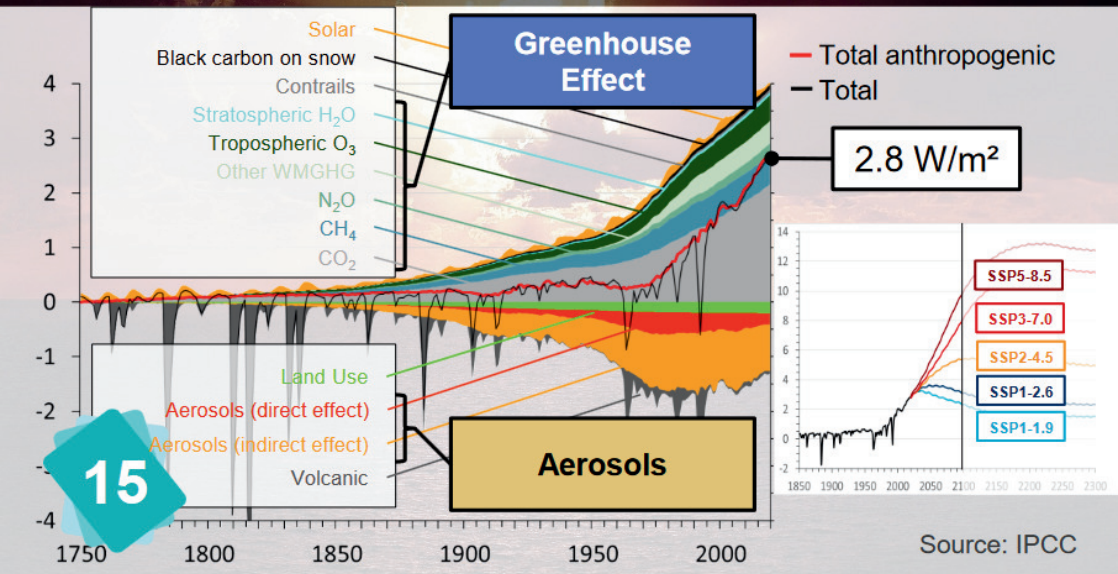
Radiative Forcing



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Source: IPCC

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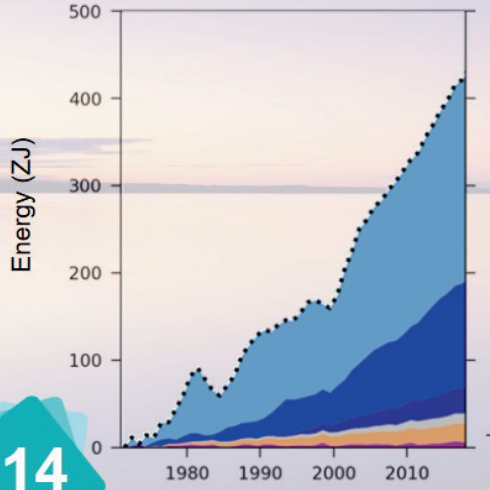
Radiative forcing represents the difference between the energy that reaches the Earth each second and the energy that is released. It is rated at 2.8 W/m² (Watt per square metre), 3.8 W/m² from the greenhouse effect and -1 W/m² from aerosols.

Set 3

Energy Budget



91 %	Ocean
3 %	Melting ice
5 %	Soil
1 %	Atmosphere

Source: IPCC

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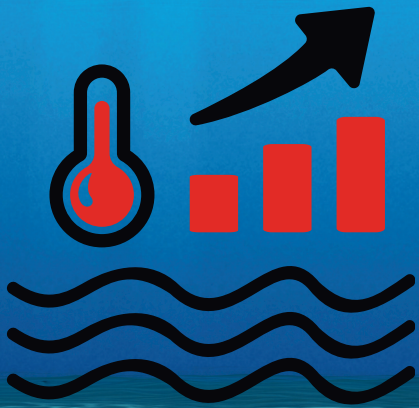
This graph explains where the energy accumulated on Earth due to radiative forcing goes. It warms up the ocean, melts ice, dissipates into the ground and warms up the atmosphere.

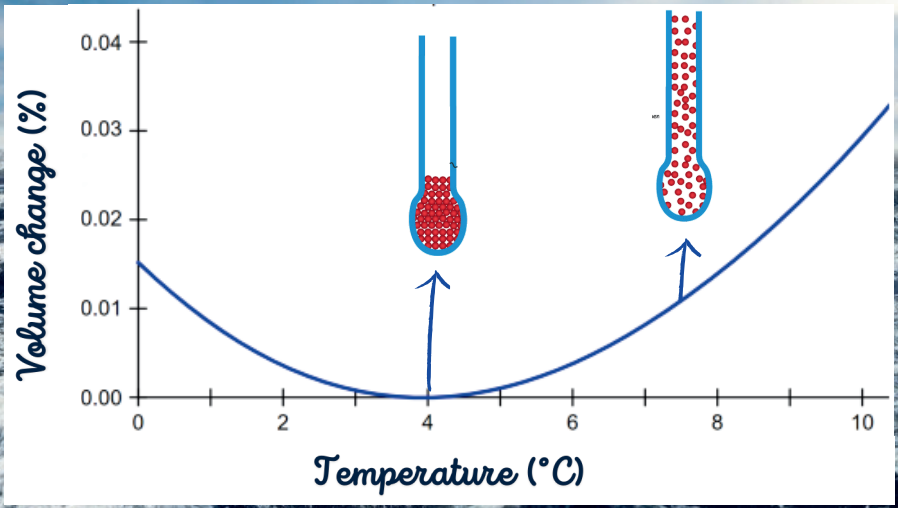
Set 3

Rise of Ocean Temperature



Ocean stores 91% of the excess heat from the earth, so this radiation of the atmospheric heat absorb by the ocean increased the temperature.

Thermal Expansion



Thermal expansion happens when water gets warmer, increasing its temperature. Which lead to a lower density and therefore the larger its volume per unit of mass. In oceans, the seawater absorbs heat from the atmosphere, leading to an increase in the volume.

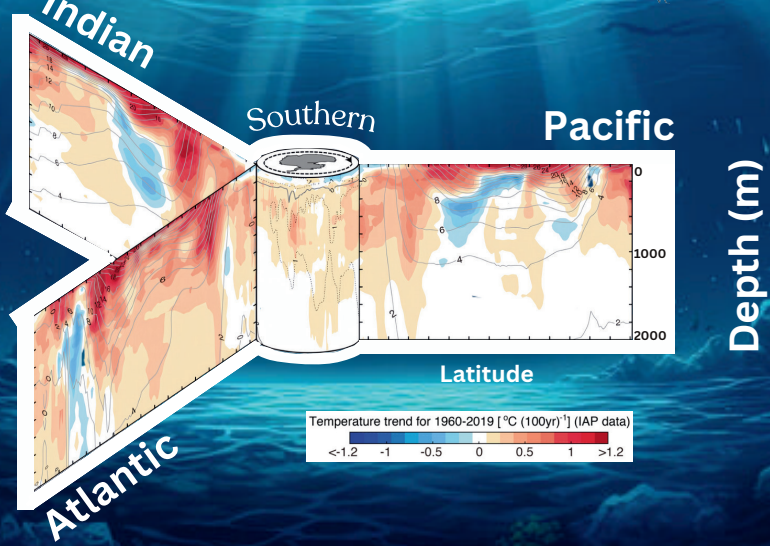
Melting of Glaciers

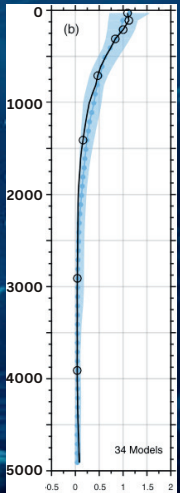
The rising temperature of the Earth and ocean heat increases melting of glaciers and results in the global sea level rise.

Melting of Ice Sheets

Warmer air and ocean water causes the ice to shrink, melt the edge and base of the ice sheet causing ice melt more quickly and flow more rapidly to the sea. Melting of Greenland and Antarctica's ice sheets accounted for about one-third of observed global sea level rise between 2006 and 2015.

Variability on the water column

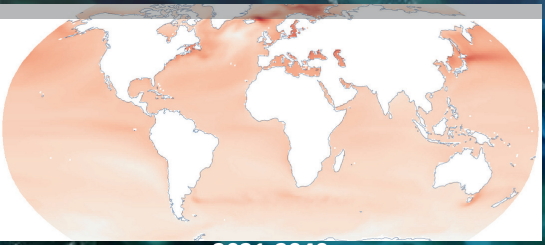




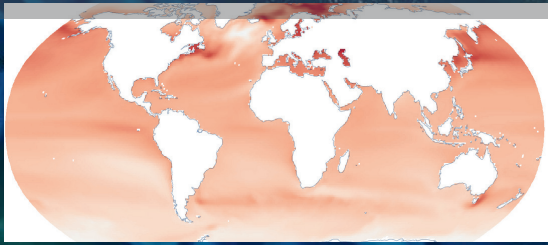
Global profile scenario RCP4.5

The penetration of heat into the deep oceans is evident, primarily through the Atlantic Ocean and Southern Ocean. Studies indicate a total full-depth ocean warming, with contributions of 41%, 22%, 29% and 8% from the 0–300-m, 300–700-m, 700–2000-m, and below-2000-m layers, respectively.

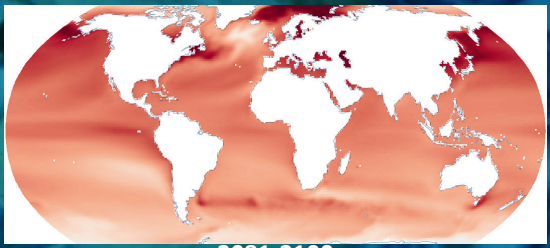
TEMPORAL VARIABILITY



2021-2040



2041-2060

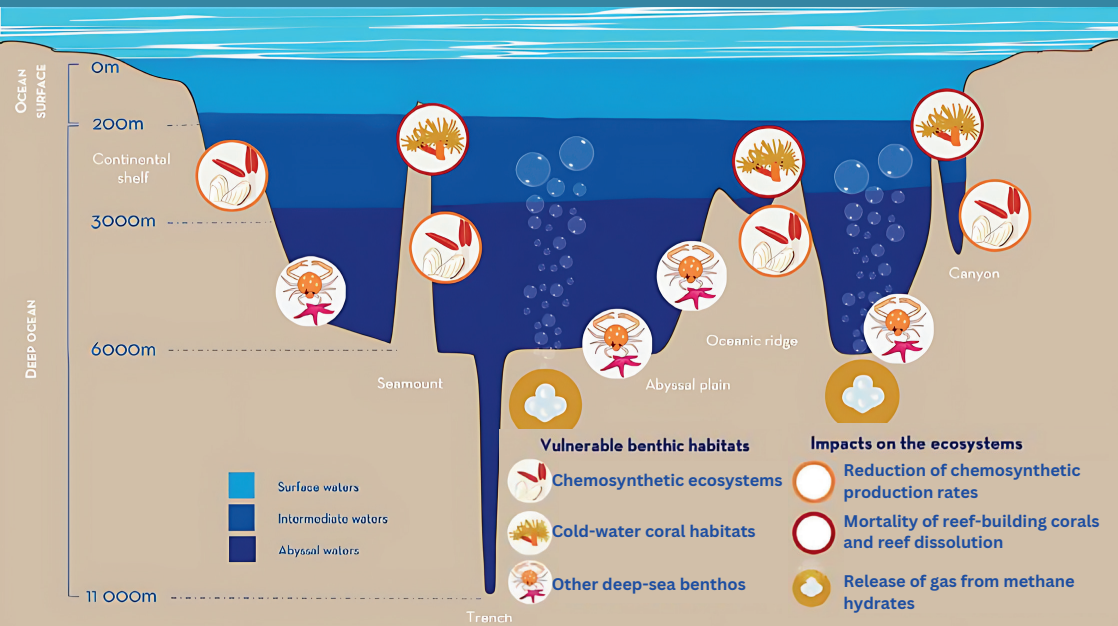


2081-2100

Sea surface temperature (°C)

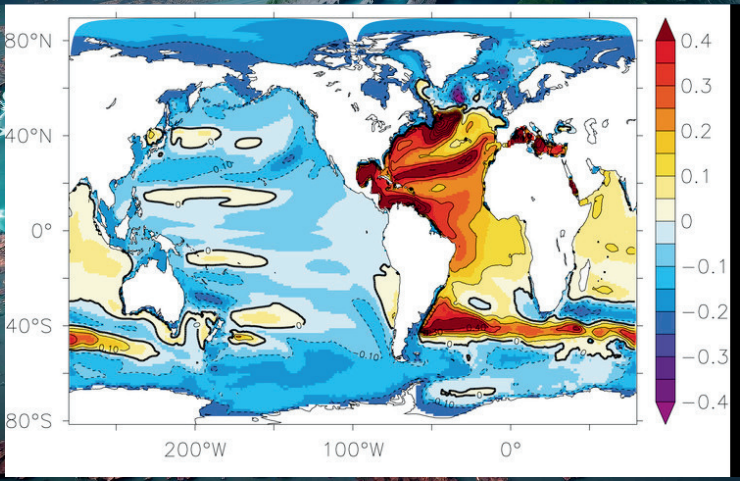
The averaged sea surface temperature projection is strongly increasing with time. In the case of the SSP2-4.5 scenario it would reach +4°C in certain regions (North pole, Asia South coast,..) during the period 2081-2100.

Impacts on deep-sea ecosystems



The variability on the ocean depth temperature affects deep-sea ecosystems. Its warming destabilize the distribution and health of species. For example, deep sea corals (200 - 3000 m), are sensitive to variations in temperature. Their deterioration exacerbates the vulnerability of other species which find shelter and food in their habitats.

