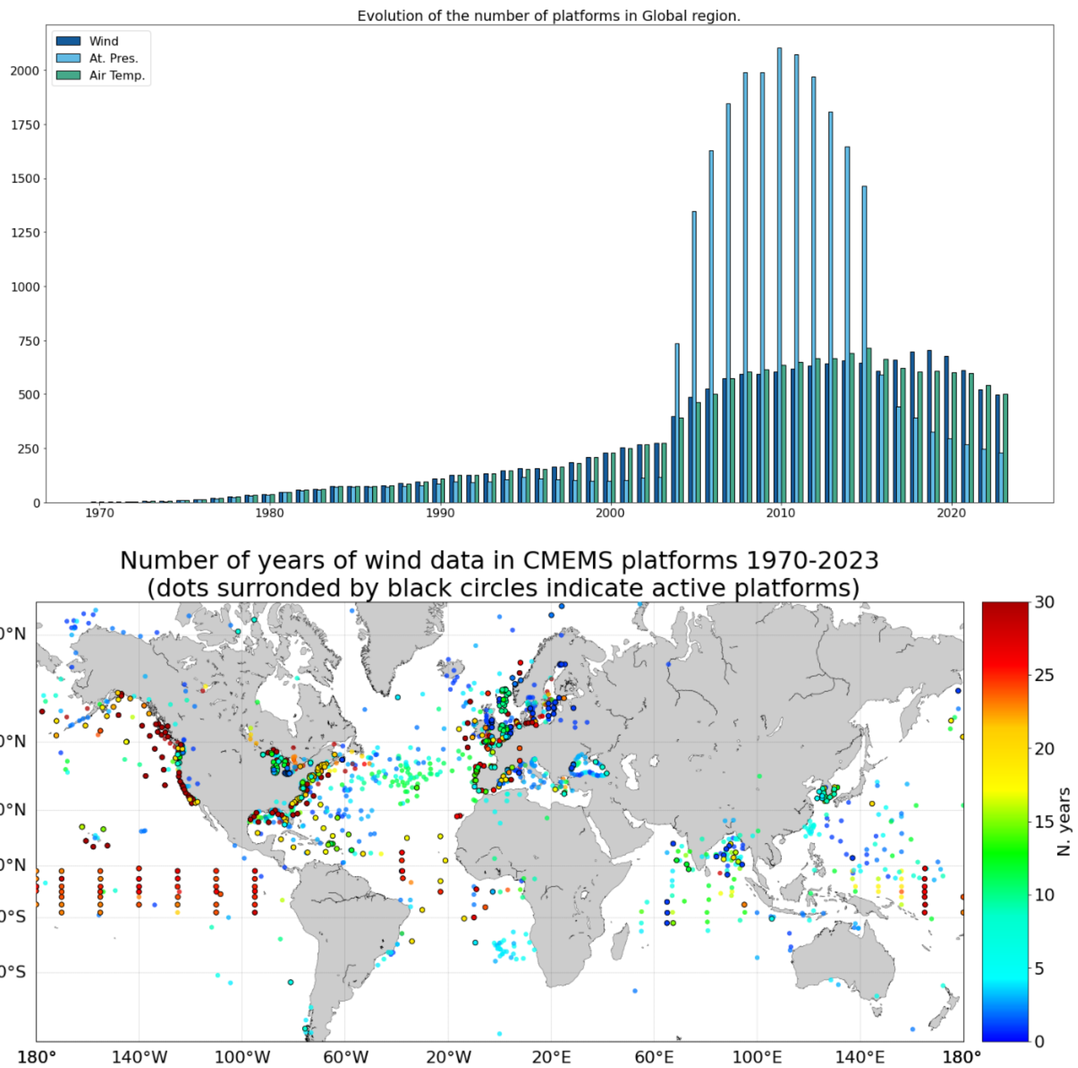


Figure 6: Evolution of number of meteorological platforms between 1970 and 2022 at global scale (top panel). wind data geospatial coverage at global scale, coloured by time coverage (bottom panel).

References

Von Schuckmann Karina, Garau Bartolomé, Wehde Henning, Gies Tobias, Durand Dominique, Reseghetti Franco (2010). **Real Time Quality Control of temperature and salinity measurements within MyOcean and Copernicus in situ TAC**. CMEMS-INS-CURRENT-RTQC. https://doi.org/10.13155/74317

Hammarklint Thomas, Kassis Dimitris, Wehde Henning, Rickards Lesley (2010). **Real Time Quality Control of Current measurements within MyOcean and Copernicus in situ TAC**. CMEMS-INS-CURRENT-RTQC. https://doi.org/10.13155/74316

Notarstefano Giulio, Gerin Riccardo, Bussani Antonio, Bolzon Giorgio, Poulain Pierre-Marie (2010). **Real Time Quality Control and Validation of Current Measurements inferred from Drifter Data within Copernicus In Situ TAC**. CMEMS-INS-DRIFTER-RTQC. https://doi.org/10.13155/74299

Perez Begoña, De Alfonso Alonso-Muñoyerro Marta, Huess Vibeke, Rickards Lesley (2010). **Near Real Time Quality Control and validation of Sea Level in-situ data within MyOcean.** CMEMS-INS-SEALELEVEL-RTQC. https://doi.org/10.13155/74307

Jaccard Pierre, Hjemann Dag Oystein, Ruohola Jani, Ledang Anna Birgitta, Marty Sabine, Kristiansen Trond, Kaitala Seppo, Mangin Antoine (2018). **Quality Control of Biogeochemical Measurements**. CMEMS-INS-BGC-QC. https://doi.org/10.13155/36232

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.

Copernicus Marine In Situ Team (2020). Copernicus In Situ TAC, **Real Time Quality Control for WAVES**. CMEMS-INS-WAVES-RTQC. https://doi.org/10.13155/46607.