WEATHER CLIMATE WATER

WORLD METEOROLOGICAL ORGANIZATION

Ocean, climate and weather: the role of the World Meteorological Organization

When it comes to the weather, most of us think only about what is happening in the atmosphere. If we ignore the ocean, however, we miss a big piece of the picture: covering some 70 per cent of the Earth's surface, 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 regularly monitor the ocean, model how it affects the atmosphere and deliver marine services to support coastal management and safety at sea. Today, the growing impacts of climate change are making ocean observations, research and services more critical than ever before.

Ensuring safety at sea and on land

The World Meteorological Organization (WMO) collaborates with the International Maritime Organization to provide standardized information, forecasts and warnings to ensure the safety of life and property at sea. This increasingly includes disseminating maritime safety information for the Arctic, where melting sea ice is boosting marine traffic. WMO works to improve search and rescue operations and emergency responses to environmental hazards such as oil and chemical spills and radionuclide fallout. It also supports the efforts of national weather agencies to deliver forecasts and warnings to protect coastal and inland communities from hazards such as ocean-generated storms and related storm surges, coastal flooding and high winds. Developing multi-hazard early warning systems for addressing coastal inundation is now a high priority.

The enormous amount of energy captured by the ocean creates the world's most powerful and destructive storms, known variously as cyclones, typhoons and hurricanes. WMO's tropical cyclone Regional Specialized Meteorological Centres and Tropical Cyclone Warning Centres facilitate international collaboration and the sharing of best practices (they also decide on the names of each year's storms to improve coordination and the clarity of warnings).

Rising sea levels can damage freshwater supplies and worsen storms and coastal inundation. Better projections of how storm patterns will change, polar ice sheets melt

OOCL BELGIUM

How the ocean shapes weather and climate

The ocean's tight linkage with the atmosphere makes understanding its behaviour vital for forecasting weather and climate conditions. The ocean absorbs most of the solar energy reaching the Earth; because the Equator receives much more solar energy than do the Poles, enormous horizontal and vertical ocean currents form and circulate this heat around the planet. Some of these currents carry heat for thousands of kilometres before releasing much of it back into the atmosphere.

Another key interaction is that, because the ocean warms and cools more slowly than the atmosphere, coastal weather tends to be more moderate than continental weather, with fewer hot and cold extremes. Evaporation from the ocean, especially in the tropics, creates most rain clouds, influencing the location of wet and dry zones on land.

Over 90 per cent of the extra heat trapped by humanity's carbon emissions is stored in the ocean – only about 2.3 per cent warms the atmosphere, while the rest melts snow and ice and warms the land. As a result, the atmosphere is warming less quickly than it otherwise would. This should not lull us into inaction, however, as ocean warming only delays the full impact of climate change. Much of the ocean's newly absorbed heat will flow out into the atmosphere over the coming centuries.

Weather forecasters combine ocean observations and knowledge of how ocean–atmosphere interactions shape long-term weather and climate patterns with atmospheric observations of daily temperature, wind, precipitation and other variables. Together, these data become key inputs for weather and climate models. The WMO community therefore has a major stake in supporting ocean observations, research and services.

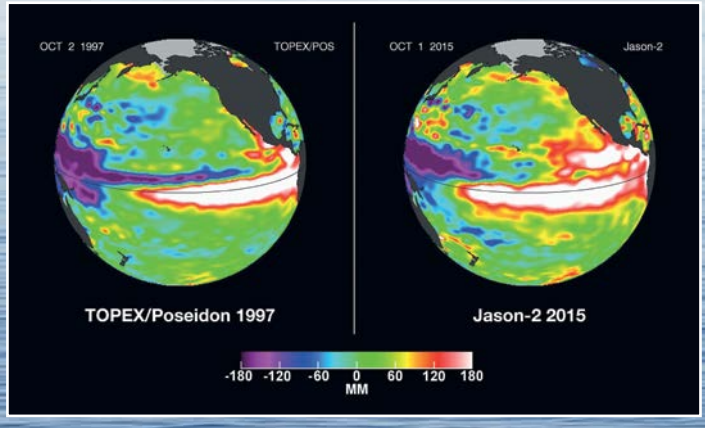
and regional sea levels rise is vital for the improved safety of life and property at sea and for coastal zone management. WMO has launched a dedicated programme to help small, vulnerable islands to use weather, marine and climate services. This will contribute to the implementation of Sustainable Development Goal 14 – Conserve and Sustainably Use Oceans, Seas and Marine Resources for Sustainable Development.

Observing the ocean

Because the ocean is a global commons, strong international coordination is needed to ensure regular and sustained observation. To track how the ocean is warming and changing, WMO co-sponsors the Global Ocean Observing System. This coordinated system encompasses networks of ships, buoys and other observation instruments and is led by the Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization.

Technological advances are revolutionizing our ability to systematically monitor the ocean and thus understand its role in weather and climate. The Argo array of more than 3 000 drifting floats is providing continuous data from the upper 2 000 m of the ocean; these data are then freely distributed. WMO collaborates with the maritime industry to ensure continuous weather and ocean observations from Voluntary Observing Ships and ocean-based observing platforms. To improve observations in hard-to-reach regions, WMO has initiated the Year of Polar Prediction (mid-2017 to mid-2019). The WMO-hosted World Climate Research Programme is promoting the Polar Challenge competition, which will reward the first team to complete a 2 000-km continuous mission under the sea ice in the Arctic or Antarctic using an autonomous underwater vehicle.

Despite these advances, 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.



