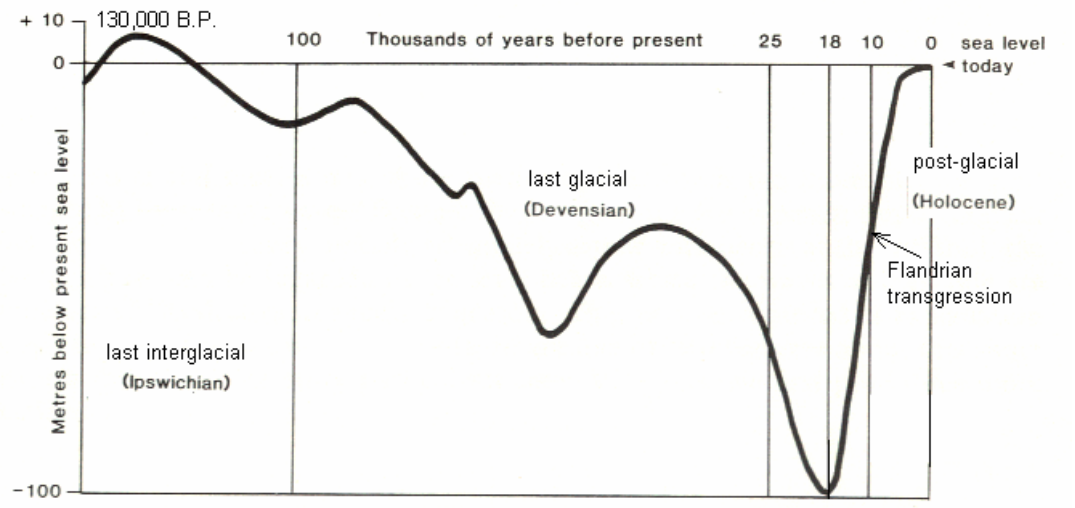
AS Geography 1.3 Coastal Environments *Student Notes*

The possible physical and human causes of long-term sea level change, to include both isostatic and eustatic change.

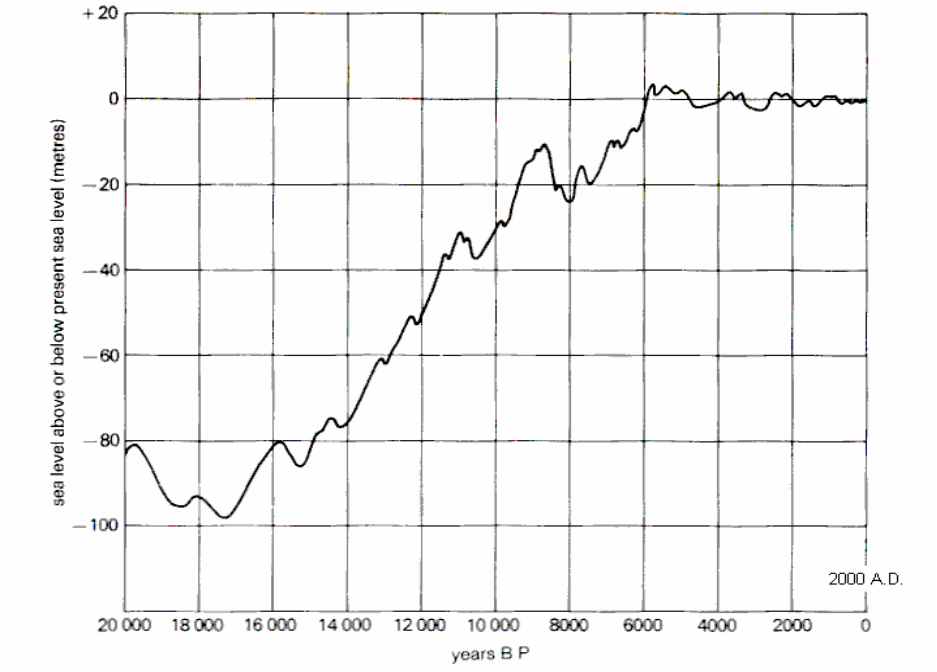
You need to understand long-term changes in sea level and how these changes relate to actual changes in the past and how they may relate to possible future changes

Eustatic Changes in Sea Level

The lowering of temperatures during cold stages of the **Pleistocene** had the effect of transferring huge volumes of water from the oceans to the land-based glaciers, thus lowering world sea level by as much as 100m (during the **Devensian** about 18,000 years ago). This had also happened in earlier stage of the Pleistocene. These cold "**glacials**" were interrupted by "**interglacial**" periods, such as the **Ispwichian** interglacial, in which the climate was moderately warm. Evidence suggests that sea levels 130,000 year ago were up to 8m above their present level.



The graph below shows the "Flandrian transgression "; the rapid rise in sea level that took place from 18,000 years B.P until about 6,000 B.P, when sea levels reached their current level.



Isostatic changes in Sea Level

Isostatic changes in sea level are localised (***iso***lated!). The sea level appears to rise and fall due to changes in the level of the land. There are two main causes:

Tectonic causes.

