CLIMATE CHANGE AND ANTHROPOGENIC IMPACTS ON THE UPPER NILE

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INTRODUCTION

The River Nile is the world's longest flowing river draining ten African countries. The hydrologic system to the Nile has a large degree of spatial heterogeneity in terms of climate and land surface characteristics. This has been steadily altered by increased climate variability and the stable growth in economy and population and the recent conversions of land cover types between forests, agriculture, wetlands, and urban centres have played the most significant role in changing land surface characteristics, The potential effect of global warming and changes in the land surface hydrology have far-reaching impacts to populations, mainly in form of droughts, floods, famine, disease, and poverty. The aim of the study is to assess the impact of climate and land use change on the hydrology of the Kyoga basin (Figure 1), within the Upper Nile. Due to the sparse climate gauge network in the region, the study incorporates several remote sensing products.

SPATIAL AND TEMPORAL RAINFALL MODELLING

Generalised Linear Models under GLIMCLIM (Chandler 2006) are used to stochastically generate precipitation data sets. Logistic (occurrence) and Gamma (amounts) models are developed for several rainfall zones within the Kyoga basin. In general, GLM performance improves with quality of precipitation data available to defined the models (Figure 2).

REMOTE SENSING PRODUCTS

Remote sensing products tend to overestimate precipitation over the tropics, hence Power Law functions are being used to fit remote sensing data to gauged data (Figure 3).

HYDROLOGICAL CONCEPTUALISATION

A semi-distributed physically based hydrological model has been setup using the Soil Water and Assessment Tool, SWAT (Arnold et al.,1996) to simulate stream flow, PET, ET, groundwater flow, and soil moisture on a daily temporal resolution. Model parameters are derived using Latin Hypercube - Monte Carlo simulations (Figures 4, 5, & Table 1).

CONCLUSION

- GLMs adequate model equatorial precipitation over Yoga;
- GLMs can generate precipitation for un gauged sites;
- SWAT is able to simulate several hydrological components even for non gauged basins.

