European Commission

Green Paper

Marine Knowledge 2020

from seabed mapping
to ocean forecasting

Maritime Affairs

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Cover picture: Sunset cup coral (*Leptopsammia pruvoti*) shot at the Marine Protected Area of Portofino, Italy. – © Marco Faimali.

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Directorate-General for Maritime Affairs and Fisheries

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The open ocean observatory ODAS Italia 1 moored in the Ligurian Sea and managed by the National Research Council of Italy

1 Vision

The oceans and seas that surround Europe offer new opportunities to meet the Europe 2020 goals [1]. To realise this potential, we need to make it easier for companies to invest. We need to lower costs, reduce risks and stimulate innovation. And we need to ensure that this expansion of the blue economy is sustainable. The resources are large but not infinite. To ensure that the expansion of the blue economy happens, that it is sustainable and that Europe's seas will achieve good environmental status [2] we need to know what the state of the sea is now, how it was in the past and how it might change in the future. The Commission aims to work together with Member States to bring together available resources and mechanisms to deliver that knowledge for the benefit of industry, public authorities, researchers and society.

This will include a flagship project to prepare a seamless multi-resolution digital seabed map of European waters by 2020. It should be of the highest resolution possible, covering topography, geology, habitats and ecosystems. It should be accompanied by access to timely observations and information on the present and past physical, chemical and biological state of the overlying water column, by associated data on human activities, by their impact on the sea and by oceanographic forecasts. All this should be easily accessible, interoperable and free of restrictions on use. It should be nourished by a sustainable process that progressively improves its fitness for purpose and helps Member States maximise the potential of their marine observation, sampling and surveying programmes.

While the EU can provide support through the Common Strategic Framework for structural funding, including the European Maritime and Fisheries Fund, commitment from Member States and the private sector is needed to achieve this goal.

1. Europe 2020 A strategy for smart, sustainable and inclusive growth Brussels, 3.3.2010 COM(2010) 2020.
2. As required under the Marine Strategy Framework Directive (2008/56/EC) by 2020.

2 This Green Paper

The Commission's 'Marine Knowledge 2020' Communication of September 2010[3], explained why we need to unlock the economic potential of Europe's wealth of marine observations. It showed this would contribute towards meeting Europe 2020[4] targets on employment, innovation, education, social inclusion and combatting climate change. It would provide the knowledge base to facilitate the growth of a sustainable, job-creating 'blue economy' in marine and maritime sectors by improving the competitiveness and efficiency of industry, public authorities and researchers. It would stimulate innovation and improve our understanding of the behaviour of the sea. The Communication then outlined the basic principles for a strategy that would enable investments in marine observation from Member States and the EU to realise their potential for creating sustainable growth and jobs.

Central to this strategy was the concept of a European Marine Observation and Data Network (EMODnet[5]), a network of marine organisations that would provide a single entry point for accessing and retrieving marine data derived from observations, surveys or samples from the hundreds of databases maintained on behalf of agencies, public authorities, research institutions and universities throughout the EU. It would also deliver digital map layers of parameters derived from these primary data for entire sea basins around Europe.

But the 'Marine Knowledge 2020' initiative is broader than EMODnet. It provides a unifying framework for all ongoing activities on marine observation within the EU. It embraces the full cycle, from initial observation through to interpretation, processing and dissemination. It enshrines basic principles such as '*collect data once and use them for many purposes*' and '*data should be interoperable, accessible and free of restrictions on use*'.

These common principles, rules and standards ensure that Member States' programmes, as well as other significant EU efforts can contribute, together with EMODnet, to create a capability much greater than the sum of its parts. These include the marine service of the European Earth moni-toring programme (GMES)[6], the Data Collection Framework in fisheries and new pan-European research infrastructures identified by the European Strategy Forum for Research Infrastructures (ESFRI).

Since the adoption of 'Marine Knowledge 2020', there has been good progress. Preparatory actions under the integrated maritime policy have delivered prototype thematic portals for EMODnet for selected sea-basins. An interim evaluation[7] based on user feedback has confirmed the basic soundness of the technological choices and the processes for assembling disparate data sets. On this basis, a second phase of EMODnet, financed by the Integrated Maritime Policy Financial Regulation[8], has begun. This will provide access to a digital map of all European waters by the end of 2014.

This will show, through a single access point, the depth of water, as well as the nature of sediments, the whereabouts of minerals, zones of human activity and the type of habitat. It will be accompanied by observations of physical, chemical and biological parameters such as temperature, salinity, acidity, chemical pollution and marine life. It will be tightly linked to the GMES marine service which will continue to deliver progressively more refined observations and forecasts of the state of the ocean.

However, there are a number of new challenges to be faced:

3. Marine Knowledge 2020: marine data and observation for smart and sustainable growth, 8.9.2010 COM(2010) 461.
4. See footnote 1.
5. In this Green Paper we will endeavour to limit the use of acronyms but please indulge us in this one which will recur throughout the text.
6. Commission Communication on the European Earth monitoring programme (GMES), 30.11.2011, COM(2011) 831 final.
7. Annexed to this Green Paper.
8. Regulation (EU) No 1255/2011 of the European Parliament and of the Council of 30 November 2011 establishing a Programme to support the further development of an Integrated Maritime Policy.

(1) major EU initiatives, especially EMODnet and GMES, have so far been implemented through limited-duration projects that will finish by 2014.

(2) the prolonged financial crisis has focused attention on public spending. There is an even greater need to ensure that some one and a half billion euro spent annually by EU Member States on Europe's marine monitoring network is cost-effective.

(3) easier access to fisheries data has not happened.

(4) the March 2011 earthquake and tsunami tragedy in Japan, followed by the nuclear accident at Fukushima, highlighted the benefits of bringing near-real time information on the state of the marine environment into the public domain.

