Identification of the SWAT Model Parameters on the Bani catchment (West Africa) under Limited Data Condition

Jamilatou Chaibou Begou[1], Seifeddine Jomaa[2], Sihem Benabdallah[3], Pibgnina Bazie [4] and Michael Rode[5]

[1] Faculté des Sciences et Techniques, Université d'Abomey-Calavi, Benin and Centre Regional AGRHYMET, Niamey, Niger (jamilabegou@yahoo.fr),
[2] Department of Bioenergy and Department of Aquatic Ecosystem Analysis and Management, Helmholtz Centre for Environmental Research (UFZ), Germany (seifeddine.jomaa@ufz.de),
[3] Centre de Recherche et des Technologies des Eaux (CERTE), Soliman, Tunisia (sihem.benabdallah@certe.rnrt.tn),
[4] Centre Regional AGRHYMET, Niamey, Niger (P.Bazie@agrhymet.ne),
[5] Department of Aquatic Ecosystem Analysis and Management, Helmholtz Centre for Environmental Research (UFZ), Germany (michael.rode@ufz.de).

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1. Introduction and Objectives

- Managing water resources requires reliable data on the resource. It's therefore important to have accurate estimates of hydrologic variables at ungauged sites for water resources planning and management and for ecological studies.
- Prediction in ungauged basins is especially needed in West Africa where: (i) Hydrometric networks are now becoming less dense, (ii) Precipitation and rivers flows have undergone a significant decrease since the seventies and (iii) the economy is largely dependent on rain-fed agriculture which is exposed to climate change impacts.
- Evaluating water resources of ungauged basins in West Africa will help develop irrigated agriculture, which has become a key alternative solution to ensure food security to the population and reduce its vulnerability to climate change.
- **The main objective** of this study is to evaluate water resources of many ungauged basins in West Africa and bring assistance to the process of adaptation to climate change at local, national and regional levels. The specific objectives are to:
  - Calibrate the SWAT model on many reference basins where data are available and identify sets of parameters that best represent basins response;
  - Regionalize model parameters in order to simulate discharge of ungauged basins.
- To this end, the SWAT model was calibrated on the Bani catchment and its most sensitive parameters were determined.

2. Material and methods

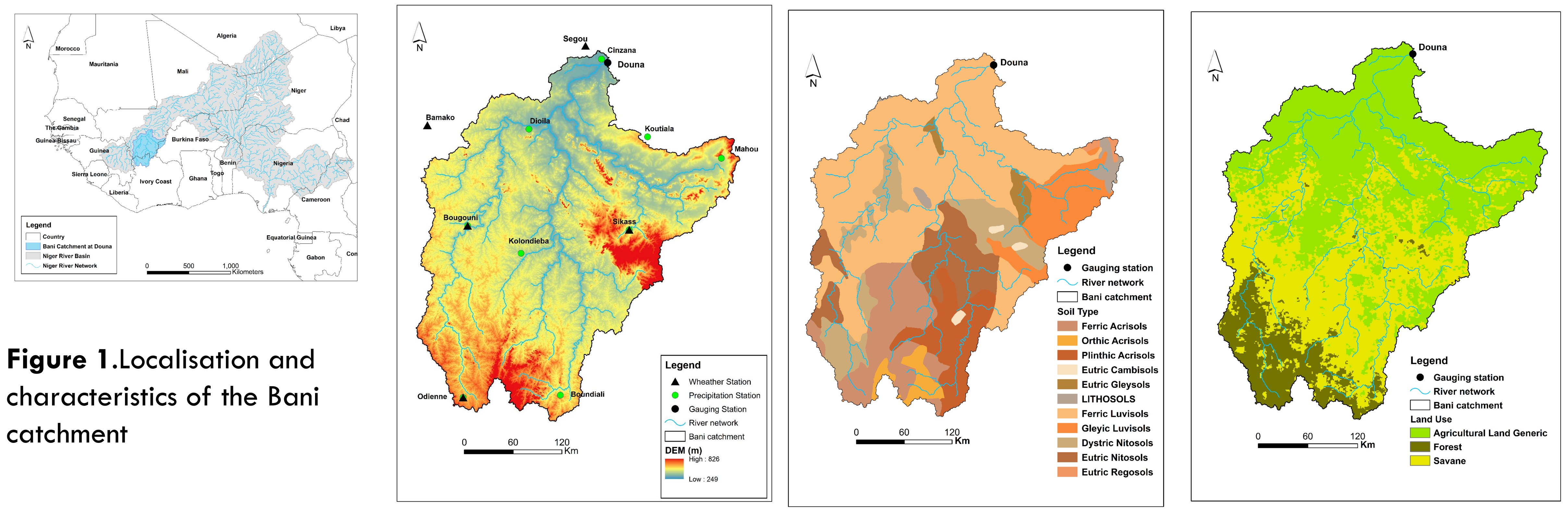

Figure 1.Localisation and characteristics of the Bani catchment

- Catchment: Bani
- Area: 100,000 Km²
- Average annual precipitation: 1050 mm
- Average annual PET: 1930 mm
- Average annual discharge: 184 m³ s⁻¹
- Outlet: Douna

Material

- Model: SWAT (Arnold *et al.*, 1998);
- Hydrosheds conditioned DEM (90 m);
- Hydrosheds river network (500 m);
- Water Base land use map (400 m),
- FAO Soil Map (scale of 1:5 000 000);
- Daily measured rainfall;
- Daily measured maximum and minimum temperature;
- Daily observed discharge.

