It is my great pleasure to be invited to speak to you at this Expert meeting on the Ocean, Seas and Sustainable development – thank you for the invitation.

Outline

- Progress in marine research since Rio 92
- Scientific community network
- From research to observation
- Scientific priorities emerging from Rio+20
- Building science/policy interfaces

2

It will be a bit of a challenge to provide you with a detailed vision of marine science priorities and observations in 15 minutes so I'd like to articulate my presentation around 5 points

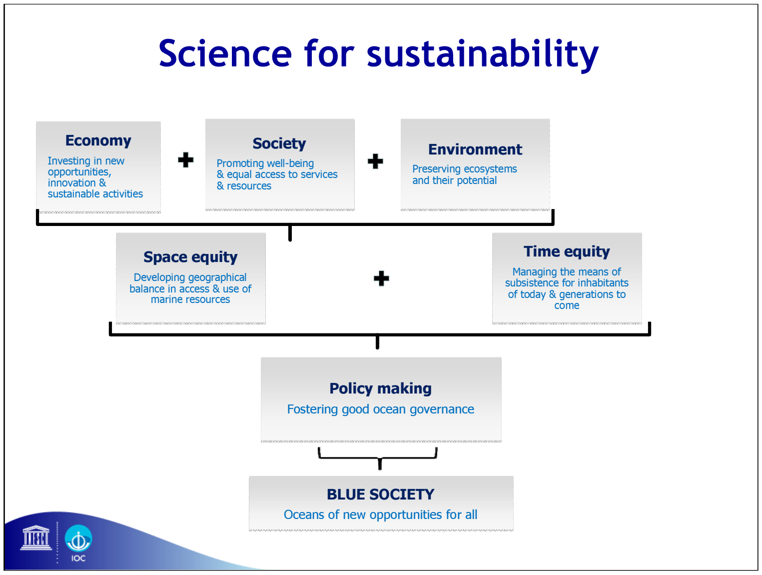
-first, I'll give a quick overview of the advancements in ocean science since Rio 92;

-I will then talk a bit about How the Scientific Community has supported these advancements, before moving on to

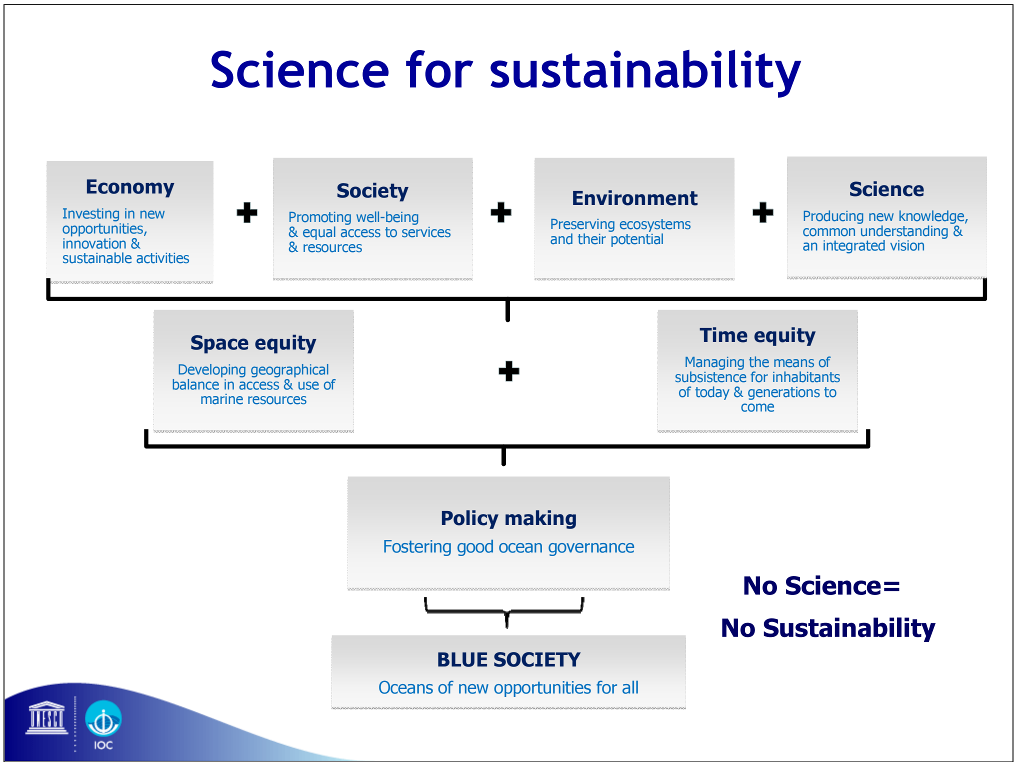
- The role of global ocean observations in responding to societal needs

