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INSTITUTE OF
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Holocene Sea level : What happened along our coast for the last 10kyr?

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Introduction

- BSc. Applied Biology (Aquatic) (USM,2010)
- MSc. Marine Science (USM, 2013)
- PhD. Oceanography (UMT,2016)

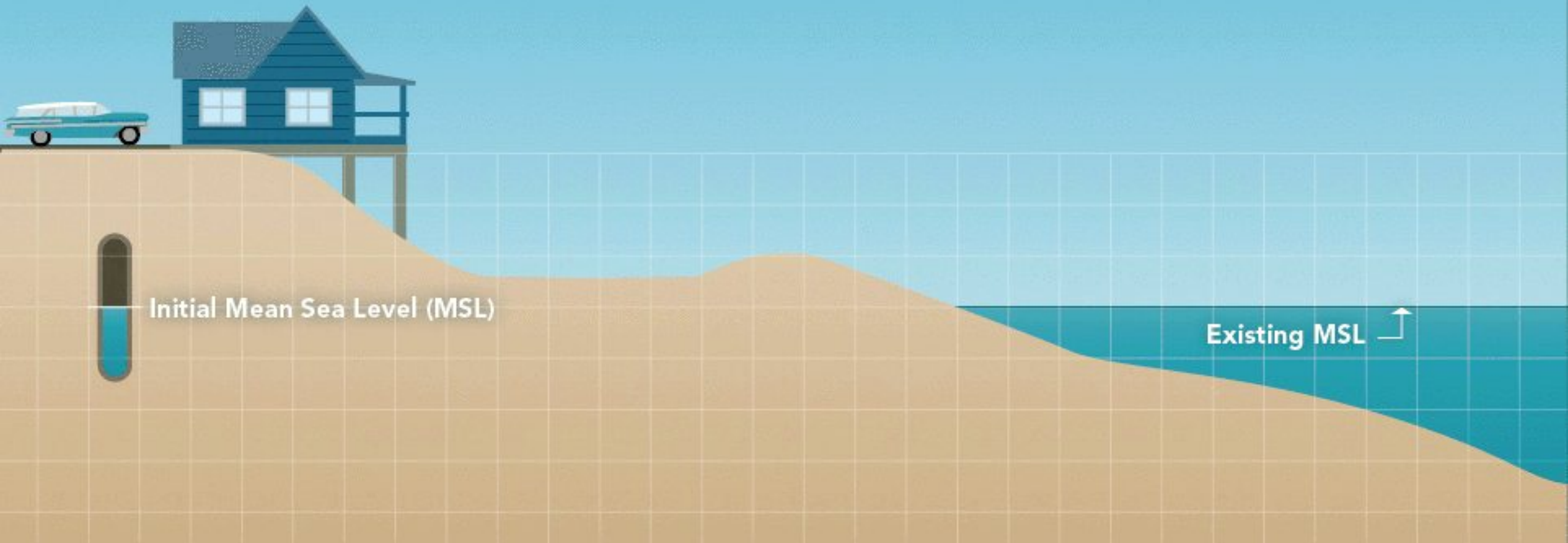


The International School of Foraminifera



K-T (K-Pg) boundary

Coastal Dynamics of Sea Level Rise (SLR)



What is sea level changes?

- The changes of water level relative to land elevation.
- The increase of water level (sea level rise) or the decrease of water level (sea level fall) happened numerous time throughout the geological time.

