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

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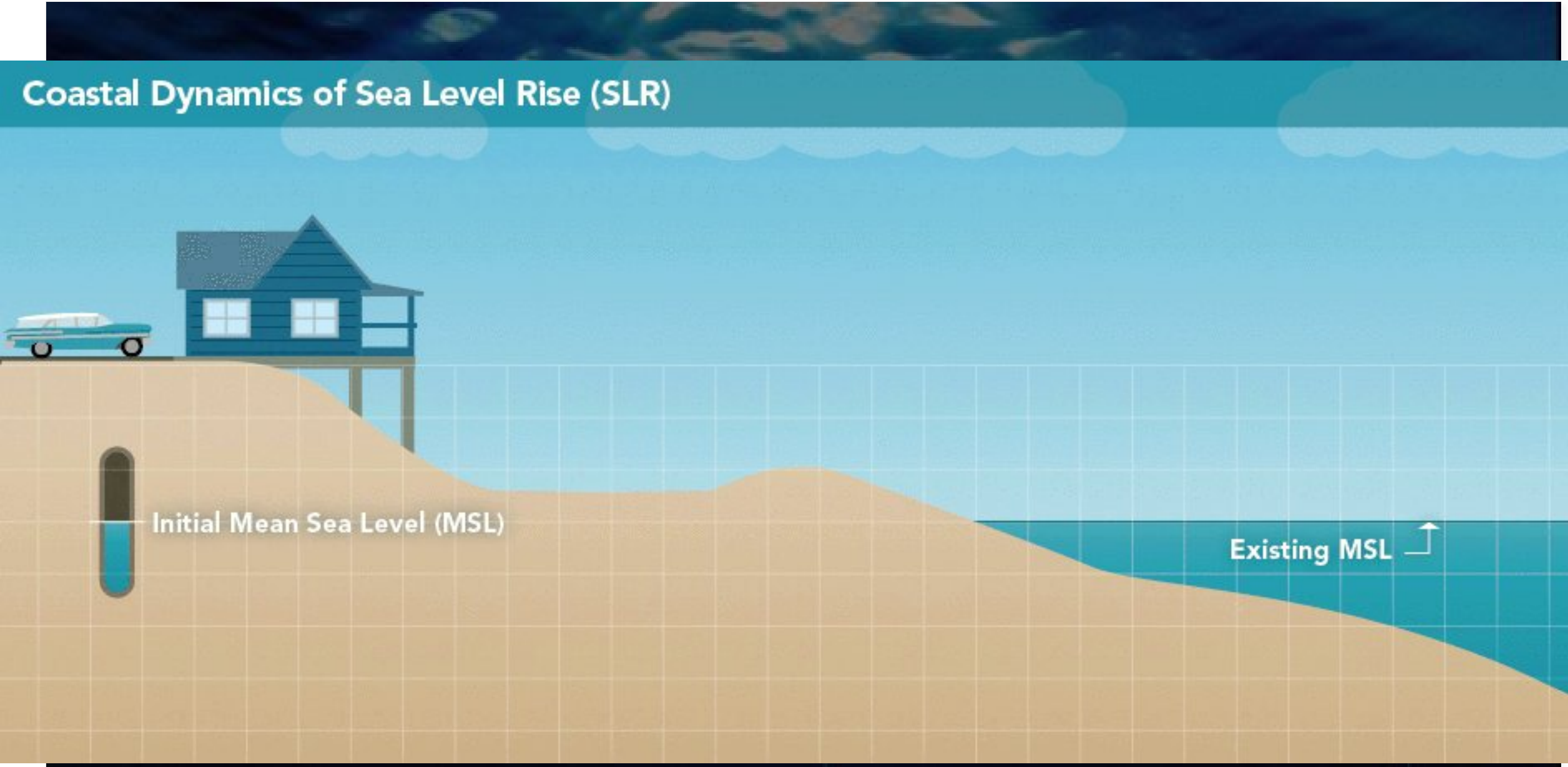
Introduction

- 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



What is sea level changes?

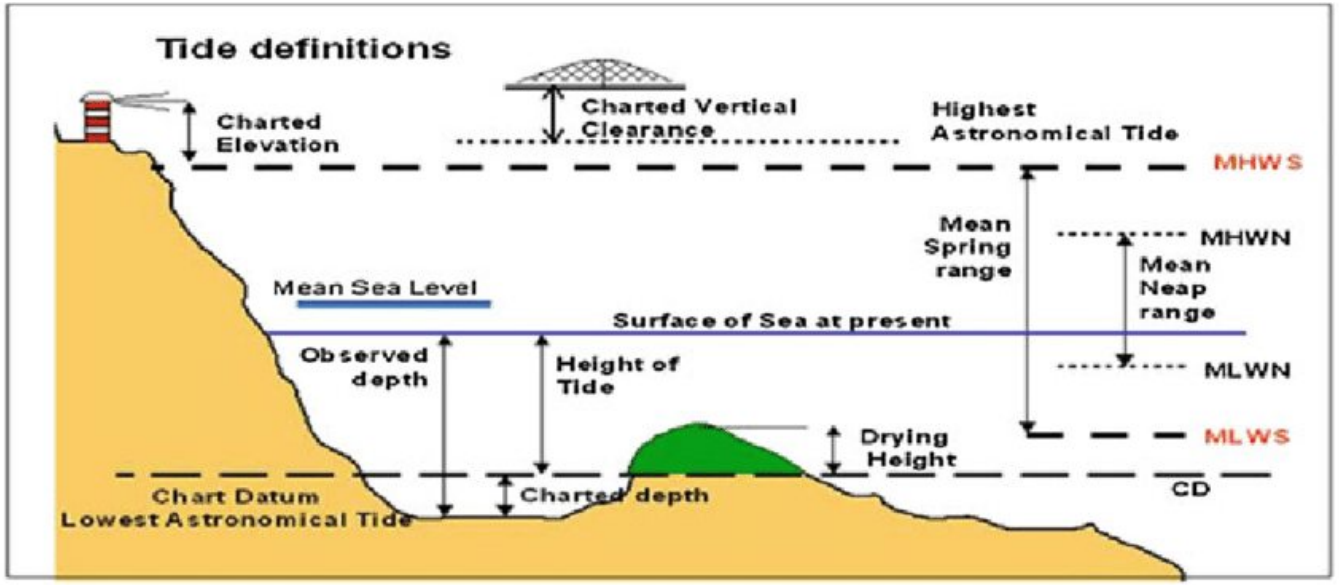
- The changes of water level relative to land elevation.
- The increase of water level (sea level rise) or the decrease of water level (sea level fall) happened numerous time throughout the geological time.

