

# Season-based PDM rainfall-runoff modelling for large basins in southeastern Brazil



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## Highlights

- A season-based probability distributed model was developed.
- It aims to assist water management in basins of distinct seasonality.
- It performed well in Brazilian large basins of size up to ~70000 km<sup>2</sup>.
- It performed best for Furnas (~50000 km<sup>2</sup>) of good input data.
- The calibration parameters vary between wet and dry seasons.

## Introduction

Southeastern Brazil is characterized by seasonal rainfall variability. During 2014 and 2015, the region suffered from one of the most severe droughts since 1960. The resulted water crisis has seriously affected water supply to the metropolitan region of São Paulo and hydroelectric power generation to the entire country.

This study was carried out in the context of providing scientific support for the crisis. The final objective is effective and efficient forecasting and prediction of large reservoirs inflow, which enables appropriate adaptation measures being made and implemented in time to avoid potential economic, social and environmental losses.

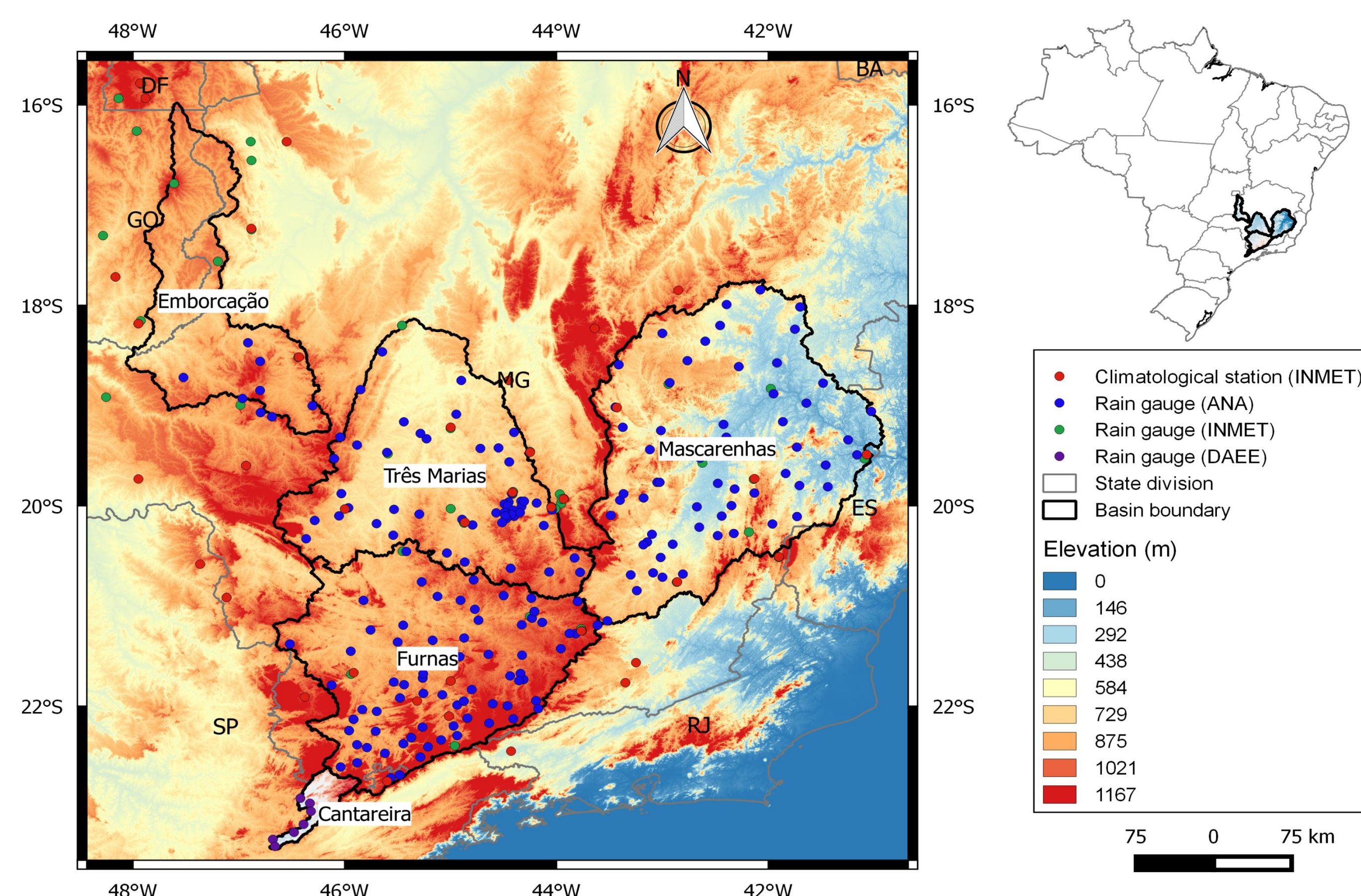


Fig. 1. Location of the study basins.

