MORPHOLOGICAL RESPONSE OF THE NEARSHORE SEABED DUE TO OFFSHORE PRECONDITIONING FEATURES

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Nearshore submerged structures for coastal protection are being applied in increasing numbers worldwide, with Multi-Purpose Reefs (MPR's) also becoming a favoured approach. MPR's look to combine coastal protection through the dissipation of wave energy offshore and a consequent increased beach width, marine habitat/ecological enhancement, and public amenity (e.g., diving, snorkelling, surfing, etc.). However, while there have been improvements in performance with respect to the addition of surfing amenity by using traditional construction methods (e.g., large rock such as used to construct the MPRs in Borth, Wales and Palm Beach, Australia), there are still issues of high design tolerances and challenging construction conditions close to the beach on exposed coasts.

This work continues research regarding offshore preconditioning features; the companion manuscript to this work takes an iterative design approach to establish the relationships between preconditioning features and surf zone response using the parameters of peel angle as a proxy for surfing wave quality (Atkin *et al.*, 2019). The way in which a wave breaks is largely a function of the path wave orthogonals and the bathymetry that wave orbitals encounter as the wave propagates shoreward. This effect is commonly referred to in surf science literature as preconditioning and occurs at a range of scales. Atkin et al. (2019) considered seabed features that do not cause wave breaking but influence the way in which they break. The assessment first quantified the dimensions of a number of known natural wave preconditioning features, and then applied iterative numerical model simulations of the heuristic seabed features (Figure 1). The impact of an offshore feature was considered in terms of the wave propagation in the lee of the feature and breaking patterns, or surf zone plan-shape, near the shoreline. This investigation concluded that offshore features can be considered as either disruptive or focus preconditioners.

The previous investigations into offshore submerged structures has been directed at the effects of wave preconditioning on wave breaking patterns in the surf zone, although did not consider the feedback effects of modifying wave height gradients on the morphology of the beach. Here, numerical morphological modelling is used to consider the beach and nearshore seabed response using the findings presented in the earlier companion manuscript.

Two components of morphological response are investigated; shoreline response and surfability of waves in the surf zone due to the combination of wave preconditioning on offshore structures and the consequent modifications to the nearshore seabed. There are natural examples that produce high-quality surfing conditions and also result in salient formation, even though these natural features are significantly seaward of the existing principles of salient formation in the lee of submerged reefs. The latter process is poorly understood, but likely due to a combination of processes, including the diffusion of radiation stress.

This work adds to the literature base of our theoretical understanding of the integration of coastal protection and surfing amenity.

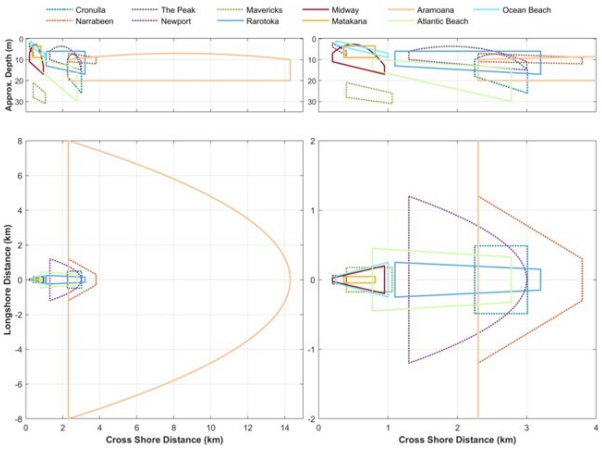

Figure 5. Heuristic profile (top) and footprint (bottom) estimates of known natural seabed features at full (left) and zoomed (right) view. (Atkin *et al.*, 2019).

Reference:
Atkin, E., S. T. Mead and D. J. Phillips 2019. Investigations of Offshore Wave Preconditioning. Journal of Coastal Research, Special Issue 87: Surf Break Management in Aotearoa New Zealand. pp78-90.