DOSI
DEEP-OCEAN STEWARDSHIP INITIATIVE

INFORMATIONSHEET

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Identifying Deep Ocean Science Gaps for Understanding and Monitoring Climate Change

The Intergovernmental Panel on Climate Change (IPCC) reports provide the most comprehensive assessment of present and future climate change, its causes, potential impacts and response options. They principally focus on what is known with high-to-medium confidence and de-emphasize lesser-known or more uncertain processes. This skewness in reporting is exacerbated in the 'Summary for Policymakers', with the aim of supporting straightforward decision making but resulting in the **critical omission of potential high-impact low-confidence issues.**

The deep ocean provides critical climate regulation, houses a wealth of mineral and genetic resources, and is a vast repository for biodiversity. Due to logistical and technological challenges hindering observation, however, many climate-relevant deep ocean processes are known only with low confidence levels. The result is that **the deep ocean is underrepresented in policy considerations and critical research needs are shielded from view.**

Our aims are to (1) identify key research priorities to improve IPCC confidence levels in deep ocean systems, and **(2)** encourage better representation of low-confidence high-impact deep ocean processes in the communication of IPCC results to policymakers. Addressing these aims will ensure accelerated improvement of climate predictions and informed climate change mitigation efforts.

In a DOOS/DOSI-led effort, 25 researchers reviewed ~4,000 pages of IPCC AR6 cycle reports to assess all statements of "low confidence" related to the deep ocean. By categorizing these major climate-relevant knowledge gaps, we are seeking to highlight key areas where coordinated effort within the science community will improve confidence for AR7. The **165 deep-ocean related "low confidence" statements identified account for ~30% of the total "low confidence" entries in the AR6 chapters reviewed** (4098 pages of 7641 total) and highlight critical knowledge gaps across all ocean disciplines.

Major Causes of Low Confidence: Most of the "low confidence" statements were not explained (37%) or were due to either a limited number of studies (28%) or a lack of observations (20%).

Examples of Critical Deep Ocean Science Gaps Identified in Our Study

PHYSICAL	BIOGEOCHEMICAL	BIOLOGICAL
Ongoing rate of Atlantic Meridional Overturning Circulation weakening	Effectiveness of ocean fertilization or alkalinity enhancement	Range shifts associated with warming
Impacts to ocean upwelling and downwelling systems	Changes in oceanic N2O production in response to expanding oxygen minimum zones	Changes in primary and secondary production trajectories (which fuels deep-ocean food webs)
Changes to Southern Ocean circulation and watermasses, including contribtions to basal ice sheet melting	Changes to ocean sediment carbon burial (constituting positive or negative climate feedbacks)	Energetic consequences of acidification
	Impacts to ocean biological pump	Impacts of mCDR on biodiversity and ecosystem services

