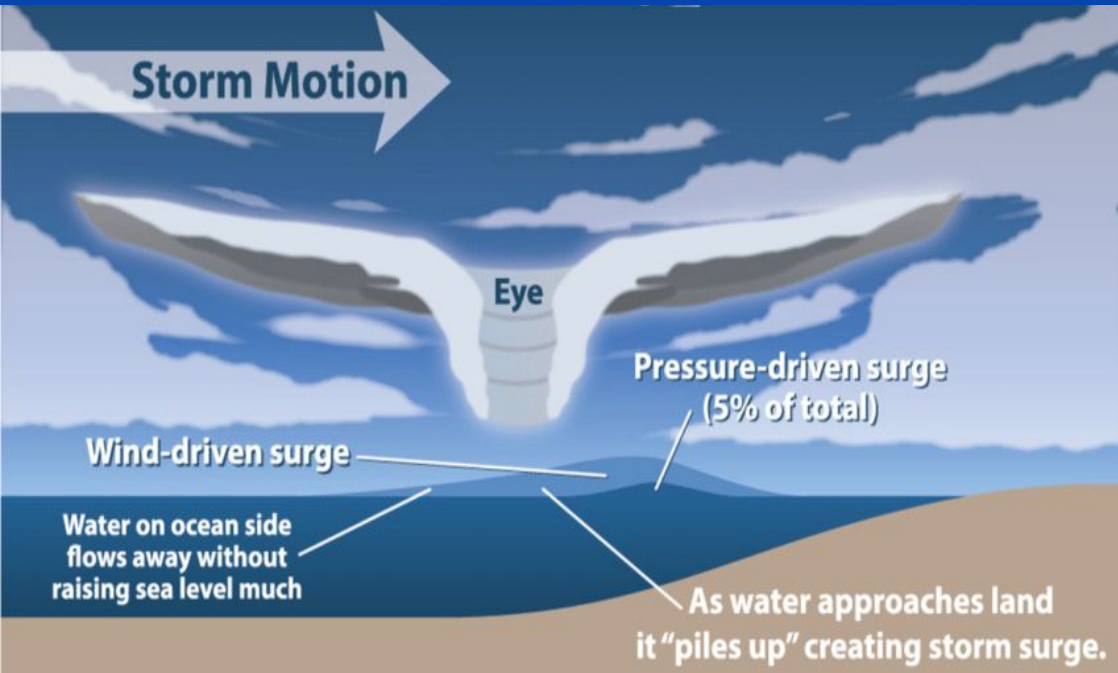
Storm surge


Storm Motion
Eye
Pressure-driven surge
(5% of total)
Wind-driven surge
Water on ocean side
flows away without
raising sea level much
As water approaches land
it "piles up" creating storm surge.

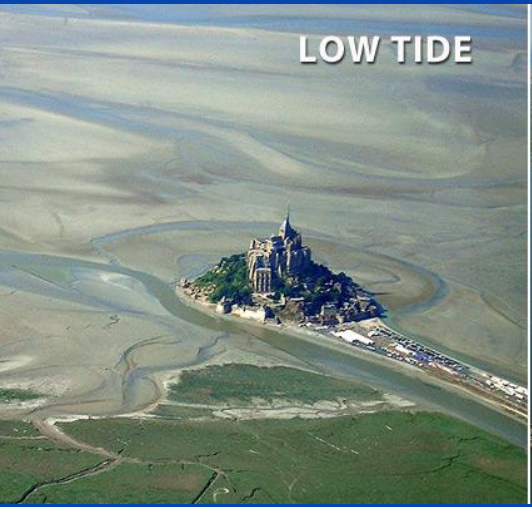
When a cyclone approaches the shore, atmospheric pressure near-shore drops.

The first consequence is that the mean water level rises, a 1-hPa (hectopascal) drop in atmospheric pressure causes a 1-cm sea level rise.

A cyclone also brings strong winds (related to pressure gradient) blowing on-shore which creates the accumulation of water near-shore.

