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MEAN DISTRIBUTION AND CHARACTERISTICS OF THE SQUALL LINES OBSERVED OVER THE AMAZON BASIN

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1. INTRODUCTION

Narron bands of convective clouds that are originated at the northern coast of South America, are identified in the satellite imagery. Some of the narrow convectives bands moves inland as squall lines (SL) but others dissipate near the coast. The propagating and non-propagating lines are associated with the sea-breeze circulation.

The maximum frequency of SL over the Amazon Basin occurs in winter months at the Southern Hemisphere, when the Atlantic ITCZ is more intense and organized in its north position. The minimum frequency is observed during the spring and summer of the Southern Hemisphere, when the ITCZ is not well defined (Cavalcanti, 1982).

According to Molion and Kousky (1985) the reduction of thermal contrast, during the nigth induce dissipation of the SL at Amazon. However, these systems can recommence his activity in next day, when the heating at the superface is established.

In a previous study Cohen (1989) described in detail SL with strong and moderate intensity. In the present work the mean distribution and characteristics of these SL are described.

2. DATA AND METHODS

The SL originating at the Northern coast of South America were analysed from March 1979 to December 1986. The analyses was performed by inspection of analogical imagery of GOES-E and GOES-W satellite with a 3 hours interval.

The horizontal dimensions of the SL was estimated when these systems had very well established convective activity, in general around 21:00 UTC.

The lifetime of the SL was calculated from imageries that showed the formation and dissipation of these systems. The error of estimation is 1.5 hours, due to the interval of 3 hours between each imagery.

The non-propagation lines are denominated coastal SL (CSL). The propagation SL (PSL) are subdivided into two categories: (a) horizontal displacement between 170 and 400 km from the coast (PSL1) and (b) horizontal penetration beyond 400 km (PSL2). The PSL1 can be transformated to the PSL2 when regeneration of the SL occurs before its classification as PSL1. However, special attention to this situation was observed.

A relationship between SL and ITCZ was observed in five years analysed by Cavalcanti (1982). So, analyses of the influnce of ITCZ in the characteristics of the propagation of the SL were done. The ITCZ analyses were the following: (a) the numerical value was assigned to the visual aspect of ITCZ; (b) it was objective verified if the ITCZ was localized north or south of the Central Point (CP) of the SL. So, the comparison between the latitute of the CP of the SL and the latitute of the ITCZ wich intersect the meridian of 48º W was done. When the dissipation of SL occurs in both or one of their extremities, this indicates a false meridional displacement of the system. The propagation speed of SL was calculated by division between the distance traveled by the CP of the SL and the lifetime.

3. MEAN DISTRIBUITION

Basead on the definition of the SL as out-lined in the previous sections, the period 1979-1986 had 268 cases, which were classified as 62% CSL; 11% PSL1 and 27% PSL2 (Fig.1).

The annual distribution of SL types, during 1979-1986, is shown in Fig.2. In general, the CSL is more frequent than the PSL1 and PSL2 with the exception of 1985. Only in 1982 the PSL1 were more frequent than the PSL2.

4. MEAN CHARACTERISTIC

The mean propagation speed of the PSL1 and PSL2 were 12 and 16 m/s, respectively. Molion and Kousky(1985) estimated that the average propagation speed of the SL over the Amazon Basin was 10º of longitute/day. According to Fernandez(1982), the average speed of SL over West Africa is 14.8 m/s and Atlantic ocean is

14.6 m/s. At Venezuela, the SL showed average speed of 13 m/s (Fernandez, 1980). The propagation speed of the PSL1 lies between 5 and 30 m/s, but 77% of the cases were the range of 5 and 15 m/s (Fig.3a). The greastest number of PSL2 (86%) traveled at speeds within the range of 5 and 25 m/s (Fig.3b).

The mean lifetime of CSL, PSL1 and PSL2 is 9, 12 and 16 m/s, respectively. The SL observed in the Gulf of Carpentaria had a lifetime of 12 to 24 hours (Drosdowsky and Holland, 1987). The mean lifetime of the SL over West Africa is 39.9 hours while over Atlantic is 9.7 hours(Fernandez, 1982). However, the SL at Venezuela had mean lifetime of 3.5 hours (Fernandez, 1980 ; Betts et al., 1976):

The maximum displacement traveled by the PSL2 was of order 2000 km. According to Fernandez (1982) the average displacement of the SL at West Africa is 2100 km while at Venezuela is 150 km (Betts et al., 1976).

It was observed that the extremes points of the SL follows the displacement of the ITCZ (Cavalcanti, 1982). So, in Fig. 4 shown that SL are usually south of the ITCZ. The SL at West Africa has similar behavior but with opposite symmetry to the ITCZ during the GATE (Fernandez, 1982).

It was observed that the maximum number of the SL, independent of the propagation inland, occured when the ITCZ was well established (Cavalcanti, 1982). Here, it was observed that the PSL2 type is more frequent when the ITCZ is very well established and that the PSL1 does not depende on the ITCZ condition (Fig.5). This result suggests that the convective condition associate to ITCZ can be a possible indication of the propagation of the SL inland.

