

Modeling the response of non-perennial streams to climate change impact: The Bouregreg watershed in Morocco

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Objectives

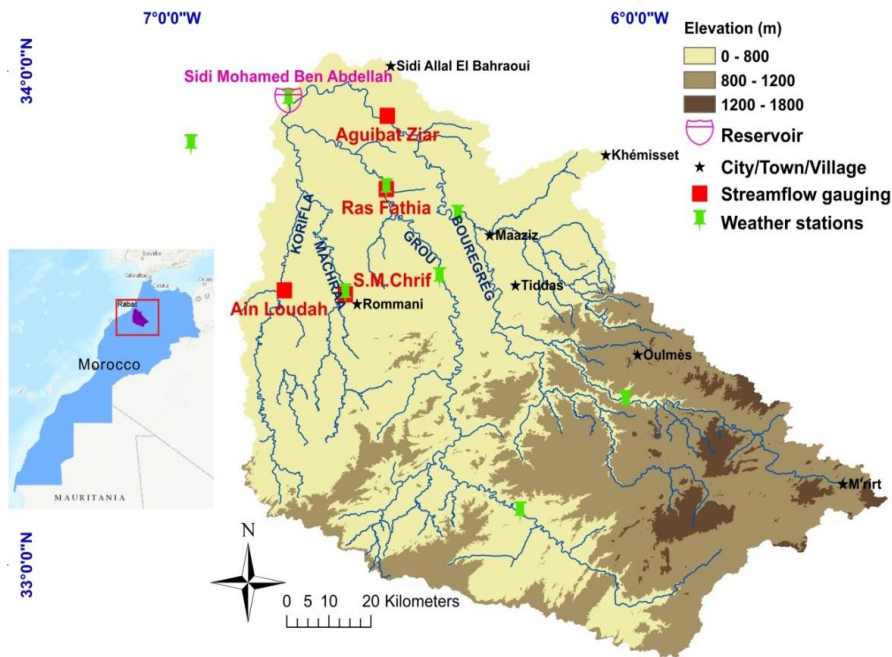
General objective

- To identify the impact of climate change on the flows regime of the river network in one of the strategic watersheds in Morocco, Bouregreg watershed (BW)

The specific objectives

- to investigate potential changes in terms of climate patterns over BW at mid and end-century
- to assess flow regime alterations by evaluating streams responses to future climate
- to discuss the potential ecological consequences of flows alterations in the study area