This generates what we call storm surge, which could be compared to a tide created by the storm.

Tides



Tides are a consequence of the gravitational forces exerted by the moon and the sun as well as the rotation of the earth. The tidal range (ie.the height difference between high tide and low tide), depends on the position of the sun, the moon and the earth. For instance, when all the bodies are almost aligned (full moon or new moon), the tidal range will be at its biggest whereas when they form a right angle (first quarter or third quarter), the range will be the smallest. The higher the tidal range is, the most likely it is that marine submersion will occur.

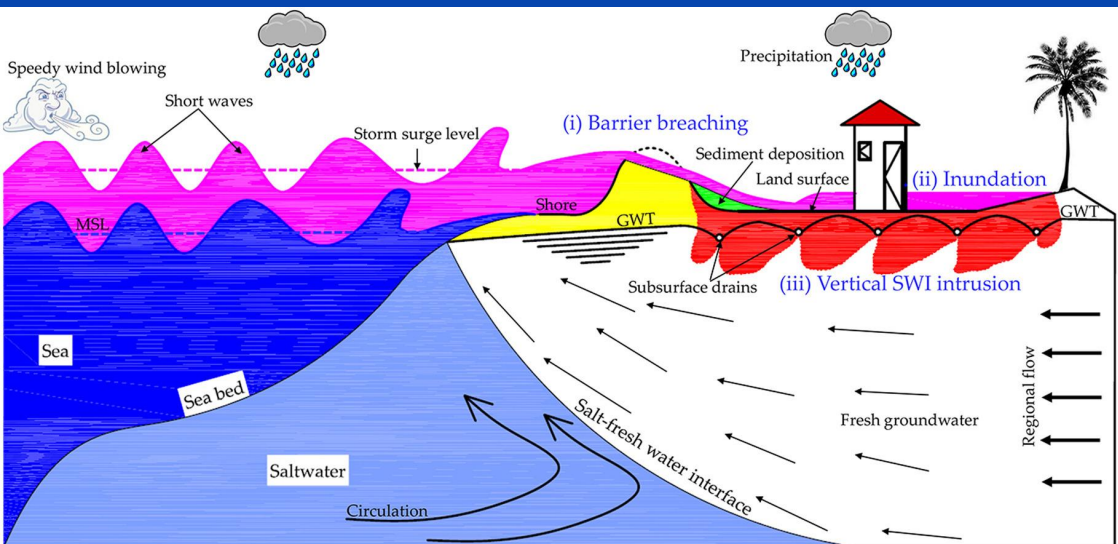
Large waves

Waves are created by wind friction on water surface. The energy transmitted to the waves depends on the wind speed, the fetch (distance where the wind blows) and the duration in time of such winds. This 3 parameters are usually large for cyclones which translates into very powerful sea states. At first, when at sea, they create large ground swells that travel 100s of kms to shore and get there before the storm, they can be seen as a warning. When the cyclone gets close the sea state becomes irregular and hard to predict.

