European Marine Observation and Data Network (EMODnet) response to the European Oceans Pact call for evidence

As a central pillar of European Marine Knowledge**, **EMODnet welcomes the call for evidence to shape the European Oceans Pact. This document, together with a related shorter statement, are submitted as the EMODnet response to the European Oceans Pact call for evidence. Both inputs have been co-written by the EMODnet Steering Committee representatives and Coordinators of the EMODnet Secretariat, Central Portal, seven thematics and data ingestion as core components of the EMODnet *in situ* marine data service. ***This document reiterates key pillars of EMODnet's current service and provides further evidence and concrete examples of how EMODnet is already making a difference in providing open and free marine knowledge for Europe and beyond. It also calls for strengthened investment in EMODnet as a key EU asset for marine knowledge, to meet the increasing and expanding user and wider societal needs, not only for the established, large and diverse user-base, but also in EMODnet's key role as the in situ component of the European Digital Twin Ocean (EUDTO).***

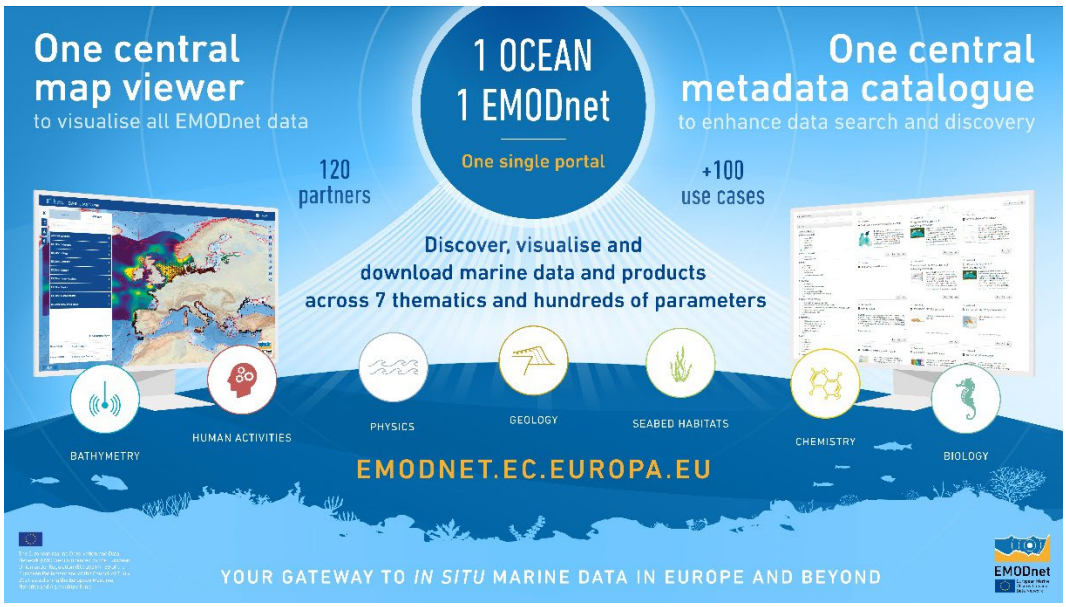

Figure 1: The EMODnet EC in situ marine data service and single Portal

As the European in situ marine data service of the European Commission**, **owned and managed by Directorate-General for Maritime Affairs and Fisheries (DG MARE), EMODnet is a key EU asset for marine knowledge**, **already serving more than 120,000 diverse stakeholders per year via its single, public EMODnet Portal[1] (see Figure 1). In Europe, EMODnet has been a crucial provider of trusted marine knowledge over the past decade and more, in a landscape that increasingly recognises the societal value and crucial, cross-domain role that marine knowledge provides in supporting EU and global policies, serving diverse user needs from administration

1 emodnet.ec.europa.eu

and policy implementors at National, Regional, European and Global scales, to the private sector and Blue Economy and academia that collectively drive Research and Innovation – all of which need marine knowledge to underpin the green and digital transition and to meet the ambitious EU goals for a more competitive and resilient Europe that is climate neutral and that restores biodiversity and ecosystems whilst reducing and eliminating pollution.