Observatory vs Experimental

Sea-level study is an observatory science.

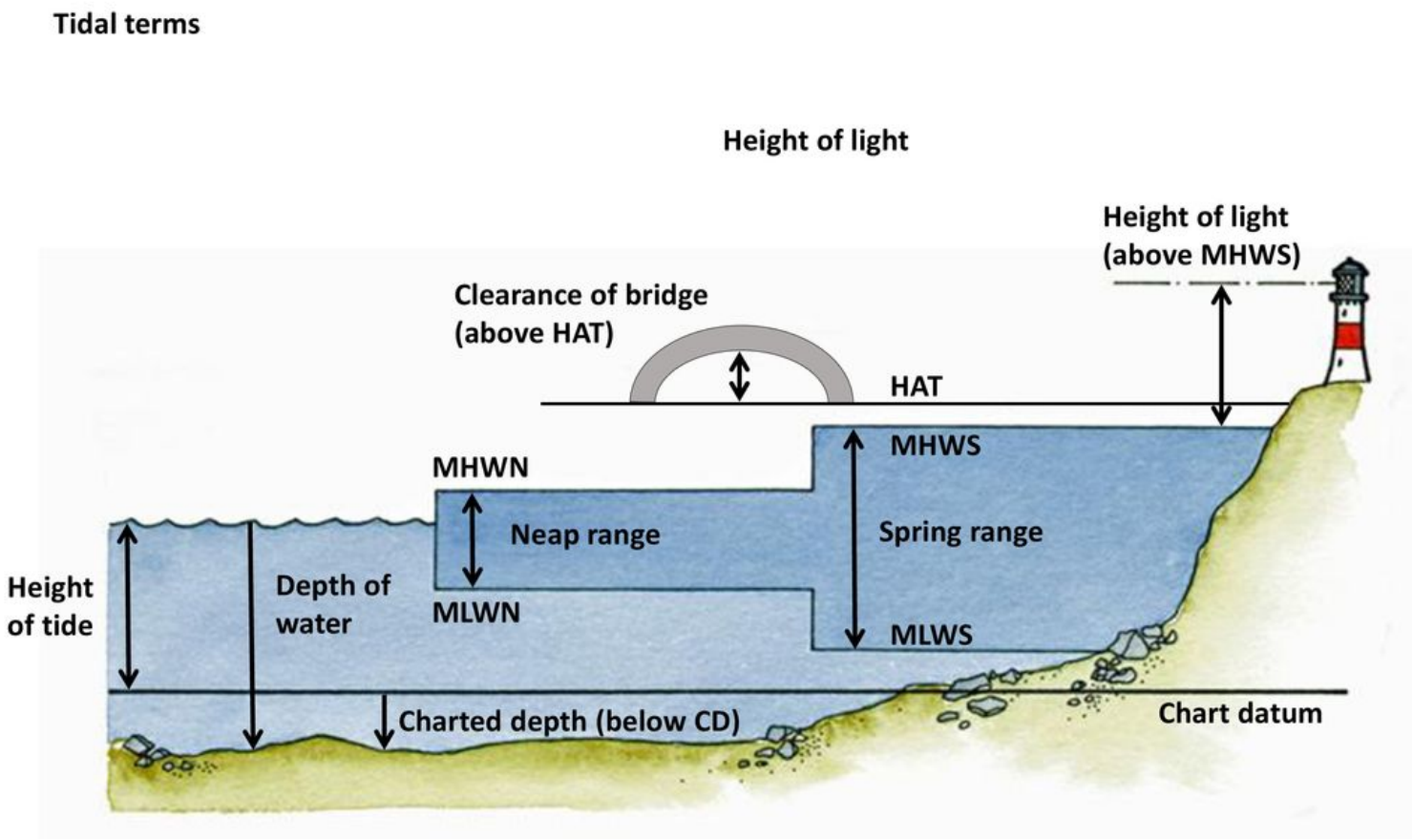
How do we measure sea level changes?

- 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.



