Adaptation of a hydrological model for the upper Athi river to predict runoff from rainfall in it's catchments

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Abstract:

The Athi river, at Baricho waterworks, is an important source of water for Malindi and other coastal towns of Kenya while the proposed Munyu Dam is also located on the upper Athi. However, the lower Athi or Sabaki has problems of high sedimentation causing siltation and damage to water pumps at the Baricho Waterworks, thus making exploitation difficult and treatment expensive. This has led to increased exploitation of the Mzima Springs, which is clear and requires minimal treatment. Correlation studies have shown that the Athi River in it's lower reaches below the confluence with Tsavo River is maintained in dry weather by the Tsavo River whose natural flow is limited to about 3 cumecs, the source of which is the Mzima Springs. It is therefore necessary to investigate means of exploiting the upper Athi without undue dependence on the Tsavo. Data prepreparation consisted of aligning by stacking using the Excel software SSCstat all the data to be used into respective arrays or daily data series. The data consisted of discharge for two regular gauging stations, four rainfall and one evaporation station. Gaps in the arrays were bridged by common methods like regression and graphical methods. Thus for the split sample method two thirds of the data in the longer series was used for calibration and one third for verification or testing. The Galway Flow Forecasting System(GFFS) was applied on the above data. From the point of view of the efficiency criteria, the Linearly Varying Gain Factor Model (LVGFM) performed better than the others used. The varying gain factor element takes care of the negative cumulative effect of evaporation, which the Simple Linear Model(SLM) and Linear Perturbation Model (LPM) do not address. The superiority of the L VGFM over the other models is also vindicated by the significantly higher correlation(0.5040) between estimated and observed discharges. Efficiency, R2 of about 48% was achieved in calibration and largely sustained, at about 20%, through verification. Of the others, only LPM attained about 49% efficiency during calibration which was not sustained to verification where it dropped to (-ve)5%. The relatively low levels of efficiency in all models used, especially with Soil Moisture Accounting and Routing(SMAR), can be attributed to errors in the data that were introduced by estimating the numerous missing values. The results obtained with the LVGFM are nevertheless acceptable given the data limitations. The model was adapted for simulation and forecasting of discharges in the Athi catchment at RGS 3DA2(Munyu Dam) using rainfall data for Dagorreti Meteorological station, the split series technique and a memory length of 15 days.