

#SROCC

The Ocean and Cryosphere in a Changing Climate

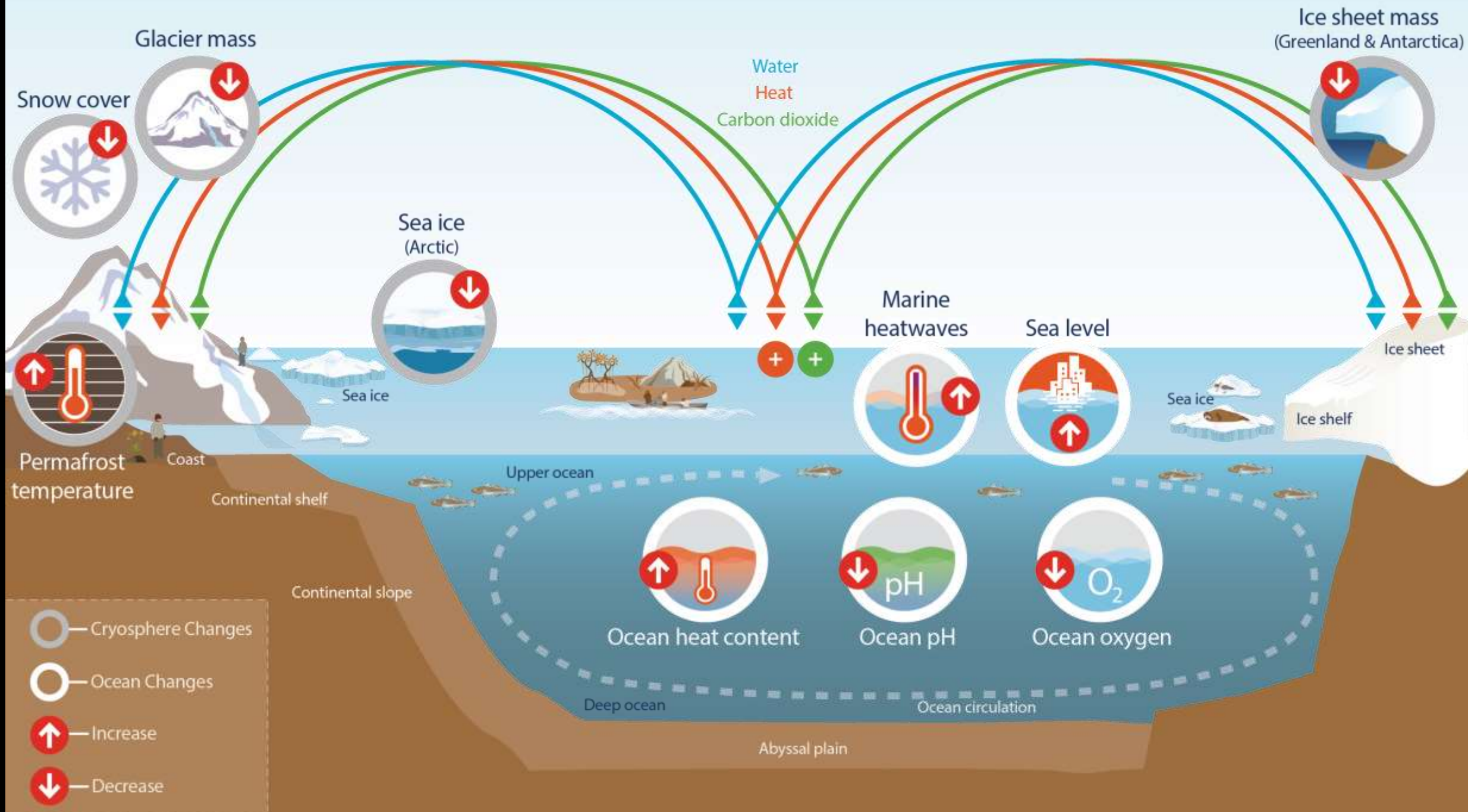
Oceanographic changes: Ocean warming, sea level rise, ocean acidification and ocean deoxygenation



