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An introduction to the 'Oceans and Society: Blue Planet' initiative

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ABSTRACT
We live on a blue planet, and Earth's waters benefit many sectors of society. The future of our blue planet is increasingly reliant on the services delivered by marine, coastal and inland waters and on the advancement of effective, evidence-based decisions on sustainable development. 'Oceans and Society: Blue Planet' is an initiative of the Group on Earth Observations (GEO) that aims to ensure the sustained development and use of ocean and coastal observations for the benefit of society. The initiative works to advance and exploit synergies among the many observational programmes devoted to ocean and coastal waters; to improve engagement with a variety of stakeholders for enhancing the timeliness, quality and range of information delivered; and to raise awareness of the societal benefits of ocean observations at the public and policy levels. This paper summarises the role of the initiative, current activities and considerations for future directions.

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Introduction

We live on a blue planet, and Earth's waters benefit many sectors of society. The future of our blue planet is increasingly dependent reliant on the services delivered by marine and coastal waters. For example, 10–12% of the world's population rely on fisheries and aquaculture for their livelihoods and over 80% of the world's trade is carried by sea (UNCTD 2017; FAO 2018). In recent years, the global community has prioritised the need for concerted action to maintain these services through the agreement on the United Nations (UN) Sustainable Development Goal (SDG) targeted at the oceans (SDG 14: Life Below Water) and the proclamation of a Decade of Ocean Sciences for Sustainable Development (2021–2030) (UNGA 2015; UNESCO 2017). Maintenance of these services relies on the advancement of effective, evidence-based decisions by governments, civil society and the private sector about sustainable development, ecosystem management, food security, ocean-resource utilisation and natural disasters. At the same time, the increasing global population and expanding economies have an impact on the health of the ocean through anthropogenic inputs and loadings of debris, waste, nutrients, and sundry other constituents into the ocean (e.g. Schmidt et al. 2017; Hurley et al. 2018). These inputs, coupled with climate change, are rapidly changing the heat content (Cheng et al. 2016; Zanna et al. 2019), chemistry of the ocean (Breitburg et al. 2018), and impacting marine and coastal ecosystems (Carstensen et al. 2011; Doney et al. 2012; Hewitt et al. 2016;

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Provencher et al. 2018; Seuront 2018; Dutkiewicz et al. 2019; Green et al. 2019).

Evidence-based decisions in the aquatic realm (marine, coastal and inland waters) need to be underpinned by the collection of physical, chemical and biological data about coastal and open-ocean areas through direct (or 'in situ') measurements and remote-sensing technologies, commonly referred to collectively as ocean and coastal observations. These observations are transformed into information products, ocean forecasts and services that can be used to create knowledge for effective, evidence-based management and policy decisions (Malone et al. 2014; Le Traon et al. 2019). For example, the implementation of the Sendai Framework for Disaster Risk Reduction requires ocean observations for early warning systems to allow people to prepare and mitigate against ocean-related hazards such as tsunamis, storm surges and extreme waves (UNISDR 2015; Arduino et al. 2017). The ocean has a significant impact on global climate patterns, and observations provide essential information for forecasting precipitation and drought, the source of replenishment of water supplies, and for climate events that can lead to public health concerns or changes in energy demand (Malone et al. 2010; Mendez-Lazaro et al. 2014; McCarthy et al. 2018).

There are key ocean observations that contribute to the Essential Climate Variables (ECVs) developed in support of the United Nations Framework Convention on Climate Change (UNFCCC) (GCOS 2016). Furthermore, per the Global Ocean Observing System (GOOS) Framework for Ocean Observing (Lindstrom et al. 2012), there have been significant recent efforts to articulate Essential Ocean Variables (EOVs) that address biology, ecology, and biogeochemistry in addition to physical ocean characteristics (Cai et al. 2015; Hayes et al. 2015; Constable et al. 2016; Cristini et al. 2016; Bax et al. 2018; Duarte et al. 2018). A further complement are the Essential Biodiversity Variables (EBVs) being developed by Marine Biodiversity Observation Network (MBON), a theme of the GEO Biodiversity Observation Network or GEO BON and a key partner of GEO Blue Planet (Navarro et al. 2017; Miloslavich et al. 2018; Muller-Karger et al. 2018). In addition, ocean observation of these variables helps improve predictions of longer-range forecasts of weather (Legler et al. 2015). Ocean biological and biodiversity observations are critical in monitoring the health of and changes to ocean and coastal ecosystems and biodiversity, and are required to gauge progress towards the Aichi biodiversity targets (Andrefouet et al. 2008; CBD 2010, 2014; Miloslavich et al. 2017). Ocean observations are also important in managing fisheries and aquaculture (Saitoh et al. 2011; Solanki et al. 2015; Hazen et al. 2018). More generally, ocean information and decision support tools are needed for sustainable management of the oceans and seas and sustainable development of the blue economy.

