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MESOCLIMATE AT THE TAPAJÓS-AMAZON RIVER CONFLUENCE

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1. INTRODUCTION

The relatively few surface climate stations in the Amazon play an important role in defining the meaning of remotely sensed data and in constraining large-scale models. The eastern Amazon suffers seasonal drought (Fig. 1, bottom panel) and is thought to be susceptible to conversion from forest to savannah depending were drought to persist for some seasons (Sternberg, 2001), even if there were no strong deforestation pressure from encroaching agriculture. Regular river breezes lead to subsidence clearing over the rivers and to a marked decrease in rainfall along a narrow strip along the river, where most of the long-term climate stations in the Amazon region lie.

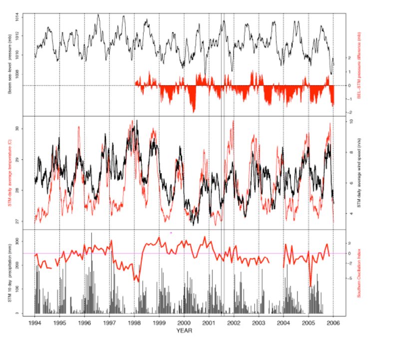

Fig. 1. Regional climate record since 1994. Top panel: Surface pressure at Belém (BEL, black) and Belém-Santarém pressure difference (red bars). Center panel: Santarém (STM) mean daily temperature (red) and wind speed (black). Bottom panel: ENSO index (red) and precipitation (pentad values, black).

2. SITE AND DATA DESCRIPTION

We seek to identify the consequences of local circulations on winds, the average incident solar radiation, surface temperature and humidity, and rainfall using data from eight automatic weather stations and three flux towers located in the LBA-ECO Santarém study area, part of the Large-Scale Biosphere-Atmosphere Experiment in the Amazon (LBA; see Fig. 2).

3. RESULTS

•While nocturnal calm conditions are normal just a short distance inland, convective conditions along the river itself are always present. Nocturnal average wind speeds at 3 m altitude near the Amazon River are comparable to those observed at the top of the 63 m tower at the km83 site;

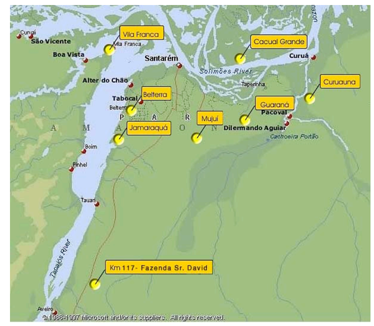

Fig. 2 LBA-ECO weather and flux station network

* Breeze effects are present on most days (Fig. 3), but flow reversal only occurs during period of slack easterlies. The large-scale pressure field that leads to these occasions will be discussed. Estimates of the mesoscale pressure gradient that leads to the river breeze are made and compared with modeled case studies.

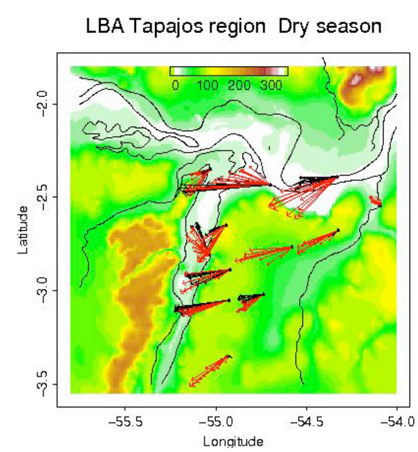

Fig. 3. Dry season average wind vectors by hour in the Tapajós LBA-ECO study area, shown in red for the daytime period average.

* Statistics of global incident short-wave radiation are presented. Average maximum hourly solar radiation peaks are coincident with local noon, but the effects of clouds push the average hourly radiative flux to later in the day. The average hourly minimum solar radiation peaks before (after) local noon for sites near (distant from) the river (Fig. 4).

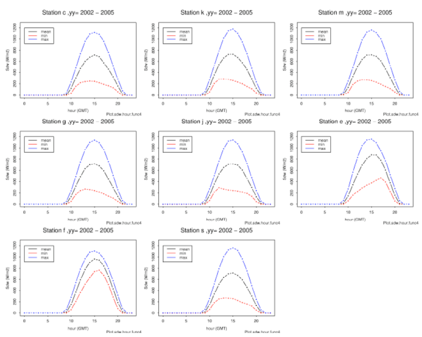

Fig. 4. Average diurnal solar radiation plots for eight automatic weather stations. In each panel is the mean half-hourly maximum (blue), the average over the half hour (black), and the mean minimum over the half-hour period. Dry season values. Station code: “c”-Belterra; “k” = km77; “m”= Mojui; “g”=Guaraná; “j”=Jamaraqua; “e”=Embrapa; “f”=Vila Franca; “s”= Sudam. “f” and “e” are riverside stations.

* The diurnal distribution of rainfall amount indicates that stations close to the river fail to observe afternoon convective rainfall correctly. Stations near the river register only the ‘basin-wide’ precipitation resulting from synoptic disturbances that typically pass through this region in the very early morning (Fig. 5). Comparisons with satellite-based estimates of rainfall intensity are presented. Implications of how these mesoscale circulations can lead to biases in the regional climate record are discussed.

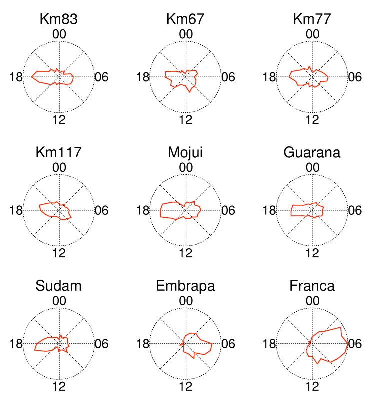

Figure 5. 24-hour rain dials showing the diurnal characteristics of rainfall amount averaged over the year. Stations are those shown in Figure 1. “Embrapa” and “Franca” are located along the Amazon River. Other stations are inland.

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REFERENCES

Sternberg, L. S. L., 2001. Savanna-forest hysteriesis in the tropics. *Global Ecology & Biogeography* 10, 369-378.