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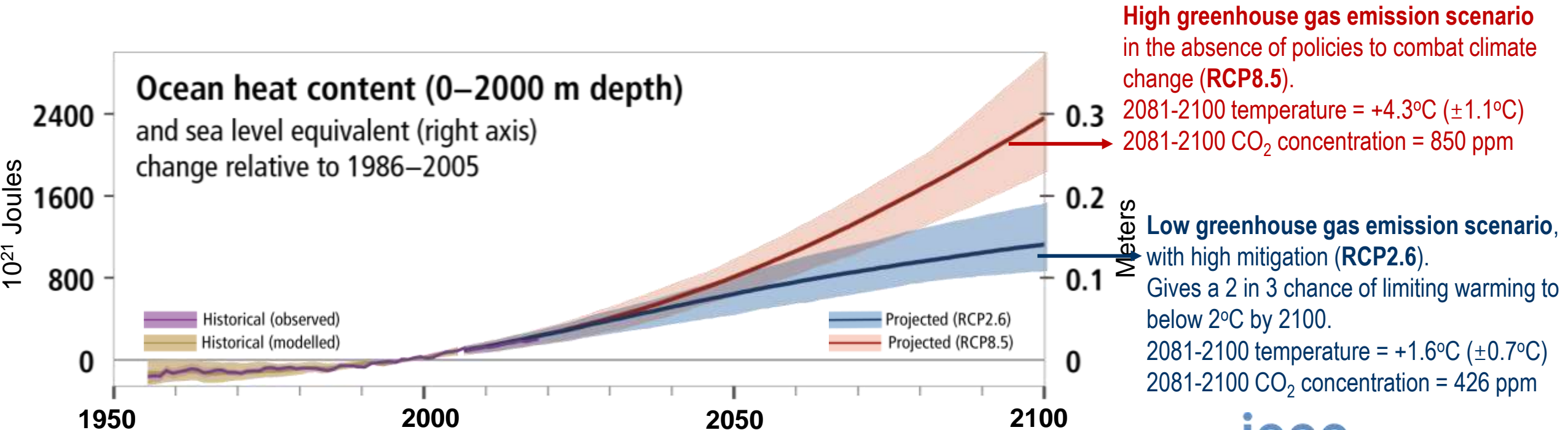






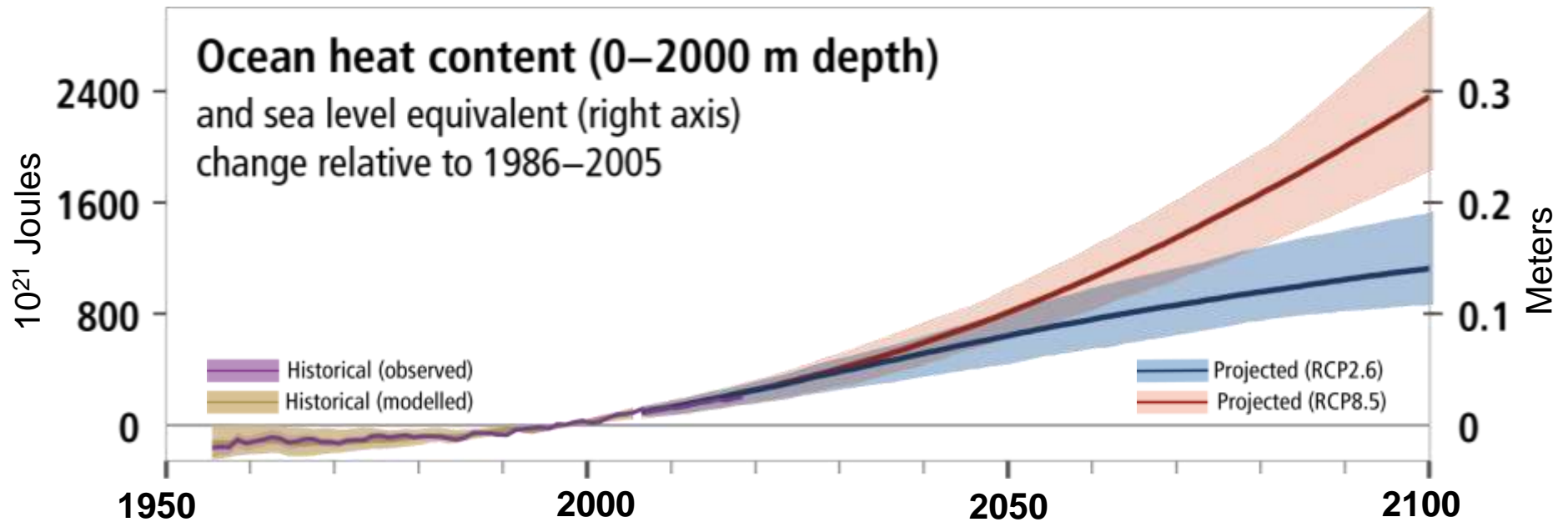
Ocean warming

Due to emissions of heat-trapping gases resulting from human activities, the global ocean has warmed as it has taken up more than 90% of the excess heat in the climate system, making climate change irreversible.





