Hydrologic Modeling with Remote Sensing for Groundwater Resource Management within the Sand River Catchment, South Africa
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Abstract
The Limpopo River Basin (LRB) is a transboundary river basin that spans Botswana, Mozambique, South Africa, and Zimbabwe. The basin is home to approximately 13 million people and is severely impacted by groundwater extraction due to its critical resources, especially as the result of population growth and climate change. Due to the lack of proper management of these water resources, the region has experienced severe groundwater depletion, leading to reduced water availability and increased water stress. This study aims to address these issues by implementing integrated approaches, including remote sensing and hydrological modeling, to better understand and manage groundwater resources.

Figure 1. Land Cover Map of Delimited Sand River Watershed at Soutpansberg Mountains. Land cover data were obtained and analyzed to support curve number calculations for each delineated subwatershed using the SCS Curve number method. The average curve number was found to be 60, based on USDA TR-55 CN tables.

Methodology (continued)

Results

Figure 2. Meteorological and Remote Sensing Data, Water Balance. Monthly data from TRMM GPCP and the Global Land Data Assimilation System (GLDAS) were obtained and used to represent change in groundwater storage. Precipitation data was collected from 12 gauges in the LRB. Evapotranspiration data was estimated for the Kenzie-Addington Model. Runoff values were collected from a river gauge at Waterpoort, Sand River (the outlet of the watershed) (Model 2009)

Figure 3. Precipitation and Model Flow at Soutpansberg Mountains. Model results from August 2019 – July 2020. Model flow is shown compared to the gauge at Waterpoort (outlet of the watershed).

Current Limitations and Goals:
• No validation data for groundwater resources
• GRACE data to supplement
• Calibration of model parameters
• Improved lag time and baseflow estimates

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References

Figure 4. HEC-HMS Flow Diagram. HEC-HMS is a software developed by U.S. Army Corps of Engineers hydrologic model development. Generated models can be highly parameterized with both generated and user-specified methods. Terrain data can also be included. A digital elevation model analysis was performed in QGIS to delineate the Sand River watershed within the Soutpansberg Mountains. (HEC-HMS Technical Manual)