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METEOROLOGICAL SERVICES FOR MARINE OPERATIONS

Purpose of Document

The purpose of this document is to inform Members of the key activities and progress for meteorological services for marine operations since EC-68. For EC-69, there are no decisions related to marine services due to the impending Fifth Session of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM-5) in October 2017, where key decisions will be taken. These will then be presented to the WMO EC-70 and IOC EC-51 in 2018. Key activities and progress are outlined below.

JCOMM-5 Session and Associated Meetings

JCOMM-5 Overview

The fifth session of JCOMM will be held in Denpasar, Bali, Indonesia, from 25 to 29 October 2017. Prior to JCOMM-5 and at the same venue, there will be a 'Women in Marine Leadership' Workshop (21 to 22 October) and the Scientific and Technical Conference (TECO) "Toward an Integrated Met-ocean Monitoring, Forecasting and Service System" (23 to 24 October). The JCOMM Management Committee will meet on 30 October to finalize management matters related to the outcomes to the session and associated meetings. In keeping with the Memorandum of Understanding between WMO and IOC, and the fact that the previous JCOMM-4 was co-ordinated by the IOC, for this session, WMO is leading the coordination.

WMO recognizes with thanks the kind offer from the Government of Indonesia for hosting the above events, and notes that the related administrative process is under way.

Members are invited to make all necessary efforts to facilitate the participation of their experts in the JCOMM-5 and associated meetings. Members and partner organizations are also encouraged to provide financial and in-kind support to support their delegates and those from developing countries, if possible.

Overall expected outcomes of JCOMM-5 include:

- Highlights and achievements of the JCOMM-4 intersessional period;
- Actions planned for each Programme Area, plus cross-cutting areas;
- Change of the vocabulary to include 'information products and services';
- Governance arrangements to be confirmed;
- Identification of clear outputs where Members/Member States benefit;
- Improved path to information on the impacts of climate on ocean, and ocean on climate;
- Formation of new teams that will benefit the Members and Member States;
- Contribution of the ocean aspects within the Global Framework for Climate Services;
- Future vision for JCOMM.

Anticipated decisions at JCOMM-5

It is expected that the Services and Forecasting Systems Programme Area (SFPSA) will be restructured to ensure alignment to the WMO Service Delivery Strategy, compliance with the mandatory obligations of Safety of Life at Sea and the associated Worldwide Met-Ocean Information and Warning Service (WWMIWS), and emerging activities such as marine environmental emergency response, coastal services, and long-standing responsibilities on sea ice and waves. It is also expected that two new Expert Teams will be formed; for the Meteorological and Oceanographic Services within the WMO Information System (ET-MOWIS); and the Marine Environmental Emergency Responses (ET-MEER).

The restructuring also aims to strengthen the interaction with other supporting WMO and IOC Programmes, and activities by other partners (e.g. IMO, IHO).

Several WMO Technical Regulations (revised and/or new) will also be presented for approval by JCOMM, including:

- *Manual on Marine Meteorological Services* (WMO-No. 558) and *Guide on Marine Meteorological Services* (WMO-No. 471);
- WMO *Guide on Sea-Ice Information Services* (WMO-No. 574);
- Operational Ocean Forecasting Guide (no number yet)
- Marine contribution to the WMO *Manual on Global Data Processing Forecasting System (GDPFS)* (WMO-No. 485).

Noting that the WMO *Task Team for Marine Competency Requirements* – drawing on JCOMM expertise – completed their task through the approval of the marine competency framework at Cg-17, a new *Task Team for Marine Competency Implementation* is required to progress the next stages of competencies. The Terms of Reference and nominations for membership of the *new Task Team for Marine Competency Implementation (TT-MCI)* will be presented to JCOMM-5 for approval.

Communication of JCOMM (general) and marine services information to WMO Members and UNESCO-IOC Member States can be strengthened. In this regard, Terms of References for:

- JCOMM Focal Points per WMO Member;
- Marine Services Focal Point per WMO Member

will be presented for approval, noting that the WMO already has JCOMM Focal Points per WMO Member (without any Terms of Reference), and that IOC is also requesting JCOMM Focal Points per IOC Member State (and which has been agreed by JCOMM Management Committee).

