NECCTON

NEW COPERNICUS CAPABILITY FOR TROPHIC OCEAN NETWORKS

Stakeholder Engagement Activities

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1. Methodology and organisation

Define the audience

The audience for the workshop was defined in collaboration with the organizing team. It was decided that the event would target both the already identified project stakeholders and a part of the Copernicus Marine Service users. To identify these users, a selection was made from contacts who had shown interest in or were already using Green Ocean products (i.e. biogeochemical products) derived from models.

Define the event format and agenda

The organisation of this workshop required upstream work with the project partners, in particular the WP leaders for whom parallel sessions were dedicated. Leaders of WP5 to 8 were consulted, which ultimately led to the final format of the event, i.e. the holding of 2 rounds of 4 parallel sessions.

Prepare the tools and the presentations

These meetings with WP leaders also provided an opportunity to define the questions to be included in the Slido and Mural tools. While the Mural boards were prepared by a service provider, the questions asked in both tools were discussed with the WP leaders through 30min bilateral meetings in order to refine them and ensure consistency between the parallel sessions.

Then, the day before the workshop, a 30-minute test session was held with all the speakers to check the logistics and fluidity of the tools and transitions.

Course of the event

The agenda, which was prepared and validated by partners several weeks in advance, included a first plenary session in the morning, then the parallel sessions which took place during the afternoon of the first day of workshop. Each parallel session was dedicated to a WP, i.e. a main category of data produced in NECCTON (biogeochemistry, benthic, HTL, stressors). It started with a quick introduction presenting the future products and methodology, as well as how to use the participative tools. Then it featured the interactive Slido survey and Mural board for collecting live feedback. These tools were a great help, as the responses collected could be stored and summarised, in addition to the recordings of the workshop, which provide an exhaustive record of the exchanges (a summary of feedback is presented in section 3). Parallel sessions were held during 2 rounds of 1 hour and ended with a common wrap up. They were animated by the specific WP leader and one member of the Portfolio and Stakeholders Engagement team for Mercator Ocean.

The second day was a single morning session dedicated to South Pacific Stakeholder Community, with a focus on the Pacific Tuna case study, which explained the lower attendance.

This workshop was integrally held on Zoom and all sessions were recorded.

Collect additional feedback

After the workshop, in order to complete the received feedback, a survey (built on TypeForm) was sent. The audience of this survey wasn't the audience of the workshop, but the users from Copernicus Marine who currently download biogeochemical data. Indeed, they can be seen as future potential users of the NECCTON products. The aim of this survey was to raise awareness among new users, to confirm whether the products designed in NECCTON really do meet a need and to refine some technical specifications of the products (resolution, regions,etc).

The feedback gathered during the workshop combined with the results of the survey were used to draw up a real codesign and to build the 4 technical specification reports (D5.1, D6.1, D7.1, D8.1).

2. Analysis of the audience

Using the list of attendants and the registration, an analysis of the participants could have been done.

In total, 126 participants logged on to the event, which exceeded the expected KPI of 100 participants. It included 53 (42%) project partners, i.e. 73 external people. The first day was the most attended, with 120 people during the day. The second day was followed by 50 people, 44 of whom were already present the day before (Figure 1). This can be easily explained by the very specific topic addressed on the second day of the workshop.

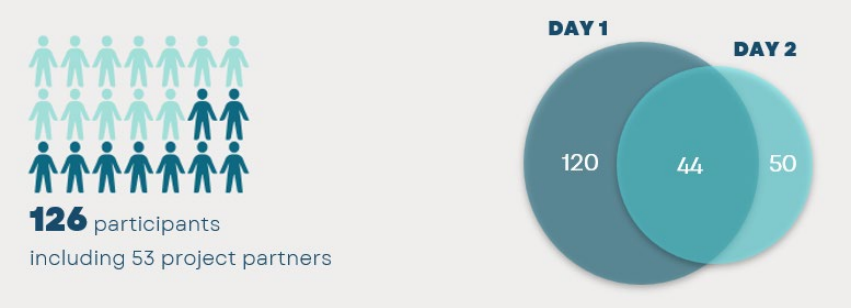


Figure 1 : Number of particpants

Among all the participants, 88% were registered through an email and form sent the weeks before the event.

26 countries were represented in the audience, especially England, Italy, France, Germany or the Netherland and Greece (Figure 2). Countries outside Europe were also present, with South Korea, Vietnam, Morocco or India.

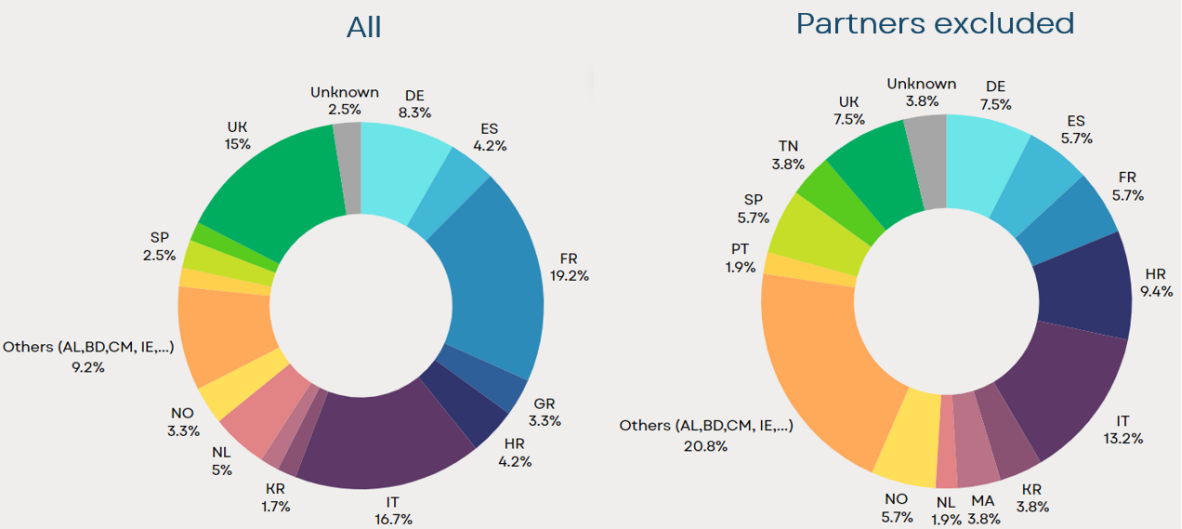


Figure 2: Country of participants

Regarding the participants, once the project partners are excluded, they come mostly from research institutes, national or university related. The Figure 3 shows all the organizations represented in the audience. If several participants were involved in the same organization as some of the speakers (MOi, PML), there was also a significant number of scientists and student from various universities and research institutes across the world (ISPRA, KIOST, HI,…) as well as representatives of stakeholder institutions such as the FAO, CMCC or even ICCAT and IOTC.

