A REMINDER FOR THE BLUE COP - LIMITING WARMING TO 1.5°C CRUCIAL TO PROTECT OCEANS AND OCEAN SERVICES

Summary

Ocean systems are particularly vulnerable to climate change and are already heavily impacted today. This briefing provides an overview of the latest science including from the latest IPCC special reports on key risks for ocean systems including from sea-level rise, ocean acidification and impacts on marine and coastal ecosystems. The analysis underscores the need to limit warming below 1.5°C to limit impacts on ocean systems. It is clearer than ever that exceeding that warming level will fundamentally affect ocean systems and undermine any other attempts to protect them. Limiting warming to 1.5°C remains of paramount importance to safeguard the oceans.

Key climate risks for ocean systems

Sea-level rise

Sea-level rise as a result of anthropogenic climate change is a key impact affecting ocean and coastal systems. **If warming is not limited to around 1.5°C by 2100, we face a sea-level rise risk of more than 5 m 2300**([1]. Only limiting warming to 1.5°C gives us a chance to limit sea-level rise to around 1m in the long run[2].

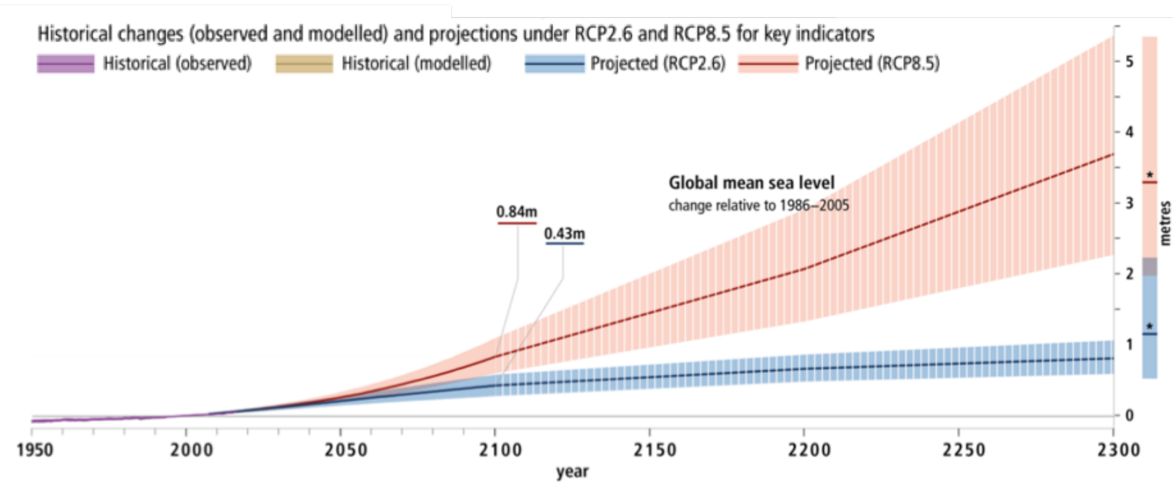

Figure 1: Observed and modelled historical changes in global mean sea level since 1950, and projected future changes under 'well below 2°C' (RCP2.6) and high (RCP8.5) greenhouse gas emissions scenarios. Extracted from IPCC SROCC Figure SPM.1.

Warming exceeding 1.5°C will greatly increase the probability of reaching critical **tipping points for the Greenland and Antarctic ice sheets**[3, 4]**. These tipping points are uncertain, but estimated to lie between 1.5°C and 2°C**[5]**.** Reaching such tipping points could lead to unstoppable multi-meter sea-level rise over centuries and millennia to come.

A rise in sea levels will lead to a steep increase in coastal flooding risks. **For many SIDS, local extreme sea levels that historically occurred once per century are projected to occur at least annually by 2050 under all future emission scenarios**[1]**.** Long-term risks from flooding are reduced under 1.5°C, but will still increase substantially. The drastic future increase in coastal flooding risks demonstrate the loss and damage inflicted by climate change even when warming is limited to 1.5°C.

Tipping points

Warming beyond 1.5°C strongly increases the risks of reaching critical tipping points of ocean systems. **About two-thirds of critical thresholds in ocean systems identified in climate models may be crossed under a 2°C warming - compared to about one-third under 1.5°C**[6].

The risk of exceeding critical thresholds for Arctic will increase for warming beyond 1.5°C. The chance of having an sea-ice free Arctic is projected to be around 1% if warming would be stabilised at 1.5°C, while it increases to 10–35% for stabilised global warming of 2°C[1], with very profound impacts on marine and coastal ecosystems as well as on the livelihoods of indigenous communities.