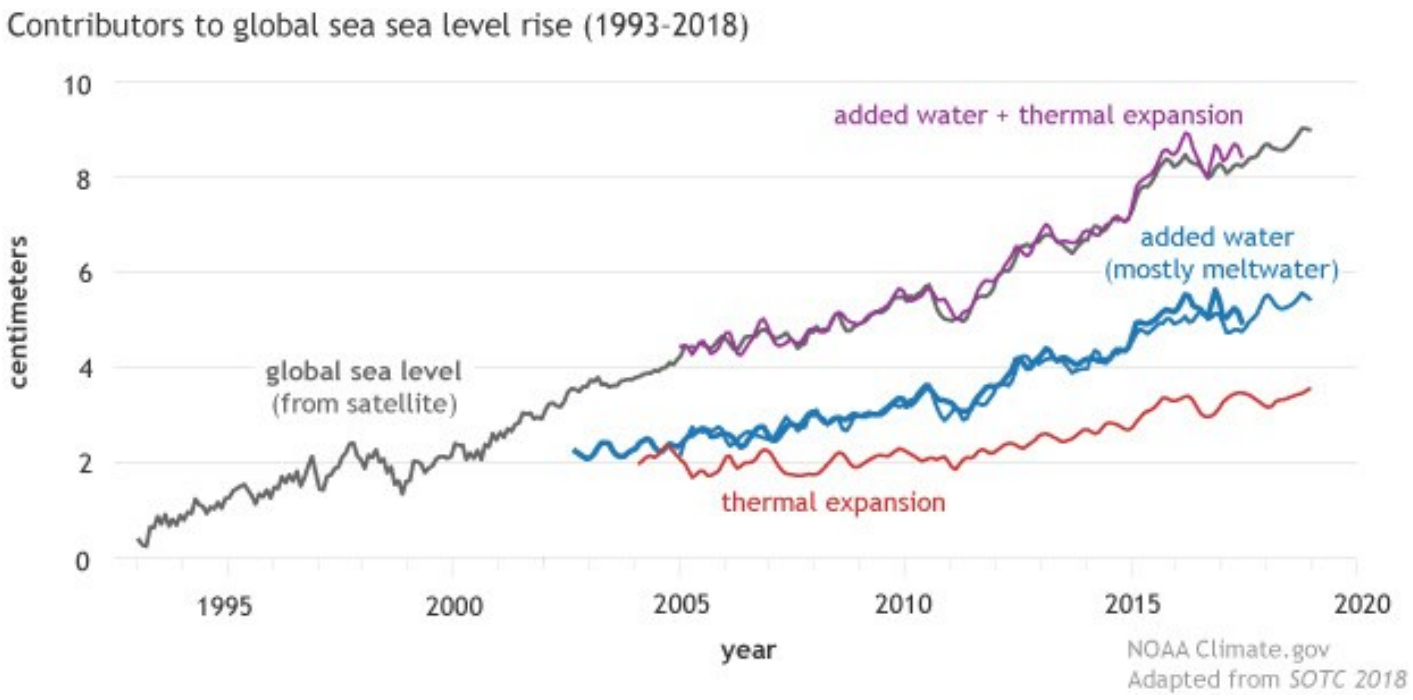
Geodetic datums

- 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.



How do we measure past sea level?

