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Monitoring of groundwater, morphological and ecological development of the Perkpolder managed realignment following tidal restoration

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Innovative, sustainable and cost-effective coastal protection solutions are required to adapt to environmental change and enhance ecosystem functioning. Managed realignment is an example of an ecosystem engineering coastal management approach motivated by concerns about biological conservation and sea-level rise. It involves relocating the line of defense landward, thereby mimicking what would normally happen with marine environments during a period of sea-level rise. The retreat allows new salt marshes to develop offering a range of ecosystem services. Despite the ongoing execution of managed realignment projects in, amongst others, the UK, Germany, the Netherlands, Belgium and Spain, it remains unclear whether management realignment is able to deliver on the expected socio-economic and environmental benefits.

Here we report on the short-term (0-4 years) development of physical and ecological processes of the Perkpolder managed realignment area in the Scheldt estuary, the Netherlands, following tidal restoration in 2015. The overarching goal of the Perkpolder project was to realize 75 hectares of low-dynamic tidal nature contributing to Natura2000 conservation goals for the Western Scheldt estuary as well as serving as a compensation measure for the extension of the navigation channel for the Antwerp harbor.

The Perkpolder managed realignment is considered a unique opportunity to monitor and study the biotic and abiotic changes in an area transforming from a freshwater agricultural area to a tidal saline natural area. An interdisciplinary monitoring framework was set up to record the abiotic and biotic developments of the Perkpolder realignment area, particularly focusing on morphological changes, colonization of the new tidal area by benthic macrofauna and vegetation, and its function as foraging area for water birds. Also the groundwater system is studied and its effect on the surrounding agricultural land.

A mitigation measure, called ‘SeepCat’, was installed on the border of the new tidal area and the agricultural land to protect the freshwater lens used by farmers for irrigation. The lens was expected to shrink by this local sea level rise. From the groundwater measurements, it was concluded that the SeepCat system was functioning well enough to compensate for the effects of the new tidal area.

Using a Delft3D numerical model simulation, it was shown that the design of the morphological template has a large impact on the rates of morphological change. Additionally, the sediment import, estimated from SPM concentration and discharge measurements, varied strongly in time, and sediment was also being exported for a number of tides. Controlled laboratory experiments show that seedlings of pioneer marsh plant species survive best in a well-drained soil without sediment dynamics. Yet, seedlings can tolerate some moderate sediment dynamics. From a benthic community perspective, the development of the managed realignment Perkpolder is encouraging. A biologically active intertidal area has formed within a short time frame. Within 3 years, the benthic macroinfaunal community shows a development towards a community found on natural tidal mudflats and is expected to reach a stable community in years rather than decades. The area is also frequently visited by birds, which forage during low tide and rest on the surrounding dikes during high tide.