The critical role of ocean science in responding to climate change

A call from the ocean research community

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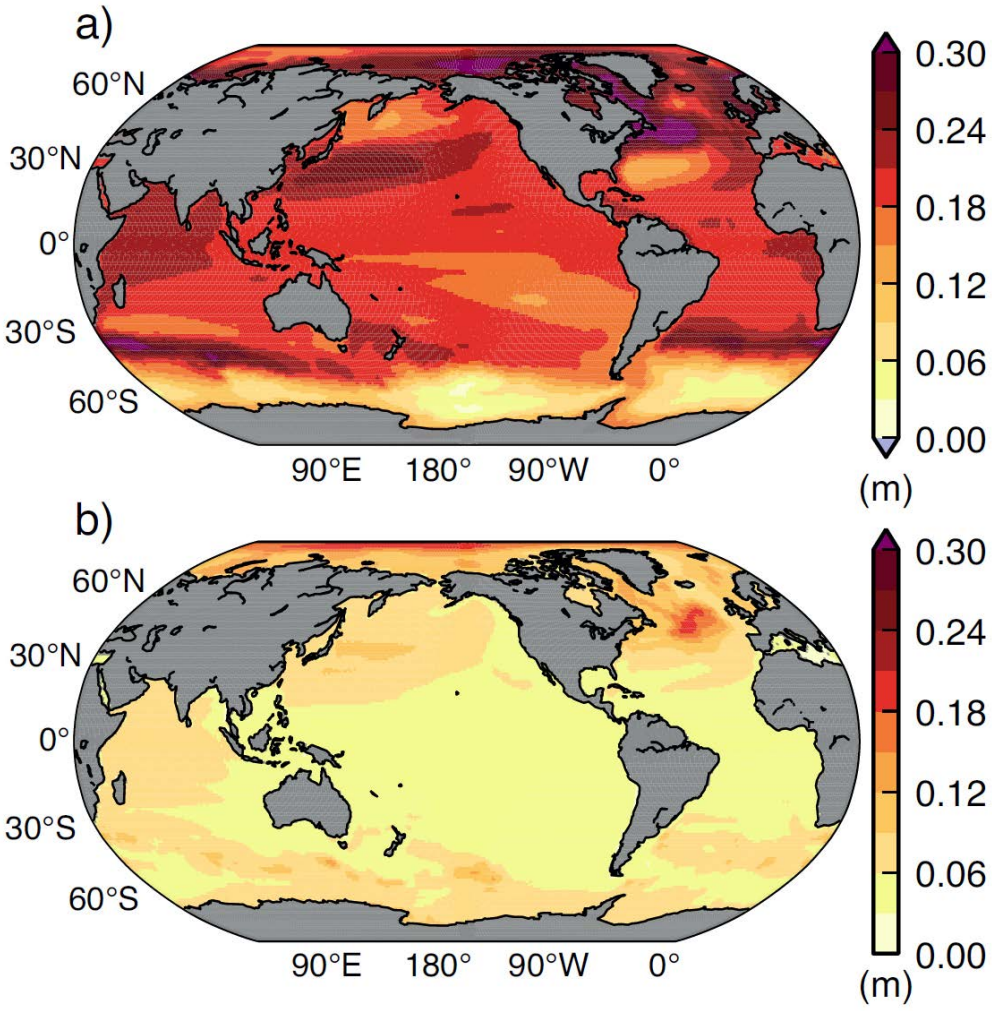
European Marine Board and

Consortium for Ocean Leadership

Key role of the ocean

- The ocean is a key component of the global climate system.
- Climate change alters physical, chemical, and biological properties of the ocean. Marine ecosystems have responded and will continue to respond to these changes.
- Human societies depend on ocean services, which are sensitive to climate change.
- Successful adaptation and mitigation strategies must consider the ocean.

Key uncertainties remain



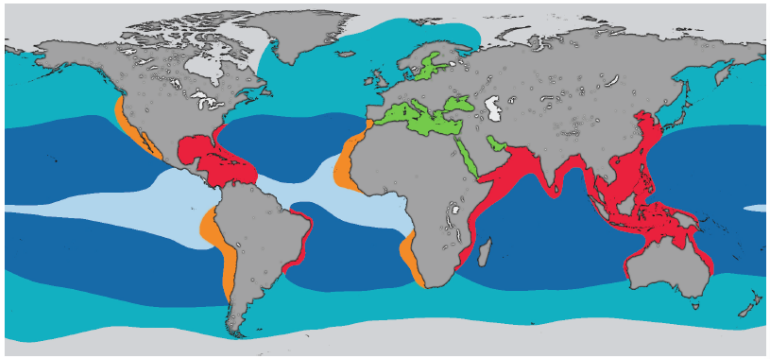
Projected sea-level change over the 21st century

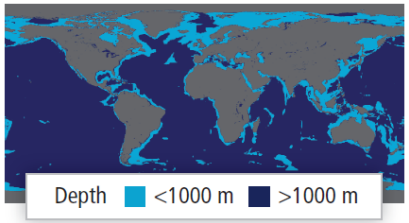
Uncertainty (model spread)

