Geophysical Research Abstracts
Vol. 14, EGU2012-279-1, 2012
EGU General Assembly 2012

Morphological developments after a beach and shoreface nourishment at Vlugtenburg beach, the Netherlands

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For the last decades Dutch coastal policy requires sand nourishments to mitigate the effects of coastal erosion. Over time, the nourishment strategy has evolved from direct protection approach to a feeder approach; instead of placing the sand on the beach or dune where it directly benefits safety, sand is placed on the shoreface or alongshore concentrated. Subsequently natural processes redistribute the sand over the profile and alongshore.

With the shift in nourishment approach, a study was started to investigate in detail how nourished sand is redistributed in space and time.

Here we present results from a high resolution bathymetric survey campaign conducted at Vlugtenburg beach at the south west coast of the Netherlands. At this site a beach and shoreface nourishment of 5.4 million m3 was installed in spring 2009, moving the shoreline approximately 250 m forward. Since the completion of the project, a total of 22 profiles were measured monthly extending from the dunefoot to 9 m below mean sea level. These surveys are executed using walking GPS surveys for the subaerial part and jetski surveys for the subaqueous part.

Observations show that the morphodynamic evolution can be characterized by two stages; first a period of rapid changes followed by a period of more stable topography. In the first period, 12 to 15 months after construction, a large cross shore (offshore) movement of the nourished sand is found. The cross shore movement results from a rapid adaptation of the construction profile (characterized by a steep foreshore slope from -2 to -4 m) to a more natural profile with a large subtidal bar.

A sediment budget analysis over all 28 surveys up to present shows a gradual loss of volume. As topographic changes below the -8 m and above +3 m are small, it is most likely that the majority of the sediment deficit can be contributed to alongshore losses. Furthermore, the domain itself is subdivided in various coastal sections, revealing that the cross shore volumetric changes within the domain are significantly larger than the alongshore losses. As a consequence of the adaptation process the high waterline has retreated approximately 50 m over the last 2 years.

The observed changes are correlated with nearby wave data to investigate the impact of storm events. It is observed that in autumn when wave forcing is strong, the profile adaptation is accelerated. The impact of storm events is visible most clearly in the active marine zone (+1 to -4m). Higher up the profile the volume changes are much more gradual.

The findings of this study show the impact of the cross shore location of a nourishment in the profile. If the man-made profile consists of steep unnatural slopes in the active marine zone, a fast cross shore adaptation can be expected.