

# Tides and extreme tide events

## What causes tides?

Tides are the daily rise and fall of sea levels, caused mainly by the gravitational pull of the moon as it revolves around the earth. Tides are also affected by the earth's rotation and the gravitational pull of the sun.



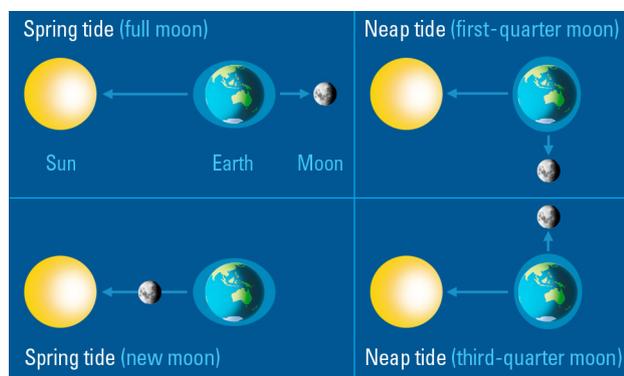
**Figure 1.** Low and high tide in Funafuti, Tuvalu. Photo: Molly Powers-Tora (2014).

## What are spring tides and neap tides?

Spring and neap tides are part of the normal tidal cycle and occur regularly, usually twice per month.

Spring tides are very high tides and very low tides that occur during full and new moon phases, when the gravitational forces of the sun and moon combine to exert a stronger pull on the oceans.

During the moon's quarter phases each month, the sun and moon are at right angles, and the gravitational forces cancel each other out, resulting in lower high tides and higher low tides called neap tides.



**Figure 2.** Spring and neap tides occur every month and correspond with the phases of the moon.

Source: [www.moononly.com](http://www.moononly.com)

## What are king tides?

The term king tide is commonly used to describe an especially high spring tide. King tides occur a few times every year, when the gravitational pull of the sun and moon upon the earth is strongest.

This happens when the moon is closest to the earth in its monthly orbit. When this coincides with a spring tide, it will produce an especially high tide, or king tide.

In the Pacific, the highest king tides are likely to occur during the months from November to March, when the earth is also closest to the sun in its annual orbit.

## What do I need to know about king tides?

King tides are a natural part of the tidal cycle and are predictable. A king tide can cause coastal flooding, even on a clear, sunny day.

When king tides coincide with cyclones, floods or storms, water levels can rise significantly, potentially causing damage to property and the coastline. The actual height reached by a king tide will depend on the local weather and ocean conditions on the day.

It is also important to know that king tides have always occurred and are not a result of sea level rise.



**Figure 3.** Strong southeasterly winds and currents combine to create higher than normal tides in Levuka, Fiji.

Photo: Molly Powers-Tora (2013).



Australian Government  
Department of Foreign Affairs and Trade  
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Climate and Oceans Support  
Program in the Pacific



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## How are tides predicted?

The time and approximate heights of tides are very predictable. They follow the laws of physics and can be calculated with mathematical formulas.

By observing and recording tides at a single location over many years, we can gain a better understanding of tides and sea level changes over time.

The Pacific Sea Level Monitoring Project has been recording sea level and weather statistics at 12 Pacific countries for more than 20 years.

These observations tell a story about the sea levels at these locations, such as: How high was the highest tide in Apia? What effect does El Niño have on sea levels in Kiribati? All of this information is also used to verify and improve tide predictions.

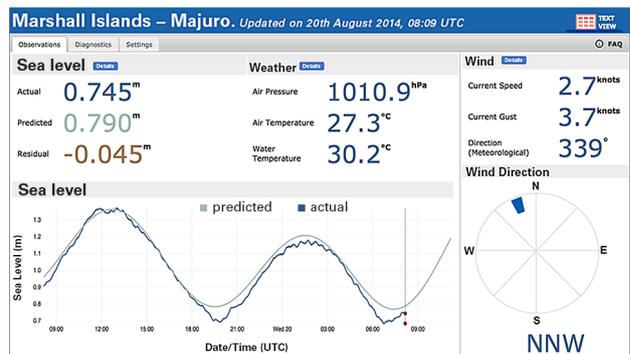


**Figure 4.** Technicians working on the recently-refurbished Cook Islands tide gauge, which has been monitoring sea level and weather conditions in Rarotonga for over 21 years.

## Why are some tides higher or lower than predicted?

Tide levels can vary from predicted levels for a number of reasons, including:

- 1. Geography:** The shape of bays and other coastal geography can magnify or otherwise influence water levels.
- 2. Weather:** Wind speed and direction, air temperature, barometric pressure and other weather conditions can greatly affect water levels.
- 3. Waves:** Both nearby and faraway events such as storms, landslides and earthquakes can create large waves that lead to coastal flooding.
- 4. Climate drivers:** El Niño or La Niña conditions in the Pacific can raise or lower sea level by as much as 50 cm.
- 5. Sea-level rise:** Through assessing observations and research, the Intergovernmental Panel on Climate Change (IPCC) concluded that global average sea levels have been rising at a rate of about 3 mm per year since 1993. Levels were 225 mm higher in 2012 compared to 1880. Sea-level rise can contribute to higher tides, but the rates are not the same at all locations.



**Figure 5.** Predicted vs actual sea level at the Majuro tide gauge Marshall Islands, 20 August 2014.

The **Pacific Sea Level Monitoring Project** provides sea level and meteorological information for 12 countries and tide predictions for 17 locations in the Pacific region. It is an important resource for those involved in disaster mitigation and adaptation planning, coastal development, and the shipping, fishing and tourism industries.

To access tide calendars, wave and weather maps, and climate data for your location visit:

[www.bom.gov.au/pacific/index.shtml](http://www.bom.gov.au/pacific/index.shtml)

For Real-Time Display of tide gauge data, visit: <http://www.bom.gov.au/cosppac/rtdd/q1c7o0hj48yu/>