

DROUGHT CHARACTERISTICS OVER TWO LARGE BASINS IN MOROCCO (TENSIFT AND SEBOU).

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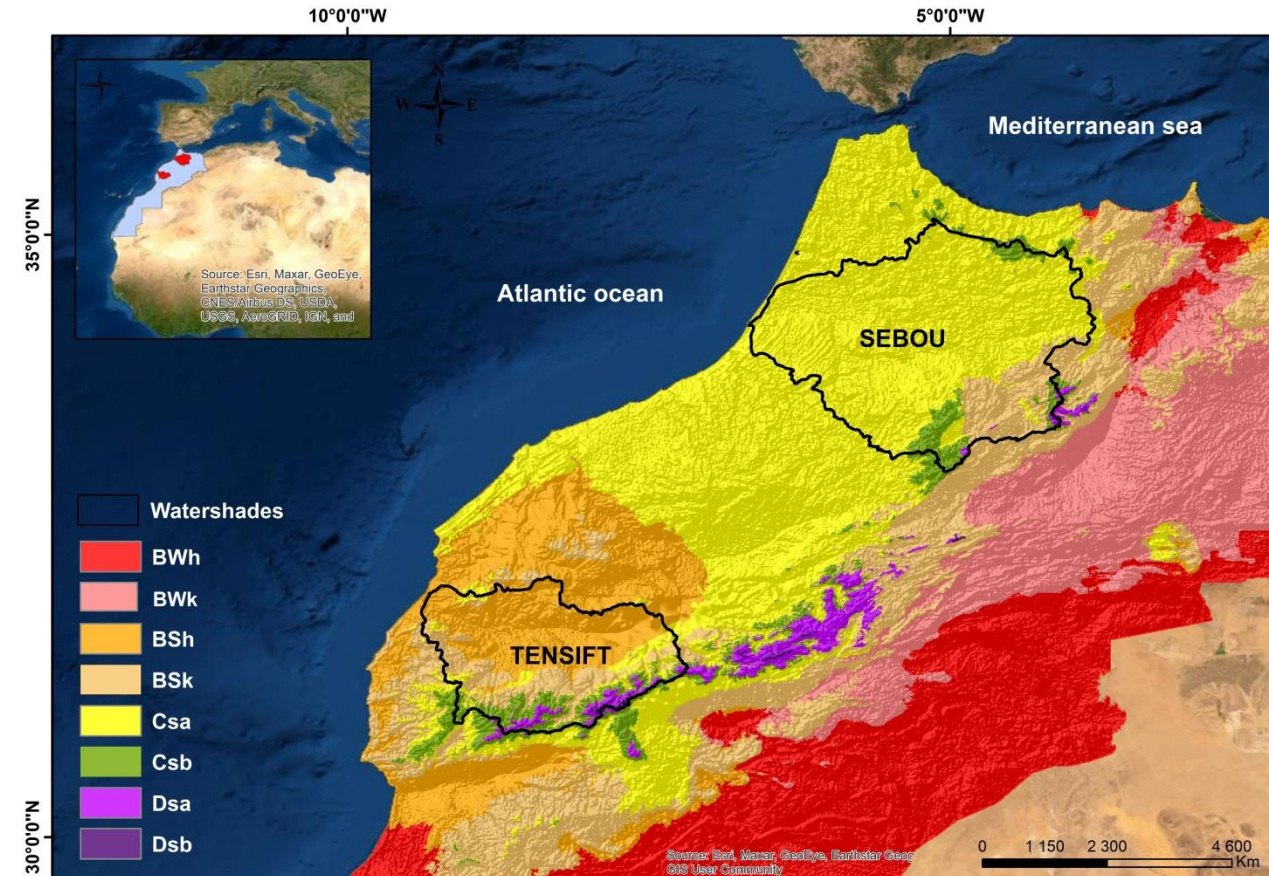
- Drought is one of the most pervasive recurring hazards with the greatest impact on society, but is challenging to understand, quantify and manage.
- It is primarily induced by precipitation deficit.
- Impacts depend crucially on the length, severity, and areal extent of drought events.
- Drought indices are essential for characterizing the nature and severity of drought.
- The rationale of the present study is based on **the characterization of meteorological drought in two basins of different climate and water resources**. Three parameters are analyzed: **severity, magnitude and areal extent**.

Tensift Basin :

- › Center of Morocco covering an area of **24 000 km²** .
- › Semi-arid climate (**BSk**).
- › Tensift is the water tower of the Haouz plain.

