

# Ocean Science to support Climate Change Adaption and Mitigation

## IOC-UNESCO related activities

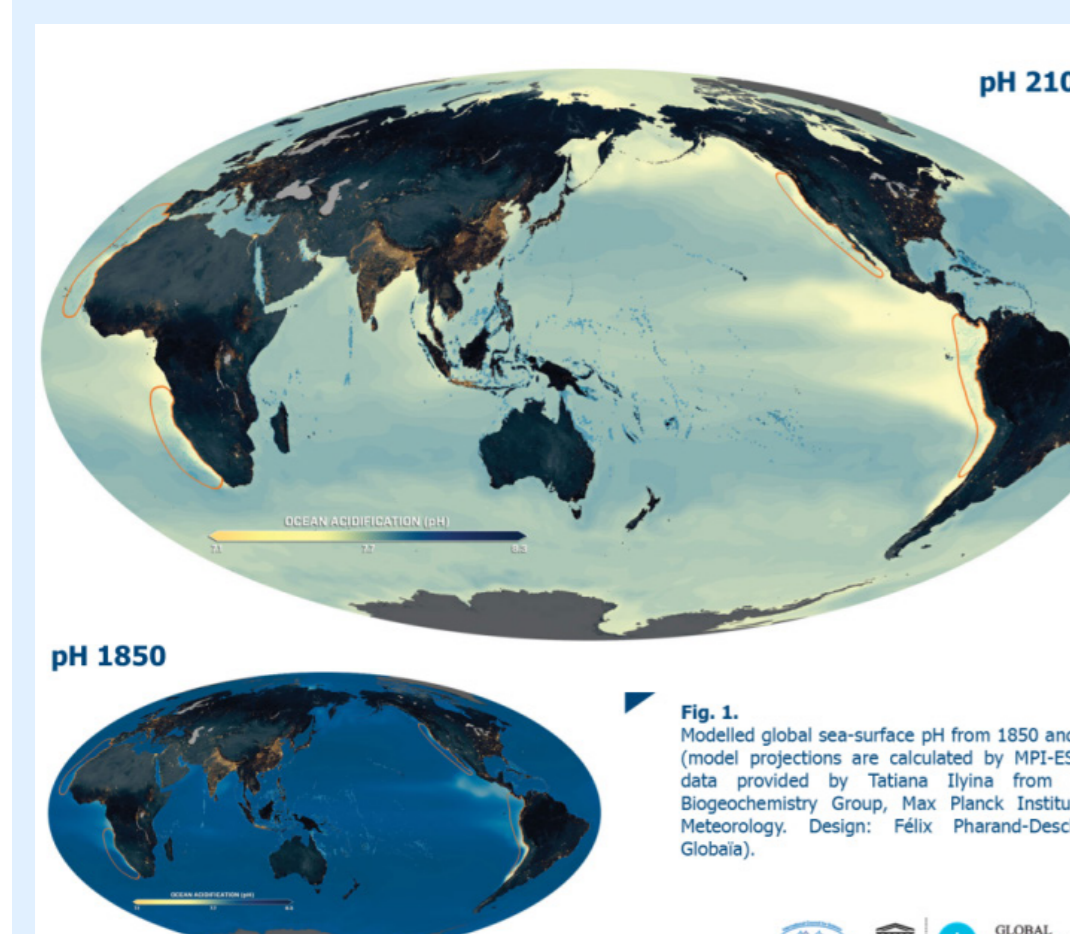
The world ocean is an integral part of the climate system. It captures 90 percent of excess heat in the climate; it has absorbed over 28 percent of the anthropogenic carbon emitted since the dawn of the industrial age. This has resulted in ocean warming, ocean acidification, and sea level rising.

The Global Climate Observing System (GCOS) recognizes these three parameters as Global Climate Indicators.

Ocean Science, starting from research and systematic observations, needs to lead to knowledge based decisions and action at the national, regional and global levels.

## Ocean Science = Research + Observation + Assessments

### Ocean Acidification



**GOA-ON**  
Global Ocean Acidification Observing Network

The ocean absorbs up to 30% of the annual emissions of anthropogenic CO<sub>2</sub> to the atmosphere, helping to alleviate the impacts of climate change on the planet.