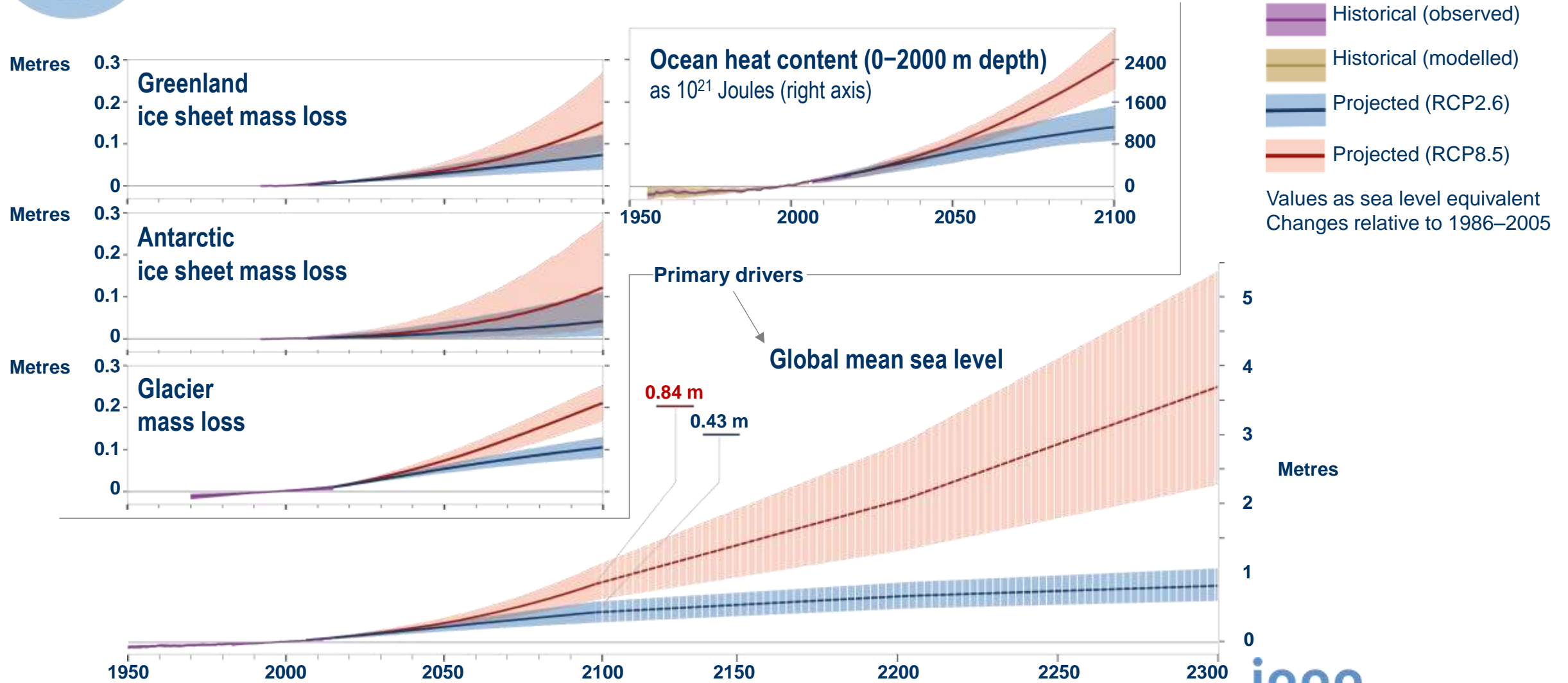
Ocean warming



- **Ocean warming is continuing unabated.** Since the last three decades, the rate of ocean warming has increased and around half of the total heat gain in the global ocean has occurred in the Southern Ocean in the last decade.
- **The ocean will continue to warm throughout the 21st century.** By 2100, the ocean will take up 2 to 4 times more heat if global warming is limited to 2°C and up to 5 to 7 times at higher emissions.