Methods

- 1- Setup of the SWAT2012 model on the Bani catchment;
- 2- Application of the baseflow filter to determine the Alpha Factor;
- 3- Semi-automated calibration within SWATCUP using GLUE
  - Number of simulations: 10,000;
  - Warm-up period (2 years): 1981-1982;
  - Calibration period (10 years): 1983-1992;
  - Validation period (5 years): 1993-1997;
  - Sensitivity analysis: global sensitivity analysis;
  - Number of calibrated parameters: 11.

3. Results

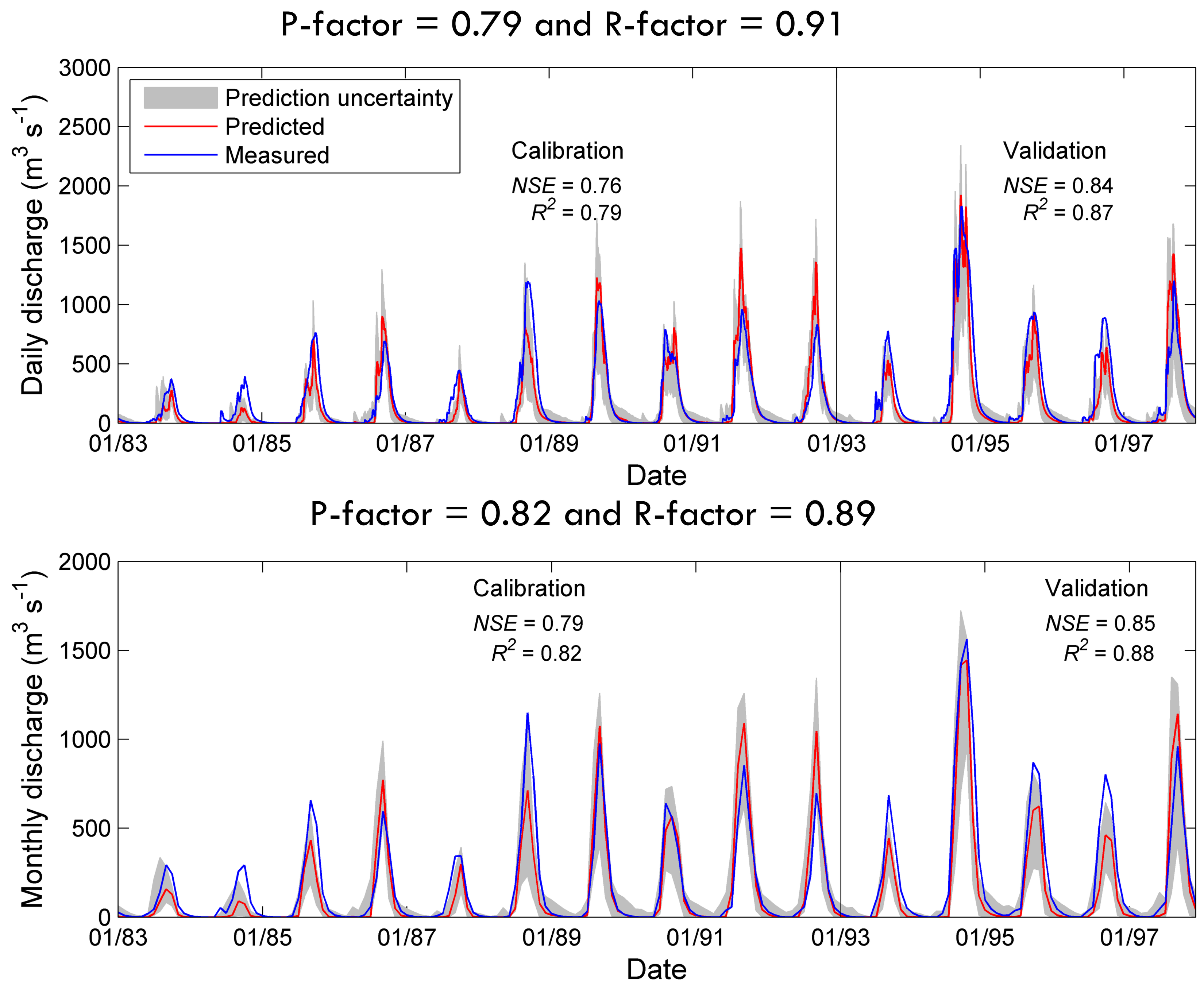

Figure 2 Predicted and observed hydrographs at Douna at daily and monthly time steps.

Table 1. The most sensitive SWAT paramters

Parameter	Description and its calibration range
CN2	Curve number II (20%)
ESCO	Soil evaporation compensation factor (0.01-1)
SURLAG	Surface runoff lag coefficient (0.05-24)
OV_N	Manning's "n" value for overland flow (0.01-30)

Uncertainty analysis

P-factorday: 0.79
R-factorday: 0.91

P-factormonth = 0.82
R-factormonth = 0.89

4. Conclusions

- Results showed that the model performance can be judged as very good (Moriasi *et al.*, 2007) especially considering limited data condition and high climate, land use and soil type variabilities in the studied basin (Figure 1).
- Prediction uncertainty is acceptable: most of the observed data (around 80%) are bracketed by the 95PPU within an acceptable width (R-factor < 1). However, model is characterized by more prediction uncertainties during high flows (Figure 2).
- The most sensitive parameters are mostly related to surface runoff reflecting the dominance of this process on the streamflow generation (Table 1).

References

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