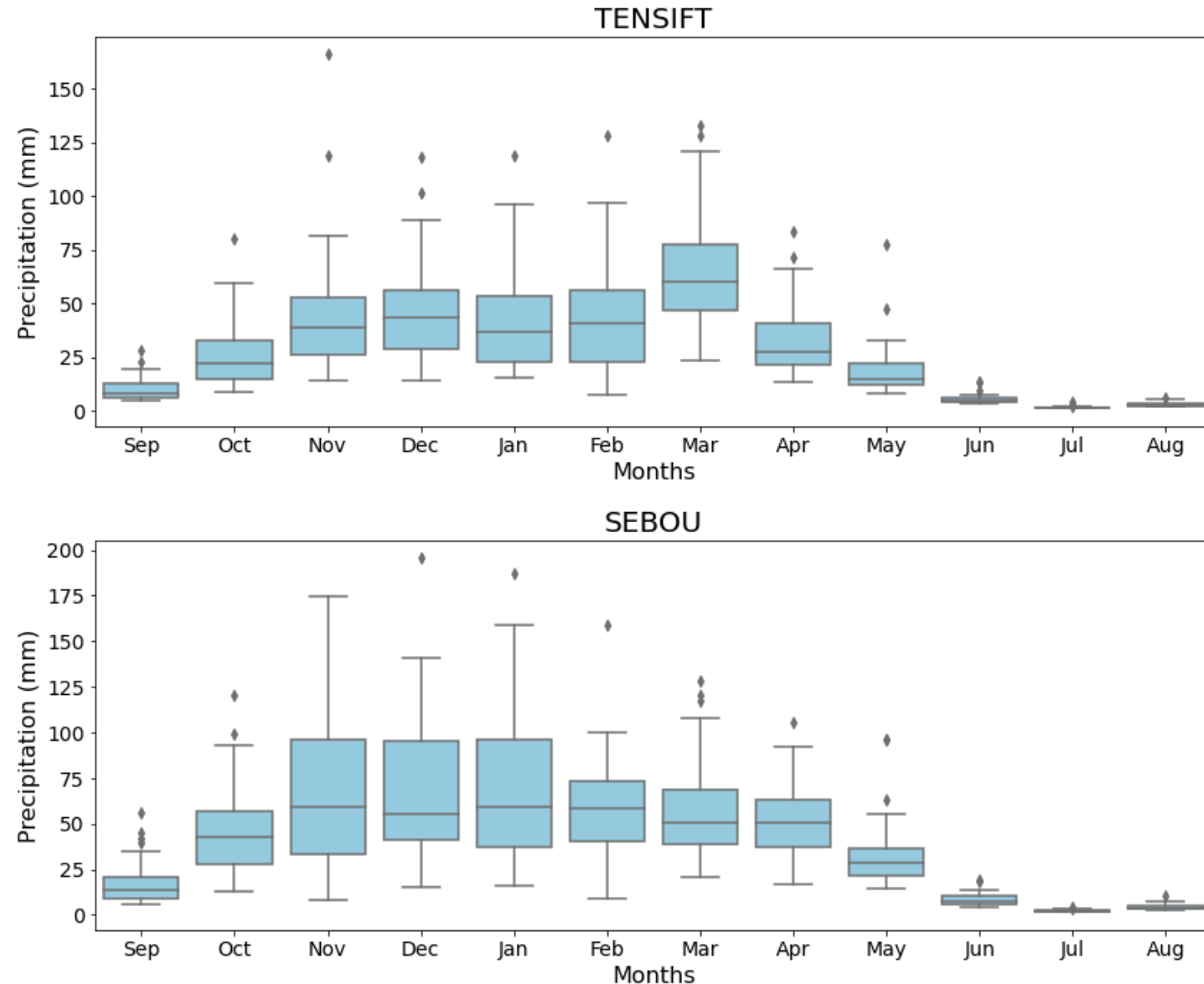
Sebou basin :

- › Northern Morocco covering nearly **40 000 km²**.
- › Mediterranean climate (**Csa**) with oceanic influence.
- › It contributes to **30 %** of the national potential of surface water resources and **20 %** of groundwater resources.



The study area with the Köppen-Geiger climate classification map (Beck et al., 2018).

- **Monthly** precipitation data from Climate Hazards Group InfraRed Precipitation with Station data (**CHIRPS**) from **1981 to 2021**, with a spatial resolution of **0.05° × 0.05°**.
- Precipitation is irregularly distributed in time/space.
- Most of the precipitation falls during winter and spring : October until April.
- **Tensift** basin : low and irregular rainfall of **240 mm/year**.
- **Sebou** basin : strong rainfall gradient with a mean annual rainfall of **560 mm/year**.



Interannual monthly average rainfall derived from CHIRPS (1981-2021)

