Measuring Carbon Balances in the Amazon Basin

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S.R. Saleska,L. Hutyra, E. Hammond-Pyle, B.C. Daube, S. C. Wofsy
Dept. of Earth & Planetary Sciences, Harvard University

P.B. de Camargo, S.A. Vieira
CENA/Universidade de Sao Paulo, Brazil

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Hypothesis: undisturbed tropical forests are a net sink for atmospheric CO_2

I. Review: Plot studies (Phillips '98), eddy flux (Grace '95), models (Tian '98)
--> show substantial (5-6 tC/ha-yr) uptake in tropics

II. Methods: Integrated study of

A. ground-based biometry (tree growth & mortality) (began Feb. 2000)

B. tower-mounted micrometeorology (eddy flux)
including: -eddy fluxes at 2+ levels (began April 2001)
-distributed met. stations (Fitzjarrald)
-radon as transport tracer (Martens)

III. Initial Results: system in carbon balance or losing carbon

Literature Review

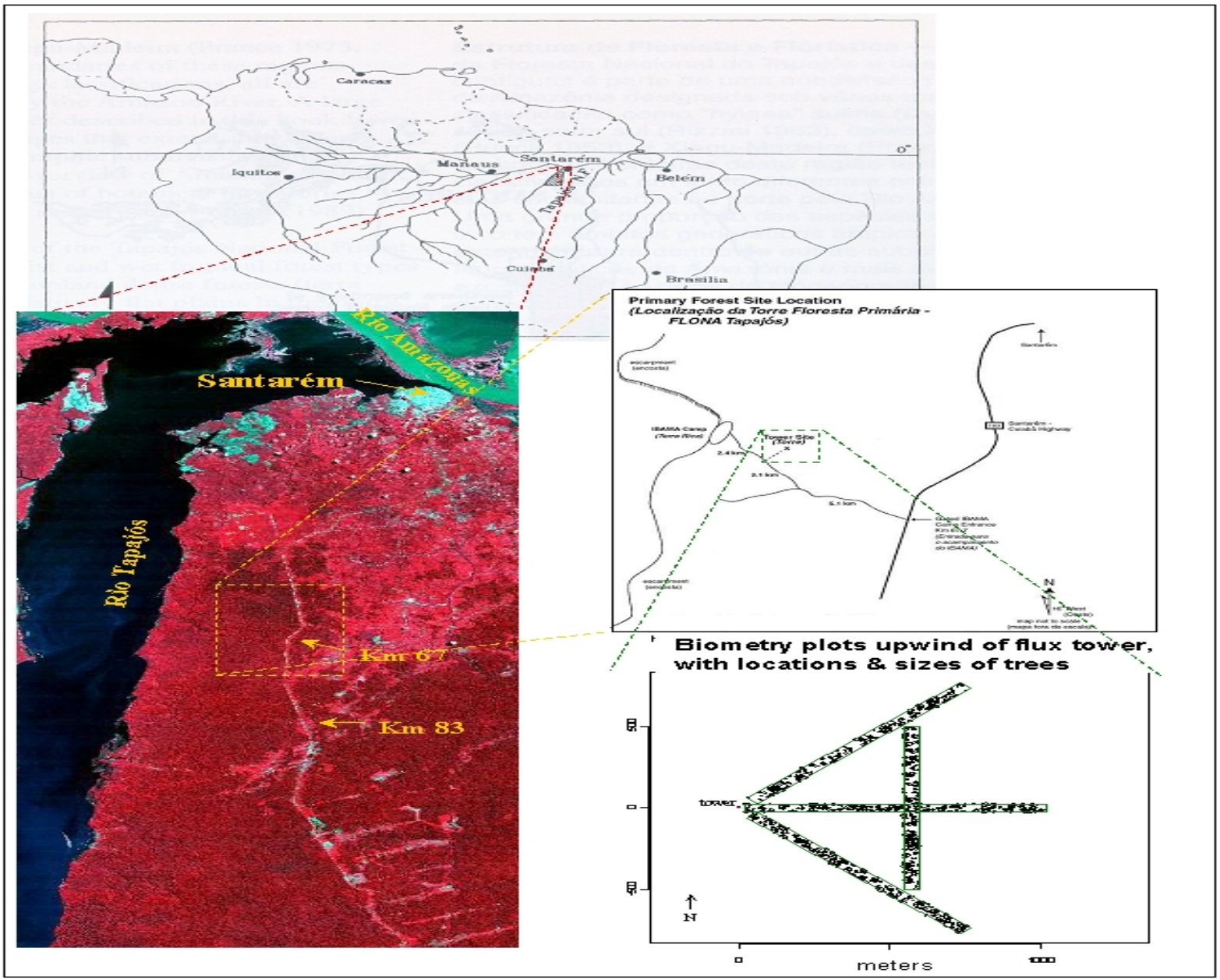
- Long-term forest plots show accumulation of biomass (Phillips, et al., 1998)

