SEA LEVEL RISE

This factsheet provides information on sea level change relating to the Coromandel Peninsula – what has happened already, what may occur in the future and what the possible implications are. It is intended as a guide only.

SEA LEVEL HAS CHANGED IN THE PAST

Global sea level has changed considerably over many thousands of years. When the climate was warmer, around 125,000 years ago, sea level was several metres higher than it is today. By contrast, during the last glacial maximum (around 20,000 years ago), the sea's level was more than 120m lower than it is today.

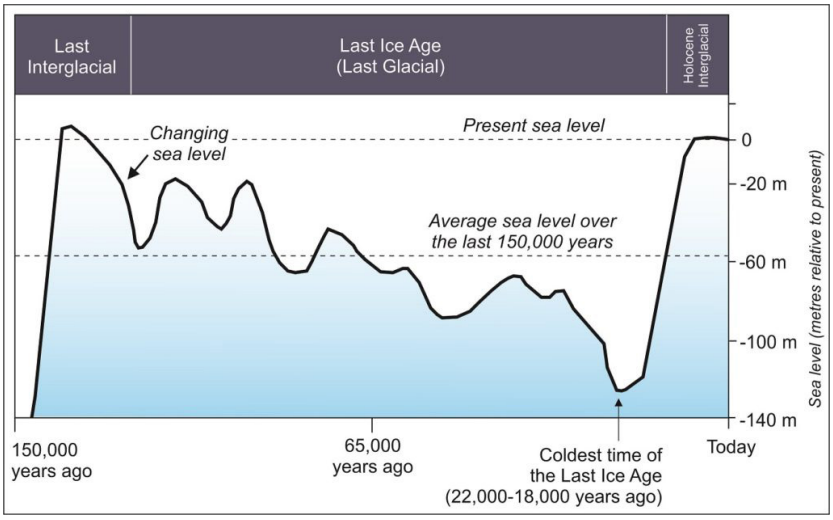

Figure 1 Historical sea level rise (source https://patricknunn.org/writing/books/the-edge-of-memory-ancient-stories-oral-tradition-and-the-post-glacial-world/recalling-post-glacial-sea-level-rise/)

Since 1900, after around two thousand years of relatively little change, global mean sea level (GMSL) has risen approximately 18 cm at a rate of 1.7mm a year. Since satellite measurements began in 1993, GMSL has risen more quickly, at a rate of 3.4mm per year (NZSeaRise, 2020[1]). This increase is due partly to natural climate variability and partly to warming of the atmosphere and oceans.

Figure 2 Meltwater at the Nansen Ice Shelf (source https://www.washingtonpost.com/news/energy-environment/wp/2017/04/19/the-surface-of-antarctica-is-covered-with-flowing-water-that-has-scientists-worried/)

[1] https://www.searise.nz

Global mean sea level rise is largely driven by:

1. rising global atmospheric temperatures which warm and expand oceans, and
2. the melting of ice on land, increasing the runoff of freshwater.

This is further impacted by local changes in land levels.