Extreme events

Tropical cyclones represent an existential threat to tropical islands and coastal communities. **Coastal hazards will be exacerbated by an increase in the average intensity, magnitude of storm surge and precipitation rates of tropical cyclones.** The average intensity of tropical cyclones, the proportion of Category 4 and 5 tropical cyclones and the associated average precipitation rates are already projected to increase under 2°C of warming[1], highlighting the need to aim for maximum warming levels of 1.5°C. Under 2.5°C of global warming, the most devastating storms are projected to occur up to twice as often as today[10].

Marine heatwaves severely affect coastal and ocean ecosystems, for example causing coral bleaching and mangrove decline. Marine heatwaves are projected to further increase in frequency, duration, spatial extent and intensity. **Under 2°C of warming, such heat waves would occur 20 times more often by the end of the 21st century compared to the second half of the 19th century**[1]**.**

Ocean acidification

As a result of anthropogenic CO_2 emissions, ocean acidification over the coming centuries could be higher than any time in the past 300 million years[7]. **If warming can be limited to 1.5°C, passing thresholds for widespread decline in aragonite, which is essential to marine calcifiers like corals, can be avoided for the 21st century**[1]. However, the impacts of ocean acidification over the next decades will leave a substantial legacy in the marine environment for centuries[8].

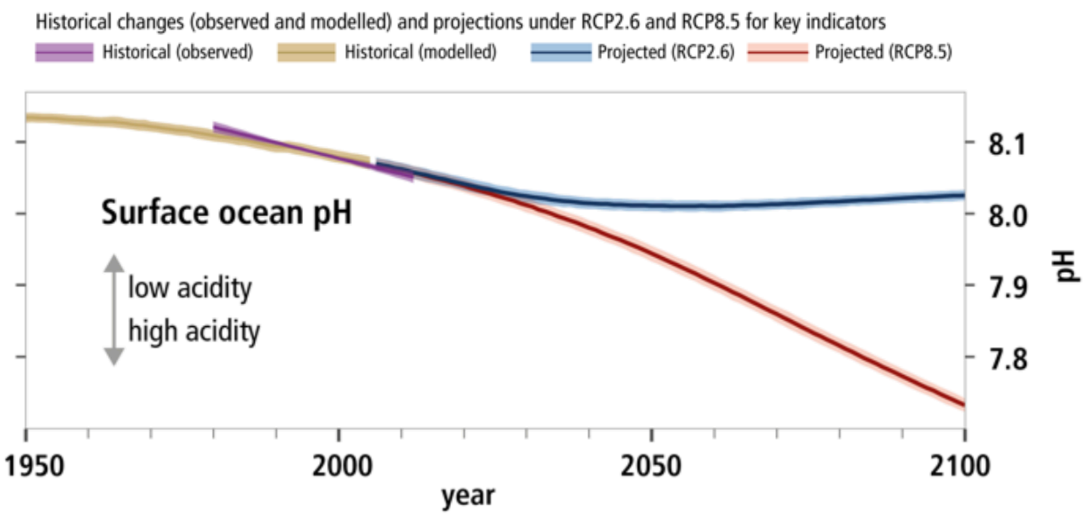

Figure 2: Observed and modelled historical changes in global surface ocean pH since 1950, and projected future changes under 'well below 2°C' (RCP2.6) and high (RCP8.5) greenhouse gas emissions scenarios. Extracted from IPCC SROCC Figure SPM.1.

Oxygen loss

Due to climate change, the oceans are losing oxygen which has severe consequences for marine life and vulnerable communities and fisheries[9]. **Projected rates of oceanic oxygen decline could be reduced dramatically, if global warming was limited to around 1.5°C**[1].

