Ocean Observing System Report Card 2018

Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) of the World Meteorological Organization (WMO) and UNESCO's Intergovernmental Oceanographic Commission (IOC)

GLOBAL OCEAN OBSERVATIONS

Real-time ocean observations...

...are critical to predict, manage and mitigate the effects of extreme weather events that have high impact on the safety of life, property and the economy.

For example surface measurements from ships, drifters and buoys provide critical information for marine forecasts for shipping and fisheries; additionally warmer ocean temperatures, rising sea level and variability in the major boundary currents can influence natural phenomena such as tropical cyclones.

In situ and satellite observations, particularly of upper ocean temperature and salinity ahead of tropical cyclones, are fundamental to improve the representation of the upper ocean thermal structure that significantly influence the development and the intensification of tropical cyclones.

Underwater gliders, profiling floats and drifters are very useful platforms for gathering real-time upper ocean observations that are key for tropical cyclone forecasting. These instruments, deployed in the tropical oceans during cyclone season, enable improved storm intensity forecasts.

Real-time ocean observations in regions where tropical cyclones occur are necessary to improve early warning systems and for timely decision making to manage risk and improve emergency response efficiency.

INTERNATIONAL PARTNERS

Significant progress has been made over the last few years, in weather and climate forecasts, in improved early warning systems at sea as well as on land, and better scientific understanding of climate change and variability. This progress is the result of contributions and collaborations from many nations to support ocean observing, many of whom also contribute as WMO Members and IOC of UNESCO Member States.

Based on operational platforms registered at JCOMMOPS as of June 2018: 86 countries

However, a much smaller number of nations and partners contribute to the global-scale dimension of the ocean observing enterprise and the infrastructure required to keep the entire system operating efficiently. With the increasing societal demand for ocean-based observations and information, our challenge is to grow the global ocean observing system to meet those demands. Consequently, a wider alliance of contributors is needed to maintain and improve the existing observing efforts.

JCOMM thanks all Members/Member States and contributors for their continued support and encourages further contributions to improve the global ocean observing system to better meet society's needs.

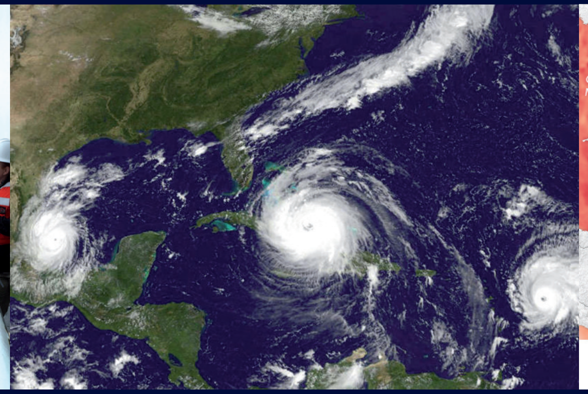
Olivier Dugornay, Ifremer

CORE Education LTD

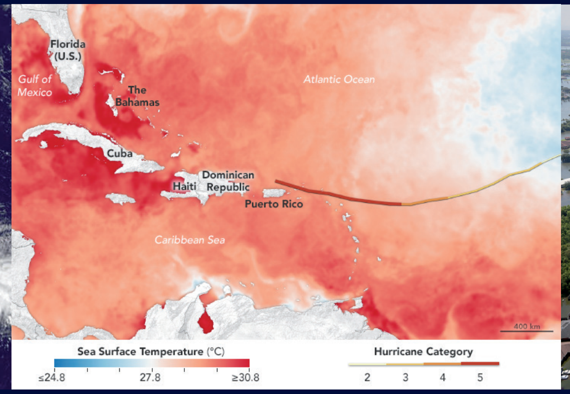
U.K. Met Office

D. Costa, NMFS 87-1851

K. Key, Scripps



Satellite image of Irma (center), Jose (right) and Katia (left) tropical storms churning in the Atlantic Ocean at the same time during 2017. NOAA.



Sea Surface Temperature map of the Caribbean Sea and Gulf of Mexico on Sept. 5, 2017. The threshold temperature warm enough to fuel a hurricane is 27.8°C; the yellow-to-red line on the map represents Irma's track from Sept. 3 - 6. NASA Earth Observatory.