- I'll touch briefly on the Scientific Priorities emerging from Rio+20 and finish with

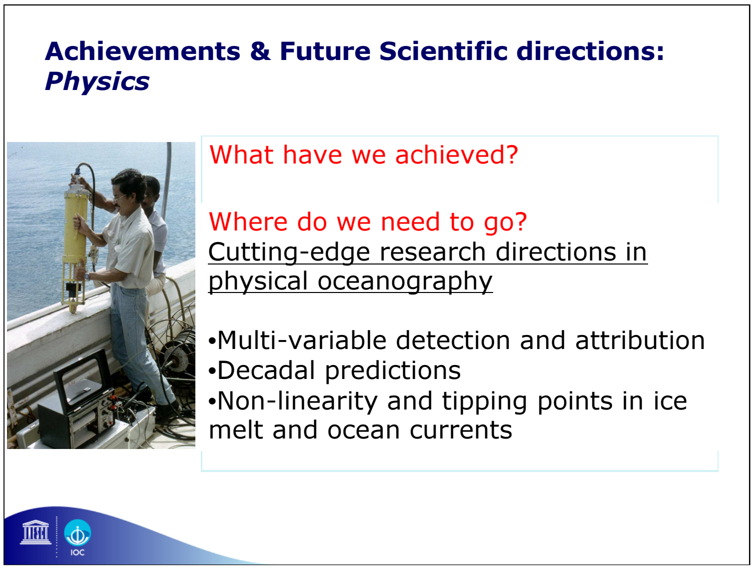
- How to make sure science ends up in the right place, through effective science/policy interfaces



At IOC and certainly at UNESCO, we believe that science is a key element of the wider sustainable development architecture. Scientific knowledge is needed to help people make informed decisions for their own benefit, now and into the future, and to address social, environmental and economic challenges of the 21st century related to ocean management.



Without this knowledge and input from scientific research, sustainable development will <u>not</u> be achieved. The scientific community has an <u>essential</u> role to play in producing and sharing reliable information on our changing ocean, and to support the formulation of sustainable policies, the planning of economic activities, and the development of new technologies, leading to integrated ocean and coastal management.



So where and how has the science of the ocean and climate advanced since Rio 92?

Where are we today and where do we need to be in terms of building additional knowledge to achieve sustainable management of the ocean and coasts?

If we look at it beginning from a physical perspective

We have achieved:

- Consistency in observed anomalies of temperature and related variables

-A Coherent overall understanding of patterns of change, and

-Quantitative understanding and pattern attribution using models

Where do we **need** to go?

We need Cutting-edge research directions in physical oceanography, including

•Multi-variable detection and attribution

•We need further development of decadal predictions

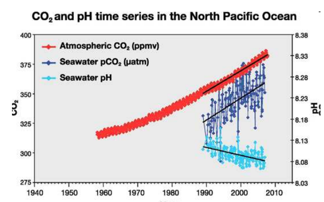
•And forecasts of non-linearity and tipping points in ice melt and ocean currents

Achievements & Future Scientific directions:
Chemistry (OA and carbon)

What have we achieved?

Where do we need to go?