Global mean sea level rise

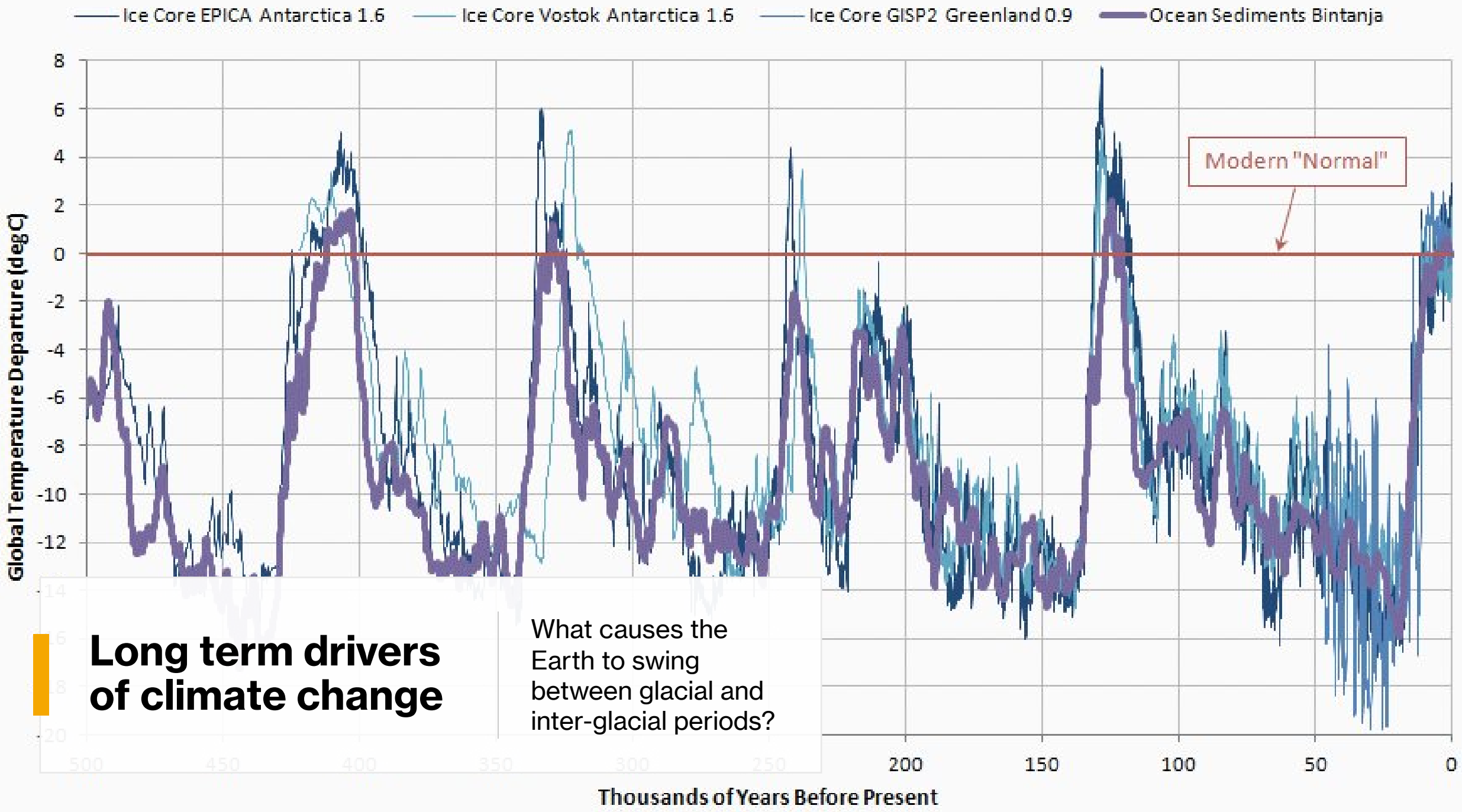


https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level#:~:text=Global%20mean%20sea%20level%20has,of%20seawater%20as%20it%20warms.

- 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.