WMO Marine Services Assessment

An ad hoc Working Group on Marine Services has been established by the Secretary-General following the discussions at Cg-17 to strengthen marine services. Decision 49 (EC-68) provided further direction to the Working Group. The results of their assessment will be considered by JCOMM-5 and reported to EC-70.

The draft report of the Working Group was submitted to the WMO Secretariat in March 2017 and the results are being considered in the context of WMO strategic planning to ensure the strengthening of WMO's ability to provide support to marine and coastal safety services. The draft Executive Summary and Recommendations are given in Annexes 1 and 2, respectively. Members are encouraged to provide the relevant support necessary for WMO to strengthen their marine and coastal safety services.

Coastal Inundation Forecasting Demonstration Project

Recalling the express need to improve the multi hazard early warning (MHEWS) of vulnerable coastal communities from coastal inundation hazards, and the fact that the Coastal Inundation Demonstration Forecasting Project (CIFDP) was established in 2009, the Commission for Hydrology (CHy) at its fifteenth session (December 2016), the JCOMM Management Committee at its twelfth session (November 2015) and the CIFDP Project Steering Group at its seventh meeting (February 2017) all agreed that the sustainability of the CIFDP, and the value of its remaining a 'demonstration' project needs to be examined.

An independent/external evaluation of the CIFDP has been recommended by the CHy and CIFPD Project Steering Group, in order to assess the strengths, room for improvement and ongoing sustainability of the projects beyond demonstration phase, and opening up opportunities for other countries to engage in a MHEWS for coastal inundation.

Members are encouraged to consider offering funding to support this independent evaluation, to be carried out in 2017, with the expectation that results will be reported to CHy, JCOMM and WMO in 2018.

UN Ocean Conference

A high-level United Nations Conference to Support the Implementation of Sustainable Development Goal 14, "Conserve and sustainably use the oceans, seas and marine resources for sustainable development", will be convened at United Nations Headquarters in New York from 5 to 9 June 2017, co-hosted by the Governments of Fiji and Sweden (https://oceanconference.un.org/).

The Conference will provide an excellent opportunity for the WMO community to demonstrate the contribution of NMHSs and related agencies to support sustainable development, the blue economy and safety of people at sea and in coastal zones vulnerable to marine hazards, and the Secretariat has prepared a series of statements (Annex 3) as contribution to the "Call for Action" and the concept papers that will inform the Conference, focusing on marine services, observations and research

Members are encouraged to make all necessary efforts for participation of their experts in the Conference. Members are also urged to communicate with their country's delegation to the Conference to ensure that the WMO messages and Member's priorities are reflected in the statements and interventions to the final "Call for Action" as outcome of the conference.

El Niño Information System

There is a recognized need for WMO to strengthen its role in providing robust observations, data and products for improving early warning of El Niño events and impacts. Responding to this need, WMO – through collaboration between relevant Commissions (JCOMM, CCl, CBS, and CAS) - is determining the best way to strengthen the El Niño Information System to ensure that improved support is provided to Members.

Members are urged to support this effort, which will help advance early warning of seasonal and sub-seasonal impacts from the El Niño and La Niña effects, in an effort to improve resilience and adaptation strategies by affected communities.

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Annexes: 3

ANNEX 1

Ad Hoc Working Group for Marine Services

Marine Services Assessment Report (draft): Executive Summary

With over 90% of world trade carried by the international shipping industry, it is easy to see why disruptions to this global supply chain from the effects of marine weather are a key agenda item for Governments and International agencies. The value of trade passing through sea ports is $4 trillion USD every year. Marine weather services provide safety and efficiency information to aid decision making on the bridge and within operations centres.

Marine services don't just contribute to shipping, they also provide essential information to coastal communities for transport, safety and environmental management. Population trends and changing climate conditions have increased the vulnerability of coastal populations and infrastructure to the effects of weather and ocean.

The assessment report proposes the following high level recommendations:

(a) That WMO incorporates a marine priority into the next Strategic Plan;
(b) That WMO increases the resources for enabling marine service activities.

