Climate change impact on water resources: a case study of Settat-Ben Ahmed watersheds, Morocco

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Introduction

Warming of climatic system is unambiguously real since the 1950s (IPCC, 2007). Morocco, which is part of the southern Mediterranean shore, is a country negatively impacted by global warming (Knippertz *& al.*, 2003, Driouech, 2010, Sebbar *& al.*, 2011). Precipitation and temperature evolution in this area are in line with global developments (Sebbar, 2011, Nouaceur *& al.*,2014). Studies show that climate change is reflected by an intensification of precipitation and a reccuring of extem events (espetially in the latest decades) (Christensen *& al.*, 2007).

I.Data and methodology

1.Study area

The Settat – Ben Ahmed plateau (Chaouia, Morocco) hydraulic bassin is located between 33°15'N, 7°00'W & 32°50'N, 7°40'W, it's extended over an area of 1594.3 km^2 with altitude varying from 796 m to 229 m (Fig.1). This study was espetially focalized on Tamedroust and Mazer rivers within data availability. The piezometric evolution was observed at two boreholes located downstream of the two rivers mentioned above.

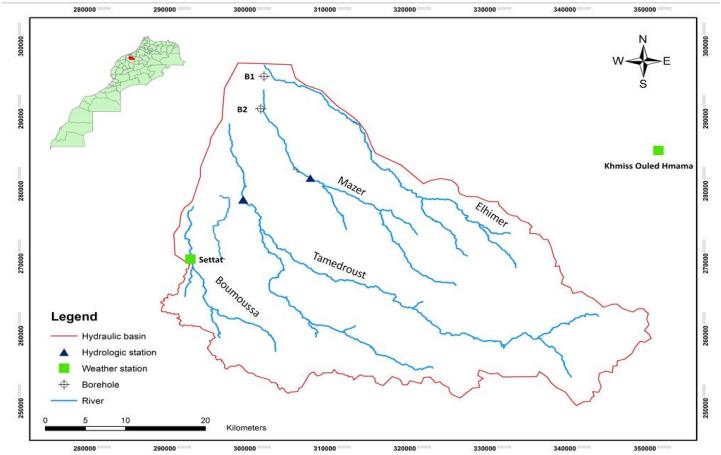

Fig. 1. Study area boundary and stream network of the Settat-Ben Ahmed Plateau basin.

2. Data and methods

The weather data used in this study are from NASA's data base (https://power.larc.nasa.gov/data-access-viewer/). Hydrological and hydrogeological data were provided by the Bouregreg and Chaouia Hydraulic Basin Agency (ABHBC). For over a decade, climate change detection and attribution studies have increasingly focused on changes in extreme events (Easterling *& al*., 2000). In this study, we have choosen to use some of the ClimDex 27 climate indices (http://etccdi.pacificclimate.org/index.shtml) which has been developed in different stages (Zhang and Yang, 2004) for data from two meteorological stations (Settat and Khmis Ouled Hmama), and for four decades (1981-2019).

II.Results and discussion

1.Precipitation

Precipitation annual indices was calculated for two stations. Evolution of total annual rainfall has shown a decrease between the third (2001-2010) and last decade (2011-2019) with an important rate in Settat station (from 440 to 420 mm/year) (Fig. 2.a). However, intense rainfall are reccuring more often in the last decade. It has attend its maximum, for Settat at 2020 and at 2018 for Khmiss Ouled Hmama (Fig. 2.b). Evolution of precipitation in this area is similar to Morocco's precipitations evolution (SEBBAR *& al*., 2011; KHOMSI *& al*., 2016), wich is similar to its evolution in the mediterranean basin (KIOUTSIOUKIS *& al*., 2010).

