Controls on stream carbon in the Amazon Region, Tapajos National Forest

Marc G. Kramer (1), Raimundo Cosme de Oliveira Junior (2) Christopher Potter (3), Steve Klooster (4)

(1) University of California, Earth Sciences Department, Santa Cruz, USA, NASA Ames. (2) Embrapa Amazonia, Orienta, Belem, Para, Brasil
(3) NASA Ames Research Center, Moffett Field, USA (4) California State University, Monterey Bay, Seaside, CA, USA

Collaborators David Fitzjarrald et al.

Motivation

Objective: Examine the influence of land cover, topography and soil on stream hydrology and carbon flux and composition in the Amazon.

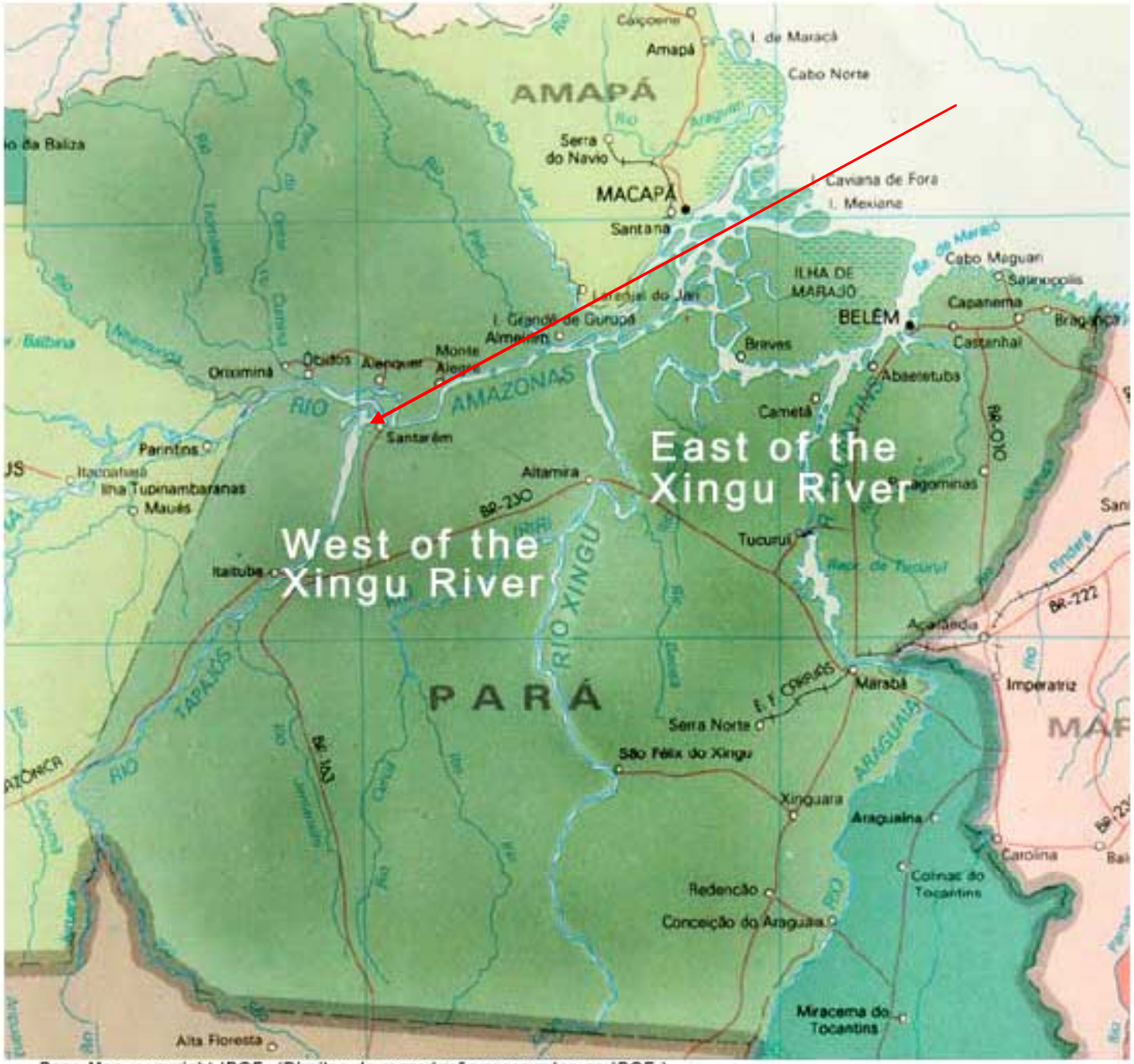
•Understand underlying controls (geomorphic and land-use change) on hydrology and carbon flux in the region at the mesocale.

•Parameterize and improve model simulations of hydrology, carbon and nitrogen dynamics.

.

