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Continental levering as a driver of Holocene relative sea-level variability in the Auckland-Northland region, New Zealand

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Meltwater-driven ocean loading on the continental shelf is hypothesised to be a significant driver of Holocene relative sea-level (RSL) variability around the New Zealand coast. The Auckland-Northland peninsula, at the northern end of the North Island, is a key laboratory for examining the impact of meltwater loading on Holocene land deformation and RSL variability in New Zealand. The coastline is convoluted with a variable-width continental shelf, the region is considered to be tectonically stable, was ice-free during the last glaciation, and contains a major sub-set of the population of RSL index points assembled for the New Zealand palaeo sea-level database.

Glacial isostatic adjustment (GIA) modelling for sites down the length of the peninsula predicts significant variability in Holocene RSL changes over distances as short at 50 km. This variability is the product of spatial variations in solid Earth deformation driven by postglacial meltwater loading on the continental shelf and controlled by the shelf width. At the southern end of the peninsula modelling predicts $\sim$1 m of subsidence during the Holocene. The amount of subsidence increases to the north, with the northern end of the peninsula predicted to subside $\sim$12 m during the Holocene. The effect of this spatially variable subsidence on predicted RSL change is dramatic. Modelling predicts the southern end of the peninsula experienced a pronounced RSL highstand of +2.5 m above present beginning c. 8,000 years BP. With increasing distance to the north the magnitude of the predicted highstand decreases to $\sim$1 m above present, with the onset of highstand conditions postponed until c. 5,000 years BP at the northern tip of the peninsula.

RSL index points recovered from coastal environments around Auckland and Northland show an overall moderate agreement with the GIA-model predicted spatial patterns in the timing and magnitude of RSL changes. RSL indicators fit excellently with the GIA-predicted RSL histories for some localities (Henderson Bay, Matarui Bay, Kaituna Bay), though in some of these locations there are only single RSL index points. In other locations a broader spread in the observations of RSL results in a less precise fit with the GIA RSL predictions (Mahurangi Estuary, Southern Kaitoke, Okahu Bay, and Miranda), but the trend is for the GIA-predictions to over-estimate RSL when compared to a number of beach ridge RSL index points. Notably, two sites on the Coromandel peninsula, to the southeast of the Auckland-Northland peninsula, show significant disagreement between the GIA-model predictions of RSL change and RSL index points (Coromandel Harbour and Whitianga).

Ongoing work seeks to produce new records of RSL changes and enhance existing RSL records, particularly in localities where only single RSL index points presently exist. The new records will be used to better characterise observed RSL variability in the Auckland-Northland region. This expanded observational data set will be compared with GIA model predictions in order to improve our understanding of the impact of meltwater loading on Holocene RSL variability. Persistent misfits between data and observations will provide insight into local-scale processes.