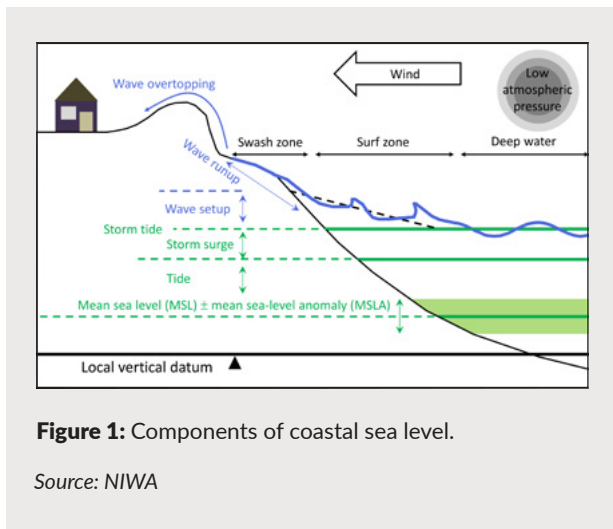




# Components of coastal sea level

This fact sheet outlines the components which make up sea level at the coast.



**Figure 1:** Components of coastal sea level.

Source: NIWA

The elevation that the sea reaches at a shoreline is determined by the following components (also shown in figure 1).

- **Mean sea level (MSL)** – the average level of the sea over a defined period, usually 18–20 years. The measurements are relative to a fixed reference level, known as a *vertical datum* (see supplementary information sheet 10 on Datums in the guidance). MSL continues to rise due to climate change.
- **Mean sea-level anomaly (MSLA)** – this is the difference between actual sea level and the mean sea level (MSL), on time scales ranging from months to several years. Anomalies between the two can be due to short-term climate variability or longer-term fluctuations caused by seasonal effects (annual cycle), the El Niño-Southern Oscillation and the Interdecadal Pacific Oscillation (IPO). For example, sea levels are a few centimetres higher in late summer and early autumn, and a few centimetres lower

in winter and early spring. During the longer-term El Niño phases, sea levels tend to be lower, and during La Niña phases, sea levels tend to be higher. And, when the IPO is in its negative phase, which it has been since 1999, sea levels can increase by up to 5 centimetres.

- **Astronomical tide** – this is the largest contributor to variations in sea levels. Tides result from the gravitational attraction of the moon and sun, and can be forecast well ahead. They oscillate above and below the combined MSL and MSLA for any given month. More information about tides is provided in fact sheet 4 in this series.
- **Storm surge** – the temporary increase in regional sea level due to low barometric (air) pressure combined with strong onshore winds. Conversely, high pressure and winds blowing offshore tend to lower the sea level below the predicted tide. Storm surges are described in fact sheet 5 of this series.
- **Storm tide** – this term describes the temporary rise in sea level offshore of the zone where waves break. Storm tide is the combination of the four components described above (MSL + MSLA + tide + storm surge).
- **Wave set-up and run-up** – at the shoreline, the maximum vertical height reached by the sea is a combination of the wave set-up (the height of seawater landward of the zone where waves break), and the wave run-up (or *swash*; the waves running up the beach). These act on top of the storm tide. Both wave set-up and run-up can vary a great deal, even over a short length of coast, depending on the type of beach, its slope, the backshore features and whether coastal defence structures are present or not.

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