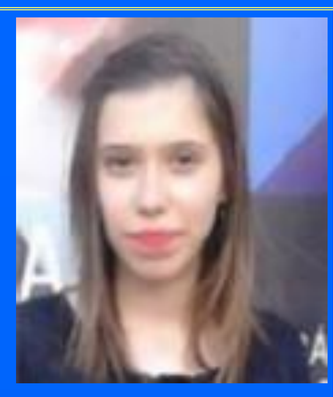
Analysis of climate change on Portuguese watersheds



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Introduction

Climate change has been studied in the last years as potential drive for hydrological alterations, with several environmental impacts such as changing precipitation, evapotranspiration, weather events, reducing snowfall and ice regions (Pumo *et al*., 2016; Viola *et al*., 2017). Water resources constitute national strategic reserves, being fundamental for the subsistence of populations and growth of the economy. Climate change has also considerable impacts on the environment at a global level, affecting the different components of the hydrological cycle that is in terms of water resources quantity and quality. On the other hand, the urbanization process and the land use also significantly contribute to the hydrological changes. Urban population is growing worldwide particularly due to the increased migration fluxes towards urbanized areas (Pumo *et al*. 2017), placing additional stress on the land-use planning policies. So, it is imperative to develop scenarios along sensitive watersheds, oriented towards the data production, which improve the knowledge of systems response. Currently, hydrological simulation models are increasingly used to study and address various problems related to water availability, in quantity and quality. The use of these models aims to obtain solutions regarding the best practices to be adopted in the management of water resources. Additionally, the models also devise the landscape long term changes and in water availability, due to climate change. Therefore, in recent decades, several hydrological simulation models have been developed (Bieger *et al*., 2017).

In the present work it is intended to assess the effect of climate change and land use (or land cover) dynamics on the surface masses existing in Portugal, which are the predominant origin for drinking water, used for domestic and industrial consumption. To achieve the objective, numerical modelling is applied, through dynamic models to test scenarios, involving the analysis of a wide range of parameters such as soil, vegetation, sunlight exposure, precipitation, water pH, temperature, dissolved oxygen and other, in Portuguese hydrographic basin.

Materials and Methods

In this study, it was used the computational code SWAT (Soil & Water Assessment Tool), which is a semi-distributed physically based model of watershed in daily, monthly and yearly calculations. It allows to simulate the quality and quantity of surface and groundwater as well as predict the environmental impact of land use, land management practices and climate change (Gassman *et al.,* 2007, Bieger *et al.,* 2017). For SWAT model calibration and validation, it was used a minimum of 15 years datasets, where the first 10 years were used as calibration data and the remaining 5 years were used to validate the model outputs (Figure 1).

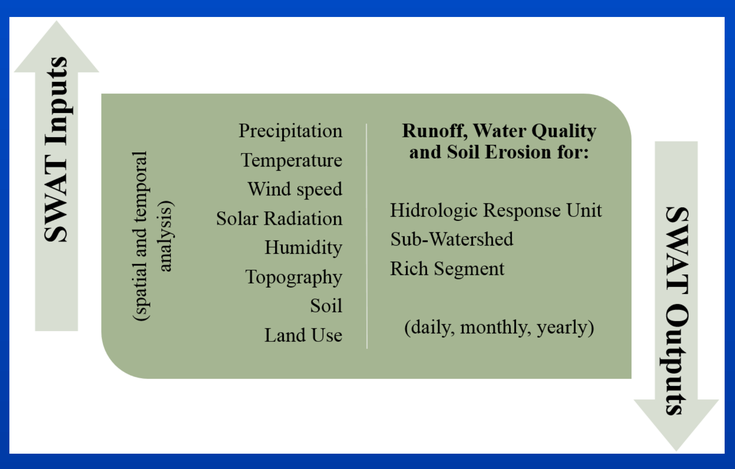

Figure 1: SWAT data Inputs and Outputs

The study was carried out in the Sorraia River (Southern Portugal) over an area of ~7730 km^2 and a longitudinal maximum length of ~155 km (Figure 2). In the region, the climate is dry sub-humid, with hot and dry summers and mild and wet winters. The annual precipitation varied from 200 to 900 mm, with the average of ~500 mm and a mean annual surface air temperature round the ~15ºC, varying from ~9 to 22ºC (Almeida *et al*., 2018).

