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LANDSCAPE HETEROGENEITY AND REGIONAL CLIMATIC VARIABILITY IN THE EAST CENTRAL AMAZON REGION.

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1. Introduction:

Because of logistical constraints or landscape inhomogeneity, meteorological observations are often made in areas unrepresentative of their regional surroundings. The success of extrapolation through either numerical modeling, use of remote sensing products or both still hinges on the accumulating evidence from individual measurement sites. In the Amazon, river breezes are known to exert a strong influence on regional climate (Oliveira and Fitzjarrald, 1993).

One of the intensive observation sites of the LBA-ECO project is in and around the Tapajos National Forest (TNF), near Santarém, Pará, Brazil (2° 25'S, 54° 42'W), near the confluence of the Tapajos and Amazon rivers. The TNF is a thin strip of forest wedged between a partially managed mosaic of forests, pastures, agricultural fields and secondary succession to the east and the 10-25 km wide Tapajos River to the west. To the north is the braided expanse of the main Amazon River. This region experiences persistent easterlies during much of the year, a "continental trade wind" regime. These trades are punctuated at intervals by light winds associated with weakening of the large-scale E-W pressure gradient by synoptic-scale events. Breeze effects are notable in every season. During these slack intervals, local circulations are seen by wind direction reversals. Breezes lead to strong gradients in precipitation and cloudiness. In the daytime, rivers are clear areas surrounded by cloudier land areas. These biases could distort the historical record toward lower precipitation and higher incident solar radiation at climate stations commonly found in river port cities. Measurements of H, LE, and F_C (the CO_2 flux) at the TNF may also be biased both by precipitation anomalies and by changes in radiative fluxes caused by enhanced cloudiness.

2. Methodology:

A small network of surface observation systems was designed to help quantify these effects near Santarém. These include a minimal network of surface observation stations, a cloud ceilometer, *in situ* data complemented by hourly recording of GOES infrared and visible satellite imagery in the region. In 1998, two automatic weather stations were installed; three additional stations were added in 2000. These are supplemented by the regular hourly observations at the Santarém airport and at the three LBA-ECO eddy flux towers (Fig. 1). At one of these flux towers, a Vaisala cloud ceilometer capable of recording cloud base to 12,000 m was installed in early 2001. Observed convective cloud base, a good measure of the mixed layer thickness, varies between 800 in the wet season to 1500 m in the dry season (Fig. 2). Evidence of the breeze is sometimes apparent at stations as far as 50 km from the rivers. Wind direction reversal at the surface occurs during slack easterlies (afternoon wind speed < 1.5 m/s). Radiation anomalies depend on distance from the nearest river. The perturbation pressure gradient of the river breeze can be found through composite analysis. Nocturnal flows following local topographic gradients are seen, including the *terral* along the Tapajos River (Bates, 1864). Precipitation and specific humidity (q) each show two peaks diurnally. The precipitation peak in the early morning hours is consistent with previous studies of propagating squall line circulations from the coast (Cohen and Silva Dias, 1989). The afternoon peak is apparently related to enhancement of local convective activity by surface heat fluxes. The q peaks occur when positive LE coexists with shallow surface-layer inversions during the morning and evening transitions (Fig. 3). Hourly composites of forced cumulus cloud-cover fraction from GOES images illustrate the preferred regions for initial convective activity, locations consistent with the idea of convergent river breezes (Fig. 4) The TNF sites of the LBA flux towers appear to be located in an anomalously cloudy region during large portions of the transition and dry seasons.

3. Acknowledgements:

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4. References:

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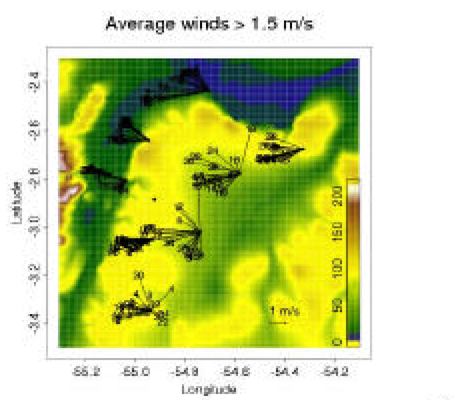

Fig. 1. Weather and flux station sites near Santarém Pará, Brazil in LBA-ECO. Arrows give median wind vector by hour.

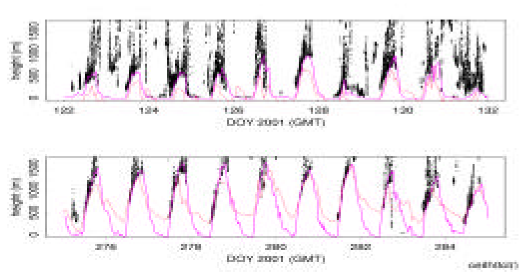

Fig. 2. Series of cloud base measurements at the km67 flux tower for wet season (top) and dry season (bottom). Solid line is the lifting condensation level of air at the open pasture site; dashed is the LCL at forest site.

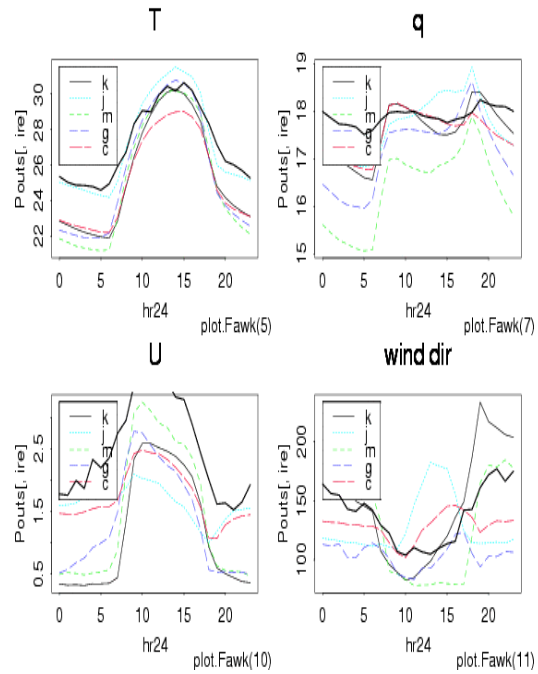

Fig. 3. Hourly median values of rainfall and specific humidity at the five automatic weather stations in LBA-ECO.

Fig. 4. Average daytime low cloud cover for May 1999 obtained from GOES images.