'Oceans and Society: Blue Planet' (denoted in the following as GEO Blue Planet) is an initiative of the Group on Earth Observations (GEO). Established in 2005, GEO is a partnership of more than 100 member countries and over 100 Participating Organizations. GEO envisions a future wherein decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations and information (GEO 2016). Together, the GEO community is creating a Global Earth Observation System of Systems (GEOSS) that will link Earth observation resources worldwide to measure and monitor our progress towards addressing societal challenges (GEO 2016). Following the adoption of the *Strategic Plan: Implementing GEOSS 2016–2025*, the GEO-XII Plenary requested that an enhanced legal standing be sought for the Group on Earth Observations (GEO) Secretariat, while maintaining its intergovernmental status. This has been achieved through the renewal of a Standing Agreement between the World Meteorological Organization (WMO), which hosts the Secretariat, and the Secretariat Host Nation (Switzerland). Switzerland has acknowledged the Standing Agreement with the WMO and confirmed that GEO and its Secretariat are covered by the Headquarters Agreement concluded between WMO and the Swiss Federal Council. The GEO Work Programme is the foundational document describing the nuts and bolts of activities contributed by the GEO community to supply the Earth observation data and information needed to address challenges across all of the important policy areas that governments, science and society face today. The GEO Work Programme serves two functions:

(1) It is used by GEO Members and Participating Organizations to agree on priorities and activities. By quantifying resources needed for the activities including and valuating the contributions committed, the GEO Work Programme provides a tool to match ambitions with available resources; and
(2) It provides an overview of the scope of GEO's plans, thus serving as a basis to help stakeholders align their contributions.

GEO Blue Planet operates as a network of ocean and coastal-observers, including data, product and information providers; social scientists, environmental scientists and economists; and, perhaps most importantly, user representatives from a variety of stakeholder groups, including international and regional organisations, NGOs, national institutes, universities and government agencies. The overall goal of the initiative is to ensure the sustained development and use of ocean and coastal observations for the benefit of society. In the value chain of ocean and coastal observation collection, transformation and use (Figure 1), GEO Blue Planet focuses on connecting stakeholders with available data and products, working with stakeholders to develop decision support tools and identifying additional information needs. This paper introduces GEO Blue Planet activities and the role of GEO Blue Planet in linking society with the ocean and coastal observation community.

Ocean and coastal information for societal benefit

GEO Blue Planet's mission is to advance and exploit synergies among the many observational programmes devoted to ocean and coastal waters; to improve engagement with a variety of stakeholders for enhancing the timeliness, quality and range of information delivered; and to raise awareness of the societal benefits of ocean observations at the public and policy levels. The initiative promotes, partners with and leads working groups, projects, communities and programmes that support the GEO Blue Planet mission.

Societal awareness

The ocean is a major source of food, transport, commerce and recreation, and is a large contributor to the global economy as well as sustaining individual livelihoods at the local and sub-regional levels. As such, it directly and indirectly supports a significant proportion of the global population. Many social and economic processes on land impact the ocean, (for example, the flows of nutrients, plastics, and chemical pollutants into the ocean, and the increased absorption of atmospheric carbon dioxide) while awareness of these impacts is generally very low. If people are not aware of the importance, as well as the vulnerabilities, of the ocean, they are even less likely to understand the impacts that ocean observations can have (and do have) on their everyday lives and how their actions impact the ocean. The scientific community needs, therefore, to work together to explain, in simple and meaningful terms, what ocean observations are, what types of products and services can be derived from them, and how they are essential for the health, wealth and well-being of humankind and the sustainability of our global civilisation and habitability of our planet. GEO Blue Planet works with ocean communicators to share ideas, expertise and experience, to improve communications and garner input to design proper science-based coastal and ocean observing systems, to address problems of societal relevance and

Figure 1. The value chain of ocean and coastal observation collection, transformation and use.

support for sustained ocean and coastal observations. In effect, GEO Blue Planet serves to link the science and research community with ocean users and society at large, and enable appropriate science-based solutions and provide scope and requirements for operational systems that address user needs in a sustained manner.

