The Atmospheric Boundary Layer heights in central Amazonia during the experiment GoAmazon 2014/5

Gilberto Fisch – fisch.gilberto@gmail.com

Instituto de Aeronáutica e Espaço (IAE), Brazil

Rayonil G. Carneiro (INPE), Brazil

1. Introduction

Amazonia it is well know as a source of convection and it has a strong influence on the climate. Although this region is mainly covered by tropical forest, there is a high rate of deforestation for cattle activities and crop productions. For a microscale perspective, the presence of clearing of different dimensions/sizes can alter the energy budget at the surface producing a low level convergence and an increase of upward movement, thus originating clouds and rainfall. The Planetary Boundary Layer (PBL) responds to all these processes, so the importance for its study.

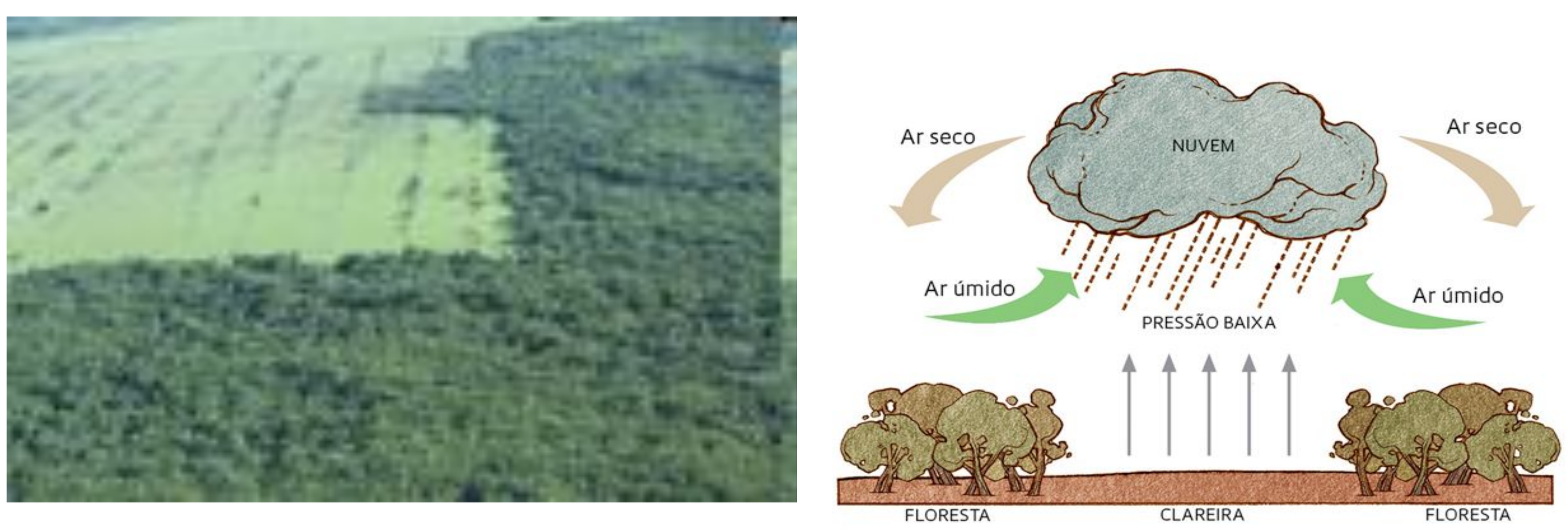

Figure 1. Example of the tropical deforestation and a schematic cloud formation.

2. Methodology

a) *IN SITU* MEASUREMENTS

The CHUVA Project / Go Amazon 2014/5 field campaigns was held during the wet (feb-mar IOP1) and dry seasons (sept-oct IOP2) for the years 2014 and 2015. It provides new and original data set as remote sensing instruments (ceilometer, minisodar, windprofiler, lidar, microwave radiometer), as well routine rawinsounding data (6 launchings per day) for a heterogeneity site (mixture of tropical forest and agricultural pasture) at central Amazonia.(Figure 2).