  → *but some sites logged; selection issues?*

- Initial eddy-covariance studies show substantial net uptake (Fan et al., 1990; Grace et al., 1995; Mahli et al., 1998)

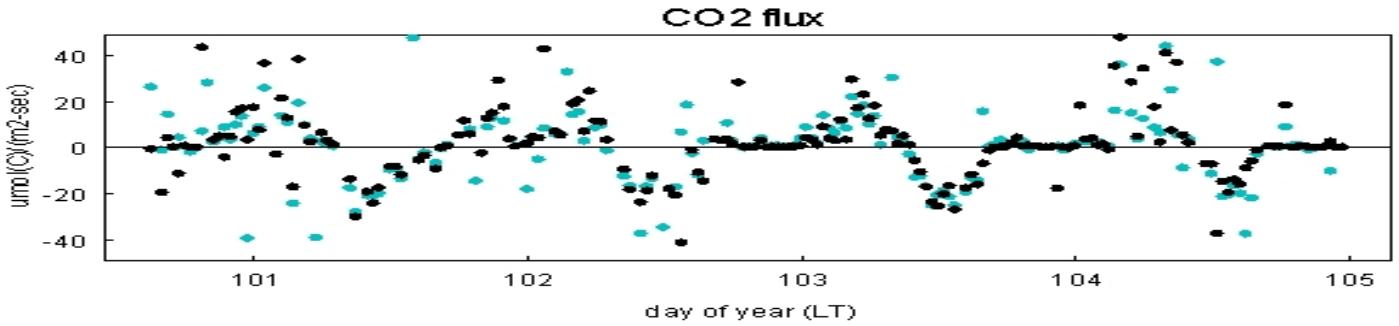
  → *but these studies were short (≤1 yr);*
  + meteorology issues?

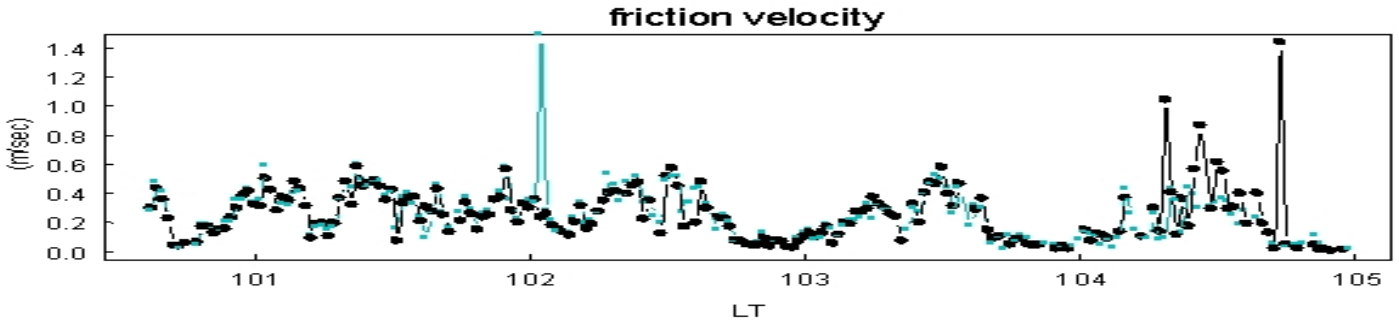
- Some models (Lloyd & Farquhar, 1996; Tian et al. 1998) predict strong [CO_2]-driven increase in tropical uptake

