P1.20 # EVOLUTION OF ALBEDO, NET RADIATION AND SOIL HEAT FLUX BEFORE AND AFTER A FOREST BURNING IN SOUTHERN AMAZONIA

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1. INTRODUCTION

Forest clearing and subsequent burning of the downed biomass are parts of the occupation process in the Amazon region. This causes a clear impact on the environment, including effects on the weather and the climate. Thus, campaigns with controlled burnings were effected in clearings of virgin "Terra Firme" Amazonian Forest in the Alta Floresta, MT region of Brazil (Fazenda Caiabi), to assess the combustion process and some of its consequences. These clearings were cut, allowed to dry and then burnt using the local traditional method. This work presents the evolution of components of the energy balance (net radiation and soil heat flux) plus albedo measured continuously (DOY 150 to 330) in the 200 x 200 m^2 site centered at 9°57'42.20" S and 56°20'52.05" W. The site was downed on May 26, 1999 (DOY 146), after 15 days of work, and its burning was effected on August 24, 1999 (DOY 236), starting at 11:35 LST.

2. METHODOLOGY

At the top level of a 6 m tower, which was built with three vertical hard wood logs, incident and reflected solar energy pyranometers (Kipp & Zonen), a net radiometer (REBS), and a type K fireproof unshaded thermocouple (Robert Shaw / Salvi Casagrande) were installed; a similar thermocouple was kept at 2 m. In the soil, a heat flux plate (REBS) was installed at XX cm, plus four type T thermocouples (REBS), respectively at the depths of 5, 10, 20 and 40 cm. Also, at the height of 1 m, near the tower, a tipping bucket pluviometer (Hydrological Services) was installed. The data were recorded continuously on a Campbell CR10X Data logger, except for DOY 235 to 239, the days around the burning. The rate was of 10 minutes averages until DOY 245 and, thereafter, of 15 minutes . Power was provided by a 24 A h battery connected to two 11 W solar panels (Solarex).

3. RESULTS

The daily albedo was taken as the average of the ratio of the reflected and the incident solar radiation between 8 and 16 LST, giving values that do not differ significantly from the ones obtained dividing the total daily reflected solar energy by the incident energy . It shows (see Figure) an increase from 0.165 to 0.20, since four days after the slashing of the forest until its burning, due to the drying (yellowing and/or browning) of the cut green leaves. The sudden changes around DOY 173 were due to the only rainfall before the burning (5 mm were measured 6 km away, at Caiabi's headquarters; all other rainfall data were taken at the clearing),. After the burning, the soil was covered with patches of whitish ashes (due to complete burning, especially of trunks and branches) plus black areas (mostly due to incomplete burning of leaves), while the remaining trunks (usually with diameters above 10 cm) had their surface blackened. The albedo fell to 0.11, which rose to 0.12 on DOY 249 (due to the wind spreading of the finer whitish ashes over the heavier black residues). On DOY 249, between 16:15 and 18:00 LST, there was a rainfall of 13.5 mm, causing an immediate decrease of the albedo to 0.065 on the next day , due to the wetting of the ground, and the disappearance of most of the whitish ashes, leaving the darker residues or exposing the nude reddish soil surface. With the drying, the albedo rose rapidly, but was reduced immediately after each subsequent rain, with its local maxima showing linear increases until DOY 284 (from 0.09 to 0.135), Thereafter, until DOY 299 there was a decreasing trend of the maxima, reaching 0.12; subsequently, this trend reversed at a slower rate, reaching 0.13 on DOY 330, after three non rainy days. On DOY 330 there was already a slight regrowth resulting in a uniform distribution of green bushes, covering no more than 5% of the total area. There were no measurements of the albedo of the original canopy; notwithstanding, a similar forest in Rondônia (at 10°S and ca. 500 km to the West of Alta Floresta) presented albedos around 0.14 and 0.12 during the dry and wet seasons, respectively (Galvão, 1999). The albedo evolution shown is similar the one found by Fisch et al. (1994) after the burning of a pasture in Marabá, PA (5°10'S), but with smaller trends, probably due to the incipient regrowth at Caiabi.

The total daily daylight net radiation, which is partitioned into sensible, latent and soil heat flux, plus storage in the downed biomass, was relatively steady before the burning, averaging around 12 MJ m^{-2}, but, which correspond to about 65% of the total daily incident solar radiation in these days; notwithstanding, there were two days with values around 5 MJ m^{-2}, but maintaining the 65% proportion. During this period (prior to the burning), the soil heat flux had a regular daily cycle, but with very low amplitude (measurements still being verified), certainly due to the insulating action of the downed biomass which

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covered the ground; similarly, the soil temperature at the depth of 10 cm oscillated no more than 2 C per day.