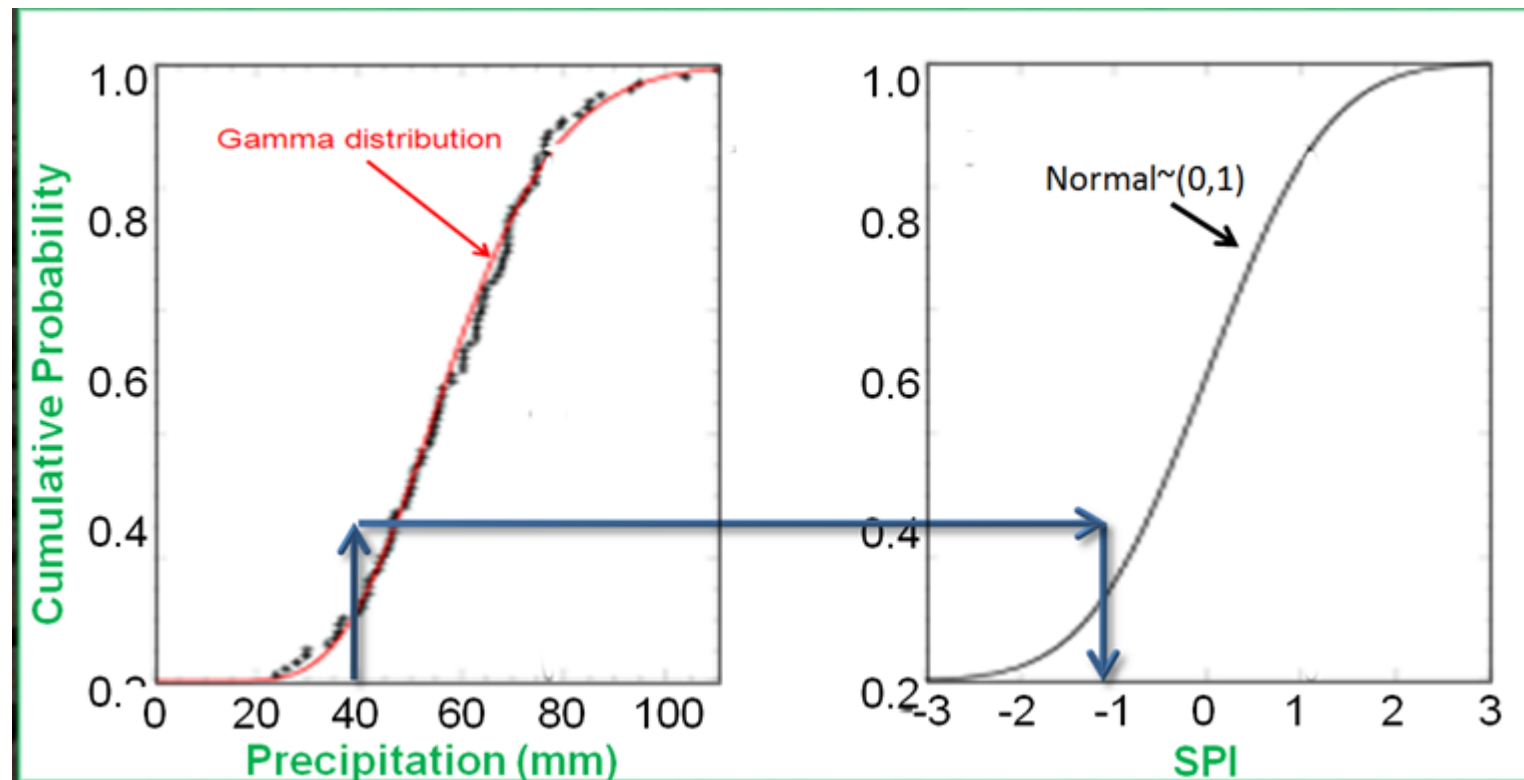
SPI, Standardized Precipitation Index

Based on the cumulative probability of rainfall amount for a time scale

Fitted to a gamma distribution

Transformed into standard normal (mean=0 and sd=1)

SPI provides a simple mechanism to evaluate the severity, magnitude and location of drought