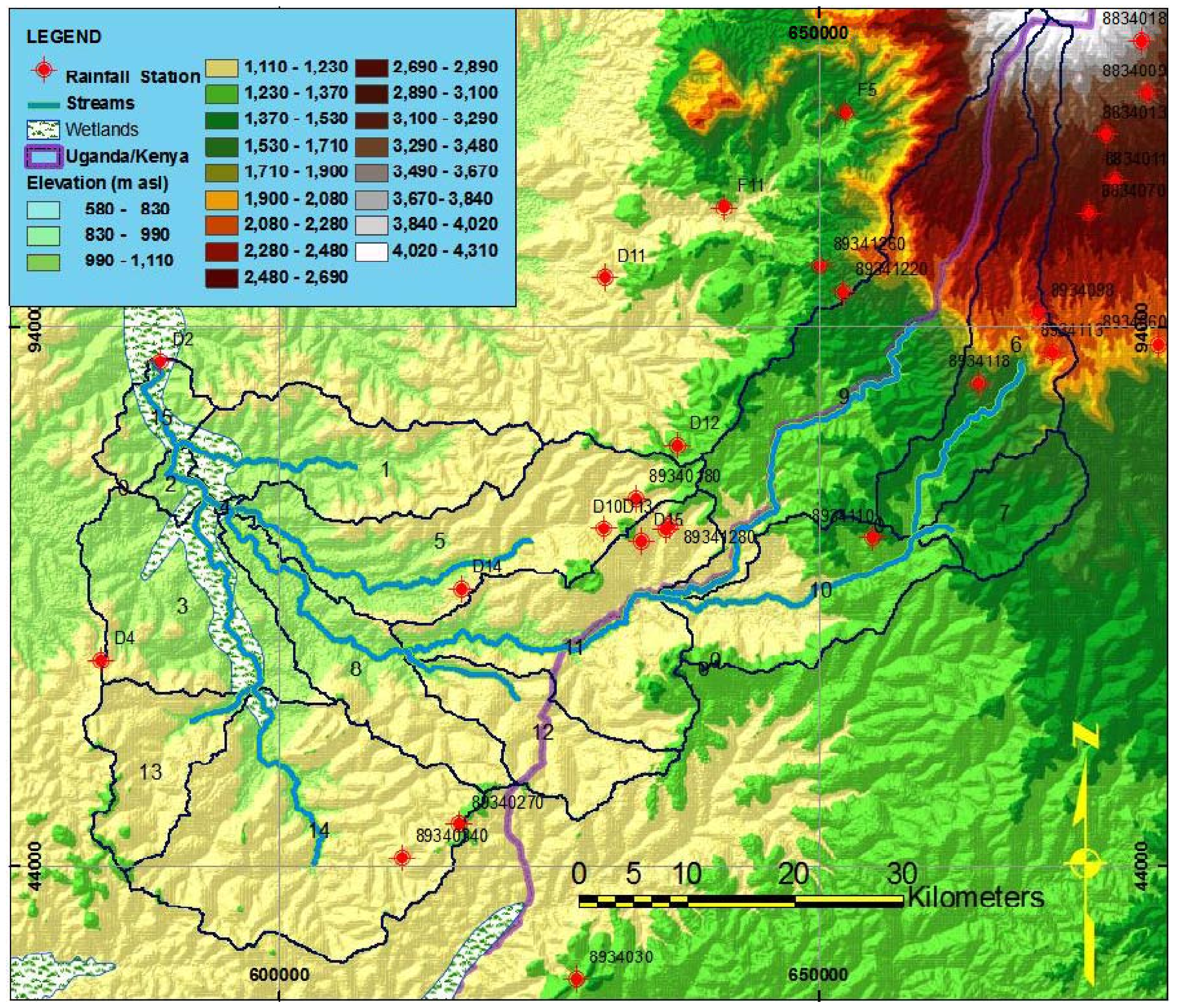

Figure 1. Kyoga sub basin

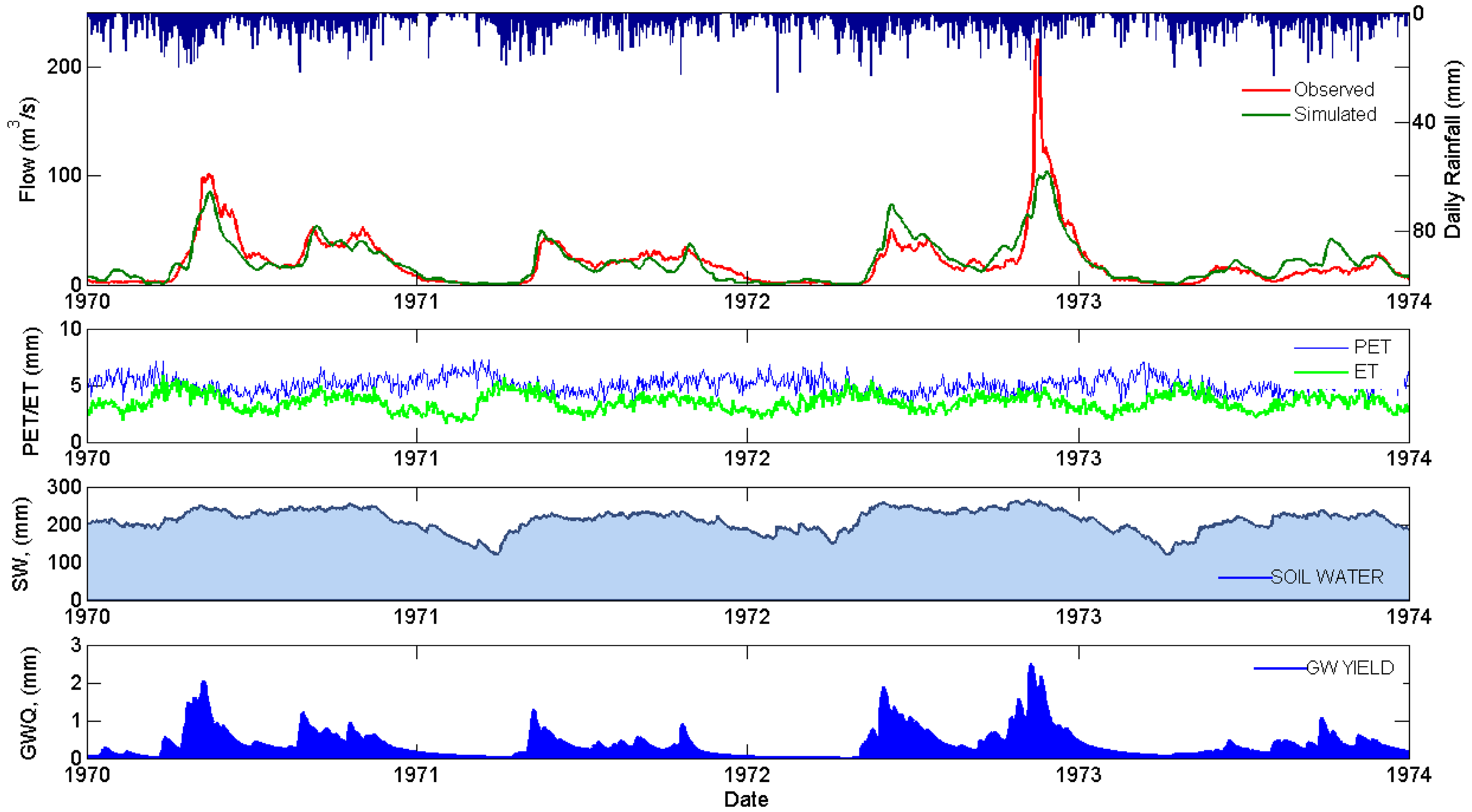

Figure 4. Simulated stream flow, soil water & ground water yield [NSE = 0.77, R^2=0.82]

