

# **Influence of Lithology, Climate and Topography on the duration of flow intermittence in Burkina Faso.**

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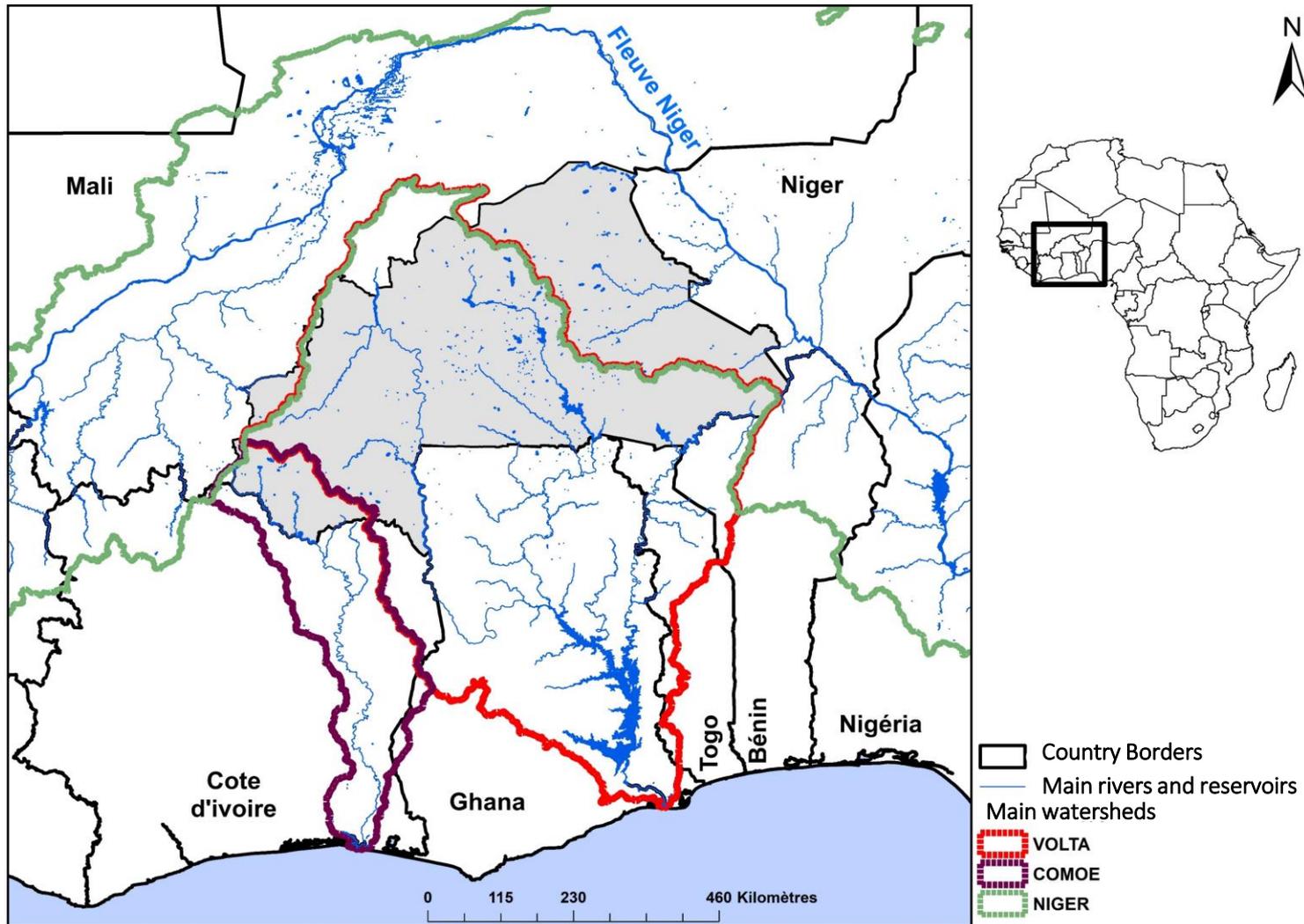
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# 1. Objectives of the study

This study aims to identify the potential factors that best explain the geographic variations of the hydrological regime of rivers in Burkina Faso, and in particular the duration of intermittency, and to discuss their interactions.