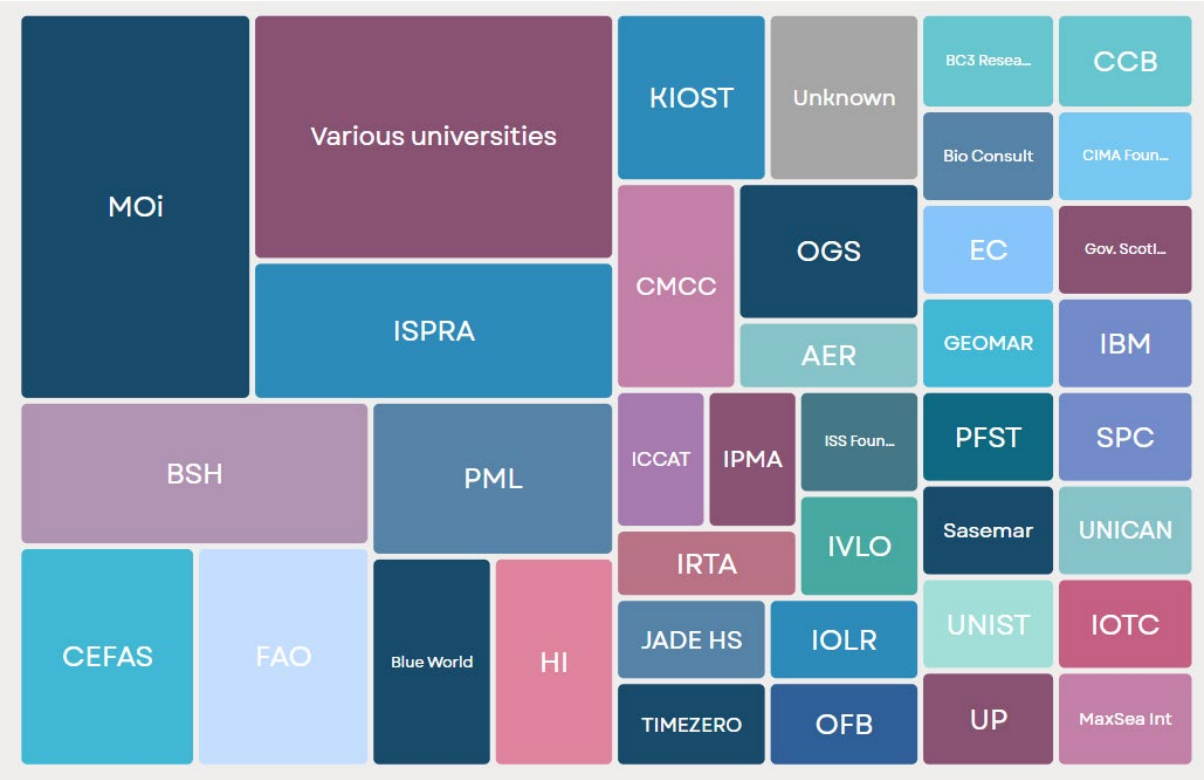


Figure 3: Organisation of participants (consortium excluded)

3. Summary of the parallel sessions

These minutes are a summary of the Stakeholder Workshop event, and especially the 4 parallel sessions that occurred in the afternoon of the 28th June 2023. This parallel session was dedicated to specific categories of products built in NECCTON, also corresponding to the work packages 5 to 8.

This summary includes feedback received from stakeholders through different sources: in the Slido surveys, on the Mural collaboration tool, and through questions asked directly to moderators during the session.

Parallel session WP5: Pelagic biogeochemistry

Copernicus Marine pelagic biogeochemical data

The Copernicus Marine pelagic biogeochemical data is especially used to conduct scientific research and analysis. Users are satisfied with the accuracy and quality of the data. The most used variables in Copernicus Marine are:

- Chlorophyll-a
- Oxygen
- Nutrient data (phosphate, nitrate, silicate)
- Net primary production

With historical data (<30-40 years) and climate projections (next 50 years).

Copernicus Marine data quality and uncertainty

Uncertainty metrics are raising a huge interest, especially the ones derived from multi-model ensembles and from multiple future scenarios (climate simulations only). Also, having a ground truthing and documentation for each area was asked, as it would be helpful to assess models outputs. Many questions were addressed regarding the quality check and the flagging of quality issues on Copernicus Marine data.

The main barriers encountered using Copernicus Marine data were the insufficient spatial and temporal resolution, some lack of biological variables, or difficulties exploring the online portal with too many products displayed.

Interest in the new products: Mesozooplankton and micronekton

Among the new or improved products, the main interest is for the mesozooplankton biomass, especially in the Arctic, Northwest Shelf, Iberia-Baltic-Irish domain and at global scale. The areas of the Baltic, Mediterranean and Black Sea are not considered by users when it comes to these new or improved biogeochemical data. Regarding the Arctic, some explanations were required about the modelling of production under the ice especially, considering the light attenuation and stratification process.

The mesozooplankton data as well as the micronekton data are asked to have a spatial resolution of a few kms, with vertically resolved data (3D in space) and at a daily frequency.

Interest in the new products: SPM, DOM and POM

The suspended particulate matter (SPM) data is important for user regarding visibility and nutrient source. This data is asked to have a spatial resolution of a few kms at a daily frequency, with mostly past reconstruction and also daily to weekly forecast.

The dissolved organic matter (DOM) products are asked to have a spatial resolution of a few kms, with vertically resolved data (3D in space) and at a daily frequency. The most used component is the dissolve organic carbon, with the aggregation of Individual labilities.

The particulate organic matter (POM) products are asked to have a spatial resolution of a few kms, with vertically resolved data (3D in space) and at a daily frequency, and if possible, with data on specific POM size classes and vertical flux. The most used component is the Particulate organic carbon, made either of the living (all plankton) and the non-living fraction (dead particulates, e.g. fecal pellets).

Interest in the new products: Reflectance

Users have shown very little interest in reflectance products, although some use them as a validation tool, mainly for coastal applications, and based on spectral bands similar to OLCI sensor. The spatio-temporal distribution of chlorophyll remains the most important biogeochemical component related to light for most of user's activities.

Interest in the new products: Others

Other biogeochemical products of interest have been listed. Regarding plankton and primary production, there was ice algae biomass and production, diel vertical migration, mesopelagic and deep scattering layer, ratio between diatoms and nanophytoplankton or even "non-standard" groups like jellies or toxic species, biodiversity within trophic guilds (phytoplankton, zooplankton). Regarding other topics, users were interested in eutrophication, alkalinity, pH and aragonite saturation, salinity or even regional index of ocean heat.

Other questions and comments

- Products on original model levels would be useful rather than interpolating to coarse z levels
- <1km and hourly resolution would be nice, if feasible
- In Copernicus Marine, increase the number of biogeochemical models
- How will pelagic models be linked to projections of impacts from pressures (OWP, fishing)? Will this be done via the HTL models?
- Would lability be variable with environmental conditions?

