

# IOC-R: A vision of Coordinated Ocean Carbon Research and Observations for the Next Decade

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There were many contributors to this effort, including participants of an international workshop held last year and other experts in the community who shared their ideas and insights.

Integrated Ocean Carbon Research (IOC-R)  
A formal IOC working group sponsored by:



# Global Research Programs where ocean carbon is only one part of their mission



GCP is focused on carbon, but not just ocean



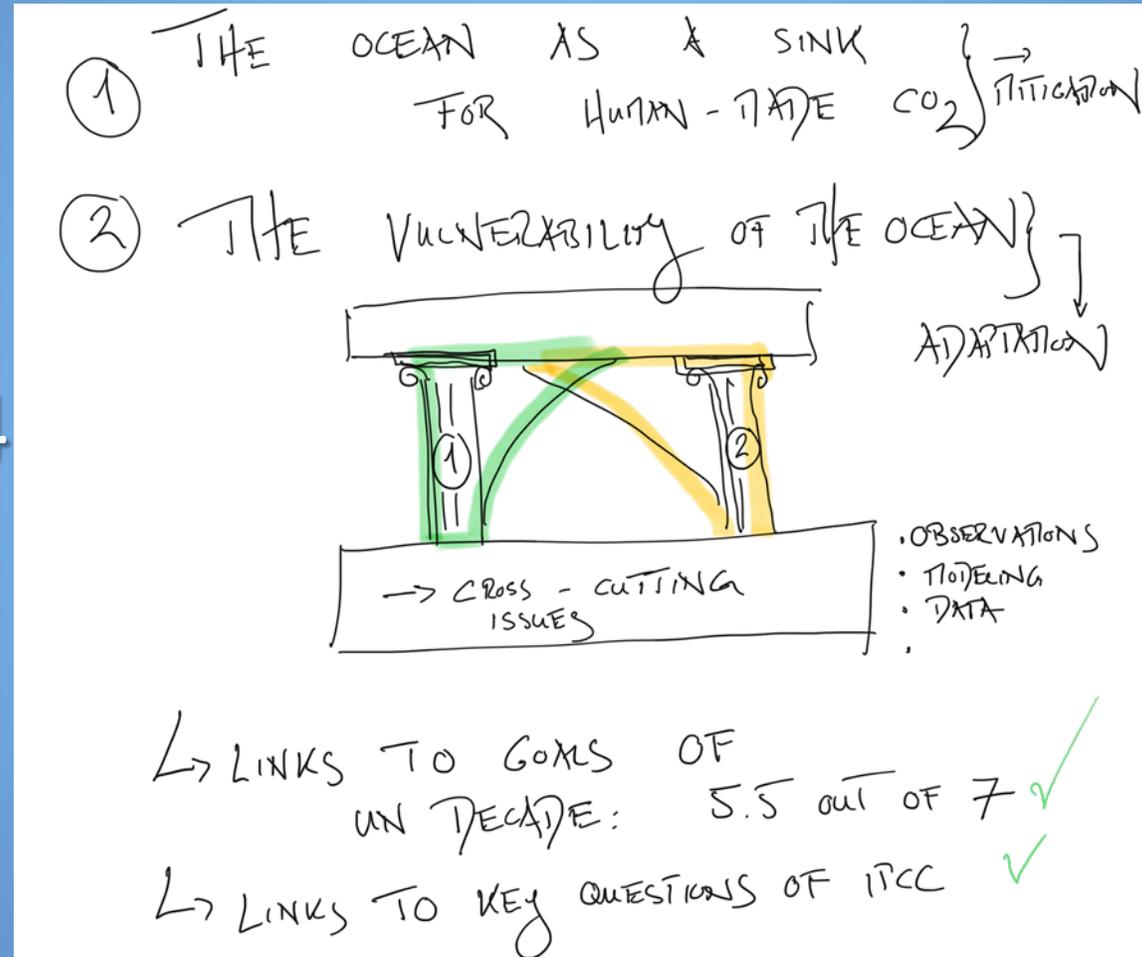
IOCCP coordinates ocean carbon observations, but is not a research program



