Geophysical Research Abstracts
Vol. 12, EGU2010-4743, 2010
EGU General Assembly 2010

Overwash threshold experiment for gravel barriers

Ana Matias (1), Jon Williams (2), Andrew Bradbury (3), Gerhard Masselink (2), and Óscar Ferreira (1)

(1) CIMA - Universidade do Algarve, Campus de Gambelas, 8005-139 Faro, Portugal (ammatias@ualg.pt)(oferreir@ualg.pt), (2) School of Marine Science and Engineering, University of Plymouth, Plymouth, PL4 8AA, UK (jon.j.williams@plymouth.ac.uk)(g.masselink@plymouth.ac.uk), (3) Nat. Oceanography Centre, University of Southampton,Southampton SO14 3ZH, UK (apb2@noc.soton.ac.uk)

Field measurements of overwash effects, associated physical forcing, and determination of threshold conditions, are much less common for gravel than for sandy barriers (e.g., field measurements by Lorang, 2002; Bradbury et al., 2005; and laboratory studies by Obhrai et al., 2008). In order to define overwash thresholds for gravel there is a need for measurements under a variety of forcing conditions that include waves, tides and surges. Flume experiments allow the manipulation of physical forcing and can make a valuable contribution to improve the understanding and prediction of overwash.

To study gravel barrier overwash processes, BARDEX proto-type scale laboratory experiment was undertaken in the Delta flume (Williams et al., 2009). A 4 m high, 50 m wide gravel barrier composed of sediments with D50 = 10 mm was emplaced in the flume and subjected to a range of water levels, wave heights and wave periods.

Barrier morphology was surveyed before and after each run. Two situations were simulated: overwashing and overtopping. Following Orford and Carter (1982) terminology, the distinction between overtopping and overwash was based on the type of morphological change over the barrier crest. Overtopping causes vertical accretion at the crest, whereas overwashing promotes the formation of washover deposits landwards from the crest. Ten overwash experiments were conducted (divided in 63 runs), and overtopping was recorded in 22 runs and overwash in 20 runs. In other runs, only the beach face was reworked by waves.

In a systematic series of tests water levels were varied between 3.00 m and 3.75 m (in steps of 0.125 m); wave height was varied between 0.8 m and 1.3 m (in steps of 0.05 or 0.1 m); and wave periods of 4.5, 6, 7 and 8 seconds were used. These hydrodynamic conditions were used to compute wave run-up using several well-known formulae (cf., Powell, 1990; Stockdon et al., 2007). Comparison between run-up estimations and the barrier crest elevation prior to wave action show those formulas underestimate the run-up limit. The discrepancy, which can reach almost 1m, is attributed to several causes, including: (1) scale effects of the prototype; (2) applicability of most run-up formulae only to sandy barriers and beaches; and (3) important, infrequent (<1%) extreme waves that are not included in the formulae.

In coastal hazards studies, overwash is inferred from the relation between wave run-up and the barrier crest height. This study shows that storm hazard forecast may fail to predict overwash occurrence for gravel barriers environments because run-up estimative by existing formulae fail to capture extreme events and other approaches are thus needed.

Bradbury, A., Cope, S.N., Prouty, D.B., 2005. Predicting the response of shingle barrier beaches under extreme wave and water level conditions in Southern England. Proc. Coastal Dynamics.

Lorang, M.S., 2002. Predicting the crest height of a gravel beach. Geomorphology, 48, 87-101.

Obhrai, C., Powell, K., Bradbury, A., 2008. A laboratory study of overtopping and breaching of shingle barrier beaches. Proc. Coastal Engineering, Hannover, Germany, pp. 1497-1508.

Orford, J. And Carter, R.W.G., 1982. Crestal overtop and washover sedimentation on a fringing sandy gravel barrier coast, Carnsore Point, Southeast Ireland. J. Sedim. Petrology, 52, 265-278.

Powell, K.A., 1990. Predicting short term profile response for shingle beaches. HR Wallingford SR Report, vol. 219.

Stockdon, H.F., Sallenger, A.H., Holman, R.A., Howd, P.A., 2007. A simple model for the spatially-variable coastal response to hurricanes. Mar. Geol., 238, 1-20.

Williams, J.J., Masselink, G., Buscombe, D., Turner, I.L., Matias, A., Ferreira, A. Metje, N., Coates, L., Chapman, D., Bradbury, A., Albers, A. & Pan, S., 2009. BARDEX (Barrier Dynamics Experiment): taking the beach into the laboratory. J. Coastal Res., SI 56, 158-162.