## 2. Presentation of the study area and intermittency Overview

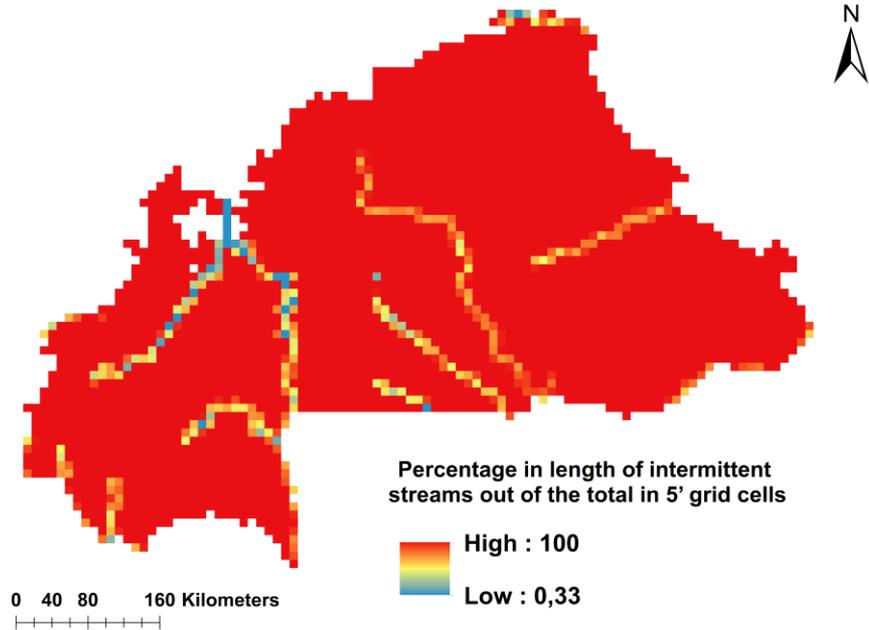


## 2. Presentation of the study area and intermittency Overview

Proportion in length of **permanent** vs. **intermittent** rivers

Burkina Faso, **Majority = intermittent**

Data Source :  
National hydrographic database BNDT  
(Base Nationale de Données Topographiques)



Example of an intermittent river: Massili in Gonsé (Burkina-Faso)

