Changes in rainfall regime over Burkina Faso under climate change conditions

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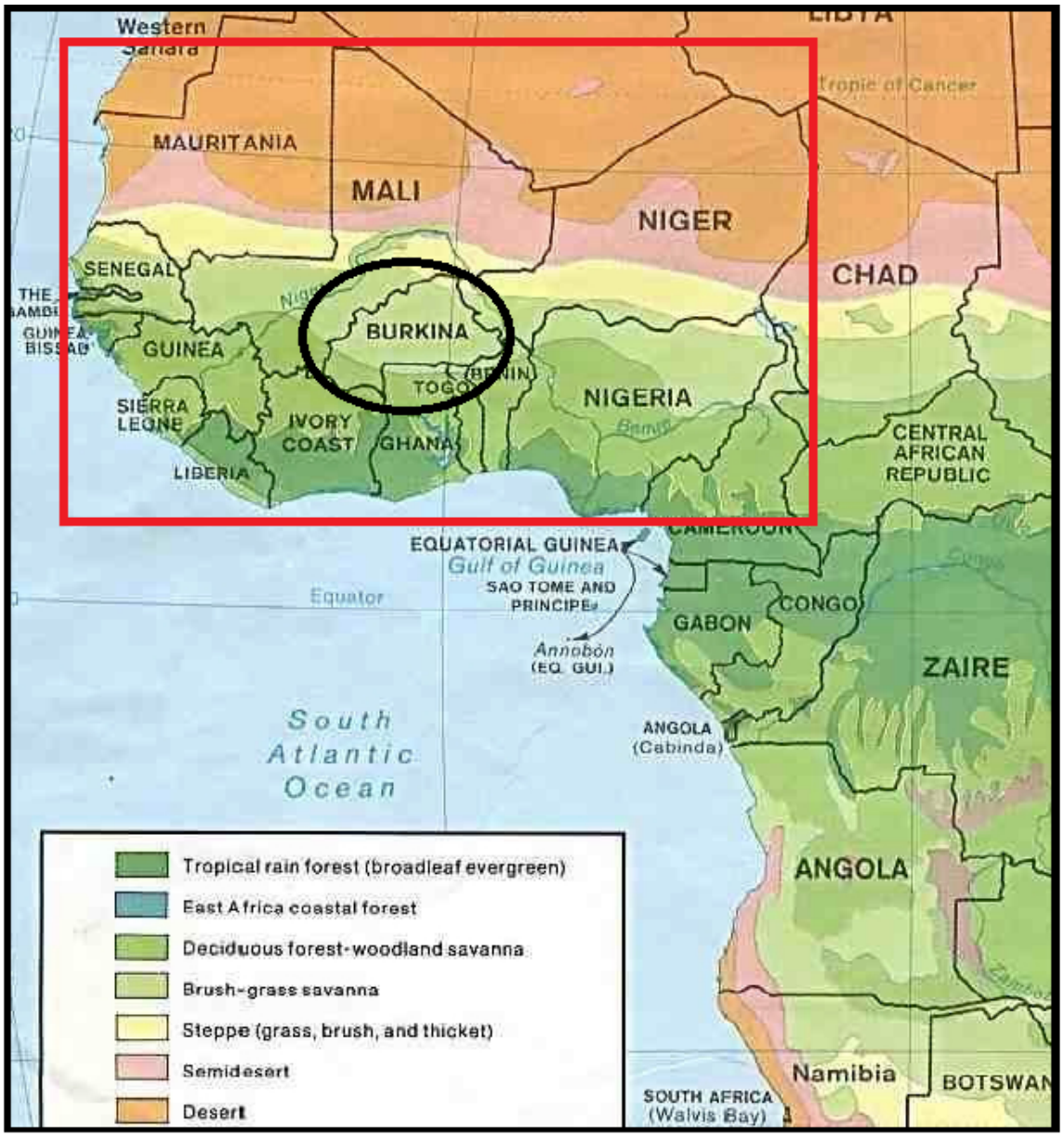
Conférence AMMA, Toulouse 2012

Study area



- Burkina Faso is situated at the core of West African region
- A surface of 274 200 km^2
- The country well represents the mean Sahelian climate conditions
- Drougth conditions since 1970 with a significant decrease in the annual rainfall amount

