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OBSERVATIONAL ASPECTS OF THE CONVECTIVE BOUNDARY LAYER AT PASTURE IN AMAZONIA DURING LBA RACCI 2002 EXPERIMENT

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1. INTRODUCTION

There is a worldwide concern about the climatic change due to the anthropogenic factor. In the Amazon region this action is being made by the tropical deforestation in a large scale for select logging or cattle activities. However, Amazonia is an important source of moisture locally and remotely as well as aerosols and trace gases for the atmosphere. This has a direct impact on the air quality as well as for regional climate.

Several studies of numerical simulation of the tropical deforestation were already made (e.g. NOBRE *et al*. (1991). The results showed that there will be an increase of the surface air temperature (ranging from 0.6 up to 2.0 °C), reduction of the precipitation and evapotranspiration (to a value of 20 a 30% of the control – forest scenarious) and a longer dry season. However, the influence of the land use on the boundary layer is not direct. Observational studies of the developing of the Convective Boundary Layer (CBL) in the Amazon showed that the height of the dry CBL over pasture is 800 m deeper than the CBL from forest due to the lower soil moisture content and higher sensible heat fluxes (FISCH et al., 2004). This does not happen during the wet season. For forest this variation does not exist as the trees uses water from deep layers. During the wet season, the two biomes (forest and pasture) show similar behaviors.

The objective of this work is to show the patterns of the CBL developed over pasture during the transition from the dry season to the onset of the wet period (LBA RACCI Experiment 2002).

2. DATA SETS AND METHODOLOGY

This work was made with the data collect during the field campaign of LBA/RACCI 2002 (http://www.lba.iag.usp.br). This experiment was designed to collect meteorological data during the transition period from the dry season to the onset of the wet period in order to identify and study the role of the aerosols to inhibit or trigger the wet convection

The data were made with rawinsoundings using sondes Vaisala RS80-15G coupled with the receiver DIGICORA II (Vaisala Oy, Finland). The sonde measured the air temperature, relative humidity and atmospheric pressure. The winds were computed using GPS technique. The soundings were made from the Sept 15 until Oct 30, 2002 at a cattle pasture site at Ouro Prêto D´Oeste (Rondônia, southwest of Amazonia) at 8, 11, 14 and 17 local time - LT. At the same site, it was installed an automatic weather station, a sodar equipment (REMTECH II – France) and an eddy correlation instrument in order to complete the analysis. A meteorological radar (S Band) was also deployed close to the pasture site.

The heights of the CBL were computed using profiles of potential temperature (θ) and specific humidity (q). These heights were compared with others techniques (for instance SODAR measurements and using Richardson numbers estimates with good agreement (Santos and Fisch, 2006). The average properties of the CBL were computed from the surface up to the height of the CBL.

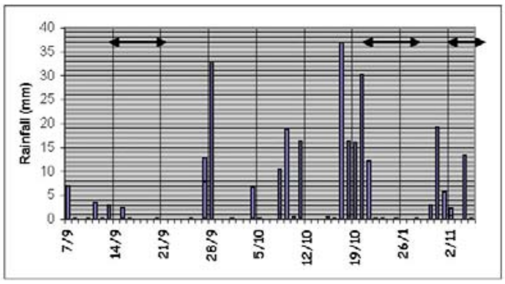

Figure 1- Time series of rainfall at the pasture site during LBA-RACCI 2002 in Rondonia.

3. RESULTS AND DISCUSSION

Table I presents a summary of the termodynamic properties from the dry period (Sept 19-30, 2002) and wet period (Oct 15-30, 2002).