(5) uncertainty as to the present and future impact of climate change on Europe's seas and coasts is stalling local and regional authorities' efforts to adapt.

and also new opportunities:

(1) a study[9] has shown that private companies collect even more data than public authorities, but these have not been incorporated within EU initiatives so far.

(2) what will be provided through EMODnet in 2014 is an improvement over what exists and will already provide useful services to public and private bodies. However, it does not stretch the capabilities of current technology. The digital terrain model of the European seabed will be delivered at a resolution of about 250 metres; four times better than what was previously publicly available on a pan-European scale. Surveying instruments have a precision of centimetres, which would allow the creation and distribution, at least in some regions, of the much higher resolution product that users want.

(3) the 2014-2020 financial framework for the EU offers an opportunity to develop a more sustainable governance structure in which the collection, assembly and dissemination of marine data moves from being a set of projects defined by the Commission to a continuous, integrated process with priorities based on the needs of users in industry, public authorities and the research community.

(4) the rapid expansion of offshore wind power will transform, stimulate and augment the overall marine economy. Benefits of better access to marine data calculated on the basis of the 2010 economy will be underestimates.

(5) the new Horizon 2020 research programme offers an opportunity to improve technologies for gathering and processing marine observations.

(6) Member States and Associated Countries have agreed to pool resources in a Joint Programming Initiative 'Healthy and Productive Seas and Oceans' that can provide a framework for coordination of observation programmes[10].

This Green Paper takes stock of what has been done. It then opens a debate on the best strategy for moving forward to a new phase that meets the challenges defined here and profits from the opportunities to deliver an accessible, sustainable digital mapping of European sea-beds by 2020. It would also provide timely information on the present and past physical, chemical and biological state of the overlying water column and forecasts, together with a process that helps Member States maximise the potential of their marine observation, sampling and surveying programmes.

9. Marine Data Infrastructure, Final Report submitted to DG Maritime Affairs and Fisheries, November 2009.

10. Commission Recommendation of 16 September 2011 on the research Joint Programming Initiative 'Healthy and Productive Seas and Oceans' (2011/C 276/01).

3 The need for marine knowledge

3.1. Industry

Our seas and oceans can provide the stimulus we need to get our economies moving. They can provide challenging, rewarding jobs that meet the expectations of our young people. They can provide the clean energy we need if we are to avoid a climate catastrophe. They can provide protein for healthy diets. They can provide pharmaceuticals or enzymes from organisms that inhabit the greatest extremes of temperature, light, and pressure encountered by life. And a growing global hunger for raw materials is increasing the economic attractiveness of deep-sea mining.

These new opportunities for blue growth and jobs are being driven by two developments. First, a shortage of available land and freshwater is encouraging mankind to look again at the 71% of the planet covered by saltwater. Second, rapid advances in underwater observation, remote handling and construction technology, developed primarily in the petroleum industry, now allow safe operations in deeper waters under a wider range of oceanographic and meteorological conditions.

In some sectors the growth is already happening. For instance, wind energy is the fastest growing form of electricity generation in terms of installed capacity. Already, 10% of wind installations are offshore and this proportion is growing. The European Wind Energy Association reckons that by 2020, 30% of new construction will be offshore and 60% by 2030. Success breeds success. Investments such as electricity grids for these offshore wind platforms will bring growth to other industries in their wake.

However, working at this new frontier will inevitably be costlier and riskier than operating on land if each offshore facility needs to construct its own ancillary services such as cabling or supply networks. Or if all are obliged to carry out separate surveys of the sea bottom, to measure tide and currents, assess marine life that might be disturbed by their activity and monitor risks from tsunamis, storms or unfriendly marine life.

For instance, aquaculture operators need warnings of approaching toxic algal blooms or jellyfish invasions. Mining companies need to know the topography and geology of the seafloor. Insurance companies and investors in ports and tourism need data on past extreme events to estimate the likelihood of future damage and to develop climate-proof coastal infrastructure. Biotechnology companies looking for new pharmaceuticals or enzymes to catalyse industrial processes need to know where to look for the strange life forms that can live without light or withstand extremes of temperature.

Marine knowledge is needed in the licencing, design, construction and operation of offshore installations. A leading licensee of offshore wind energy has argued[11] that marine data should be a public good, that business could be more competitive and the cost of generating offshore energy cut if there were clearer public policies on data ownership, less cost-recovery pricing from public bodies and common standards across jurisdictions and disciplines.

And, since '*even an entire society, a nation, or all simultaneously existing societies taken together, are not owners of the Earth. They are simply its possessors, its beneficiaries, and have to bequeath it in an improved state to succeeding generations*' [12], this new marine economy needs to be sustainable. Offshore operators need marine knowledge to assess and limit the environmental impact of any proposed activity.

11. Twelfth meeting of Marine Observation and Data Expert Group, 10 March 2011 https://webgate.ec.europa.eu/maritimeforum/node/1709
12. Karl Marx, Capital Vol. III Part VI Transformation of Surplus-Profit into Ground-Rent.

3.2. Public authorities

Coastal authorities need knowledge of erosion rates, sediment transport and topography to determine whether protection, accommodation or retreat is the most appropriate strategy for managing shorelines. Fisheries authorities need data on past effort and catch composition to set quotas for the following year. Public health authorities need to assess whether the sea is safe for bathing and seafood safe for eating. Civil protection authorities need to be able to calculate where an oil spill will hit the shore. Coastguards need to know how long survivors of an accident can survive in the water. Environmental authorities need to assess the environmental status of their seas and oceans and to ensure they remain safe and clean [13]. The achievement of EU goals on integrated coastal zone management [14] and maritime spatial planning [15] requires knowledge of human activities and sensitive habitats. Maritime surveillance by radar or sonar is improved with knowledge of sea-surface conditions, temperature and salinity.

