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A simple operating model of the Van der Kloof Reservoir using ANN streamflow forecasts

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ABSTRACT

The operation of Van der Kloof Dam on the Orange River was investigated with an artificial neural network and a spreadsheet model. The objective was to simulate inflow into the dam and optimize reservoir operation for optimum power generation.

The advantage of artificial neural networks lies in their ability to simulate both linear and non-linear systems and the modeller does not need knowledge of the physical processes driving the system hydrology. The current operation of the Orange River was reviewed and literature review was conducted for reservoir operation and artificial neural networks. The hydrology of the Orange River (1977 – 2008), the water requirements and hydropower plant layout were investigated. A 1-month ahead streamflow model was then developed to predict inflow into Van der Kloof Dam over an operating period of 12 months. The resulting simulation was satisfactory, proving the power of artificial neural networks.

The inflows were used to optimize reservoir operation by maximizing hydropower and minimizing water supply deficits. The software used to build the network, NeuroSolutions, however did not have an algorithm for optimizing reservoir operation. The embedded genetic algorithm was only available for optimizing network training. As a result, the operation of the reservoir was optimized on Excel which was found satisfactory for the one reservoir system investigated. Potential areas for further research include seasonal models and annual forecasting models with robust monthly disaggregation.