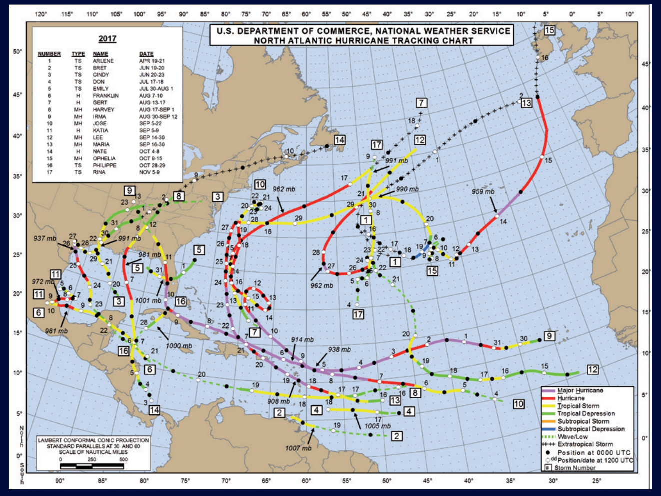
Epic amount of rainfall in Port Arthur, Texas, from Hurricane Harvey, August 2017. U.S. Air National Guard, Sgt. Daniel J. Martinez.

NOAA's Adopt a Drifter Program

Angela Hibbert, NOC

Parafilms/Green Edge

U.S. Integrated Ocean Observing System



National Weather Service

The 2017 Atlantic hurricane season...

...was one of the most destructive on record. Damage costs exceeded 250 billion dollars in the United States alone, while recovery for the worst hit Caribbean islands will take years. The US National Oceanic and Atmospheric Administration (NOAA) made accurate advance predictions that the season would be above average. The outlook was based, in part, on ocean observations. Without the forecasts and warnings, the loss of life would have been even higher. Gliders and air-deployed micro floats provided higher density measurements ahead of hurricanes Irma and Jose, which helped to improve the forecast of storm intensity in the days and hours before they made landfall.

Ocean observations for education and outreach activities

Ocean observation data and instruments are being integrated into more educational and outreach activities. In 2017, the 1st Ocean Observers workshop (*www.oceanobservers.org*) brought together ocean scientists, educators, marine communicators, sailing community and students who were willing to share resources and experiences on *in situ* ocean observing educational activities and to establish new international collaborative partnerships. These activities allow the students to engage by using *in situ* data in their classrooms and to form partnerships with schools in different countries. This type of educational partnership mirrors international scientific collaborations in ocean observing.

CONTACTS

General information: **www.jcomm.info**
Networks status: **www.jcommops.org**
Assistance: **reportcard@jcommops.org**
If you wish to contribute to the global ocean observing system, please contact: **support@jcommops.org**
Authors: JCOMM Observations Coordination Group (OCG) and and Observations Programme Support centre (JCOMMOPS)

More information at:

www.jcommops.org/reportcard2018

The Global Ocean Observing System

United Nations Educational, Scientific and Cultural Organization

Intergovernmental Oceanographic Commission

WMO

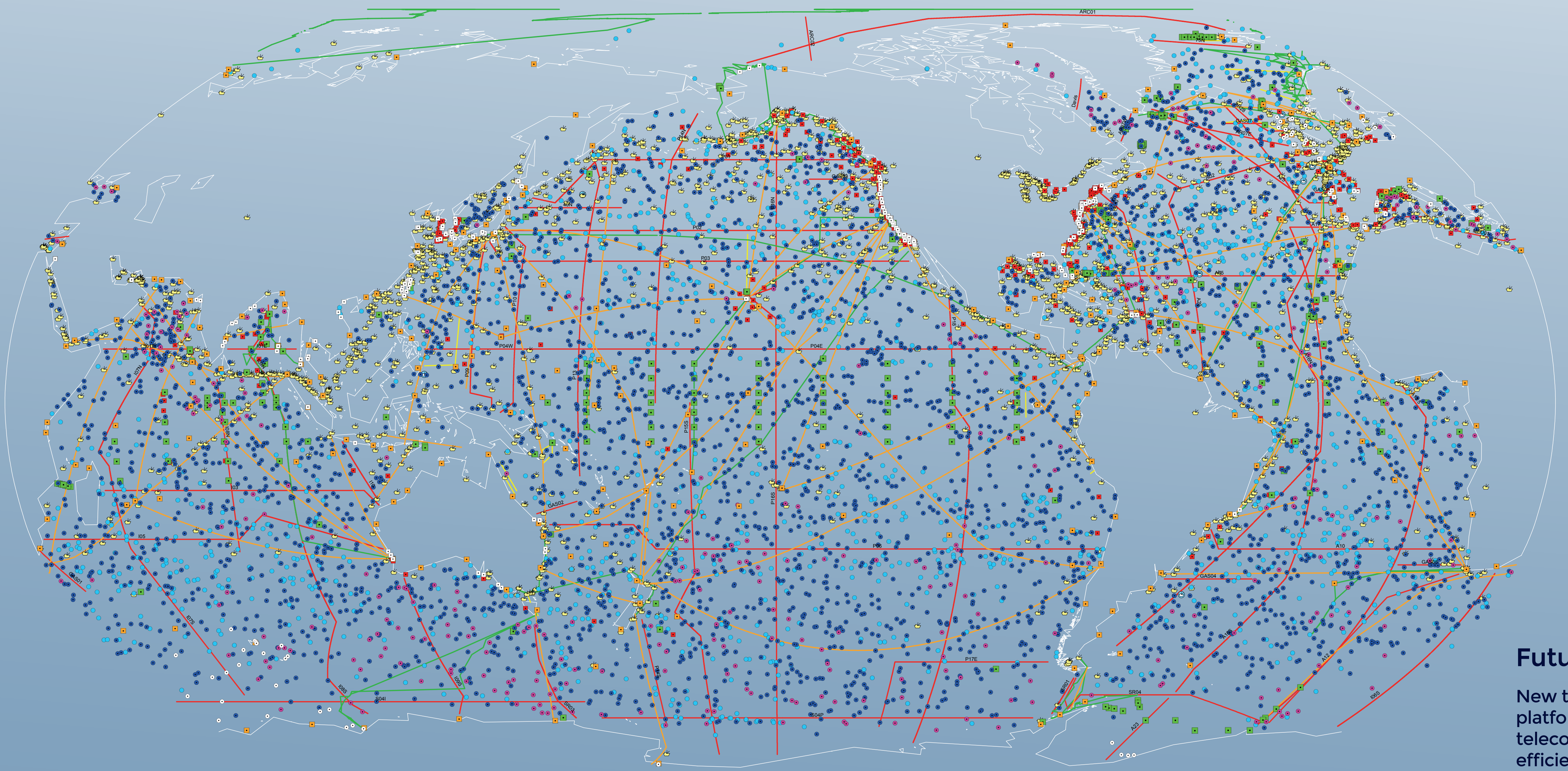
IN SITU AND SATELLITE OBSERVING SYSTEM STATUS