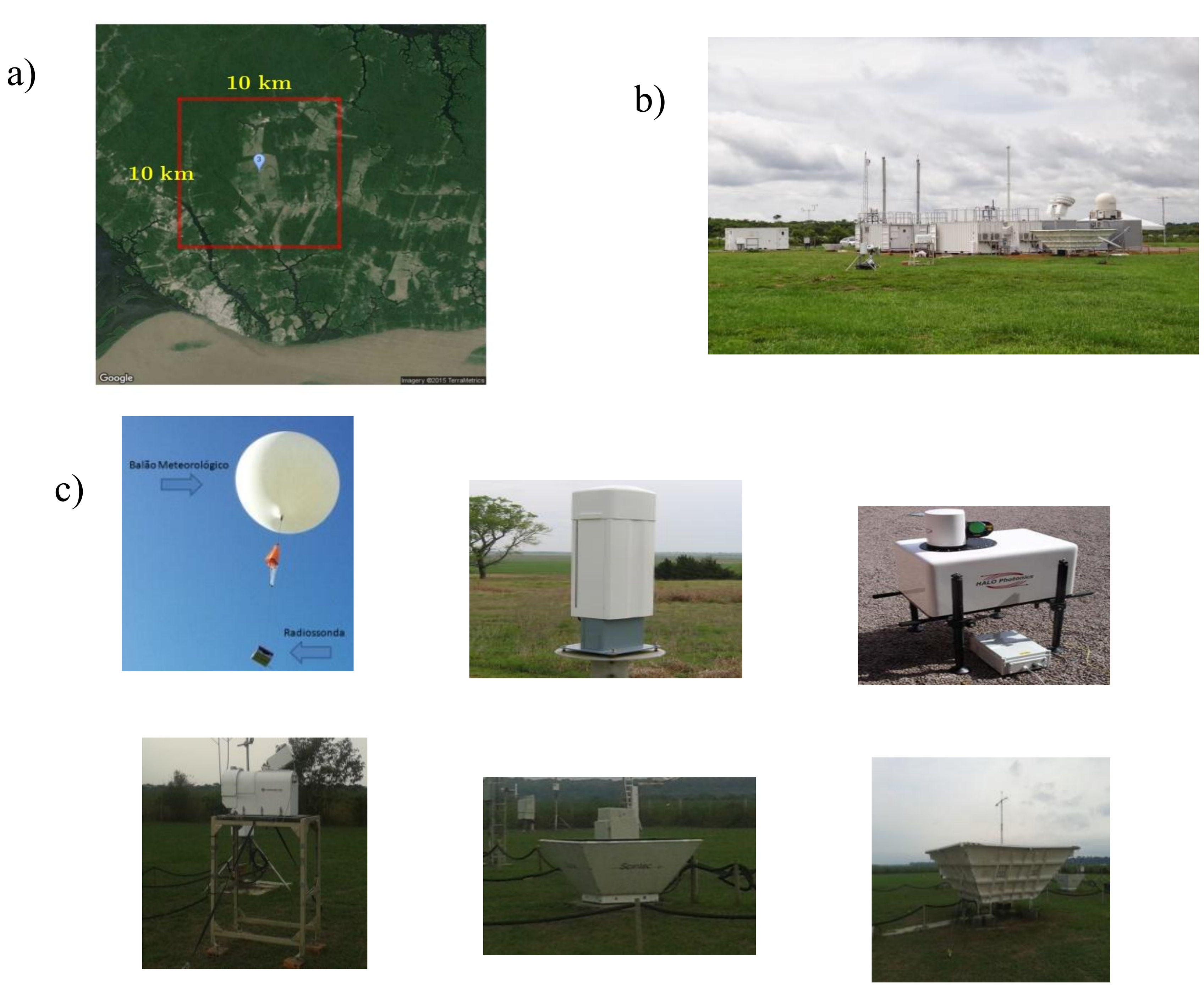

Figure 2. The geographic position (a), aerial view (b) and 6 differents instruments used (radiosondes, ceilometes, lidar, microwave radiometer, sodar and windprofiler (c) .

