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Regional scale hydrological modeling: An insight into the water resources of African continent

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Africa holds around 9% of global renewable water resources for 15% of world's population living in the continent. The occurrence of these water resources is unevenly distributed across the continent, with higher rainfall proportions mainly concentrated in Central and Western Africa. Most of the population living in the North, South and horn of Africa are mainly dependent on large transboundary groundwater aquifers. Policy makers are highly dependent on aggregated estimates of surface and groundwater resources at basin and/or country scale which have been largely produced by FAO and UNESCO. However, spatial occurrence and regional scale assessment of African water resources remain less investigated and under discovered todate. This study aims a grid-based assessment of the African water resources, which will enable researchers to identify potential locations for generation of surface runoff and recharge to the groundwater systems.

Traditionally, rainfall and related climatological variables are incorporated into the hydrological model as time series of measured records at a specific location. Recent advances in space and information technology and sciences made it feasible to use climatological grid inputs at monthly time step in this modeling study. A Thornthwaite-type water balance has been developed using the programming language Python and distributed dynamic modeling environment PCRaster. The concept has been formerly adopted in physically distributed WetSpass model, which gives fair estimation of long-term averaged hydrological processes for smaller catchments. Issue of selecting spatial resolution in this continental scale modeling has been addressed by keeping the grid size reasonably small to utilize available global satellite datasets, and to encompass spatial heterogeneity and nonlinearity of natural soil, landcover, atmosphere. Rainfall input to the each grid has been simulated into four vertical reservoirs at each timestep to calculate interception, runoff, evapo-transpiration and recharge. These hydrological processes were defined using scientifically proven and validated methods varying in complexity from simple to complex for calculating the vertical water balance of each grid. Visualization of model results with existing basin-scaled modelling studies will be able to identify potential locations to introduce the concept of sustainable productivity of the basin over similar climatic conditions.