These high level recommendations are in recognition of the assessment report findings that MMOP has taken on additional responsibilities since 2008 in addition to its core responsibilities for regulation of Maritime Safety Services. Evidence from maritime safety regulatory partners (IMO and IHO) has highlighted that WMO has not been seen to be engaging and improving the Worldwide Met-Ocean Information and Warning Service (WWMIWS), or other Safety of Life at Sea (SOLAS) matters as well as it could be. Members have also expressed a requirement for more support from WMO for developing and strengthening national marine services (including coastal).

The assessment report proposes that WMO approves the instigation of a second phase task to develop a marine services strategy and implementation plan.

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ANNEX 2

Ad Hoc Working Group for Marine Services

Marine Services Assessment Report (draft): Recommendations

In the context of the high level programme outcome, stated in the Introduction of the Marine Services Assessment Report:

For WMO to support the National Hydrological and Meteorological Services (NHMSs) role as the authoritative agency for marine meteorological safety information and services in order to improve; safety and health, environmental benefits, security and socio-economic benefits in the marine environment to support; mariners, safety/security agencies, and economic sectors in making informed decisions related to marine meteorological information.

Having assessed the current activities and resources of the marine safety services at WMO, the Ad-Hoc Working Group recommends the following high level recommendations:

(a) Request Marine Services as a Priority at WMO (particularly addressing the needs of Regional Associations/regional needs);

(b) Acknowledge that Marine services have a responsibility to deliver on both regulatory and non-regulatory activities;

(c) WMO accepts the analysis of the Ad Hoc Working Group on the current activities and emerging priorities, and further accepts the Assessment Group's recommendation for re-basing the budget for more activities and adding extra staff to increase the WMO's capacity to meet its marine regulatory responsibilities and undertake the new strategic priorities;

(d) On the assumption that this Scenario is accepted, WMO should develop a Marine Services Implementation Plan to guide the future development of the marine services activities at WMO.

In relation to the request for a marine priority, the Marine Assessment Working Group presents the request below.

The Marine Assessment Working Group request a marine services priority in the next session, given:

- The request at Cg-17 by the President and Members for a renewed focus on marine services;
- An increasing global population (especially urban and coastal, with 40% of the global population currently living within 100km of the coast);
- An increasing use of the coastal and marine area through increased transportation (industry and leisure);
- Increased risk exposure in the marine environment (e.g. new shipping in the Arctic area with melting sea-ice, increasing trend in the proportion of shipping losses related to weather);
- The emerging blue economy (fourfold increase in last 40 years);
- Dependency on maritime transport to contribute to the global supply chain (more than 90% of world trade is delivered by sea);
- Increased storminess in a changing climate and subsequent impacts on people, infrastructure and maritime operations at sea and on the coast;
- Increased focus on SIDS and Polar regions, both of which rely on marine services for safety and sustainability;
- Global interest in environmental health and food security;

- The existing international global frameworks that are driving global priorities, and which marine is inherent in (e.g. Sendai, SDGs, SAMOA Pathway for SIDS, etc.).

The Marine Assessment Working Group proposes the Marine Services Priority to:

- Enhance the ability of NMHSs to provide meteorological service in support of protecting lives and property at sea and on the coast, and to ensure efficient and environmentally responsible maritime operations, through:
  - Acknowledging WMOs obligation to meet the UN Convention for Safety of Life at Sea (SOLAS), and supporting the operations of the WWMIWS (as per IMO Assembly resolution 1051/A29);
  - Turning scientific research and development into marine services (based on international obligation and client needs) , maximizing opportunities and overcoming challenges, for example associated with the GMDSS Review, and introduction of potential e-navigation services;
  - Ensuring continual quality of service through full and proper implementation of quality management systems, marine meteorological personnel competency and qualifications requirements;
  - Enhancing capabilities of Members, through consultation with partners, to support and strengthen the sustainability of maritime and coastal safety services for SIDS and LDCs; services in support of DRR (e.g. early warning of coastal inundation), and reduction of SAR (Search and Rescue) and environmental emergencies (e.g. Oil spills), and investigation of cost recovery mechanisms (as referenced in Cg-17);
  - Promoting the sharing, integration and interoperability of observations and marine meteorological data in order to improve seamless use of this data for marine forecasts, warning and other products;
- Reaffirm to the National Meteorological and Hydrological Services (NMHSs) their role as the authoritative agency in Members for marine safety services;
- To achieve the first two points, enhancing the relationship with partners (e.g. governmental, intergovernmental and private), regional associations, JCOMM and other technical commissions.