Sea level rise





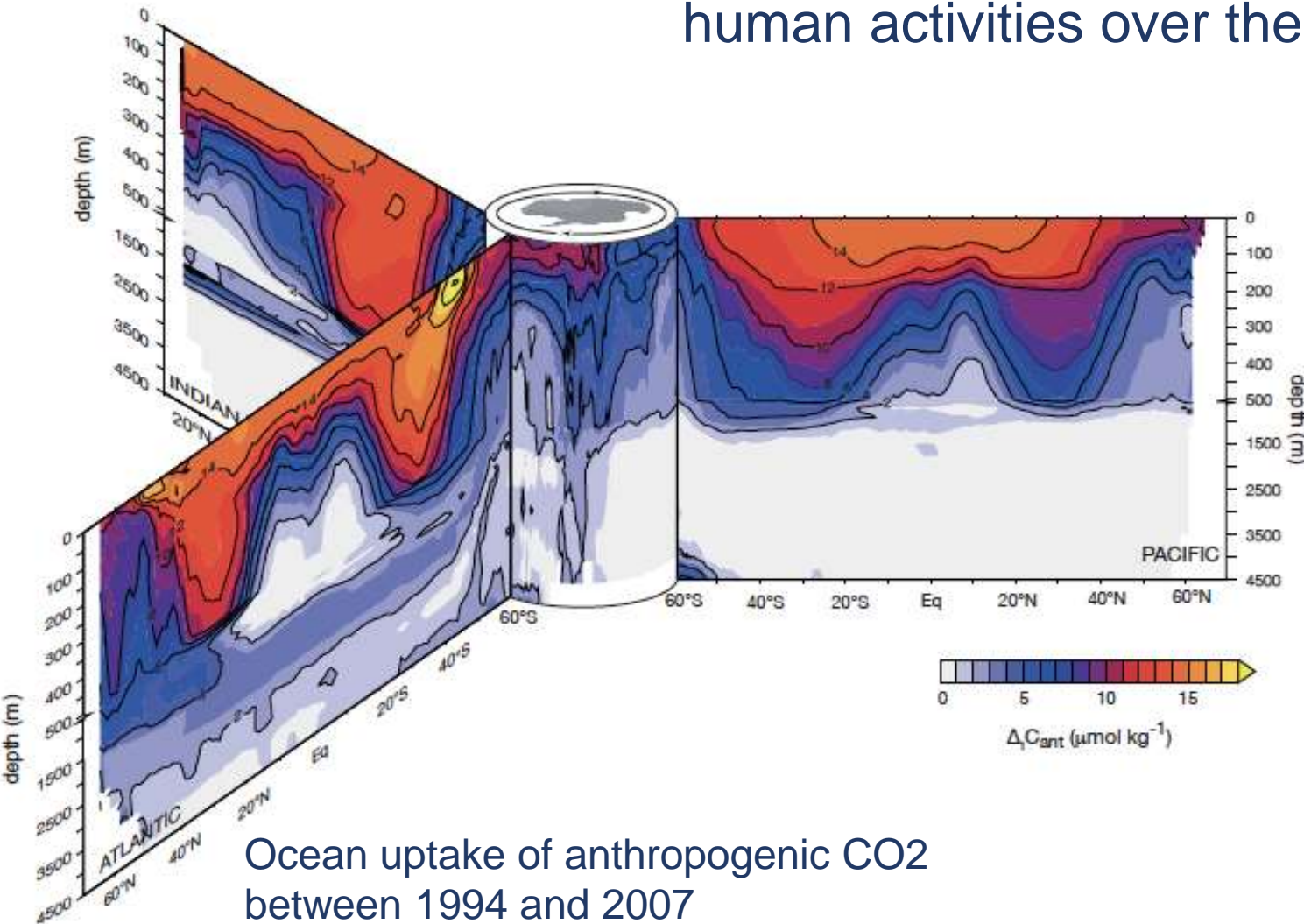
Sea level rise

- During the 20th century, the global mean sea level rose by about 15cm. **Sea level is currently rising more than twice as fast.**
- Sea level rise **will further accelerate** reaching up to 1.10 m in 2100 if emissions are not sharply reduced.
- **There is no scenario that stops sea level rise this century.** We have the choice between below 1 metre and up to several metres of sea level rise by 2300



Ocean acidification

The ocean has taken up 20-30% of the global emissions from human activities over the past 3 decades.