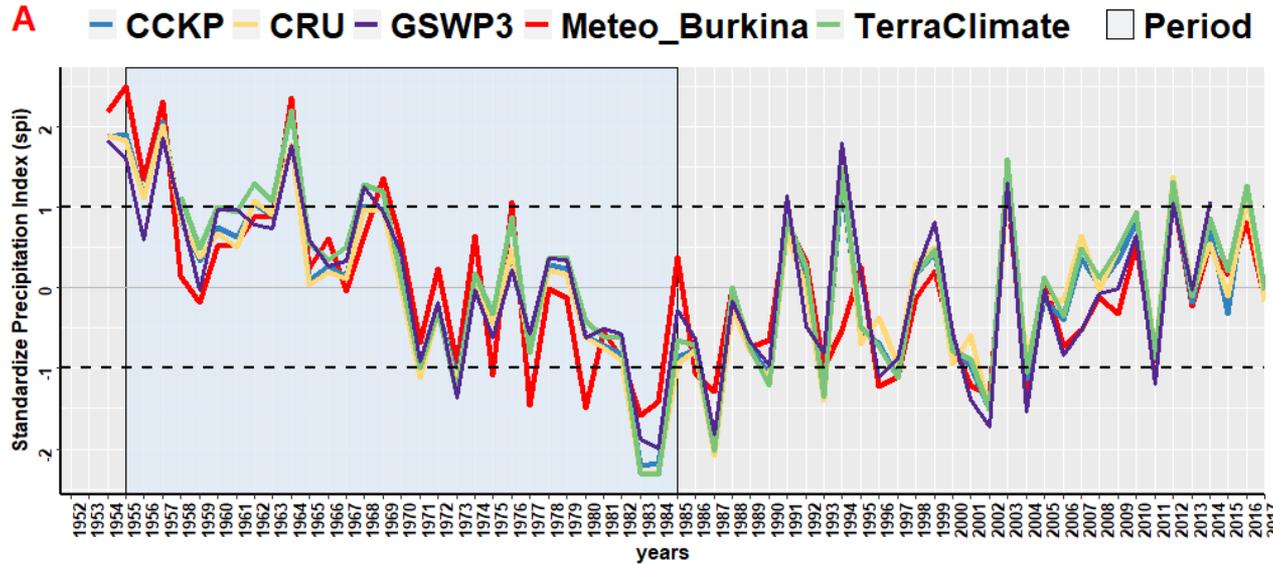


Dry Period 13/04/2019

Wet season 04/08/2019

# 3. Data and Methods

## Availability of data over the period (1952-2017)



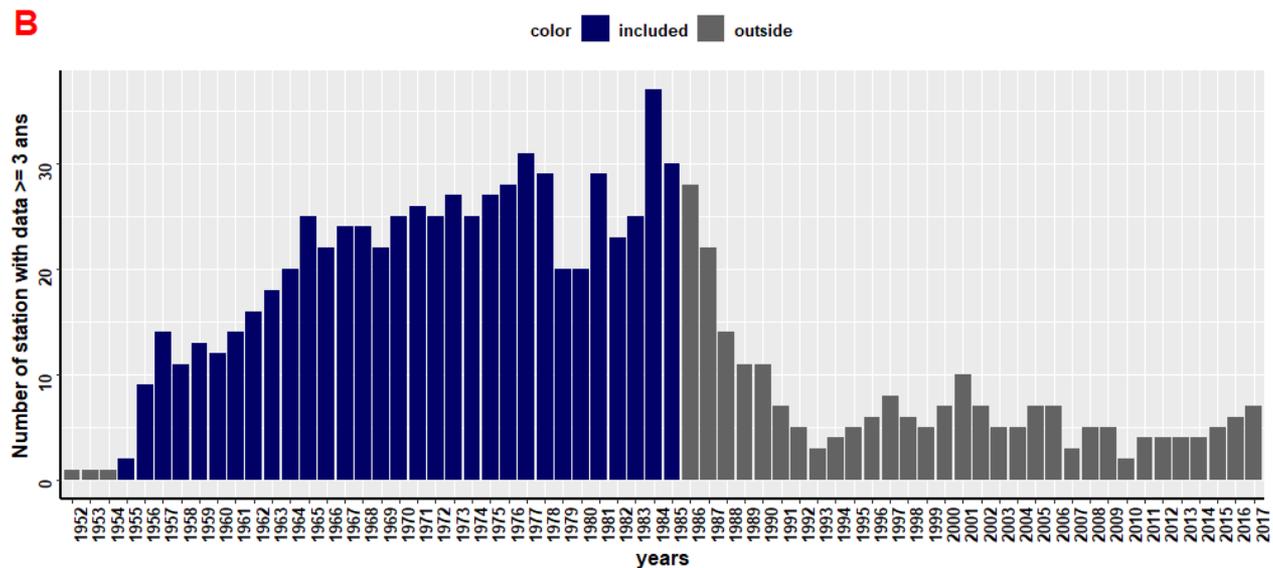
**A** A period of drought (1970-1990)

**B** Maximum number of gauging stations between (1955-1990)

Choice of study period 30 years (1955-1985):

49 gauging stations selected with at least 4 years of data

- Normal period : 1955-1970 (15 years)
- Drought period : 1970-1985 (15 years)



### 3. Data and Methods

Duration of intermittency evaluated by mean number of dry months ( $\overline{Ndry}$ ) per year .

$$\overline{Ndry} = \frac{\sum_i^n Ndry(i)}{n}$$

$Ndry(i)$  : the number of dry months in year (i)

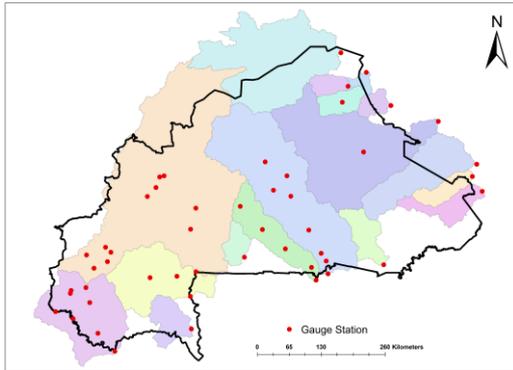
n : number of years considered

#### Classification of similar gauging stations into different classes.

Mean number of dry months /year	Class	Number of gauging stations (49)	%
(0 – 2)	Permanent	18	36,7%
(3 – 5)	Weakly Intermittent	6	12,2%
(6 – 9)	Highly Intermittent	22	45%
(10 – 12)	Ephemeral	3	6,1%

