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Longshore Sediment Transport on a Macrotidal Mixed Sediment Beach, Birling Gap, United Kingdom.

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Mixed beaches (MBs), with sediment sizes ranging over three orders of magnitude, are an increasingly important coastal defence on > 1/3 of the shoreline of England and Wales. In East Sussex, the combined effect of coastal defence management schemes (extensive groyning and sea wall construction) has reduced beach sediment supply. Local authorities counteract the increased flood risk by recycling or artificially recharging beaches on the most vulnerable and populated areas. Beaches lose sediment predominantly via longshore transport (LST) whose accurate quantification is critical to calculating recharge amounts needed for effective beach management. Industry does this by using sediment transport modelling which depends on reliable input data and modelling assumptions.

To improve understanding of processes and quantification of LST on MBs, this study has accurately measured sediment transport on a natural, macrotidal, MB. The 1.2 km natural MB at Birling Gap, East Sussex here is located on the downdrift end of an 80 km long sub-sedimentary cell and is oriented WNW-ESE. The beach lies on a low gradient chalk shore platform backed by sub-vertical chalk cliffs. It is composed primarily of flint gravel with a peak grain size distribution of 30 to 50 mm, and a sand content of up to 30%.

Sediment transport was measured using pebble tracers and GPS surface surveys during three survey periods of three to five consecutive days in March, May and December 2006. Tracer pebbles, matching the beach pebbles' D50, were made of an epoxy resin with a copper core allowing their detection and recovery to a depth of 40 cm using a metal detector. Tracers were deployed on the upper, middle and lower beach, from the surface into the beach to depths of up to 40 cm. They were collected on the low tide following deployment. The wave conditions were recorded on a Valeport DWR wave recorder located seaward of the beach on the chalk platform. Over the three study periods a large spectrum of wave heights (0.1 to 2.6 m) and periods (2 and 13.4 s) was observed. Wave direction varied from 14 to 106º to the beach. In total, up to 300 tracers were used on every day of deployment. The recovery rate after one tide varied from 58.4 to 100%. Significant longshore transport was observed, up to a maximum of 145 m.

The results show that pebble behaviour on a natural MB is extremely sensitive to position on the beach profile and to changes in the water level and wave conditions associated with tidal conditions. Longshore sediment transport rates ranged from 0 to 120.55 m3 tide-1. Longshore wave power and immersed longshore transport were calculated and a drift efficiency coefficient of 0.04 was derived. These results contribute to the data bank on LST on MBs. Ultimately they will help to refine the current models used by the industry and support beach managers in anticipating sediment volumes that will be necessary to sustain a MB prior to storm events.

Key words: mixed beach, longshore sediment transport, sediment tracer.