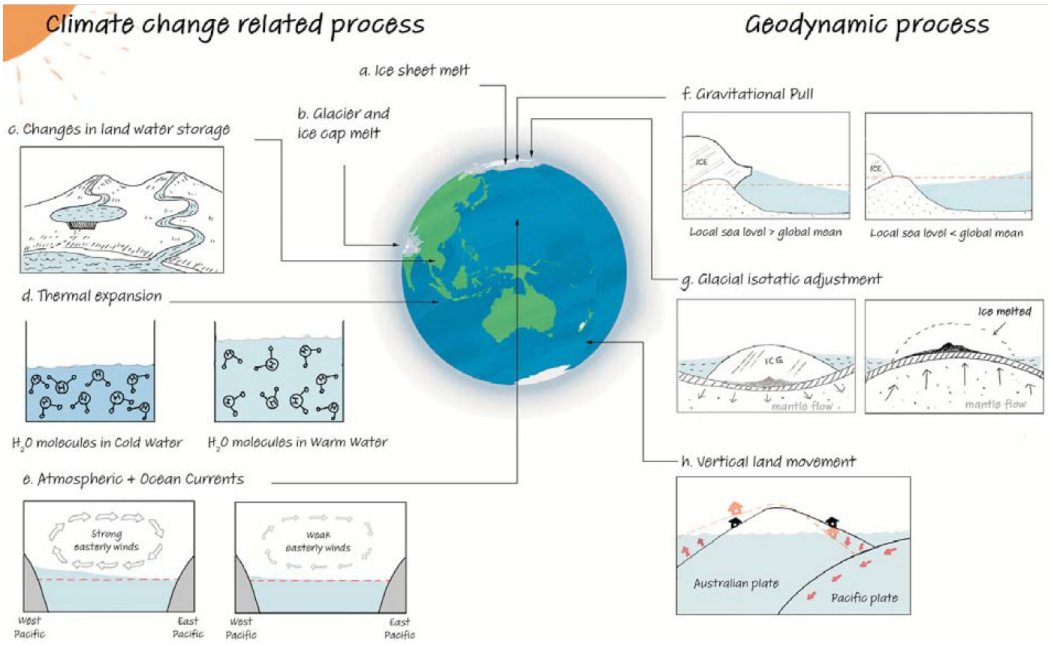

Figure 3 Coastal processes contributing to global sea level changes (source: Katy Kelly GNS Science)

LOCAL SEA LEVEL CHANGE IS THE MOST IMPORTANT

How global sea level rise looks at your local coast will differ depending on several variables. For example, local winds and currents can pile water up against the coast or move it away, causing locally relevant changes in sea level. Scientists also know that meltwater does not spread evenly around the globe, affected by gravitational attraction. Regional climate events like La Niña and El Niño can also have an influence, as can seasonal changes. For example, the sea level changes over the course of the year due to temperature – it is about 10cm or so higher at the end of summer than it is in winter (Stephens *et al*. 2020[2]).

Of particular importance to New Zealand is what is known as relative sea level (RSL). This is a measure of the change in sea level against a reference point on land. These measurements describe the movement of both the sea and the land – recognising that New Zealand's active geology and frequent earthquakes can cause the land to be uplifted (land lifting) or subside (land sinking). The movement of the land upwards in some locations can lower rates of relative sea level rise. Conversely, land that is sinking can exacerbate any increases in sea level, causing higher rates of relative sea level rise.

Relative sea level can be readily measured by tide gauges, such as those in the Port of Auckland and at Tararu and Whitianga in the Coromandel, and GPS survey instruments.

In the southern Firth of Thames, survey instruments have recorded land subsidence of approximately 8-10mm per year in the recent past. This subsidence is thought to be due to tectonics and the compaction of sediment and contributes to a relative sea level rise of approximately 14mm/year in the southern Firth (NZSeaRise, 2020)[3].

