

Tides, waves and climate change

Waves and tides move sediment around the coastal zone, making them incredibly important for coastal processes. Climate change is negatively effecting our seas and global sea levels are rising, putting further pressure on our coast.



Tides

Tides are the result of the gravitational pull of the moon, sun, and other astronomical bodies on the oceans. They are independent of wind speed and direction. The North Sea has twice daily high and low tides.

The incoming tide is known as a 'flood' tide and a retreating tide is the 'ebb' tide. Tidal patterns cycle every 28 days and within each cycle there are spring and neap tides.

Types of Tides

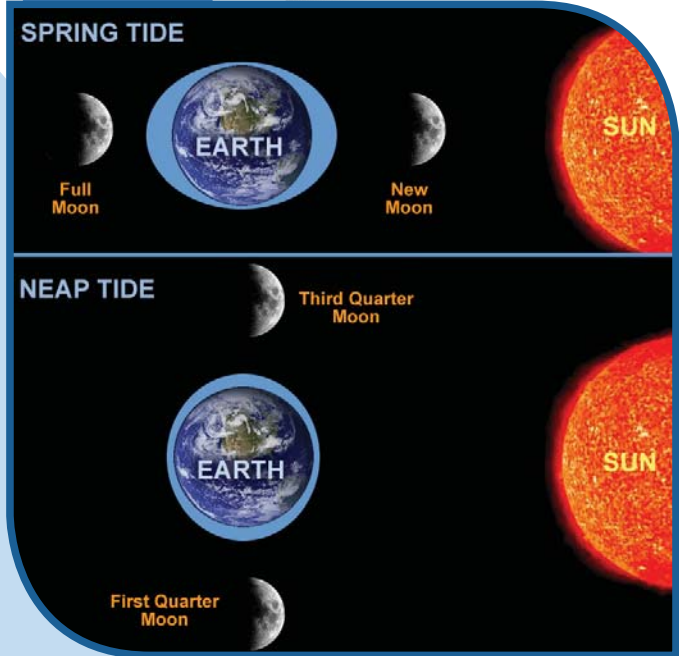
Spring Tide

During a spring tide, we experience the highest high tides and lowest low tides. Spring tides (not related to the season) are caused when the Earth, Sun, and Moon are aligned and exert the greatest amount of gravitational pull on the oceans; this is identified by a full moon or new moon.

Neap Tide

Neap tides cause high tides to be lower and low tides to be higher than usual, resulting in a far less obvious difference between daily high and low tides. This happens when the Moon is at the first or third quarter of its cycle.

The position of the Sun, Moon and Earth in relation to spring and neap tides



Picture taken from https://www.windows2universe.org/earth/Water/images/tides_lg_gif_image.html

Aerial images of Cromer Pier

High tide



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Low tide



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Tides can change quickly and can cut off sections of beach. Always check the local tide times before visiting the beach.

Tide Tables

The speed at which a tide travels around the coastline is determined by the shape of the coastline, depth of water, topography of the sea floor as well as many other considerations. This results in the tide reaching different parts of the UK at different times.

Fortunately, tides are predictable and can be read using a tide table or chart. Tide tables are available for specific locations along the coast and provide times of high and low water for each day. An example of a tide table and how to read it is below.

Tide times vary along the coast



Picture credit: <http://www.bbc.co.uk/news/uk-25253722>

© National Oceanography Centre, Liverpool

Mon 1st	01:01	08:09	14:12	20:24
Dec 2014	4.52m H	1.34m L	4.30m H	1.80m L
Tue 2nd	02:15	09:18	15:19	21:34
	4.56m H	1.27m L	4.43m H	1.64m L
Wed 3rd	03:22	10:19	16:15	22:34
	4.68m H	1.17m L	4.61m H	1.42m L

Times in GMT, heights in metres above chart datum (approximately the lowest level due to astronomical effects).

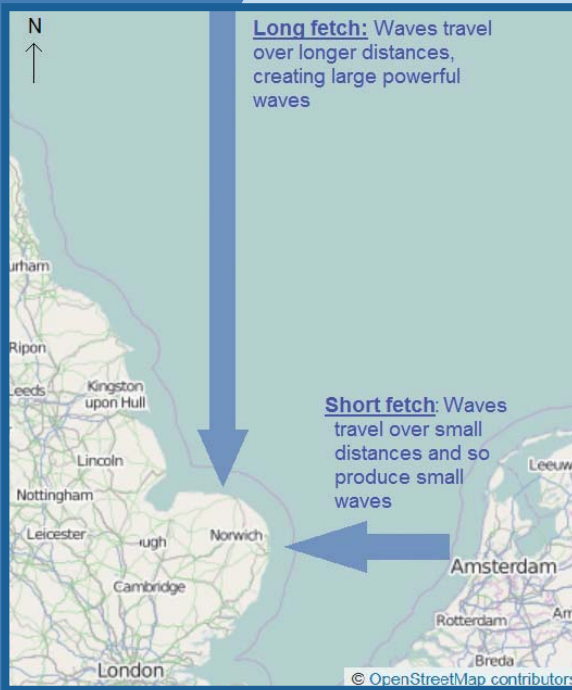
Predictions DO NOT include meteorological effects.

(H - high water, L - low water)

Tide tables can be used for a variety of reasons including recreation and to aid fishermen. To find out more about tide tables, and to find tide times in your area, please visit www.metoffice.gov.uk/public/weather/tide-times

Waves

Waves are created as the wind blows over the surface of the sea and the moving air transfers its energy to the water. The size and amount of energy the wave has depends on the strength of the wind and how far the wave has travelled (fetch). Waves with a small fetch have not travelled far and will be smaller, whereas waves with a long fetch have travelled further and will be larger and more powerful.