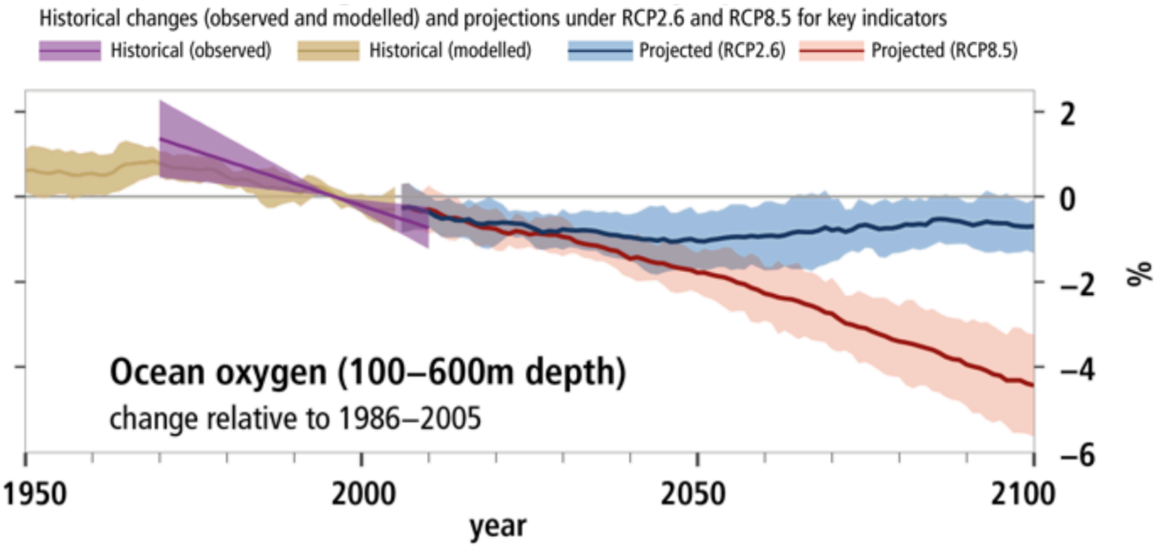

Figure 3: Observed and modelled historical changes in global ocean oxygen since 1950, and projected future changes under 'well below 2°C' (RCP2.6) and high (RCP8.5) greenhouse gas emissions scenarios. Extracted from IPCC SROCC Figure SPM.1.

Marine ecosystems

Rising sea levels will pose a severe risk for coastal ecosystems, like mangroves and salt marshes. Mangroves and sea grasses are vulnerable to a multitude of climate impacts, including ocean warming, ocean acidification, sea level rise and increased storminess[1], and recovery rates of these fragile ecosystems are slow[11]. Mangroves may be completely submerged before the end of the century in areas where sediment input is not sufficient for mangroves to grow in pace with sea-level rise[12], and the important ecosystem services they provide – including coastal protection – will be lost**. Climate impacts on coastal ecosystems will also fundamentally impact the ability of coastal ecosystem to sequester carbon**[13].

Already today, tropical coral reefs are substantially affected by bleaching as well as ocean acidification, and will not survive a warming of 2°C[1]**.** Limiting warming to 1.5°C will leave some chance for ecosystems to adapt, but the major parts of the current tropical coral cover will be lost still.

There are large benefits to marine fisheries of meeting the 1.5°C global warming target[14]**.** Benefits are largest for tropical regions. In the Indo-Pacific, reduction in maximum catch potential doubles between a warming of 1.5°C and 2°C. Under a warming pathway implied by current policies, Indo-Pacific maximum catch potential would be almost halved.

Warming beyond 1.5°C will fundamentally affect coastal and marine organisms and ecosystem services. A warming beyond 1.5˚C implies substantial risks for almost all key marine organisms and ecosystem services identified in the latest IPCC special reports[1, 5]**.**

References

1. IPCC (2019) Summary for Policymakers. *IPCC Special Report on the Ocean and Cryosphere in a Changing Climate*, eds Pörtner H-O, et al., p 42 pp.
2. Mengel M, Nauels A, Rogelj J, Schleussner C-F (2018) Committed sea-level rise under the Paris Agreement and the legacy of delayed mitigation action. *Nat Commun* 9(1):601.
3. Robinson A, Calov R, Ganopolski A (2012) Multistability and critical thresholds of the Greenland ice sheet. *Nat Clim Chang* 2(6):429–432.
4. DeConto RM, Pollard D (2016) Contribution of Antarctica to past and future sea-level rise. *Nature* 531(7596):591–597.
5. IPCC (2018) Summary for Policymakers. *Global Warming of 1.5°C. An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-Industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change,* ed Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor and TW (World Meteorological Organization, Geneva, Switzerland), p 32 pp.
6. Drijfhout S, et al. (2015) Catalogue of abrupt shifts in Intergovernmental Panel on Climate Change climate models. *Proc Natl Acad Sci* 112(43):E5777–E5786.
7. Caldeira K, Wickett ME (2003) Anthropogenic carbon and ocean pH. *Nature* 425(September):2003.
8. Mathesius S, Hofmann M, Caldeira K, Schellnhuber HJ (2015) Long-term response of oceans to CO_2 removal from the atmosphere. *Nat Clim Chang* 5(August):1107–1113.
9. Laffoley D, Baxter JM (2019) *IUCN - Ocean deoxygenation: Everyone's problem - Causes, impacts, consequences and solutions.* eds Laffoley D, Baxter JM.
10. Bacmeister JT, et al. (2016) Projected changes in tropical cyclone activity under future warming scenarios using a high-resolution climate model. *Clim Change*:1–14.
11. Macreadie PI, et al. (2015) Losses and recovery of organic carbon from a seagrass ecosystem following disturbance. *Proceedings Biol Sci* 282(1817):20151537.
12. Lovelock CE, et al. (2015) The vulnerability of Indo-Pacific mangrove forests to sea-level rise. *Nature* 526:559.
13. Fyson C, Schleußner C-F, Hare WL (2019) *The dangers of blue carbon offsets: from hot air to hot water?*
14. Cheung WWL, Reygondeau G, Frölicher TL (2016) Large benefits to marine fisheries of meeting the 1.5°C global warming target. *Science (80-)* 354(6319):1591–1594.