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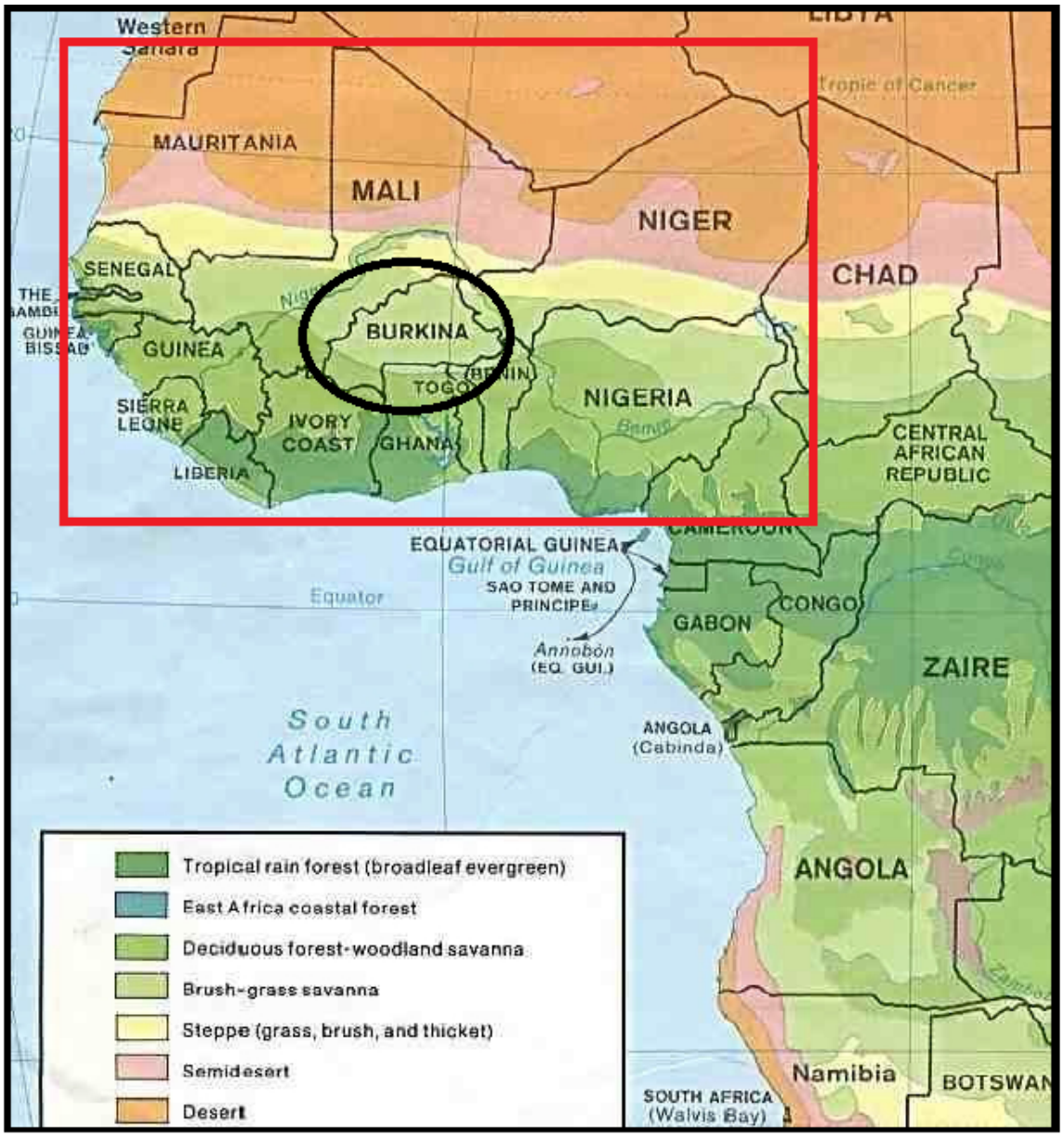

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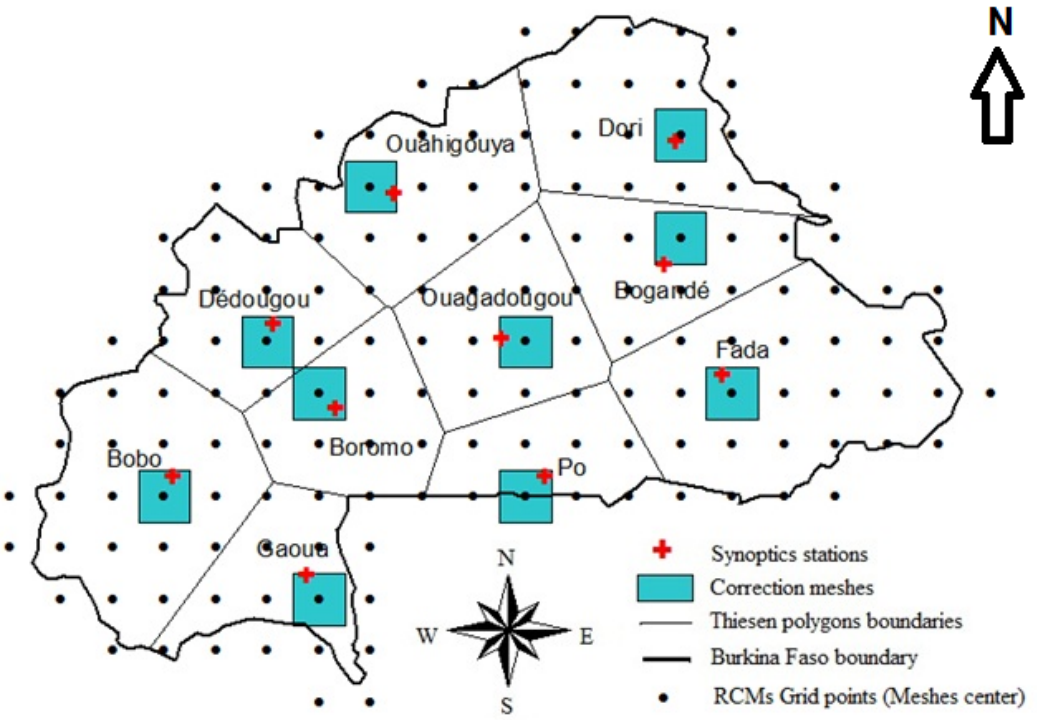
Objectifs

- Characterize the rainfall regime variability over the last five decades :1961-2009 period