- Detection of ocean pCO_2 trends
- Increasing atmospheric CO_2, climate variability and climate change impacts at regional scales
- Impact of change in ecosystems on ocean carbon cycle
- Role of coastal carbon and valuation
- Quantifying uncertainty
- Impacts of OA on marine biota



Looking at the chemistry of the ocean:

We have observed that trends in Carbon, pH and ocean acidification exist, appear persistent, and show coherence; and although they are still incomplete, we are progressing in quantitative understanding

But we need to improve :

- The Detection of ocean pCO2 trends and inventory departures from expected values
- The Attribution of the contribution of increasing atmospheric CO2, climate variability and climate change at regional levels;
- Our understanding of the Impact of change in ecosystems on the ocean carbon cycle, as well as stock and vulnerability of coastal carbon and its valuation, and
- We need to quantify the uncertainty in trends and to identify the impacts of OA on marine biota

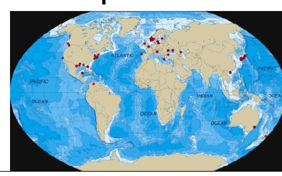
Achievements & Future Scientific directions : *Chemistry* (Oxygen)

What have we achieved?

Where do we need to go?

Research directions on ocean oxygen:

- Attribution of oxygen changes to climate change and/or variability
- Understanding of tropical de-oxygenation
- Impacts on marine life
- Effective management practices to reduce coastal de-oxygenation



Still on the chemistry, but focusing on oxygen…

We have observed that trends in sub-surface oxygen exist (and appear persistent), but there is no coherent understanding of the patterns of change.

In fact, the implications of deoxygenation are still poorly known, particularly in terms of :

- oxygen stress on fish and other marine organisms
- reduction in available habitat and
- changes in growth performance of fish

[CLICK]

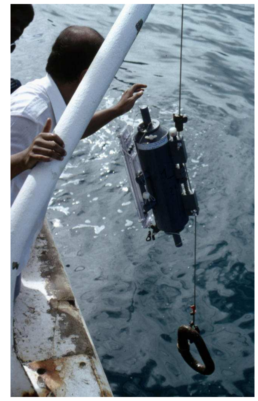
So we need cutting edge research to address the issues shown here.

Achievements & Future Scientific directions : *Ecosystem functioning*

What have we achieved?

Where do we need to go?

- Understand impact of multiple stresses
- Ecosystem shifts and tipping points
- Capacity of ecosystems to adapt
- Management options in coastal areas and socio-economic impacts



Looking at ecosystem functioning :

Impacts on marine ecosystems are reported, observed trends exist and appear persistent and coherent, although again, we still have incomplete quantitative understanding

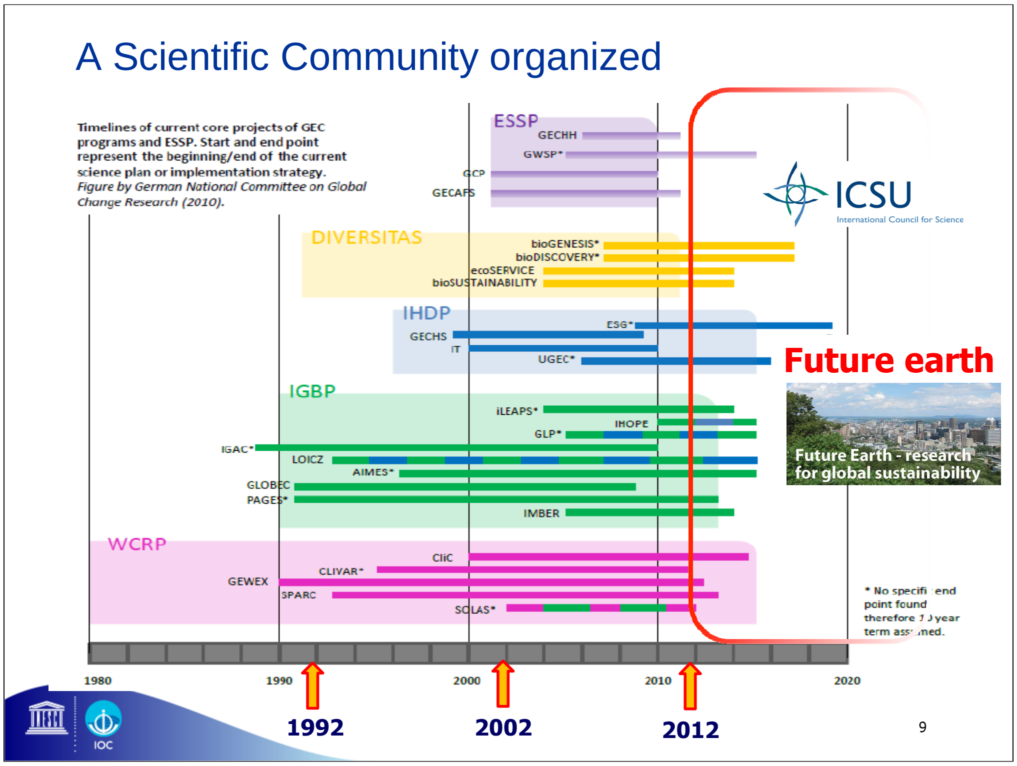
Where do we need to go?