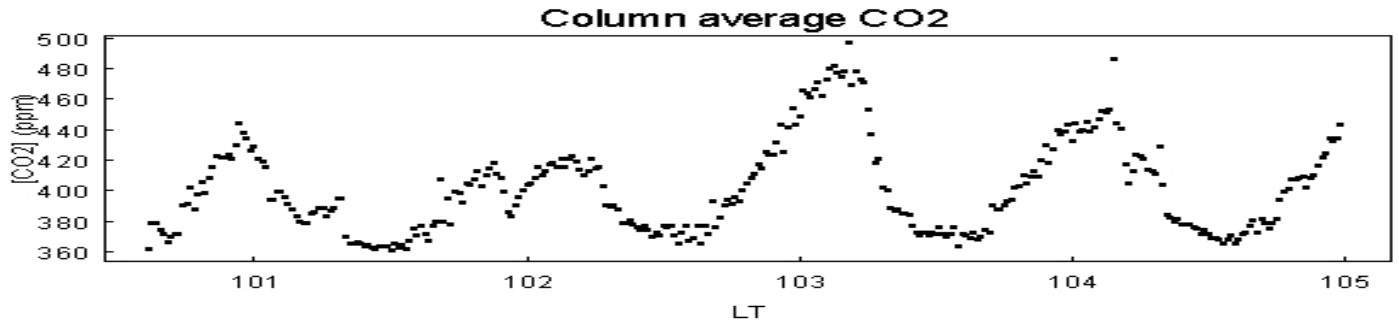

Caracas
Iquitos
Manaus
Santarém
Belém
Cuiabá
Brasília
0°
Rio Amazonas
Santarém
Rio Tapajós
Km 67
Km 83
Primary Forest Site Location
(Localização da Torre Floresta Primária - FLONA Tapajós)
Biometry plots upwind of flux tower, with locations & sizes of trees
tower
N
meters

Eddy Flux instrument

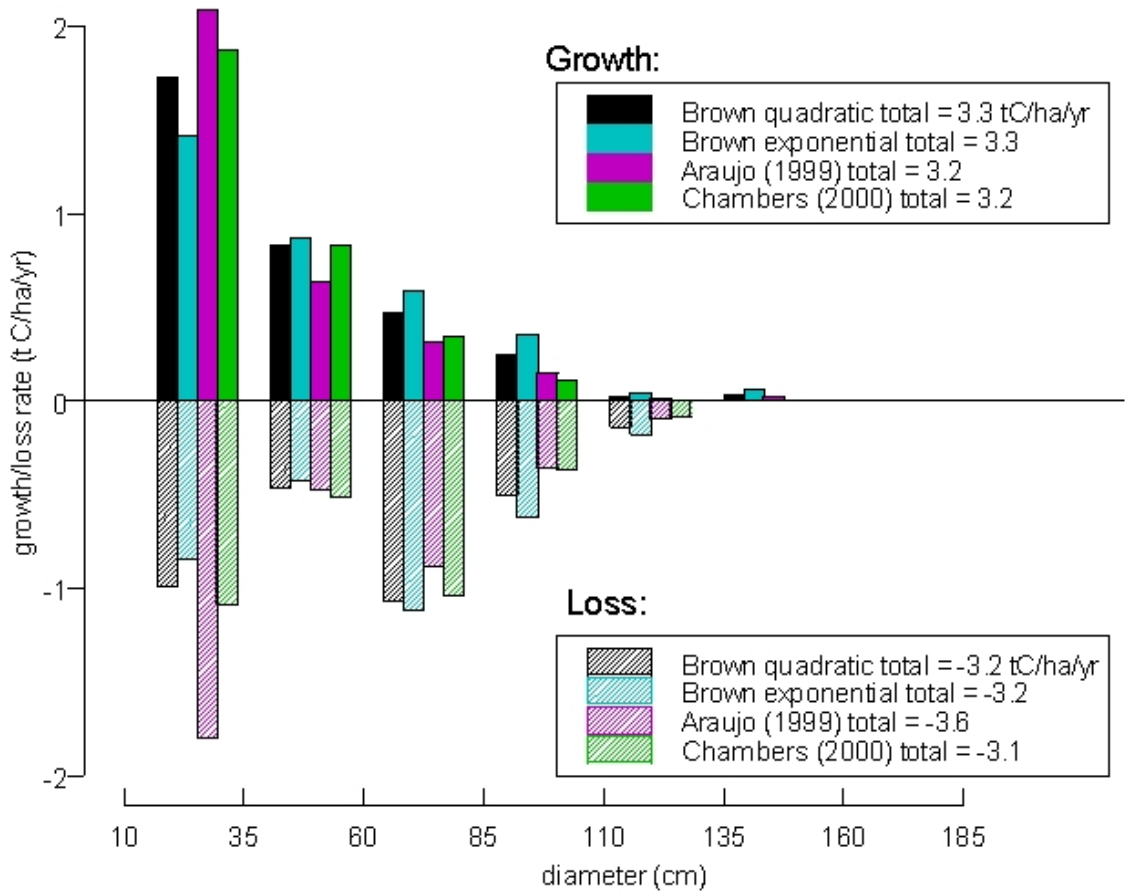
- Engineered pressure- and temperature-controlled Licor CO_2 analyzer system (accuracy <0.2ppm, long-term precision < 0.1 ppm CO_2)
- CO_2-analyzer mounted on-tower (~5 ft from eddy sample inlet)
- Eddy flux at two levels (58m, 47m)
- [CO_2] profile (sequential) and [CO_2] column average (instantaneous)


