Regional fact sheet - Ocean

Common regional changes

Marine heatwaves have become more frequent over the 20th century (*high confidence*) and are also projected to increase around the globe over the 21st century (*high confidence*).

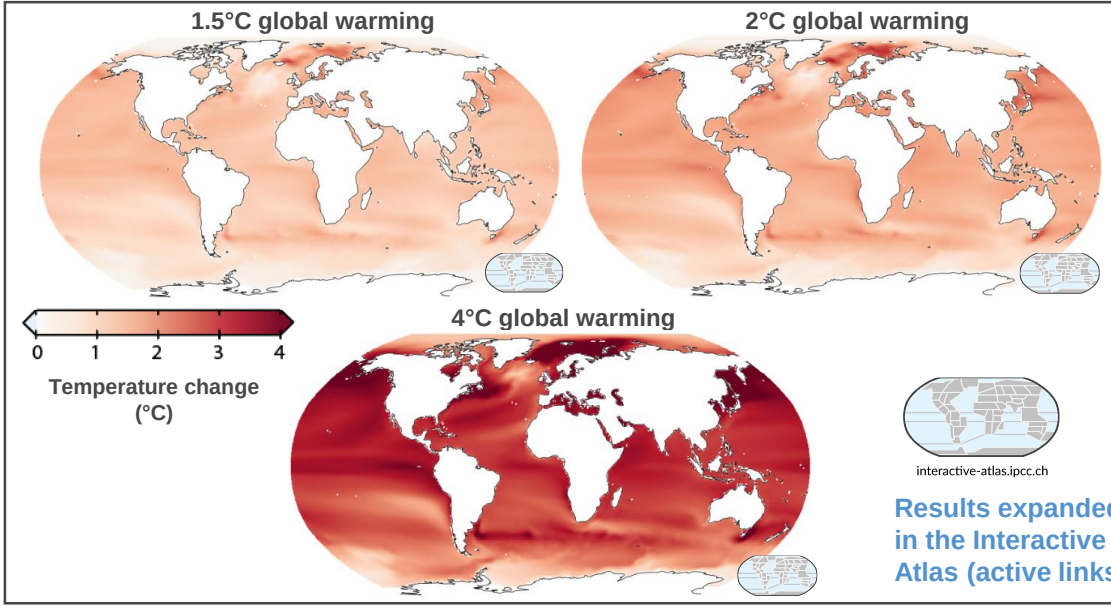
Anthropogenic warming is *very likely* to further decrease ocean oxygen concentrations, and this deoxygenation is projected to persist for thousands of years (*medium confidence*).

It is *virtually certain* that global mean sea level will continue to rise over the 21st century in response to continued warming of the climate system, and this rise will continue for centuries to millennia due to continuing deep ocean heat uptake and mass loss from ice sheets (*high confidence*).

Over the 21st century, the majority of coastal locations have a median projected regional sea level rise within ± 20% of the projected global mean sea level change (*medium confidence*).

With the rising atmospheric CO_2 concentration, the ocean acidification has increased globally over the past four decades (*virtually certain*).

In the open ocean, acidification, changes in sea ice, and deoxygenation are detectable in many areas (*high confidence*).



Projected changes in annual sea surface temperature at 1.5°C, 2°C, and 4°C (in rows) global warming relative to 1850–1900.

Results are based on simulations from the CMIP6 multi-model ensemble (26 global climate models) using the SSP5-8.5 scenario to compute the warming levels.

Results expanded in the Interactive Atlas (active links)

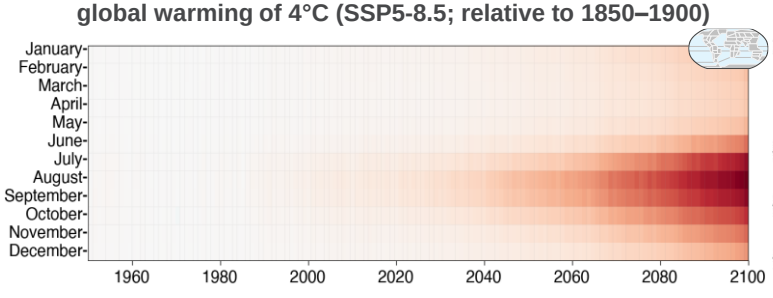
Sea surface temperature change (ºC) – annual, global (SSP5-8.5; relative to 1850-1900)