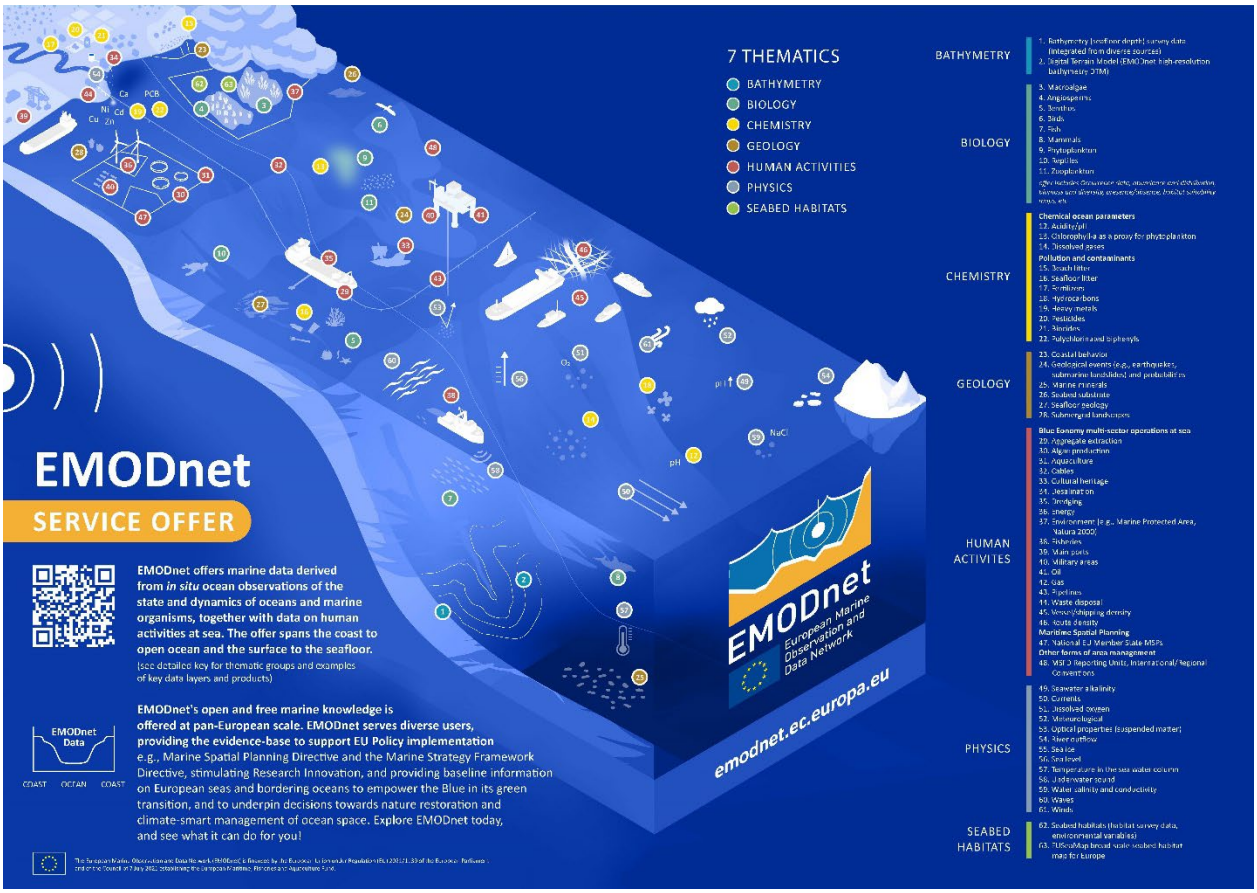

Figure 2: EMODnet service offer infographic

Thanks to dedicated EU funding, ***EMODnet has evolved significantly over the last 15 years since its creation, into the operational, centralised public service*** that it is today (see Figure 1, 2). And, whilst EMODnet continues to evolve, ***EMODnet's core purpose remains the same*** – to assemble, standardise and harmonise *in situ*[2] ocean observation, marine monitoring and data collection efforts ***to deliver open, free and Findable, Accessible, Interoperable and Reusable (FAIR) data and data products on the marine environment and human activities at sea, at pan-European scale.***

