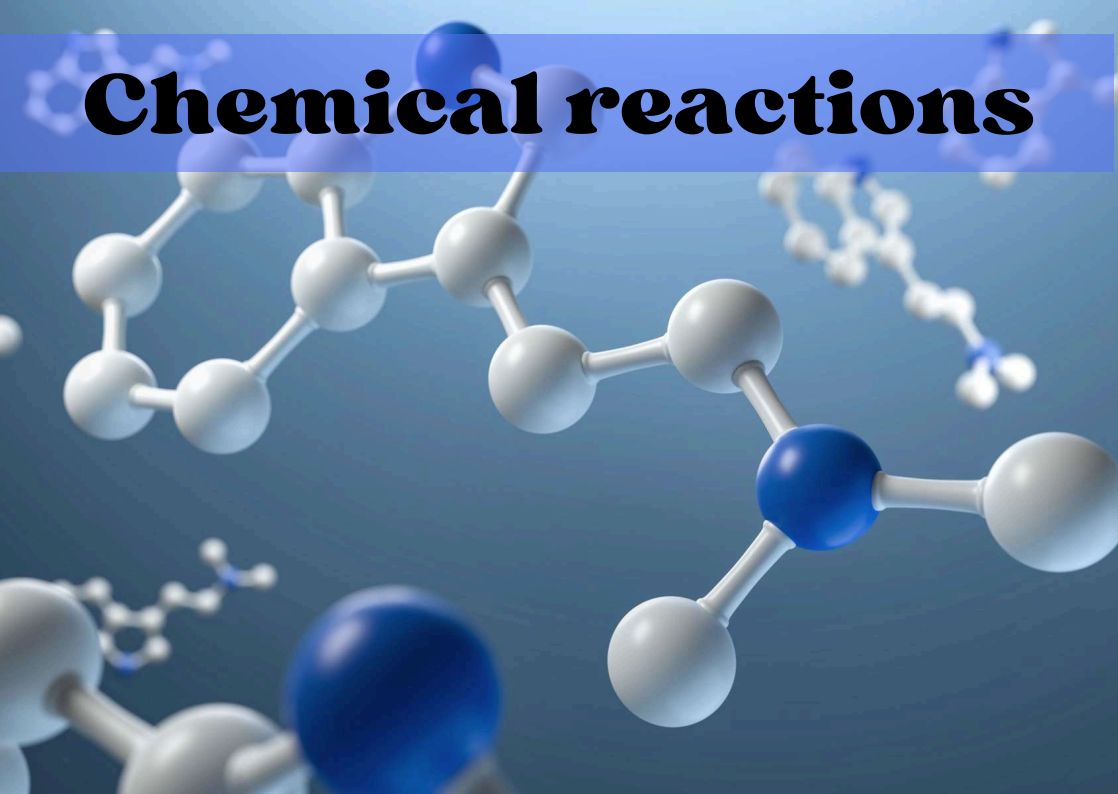
Chemical reactions



Chemical reactions

$$CO_2 + H_2O \longrightarrow H_2CO_3$$

The dissolved carbon dioxide reacts with water. Carbonic acid is created as described by the previous reaction .
Then carbonic acid dissociates, creating bicarbonate ion and an H^+ ion.

$$H_2CO_3 \longrightarrow HCO_3^- + H^+$$

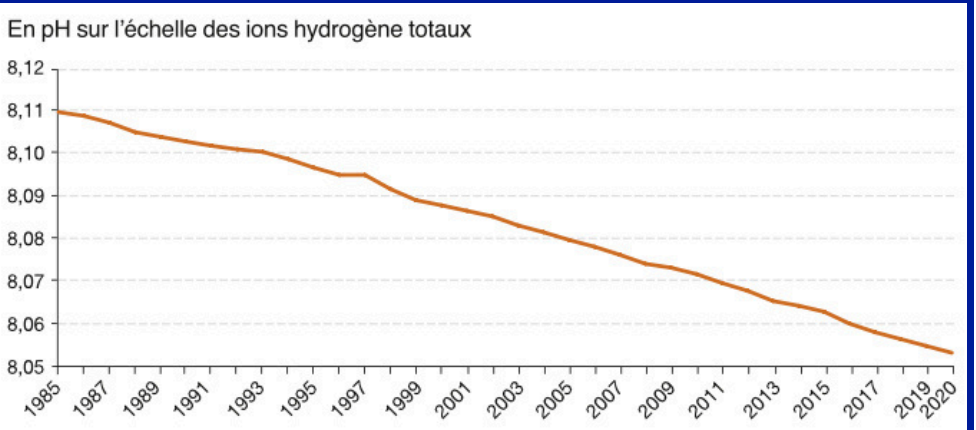
Bicarbonate ion dissociates and one more H^+ ion is created.

$$HCO_3^- \longrightarrow CO_3^{2-} + H^+$$

So at the end of those reactions, for one molecule of carbon dioxide there are two H^+ ions created.

