Chapter 7

A Spatial Database of Hydrological and Water Resources Information for the Nyangores Watershed of Kenya

Luke O. Olang
The Technical University of Kenya (TU-K), Kenya

Mathew Herrnegger
University of Natural Resources and Life Sciences (BOKU), Austria

Doris Wimmer
University of Natural Resources and Life Sciences (BOKU), Austria

Josef Fürst
University of Natural Resources and Life Sciences (BOKU), Austria

ABSTRACT

Advances in environmental remote sensing have provided an opportunity to monitor water resource systems in vulnerable regions with data scarcity. The spatial datasets can be used to build spatial models of reality to enable derivation of catchment based characteristics, also often required by models in hydrology. The derived estimates can then be mapped and cartographically presented to support water resources planning within the concerned developing regions. This contribution presents a database of water resources information for an upstream catchment of the Mara River Basin of Kenya developed from freely available spatial datasets. Additionally, water quality parameters (pH, electrical conductivities and Total Dissolved Solids) selected as essential indicators of the suitability of the water resources for domestic applications were measured and mapped. The database, packaged as spatial maps, has been presented to the local stakeholders for developing appropriate catchment management strategies within the important watershed.

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INTRODUCTION

Many water resource systems in the developing countries are continually faced with formidable water quantity and quality challenges consequent of environmental change effects (Dessu et al. 2014). An understanding of the environmental changes and their interactions within the complex water systems is necessary for developing considerate planning options required to support an integrated and sustainable management. However, there exists inadequacy of observed hydrological data required to understand the impact of the changes within the vulnerable watersheds. This constraint not only hampers extended hydrological predictions, but also the design of appropriate water management structures required to safely control surface water flows within the catchments during storm events (Onyando et al., 2005; Juston et al. 2014). In such regions with data limitation, physically based modeling approaches can be employed to define the interactions of concerned hydrological variables using parameters that can be obtained from the physical conditions of the basins (McColl and Aggett, 2007; Baldyga et al. 2007). The application of such an approach has been boosted by the recent advances in environmental satellite remote sensing techniques with the capacity to provide spatial datasets that exemplify the physical conditions. However, considering the difficulty of validating the model estimates due to lack of in-situ hydrological observations, the remotely sensed spatial datasets require adept processing based on hydrological experience in order to adequately represent the land surface terrestrial processes (Refsgaard and Hans 2004; Ayuyo and Sweta 2014). Furthermore, the geographic entities that define the process should be topologically defined to create a conforming virtual model of reality from which correct hydrological parameters can be derived.

Today, a large amount remotely sensed datasets are available for many regions around the globe due to the need for integrated environmental monitoring and assessment (Githui 2009; Olang et al. 2012). To select the right sets of data that address a unique water resource challenge of a region, with respect to the socio-economic demands, it is essential to comprehensively review the metadata to understand the generation process and recommended overall applicability of the data (Olang et al. 2011; Kilonzo et al. 2014). It is also necessary, where possible, that the derived estimates are authenticated through short-term measurements and validation achieved through on the ground-truthing of selected geographical entities. In cases where detailed analysis is supported by a spatial information system, it is further vital that the spatial maps are cartographically and visually presented in an elaborate manner that clearly communicates the results to the concerned decision makers (Hake et al. 2002; Zlinszky & Timár 2013). In most river basins of East Africa, spatial maps of hydrological and water resources information is rapidly gaining prominence due to ease of interpretation by the local stakeholders charged with day
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