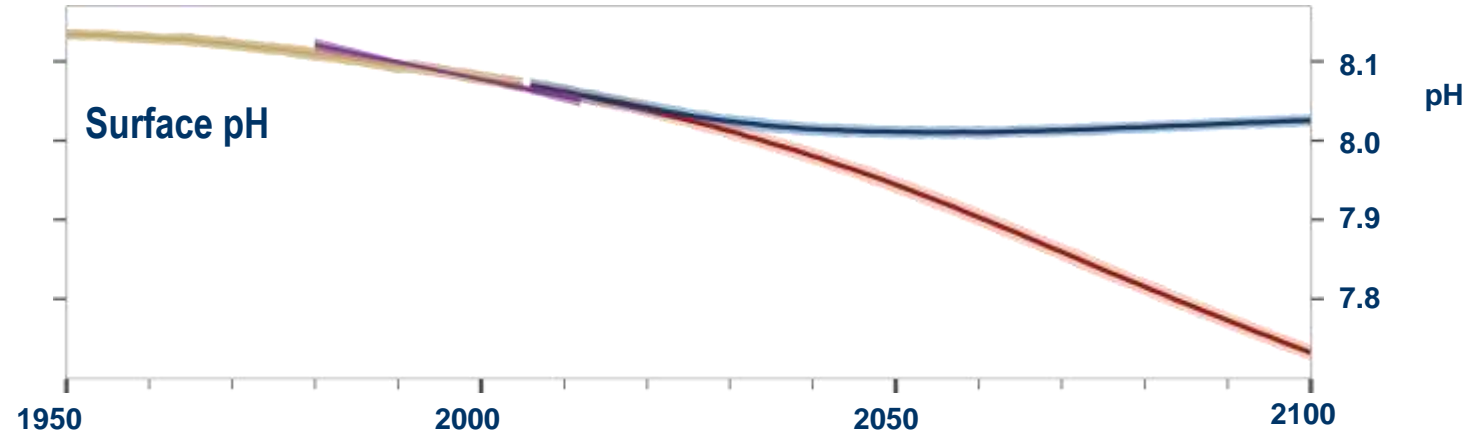
Ocean uptake of anthropogenic CO₂ between 1994 and 2007

The increase in anthropogenic CO₂ occurs throughout the upper 1000 m, with different penetration depths, reflecting largely differences in the efficiency, with which the anthropogenic CO₂ is transported from the surface to depth



Ocean acidification

- Historical (observed)
- Historical (modelled)
- Projected (RCP2.6)
- Projected (RCP8.5)

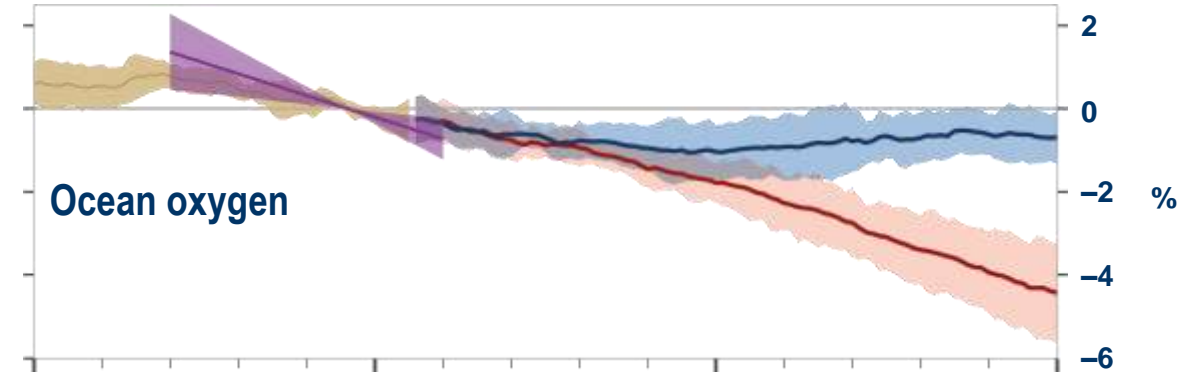


- As a consequence of anthropogenic carbon uptake, the ocean has undergone increasing surface acidification.
- Continued carbon uptake by the ocean by 2100 is virtually certain to exacerbate ocean acidification.