2 In situ marine data are derived from ocean observations and primary data taken in/around the Ocean (ground-based sampling) which are complementary to satellite-derived data from remote sensing. See also EMODnet and Copernicus Marine Service joint communication on *in situ* marine data (published November 2023):

Today, EMODnet has the most comprehensive and diverse European marine knowledge offer based on diverse in situ ocean observations *(see Figures 1 and 2). The broad EMODnet service offer includes a wide diversity of parameters of the state and dynamics of oceans and marine organisms from coast to open ocean and from surface to seafloor – including many properties that cannot be made by satellites, and the human dimension including human activities at sea and Maritime Spatial Planning, all integrated in EMODnet in its integrated and holistic marine knowledge offer.*

The diverse and concrete EMODnet use cases[3] exemplify the value creation that EMODnet brings to diverse stakeholders, democratising high value in situ ocean observation primary data into Findable, Accessible, Interoperable and Reusable (FAIR) data and data products, offered at pan-European scale. This includes ***EMODnet's provision of marine knowledge to support EU Policy implementation,*** from Maritime Spatial Planning to the Marine Strategy Framework Directive, among others (see further evidence below).

As the in situ marine data component of the European Digital Twin Ocean (EUDTO), ***EMODnet is at the forefront of digital marine knowledge services for Europe***.

And EMODnet's core role in EUDTO is delivered in direct partnership with the Copernicus Marine Service (CMEMS), jointly providing integrated marine knowledge and digital marine services as a direct contribution to the Mission: Restore our Ocean and Waters cross-cutting Digital Ocean and Water Knowledge system. The EUDTO data infrastructure (EDITO) with a common data lake of EMODnet and CMEMS data was showcased at the Digital Ocean Forum 2024 and continues to evolve based on EMODnet and CMEMS service offers, in combination with the wider digital twin ocean analytical tools and modelling capabilities. In March 2025, stakeholders will be able to access and test EMODnet's *in situ* data offer on the cloud (the EDITO platform of the EUDTO) as part of the open and free EMODnet Open Sea Lab 4.0[4]**,** an EMODnet hackathon series that attracts diverse participants from the public and private sectors to produce applications based on EMODnet's open and FAIR data, to meet societal challenges.

EMODnet, CMEMS and EUDTO are all core European marine knowledge assets which together with serving EU Policy can also serve the European Open Science Cloud (EOSC) marine node and the wider EU Green Deal data space.

EMODnet is implemented by a ***large expert network of more than 120 organisations across and the EU and associated countries*** that deliver EMODnet's diverse service daily. They work with hundreds more experts that conduct *in situ* ocean observations and primary data collection activities and the many experts that curate data at National and Regional levels, ready for EMODnet to harvest, assemble, standardise and integrate. Through this large 'ecosystem' of high expertise, EMODnet creates ***flagship data products, all of them pan-European and many of them being a unique EMODnet capability.*** These include the EMODnet Digital Terrain Model (DTM) for harmonised bathymetry, the EMODnet EUSeaMap broad-scale Seabed Habitat Map for Europe, EMODnet's pan-

3 https://emodnet.ec.europa.eu/en/use-cases
4 https://opensealab.eu/

European Marine Litter Database, and EMODnet Vessel Density composite maps, to name a few. All are directly funded by the European Union and provided as open access data products via EMODnet's data and web services.

EMODnet services are already valued across the EU and beyond. Here are just some examples of how EMODnet is already making a difference.

EMODnet is a trailblazer in the implementation of the EU INSPIRE Directive for Spatial Data Sharing and the European Open Data Directive, applying this to the marine domain, as a backbone to EMODnet's provision of open, free and FAIR data, data products and services on the marine environment and human activities at sea. As a result, ***EMODnet's expertise and cooperation with Member States and wider stakeholders has led to the release of vast amounts of National high value datasets*** including from National geological, hydrographical (bathymetry) and wider marine and coastal data.