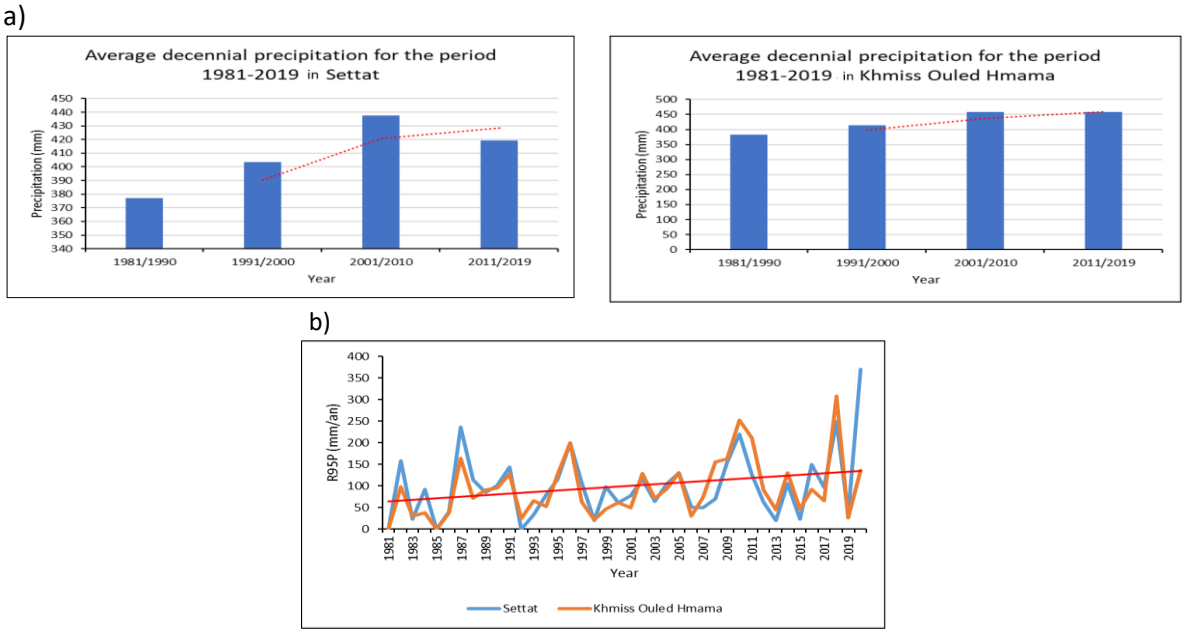

Fig. 2. Evolution of rainfall indices : a) Average rainfall ; b) R95P (Intense rainfall).

2.Temperatures

All temperature indices (TMean, Max, Min & TX90P) has shown an increase during the studied period for both of stations. The maximum number of hot days (25 and 27 days) has been recorded consecutively in 2001 and 2017 either for Settat or Khemiss Ouled Hmama (Fig. 3.d). The decade 2001-2010 is considered by the World Meteorological Organization (WMO, 2013) to be the warmest decade globally since meteorogical records has begun (NOUACEUR *& al*., 2013).