We need to integrate multiple data streams (including genetic) into information;

•We need to understand the impact of multiple and simultaneous stresses, including climate change, fisheries, ocean acidification and deoxygenation on species, size distribution, life stages and trophic dynamics;

•to identify ecosystem shifts and tipping points, as well as the capacity of ecosystems to adapt;

•And we need to do this since it is critical for defining management options in coastal areas as well as determining socio-economic impacts (including livelihoods and adaptation to climate change)



The role of the scientific community has been essential in reaching these advancements.

In fact, the first Rio summit was pivotal in organizing the scientific community around a number of Global Environmental Change core programmes: the World Climate Research Program (WCRP), the International Geosphere-Biosphere Program (IGBP), DIVERSITAS, and the Earth System Science Partnership or ESSP. Since then, several projects, investigating anthropogenic influences on the Earth system have been launched and financed. Now we've reached a point where gaps in knowledge need to be identified and a new generation of projects developed.

Rio+20 provided an opportunity for the scientific community to review and reshape the global science agenda. Together with the International Council for Science or ICSU, a body that federates 120 national scientific bodies and International Scientific Unions, UNESCO organised in Rio a Forum on Science, Technology and Innovation for Sustainable Development. The aim was to help establish the research, technology and policy agendas that will be needed after Rio+20, as summarized in the outcome document 'Future Earth'.

The result of this process is a new 10-year international research initiative on Earth system science for global sustainability, within which marine research will feature pre-eminently.

Future Earth will develop the knowledge for responding effectively to the risks and opportunities of global environmental change and for supporting transformation towards global sustainability.

It will mobilize thousands of scientists while strengthening partnerships with policy-makers and other stakeholders to provide the knowledge for sustainability options and solutions in the wake of Rio+20 by:

Moving toward Solution-orientated research for sustainability, linking environmental change and development challenges to satisfy human needs for food, water, energy, health;

Ensuring Effective interdisciplinary collaboration across natural and social sciences, humanities, economics, and technology development

Producing Timely information for policy-makers;

Ensuring the Participation of policy-makers, funders, academics, business and industry, and other sectors of civil society in co-designing and coproducing research agendas, and through

Increasing capacity development in science, technology and innovation, especially in developing countries, and engagement of a new generation of scientists.

For your information, Future Earth is a partnership supported by International Council for Science (ICSU) , International Social Science Council (ISSC) , Belmont Forum (a high level group of major research funders), UNESCO, UNEP, UNU, and WMO.

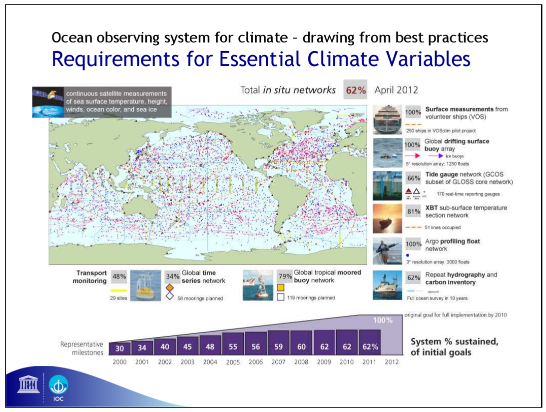
These major advancements in ocean science would not have been possible without a global mechanism for monitoring the ocean.