Methods

- Use 90-m SRTM digital elevation (DEM) data and land cover/land use maps derived from Landsat-TM to select several catchments in the Tapajos national forest drainage area with contrasting land use, topography, and soils.
- Field sampling of throughfall, lysimeter and stream water components to provide insight into flow path dynamics and a better understanding of the chemical nature of carbon under contrasting land use patterns.
- End-member sampling of groundwater wells and throughfall.



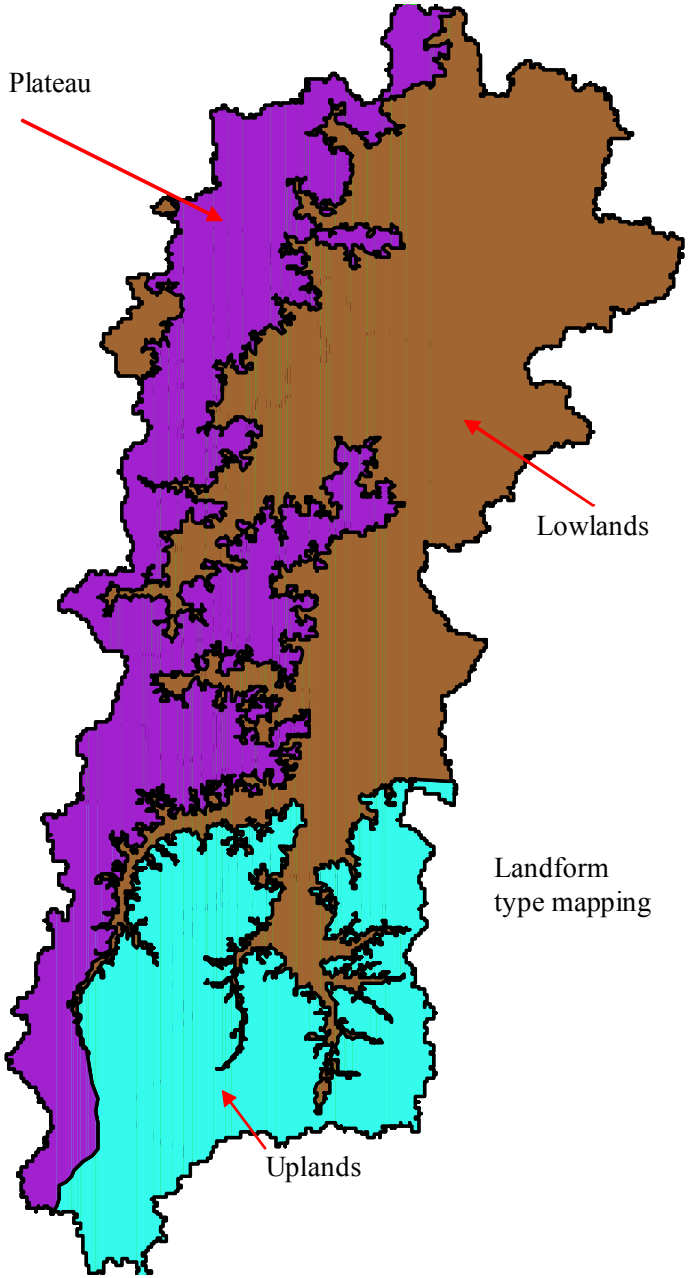
Santarem


AMAPÁ
MACAPÁ
East of the
Xingu River
West of the
Xingu River
PARÁ

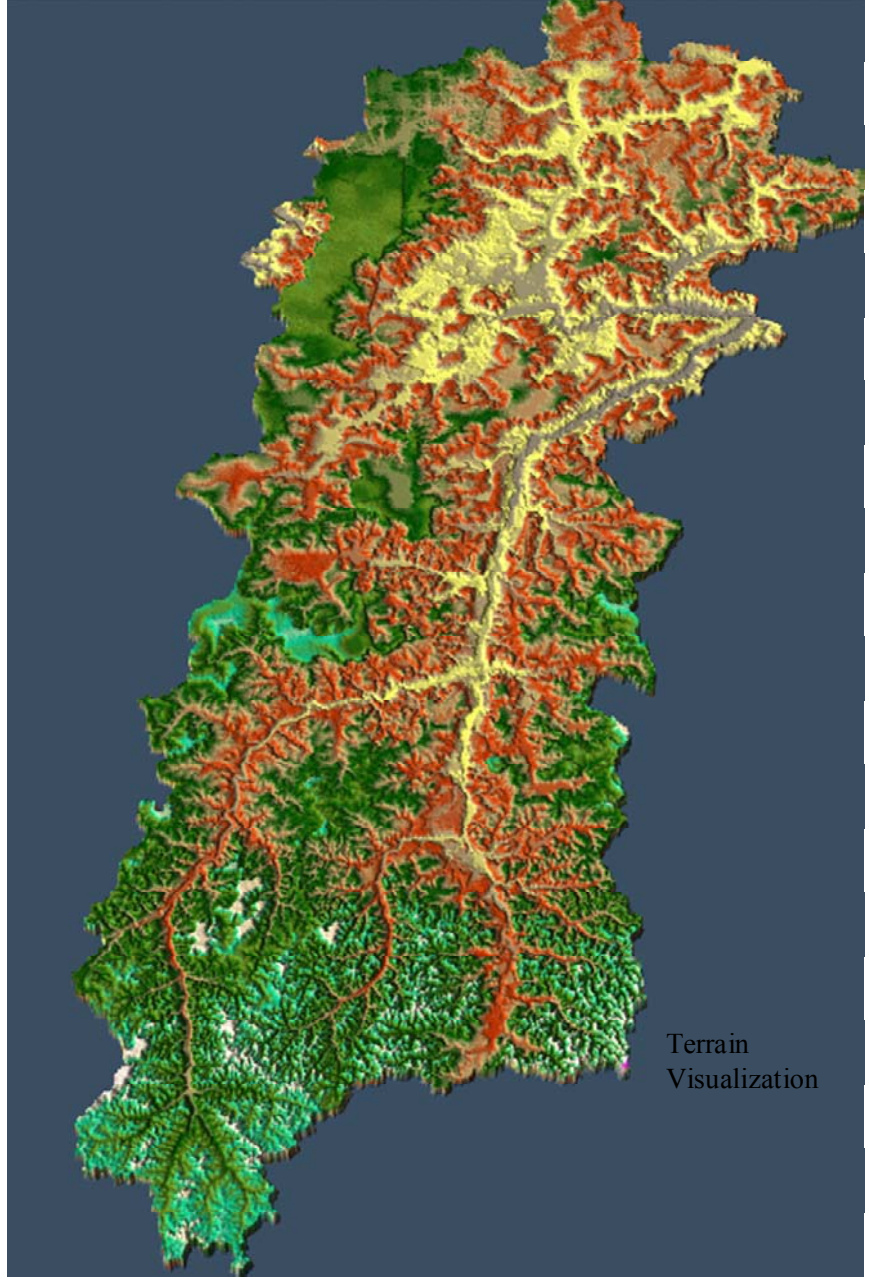

Natural Tropical Rainforest

Soy production in Mojui Catchment

Logging activity

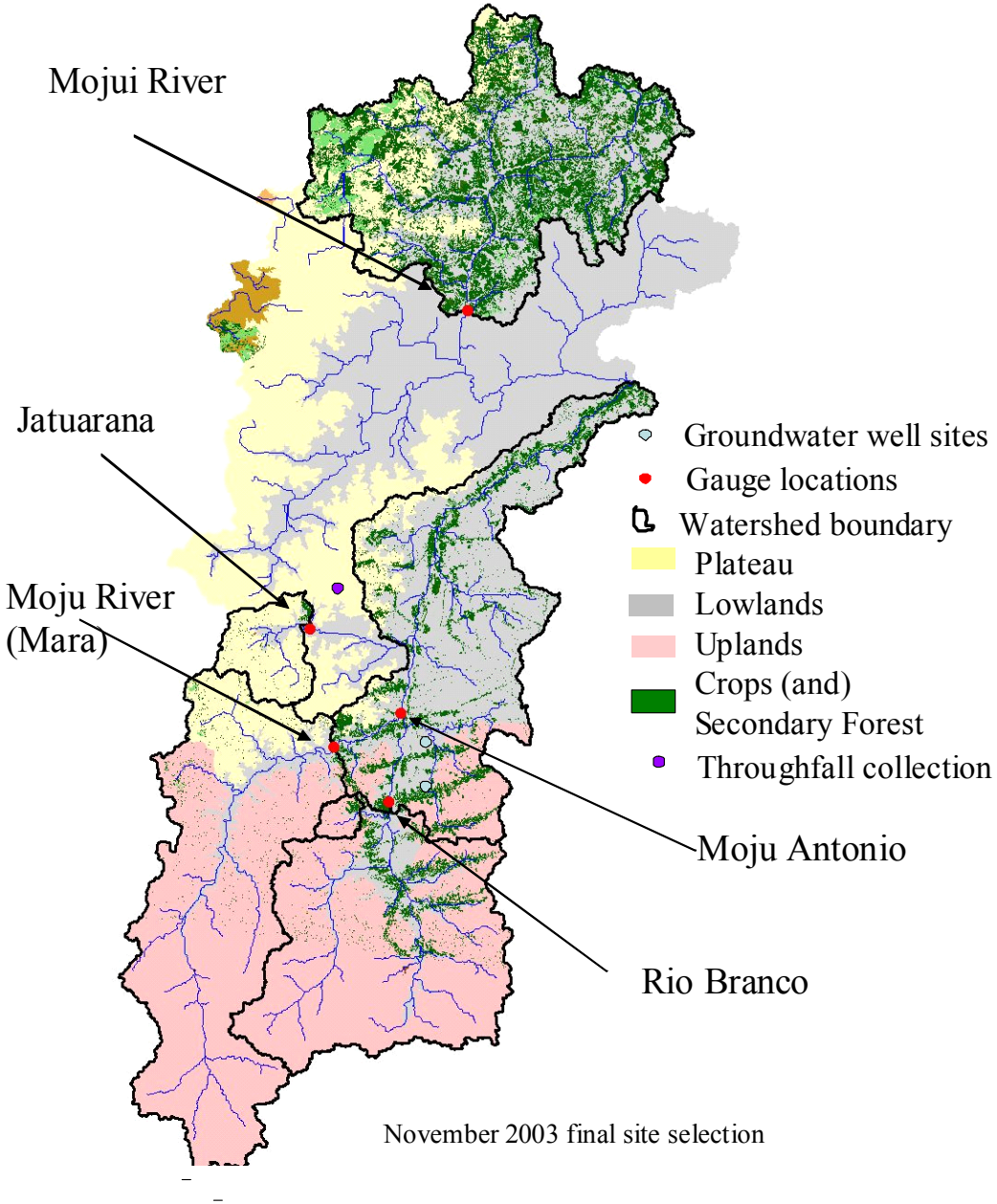


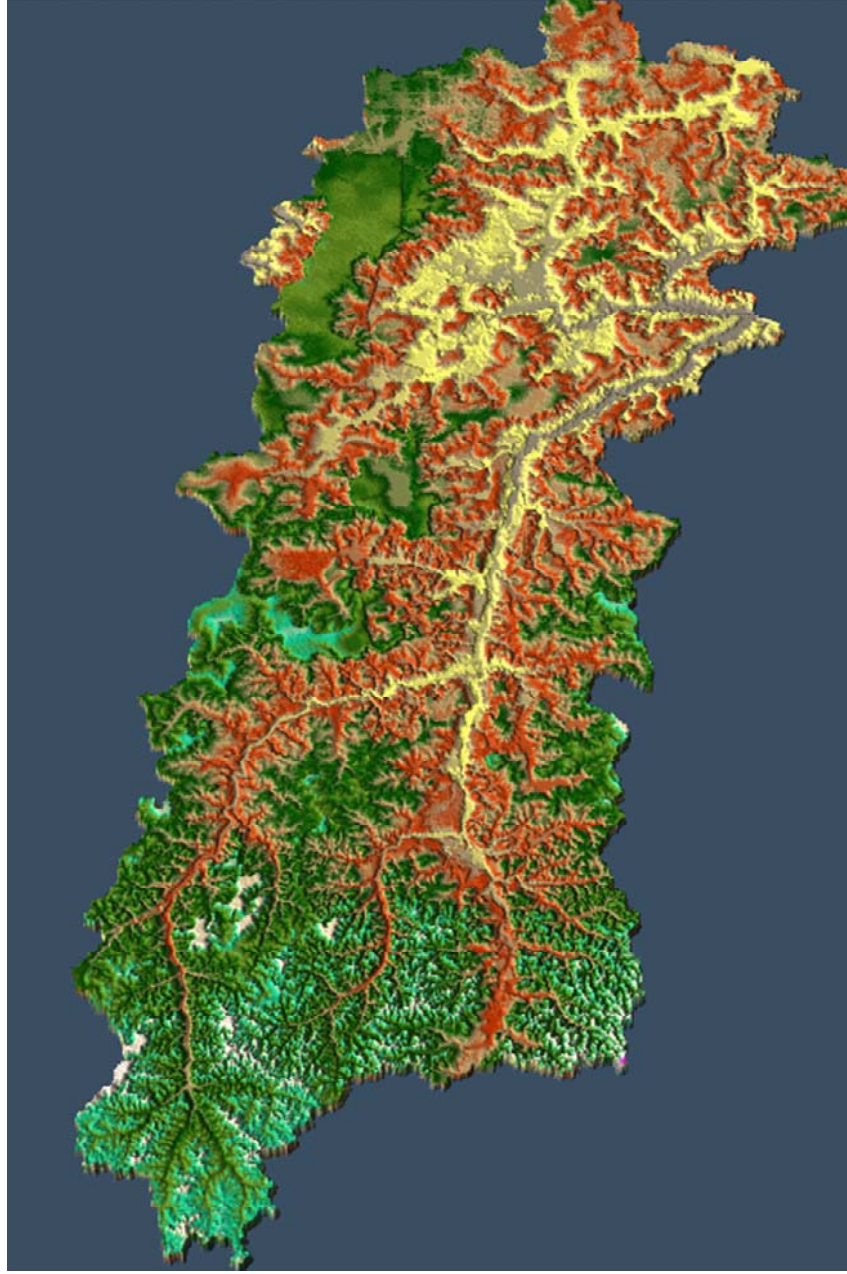
Landform type mapping