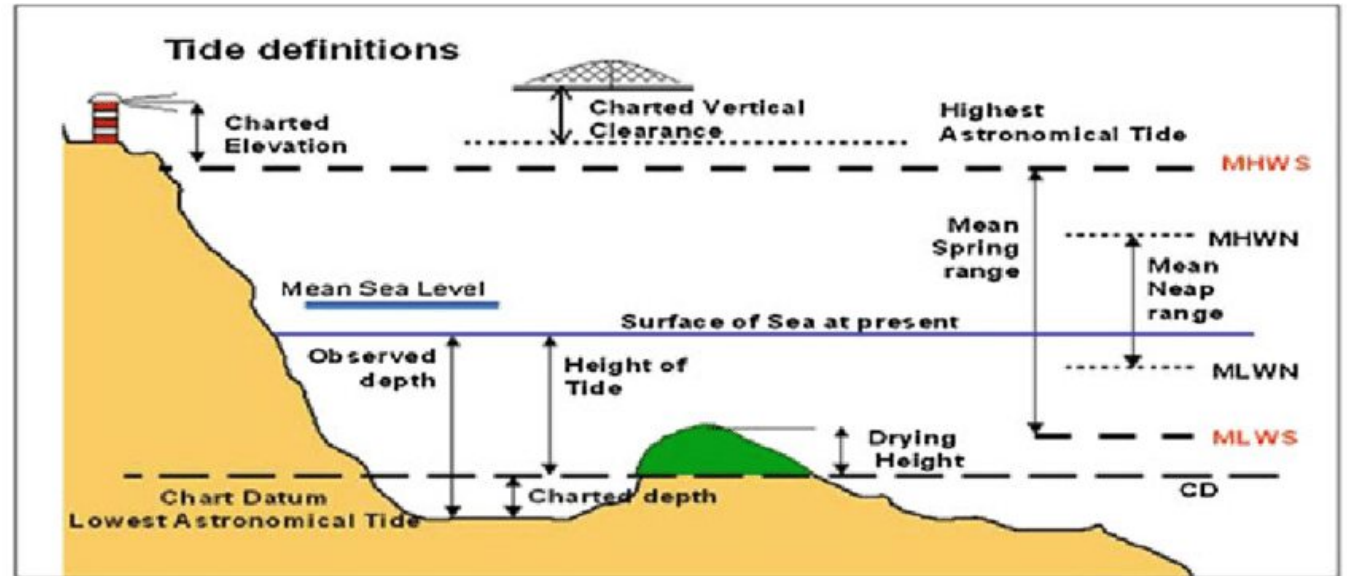
Observatory vs Experimental

Sea-level study is an
observatory science.



How do we measure sea level changes?

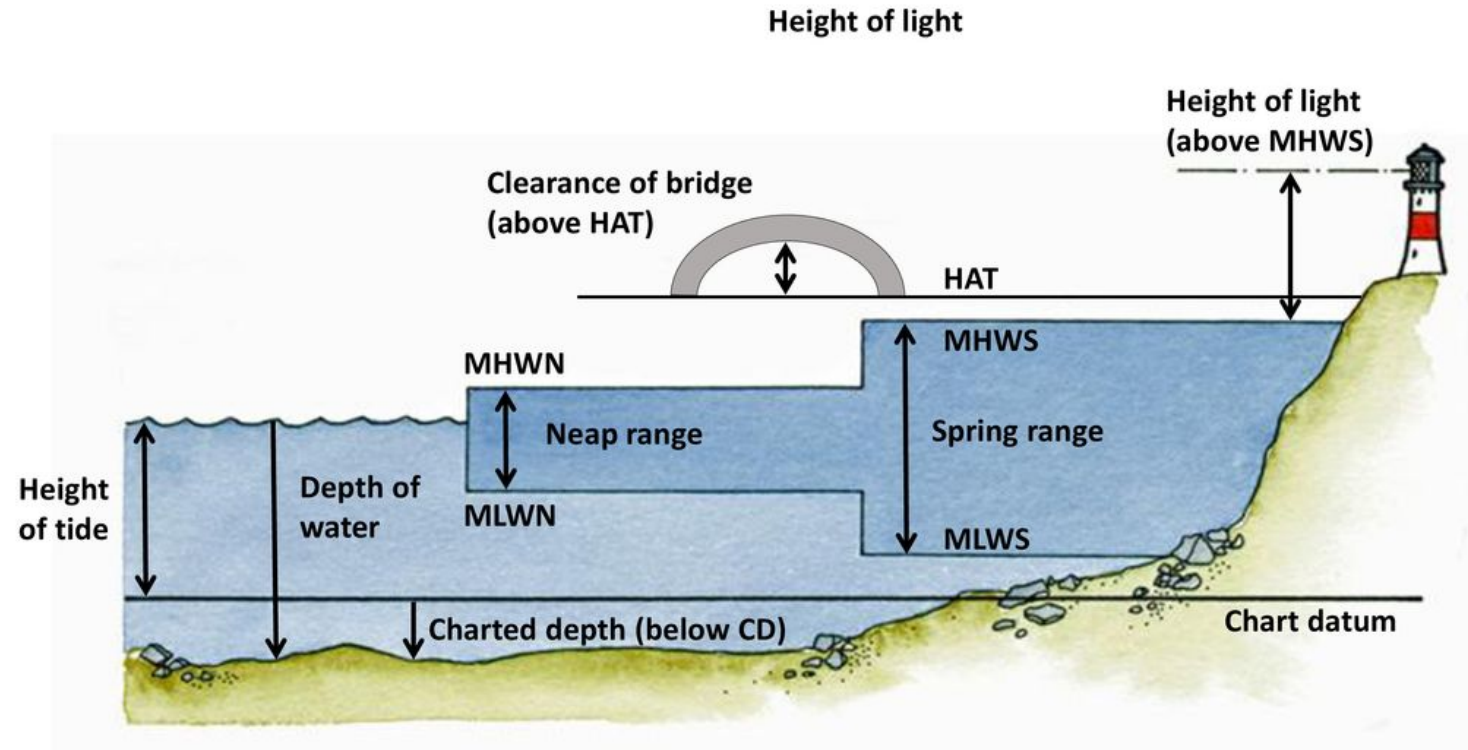
- Sea level is primarily measured using tide stations and satellite laser altimeters.
- Tide stations around the globe tell us what is happening at a local level – the height of the water as measured along the coast relative to a specific **point on land**.
- **The point on land is known as geodetic datum.**
- Satellite measurements provide us with the average height of the entire ocean. Taken together, these tools tell us how our ocean sea levels are changing over time.



