Modeling of the hydrology and nitrogen fluxes in a regulated semi-arid catchment using SWAT model: the Tafna River (North-West Algeria)

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Introduction:

As in most Mediterranean countries water management is an acute problem. In Algeria, the water issues are posed for a long time to authorities and management agencies. Indeed the competition between agriculture, industry and drinking water supply for accessing to this resource with a pronounced drought have shown how necessary it was to give greater attention to water (Remini, 2005). In recent decades, the population explosions, the development of industry and agriculture have modified the biogeochemical cycle of nitrogen to increase nitrates in waters (Taleb, 2004), which was observed a slow but inexorable rise and without a primer stabilization of nitrate content of ground and surface water in some regions (Taleb et al. 2008). Nitrate pollution is associated to the development of farms, excessive fertilization of agricultural areas, waste (organic, minerals ...) and even the sewage sludge by oxidation of organic nitrogen and ammonia to nitrate (Boualla et al, 2011).

By applying agro-hydro environmental model SWAT (Soil and Water Assessment Tool), **the main objective** of this study is to evaluate and quantify the impact of current agricultural practices on the surface water quality, particularly nitrates as 40 to 80% are present in the water systems and come from agriculture especially fertilizer surplus (Isermann, 1990; Kronvang et al, 1995).

Study area:

The basin of wadi Tafna is located in North-West of Algeria (Figure 1). The elevation in Tafna varies from sea level to 1100 m, with a drainage area of 7 200 km^2. This watershed drains a semi-arid region, where annual average precipitations is lower than 300 mm and exceeded by the evaporation loss most of the year. The daily discharge in the estuary varies from 0 to 107.7997 m^3 / s. Five reservoirs exist in the catchment (the stored volume vary between 15 and 177 million m^3)

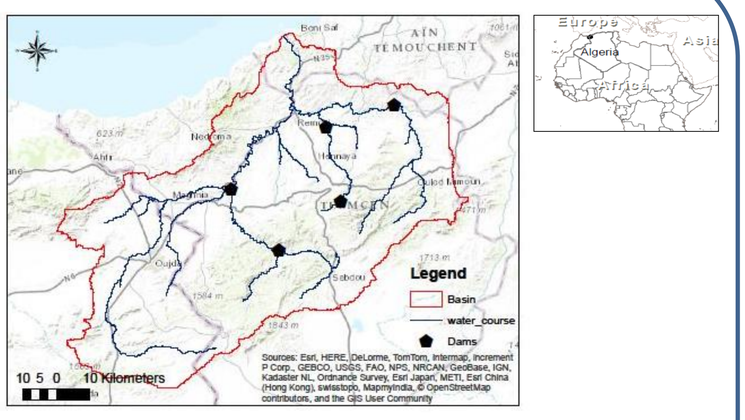

Figure 1. Tafna catchment localization.

Data used to build the SWAT project

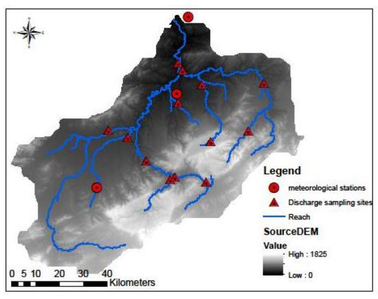

Figure 2 Digital Elevation Model (DEM) 25 m × 25 m.

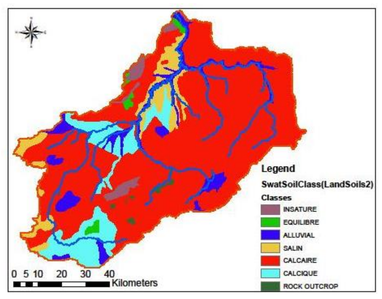

Figure 3. Soil map (soil map of Algeria, 1952.Durand, 1954).

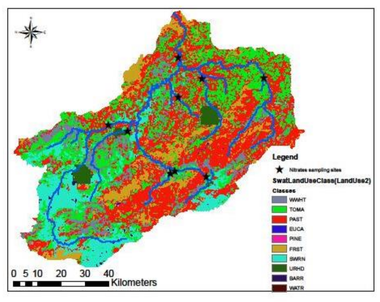

Figure 4. Land use map.

- The daily climate data (precipitation, humidity, wind speed and temperature) of 3 Stations Oujda (in Morocco), Zenta and Beni Saf (in Algeria) from 1/1/2000 to 12/31/2013.

We also grouped:

- The daily flow rates of 13 stations from September 2000 to August 2013 (National Agency for water resources)
- The monthly concentrations of surface water Nitrates of 8 stations (National Agency for water resources) from January 2007 to December 2011 and in 16 stations the concentrations of nitrates in surface water from December 2012 to February 2014.