# Expert Workshop on Integrated Ocean Carbon Research

IOC-UNESCO Headquarters, Paris, France

Oct. 28-30, 2019

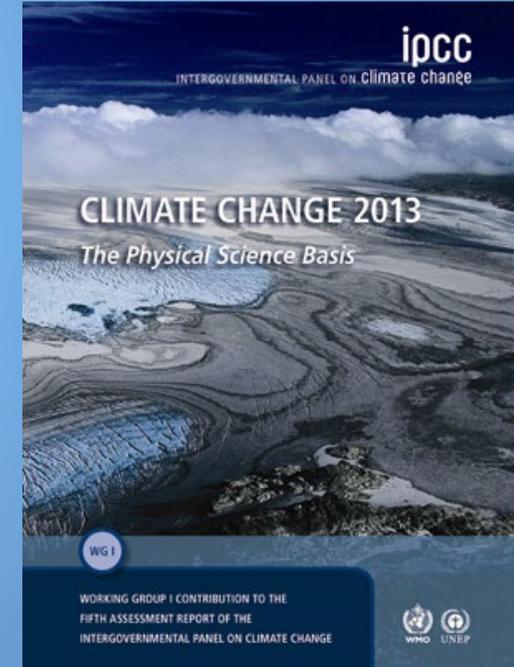
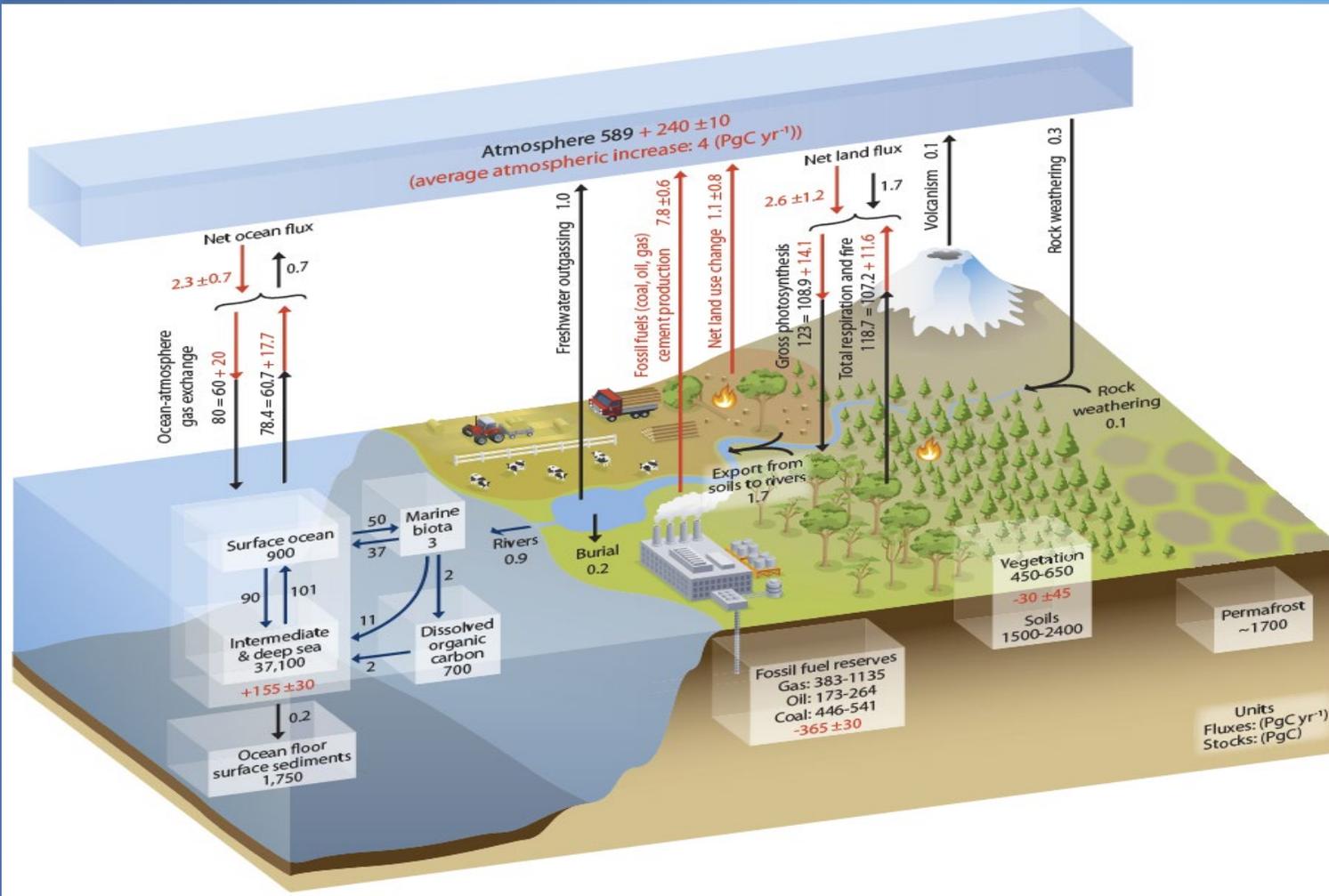


Participants: 34  
Countries: 16

**Mission:** The Integrated Ocean Carbon Research (IOC-R) effort aims to address key issues in ocean carbon research through a strategy of research and observational goals.