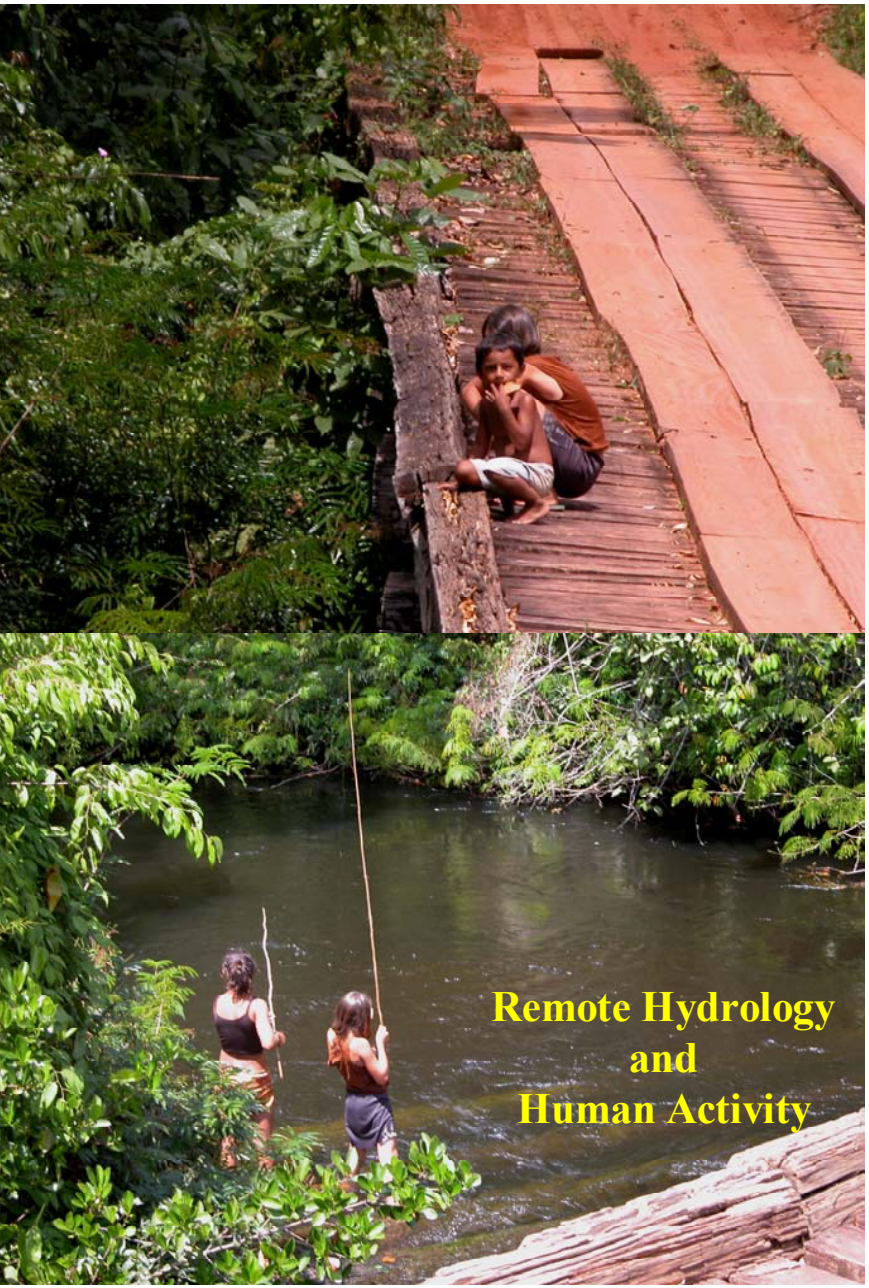
Terrain Visualization

SRTM-derived 90m digital elevation model of the area.


Mojui River
Jatuarana
Moju River
(Mara)
Moju Antonio
Rio Branco
Groundwater well sites
Gauge locations
Watershed boundary
Plateau
Lowlands
Uplands
Crops (and)
Secondary Forest
Throughfall collection
November 2003 final site selection



								Landcover Type				
Basin Id	Drainage area	Basin Elevation Min	Max	Mean	Std	Geomorphic Setting	Primary forest	Non-forest	Green Pasture	Secondary Forest	Shadow	Landcover Status
	(ha)	(m)	(m)	(m)	(m)		(%)	(%)	(%)	(%)	(%)	
Mojui	123489	56	202	125	30	Lowlands/Plateau	53	8	5	29	6	Altered
Jatuarana	14200	117	216	158	19	Plateau	97	0	0	3	0	Intact
Moju Mara	102704	77	301	179	34	Uplands	99 (60)	0	0	1	0	Intact
Branco	94492	79	318	170	38	Uplands	98 (47)	1	1	5	0	Partially Altered



