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WEATHER CLIMATE WATER
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World Meteorological Organization
Organisation météorologique mondiale
Organización Meteorológica Mundial
Всемирная метеорологическая организация
المنظمة العالمية للأرصاد الجوية
世界气象组织

Secrétariat
7 bis, avenue de la Paix – Case postale 2300
CH 1211 Genève 2 – Suisse
Tél.: +41 (0) 22 730 81 11
Fax: +41 (0) 22 730 81 81
wmo@wmo.int – public.wmo.int

KEY MESSAGES BY THE WORLD METEOROLOGICAL ORGANIZATION AS A CONTRIBUTION TO THE CALL FOR ACTION 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 marine services for coastal management and safety at sea. 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 messages on specific targets of SDG 14

a) Target 14.1: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution

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. 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**

b) Target 14.2: By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans [addressing also changes in the Arctic]

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.

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.

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.**
- **Navigational warning services based on marine meteorological data should be strengthened in the Arctic to ensure the safety of ships and lives at sea and to optimize navigation routes including reducing environmental risks.**

c) Target 14.3: Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels [addressing also other marine hazards due to climate change]

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.

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.**
- **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.**
- **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.**

g) Target 14.7: By 2030, increase the economic benefits to small island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism [addressing also weather and climate hazards]

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.

- **Small island developing States and their partners should collaborate on investing in and developing stronger weather and climate services for reducing disaster risk, strengthening climate resilience and adaptation and supporting sustainable development.**
- **Multi-hazard warning systems should be strengthened or introduced in Small Island Developing States to protect life and property in the most efficient and effective manner possible.**

h) Target 14.a: Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries

Because the ocean is a global commons, 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.

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.**
- **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.**
- **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.**