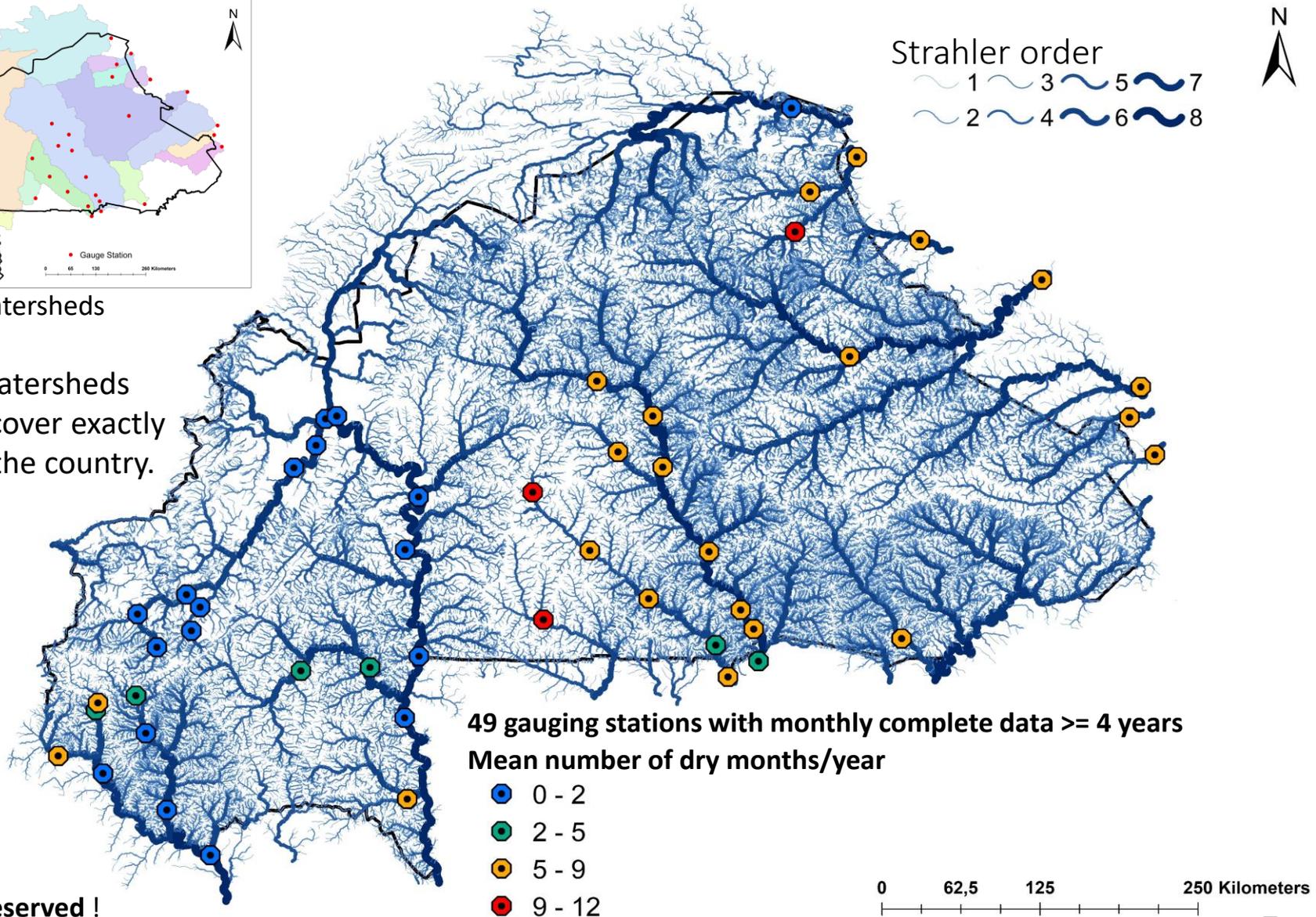
### 3. Data and Methods

Duration of intermittency evaluated by the mean number of dry months/year (1955-1985).



Watersheds

The watersheds studied cover exactly 87% of the country.