Coastal erosion

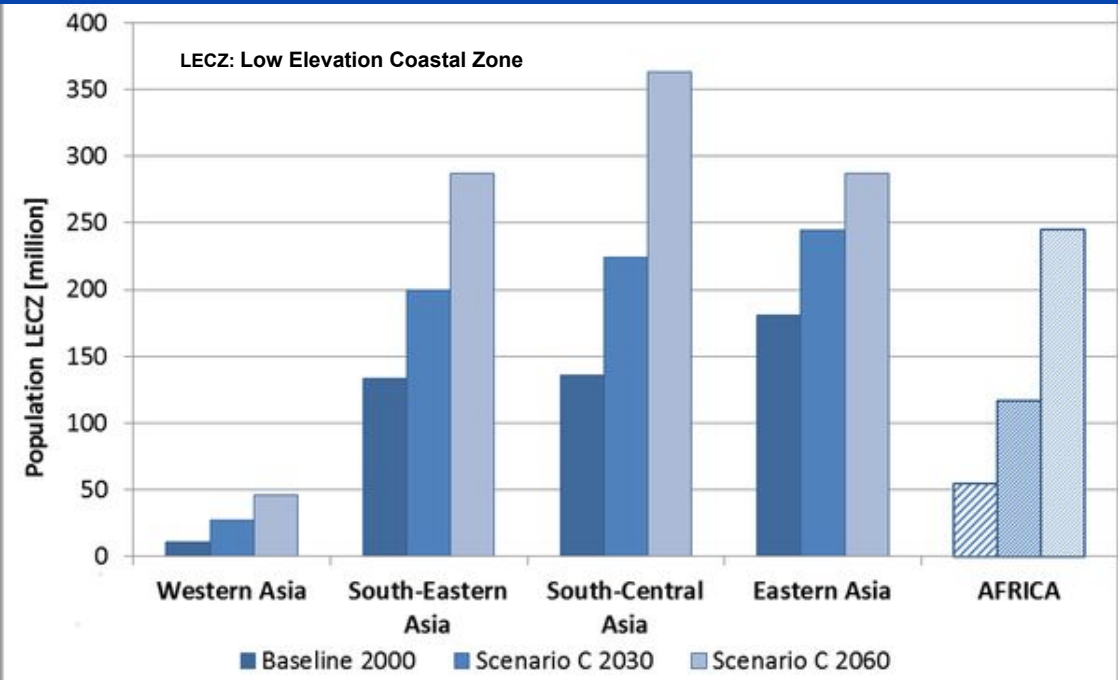
For several decades, we have observed a retreat of the coastline in regions like Normandy in France. Successive storms attack the cliffs and cause significant erosion. The increase of the power of these big storms will accelerate this retreat.

Water table salinization due to seawater intrusion



On the coast, salt water in the aquifers is located below the fresh water (because it is denser) and they are separated by the salt-fresh water interface. When marine submersion occurs, salt water infiltrates vertically in the water tables. The rise of the water level will also increase the hydraulic head in the aquifers and the salt-fresh water interface will shift further and at the same time salt the fresh water. Furthermore, in areas where the aquifers have a high hydraulic conductivity and where withdrawal of fresh water is important, the infiltration is amplified.

Threat for human lives



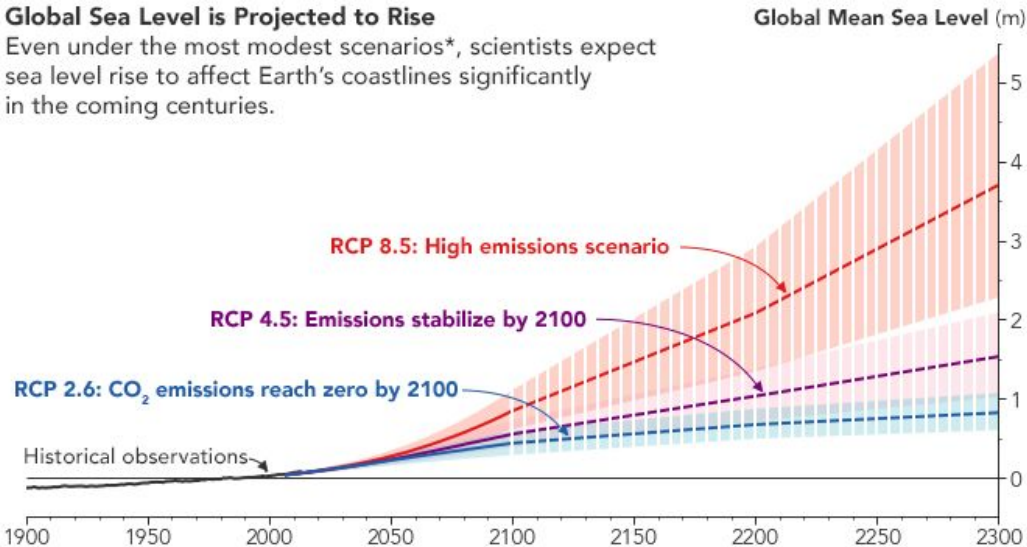
The coasts are the areas most exposed to climate change. They are also the areas with the highest population growth, which increases the risk of humanitarian disaster.

