SOME CHARACTERISTICS OF THE TEMPORAL EVOLUTION OF THE ATMOSPHERIC BOUNDARY LAYER ABOVE PANTANAL WETLAND

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ABSTRACT

Pantanal is one of the biggest Wetland regions of the world, with an area of approximately 150,000 km^2. It is located in central part of the South America (19^{o}S, 57^{o}W) and presents a climatology which is characterized by a very dry season and a wet period in which strong floods are often observed. The Interdisciplinary Pantanal Experiment (IPE) aims to investigate the micrometeorological aspects and the differences between these two seasons. An important goal of IPE researches is to characterize the atmospheric boundary layer (ABL) structure above Pantanal Wetland, particularly the nocturnal boundary layer (NBL). For this purpose, it is important to take into account the meteorological processes which drive the early evening transition (EET) and define classes of the NBL. In Pantanal some case studies have shown two distinct classes of EET: a) one with the generation of a strong low level jet (LLJ), below 600 m height; b) one other without a well defined LLJ. LLJ is more frequent during the dry season and seems to be generated as a response to the strong stability created by next surface intense radiative cooling process after the sunset. Besides the LLJ, other aspects of the dry and wet CLA structure are presented and some possible physical explanations of the results are discussed.

DISCUSSION OF THE RESULTS

The place selected for the experiment is in the southern region of Pantanal Wetland, in Passo do Lontra, Mato Grosso do Sul State.

Measurements were made using a 21m aluminum tower located near to the Mato Grosso do Sul Federal University Reserve.

The region is characterized by seasonal floods.

We used meteorological data obtained in two Experimental Campaigns: IPE-2, under dry conditions, carried out in September 1999 and IPE-3, under wet conditions (with some flooded areas with mean water layer height of 34cm). During IPE-2, vertical soundings of the atmospheric boundary layer were performed with sodar and radiosonde. During IPE-3 campaign, only radiosonde data were available.

We present some results which show some differences in atmospheric boundary layer structure during early evening transition (EET) events as discussed by Acevedo and Fitzjarrald (2001). We have studied situations with the presence of a low level jet (LLJ) over Pantanal and without the occurrence of such a LLJ (here we consider the Stull (1988) definition for LLJ).

In the figure 1 we present vertical profiles of **v** (wind speed; m/s), **q** (specific humidity; g/kg), **Tpotv** (potential virtual temperature; ºC) and **RiB** (Bulk Richardson number) for two situations: with LLJ and without LLJ.

From the figures, it seems that LLJ acts to mix the atmospheric layers below the maximum wind velocity region as suggested by Mahrt et al. (1979). This can be observed in RiB, q and Tpotv vertical profiles.

In figures 2 and 3 we present the EET temporal evolution of some CLS parameters such as Tpot (measured at 8m and 22m), relative humidity (at 8m and 22m), net radiation (at 4m and 21m) and the buoyancy length scale $l_b = \sigma_w / N$, where σ_w is the standard deviation of the vertical velocity fluctuations, w', and N is the Brunt–Väisälä frequency. The figure 2 presents a situation with LLJ and the figure 3 presents a situation without a LLJ.

Some interesting differences between figures 2 and 3 are observed:

- The temporal evolution of the length scale l_b. - In the figure 2 it presents a minimum value at 18 Hs (local time). After this time, it grows up (and between 19 Hs and 22 Hs, it is not defined because $\partial\theta_v / \partial z < 0$). An opposite l_b evolution is observed when there is no LLJ: l_b decays continuously during the early night, as is show in figure 3.
- The temporal evolution profiles of θ_v also show differences between situations with LLJ and without LLJ. In the former, there is a rapid fall in θ_v values and a simultaneous jump in relative humidity. This kind of phenomena have been identificate by Acevedo and Fitzjarrald (2001) with data obtained in Albany region (NY-USA). However, during the

night without LLJ, the temporal evolution of θ_v and relative humidity (RH) are quite linear.

- The temporal evolution of the net radiation Rn, presents, also, some differences when we compare the situation with and without LLJ. At the former, the Rn value stabilizes at the early evening. An opposite behavior is observed for Rn in nights without jet: Rn continues to fall during the night, at least until 22 Hs.

