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Ethiopian Central Rift Valley basin hydrologic modelling using HEC-HMS and ArcSWAT

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An Integrated Water Resources Management (IWRM) shall be applied to achieve a sustainable development, to increase population incomes without affecting lives of those who are highly dependent on the environment. First step should be to understand water dynamics at basin level, starting by modeling the basin water resources. For model implementation, a large number of data and parameters are required, but those are not always available, especially in some developing countries where different sources may have different data, there is lack of information on data collection, etc.

The Ethiopian Central Rift Valley (CRV) is an endorheic basin covering an area of approximately 10,000 km2. For the period 1996-2005, the average annual volume of rainfall accounted for 9.1 Mm3, and evapotranspiration for 8 Mm3 (Jansen et al., 2007). From the environmental point of view, basin ecosystems are endangered due to human activities. Also, poverty is widespread all over the basin, with population mainly living from agriculture on a subsistence economy. Hence, there is an urgent need to set an IWRM, but datasets required for water dynamics simulation are not too reliable.

In order to reduce uncertainty of numerical simulation, two semi-distributed open software hydrologic models were implemented: HEC-HMS and ArcSWAT. HEC-HMS was developed by the United States Army Corps of Engineers (USACoE) Hydrologic Engineering Center (HEC) to run precipitation-runoff simulations for a variety of applications in dendritic watershed systems. ArcSWAT includes the SWAT (Soil and Water Assessment Tool, Arnold et al., 1998) model developed for the USDA Agricultural Research Service into ArcGIS (ESRI®). SWAT was developed to assess the impact of land management practices on large complex watersheds with varying soils, land use and management conditions over long periods of time (Neitsch et al., 2005).

According to this, ArcSWAT would be the best option for IWRM implementation in the basin. However, considering data uncertainty and model complexity a previous hydrologic assessment of the basin based in HEC-HMS simulation is advisable. As a first approach HEC-HMS was implemented for basin modeling in order to get physical parameters of interest, results from HEC-HMS calibration were used to setup the accuracy of the ArcSWAT numerical modelling.

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