Parallel session WP6: Benthic products

Expectations about the session

Most users wanted to learn more about NECCTON project in general, some of them heard about it in the Copernicus General Assembly. Some had more precise expectations, especially about habitat mapping and emblematic species mapping, benthic modelling including stressors anthropogenic activities, potential inputs for seagrass extent mapping.

Users would like to be updated about NECCTON annually or biannually, with brief updates on model development and case studies and stakeholders meeting.

User activity and targeted policies

The activity of users varies between ecological modelling (species distribution, pelagic-benthic coupling, climate or coastal) or Earth observation science to policy awareness raising, MPA management or consulting.

The policy they are targeting with NECCTON products are marine spatial planning, MSFD (EU Marine Strategy Framework Directive), fishery or MPA management, Habitat Directive or the application of the SDG14 (Sustainable Development Goal 14: Life Below Water).

Copernicus Marine benthic products

Copernicus Marine benthic data is especially used to conduct scientific research and analysis, and sometimes to inform policy and decision-making processes or even develop conservation and management strategies. Users are satisfied of the accuracy and quality of the data, even if most of them rate their experience as moderate or more rarely as high and using only green and blue ocean products. The applications of Copernicus Marine benthic data are mainly on the coastal area and the continental shelf. The most used variables in Copernicus Marine are:

- Carbon flux to the seabed
- Suspended Particulate Matter (SPM)
- Species map
- Benthic O2

With historical data (<20 years) and climate projections (next 10, 25, 50 and 100 years).

The main barriers encountered using Copernicus Marine data were the format of data (NetCDF) and its transformation, as well as the size of the downloaded data and the lack of stability when downloading big datasets. Some users were also confused by the structure of the search webpage.

Interest in the new products

The main variables of interest, regarding benthic area, are the spatial biomass of benthos, benthic – including algae – species and their ecosystemic function and vulnerability, habitat mapping, shear stress, which are seen as the drivers for benthic habitats as well as anthropogenic stressors. Some geochemical variables are also expected, such as denitrification, sediment type and composition, level of seabed disturbance and turbidity, or carbon sedimentation and storage.

In terms of resolution, the environmental variables are expected to be at a few kms and monthly.

For the species maps products, the presence/absence and biomass are requested, with a spatial resolution of a few kms.

For the suspended particulate matter (SPM) product, the spatial resolution desired is also a few kms, at a daily frequency and mostly for past reconstruction. SPM is important for the user as it is considered a nutrient source.

They also would be interested in the light propagation close to bottom, habitat loss (in addition to disturbance), longevity or lifespan of benthic species or even maps at species community level.

Interest in the new products: stressors

Regarding the stressors, the most requested one remains the climate change, then environmental stressors such as oxygen, temperature, nutrients or physical sea bottom disturbance. Anthropogenic stressors are also asked: offshore wind farm construction, extraction of sediment, fishery (especially bottom trawling) or plastic. These stressors could be declined in scenarios, either by climate (RCP2.6, RCP4.5 or RCP8.5) or by policy changes (MPA extent, fishery, river discharge).

Uncertainty metrics

Uncertainty metrics are asked for benthic products. These metrics should come from multiple model comparisons and be available locally (per raster cell). The local uncertainties should be completed by an overall confidence level.

Other questions and comments

- Not all products will be available in all areas.
- Benthic data will also be included in future scenario projections.
- It's difficult to separate the benthic system from the pelagic system as the carbon flux can be an interaction between both. There will be a big challenge in designing the 2-ways coupling.
- The spatial resolution of the future products will be around 2-3km

Parallel session WP7: Higher Trophic Level Modeling

Target species and functional groups of interest

Users are particularly interested in key commercial and ecological species, from marine mammals to sea turtles and their preys, as well as seabirds and multispecies demersal fishes assemblages. Zooplankton in all range sizes is repeatedly asked for, including its biomass and the related functional groups.

A few specific species raise a particular interest: harbor porpoise, tunas, billfishes and mackerel.

Spatial and temporal resolution

Among the areas requested, the most redundant are the Mediterranean Sea, with a special focus on the Adriatic Sea, the North and the Baltic Sea and the whole Atlantic Ocean. The expected resolution

varies upon users, from 1x1 to 10x10km grid cells, even 30x30km for statistical products with a demand for a tool allowing to change data resolution in order to adapt to scientists' models.

The requested temporal resolution of products varies from daily, weekly to monthly, quarterly or yearly. No overriding claim can be inferred. For the hindcast, the most requested time period is from the 1990's to present, while forecast are expected to be 5 to 10 years long.

The frequency of updates is asked to be yearly, if not biannually.

Stressors

For users, the climate scenarios are closely linked to IPCC scenarios – especially RCP 2.6, 24.5 and 8.5.

Regarding fishing, users would like data about fishing effort (spatially and temporally) with its evolution in time, as well as ghost fishing and bottom-related methods in particular.

Future use of HTL products

The HTL products have to be usable with other products like pollutants and stressors, obviously with LTL including benthic habitats, macrofauna and algae, also with physical aspects like ocean circulation or sea surface temperature.

This data would be used for several tasks, such as:

- Single-species model like tuna, billfishes, sharks, and marine mammals. This includes their distribution and habitat
- Comparison with other modelling outputs and approach
- Forecast, including the effect of climate change on ecosystems
- Policy information and development (TAC, MAP, MSP…) including their design and effectiveness
- Environmental assessment in general, and comparison with ground data

The output format is expected to be time series in raster data but also memory effective without blank cells. A set of R scripts could also be provided, to help with the downloading, data analysis or change of resolution.

Parallel session WP8: Marine pollution and stressors modelling

Areas of use and interest

Most of users make use of pressure and stressors data in their work and are much interested in cumulative assessment. Their sources of information are mostly local data through monitoring, and literature.

The areas of interest are essentially the MPA, and Natura 2000 sites where there is a focus on the impact of pressures: noise, aquaculture, marine traffic, oil and gas exploitation, plastic pollution. Some targets are particularly sensitive to pollutants, such as marine mammals, sea turtles, deep cold coral reefs or commercial fish species.

Spatial and temporal resolution

The expected spatial resolution would be finer (1 to 5km) at the coast and in estuaries.

The temporal resolution varies upon the type of data. It can be hourly to daily, for oil spills for instance. But the most frequent answer is monthly or seasonal for multi-stressors index or fisheries.

Oil spills

The most useful information is simulating the fate of real spills using oil concentration, rather than statistical assessment supported by models. For the Mediterranean Sea, the most hazardous oil spills are the medium ones (from 7 to 700 tons) even though they're rare. The major source of these oil spills is considered to be oil terminals including ship-to-ship operations, and sometimes oils exploration and production areas.

Targeted species

The main additional products requested would be the number of days beyond average or exceeding threshold, for pollution mostly.

Some species are particularly targeted in users' studies, mussels, cod, sea bream, sea bass or hake. Other species, such as eel, sea turtles, cetaceans, macroalgae (Posidonia especially) are seen as important from an ecological perspective while not necessarily directly exploited.

4. Survey results and analysis

After the workshop, a survey was sent to the users of biogeochemical data from the Copernicus Marine Service. The aim of this survey was to raise awareness among new users and to confirm whether the products designed in NECCTON really do meet a need.

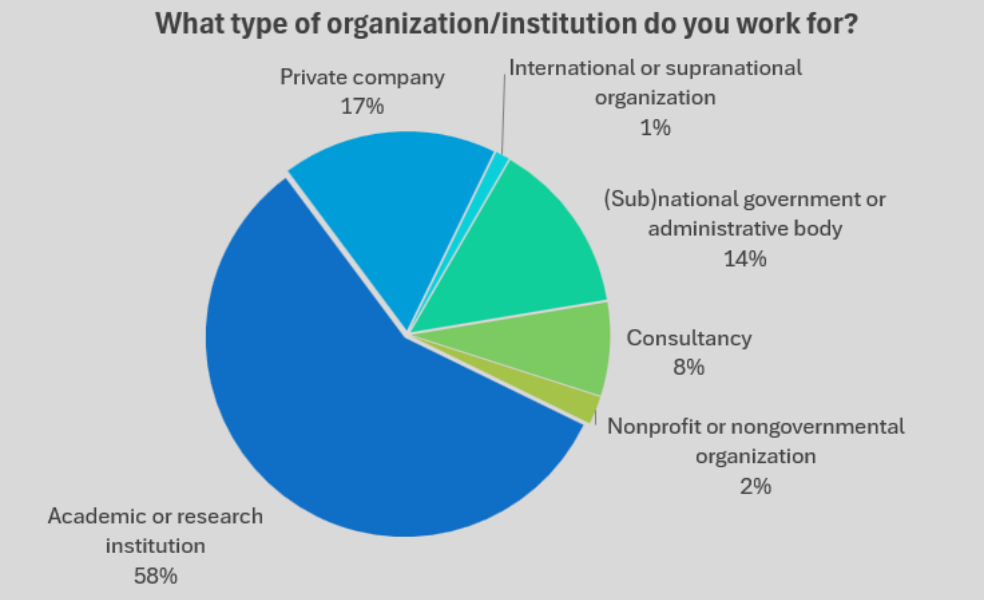
The survey gathered 239 responses, with a completion rate of 54.4%.

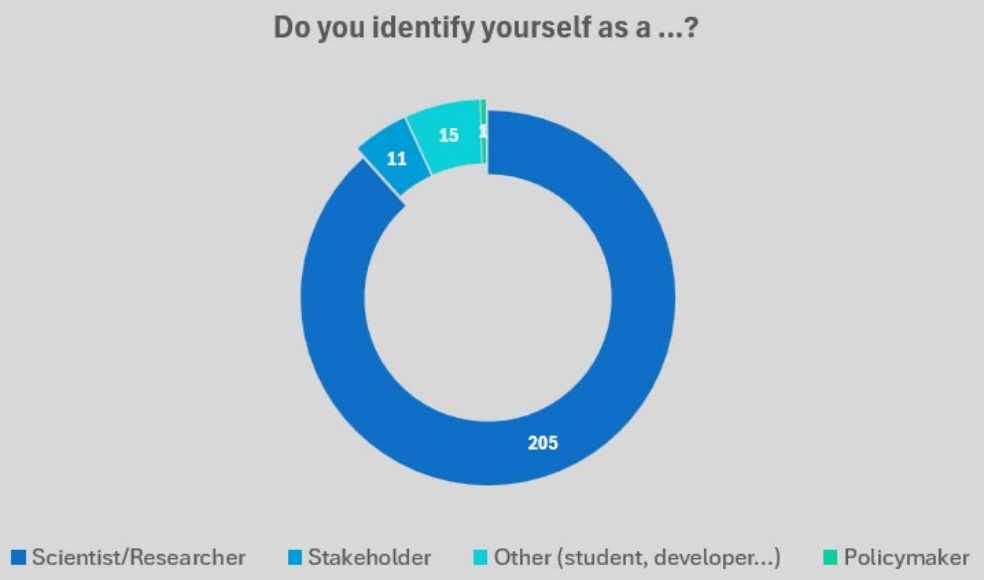
Regarding its content, this survey was divided into 4 axes: the collection of information about the respondents, their use of products and data in general, the potential contribution of NECCTON and its outcomes in their work, and finally their needs about visualization, uncertainties and formats.

Information on respondents

The country of origin of respondent is very diverse: Italie (10%), France (6.5%), Indonesia (6.1%), China (4.8%) or Spain (4.8%) for the most frequent. In total, almost 70 different countries have been selected, and not especially in Europe but all over the world.

Many of them (63.6%) work for an academic or research institution, while others are employed by private companies (19.2%) or a (sub)national government/administrative body (15.5%).



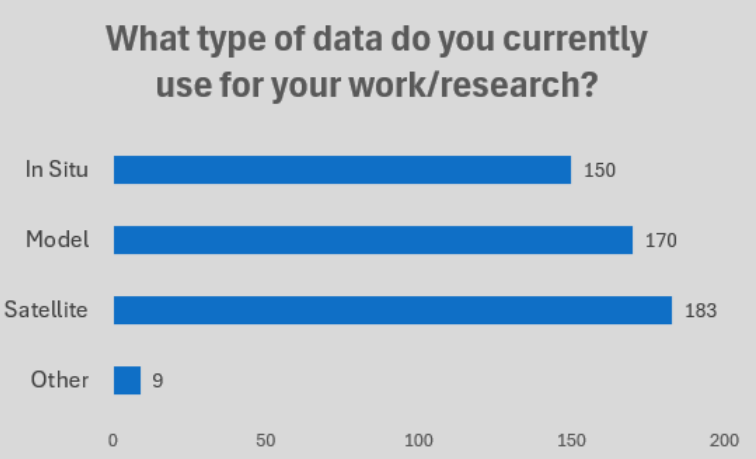


The large majority of respondent identify themselves as scientist or researcher (88.4%). Stakeholders are much rarer (4.7%) as well as policymakers that were almost absent (0.4%).

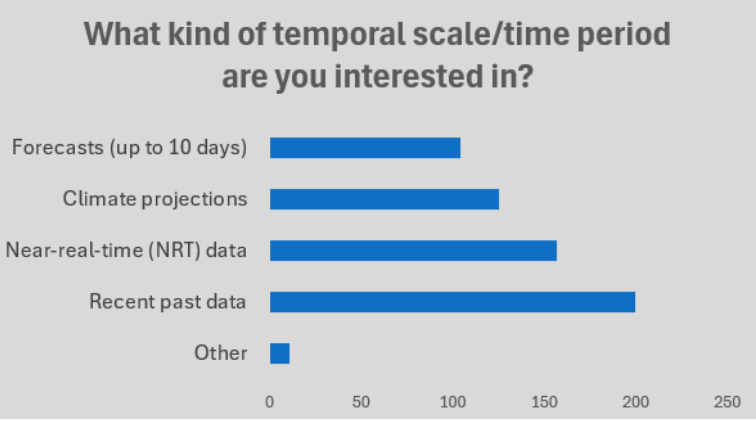
Their usual scale of work is regional (61.4%) but also national (38.1%) or even global (36.4%). The field of their organization are very diverse: marine conservation and biodiversity (53.6%), climate and adaptation (50.6%), coastal service (45.6%), science and innovation (44.4%) or even ocean health (36.8%) or natural resources and energy (30.1%).