During the dry period (DP) the CBL were higher than 2000 m (for instance Sept 20). On Sept 19, the sounding at 14 LT was almost 2000 m (the 17 LT was lost due to the mal functioning of the sonde) inducing a final height of the CBL by 2200 m. These two days were the end of a very dry period, with a lot of burning and smoke around. During Sept 20-30, the burning was not so intense due to some sporadic rainfall. From Oct 15 onward (especially from Oct 17 until 21) there were some convective rainfalls almost each day during afternoon hours. The rain modifies the structure of the CBL, sometimes inducing a stable boundary layer after a strong rainfall, even with surface solar heating afterwards. These types of situations were extracted

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from the data-set used to compute the mean properties (Table I). The height of the CBL reduces from the DP to the WP by a value around 150 m, almost the same potential temperature and a small increase of the specific humidity (0.3 g/kg). The surface sensible heat (H) fluxes show clearly the difference between the dry and wet period, presenting maximum H around 200-250 W/m2. For the wet period, H is lower with maximum H lower than 200 W/m2. The CBL growth mainly due to the surface heating (e.g. the sensible heat flux). As the soil is wet (due to the rainfall), the partition of energy occurs predominantly by the latent heat fluxes (which does not directly growth the CBL.

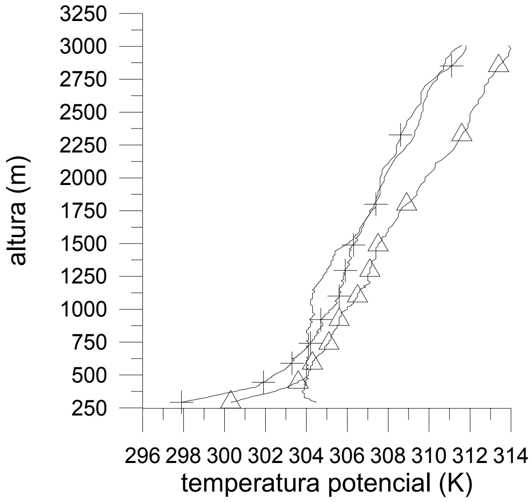

Figure 2. Profiles of potential temperature for 3 soundings on Oct 19, 2002: 11 LT (solid line), 14 LT (cross) and 17 LT (triangle).

Figure 2 A case study of the thermodynamic structure was made using Oct 19,2002. Between the sounding of 11 and 14 LT, a convective shower occurs at the pasture site with a rainfall of 16 mm. At 17 LT the water has been evaporated and the surface was dry. Initially there is a cooling of the profile (14 LT sounding) and later a heating (sounding 17 LT). However the thermal stratification (stable characterization) did not change after the evaporation of the surface water, only shifted of a warm environment (Figure 2). This happens because the partition of energy was mainly by latent heat fluxes that did not start a shallow convective boundary layer. The specific humidity (Figure 3) clearly shows this pattern, with initially only the lower part of the CBL (at 14 LT sounding) and later for the all layer (for 17 LT sounding). The solar radiation fluxes reducing from 617 W/m2 at 13 LT to 63 W/m2 at 14 LT (during the rain), increasing to values around 160-180 W/m2 until sunset (Figure 4). The sensible heat flux responds to this variation, presenting a negative value (-17 W/m2 at 14 LT) during the rain and a small (lower than 20 W/m2 but positive values afterwards.

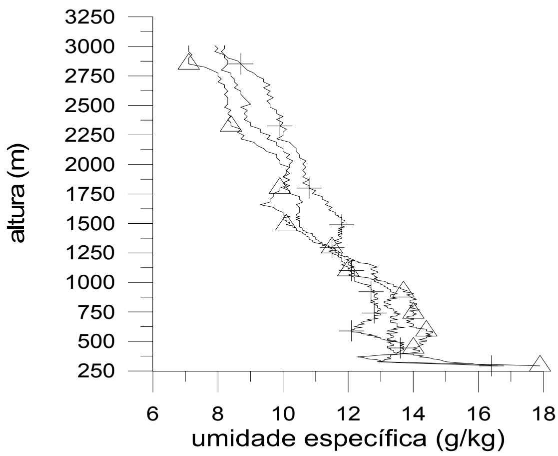

Figure 2: Same as Figure 1 for specific humidity.