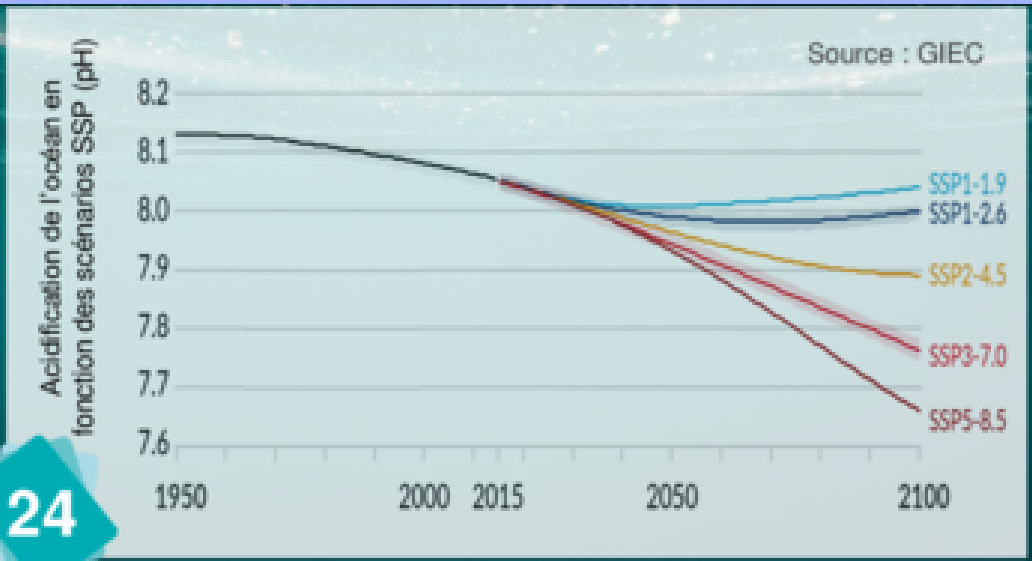
pH

pH



Source : *E.U. Copernicus Marine Service Information,*

Ocean Acidification



Ocean acidification

Ocean acidification is the decrease in pH of Earth's oceans. Between 1950 and 2021, the average pH of the ocean surface dropped from approximately 8.15 to 8.05.

According to the 6th IPCC report, ocean pH could decrease to 7.8 by 2100. This would make the oceans 150% more acidic and cause damage to half of marine life.

CO2 increase

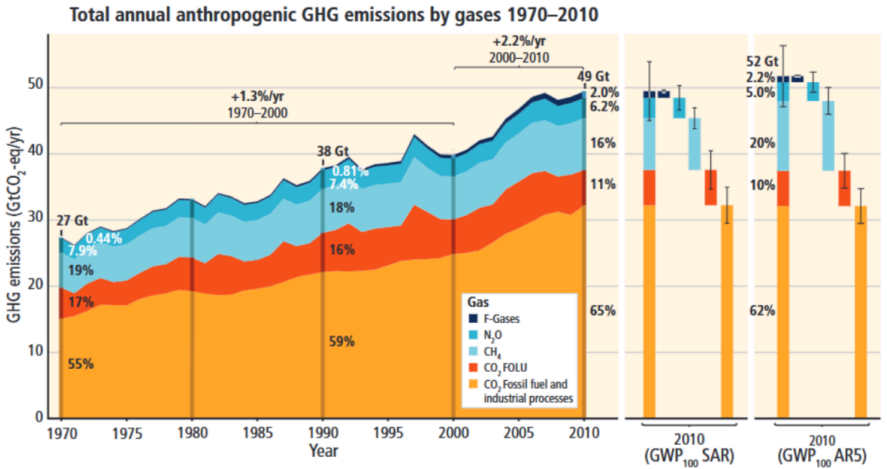


Figure 1 : Total annual anthropogenic greenhouse gas (GHG) emissions (gigatonne of CO2-equivalent per year, GtCO2-eq/yr) for the period 1970 to 2010. Right hand side shows 2010 emissions, using alternatively CO2-equivalent emission weightings based on IPCC Second Assessment Report (SAR) and AR5 values.