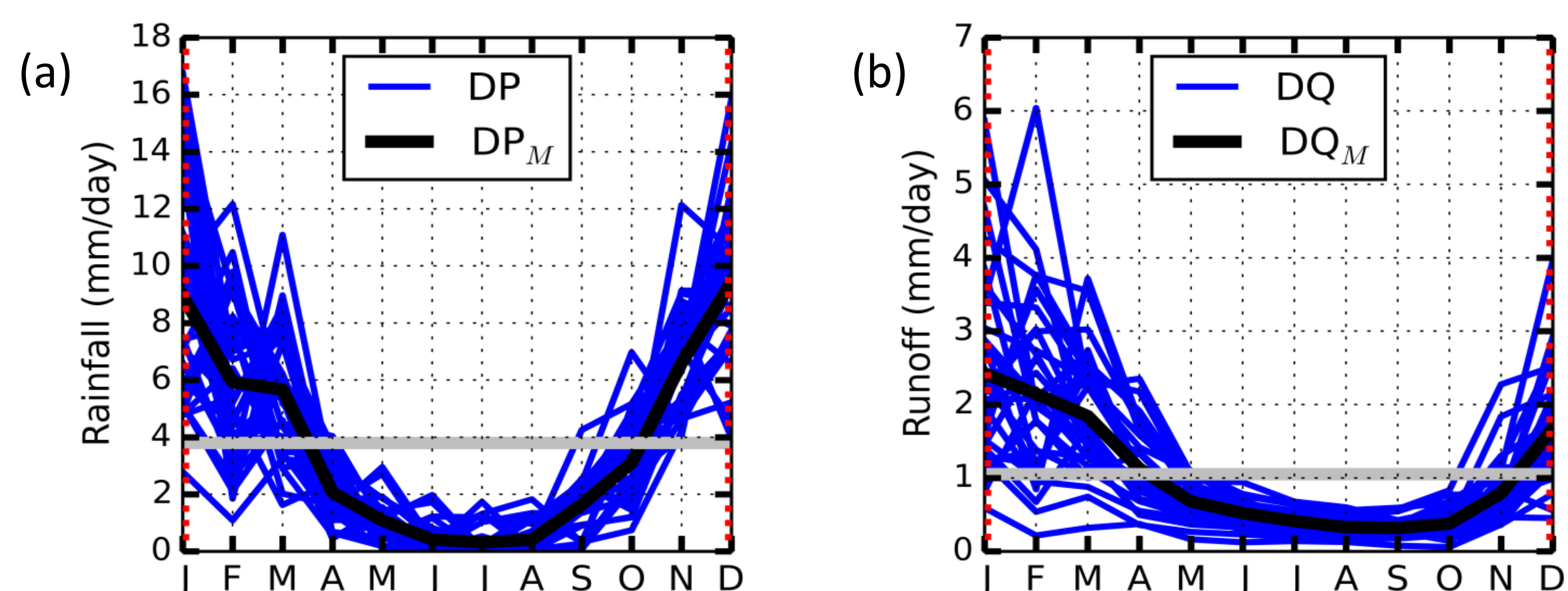


Fig. 2. Seasonality of Três Marias (1985-2015).

Rainfall: ANA and CEMADEN; Runoff: ONS.

## Acknowledgements

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## Note

CT – Cantareira; EB – Emborcação; TM – Três Marias; FN – Furnas; MC – Mascarenhas.  
NSE – Nash-Sutcliffe Efficiency; NSE-log - logarithmic transformed NSE.

## Methods

- The probability distributed hydrological model, or PDM-CEMADEN, by Cuartas (2008), based on PDM of Moore (2007);
- Model parameters by different season;
- Model evaluation by different season;
- Non-dominated sorting genetic algorithm II (NSGA-II) of Deb *et al.*, (2002).

