Hydrodynamic and Sediment Dynamic Field Study on a Ridge and Runnel Beach

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The processes of sediment transport and the development of beach profiles in response to hydrodynamic conditions is poorly understood. Inter-tidal zones with low slope often exhibit ridges and runnels as characteristic features. Modelling suggests that these features may be associated with long period water flows, although no direct evidence exists and the processes of ridge migration are unknown. The reasons for the development of inter-tidal profiles are equally unclear. It is important, therefore, to study the sediment transport processes under the rapidly changing shoreline conditions of a macro-tidal beach.

A collaborative nearshore field program led by the Universities of Plymouth (UP) and Southampton (US) is underway as part of the MAST II CSTAB project. This paper reports on the recent field exercise on the Belgian coast which used a range of contemporary techniques for the study of the hydrodynamic environment and sediment dynamics over a well developed ridge and runnel system. Further collaboration with the University of East Anglia (UEA), University of Liverpool (LU) and Universidad de Cantabria (UC) has produced a wide-ranging data set which will lead to an improved understanding of these features. The relationship of such processes to the Middelkerke offshore banks are the focus of attention for the partners in CSTAB.

The beach selected for this study is sited at Nieuwpoort on the Belgian coastline between Oostende and Dunkerque. The coastline is heavily groyned in the surrounding region, with this relatively natural sandy beach being the main exception. The beach slopes gently, with an inter-tidal zone of approximately 500m in width and a tidal range of between 4m and 5m.

The instrumentation for this study was deployed over 3 stations, along a shore-normal transect (figure 1); two inner stations on 200m beach cables and a further self-recording system beyond these. The inner hydrodynamic station (A) was measurement of the longshore and cross-shore velocity field combined with an array of four pressure sensors (two attached to the H-frame, one placed shoreward in a runnel and the other sited seaward along the transect). The main sediment dynamics station (B) was sited on the seaward face of this ridge and, in addition to current meters and a pressure sensor contained 9 optical backscatter sensors (OBS) deployed as two vertical arrays of 6 and 3. The UEA collaboration involved the deployment of instrumentation at this station, to aid estimation of the sediment transport. This consisted of two downward-looking acoustic backscatter (ABS) instruments for measuring suspended sediment concentration profiles and a further sideways-looking ABS for monitoring the evolution of bedforms below the station. The results of the downward-looking ABS are compared with the profiles measured by the OBS array.

The third station (C) was deployed by Universidad de Cantabria which allowed measurements to be made at distances in excess of 200m from the recording station. This self contained system comprised an array of three EMCMs and an accurate pressure sensor located on the crest of the second ridge. The system is self recording and battery powered; it is serviced usually every low tide.

These measurements were combined with a novel technique pioneered by the University of Liverpool. This employs a new tracer coating with enhanced magnetic susceptibility. The coated material can be readily monitored between tides using a simple induction loop. Core samples were also taken for laboratory analysis. The results of this new technique are assessed and compared with a traditional fluorescent dye tracer. The study was sited adjacent to the central field station.

In addition, detailed 3-D surveying was performed at each low tide during daylight using a theodolite coupled to a laser ranger. These data permit an overall picture of the change in beach profile to be compared with the information from the instruments.

Data will be presented outlining the hydrodynamic environment over ridge runnel systems and the ensuing movement of beach material, compared with observed changes in beach topography. An assessment of the magnetic tracer movement in relation to the data obtained from the instrumentation along the main transect is presented.

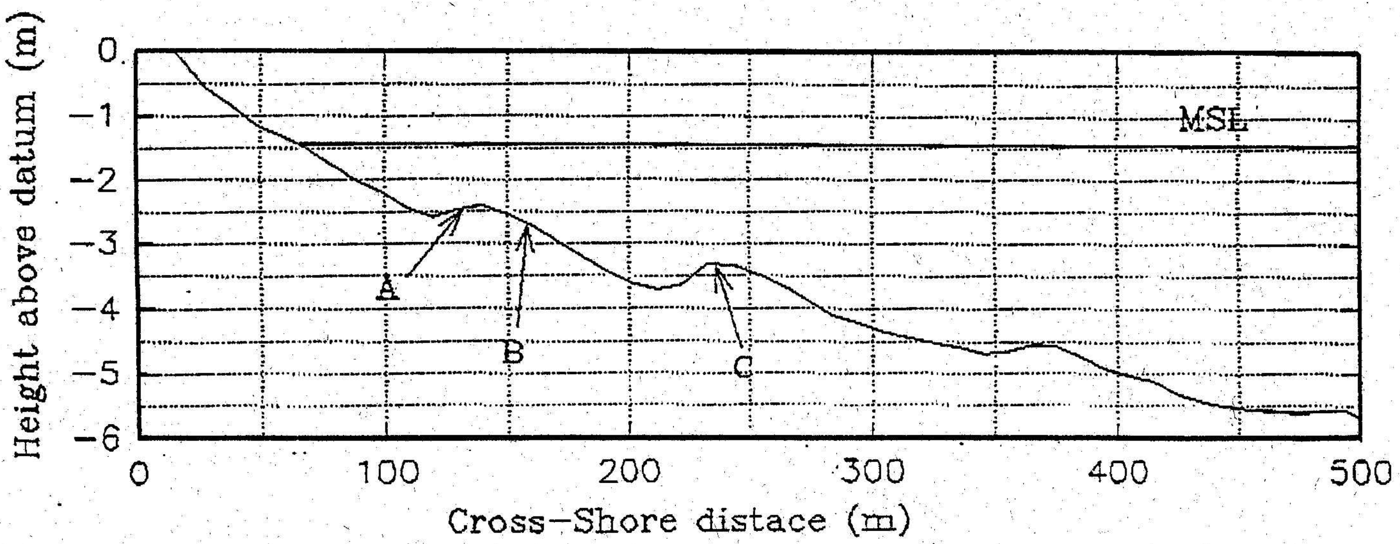

Figure 1: **Beach Profile 23rd May 1993 (am) - Nieuwpoort, Belgium**