From evaporation to precipitation:
the atmospheric moisture transport
8th EGU LEONARDO CONFERENCE
Ourense, Spain
25-27 October 2016

Are the Mesoscale Convective Systems the Major Precipitating Sources in Amazon Basin?

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Introduction

Mesoscale Convective Systems (MCSs) are known to cause large cumulative rainfall in different regions of the world, and represent the largest existing convective storms (Houze, 2004). They are intense and extensive and can last many hours. A climatology of the MCSs over the Amazon basin was recently obtained (Rehbein et al., 2016a). However, many questions about the MCSs and its impact in the precipitation over the Amazon basin are still unanswered...

- How the intensity of MCSs can vary across the Amazon basin and according to the year?
- Which is the amount of rain caused by MCSs over the Amazon basin?
- Are the Mesoscale Convective Systems the major precipitating sources in the Amazon basin?

Therefore, the objective of this study is to verify the contribution of the MCSs for precipitation in the Amazon basin.

Materials and methods

Algorithm: Forecast and Track the evolution of Cloud Clusters (ForTraCC; Vila et al., 2008) was applied to infrared satellite images with spatial and temporal resolution of 4×4km and 30 minutes, respectively (Janowiak et al., 2001), to identify and track the MCSs. The threshold 150 pixels (2,400km²) with brightness temperature of 235K or less defines the MCSs. More details in Rehbein et al. (2016a).

Precipitation: Monthly Tropical Rainfall Measurement Mission (TRMM-3B43) → spatial resolution of 0.25º×0.25º

Region: The geographical domain and topography of the Amazon → Observatoire de Recherche en Environment (ORE-HYBAM).

Results

Fig. 1a shows that the monthly distribution of MSCs follows the annual cycle of the precipitation over the Amazon basin.

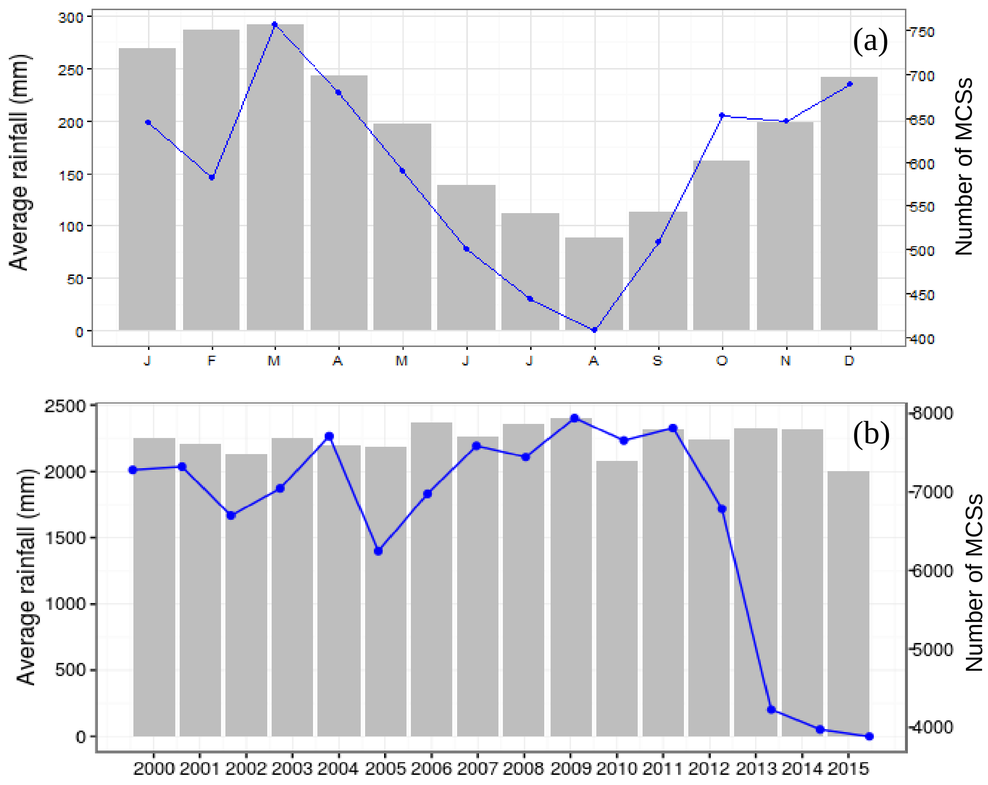

Fig. 1 – (a) Monthly distribution of the MCSs (line) and monthly mean rainfall (bars) over the Amazon basin, (b) Annual distribution of the MCSs (line) and annual mean rainfall (bars) over the Amazon basin. Adapted from: Rehbein et al. (2016). Precipitation data from Tropical Measurement System (TRMM - 3B43)

There is not a clear relationship between the interannual variations (Fig. 1b), e.g., 2010 was a dry year in the Amazon basin, and the MCSs were above the average.

Also, between 2012 and 2015, the MCSs showed a marked tendency reduction in number.