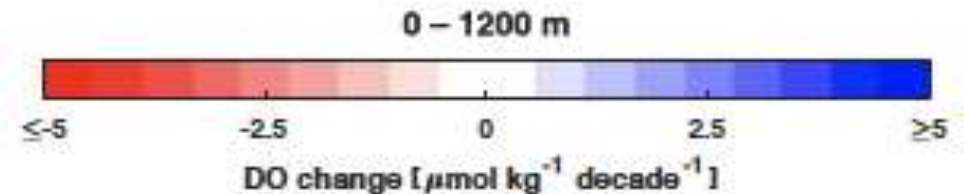
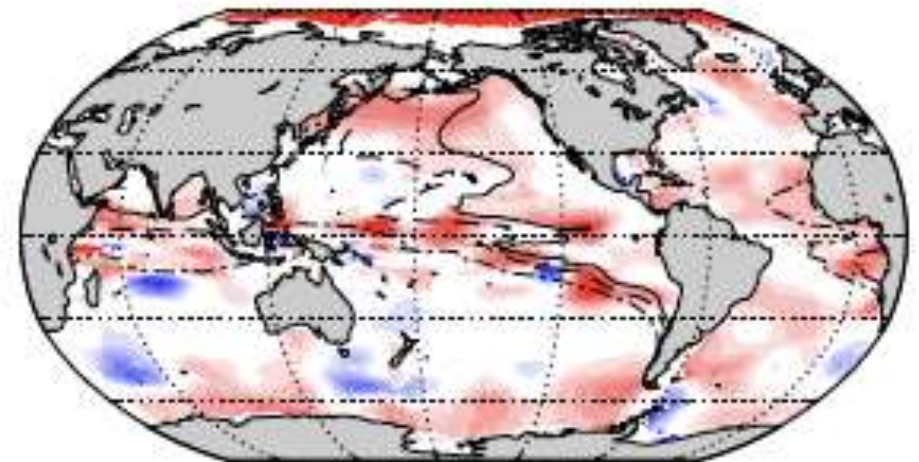


Ocean deoxygenation

- Surface ocean warming is making the surface ocean less dense relative to deeper parts of the ocean and inhibiting mixing and exchange of heat, carbon, nutrients and oxygen.
- A loss of oxygen has occurred from the surface to 1000 m
- Ocean oxygen is projected to further decline over the 21st century.



