



CARBON TRACKER AND WATER AVAILABILITY: CONTROLS OF LAND USE AND CLIMATE CHANGES

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FAPESP Process 2008/58120-3 | Term: Sep 2009 to Sep 2013

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SCIENCE QUESTIONS AND OBJECTIVES

Our research concerns on the investigation of the consequences of either the global climate changes (CG) and the land use changes (LUC) in the functioning of ecosystems, with emphasis on the water and carbon cycles, especially in the sectors of water resources and agriculture, and the balance of carbon in the Amazon basin. We seek to measure and interpret greenhouse gases (GHG) and surface hydrometeorological exchanges at large and regional scale in Brazil, both due to the climate variability and LUC, using consistent field measurements of flux tower sites with measurements of climate, fluxes of CO₂ and evapotranspiration, radiation, soil moisture and river discharge, groundwater, litterfall

photosynthesis, and aircraft (*Figures 1 and 2*) and numerical modelling of the land-atmosphere system. We aim to answer (i) if the Amazon basin operates as a sink or source of GHG and (ii) on what extension the LUC alters the water availability and flood events, and how it might combine the CG. By means of a consortium of Brazilian and USA/UK institutions we plan to develop spatio-temporal distributions of carbon fluxes, estimating mean net carbon flux for Amazon basin, using a computational assimilation system – the Carbon Tracker-Amazonia; and calculating the patterns in soil water and river runoff status, flood events and ecosystem productivity in the Amazon basin and across several meso-scale watersheds in the Cerrado and Atlantic Forest biomes for a range of climate scenarios.

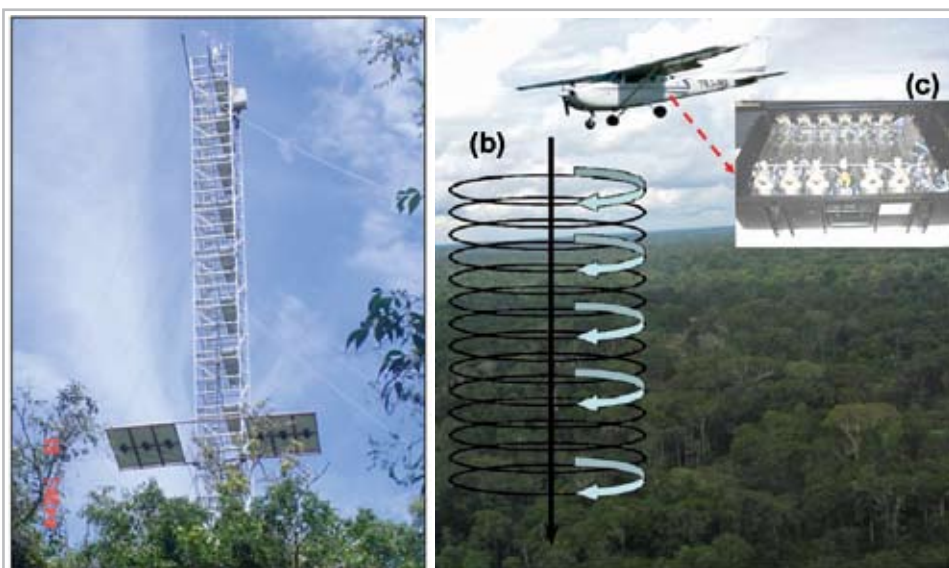
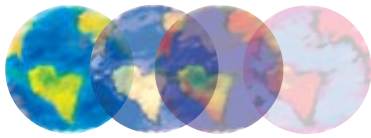


Figure 1. (a) Flux tower over a floodplain area in the ecotonal region of Bananal Island (frontiers of Tocantins-Mato Grosso-Pará); (b) Measurement of atmospheric greenhouse gases with aircraft's downward sampling using (c) a portable compressor and flask unities



CURRENT RESULTS AND PERSPECTIVES

Vertical profile sampling of atmospheric air from aircraft at Santarem, Manaus and Alta Floresta for subsequent GHG concentration analysis in the laboratory have been performed successfully and preliminarily tested in the Carbon Tracker Amazonia assimilation system, which showed substantial areal contribution over the Amazonia that helped to change the global CO₂ concentration (Figure 2b).