More specific recommendations from the Marine Assessment Working Group include:

- To move forward, WMO needs to position itself as the authoritative voice for marine safety information service and assist members in this regard. In relation to this, WMO also needs to encourage partners to be more inclusive of WMO's role in the regulatory framework;
- WMO needs to consider a framework for GDPFS and MEER, in the context of the marine services;
- WMO to encourage Members to establish marine focal points for their marine activities for better coordination of marine safety services;
- WMO to encourage IMO to establish a marine meteorology panel (similar to the Panel coordinated by ICAO for aviation meteorological services) that acts as an advisory board of industry leaders and other international marine stakeholder for user requirements and marine services;
- WMO Marine Services to have a more focused engagement with internal WMO colleagues and other technical commissions (beyond JCOMM), to ensure that marine issues are elevated, recognized and included within the broad range WMO activities (e.g. MHEWS, DRR, GFCS, Hydrology);
- In line with the recommended Scenario for rebasing the budget and an assumption of appropriate resources, WMO Marine Services should have a more focused engagement strategy with external partners, for annual review, including working closely with:
  - IMO/IHO;
  - IOC;
  - Regional associations;

- WMO should develop more visible plans for capability development of Member States; implementation of Quality Management; and the Marine Forecaster Competency Framework;
- WMO, IOC and other relevant agencies (e.g. IMO-FAO-DOALOS) to consider ways in which data buoy vandalism can be reduced, particularly through capacity development initiatives that raise awareness of the importance and value of marine observations, data management and services for societal and economic benefit;
- WMO Secretariat to work with JCOMM Management prior to each JCOMM session to consider rationalizing the Expert Teams related to marine safety services, thereby keeping up with progress and emerging issues;
- With respect to JCOMM, the JCOMM Management Committee, WMO and IOC should ensure that their secretariat support is optimally provided, and well-coordinated with a clear structure whilst avoiding duplication of efforts;
- A more permanent solution for management of, and a long-term plan to sustain JCOMMOPS be developed as soon as possible;
- A next step that the same process of assessment also happens for marine observations in MMOP, and an assessment of the overall marine activities (outside of MMOP) for WMO;
- From this recommended subsequent assessment, WMO needs to consider how to better coordinate all the disparate marine activities in WMO (for example, a 'marine platform' that might cover all marine activities in WMO);
- Encourage WMO to be consistent with their terms to cover 'marine' – including clarification of the terms 'water', 'hydrology' and 'hydrometeorology', within which the term 'marine' is usually included. Consider the word 'marine' being used in its own right.

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ANNEX 3

UN OCEAN CONFERENCE: WMO STATEMENT
CONTRIBUTION BY THE WORLD METEOROLOGICAL ORGANIZATION TO THE CONCEPT PAPERS FOR THE PARTNERSHIP DIALOGUES OF THE OCEAN CONFERENCE 2017 TO IMPLEMENT SDG 14

Background: the ocean, the atmosphere and the role of the World Meteorological Organization

Covering some 70 per cent of the Earth's surface and storing over 90 per cent of the extra heat generated by humanity's carbon emissions, the ocean is a major driver of the world's weather and climate. The ocean is also a major driver of the global economy, carrying more than 90 per cent of world trade and sustaining the 40 per cent of humanity that lives within 100 km of the coast. Recognizing this, national weather agencies and researchers under the umbrella of the World Meteorological Organization (WMO) regularly monitor the ocean and model how it interacts with the atmosphere and cryosphere. These efforts support the delivery of disaster risk reduction and marine services for coastal management and safety at sea, particularly in areas with vulnerable coastal communities. They also improve our understanding of the physical processes that affect ecosystems and conservation efforts. Today, the growing impacts of climate change are making oceanic and atmospheric observations, research and services more critical than ever before, especially in regions particularly affected by climate change impacts, such as Small Island Developing States and the Arctic.

Key concepts recommended for insertion in paragraph (l) of the zero draft of 9 March 2017

Recognizing both the key role of the oceans in our climate system as well as the detrimental effects of increased CO_2 and other greenhouse gas levels in the atmosphere on oceanic systems – such as ocean warming, decline of sea ice, sea level rise, ocean acidification, increased storminess, high waves, coastal erosion and coral reef bleaching – and associated socioeconomic impacts, develop effective adaptation and mitigation measures and ensure the implementation of the relevant obligations and commitments.

