Detecting Bedform Migration in Portsmouth Harbor on Relatively Short Time-Scales from High-Resolution Multibeam Bathymetry

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Bedforms are common features in shallow marine environments, and their presence evokes questions regarding the spatial and temporal stability of the seafloor. Though observation of bedform dynamics from multibeam bathymetry and its derived products enhances understanding of seafloor stability, the ability to successfully detect bedform migration depends on (1) the survey resolution and positioning uncertainty, and (2) the establishment of an optimum survey-repetition rate.

We have undertaken analysis of the short-term dynamics of a large bedform field (area = 0.12 km^2; bedform wavelength (λ) = 8 to 16 m, height (h) = 0.4 to 0.8 m) at the entrance to Portsmouth Harbor using high-resolution bathymetry from a Kongsberg EM3002D multibeam sonar system. Position, heading and attitude data were acquired with an Applanix POS/MV system with integrated real-time kinematic (RTK) GPS correctors, which provided a horizontal positioning uncertainty of $\leq$ 0.1 m at the GPS receiver. Surveys were conducted on June 8, 14 and 15 in 2007 and July 3 and 9 in 2008, allowing observation of bedform migration on 24-hour and 6- and 7-day cycles, the latter of which approximates the neap-spring tidal cycle. A new approach was developed and used for detecting and quantifying bedform migration over short periods. The preliminary results indicate that bedform migrations of $\geq$ 0.1 m were successfully resolved.

Initial analysis indicates that bedforms are active on both 24-hour and multi-day cycles, with migrations of greater than 1.2 m observed on multi-day cycles. The highest rates of migration occur within higher-frequency bedforms (λ = 5 m, h = 0.25 m) located along the eastern perimeter of the bedform field. A reciprocal pattern of bedform migration is observed within the survey area, in which bedforms in the eastern and western halves of the bedform field migrate in opposing directions. The eastern half of the bedform field is the most active and is ebb-dominated (southward-migrating), while the western half of the bedform field is flood-dominated (northward-migrating). A comparison of bathymetry from 2007 and 2008 indicates that individual bedforms cannot be tracked from one year to the next without a higher survey-repetition rate. This suggests that annual migration distances are greater than the bedform wavelength, and/or that bedform morphology (such as crest sinuosity and bifurcation) changes significantly over time-scales shorter than one year.