Use of products and data

Marine data are usually used to conduct scientific research and analysis (90.3%), but also to assess and monitor the health of marine ecosystems (43.9%) or to develop conservation and management strategies (34.2%). Satellite, model and in situ data are used in almost equal proportions (respectively 76.9%, 71.4% and 63%).

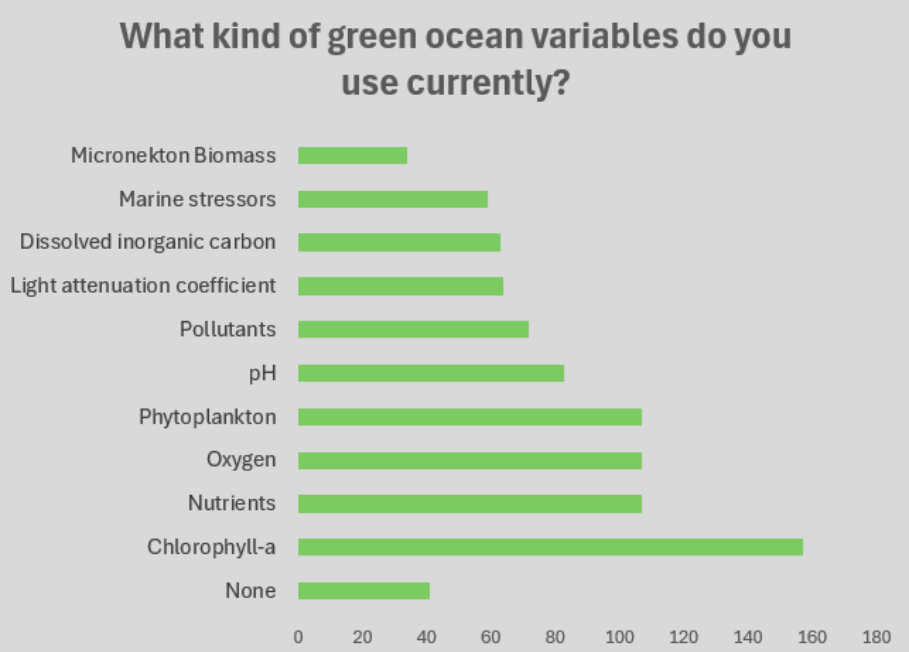


Respondents are interested in daily (62.3%), monthly (59%) and hourly (49.4%) data for a time period corresponding essentially to recent past data (83.7%), near-real-time data (65.7%) and climate projections (52.3%). Back in time, they indicated that the data should go to at least 20 (30.1%) or 40 years (31%). In the future, they are mostly interested in the next 10 years (45.8%), but also the next 25 (33.6%) and 50 years (31.5%).



Regarding spatial resolution, the finest options were the most selected, i.e. below 1km (47.2%) to a few kms (40%). Many respondents were interested in global datasets (58.5%), while the Mediterranean Sean (35%) and the Atlantic Northwest Shelf (NWS) (30.8%) were the areas raising the stronger interest.

Respondents are already using green ocean variables, especially chlorophyll-a (67.1%), nutrients (45.7%), oxygen (45.7%), phytoplankton (45.7%) and pH (35.5%).



The majority of them are satisfied with the accuracy and quality of data they are using (81%). The main reasons of unsatisfaction are the lack of spatial resolution, the insufficient temporal length of datasets, or too much uncertainty.

Only a few of them use ocean monitoring indicators (34.2%), but when they do, they especially look at wave height, currents, tide, sea surface temperature or oxygen.

Interest in NECCTON products

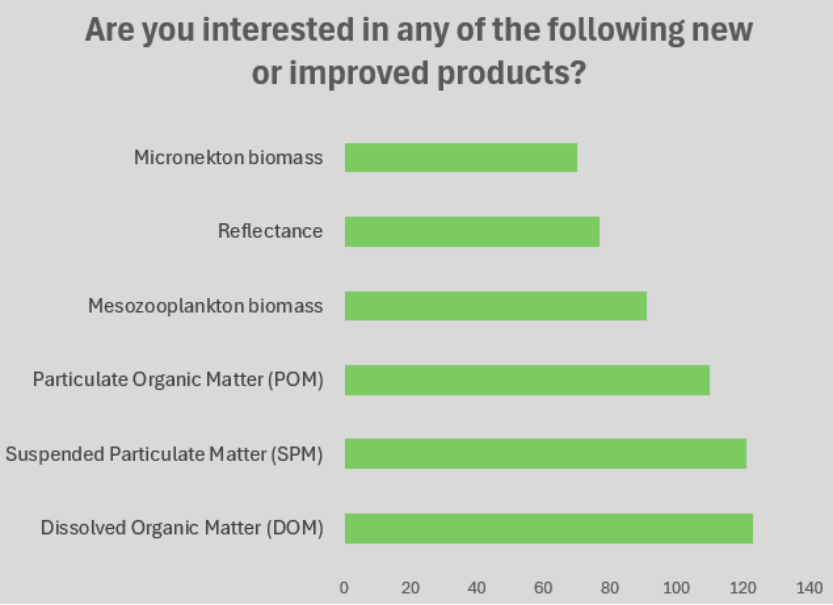
Among the new and improved products designed in NECCTON, the ones meeting the greater interest seem to be Dissolved Organic Matter (DOM) (62.1%), Suspended Particulate Matter (SPM) (61.1%) and Particulate Organic Matter (POM) (55.6%), available as vertically resolved data (3D in space) (81.7%).

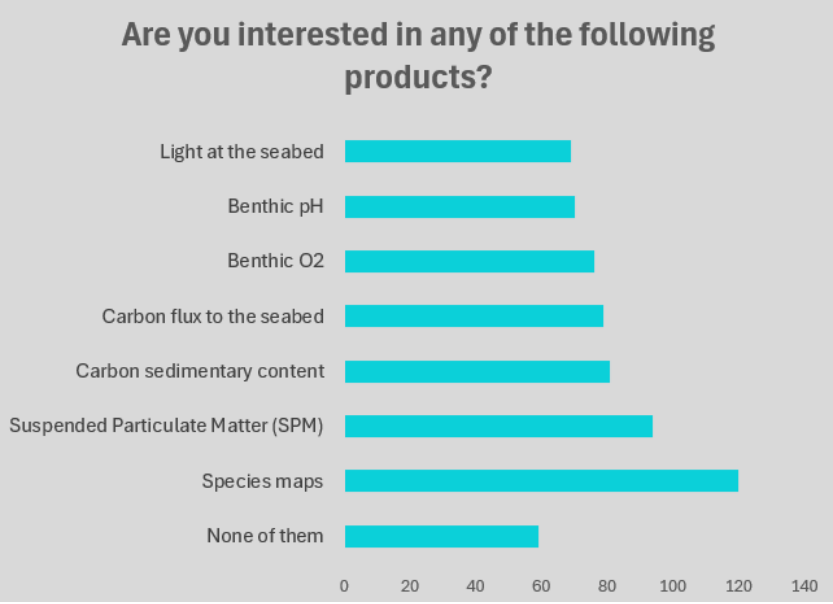
SPM is commonly used for visibility (47.8%), nutrient source (45.2%) and erosion (30.3%) estimations.

