Understanding Potential Climate Change Impacts on Water Resources Within a Fractured Rock Watershed in Northern Togo

More than 72% of sub-saharan Africa land surface is comprised of hard rock with fractured rock aquifers supplying water to an estimated 25% of the rural population. Given low porosity and storativity, fractured rock aquifers are particularly vulnerable to stresses such as projected population growth and climate variability. General circulation models of sub-saharan Africa predict increases in temperature and in occurrences of extreme precipitation trends, such as flooding and drought. Adaptation strategies that promote optimal uses of water resources have emerged, although, most focus exclusively on surface water resources. This project aims at developing a hydrologic model of the Koumfab watershed, in northern Togo, that will serve as a basis for simulating SW-GW interactions and their responses to different climate scenarios. The Koumfab watershed (83 km$^2$) is underlain by crystalline rocks of the West African Craton and consolidated sedimentary rocks of the Volta basin. Climate data relies on a single, within-watershed weather station that records precipitation, humidity, and temperature data. Surface water data within the watershed consists of limited records of reservoir stage and stream discharge. The groundwater flow system within this watershed is characterized using a total of 37 wells to determine depth to water and hydraulic gradient, estimate hydraulic parameters from pumping test responses, and lithologic unit descriptions. Drone surveys of surface outcrops are used to characterize the fracture network and relate fracture patterns to equivalent network permeability. Analysis of well logs suggest that the Koumfab watershed is underlain by a semi-confined aquifer; it consists of a weathered horizon (25 m average thickness) overlying a fissured horizon where most of the productive fractures occur (20–40m). Characteristic of fractured rock aquifers, transmissivity values are highly variable and range from $2.3 \times 10^{-6}–3.1 \times 10^{-4}$ m$^2$/s in the sandstone unit, and $5.8 \times 10^{-6}–7.3 \times 10^{-4}$ m$^2$/s in the migmatite/gneiss unit.