In situ and satellite observations are fundamental for delivering marine weather and ocean services (*e.g.* forecasts) to support safety of life and property at sea, maritime commerce and the well-being of coastal communities. Not only they underpin scientific knowledge and the intricate relationship between the ocean, the atmosphere and the ice, but they also provide insights into the global weather and climate system and the impacts of long-term climate change. These ocean observations also provide information on the occurrence of marine natural hazards and increasing stress on the ocean from human activities; both posing challenges to sustainable development.

The **Ocean Observing System Report Card 2018** seeks to inform ocean observing stakeholders, society and decision-makers about the status of the global ocean observing system coordinated by the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM).

The global ocean observing system has developed significantly over the last few years, with emerging networks and sensors helping to meet new requirements and to deliver critical data at different time and space scales. For instance, global ocean heat content, increasing ocean acidification and sea level rise can now be observed with unprecedented accuracy. Continued availability and expansion of *in situ* observations are vital to maintaining, and improving upon, that success.

For many years, the satellite network has enabled us to accurately measure fundamental variables such as: ocean surface temperature and salinity, ice coverage, ocean color (an indication of ocean productivity), sea level and sea surface winds. The satellite network relies upon and complements the *in situ* observations. Together they provide foundational knowledge about the ocean environment and enable a wide range of forecasts and services.



Map legend: see *in situ* and emerging networks tables. Symbols size in the map are exaggerated in the order of hundreds kilometres for readability.

JCOMM *in situ* networks	**Implementation** Status	Trend	**Data & metadata** Real-time	Archived high quality	Metadata	**Comments**
Ship based meteorological measurements – SOT/VOS	★★☆	→	★★☆	★★★	★★☆	Increasing number of Automatic Weather Stations installed globally.
Ship based oceanographic measurements – SOT/SOOP	★★★	→	★★★	★★☆	★★☆	More than 95% of data transmitted in real-time.
Ship based aerological measurements – SOT/ASAP	★★☆	→	★★☆	☆☆☆	★☆☆	European E-ASAP programme is providing the only steady and stable real-time radiosonde datastream over oceans (mostly North Atlantic).
Sea level gauges – GLOSS	★★★	→	★★☆	★★★	★★☆	Over the past year the GLOSS web pages were re-written and interface to users is continuously improving.
Drifting buoys – DBCP	★★☆	↓	★★★	★★☆	★★☆	Good coverage other than high latitudes where coverage has declined and is inadequate.
Moored buoys – DBCP	★★☆	→	★★★	★☆☆	★☆☆	Many coastlines are not covered. Real-time data delivery is good but access to archived data and metadata is presently inadequate.
Interdisciplinary moorings – OceanSITES	★★☆	→	★★☆	★★☆	★★☆	OceanSITES Deep Ocean Challenge has a pool of 50 deep Temperature, Salinity, Pressure recorders, collecting time series data at new key locations in the deep (>3500m) ocean.
Profiling floats – Argo	★★★	→	★★★	★★★	★★★	More than 1 scientific paper per day logged.
Repeated transects – GO-SHIP	★★★	→	☆☆☆	★★★	★★☆	Increased international participation: Ireland leads its 1st cruise.