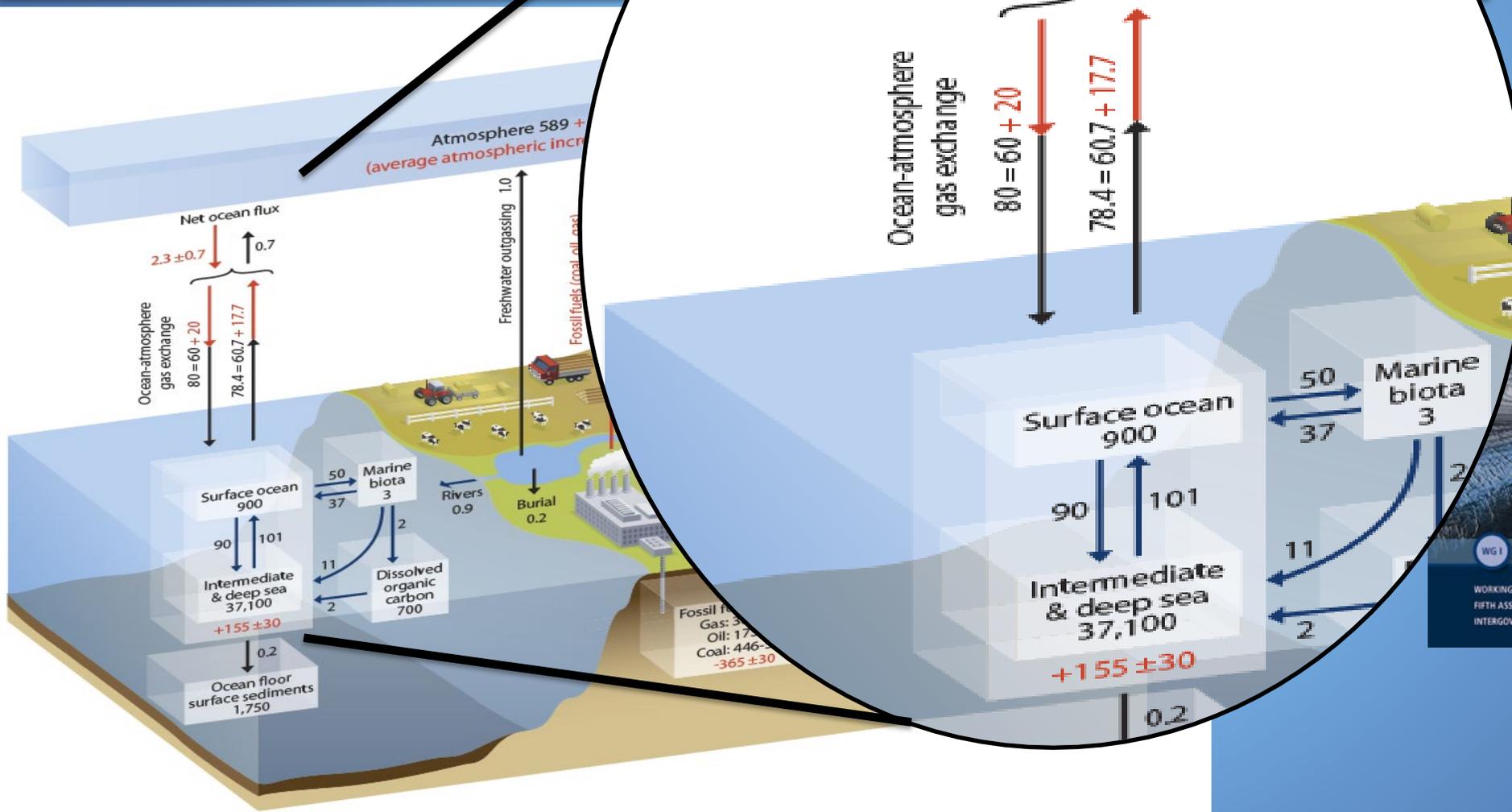
# Four Key Questions:

1. Will the ocean uptake of anthropogenic CO<sub>2</sub> continue as primarily an abiotic process?



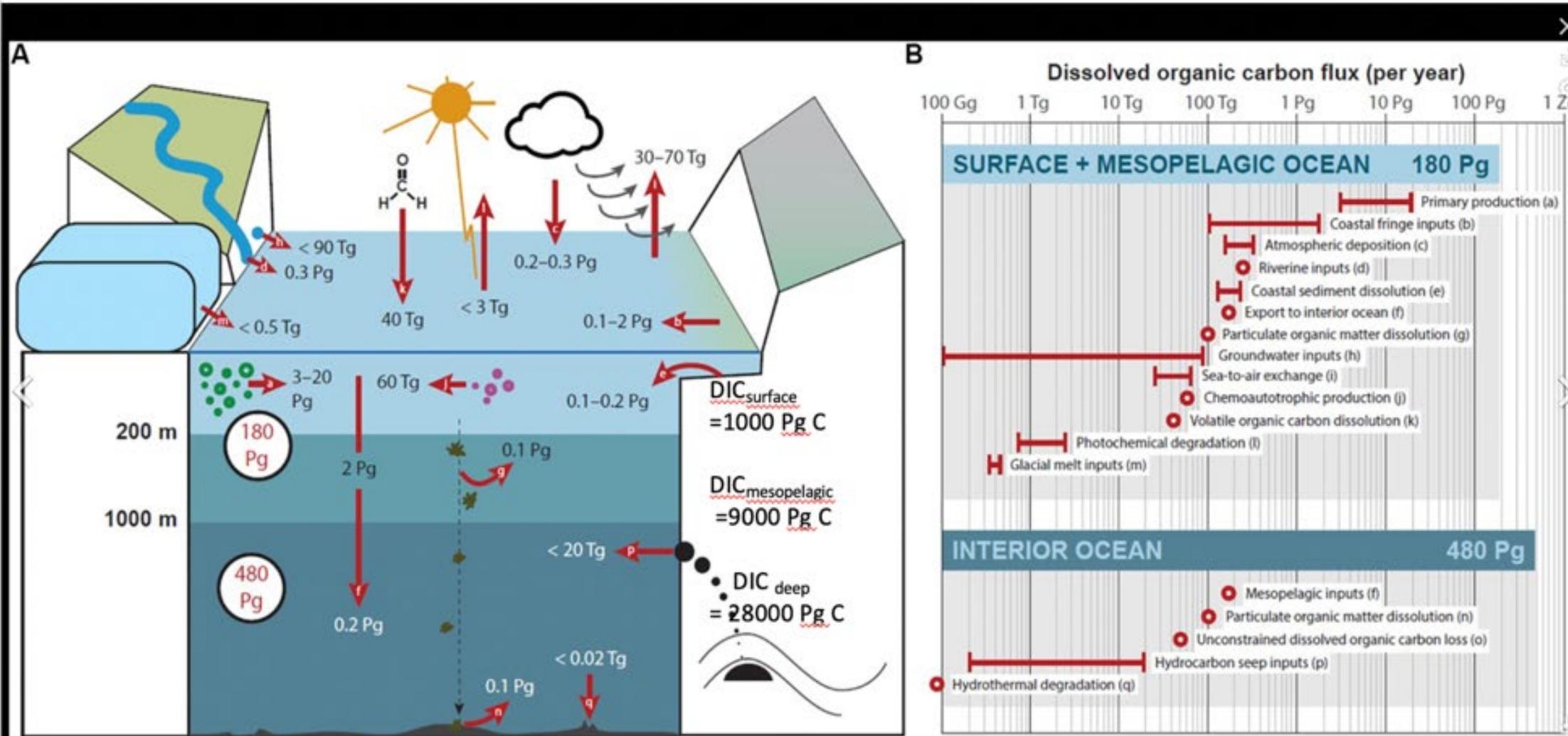
# Four Key Processes:

1. Will the ocean uptake of CO<sub>2</sub> be primarily an abiotic process?



# Four Key Questions:

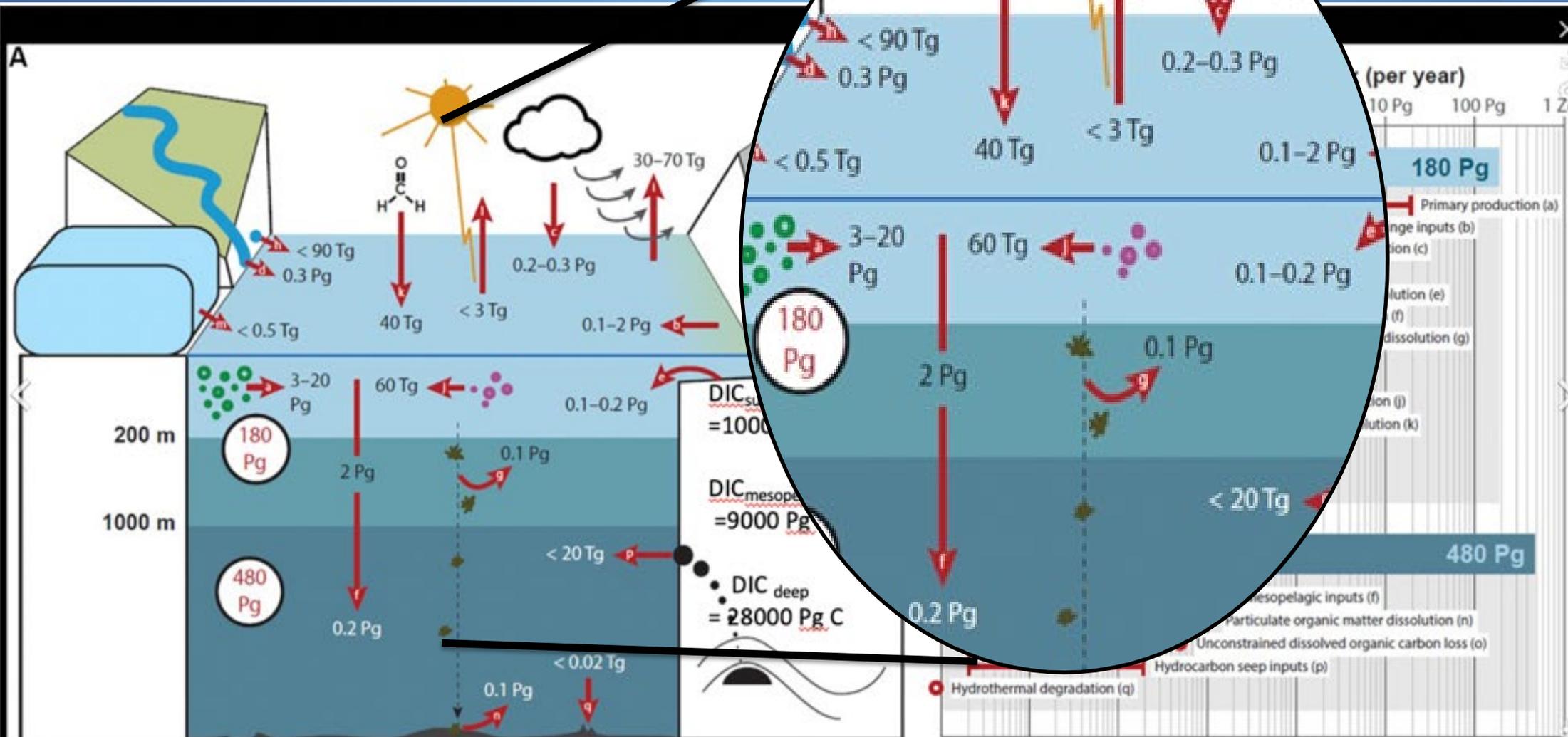
2. What is the (changing) role of biology in the ocean carbon cycle?



