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Evaluation of Remotely Sensed Evapotranspiration as a Proxy of Water Balance and Land Cover Changes

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Abstract

Evaluation of water losses and land cover dynamics of a basin is an important step in conditioning hydrological models. In this study the tempo-spatial pattern of remotely sensed evapotranspiration (ET) are used to explain the causes of changes in water balance and land cover in the river basin. To the Wami River basin in the central east of Tanzania, a time series of 644 ET images (year 2000–2013) from 8-days MODIS ET was extracted and analysed using a novel approach. First, the principal component analysis (PCA) was used to compute the principal components of time series. Then the Mann-Kendall trend test and Sen's Slope was used to analyse long term trends of loadings. And finally the Kendall, Wilcoxon and Kruskal-Wallis tests were used for comparison of component scores against elevation, slopes, soil and land use patterns. The first five principal components of ET covering the basin, explained the 99.88 % of the total variance in the dataset. The first four components reflect the meteorological patterns leading to seasonal and event based water balance changes, whereas the fifth component reflects the land cover trends in the basin. From the findings, the components may be used to explain the season lag between rainfall and ET when the latter is used to condition the hydrological model. The extreme ET patterns may also be used to explain the difference between rainfall peaks, changes in streamflows and the delayed ET responses. The land cover trend may be used to factor in the impacts of land cover change in the hydrological model. The natural forest in the Eastern Arc Mountains and low slopes/ downstream loam soil may also be explicitly considered in conditioning the hydrological model because they exhibit relatively higher ET from deep groundwater and shallow groundwater respectively at the end of the dry period. It is expected that, these findings will highly improve the conditioning of the hydrological model in the Wami River basin.

Keywords: ET, land cover, MODIS, PCA, water balance

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