Within the DOM, the element that respondents are looking for most are organic phosphorus (96.9%), organic nitrogen (94.1%) and organic carbon (91.7%). For the POM, they don’t seem to be interested in this product (94.7%).

Regarding remote sensing reflectance (rrs), it is mainly used for model validation (41.3%), although almost half of the respondents don't seem to be interested in it (40.9%).

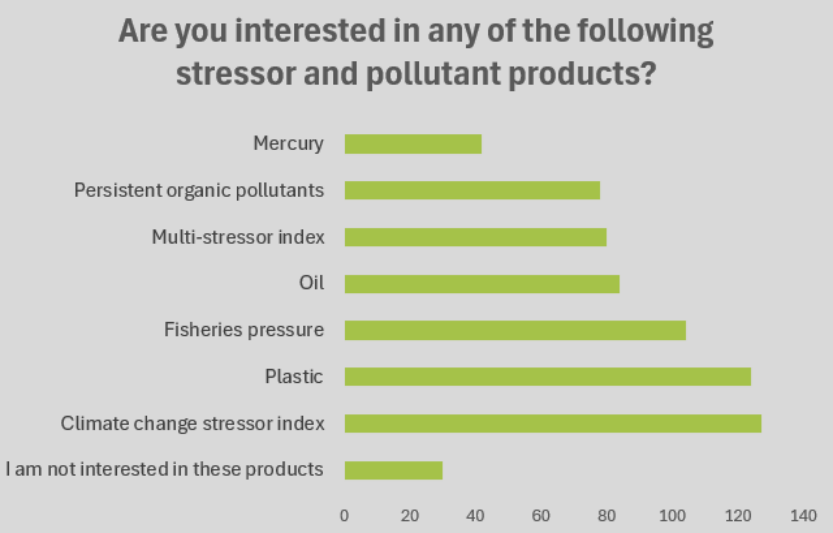
For lower and higher trophic level products, the ones which raised an interest among the users surveyed were small-pelagic biomass (63.4%), marine mammals (57.6%), species map (53.1%), unspecified fish and biomass (48.8%), higher trophic level habitat (47.7%), Suspended Particulate Matter (SPM) (41.6%).





Regarding target species, functional groups, and size ranges, preferences lean towards the pelagic and demersal species (46.5%), key commercial species (45.5%), marine mammals (43.9%) and size-groups/functional groups (41.4%). The purpose or application of using these products is to investigate trophic linkages, understand and evaluate contaminants and pollutants in the food web, or even produce stock assessments for fishery management.

Respondents are mostly interested in stressors and pollutant products, especially in climate change stressor index (58%), plastic (56.6%) and fisheries pressure (47.5%). In their opinion, the main threats and pressures to the ocean seem to be the marine traffic, plastic and chemical pollution from the land and dumping, climate change, invasive species and the fishing industry. They are interested in having cumulative effects assessment (55.5%) but don't use any specific tool to address it already (82.3%).



Visualization, uncertainties, and data formats

Only 24% of respondents use the visualization tool provided by different services – including Copernicus Marine. Most of them (59%) download the data and plot it themselves.

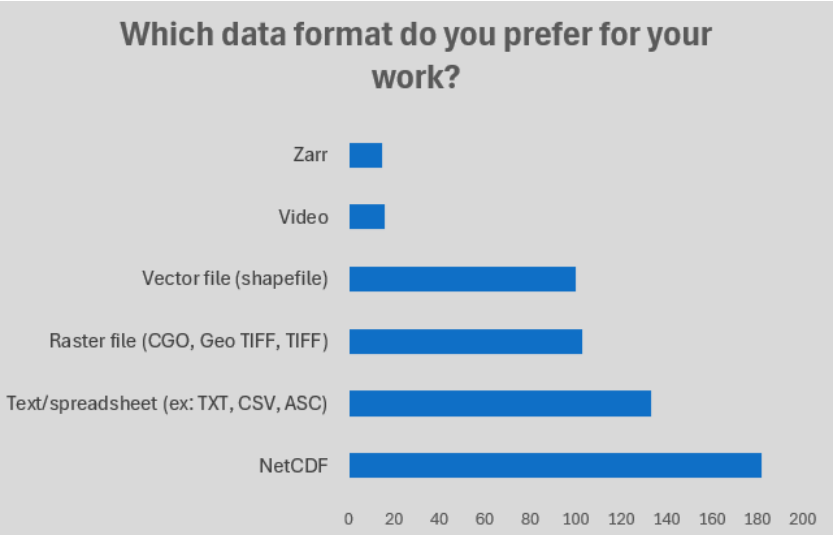
The most useful functionality to this kind of tool is the upload of the coordinates to define a region or through the import of a Shapefile (75.5%). Other functionalities are also seen as useful, such as basic metric calculations (average, minimum, maximum, percentile) (56.4%), superimpose several layers of indicators and data (55.9%), import their own data (55.5%) or save the data selection criteria (52.3%).

Respondents are interested as well in the machine learning algorithms (61%) in addition to the marine products, and they are very much inclined to have uncertainty estimates for the products (89.3%).

According to them, this uncertainty should be delivered as an additional parameter (for example associated variance for a given product at each time and location) (84.6%) or possibly as a probability of exceeding a given threshold (43.8%).

In terms of format, NetCDF is preferred (77.1%), as text or spreadsheet (TXT, CSV, ASC) (56.4%) and raster file (CGO, GeoTIFF, TIFF) (43.6%).

Finally, at the very end of the survey, respondents had the opportunity to enter their email to receive more information about NECCTON or provide further feedback. In total, 134 (out of 239 respondents) email addresses were collected.



