

Validation of the SWAT model regarding the rainfall-runoff process in the Upper Ouémé catchment area: case of Terou-Igbomakoro basin

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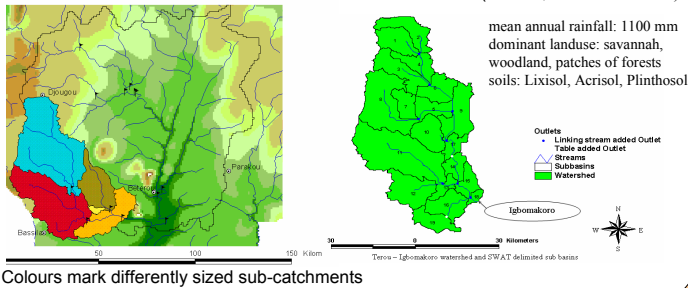
INTRODUCTION

The main task of the hydrological subproject A2 of IMPETUS is the description and quantification of the hydrological processes at different scales in Benin. The goal is to provide a hydrological modelling tool for a scenario analysis for evaluating environmental and climate change effects on catchment hydrology.

The objective of this study is to adapt and validate the SWAT (SOIL & WATER ASSESSMENT TOOL) model for the rainfall-runoff process in the Terou basin, by assessing / predicting surface runoff volume, the discharge (rate) and sediments loadings per land use in Terou catchment.

THE RESEARCH AREA

The size of the catchments investigated by IMPETUS range from local to regional scale (from 3 to 15.000 km²). The focus of this study is the Terou-Igbomakoro basin (2305 km²). In future, the SWAT model will be applied to the whole Terou (Wanou, about 3100 km²).



SWAT MODEL

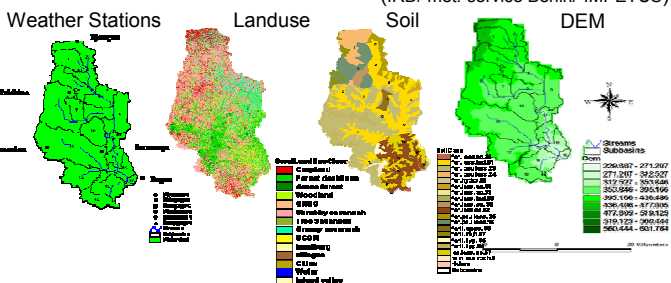
SWAT is a hydrologic / water quality model developed by the United States Department of Agriculture - Agricultural Research Service (USDA-ARS) (Arnold et al., 1998). It is a continuous time model that operates on a daily time step. The objective of the model development was to predict the impact of management on water, sediment, and agricultural chemical yields in large ungauged basins. Therefore, the model:

- ✓ is physically based;
- ✓ uses readily available inputs;
- ✓ is computationally efficient to operate on large basins in a reasonable time;
- ✓ is continuous in time and capable of simulating long periods for computing the effects of management changes.

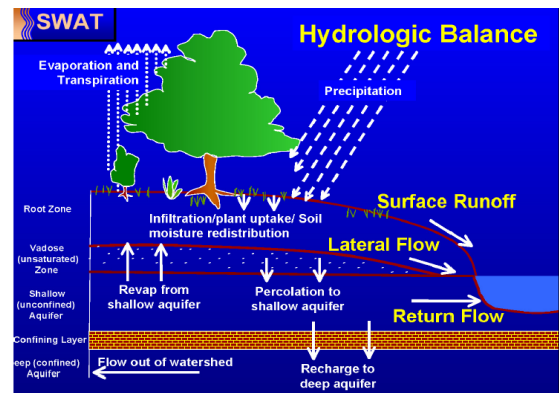
Runoff was assessed by the SCS curve number procedure and erosion by the MUSLE approach (Williams 1975). SWAT was built with state-of-the-art components with an attempt to simulate the processes physically and realistically.

Hydro GIS – Model input data

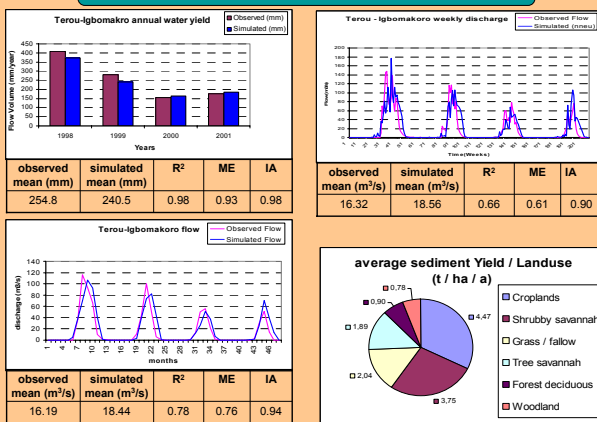
- Digital elevation model 50m pixel.
- Landuse 30m pixel (RSRG / IMPETUS).
- Soil map 1:200.000
- Weather/Climate: 6 stations (IRD/ met. service Bénin/ IMPETUS)



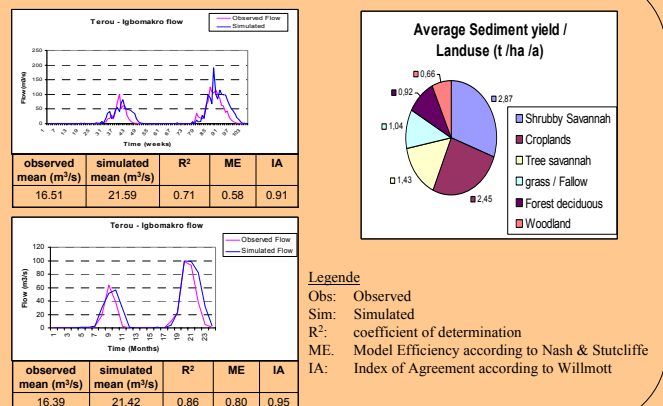
- Discharge gauging stations (IRD and DH)
- IMPETUS-measurements (climate, soils, vegetation, topography, hydrogeology)



CALIBRATION RESULTS (Period 1998 – 2001)



VALIDATION RESULTS (Period 2002 – 2003)



CONCLUSION

During calibration step, the flow volume matched well with the measured flow at annual, monthly and weekly scales. Annual simulated volume was slightly under predicted (240.5 mm versus 254.8 mm of observed), while during validation period it was overpredicted. However, all the statistics reveal a high model quality for both periods. These results give evidence, that the hydrological processes in Terou_Igbomakoro basin are modelled realistically by SWAT. A mean erosion rate of 4.47 t/ha/year in croplands; 2.04 t/ha/year in fallow lands, and a mean value of 2.3 t/ha/year for the whole catchment was computed during calibration period. Due to lack of data a validation of the erosion model is still pending.