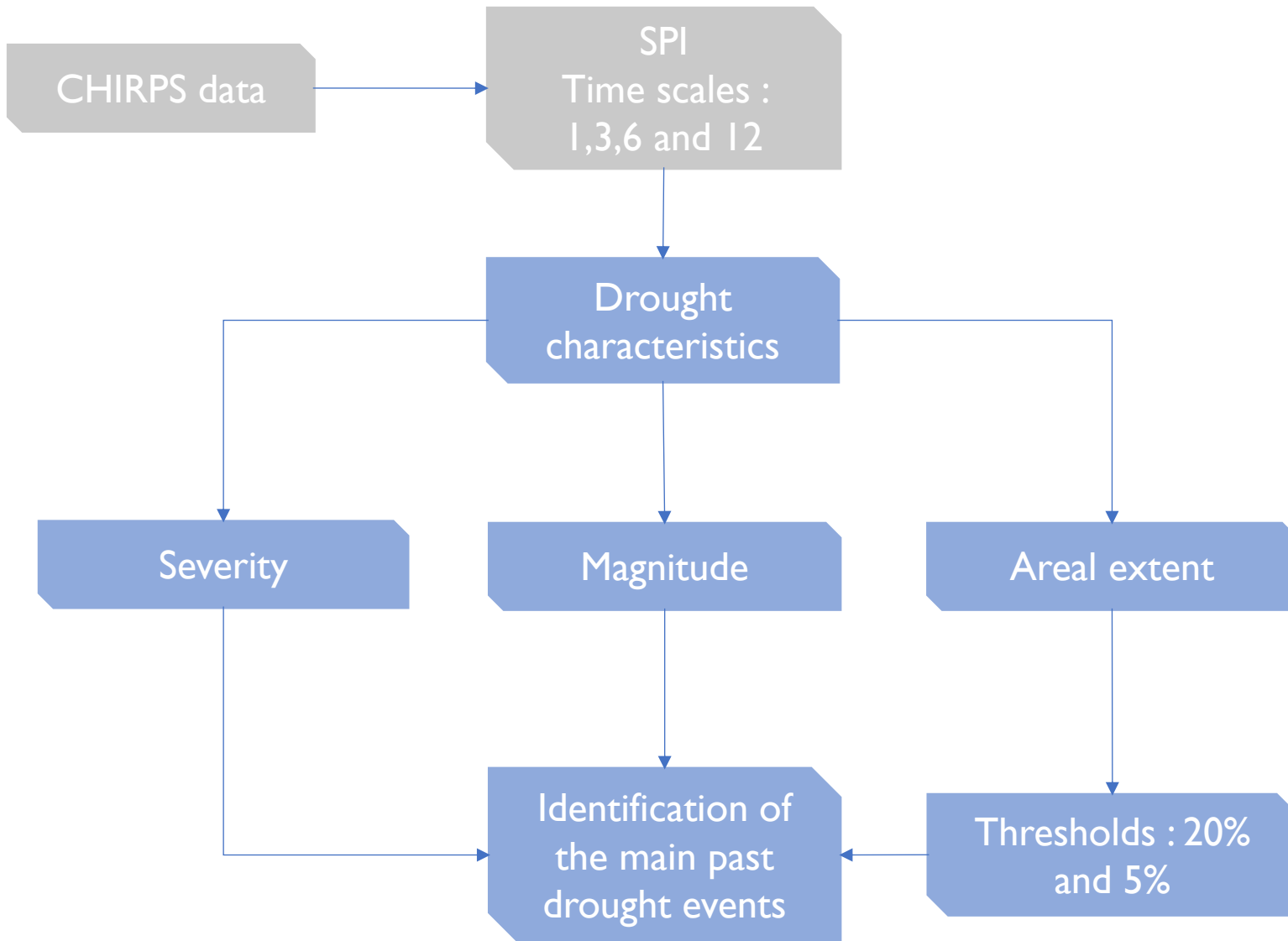


Introduction

Data and methods

Results and discussion

Conclusions

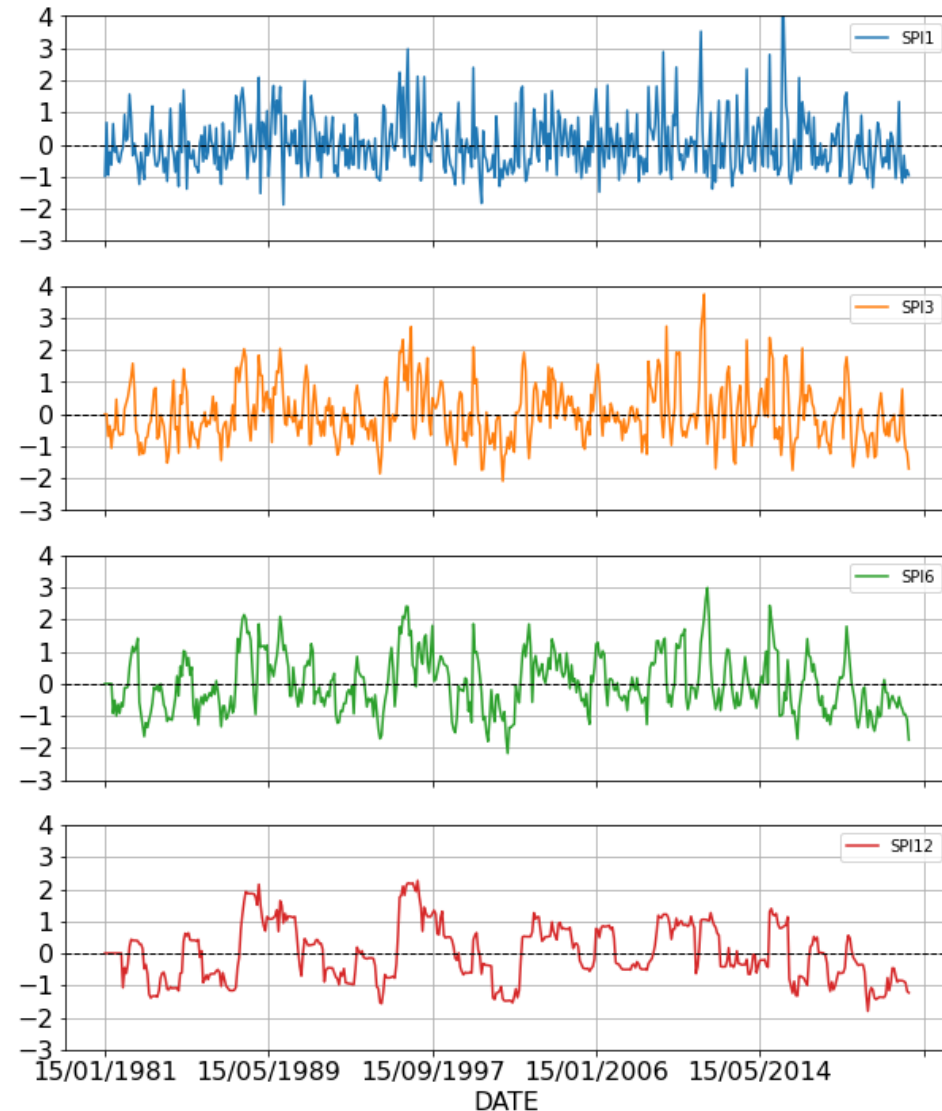


Drought classification based on the SPI index and corresponding event probability

Index value	Drought categories	Probability (%)
0 to -0.99	Mild drought	34.1
-1 to -1.49	Moderate drought	9.2
-1.5 to -1.99	Severe drought	4.4
-2 or less	Extreme drought	2.3

- The use of multiple time scales allow distinguishing the main drought events and reduce minor droughts.
- At longer time scales (annual) drought becomes less frequent and of longer duration.
- At short time scales (monthly) : Minor droughts are events characterized by both: short duration and, at the same time, low magnitude.

