Monthly Streamflow Prediction in the Volta Basin of West Africa: A SISO NARMAX Polynomial Modelling

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Single-Input-Single-Output (SISO) non-linear system identification techniques were employed to model monthly catchment runoff at selected gauging sites in the Volta Basin of West Africa. NARMAX (Non-linear Autoregressive Moving Average with eXogenous Input) polynomial models were fitted to basin monthly rainfall and gauging station runoff data for each of the selected sites and used to predict monthly runoff at the sites. An error reduction ratio (ERR) algorithm was used to order regressors for various combinations of input, output and noise lags (various model structures) and the significant regressors for each model selected by applying an Akaike Information Criterion (AIC) to independent rainfall-runoff validation series.

Model parameters were estimated from the Matlab REGRESS function (an orthogonal least squares method). In each case, the process model was fitted first followed by a fitting of the noise model. The coefficient of determination (R-square), the Nash-Sutcliffe Efficiency criterion (NSE) and the F statistic for the estimation (training) series were used to evaluate the significance of fit of each model to this series while model selection from the range of models fitted for each gauging site was done by examining the NSEs and the AICs of the validation series.

Monthly runoff predictions from the selected models were very good, and the polynomial models appeared to have captured a good part of the rainfall-runoff non-linearity. The results indicate that the NARMAX modelling framework is suitable for monthly river runoff prediction in the Volta Basin. The several good models made available by the NARMAX modelling framework could be useful in the selection of model structures that also provide insights into the physical behaviour of the catchment rainfall-

runoff system.