from Wagner et al., 2020

# Four Key Questions:

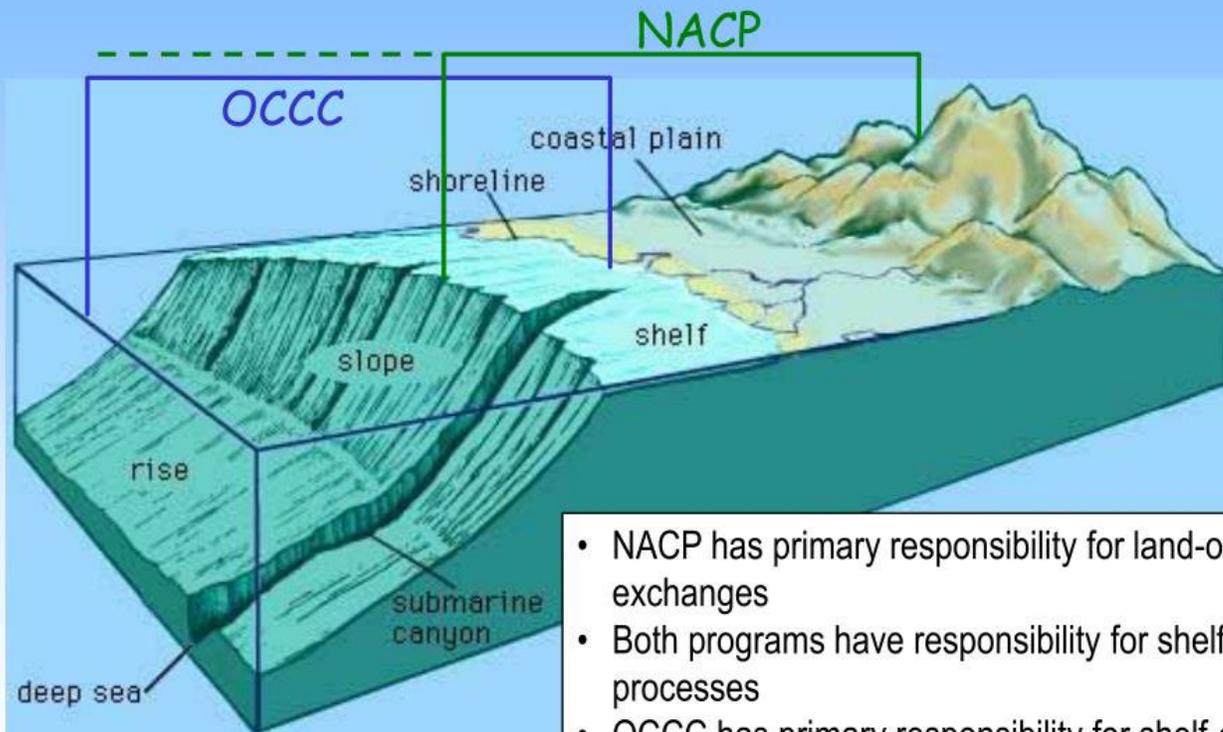
2. What is the (changing) role of biology in the carbon cycle?



# Four Key Questions:

3. What are the exchanges of carbon between the land-ocean-ice continuum?

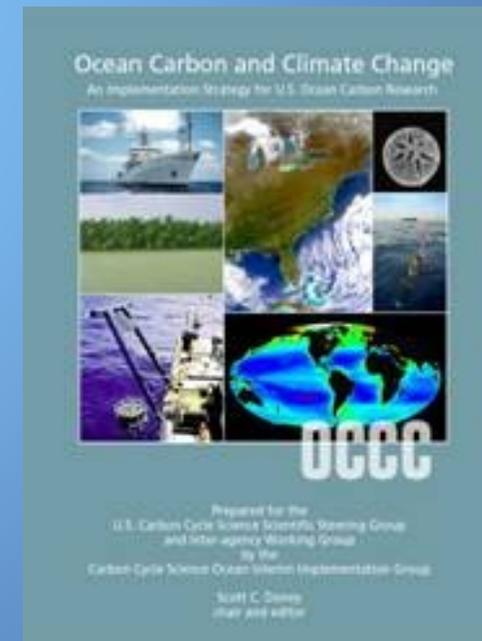
**Coordinate NACP and OCCC to give a continuum from dry land to the open ocean**



- NACP has primary responsibility for land-ocean exchanges
- Both programs have responsibility for shelf processes
- OCCC has primary responsibility for shelf-open ocean exchanges