However, this comes at a steep ecological cost, as the absorbed CO<sub>2</sub> reacts in seawater and results in changing acidity levels in the ocean, affecting the aragonite saturation state, which is the main form of calcium carbonate used by key species to form shells and skeletal material (e.g. reef building corals and shelled molluscs). Concerns about ocean acidification, first expressed in the early 1980s, have been confirmed. Observations of marine acidity at open ocean and coastal locations have revealed that present-day conditions are often outside preindustrial bounds. In some regions, the changes are amplified by natural processes like upwelling (cold often, CO<sub>2</sub> and nutrient rich water from the deep rises toward the sea surface), resulting in conditions outside biologically relevant thresholds.

### Ocean observations for societal benefit - Climate, services, ocean health

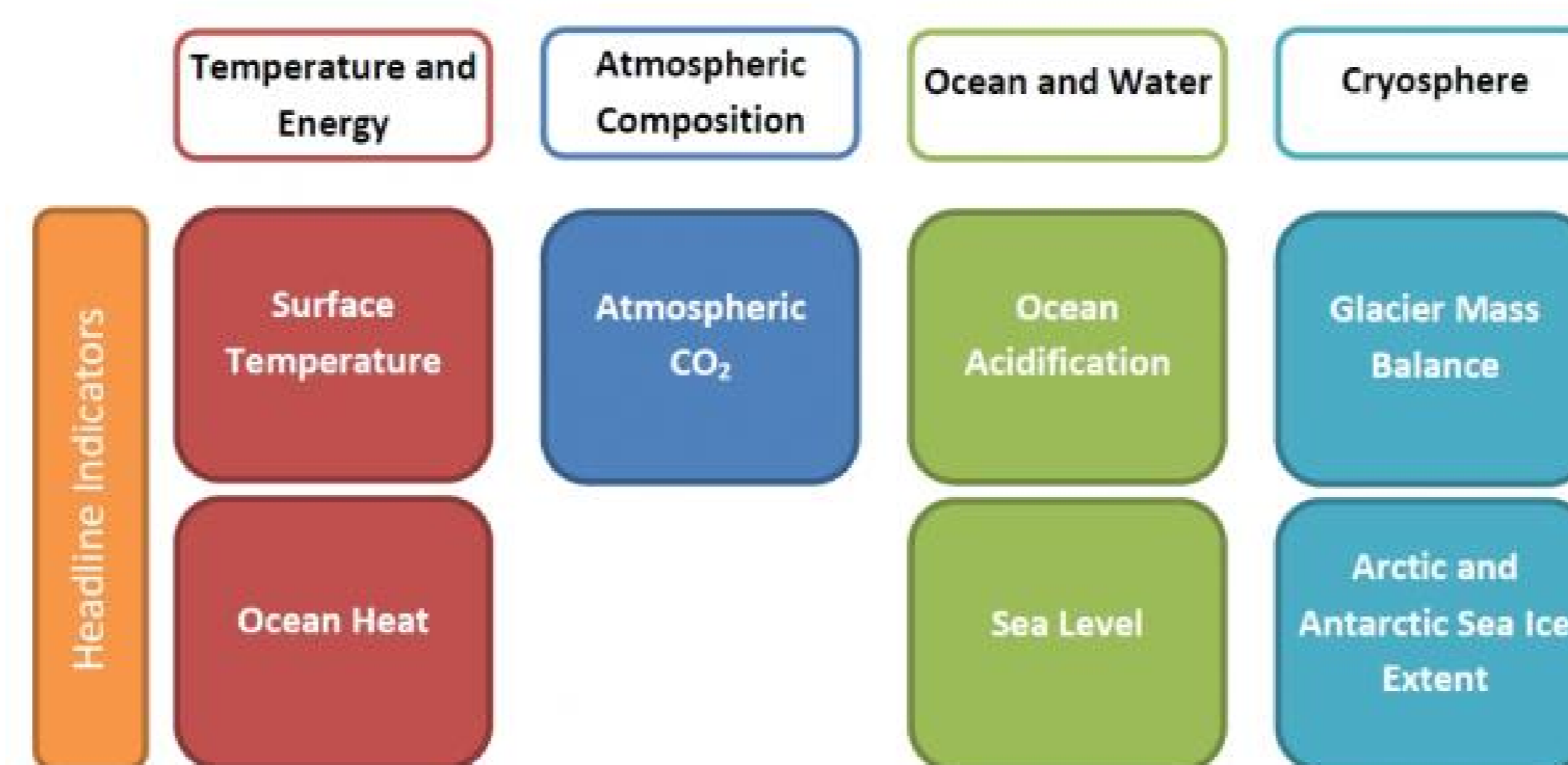



Figure 4: Global Climate Indicators (source: GCOS).

