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Assessment of water management tools for the geothermal reservoir Waiwera (New Zealand)

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Water management tools are essential to ensure the conservation of natural resources. The geothermal hot water reservoir below the village of Waiwera, on the Northern Island of New Zealand is used commercially since 1863. The continuous production of 50 °C hot geothermal water, to supply hotels and spas, has a negative impact on the reservoir. Until the year 1969 from all wells drilled the warm water flow was artesian. Due to overproduction the water needs to be pumped up nowadays. Further, within the years 1975 to 1976 the warm water seeps on the beach of Waiwera ran dry. In order to protect the reservoir and the historical and tourist site in the early 1980s a Water Management Plan was deployed. The "Auckland Regional Water Board" today "Auckland Regional Council" established guidelines to enable a sustainable management [1].
The management plan demands that the water level in the official and appropriate observation well of the council is 0.5 m above sea level throughout the year in average. Almost four decades of data (since 1978 until today) are now available [2]. The minimum water level was observed beginning of the 1980s with -1.25 m and the maximum recently with 1.6 m. The higher the production rates from the field, the lower the water level in the observation well. Highest abstraction rates reached almost 1,500 m3/day and lowest were just above 500 m3/day. Several models of varying complexity where used from purely data driven statistical to fully coupled process simulation models. In all cases the available data were used for calibration and the models were then applied for predictive purposes. We used the Nash-Sutcliffe efficiency index to quantify their predictive ability.
The recommendation for the full implementation of the water management plan is the regular revision of an existing multivariate regression model which is based on the Theis well equation. Further, we suggest improving the underlying geological model of the process simulations to provide a more flexible tool for future and prospective scenarios which are not covered by data driven models [3].

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