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Statistical analysis and forecasts of long-term sandbank evolution at Great Yarmouth, UK

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Abstract

A data-driven model has been developed to analyse the long-term evolution of a sandbank system and to make ensemble predictions in a period of 8 years. The method uses a combination of empirical orthogonal function (EOF) analysis, (to define spatial and temporal patterns of variability), jack-knife resampling, (to generate an ensemble of EOFs), a causal auto-regression technique, (to extrapolate the temporal eigenfunctions), and straightforward statistical analysis of the resulting ensemble of predictions to determine a "forecast" and associated uncertainty. The methodology has been applied to a very demanding site which includes a curved shoreline and a group of mobile nearshore sandbanks. The site is on the eastern coast of the UK and includes the Great Yarmouth sandbanks and neighbouring shoreline. A sequence of 33 high quality historical survey charts reaching back to 1848 have been used to analyse the patterns and to predict morphological evolution of the sandbank

system. The forecasts demonstrate an improved skill relative to an assumption of persistence, but suffer in locations where there are propagating features in the morphology that are not well-described by EOFs.



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Keywords

causal AR prediction; empirical orthogonal function (EOF); jack-knife; long-term changes; sandbanks; statistical analysis

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