A better understanding of ocean climate and ecosystems, as well as human impacts and vulnerabilities, requires the coordination of a continuous and long-term system of ocean observations. In this context, the GOOS coordinates observations around the global ocean for three critical themes: climate, ocean health, and real-time services. These themes correspond to the GOOS mandate to contribute to the UNFCCC, the Convention on Biological Diversity and the IOC/WMO mandates to provide operational ocean services, respectively.

### Global record of how, where, and by whom ocean science is conducted



**Global Ocean Science Report**

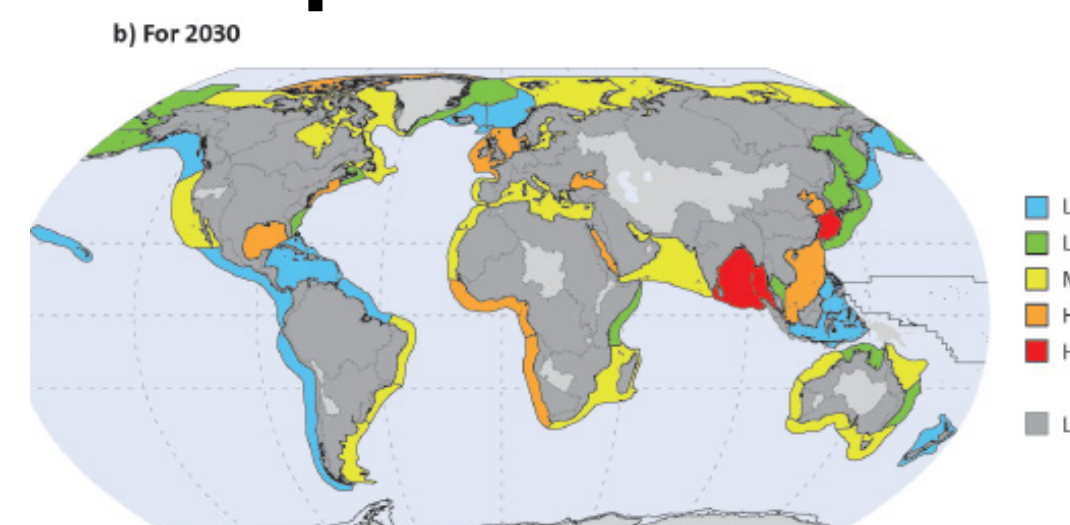
The Current Status of Ocean Science around the World

Figure 7: First edition of Global Ocean Science Report (IOC-UNESCO, Global Ocean Science Report, 2017 <http://unesco.org/gosr>).

The Global Ocean Science Report (GOSR) assesses for the first time the status and trends in ocean science capacity around the world. The report offers a global record of how, where, and by whom ocean science is conducted: generating knowledge, helping to protect ocean health, and empowering society to support sustainable ocean management in the framework of the United Nations 2030 Agenda.

The GOSR identifies and quantifies the key elements of ocean science at the national, regional and global scales, including workforce, infrastructure and publications. It is the first collective attempt to systematically highlight opportunities as well as capacity gaps to advance international collaboration in ocean science and technology.

