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PREDICTING DUNE EVOLUTION IN CORNWALL FOR COASTAL MANAGEMENT

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Dunes provide a range of ecosystem services, including natural resilience against coastal flooding, and it is essential for proactive coastal zone management to forecast future dune behaviour as sea levels rise. However, dunes exhibit dynamic behaviours over a wide range of spatial and temporal scales, posing challenges for predicting their evolution. Here we demonstrate a high degree of variability in contemporary dune behaviour along a single coastal region, across 31 sites in Cornwall, southwest England. Rates of change varied widely, with sediment loss ranging from -12.4 $m^3/m/yr$ to a gain of +5.1 $m^3/m/yr$, and dune retreat/advancement ranging from -3.7 m/yr to +1.6 m/yr. These findings validate scepticism regarding the applicability of the Bruun rule over long timescales and underscore the importance of incorporating site-specific factors, such as sediment supply, aeolian transport, underlying rock surface and estuarine channel dynamics, into future model development. Nonetheless, this study demonstrates that combining contemporary dune behaviour analysis with the Bruun Rule offers a practical approach for initial predictions of future dune evolution. When combined with observed data, the Bruun Rule can effectively identify coastal change “hot-spots” and guide coastal management decisions. Until more sophisticated models are developed, we recommend a staged approach for coastal managers: starting with regional-scale projections using observed trends and the Bruun Rule, followed by targeted application of reduced complexity and process-based models in areas of high concern. Incorporating probabilistic assessments is essential for managing uncertainties in these predictions, ensuring more informed and effective coastal management strategies.