Geodetic datums

- A geodetic datum is an abstract coordinate system with a reference surface (such as sea level) that serves to provide known locations to begin surveys and create maps.
- Vertical datums are used as a reference level to which bathymetric soundings are referenced for nautical charts.

Tidal terms

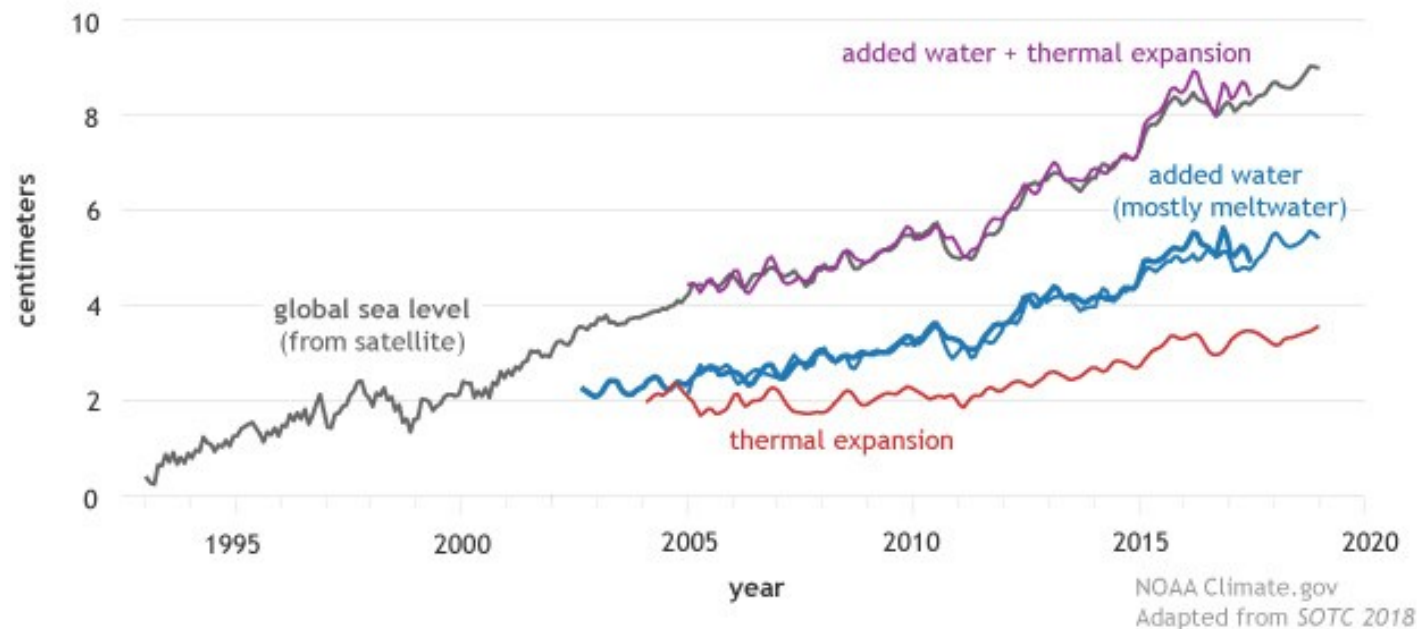


A wide-angle landscape photograph showing a grassy cliff edge on the left, a steep rocky cliff face in the center, and the ocean on the right. The sky is filled with soft, grey clouds. In the distance, a small island or headland is visible across the water.

**How do we
measure
past sea
level?**

Global mean sea level rise

Contributors to global sea level rise (1993-2018)

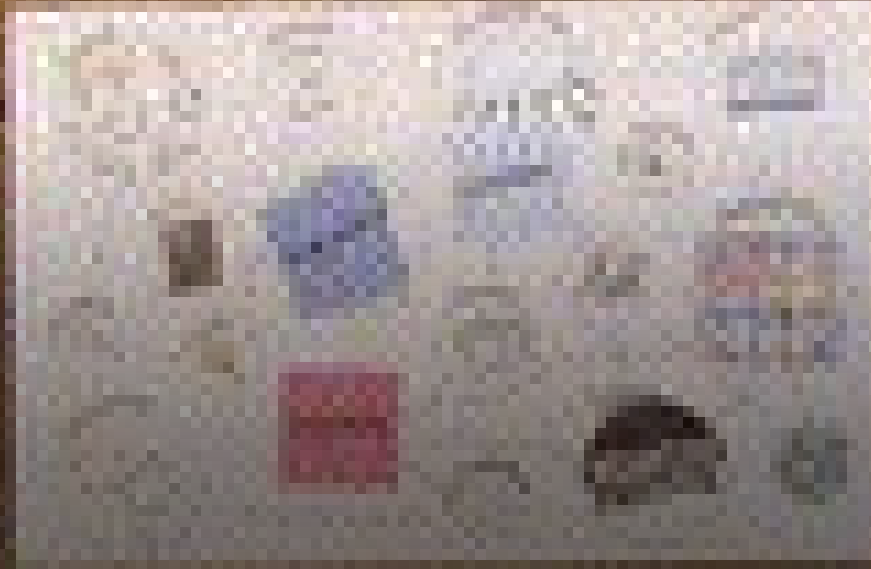


- Sea level has risen 8–9 inches (21–24 cm) since 1880.
- In 2019, global sea level was 3.4 inches (87.61 mm) above the 1993 average – the highest annual average in the satellite record (1993-present). This is an increase of 0.24 inches (6.1 mm) from 2018.