Long term vs Short term drivers

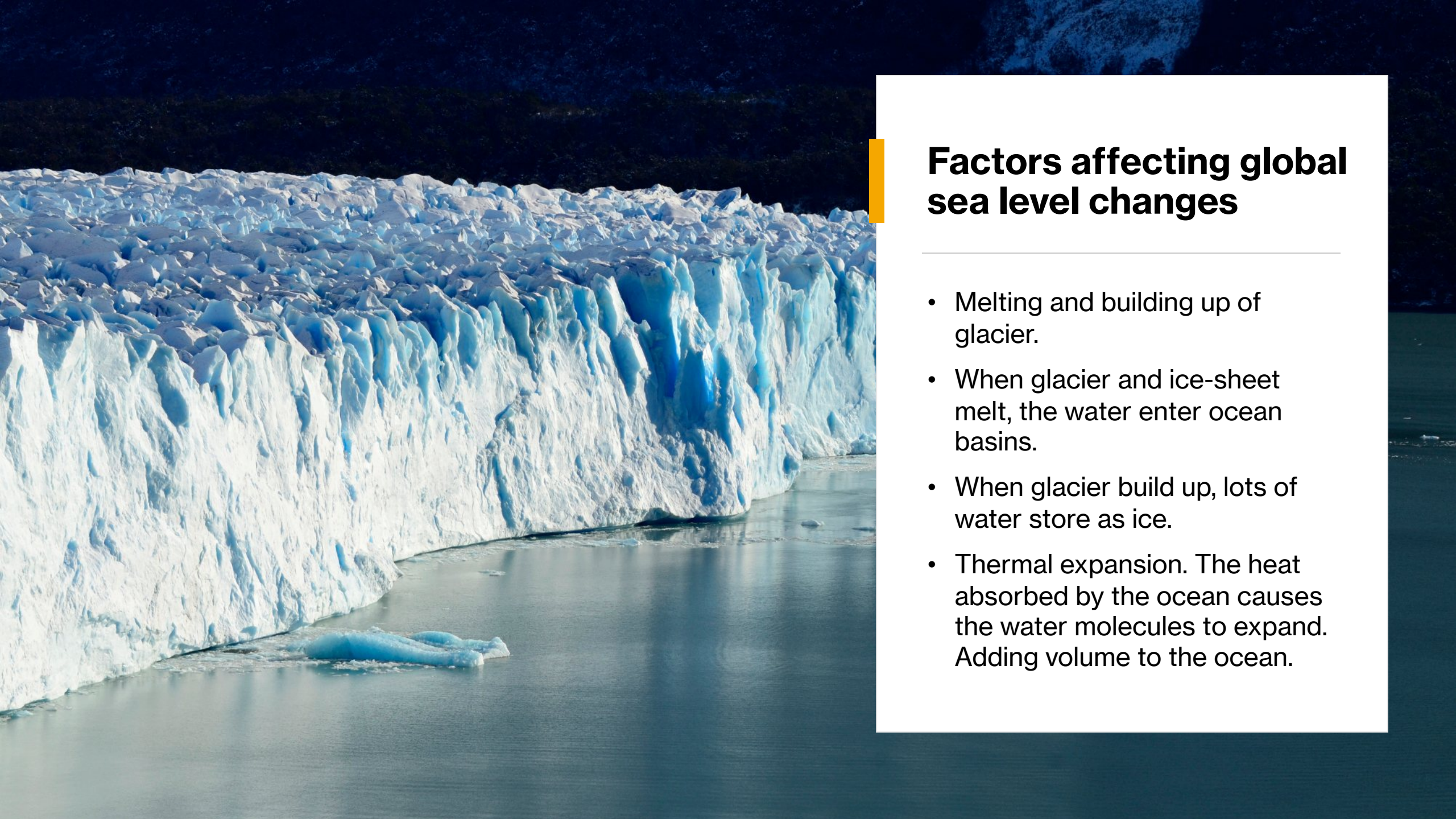
Let’s Kahoot



Long term drivers of climate change

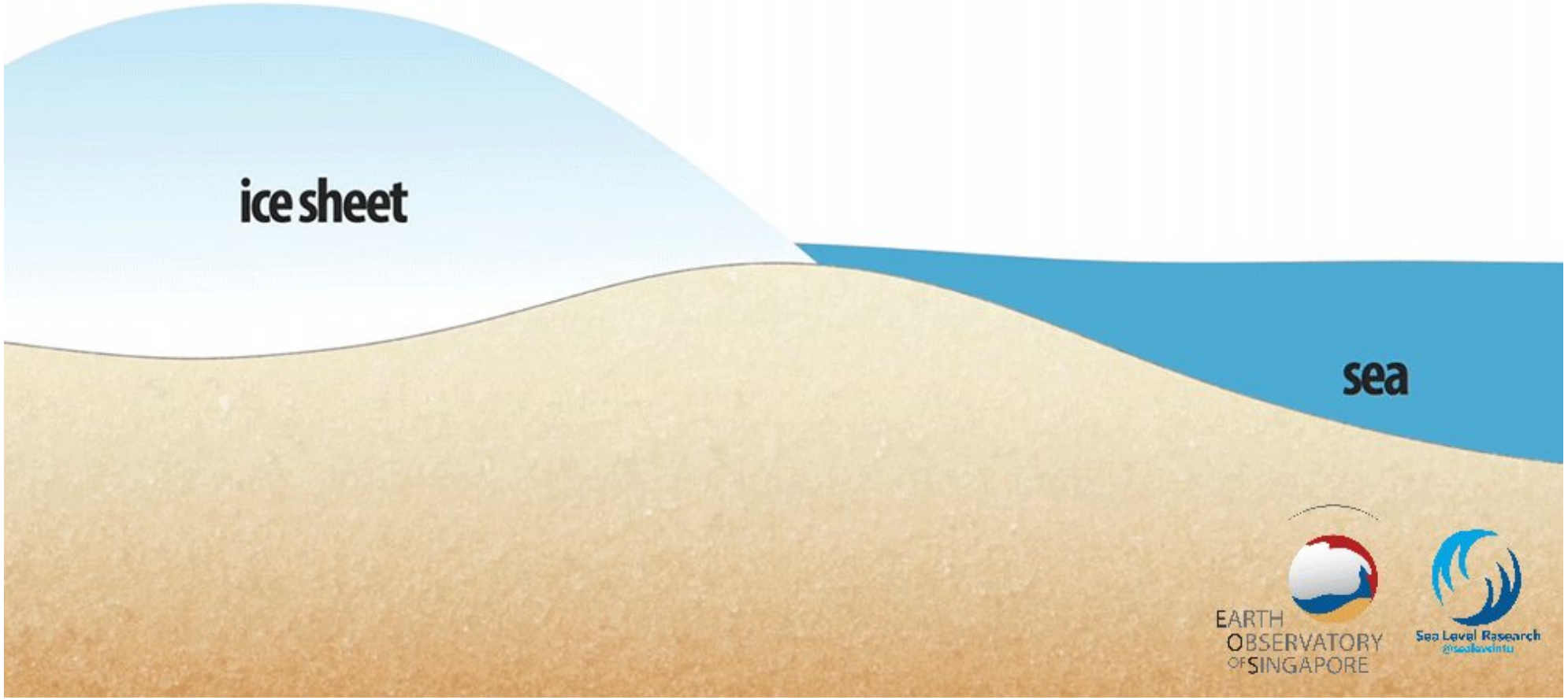
What causes the Earth to swing between glacial and inter-glacial periods?