Sampling Scheme

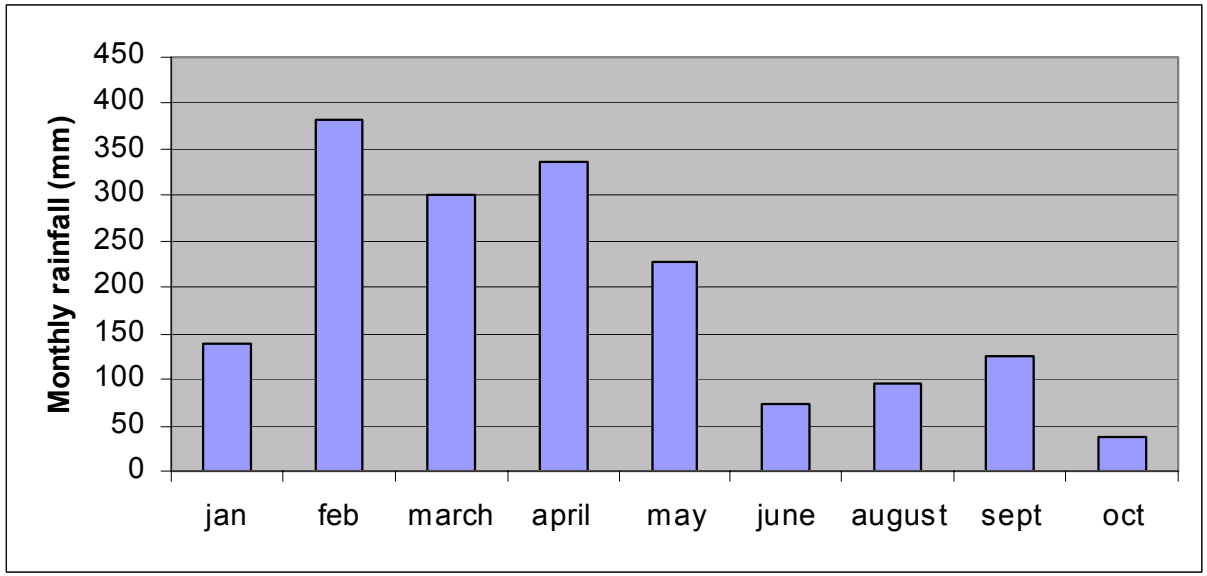
- Syringe filtration using 0.7 µm glass fiber filters
- 100 ml of water per sample
- Measure stream water level
- Measure stream flow

- Continuous water level measurements

Sampling Scheme

Monthly sampling scheme
Nov 2003- April 2004
Bi-weekly April 2004-Present

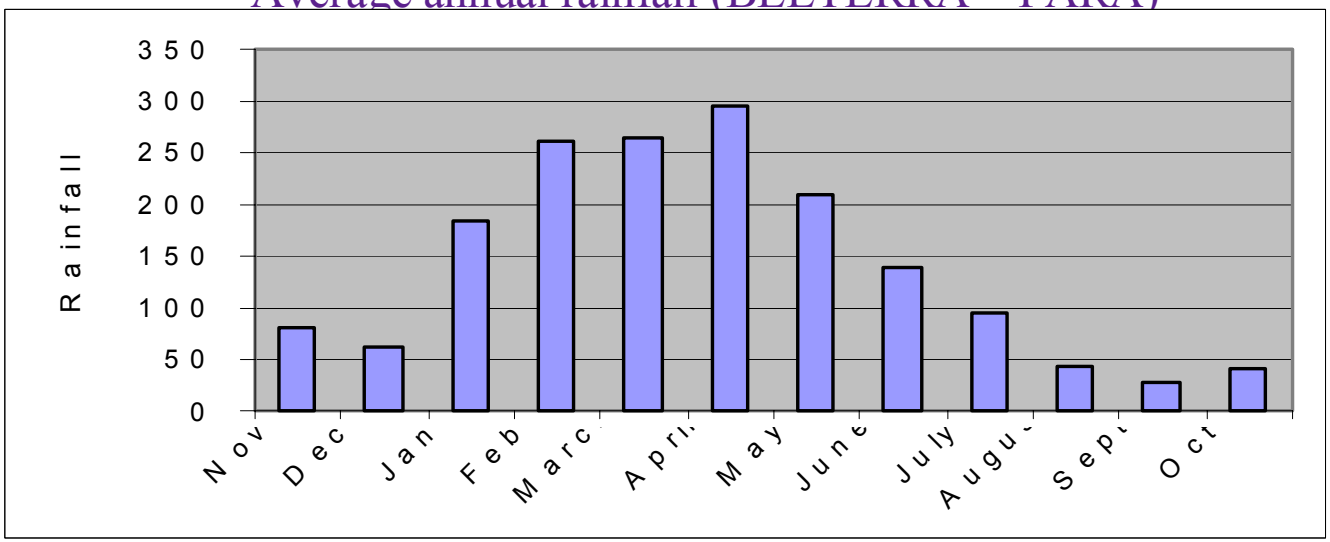
PRELIMINARY RESULTS



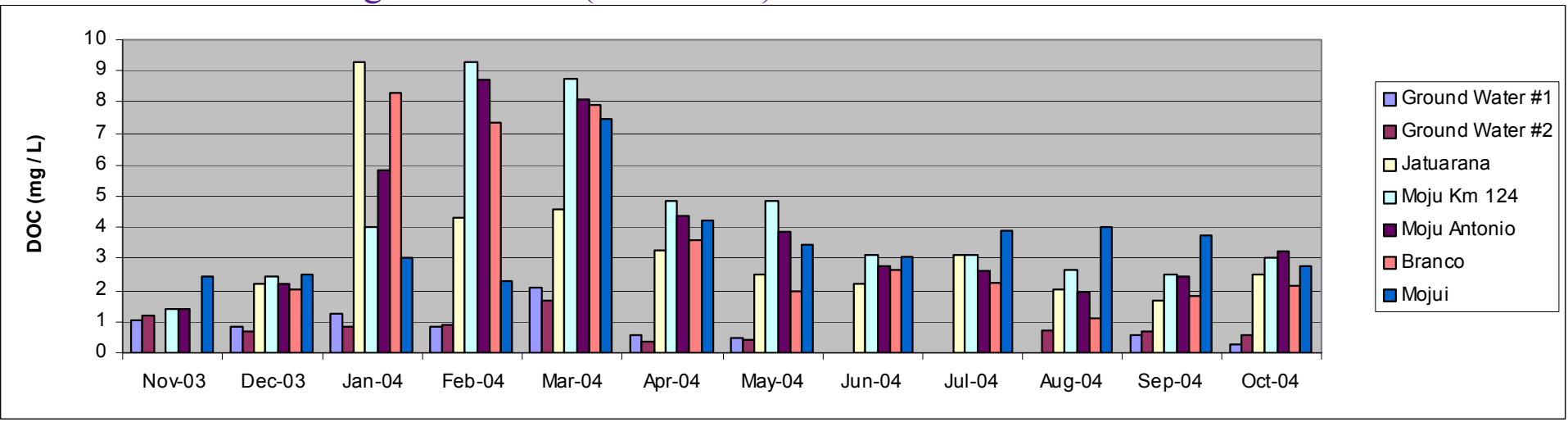
Total Rainfall 1.74 m

2004 Rainfall from Mojui rain gauge (Courtesy Fitzjarrald et al.)

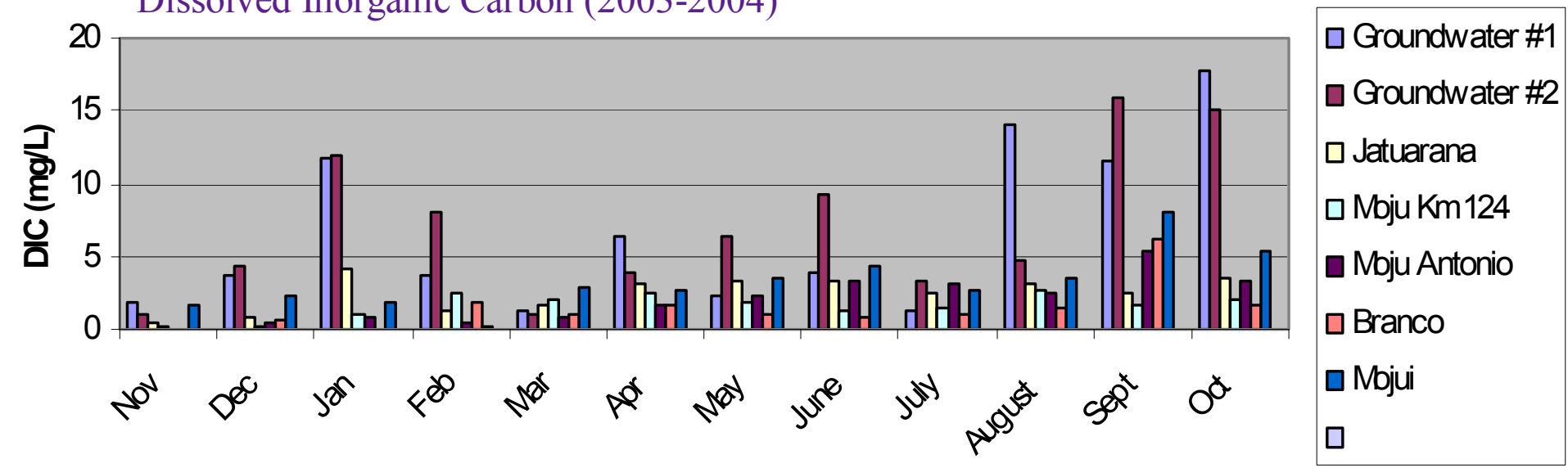
Average annual rainfall (BELTERRA – PARÁ)



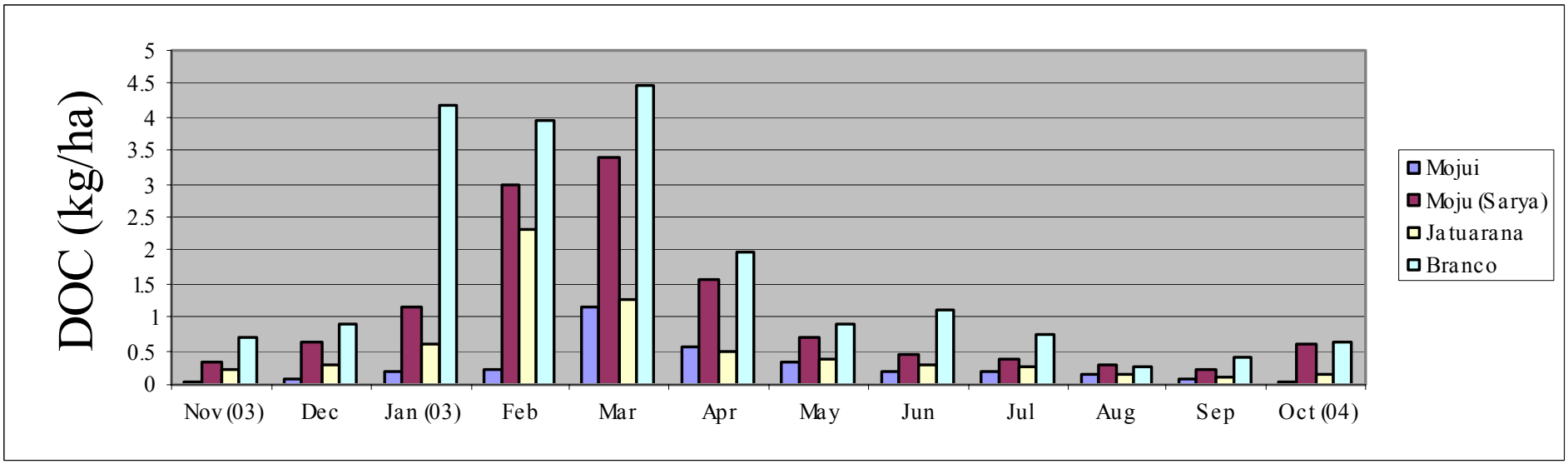
Dissolved Organic Carbon (2003-2004)



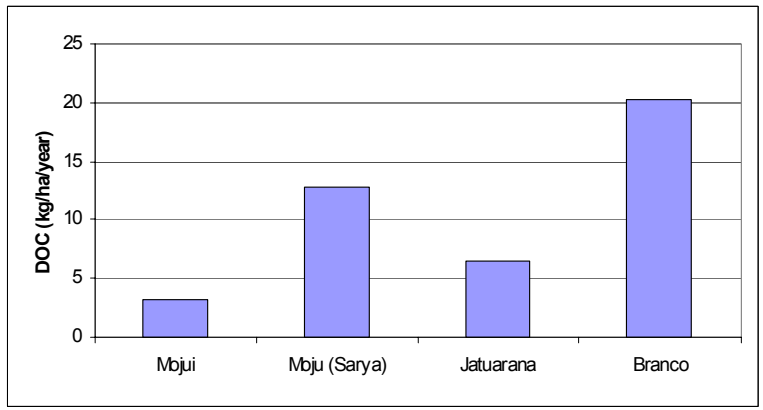
Dissolved Inorganic Carbon (2003-2004)



Monthly DOC Flux



Annual DOC flux



Summary

- Our results suggest topography and soils are important controls on hydrology and DOC flux in these catchments. Natural forest catchment DOC flux ranges from 20 kg/ha/year – 6 kg/ha/yr depending on landform type and soil drainage.

- A strong seasonal increase in DOC concentration and flux was observed in all natural forested catchments during the wet season.

- By contrast only a slight increase DOC concentration has yet been observed in catchments which have experienced more intensive land-use change.

- These results indicate that DOC enrichment normally associated with the onset of the wet season may be reduced in catchments with more intensive land-use change. Lower amounts and concentrations of DOC in these streams may be the result of less rainfall percolation through the forest canopy [1] and flow-through in thick active A horizons found in natural forests.

- The Mojui drainage basin, where forest conversion to pasture and agriculture is greatest, had the lowest flux of DOC (3 kg/ha/yr). This may be associated with reduced stocks of above ground biomass and soil C.

- A tight linkage between stream hydrograph response and individual rainfall events was observed in upland streams.

- By contrast stream hydrograph response was not well associated with individual rainfall events in lowland streams.

Next Steps

- Continue monitoring streams and detecting land use change.
  Land use change is VERY change is rapid…

- Use stable isotopes 18O and 2H to evaluate differences in evapotranspiration between catchments.

- Combine isotopic, chemical, hydrometric (continuous water level measurements), rainfall data to infer flow path differences between catchments.

- Apply and test this geomorphic framework to other catchments in the region.

- Incorporate results into a modeling framework to predict hydrologic and carbon flux over larger spatial scales and predict future changes.


LBA
-ECO
a component of the
Large-Scale
Biosphere-
Atmosphere
NASA