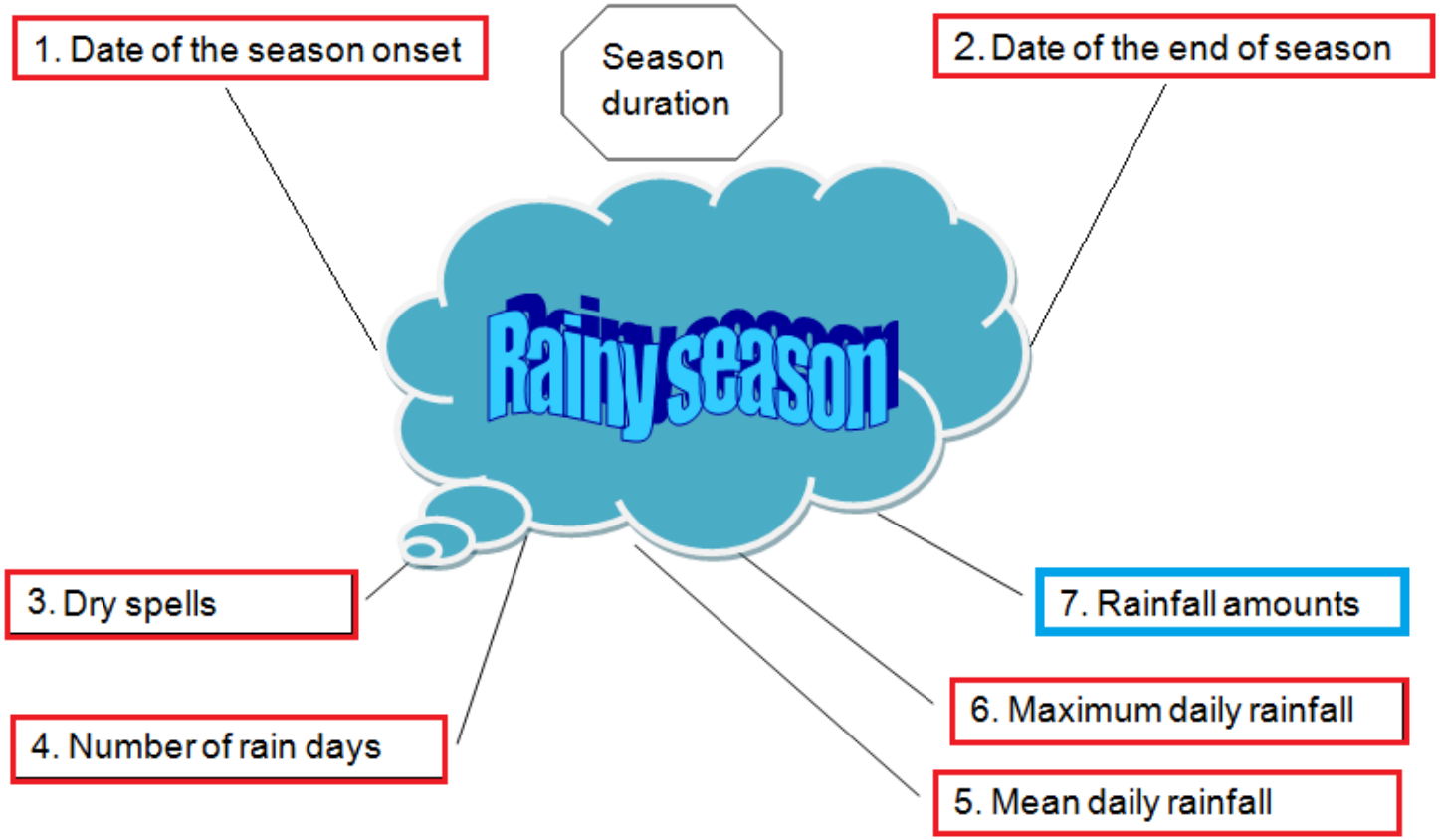
- Assess changes in the rainfall regime under a climate change condition from the rainfall simulated by regional climate models (RCMs)

Rainfall data

- Synoptic network with 10 stations (1961-2009)
- Spatialized rainfall data at 0.5°x0.5° : IRD, CRU, WATCH (1901-2000)
- Five RCMs simulations under the intermediate scenario of A1B (1961-2050) : CCLM, HadRM3P, RACMO, RCA et REMO
- GCMs outputs as boundary conditions



Rainy season discretization



- Period of the rainy season, from the onset to the end of season
- Number of rain days (frequency)
- Rainfall amounts and rainfall classes (intensity)
- Dry spells duration

Relations within the characteristics

Multiple linear regression model of the annual rainfall amount

$$P(t) = f(X_t) = C + \sum_{j=1}^{j=6} a_j x_{j,t}$$

P_t Annual rainfall amount for year t

- Regression model performed over a period
- Reproduction of the annual rainfall amount from six characteristics (x_j) :
  Season onset, End of season, Number of rain days, Mean daily rainfall, Maximum daily rainfall and Mean dry spell length
- Computation of the contribution of each characteristic x_j to the change in the annual rainfall amount between $P1$ and $P2$ from α_j :

$$\alpha_j = a_j \frac{(\overline{x}_{j.P2} - \overline{x}_{j.P1})}{(\overline{\mathcal{P}_{P2}} - \overline{\mathcal{P}_{P1}})}$$

