

The onset of the rainy season in Western-Central Brazil simulated by Global Eta Framework model

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Introduction

The seasonal cycle of precipitation in tropical South America is determined by the monsoonal system. The transition from dry to wet season occurs in austral spring (September-November, SON) when intense convection from northwestern South America rapidly shifts southward to the southern Amazon Basin and Western-Central Brazil (WCB) in October and further to the Southeast of Brazil in November. This study evaluates ability of the global atmospheric model, Global Eta Framework (GEF), at 25-km horizontal resolution, to simulate the onset of the rainy season in WCB region. The simulations are based on a 5-member ensemble seasonal integrations for the years 2011 and 2013.

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Model and methods

Global Eta Framework (GEF) was developed by Zhang and Rančić (2007) as a unique global expansion of the regional Eta model, based on a general curvilinear formalism and capable of running on various rectangular spherical grids. In this study, the model uses a cubed-sphere grid topology, whose symmetry and uniformity enable a highly scalable and efficient performance. A specific version of the cubed-sphere used in this study provides an equal-area grid topology (with exception of three grid boxes around vertices) without angular discontinuities across the edges (Purser and Rančić, 2011; Purser et al., 2014; Rančić et al., 2017)

Marengo et al. (2001) defined the pentad that represents the onset of the rainy season as the one with daily precipitation greater than 4 mm day⁻¹, preceded by at least 6 out of 8 pentads with daily precipitation less than 3.5 mm day⁻¹, and followed by at least 6 out of 8 pentads with daily precipitation of more than 4.5 mm day⁻¹.

Model-relative threshold criteria (Zeng and Lu, 2004; Geil et al., 2013):

$$NPI = \frac{P_{\text{threshold}} - P_{\text{min}}}{P_{\text{max}} - P_{\text{min}}}$$

NPI - normalized precipitation index

P_{threshold} - 5-days average precipitation threshold defined by Marengo et al. (2011)

P_{min} and **P_{max}** – the 16-years climatological values of the area-averaged minimum and maximum monthly CMORPH precipitation

