GRAVEL BEACH PROFILE EVOLUTION IN WAVE AND TIDAL ENVIRONMENTS

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INTRODUCTION
Gravel beaches are particularly prevalent in the UK. They have a function as a natural coastal defence, protecting the backshore region against wave run up and extreme water levels. In a previous study a comparison of beach profile evolution was made between numerical model simulations and large scale experiments under constant water level, with particular emphasis on the tendency for onshore transport and profile steepening during calm conditions (Jamal et al., 2010). The present paper extends that investigation to study the influence of the advection of surf processes induced by tidal water level variations effects, on gravel beach profile evolution.

METHODOLOGY
We use a variant of the public domain numerical model, XBeach (v12). The improvements made to the model are detailed in Jamal (2011) and include: use of Lagrangian interpretation of velocity; introduction of a new morphological module incorporating waves and currents (Soulsby, 1997); beach infiltration taken into account in the unsaturated area of the swash region (Packwood, 1983).

On gravel beaches, the level of the groundwater interface is closely linked to the tidal elevation throughout both flood and ebb tide, with higher frequency wave signals filtered out. Therefore, to good approximation, the groundwater interface inside the beach can be assumed to follow the tidally modulated water level. In this model, infiltration is active when the beach is considered unsaturated. This is determined by comparison of the instantaneous incident wave surface elevation in relation to the tidal modulation of the mean water level. The water table and the mean water elevation of the external water assumed to be instantaneously coupled.

A preliminary simulation analysing the effects of tides on gravel beach profile development is presented. These results build on the work presented in Jamal et al. (2010).

RESULT AND DISCUSSION
The simulations show the effects of tidally induced variations of the water level over a complete semi-diurnal tidal cycle. Figure 1 shows these effects for simulated wave of height 0.6 m and period 3.2 s incident on a beach of permeability 0.02 m/s and friction factor 0.015. The tidal range of 2.5 m corresponds to a typical meso-tidal environment. Sediment is observed to be carried up the slope during the flood tide and deposited there. This profile has features in common with the non-tidal accretionary profiles shown in the previous work. However the effect of the tide can be seen to smear these features over a wider region. The berm size is bigger with tidal fluctuations than without, in agreement with Trim et al. (2002). The simulations also correctly show the location of the predicted berm above the high tide on the upper beach, as identified in the Powell (1990) parametric model. Hence, the model is now able to predict these and other anticipated profile changes associated with gravel beaches under wave and tidal forcings.

Figure 1 - Gravel beach profile simulation results: simulation of 1 day semidiurnal tide (solid blue); simulation of 3000 waves under constant water level (dotted red); initial beach profile (dotted black)

REFERENCES
Powell, (1990): Predicting Short Term Profile response for shingle beaches, Report SR 219, HR Wallingford, Oxfordshire, UK