More studies are needed to understand the different aspects of the nocturnal atmospheric boundary layer in the presence of a low level jet.

CONCLUSION

The results have shown that the vertical structure of the atmospheric boundary layer above Pantanal Wetland presents different characteristics depending on the occurrence or not of a low level jet above the region.

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REFERENCES

Stull, R. B. **An introduction to boundary layer meteorology.** Dordrecht: Kluwer, 1988. 666 p.

Acevedo, O. C.; Fitzjarrald, D. R. The Early Evening Surface-Layer Transition: Temporal and Spatial Variability. **Journal of the Atmospheric Sciences,** v. 58, n**.** 17, p. 2650-2667, 01 sept. 2001

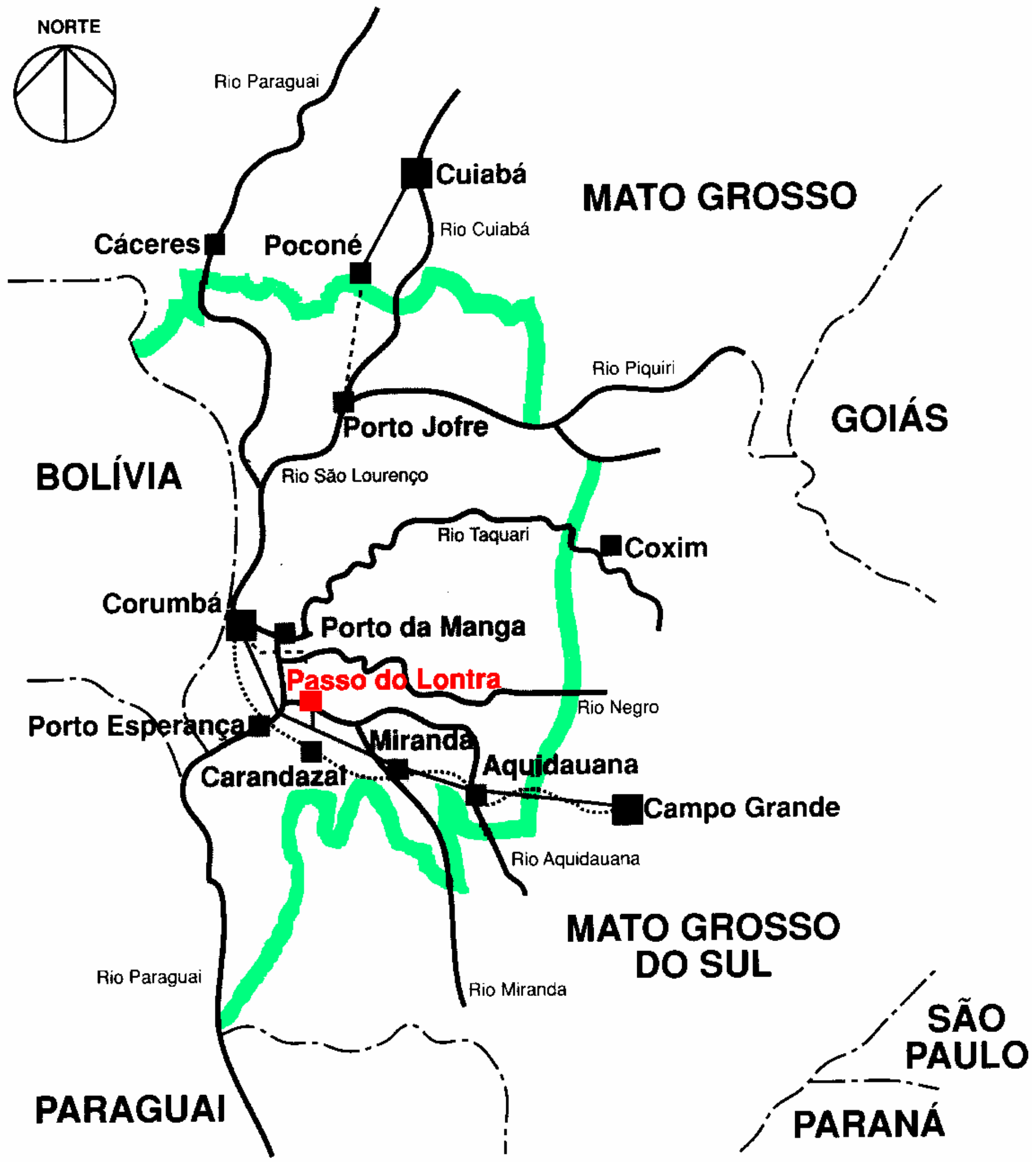
Mahrt, L.; Heald, R.C.; Lenschow, D. H.; Stankov, B. B.; Troen, I. **Boundary-Layer Meteorology,** 17, n.2: 247-264, September, 1979.