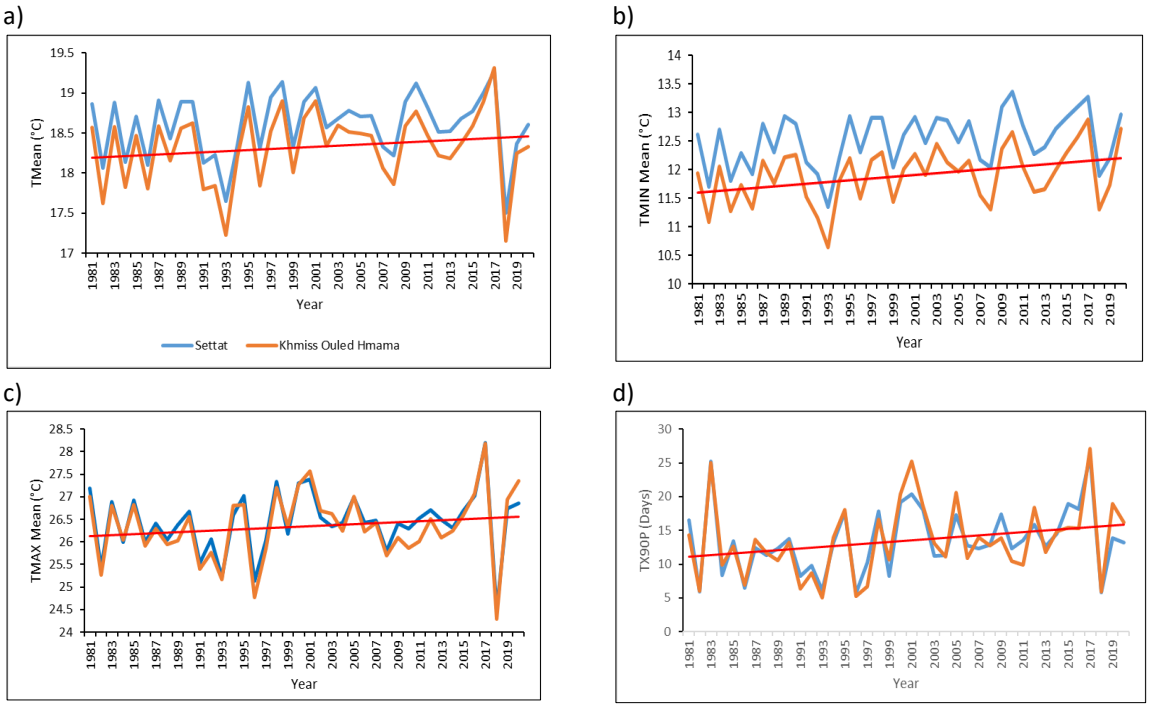

Fig. 3.Evolution of temperature indices : a)Average temperature (TMean) ; b)Minimun temperature (TMin) ; c)Maximun temperature (Tmax) ; Hot days (TX90P).

3.Flowrate and piezometry

Evolution of flowrate in Mazer and Tamedroust has a similar global trend over the studied period. The must importat flowrate has been recorded in 1996 wich is known globally as a wet year. After this, the trends has shown a significant decrease until 2005 for Mazer and 2008 for Tamedroust (Fig.4.a). During those last year, the number of days with null flowrate (F=0 indice) knew its maximum. That impacted the general trend of F=0 indice to be increasing from 1981 to 2005 and 2008 (fig.4.b).

Concerning piezometric level's fluctuation, the global trend is decreasing for both boreholes (B1 and B2) (Fig.4.c). That represent an evident bad repercition of drought by reduction of surface water runoff and, consecuently, less recharge to aquifers. The same situation was registered in others regions of Morocco for the period from 1960 to 2004 (Aoubouazza *& al*., 2019).

Conclusion

The purpose of this study is to evaluate climate's impact on runoff and groundwater in Settat-Ben Ahmed Plateau. Results show significant trend in temperatures wich confirm the warming in this area. It also shows an important decreases in runoff and piezometric levels during the lastest decades. In the other hand, the occurrence of extem events has grown.

Adknowledgement

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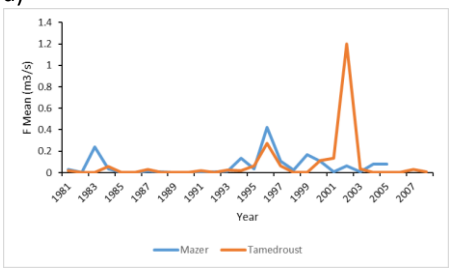
a)



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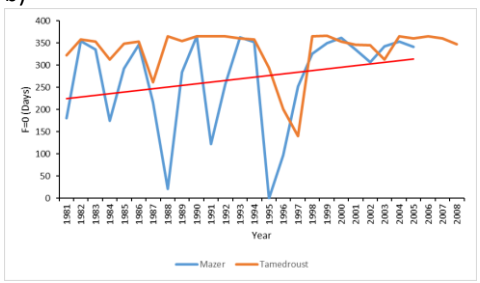

c)

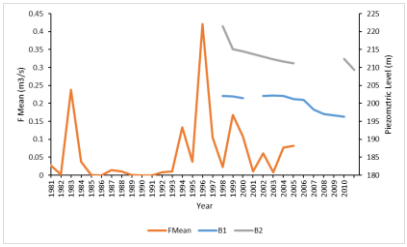

Fig. 4.Evolution of flowrate and piezometric level : a)Average flowrate (FMean) ; b)Number of days with null flowrate (F=0) ; c)Piezometric level.

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