Micro instabilities lines generated due to river and sea breeze in eastern Amazonia

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The squall lines that occur in Amazon Basin represent one of the atmospheric systems very important in the production of precipitation (Garstang et al., 1994, Cohen et al, 1995, Alcantara et al, 2011), whose origin is associated with the sea breeze circulation (Kousky, 1980). These squall lines have large dimensions then are easily viewed in satellite image and can be classified like a system of the synoptic scale.

The RAIN Project (Machado et al, 2014) realized a campaign in Belem during the period of June, 7 to 30 2011, when it was possible to observe many squall lines like described in the previous paragraph. However, it is important to note that through the X-band radar installed by RAIN Project in Belem, it was possible to identify a new type of squall line, which also showed a high intensity of rainfall. For the purpose of this work we call this new type of Squall line: Micro Instability Line (MIL). The MILs whose orientation was parallel to the Bay of Marajó were called Micro Fluvial Instability Lines (MFIL) due to its formation being associated with river breeze circulation and those whose the orientation was parallel to the atlantic coast were called Micro Sea Instability Lines (MSIL) which its origin is associated to sea breeze.

This study aims to understand the formation and structure of these new convective systems to help its predictability. We used the images of satellite GOES-12 to catalog every cases of classic squall line that occurred during the whole period of the RAIN Campaign in Belem. Posteriorly, the reflectivity data of the X-band radar was utilized to identify the formation of this new type of squall lines as well as their relationship with the classic cases of Squall Line. During this period were observed 7 cases of MFIL and 16 MSIL. Of this total were observed 3 cases of MFIL and 4 MSIL

in the absence of classical squall lines. In general the MFIL had its formation earlier (from 15 to 19:30 UTC) than MSIL (between 17:30 and 23UTC). The mean feature for these small convective systems showed lifetime of almost 2 hours while for classical squall lines is 12 hours. Finally, the mean length for MIL is 150 km while the length of the synoptic instability lines is 1400km.

The average wind obtained during RAIN campaign showed that the wind intensified between 13 and 17 UTC (minus 3 to Local Time) moreover the meridional wind direction changed from south to north indicating the presence of river breeze in the region where there is the formation of MFIL.

We used the BRAMS (Brazilian developments on the Regional Atmospheric Modelling System) to perform high-resolution numerical simulation for case study of MFIL and MSIL when it was observed the classical instability line and furthermore we did simulation for cases of MSIL when the formation of classical instability line didn't occur. The model domain includes a coarsest grid and a finest grid in which the spatial resolution was 3 and 1 km, respectively. The vertical resolution is 50 meters close to the surface and progressively increases by a factor 1.1 until it reaches 2000 meters, and keeps constant up to the model top (around 20 km). Through these simulations it was possible to verify the origin of these new convective systems both in the presence and in the absence of synoptic squall lines. The MFIL has its origin associated the river breeze that comes from the Marajó bay towards the mainland and converges with east winds, while the MSIL has its origin associated with sea breeze. These systems are deep and reach height of 14km. Generally, the MSIL are embedded in clouds that belong to classical Squall Lines which are observed on satellite image as a single convective organization, moreover seem to have a series of pulses of precipitation, giving an idea of existence of another internal scale of the organization. However, the MFIL propagation from Belem city to Marajo island showed maximum convection when it was crossing the Bay of Marajo, where there is intense transportation of cargo and passengers, and shipwrecks are the most frequent type of accidents in this bay.