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Optimal design of saltwater intrusion control systems by Global Interactive Response Surfaces: the Nauru island case study

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Infiltration galleries and scavenger wells are often constructed to prevent saltwater intrusion in coastal aquifers. The optimal design of these infrastructures can be framed as a multi-objective optimization problem balancing availability of fresh water supply and installation/operation costs.
High fidelity simulation models of the flow and transport processes can be used to link design parameters (e.g. wells location, size and pumping rates) to objective functions.
However, the incorporation of these simulation models within an optimization-based planning framework is not straightforward because of the computational requirements of the model itself and the computational limitations of the optimization algorithms.
In this study we investigate the potential for the Global Interactive Response Surface (GIRS) methodology to overcome these technical limitations.
The GIRS methodology is used to recursively build a non-dynamic emulator of the process-based simulation model that maps design options into objectives values and can be used in place of the original model to more quickly explore the design space.
The approach is used to plan infrastructural interventions for controlling saltwater intrusion and ensuring sustainable groundwater supply for Nauru, a Pacific island republic in Micronesia.
GIRS is used to emulate a SEAWAT density driven groundwater flow-and-transport simulation model.
Results show the potential applicability of the proposed approach for optimal planning of coastal aquifers.