Shoreline Response to the Southern Annular Mode at WEC site: Satellite Analysis

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Understanding shoreline dynamics is a key step towards the successful management of coastal environments. This study investigates natural shoreline variability at Grassy Beach, focusing on the relationship to the Southern Annular Mode (SAM) climate driver. The present analysis is part of a larger study into the influence of a nearshore wave energy converter (WEC), installed in 2021, on the local shoreline dynamics. Grassy Beach is a sandy embayment on the southeast coast of King Island in Bass Strait, Australia, with a wave climate dominated by southerly refracted Southern Ocean swells. Shoreline position pre-WEC deployment from 1987 to 2021 was determined from 420 Sentinel and Landsat satellite images using the CoastSat Python toolkit. Empirical orthogonal function (EOF) analysis found seasonal beach rotation signal to be a dominant mode of variability (20% of total variability), with opposing shoreline movement at either end of the embayed beach and a pivot point near the middle. The corresponding temporal EOF alternated in sign between winter and summer. These results show shoreline retreat (erosion) happening in winter at the exposed eastern end and during summer at the western end. The Bass Strait wave climate is influenced by SAM, with more powerful waves likely in Austral autumn and winter when the SAM index is positive. A positive phase of SAM during winter was found to increase shoreline retreat at the eastern end leading to a stronger beach rotation signal describing 24% of the total variability. These results provide new insights into the influence of SAM on shoreline dynamics and highlight the importance of considering relevant climate drivers as an indicator of beach erosion. For nearshore structures such as WECs, it is critical to first assess the site’s natural variability and relevant driving factors through a multi-decade spatio-temporal analysis before analysing the coastal impact of such structures.