The *in situ* global ocean observing system is composed of multiple platforms, including ship-based weather stations, moored and drifting buoys, autonomous profiling floats, dedicated research vessels and tide gauges, which observe a range of essential environmental variables.

Although the *in situ* ocean observation system provides many fundamental observations, it remains vulnerable, as many of its components are reliant on short-term commitments through research programmes.

Emerging networks and extending capabilities	**Highlights**	**Readiness level**
OceanGliders	Operational multidisciplinary systems exist in several different regions.	MATURE regionally; PILOT globally
HF radars	Nine countries sharing surface currents globally; waves and meteotsunami warning testing regionally.	MATURE regionally; PILOT globally
Surface based measurements CO2 - SOCONET	Becoming part of multi-platform, continuing assessments.	PILOT to MATURE
Biogeochemistry & Deep floats – Argo	Regional pilots, ready for the global.	PILOT
Animal borne sensors	Regional pilots, polar ocean observations.	PILOT

More information on Global Ocean Observing System readiness level at: www.goosocean.org

Challenges

Today, one of the greatest challenges facing the global ocean observing system is in securing the sustained resources needed to meet the expanding societal demands. This includes filling observation gaps such as in the Arctic, the Southern Ocean, regional basins and the deep ocean below 2,000 meters; and to expand our capability to measure more biogeochemical and ecosystem variables. Other specific challenges include the increasing costs to maintain moorings and deploy instruments in remote areas, in a context of decreasing access to academic and commercial ship time, and the communication to coastal communities to avoid vandalism to the existing moored buoys.

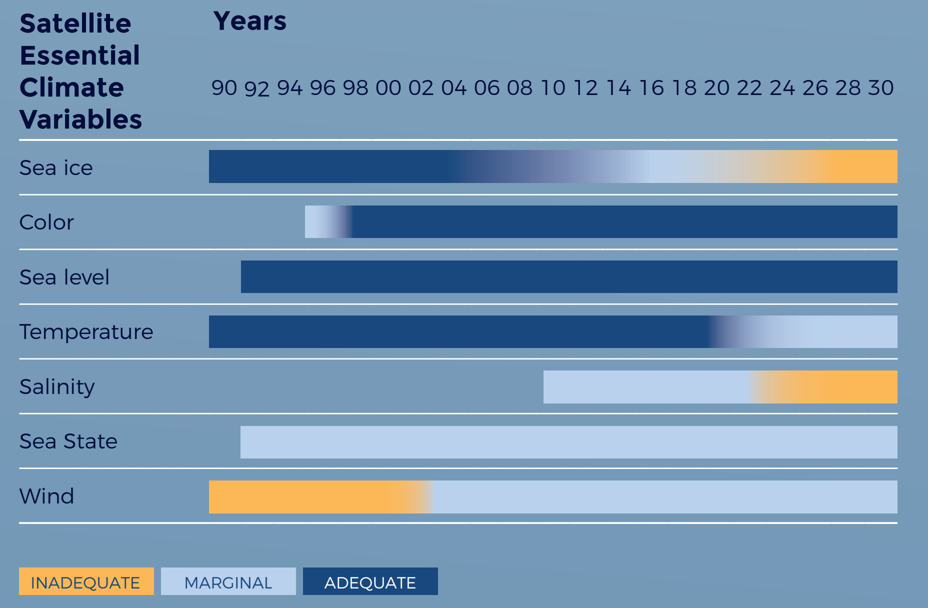
Optimization of resources, technology development and coordination with partner countries to share best practices and transfer expertise can enhance and enable expansion of the system. Developing global initiatives in these areas is an ongoing challenge that carry many benefits. Only by having a fully integrated and rigorously monitored ocean observing system will we be able to respond to the many scientific and societal needs to ensure a healthy ocean and a healthy planet.

We need to strengthen international cooperation to maintain and improve the system, and to increase the levels of long-term funding needed to sustain an efficient, integrated, innovative and fit for purpose global ocean observing network.

Future

New technologies based on autonomous platforms, smart sensors and improved telecommunications can offer more cost-efficient solutions towards improving the global observing system. Using these technologies helps to improve the multidisciplinary ocean observing system as well as responding to new requirements. It is important to introduce gradually technological and scientific innovations alongside the existing observing networks while preserving some stability. The diversity and complementary nature of the systems should ultimately lead to better quality observations both spatially and temporally and better measurement accuracy.

The observing system also needs to develop stronger links with the downstream users of the observations, in order to increase system responsiveness and to ensure that it is fit for purpose. Developing these vital end-to-end links is both a current and future challenge.



More information on satellite status at www.jcommops.org/reportcard2018