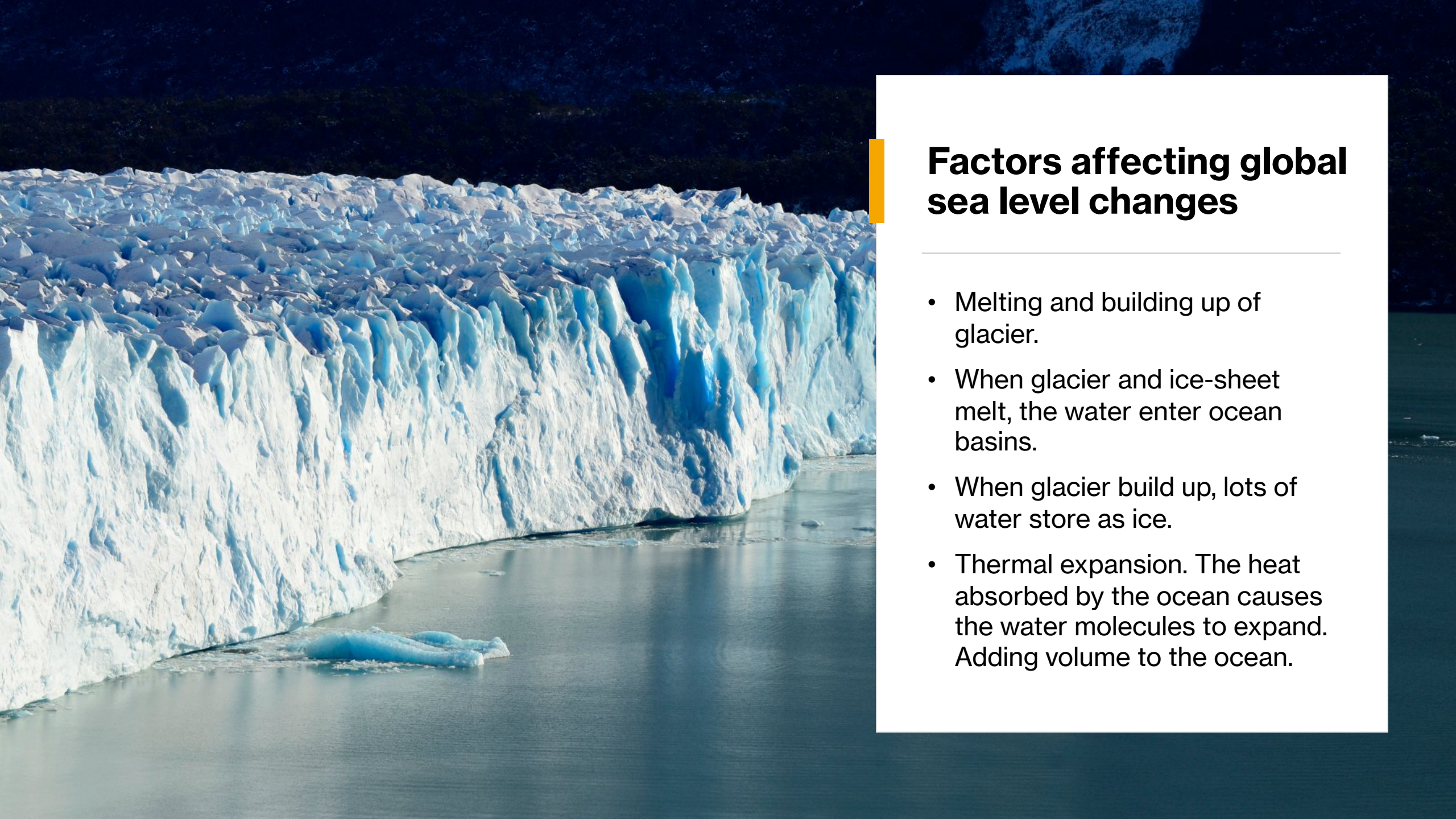
Short term drivers



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
EARTH
OBSERVATORY
OF SINGAPORE
Sea Level Research