Study area



Drainage area 9656km²

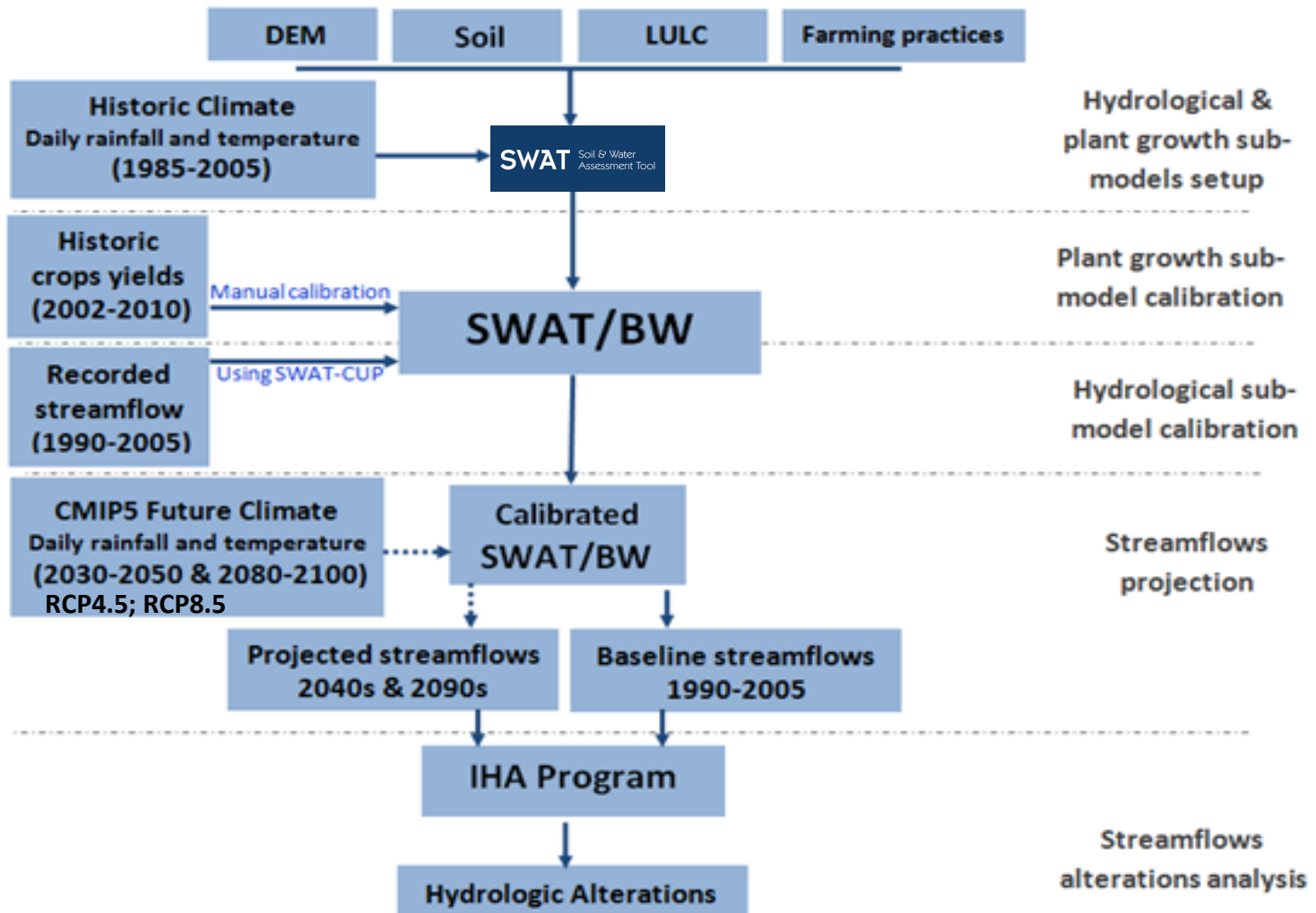
Land use: pasture and rangelands (30%), oak forest (24%), and bare land (14%), farming (rainfed winter wheat, pulses and olive trees, 28%)

The Bouregreg watershed (BW), North-West Morocco

The stream network is composed of four non-perennial rivers: Korifla, Grou, Machraa and Bouregreg rivers

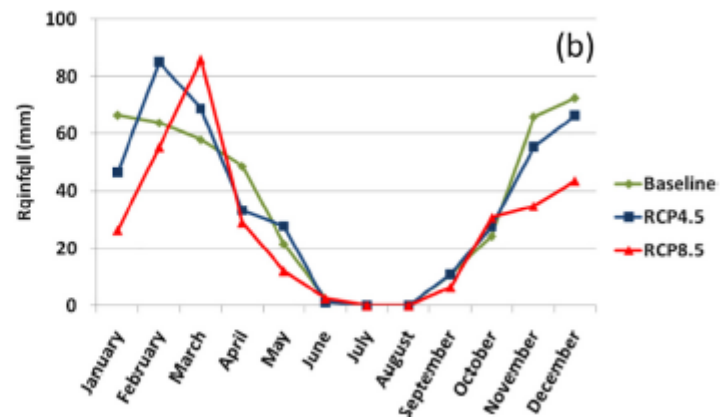
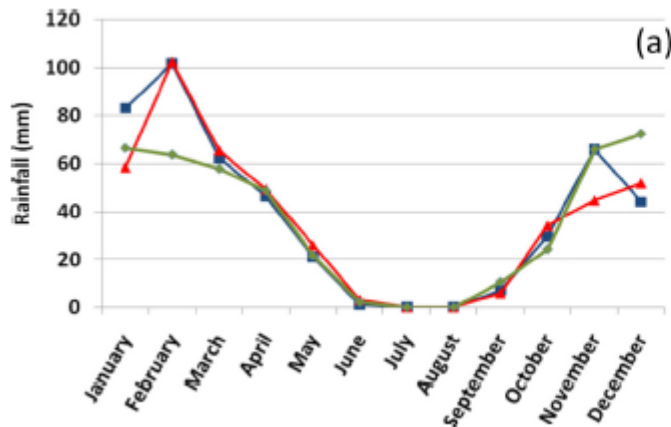
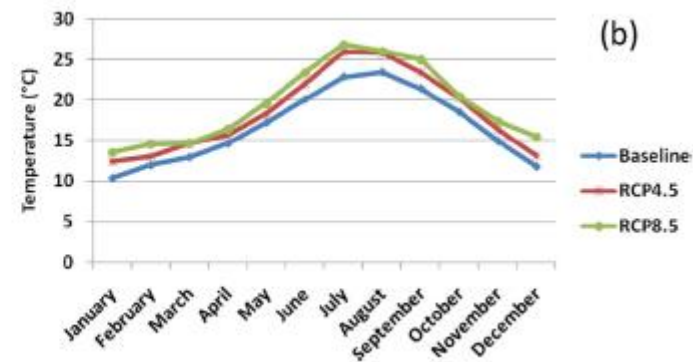
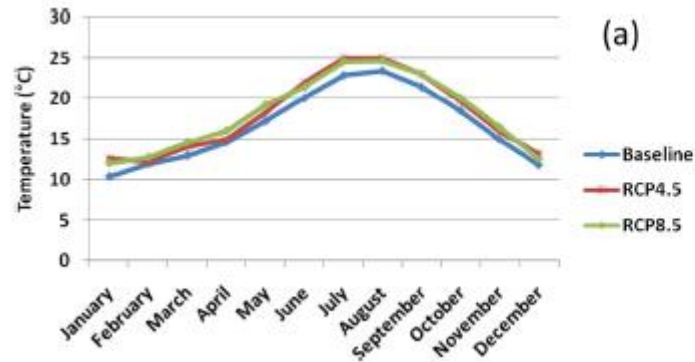
It provides drinking water to a quarter of Morocco's population (Rabat, Casablanca and Kenitra regions),