3.3. Science

Scientific understanding underpins industrial innovation and environmental protection.

Marine science depends on observations. We cannot run controlled experiments with two planet Earths. Only by looking back at the past can we understand what might happen in the future. Gaps left in the record cannot be filled later. An editorial on this subject in the scientific periodical 'Nature' argued that '*an accurate and reliable record of what is going on can trump any particular strategy for trying to understand it*' [16].

With these observations, scientists can begin to reduce uncertainty about the past and present behaviour of processes such as ocean circulation, ice melting, sea-level rise, carbon uptake, ecosystem shifts or ocean acidification – all of which have significant impacts on human well-being and natural ecosystems. Better monitoring of the seas and oceans is not enough to reduce this uncertainty, but it is certainly necessary. The Economist [17] has suggested that governments are not spending enough on satellite observations.

Reducing uncertainty in the past and present can improve forecasts for Europe's climate that are fed into the review and assessment process of the Intergovernmental Panel on Climate Change (IPCC). Wide international participation and careful peer-review ensure that the Panel's assessments are the main vehicle for informing government officials responsible for introducing adaptation measures.

3.4. Civil Society

Citizens in a democracy need information for holding their elected representatives to account on issues that affect their neighbourhood, their livelihoods, their health or the planet Earth that they wish to bequeath to their children. Experience has shown it is wrong to assume that the technical background to these issues is best left entirely to the appropriate responsible authorities. An editorial in Nature [18] used the example of the Fukushima accident to make the case that better public access to data would contribute to better risk assessment: '*This would unleash the diverse creativity of academic researchers, journalists, software geeks and mappers*'.

13. Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive).
14. Recommendation of the European Parliament and of the Council of 30 May 2002 concerning the implementation of Integrated Coastal Zone Management in Europe OJ L 148, 6.6.2002, p. 24-27.
15. Maritime Spatial Planning in the EU – achievements and future development, COM/2010/0771 final.
16. Editorial Nature 450, 761 (6 December 2007).
17. Editorial Economist 'Something to watch over us'. 12 May, 2012.
18. 'A little knowledge', Nature 472, 135 (14 April 2011).

4 Availability and interoperability

Bottom sediment sampling on board R/V Geomari in Gulf of Finland

© GTK

4.1. Bottlenecks

The European Commission, in its 2010 Communication 'Marine Knowledge 2020' [19], pointed out that bottlenecks were preventing investments in marine data from delivering their potential benefits. Data were held by hundreds of different institutions in the EU – hydrographic offices, geological surveys, local authorities, environmental agencies, research institutes, universities. Finding out who held the data was a major challenge. Obtaining them could take weeks of negotiation. And putting them together to provide a complete picture could be a complex and lengthy process. Many data were typically neither accessible nor interoperable.

4.2. Multiple use of marine data

The same marine observations on physical, chemical and biological parameters can meet the needs of a multitude of end-users. For example, data on ocean temperature and salinity are used for assessing ocean climate change, choosing sites for aquaculture or determining the limits of sonar to detect submarines. Data on seabed substrata are needed to plan the extraction of aggregates or hydrocarbons, ensure secure foundations for wind turbine platforms, or assess the impact of fishing. The same data on marine habitats can be used to assess the impact of a new facility or to report on the state of the environment.

It is this multiple functioning of underlying marine data across disciplines and sectors that makes an open access policy the most efficient option. For such a policy to be efficient and effective, the data need to be publicly available and interoperable. Commission policy is that marine data should be relevant, accessible, free of charge and free of restrictions on use.

19. See footnote 3.

4.3. Competitiveness and Innovation

There is a clear cost to the fragmentation and inaccessibility of marine data. The impact assessment [20] accompanying the Communication estimated that existing users would save € 300 million a year if the data were properly integrated and managed. These estimates do not take into account inevitable future growth in the marine economy and the consequent increased demand for data. The first specific objective of 'Marine Knowledge 2020' is to reduce costs for industry, public authorities and researchers.

Without better accessibility to marine data, added-value services such as fish stock assessment or vulnerability of coastal infrastructure to storm surges can only be provided by the organisations holding the data. This is inefficient and anti-competitive. Opening up these resources allows new operators to enter the market. Interoperability allows small businesses or academics to develop new products and services based on data from different sources and of different types. The value of this to the EU economy is hard to estimate, but the impact assessment suggested it could be of the order of € 200 million per year. The second specific objective of 'Marine Knowledge 2020' is to stimulate innovation.

That estimate does not take into account a rationalisation of present marine observation systems that would reduce uncertainty in our understanding of the behaviour of the sea. The economic value of this is even harder to guess, but could be even greater. Indeed, uncertainty is a principal enemy of those responsible for designing offshore structures that can withstand the vagaries of the sea, for managing fish stocks or for designing protected marine areas. It has been estimated [21] that a 25% reduction in uncertainty in future sea-level rise would save public authorities responsible for coastal management approximately € 100 million per year.

An optimised, accessible and interoperable marine observation system that helps scientists reduce uncertainty would be a major contribution to climate change adaptation. Ocean acidification or changes in ocean salinity and dissolved oxygen will certainly have an impact on marine ecosystems and our ability to harvest from them. Earlier information will give industries such as that for shellfish aquaculture time to adapt. And, although it is certain that the planet is warming, it is not clear what is going to happen to local climates in Europe over the next decades [22]. However, it is known that changes in ocean circulation drive the severity or mildness of Europe's seasons. With more certainty, forecasts of energy demand or agricultural production can be improved. Investments in adaption can be made in confidence. The third specific objective of 'Marine Knowledge 2020' is to reduce uncertainty in our understanding of the behaviour of the sea.