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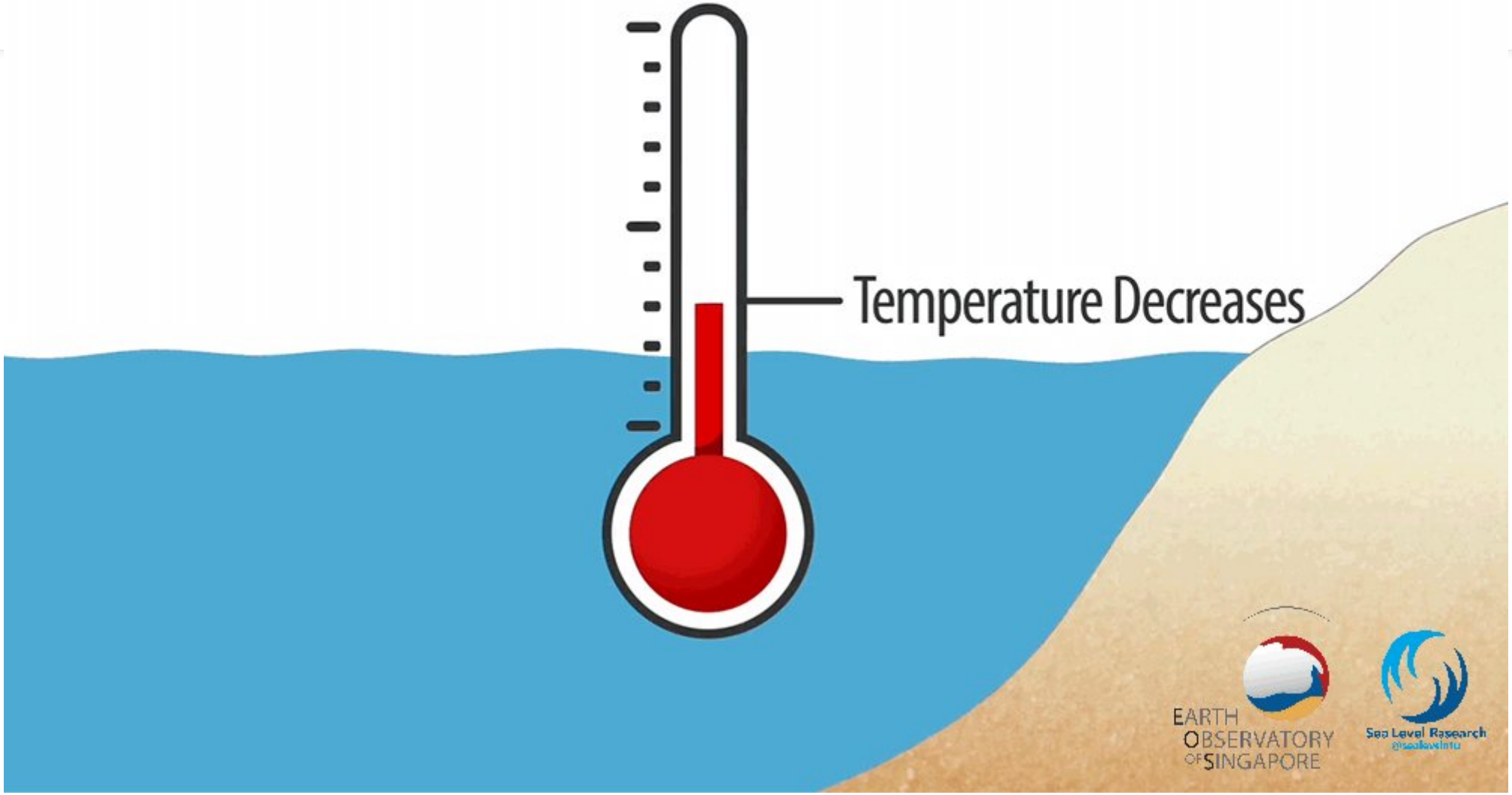
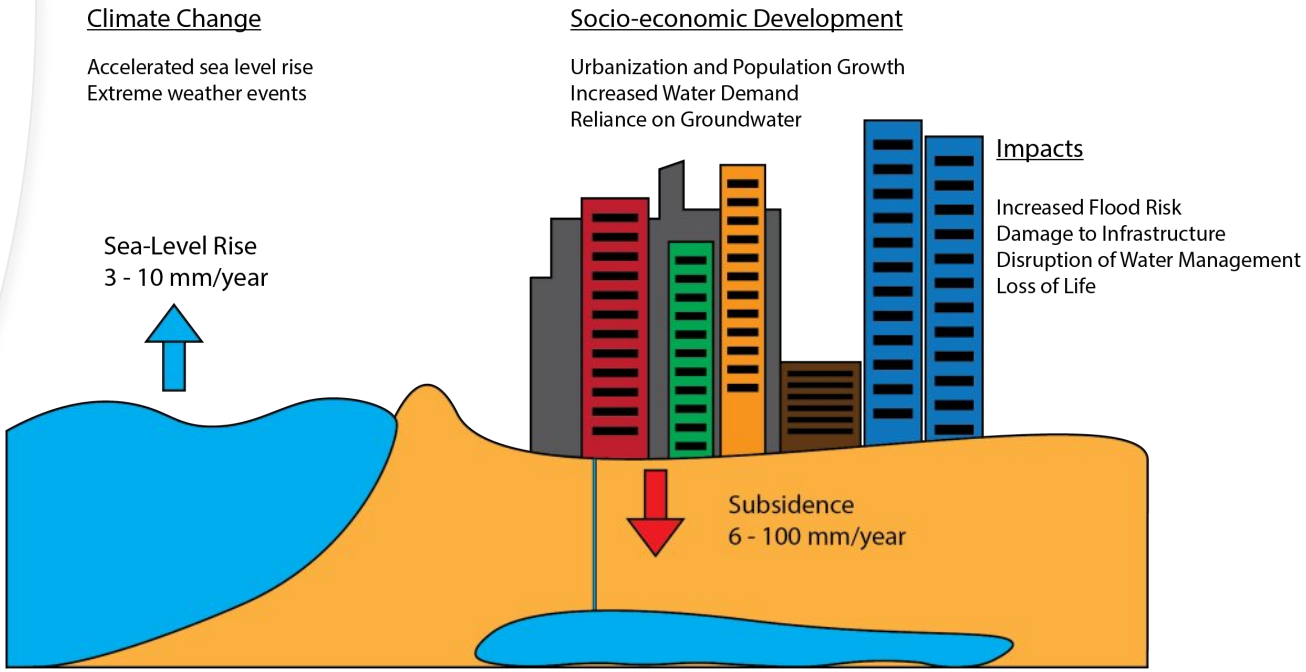
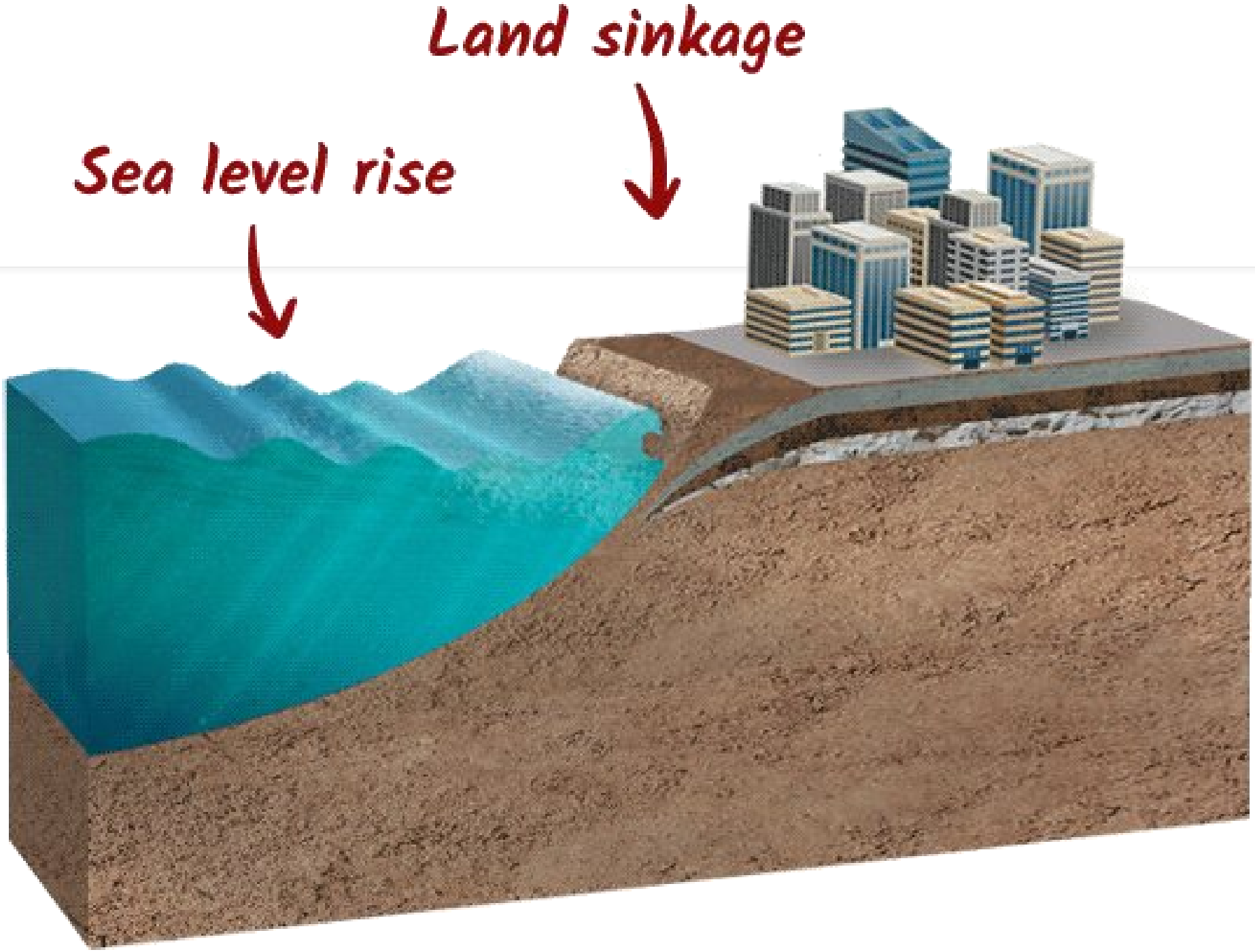

