A-Level Geography Resource Package

[Physical >> Coastal Systems & Landscapes >> 3.1.3.3 Coastal Landscape Development]

Content Guide:

Online users can click the links here to take them to specific parts of this document

Pg. 1 | Historical Sea Levels

Pg. 2 | Types Of Sea Level Change

Pg. 3 | Landforms Of Emergence

Pg. 4 | Landforms Of Submergence

Understanding Sea Level Changes Over Time & Their Landforms

1.0 Historical Sea Levels:

I reckon a good place to start with this topic is by analysing sea levels over a longer period of time historically, through which we can build up a picture of trends and anomalies, especially in recent years and further into the future.

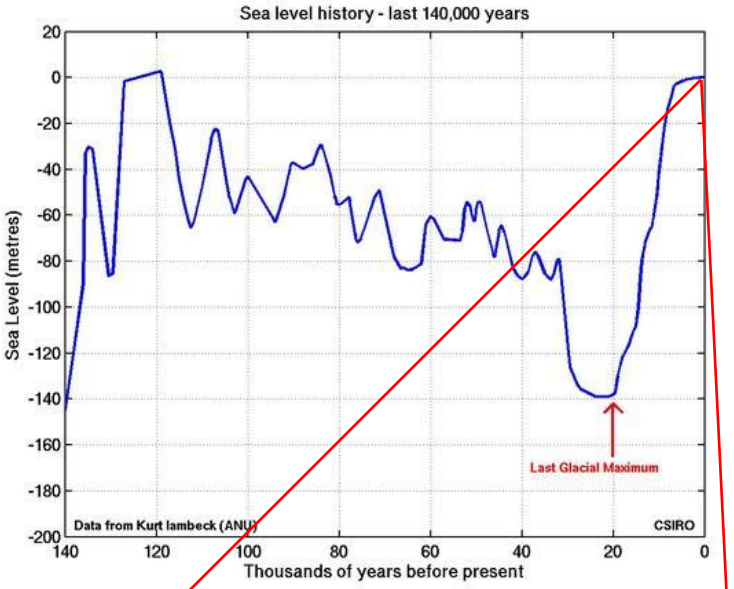
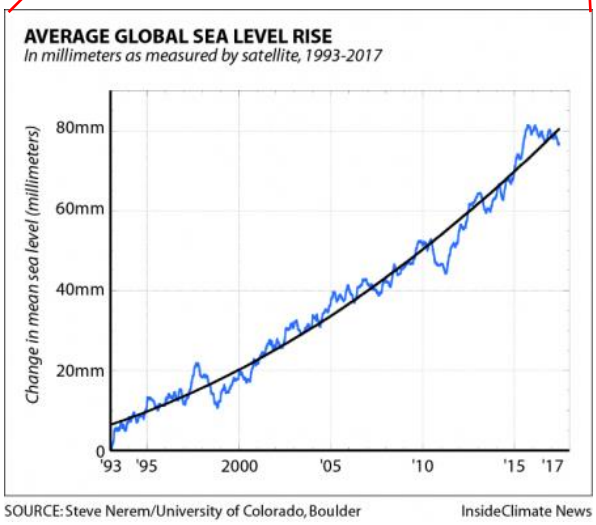


Figure 1, to the right indicates relative mean sea levels on a global scale over the last 140,000 years. We can see that overall this has naturally fluctuated quite significantly through earth's glacial and interglacial periods.

Where there is a glacial maximum, more water is stored within the frozen cryosphere in areas such as ice sheets, caps and glaciers. As global temperatures increase, this then melts and enters earth's bodies of water, thus increasing the level of the sea relative to land (assuming that remains fairly constant.)

However, figure 2, to the right, suggests that in recent years there has been a marked upward curve from a flat period. We should be flattening out before sea levels reduce again as per figure 1, but this is not the case, with the trend primarily mirroring temperature rise as a result of anthropogenic climate change.



^ Sea Level rise by an expected over 1m by 2100 would have tremendous economic and environmental damage if it continues unchecked, first in flood prone lower income countries such as *Kiribati* (A-Level A* Case Study Fact File on this!), but over a longer term also on a global scale.

Key Term Check!

'Anthropogenic' means human originated – and is a really great example of A* Geographical Terminology in describing humanity's impact on the world around us, for example in terms of global warming.

2.0 Types Of Sea Level Change:

There are two main types of sea level change you need to know for your A-Levels:

EUSTATIC involving the global variation in *volume* of water.

&

ISOSTATIC involving the global variation of *land height* over longer periods of time.

Make sure you don't confuse these two if asked in an exam, as they are very different!

I like to remember which is which by considering that **HU**mans have a much greater role in **EU**static sea level rise. Pronounced correctly, they sound fairly similar!

2.1 Eustatic Sea Level Change:

This is the one that is currently most affected by human activity!

Eustatic change is when the sea level changes due to an alteration in the volume of water in the oceans or, alternatively, a change in the shape of an ocean basin having the same effect. Eustatic change is always global.

