P2.2 GENERAL ASPECTS OF THE REBIO-JARU AMAZON FOREST MICROMETEOROLOGICAL TOWER LBA WET SEASON CAMPAIGN AND PRELIMINARY RESULTS

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1. INTRODUCTION

During the 1999 Wet Season in Amazonia, several activities of the LBA Project took place at the biological reserve Reserva Biológica do Jaru (Rebio Jaru), located about 105 km North of Ji-Paraná, Rondonia, Brazil. At this site, a 60 m tall Micrometeorological Tower (10^o 4.706' S; 61^o 56.027' W) was installed for the measurement of the radiation balance, of the turbulent fluxes of momentum, sensible and latent heat, of the soil heat flux, of the wind profile, and of the rainfall.

Also, to understand the role of the forest canopy for the exchange of energy and momentum with the atmospheric flow, vertical profiles of temperature, specific humidity, wind velocity, net radiation and PAR were measured above and billow the canopy.

Thus, more than 80 simultaneous measurements were made from the end of January to the beginning of March 1999.

2. PRELIMINARY RESULTS

Figure 1 shows the position of the instruments on the tower. The fast response instruments were sampled at 16 Hz, while for the slow response ones the sampling rate was 0.1 Hz.

Figures 2(a-b) show the hourly averaged profiles of wind velocity (u) and temperature (T) for diurnal hours of a typical day during the rainy season at Rebio Jaru. These figures show clearly that there is an inflexion point in the vertical wind profile, at 38 m of height, which indicates the existence of the instability suggested by Raupach *et al*. (1996), among others. Also, one may infer that the wind velocity appears to be influenced by the canopy up to a height above 38 m, while for the temperature field this seems to occur only up to about 32 m. These results suggest the existence of two physically different heights for the canopy: (a) a thermodynamic, which is associated with the average level at which the forest presents a "closed" canopy; (b) an aerodynamic, which is associated with the average level where the isolated trees and the higher branches of the forest are located.

Another result concerning the roughness characteristics of the forest is the determination of the zero-plane displacement. The methods of Molion and Moore (1983) and of De Bruin and Moore (1985) were used, with the following results, respectively: d = 26.6 ± 0.6 m, zo = 3.6 ± 0.7; d = 25.0 ± 2.3 m, zo = 1.8 ± 0.6m. These computations were performed using data from 8 runs for which the absolute value of the Monin-Obukhov stability parameter was less than 0.05. These results were compared with the ones by Viswanadham et al (1990) for the reserve Reserva Ducke (2^o57' S; 59^o 57' W), Central Amazonia, that is, d = 30.9 ± 0.4 m and zo = 2.2 ± 0.1 m, obtained using Molion and Moore's method, and suggest that there are differences between both reserves due to differen heights and capacity to absorb momentum.

The hourly averaged wind direction histograms present two variability patterns, depending on the hour of the day: Figure 3 shows typical histograms for the wind directions (a) between 11 AM and 4 PM local time, and (b) for the interval 8 PM and 9 AM. The first is unimodal, while the second is bimodal. A possible interpretation for this is that for the interval (a), with stronger winds and more convective activity, there is predominance of the effects of scales greater than the local one, a fact which is absent in case (b).

Concerning the energy balance, Figure 4 shows hourly average values of the Bowen ratio (Bo = H / λE)for the diurnal period, with their respective standard deviations. These results were obtained using 35 days of data, where H and λE, respectively the sensible and latent heat fluxes, were calculated by the flux-gradient method (Arya, 1988). The general pattern of hourly variability for the wet season obtained at Rebio-Jaru is similar to the one shown by Viswanadham *et al*. (1990) for measurements at the above mentioned Reserva Ducke, Central Amazonia, during the dry season. The mean maximum value obtained at Rebio-Jaru (less than 0.2), is smaller than what was obtained by these authors for the Reserva Ducke, probably due to the fact that during the wet season a larger portion of the available energy is used in evapotranspiration.

Another interesting aspect concerning the energy and momentum exchanges studied at Rebio-Jaru is the difficulty to estimate the frequency associated with the spectral gap: the analyses of variance of the vertical component of the wind and of the temperature do not show a clear relative minimum, even when the sample segment was considerably increased (from 20 min to 3 hours).

This difficulties in estimating the spectral gap was studied by several authors (e. g., Sun *et al*.,(1996), who attributed it to the eventual occurence of factors such as the existence of local circulation and isolated eddies, which may introduce low frequency fluctuations to the turbulent signal. These factors probably occur in the flow studied here because: (a) the forest at Rebio Jaru is surrounded by trips of deforested areas ("fish-bone"), which may

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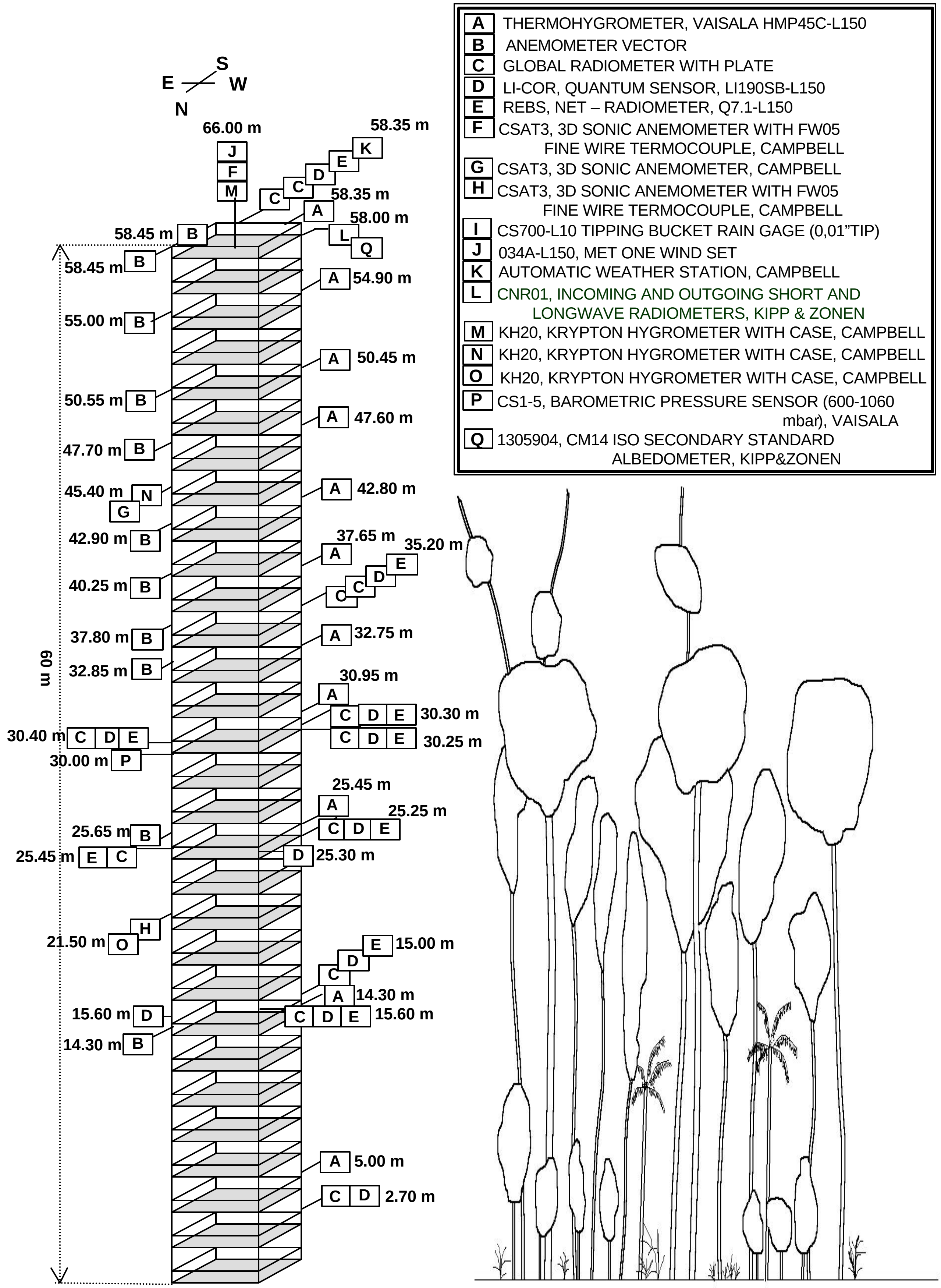
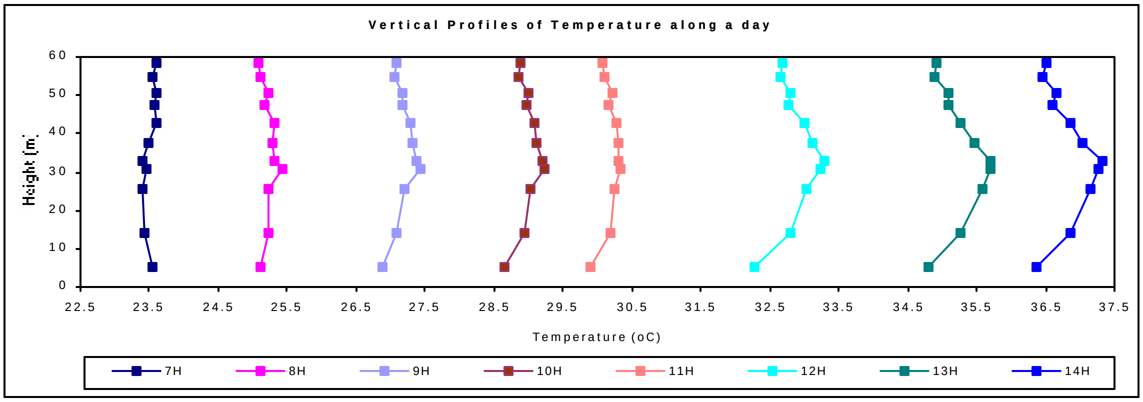