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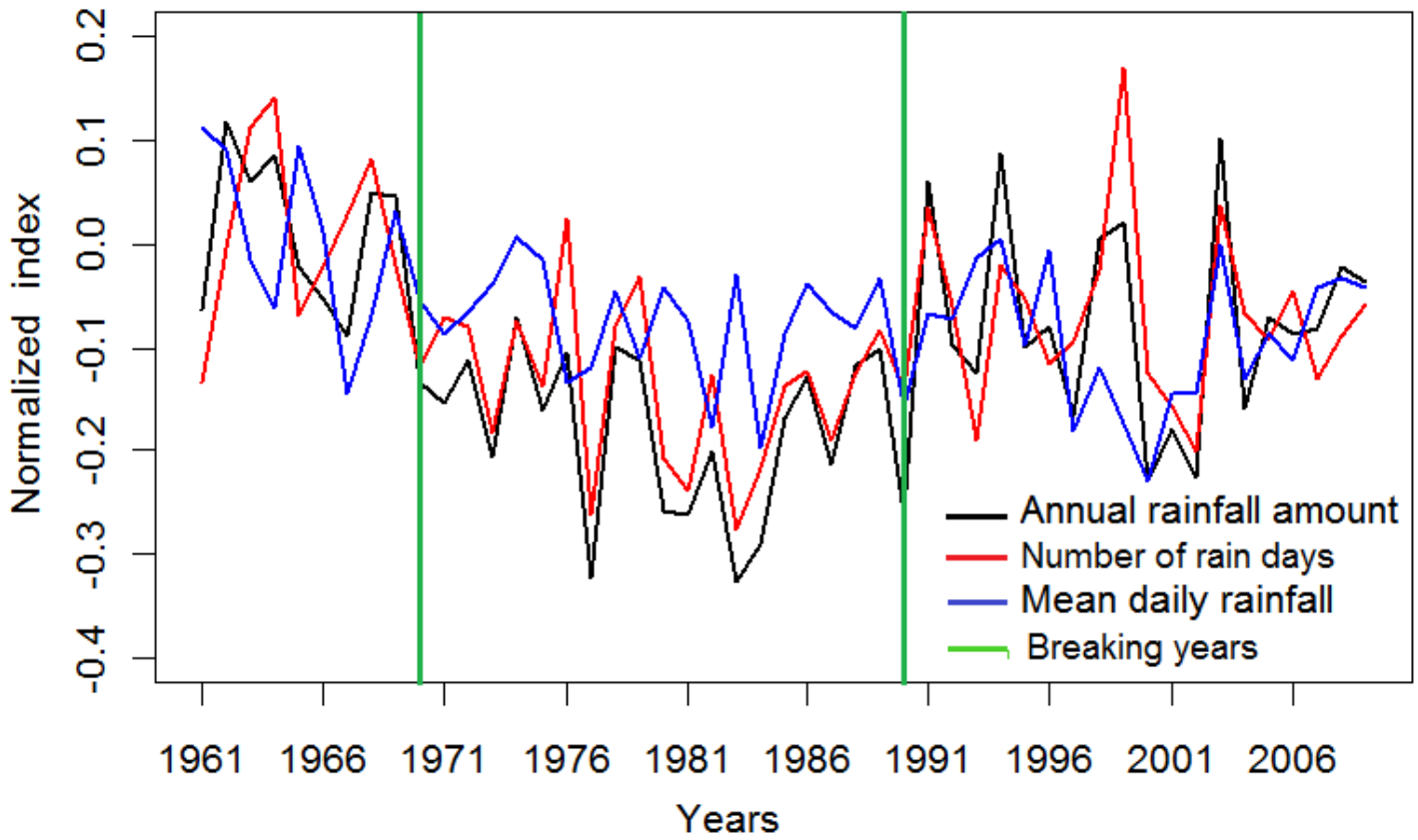
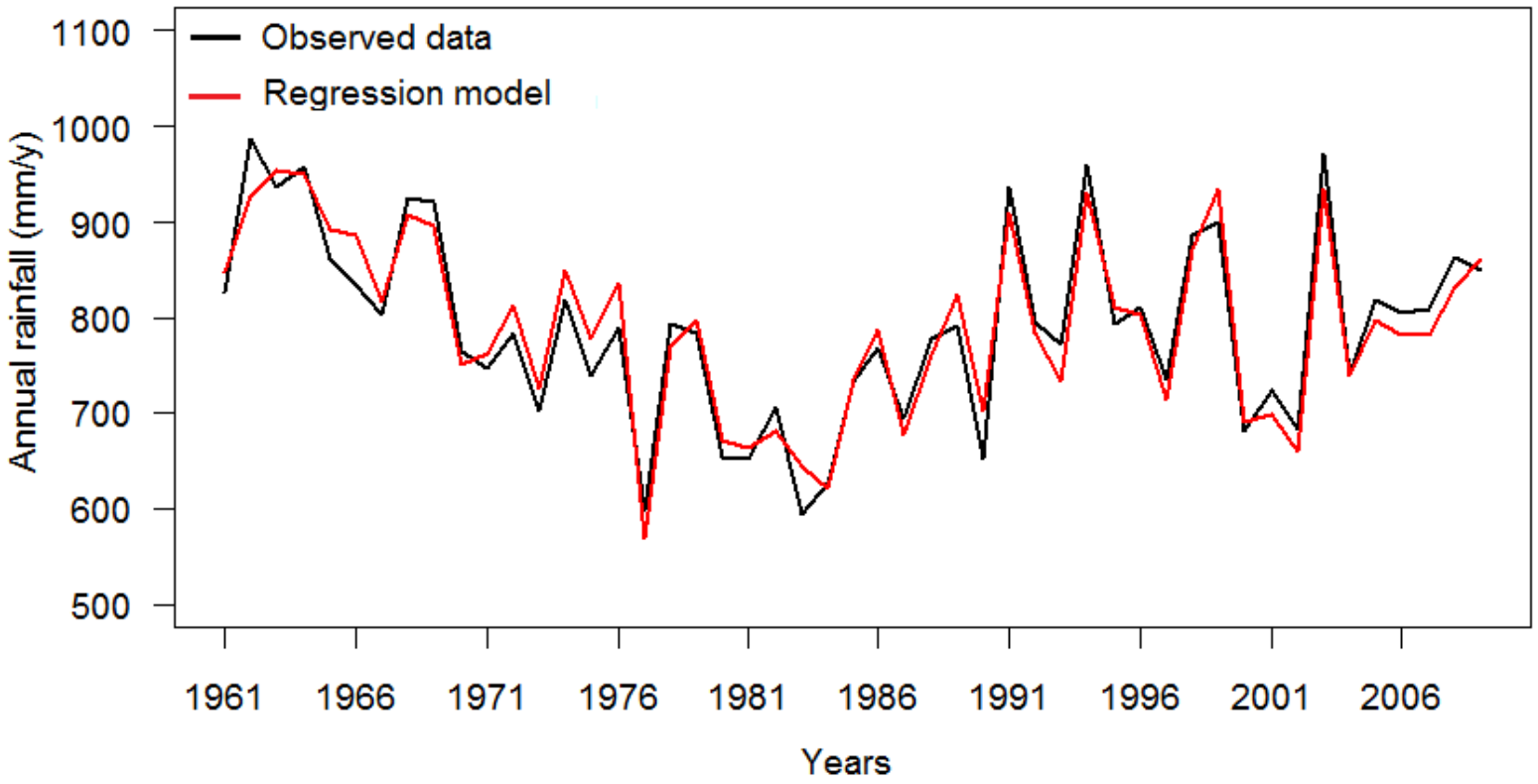
Rainfall variability during 1961-2009



