Combined effects of climate and land use change on hydrological alteration of a Mediterranean catchment: case study of the Siliana catchment in Tunisia

ELI DAY

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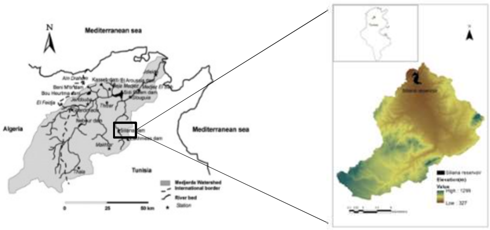
Introduction

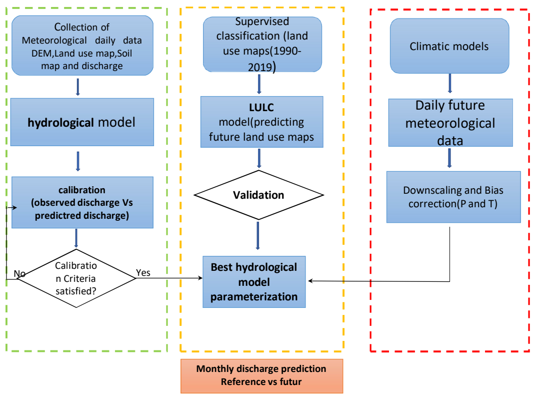


Siliana catchment reached an increasingly sever water stress in recent years, and a high vulnerability to climate change and land use change .

Objectives

- Assessing the performances of the SWAT model in simulating the hydrology of a Siliana catchment
- Assessing the hydrological impacts of LU and CC in the Siliana catchment
- Quantification of the total uncertainty associated with the combined impacts of land use and climate change

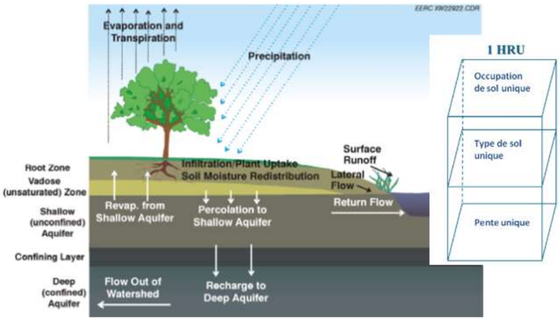
Methodology



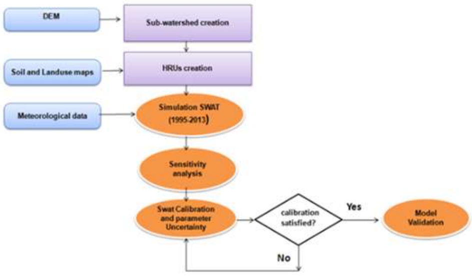
Hydrological modelling methodology

SWAT

(Soil and Water Assessment Tools (Arnold et al., 1998)



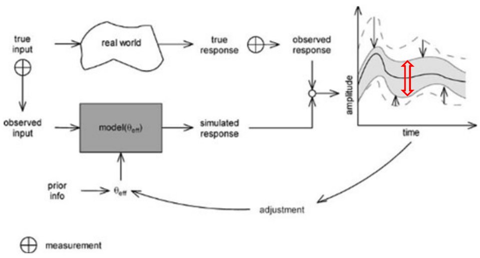
Hydrological modelling methodology



Flowchart of the general modelling approach

Uncertainty analysis

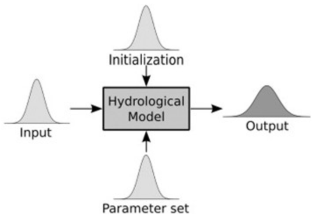
General uncertainty estimation process



Sellami et al,2014

Uncertainty analysis

Source of uncertainty



Sellami et al,2014

Uncertainty analysis

- Nash and Sutcliffe (1969)

O_i =débit observé ; $\bar{O}$=moyenne des O_i ; P_i = le débit simulé

$$NS = 1 - \frac{\sum_{i=1}^{n}(P_i - O_i)^2}{\sum_{i=1}^{n}(O_i - \bar{O})^2}$$

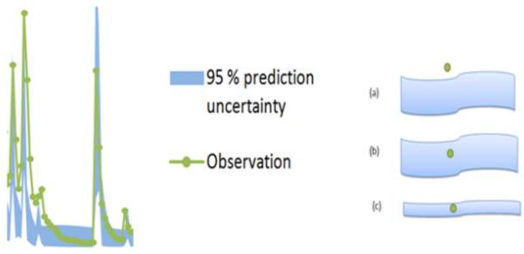
- P factor : Percentage of observation data bracketed in the uncertainty interval

$$\mathbf{P} = \frac{NQ_{in}}{n} \times 100$$

- R factor :Relative width of the uncertainty interval

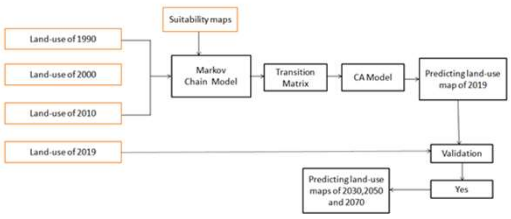
$$\mathbf{R} = \frac{\frac{1}{n}\sum(Q^M - Q^M)}{\sigma_{obs}}$$