Bridging the gap between data providers and stakeholders

Large parts of society live, work and play on or near the ocean, as well as plan and prepare for impacts of ocean and coastal conditions that are often poorly understood. Ocean and coastal observations contribute data and information that helps us to understand complex and changing biological, chemical and physical conditions. While understanding ocean and coastal systems is important for scientists and society at large, the real value of the investment in ocean observations and derived product generation is the possibility that we can make better decisions based on what we observe. Ocean and coastal observations become useful if data are transformed to knowledge that forms the basis for better, or wiser decision making (Mackenzie et al. 2019). Conversely, it is also important that members of society understand the contribution of ocean and coastal observations to sustainable development. GEO Blue Planet recognises the importance and value of engaging with all institutions that play a role in converting ocean and coastal observations to meet the information needs of communities and stakeholders. After decades of Earth observation development, there is a realisation of the importance of meeting these needs in terms of societal benefit and sustainable development. Information that is co-produced with scientists and stakeholders has been demonstrated to lead to more concrete and effective outputs (Lemos and Morehouse 2005; Walter et al. 2007; Roux et al. 2010; Kirchhoff et al. 2013; Reed et al. 2014; Howarth and Monasterolo 2017). GEO Blue Planet works to share best practices for stakeholder engagement and co-develop decision support tools in order to support beneficial changes in policy and behaviour.

Understanding the decisions stakeholders are required to make and what information is required to support those decisions is a key focus of GEO Blue Planet. GEO Blue Planet supports regional workshops that bring together representatives of government, research institutions, industry and NGOs to assess the local needs in terms of ocean and coastal observation-based products and services and to plan the capacity development required for the development/hosting/maintenance and use of such services. GEO Blue Planet also makes understanding information needs and stakeholder priorities a focus of international GEO Blue Planet symposiums. These symposiums are held every one to three years in different regions. Previous symposiums took place in Brazil (2012), Australia (2015), the United States (2017) and France (2018). Through the organisation of the symposiums, GEO Blue Planet provides a valuable platform to bring together stakeholders and data producers and allow in depth two-way conversations about user requirements within the constraints (e.g. technical, and economic) of producers' capabilities. For example, a discussion between a user from the ocean energy sector with an ocean forecaster might focus on the user's spatial resolution requirement. When considered relative to the existing operational capabilities and challenges of increasing either the horizontal (and/or vertical) resolution of the forecast, the general requirement of the user for finer resolution can dictate the priorities for cost-effective investments and direction for future product development and improvement efforts.

Following discussions at the 2017 GEO Blue Planet Symposium, a GEO Blue Planet working group was initiated to develop an on-line portal summarising and clarifying the 'oceanscape' of organisations working in the realm of ocean and coastal information. The group has developed a data entry template for each organisation that will be included in the portal. This includes questions about organisation structure (type, geographical scope, members/countries involved, funding sources, etc.), vision/mission/objectives, and key areas of activity (e.g. data, products/services, capacity building etc.). Organisation representatives will be able to request an account to enter their own information. The portal will include: (a) a map with pins indicating the locations of the organisations' headquarters; (b) a list of organisations in alphabetical order; (c) a filter option, to display only certain types of organisation; (d) a keyword search function, to quickly find a specific organisation or to explore organisations working in a particular area; and, (e) a page for each organisation displaying key information and a URL to click through to the organisation's website. A future development of the website will include a relationships/connections functionality that will show how different organisations are related or working with one another. It is anticipated that the portal will be used by people within the ocean and coastal observing community looking for information on existing organisations and for potential collaborators, but also for people outside the community, such as government and industry users who are not familiar with (and possibly daunted by) the complexity of organisations working towards seemingly very similar objectives. In the long term, it is planned that ocean/coastal information products and services will also be included, and therefore the portal will serve as a robust and sustained interface between potential users and the providers of products and services.

