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Land use change impacts on the hydrology of Southwestern Highlands of Ethiopia: Is observation uncertainty hiding the signal?

Solomon Gebreyohannis Gebrehiwot (1,2), Giuliano Di Baldassarre (3,4), Kevin Bishop (5), Sven Halldin (3,4), Lutz Breuer (1,6)

(1) Justus-Liebig-Universität, Giessen, Inst. of Landscape Ecology and Resources Management, Giessen, Germany (solomon.g.gebrehiwot@umwelt.uni-giessen.de), (2) Ethiopian Institute of Water Resources, Addis Ababa University, P.O.Box 150641 Addis Ababa, Ethiopia, (3) Department of Earth Sciences, Uppsala University, Villavägen 16, 752 36 Uppsala, Sweden, (4) Centre of Natural Hazards and Disaster Science, CNDS, Uppsala, Sweden, (5) Department of Aquatic Sciences, Swedish University of Agricultural Sciences, Almas Alle 8, 750 07 Uppsala, Sweden, (6) Centre for International Development and Environmental Research (ZEU), Justus Liebig University Giessen, Senckenbergstraße 3, 35390 Giessen, Germany

In this study, we analyze how much observation uncertainty in river discharge mask a land use impact on hydrological regime. Long-term hydrological data (1986-2013) from an 1890 km2 sized watershed (Upper-Didesa) in the highlands of Ethiopia was used. A recession flow analysis was employed to assess the impacts of land use change on the storage function; a linear reservoir model was used to analyze the storage changes. The linear reservoir model parameter is calibrated to different levels of storage and generate recession flows respective to the different values of the model parameter. Based on previous studies, ranges of random normally distributed error dimensions were allotted to observed discharge. Then, discharge was generated using normal probability distribution on different magnitude of error ranges; which are 5%, 10%, 25%, 50% and 75%. Flows were generated for all years, driest year and wettest year. Then every two combinations between flow generated with levels of storage characteristics and ranges of error were compared using step change test. Any time series generated with storage analysis significantly lower than the paired time series from the error range analysis is considered as not-masked (land use change impact is detectable); whereas non-significant differences between the pairs are considered as being masked by land use change impact. The results showed that 75% error range and above in discharge are masking the signals of land use change impacts on average during wettest years, while a 50% error range has the ability to mask land use change impact during the driest year. Land and water resources planning are based on the hydrological regime assuming reveals land use change other anthropogenic impacts. However, this study showed the necessity of improving observational data quality for proper planning land use and water resources developments in the areas of active land management changes like Southwestern Ethiopia.