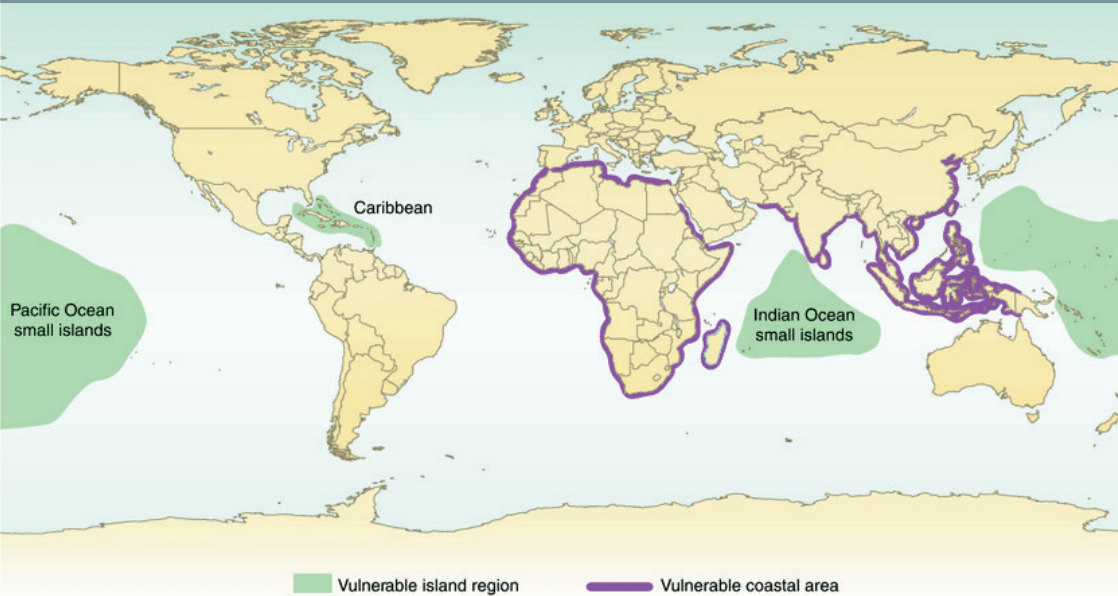
Variability around the globe



SLR average (2091-2100) due to temperature change

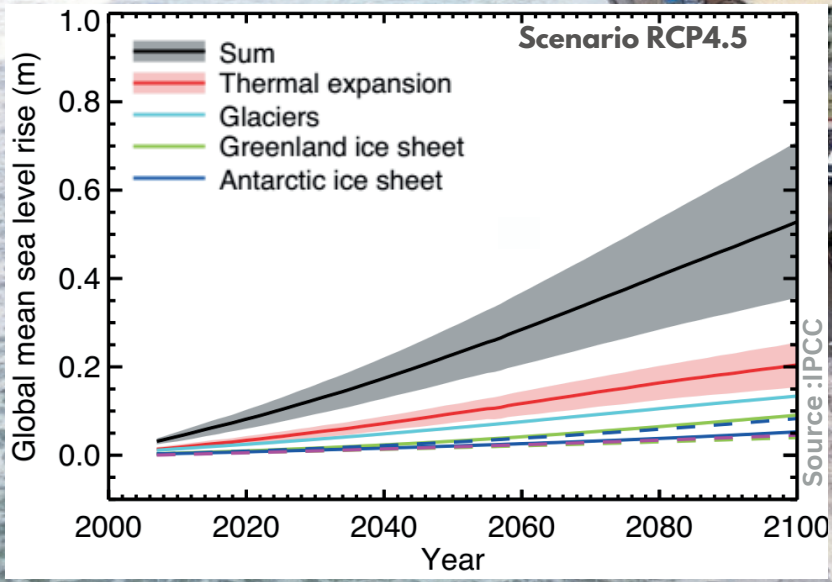
Perturbations of the currents in the Atlantic ocean are resulting in heat accumulations. These effects are additionning with those induced by the radiative forcing, leading to a projection of sea level rise up to 0.4 m in the Atlantic. However other regions experience a negative variation.

Coastal flooding



Several regions are vulnerable to coastal flooding caused by future relative or climate-induced sea-level rise. At highest risk are coastal zones with dense populations, low elevations, strong rates of subsidence, and/or inadequate adaptive capacity.

Global Mean Sea Level rise budget



Thermal expansion

35%

Glaciers

25%

Greenland ice sheet

11%

The two largest terms of the Global Mean Sea Level budget (GMSL) rise are ocean thermal expansion (accounting for about 35% of the observed GMSL rise) and glacier mass loss (accounting for a further 25%, not including that from Greenland and Antarctica).