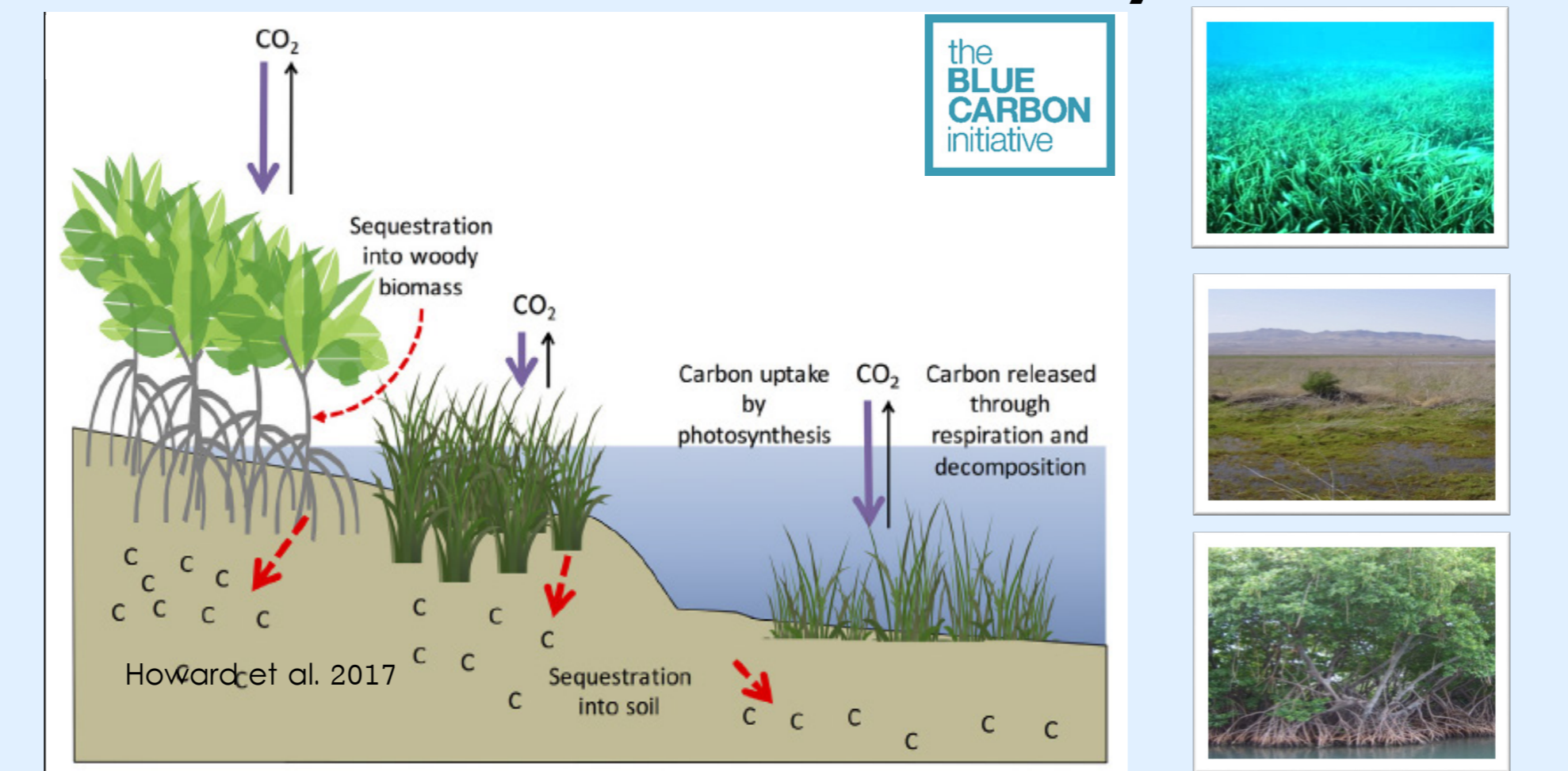
### Eutrophication & climate change



Over the last century the marine environment has experienced very large increases in the levels of nutrients such as nitrogen and phosphorus because of human activity.

Eutrophication is further increasing the vulnerability of marine ecosystems to climate change, and has severe impacts on ecosystem services, altering their carbon storage function.