These specific objectives were endorsed by the Council in December 2011 [23].

1. Are there any reasons why there should be exceptions, other than those related to personal privacy, to the Commission's policy of making marine data freely available and interoperable?

20. European Marine Observation and Data Network Impact Assessment, 8.9.2010, SEC(2010) 998.

21. See footnote 20.

22. The real holes in climate science Nature Vol 463, 21 January 2010.

23. 3139th Environment Council meeting Brussels, 19 December 2011.

5 Progress so far

5.1. National efforts

Data on the marine environment are a valuable asset. Long-term trends can only be distinguished from seasonal changes and decadal-scale natural variation if observations from the past, including those collected before the advent of digital storage devices, can be compared with those of the present. If these data are lost they are gone forever. Observations cannot be repeated.

And they need to be available for use immediately to prepare for threats such as incoming oil-slicks.

Accordingly, a number of Member States are setting up national processes for proper stewardship of data that ensures not only safe archiving, but also cataloguing using standards and technology that allows fast retrieval of data through automated processes. These national systems are the foundations of the distributed processes that are being built up at EU level using INSPIRE[24] -based standards. Examples include MEDIN in the UK, the French Ifremer-Sextant geoportal, the German MaNIDA coordination of research data and their MDI-DE initiative for agencies. Regional initiatives, such as the Spanish Balearic Islands Coastal Observing and Forecasting System[25], can also contribute.

2. How can Member States ensure that the data they hold are safely stored, available, and interoperable?

5.2. European Marine Observation and Data Network (EMODnet)

The concept of a European Marine Observation and Data Network (EMODnet) that would unlock fragmented and hidden marine data resources was first mooted in the 2006 Green Paper for maritime policy[26]. EMODnet is a network of organisations supported by the EU's integrated maritime policy. These organisations work together to observe the sea, to render the marine data collected freely available and interoperable, to create seamless data layers across sea-basins and to distribute the data and data products through the internet.

A first set of preparatory actions was launched in 2009 to set up prototype data platforms. Six thematic assembly groups – for hydrography, geology, physics, chemistry, biology and physical habitats – brought together a network of 53 organisations. These were largely public bodies – hydrographic offices, geological surveys, oceanographic institutes – that already manage marine data themselves. They were supported by private companies with expertise in data processing and dissemination.

These groups constructed internet gateways to data archives managed by Member States and international organisations. They reinforce and build on ongoing efforts within the Member States such as those listed in section 5.1. From these six portals, public or private users of marine data can now not only access the standardised observations themselves, together with data quality indicators, but also data products such as sediment or physical habitat maps for entire sea basins. No restrictions have been imposed on access or use of these data products. The work builds on and reinforces the INSPIRE Directive[27], the Environmental Information Directive[28] and the Directive on the

24. Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE).
25. This is not an exhaustive list of national endeavours.
26. Green Paper 'Towards a future Maritime Policy for the Union: A European vision for the oceans and seas', 7.6.2006 COM(2006) 275.
27. See footnote 24.
28. DIRECTIVE 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information.

re-use of public sector information. The Common Information Sharing Environment (CISE)[29] will be able to import EMODnet data and so provide information[30] to maritime authorities in environment, fisheries, transport, border control, customs, and general law enforcement as well as defence.

The work was guided and monitored by an independent group of experts and an interim evaluation[31] has confirmed the soundness of the approach. Accordingly, the work is being extended under the 2011 Regulation to support the Integrated Maritime Policy[32] to cover all European sea basins. A thematic group on human activities will be set up to complement the other six. By 2014, the aim is to deliver a medium-resolution[33] mapping of European seas for these seven themes.

The Regulation also supports prototype 'sea-basin checkpoints' for the first time. These are mechanisms to identify whether the present observation infrastructure is the most effective possible and whether it meets the needs of public or private users. The first two will cover the North Sea and the Mediterranean.

The Commission proposal for a new European Maritime and Fisheries Fund[34] under the 2014-2020 financial framework aims to provide financial support for EMODnet's move towards operational capability. With a secure budget, the Network can move from being a set of finite-duration projects specified by the Commission to a continuous and sustainable process, with priorities defined by the needs of industry, public authorities and the research community. Options for a governance structure for this process are outlined in section 6 of this paper.

The thematic groups allow the appropriate experts to define a common structure for all data within each theme. For instance, biological species observations need at least common descriptions for the time, place and method of sampling, the name of the species and precision of measurement. The interim evaluation of EMODnet[35] found the proposed fields for thematic groups logical, but suggested that consideration be given to merging the hydrography and geology groups. Nearly all nations have separate hydrographic agencies and geological surveys with separate missions, but there is now some overlap. Both are now concerned with environmental protection and some of the instruments and methods used for surveys are the same. Both construct knowledge of the seafloor from multibeam echosounder surveys.

3. Are the seven thematic groups of the European Marine Observation and Data Network the most appropriate? Should some be combined? (e.g. geology and hydrography) or should some be divided?

4. What should be the balance in EMODnet between providing access to raw data and developing digital map layers derived from the raw data across seabasins?

29. Directive 2003/98/EC of the European Parliament and of the Council of 17 November 2003 on the re-use of public sector information.
30. Communication on a Draft Roadmap towards establishing the Common Information Sharing Environment for the surveillance of the EU maritime domain, 20.10.2010 COM/2010/0584.
31. See footnote 7.
32. Regulation (EU) No 1255/2011 of the European Parliament and of the Council of 30 November 2011 establishing a Programme to support the further development of an Integrated Maritime Policy.
33. For instance one eighth of a minute longitude and latitude for digital terrain model and 1:250 000 for seabed sediments.
34. Proposal for a Regulation of the European Parliament and of the Council on the European Maritime and Fisheries Fund, 2.12.2011, COM(2011) 804 final.
35. See footnote 7.