NASA

Forecasting climate variability

In addition to influencing the geography of the planet's climate zones, the ocean causes the climate to vary over periods of weeks to decades through regular oscillations. Examples are the El Niño-Southern Oscillation in the tropical Pacific, the Indian Ocean Dipole and the North Atlantic Oscillation. Oscillations are caused when changing patterns of sea-surface temperature, atmospheric pressure and wind interact to produce climatic periods that are warmer or cooler, or wetter or drier, than normal.

With improved monitoring of the ocean and atmosphere and enhanced scientific understanding, scientists can increasingly identify and predict these oscillations – and thus the climate and weather. WMO Regional Climate Centres and Regional Climate Outlook Forums use this knowledge to produce consensus seasonal climate forecasts.

The ocean and climate change

Studying the ocean is also essential for gaining a better understanding of human-induced climate change. The World Climate Research Programme coordinates efforts to understand fundamental questions about the ocean and climate and how their interaction leads to extreme events.

The ocean stores most of the heat that is being trapped by humanity's greenhouse gases and plays a major role in how climate change is progressing. It also absorbs some of the carbon dioxide emitted by human activities, causing sea water to become more acidic (or, more correctly, less alkaline). This is already damaging coral reefs and the reef fisheries on which some one billion people rely.

WMO coordinates efforts to study how the ocean and the atmosphere exchange gases and aerosols. In collaboration with other organizations, such as the Food and Agriculture Organization of the United Nations, WMO is also supporting observations that are needed for a better understanding of how climate change is affecting marine productivity and fisheries.

NASA

About WMO

The World Meteorological Organization is the United Nations system's authoritative voice on weather, climate and water. Its precursor, the International Meteorological Organization (1873–1951), was established as a direct result of an international maritime conference held in 1853 and of governments' recognition of the need to provide weather safety information for shipping.

The 191 WMO Member States and Territories collaborate to strengthen the scientific and operational foundations of their weather, climate, hydrological, marine and environmental services. They do this by sharing observations and data, collaborating on research, setting technical standards and designing effective services. In this way, WMO contributes significantly to human safety and well-being and to sustainable development.

The World Meteorological Organization is committed to working with its partners to expand our knowledge about the ocean itself and, in particular, its role in weather and climate. The entire WMO community, from National Meteorological and Hydrological Services to research institutes, meteorological societies, and private-sector service providers, is poised to contribute. Together, these organizations are already providing the data, research findings and operational services that decision-makers need to address the diverse array of ocean-related challenges.

WMO programmes, activities and collaborations focusing on or relevant to the ocean

Warning services and communication systems

- World-Wide Metocean Information and Warning Service (WWMIWS), co-sponsored by the International Maritime Organization (IMO) and WMO
- Global Maritime Distress and Safety System (GMDSS), co-sponsored by IMO, International Telecommunications Union (ITU), WMO, International Hydrographic Organization (IHO) and the International Cospas-Sarsat Programme

Programmes

- Marine Meteorology and Oceanography Programme (MMOP)
- Tropical Cyclone Programme (TCP)
- World Climate Research Programme (WCRP), co-sponsored by WMO, Intergovernmental Oceanographic Commission of the United Nations Educational, Scientific and Cultural Organization (IOC/UNESCO) and the International Council for Science (ICSU)
- World Weather Research Programme (WWRP)
- Global Atmosphere Watch (GAW)
- WMO Integrated Global Observing System (WIGOS)
- Programme for WMO Small Island Developing States and Member Island Territories
- Agricultural Meteorology Programme (AMP)

Technical and scientific bodies

- Joint WMO–IOC Technical Commission on Oceanography and Marine Meteorology (JCOMM)
- Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP), co-sponsored by FAO, International Atomic Energy Agency (IAEA), IMO, IOC/UNESCO, United Nations Development Programme (UNDP), United Nations Environment Programme (UNEP), United Nations Industrial Development Organization (UNIDO), WMO

Observing systems and related entities

- Global Climate Observing System (GCOS), co-sponsored by WMO, IOC/UNESCO, UNEP and ICSU
- Global Ocean Observing System (GOOS), co-sponsored by IOC/UNESCO, WMO, UNEP and ICSU
- WMO/IOC Joint Technical Commission for Oceanography and Marine Meteorology in situ Observing Programmes Support Centre (JCOMMOPS)
- GCOS–(GOOS)–WCRP Ocean Observations Panel for Climate (OOPC)

Projects

- Coastal Inundation Forecasting Demonstration Project (CIFDP)
- Climate and Ocean: Variability, Predictability and Change (CLIVAR)

Regional centres

- Regional Specialized Meteorological Centres (RSMCs) (6)
- Tropical Cyclone Warning Centres (TCWCs) (6)
- Regional Marine Instrumentation Centres (RMICs) (2)
- Centre for Marine-Meteorological and Oceanographic Climate Data (CMOC) (1), co-sponsored by WMO and IOC/UNESCO
- Regional Climate Centres (RCCs)

Key WMO partners in ocean matters: Food and Agricultural Organization of the United Nations (FAO) • Group on Earth Observations (GEO) • International Atomic Energy Agency (IAEA) • International Council for Science (ICSU) • International Hydrographic Bureau (IHO) • International Maritime Organization (IMO) • Intergovernmental Oceanographic Commission (IOC/UNESCO) • United Nations Conference on Trade and Development (UNCTAD) • United Nations Development Programme (UNDP) • United Nations Environment Programme (UNEP) • United Nations Industrial Development Organization (UNIDO)

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