At the beginning of an ice age, the temperature falls and water is frozen and stored in glaciers, ice sheets and caps; meaning water is taken out of the sea but not put back leading to an overall fall in sea level.

Conversely, as an ice age ends, the temperature begins to rise and so the water stored in the glaciers will re-enter the hydrological cycle and the sea will be replenished, rising sea levels.

Increases in temperature outside of an ice age like global warming will also affect the sea level since an increasing temperature will cause the ice sheets to melt, putting more water in the sea.

The shape of the ocean basins can change due to *tectonic movement*. E.G. If some land under the water sinks downwards, the ocean basin will become larger, the volume of the oceans becomes larger but the overall sea level will fall since there's the same amount of water in the ocean and vice versa.

2.2 Isostatic Sea Level Change:

Isostatic sea level change is the result of an increase or decrease in the height of the land. When the height of the land increases, the sea level falls and vice versa. Isostatic change is a local sea level change.

During an ice age, isostatic change is caused by the build-up of ice on the land. As water is stored on the land in glaciers, the weight of the land increases and the land sinks slightly, causing the sea level to rise slightly. This is referred to as *compression*. When the ice melts at the end of an ice age, the land begins to rise up again and the sea level falls. This is referred to *decompression or isostatic rebound*. Isostatic rebound takes place incredibly slowly and is still taking place from the last ice age.

Isostatic sea level change can also be caused by *tectonic uplift or depression*. As this only takes place along plate boundaries, this sort of isostatic change only takes place in certain areas of the world.

N.B. We are about to move on to landforms of emergence and then submergence. Emergence involves where isostatic rebound occurs faster than sea level rise, hence 'revealing' previously covered landforms, whilst submergence involves land being covered by a Eustatic growth of sea levels.

3.0 Landforms Of Emergence:

3.1 Raised Beaches:

A raised beach is a beach at a level above the shoreline, not reachable by waters at high tide. A raised beach is sometimes called a marine terrace.

A raised beach is formed by wave action when it is close to the waterline. During a later period, a change in sea level or an uplift of the land can put it beyond the water's reach.

Recap!

Coastlines can be either 'emergent' or 'submergent.' From the previous page, I clarified the difference. In an emergent coastline, isostatic rebound (land rising) occurs faster than sea level rise, hence 'revealing' coastal landforms, which are shown here, and vice versa for submergent.

The figure above showcases the famous raised beach profile at Ballyhillin in Ireland.

3.2 Marine Platforms:

Marine Platforms are essentially wave cut platforms which are permanently (in usual conditions that is) resting above the surface of the ocean. This is because the land the platform has been formed on is slowly rising upwards.

Over time, this may become vegetated and hence look like a part of the historic cliff profile.

Did you know? Much of the North of the UK, Ireland and Scotland is actually rising upwards owing to postglacial rebound (isostatic rise), whilst the South is being pushed down like a seesaw. At the same time, eustatic sea levels are rising, putting the flatter south of the country at even more risk!

The figure to the left is of a well-vegetated marine platform in Northern California. Many of these can be found along the US West Coast, as well as in Spain, Portugal, New Zealand and more! Note the 2-step landscape giving away the fact that the lower slope used to be inundated by water at high tide.

N.B. Next page – Landscapes Of Submergence (Rias, Fjords, Dalmatian Coastlines)

4.0 Landforms Of Submergence:

Key Term Check!

'Periglacial' means seasonally glacial areas, where permafrost melting and thawing occurred/s annually!

4.1 Rias:

A ria is a type of estuarine coastline, marked by a drowned river valley – i.e. a section of river valley flooded by the sea, making it much larger and more spread than would be expected based on the river.

They are common in periglacial areas that were adjacent to land covered by ice, e.g. Southern England.

Rivers eroded steep-sided V-shaped valleys into the frozen landscape giving the ria a V-shaped cross section when the valley flooded.

Here is a famous city located along the fringes of a Ria – but which one is it? Answer at the bottom of the page!

4.2 Fjords:

Fjords are drowned glacial valleys – similar to Rias. They are common in glaciated areas, e.g. western Norway. Many Scottish sea lochs are fjords.

Fjords often have a relatively straight profile as glaciers truncate spurs to produce a direct downslope route. Glacier erosion is often cut deep into the landscape, often tens of metres lower than the adjacent unglaciated land - meaning that fjords are often deeper than the adjacent sea.

The figure above shows a classic Western Norwegian Fjord (where they get their name from!) Note the difference in appearance and path from the Ria

4.3 Dalmatian Coastlines:

This is composed of long, narrow islands running parallel to the coastline and separated from the coast by narrow sea channels called sounds.

They are produced by sea level rise flooding the coastline with the geological structure of fold hills aligned parallel to the coast.

Sadly not named after a dog, but rather a region in Croatia, the above figure shows the parallel bands making up a typical dalmatian coastline

Many thanks for reading and using this resource – good luck!

Last Updated: 04/01/21

Sydney, Australia!