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OBSERVATIONS OF GRAVEL BEACH DYNAMICS FROM SPACE

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Gravel barrier systems provide vital protection against coastal flooding and erosion. They are highly dynamic and exhibit complex responses to hydrodynamic forces across various timescales (from hourly to centennial). Importantly, the study of gravel beach dynamics has received considerably less attention than sandy beaches, particularly at interannual to decadal timescales. Current evidence suggests that at regional scales, large-scale climate signatures might exert a key control on gravel barrier evolution. In this study, we utilize over four decades of satellite-derived shoreline (SDS) data to investigate the long-term dynamics of 45 gravel systems in the British Isles using a site-specific SDS extraction methodology. We determine long-term shoreline trends along 1,554 shore-normal transects and investigate possible links with the prevailing atmospheric indices (AO, NAO, and WEPA). Our results reveal significant variability in shoreline trends, ranging from -4.73 m/year to +10.5 m/year. The majority of transects (62%) remained stable over the study period (1984 – 2023), 22% showed positive trends (progradation), while 14% showed negative (transgressive) trends. Overall, less than 20% of transects show statistically significant correlations with AO, NAO, or WEPA. Large scale atmospheric indices were more strongly correlated with the behaviour of nesses, with 29% and 26% of transects showing average correlations of -0.36 and -0.34 with NAO and AO, respectively. In contrast, open beaches exhibited the weakest relationships with atmospheric forcing. Notably, atmospheric index variability did not seem to describe beach behaviour well in areas with the highest rates of progradation.