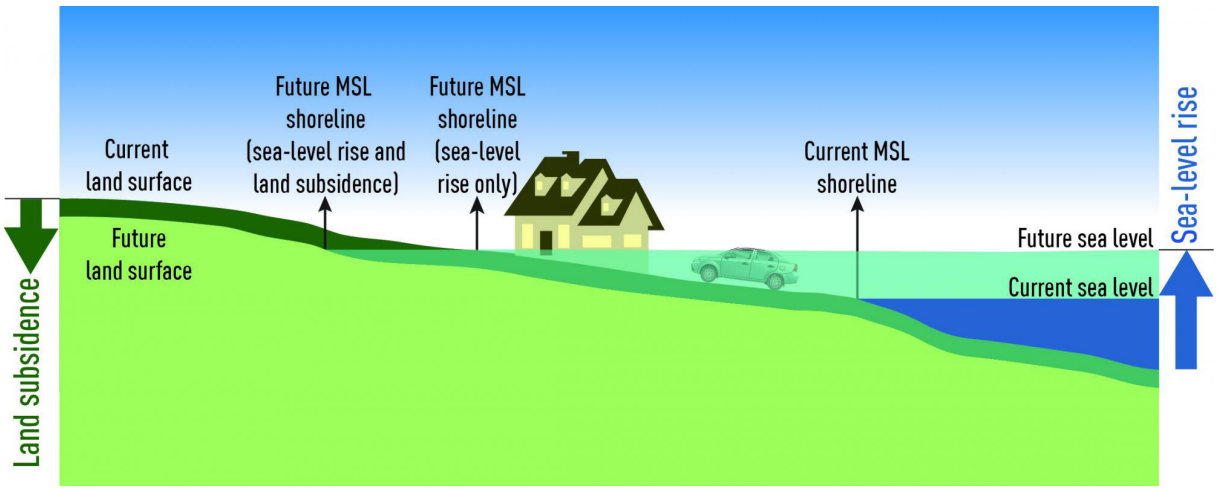

Figure 4 Processes influencing local sea level change
(source: https://niwa.co.nz/natural-hazards/hazards/sea-levels-and-sea-level-rise)

[2] Stephens, S.A., Bell, R.G. & Haigh, I. (2020). *Spatial and temporal analysis of extreme storm-tide and skew-surge events around the coastline of New Zealand*. Natural Hazards and Earth System Sciences, 20, 783-796.

[3] In predicting RSL, the MfE Guidance (2017) does not recommend factoring in future earthquake-generated uplift or subsidence due to the deep uncertainty associated with when and how much. However, long-term susbidence or uplift should be factored in where data exists.

PROJECTIONS OF SEA LEVEL RISE

While there is uncertainty about how much sea level will rise, and by when, what we do know is that our recent greenhouse gas emissions have already locked-in an estimated 0.3 - 0.5 m of GMSL rise by 2050, relative to the current sea level and an estimated increase of 1.6 to 1.7 m by 2120. Increased melting of the ice sheets in Greenland and the Antarctic would have significant consequences for GMSL[4].

As rising seas are a key driver of the extreme water levels associated with storms (bringing larger tides and waves), we can confidently say that storm events that used to be historically rare (e.g. a 1 in 100 year event) will occur much more frequently by the middle of the 21st century. This will increase risks to communities in some areas and expose new areas to risk over time, requiring appropriate responses.

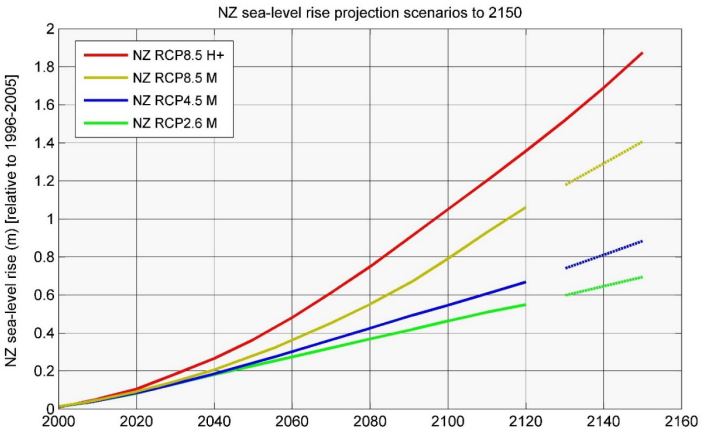

Figure 5 Four scenarios that project the sea level rise NZ could expect out to the year 2015; each scenario is based on how successful emissions mitigation policy could be, with H+ (the red line) being the most pessimistic and 2.6 M (the green line) being the most optimistic[5]

SLR (metres)	Year achieved for RCP8.5 H+ (83%ile)	Year achieved for RCP8.5 (median)	Year achieved for RCP4.5 (median)	Year achieved for RCP2.6 (median)
0.3	2045	2050	2060	2070
0.4	2055	2065	2075	2090
0.5	2060	2075	2090	2110
0.6	2070	2085	2110	2130
0.7	2075	2090	2125	2155
0.8	2085	2100	2140	2175
0.9	2090	2110	2155	2200
1.0	2100	2115	2170	>2200
1.2	2110	2130	2200	>2200
1.5	2130	2160	>2200	>2200
1.8	2145	2180	>2200	>2200
1.9	2150	2195	>2200	>2200