Temperature Decreases
EARTH
OBSERVATORY
OF SINGAPORE
Sea Level Research

Factors affecting local sea level changes

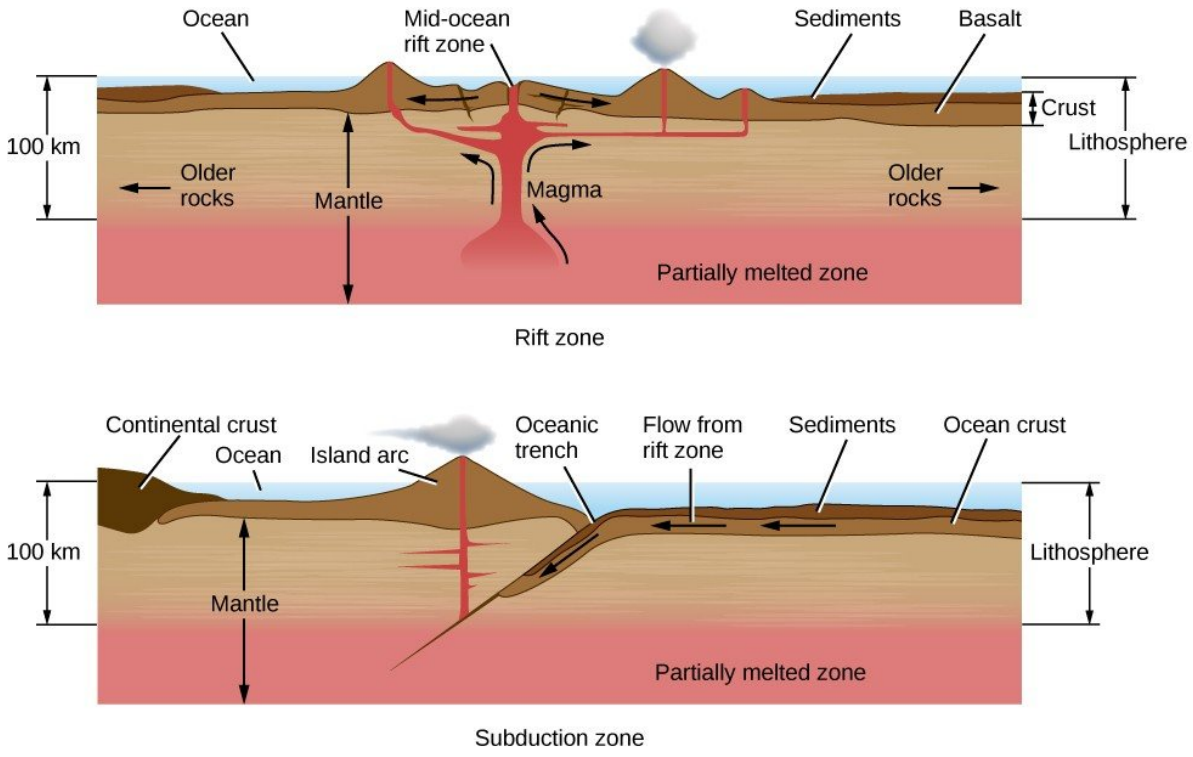
- Several local factors determine the rise and fall of local sea level pattern.
- These factors include land subsidence, ocean currents, tidal pattern, variations in land height and local climates.
- Land subsidence is the sinking of land area due to massive weight of cities and extraction of ground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

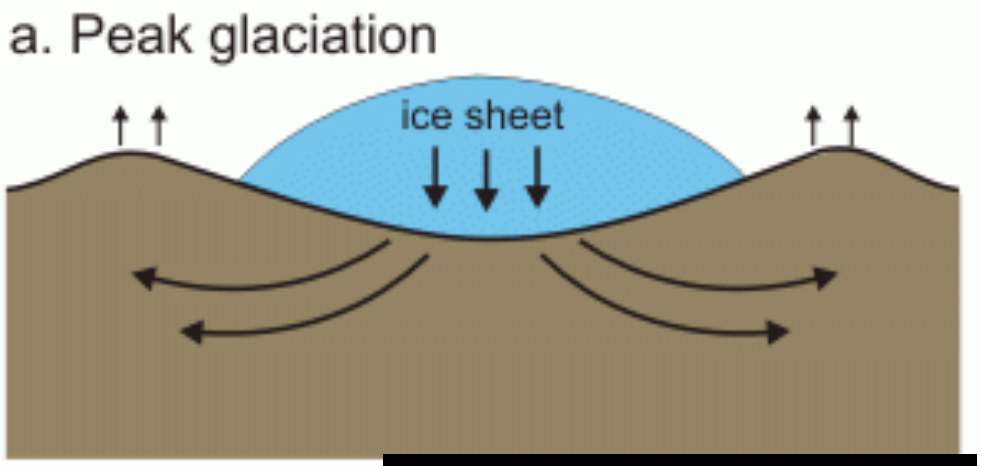



Land sinkage
Sea level rise

Factors affecting local sea level changes

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





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