5.3. GMES Marine Service

The European Earth monitoring programme (GMES)[36] is a flagship of European Union space policy[37]. The main objective of its marine service is to deliver products and services that added-value service providers can build on to provide services to public and private users. The vision is to ensure that products are developed from the most advanced technology, satellite observations, computational power and forecasting capability available in Europe.

Under the GMES programme, a marine service has been progressively developed and implemented by 60 organisations. This processes and analyses information from in-situ and space measurements to deliver two classes of information: (1) ocean observations and (2) monitoring and forecasting.

Ocean models are used to deliver three-dimensional past, present and future ocean states[38] at a global and European sea-basin level for different parameters such as sea temperature, currents, salinity, sea ice, sea level, wind and biogeochemistry. Until now, this marine service has been funded through the EU's research budget. As of 2014, GMES will enter its full operational phase and should be funded through an operational budget.

In addition to the marine service which has, up to now, focused on observation and providing near-real time and forecasted information on the oceans, a GMES climate service is proposed. The simulation models of the current marine service need to be calibrated and validated against observations of the past, so the marine service already has the capacity to store and process these time series of ocean observations. This investment will be useful for determining changes in ocean characteristics for the Marine Strategy Framework Directive, as well as providing a valuable building block of the proposed new climate service.

Standards are being developed so that both the GMES marine service and EMODnet can access the same in-situ data.

5. Should a common platform be set up to deliver products from both GMES and EMODnet?

6. Should the GMES marine products and service also be tailored for use by those studying climate change and environmental protection as well as those needing a near-real-time operational service?

5.4. Data Collection Framework for fisheries

Since 2001[39], the EU has funded the collection and dissemination of data on EU fisheries by national authorities. Data from surveys, samples and reported catch, effort and discarding enable the impact on the fish stock to be assessed. Parameters such as fleet capacity, employment and profitability also enable analysis of the socio-economic health of fishing communities. The primary purpose is to support management of the Common Fisheries Policy, though a revision in 2008[40] extended the data to the aquaculture and processing sector and widened access for scientific or public awareness purposes.

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36. See footnote 6.

37. Communication 'Towards a Space Strategy for the European Union that benefits its citizens' 4.4.2011 COM(2011) 152.

38. Effectively the oceanographic equivalent of a weather forecast.

39. Council Regulation (EC) No 1543/2000 of 29 June 2000 establishing a Community framework for the collection and management of the data needed to conduct the common fisheries policy.

40. Council Regulation (EC) No 199/2008of 25 February 2008 concerning the establishment of a Community framework for the collection, management and useof data in the fisheries sector and support for scientific advice regarding the Common Fisheries Policy.

Article 37 of the Common Fisheries Reform proposal[41] goes further. It obliges Member States to collect biological, technical, environmental and socio-economic data and to cooperate regionally. These provisions of the Basic Regulation will replace the 2008 Regulation. The details will be spelled out in a new EU Multi-Annual Programme for 2014-2020.

The Commission proposal for a new European Maritime and Fisheries Fund[42] under the 2014-2020 financial framework proposes that the Data Collection Framework for Fisheries shift from centralised to shared management, so that Member States take over responsibility for managing funding and monitoring implementation from the Commission.

In general, fisheries advice requires data from all countries that fish a particular species or particular area. Once the data are assembled for a specific purpose, the aggregated data may be published in a report. However, the raw data provided by the Member States cannot currently be distributed for other purposes without the consent of those who provided the data. In practice, this procedure is so cumbersome that it never happens. This leads to a lack of independent checks, which severely limits confidence in the results and stifles innovation.

The Commission believes that overcoming issues of personal and commercial confidentiality is straightforward. It is perfectly feasible to distribute fisheries information that meets all requirements for understanding the ecosystem without revealing the activity of individual vessels. The new Multi-Annual Programme 2014-2020 has been framed accordingly.

Currently, EMODnet does not provide access to data collected under the Data Collection Framework.

7. Should data that is assembled under the Data Collection Framework for a particular purpose such as a fish stock assessment be available for re-use without the requirement to obtain authorisation from the original providers of these data?

8. Should an internet portal similar to those for EMODnet be set up to provide access to data held by Member States, as well as data assembled for particular stocks, particular fleet segments or particular fishing areas? If so, how should it be linked to EMODnet?

9. Should control data, such as that derived from the Vessel Monitoring System that tracks fishing vessels, be made more available? If so, how can confidentiality concerns be resolved?

5.5. Research

EU Member States spend approximately € 1.85 billion a year on marine research. About half is on infrastructure for facilitating observation. This includes ships, underwater observatories, floating buoys, drifting devices, remotely operated or autonomous underwater vehicles, all equipped with a range of sensors and analytical capabilities. The European Strategy Forum for Research Infrastructures (ESFRI) has currently identified six pan-European infrastructures that will have an essential role for the European marine research community. The Commission's 2010 Communication on an 'Innovation Union' proposes that 60% of infrastructures identified by ESFRI be launched or constructed by 2015.

41. Proposal for a Regulation on the Common Fisheries Policy [repealing Council Regulation (EC) No 199/2008] COM(2011) 425.
42. Proposal for a Regulation of the European Parliament and of the Council on the European Maritime and Fisheries Fund, 2.12.2011, COM(2011) 804 final.

The EU's contribution to marine and maritime research related actions in the Seventh Framework Programme amounted to € 350 million[43] annually. € 25-30 million per year of this is dedicated to marine research infrastructures and research on marine observation technologies (sensors and systems for marine observation). The Framework Programme has also supported the SeaDataNet project, which has been instrumental in harmonising marine data standards and ensuring interoperability between marine databases. SeaDataNet technology is fundamental to the EMODnet platform. Other EU projects make observations to improve our knowledge of the sea.

