

Groundwater flow and saltwater distribution near a gully in the Zwin

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The Zwin nature reserve is an important mudflat and salt marsh area near the Belgian–Dutch border. Recently the Flemish government has approved the expansion of the Zwin with 120ha. This expansion was necessary as the Zwin is threatened by sanding and would completely disappear if no action was undertaken. The impact of the enlargement on the groundwater flow and saltwater distribution in and around the Zwin has been studied by Lebbe *et al.* (2009). This study is a continuation on this previous research but on a particular part of the area with a higher level of detail. For this study six boreholes were made near a gully in the Zwin perpendicular to the coast line. The distance of the boreholes to the gully ranges between 1 and 103m. In these boreholes two rounds of EM39-measurements were performed and hydraulic heads were measured with automatic data loggers during four months (Oct. 2011 – Jan. 2012). Based on these measurements a density dependent groundwater flow model was made using the MOCDENS3D code. The EM39-measurements showed that only the upper few meters are subject to changing saltwater distributions. This is mainly due to the periodical inundation of a part of the study area. The measurements of the hydraulic heads indicated that the hydraulic heads in the neighbourhood of the gully are dominated by two processes (tides and weather). As the gully is connected to the sea, the water level in the gully is influenced by tides. This effect is prolonged and results in changing hydraulic heads in the vicinity of the gully. The effect of the tides however diminishes with increasing distance (from 20-120cm at 1m to 0-10cm at 103m). These tidal fluctuations of the heads are asymmetric with a quicker rise than drop (22% of the cycle period is rise at 1m and 43% at 103m). The second process that governs the hydraulic heads in the neighbourhood of the gully is the wind direction and speed. During longer periods of westerly winds the hydraulic heads in the area elevated with 20-25cm in all wells. This is due to the fact that the winds forces water into the Zwin during high tide and blocks the water to flow out during low tide. The preliminary results of the groundwater model show that the groundwater flow directions and velocities near the gully show large variations in semi-diurnal cycles which are strongly influenced by cycles of a longer period such as death and neap tide and variation in wind speed and direction. The model also simulates the development of a typical fresh water tongue from the higher area toward the gully within the saltwater body. This research can be useful in the future with the foreseen sea level rise. By understanding the processes of groundwater flow and saltwater distribution in tidal flats as the Zwin remnant, one can obtain insights in the ways the present day saltwater distribution in the phreatic aquifer in the coastal plain has developed during the Holocene from an aquifer which was at the start filled with fresh water.

References

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