Methods



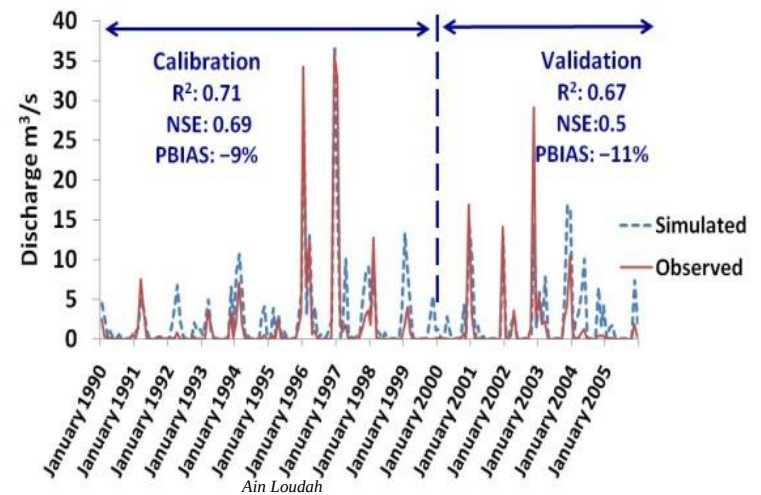
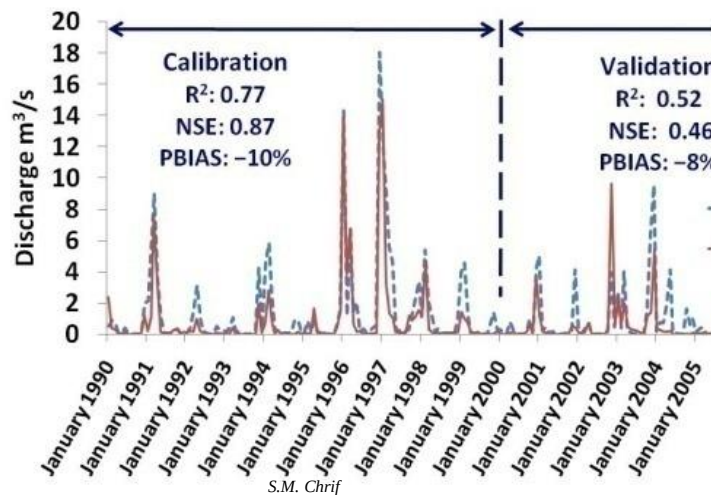
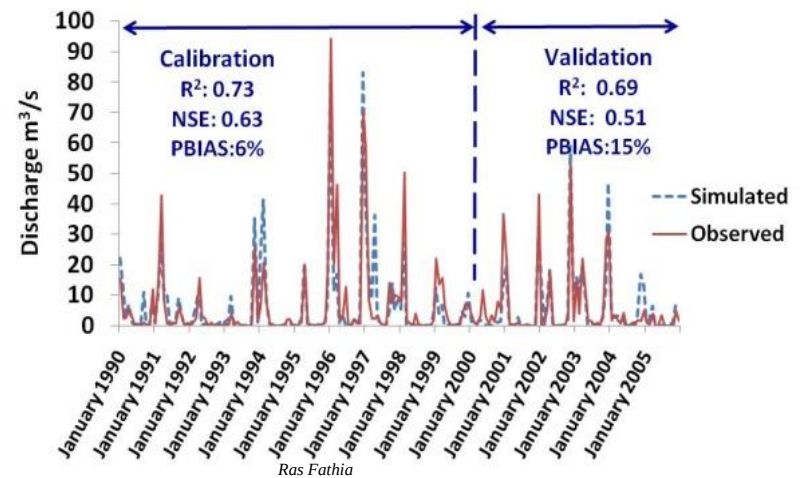
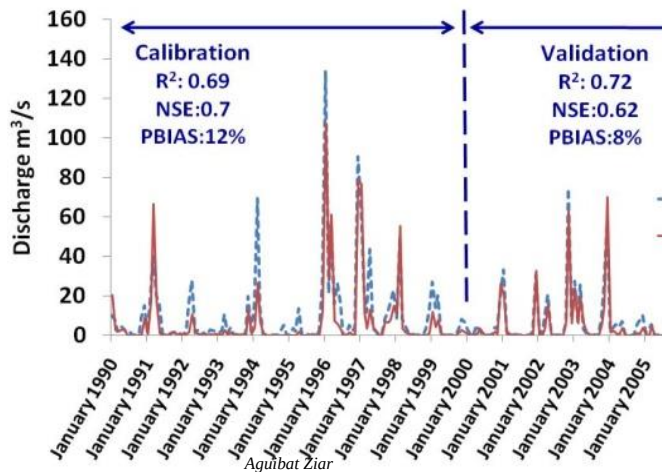
Results