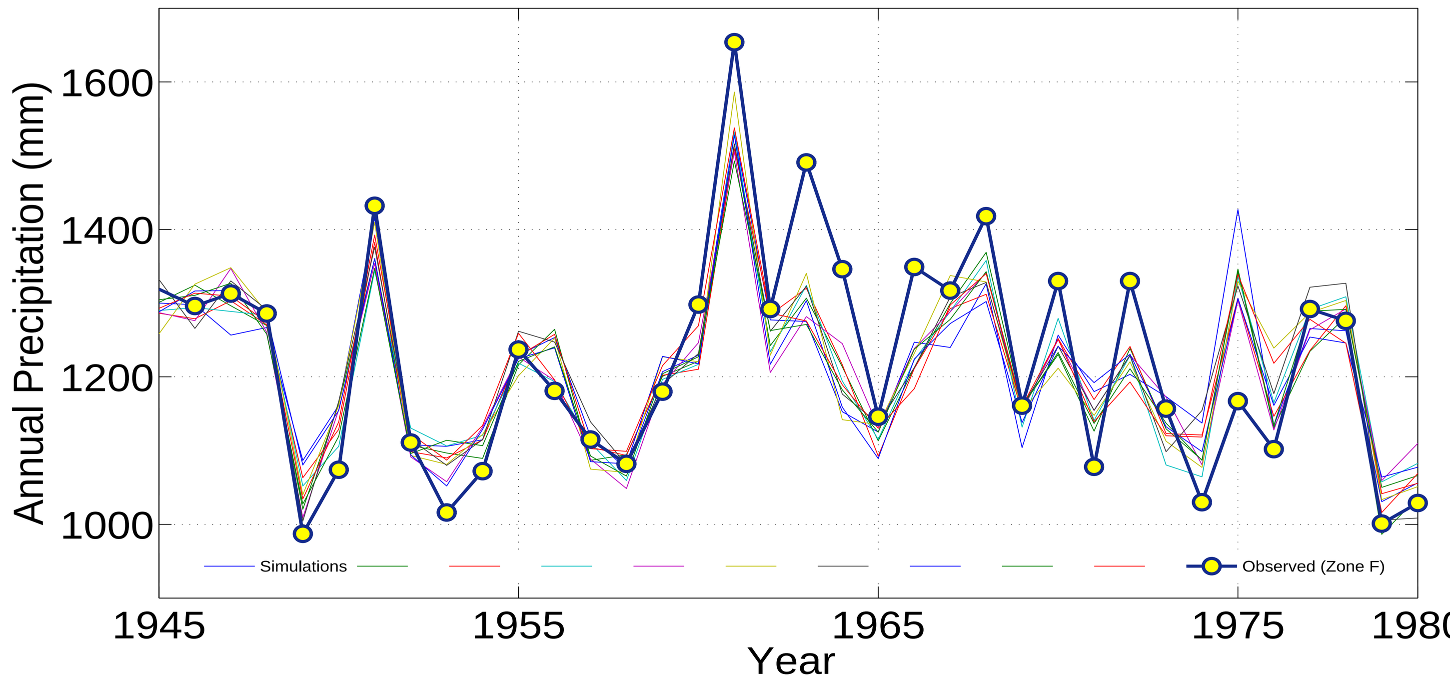

Figure 2. GLM simulations of annual rainfall, Mpologoma

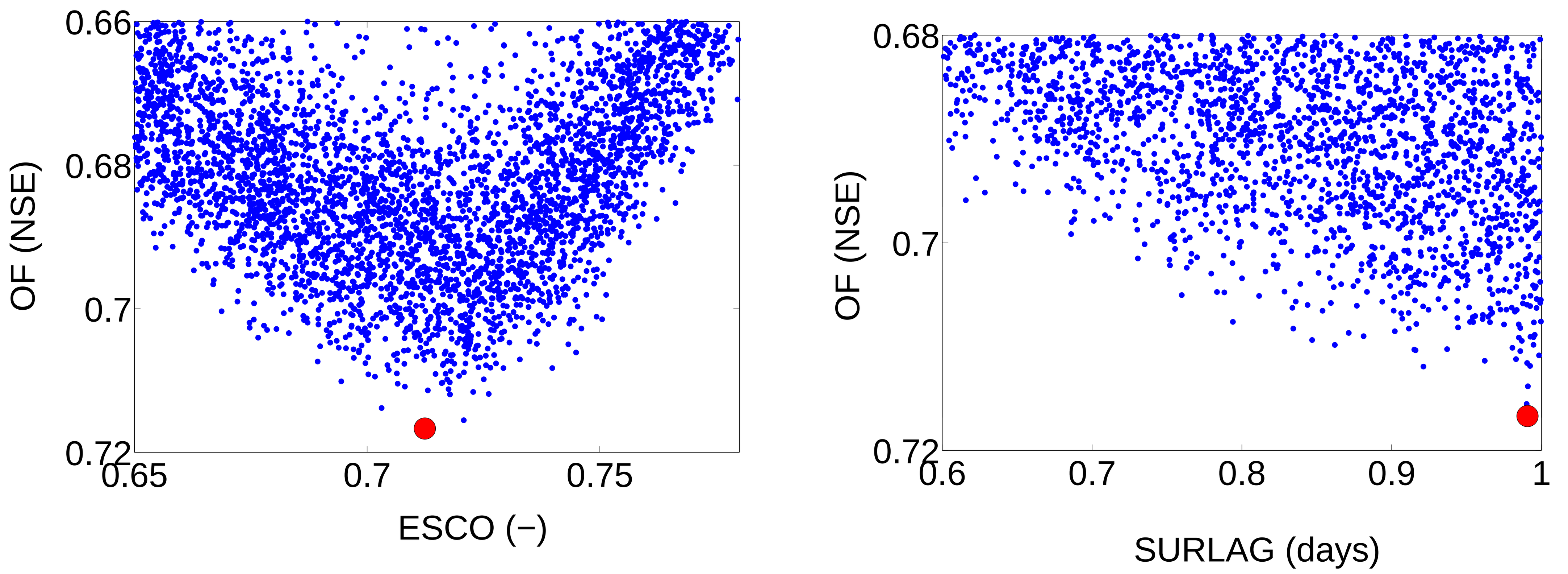

Figure 5. Objective function versus parameter value

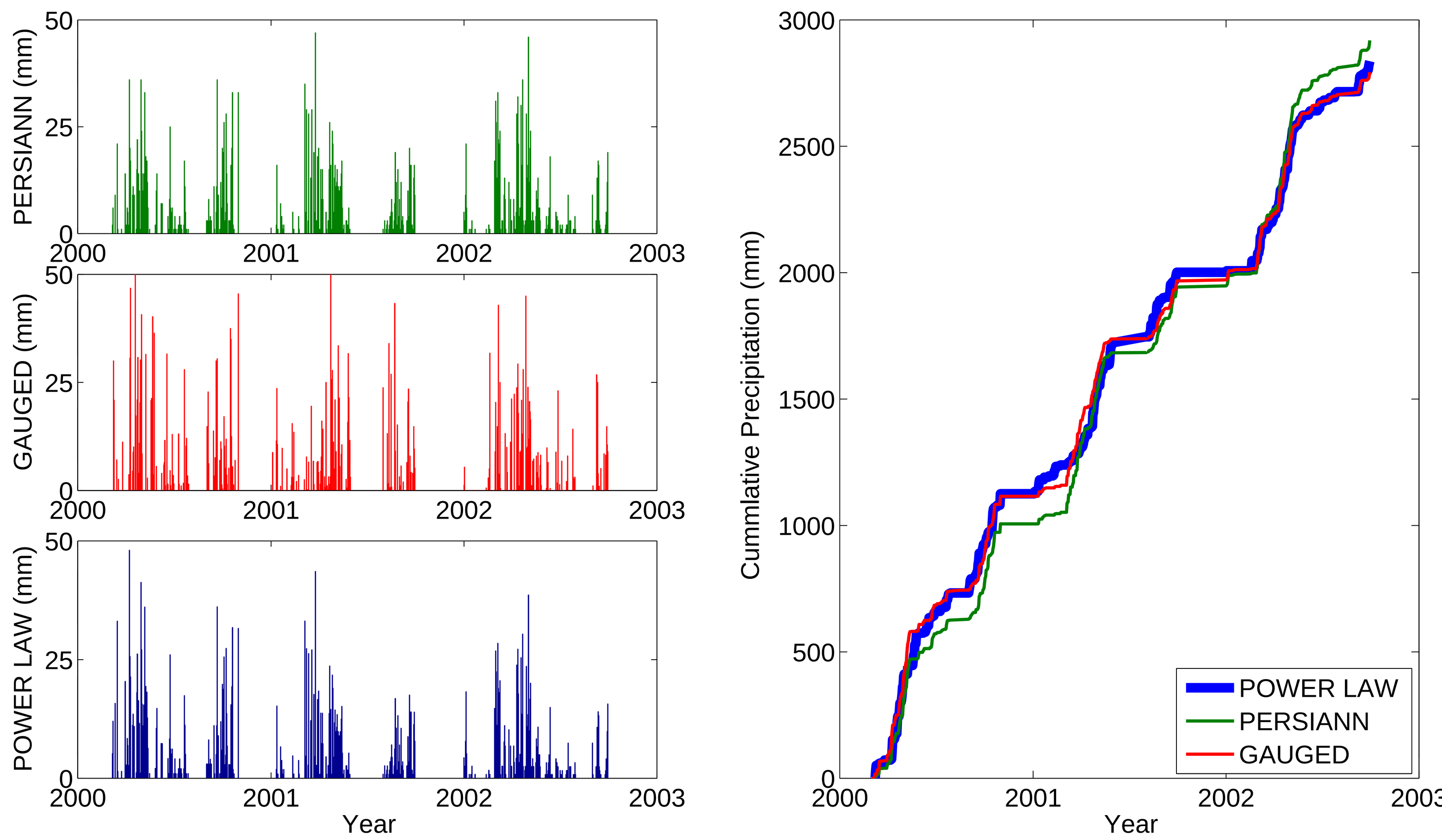

Figure 3. Power law fit to PERSIANN products

Table 1. Calibrated Model Parameters for sub basin within Kyoga basin

Parameter	Units	Definition	Min	Max	Process
CN2	(-)	Runoff Curve Number	35	98	Runoff
SURLAG	(days)	Surface Runoff lag coefficient	0	10	Runoff
CANMX	(mm)	Max water that can be trapped in the canopy when fully developed	0	10	Runoff
EPCO	(-)	Plant uptake compensation factor	0	1	Evaporation
ESCO	(-)	Soil Evaporation compensation coefficient	0	1	Evaporation
CH_K2	(mm/hr)	Effective hydraulic conductivity in main channel	0.01	150	Channel
SLOPE	(m/m)	Average slope steepness in main Channel			Geomorphology
SOL_K	(mm/hr)	Saturated Soil Conductivity	0	100	Soil
SOLAWC	(mm/mm)	Available water capacity of soil layer	0	1	Soil
GWQMN	(mm)	Threshold water depth in shallow aquifer required for return flow	0	5000	Soil
ALPHABF	(days)	Base flow alpha factor	0	1	Groundwater
GWDELAY	(days)	Groundwater delay time	0	50	Groundwater
REVAPMN	(mm)	Threshold depth of water in shallow aquifer for "REVAP" OR - Percolation to the deep aquifer to occur	0	500	Groundwater

References

1. Arnold, J. G., Williams, J. R., Srinivasan, R., and King, K. W. (1996), SWAT. Soil Water Assessment Tool, Report of USDA/Agricultural Research Service and the Texas Agricultural Experiment Station, Blacklands Research Center, Temple, TX.

2. Chandler, R.E., (2006), GLIMCLIM: Generalized linear modelling for daily climate time series: software and user guide. Department of Statistical Science, University College London, Available from: