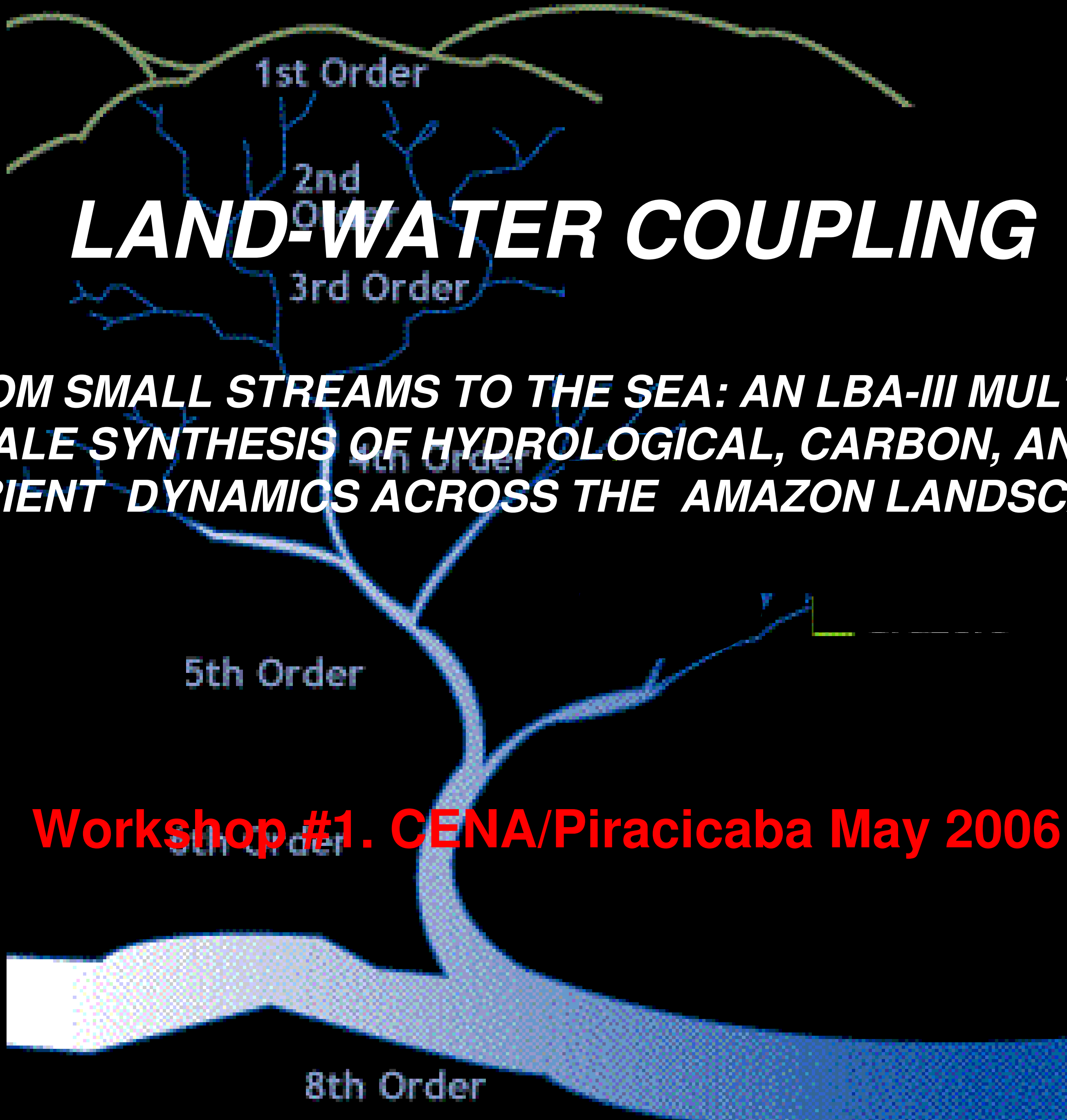
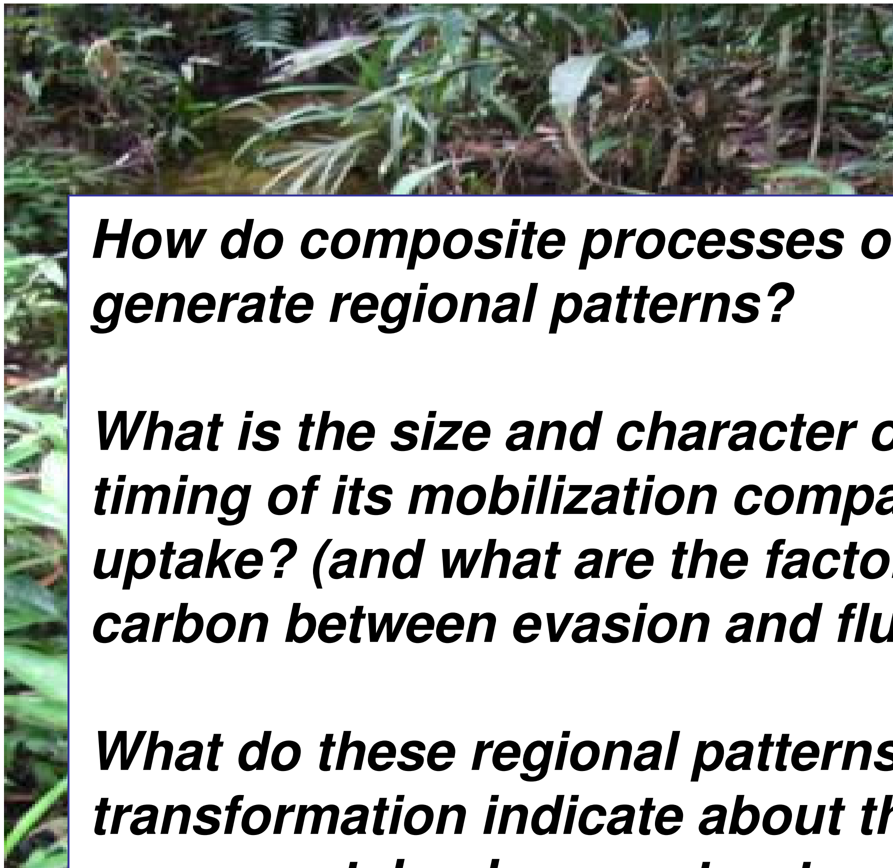
LAND-WATER COUPLING

FROM SMALL STREAMS TO THE SEA: AN LBA-III MULTI-SCALE SYNTHESIS OF HYDROLOGICAL, CARBON, AND NUTRIENT DYNAMICS ACROSS THE AMAZON LANDSCAPE



Workshop #1. CENA/Piracicaba May 2006

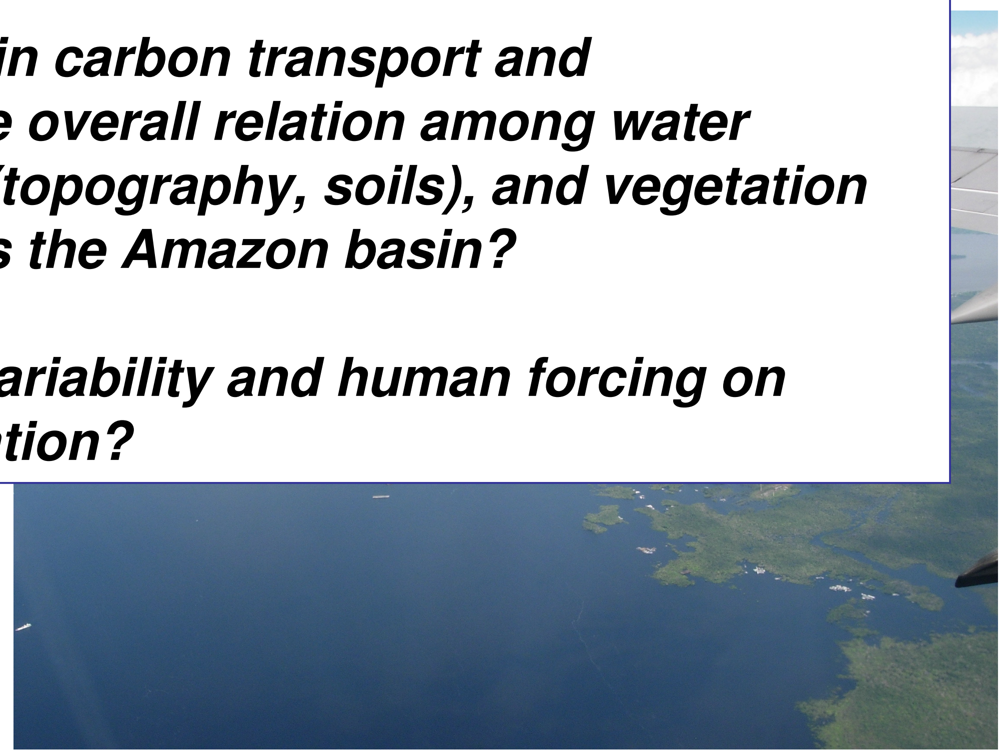


How do composite processes of land-water interactions scale up to generate regional patterns?

What is the size and character of the riverine carbon pool and the timing of its mobilization compared to net atmosphere-land carbon uptake? (and what are the factors controlling the partitioning of carbon between evasion and fluvial export?).

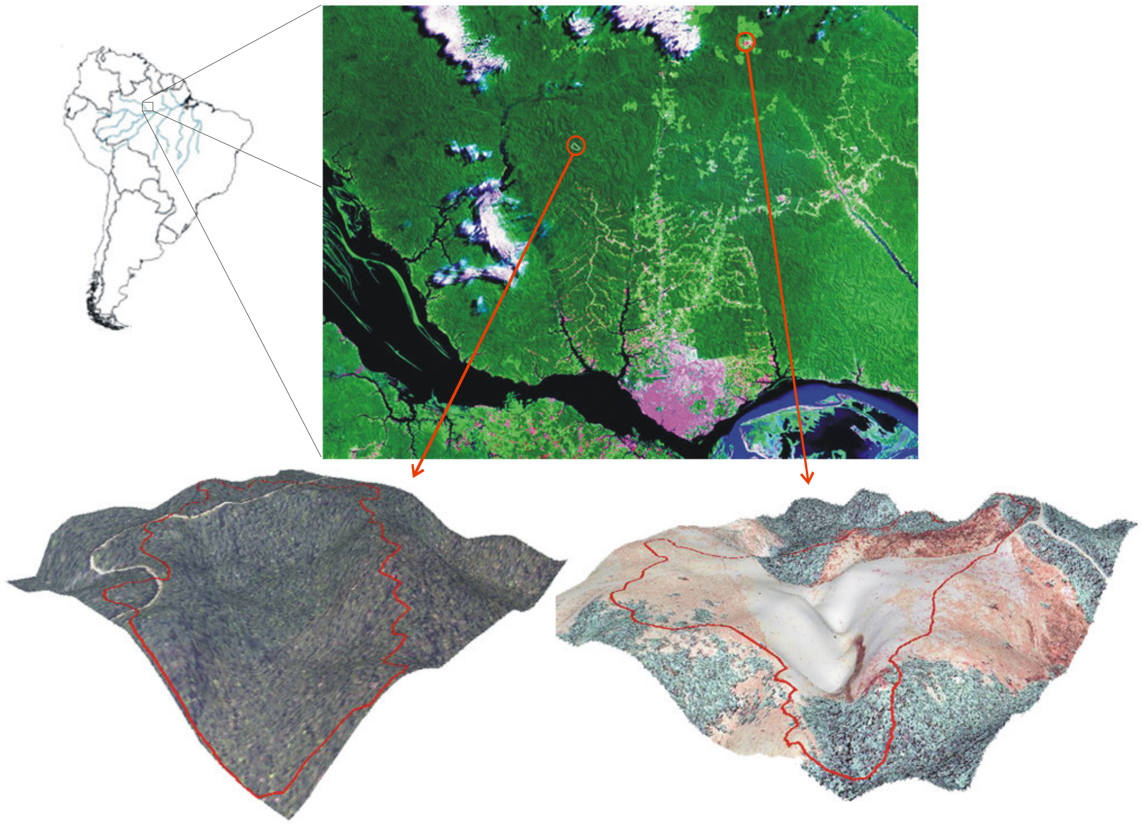
What do these regional patterns in carbon transport and transformation indicate about the overall relation among water movement, landscape structure (topography, soils), and vegetation structure and productivity across the Amazon basin?

What are the effects of climate variability and human forcing on water and fluvial carbon mobilization?



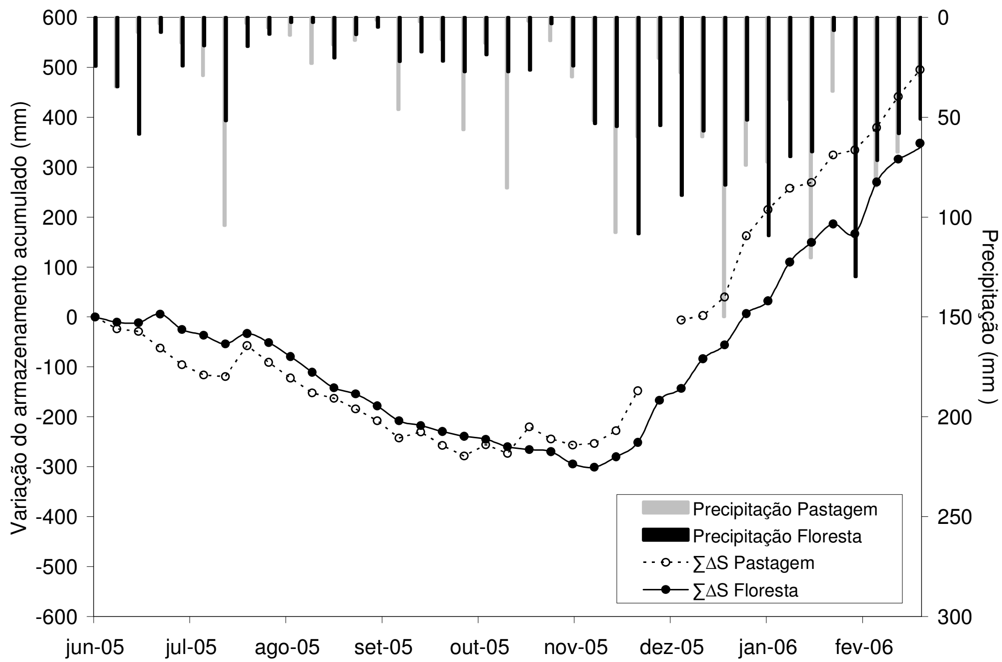
HYDRO THEME………

Effects of deforestation on hydrologic response: from scale reduction to large basins



INPA/INPE Group: Daniel Andrés Rodrigues, Javier Tomasella, Luz Adriana Cuartas, Ralph Trancoso da Silva, Rita de Cassia da Silva.

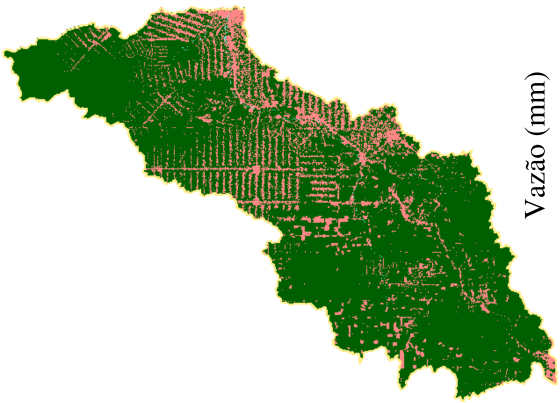
Water Balance
Comparison of cumulative changes of storage



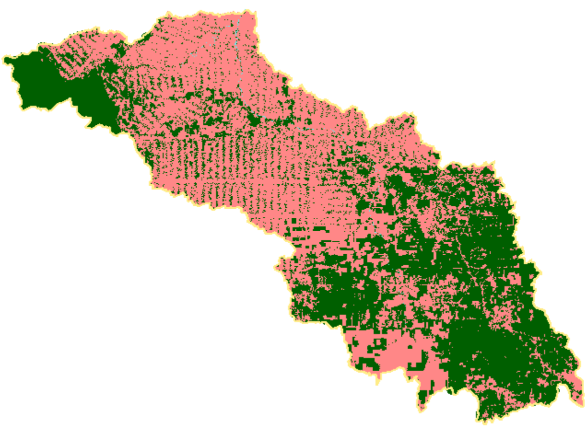
Cobertura da terra	Precipitação ($mm.dia^{-1}$)	Vazão ($mm.dia^{-1}$)	Evapotranspiração ($mm.dia^{-1}$)	Variação do armazenamento ($mm.dia^{-1}$)	Coef. de escoamento (Q/P)
Pastagem	5.96	1.88	2.40	1.68	0.32
Floresta	5.83	0.90	3.50	1.43	0.15

Do we see such signals, at (Ji-Parana) Mesoscale?

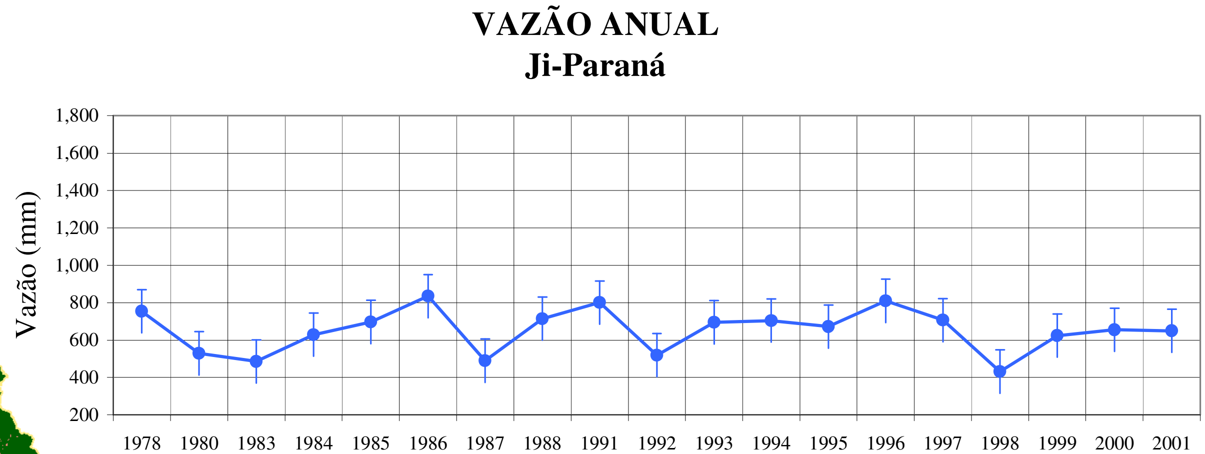
1984

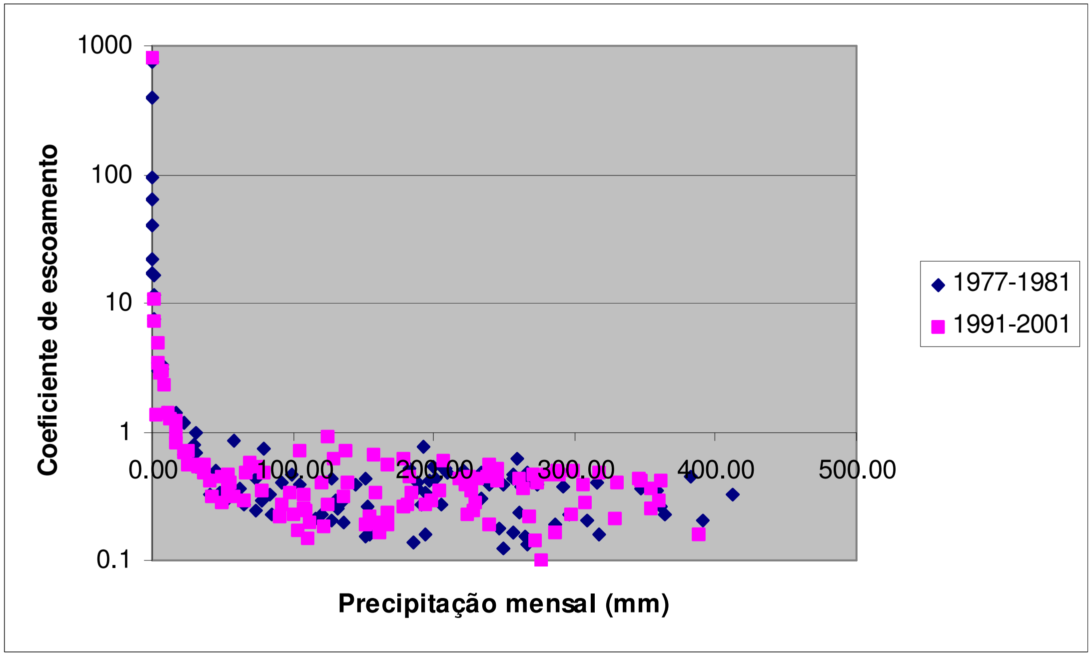


2001



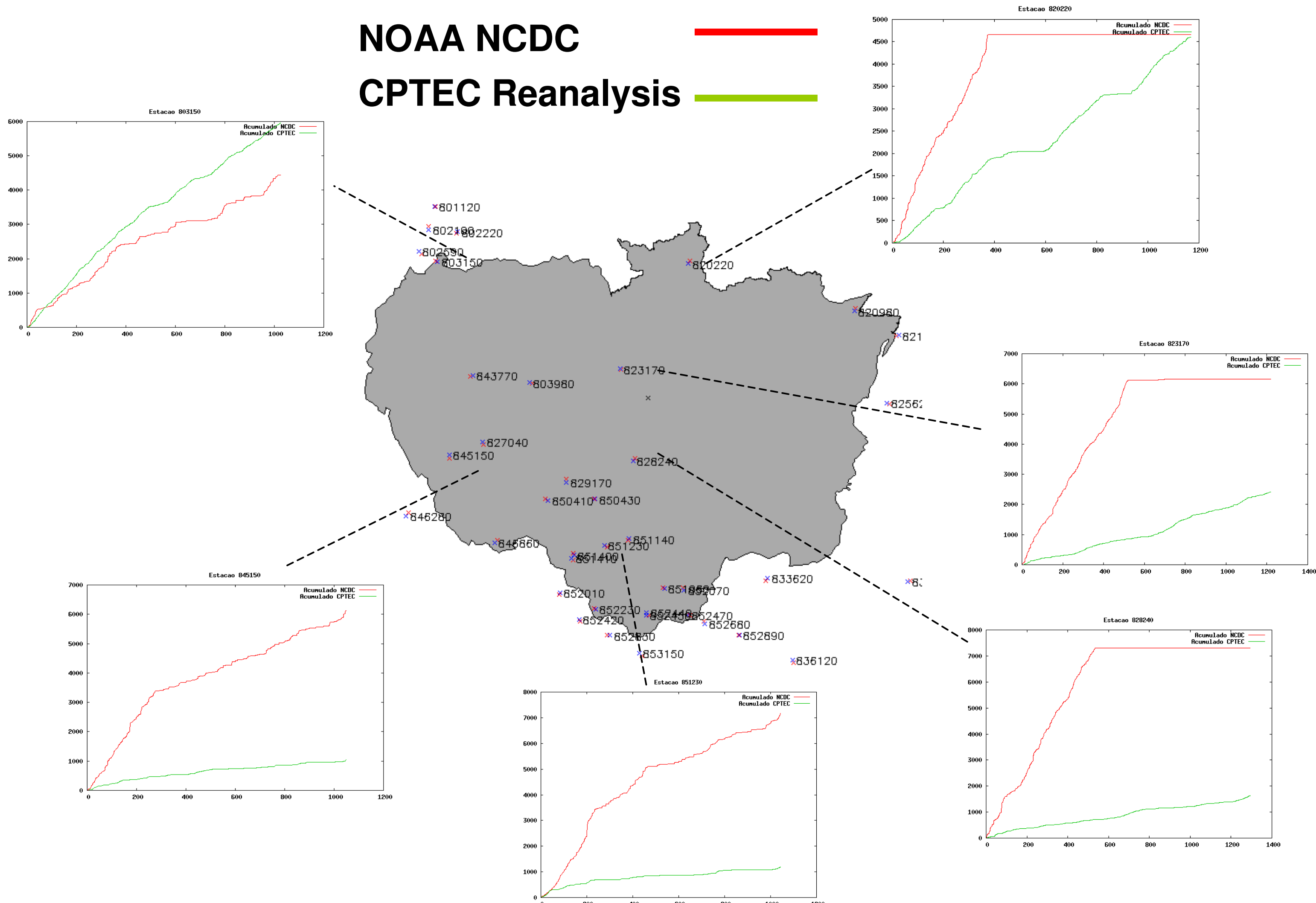
Claudia Linhares (2005)

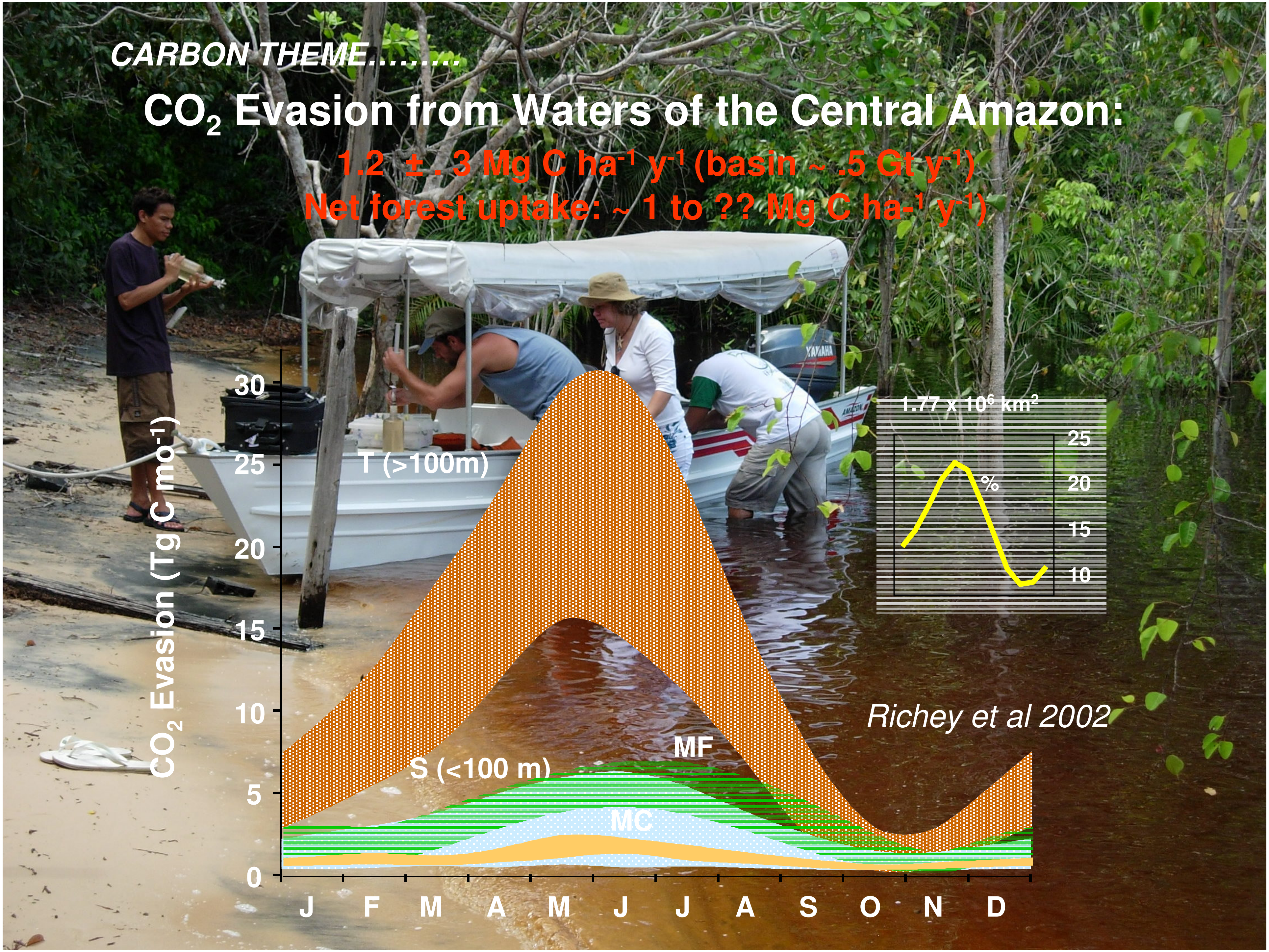




Challenging Issue: Surface Forcing/Precip Fields

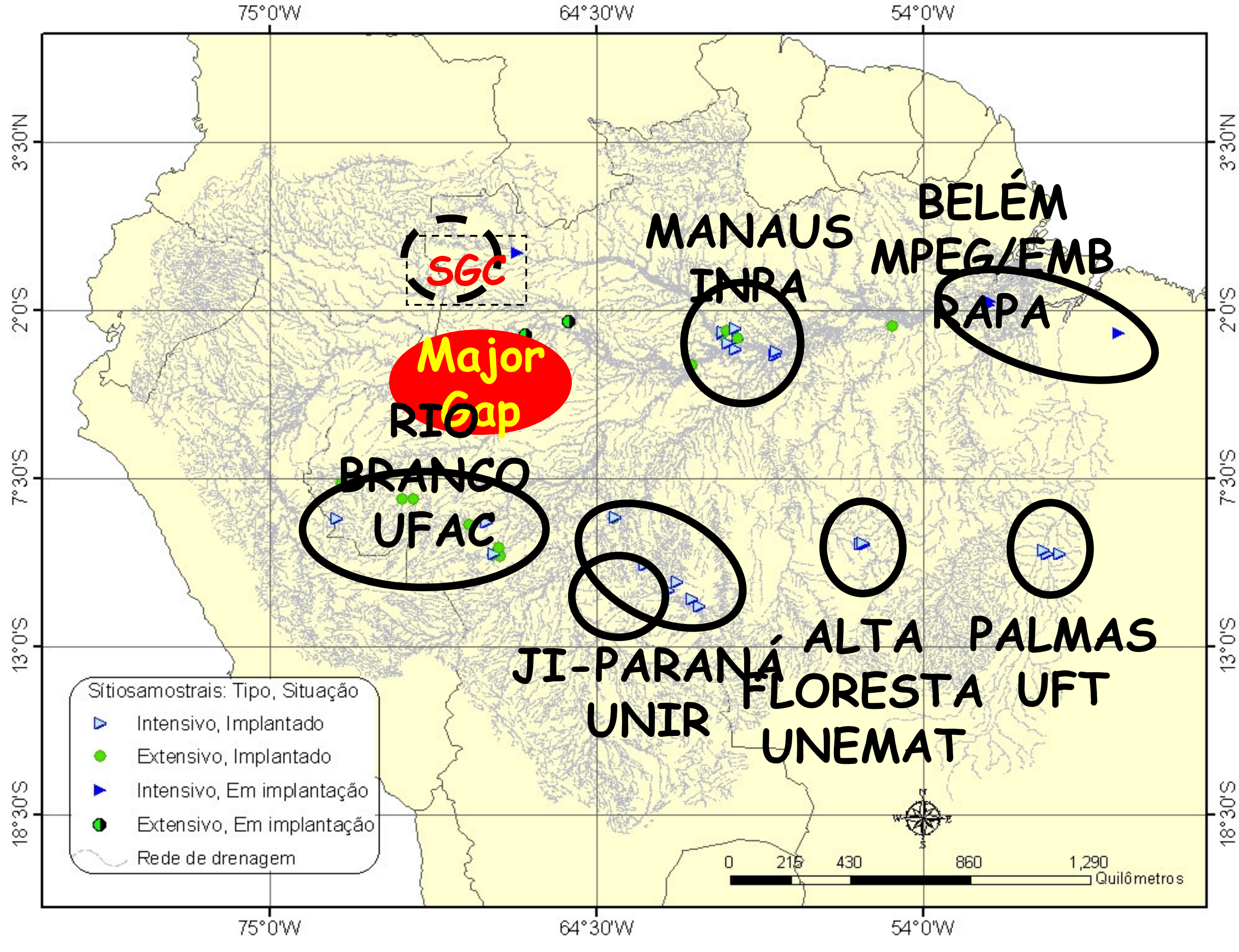
ACCUMULATED PRECIPITATION




CARBON THEME.........
CO_2 Evasion from Waters of the Central Amazon:
1.2 ± .3 Mg C ha^{-1} y^{-1} (basin ~ .5 Gt y^{-1})
Net forest uptake: ~ 1 to ?? Mg C ha^{-1} y^{-1})
CO_2 Evasion (Tg C mo^{-1})
30
25
20
15
10
5
0
T (>100m)
S (<100 m)
MF
MC
J F M A M J J A S O N D
1.77×10^6 km^2
25
20
15
10
%
Richey et al 2002

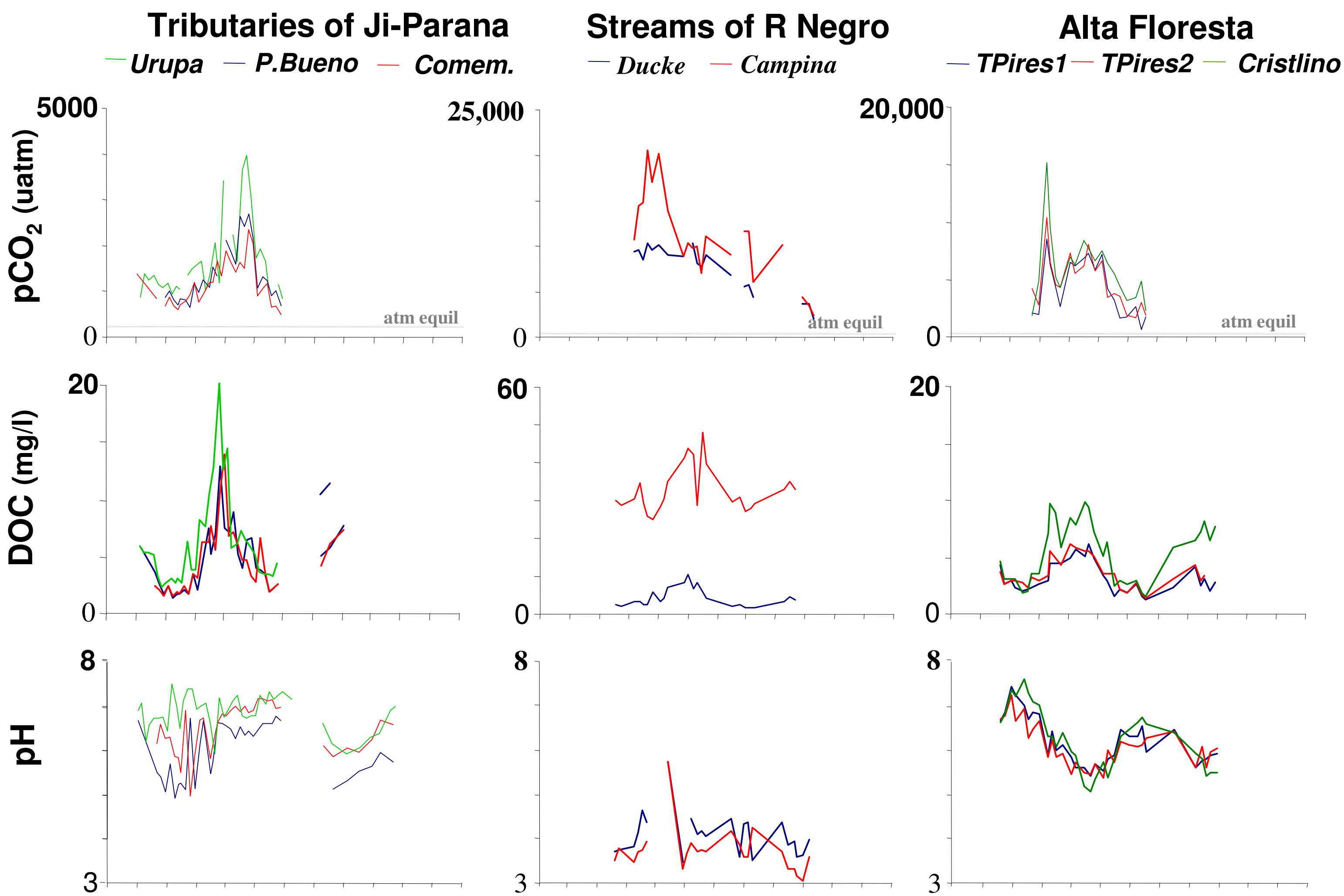
REDE BEIJA-RIO

Maestro: Alex Krusche



CROSS-BASIN TIME/SPACE SCALING

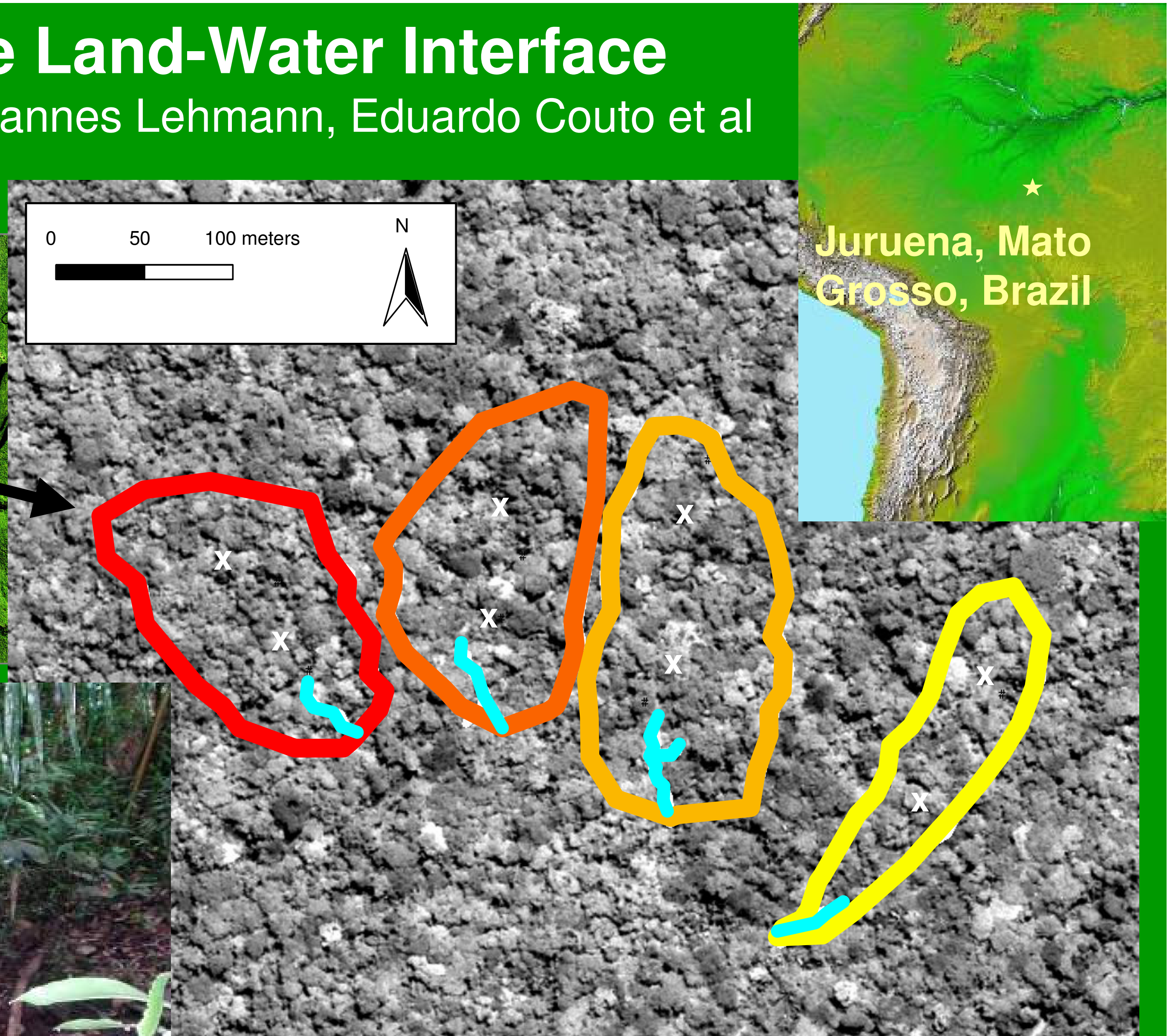
pCO_2 tracks hydrograph, with DOC, H^+ ; Consistent patterns/Different magnitudes



Jan 1, 2004 – Dec 31, 2006

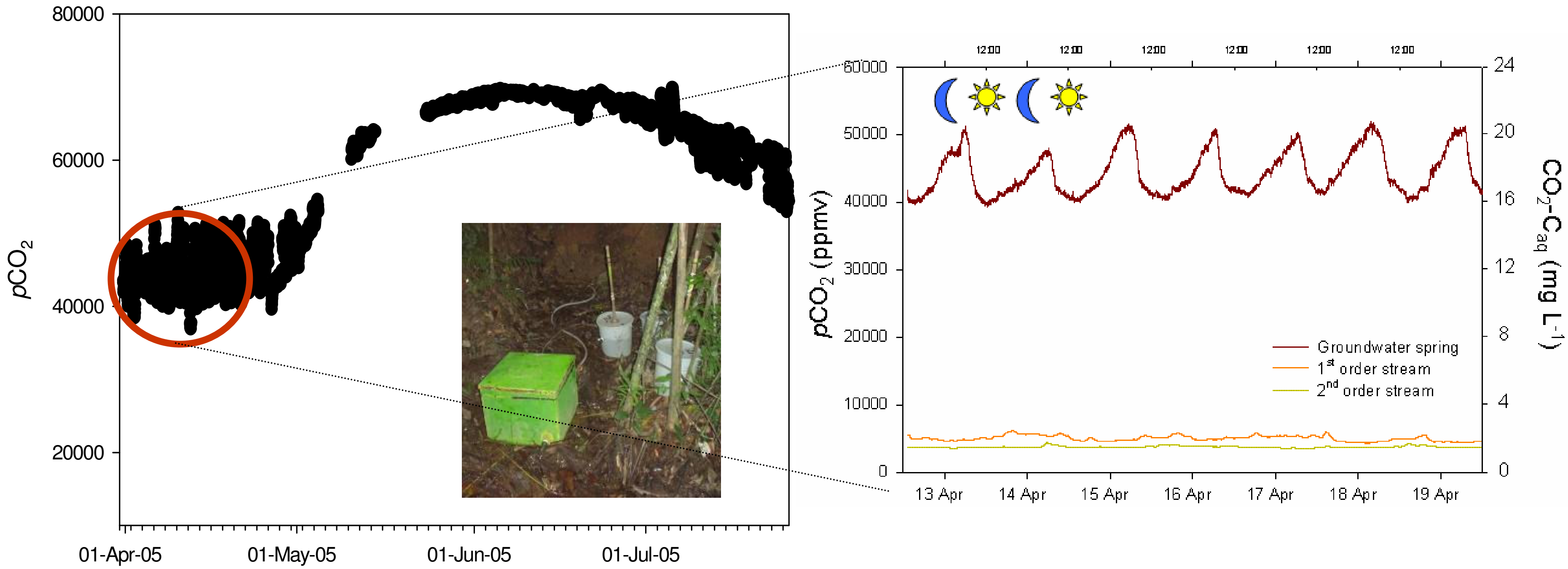
Immediate Land-Water Interface

Mark Johnson, Johannes Lehmann, Eduardo Couto et al



IKONOS Panchromatic Image
(Courtesy EOS-Webster)

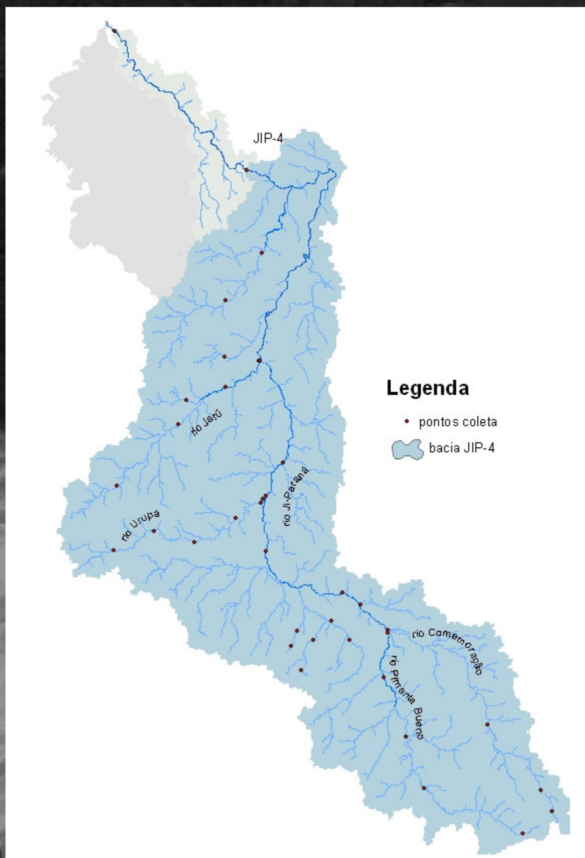
CO_2 Fluxo do sistema terrestre à aquática

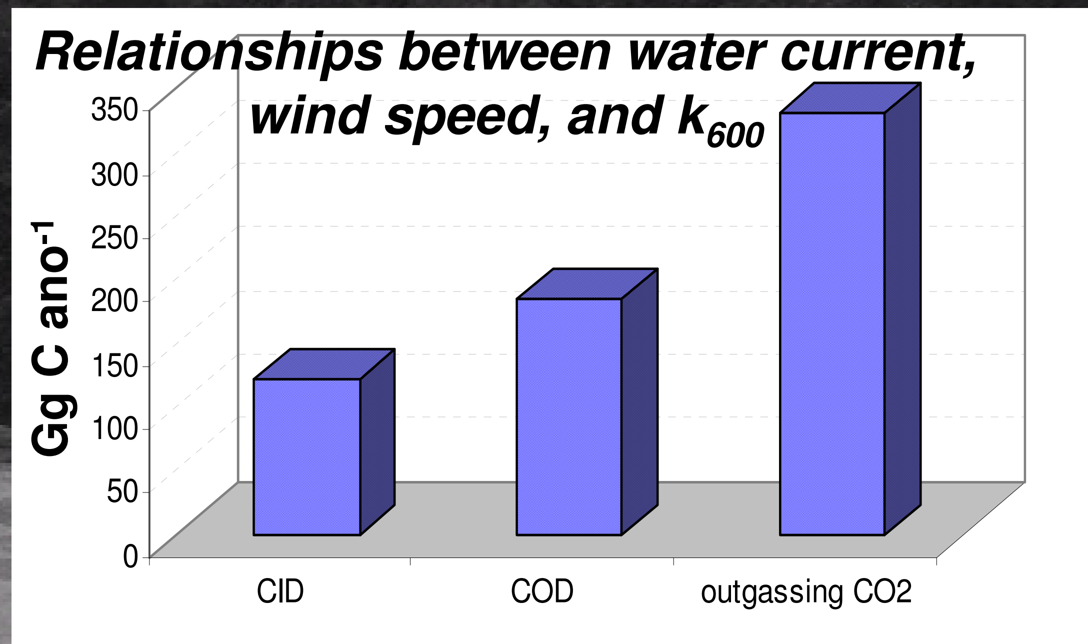


Outgassing from emergent groundwater (±35,000 uatm) at Juruena yields ~25% of original .5 Gt/y

● Resultados: comparação formas de C exportadas pelo Ji-Paraná

"O papel da evasão de CO_2 de pequenos rios no balanço local e regional de C na Amazônia"



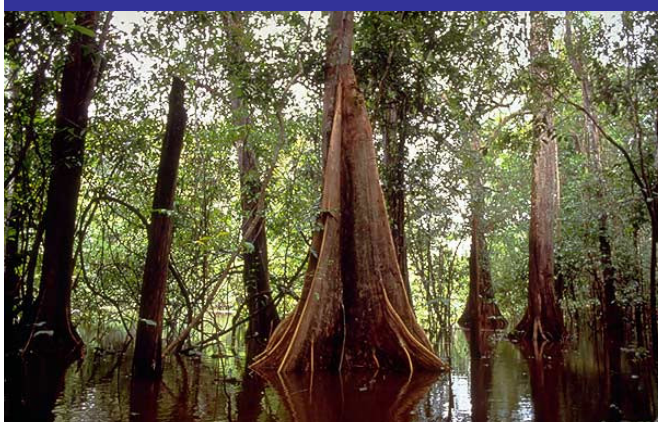


Evasão CO_2 : 2,8 x > CID e 1,8 x > COD

Mª de Fátima F. Lamy Rasera




Water circulation dynamics in Amazon river/Curuai floodplain system through remote sensing

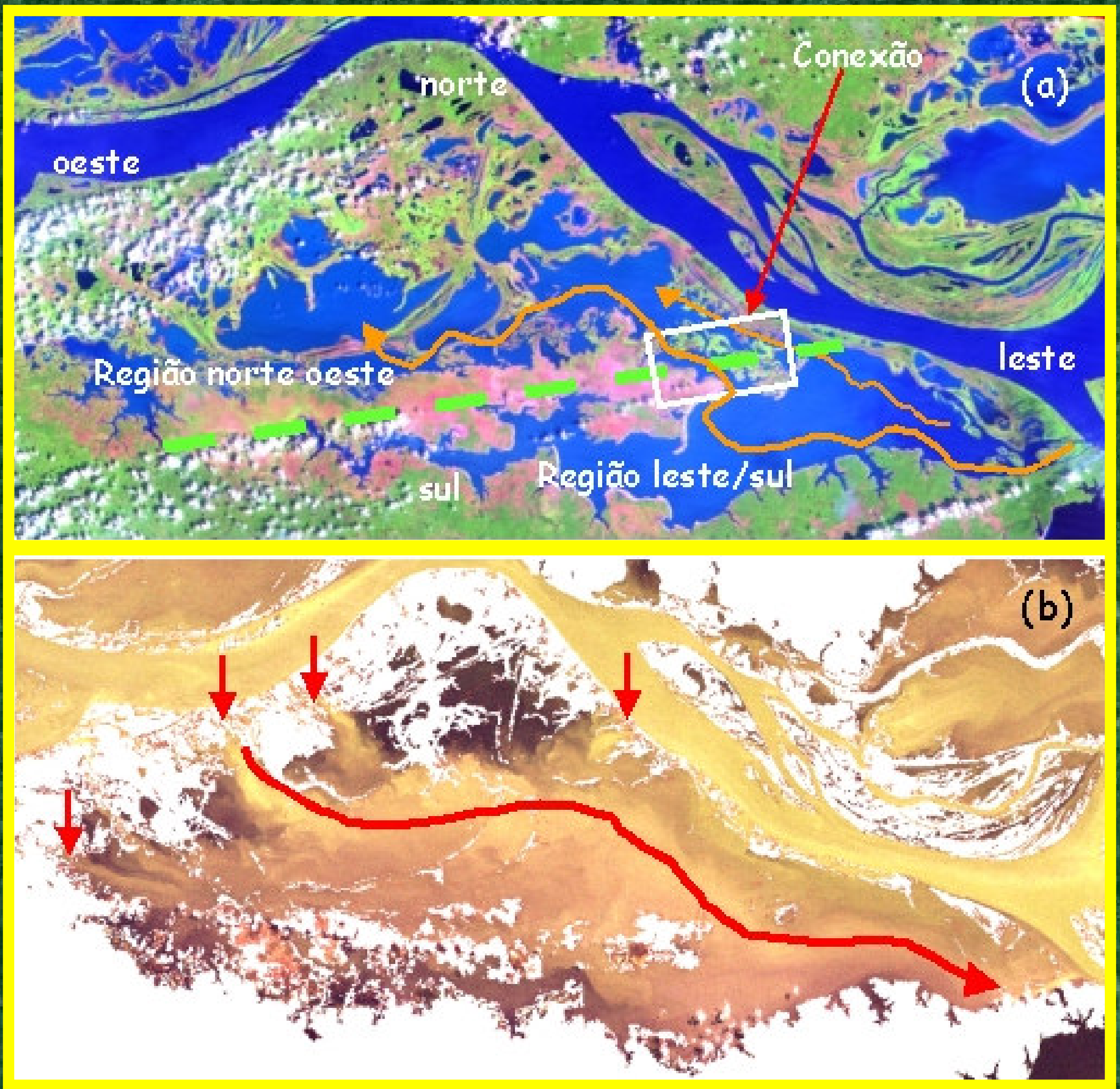




Cláudio Barbosa
Evlyn Novo
J. Melack

FAPESP
LBA-LC-07

Conceptual Model of water circulation in Curuai floodplain



1- Tapajós river reach high level

2 – increase water level at east of Curuai floodplain

3 – east-west flux begins

4 – at 720 cm water level, inputs from igarapés (northern/western borders) are dominants

5 – the system reach equilibrium (may/June)

6 – the water movement is driven by natural barrier. (two distinct regions)

Water composition

Low and rising (2 e 3)

TSS (dominate)

High and decline (1 e 4)

TSS + CLO (dominate)

Potential CO_2 Sources & Timing

…. And much more data being analyzed – but answer "not in"…

- **2002 estimate seems conservative, with spatially/temporally highly variable distributions, from seeps to big rivers**
- **Small reactive rapid cycling pool**
- **"Heavy" C^{13} – but from where? C4? Weathering residual?**
- **< 5kDa size fraction of DOC, and coherency of pCO_2, DOC, and pH are suggestive of controls**
- **Possible localized in situ primary production is important**

- ***How to dial in to overall basin Carbon budget – is the land/water coupling and fluvial system 'de-coupled" to some extent from the upland?***

Fundamental Questions for Small Basin Synthesis:

Neill, Markewitz, Johnson, Krusche, Figueiredo,

Chaves, Davidson

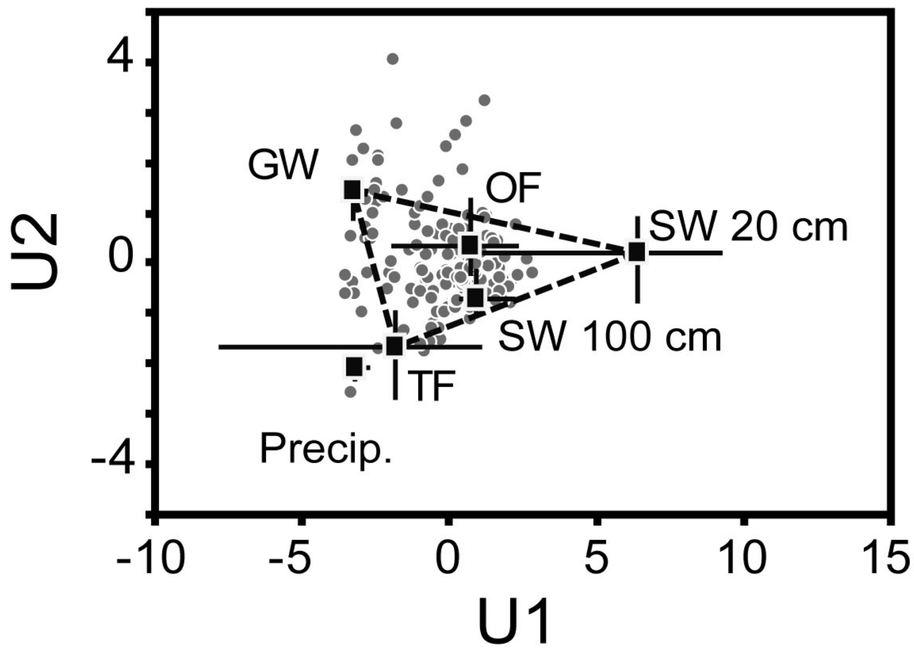
- How do flowpaths change with deforestation?
- How do flowpaths change with watershed scale?
- How do flowpaths change with soil type?
- How do transformations in flowpaths controls stream chemistry?

Use this information to predict movement of materials from land to water at larger scales

One Approach:
End Member Mixing Analysis for Multiple Sites

Rancho Grande, Paragominas, Juruéna, Nova Vida, Manaus

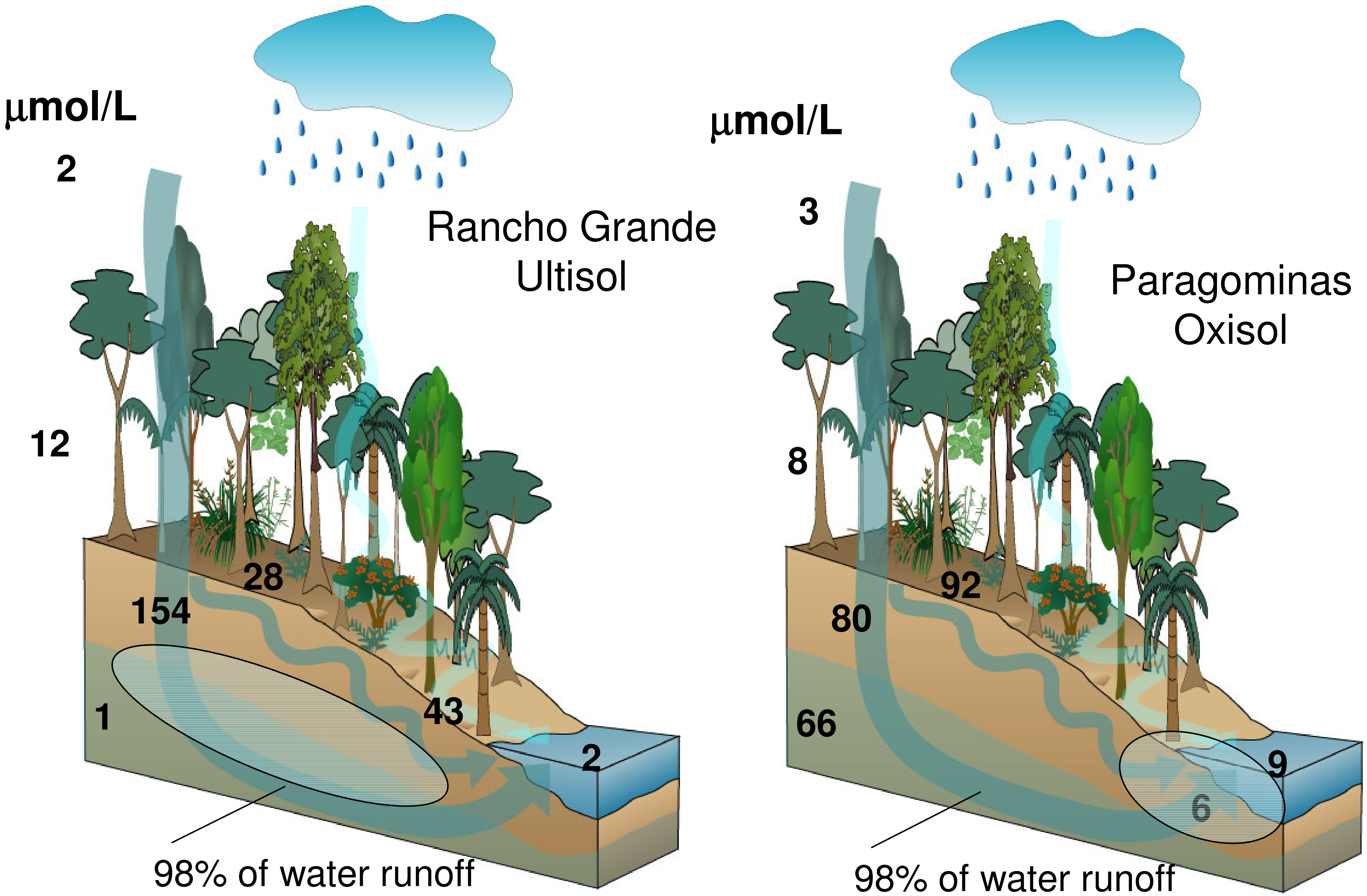
Rancho Grande Forest



Understanding where stream water comes from

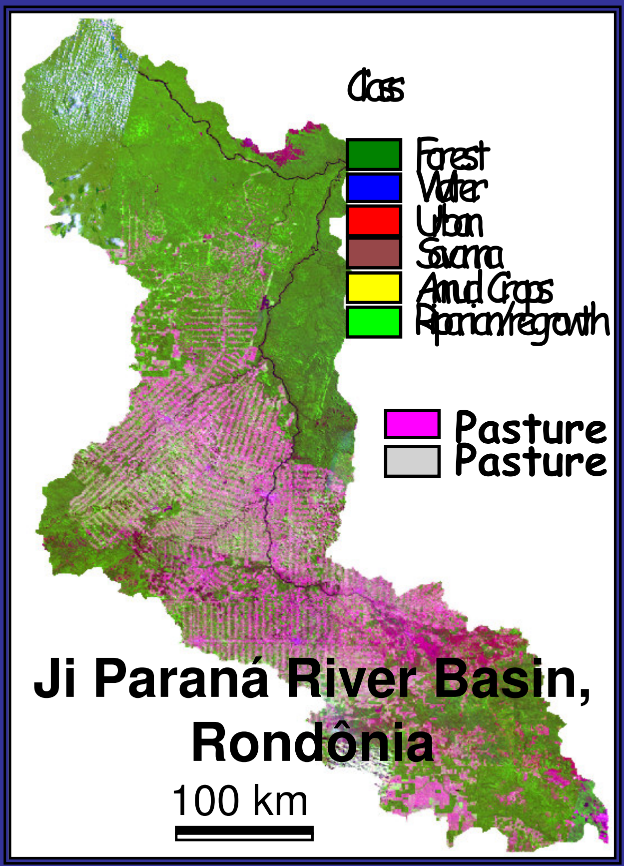
Cross-site synthesis: NO_3^- concentrations—an example

(C. Neill, D. Markewitz, A. Krusche, R. Figueiredo, J. Chaves, E. Davidson)

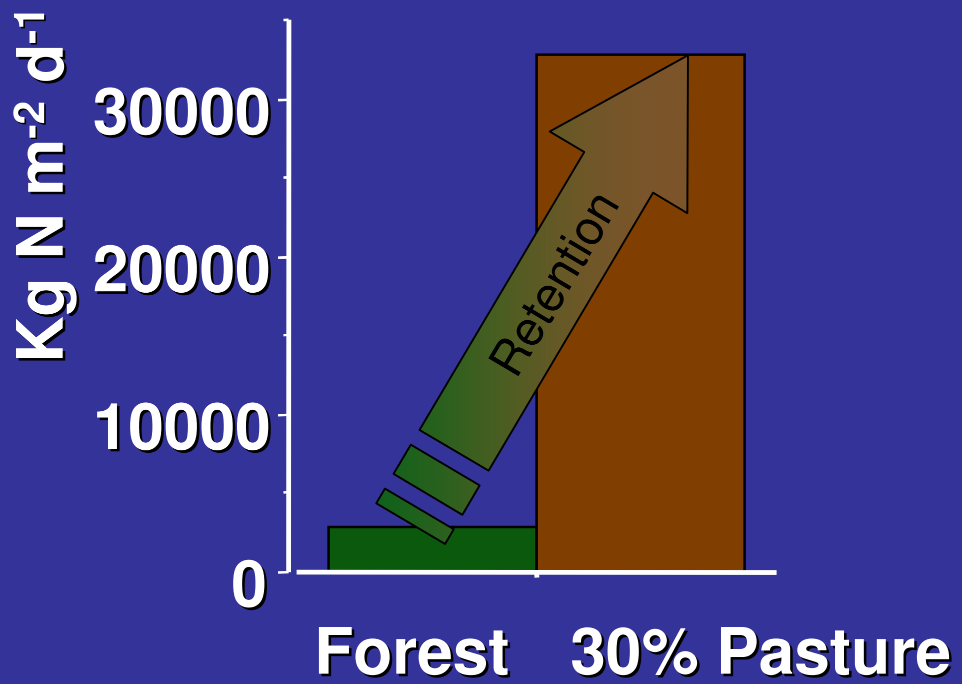


Small Stream Alteration has a Disproportionate Impact on Regional N Budgets

ND 31: Deegan, Neill, Krusche, Ballester, Victoria



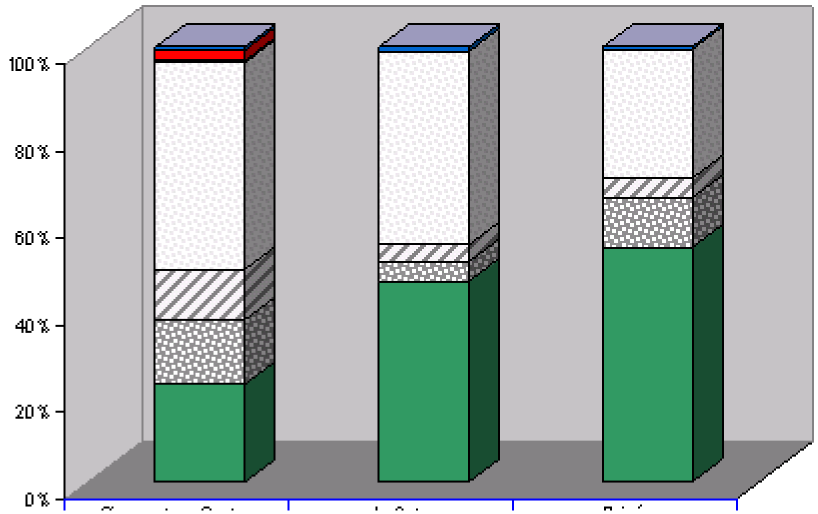
700% increase N retention with only 30% land altered

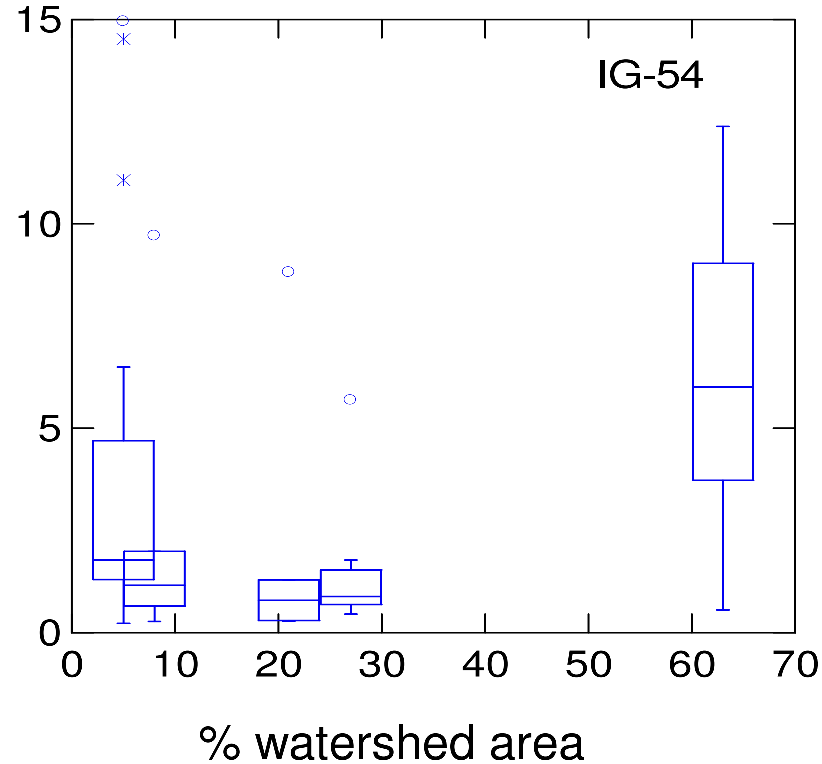


Total N Uptake by small streams in watershed

BUT IN LARGER STREAMS/MORE LANDUSE….

Land use classes percentages in each catchment - Landsat 2004





<u>Downstream increase in nitrate concentration related to croplands</u>

Nitrate concentrations (µeq L^{-1}) in *Igarapé 54* (IG-54plotted according to the percentage of the drainage area upstream of each sampling stations. The total catchment area is 21,702 ha.

LAND-WATER COUPLING

Next-Phase Synthesis Activities: Quintafeira -> Next Year

I. Provision of datasets for respective synthesis activities

Activity 1. Provision of geospatial datasets, in support of synthetic, simulation modeling activities

Activity 2. Provision of composite datasets and data-sharing for specific synthesis activities

Activity 3. Ready access to published papers and datasets

Activity 4. River drainage networks: from small streams to regional floodplains

II. Hydrological Processes: from Hillslopes to the Atlantic

Activity 5. Scale-dependent surface climate forcing of hydrology and coupled biogeochemical models

Activity 6. Flow path differentiation as a function of soil type, topography, and landuse in lower order catchments: Hydrological and Geochemical Interpretations

Activity 7. Why can’t we see microscale landuse change effects at the mesoscale?

Activity 8. Controls on Regional Water Balances of Amazônia: 197x – 2005

III. Lateral transport: Evaluation of C and Nutrient Dynamics from Soils to Streams across Riparian Interface

Activity 9. Processes Controlling Solute and Gas Fluxes across Land/Stream boundaries

Activity 10. Relation of Regional GPP/NPP/C sequestration/litterfall to C Available for Export

Activity 11. Injection of Soil water CO2 into streams (of different orders)

Activity 12. Composite Evaluation of Hydrology/BGC Models across small order streams

IV. Downstream advection and reaction, lateral exchanges and gas dynamics in large inundated areas.

Activity 13. Nutrient Inputs Related to Nutrient Outputs at Multiple Scales

Activity 14. Hydrological and Biogeochemical Scaling in the Ji-Parana River basin

Activity 15. Transport, Reaction, and Outgassing of CO2

Activity 16. Mesoscale-to Basin-scale

Activity 17. Floodplains/River boundaries