Spectral analysis of interannual bed level variations at a beach in Duck, North Carolina, USA

Vanesa Magar[1], Dominic Reeve[1], Marc Lefranc[2], & Rebecca Hoyle[3]

[1] School of Marine Science and Engineering, University of Plymouth, UK
[2] Phlam and CERLA, Université des Sciences et Technologies de Lille, France
[3] Department of Mathematics, University of Surrey, UK
vanesa.magar@plymouth.ac.uk

The nearshore dynamics of a sandbarred beach at Duck, N.C., U.S.A., surveyed monthly for 26 years, is analysed using spectral methods and recurrence plots. The first part of the study focused on two shore-normal bathymetric profiles at locations where the beach is quasi longshore uniform. A singular spectrum analysis (SSA) permitted the identification of the fundamental, dominant frequencies of oscillation. The identification of interannual quasi-periodic cycles of varying periodicities at different locations along the profile led to the characterisation of bathymetric regions based on the properties of the local quasi-periodic oscillations. Yearly and quasi-yearly cycles were linked to the monthly averaged wave conditions, and some regime changes observed in the temporal behaviour agreed well with observations of sandbar configuration changes and sandbar dynamics. In these cases such changes could generally be associated to extreme storm events, as found by previous authors. Some of the interannual patterns may be associated with the North Atlantic Oscillation.

The second part of the study concentrated on an in-depth investigation of coherent temporal patterns and their likely origin. It is shown that these patterns are linked to large-scale phenomena using a multivariate EOF (MEOF) analysis and a Multichannel SSA (MSSA). These methods were applied to the whole bathymetry and to three potentially important monthly forcings: the North Atlantic Oscillation (NAO), the monthly wave height (MWH) and the monthly mean water level (MWL). Even though no interannual coherent patterns were found, a few at monthly timescales were identified. Of these, the yearly and semi-yearly patterns forced by the MWH were clearly dominant, followed by a few patterns at shorter timescales linked to the NAO.