P1.8 TURBULENT FLUXES, TEMPERATURE AND HUMIDITY CONVERGENCE AFTER SUNRISE

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1. INTRODUCTION

In recent years, most of the planetary boundary layer research is directed toward the understanding of turbulent fluxes in inhomogeneous conditions, either in time or space. However, only few studies have reported turbulent flux measurements during temporal transitions. The understanding of their behaviors in these conditions is very important to obtain a more realistic description of the surface-atmosphere interaction, something that would improve the description of boundary layer dynamics.

The first few hours after sunrise are ideal for the observation of temperature and moisture convergence next to the surface. This is a consequence of the rapid evolution of the convective layer height and the fact that the shallow mixing layer determines relatively large variations of these properties in the period.

The purpose of this study was to verify that an alternative approach could be used to estimate surface temperature and moisture fluxes, using measurements from tethered balloon soundings.

2. SITE

The data were collected as a part of LBA (Large-Scale Biosphere-Atmosphere Experiment in Amazon) project, at the pasture flux tower site, in Santarém, PA, Brazil (S 03º 01' 11.4" - W 54º 53' 39.3´´). The site is located at a farm, at the km 77 of the Santarém-Cuiabá highway. Tethered balloon soundings were made at that location in the months of July and October 2001.

3. MEASUREMENTS

Balloon launches occurred during nighttime and transition periods, sunset and sundown, one-week field campaign in July and October 2001.

The temporal evolution of the potential temperature, specific humidity, wind speed and direction, during early morning in July and October are shown in figures 1 and 2 respectively.

Assumed that the boundary layer is horizontally homogeneous, the surface heat flux can be obtained by integration the thermodynamic equation

$$\frac{\partial \overline{q}}{\partial t} = -\frac{\partial \overline{w'q'}}{\partial z}.$$

Integrating the above equation from the surface to the top of the mixed layer, (h), and assuming $(\overline{w'q'})_h = 0$:

$$(\overline{w'q'})_0 = \int_0^h \frac{\partial \overline{q}}{\partial t} dz .$$

Analogously for $\overline{w'q'}$,

$$\frac{\partial \overline{q}}{\partial t} = -\frac{\partial \overline{w'q'}}{\partial z}$$

$$(\overline{w'q'})_0 = \int_0^h \frac{\partial \overline{q}}{\partial t} dz$$

The surface fluxes were estimated from the soundings obtained at three different mornings and then compared to the eddy correlation system fluxes measured at nearby micrometeorological tower (Sakai; et al. 2002). The flux estimation was based on the temperature and humidity convergence during the first hours in the morning. Data from two subsequent soundings were used to determine the height at which the potential temperature and specific humidity were about the same.

Comparison of the surface fluxes estimated from the temperature and moisture convergence and eddy flux data during the July 2001 field campaign are shown in figure 3. Note that there is a good agreement between the accumulation and the eddy covariance flux methods during the early morning hours.

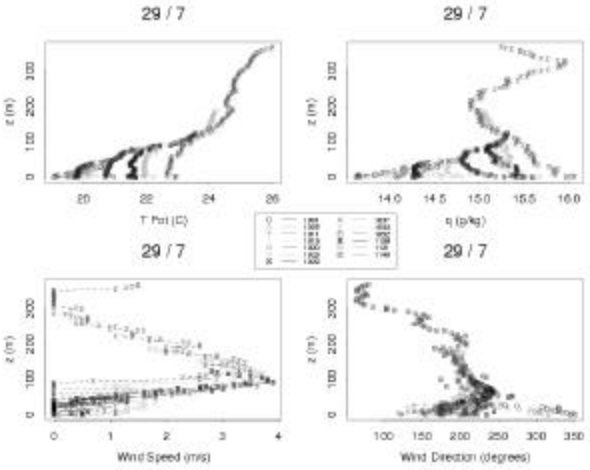

Figure 1: Early morning soundings in July 29 2001.

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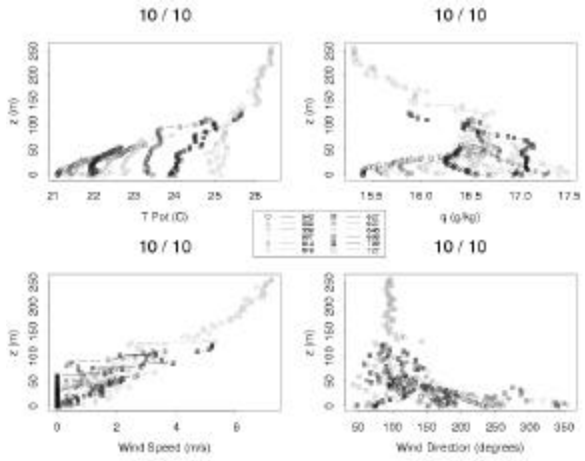

Figure 2: Early morning soundings in October 10 2001.

4. CONCLUSION

There is a good agreement between the fluxes estimated from the soundings and directly measured by eddy correlation. It shows that the used method is a good approach for the estimation of the surface fluxes based on the tethered balloon data.

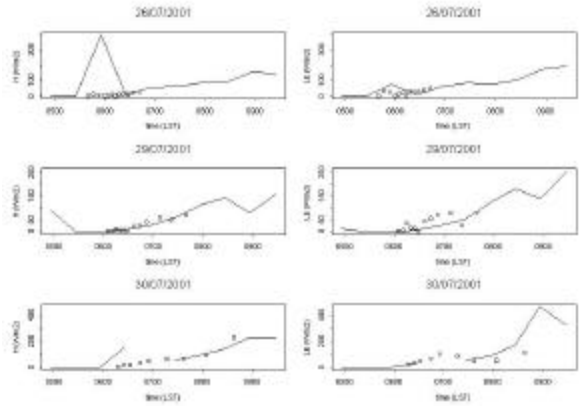

Figure 3: Comparison of the surface flux estimate from temperature and moisture from tether balloon (circles) and eddy flux data (line) during the July 2001 field campaign.

5. ACKNOWLEDGEMENTS

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