- Mean temperature has been predicted to increase by up to 2.79 °C in the 2090s (RCP8.5), and a higher variability in rainfall regime is expected.



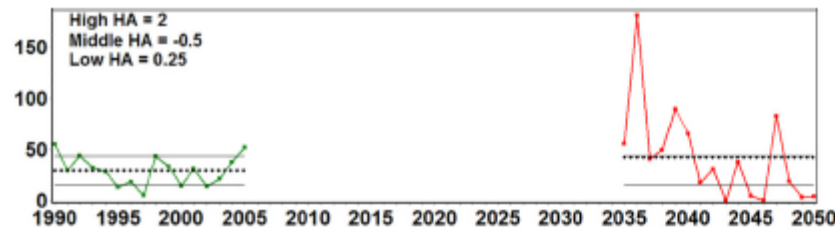
Results

- SWAT Model performances in simulating streamflow at the four gauging stations is satisfactory

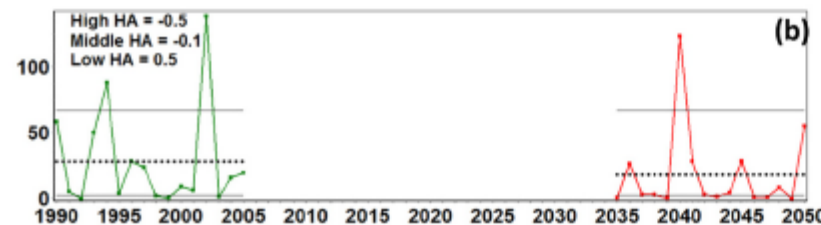


Results

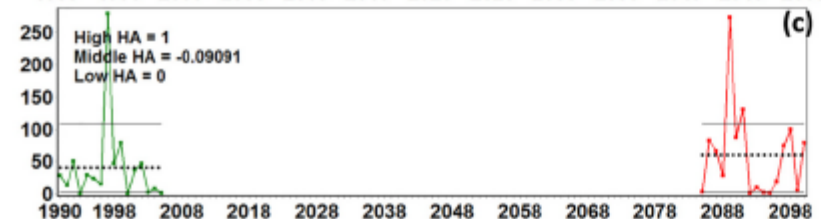
- Most of the river network will experience both a decrease in monthly flow magnitude (mostly in November and December), and an increase (dominantly in February and March) when compared to baseline.