Developing capacity

The ocean transcends national boundaries, is vast and challenging to access and as such, international collaboration is essential for oceanographic activities. Capacity building for the use of ocean observation data and information provides a larger pool of trained personnel, more representation at the world scale and fulfils demand for such personnel (Bax et al. 2018; Benson et al. 2018; Miloslavich et al. 2018). Capacity building in terms of data collection and analysis, infrastructure and availability and access to integrated data sets is also critical to ensure adequate monitoring of the marine environment on local, regional and global scales. Currently, there are geographical gaps in ocean observations in many parts of the world due to the imbalance in ocean observation capabilities (human resources and infrastructure/technology) (Koslow and Couture 2015; Legler et al. 2015; Bax et al. 2018). Capacity building requires at the very least two-way interaction between countries with different cultures, languages, indigenous knowledge, educational programmes, societal priorities and degrees of development, which is enhanced for example through exchange of personnel, knowledge and expertise between countries. Such exchanges are facilitated by international organisations such as the Partnership for the Observation of the Global Ocean (POGO), the Intergovernmental Oceanographic Commission (IOC) and the Scientific Committee on Oceanic Research (SCOR), among others, as well as national and binational programmes. Capacity building can be effective through the participation of scientists from developing countries in training programmes and research projects run in collaboration with developed countries. The GEO Blue Planet Initiative works to link existing capacity building efforts and share best practices for integrated and open access to data and products.

Increasing data discoverability, access and utilisation

Significant investment has been made by some nations in a range of ocean data, modelling and analysis at regional, national and global scales. Despite (or perhaps because of) the growing number of datasets and data portals, stakeholders continue to express that data access, discovery and use remains a challenge (CSIRO 2018; Plag & the workshop participants, 2018; Scarrott et al. 2018). The paradigm is changing from putting an onus on the user to individually and inefficiently locate and retrieve data on a piecemeal basis to one where data and information is collated in some manner; moving terabytes of data in a duplicative manner from place to place is no longer a viable or sensible approach. However, user needs vary at local, national and regional levels and this is reflected in the growing number of existing catalogues, archives, platforms, and portals. The challenge is to understand these different user requirements and provide a framework open to different type of users for transforming Earth observation data into information and ultimately actionable knowledge (Djavidnia 2018). To do this, it is crucial to engage with stakeholders and users at both policy and technical (operational) levels to: (a) understand their information needs and facilitate the mapping of data sets and derived products to their requirements; (b) strengthen, or where necessary, build, capacity to access existing datasets; (c) identify gaps and stream new requirements to the earth observation and implement as funding and capacity permits and; (d) put in place a continuous feedback process on user needs.

GEO Blue Planet works with data providers to increase data discoverability and integration of data sets including traditional geospatial data (e.g. management boundaries), time series monitoring data (e.g. coastal and ocean moorings), gridded and merged datasets (e.g. satellite remote sensing products) and complex multi-dimensional data cubes (e.g. ocean models). GEO Blue Planet is particularly focused on supporting the advent of systematic and regular provision of analysis ready and quality assured data.

Currently, finding observation-based solutions for decision-making is not trivial, but rather entails combining know-how and resources from many distributed sources. GEO is working towards establishing a Marine Knowledge Hub, which would represent a single repository with access to all data and documentation associated with Earth observation applications for sustainable management of the environment. The resources would include: (a) research papers and reports describing methods used and results; (b) software algorithms and cloud computing resources used for processing; (c) access to Earth observation (in situ, satellite remote sensing and modelling) data and output; and (d) the results. This information would be supplemented by a set of cloud computing services that store big datasets of Earth observation data, and which provide a set of Application Programming Interfaces (APIs) to allow access to cloud computing services. Additionally, a set of data services would also form part of the Knowledge Hub with APIs providing access to (1) authoritative, curated and validated in situ observations that support the different uses of EO; and (2) analysis-ready data (including multi-satellite datasets) from images freely available in repositories of space agencies or service providers. The Marine Knowledge Hub will place a special emphasis on identifying ways in which to lower the barriers for developing countries to, in an open-source environment, gain access to free cloud services and best practices for the processing and analysis of big Earth (marine) observation data for sustainable development.