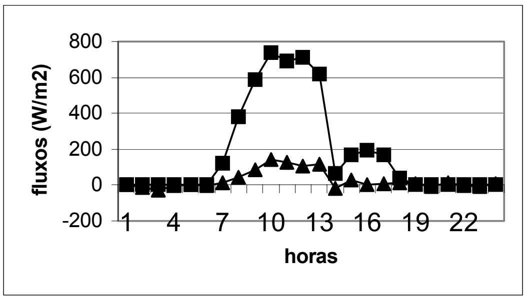

Figure 3: Daily Cycle of Solar Radiation (square) and Sensible Heat fluxes (triangle) for Oct 19, 2002.

4. CONCLUSIONS

The results showed the role of the soil moisture in order to characterize the structure (height, average properties, atmospheric stability) for the convective boundary layer at a pasture site.

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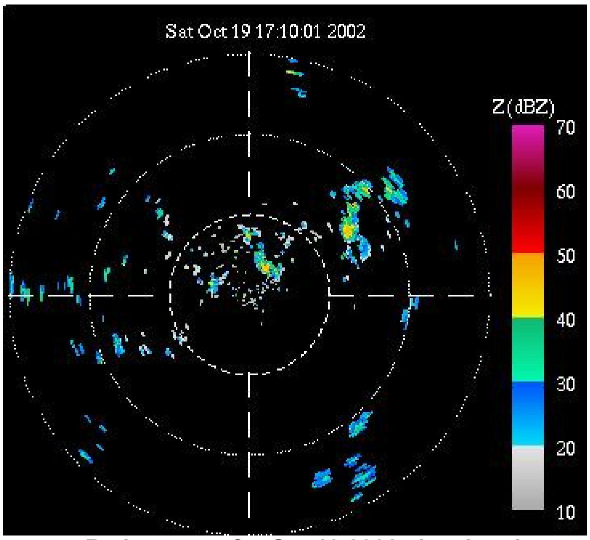

Figure 4: Radar scope for Oct 19,2002 showing the convective cells.

Table I: Thermodynamic characteristics of the CBL.

DP	h_θ	h_q	θ	q	WP	h_θ	h_q	θ	q
Day	**(m)**	**(m)**	**(K)**	**g/kg**	**Day**	**(m)**	**(m)**	**(K)**	**g/kg**
18/09	1760	1320	307,3	12,2	**15/10**	1120	1050	304,3	14,0
19/09	--	--	--	--	**16/10**	1630	1500	306,7	11,5
20/09	2240	2270	308,6	10,7	**17/10**	*	670	*	15,6
21/09	1780	1270	307,0	12,0	**18/10**	980	*	304,2	*
22/09	1550	1200	305,8	14,0	**19/10**	*	1050	*	14,1
23/09	1700	1610	306,7	13,5	**20/10**	1030	1000	304,3	14,6
24/09	1280	1250	305,3	12,7	**21/10**	1730	1760	306,9	14,5
25/09	1840	1790	307,0	11,5	**22/10**	1340	1320	306,2	13,9
26/09	1560	1510	307,4	11,9	**23/10**	1380	1370	307,0	13,0
27/09	1530	1510	306,2	12,8	**24/10**	1480	1500	306,9	13,0
28/09	*	975	*	15,8	**25/10**	1020	1090	304,3	14,0
29/09	1640	1580	306,7	13,2	**26/10**	1230	1240	307,8	13,4
					27/10	1280	1250	308,6	13,5
					28/10	1660	1600	309,0	11,6
					29/10	1330	1280	306,6	12,4
Avg	**1690**	**1480**	**306,8**	**12,8**	**avg**	**1320**	**1300**	**306,4**	**13,5**
Std	**252**	**350**	**1,0**	**1,1**	**Std**	**251**	**224**	**1,7**	**1,1**

DP: dry period and WP: wet period