Micrometeorological Tower and landscape characteristics of Pantanal Wetland “Passo do Lontra ”Experimental Site”

Micrometeorological tower built in Pantanal wetland

Tower Northern side

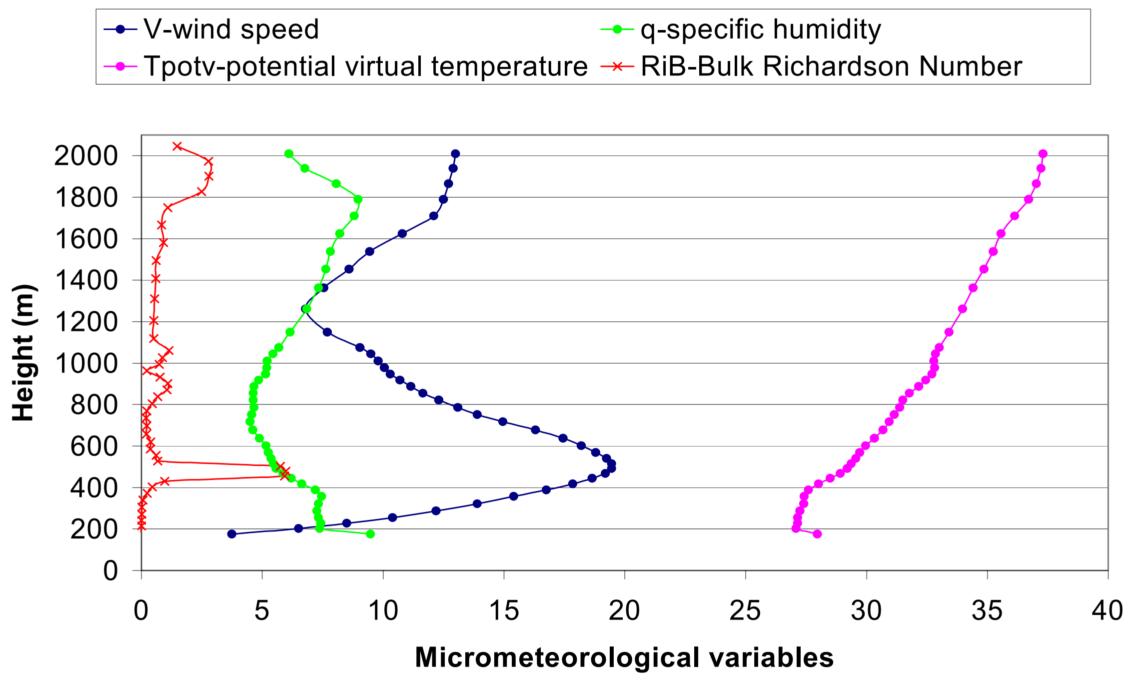
Tower southern side



Pantanal Wetland Map showing the location of UFMS Passo do Lontra Experimental Site

Figure 1 – Vertical structure of the Pantanal atmospheric boundary layer for situation with LLJ and without LLJ.

