Geophysical Research Abstracts
Vol. 21, EGU2019-8834, 2019
EGU General Assembly 2019


# Large-scale wave flume experiments with mixed sand

Franziska Staudt, Daniel Posanski, and Stefan Schimmels

Forschungszentrum Küste (FZK) - Coastal Research Center, Leibniz Universität Hannover, Merkurstr. 11, 30419 Hannover, Germany

The prediction of the wave-induced transport of natural sandy sediment is a complex problem for coastal geomorphologists and engineers. Existing sediment transport models yield reliable results for unimodal sediment (i.e. comprising one grain size only). However, although most coastal and estuarine environments comprise a range of sediment grain sizes, these models cannot yet represent the complex small-scale processes influencing the transport of sediment mixtures. To better understand these processes and to improve transport models accordingly, physical experiments with mixed sediment are essential.

While fluvial studies have investigated the effects of different grain sizes on the mobility of a mixture (oftentimes gravel and sand), and could explain the changing transport behaviour to a certain degree, the net sand transport under wave action is additionally affected by several wave-induced flow processes. A limited number of experiments with mixed sand have been conducted in so-called oscillatory flow tunnels (OFTs). These OFTs mimic the near-bed horizontal flow under wave action, but cannot reproduce all wave-induced flow processes, e.g. net currents or vertical flow velocities, which have been found to contribute to sediment transport significantly. So far, only one known experiment has investigated a sediment mixture (sand and gravel) in a large-scale wave flume. Subsequently, the existing database is insufficient for further improvement of mixed sand transport models.

To broaden the database and to systematically investigate the transport behaviour of different sand mixtures under full-scale waves, a series of experiments was conducted in the Large Wave Flume (Großer Wellenkanal, GWK) in Hannover in spring 2018. Bimodal sand treatments consisting of fine ($D_{50}$ = 0.21 mm) and coarse ($D_{50}$ = 0.58 mm) sand at different fractions (100:0, 75:25, 50:50 and 25:75 %) were subjected to two different monochromatic wave conditions ($H_1 \approx 1.5$ m, $H_2 \approx 1.0$ m, $T_1 = T_2 = 7.0$ s). A range of high-resolution instruments was used to measure bed profiles, ripple development, near-bed flow processes and sediment concentrations as well as suspended sediment and grain-size distribution. Depending on the grain-size distribution and the wave parameters, the transport regime ranged from sheet flow to ripple development, yielding different net transport rates for the various mixtures. The presentation will describe the experimental setup and methodology in detail and will present initial observations of the transport regime, bed-form development and net transport rates in relation to the grain-size distribution of the sand mixture.