Specific contributions to the concept papers for the partnership dialogues

1. Addressing marine pollution

Status and trends

The atmosphere is the most important pathway for natural and anthropogenic chemicals to enter the global environment. When nutrients that limit primary production in large areas of the ocean (namely nitrogen, iron, and phosphorous) enter sea water, they have a fertilizing effect that influences marine biological productivity and biogeochemistry as well as the carbon cycle. While anthropogenic reactive nitrogen entering the ocean via rivers is important in coastal areas, atmospheric deposition is the primary mechanism by which this land-based nitrogen reaches the open ocean. Although most of the atmospheric nitrogen is inorganic (nitrate, ammonia), it is estimated that about 20-25% of the total that is deposited is organic nitrogen. Anthropogenic inputs of nitrogen also lead to an increase in overall ocean CO_2 uptake. The resulting reduction in climate change forcing is offset to a small extent by an increase in ocean emissions of N_2O (a powerful greenhouse gas). In the case of iron and phosphorous, much of what is input to the ocean originates from atmospheric mineral particles such as desert dust and volcanic ash.

Challenges and opportunities

In order to better characterize the magnitude of the atmospheric input of these substances into the ocean, the following actions are needed:

- Chemical pollutants and sand and dust originating from land-based sources need to be more comprehensively monitored and their interaction with the ocean and marine life more fully studied;
- Expanded observations of the atmospheric deposition of nutrients (including organic nitrogen and ammonia, organic and inorganic phosphorous) and aerosol composition and concentrations to coastal and open ocean sites in order to properly characterize the magnitude of continental outflow and input into the oceans as well as the biogeochemical cycling of these nutrients;
- Forecast models should be improved to complement observations and contribute to the understanding of the transport and deposition of mineral dust to the oceans.

2. Managing, protecting, conserving and restoring marine and coastal ecosystems

Status and trends

The Arctic is the site of dramatic and unprecedented warming. This regional warming contributes to sea level rise, affects weather patterns around the world and threatens to trigger further changes in the global climate system. The rate of change is challenging the current scientific capacity to monitor and predict what is becoming a journey into uncharted territory. While global temperatures continue to rise, with 2016 confirmed as the warmest year on record (more than 1° C above pre-industrial levels), the Arctic as a whole is warming at least twice as fast as the world average, and in places even faster. The unprecedented warming and loss of sea ice are already affecting Arctic marine ecosystems, including fisheries.

Challenges and opportunities

Shipping activity has expanded, and regular journeys through the Arctic are a real possibility by the middle of the century. The expected increase in traffic and activity comes with its own share of risks. Ice-laden polar seas are challenging and dangerous to navigate, whilst any oil spills could be catastrophic. Ocean acidification (which is more pronounced in polar oceans) is also predicted to have a detrimental effect. The Arctic and Antarctic are the world's most poorly observed regions, even though they are sometimes on the doorstep of densely populated areas. Moreover our weather and climate models and forecasting systems are not designed to simulate the extraordinary environmental conditions prevailing at the poles.

Existing partnerships

- Year of Polar Prediction: The World Meteorological Organization, in partnership with global partners, has launched the Year of Polar Prediction (2017-2019) to bring scientists together from around the world to accelerate and coordinate international cooperation and research, enhance observations and boost collective knowledge. The science and technology improvements, developed under the Year of Polar Prediction umbrella, will be the foundation of the future observational network and predictive systems in Polar Regions. To address these challenges:

    - Coordinated and adequately funded observation networks are crucial, particularly in data-sparse regions such as the polar oceans, to improve understanding and predictions of weather, climate and ocean conditions;
    - Weather and climate forecasting and warnings services based on marine meteorological data should be strengthened in polar regions to ensure the safety of

ships and lives at sea and to optimize navigation routes including reducing environmental risks.

http://www.polarprediction.net/yopp/
https://oceanconference.un.org/commitments/?id=14082

- Assessing the state of marine geoengineering: a comprehensive assessment of the state of knowledge, science capacity and understanding of information gaps in marine geoengineering and identification of appropriate research to address these gaps (GESAMP WG 41, WMO, IMO, IOC/UNESCO, IPCC, WCRP and other relevant international, academic and science bodies).