Period	Scenario	Mean	Std. Dev.	P5	P95
Warming 1.5°C	SSP5-8.5	1.0	-	0.9	1.0
Warming 2°C	SSP5-8.5	1.3	0.1	1.2	1.4
Warming 4°C	SSP5-8.5	2.7	0.1	2.6	2.8

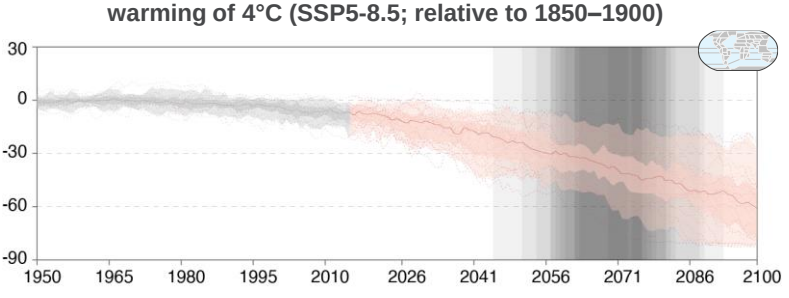
Assessed sea level rise (meters) – annual, global near, mid- and long term (SSP5-8.5; relative to 1995–2014)

Period	Scenario	Mean	Std. Dev.	P5	P95
Near Term	SSP5-8.5	0.1	0.1	-	-
Medium Term	SSP5-8.5	0.3	0.1	0.1	0.4
Long Term	SSP5-8.5	0.7	0.2	0.3	1.0

Annual Arctic Ocean sea surface temperature change ºC for global warming of 4°C (SSP5-8.5; relative to 1850–1900)



Annual Arctic Ocean sea ice concentration change % for global warming of 4°C (SSP5-8.5; relative to 1850–1900)



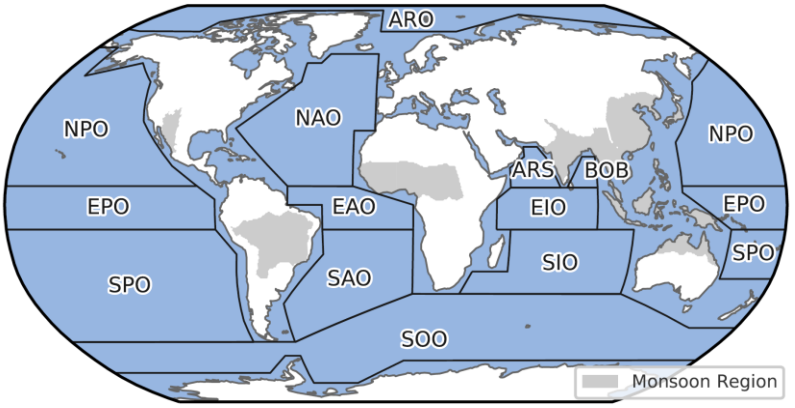
Arctic Ocean (ARO)
- The largest changes in the frequency of marine heatwaves are projected to occur in the Arctic Ocean (*medium confidence*).