Figure 6 The sea level heights (SLR metres) that are predicted to be experienced and when under these emission reduction scenarios (MfE, 2017)

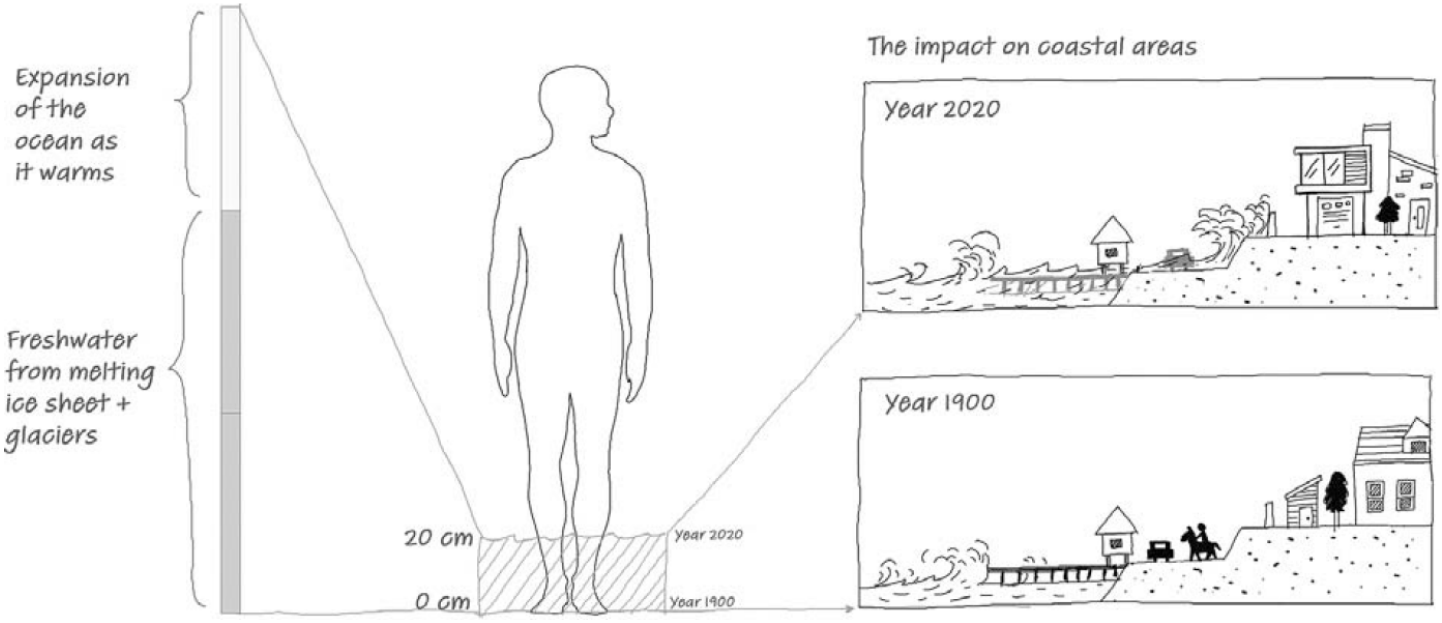

Figure 7 The increasing flooding impacts at the coast from a 20cm change in sea level (source: Katy Kelly GNS Science)

[4] IPCC *Special Report Oceans and Cryosphere in a Changing Climate* (2019; in press) has provided further updates to the global sea level rise projections that will need to be incorporated into the 2017 MfE Guidance.

[5] MfE (2017). *Coastal Hazards and Climate Change: Guidance for Local Government*. Wellington, NZ, Ministry for the Environment.