3. Minimizing and addressing ocean acidification

Status and trends

The ocean currently absorbs one fourth of anthropogenic CO_2 emissions. Enhanced CO_2 uptake affects seawater acidity. The current rate of ocean acidification appears unprecedented at least over the last 300 million years, and projections show it will continue to accelerate at least until mid-century. Globally averaged surface CO_2 reached new highs in 2015 at 400.0±0.1 ppm. This value constitutes 144% of pre-industrial (before 1750) levels. The increase of CO_2 from 2014 to 2015 was larger than that observed from 2013 to 2014 and of the average annual increase over the past 10 years. The El Niño event in 2015 contributed to the increased growth rate through complex two-way interactions between climate change and the carbon cycle.

The extra heat that oceans absorb due to increased atmospheric levels of greenhouse gases also directly affects ecosystems. Fisheries are starting to shift away from the equator and towards the poles, while many coral reefs are experiencing major bleaching events. Further damage to reefs and other life forms is caused by chemical pollutants and sand and dust that enter the ocean from the atmosphere.

Challenges and opportunities

The enormous amount of energy contained in the upper ocean creates the world's most powerful and destructive storms, known variously as cyclones, typhoons and hurricanes. Climate change is expected to influence the frequency and intensity of these events, and it is clearly undermining the resilience of natural barriers such as coral reefs, barrier islands, mangroves and wetlands. More storms and weaker defenses increase the vulnerability of coastal communities and assets to the impacts of marine weather.

- CO_2 observations from long-term stations, together with surface and interior ocean measurements from ships, need to be sustained and extended;
- Better information on trends in ocean heat content, measured both vertically from the surface to deep-sea waters and horizontally from the poles to the equator, is needed to inform policy-making on climate adaptation and resilience, fisheries, coastal management and related issues.

Existing partnerships

- Integrated Greenhouse Gases Information System (IG3IS): an independent information system to help countries to improve the quality and confidence in national GHG emission inventories. This will be achieved by joining atmospheric observations and inverse modeling techniques – the "top-down" – with spatially and temporally explicit emission inventory data – the "bottom-up". The combination of these data sources will better inform emission reduction policies and measures.
  http://www.wmo.int/pages/prog/arep/gaw/ghg/IG3IS-info.html

Possible areas for new partnerships

Building on existing efforts, the following new partnerships could be promoted:

- The United Nations system can assist States to strengthen the resilience of coastal communities that are vulnerable to tropical cyclones, associated storm surges and other extreme events and support their climate change adaptation strategies, including through multi-hazard impact-based forecast and warning services (WMO, IOC/UNESCO, UNISDR);
- The United Nations and its specialized agencies should enhance the assistance they provide to States for improving the observation, coastal bathymetric data, modelling and forecasting of extreme weather events and the development of multi-hazard early warning systems and risk management strategies (WMO, IOC/UNESCO, IMO, IHO, UNISDR).

4. Increasing economic benefits to SIDS and LDCs and providing access for small-scale artisanal fishers to marine resources and markets

Status and trends

Small Island Developing States are particularly vulnerable to climate impacts such as sea-level rise, droughts, floods, coastal surges, and typhoons (also known as hurricanes and cyclones). Climate impacts are also affecting marine ecosystems that provide natural defenses against marine hazards and marine living resources; this in turn affects important economic sectors such as tourism and fisheries. Partnerships that address in a more integrated way the resilience of Small Island Developing States to climate change and integrated ecosystem management can facilitate addressing these challenges in contexts where technical resources may be limited due to isolation and small population bases.