Absolute change in dissolved oxygen over the period 1960-2010

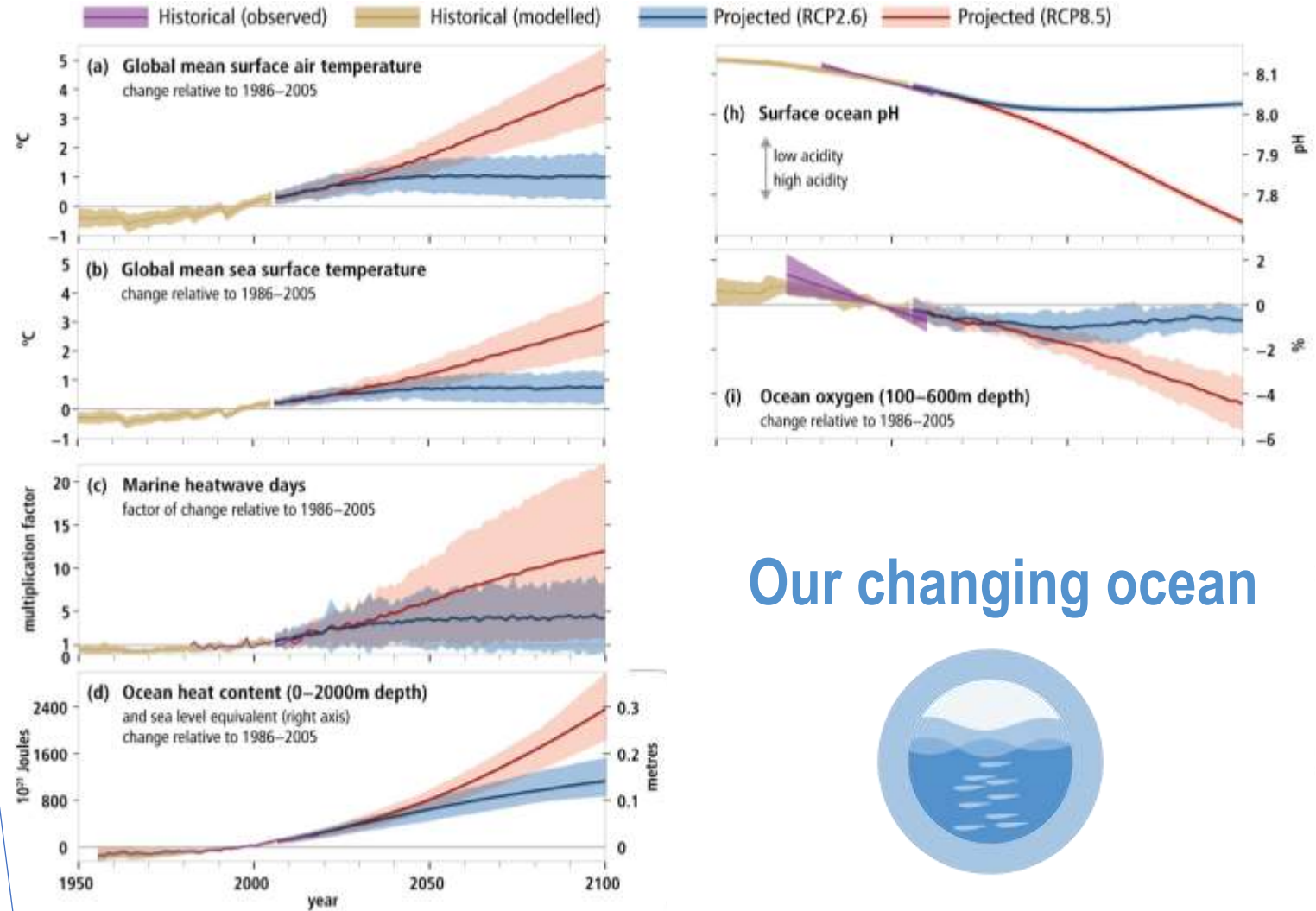
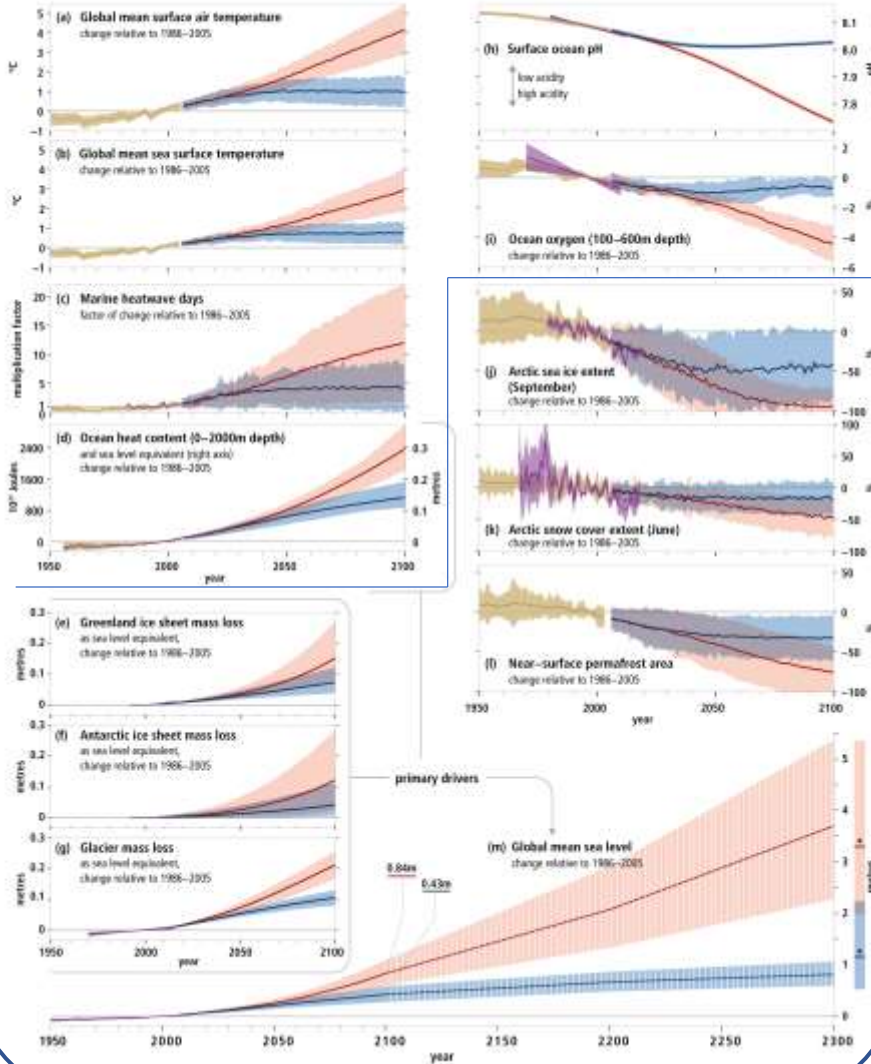


The ocean is transitioning to new states, unprecedented since the pre-industrial.