The mean dimensions of the systems are of the order of 1400 km in lenght and 170 km in width. The mean dimension of the SL at Africa is 750 km in length and 433 km in width. However, the mean length and width of the SL at Venezuela are 98 km and 29 km, respectively (Betts et al., 1976).

5. CONCLUSIONS

The greastest frequency of these squall systems (CSL, PSL1 and PSL2) occurs from April to August. However, the PSL2 type is more frequent in July. This results may be a consequence of the method of the analyses due to the region, in this month, being less affected by organized convective systems, favoring the thermal contrast between the land and ocean. Moreover, in the absence of convective systems it is easy to the identification of the SL. The average speed of propagation of the PSL1 and PSL2 are 12 and 16 m/s, respectively. It was observed that the PSL2 type is more frequent when the ITCZ is very well establihed and PSL1 is not depend on the ITCZ condition.

Generally, the SL has its convective activity recommencing the day after formation when the heating at the superface is established as suggested by Molion and Kousky (1985). But, this is not the only mechanism responsible for the maintenance of the systems because in this work there were observed cases in which the dissipation occured in hour of heating. It was noted, in some cases, that the regeneration of the PSL1 and PSL2 occurred on its north extreme during the nocturnal period. Therefore, it is necessary to analyse with more criterion the influence of the topography in adjacent regions (northwest Para and West Amapa).

6. REFERENCES

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7. FIGURES

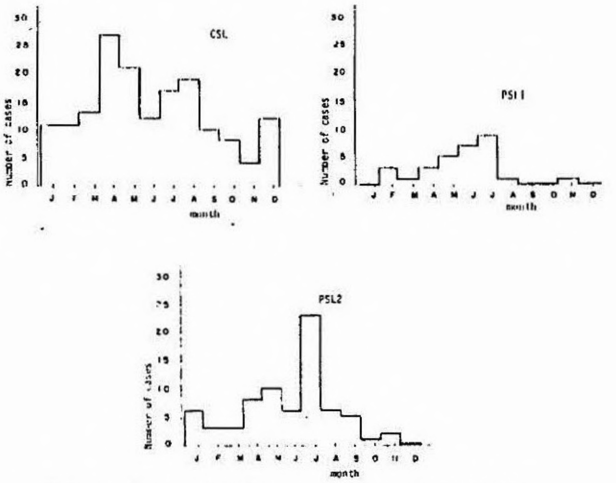


Fig.1. Distribution of the number of the squall lines types during 1979-1986.

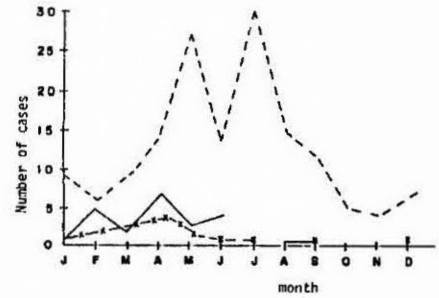


Fig. 4. Number of the squall lines:

-.---- ITCZ to North of the CP of the squall lines.

-x-x-x-ITCZ to South of the CP of the squall lines.

——— The CP OF the squall line together with the ITCZ.

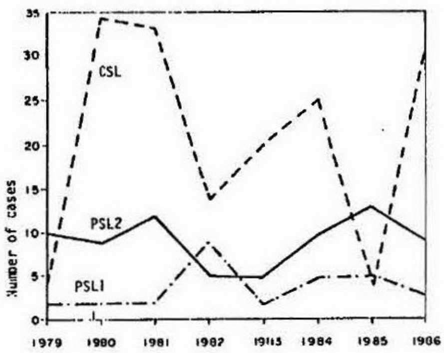


Fig.2. Annual distribution of the squall lines, during March 1979 to December 1986.

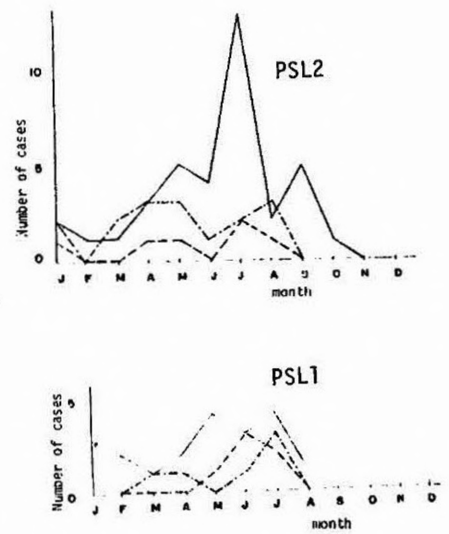
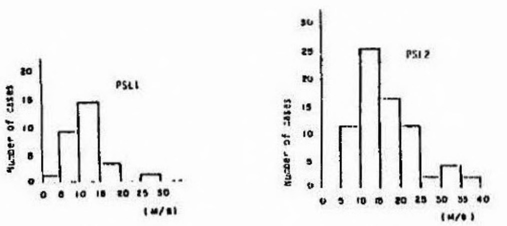


Fig. 5. Number of the squall lines for different visual aspests of the ITCZ:

- - - - ITCZ is not established.

-.-.-.- ITCZ is established.

——— ITCZ is very well established.



(a) (b)

Fig. 3. Speed of propagation of the PSL1 and PSL2.