Radiosonde: The radiosonde system (RS) used in the experiment was DIGICORA (MW12) (Vaisala Inc. Finlândia), which uses radiosondes RS92SGP, released at 02, 08, 11, 14 and 20 Local Time (LT). The potential temperature and specific humidity profiles were used to estimate the PBL height.

Wind Profiler: Measurements of the Wind Profiler and RASS (radio acoustic sound system) RWP915 model from Vaisala Inc. (Finlândia) were used to direct the continuous measurements of the PBL. We have followed the methodology used by Wang et al. (2016), where the maximum electromagnetic refractive index occurs at the top of the PBL.

Mini-SODAR: From the SODAR the vertical profiles of wind speed and direction were measured in time intervals of 30 minutes and a maximum range of 400 meters height. The NBL heights were determined using the concept of the maximum wind height as suggested by Neves and Fisch (2011).

Ceilometer: a model CL31 ceilometer from Vaisala, Inc. Finland provides measurements of the optical backscatter, with a temporal resolution of 16 s and averages of 30 minutes were taken.

Microwave Radiometer Profiler (MWR): The MWR (model MP3000A (Radiometrics Corp., Boulder, CO, United States) provides vertical profiles of temperature, humidity, and liquid water content as well as surface pressure at 5 minute intervals. The data obtained from the MWR were combined with the vertical pressure profiles obtained from the radiosondes and interpolated for the entire daily cycle. The potential temperature was computed throughout the day and thus the height of the PBL.

Lidar Doppler: The Lidar is a stand-alone remote sensing instrument that provides measurements of radial velocity and backscatter attenuated in time. Through the variance of the vertical velocity (), it determines the depth of the PBL, following the method of Huang et al. (2017): the layer in which exceeds a certain limit (0.1 $m^2 s^{-2}$).

3.Discussion and Results

The diurnal cycle of the PBL is shown at Figure 3 considering the 2 years of measurements. The typical values for the NBL are around 250-350 m and the CBL has a strong growth during the late morning, reaching values between 1500-1600 m by 14 Local Time (LT).

