CLOUD CLUSTER LIFE CYCLE OVER THE AMAZONIA DURING THE WET AMC/LBA CAMPAIGN

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1. INTRODUCTION

Tropical convective systems are important because they account for most of the total rainfall. Moreover they are responsible for the main vertical exchanges of energy in the tropical troposphere.

An automatic method using GOES high resolution infrared images, has been used for tracking cloud clusters during their life cycle. The method allows for the tracking of every mesoscale convective cloud cluster, defined as adjacent pixels colder than a brightness temperature threshold. The tracking algorithm is based on the cluster overlap between two successive images. The methodology allows an objective determination of parameters such as size, mean temperature, temperature variance, duration, coordinates of the center of gravity, speed, trajectory, eccentricity and many other radiative and morphology properties of cloud clusters.

Two tracking methodology making use of the same image dataset are compared. The main difference between these two methods is the criterion used to identify clusters between two succesive images.

Using full space and time resolution satellite data, the study is here limited to the Amazonian region (20S-7N; 60W-30W) during the wet season Atmospheric Mesoscale campaign (WET AMC) of the Large scale Biosphere Atmosphere experiment in Amazonia (LBA), in January-February 1999.

2. METHODOLOGY

Convective clouds are detected using the GOES infrared channel, assuming that cold cloud top temperatures are strongly related to deep convection. Indeed this assumption is relevant for tracking tropical cloud clusters throughout their lifetimes since in the tropics cold cirrus with a large emissivity generally result from deep convection. A brightness temperature threshold depicts cold cirrus shields which may last longer than deep convection, i.e. cloud clusters are tracked including the dissipation stage when convection is no longer active.

Convective clouds are identified using a brightness temperature threshold. We use here two thresholds, 235 K and 210 K that aim to depict convective clusters and very deep convective cells respectively.

In the first methodology described by Mathon and Laurent (1999), cloud area that exceed 5000 km2 are considered for the tracking from one image to the successive one. The tracking algorithm is based on the overlapping method described by Williams and Houze (1987) or Arnaud et al. (1992). This technique simply assumes that cloud clusters at a later time correspond to those of an earlier time when their positions overlap. When several clusters overlap we consider the pair with the largest overlapping surface. The method allows for disanguishing spontaneous initiations from cluster split generations and actual dissipations from cluster mergings.

In the second methodology described by Machado et al. (1998), every cluster is analysed in every image. In a second step, the correspondence between successive image clusters is made by minimizing a cost function taking into account the structural and radiative characteristics of the clusters.

Using high resolution GOES images (30 min apart, spatial resolution of about 5 km) it is possible to track every mesoscale convective system of one hour life duration or more. However the cloud cluster identification is possible only in case of very good image data. Actually the GOES images received and archived in CPTEC (Centro de Previsão de Tempo e Estudos Climáticos) presented many failures such as bad pixel values, missing lines or missing images. Therefore a premilinary but huge work was undertaken to clean the dataset. In case of a few missing pixel or lines the missing values were replaced by the nearest pixel values, if too many lines were missing the entire image was skipped. After this preprocessing 343 images were missing between January 14th and February 12th, 1999, i.e. on average 23 out of a total of 48 per day. After the 12th of February the tracking algorithm was no more performed because the number of missing images was too large.

In the first tracking methodology an interpolation scheme makes it possible to generate virtual images from the displacement of the cloud clusters of the previous images. This interpolation scheme is no more applied if more than 10 successive images (i.e. 5 hours) are missing.

3. RESULTS

Figure 1 shows the trajectories of the main mesoscale convective cells over the whole Amazonian region. As a whole the picture is quite complicated, showing that there is no preferential cloud propagation at this scale. However some patterns can be seen when considering classes of convective systems based on life duration, size or diurnal cycle, or when considering smaller regions (results not shown).

In Fig. 1 are plotted only the trajectories of the cloud clusters beginning by spontaneous initiation and ending by actual dissipation. Table 1 shows how the 2953 tracked clusters begin and finish their life cycle. New (end) dataset means that the cluster was generated (dissipated) at the beginning (end) of the dataset or after (before) more than 10 missing images.