Annexes

A. Flyer and agenda of the event

AGENDA

DAY 1

9 am – 10 am (CET) - Plenary Session:

- Introduction to NECCTON
- Presentation of products
- Visualization tool
- Case-studies
- User Testimonies

10 am – 13 pm (CET) - Parallel Sessions – 2 rounds:
11:15 to 11:45 Break

- New and improved capabilities for pelagic lower-trophic-level modelling
- New capability in benthic habitat modelling
- New Capabilities in higher-trophic-level modelling
- New capability in marine pollution and stressors modelling

13 pm – 13:30 pm (CET) - Wrap-Up:

- Reporting of parallel sessions

- Conclusions

DAY 2

9 am – 9:30 am (CET) - Introductory Session:

- Welcome and Objectives
- Presentation of main findings of Day 1

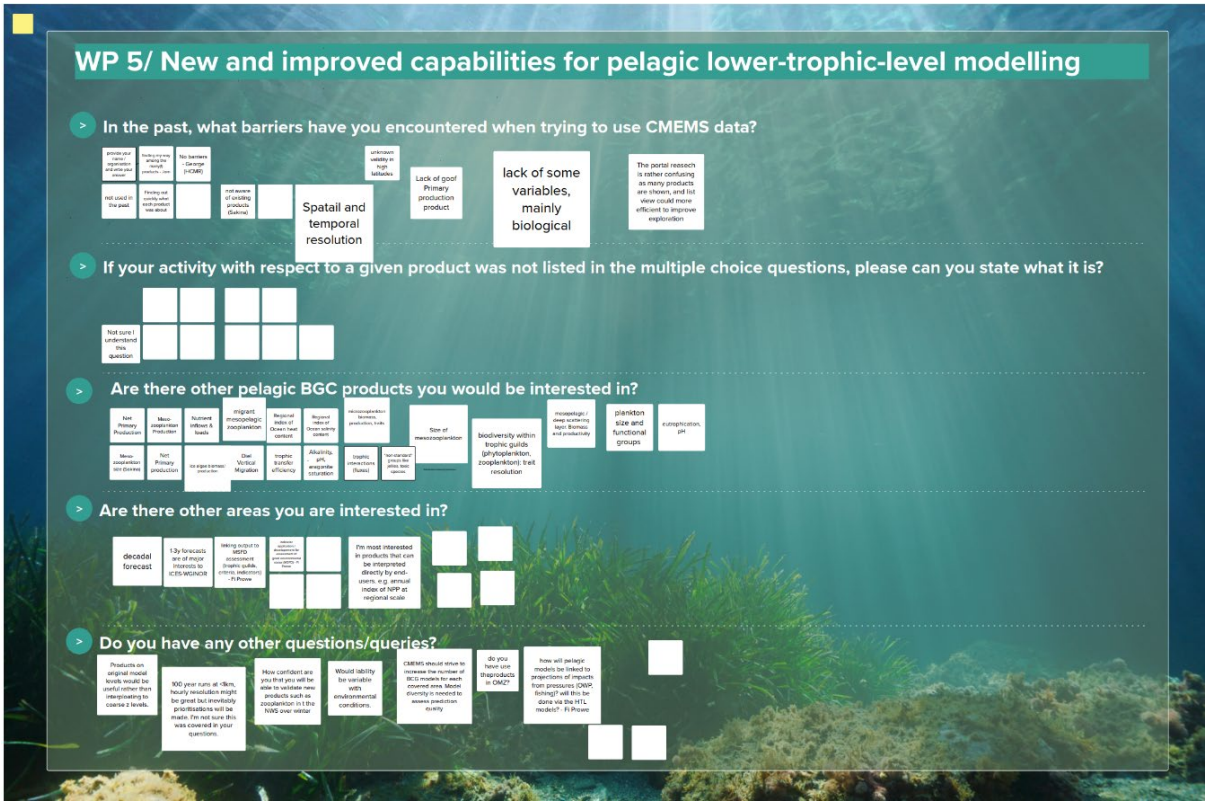
9:30 am – 10:30 am (CET) - Discussion Session:

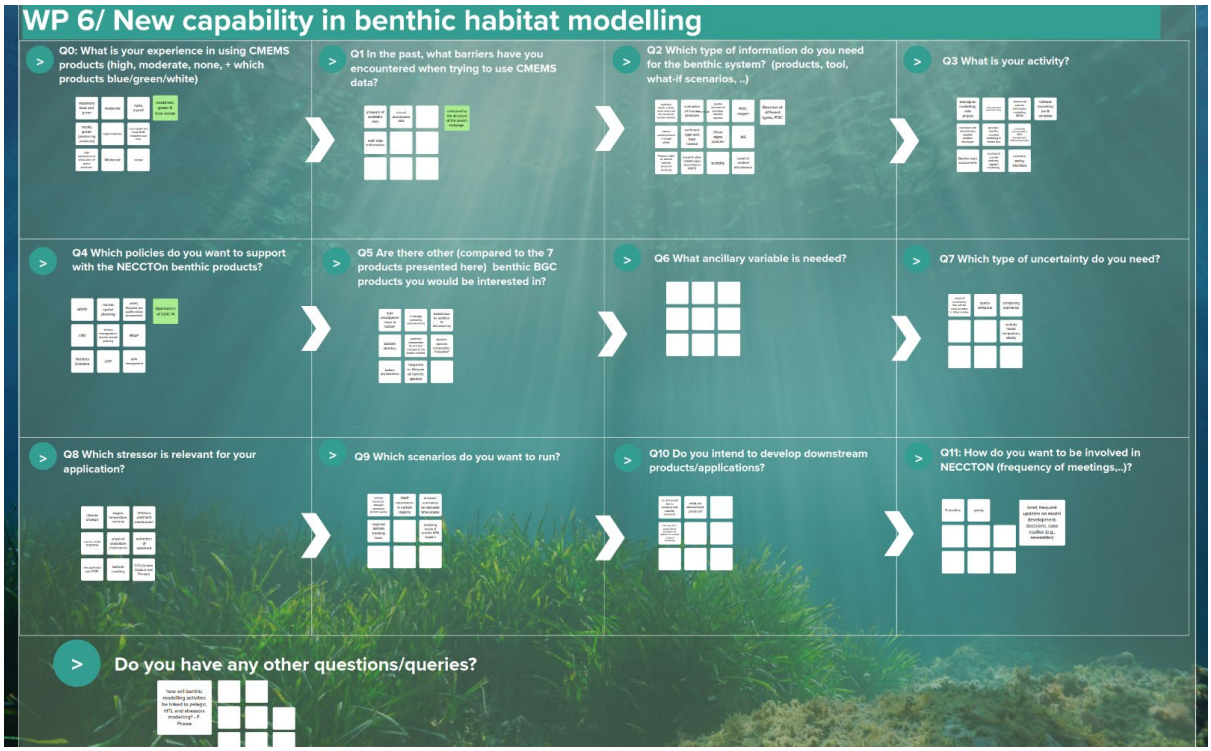
- Discussion panel with Pacific stakeholders
- Case studies

