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A Heuristic Approach to Effective Sensor Placement for Salinity State Reconstruction in a Low-Lying Polder

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Salinization of polders is often caused by exfiltration of saline groundwater. When the salinity level in the polder ditch exceeds a certain threshold, to maintain acceptable surface water quality, freshwater is introduced through the upstream structure of the polder to flush the surface water system. Land subsidence, climate change and sea level rise accelerate salinization by enhancing the intrusion rate increasing the pressure on water managers to reconsider salinity management in low-lying polders. Understanding the system state correctly before giving a decision is crucial and depends on the quality of the collected data and thus the quality of the monitoring network. Real time control of salinity highly depends on the ability of efficiently reconstructing the current state of the system from available measurements.

In this study, we develop a systematic approach for effective salinity sensor placement in a typical low-lying polder in The Netherlands for salinity state reconstruction. The design of sensor placement is based on simulation dataset from a hydrodynamic and salt transport model of a real catchment in The Netherlands. A low dimensional model capturing the most of the variance in the salinity dataset is produced using principal component analysis (PCA). Later, this model is used to decide on the numbers and locations of the sensors using a greedy algorithm (GA). The objective of the placement is to estimate salinity levels in the unmeasured main channels of the catchment using the available measurements depending on the selected sensor placement. 3-year spatial salinity simulation dataset simulated using SOBEK model applied to Lissertocht catchment in The Netherlands is used to evaluate the performance of our method.