CO2 flux
40
20
0
-20
-40
umol(C)/m2-sec)
101
102
103
104
105
day of year (LT)

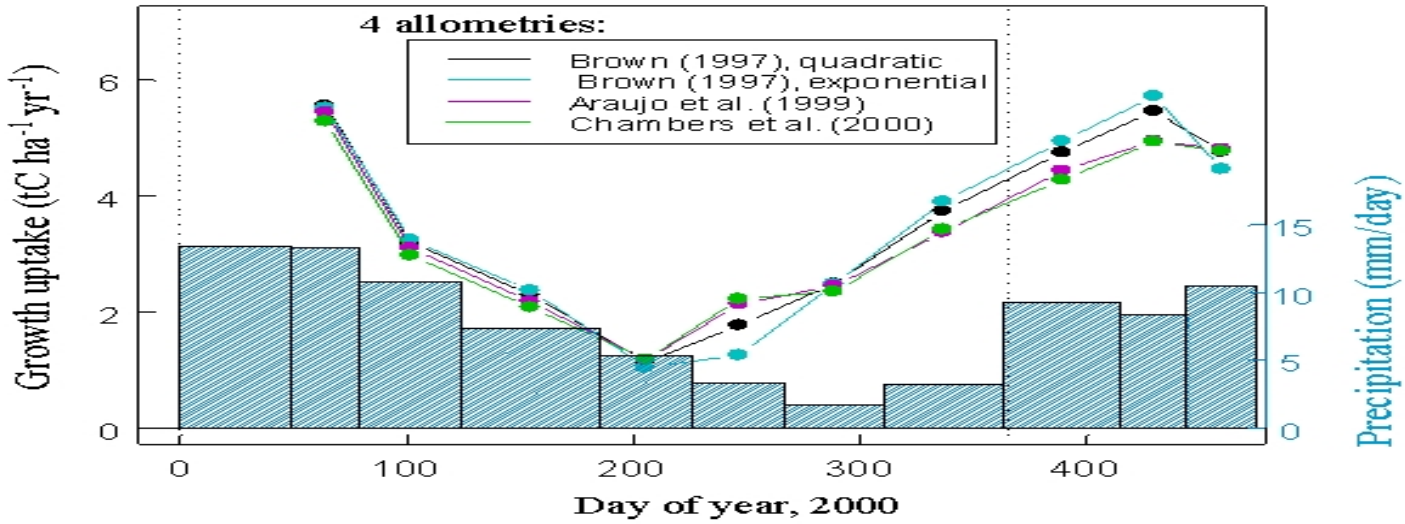

friction velocity
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
(m/sec)
101
102
103
104
105
LT


Column average CO2
500
480
460
440
420
400
380
360
[CO2] (ppm)
101
102
103
104
105
LT

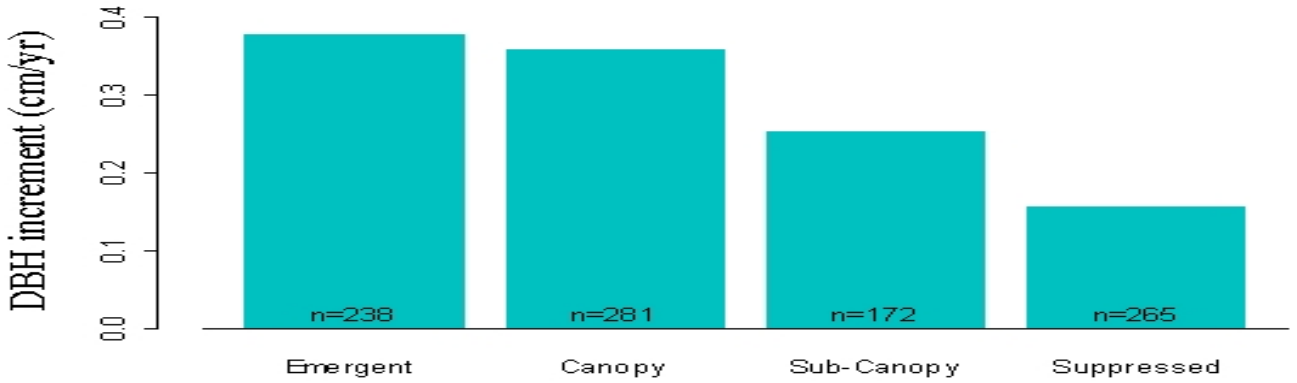
Carbon fluxes to aboveground Biomass: Tree growth & mortality, by size-class



Biometry: Tree growth Rates: (a) over time....



...and (b) by canopy status



Carbon fluxes to aboveground biomass: Summary