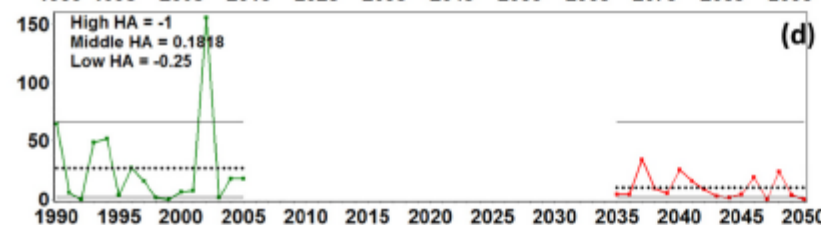
Aguibat Ziar gauge
March's mean flow - RCP8.5
[Baseline Vs 2040s]



Aguibat Ziar gauge
December's mean flow - RCP4.5
[Baseline Vs 2040s]



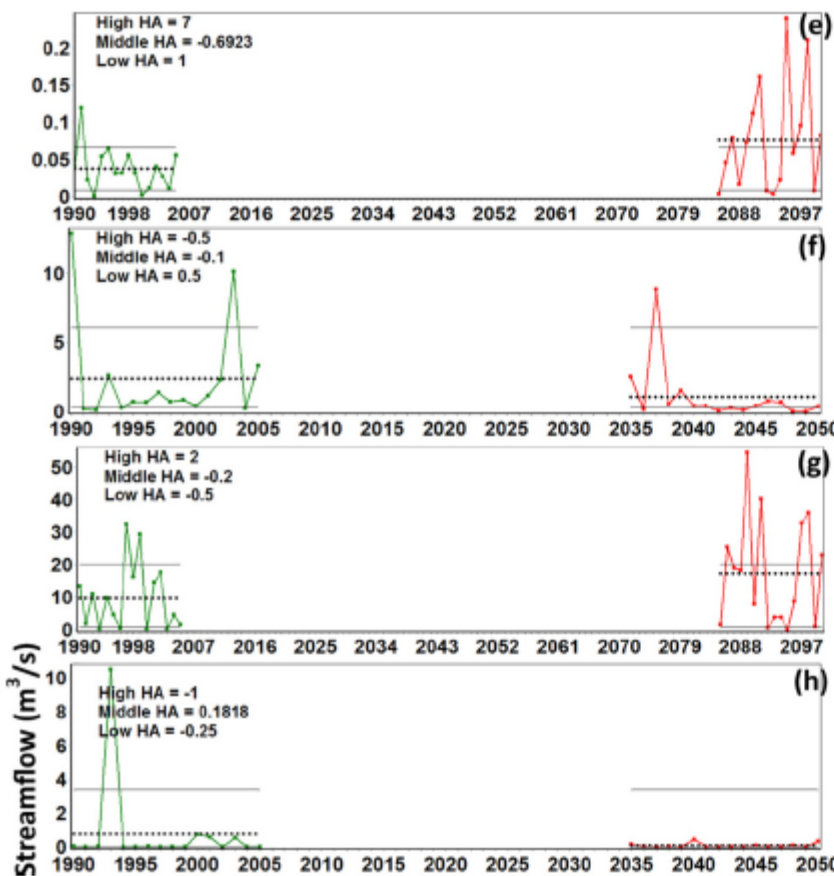
Ras Fathia gauge
February's mean flow - RCP4.5
[Baseline Vs 2090s]



Ras Fathia gauge
December's mean flow - RCP8.5
[Baseline Vs 2040s]

Results

- Under future changes in climate patterns, flow regimes in BW will be altered.
- Most of the projected alterations were estimated to become very significant in the 2090s under the RCP8.5 scenario.



S.M. Chrif gauge
August's mean flow - RCP4.5
[Baseline Vs 2090s]