EMODnet's application of EU and Global data and metadata standards and best practices not only underpins its service, but is recognised as a regional (European) best practice at an international scale. This enables EMODnet to be harvested by international catalogues including the Ocean Data Information System of IODE IOC-UNESCO and the Group on Earth Observations System of Systems (GEOSS) and other initiatives such as the Ocean Biodiversity Information System (OBIS) and the Global Biodiversity Information System (GBIF).

EMODnet delivers *crucial services to support EU Policy Implementation.* For instance, EMODnet makes an important contribution to the data and information sharing provisions of the Marine Strategy Framework Directive (MSFD) by advising on standards and improving the accessibility and interoperability of marine data. ***EMODnet is the European data platform to support the assessment of MSFD Descriptor 10 (marine litter),*** as outlined in the recently published EU Coastline Macro Litter Trend report. EMODnet's expertise is also valued and being applied to wider MSFD descriptors e.g., in the areas of marine pollution and contaminants, biodiversity and underwater noise, to further standardise and harmonise key data from EU Directive regulatory monitoring of European seas and waters, working in close cooperation with the EC including JRC, the EEA, EU Member States, Regional Sea Conventions and other regional initiatives e.g., ICES. This is exemplified in EMODnet's invited participation and representation in multiple other Technical Groups of EU MSFD, including TG Noise, TG DATA and TG Seabed, among others.

EMODnet also works directly with Member States to make their official National Maritime Spatial Plans accessible to the public as FAIR geospatial data layers on the EMODnet Portal. And, EMODnet's expert advice in Technical Groups of MSP has directly contributed to more harmonised Maritime Spatial Plans across Europe, which is serving users with much-needed cross-border MSP information, crucially complemented in the EMODnet Portal by marine environmental data and information that can support national authorities and maritime spatial planners at National, Regional and European scales to make evidence-based decisions on future MSP developments that are holistic, considering natural ecosystems as well as human needs, and to ensure planning is climate-smart, resilient and adaptable to climate and ocean change.

EMODnet stands ready to optimise and streamline its provision of EU Directive regulatory monitoring data, working closely with the European Commission services and the Joint Research Centre, the European

Environment Agency, Member States and Regional Sea Conventions, noting that achieving this would be a step-change for European marine knowledge and yet will require targeted support beyond the current core EMODnet resources.

EMODnet is also making a difference in coastal management and operations at the land-sea interface, thanks to EMOnet's diverse and expanding offer for the coastal zone, which is crucial to provide the in situ localised information that cannot be fully provided by earth observations from satellites. EMODnet's *in situ* coastal offer includes coastal ocean physical and chemical properties, coastal bathymetry, seafloor geology and substrate, marine geological events coastal erosion, and coastal vulnerability maps which collectively inform national authorities, coastal cities and communities and the Blue Economy on coastal dynamics, coastal resilience and marine geohazards (such as earthquakes, storm surges and submarine landslides). ***The EMODnet offer was also used in the first European sea-level rise assessment, launched in November 2024***, and EMODnet experts were also invited contributing editors to this landmark publication.

EMODnet's biodiversity and ecosystems offer is also broad in the coastal areas and includes pelagic and benthic (seafloor) data on marine ecosystems, also including seabed habitat maps. In partnership across marine, coastal and freshwater infrastructures and key actors, and offering a focal point for *in situ* citizen science data, EMODnet continues to consolidate and expand its ***multi- and inter-disciplinary marine knowledge offer at the land-sea interface***, adding higher spatial resolution and faster delivery of data, including on ***riverine outputs across key European river deltas and estuaries, as a direct contribution of marine knowledge the Mission: Restore our Ocean and Waters***.

EMODnet's vast offer of marine biodiversity data from phytoplankton to marine mammals is used in European, Regional and International biodiversity assessments, also thanks to ***EMODnet's Biology experts providing the data management and data publishing services for EurOBIS,*** one of the most active nodes in the Ocean Biodiversity Information System (OBIS) of IOC-UNESCO, and EMODnet has established data flows to GBIF (Global Biodiversity Information System).