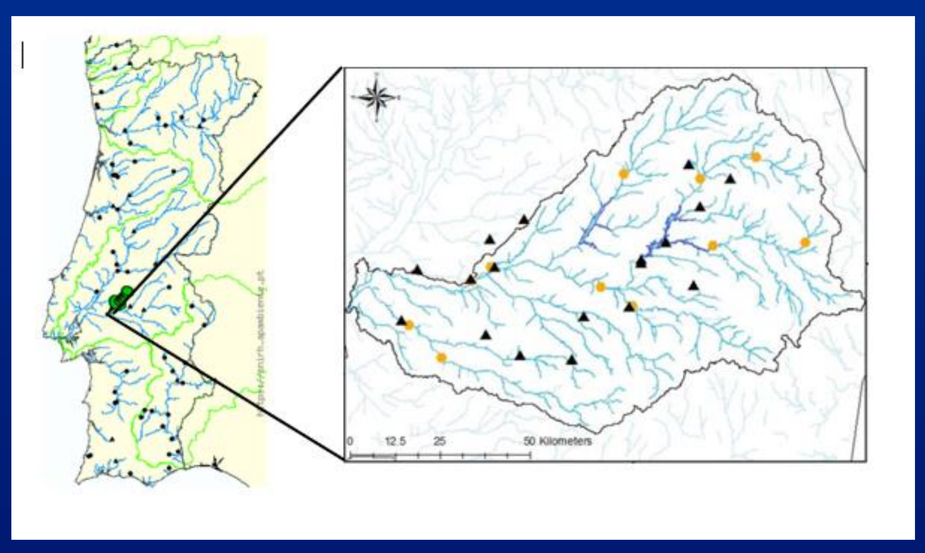

Figure 2: Sorraia River Watershead (adapted from Almeida *et al.*, 2018 and SNIRH, 2021)

Results & Discussion

The modelling approach developed in this work highlighted possible cumulative impacts of future climatic changes in the Sorraia River basin (Figure 3).

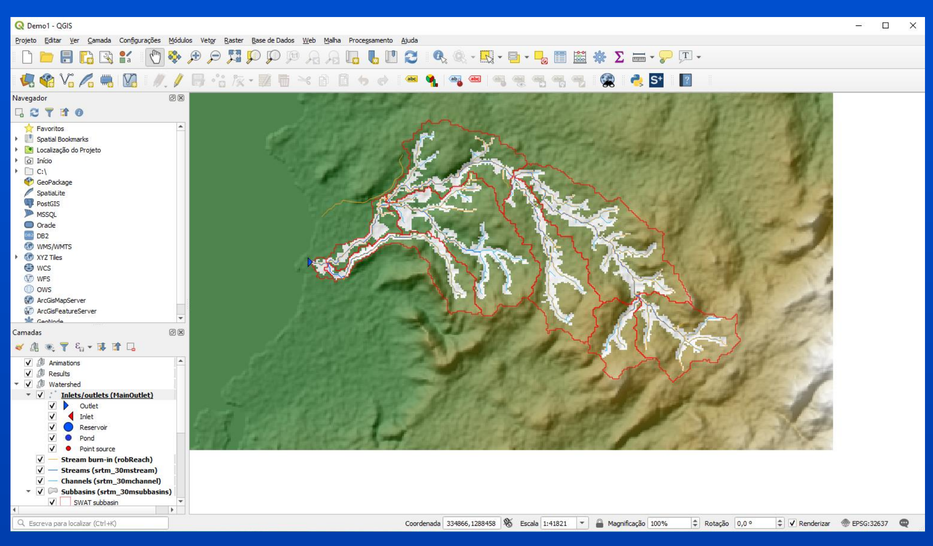

Figure 3: Simulation in the SWAT Model

It is expected a significant decrease in precipitation in the watershed for the near future. This decrease can lead to an increase in irrigation and fertilization needs over Sorraia River basin. The water quantity is predicted to fall, while water quality shows an unbalanced deterioration, with nutrient concentrations predicted to increase, due to the increased use of chemical fertilizers and decrease in water availability in rivers.

According to Almeida *et al*. (2018) the climate change plays an important role in affecting the quantity and quality of water in the study basin. They can be considered as a starting point for the definition and implementation of hydrological management plans that allow for the neutralization of negative impacts. The SWAT model can be further explored to test the effects of management practices and the degree of stress they introduce on the environment, thereby contributing to a cost-effective adaptive management practice.

Conclusions

Preliminary results revealed the influence of climatic change in the precipitation. Therefore, it is expected that the development of this study, using the SWAT model, may have a significant contribution to discovering the best practices in the management of water resources. The present work is still under development.

References

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