**North American Carbon Program**

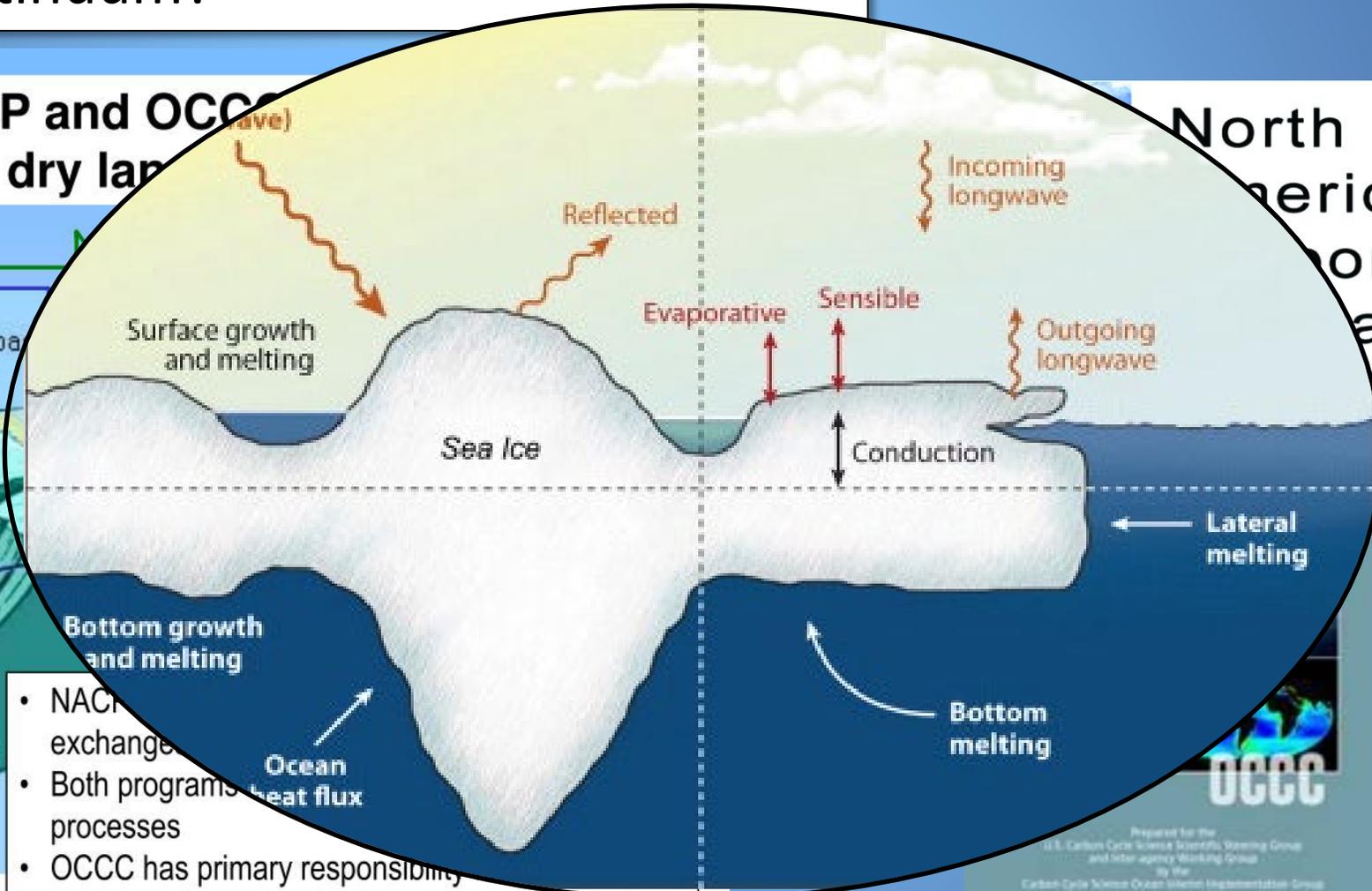
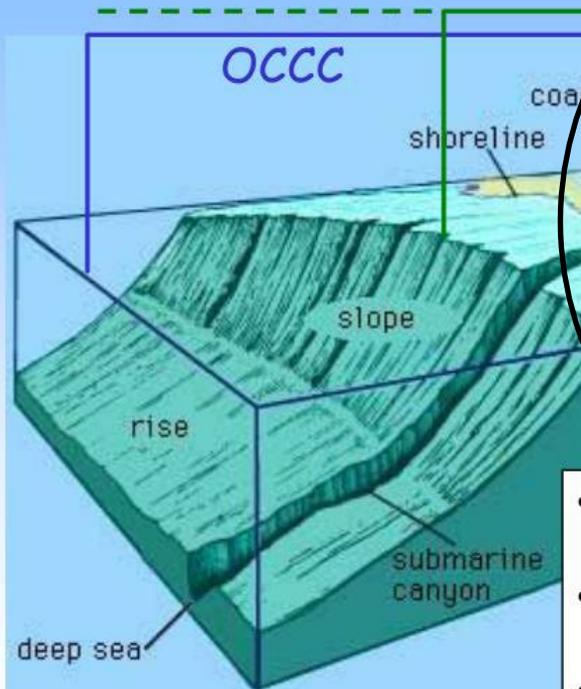