EMODnet's Seabed Habitat offer and EUSeaMap product are used in Regional sea-basin assessments e.g., OSPAR Quality Status Report 2023, noting that EMODnet's seabed habitat maps are the direct result of EMODnet's achievements in cross-thematic interoperability themselves since they are reliant upon FAIR seafloor data from bathymetry, geology, bottom-water currents and benthic biodiversity. ***EMODnet today offers crucial marine knowledge assets that can support Member States and wider stakeholders in assessing and restoring degraded ecosystems for the Nature Restoration law and Europe's contribution to the Agreement on Marine Biodiversity of Areas Beyond National Jurisdiction (BBNJ).***

EMODnet is also a recognised by global stakeholders as a regional (European) leader and best practice for in situ marine data services. The milestone of ***a fully centralised EMODnet service and central metadata catalogue*** (launched in January 2023) not only benefitted marine knowledge discovery in Europe, but also ***led to a major contribution of EMODnet towards an interoperable global ocean data ecosystem***. This was achieved through the EMODnet catalogue being harvested by the Ocean Data Information System (ODIS) of IODE IOC-UNESCO as a key contribution to the UN Ocean Decade, and by the Group on Earth Observation System of

Systems (GEOSS), both which are ongoing and increasingly automated thanks to EMDOnet's technical experts. ***EMODnet is also an essential data service and provider of marine knowledge to global stakeholders to support global environmental policy frameworks***, with a clear example being ***EMODnet's Chemistry data and expert advice being directly used by the UN 2030 SDG 14.3.1 Ocean Acidification, the Geo Blue Planet Marine Litter activity***.

EMODnet provides a coordinating framework for bathymetry data sharing from hydrographic offices, and wider public and private data collection efforts. As a result, ***EMODnet achieved (by 2020) its Marine Knowledge 2020 milestone of mapping the entire European seabed***. Today, EMODnet not only continues to deliver ever-increasing resolution of European seas and coastlines, with its flagship Digital Terrain Model driven by survey-based bathymetry data being a product of choice for Blue Economy to inform the micro-siting of coastal and offshore installations – from pipelines to offshore platforms. And, due to its global recognition, ***EMODnet is a regional hub contributing FAIR bathymetry data into the international Nippon Foundation-GEBCO Seabed 2030 initiative.***

In some EU Member States and associated countries, EMODnet initiated the first coordinated/systematic marine geological mapping programs. Today, the different seafloor geological data products produced by EMODnet provide a solid foundation for Offshore Renewable Energy (ORE) businesses to build their strategies, inform national authorities on coastal erosion and the land-sea interface, and EMODnet is directly cooperating with Caribbean Sea geological organisations to exchange on best practices, standards and data sharing, which has resulted in EMODnet offering geological seabed maps in the region.

EMODnet also provides essential physical ocean data on ocean temperature, salinity, sea level, waves and more to assess the environmental status of European marine and coastal waters, evaluate the effects of climate adaptation plans, and offer background information for the development of Blue Economy initiatives and operations. EMODnet's underwater sound data offer – delivered in cooperation with ICES – has enabled EMODnet to co-deliver a European catalogue of sound signatures[5]. All of EMODnet's physical ocean parameters are integrated for European seas, with ***some parameters offered at global scale, thanks to EMODnet's key partnerships, including with the European Global Ocean Observing System (EuroGOOS) and GOOS.***

With respect to data flow into EMODnet, EMODnet is reliant upon high quality primary data derived from European in situ ocean observations, marine monitoring and wider in-water data collection efforts that form the foundation of EMODnet and are the core of the European Ocean Observing System. Europe already has a high capability for *in situ* ocean observation, thanks largely to Member State investment in data collection efforts in National organisations e.g., Hydrographic offices, Geological surveys, oceanographic institutes and data management services, and to European Union investment in research infrastructures, data networks e.g., SeaDataNet and the EC marine data services EMODnet, Copernicus Marine and the European Digital Twin Ocean.