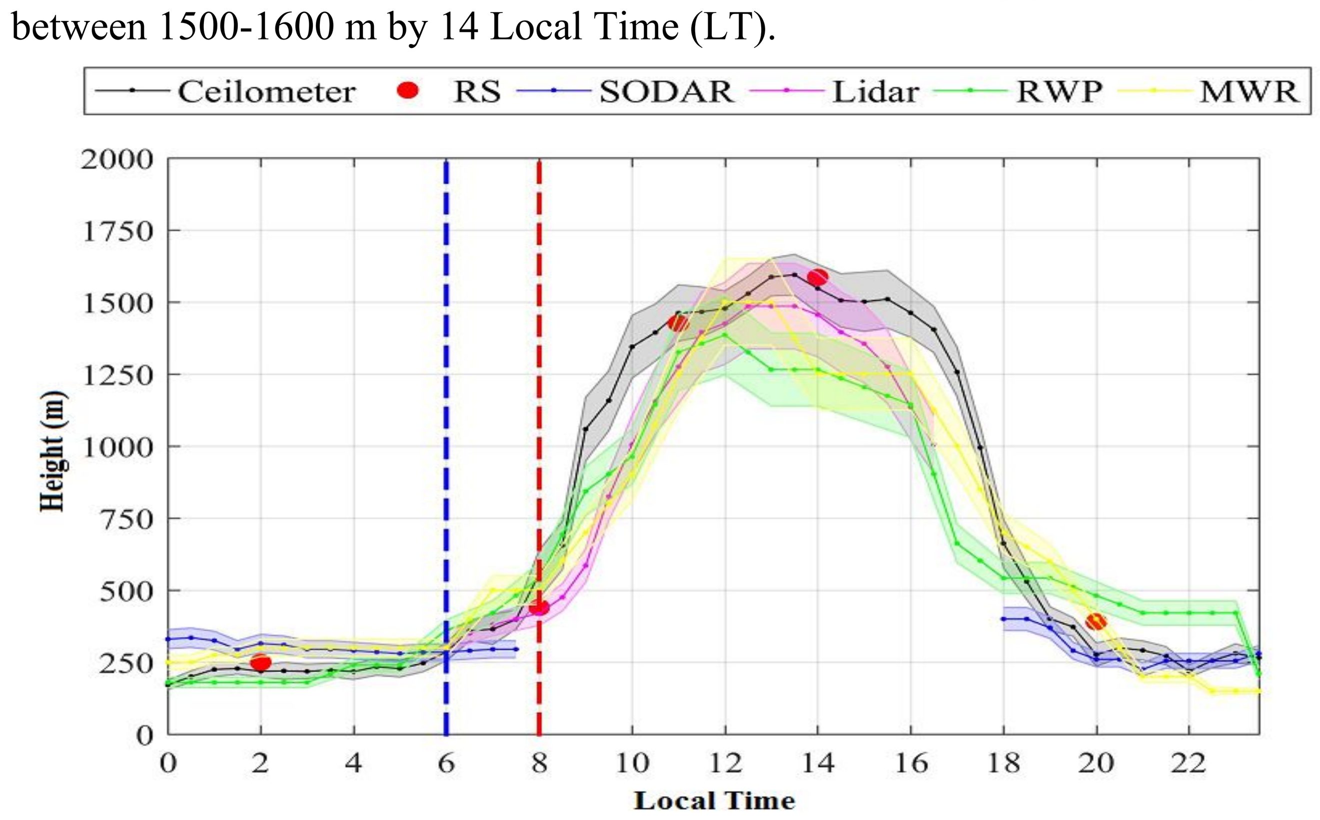

Figure 3. The diurnal cycle of the PBL. The blue and red lines represent the sunrise and erosion of the nocturnal boundary layer, respectively.

The Figures 4 and 5 showed the PBL during IOP1 (wet period) and IOP2 (dry season), respectively. The patterns are very different and they are consequence of the energy partition at the surface. For the wet season (Figure 4), the soil were wetter due to the rainfall and the sensible heat fluxes smaller, resulting the Convective Boundary Layer (CBL) around 1100-1250 m and variable and intermittent Nocturnal Boundary Layer -NBL (180-280 m depth).

