1. Introduction

Tropical forests are the largest global source of net primary production and contain up to 40% of global terrestrial biomass. The single largest component of carbon loss to the atmosphere is soil respiration. It is therefore important to quantify the variability in soil gas exchange flux in the tropics and to evaluate its relationship with environmental variables to improve our understanding of the global carbon budget. This study examined soil gas flux for CO, CH, and CO.

2. Study Site

Research was conducted in a premontane wet forest located on the eastern-facing slope of the Cordillera Central Mountain Range, in northeastern Costa Rica (10°22′N, 84°37′W). The area is believed to have been selectively harvested, but is currently reserved for research and educational purposes. Soil texture is a sandy clay and is volcanic in origin, with an average pH of 4.8. Average annual rainfall is in the area is 3500 mm/month. During the sampling period, total rainfall was 507 mm/month, and average air temperature was 25°C.

3. Methods

Soil gas flux rates were measured at 3 sub-canopy sites of varying elevation (Fig. 1). Sites were sampled twice-weekly over 6 weeks, during the transition from dry to wet season in Costa Rica. Static gas chambers were used for flux measurements. The instruments and procedures for each method are outlined below:

- LI-COR 8404 CO, CH, and CO Analyzer (CO)
  - 6-8 chambers per site per day
  - Sample time of 5 minutes per chamber
  - CO, ppm recorded with HOBO data logger (10 s intervals)
  - Leaf litter vs. no leaf litter chambers (components of flux)
  - Diurnal measurements taken every 6 hours for 3-day period to examine diurnal cycle
- SRI 1660 Gas Chromatograph (CO, CH, and CO)
  - 10 mL syringes filled at 0, 1, 7, 14, 21, and 28 minutes after chambers closed
  - 4 chambers per site per day
  - To test CO uptake, chambers injected with 2 syringes of car exhaust, and sampled in the subsequent 75-minute period

4. Results

- Observed CO flux was slightly higher than literature values for similar tropical regions
- Averaged soil respiration values from different analysis methods (LI-COR 8404 CO, CH, and CO analyzer and SRI 1660 Gas Chromatograph) were within error of one another (Table 1)
- Methane was taken up by soil rather than emitted during the wet season, indicating the study site is a net CH, sink (Table 1)
- Carbon monoxide flux was higher than reported literature values

5. Summary

- Carbon dioxide flux was slightly higher than previously reported values in similar tropical environments
- CO, flux was inhibited by high soil moisture
- Over a 24-hour period, soil respiration was highest in the evening, a combination of high soil temperature, moisture, and root respiration
- Forest litter did not significantly contribute to total soil respiration
- On average, soils in the study area take up methane
- Variability for all gas flux measurements was highly

6. Acknowledgements

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7. References


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**Table 1** Summary of average trace gas fluxes for each site, and for all sites combined, by method (LI-COR 8404 CO, CH, and CO analyzer and SRI 1660 Gas Chromatograph). All flux measurements were collected in the morning, between 9 and 11 AM. Linear regression trendline and R² are shown for each method.

<table>
<thead>
<tr>
<th>Site</th>
<th>CO Flux (ppm/min)</th>
<th>CH Flux (ppm/min)</th>
<th>WCI (%)</th>
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</thead>
<tbody>
<tr>
<td>Site 1</td>
<td>12.1±8.9E-3</td>
<td>20.5±8.6E-3</td>
<td>30.1±5.4</td>
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<tr>
<td>Site 2</td>
<td>9.9±6.8E-3</td>
<td>2.0±2.1E-3</td>
<td>22.0±3.3</td>
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<tr>
<td>Site 3</td>
<td>5.6±4.3E-3</td>
<td>1.7±8.6E-3</td>
<td>28.6±3.0</td>
</tr>
</tbody>
</table>

**Figure 2** Relationship between soil moisture (WVC) and carbon dioxide flux (CO) for all sites. Each point represents one static gas chamber analyzed with the LI-COR 8404 CO, CH, and CO analyzer. All flux measurements were collected in the morning, between 9 and 11 AM. Linear correlation relationship for all points.

**Figure 3** The carbon monoxide decline in the chamber after two exhaust injections at Site 2. Samples were taken every thirty seconds for the first 5 minutes, then five or ten minutes intervals for the remainder of the sampling period.