More than 20% of the world's population currently lives within 30 km of the coast. In Asia, more than 40% of the population (about 2 billion people) live within 60 km of the coast. The urbanization of the coastline exposes a significant portion of the population to the risk of coastal flooding.

Sea level rise

Global Sea Level is Projected to Rise

Even under the most modest scenarios*, scientists expect sea level rise to affect Earth's coastlines significantly in the coming centuries.



*Scientists use **Representative Concentration Pathways (RCPs)** to calculate future projections based on near-term emissions strategies and their expected outcomes in the future.
The RCP values refer to the amount of radiative forcing (in W/m^2) in the year 2100.

The IPCC has predicted a sea level rise ranging from 0.3m to 1.1m for the worst case scenarios by 2100. The oceans could stand 5m higher by 2300 if mankind doesn't change its behavior. Needless to say, sea level rise has and will have a very important impact on the frequence and violence of marine flooding.

Destruction of agricultural fields

Destruction of agricultural fields happens in two steps. First, when the wave comes in, the plants are pulled out. Then, after the water settles, and as it goes back to its normal level the salt is left out on the fields therefore killing all the plants that weren't pulled out at first. The damage is also long lasting as the soil absorbs the salt. Salts in the soil can absorb water. This results in less water being available for uptake by the plants, increasing water stress and root dehydration. This is referred to as physiological drought, which, can lead to reduced plant growth.

Risk for industrial sites

Coastal areas are highly strategic industry wise. The abundance of water resources, as well as the ease of transportation, has led to the development of important factories. For example, nuclear power plants, which require a lot of water, have often been built near the coast. Today this constitutes a risk of a major nuclear incident which could have enormous consequences on nature. We remember the accident of Fukushima for example which had plunged the country in a heavy crisis.

Marine Submersion

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Cyclones and other extreme weather events bring strong winds, waves and low pressure conditions. A 1-hPa (hectopascal) drop in atmospheric pressure causes a 1-cm sea level rise. Therefore cyclones can cause marine submersions (coastal flooding), on top of the sea level rise already caused by global warming.

Set 4

Cyclones

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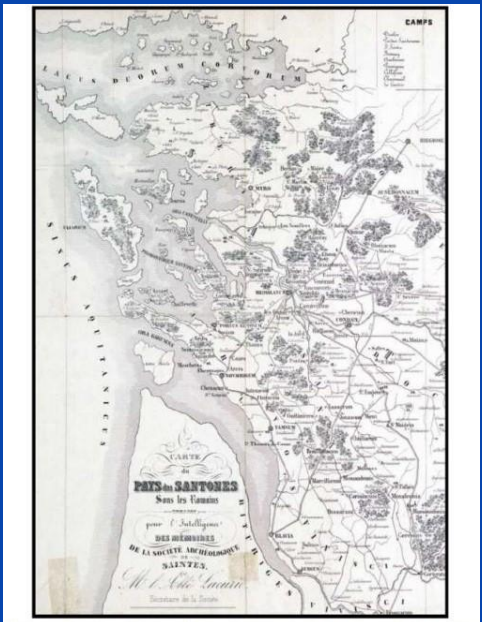
Cyclones draw their energy from warm water at the surface of the ocean. They are getting stronger because of global warming.

Set 4

Polderisation

51 B.C



Source : Société d'Archéologie et d'Histoire de la Charente-Maritime

TODAY

A polder is a large dyked and drained area, reclaimed from the sea, coastal marshes or lakes, located at a height below the maximum water level. The Netherlands is one of the most notable examples of polderisation. Between 1200 and 1665, they gained more than 200,000 hectares of land from the sea. This involved pumping water into underground canals to drain the land. Historically, this was done by a series of windmills.