Uncertainty process



Ideal situation **: Max(NS) with Max(P-factor) with Min(r-factor).**

Future land use change methodology

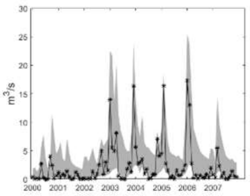


Markov modelling steps to achieve simulated LULC of 2030,2050 and 2070

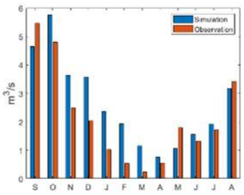
Hydrological modelling results

Classement par	Parameter (unit)
1	**CN2 ()**
2	**ESCO()**
3	**Alpha_BF(j)**
4	**SOL_K(mm/h)**
5	**EPCO()**
6	**GWQMN(mm)**
7	**SURLAG(j)**
8	**SOL_AWC()**

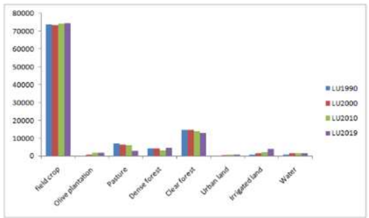
Hydrological modelling results



GLUE prediction uncertainty bounds for
Siliana catchment(2000-2007)

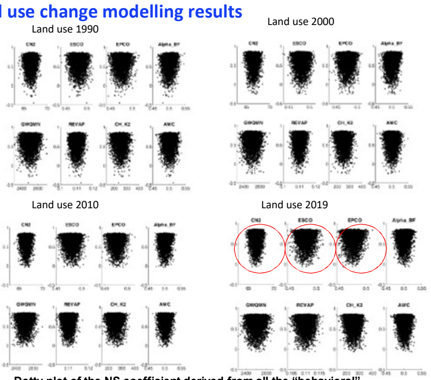


Land use change modelling results



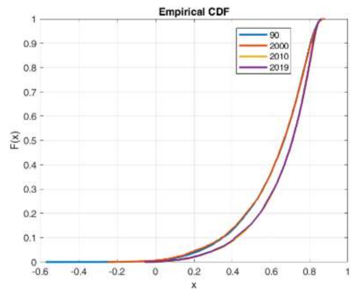
Land uses categories' changes corresponding to different scenarios at Siliana catchment

Land use change modelling results



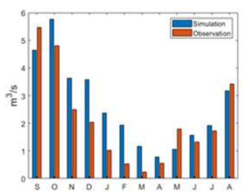
Dotty plot of the NS coefficient derived from all the "behavioral" GLUE runs for the Siliana catchment

Land use change modelling results

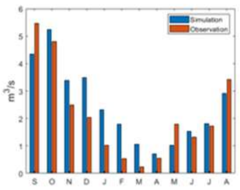


Land use change modelling results

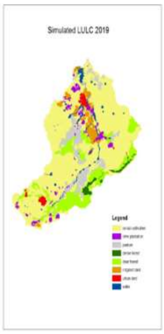
Land use 1990

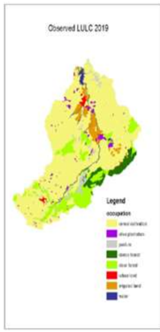


Land use 2019



Future land use change results

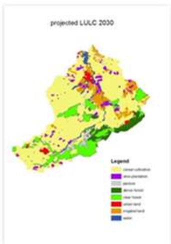


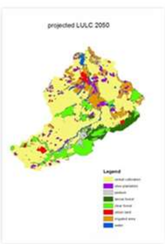


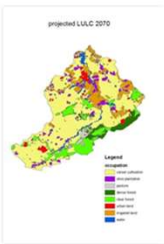
Kappa coefficient=0.79

- Poor agreement: < 0,20
- Fair agreement: 0,20 à 0,40
- Moderate agreement: 0,40 à 0,60
- Good agreement: 0,60 à 0,80
- Very good agreement: 0.80 à 1.00

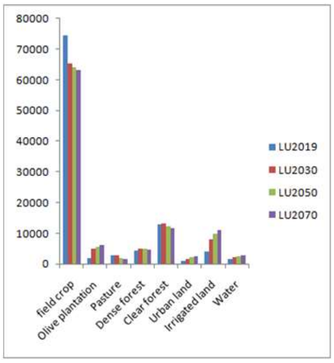
Future land use change results



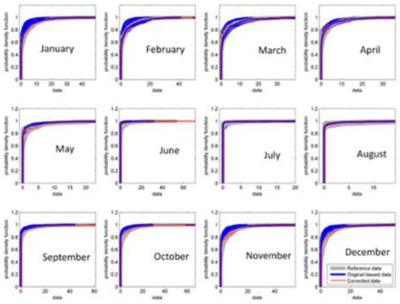




Future land use change results

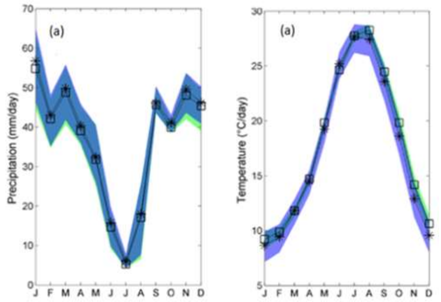


Climate models auditing results



Comparison of CDFs of original biased, bias corrected as simulated by the Climate model ensemble and observations of monthly precipitation

Climate models auditing results



Climate models bias corrected simulations versus measurements for monthly precipitation and temperature for the Siliana

In summary

- Hydrological models are valuables tools to assess water resources management.
- Uncertainty within model output is a major concern, particularly when modeling results are used to set policy.
- Some measurements can reduce the uncertainty of some parameters (e.g. soil parameter: land cover map updates).
- The combination of Markov and CA was reasonably accurate for projecting future LULC since it produed a kappa coefficient over 60%.
- The Siliana watershed is likely to experience drier and warmer conditions in the future.Climate models project a general decrease in precipitation and increase in temperature.

Thank you