Dry season with noturnal low level jet – Vertical mean profile of some micrometeorological variables above Pantanal Wetland at night



Dry season without noturnal low level jet – Vertical mean profile of some micrometeorological variables above Pantanal Wetland at night

Figure 2 - Dry Season with nocturnal low level jet – Early Evening Transition of some

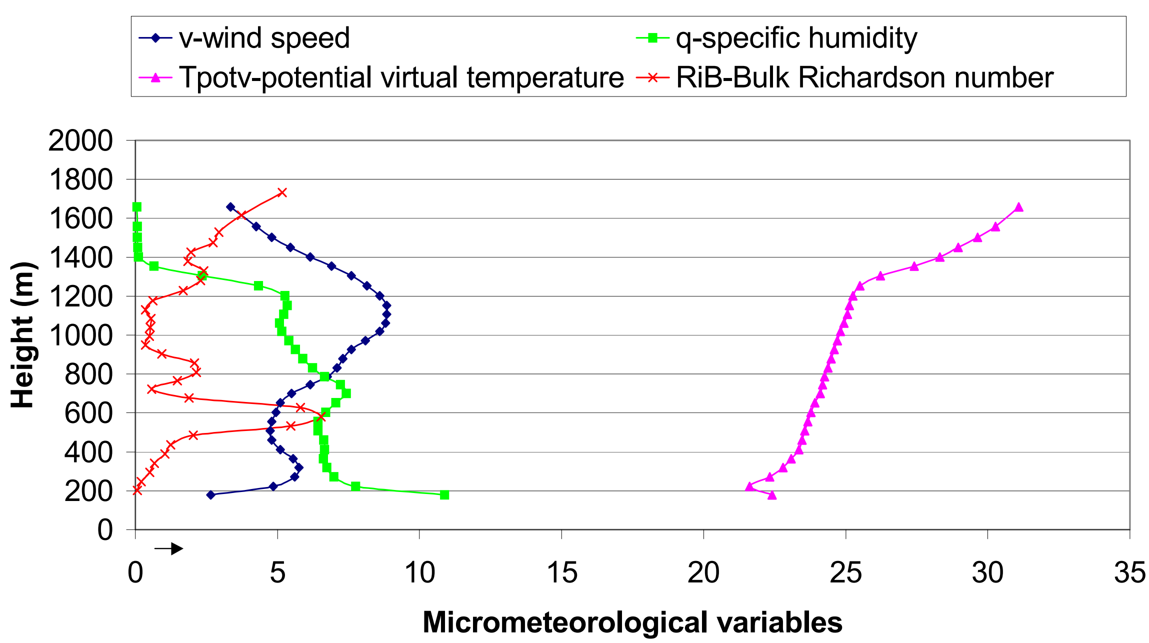


Figure 2 - Dry Season with nocturnal low level jet – Early Evening Transition of some atmospheric surface layer variables measured above Pantanal Wetland

