SPATIAL VARIABILITY IN BEACH-FACE SLOPES FROM SATELLITE REMOTE SENSING

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INTRODUCTION

The beach face is the most seaward region of the dry beach. This region is the primary interface between land and ocean, and therefore has a great influence on coastal processes such as the exchange of sediment between land and sea or the reflection of wave energy at the shoreline. In particular, the slope of the beach-face, is an important parameter in coastal engineering to calculate the vertical and horizontal excursion of wave run-up (Stockdon *et al.*, 2006).

Yet, despite the importance of the beach-face slope parameter in many formulations used by coastal engineers, this quantity remains poorly mapped along the world's sandy coastlines and the absence of large-scale datasets of beach-face slope is presently limiting our ability to deploy coastal inundation forecasting systems (O'Grady *et al.*, 2019). This work describes a novel methodology to estimate beach-face slopes with satellite remote sensing and presents large-scale datasets of beach-face slopes along open-coast sandy coastlines around the Pacific Rim.

METHODS

A recently developed method to estimate beach-face slopes from satellite-derived shorelines is presented and applied over large spatial scales to better understand regional variability and associated drivers. This method leverages the *CoastSat* shoreline mapping toolbox (Vos *et al.*, 2019) to obtain time-series of shoreline change and combine them with a global tide model (Carrere *et al.*, 2016) to estimate the best-fit slope of the beach-face over the ~35 years of available data. Briefly, the concept behind this method is that instantaneous shoreline time series mapped onto images acquired at different stages of the tide contain a tidal signal that is modulated by the beach-face slope and can be isolated in the frequency domain due to its periodicity. This method was applied along ~20,000 km of sandy coastline around the Pacific Rim (Australia, New Zealand, Chile, Peru, Mexico, California, Japan).

RESULTS AND DISCUSSION

The spatial variability in beach-face slopes around Australia and the Pacific Rim will be discussed in this presentation. As an example, Figure 1 shows the spatial distribution of beach-face slopes in Australia, along more than 5,000 sandy beaches (dataset available at https://doi.org/10.5281/zenodo.5606216; Vos et al., 2021). Very low-gradient slopes (tanβ of 0.01-0.035) are found along the highly energetic coasts of *western Tasmania*, *western Victoria* and *south-western Western Australia*, while more intermediate slopes are found along the *New South Wales* and south-east *Queensland* coasts. The largest spatial variability in the beach-face slopes is observed along the tide-modified/tide-dominated northern half of Australia, with *Queensland* and the *Northern Territory* showing the widest interquartile ranges in Figure 1b (from 0.05 to 0.1).

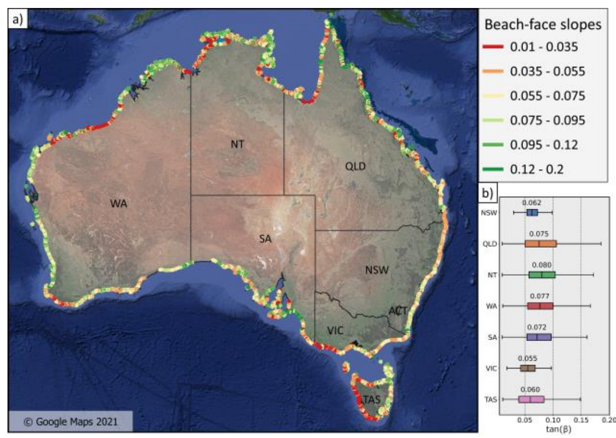

Figure 1 - a) Map of beach-face slopes around Australia, *red* indicating low-gradient beaches and *green* steep beaches. b) Boxplot of the distribution in each state.

Further results on the variability in beach-face slopes around the Pacific Rim will also be presented, including the relationship between beach-face slopes and external forcings like tidal range and average incident wave energy.

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