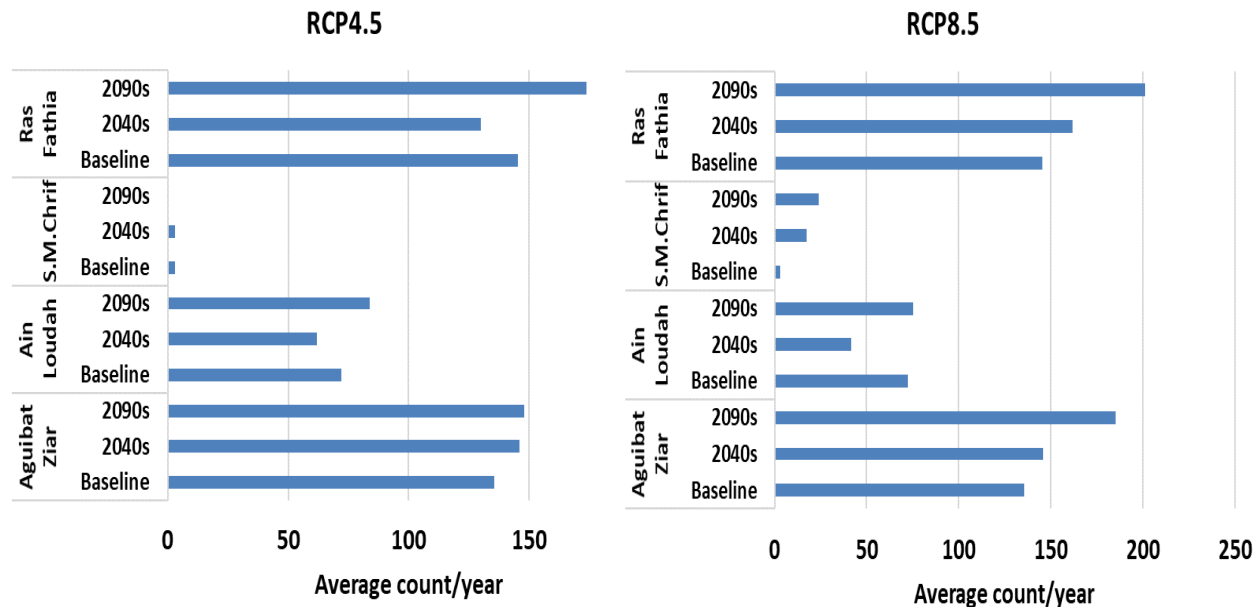
S.M. Chrif gauge
November's mean flow - RCP8.5
[Baseline Vs 2040s]

Ain Loudah gauge
February's mean flow - RCP4.5
[Baseline Vs 2090s]

Ain Loudah gauge
September's mean flow - RCP8.5
[Baseline Vs 2040s]

