European MARINE BOARD
Advancing Seas & Ocean Science

European Marine Board Expert Working Group

Submarine cables: A revolution in Ocean monitoring

Terms of Reference

September 2025

Contents

1. Background and Rationale

In order to fill current geographical observing gaps, the need for more Ocean observations over different spatial and temporal scales is well recognised by the marine scientific community. In a time of unprecedented global change, it is more important than ever to be able to understand what is happening in the Ocean, as well as the implications of these changes for marine environments and human communities. Submarine cables, housed on the seabed and used mostly for telecommunication purposes, cross all global sea- and Ocean basins and could offer an unprecedented opportunity for future Ocean observations and monitoring.

We are also in a period of geopolitical instability, with pertinent concerns about maritime and national security since submarine cables can be vulnerable to sabotage. However, the integration of sensors into cables can help increase their security and resilience, facilitating threat detections (e.g. sound of approaching vessels, excessive cable movement or vibration) and hence raise the alarm. It is therefore timely to initiate a Working Group which can leverage on the sensing opportunities offered submarine cables.

In 2010, You (2010) proposed for the first time that fibreoptic submarine cables could also be used for science and Ocean observation. Recent advances in optical and sensor technology have made it possible for these cables to improve Ocean monitoring with additional *in situ* seabed sensors. This can include the retrofitting of relevant technologies to currently active or now obsolete telecommunications cables, or the addition of specific technologies to newly laid cables. These approaches can overcome the power supply and data transfer challenges faces by other *in situ* Ocean observing infrastructures. Indeed, the sensors "needs "can be supported by the cables themselves, using their power supply and data transfer capabilities for continuous long-term monitoring on the seabed with (near) real-time data delivery. In addition, the distributed nature of the cables allows the same observation to be captured over very large distance on the seabed at the same time (Howe et al., 2019). Using submarine cables for ocean observing also provide a solution to monitoring ice-covered waters, e.g. in the Arctic, where deploying instruments at or from the surface is challenging.

Ocean observing using submarine cables offers the opportunity to acquire data covering a broad range of applications, including physical oceanography (e.g. pressure, temperature), seismic activity and geohazards detection, and acoustics. The data gathered will be useful for a wide range of applications, from marine geohazard early warning systems to climate change monitoring and acoustic observations of marine species. The data can also contribute directly or indirectly to the Global Ocean Observing System (GOOS) and Essential Ocean Variables (EOV)[1] (Howe et al., 2022), which are widely used in Ocean and climate forecasting, projections and assessments as well as Ocean protection. NASA has also considered the use of submarine cables to support calibration of altimetry and gravity for satellite sensing (Howe & Workshop Participants, 2015).

While this is an emerging topic, there are already some developments in this field. Projects such as the European-funded project SUBMERSE[2] are exploring the use of existing submarine cables for Ocean

[1] https://goosocean.org/what-we-do/framework/essential-ocean-variables/
[2] https://submerse.eu/

observation. Meanwhile, the SMART Cables Joint Task Force[3] (JTF), an initiative of three UN agencies (the International Telecommunications Union (ITU)[4], the World Meteorological Organization (WMO)[5], and the Intergovernmental Oceanographic Commission of UNESCO[6] (IOC-UNESCO)) established in 2012, focuses on the integration of relevant sensing technologies into new laid cables. This Task Force has recently been recognised by GOOS as an emerging observing network[7]. It will be relevant for this Working Group to interact with ongoing initiatives and interested parties (e.g. Navies, telecommunications and technology industry partners) and reflect their work in the eventual publication.

The policy drivers for the development of submarine cable for Ocean monitoring are broad. In Europe, the newly announced European Ocean Pact[8] will rely heavily on Ocean observations for its support and implementation, including in a dedicated European initiative to bring greater coherence to the European observing landscape. The implementation and management of other existing instruments also rely on parameters which submarine cables can measure, such as the Nature Restoration Regulation[9] (e.g. hydrological changes related to climate change) and the Marine Strategy Framework Directive[10] (e.g. related to hydrographical conditions and underwater noise). More widely, the data will support protection from marine geohazards and climate-driven hazards and support resilience ambitions.

It is notable that at present, a significant proportion of research and pilot projects presented in the literature are non-European. However, numerous national-level projects are now being developed in Europe. Developing a European-centric Position Paper should help to bring Europe up to speed and support the development of submarine cables for Ocean observing with European-level coordination.