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Results

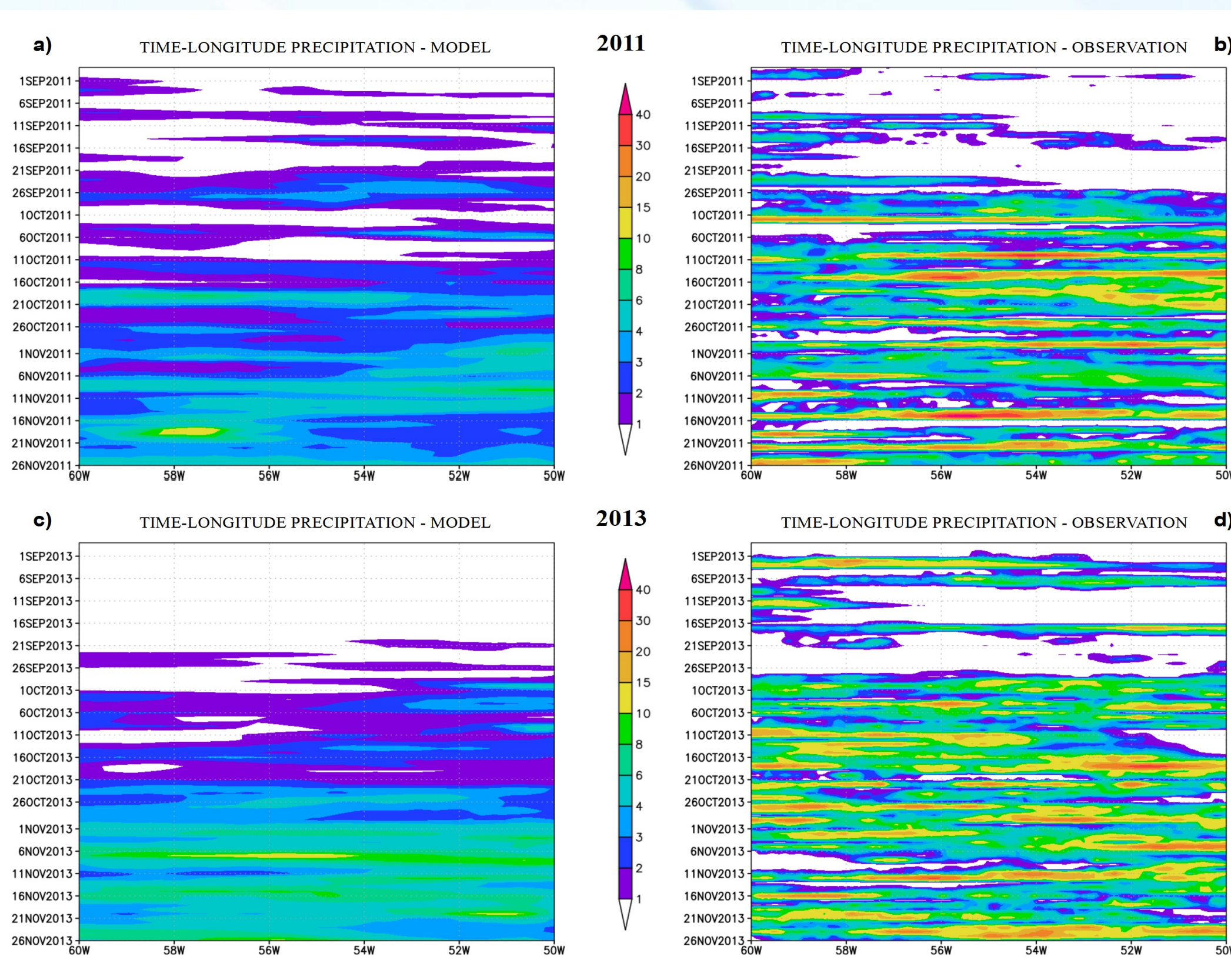
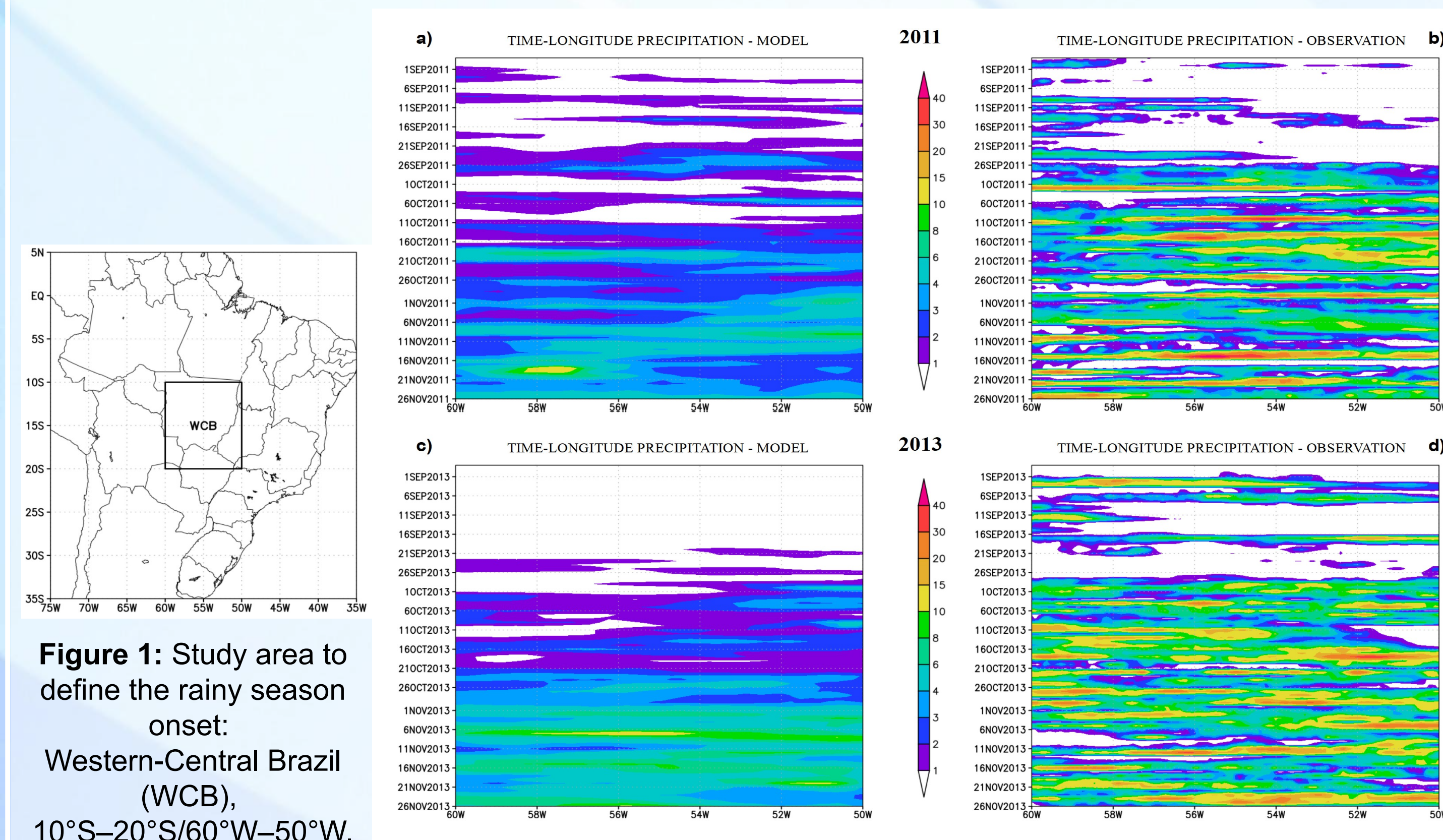


Figure 2: Time-longitude daily precipitation (mm day⁻¹) averaged over 20°S–10°S for the period 29 August–26 November (pentads 49–66) of 2011 (top row) and 2013 (bottom row). Simulated precipitation (mm day⁻¹) is on the left ((a) and (c)) and observed precipitation is on the right ((b) and (d)).

