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Remote sensing for assessment of groundwater resources, A case study of Stampriet Transboundary Aquifer

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Distributed integrated hydrological models (IHMs) are the most effective tools for estimating groundwater recharge in arid and semi-arid areas characterized by thick unsaturated zone. It is also important to capture spatio-temporal aquifer dynamics by using real-time or near-real-time data, for sustainable water resources management. However, such data is often unavailable in developing countries where monitoring networks are scarce. In recent years, remote sensing has played an important role in providing spatio-temporal information for evaluation and management of water resources. Nevertheless, application of remote sensing in groundwater studies is still limited and has mainly focused on assessment of groundwater recharge and groundwater storage as well as to provide boundary conditions and driving forces for both standalone groundwater models and IHMs. This study entails application of remote sensing data in developing the distributed integrated hydrological model for Stampriet transboundary multi-layered aquifer system shared between Namibia, Botswana and South Africa. A numerical model has been set – up using MODFLOW 6 coupled with the Unsaturated Zone Flow (UZF) Package where Climate Hazards Infrared Precipitation with stations (CHIRPS) rainfall data and Global Land Evaporation Amsterdam Model (GLEAM) potential evapotranspiration data were implemented as the model driving forces. Other input data used include digital elevation model, and land-use/landcover and also soil datasets to define unsaturated zone parameters. The model has been calibrated with groundwater level measurements as the state variables in transient conditions at daily time step for a period of 16 years. The model-simulated unsaturated zone and groundwater storage was compared to GRACE-derived sub-surface storage anomaly, further also used to constrain the model. The calibrated model provides spatio-temporal water flux dynamics as well as water balances and hence an understanding of the groundwater-resource dynamics and replenishment. This information is shown useful for proper management of the transboundary water resource as well as for policy making.