TENSIFT



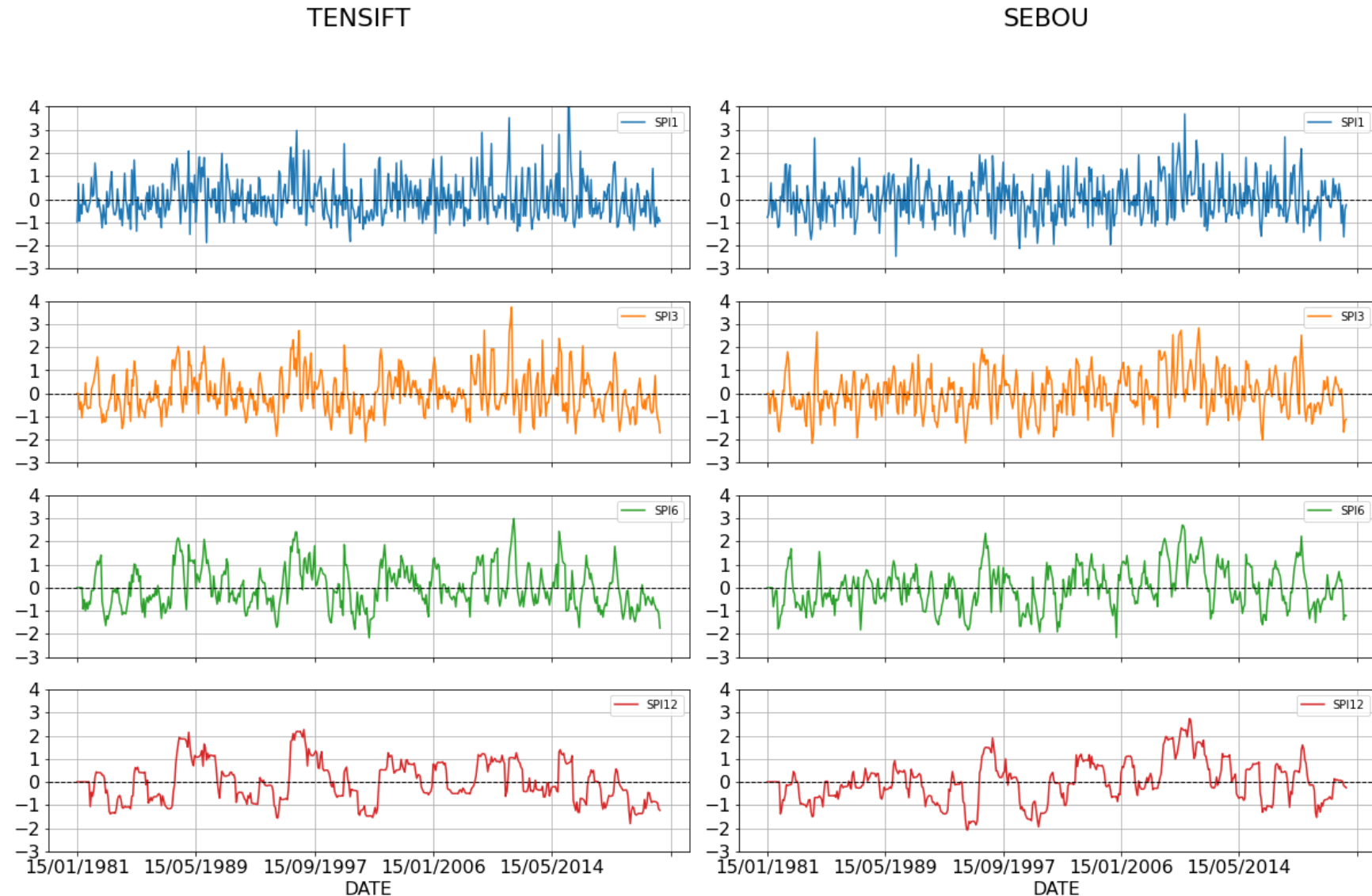
Monthly

Tremestrial

Semestrial

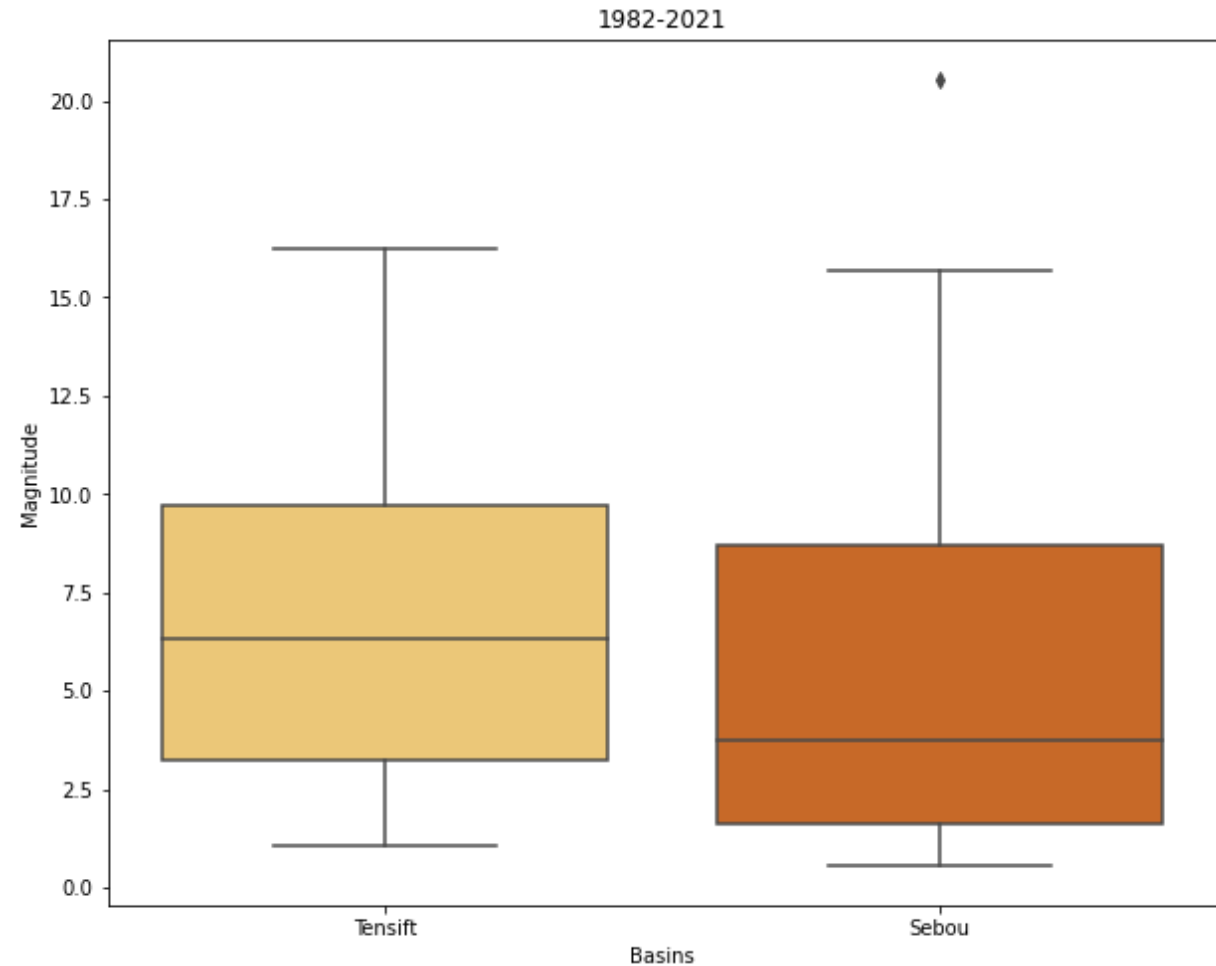
Annual

- The Tensift basin : The 6-month SPI (SPI6) and the 3-month SPI (SPI3) have reached values of **-2.18** and **-2.1** respectively in **2001**.
- For the Sebou basin the **1995** year was the driest when SPI3 and SPI12 have reached an intensity of **-2.19** and **-2.12** respectively.