Sustained ocean observations are necessary to improve our understanding and predictive ability about the natural ocean systems upon which humans depend; the human interaction with these systems: our impact on and vulnerabilities with respect to the ocean, and how ocean-related hazards will evolve.

We then need to apply that knowledge through early warning systems, improved local climate forecasts and projections, tools for ecosystem-based management, and improved governance based on sound science.

A Global Ocean Observing System is required to sustainably provide the necessary information about our ocean environment. This need was recognized in 1993, when the IOC, WMO, UNEP and ICSU decided to establish the Global Ocean Observation System or GOOS to respond to the requirements expressed by the Intergovernmental Panel on Climate Change in 1990, and the first Rio Conference.

The purpose of such an observing system is to enable the state of the ocean to be described, its changing conditions to be forecast, and its effects on climate to be predicted, as well as to facilitate sustainable development by ocean users and managers.



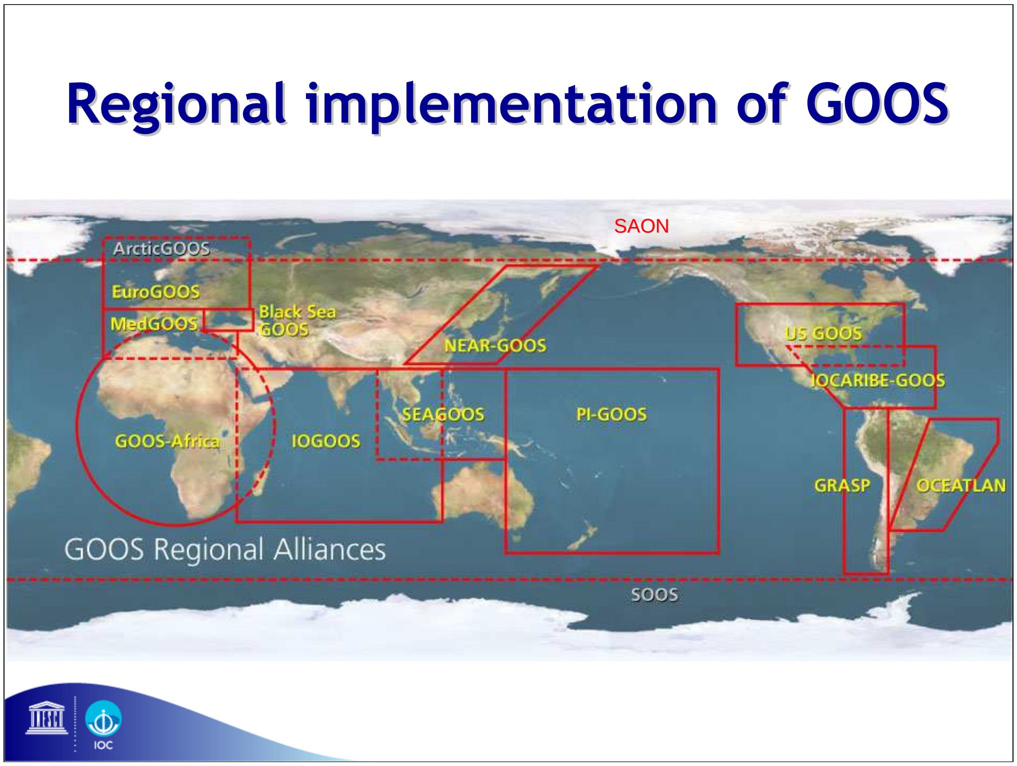
GOOS is quite a complex system, and you can see here a graphic of its in situ components. It is made up of observations from many different types of platforms: research and volunteer ships, moorings, profiling floats, surface drifters and tide gauges. These are of course complemented by surface observations of the ocean physics and color from satellites.

The map in the center shows you a snapshot of where these observations are taken in the global ocean –as you can see, the North Atlantic is particularly well-observed compared to many other regions.