### Coastal Blue Carbon ecosystems



Sequestration into woody biomass

Carbon uptake by photosynthesis

Carbon released through respiration and decomposition

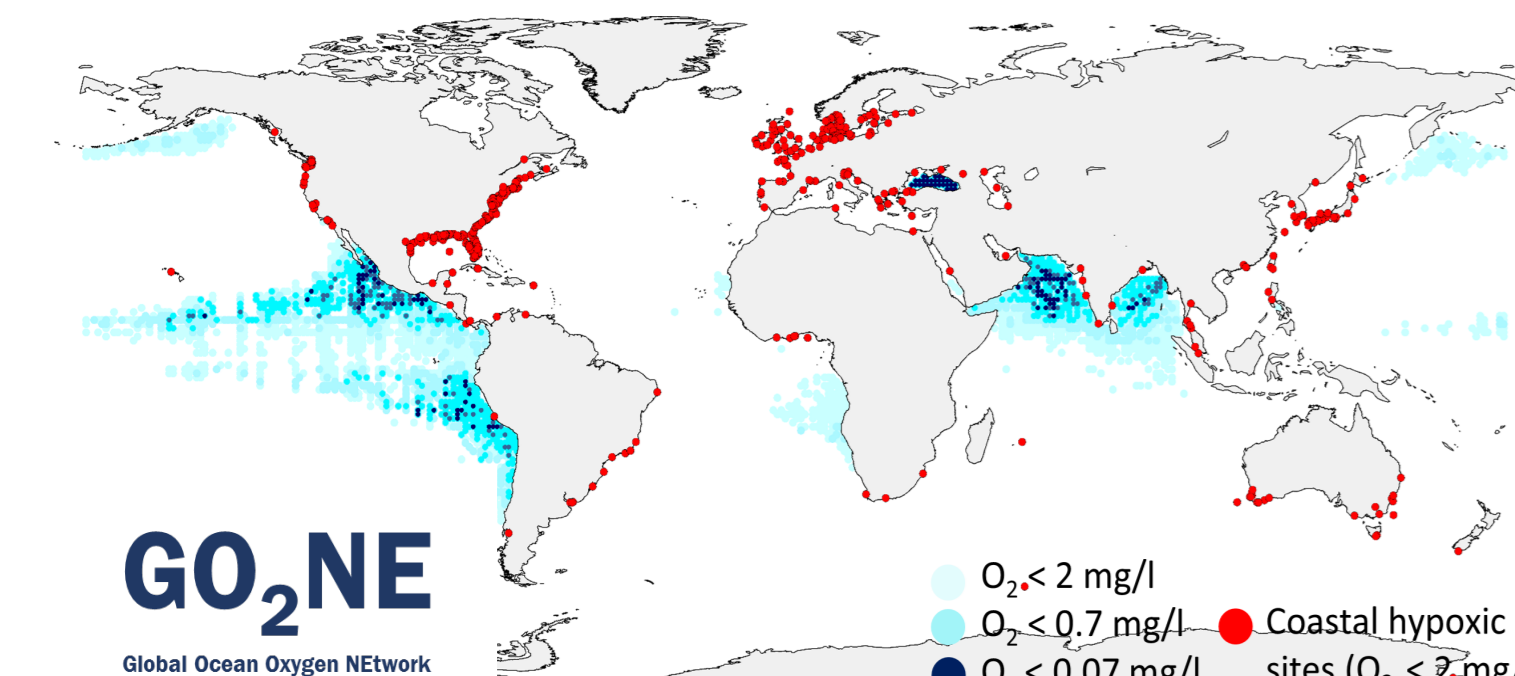
Sequestration into soil

the BLUE CARBON initiative

Howard et al. 2017

Figure 5: Carbon storage and sequestration rates of coastal blue carbon ecosystems (Howard et al. 2017).