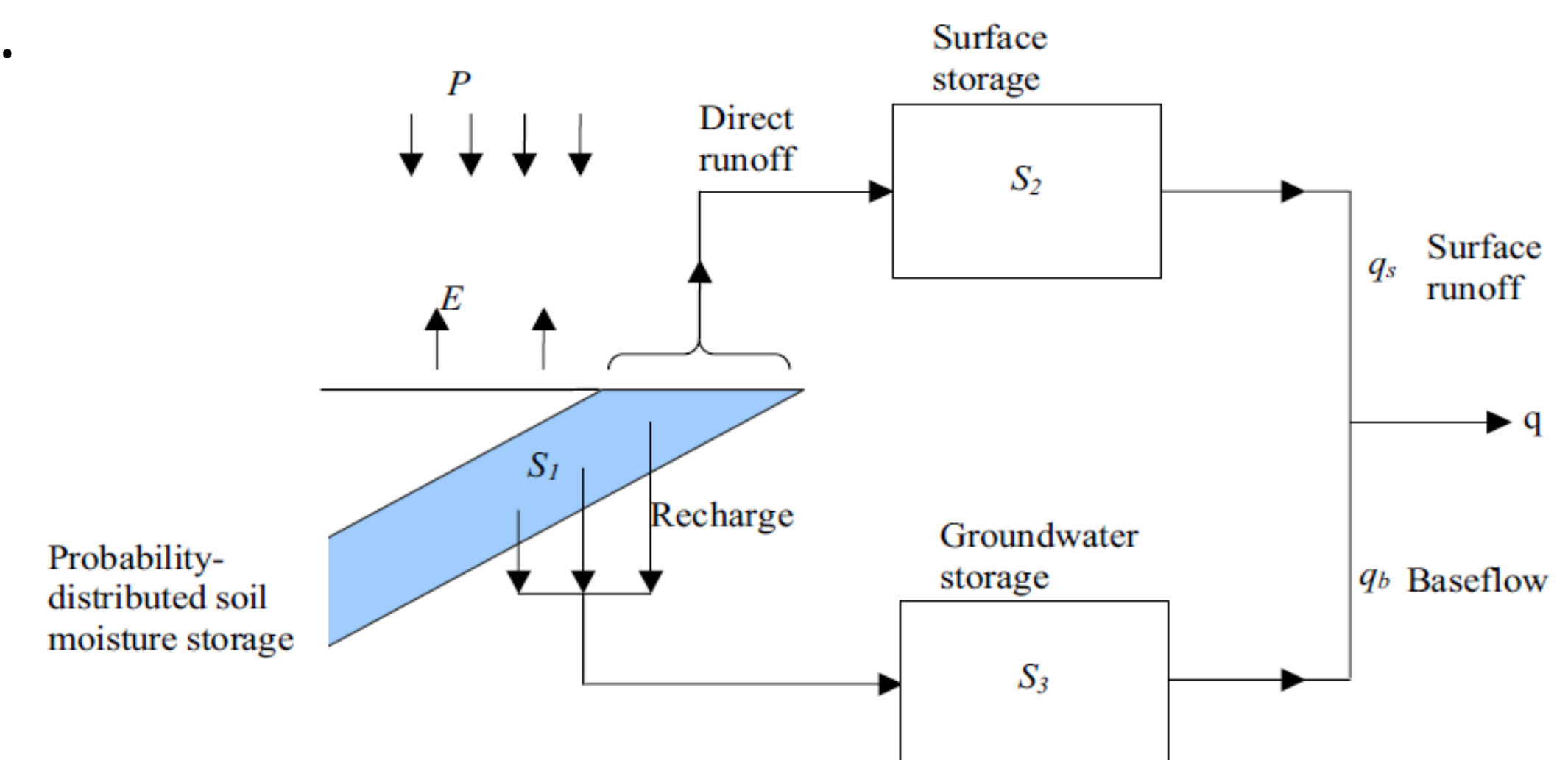


Fig. 3. The PDM rainfall-runoff model (Moore 2007).

## Results

- Optimal parameters

Table 1 The PDM-CEMADEN parameters for the study region.

Parameters	Cmax (mm)	Cmin (mm)	b (-)	kg (day)	kb (day m <sup>2</sup> )	k1 (day)	k2 (day)
Wet	2045.8	151.8	0.36	499.8	3977.3	1.1	6.3
Dry	1832.4	167.7	0.24	570.5	4122.9	0.9	8.0

- Model performance

Table 2 The PDM-CEMADEN performance (daily evaluation).