<https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level#:~:text=Global%20mean%20sea%20level%20has,of%20seawater%20as%20it%20warms.>

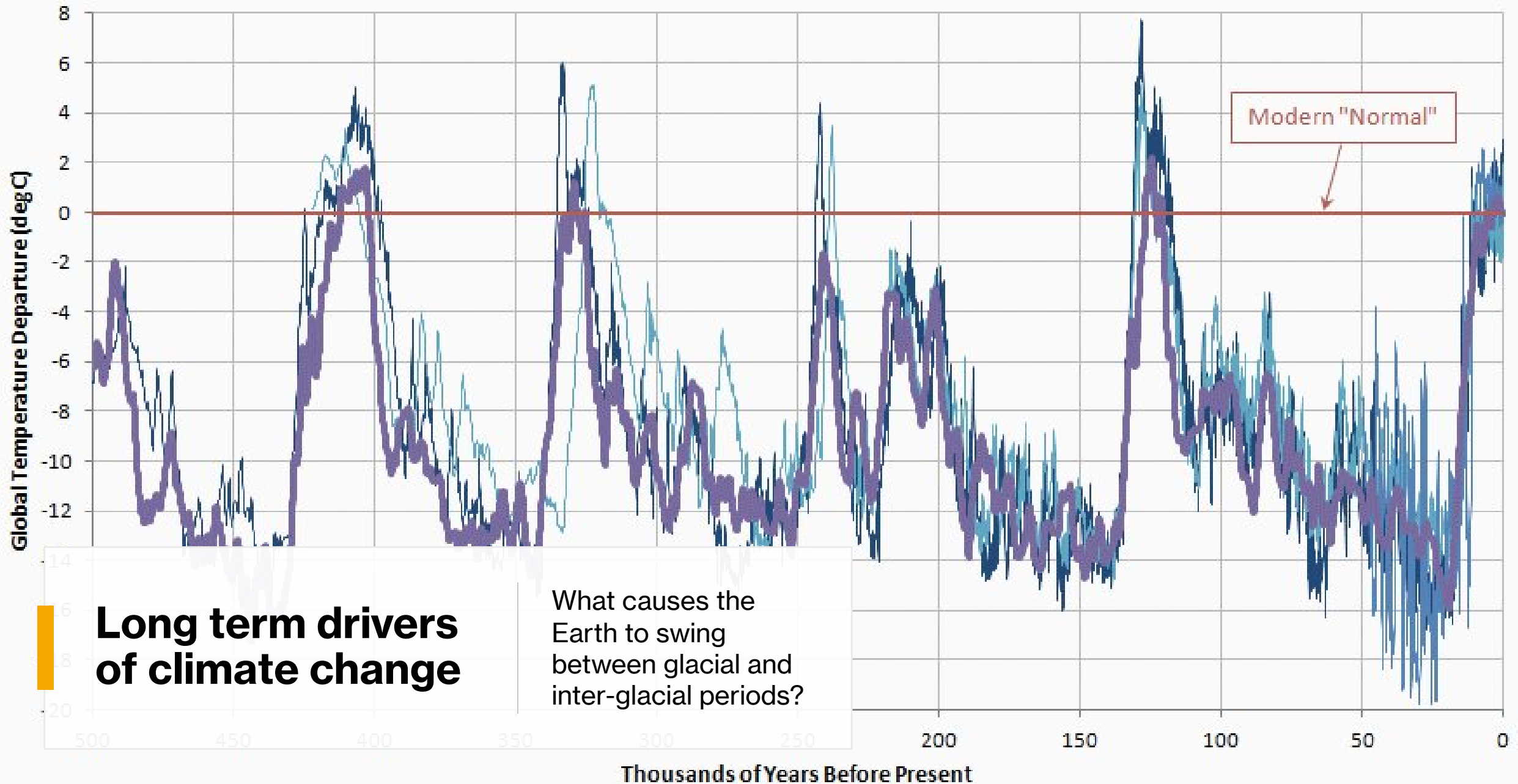
A scenic view of a wooden boardwalk winding through a sandy dune landscape. The boardwalk is made of dark wooden planks and leads the eye from the bottom center towards the horizon. On the left side of the path, there are dense, dark green shrubs and small trees. On the right side, the terrain is sandy with patches of dry, yellowish-brown grass. In the distance, the horizon line is visible under a clear, light blue sky. The overall atmosphere is peaceful and natural.