Fig 1. Schematic drawing of the micrometeorological tower located at Jaru Biological Reserve (Rebio-Jaru), with all instrumetation installed during the AMC/LBA wet season campaign

induce local circulation due to differences in the energy energy balance between sectors of the "fish bone"; (b) the existence of thermal convection and consequent generation of cumulus clouds above the region creates a physical mechanism that provides the existence of intense alternating upward and downward motions (updrafts and downdrafts)

For this reason, we present (Figure 5) the dependence, on the sampling interval of the turbulent data used, of the values of the sensible heat flux calculated by the eddy-correlation method,.

(a)



(b)

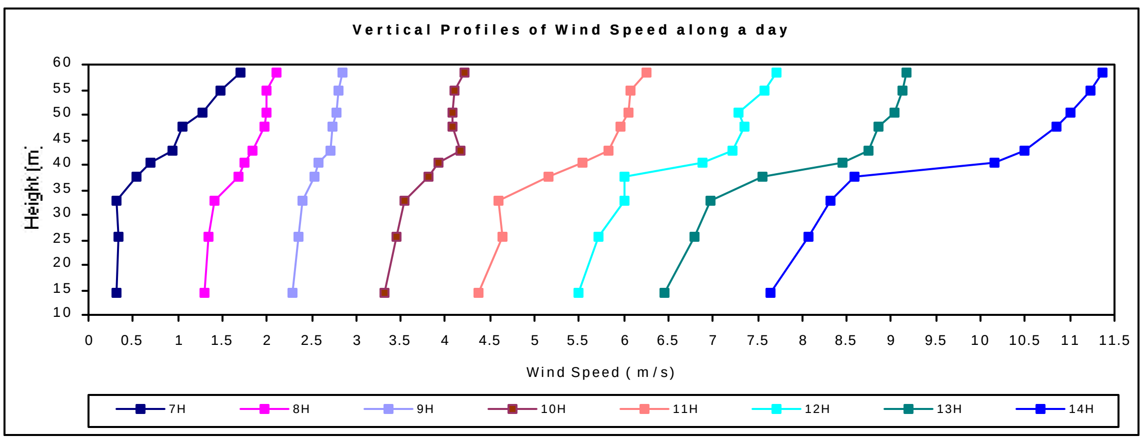
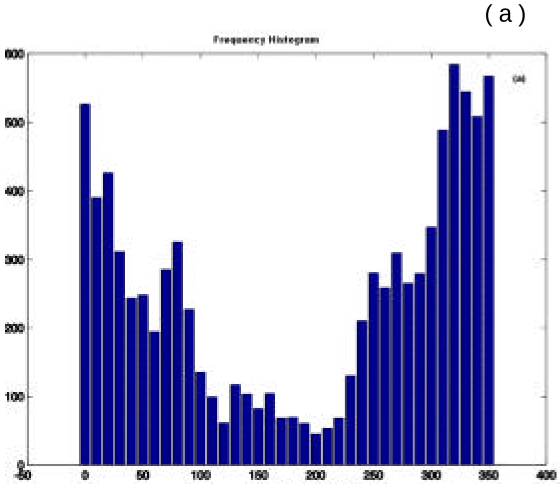


Fig. 2. Hourly averaged profiles of: (a) wind velocity; and (b) temperature; from 7:00 to 14:00 (L.T.), of a typical day during the rainy season at Rebio Jaru. The legends refer to the hour of day (L.T.). To easier visualization of the vertical profiles, values of temperature were added by 1 $^{\circ}$C, and values of wind velocity, by 1 m/s, at each step in time (at each hour).