The Commission's 'Horizon 2020' proposal for a research and innovation programme in the years 2014-2020 includes a larger budget and simpler procedures than the outgoing programme. This research programme can contribute to the 'Marine Knowledge 2020' objectives through (1) support to the development and integration of marine research infrastructures at EU level, (2) development of user-oriented and cost-effective marine observation technologies, (3) research projects that will deliver data on the marine environment and its interactions with human activities, including for the Marine Strategy Framework Directive.

To encourage the development of intellectual property, ideas developed in EU research programmes become the property of the researcher. So new sensors or marine observation platforms will not only support more efficient, effective monitoring of our seas and oceans, but can also provide the basis for export potential in a high-technology sector with a global market.

However, ocean observations themselves cannot be patented and will benefit the economy most if they are made freely available. At present, many of these observations are not disseminated once the research project has finished. This is partly because researchers wish to publish their results before releasing them, but also because there are no incentives or requirements for them to make the effort.

10. What should be the focus of EU support to new marine observation technologies? How can we extend ocean monitoring and its cost effectiveness? How can the EU strengthen its scientific and industrial position in this area?

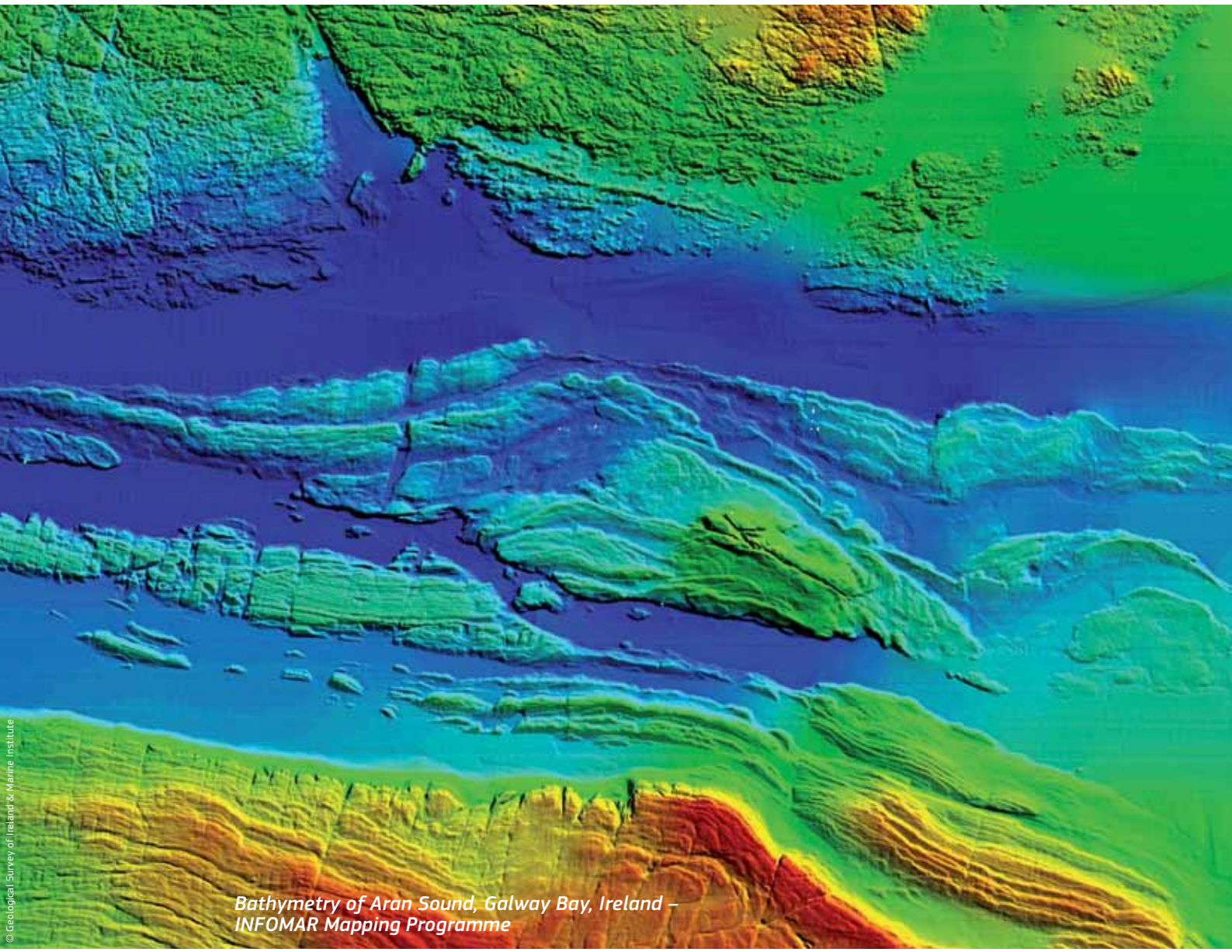
11. Should there be an obligation for research projects to include a provision ensuring the archiving and access to observations collected during the research project?

5.6. Environmental Reporting

A wide range of data is collected by Member States to implement EU Directives such as the Water Framework Directive, the Bathing Waters Directive, the Habitats Directive, and, most recently, the Marine Strategy Framework Directive. Member States also report environmental indicators to regional sea conventions such as OSPAR, HELCOM, the Barcelona Convention and the Bucharest Convention. As part of the obligations of the Marine Strategy Framework Directive, Member States have a legal obligation to report data underlying initial assessments and stemming from monitoring programmes to the Commission and the European Environment Agency. The reporting requirements of the Marine Strategy Framework Directive are the basis of the marine component of the Water Information System for Europe, WISE-Marine. Under Article 19 of the Marine Strategy Framework Directive, there is a requirement for Member States to provide access to data resulting from the assessments and monitoring. EMODnet will be used to enable this access.

The European Environment Agency has been fully involved with the development of EMODnet. The prototype portals already built in the first phase of the project and the more advanced ones being prepared in the second phase were specifically designed to deliver parameters that can be used for constructing indicators that will be necessary to assess the state of the environment under the Marine Strategy Framework Directive.

43. Out of a total of € 5.4 billion on average.



Bathymetry of Aran Sound, Galway Bay, Ireland – INFOMAR Mapping Programme

The reporting protocols used for different reporting mechanisms are not necessarily the same, but in the context of the Marine Strategy Framework Directive, greater convergence is expected. And while some of the data used to construct the indicators reported to the competent authority or the Commission are publicly available, many are not.

12. Should the 'push' process whereby marine environment reports are delivered be progressively replaced by a 'pull' process, whereby data are made available through the internet and harvested by the competent authority using technology developed through EMODnet?

5.7. Climate Change Adaptation

To support the development and dissemination of the knowledge base on adaptation, the Commission launched the European Climate Adaptation Platform, CLIMATE-ADAPT[44] in March 2012, a publicly accessible internet site to support policy-makers in the development of climate change adaptation measures and policies at EU, national, regional and local levels. CLIMATE-ADAPT features a section on EU marine and fisheries policies, indicators of climate change and a database of adaptation case studies, in particular those from OURCOAST[45]. The Commission is developing a proposal for an EU Adaptation Strategy, to be adopted in 2013.

A more structured approach to marine observations can deliver more accurate indicators of local changes in climatic parameters such as sea-level rise and ocean acidification to the CLIMATE-ADAPT platform and therefore help the adaptation process.

13. What information on the behaviour of our seas and coasts can best help business and public authorities adapt to climate change?

5.8. International Initiatives

Piecing together a global picture of the marine world and how it is changing requires observations and data from organisations outside Europe as well as inside. More structured and open access to European marine observations and data, as described in this Green Paper, will enable Europe to provide a practical contribution to international efforts to provide global coverage such as the Global Ocean Observing System (GOOS), the Global Earth Observation System of Systems (GEOSS) and the United Nation process for global reporting and assessment of the marine environment.

14. Are any additional measures required, over and above existing initiatives such as EMODnet and GMES, to enable Europe to support international initiatives on ocean data such as GOOS and GEOSS?

44. http://climate-adapt.eea.europa.eu

45. http://ec.europa.eu/ourcoast/

6 Governance

A sustainable marine data infrastructure requires a process to decide which observations to make, to choose which data products to create and to provide financial support for the process of collection, assembly, processing and dissemination.

6.1. Balance between efforts of EU and Member States

Member States have a legal responsibility to monitor their own waters and their own fishing fleets. Nevertheless, in some cases, there are clear advantages in pooling efforts. The obvious example is observation from Earth-orbiting satellites. It would clearly be inefficient for each Member State to launch a constellation of satellites to measure ocean colour, sea-surface temperature, sea-level and ice extent. Indeed, the EU has supported the development and initial operation of satellites through its GMES programme[36]. The EU also supports survey and sampling programmes in fisheries, where it requires the results for its own purposes.

However, there are other examples where effort at an EU level might be justified. For instance, reducing uncertainty in the magnitude and impact of climate change in Europe is impossible without monitoring the subsurface currents of the Atlantic in areas outside territorial or jurisdictional waters. Doing so does not benefit the Member State doing the monitoring more than any other Member State. It benefits all European countries, even landlocked ones.

The Arctic Ocean is another example where the EU could contribute to ongoing monitoring and mapping programmes to provide support for those who live and work there.

15. What criteria should be used to determine EU financial support of observation programmes other than those that it already supports? Can you provide examples? Could the Joint Programming Initiative for European Seas and Oceans play a role?

6.2. EU support to assembly and processing of marine data

Up to now, services from each thematic assembly group in EMODnet have been delivered by consortia through procurement contracts, with the six consortia selected through separate calls for tender for each group. In all, 53 different organisations have been involved as partners in the consortia, with many others contributing. Grants to the GMES marine service have been awarded following open calls for proposals. Again, about 60 organisations are involved. The EU budget pays for the delivery of defined outputs in procurements and contributes towards agreed eligible costs in grants. The partnerships in both EMODnet and GMES are heterogeneous. They include research institutes, agencies for meteorology or hydrography and universities. Some private companies provide software expertise.

The Commission has no influence over the composition of these partnerships; they are self-selected. The large partnerships are an indication that the agencies or institutes involved prefer to be joint owners of a common enterprise rather than suppliers to a single lead contractor.

The open calls in both cases ensure transparency and the results in both cases have been very satisfactory. However, as the initiatives mature, there is a need to ensure the long-term continuity of operations and infrastructure. Since much of the work in EMODnet involves the remodelling of national data archives, no partnership without the participation of the major national marine data centres can be complete. This might indicate the desirability of moving to a grant or a negotiated procedure which could be easier if the EMODnet partnerships had a legal status. Governance issues for the GMES marine service include a legal entity for the coordination and an appropriate financial mechanism.

16. How could the governance of EMODnet and GMES evolve to better accommodate the need for long term sustainability?

17. What could be the role of the Joint Research Centre and the European Environment Agency?

6.3. Involvement of Neighbours

Europe's seas do not only wash the shores of EU Member States. Understanding the ecological health of the Black Sea or planning a cross-Mediterranean cable requires cooperation with the neighbouring countries that share these sea-basins. For this reason, institutes from these countries have taken part in the first phase of the EMODnet construction. They too are faced with unacceptable levels of unemployment and they too can benefit from knowledge that will help them understand how to take advantage of offshore opportunities.

6.4. Selecting priorities

Mapping and monitoring the sea is, for reasons set out above, essential for sustainable economic growth, environmental protection and understanding climate change. However, public budgets are limited and priorities need to be decided. As we shift from a paradigm of collecting data for specific purposes to collecting them once and using them for different purposes, two specific questions need answering: (1) what observation infrastructure and sampling strategy are needed for a particular sea-basin? and (2) how can the EU's financial contribution provide the most added-value?

The Data Collection Framework is satisfactory on both counts. A process is in place to define what data need to be collected. Since an objective of the Common Fisheries Policy is to limit the environmental damage of fishing[46], the sampling strategy already goes beyond the interest in maximising the fish yield.

The process to select Earth observation satellites needed to monitor the oceans is similarly satisfactory. It has been defined through the GMES process by determining which parameters Earth-orbiting satellites can actually observe from a height of about 800 kilometres above the ocean. Technological progress and better scientific understanding enable progressive improvements in accuracy and the addition of more parameters. For instance, the operational monitoring of sea-ice thickness will become feasible with the launch of Sentinel-3. The European Environment Agency is in the process of identifying what other (non-satellite) measurements are needed to calibrate and validate GMES forecasting models[47].

For other observations, more needs to be done. Since shifting currents, migrating species and many economic activities do not respect national borders, the question on optimum observation and sampling infrastructure needs to be answered at sea-basin level. Within the integrated maritime policy regulation[48], a prototype mechanism has been set up to help Member States hone their observation and monitoring infrastructure. The 'sea-basin checkpoints' for the North Sea and the Mediterranean will evaluate by 2014 how well the present monitoring and assembly network meets the needs of private, public and academic users. They will determine the relative merits of different monitoring systems – ferryboxes, fixed buoys, floats – measuring the same parameter. All information sources will be considered; public and private. This information will help guide Member States in their investments. For instance, should multibeam surveying of the seabed be accelerated, or is more accurate information needed on changes in sea-level?

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46. Council Regulation (EC) No 2371/2002 of 20 December 2002 on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy.

47. Through the Seventh Framework Programme project GISC (GMES in-situ coordination).

48. See footnote 8.

Similar choices need to be made at an EU level. In the proposed marine knowledge component of the Europe Maritime and Fisheries Fund, is it more urgent to focus on assembling data on mineral resources or on marine mammals? Should the EU support surveying or sampling in international waters? Ultimately, Member States must make these decisions in the framework of the Council, but they need to have a proper evaluation of the options to guide them. The answers to these questions will depend on estimated costs and benefits.

18. Is a regular process needed to evaluate the effectiveness of the observation and sampling strategy for each sea-basin?

19. What mechanism could be envisaged to manage the evaluation and assessments needed to inform the Commission, Member States and Parliament on priorities for EU support?

7 Private sector involvement

Marine industries will certainly benefit from the measures outlined in this paper, but there is potential for increasing these benefits by encouraging the engagement of the private sector.

According to a 2009 study[49], more marine data is collected by European companies than by the public sector. If a private company collects data for its own purposes then, in principle, there is no reason for public authorities to intervene or interfere. European legislation on access and re-use of these data does not apply.

However, private companies are already obliged to collect data as part of the impact assessment they have to carry out to obtain a licence for certain offshore activity. They may also be obliged to continue monitoring once operations start. In many cases, they are obliged to hand the data collected over to the licensing authority. However, once the licence has been granted, there is no apparent competitive disadvantage in releasing these data into the public domain. The Commission is aware that imposing reporting obligations on private companies under normal circumstances creates an administrative burden that is to be avoided. However, replacing a hotchpotch of different obligations with a single reporting mechanism with common INSPIRE-based standards could reduce the existing burden. A study has been launched to help assess costs and benefits.

There may also be a case for extending reporting obligations once the licence has been granted. The cost of instrumenting offshore platforms to provide continuous information on the state of the sea would be an almost negligible increase in the overall costs of the installation. The idea would be to collect data from all EU platforms as well as other observing platforms and make them publicly available. This could well cost less than the potential benefit to the whole offshore industry of obtaining better knowledge of potential threats such as rogue waves[50], poisonous algae or radioactive leaks Improving the competitiveness of offshore business has been a prime motivation for 'Marine Knowledge 2020'. A public-private partnership whereby private companies share the expenses of running the European Marine Observation and Data Network in return for a say in the setting of priorities could accelerate this process.

20. Under what circumstances should data provided by private companies for licencing purposes be made publicly available?

21. Should licenced offshore private sector actors be obliged to contribute to wider monitoring of the sea where this is feasible?

22. What public-private partnership models can maximise incentives for industry to share data and investments in data as well as benefits to all stakeholders?

49. Marine Data Infrastructure, Final Report submitted to DG Maritime Affairs and Fisheries, November 2009.

50. Also known as freak waves, monster waves, killer waves, extreme waves or abnormal waves.

8 Responding to Green Paper

This Green Paper opens a debate on the best strategy for moving forward to accessible, sustainable digital mapping of European seabeds, as well as timely information on the present and past physical, chemical and biological state of the overlying water column and forecasts for the future, together with a process that helps Member States maximise the potential of their marine observation, sampling and surveying programmes.

This website will be open till 15 December 2012. Responses can be sent either in an official capacity or individually. The outcome of the consultation will be published on the website of the Commission's Directorate General for Maritime Affairs and Fisheries. The affiliation and name of individual contributors replying in a personal capacity will not be published unless specifically authorised.

The Commission has set up a website for responses.
http://ec.europa.eu/dgs/maritimeaffairs_fisheries/consultations/marine-knowledge-2020/index_en.htm

European Commission

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