Long term vs Short term drivers



Let's Kahoot

— Ice Core EPICA Antarctica 1.6 — Ice Core Vostok Antarctica 1.6 — Ice Core GISP2 Greenland 0.9 — Ocean Sediments Bintanja



Short term drivers





Factors affecting global sea level changes

- Melting and building up of glacier.
- When glacier and ice-sheet melt, the water enter ocean basins.
- When glacier build up, lots of water store as ice.
- Thermal expansion. The heat absorbed by the ocean causes the water molecules to expand. Adding volume to the ocean.

ice sheet

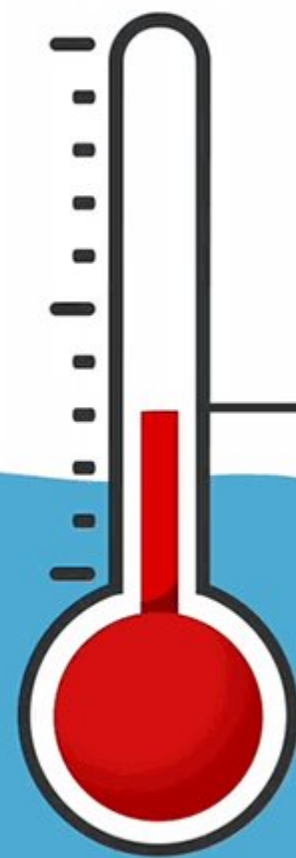
sea





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Temperature Decreases

Factors affecting local sea level changes

- Several local factors determine the rise and fall of local sea level pattern.
- These factors include land subsidence, ocean currents, tidal pattern, variations in land height and local climates.
- Land subsidence is the sinking of land area due to massive weight of cities and extraction of ground water.
- Ocean currents and tidal patterns changes with climate. Extreme climatic event such as typhoon and storm may cause higher local sea level.



Climate Change

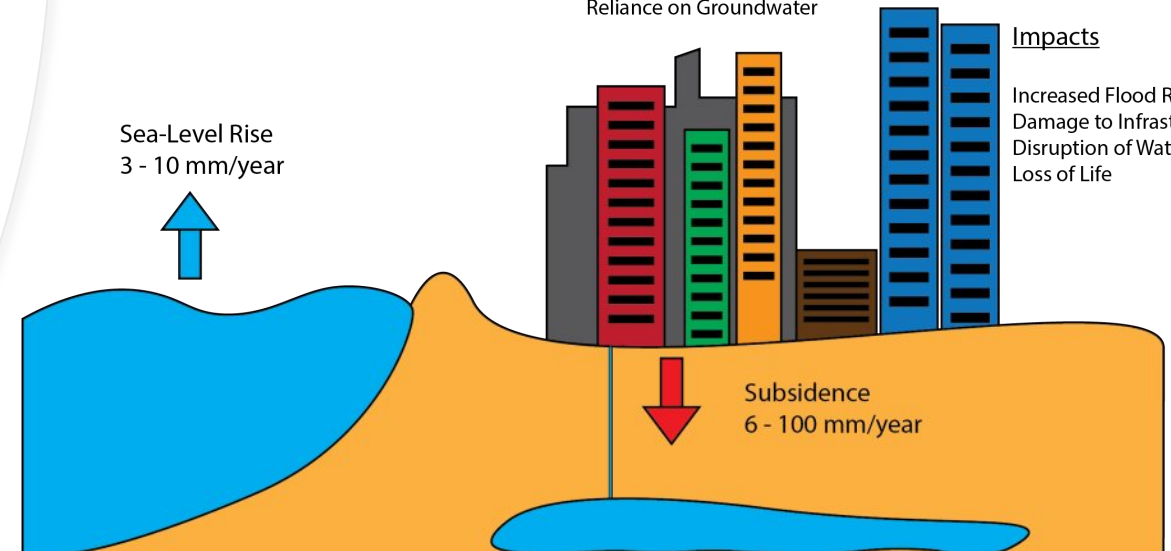
Accelerated sea level rise
Extreme weather events

Socio-economic Development

Urbanization and Population Growth
Increased Water Demand
Reliance on Groundwater