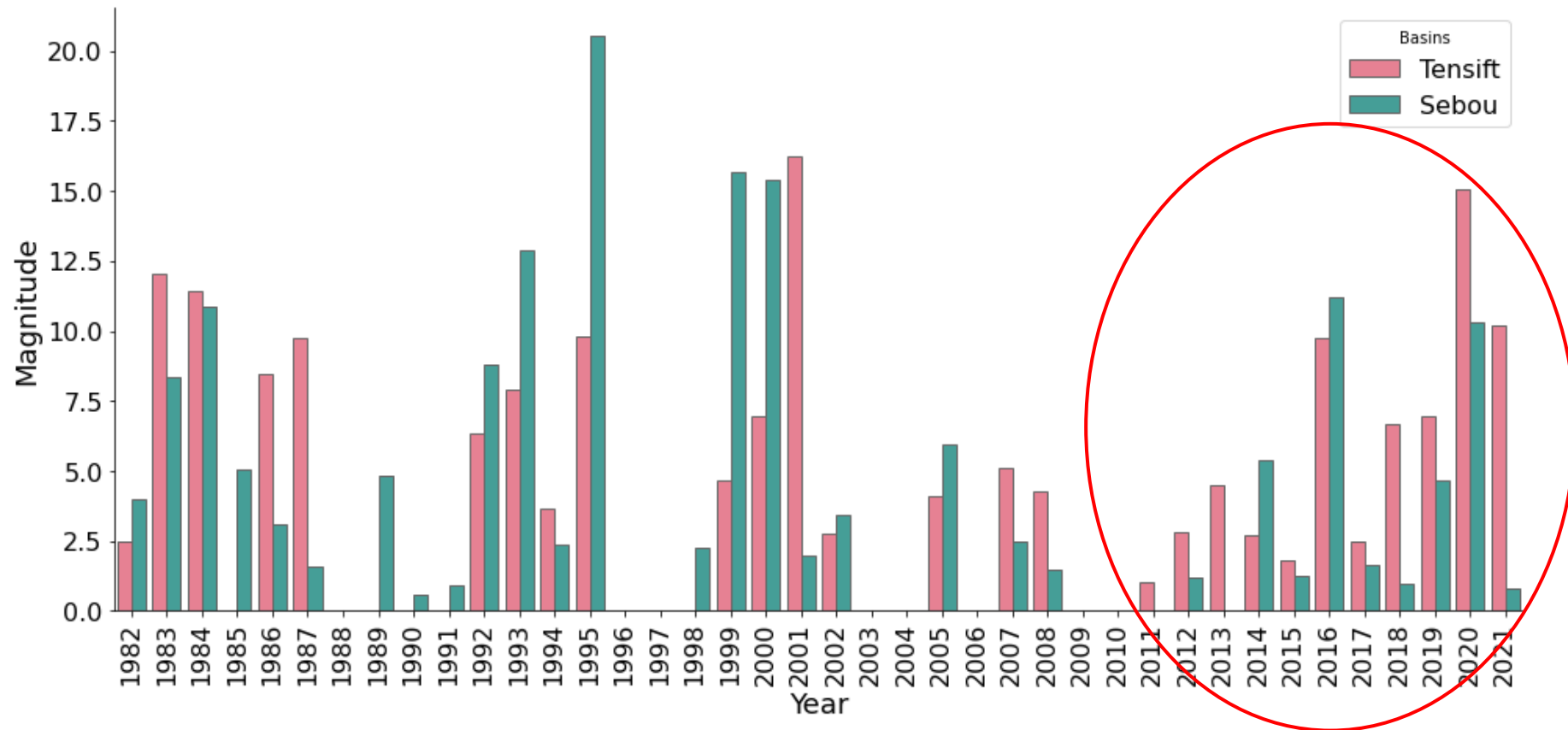


Time series of SPI at different time scales during the 1981-2021 period for the Tensift and Sebou basins.

- Drought magnitude : the sum of negative SPI values belonging to the same drought event.
- Drought events within the Sebou basin are generally of lower magnitude than those of the Tensift basin.