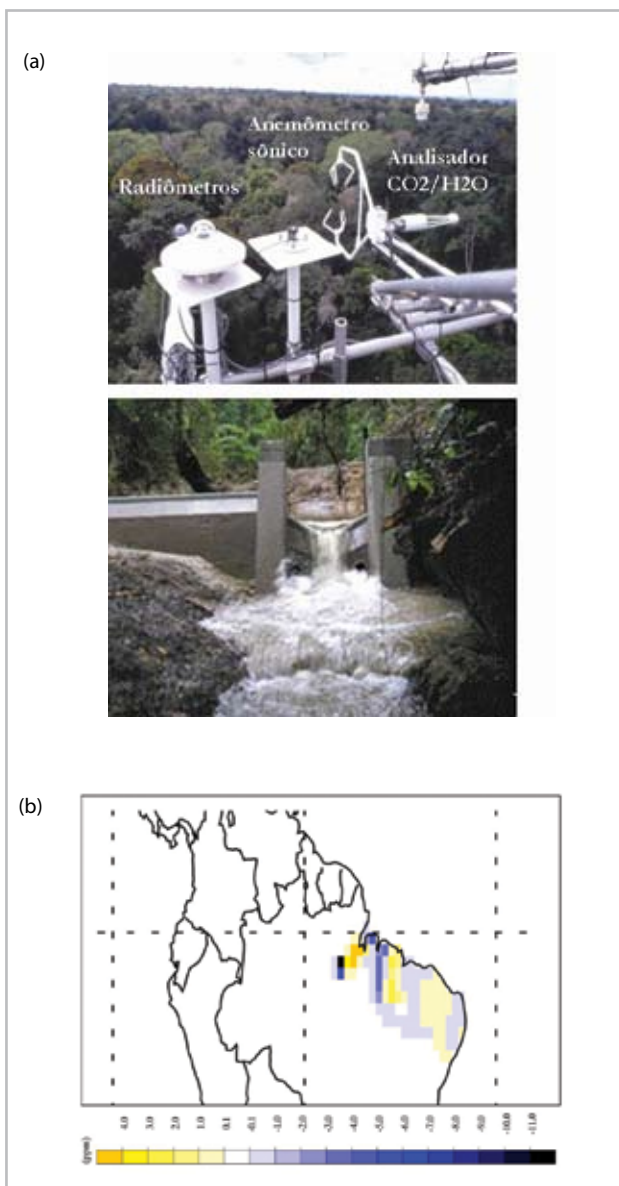


Figure 2. (a) Micrometeorological instrumentation to measure climate, CO₂ flux and evapotranspiration at the top tower, and measurement of basin discharge in the Atlantic Forest; (b) Modelled contribution (in ppm) to the global CO₂ concentration of the surface upwind Santarem, PA

RELATED PUBLICATIONS

Cabral OMR, Rocha HR, Gash JHC, Ligo MAV, Freitas HC, Tatsch JD. The energy and water balance of a eucalyptus plantation in southeast Brazil. *Journal of Hydrology*. **388**: 208-216. 10.1016/j.jhydrol.2010.04.041, 2010a.

D'Amelio MTS, Gatti LV, Miller JB, Tans P. 2009. Regional N₂O fluxes in Amazonia derived from aircraft vertical profiles. *Atmos. Chem. Phys.* **9**: 8785-8797.

Gatti LV, Miller JB, D'Amelio MTS, Gloor E, Martinewski A, Basso LS, Wofsy S, Tans, P. Vertical profiles of CO₂ above eastern Amazonia suggest a near neutral carbon balance between 2000 and 2009. *Tellus B*, DOI: 10.1111/j.1600-0889.2010.00484.x, 2010 a.

Rocha H, Manzi AO, Cabral OM, Miller SD, Goulden ML, Saleska SR, -Coupe NR, Wofsy SC, Borma LS, Artaxo P, Vourlitis G, Nogueira JS, Cardoso FL, Nobre AD, Kruijt B, Freitas HC, von Randow C, Aguiar RG, Maia JF. 2009. Patterns of water and heat flux across a biome gradient from tropical forest to savanna in Brazil. *J. Geophys. Res.* **114**, G00B12, doi:10.1029/2007JG000640.

Saad SI, Rocha H, da Silva Dias MAF, Rosolem RI. 2010. Can the deforestation breeze change the rainfall in Amazonia? A case study for the BR163 highway region. *Earth Interactions*. **14**: 1-25. DOI:10.1175/2010EI351.1

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