- Segmentation procedure for break date identification (Hubert 1989)
- Three periods with different mean annual rainfall amount : 1961-1970, 1971-1990, 1991-2009
- Two changes : a decrease for the first change and an increase for the second change

Representativeness of the regression model

Annual rainfall amount over 1961-2009 period



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- RMSE and MAE around 3% of the mean annual rainfall amount
- No significant difference between the two time series

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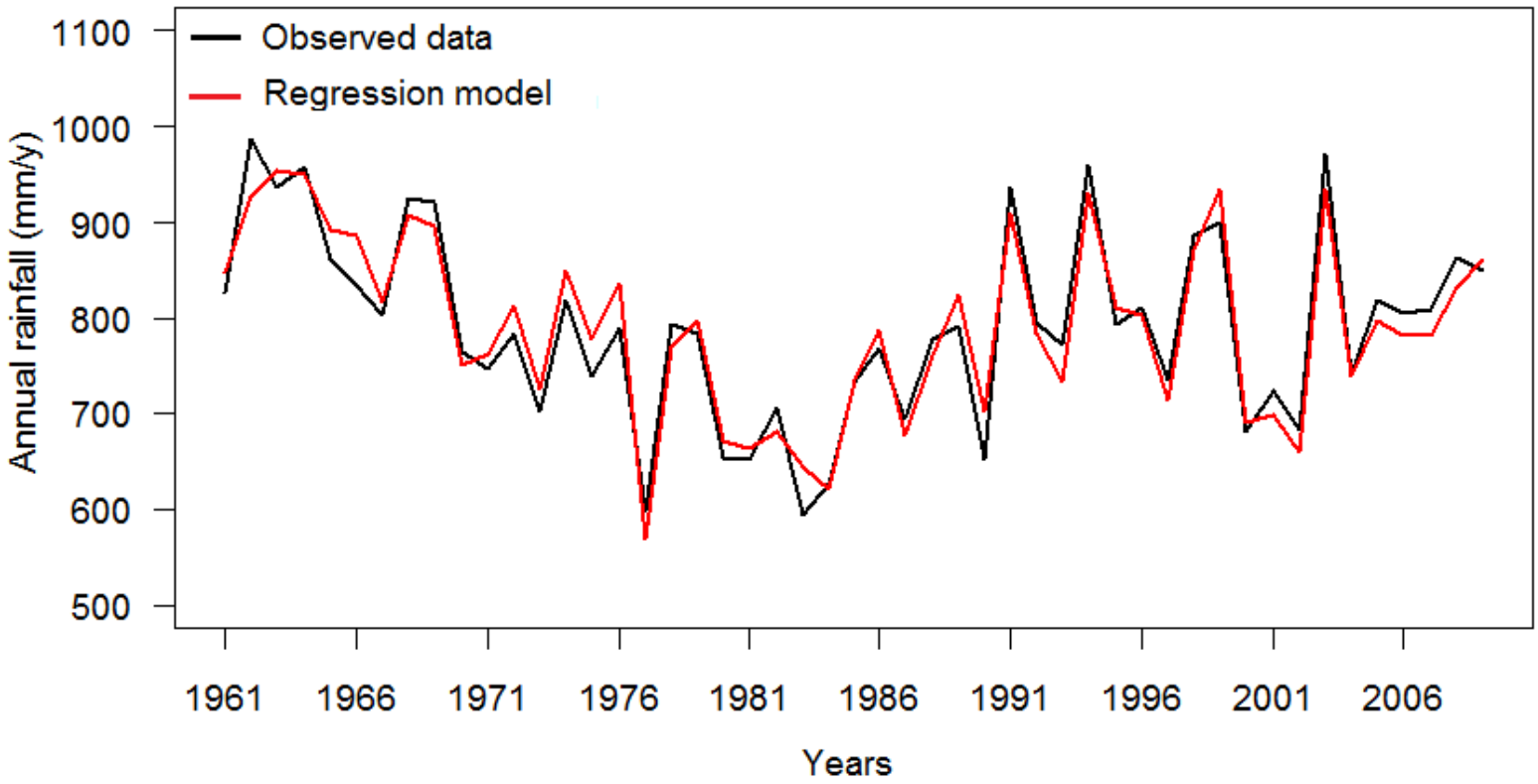