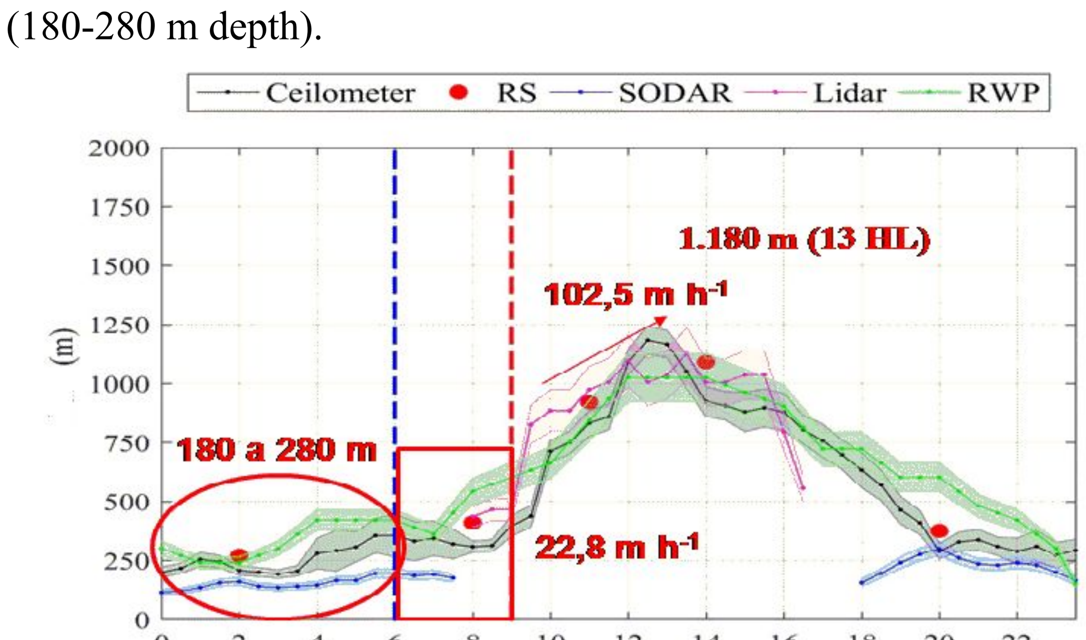

Figure 4. The diurnal cycle of the PBL during IOP1.

For the dry season (Figure 5), the CBL is deeper (the soils are dry) around 1500-1700 m, while the NBL is very stable with its depth around 250 m. There are less turbulence and intermittency at nighttime.

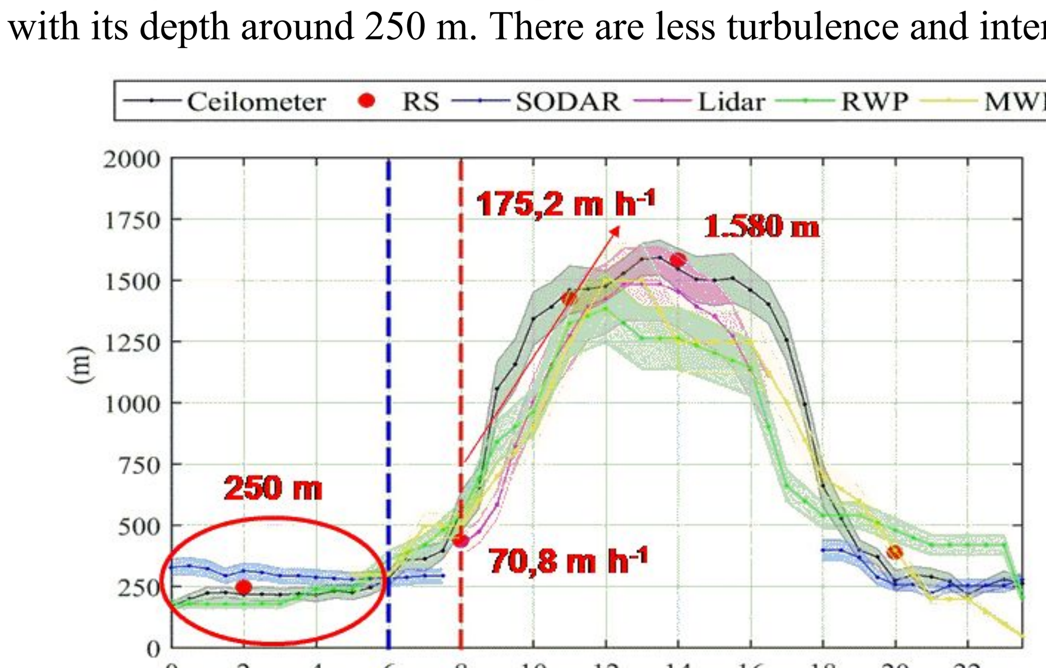

Figure 5. The diurnal cycle of PBL during IOP2.

4. Concluding Remarks

The dataset collected under Go Amazon 2014/15 experiment is unique and it provides new insights about the Amazonian BL structure. Typical values for the Nocturnal Bounday Layer depths are 200-350 m and for the Convective Boundary Layer (CBL) in the range from 1250-1500 m. The season (wet or dry) has a strong influence on the typical values. All instruments used had agreed amongst them.

Acknowledgments: This work is a contribution of the Brazilian National Institute of Science and Technology (INCT) for Climate Change funded by CNPq Grant Number 573797/2008-0 e FAPESP Grant Number 2008/57719-9.

This study had the financial support from AEB,CNPq, CAPES, FAPESP and INCT/Amazonia.