The large uncertainties in tower-based measures of tropical forest NEE have been discussed at length during the course of LBA, and are due to our limited understanding of meteorological processes controlling forest-atmosphere exchange. The problem is most evident during the night, where tower-based measures of NEE likely underestimate respiration. Recent studies have attempted to find how and where this ‘missing’ CO2 leaves the ecosystem (Staebe et al. 2004).

The micrometeorology of forest gaps, both natural and due to logging, are of interest because they may behave differently than intact forest. In terms of carbon dioxide exchange, they possibly act as chimneys with preferential venting of CO2 that may not be detected by eddy covariance. Here we address the following questions:

1. Do forest gaps exhibit different meteorology compared to intact forest (ie, is there evidence of CO2 venting via gaps)?
2. If venting is occurring, does it have a large effect on tower-based estimates of tropical forest NEE?

To study the microclimate of gaps we use data from two identical, 65 meter tall towers 400 meters apart (aligned with the wind direction) in the Tapajos National Forest. The towers were instrumented similarly to measure turbulent fluxes at 64 meters, and the CO2/H2O profile between 0.1 and 64 meters. Both towers are in an area of forest selectively logged, but one is in a large gap (diameter ~50 m) created by the logging.

**INTRODUCTION**

**CORRELATIONS ON DIEL TIME SCALES**

The wind, temperature, CO2 and H2O were remarkably similar for the two towers over the course of a typical day (FIGURE 1). This indicated that, to first order, the tower footprints were similar (ie, the effect of the gap was not dominant).

**CORRELATIONS ON SHORTER TIME SCALES**

The wind and scalar quantities were also correlated at shorter time scales (FIGURE 2). During daytime, the strong correlation between CO2 and temperature indicated there was vertical mixing between canopy and tower top heights. The strong correlation between towers, evident in the similarity of their scatter plot patterns, suggests horizontal homogeneity.

**GAP AND INTACT PROFILES**

The daytime CO2 profile was well mixed (ie, flat) at both towers (FIGURE 4, 12pm profile). At dusk, the boundary layer became stably stratified and CO2 accumulated below the canopy (7pm profile). The profile shape was fully developed by 8pm and remained throughout the night (5am profile).

At dawn, CO2 in the gap profile was evacuated more quickly and to lower heights than in the intact forest (7am profile). This suggests some venting of CO2 in the gap. As the morning progressed, CO2 was evacuated from the intact profile after 9am profile.

**EFFECT OF GAPS ON TOWER-BASED NEE**

The mean daily cycle of CO2 flux shows more positive (upward) flux during both day and night at the gap tower ($F_{C,GAP}$) relative to the intact tower ($F_{C,INTACT}$, FIGURE 5).

Integrated, the difference amounts to 3-4 TC ha-1 yr-1.

**FIGURE 4.** CO2 and H2O profile in the intact forest (blue) and gap (green) at 1200, 1500, 0500, 0700, and 0900 local time. Each profile represents the average for 30 days (January 2003).

**FIGURE 5.** Daily CO2 flux at 64 m. Intact tower (blue) and gap tower (green), from 1 year of 30-minute-averaged fluxes.

We combine this difference with the forest gap area after logging (FIGURE 6) to estimate the contribution of gap venting ($F_{C,VENT}$) to the integrated NEE.

$$F_{C,VENT} = \frac{\text{GAP AREA}}{\text{FOREST AREA}} \times (F_{C,INTACT} - F_{C,GAP})$$

$$F_{C,VENT} = 0.15 \times 4 = 0.6 \text{ TC ha}^{-1} \text{ yr}^{-1}$$

The estimated “gap-effect” on NEE (~0.6 TC ha-1 yr-1) is small compared to the ‘missing’ night time loss (~4 TC ha-1 yr-1, Miller et al. 2004). To be of comparable magnitude to the night-time losses at this site would require the gap-intact forest NEE difference to be 20 TC ha-1 yr-1 or more.

In conclusion, while some CO2 venting may occur in the gaps, it does not have a large effect on the tower-based estimate of NEE.