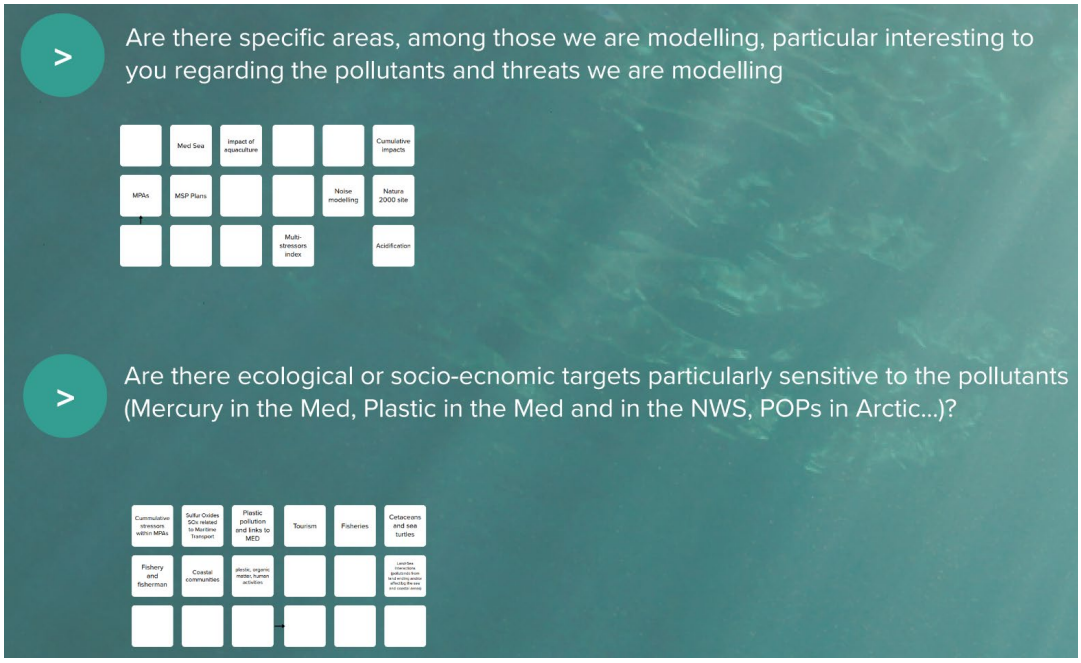
10:30 am – 11 pm (CET) - Wrap-Up:

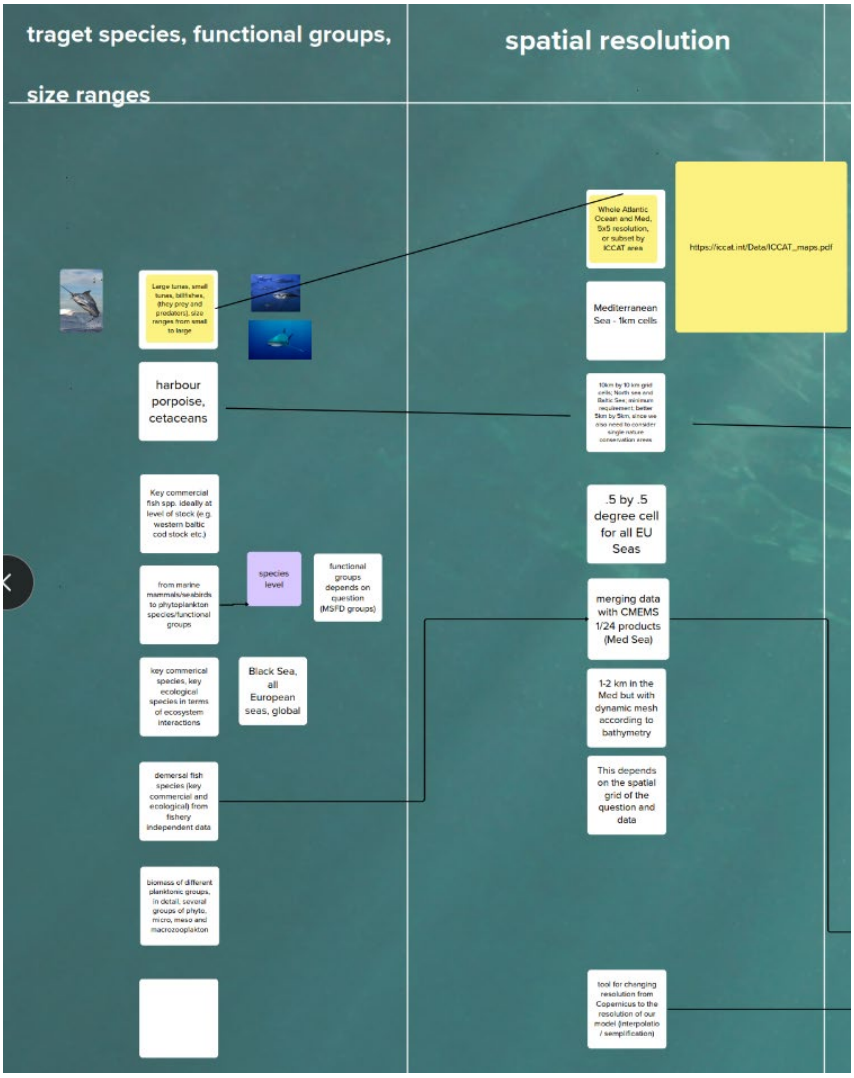
- Reporting of discussion
- Conclusions

B. Extracts from the Murals visual supports






Are there specific areas, among those we are modelling, particular interesting to you regarding the pollutants and threats we are modelling
Med Sea
Impact of aquaculture
Cumulative impacts
MPAs
MSP Plans
Noise modelling
Natura 2000 site
Multi-stressors index
Acidification
Are there ecological or socio-ecnomic targets particularly sensitive to the pollutants (Mercury in the Med, Plastic in the Med and in the NWS, POPs in Arctic...)?
Tourism
Fisheries
Cetaceans and sea turtles
Fishery and fisherman
Coastal communities


traget species, functional groups, size ranges
spatial resolution
Large lumas, small lumas, tallfishes, (they prey and predators), size ranges from small to large
harbour porpoise, cetaceans
Key commercial fish spp. ideally at level of stock (e.g. western baltic cod stock etc.)
from marine mammals/seabirds to phytoplankton species/functional groups
species level
functional groups depends on question (MSFD groups)
key commerical species, key ecological species in terms of ecosystem interactions
Black Sea, all European seas, global
demersal fish species (key commercial and ecological) from fishery independent data
biomass of different planktonic groups, in detail, several groups of phyto, micro, meso and macrozooplakton
Whole Atlantic Ocean and Med, 5x5 resolution, or subset by ICCAT area
https://iccat.int/Data/ICCAT_maps.pdf
Mediterranean Sea - 1km cells
10km by 10 km grid cells, North sea and Baltic Sea, minimum requirement; better 5km by 5km, since we also need to consider single-nature conservation areas
.5 by .5 degree cell for all EU Seas
merging data with CMEMS 1/24 products (Med Sea)
1-2 km in the Med but with dynamic mesh according to bathymetry
This depends on the spatial grid of the question and data
tool for changing resolution from Copernicus to the resolution of our model (interpolatio / semplification)