In North Norfolk, winds from northerly directions produce the longest fetch

When waves reach the shore, they release the energy by breaking. It depends on the type of coastline they meet as to how waves break. If the coastline is a solid structure, such as a cliff or sea wall, energy is released explosively with noise, spray and possibly damage to the structure. If the coastline is a beach, energy is released more gradually as it is used to move beach material.



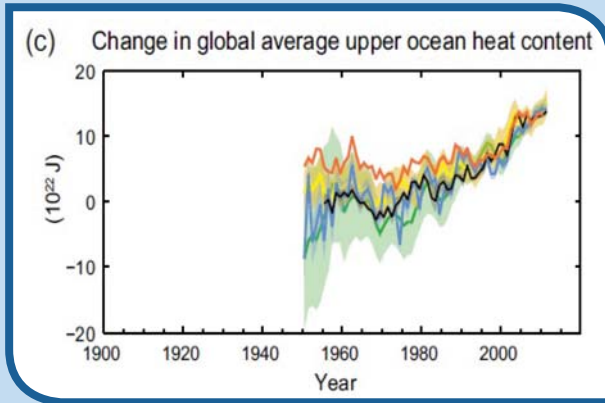
Waves along the Happisburgh Coastline

The Channel Coastal Observatory (CCO) provide coastal data, including that of beach level, to inform coastal management decisions. For more information on beach levels visit www.channelcoast.org.

Wave energy and type are associated with season. Constructive waves are lower energy waves that help to push material onshore and therefore build up the beach. These are associated with the summer months. Conversely, destructive waves generally occur in winter and pull material from the beach, moving it offshore. These types of waves, are important when thinking about sediment transfer, and the role of the beach.

Climate Change

Tides cause the most regular change in sea level; however, they are not the only cause of sea level change. For example, the Intergovernmental Panel on Climate Change (IPCC) have unequivocal evidence that the anthropogenic production of greenhouse gases is contributing to global temperature increases.

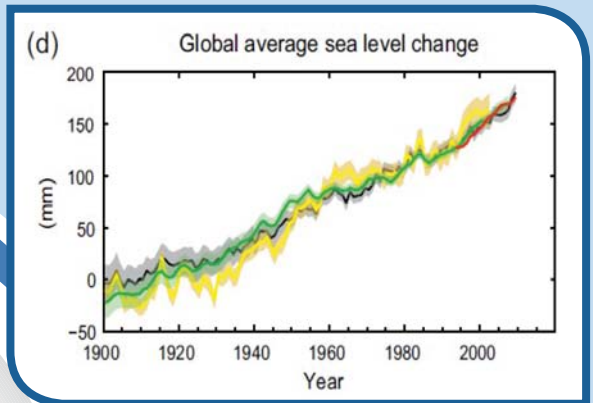


Change in sea level rise and upper ocean temperatures correlate in IPCC Fifth assesment report Figures SPM.3 C) and D)

The ocean is an effective 'sink' and it absorbs carbon dioxide (CO_2) and other greenhouse gases, as well as heat from the atmosphere. Scientists have recorded a rise in upper ocean temperatures that correlates with increased release of greenhouse gases into the atmosphere. Absorbtion of greenhouse gases into the ocean causes the water to become more acidic which is detrimental to marine life. A current effect of acidifying oceans is the bleaching of coral reefs.

Thermal Expansion

Water expands when it is heated and scientists have recorded this happening in the oceans. Oceans are expanding as global temperatures increase and cause sea levels to rise. Additionally, as the Earth warms, vast ice sheets melt, exacerbating sea level rise. Thermal expansion is expected to continue for many centuries to come. It will not be preventable as it will happen independantly of any future anthropogenic greenhouse gas releases. As the global climate changes, more frequent extreme weather and storm events are predicted. It is impossible to completely protect ourselves from sea level rise and climate change, so the important issue is how to **limit**, **prepare** and **adapt** to it.



Over the period 1910 to 2010, global mean sea level rose by 0.19 [0.17 to 0.21] m

For more information on climate change visit: www.ipcc.ch

Surges

Storm surges are temporary build-ups of water in shallow, continental shelf seas such as the North Sea. Surges are the result of a combination of low atmospheric pressure and appropriately directed strong winds which cause a dramatic increase in the volume of water close to the coastline. The height of a surge will depend on meteorological conditions; however, on the North Norfolk coast a surge of 2.5 to 3 metres can be reached. Surges have the most impact if they happen on a high tide when they can cause sea levels to be raised several metres higher than normal. Conversely negative surges can occur whereby tide heights are lower than predicted.



Storm Waves in Cromer 2013

Storm Surge 2013

On 5 – 6 December 2013, a high spring tide, low atmospheric pressure, and a strong wind led to a tidal surge along the North Norfolk coast. In some areas, water levels were higher than the 1953 North Sea surge.

In 2013, due to pre-planning and forewarning, there was no loss of life or injury as a result of the surge. The 45 mile coastline did, however, experience significant damage to sea defences and property. 116 households and 36

businesses were affected, and 20 households needed emergency accommodation. The cost of the event was substantial. Additionally, both North Norfolk District Council (NNDC) and Environment Agency sea defences were affected. Repair works commenced immediately to prevent further damage to sea defences and property. The National Oceanography Centre provides surge forecasts for every day of the year. Forecasts predict whether a surge will make tides higher or lower than the level predicted by tide tables. The forecast can be found at www.ntsif.org/storm-surges/surge-forecast



Cromer Storm Damage 2013



For more information concerning the coast, visit www.northnorfolk.org/environment. Or contact the Coastal Management Team: Email: Coastal.Management@north-norfolk.gov.uk

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