LYFE CYCLE CHARACTERISTICS OF PRECIPITATING SYSTEMS OVER PARAIBA VALLEY, BRAZIL: PRELIMINARY RESULTS OF GLM-CHUVA EXPERIMENT

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ABSTRACT

This study describes the life cycle characteristic of precipitating systems over Paraiba Valley, Brazil using ForTraCC (Forecasting and Tracking the Evolution of Cloud Clusters) tool for describing the evolution of those systems in the area of influence of a dual-polarization, X-band radar (X-POL), used during GLM-CHUVA experiment. This experiment took place between November 2011 – March 2012 (rainy season in Paraiba Valley) and preliminary statistical results show that the average duration of precipitating system is around 0.42 hours while the maximum rain rates are observed around 17 GMT (with a minimum around 10 GMT).

1. INTRODUCTION

Water is essential for life on Earth. Its distribution drives mankind way of life and its behavior determines weather, climate and environmental conditions. One of the most challenging research problems in the Earth Sciences is related to the lack of understanding about the physics involved in the measurement of the various precipitation processes (volume, distribution, rates and associated heat release). Furthermore, this difficulty is augmented by the small number of observations, especially over the tropics and the oceans.

This study describes the life cycle characteristic of precipitating systems (PS) over Paraiba Valley, Brazil using the Forecasting and Tracking the Evolution of Cloud Clusters (ForTraCC) tool for describing the evolution of those systems in the area of influence of an X-POL radar, used during GLM-CHUVA experiment. Figure 1 shows the horizontal reflectivity on a 2.6 º plan position indicator (PPI) during November 30, 2011 at 19:18 UTC. The area of influence of the X-POL radar, used during GLM-CHUVA experiment is delimited by 100 km ring (external) where the attenuation of the precipitation systems are corrected (Gematronik, 2007).Therefore this study describe the principal characteristics of the PS through analyses of diurnal and life cycle, trajectories and dislocation intensity.

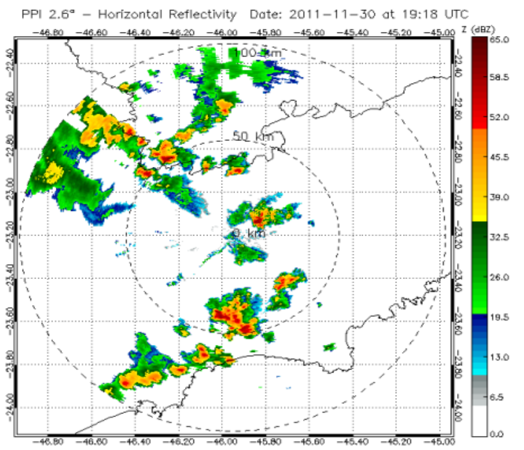

Figure 1: Horizontal Reflectivity on a 2.6 º plan position indicator (PPI) during November 30, 2011 at 19:18 UTC.

2. METHODOLOGY

The CHUVA-GLM experiment took place between November 2011 – March 2012 (rainy season in southeastern Brazil) and in order to describe the evolution of precipitating systems in the area of influence of the X-POL radar, a piece of software called ForTraCC was used to track those systems along the life cycle. ForTraCC is a nowcasting system originally developed to use satellite data to track and forecast Mesoscale Convective System (MCS) (Vila et al., 2008) but it was adapted to run using radar and ancillary data to provide an integrated nowcasting tools running over a GIS.

Approximately 36000 radar images were processed during the entire period to produce rain rate fields every 6 minutes using. The ForTraCC technique is an algorithm that allows for the tracking of PS properties. The main steps of this algorithm are the following: 1) a PS detection method based on a size and a rain rate threshold, 2) a statistical module to identify different parameters of each PS, 3) a tracking technique based on PS overlapping areas between successive images. Was used an threshold of the 200 pixels (8km^2) and 1mm/h for select and track the PS.

3. RESULTS

Around 2700 families (this means the set of PS along the life cycle from formation to dissipation) with no split or merge were detected for the entire period. Figure 2 shows the frequency distribution in terms of life cycle duration. The average life cycle duration is 0.42 hours and the median is 0.40 hours. This short time could be due to the restrictions imposed to the dataset (no split, no merge) and the size of the radar target area which reduce significantly the size of the sample.

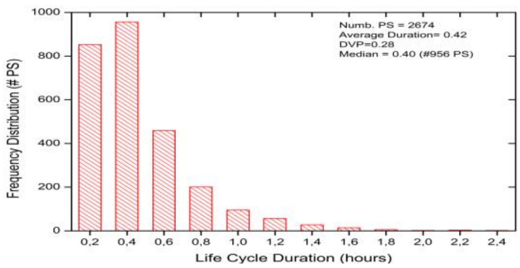

Figure 2: Frequency distribution in terms of life cycle duration.

A Figure 3 show the average lifetime of the PS area for systems with 0.2, 1.0, 1.5 and 2.3 hours. The precipitation area presents maximum size close maturation and the longer the duration the greater the maximum size and initial area expansion rate. Similar results have been observed for MCS and cloud-to-ground lightning by Machado et al. (1998) and Mattos and Machado (2011), respectively.

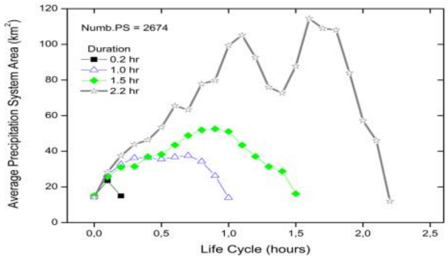

Figure 3: Average precipitating system area (km^2) over the life cycle of storms with duration of the 0.2,1.0,1.5 and 2.3 hours.

Figure 4 shows the diurnal cycle of several parameters calculated with ForTraCC including area expansion and average (blue curve) and maximum (red curve) rain rate. A sharp increase in the rain rate is observed after the system begins to expand (positive values of normalized area expansion, black curve). The maximum of precipitation is observed at 17 GMT while the minimum is observed around 10 GMT.

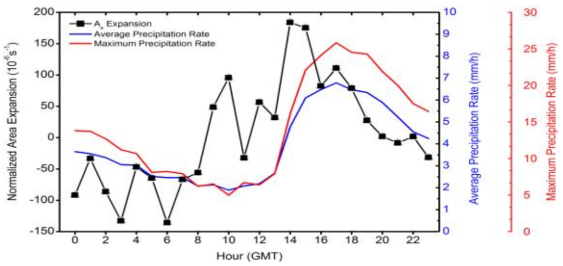

Figure 4: Diurnal cycle of several parameters calculated with ForTraCC.

4. ACKNOWLEDGEMENTS

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5. REFERENCES

Gematronik., 2007. Dual-Polarization Weather Radar Handbook, 2nd Edition. V.N. Bringi, M.Thurai, R. Hannesen (Ed.). Selex-SI Gematronik, 163 p.

Machado, L.A.T., Rossow, W.B., Guedes, R.L., Walker, A.W., 1998. Life cycle variations of Mesoscale Convective Systems over the Americas. Mon. Weather Rev. 126, 1630-1654.

Mattos, E.V., Machado, L.A.T., 2011. Cloud-to-ground lightning and Mesoscale Convective Systems. Atmos. Res.,99,377-390.

Vila, D.A., Machado, L.A.T., Laurent, H., Velasco, I., 2008. Forecast and tracking the evolution of cloud clusters (ForTracCC) using satellite infrared imagery: Methodology and validation. Weather Forecast. 23, 233-245.