Thematic activities

GEO Blue Planet promotes and supports real-life applications of observational data and the co-development of decision support tools around the ten themes presented in Figure 2. For example, GEO Blue Planet is currently working with IOCARIBE of IOC UNESCO, it's the GOOS Regional Alliance IOCARIBE-GOOS and other partners to develop a Multi-hazard Information and Forecasting system for the Wider Caribbean. The project is first focusing on the distribution and possible beaching of Sargassum seaweed and oil spills. These priorities were identified via stakeholder consultations, and will expand to include additional hazards as requested by stakeholders (IOC-UNESCO 2018; Plag & the workshop participants, 2018). The objective of this project is to implement a service that monitors, detects and provides timely forecasts to stakeholders (national and regional agencies, the fishers, the tourism industries, etc.) on coastal and marine-related hazards. The service will also provide an element of forecasting in order to be able to manage the risk and impact of such events through adequate and timely response measures. The system is being co-developed with current and potential users of and the relevant parties from the Earth observation community.

Another example is the relationship between GEO Blue Planet and the Marine Biodiveristy Network (MBON) of the GEO Biodiversity Observation Network (GEO BON). GEO Blue Planet works to help connect the MBON community to resource management practitioners and to policy makers that can benefit from information about the diversity, abundance, and distribution of life in the sea. Observation requirements developed through interactions with management practitioners and policy makers and how it is changing and applications in ecosystem and human health and economic sustainability.

To engage the global community of ocean observers and managers, GEO Blue Planet welcomes proposals for additional thematic working groups. Thematic working groups consist of communities within GEO Blue Planet that are working to share best practices and co-develop thematic decision support tools. GEO Blue currently has three thematic working groups: a working group on Earth observations for ecology and epidemiology water-associated diseases, a working group on Understanding Flooding on Reef-lined Island Coasts (UFORIC), and a working group on plastic pollution.

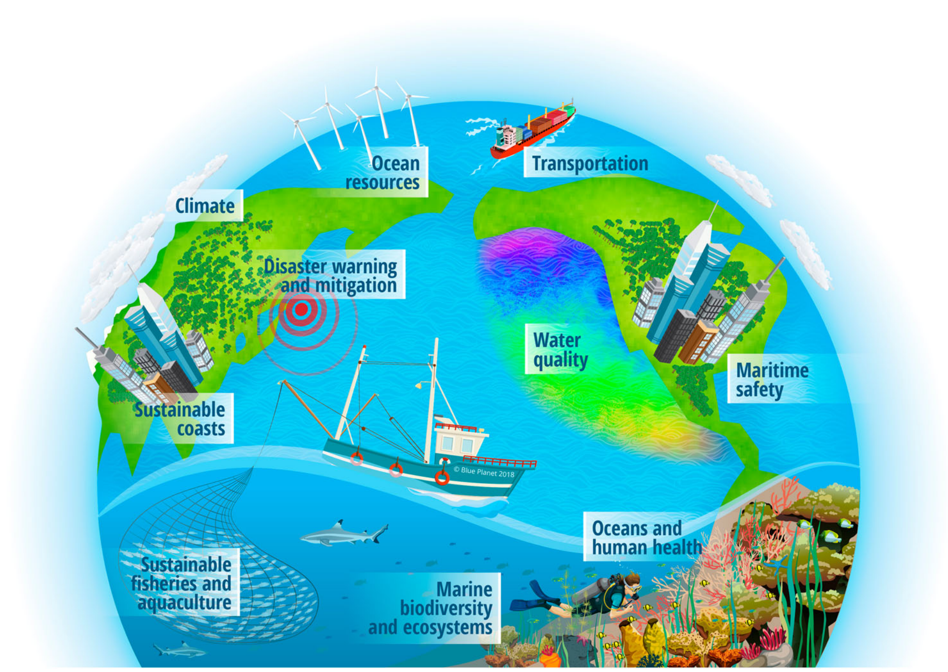

Figure 2. The GEO Blue Planet themes. Thematic activities relate to the three pillars of sustainable development – environmental protection, societal development and economic development.