(a)



(b)

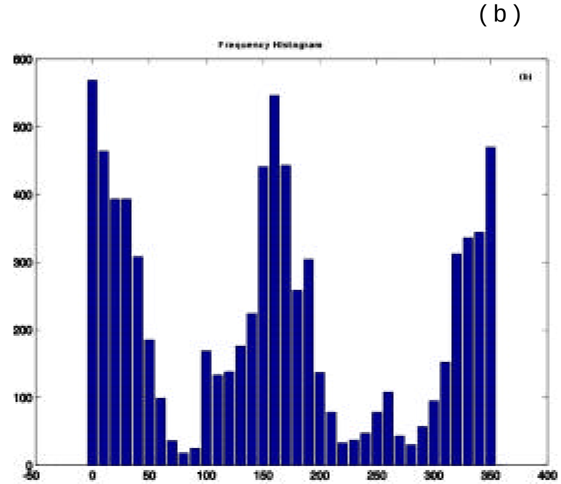


Fig 3. Frequency histograms of the hourly averaged wind direction for observations at the following periods: (a) between 11 AM and 4 PM local time, and (b) between 8 PM and 9 AM.

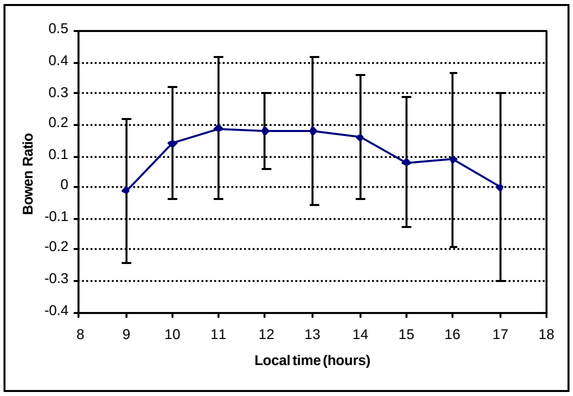


Fig 4. Average diurnal variation of bowen ratio values with respective standard deviations.

The behavior of the radiation measured above and inside the Rebio-Jaru forest can be summarized as:

a) a minimum global solar radiation albedo of 13.1% ± 1,1% and a minimum global photo-synthetically active radiation (PAR) albedo of 2,8% ± 0,3% was measured at the tower top near noon;

b) the penetration of radiation inside the canopy, determined by three five-levels profiles (westward, southward and eastward of the tower) of net radiometers, PAR sensors and pyranometers, showed a rapid decrease in radiation intensity. Less than 40% of the PAR and incoming solar radiation above the forest reaches the 30 meters level (between 5 and 10 m below the canopy top) and only about 8% of the PAR and 14% of the solar radiation reaches the 15 meters level;

c) the radiation reaching the forest floor, measured by eight net radiometers, eleven PAR sensors and 12 pyranometers regularly distributed around the tower, at one meter above the ground, and integrated over five dry days between 07:00 AM and 05:00 PM (local time), was only 4.2% ± 2.0%, 1.6% ± 1.4% and 3,4% ± 2,2% of the radiation observed above the canopy, for net radiation, PAR and incoming solar radiation, respectively (Manzi *et al*., 1999).

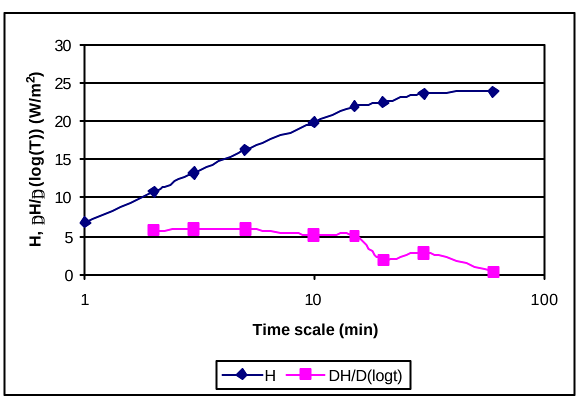


Fig 5. Average sensible heat fluxes and their changes with increasing time sampling interval.

3. ACKNOWLEDGEMENTS

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