Source : IPCC, Climate Change 2014 Synthesis Report Summary for Policymakers

CO2 increase

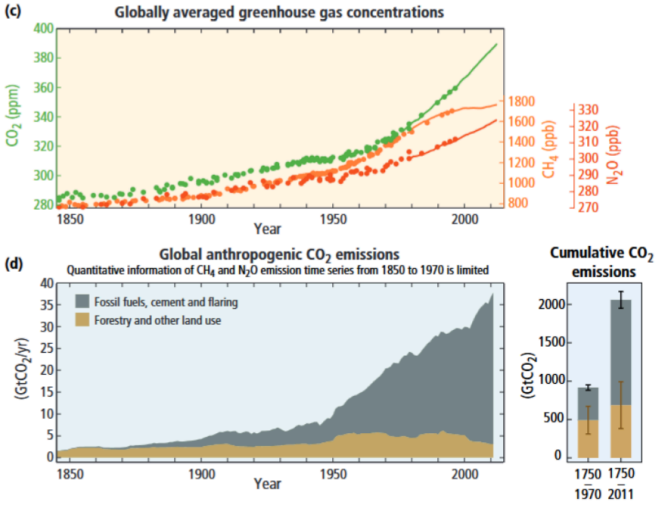
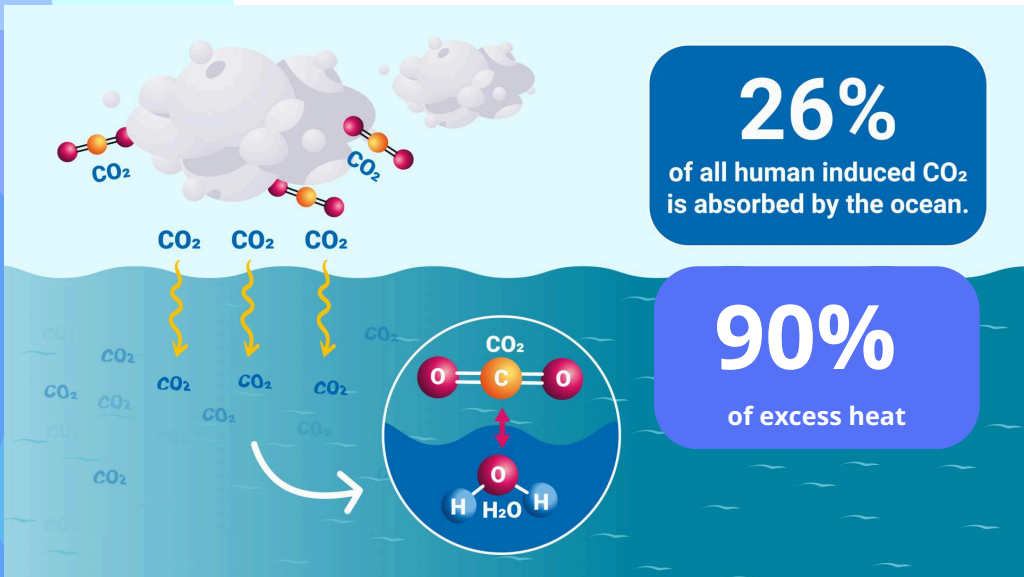


Figure 2 : (c) Atmospheric concentrations of the greenhouse gases carbon dioxide (CO2, green), methane (CH4, orange) and nitrous oxide (N2O, red) determined from ice core data (dots) and from direct atmospheric measurements (lines). (d) Global anthropogenic CO2 emissions from forestry and other land use as well as from burning of fossil fuel, cement production and flaring. Cumulative emissions of CO2 from these sources and their uncertainties are shown as bars and whiskers, respectively, on the right hand side.