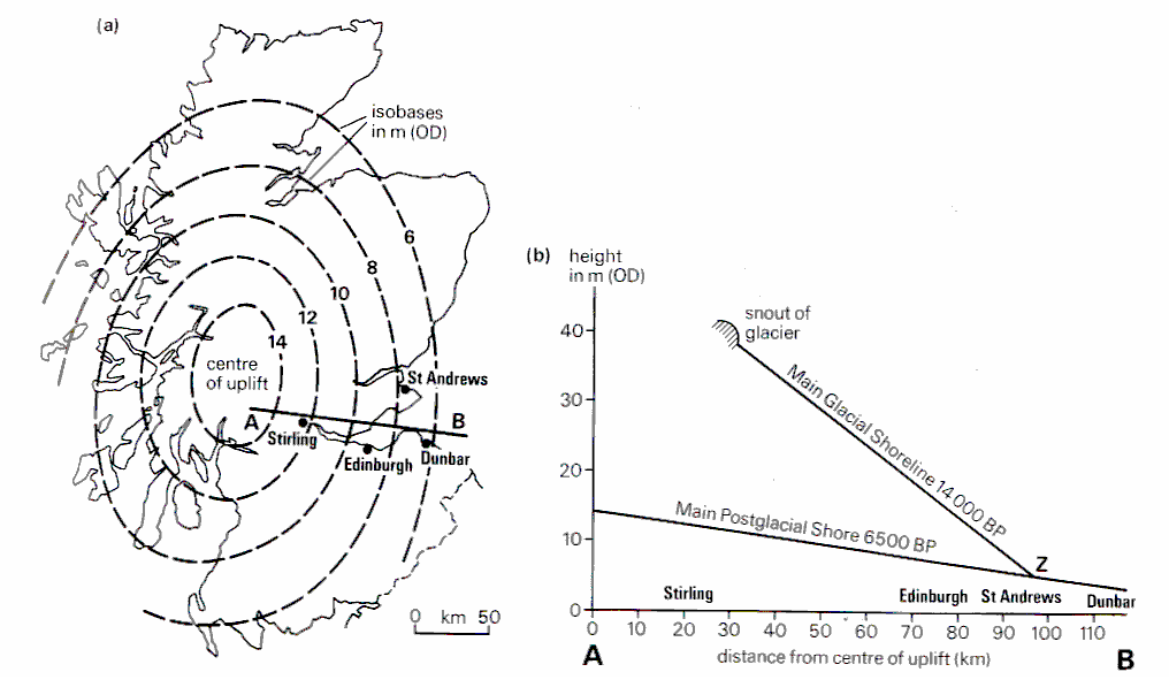
- Land levels can rise and fall in relation to the sea in relation to **earthquake activity**. The 1964 Alaskan Earthquake caused major changes to the coastline; some areas experienced a fall in sea level at localised coastal flooding, while others experienced a rise in land level (falling sea level) as the crust readjusted to the release in compression between tectonic plates. In tectonically active regions such as New Zealand, uplift occurs as part of the process of mountain building.

- **Localised subsidence** of land can take place when tectonic compressions are reduced. Much of the Mediterranean basin is subsiding as the African and Eurasian plates are no longer converging. A similar effect can be seen in Southeast England, which increases the risk of coastal flooding in the southeast. The Thames Barrier was constructed to combat this subsidence as part of the flood management of the Thames estuary.

- Localised **volcanic activity** in coastal areas can cause an apparent fall in sea level. This happened in the 1980's in the volcanically active region around Pozzuoli in the Bay of Naples when sea level in the towns harbour fell by 5 metres in a few months.

Isostatic Adjustment or Isostacy

Although eustatic changes following a glacial period can cause a global rise in sea level, the removal of the weight of an ice sheets can have to opposite effect. This is because the weight of great thicknesses of ice (over 1km in parts of Scotland) depressed the crustal rocks, forcing them down into the more mobile mantle. Removal of the weight has enabled the crust to slowly rise again. This process is called *isostatic adjustment* or *isostacy*. Although ice sheets had disappeared from Britain by 8000 years ago, isostatic adjustment is still taking places.



The map (above) shows the height pattern for shorelines that were formed in Scotland 6,500 B.P. At **A**, the shorelines lie above 14m above the present sea level, whereas at **B**, they are only 6m above modern sea level. (In the Shetlands, the same shorelines are about 9m *below* sea level, as a result of eustatic changes.) The centre of uplift is believed to indicate where glacial ice was at its greatest thickness. Shorelines formed 14,000 years ago, during the Devensian glacial, show an even greater rate of change. In many parts of Scotland, such as the Isle of Arran, the relative fall in sea level has resulted in the formation of raised wave-cut platforms, beaches, and sea caves.

Human Influences on Sea Level Change

In the past, human activity has had little impact on sea level change. Concern is now growing about the impact of global warming which is causing a global eustatic rise in sea levels (and cloud lead to isostatic changes in places such as Antarctica). The atmospheric warming causes both glacial ice at the poles to melt and the expansion of seawater as it warms. Both cause the sea level to rise. Global warming in caused by the release into the atmosphere of carbon dioxide, methane, nitrogen oxides and CFCs.

The Greenhouse Effect

Physics: Earth absorbs incoming solar radiation and then trys to cool by emitting long wavelength infrared radiation. This radiation is absorbed by Greenhouse Gases and hence can't escape → net effect should be to increase mean annual temperature.

Greenhouse Gases:

- **CO_2 → burning of carbon based fuels**
- **CH_4 → anerobic bacteria in rice fields, cows, sewage**
- **N_20 → fossil fuels and fertilizer**
- **CFCs → refrigeration and spray cans**

Importance:

- **CO_2 → 65% ; 0.4 % (150 years) ; 1**
- **CH_4 → 25% ; 1 % (70 years) ; 25**
- **CFCs → 10% ; 5 % (14 years) ; 10,000 !**