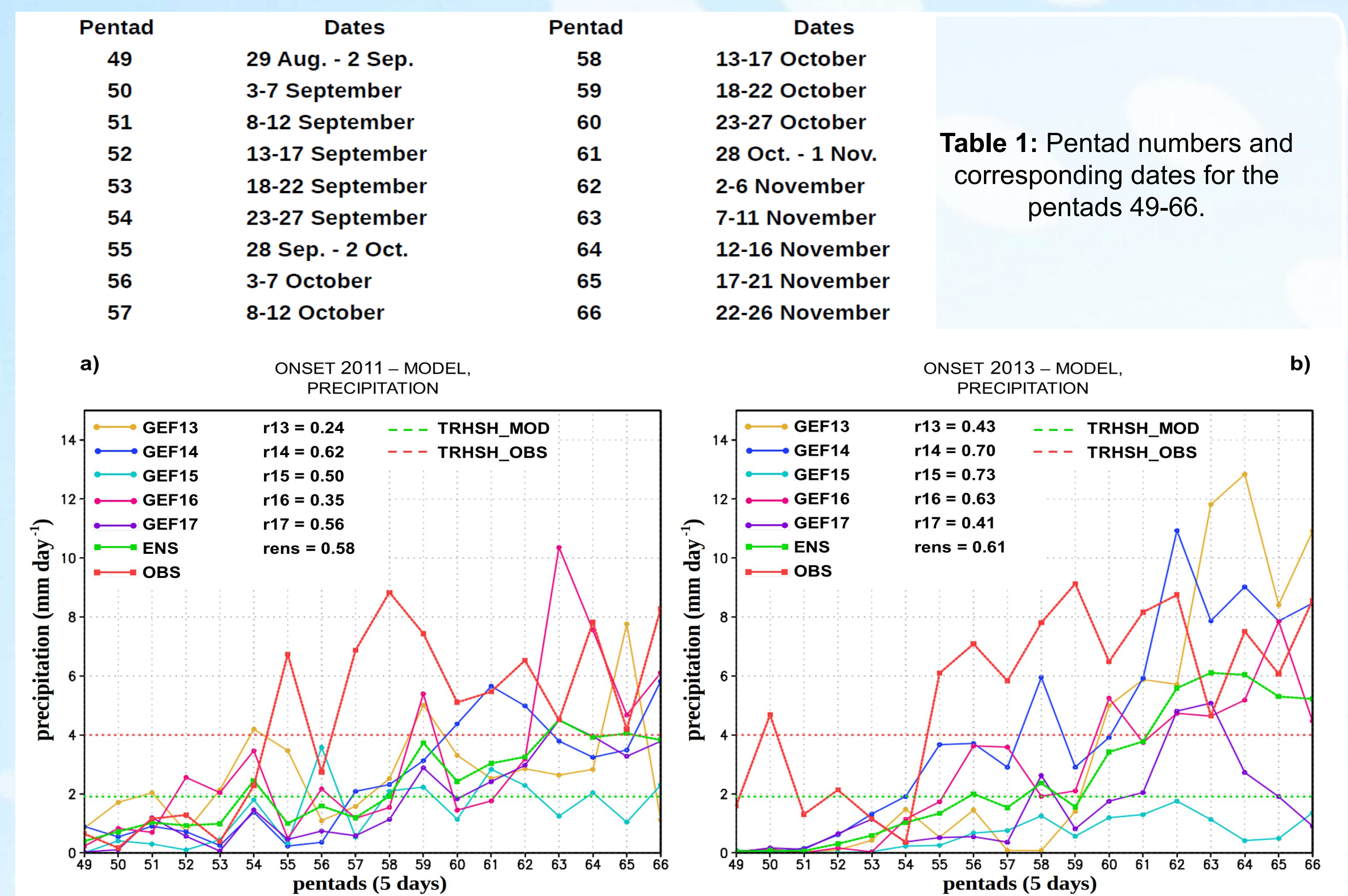


Figure 3: 5-day averaged time series of precipitation (mm day⁻¹) of all members of the ensemble, ensemble mean and observation, observed and model-relative threshold for the period 29 August–26 November (pentads 49–66) of the years (a) 2011 and (b) 2013.

Conclusions

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The simulation clearly shows the transition of precipitation regime from dry to wet, approximately at the end of September, beginning of October, which differs from observation by a couple of days

In order to explicitly define the threshold of the model simulations, the model-relative threshold is calculated and it shows that the model delays the onset for 1 or 3 pentads in presented years

The underestimate of the precipitation rate over tropical continental regions, particularly over South America, remains one of the main issues of the model

The demonstrated computational efficiency of GEF by Zhang and Rančić (2007) and the results presented in this study confirm that continuous efforts in development of the model can give significant contribution to the improvement of the seasonal forecasts at CPTEC

Acknowledgements

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