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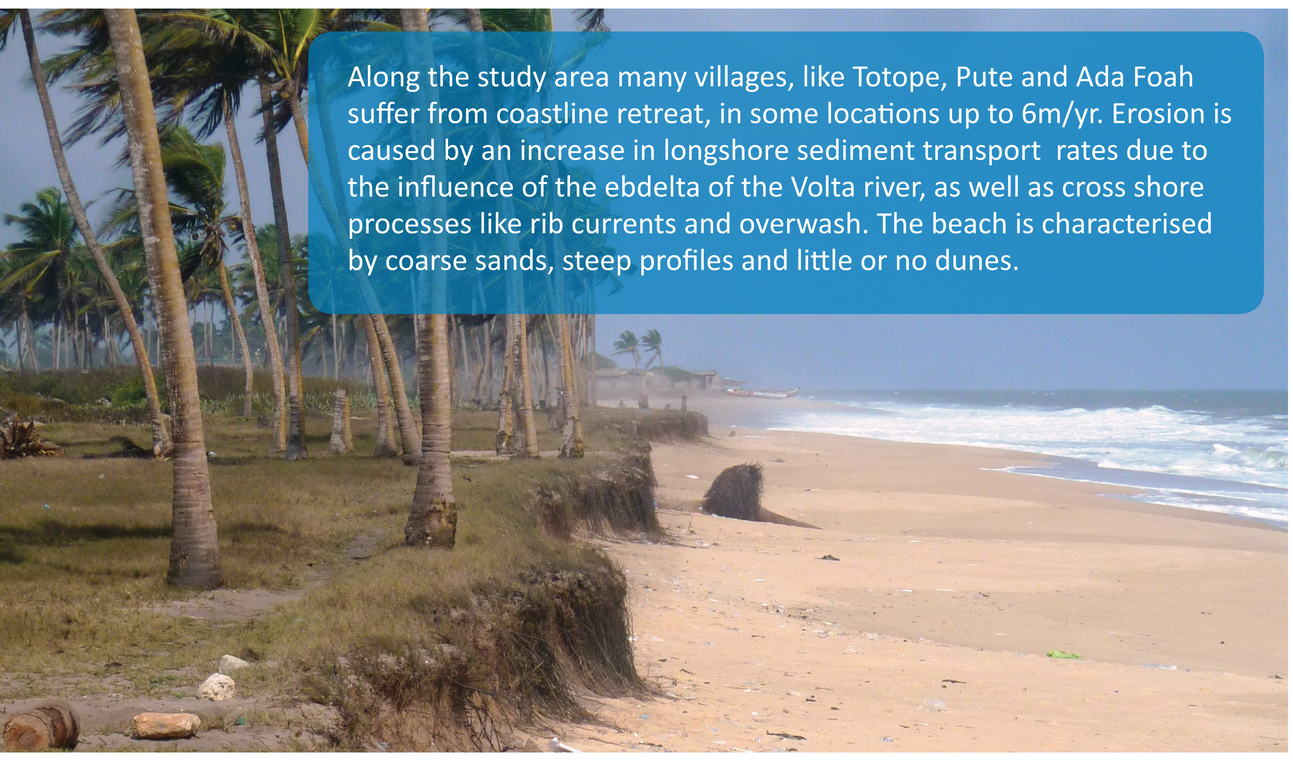
Morphologic Modelling Of The Coastal Evolution In Ada, Ghana

Gijsbert van Holland, Annelies Bolle, Bart Verheyen, Vincent Gruwez, Nicolas Zimmerman, Peter Wauters (IMDC)
contact: gijsbert.van.holland@imdc.be

The Ada coast line used to suffer major erosion. Now a series of 7 groynes (phase 1) defend the eastern part next to the Volta river mouth; 15 more groynes are under construction in phase 2.



Along the study area many villages, like Totope, Pute and Ada Foah suffer from coastline retreat, in some locations up to 6m/yr. Erosion is caused by an increase in longshore sediment transport rates due to the influence of the ebdelta of the Volta river, as well as cross shore processes like rib currents and overwash. The beach is characterised by coarse sands, steep profiles and little or no dunes.

INTRODUCTION

A couple of years ago, the Ghanaian government decided to protect the coast in Ada. Situated at the retreating delta of the Volta river the coastline suffers an approximate 6m erosion per year. In total a stretch of about 16 km will be defended with a combination of groynes and a beach nourishment. The project was split into two phases: first 7 groynes in the most critical stretch were built (IMDC, 2011).

Currently the final 15 groynes and the beach nourishment are under construction.

In order to select the most suitable design for the beach nourishment, different kinds of morphological modeling have been undertaken: long term morphological coast-line modeling (with Litpack) and shorter term modelling with XBeach to investigate the coastal processes and to select the best design for the beach nourishment.

'Groin D' during low tide: the longitudinal slope of the breakwaters matches that of the beach. Wave breakers are now visible at the tip of the breakwaters, where before waves would (only) break on the beach.

MORPHOLOGICAL MODELING

A morphological numerical model XBeach was calibrated against the beach evolution in between and east of the two eastern most groynes. Taking into account the swell dominated wave climate first XBeach was calibrated in a 1DH cross-shore profile mode. The wave asymmetry/skewness parameters and the wave breaking and dune avalanching trigger parameters were changed such that the beach retains as much as possible the original (measured) shape and shape evolution of the cross-shore profile (Verheyen, 2014).

With these calibrated parameters a one-year hind-cast of the morphological evolution around groynes A and B was performed using the 2DH XBeach model. Comparison with measurements shows that the model is capable of reproducing the important morphological changes as well as the most important processes of beach erosion and overwash over the low lying dunes (Gruwez, 2014).

TECHNICAL DETAILS OF THE DESIGN

Based on the Litpack modelling it was decided to construct groynes with an average length of 180 m. Physical modelling confirmed the dimensions: a crest width of 3,5 m and side slopes of 1 on 3. The 1 m thick filter consists of a gravel layer of 5-40 mm and 1-300 kg rock layer. On top of the filter layers the groyne will be constructed from 2-4 t rock. A perpendicular core layer of 1-300 kg rock is placed inside the groyne to reduce the permeability and increase the sand trapping efficiency. The groynes will be placed on top of the nourishment.

The beach nourishment and the dune heightening together will provide a buffer against beach erosion during storm events. The total nourishment consists of 0,6 Mm3 in the phase 1 and 3,4 Mm3 in the phase 2 area, and a uniform nourished profile with a slope of 1 on 25. Based on the 1D Xbeach simulations it was concluded that for an adequate level of protection against wave run-up and overwash events the dune should be heightened up to +6 m LAT with a seaside slope of 1 on 6 (IMDC, 2014).

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