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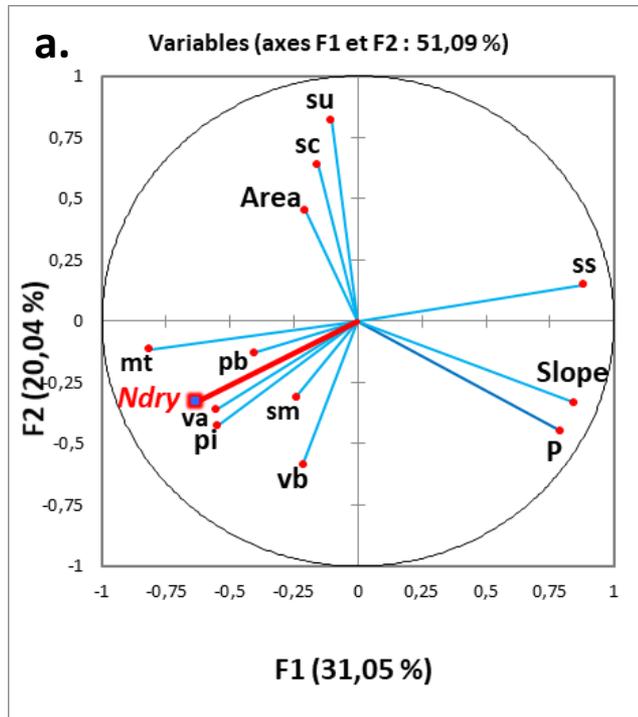
### 3. Data and Methods

#### Principal Component Analysis (PCA)

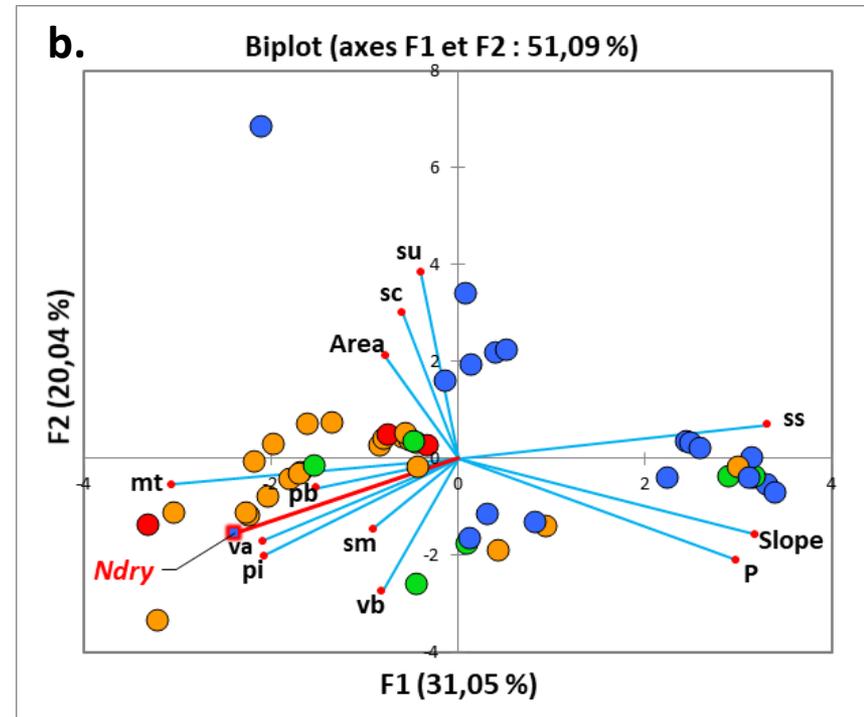
Hydrological variable		
Topography	<i>Ndry</i>	-
	Strahler order	-
	Area	km <sup>2</sup>
	Slope	°
Climate	Elevation	m
	Aridity index (AI)	-
	Potential evapotranspiration (PET)	mm
Lithology	Mean precipitation (P)	mm
	Metamorphic Rocks (mt)	%
	Intermediate Plutonic Rocks (pi)	%
	Acid Volcanic Rocks (va)	%
	Basic Volcanic Rocks (vb)	%
	Siliciclastic Sedimentary Rocks (ss)	%
	Carbonate Sedimentary Rocks (sc)	%
	Unconsolidated Sediments (su)	%
	Basic Plutonic Rocks (pb)	%
Mixed Sedimentary Rocks (sm)	%	

- The variable **Ndry** (mean number of dry months/year) is introduced into the PCA as a **supplementary variable** to coarsely **detect the explanatory variables** having the greatest impact on this hydrological variable.
- The **input variables** have different units (km<sup>2</sup>, %, mm, etc...), they have been previously **centered and reduced** so that all variables have the same weight.
- **Variables in red** are not taken into account due to autocorrelation.