Rationale for the Working Group

The topic was first proposed as a Working Group activity during a call for new topics Spring 2025 by the EMB Member Organisation IFREMER (France), specifically their ALéas MArins (ALMA; marine geohazards) team from the Geo-Ocean research unit, with contributions from Florian Le Pape, Marc-André Gutscher, Shane Murphy, Martin Patriat and Stéphan Ker. The topic was selected by the EMB Board members as a new EMB activity during a vote at the EMB Spring Plenary 2025 meeting in Brussels, Belgium.

Following this topic proposal and selection, this Terms of Reference document was developed for approval at the EMB Autumn Plenary Meeting 2025.

2. *Working Group Objectives*

An EMB activity on this topic will seek to provide a comprehensive state-of-the-art overview regarding the use of submarine cables for Ocean monitoring. It will consider use of now obsolete, active and new underwater telecommunications cable for this purpose. It will also discuss the ways in which the data

[3] https://www.smartcables.org/
[4] https://www.itu.int/en/Pages/default.aspx
[5] https://wmo.int/
[6] https://www.ioc.unesco.org/en
[7] https://goosocean.org/news/three-emerging-observing-networks-join-the-global-ocean-observing-system/
[8] https://oceans-and-fisheries.ec.europa.eu/european-ocean-pact_en
[9] https://environment.ec.europa.eu/topics/nature-and-biodiversity/nature-restoration-regulation_en
[10] https://research-and-innovation.ec.europa.eu/research-area/environment/oceans-and-seas/eu-marine-strategy-framework-directive_en

could be used in support of marine scientific research, disaster risk reduction, policymaking and maritime security.

Specific objectives may include, but are not limited to:

- Highlight Ocean monitoring opportunities offered by different types of sensors and technologies applied on submarine and underwater cables, and the potential uses of the acquired data;
- Briefly present the different sensing technologies that can be used to conduct Ocean observation with submarine cables, and their respective advantages and disadvantages;
- Present the practical requirements relating to deployment and maintenance of the cables as well as other pertinent practical aspects;
- Consider the environmental and social implications of deploying and using submarine cables for Ocean monitoring;
- Discuss the legal implications of using submarine cables for Ocean observing and data acquisition, as well as the sharing and use of the acquired data;
- Discuss the related maritime defence and security considerations linked to submarine cables, both in terms of infrastructure protection but also threat detection;
- Proposed research and policy recommendations to further the development of submarine cable technology and its use in Ocean observing.

3. Working Group Composition

Working Group Chair and co-Chair

The Working Group (WG) Chair and Co-Chair represent the WG and take responsibility for its deliverables.

Profile

The Working Group (WG) Chairs should have significant experience and expertise and be leading on the topic at national and/or European level. It is important that the Chair and Co-Chair have a big picture approach to ensure a focused and balanced view on the topic, and that they fully commit to facilitating the writing of this document.

Selection process

The Working Group (WG) Chair and Co-Chair will be selected as a result of a call for WG members' nominations issued by the European Marine Board Secretariat. The European Marine Board Secretariat in consultation with the ExCom, make the selection of the Chair from the pool of nominations received. A WG Co-Chair will be selected by the WG Chair with assistance from the EMB Secretariat.

Roles and responsibilities of Working Group Chairs

The Working Group (WG) Chair and co-Chair are responsible for ensuring the scientific quality of the WG output(s) and its timely delivery according to the WG Terms of Reference and as agreed at the kick-off meeting. The WG Chairs provide scientific leadership and act as the driving force for the WG activities with the support of a dedicated European Marine Board Science Officer who acts in the capacity of WG facilitator (see below). The mandates of the Chair and co-Chair are complimentary and the exact roles and

responsibilities can be agreed on a case-by-case basis. **The time contribution estimated for the Chair and co-Chair is 15 days per year per person** (this does not include time to travel to in-person meetings), considering the roles listed below (see Annex 3).

The WG Chairs (Chair primarily and co-Chair when the Chair is not available):

- Chair WG meetings, i.e. moderate discussions and ensure delivery of meeting outputs;
- Coordinate the scientific contributions to the document draft according to the objectives defined at the kick-off meeting;
- Maintain an overview of the content and quality of the various inputs and requests additional expertise if necessary;
- Ensure timely delivery of the WG document;
- Enhance the document's strategic impact by promoting WG activities and output at national and European levels; and
- Report uptake and dissemination of the publication to the EMB Secretariat.

Working Group Members

A Working Group of approximately 12 members is proposed.

Profile

The selected Working Group Members will preferably have a background and expertise in at least one of the following fields:

- Oceanography;
- Ocean observing;
- Marine geohazards;
- Acoustics;
- Optics;
- Cable and fibre sensing technology;
- Data processing and management;
- Marine ecology;
- Legal expertise, especially related to UNCLOS and BBNJ;
- Submarine cable industry expertise; and
- Maritime defence and security.

Working Group Member selection process

The Working Group (WG) experts will be selected as a result of a call for WG members' nominations issued by the European Marine Board Secretariat to the European Marine Board Member Organisations. WG Members are usually drawn from EMB Member organisations, although Delegates may also propose WG Members from relevant European projects and initiatives, industry and non-profit organisations if no internal candidates are available.

The co-Chairs will select the WG Members from the proposed nominations. If the Chair and co-Chair believe that external expertise are needed, they can propose additional experts, which have to be approved by the ExCom. Decisions on the composition of the WG are guided primarily on the basis of achieving the correct balance of expertise required to comprehensively address the topic at hand. When the expertise criterion has been exhausted, decisions between candidates can be made on the basis of ensuring a broad geographical representation and gender balance for the WG. Non-selection of some nominated candidates is therefore normal and bears no relation to the scientific excellence of candidates not selected.

Roles and responsibilities of Working Group Members

Working Group (WG) Members are responsible for ensuring the scientific quality of their inputs and their timely delivery according to the WG Terms of Reference. **The time contribution estimated for the Working Group Members is 7.5 days per year per person** (this does not include time to travel to in person meetings), considering the roles listed below (see Annex 3)**.**

WG Members:

- Prepare for and attend the WG meetings;
- Submit written contributions within deadlines agreed at the kick-off meeting;
- Be transparent about all uses of AI generated information, text and images in contributions (see Section 10 for further information);
- Respond to comments and submit revisions within specified deadlines;
- Provide the EMB Secretariat with images and figures, with appropriate copyright;
- Guide and adhere to the high-level strategic objectives of the publication;
- Promote the resulting publication at national level and European levels; and
- Report uptake and dissemination of the publication to the EMB Secretariat.

Engaging the wider community

During the course of the Working (WG), members may invite a selection of stakeholders or observers from the wider community to participate (e.g. from science, industry, policy, funding agencies).

Interaction with relevant international and European initiatives working in this field should be explored. This could be achieved through informal interactions during the writing process, through consultation and/or workshops held during the lifetime of the activity, by engaging key people as external reviewers, or by selecting several key experts to serve as members of the WG.

EMB Secretariat facilitation

The European Marine Board Executive Director is an *ex officio* Working Group (WG) manager. S/he nominates one or two Secretariat Science Officers to support and facilitate the WG.

The EMB Secretariat will coordinate this activity with the Chair and co-Chair. A dedicated EMB Science Officer will act in the capacity of facilitator and other EMB Secretariat staff may be involved depending on the specific topic for each WG activity.

- WG manager: *Sheila Heymans*, EMB Executive Director
- WG facilitator: *Paula Kellett*, Science Officer

4. Mode of Operation

Work programme

The work programme for the Working Group (WG) will consist of:

- One kick-off meeting and additional meetings as required (remote meetings via video conference or in-person, to be considered by the working group);
- Writing assignments;
- Regular email interactions and online progress meetings (as agreed by the WG);
- Editing to publication standard by the WG Chair/Co-Chair and EMB Secretariat;
- Revisions based on peer review comments (see section 5); and
- Final copy-editing and design by the EMB Secretariat and WG Chair /Co-Chair.

Support from the EMB Secretariat includes:

- Organisational support for WG meetings;
- Cost of all catering associated with WG meetings, including a WG dinner;
- Costs of publication (including design and printing) and dissemination of the document to relevant stakeholders;
- Writing and disseminate of meeting minutes, and maintenance of regular dialogue with the WG Chair and Co-Chair to ensure timely delivery of the document.
- Monitor and report the progress of the WG to EMB Board;
- Maintain the webpage for the WG; and
- Provide technical editing, graphic design and layout of the publication to guarantee the EMB style.

Note: WG Members and Chairs are not financially supported by the EMB (unless an extraordinary contribution is secured by one or more EMB Member Organisations). WG member participation (e.g. travel costs) is normally funded by their institution or the EMB member that proposed them for the WG. The establishment of a WG is for a limited duration and the WG will be disbanded by the Board when it has fulfilled its mandate.

General Data Protection Regulation (GDPR) policy for EMB Working Groups

Personal data for EMB Working Group (WG) Members and those involved in other EMB core activities is used for internal communication with the activity as well as external communication of the EMB activity via publications, the EMB website and EMB social media outlets.

For any new EMB activities, consent is sought at the kick-off of the activity to cover all relevant use and storage of personal data. The personal data of the working group members is retained beyond the end of the activity to enable follow-up communications for impact reporting and on related topics, and thus their data will continue to be stored, unless consent is later withdrawn. A template consent form can be found in Annex 1.

Reviewers are also contacted within the context of EMB activities. The template email they receive clearly outlines their right to act such that their input remains anonymous, in which case the reviewer would simply be listed as “Anonymous”. The reviewer will be informed of how and where their personal data will be stored. The consent of the reviewer will also be specifically sought for their personal data to be

used outside of any activities directly relating to their role as reviewer, using the template text included in this document.

The EMB privacy policy contains information about our compliance with GDPR (data protection law). In this document you can find how to send us a request to let you access your data that we have collected, request us to delete your data, correct any inaccuracies or restrict our processing of your data. Please contact us at info@marineboard.eu for more information or concerns. You have the right to lodge a complaint about the way we handle your data with Belgian Data Protection Authority.

5. Deliverables

The output of this Working Group (WG) is expected to be a Position Paper. EMB Position Papers are typically around 100 pages long and provide a detailed state-of-the-art and strategic direction for emerging topics.

The document will be peer-reviewed by a minimum of two external reviewers (ideally one European and one international) selected from proposals by the Working Group Members and will be coordinated by the EMB Secretariat. In accordance with the EMB procedures, the document will also be sent to EMB Member organisations for internal review and approval prior to finalization and publication.

The impact of the publication will be achieved *via* a targeted dissemination strategy as described below. WG Members will be required to make suggestions on how to reach end-user contacts and to contribute to the dissemination. Promotion of the document may include dedicated presentations at stakeholder events. WG Members will also be asked to notify the Secretariat of any dissemination activities or observed uptake / impact for up to two years following publication, for future impact reporting. A full outline of the decision-making procedure and system for working group operations can be found online[11].

6. Target Audience and Expected Impact

This specific publication targets the following stakeholders:

- International, European and national research funders;
- International, European and national policymakers;
- Ocean observing community;
- Relevant technology developers and owners;
- Legal experts related to UNCLOS and BBNJ;
- The international maritime defence and security community;
- The international disaster risk and reduction community;
- The telecommunication and submarine cable industry; and
- The European and international marine science community.

7. Communication and Dissemination Strategy

[11] https://www.marineboard.eu/emb-operations

The targeted dissemination strategy includes, but is not limited to:

- Developing infographics to communicate key concepts and main messages from the document;
- Collecting photographs and other graphics to include in the document, use social media, and for other communication activities;
- A dedicated (in person, online or both) launch event;
- A news release on the EMB website and shared with EMB Member organisations to share on their websites;
- Social media content throughout the WG lifetime, for the launch and as post-launch follow up;
- Dissemination of digital and printed versions of the document to relevant stakeholders; and
- Presentation of the document by WG members and EMB Secretariat at relevant national and European events.

8. Indicative Timetable

The Working Group (WG) activities are foreseen to start in early 2026 and continue for 18 months from kick-off. It is foreseen to publish the final document by summer 2027 which will include a dedicated launch event (in person, online or both) and electronic and hard copy dissemination to relevant stakeholders. The European Marine Board conduct impact reporting, based on feedback from WG members and wider stakeholders, for a period of up to two years following publication.

An indicative timetable and order of activities is presented below.