# Four Key Questions:

3. What are the exchanges of carbon between the land-ocean-ice continuum?

Coordinate NACP and OCCC  
continuum from dry land

North  
American  
on  
am



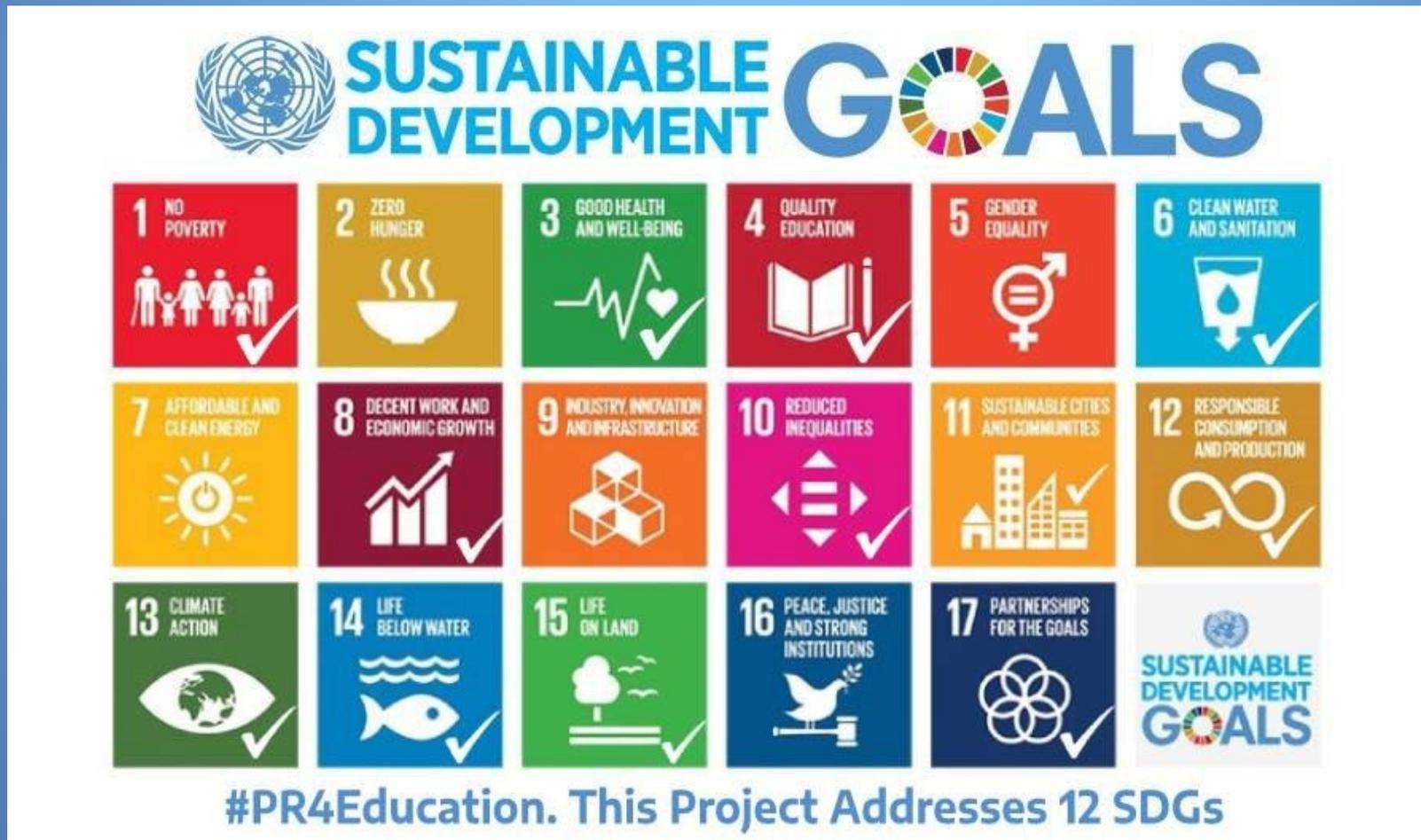
- NACP exchanges
- Both programs processes
- OCCC has primary responsibility ocean exchanges



Prepared for the  
U.S. Carbon Cycle Science Scientific Steering Group  
and Inter-agency Working Group  
by the  
Carbon Cycle Science Ocean Sciences Implementation Group  
Scott C. Doney  
Chair and editor

# Four Key Questions:

4. How are humans altering the ocean carbon cycle and resulting feedbacks?



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4. How are humans altering the ocean carbon cycle and resulting feedbacks?





## Omnibus Resolution for Oceans and the law of the sea (A/RES/72/73) of 6 December 2017

- Proclaimed the UN Decade of Ocean Science for Sustainable Development 2021-2030 and called upon the IOC to prepare an implementation plan for the Decade in consultation with [multiple stakeholders]
- Invited the UN SG to inform the UNGA about the implementation of the Decade through his report on oceans and the law of the sea based on information provided by IOC



# Ocean Decade: Societal outcomes and Science challenges

## Ocean Decade Challenges



Understand and map land and sea-based sources of pollutants and contaminants and their potential impacts on human health and ocean ecosystems, and develop solutions to remove or mitigate them.



Understand the effects of multiple stressors on ocean ecosystems, and develop solutions to monitor, protect, manage and restore ecosystems and their biodiversity under changing environmental, social and climate conditions.