With the threshold 235 K much more clusters are tracked (10973 during the same period). The number of split and merge is given in Table 2. It shows that with a warmer temperature threshold the split and merge occurrences can play a large role in the cloud cluster life cycle characteristics.

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new dataset	split gener.	initia-tion	end dataset	merge end	dissi-pation
57	396	2500	20	276	2657
2 %	13 %	85 %	1 %	9 %	90 %

Table 1. Number and percentage of differnt kind of generation (left) and ending (right) of the tracked cloud clusters, theshold 210 K

new dataset	split gener	initia-tion	end dataset	merge end	dissi pation
207	3905	6861	42	2719	8212
2 %	36 %	63 %	0.5 %	25 %	75 %

Table 2. Same as Table 1, but for the 235 K threshold.

4. REFERENCES

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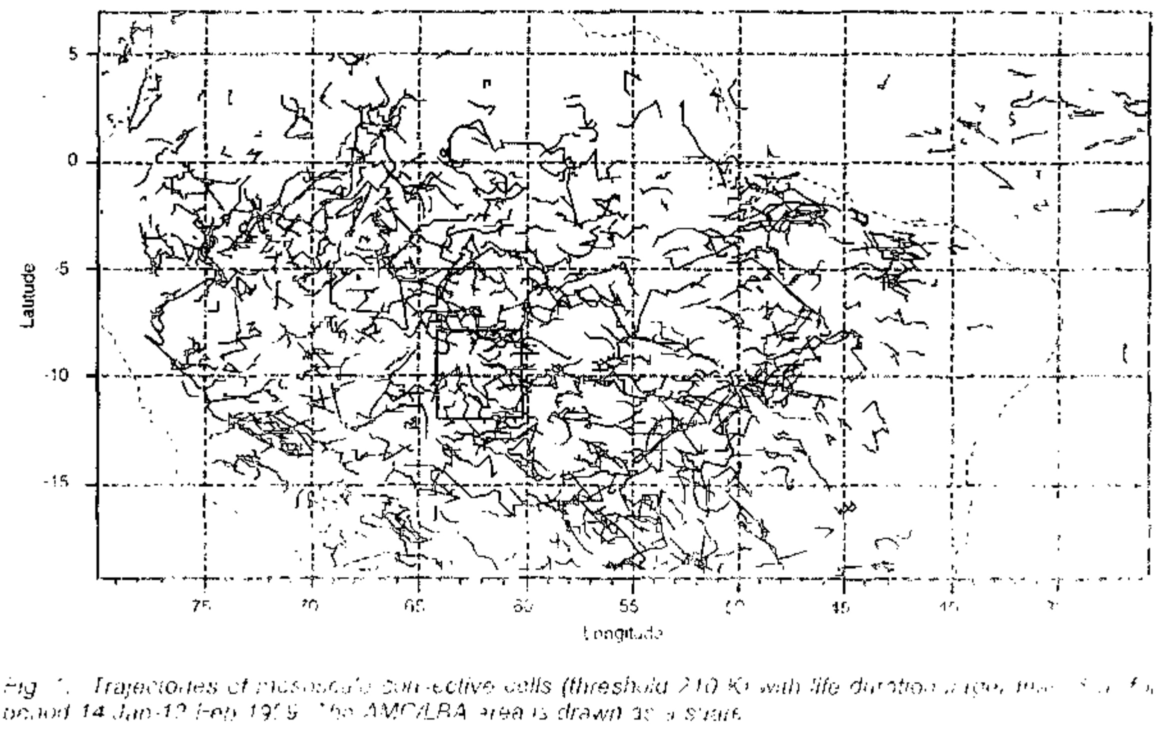

Fig. 1. Trajectories of mesoscale convective cells (threshold 210 K) with life duration [illegible] for the period 14 Jan-12 Feb 1999. The AMC/LBA area is drawn as a square.