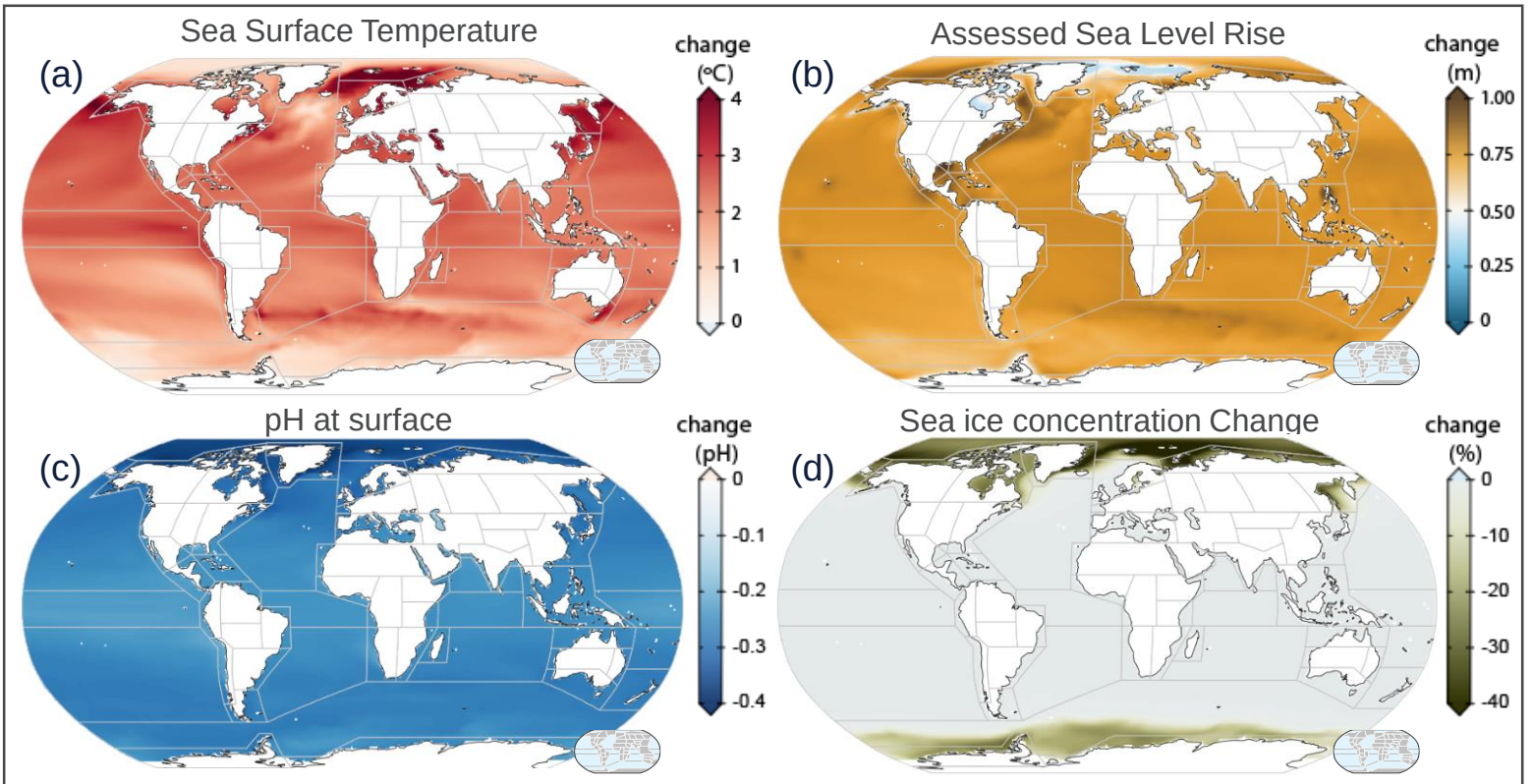
Pacific Ocean (NPO, EPO, SPO)
- The surface eastern equatorial Pacific Ocean has warmed more slowly than the global average or slightly cooled (*very high confidence*).
- The largest changes in the frequency of marine heatwaves are projected to occur in the western equatorial Pacific Ocean (*medium confidence*).
- It is *very likely* that the Pacific Ocean has freshened (decreased in salinity). The projected pattern is similar (*medium confidence*).

Southern Ocean (SOO)
- The surface Southern Ocean has warmed more slowly than the global average or slightly cooled (*very high confidence*)
- The Southern Ocean has *very likely* freshened. The projected salinity pattern is similar (*medium confidence*).

Atlantic Ocean (NAO, EAO, SAO)
- The surface North Atlantic Ocean has warmed more slowly than the global average or slightly cooled (*very high confidence*).
- It is *very likely* that Atlantic has become more saline. The projected pattern is similar (*medium confidence*).

Indian Ocean (ARS, BOB, EIO, SIO)
- The surface Indian Ocean has warmed faster than the global average (*very high confidence*)





Projected changes in annual (a) sea surface temperature, (b) assessed sea level rise, (c) pH at surrface, and (d) sea ice concentration by 2081–2100 global warming under SSP2-4.5 scenario, relative to 1850–1900 (1995–2014 for sea level rise). Results are based on simulations from CMIP6 (except for sea level rise, see Chapter 9 for details). There is *low confidence* in model projections of future Antarctic sea ice changes, particularly at the regional level.

Links for further details: TS.4, TS.4.3.1, TS.4.3.2.9, Box TS.4, 2.3, 2.3.3.5, 5.3, 5.3.3.2, 9.2, 9.2.13, 9.3, 9.3.1.1, 9.6, 9.6.3, Box 9.2, Box 9.4, 12.4.8, Atlas.3–Atlas.11