Basin	Calibration		Validation I		Validation 2	
	NSE	NSElog	NSE	NSElog	NSE	NSElog
CT	0.79	0.81			0.80	0.67
EB	0.81	0.83	0.87	0.90	0.85	0.81
TM	0.90	0.89	0.83	0.90	0.89	0.87
FN	0.92	0.93	0.87	0.88	0.93	0.90
MC	0.85	0.86	0.85	0.83	0.66	0.68

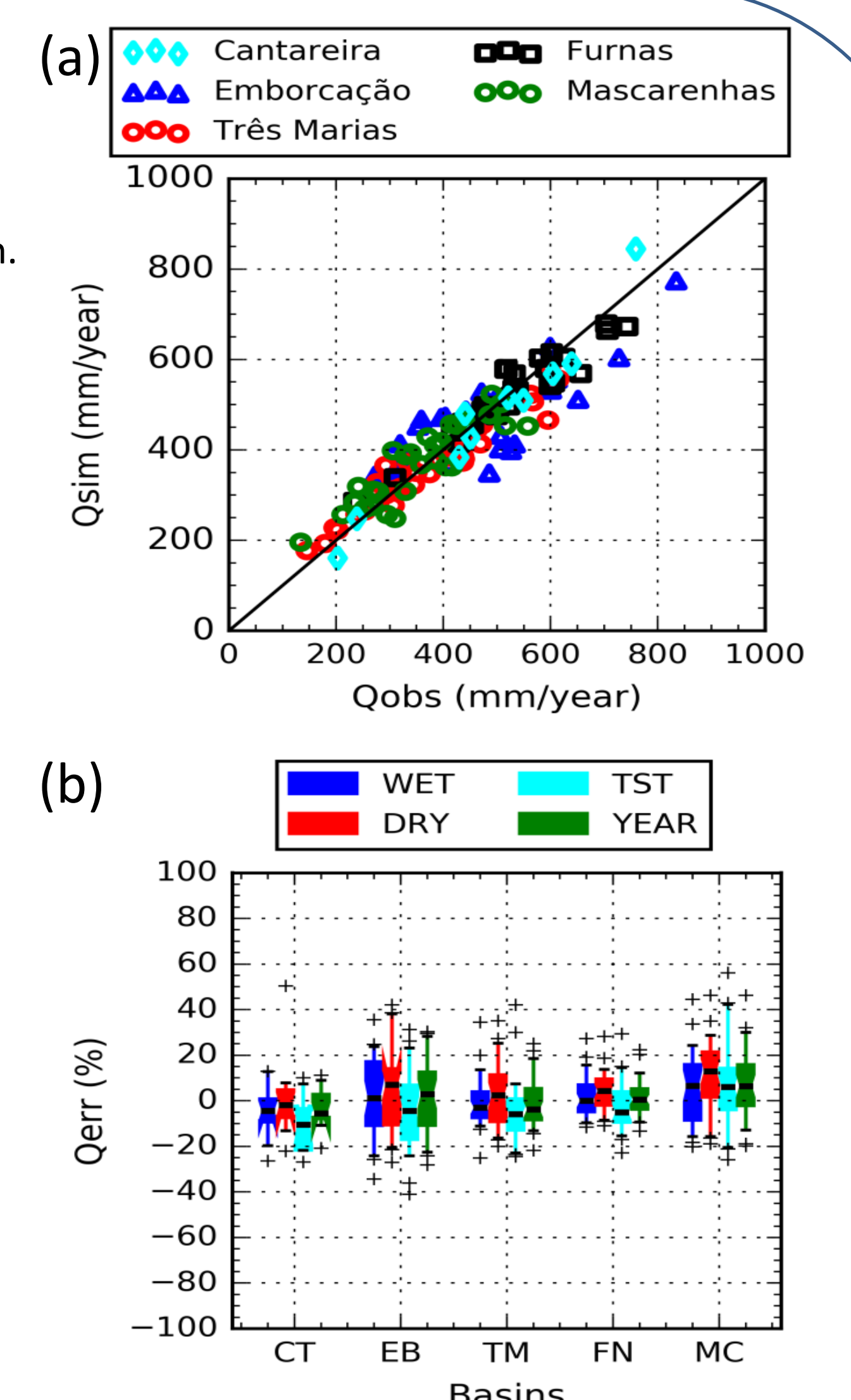


Fig. 4. (a) Annual and (b) seasonal evaluations of performance.

## Conclusions

- The season-based PDM-CEMADEN reproduced well the intra- and inter-annual variability of hydrological processes of southeastern Brazilian Basins with size up to ~70000 km<sup>2</sup>.
- The Cmax and b (kg and k2) during the wet season are larger (smaller) than those during the dry season, which means that during wet season the basin have larger limit and variation of soil water storage, larger soil conductivity and quicker surface water flow than those during dry season.
- The PDM-CEMADEN obtained best performance for the Furnas basin where the daily input of precipitation and potential evapotranspiration are with best quality.

## References

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