After DOY 249, when the first rain subsequent to the burning occurred, until DOY 295, the total daily daylight net radiation oscillated between 4.3 and 16 MJ m^{-2}, averaging 12 MJ m^{-2}. These values correspond to 51% up to 79% of the total daily incident radiation (average 65%), which varies in the range from 6.7 to 24.8 MJ m^{-2}, depending on the cloudiness; higher percentages occur on cloudy or rainy days. Following DOY 295, when the evolution of the albedo changed, until DOY 330, the percentage remains about 75% around heavy rainy days, while the average raises to 69.7%. The soil heat flux had a stronger daily cycle, with downward spikes during daylight rain episodes. Also, excepting for front passage, rainy or strong overcast days, the 10 cm depth soil temperature daily amplitude was about 8 C.

More detailed studies are still in progress, while the meteorological data continue to be collected in the field, as part of an effort started in 1991 (e. g. Carvalho et al., 1995; Gielow et al., 1996; Carvalho et al., 1998).

4. CONCLUSIONS

The downing and subsequent burning of Amazonian Forest areas introduce transient and more permanent changes in the variables that influence the weather and the climate. And as the local measurements made are typical of similar and much larger clearings opened and burned in the region studied, they may be used, possibly together with Remote Sensing data, to improve the regional weather and climate predictions.

5. REFERENCES

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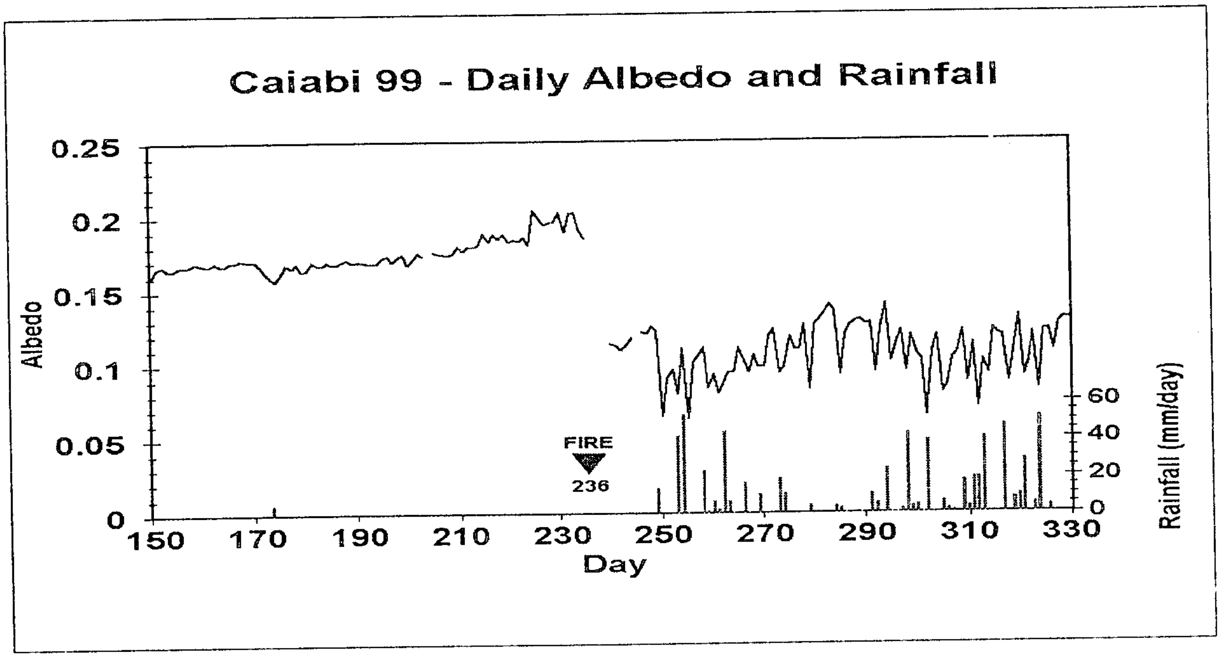

Fig. 1 - Albedo and rainfall in the slashed clearing at Fazenda Caiabi, Alta Floresta, MT - May 30 - Nov. 26, 1999.