The working group on water-associated diseases seeks to identify benefits, best practices of using Earth observations for surveillance of microbial pathogens to understand their ecology and epidemiology; to forecast and map high-risk areas of water-associated diseases; and to link with the user community. The working group will provide a forum to exchange useful information, share data and coordinate activities where feasible, to maximise benefits to society. The group is working collaboratively with the GEO Health Community of Practice, which focuses on the use of Earth observations to improve health decision-making, and the GEO AquaWatch Initiative, which focuses on developing and building the global capacity and utility of Earth Observation-derived water quality data, products and information to support water resources management and decision making.

The UFORIC working group is developing action plans to be used globally, regionally and nationally to help guide research and development activities related to understanding and predicting flooding along tropical coral reef-lined shorelines over the coming years. Activities of this working group include a project on the development of an Early Warning System for marine flooding for reef-lined islands. The aim of this project is to derive a product that provides the people living on tropical islands with timely warnings of impending marine flooding events.

GEO Blue Planet, together with partner organisations, is implementing a collaborative expert working group focusing on the mounting global challenge of plastic pollution (e.g. Nash 1992; Law and Annual 2017; Schmidt et al. 2017; Peeken et al. 2018; Villarrubia-Gomez et al. 2018) impacting the marine biosphere (e.g. Taylor et al. 2016; Nel et al. 2017; Green et al. 2019) and the food web (e.g. Provencher et al. 2018). There is a need for an international agreement on plastic pollution (Borrelle et al. 2017), and the development of such an agreement needs to be informed by Earth observations. Efforts to monitor and quantify the flow of plastics into the ocean and detect ocean plastics are evolving (e.g. Davaasuren et al. 2018; Garaba and Dierssen 2018). A workshop held on 26–27 November 2018 in Brest, France (see http://www.gstss.org/2018_Brest) brought together a wide range of societal agents engaged in ocean plastic pollution to initiate the collaborative working group.

More generally, the rapidly growing amount of marine debris challenges the health of the ocean. Recent disasters like the 2011 tsunami in Japan (e.g. Murray et al. 2018) and the 2018 Hurricane Michael have created a large amount of debris that is swept into the ocean, which adds to the continuous flow of debris from ocean traffic and rivers. Observing, quantifying and classifying marine debris are activities that urgently need to be coordinated and extended to ensure that societal stakeholders engaged in reducing this threat to ocean health have the evidence on which to base decisions and policy. The GEO Blue Planet led working group will initially focus on marine plastic pollution and then extend this to include all marine debris.

GEO Blue Planet also works to support partnerships with thematic activities within the GEO Work Programme including the Marine Biodiveristy Network (MBON) of the GEO Biodiversity Network (GEO BON). GEO Blue Planet works to connect the MBON community to resource management practitioners and policy makers that can benefit from information about changes in the diversity, abundance and distribution of life in the sea and provide guidance on their requirements for EBVs.

Sustainability agendas

Ensuring the sustainability of our oceans, coastal environments and coastal communities requires international collaboration. This is even more evident as we must consider the monitoring and reporting of ocean ecosystems which are beyond national (agreed or not) jurisdiction (i.e. EEZ waters).

GEO Blue Planet works to promote and support international activities related to global sustainability agendas including the UN 2030 Agenda and the Sendai Framework for Disaster Risk Reduction. GEO Blue Planet brings together partners from national, regional and global networks of in- situ, modelling and Earth observation from space involved in ocean and coastal observations in support of these agendas. It provides a platform to support co-development of services which respond to concrete end-user requirements, such as SDG indicator monitoring, management and reporting. GEO Blue Planet fosters the collaborations required to access and synthesise in-situ data on a global scale, and combine these with global Earth observation satellite data and models to provide global and regional products that can be used to monitor progress towards and achieve targets from global sustainability agendas.

As above, GEO Blue Planet is now playing a crucial role in supporting the UN 2030 Agenda for Sustainable Development. The 2030 Agenda has brought together Heads of State and Government and High Representatives in a joint plan of action to target areas of critical importance for humanity and the planet. 17 Sustainable Development Goals (SDGs) and 169 associated targets have been identified, many of these having direct relationship with the oceans and coasts (Singh et al., 2018).