Generate knowledge, support innovation, and develop solutions to optimise the role of the ocean in sustainably feeding the world's population under changing environmental, social and climate conditions.



Generate knowledge, support innovation, and develop solutions for equitable and sustainable development of the ocean economy under changing environmental, social and climate conditions.



Enhance understanding of the ocean-climate nexus and generate knowledge and solutions to mitigate, adapt and build resilience to the effects of climate change across all geographies and at all scales, and to improve services including predictions for the ocean, climate and weather.



Enhance multi-hazard early warning services for all geophysical, ecological, biological, weather, climate and anthropogenic related ocean and coastal hazards, and mainstream community preparedness and resilience.



Ensure a sustainable ocean observing system across all ocean basins that delivers accessible, timely, and actionable data and information to all users.



Through multi-stakeholder collaboration, develop a comprehensive digital representation of the ocean, including a dynamic ocean map, which provides free and open access for exploring, discovering, and visualizing past, current, and future ocean conditions in a manner relevant to diverse stakeholders.



Ensure comprehensive capacity development and equitable access to data, information, knowledge and technology across all aspects of ocean science and for all stakeholders.



Ensure that the multiple values and services of the ocean for human wellbeing, culture, and sustainable development are widely understood, and identify and overcome barriers to behaviour change required for a step change in humanity's relationship with the ocean.

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# Science - Society Framework for IOCR



Assessments Framework

**Assessments**  
 Global and Regional  
 Carbon & Climate  
 Carbon Mitigation  
 Adaptation Risks: OA  
 Multi-stressor  
 biogeochemistry

IPCC/ SBSTA /IPBES  
 /GCB/RECCAP

**Mitigation, Adaptation and Risk**  
 Carbon – Climate Feedbacks  
 Negative Emissions - CDR  
 Abrupt Change / Tipping Points  
 Ocean Acidification  
 Extreme events; Multi-stressors

**Co-design Science**  
 Carbon – climate - ecosystems  
 Early warnings; Extreme events  
 Coordination; Requirements



2021-2030 United Nations Decade  
 of Ocean Science  
 for Sustainable Development

SDG14

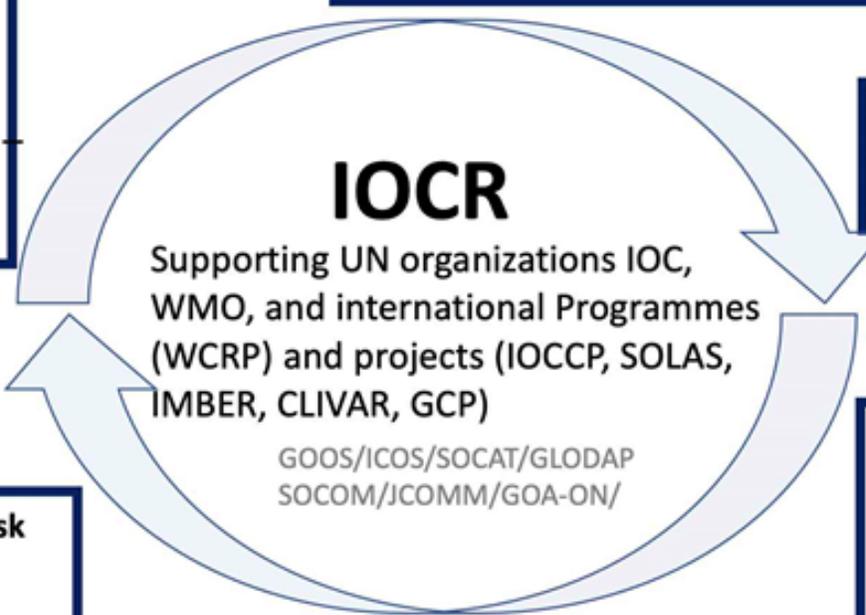


Enabling and coordination framework

**Sustained Integrated  
 observing systems -  
 Models - Products**

**Understanding Ocean  
 Carbon Processes Physical  
 and Biological Carbon  
 Pumps - Climate – Human  
 influence**

**Variability and Prediction**  
 Interannual – Decadal  
 Regional – Global  
 Coupled Models



**IOCR**  
 Supporting UN organizations IOC,  
 WMO, and international Programmes  
 (WCRP) and projects (IOCCP, SOLAS,  
 IMBER, CLIVAR, GCP)

GOOS/ICOS/SOCAT/GLODAP  
 SOCOM/JCOMM/GOA-ON/



# Approaches

- Strengthen sustained financial support for observing networks
- Enhance and coordinate the existing suite of carbon observing and synthesis projects
- Develop regional priorities
- Consider what new process studies and experiments are needed
- Identify new technologies to enhance autonomous observations and analyses
- Emphasize the integration of models and observations
- Consider the ocean's role in climate solutions- mitigation approaches
- Propose governance for the Integrated Carbon Research (IOC-R) program



United Nations  
Educational, Scientific and  
Cultural Organization



Intergovernmental  
Oceanographic  
Commission



2021  
2030 United Nations Decade  
of Ocean Science  
for Sustainable Development

***One Planet, One Ocean***

Thank You  
For  
Your Time