Source : IPCC, Climate Change 2014 Synthesis Report Summary for Policymakers

Ocean surface balance

Ocean surface balance



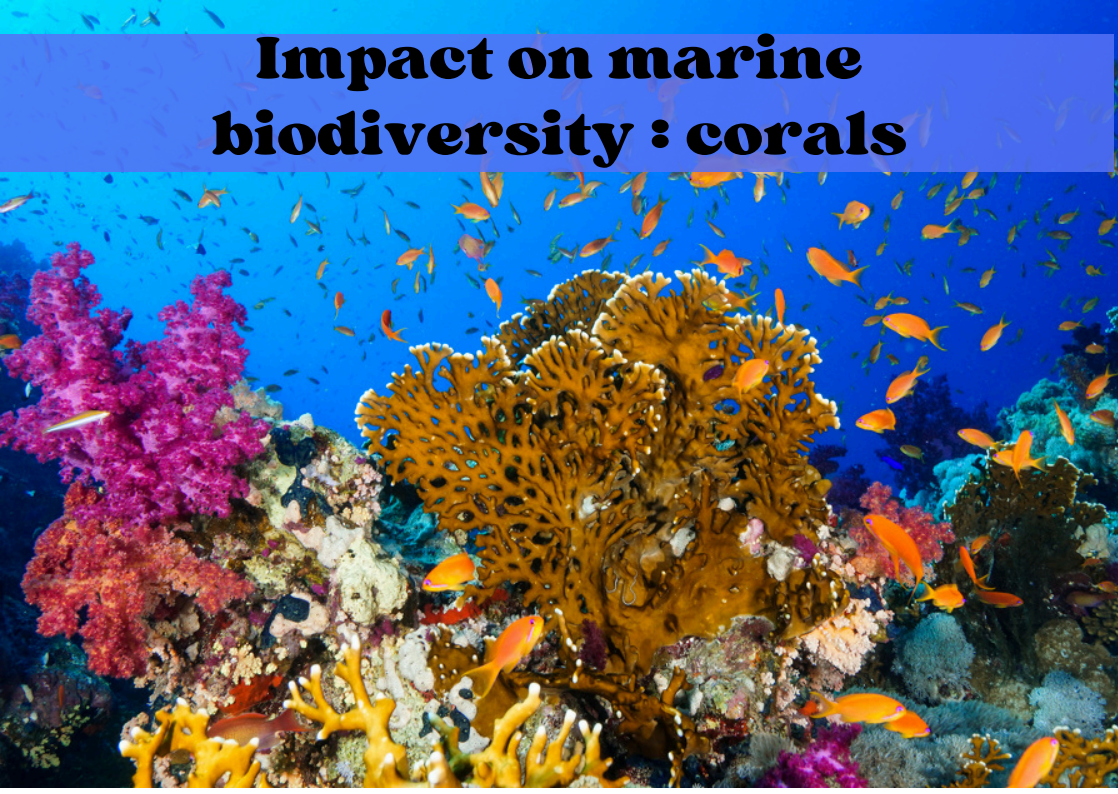
Source : Graphic: A. Vargas Terrones /IAEA

Impact on marine biodiversity : fishes

Impact on marine biodiversity : fishes

- Organisms using energy to cope with acidic conditions may have fewer resources for growth and reproduction, potentially destabilizing food chains.
- Acidification can disrupt fish behavior (ability to detect predators and feed).
- It can alter migration patterns, impacting marine ecosystems and fisheries.

Impact on marine biodiversity : corals



Impact on marine biodiversity : corals

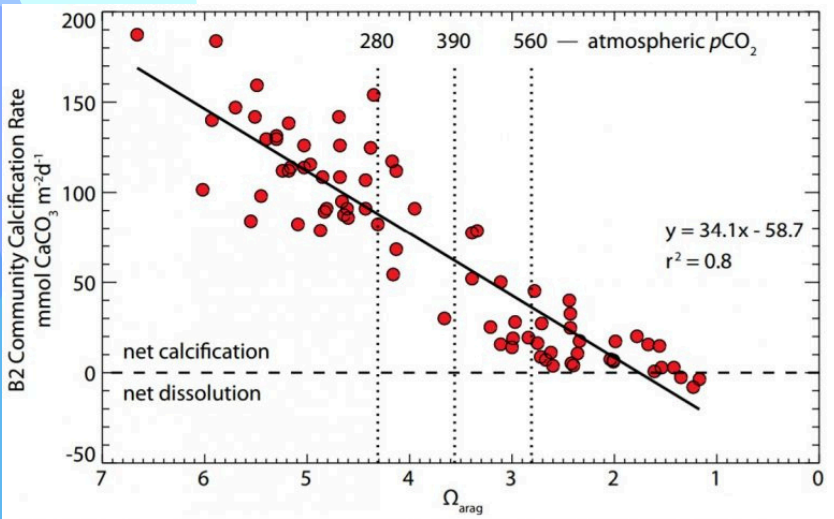


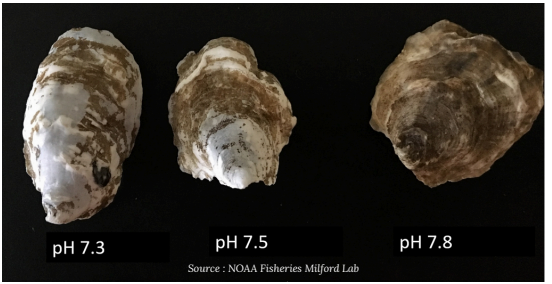
Figure : Coral community calcification rate changes in the Biosphere 2 coral reef mesocosm with respect to decreasing aragonite saturation state. Source: Kleypas et al.

Impact on marine biodiversity : crustaceans

Image credit: Shutterstock

Impact on marine biodiversity : crustaceans

Crustaceans and corals require carbonate ions to develop strong shells. Also, due to the effects of ocean acidification, crustaceans' shells are gradually eroded.



Source : NOAA Fisheries Milford Lab

Impact on human society

Graphic: A. Vargas Terrones /IAEA

Impact on human society

- An estimated three billion people who rely on marine and coastal biodiversity for their livelihoods may be affected by ocean acidification.
- A study in the United States suggests that the nation's shellfish industry could face annual losses exceeding $400 million by 2100.