Currently a large percentage of ocean-related SDG indicators are Tier III, i.e. they have no established methodology and standards or these are still being developed/tested (IAEG-SDGs 2016). While the SDG process puts emphasis on national reporting, ocean-related SDG targets and indicators are, by nature, transboundary and cannot solely be attributed to individual Member States; they require collaborative efforts. Hence the notion of national data is inadequate when applied to the ocean. In this context, ocean and coastal observation data is invaluable for monitoring and reporting of SDGs as it provides a consistent, synoptic perspective that can be leveraged in a cost-effective manner by end-users in developing as well as developed nations. Satellite sensors provide invaluable insight on physical, biological and biogeochemical ocean parameters at different spatial resolutions and temporal scales (hourly/daily to multi-annual), complementing in-situ measurements and modelling activity, including through contribution to data assimilation, and providing a nested global to basin-scale to regional to local ocean observing framework, which can be utilised to support monitoring and assessment of SDG indicators (Andries et al. 2018; Cheng et al. 2016). GEO Blue Planet works with UN agencies responsible for reporting on the SDGs to identify relevant data sets and products available to support reporting on the SDGs. GEO Blue Planet also works with stakeholders to identify information needs and information gaps for decisions related to sustainable development. For example, GEO Blue Planet is engaged in an effort to support the Caribbean Small Island Developing States in identifying and developing ocean and coastal information in support of their effort to implement the 2030 Agenda for Sustainable Development (Plag & the workshop participants, 2018).

GEO Blue Planet support for the Sendai Framework for Disaster Risk Reduction has to date focused on supporting the co-development of multi-hazard early warning systems in support of the Sendai Framework global target G: 'Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to people by 2030' (UNISDR 2015). Ongoing projects of relevance include the Multi-hazard Information and Alert system for the Wider Caribbean and the Early Warning System for marine flooding for reef-lined islands referenced previously.

Future directions and consideration

Success for GEO Blue Planet would mean routine, widespread and sustained utilisation of ocean observations and data products that support a rich suite of services, applications and research. These efforts in turn would provide diverse and valuable social and economic benefits, particularly for developing nations and transitioning economies.

Significant challenges remain toward realising this goal. Increasingly we are living in a data-rich but information-poor society. For much of the past decade the primary concern within the ocean data provider community has been ensuring the continuity of essential ocean observations. Presently the greater challenge is how to facilitate and expedite the extraction of fit-for-purpose information about the ocean and coasts in support of diverse end users. As such this will be a primary focus of GEO Blue Planet for the coming decade.

In this context, we also need to do better with respect to connecting existing and emerging global-scale frameworks and observing systems with local user needs. While simple in concept, the reality of accomplishing this is far more daunting. There are associated challenges of scalability, upward as well as downward, and technology transfer that urgently need to be addressed to maximise the return from existing regional and other pilot/prototype (e.g. research & development) activities.

Additionally, significant efforts are still required to build capacity by informing and training users as to existing ocean data and information products and their appropriate application. Data providers can accelerate this process through greater provision of fused, integrated data (multi-sensor satellite, in situ) products coupled with trans-boundary (land-sea-air) forecasts and predictions. This and other efforts that provide greater clarity, simplicity and transparency for users will prove invaluable and help break down barriers to more routine utilisation of ocean data and information products.

Toward this end, GEO Blue Planet will continue its efforts to better link data providers, intermediary service providers and end users. This includes improved coordination across data providers (e.g. the Global Ocean Observing System, the Committee on Earth Observation Satellites) to ensure that user requirements are satisfactorily addressed. Additionally, it will continue to facilitate and enhance communication with end-users and assist with the discovery and application of fit for purpose ocean data products and information by different user sectors and stakeholders. GEO Blue Planet recognises that policymaking is not always evidence-based, and this underlines the importance of connecting the broad public to applicable and useable scientific evidence.

GEO Blue Planet will promote the widespread adoption of best practices identified by the scientific community. It will also provide examples and demonstrations of successful integration and utilisation of ocean products for a variety of applications that other entities can hopefully emulate and help reduce their spin-up and implementation time, particularly through the sharing of valuable lessons learned. GEO Blue Planet will continue its effort to better link data providers and users. This includes data providers (e.g. GOOS, CEOS) as well as open ocean and coastal ocean analysis and forecasting centres (e.g. GODAE OceanView). Ultimately, it is the hope that these and other related efforts will help ensure the future is bright for our blue planet.

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