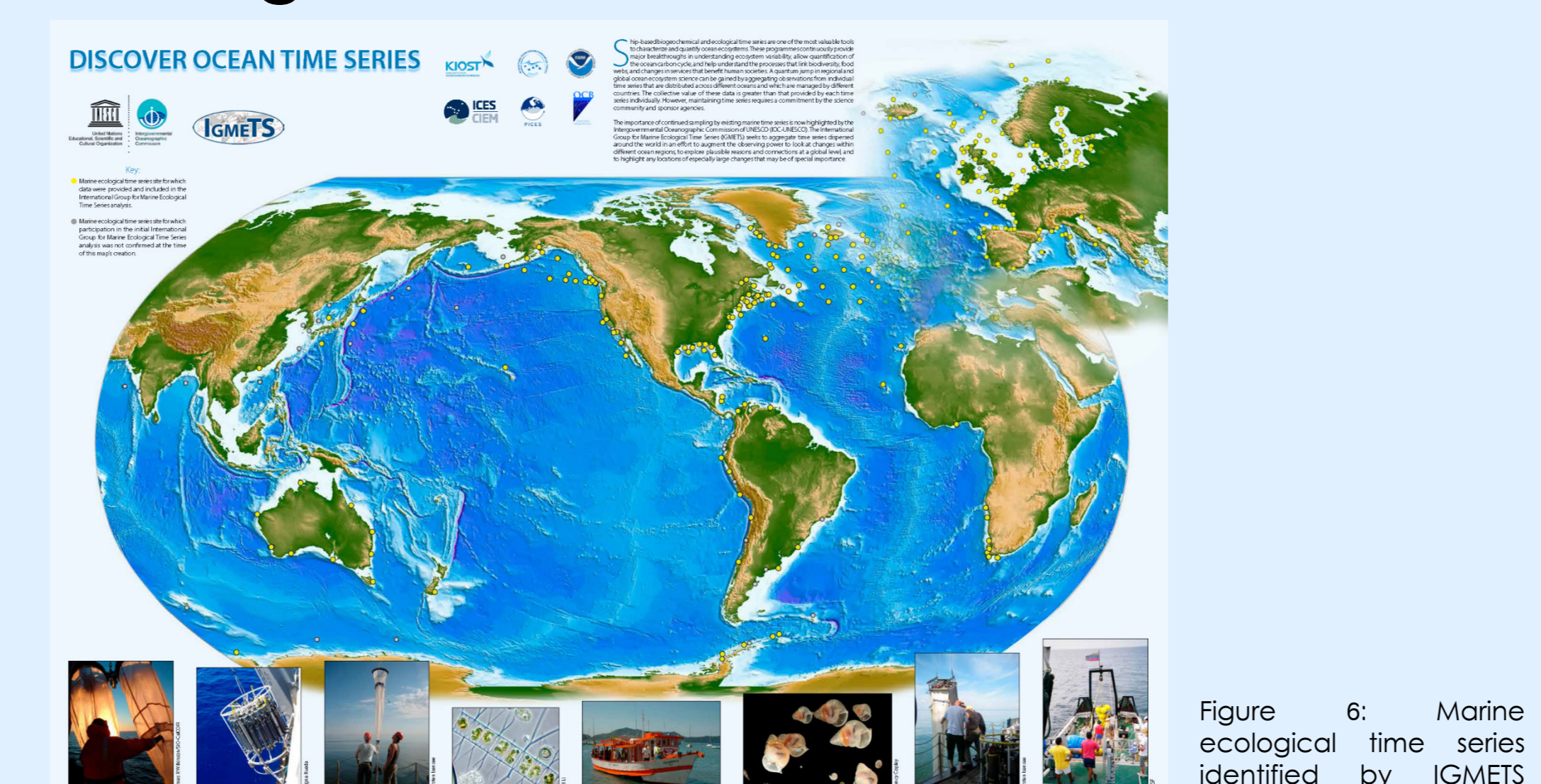
### Decreasing oxygen in the world's ocean



**GO<sub>2</sub>NE**  
Global Ocean Oxygen Network

Oxygen is declining in the ocean. Over the past 50 years, the open ocean lost approximately 0.5–1 petamoles of oxygen per decade, which translates into 1–2% and over 500 low oxygen sites have been identified in estuaries and other coastal water bodies. Through the participation of concerned scientists from across the world, the IOC expert group, the Global Ocean Oxygen Network GO<sub>2</sub>NE, established in 2016, is committed to providing a global and multidisciplinary view on deoxygenation, with a focus on understanding its various aspects and impacts. The Network offers scientific advice to policy makers and stakeholders to counter alarming deoxygenation, and to preserve marine resources in the presence of declining oxygen levels.

### Ecological Time Series



DISCOVER OCEAN TIME SERIES

IGMETS

Figure 6: Marine ecological time series identified by IGMETS (2015).

The knowledge derived from ocean science already now offers concrete support such as the contribution of blue carbon to communicated information on carbon storage, the NDCs; and ecological time series that are critical to improving modelling and predictions of climate change.