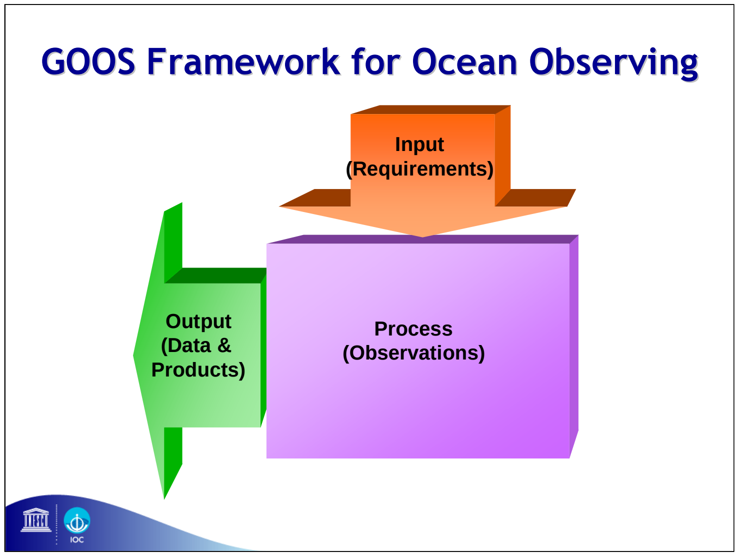
The observations themselves are funded by national research funding, and many of these networks are coordinated through the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) which identifies best practices and standards, and coordinates among observing networks.

The growth of a number of observing networks (particularly Argo, surface drifters, and tide gauges) has led to a strong rise over the last decade in implementation of this system, but other components have not grown to the requirements expressed by climate science, and implementation has stalled somewhat.

*There are measurements **from volunteer observing ships (VOS); from the global array of 1250 surface drifting floats** measuring temperature, near-surface currents and barometric pressure; from **the sea level observing system of tide gauges on the coasts**; **from a network of Ships-of-Opportunity**; from **the Argo profiling float network**, the **GO-SHIP repeat hydrography lines** for physical, carbon, and biogeochemical variables extending to the deep ocea;, from the tropical moored arrays in the Pacific, the Atlantic, and the Indian Ocean, and the OceanSITES-coordinated network of time series sites at moorings, and key transport measurements.*



Implementation of many elements of GOOS will invariably be funded on the local or national level, and reflect the local and national priorities. But promotion of global standards and of data sharing will allow for global research and regional and global assessments of the marine environment that will be key to better stewardship of the ocean, and sustained benefit from the ecosystem services it provides.



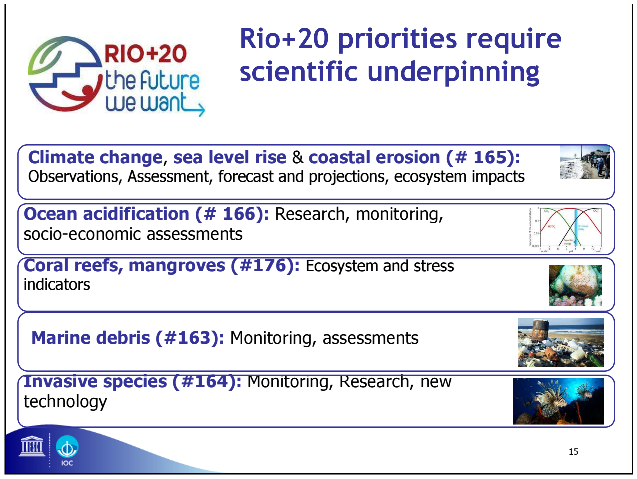
The Global Ocean Observing System is active in defining consensus requirements for observations that respond to different societal issues including:

- climate monitoring and prediction
- weather forecasting
- developing real-time ocean services
- understanding the health of ocean ecosystems and
- supporting ocean assessments like the UN World Ocean Assessment

It does a lot to coordinate global and regional ocean observing networks, to ensure that observations are distributed according to the requirements, are taken to common standards and using best practices, and that data are shared openly. GOOS works with partners to ensure data are managed and shared, and that information products useful for particular applications are being generated.