Results and Discussion:

The monthly discharge simulation of 4 stations shows a good agreement with the observations. The Nash index ranges from 0.71 to 0.85.

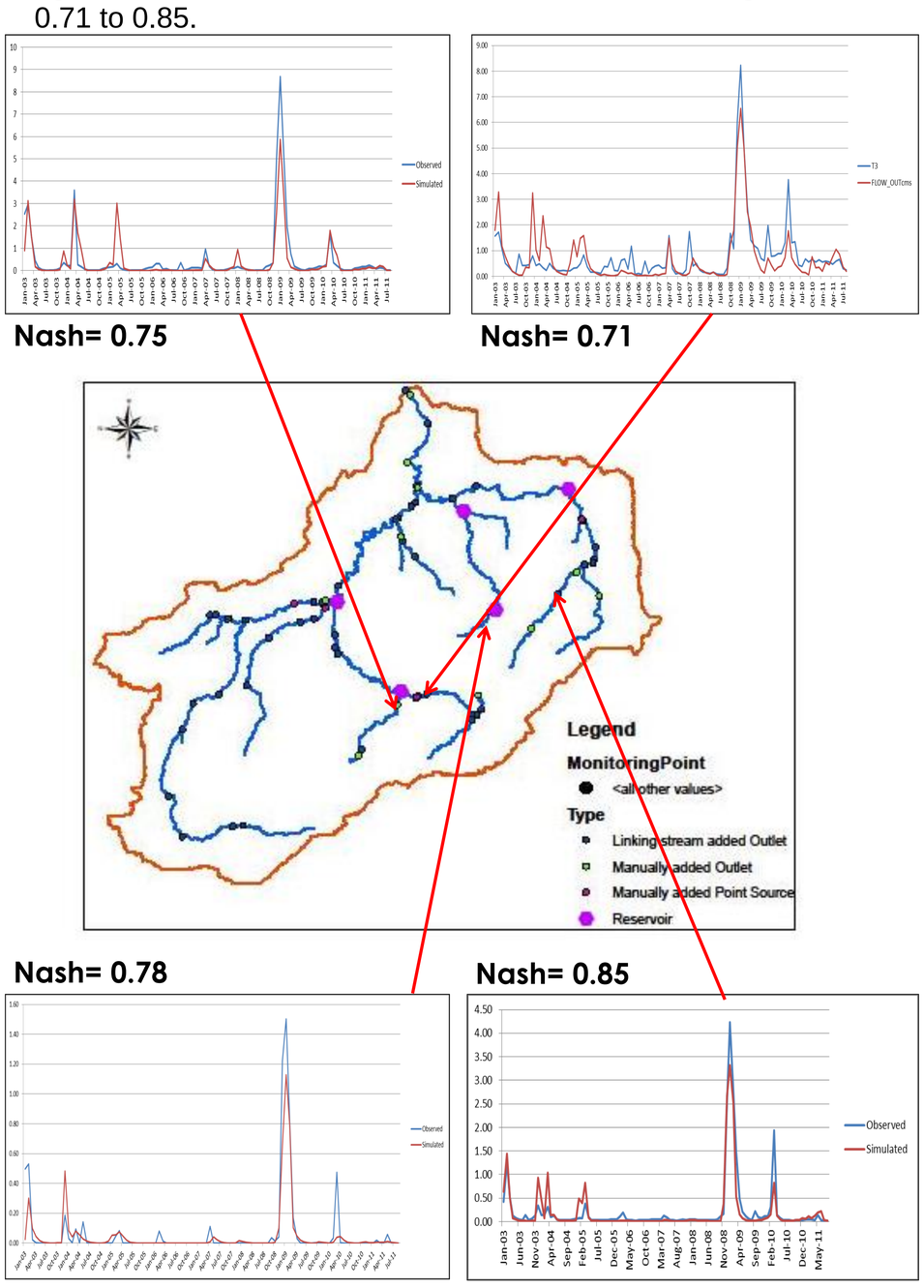

Figure 5: Monthly observed and simulated flow for 4 stations (m^3 / s)

Although we are in progress and the project has not yet expired, the first results are encouraging and we can see a compatibility between the observed and simulated values, and in our project we are in full preparation for the calibration of flow rates, to pass to calibration step of the nitrates flow in the coming months.

Conclusion

The solutions proposed by the SWAT model are interesting and the results suggest a good efficiency of the model to simulate water and nitrate transfers in wadi systems and the dams impact. Then we will have to simulate all the watershed including dams functioning before simulated in the last step nitrates dynamic.

Finally, the model could serve as a valuable support for the authorities to better manage watersheds which facilitates understanding of the land use impacts on water quality.

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