Tasks	2025			2026												2027					
	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Approval of ToR by EMB member organisations	■																				
Nominations of WG Members & Chairs	■	■	■																		
Appointment of WG Co-Chairs & Members			■	■	■																
Kick-off meeting						■															
Content drafting (incl. online meetings)							■	■	■	■	■	■	■	■	■	■					
Editing by EMB Secretariat													■	■	■	■					
Approval of draft text by WG members																■					
Internal and external review, and revisions																	■	■	■		
Design																				■	
Publication and dissemination																					■

9. References

Howe, B. M., Angove, M., Aucan, J., Barnes, C. R., Barros, J. S., Bayliff, N., Becker, N. C., Carrilho, F., Fouch, M. J., Fry, B., Jamelot, A., Janiszewski, H., Kong, L. S. L., Lentz, S., Luther, D. S., Marinaro, G., Matias, L. M., Rowe, C. A., Sakya, A. E., … Wilcock, W. (2022). SMART Subsea Cables for Observing the Earth and Ocean, Mitigating Environmental Hazards, and Supporting the Blue Economy. In *Frontiers in Earth Science* (Vol. 9). Frontiers Media S.A. https://doi.org/10.3389/feart.2021.775544

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You, Y. (2010). Harnessing telecoms cables for science. *Nature*, *466*(7307), 690–691. https://doi.org/10.1038/466690a

10. AI Disclaimer

The European Artificial Intelligence (AI) Act (EU Regulation 2024/1689) requires traceability and transparency in the use of AI. The European Marine Board AI Policy applies the requirements of the AI Act and establishes clear guidelines for AI use in EMB activities.

The EMB Secretariat will ask all Working Group members to disclose any text they have written where they have used AI, and which applications have been used. While EMB Working Groups can use generative AI in the process of drafting, this technology should only be used to improve the readability and language of the text. Replacement of key writing tasks such as producing scientific insights, creating a literature review, drawing scientific conclusions or providing recommendations by AI will not be accepted. If the Working Groups use this technology for improving the readability and language of text, it should only be done with human oversight and control, and all work should be reviewed and edited carefully. In addition, the EMB Secretariat will use AI text checking software (e.g. Quillbot, Grammarly) to scan all EMB draft documents to see how likely it is to have been generated using AI. If suspected AI generated text is found, the Secretariat will ask the authors to verify those statements with original sources e.g. academic literature/grey literature/policy documents.

Any use of AI and AI-assisted technologies has to be disclosed to the EMB Officer in charge of the Working Group, and will be clearly noted as a disclaimer in the publication together with the name of the AI system(s) used. The final decision on whether the text generated with the use of AI and AI-assisted technology is appropriate will be determined by the Chairs, with final approval of the EMB Secretariat.

The EMB Secretariat will also ask all Working Group members to be transparent about the use of any images etc. which have been generated using AI applications. Images generated using AI which appear in EMB documents should be clearly marked as such and should not perpetuate bias.

The following statement will be included in EMB documents that have been developed with the assistance of AI: Artificial Intelligence-powered tools XXX have been used to assist with the language editing of this document.

Annex 1: Consent form for Core Activities

EMB holds personal data for anyone involved in core EMB activities, including Working Groups.

The following personal data may be held by the EMB Secretariat:

- Name
- Title
- Job title
- Areas of expertise and research interests
- Previously held roles
- Institute
- Country
- Institutional email address
- Institutional postal address
- Institutional telephone number
  Photographs
- Video

This information is stored in a secure spreadsheet and folder locations, and only EMB Secretariat staff have access to this.

In accordance with the EMB Gender and Diversity Equity and Inclusion Plan[12], EMB is interested to understand more about the demographic of its Working Group Members. The following questions are optional. The information gathered from responses will be stored and used completely anonymously, for overview reporting at EMB Board level only. This form will be stored in a secure folder location, and only EMB Secretariat staff will have access to this.

How do you describe your current gender identity?

- Female / Woman
- Male / Man
- Non-binary
- Other
- Prefer not to answer

How do you identify?

- White
- Black

[12] https://www.marineboard.eu/gender-diversity

- Asian
- Mixed ethnicity
- Other
- Prefer not to answer

EMB may:

- Contact you regarding the EMB activity that you are directly involved with
- Contact you regarding other EMB activities
- Add you to the EMB stakeholder mailing list
- Make your name, institution and country publicly available on the EMB website, in EMB communications, e.g. presentations regarding the activity you are involved in, and in EMB publications
- Take your photograph during EMB activities and use these pictures in publications, on the EMB website and on EMB social media outlets
- Take video footage during EMB activities and use these pictures in publications, on the EMB website and on EMB social media outlets

The data held may be reviewed and revised by the subject, and consent for any or all of the above may be withdrawn at any time.

☐ Please tick this box to confirm that you understand the above, and that you give EMB permission to obtain, use and store your personal data as outlined above.

Name:

Date: