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Smart Salinity Management in Low-lying Deltaic Areas: A Model Predictive Control Scheme Applied to a Test Canal

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Saline groundwater exfiltration to surface water increases surface water salinization and degrades the water quality in low-lying deltaic areas. As the use of surface water is less appropriate for agricultural, industrial and drinking water production due to salinization, freshwater diverted from a river is often utilised for flushing canals and ditches in these areas. Current water management strategies for flushing control in low-lying deltaic areas have to be revised to mitigate expected negative effects of climate change, sea level increase and decreasing fresh water availability. Model predictive control (MPC) is a powerful control method that is increasingly used for managing water systems. The explicit consideration of constraints and multi-objective management are important features of MPC. In this study, an MPC scheme is developed and tested for combined salinity and water level control of a ditch/water course. Saline groundwater exfiltration fluxes and salinities are modelled by applying the Rapid Saline Groundwater Exfiltration Model (RSGEM) and used as known disturbances for the MPC scheme. The developed control scheme is applied to a test canal using real data from a Dutch polder (Polders are low lying and artificially drained areas surrounded by dikes, with a controlled surface water level below M.S.L) which is affected by high saline groundwater exfiltration. This test demonstrates the performance of the controller for a real scenario. Simulation results show that MPC can increase the operational efficiency of flushing operations.