Past and future changes in the ocean and cryosphere

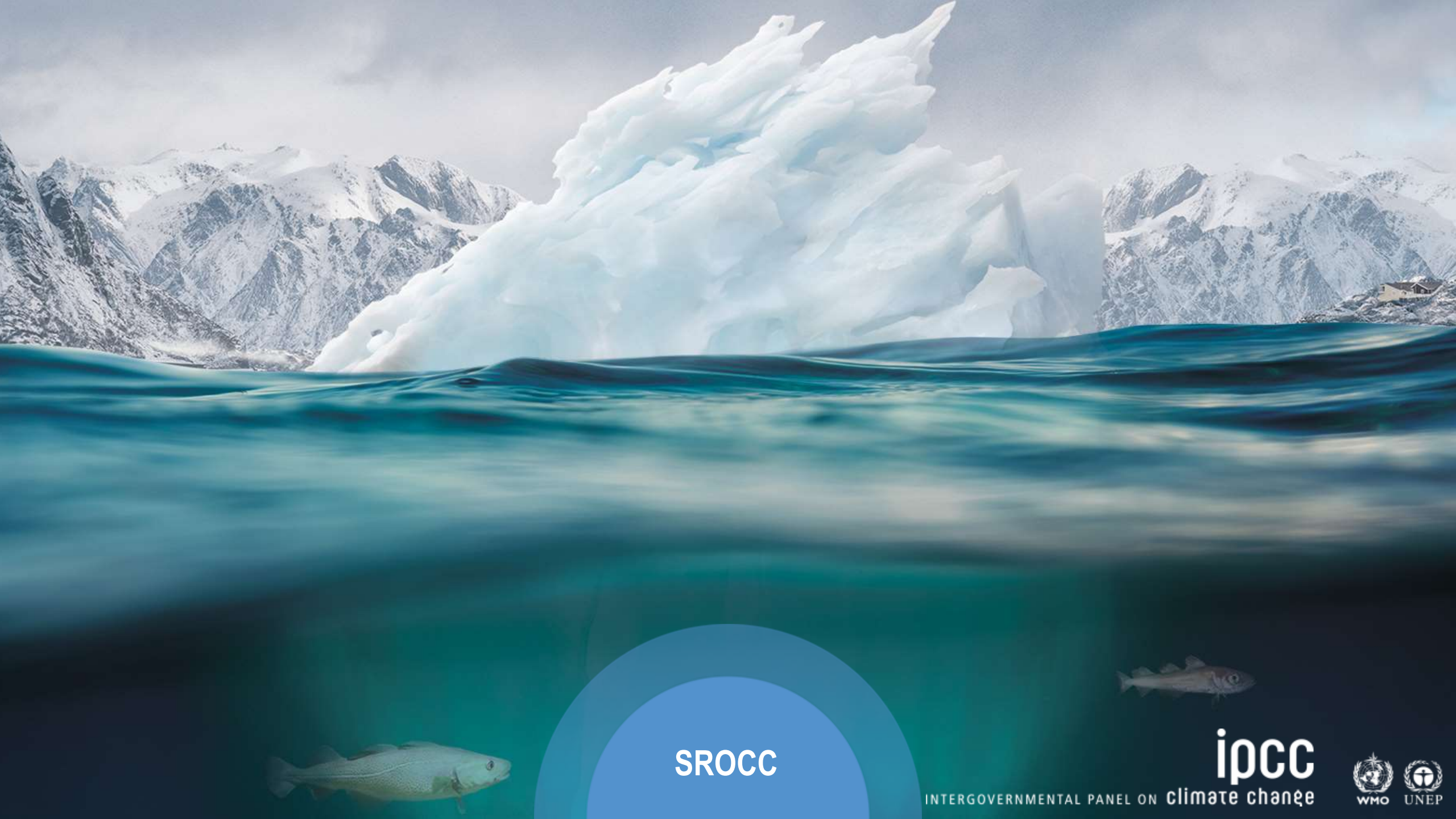
Historical changes (observed and modelled) and projections under RCP2.6 and RCP8.5 for key indicators

Historical (observed) Historical (modelled) Projected (RCP2.6) Projected (RCP8.5)



Our changing ocean





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