GOOS is constantly evaluating whether the outputs of the system, that is the data and information products, are fit-for-purpose against the stated societal requirements, and identifying plans to improve globally or regionally.

A central concept of the Framework is that the nations of the world cannot afford multiple ocean observing systems, each responding to different expressed requirements, and that one integrated system that responds to many different requirements will be far more fruitful.



In its future developments, GOOS and other international programmes will be important for informing the ocean priorities that have been identified in the Rio+20 outcome document, since most if not all require a strong scientific underpinning.

Very succinctly:

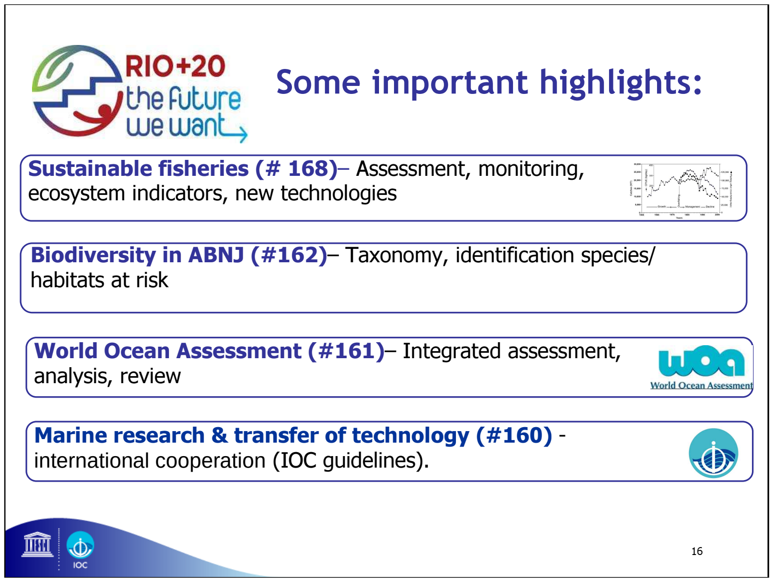
Climate change, **sea level rise** & **coastal erosion:** will require ocean observations, vulnerability assessments, the development of forecasts and projections, ecosystem impacts

Ocean acidification: will require inter-disciplinary research, monitoring, and socio-economic assessments

Coral reefs, mangroves: will require Ecosystem and stress indicators,

The problem of Marine debris: will require monitoring and assessments, and

Dealing with Invasive species: will require monitoring, research, and investment in new technology



Likewise**, Sustainable fisheries** –must be based on reliable stock Assessments, monitoring, ecosystem indicators, and new technologies;

Biodiversity in ABNJ – requires Taxonomy, identification of species and habitats at risk, and the development of environmental impact assessment procedures;

The **World Ocean Assessment** – which is itself a scientific Integrated assessment, will require definition of quantitative indicators to provide a baseline for future assessments as well as strong scientific review; and

Marine research & transfer of technology , will require not just international cooperation and the application of the IOC guidelines on this subject, but also observation and monitoring of progress.

The same is true if a dedicated Ocean Sustainable Development Goal emerges from the ongoing negotiation, *observations will be critical for monitoring progress*.

I would like to finish by recalling the importance of delivering scientific products that are credible and policy relevant.

The science-policy gap remains a challenge that agencies, governments, and institutions face in taking the information that the scientists are providing to them, and turning that information into reasoned and rational discourse combined with sound operational strategy. At both national and international levels, we need to strengthen the existing science-policy interactions.

At the international level, we need to ensure that the best available scientific information feeds the existing global assessment processes related to the ocean…whether it be the climate focused IPCC, SOFIA, focusing on state of fisheries and aquaculture, or IPBES focusing on biodiversity and ecosystem services. We also need to make sure that these processes are coordinated, and that synergies are built across the different dimensions they are addressing.

If we manage to do this, we will be able to provide accurate information to decision makers on the state of the marine environment, and to enhance the dialogue on ocean research and policy needs worldwide.

We must act now for
The Future We Want…

ioc.unesco.org

I thank you for your attention – muchas gracias por su atención