## 4. Results



PCA plot of the first two components for the hydrological variable (Ndry) and watershed variables.



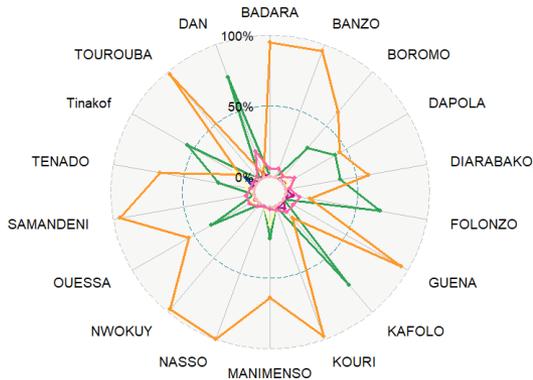
Biplot of the first two axes resulting from principal component analysis (n=49 study sites)

- Permanent
- Weakly intermittent
- Highly intermittent
- Ephemeral

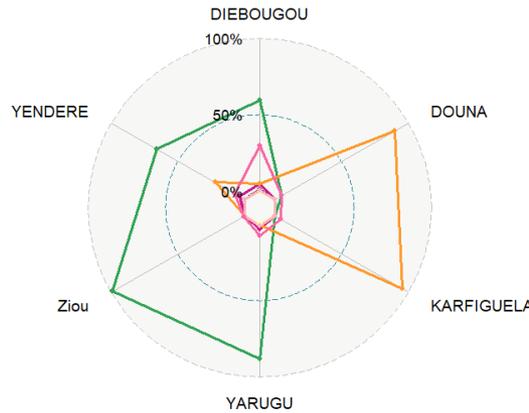
(Ndry) seems to be important when watersheds have high proportions of rocks (*mt*, *pi*, *va*, *vb*, *sm*, *pb*).

# 4. Results

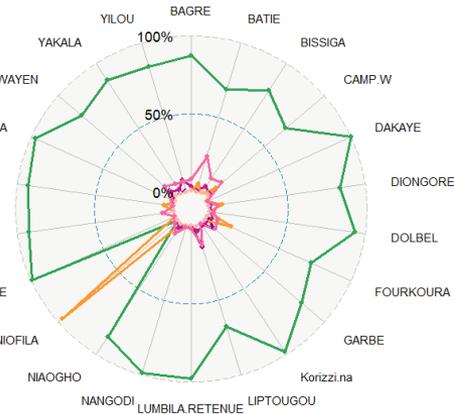
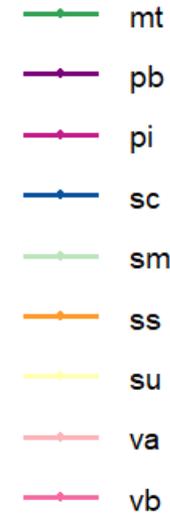
**Permanent (18)**



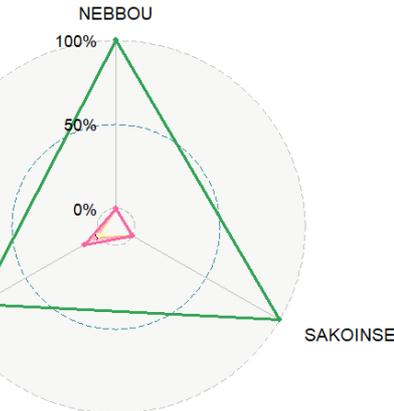
**Weakly intermittent (6)**



% occupied by the different types of lithologies per watershed.



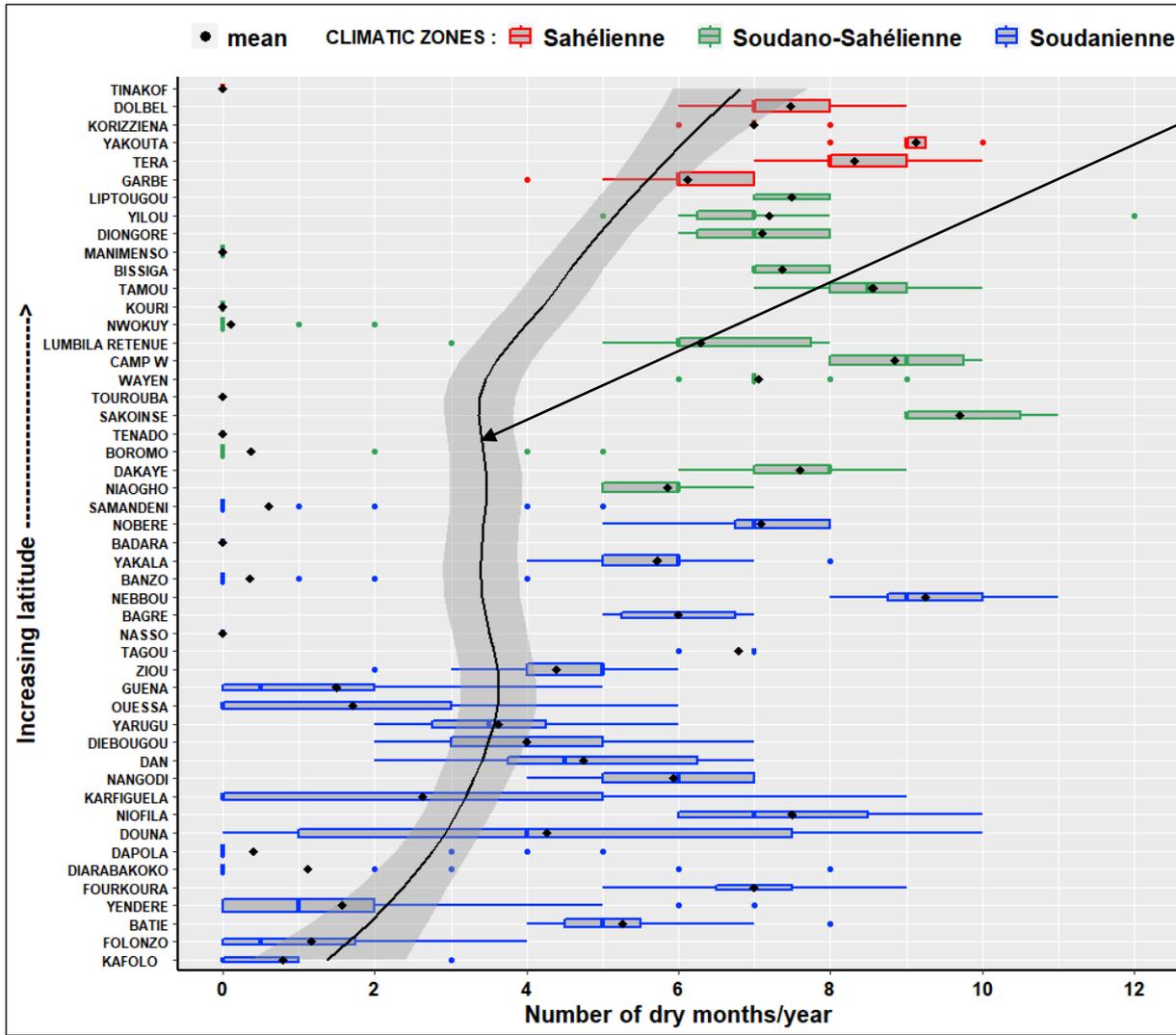
**Highly intermittent(22)**



**Ephemeral (3)**

Most of the stations classified as permanent are mostly located on sedimentary rocks and the rest of the stations classified as intermittent to ephemeral are mostly located on metamorphic rocks.

# 4. Results



*Trend curve with 95% confidence interval.*

The tendency of an increasing number of dry months as a function of latitude and therefore of the north-south rainfall gradient. However, this increase is probably contrasted by the underlying lithology and the area of watersheds because a significant fraction of the permanent rivers are in an arid climate.

## 5. Conclusions and perspective

- **Lithology** seems to be a crucial control of the intermittence class in Burkina Faso.
- Tendency of an **increasing number of dry months** as a function of latitude (**decreasing precipitation**), this increase is probably contrasted by the underlying **lithology** and the **area of watersheds**.
- Spatial determinants of intermittency to be further investigated: **Land cover**.



**Thank you for your  
Attention**