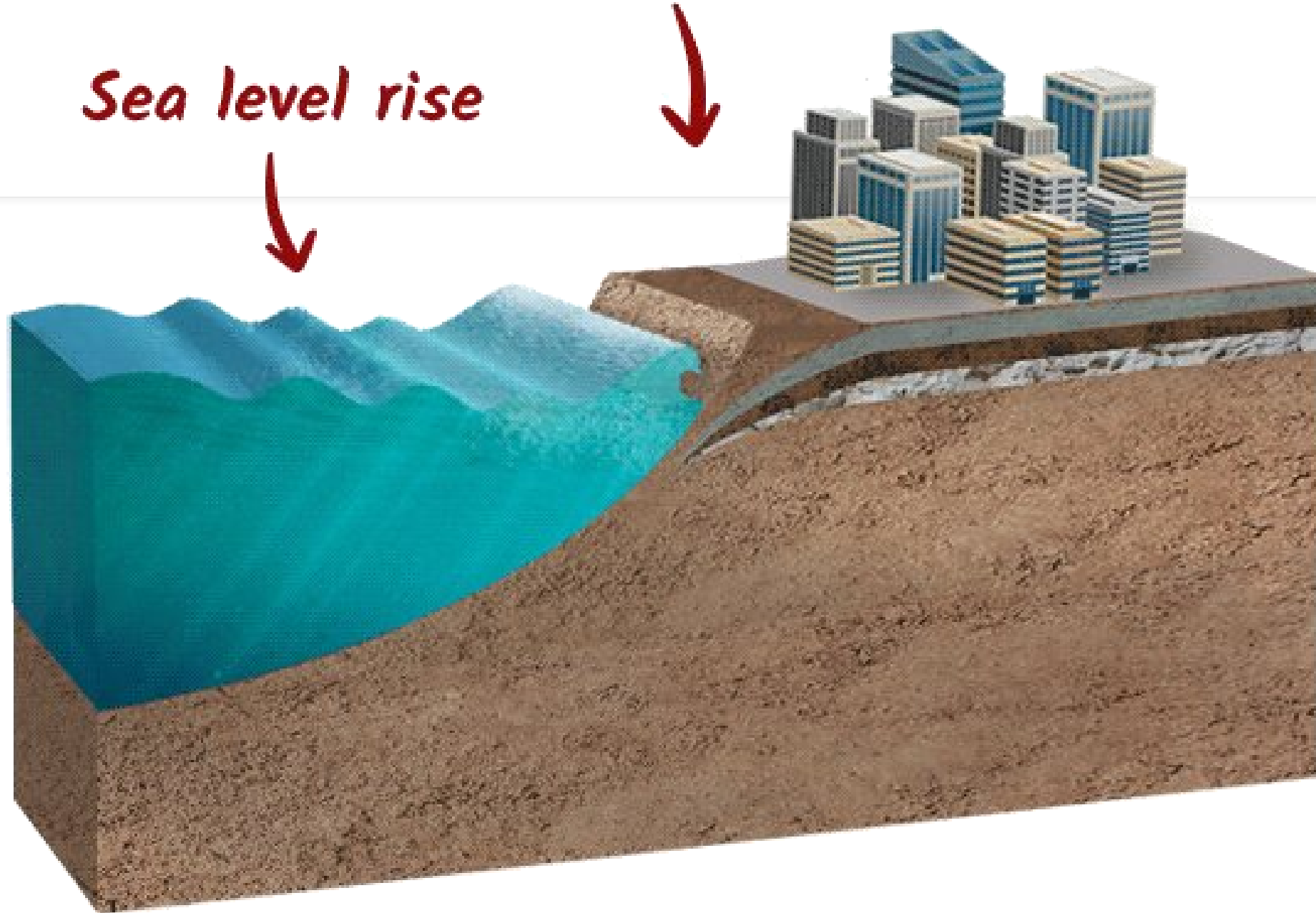
Impacts

Increased Flood Risk
Damage to Infrastructure
Disruption of Water Management
Loss of Life