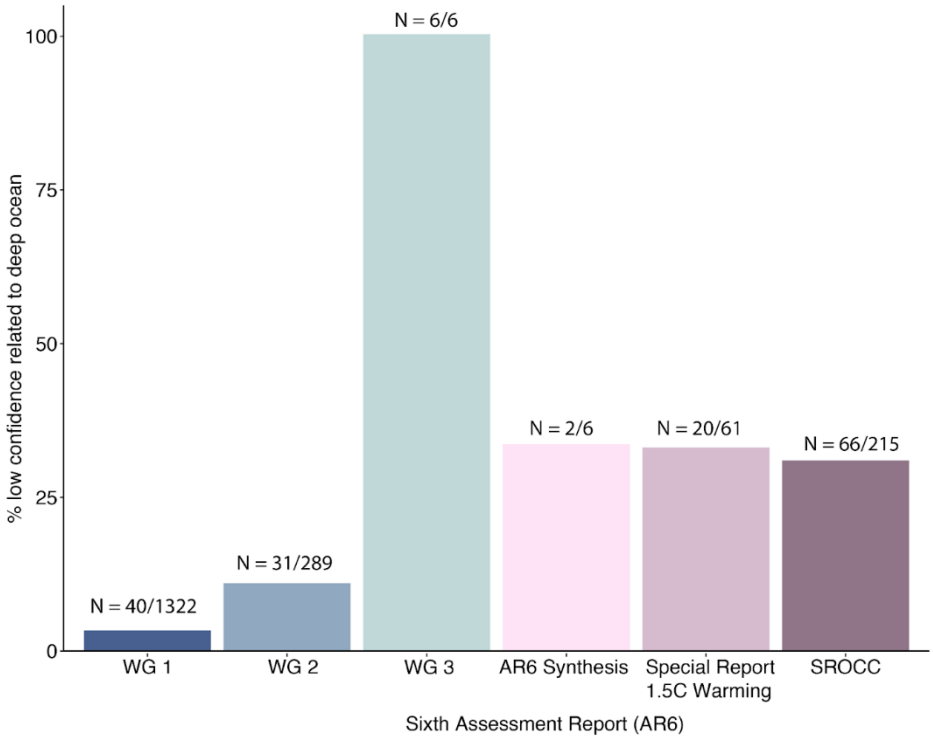

Fig 1: The percentage of total "low confidence" statements related to the deep ocean in reviewed chapters of six IPCC AR6 cycle reports.

Working Group 3 (WG3) focuses on climate solutions. Our analysis suggests that the climate solutions space is fraught with uncertainty when it comes to mitigation actions that impact the deep ocean.

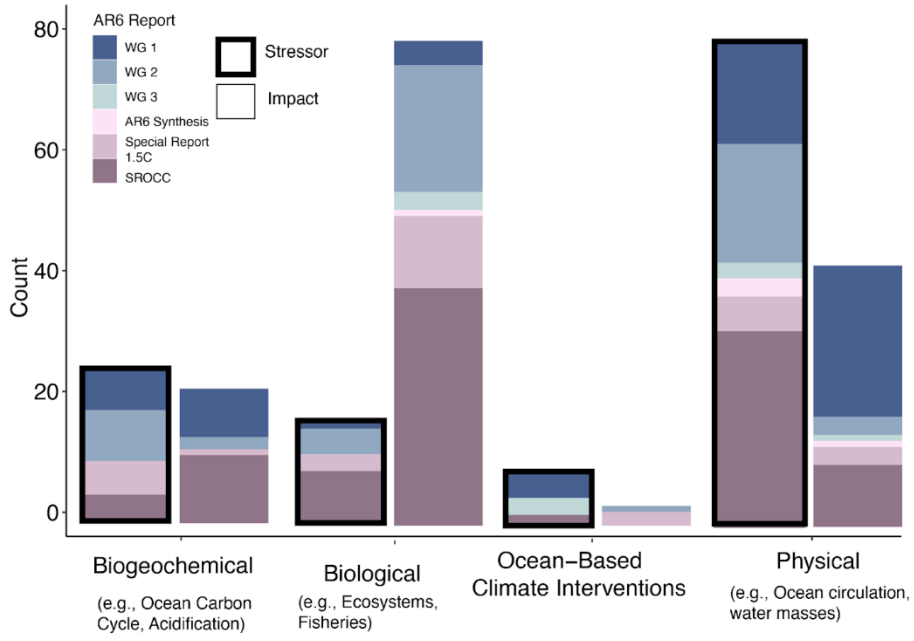

Fig 2: Many "low confidence" statements were associated with specific stressors and impacts.

Physical parameters were the most frequently-identified stressors among the low confidence designations. These stressors included but were not limited to ocean warming and circulation changes. The highest number of impacts were associated with biology, partly due to propagation of uncertainty from the physical and biogeochemical states. Critically, a significant fraction of this uncertainty stems from an unknown origin, but impacts included fundamental aspects of deep ocean biology including range shifts and biomass trends for key species. These results may also highlight biases, such as where some emerging topics such as Ocean-Based Climate Interventions (OBCIs) are seldom mentioned in the reports.

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