- Tensift Median = **6.3**
- Sebou Median = **3.7**
- The Tensift basin is more affected by drought in terms of magnitude.



Boxplots of the magnitude of drought events computed for Tensift and Sebou basins.

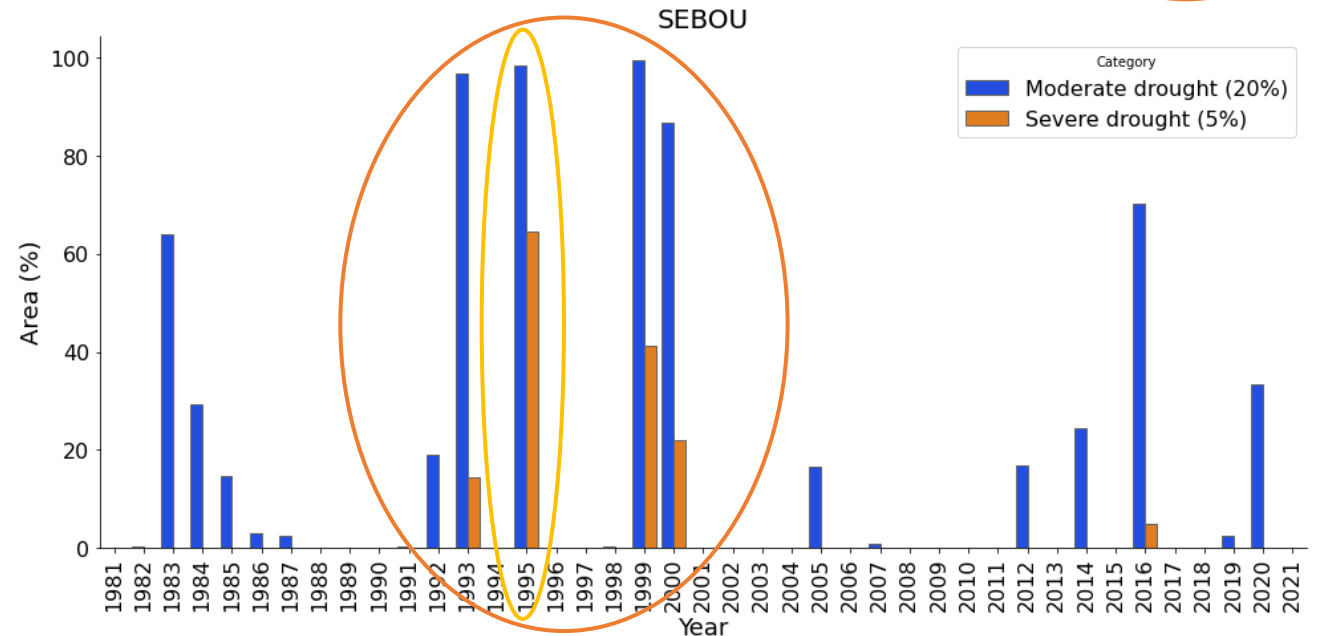
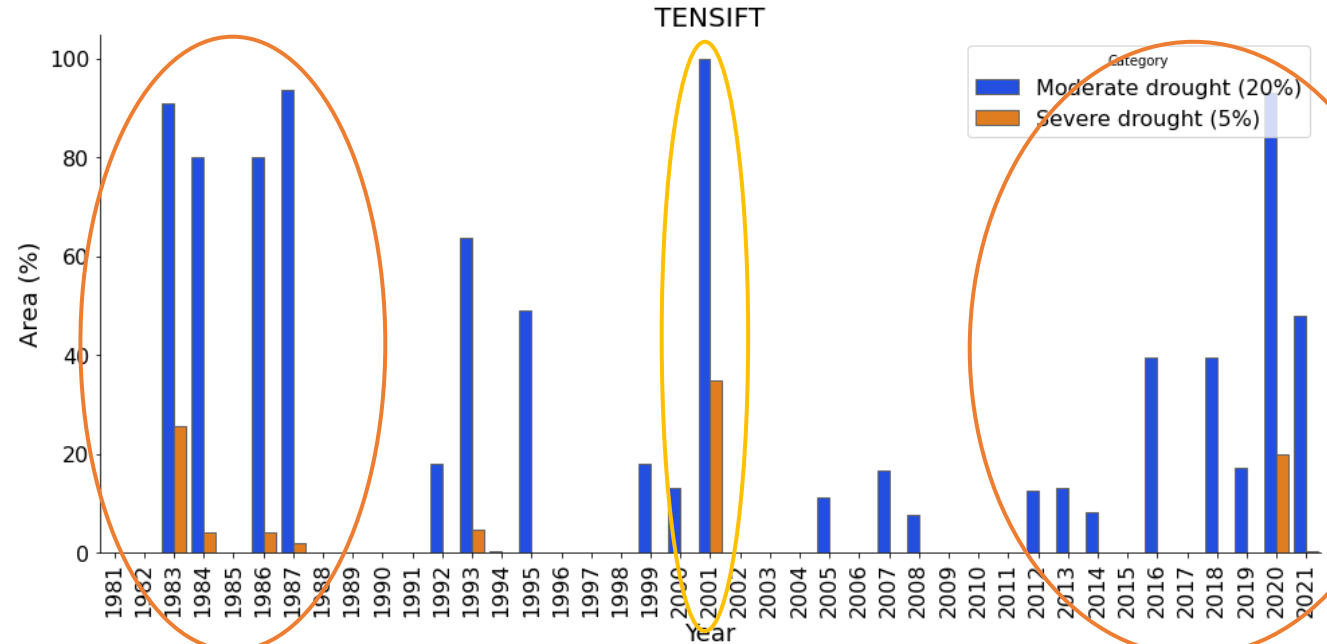