### Decade of Ocean Science for Sustainable Development

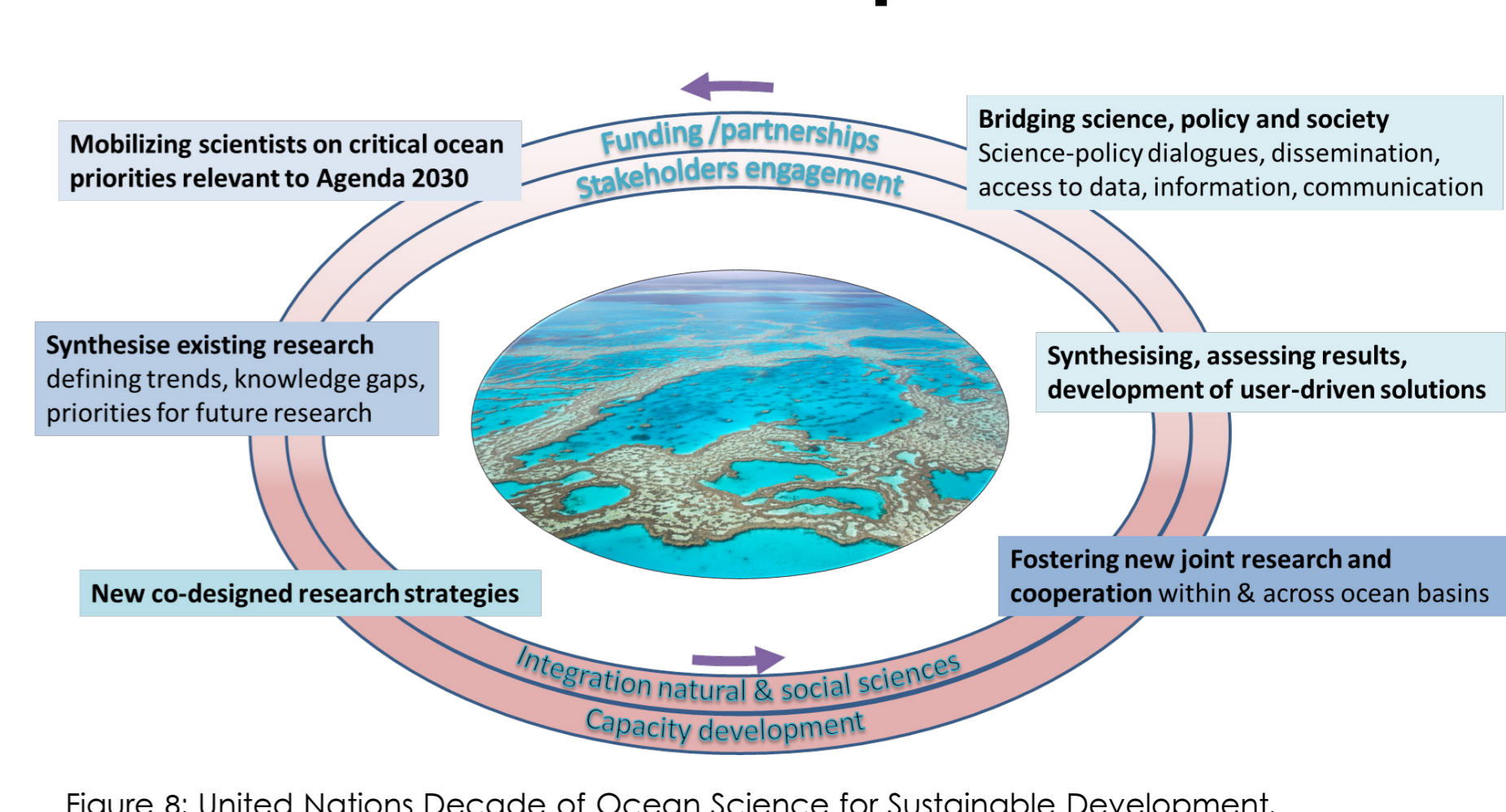


Figure 8: United Nations Decade of Ocean Science for Sustainable Development.

The Global Ocean Science Report shows clearly that ocean science capacity is lacking in the developing world, in terms of infrastructure, human resources, funding, and scientific production.

The UN General Assembly proclaimed the Decade of Ocean Science for Sustainable Development to mobilise ocean stakeholders worldwide behind a common framework that will ensure ocean science can fully support countries in the achievement of the 2030 Agenda for Sustainable Development. The Decade will stimulate action over the next ten years in areas of critical importance for the planet, people, prosperity, peace and partnership. More coordinated and consolidated observations and research will contribute to the UN processes protecting the ocean and its resources, such as the Aichi Biodiversity targets, the SAMOA Pathway, the United Nations Convention for the Law of the Sea and the Sendai Framework for Disaster Risk Reduction. IOC-UNESCO has been tasked with designing the Decade and consulting governments, UN partners, scientific organisations, the private sector and civil society to deliver, together, the ocean we need for the future we want.

## From Ocean Science to Global Action

Scientific research and observations need to continue, with the full participation of scientists from the global constituencies of IOC Member States and UNFCCC Parties.

Ocean research and systematic observations help us make informed decisions on how the ocean can continue playing its critical role in regulating the climate system, mitigating climate change, and helping us adapt to its effects.

Concrete contributions of ocean science to the work of UNFCCC, through its SBSTA, include: matchmaking Parties' needs in climate change science with opportunities for capacity development in ocean science; elucidating scientific and technical aspects of the Global Stocktake; identifying targets and developing the related methodologies to measure progress; assisting in the design of the next generation of integrated climate models and predictions; and stimulating ocean science production reflecting the needs and aspirations of UNFCCC Parties.