The diversity of in situ data being collected across Europe cannot be underestimated and ***a huge asset of the EMOD-network is that the partnership reflects the diverse expertise required to source, assemble and manage***

5 https://emodnet.ec.europa.eu/en/ecoss-european-catalogue-sound-signatures

Europe's in situ ocean observation primary data, including National Hydrographic Offices and National Geological Surveys, Marine Institutes, operational oceanographic centres (e.g., as part of EuroGOOS), National Oceanographic Data Centres, public and private organisations, and EMODnet partnerships with Research Infrastructures and other key assets in data collection around Europe.

In addition, ***EMODnet experts invest time and resources in dialogues with European Ocean Observing System[6] (EOOS) stakeholders, to provide advice and best practice on data and metadata standards and to establish and strengthen data flows into EMODnet from diverse sources, also advising at a strategic level in EOOS governance boards, also supporting the EC Ocean Observation Initiative.***

As a result of the continued effort by the EMOD-network, EMODnet has established and streamlined data pipelines from many (mostly based on National publicly funding) data collection efforts into EMODnet. And, for stakeholders seeking advice and support in data stewardship, ***EMODnet's Data Ingestion offers a public service for data sharing that is unparalleled in Europe and that attracts high demand from the private sector, European research and innovation projects, and increasingly from citizen science.***

And yet, ***many critical in situ data collection efforts remain largely un-sustained, presenting a high risk to European marine knowledge delivery.*** Going forward, ***EMODnet recognises the importance and urgent need for more sustained and coordinated in situ ocean observation as part of the European Ocean Observing System, and for a fully-functioning EMODnet to serve the in situ marine knowledge value chain and, ultimately, the marine knowledge pillar of the European Oceans Pact*** that is needed to provide the trusted, holistic marine knowledge required for Europe to meet its ambitious yet necessary targets to become a climate-neutral continent by 2050, and to move towards good environmental status of both marine and freshwater domains, with restored biodiversity and ecosystems, and reducing pollution to zero, among others.

In turn, whilst the marine data services have received European funding over the past decade and, ***there remain critical challenges, particularly for the in situ marine data services, and EMODnet urgently requires strengthened investment to not only consolidate but evolve to meet EU Policy and wider stakeholder needs for in situ marine knowledge.***

Despite the huge achievements of EMODnet over the past 15 years, ***the work to deliver EMODnet's operational service requires considerable ongoing expertise and human resources to deliver, not least to curate, standardize and integrate into FAIR data, information and knowledge that can be used by intermediate and end users, but also to develop EMODnet's digital service which needs to evolve to respond to the latest technological developments and to ensure that EMODnet remains interoperable with other services within Europe, and worldwide, as part of the European marine data space and the global ocean data ecosystem***.

There are also several ongoing challenges, which with appropriate funding for EMODnet, and the wider in situ marine knowledge value chain, are opportunities for European marine knowledge. The volume and diversity of *in situ* data that is submitted to EMODnet continues to increase, thanks to advancements and innovation of *in situ* technologies enabling new parameters to be measured, and to the expansion of low-cost sensors that are

6 https://www.eoos-ocean.eu/

set to significantly increase data collection efforts for critical marine and coastal environment and ecosystem properties. The stakeholder groups collecting data is also ever-diversifying, and ***EMODnet is increasingly the go-to hub for in situ data submissions from citizen science and private sector***, with this trend set to continue. ***These additional data sources are a huge opportunity to fill gaps in marine knowledge that still exist for many parameters across European seas and beyond*** and for which society requires more knowledge for evidence-based decision making, and to provide the data to underpin ever more accurate predictions, forecasts and scenarios on ocean and climate change, made possible via the European Digital Twin Ocean.

The ***EMODnet Call to Action***[7] (November 2023) recognised the core assets of EMODnet, its achievements of EMODnet to-date, and its diverse and expanding user-base. It then called on the EMODnet and wider stakeholders to work together to develop a community Vision for EMODnet. The ***EMODnet community Vision 2035 (to be launched in Spring 2025) recognises the need for consolidation and continued drive for excellence of core EMODnet services. It also highlights key areas where there is a known demand to evolve EMODnet marine knowledge offer and digital services*** to meet emerging societal needs, e.g., marine knowledge support to EU Policy and Europe's contribution to global policy frameworks e.g., BBNJ. This also includes the increasing demand for *in situ* multi-parametric data and information for the coastal zone and land-sea interface as well as the deep ocean, which EMODnet's expert network is well-placed to deliver with the appropriate funding, which in turn will further operationalise and diversify the provision of high volume, fast through-put FAIR *in situ* marine data to EUDTO, etc.