Magnitude of drought events (accumulated negative anomalies per event) during the 1982-2021 period for the Tensift and Sebou basins.

Temporal evolution of the fraction of area under drought conditions during the study period from 1981 to 2021.



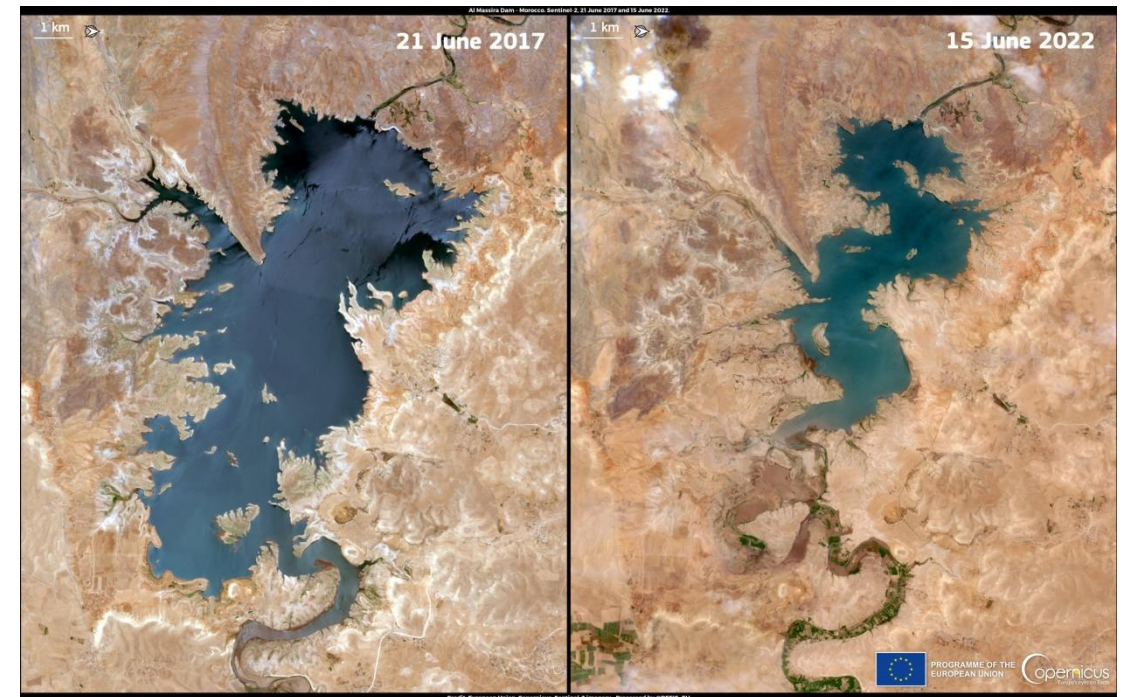
Lalla Takerkoust dam : **7%** in February 2020 and **14.3%** at the same date in 2021.



The main conclusions are :

- The SPI was an efficient tool for analyzing meteorological drought. It could be more appropriate for defining drought characteristics.
- The Tensift basin has experienced more drought episodes than the Sebou basin, this means that towards the South of Morocco drought impacts are increasing.
- The most severe events were observed at different years over the basins which approve the different patterns of drought in a regional context.

- The country's average dam filling rates have steadily declined due to low rainfall levels since 2015. Some of the most worrying conditions are observed in the Al Massira reservoir that is currently at **6.3%** of its total capacity (15 June 2022). In addition to damaging effects on agriculture nationwide.



Thank you for your attention