Results

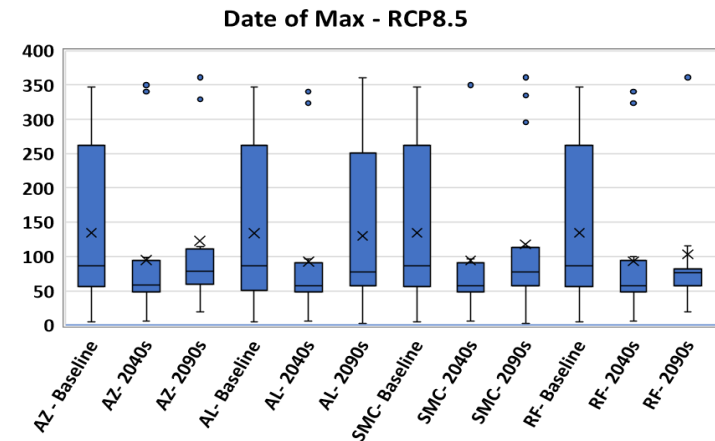
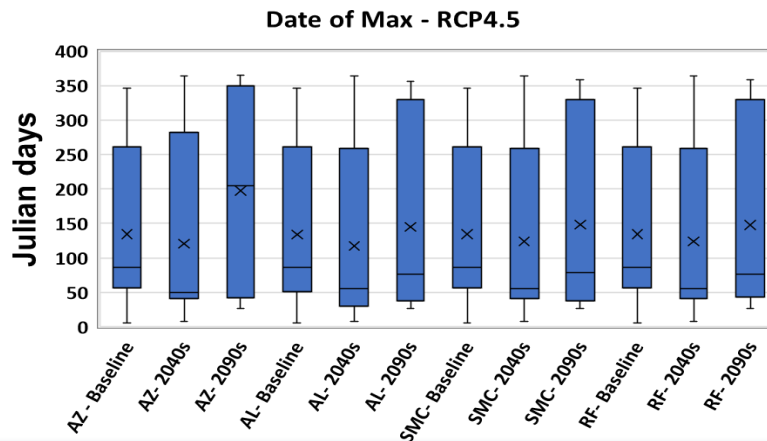
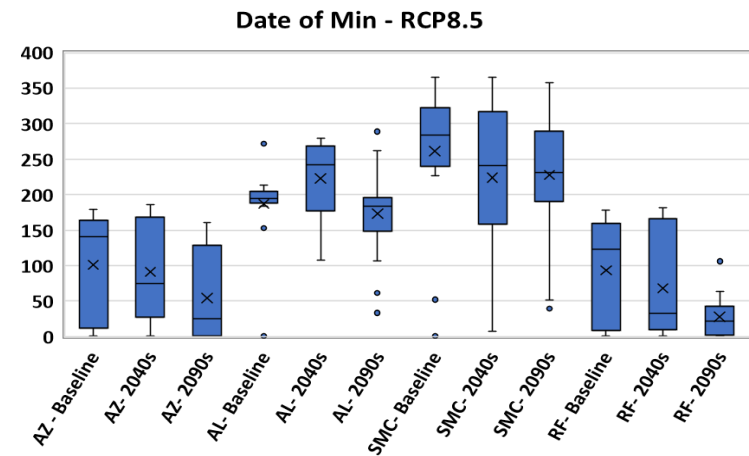
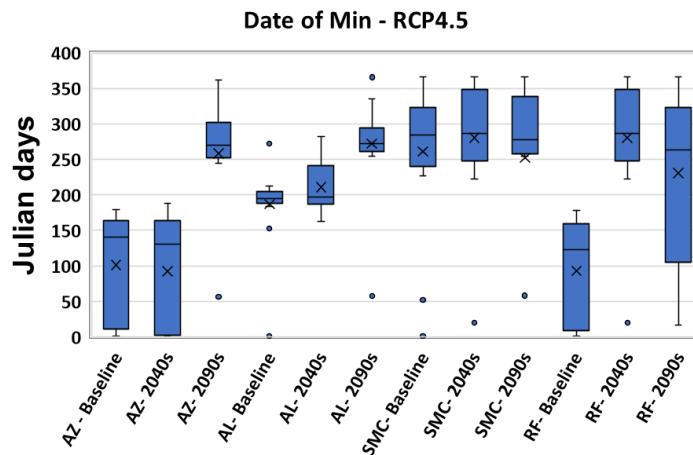
- The RVA analysis highlighted an increase in the frequency of occurrence of 1- 3-, 7-, 30-, and 90-day maximum flows, mostly in the low-RVA category,
- The RVA method revealed an increase in zero-flow occurrence in comparison to the baseline.



Number of zero-flow days

Results

- Trend of minimum flow under RCP4.5 indicates a delay in the timing. Under RCP8.5, minimum flow will occur earlier than in the baseline across all the BW streams.
- Maximum flow being slightly earlier than in the baseline in the 2040s and later in the 2090s (from 10 to 60 days).



Results

- Flow regime will be altered in the future in all the tributaries.
- Machraa stream (gauged by S.M.Chrif) is supposed to be the most altered under RCP8.5 scenario.

		Aguibat Ziar	Ain Loudah	S.M.Chrif	Ras Fathia
		2040s	2040s	2040s	2040s
RCP4.5	Number of zero-flow days	8	-14	4	-10
	Date of min	5	13	2	85
	Date of max	-1	-1	-1	-1
	DHA average	5	9	2	32
RCP8.5	Number of zero-flow days	8	-42	496	12
	Date of min	-10	20	-13	-40
	Date of max	-28	-35	-35	-28
	DHA average	15	32	181	27

$$\text{DHA} = [(\text{Post-impact value}) - (\text{Pre-impact value}) / (\text{Pre-impact value})] \times 100\%$$

Conclusions

- **BW's flows regimes will be altered by the impacts of future climate under both pessimistic and realistic emission scenarios.**
- **The identified alterations concern important eco-hydrological indicators.**
- **Changes in the magnitudes of monthly flows, frequency of low-flows, timing and magnitudes of extreme water conditions being forecasted.**
- **Hydrological alterations are expected to be more severe during the last 15 years of this century.**
- **Future climate will affect the riverine ecosystems and the regular water supply for the associated communities.**
- **To preserve the health of the BW ecosystems the management must be a focus on stream conservation**

Thank you!



Youssef Brouziyne, Anna Maria De Girolamo, Aziz Aboubdillah, Lahcen Benaabidate, Lhoussaine Bouchaou, Abdelghani Chehbouni. 2021. Modeling alterations in flow regimes under changing climate in a Mediterranean watershed: An analysis of ecologically-relevant hydrological indicators. Ecological Informatics, 61