Correlation tests was made and it was observed:

- There is not a linear correlation between the rainfall and MCSs over the Amazon basin during the wet season, Figs. 2a and 2b, and transition months → wet season the distribution of the MCSs is more homogeny along the Amazon.
- There is better correlations (about 0.7) during the winter (dry season) → in the dry season, the MCSs and rainfall are displaced and concentrated to the north part of the basin, Figs. 2c and 2d;
- The spatial correlations between MCSs and topography are more evident over the region of precipitation hotspots close to the Andes Mountain.

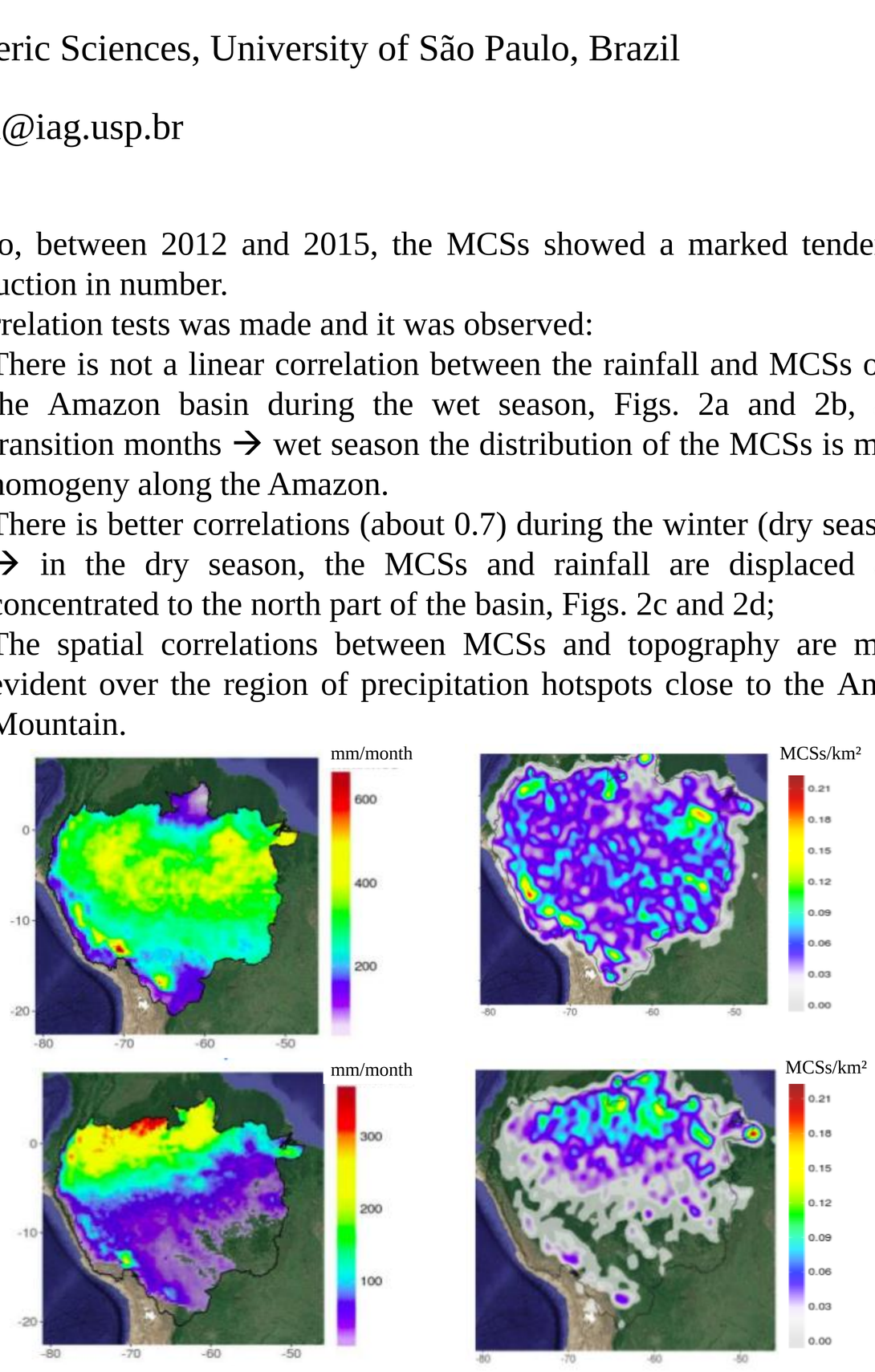

Fig 2 – (a) Precipitation (mm/month) and (b) density of MCS (MCSs/km²) during March, (c) Precipitation (mm/month) and (d) density of MCS (MCSs/km²) during August.

Conclusions

There is clear correlation for the dry season, but not during the wet season. This relatively low correlation occurs because each algorithm identify differently the related phenomena. In one hand ForTraCC identifies cloud cluster tops and the other, TRMM-3B43 is designed to measure and estimate precipitation. Both measurements are complementary and with a general overview they have good agreement, but not in a pixel-by-pixel correlation. Despite that, MCSs density is still a good tool for evaluating possible hotspots of deep convection.

References

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Aknowlegdements: This work was supported by FAPESP (acronym of the Portuguese, São Paulo Research Foundation) via process No. 13/50521-7.