However, to realise the high societal demand for marine knowledge a continuation of business as usual for EMODnet is not enough. EMODnet today delivers a core service, but one that has limited agility to evolve according to policy requirements and user needs, despite being an operational EC service.

The in-house expertise of the EMOD-network of > 120 organisations across the EU exists and stands ready to evolve the service to support EU Policy and global stakeholders into the future. This high-value expert network is a huge asset to Europe and is already existing, motivated and ready to step up its delivery, as required.

In short, with appropriate funding going forward, EMODnet could not only function, but could thrive, leveraging its expertise and extensive network of stakeholders across the marine knowledge value chain to support EU Policy in a more systematic and comprehensive way, for the benefit of all.

With strengthened investment, EMODnet could support the EC Ocean Observation Initiative as the hub for in situ ocean observation primary data so that higher volumes of data from diverse sources can be ingested faster, to streamline the delivery of FAIR, integrated marine knowledge, for users of the EMODnet Portal, the European Digital Twin Ocean, the marine node of the European Open Science Cloud and EU Green Dea data space, and more.

With further investment, EMODnet could become the reference for European marine in situ data service innovation and recognised regional (European) authority in in situ marine data, data products and associated

7 https://emodnet.ec.europa.eu/en/emodnet-call-action-launched-3rd-open-conference-and-jamboree

metadata, complementary to Copernicus Marine Service's recognised leadership in marine environmental data from remote sensing satellites, and predictions and forecasting from computer models. And, with additional funding for international partnerships and data diplomacy, building on the network's expertise that delivered the EMOD-PACE EU-China partnership project, ***EMODnet could engage at the level expected by other regions and regional data services worldwide, as well as contribute European expertise to global initiatives, including engaging in capacity building, data interoperability and promoting data sharing, further establishing EMODnet as a key regional partner in the global ocean data ecosystem, to 2030 and beyond.***

As an established EC marine data service, EMODnet is already delivering trusted marine knowledge for society. And as network of more than 120 organisations, ***EMODnet stands ready to actively contribute to shaping Europe's comprehensive agenda for marine knowledge, as a pillar of the Oceans Pact, and to step up to meet the increasing and diversifying marine knowledge needs of society,*** in close cooperation with the European Commission, with other key actors in the ocean observation, marine data and marine knowledge value chain, and with the wider marine, maritime and coastal communities across Europe and beyond.

EMODnet response to the European Oceans Pact signatories: EMODnet Steering Committee representatives including (co)Coordinators of all key components of the operational EMODnet marine data service, namely the Secretariat, Central Portal, seven thematics and data ingestion, namely:

Kate E. Larkin, Head of the EMODnet Secretariat, Seascape Belgium; Conor Delaney, Technical Coordinator, EMODnet Secretariat, Seascape Belgium; EMODnet Central Portal Technical Team, Belgium; Thierry Schmitt, Coordinator of EMODnet Bathymetry, SHOM, France; Joana Beja, Coordinator of EMODnet Biology, VLIZ, Belgium; Alessandra Giorgetti, Coordinator of EMODnet Chemistry, OGS, Italy; Anu Kaskela, Coordinator of EMODnet Geology, GTK, Finland; Alessandro Pititto, Coordinator of EMODnet Human Activities, COGEA-BIP Group, Italy; Antonio Novellino, Coordinator of EMODnet Physics, ETT, Italy; Patrick Gorringe, ci-Coordinator EMODnet Physics, SMHI, Sweden Ville Karvinen, Coordinator of EMODnet Seabed Habitats, Syke, Finland; Sissy Iona, Coordinator of EMODnet Data Ingestion, HCMR, Greece; Dick Schaap, Technical Coordinator of EMODnet Data Ingestion and several EMODnet thematics, MARIS, The Netherlands.