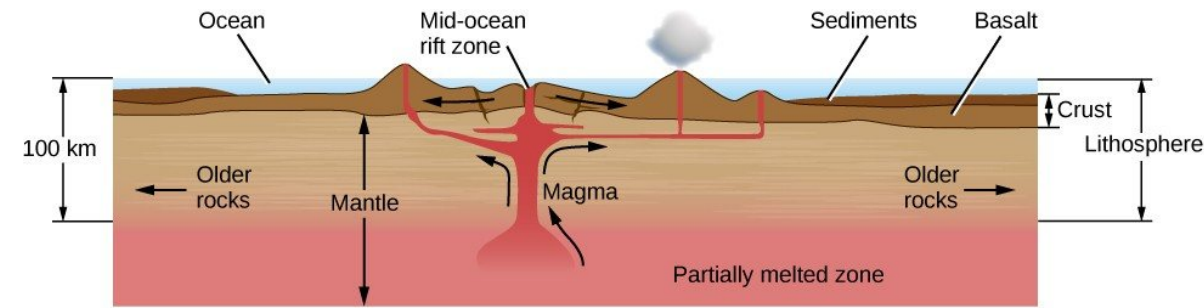
Land sinkage

Sea level rise

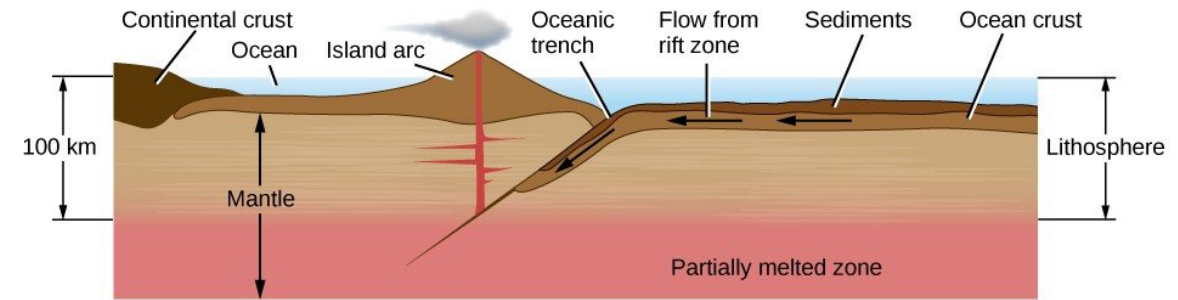


Factors affecting local sea level changes

Variation in land height- vertical land movement and isostatic adjustment.



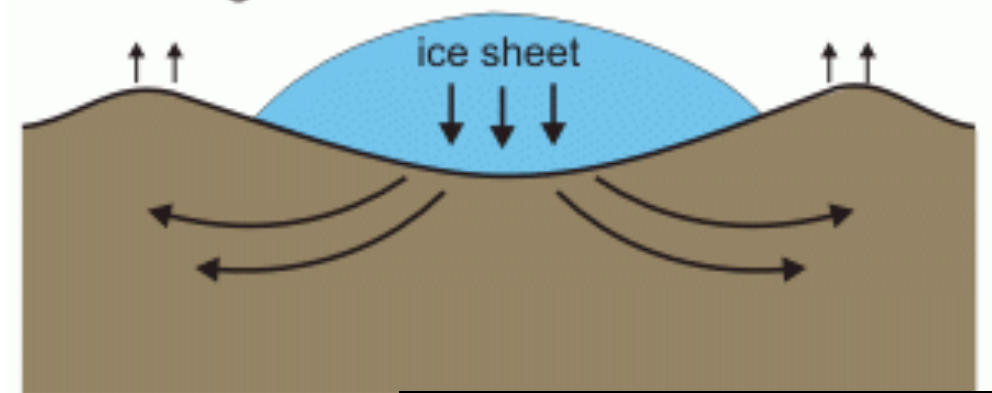
Rift zone



Subduction zone

This Photo by Unknown Author is licensed under CC BY

a. Peak glaciation



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**What are the implications
of sea level changes?**



- Coastal flooding
- Extreme storm surge.
- Ecosystem destruction
- Coastal erosion
- Many large cities are subjected to sea-level rise