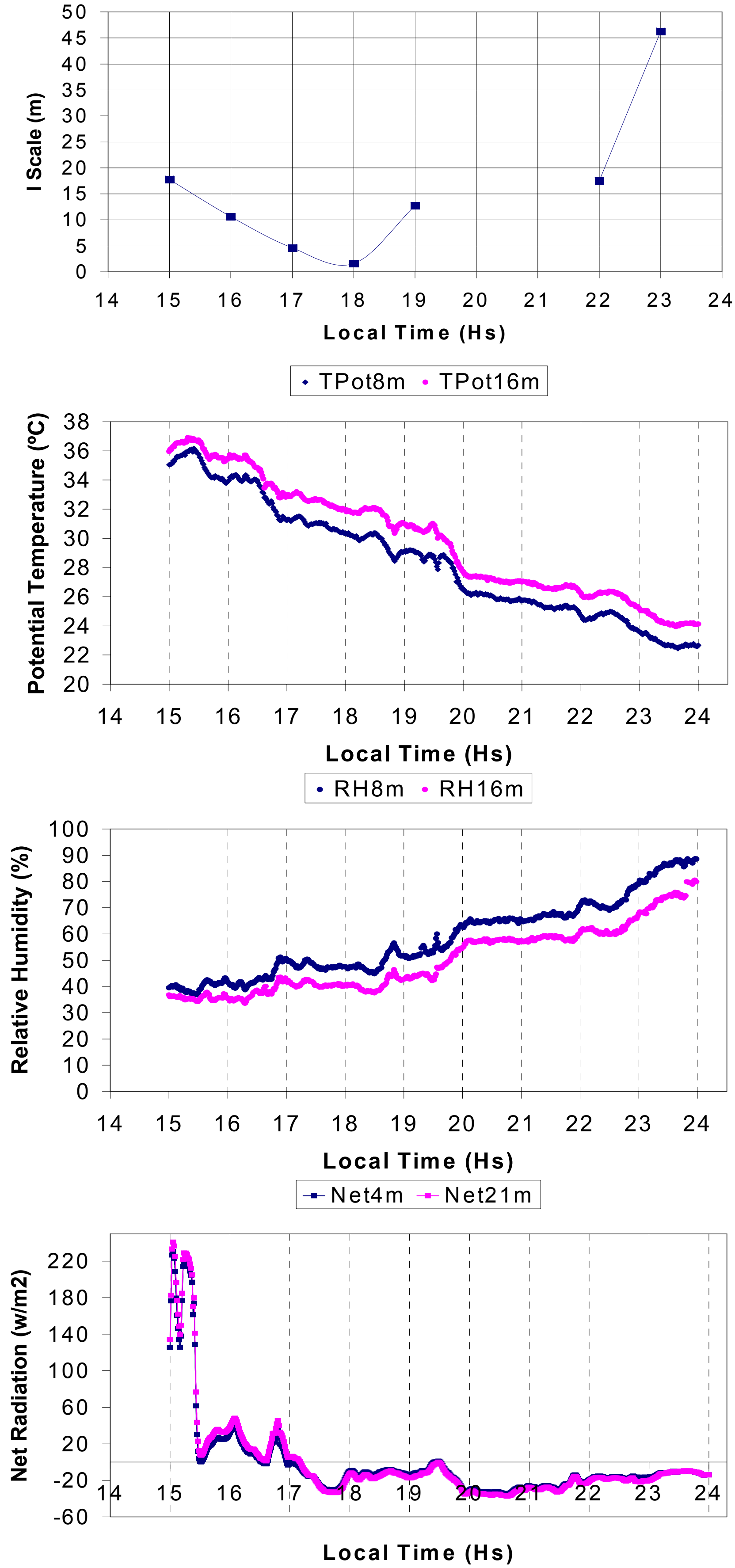
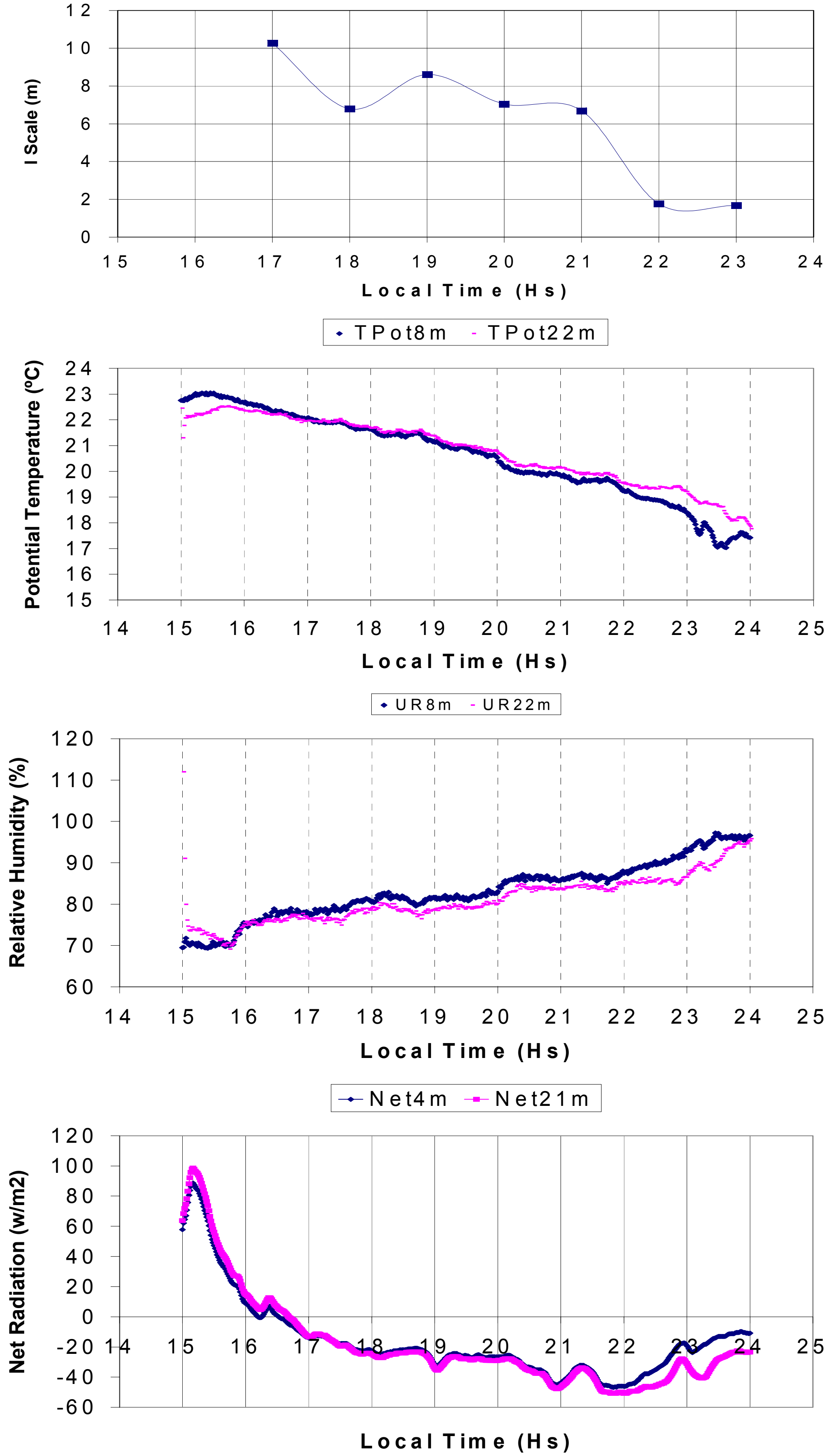
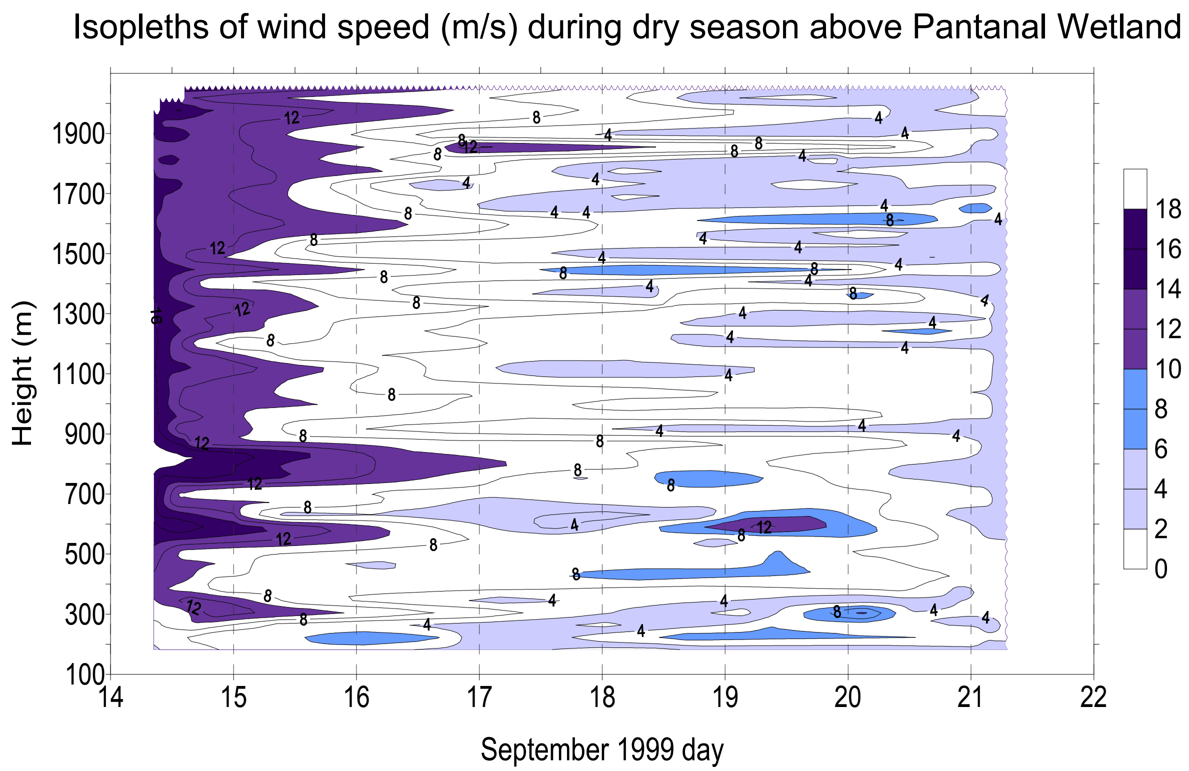
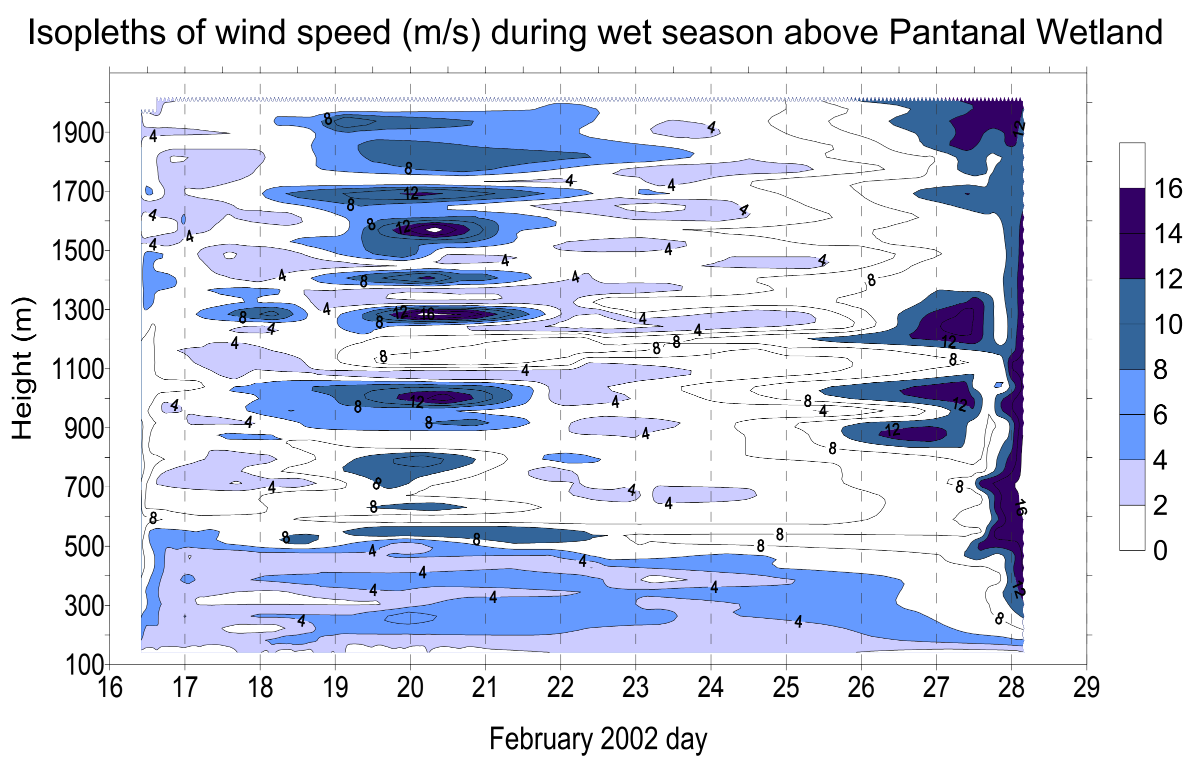


Figure 3 - Dry Season without nocturnal low level jet – Early Evening Transition of some atmospheric surface layer variables measured above Pantanal Wetland




Isopleths of wind speed (m/s) during dry season above Pantanal Wetland
Height (m)
100
300
500
700
900
1100
1300
1500
1700
1900
14
15
16
17
18
19
20
21
22
September 1999 day
0
2
4
6
8
10
12
14
16
18


Isopleths of wind speed (m/s) during wet season above Pantanal Wetland
Height (m)
100
300
500
700
900
1100
1300
1500
1700
1900
16
17
18
19
20
21
22
23
24
25
26
27
28
29
February 2002 day
0
2
4
6
8
10
12
14
16