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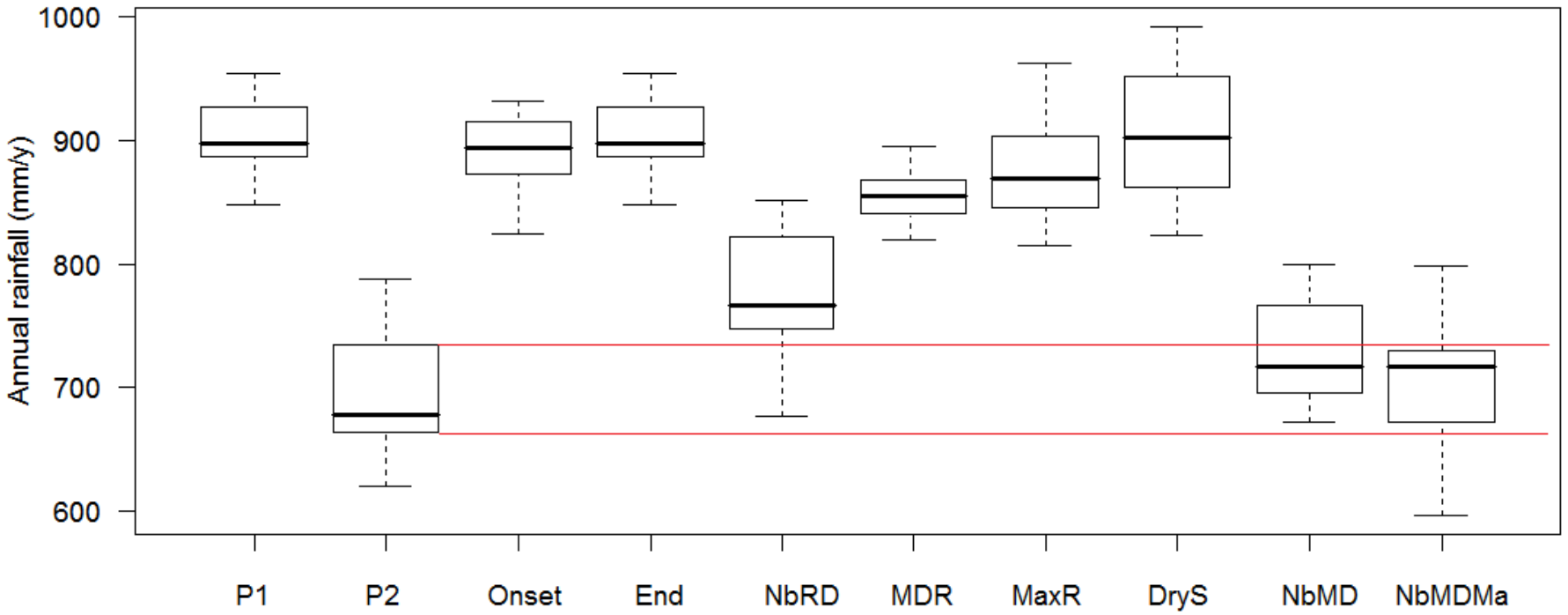
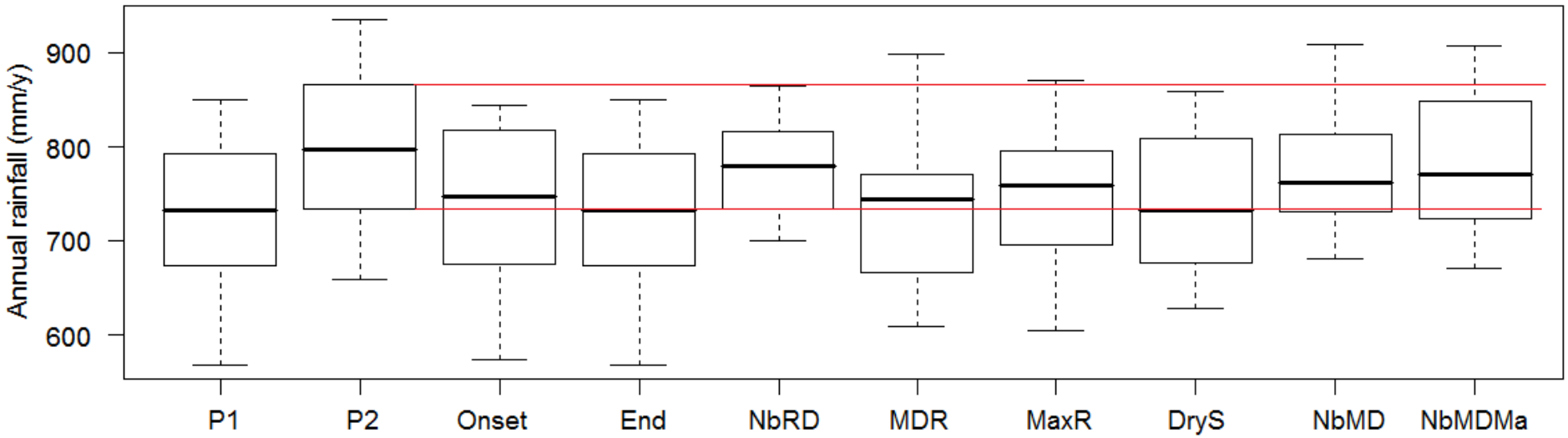
Decreasing change between 1961-1970/1971-1990



- The Change is reproduced from a combination of three characteristics : Number of raindays, Mean daily rainfall and the maximum daily rainfall
- The rain days presents the highest contribution at 70% of the shift

Increasing change between 1971-1990/1991-2009



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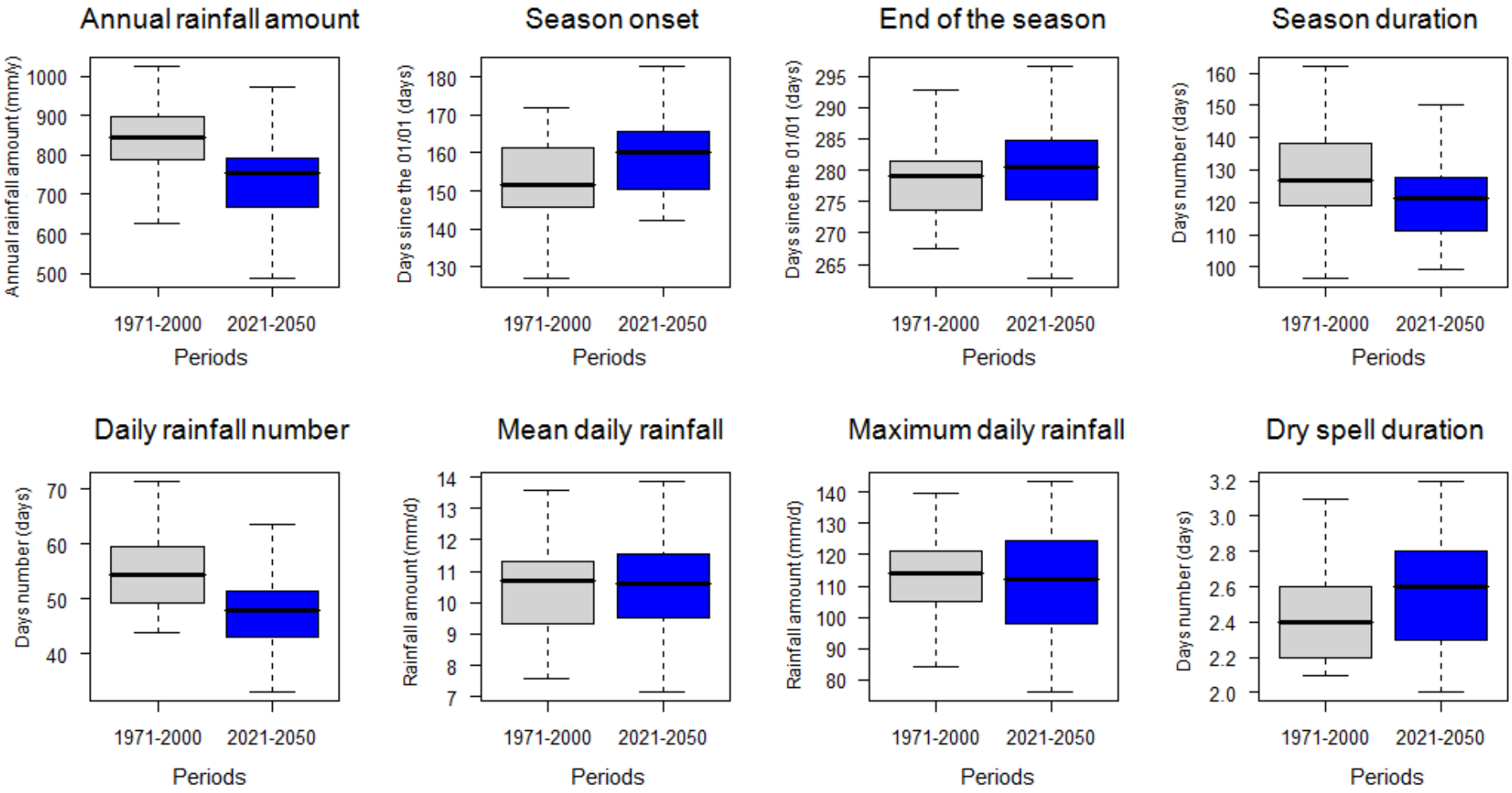
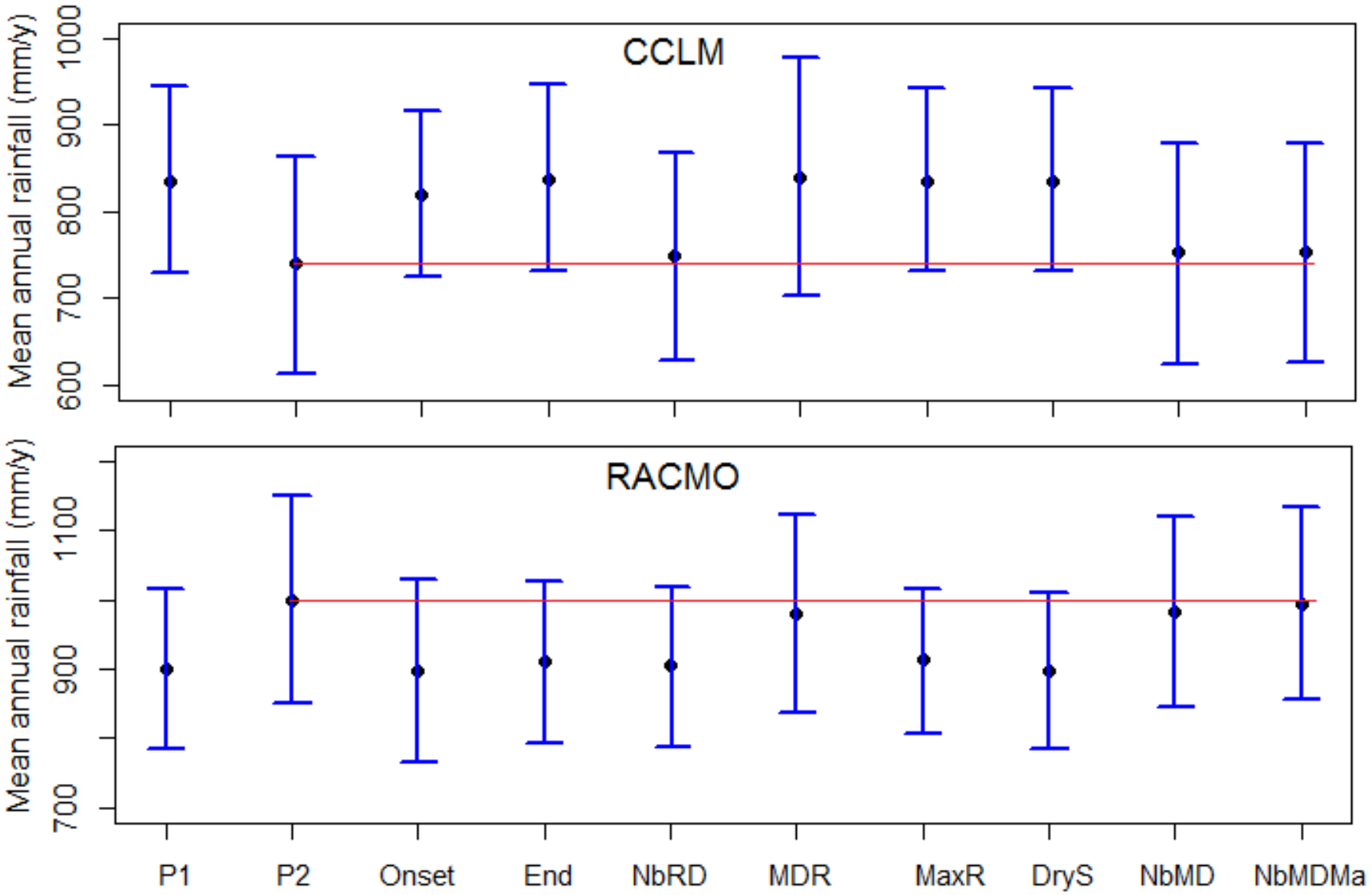
Future changes in rainfall regime (RCMs)

Changes in rainfall regime between 1971-2000 and 2021-2050 from CCLM rainfall data



Explanation characteristics from two RCMs



Explaining variables of the changes in rainfalls

Changes between 1971-2000 and 2021-2050 from the five RCMs

- Decrease in the annual rainfall amount
  - Decrease of 15% for CCLM explains at 95% by a decrease of 15% in the number of rain days
  - Decrease of 5% for RCA explains at 60% by a decrease of 5% in the number of rain days
- Increase in the annual rainfall amount
  - Increase of 5% for HadRM3P explains at 75% by an increase of 5% in the mean daily rainfall
  - Hausse de 10% RACMO explains at 70% by an increase of 10% in the mean daily rainfall
- No significant change in the annual rainfall amount for REMO

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Conclusion

Recent changes in rainfall regime over Burkina Faso

- 1971-1990 is the driest period during the 20^{th} century with a decrease of more than 20% in the annual rainfall amount
- Rainfall recovery over 1991-2009 but the annual amounts remain lower than those over 1960 decade
- Changes are due to the decrease in the frequency of rainfalls at the heart of the rainy season (June-Aughust)

Two robust changes projected in the rainfall regime by the five RCMs

- A delay of about one week for the end of the rainy seasons
- A lengthening of the dry spells at about 20%

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Thanks

Thank you for your attention

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