Existing partnerships

- Global Framework for Climate Services for SIDS (GFCS-SIDS): Small island developing States and their partners collaborate on investing in and developing stronger weather and climate services for reducing disaster risk, strengthening climate resilience and adaptation and supporting sustainable development (WMO, WFP, FAO, UNDP, WHO, WB, UNESCO, IFRC, UNISDR, IUCN, ACS, CMO, CIMH, CDEMA, CCCCC and other partners); https://sustainabledevelopment.un.org/partnership/?p=7339
- International Network for Multi-Hazard Early Warning Systems (IN - MHEWS): Multi-hazard warning systems should be strengthened or introduced in Small Island Developing States to protect life and property from coastal hazards in the most efficient and effective manner possible (for example, coastal inundation forecasting and early warning and safety of fishing boats) (WMO, WHO, UNDP, IOC/UNESCO, UNESCAP, UNISDR, UNOOSA/UN - SPIDER, IFRC, ITU, GFZ, and GIZ). http://www.wmo.int/pages/prog/drr/documents/IN-MHEWS/2016.06.07%20-%20IN-MHEWS%20Concept%20Paper_clean.docx

Possible areas for new partnerships

Building on existing efforts, the following new partnerships could be promoted:

- Strategic Information and Warnings to the UN system: The United Nations Operations and Crisis Centre should be supported on crisis management and humanitarian issues related to marine and coastal natural disasters through the establishment of a common technical platform with the provision of impact-related products, information and their interpretation, particularly for vulnerable small island developing States (UNOCC, WMO, other UN partners);

- Global Meteo-Alarm System: Risk-informed warnings disseminated by competent national authorities for the most vulnerable places and populations with high exposure in extreme weather and climate conditions should be aggregated and scaled-up into a global alarm system covering ocean and continental areas for building resilience in the fields of maritime safety and sustainable coastal development (WMO, IOC/UNESCO, UNISDR).

5. Increasing scientific knowledge, and developing research capacity and transfer of marine technology

Status and trends

Because the ocean is a global common, strong international coordination is needed to ensure regular and sustained observation. Under the umbrella of intergovernmental organizations, global observing systems coordinate observations of the physical, chemical and biological parameters of the ocean through an integrated observing system of satellites, ships and moored and autonomous platforms. Technological advances in telecommunications, autonomous platforms and new sensors are revolutionizing our ability to systematically monitor the ocean and thus understand its role in weather and climate. In the past decade, profiling floats have enabled us to go below the surface and systematically monitor the upper layers of the ocean for the first time.

Challenges and opportunities

In the coming years, new technologies will enable us to systematically observe the deep ocean, including where the ocean is covered by ice. They will also improve our ability to monitor chemical and biological variables relevant to issues of ocean health, such as ocean acidification. The need for adapting to climate change in coastal regions and islands and for supporting climate-sensitive sectors (fisheries, coastal cities and ports, tourism, etc.) will require the development of information products and services based on climate predictions and the exchange of climate-relevant coastal data, in particular on sea levels, waves and storm surges. WMO Regional Climate Centres and Regional Climate Outlook Forums use this growing knowledge to produce consensus seasonal climate forecasts.

- Vast stretches of the ocean are still understudied. More long-term, sustained observations are needed for gaining a better understanding of natural and human-induced changes in the marine environment;
- To expand the number of countries that can contribute to global ocean observations it is necessary to facilitate the transfer of manuals, guidelines, observation instruments, computer equipment and software, technical skills and scientific expertise to developing countries;
- The free and unrestricted exchange of oceanographic data, including climate data relevant for climate services, should be promoted and facilitated by internationally agreed policies and protocols.

Possible areas for new partnerships

Building on existing efforts, the following new partnership could be promoted:

- El Niño/Southern Oscillation Information System: improved monitoring of the ocean and atmosphere combined with an enhanced scientific understanding of the Earth system should be promoted to increasingly enable scientists to predict the El Niño/Southern Oscillation and other ocean oscillations – and thus the climate and weather.

6. Enhancing the conservation and sustainable use of oceans and their resources by implementing international law as reflected in the United Nations Convention on the Law of the Sea

Navigational warning services based on marine meteorological data play a critical role for the safety of ships and lives at sea and the optimization of navigation routes in implementation of legal instruments such as the International Convention on the Safety of Life at Sea 1974.

Possible areas for new partnerships

Building on existing efforts, the following new partnership could be promoted.

- Fostering the collection and sharing of bathymetric data: ensuring the bathymetric measurements are taken as a regular observation along with met ocean requirements to improve capacity for modelling and forecasting of both deep ocean and coastal zones (WMO, IHO, IMO, IOC/UNESCO).

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