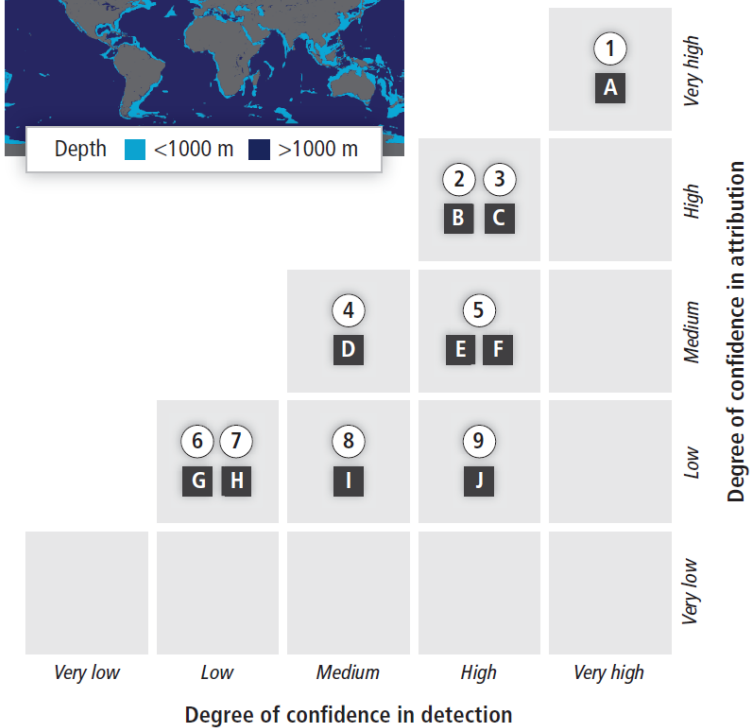
RCP4.5, 21 models, RMS spread

IPCC AR5 WG I, Fig. 13.16

Key uncertainties remain







High-Latitude Spring Bloom Systems (HLSBS)
Semi-Enclosed Seas (SES)
Coastal Boundary Systems (CBS)
Eastern Boundary Upwelling Systems (EBUE)
Equatorial Upwelling Systems (EUS)
Subtropical Gyres (STG)
Deep Sea (DS)

Physical and chemical systems

1. Increased ocean temperature and decreased pH (WGI Sections 3.2, 3.8, 10.4; WGII Sections 30.3.1–2, 30.5)
2. Decrease in dissolved oxygen (WGI Sections 3.8, 10.4, 30.3.2)
3. Increase in temperature extremes (WGI Sections 30.3.2, WGII Sections 30.3.1, 30.5.3–4)
4. Increased water column stratification and reduced ocean mixing and ventilation (WGI Section 3.8; WGII Section 30.3.1)
5. Decreased Deep Sea dissolved oxygen and pH (Sections 30.3.2, 30.5.7)
6. Increased upwelling (Sections 30.5.5, 30.5.2)
7. Changes in wind and wave stress (Sections 30.3.1, 30.5.1, 30.5.6)
8. Increase in hypoxic areas (Sections 30.5.3–5)
9. Expansion of low-productivity waters (WGI Section 3.8.4; WGII Section 30.5.6)

Biological systems

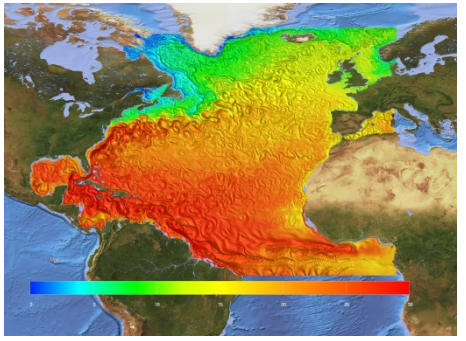
A. Coral bleaching and mortality (Sections 30.5.3–4, 30.5.6, Box CC-CR)
B. Changes in distribution of tuna stocks (Section 30.5.6)
C. Poleward expansion of distributions of plankton communities (Section 30.5.1)
D. Redistribution of marine plants and animals to higher latitudes (Sections 30.4, 30.5.1–6, Box CC-MB)
E. Increased fisheries catch potential (Section 30.5.1, Box CC-MB)
F. Decreased fisheries catch potential (Sections 30.5.3–4, 30.5.6, Box CC-MB)
G. Changes to net primary productivity (Box CC-PP)
H. Changes to Deep Sea ecosystems (Section 30. 5.7)
I. Changes to reproduction and migration (Sections 30.4, 30.5.1–6)
J. Decreased calcification (Sections 30.5.3–4, 30.5.6, Box CC-OA)

IPCC AR5 WG II, Fig. 30.11

Emerging issues, data gaps, and research needs

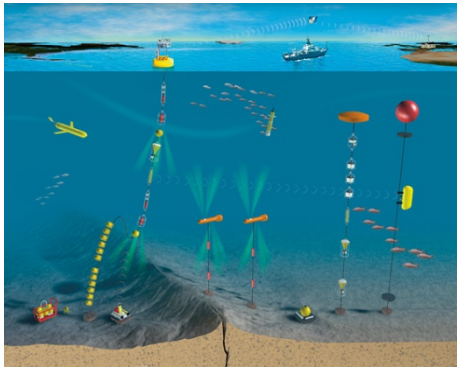
THE OCEAN CLIMATE NEXUS

- Insufficient understanding of some key processes, e.g.,
  - mixing in the ocean interior
  - interactions between ecosystem functioning and biodiversity



- Sustaining and enhancing the ocean observing system
  - integrating biogeochemical and biological observations
  - improving coverage (space and time)
  - filling gaps in the deep ocean

- Combining advanced models with observations
- International cooperation



Towards more reliable projections

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