University of Sao Paulo

Laboratory of Isotopic Ecology –CENA/USP

Spatial and seasonal variations in the carbon isotopic composition of methane over a five-year period in stream sediments of eastern Amazonia

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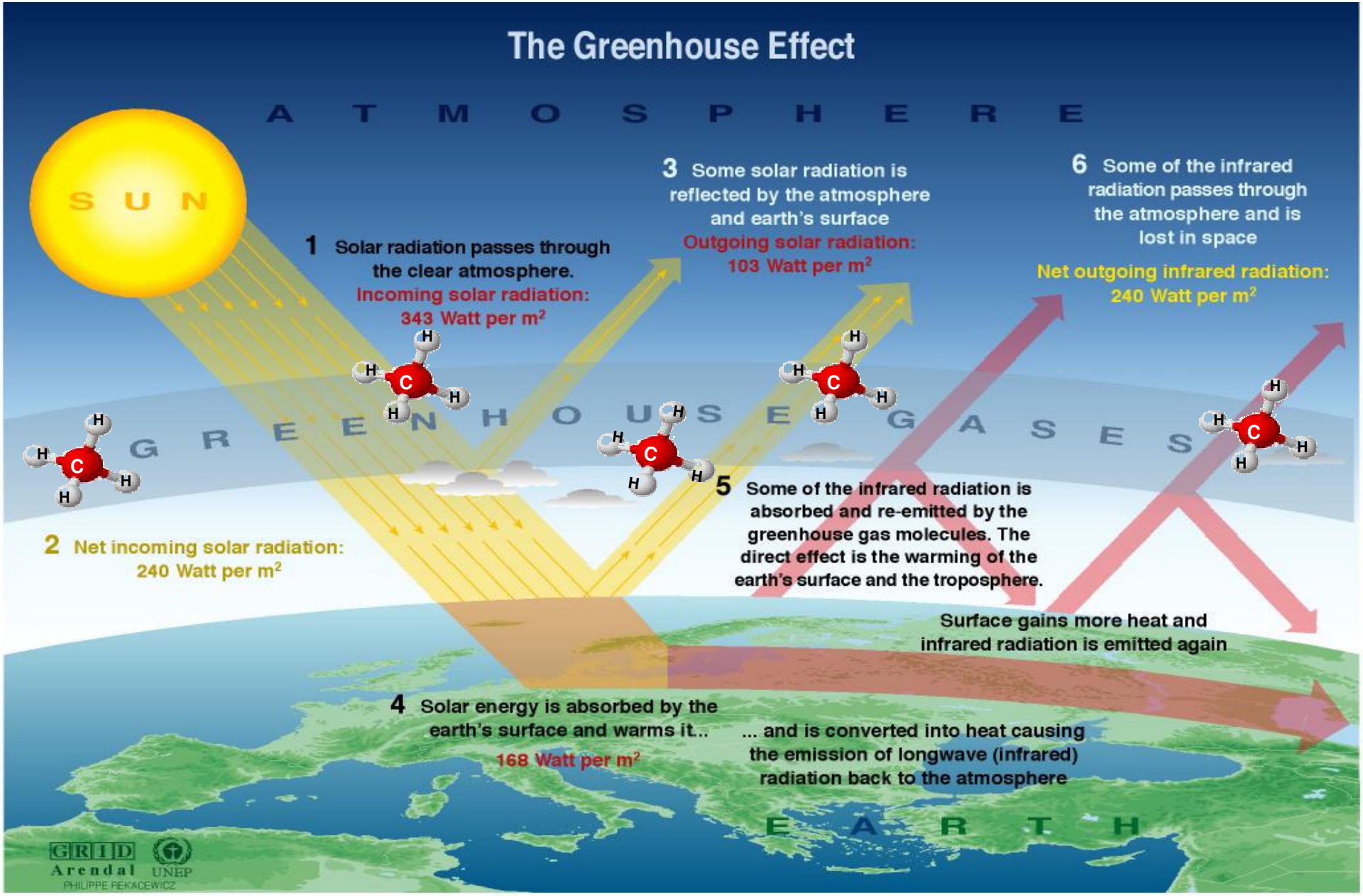


Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.

http://www.grida.no/climate/vitalafrica/english/09.htm

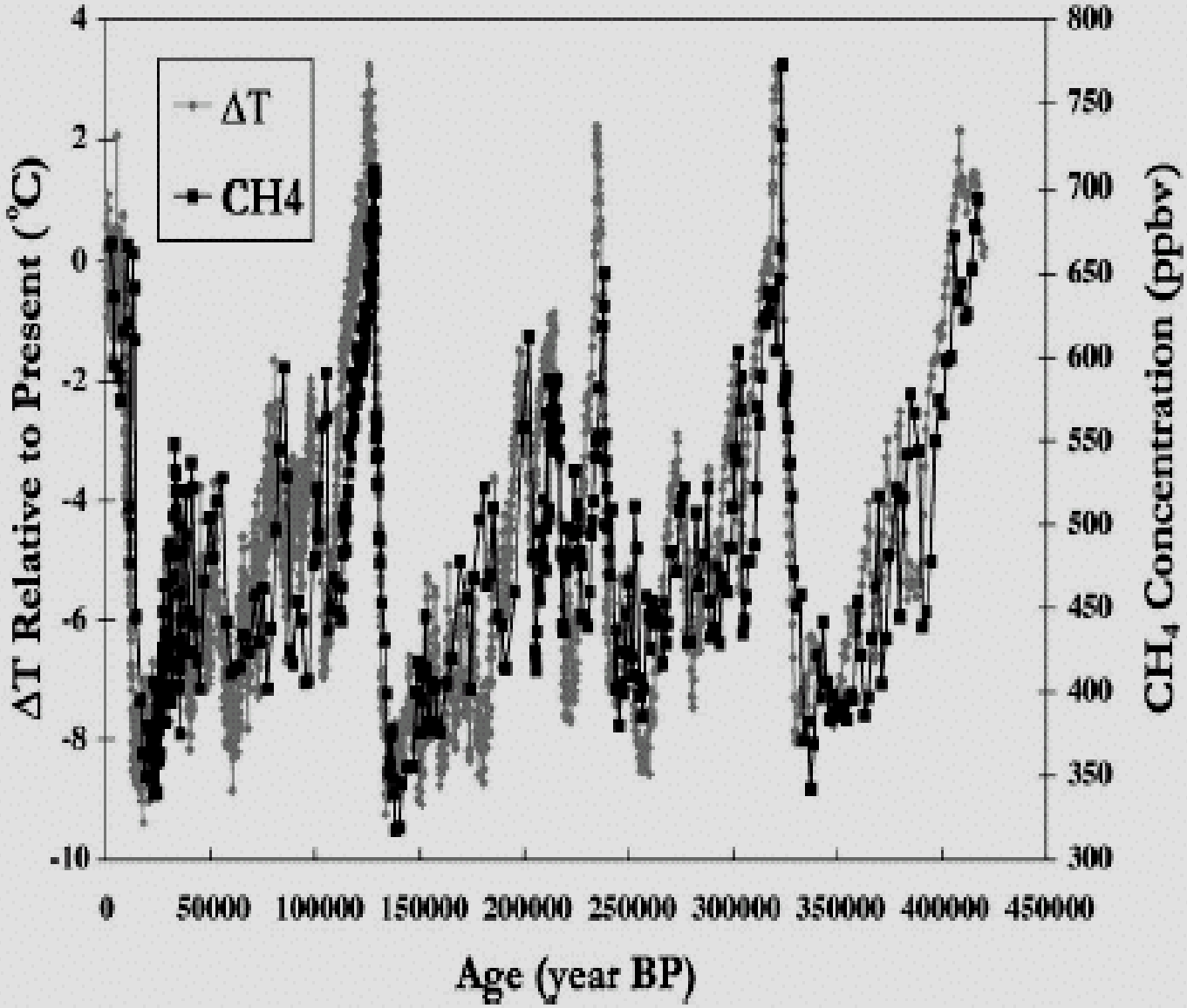
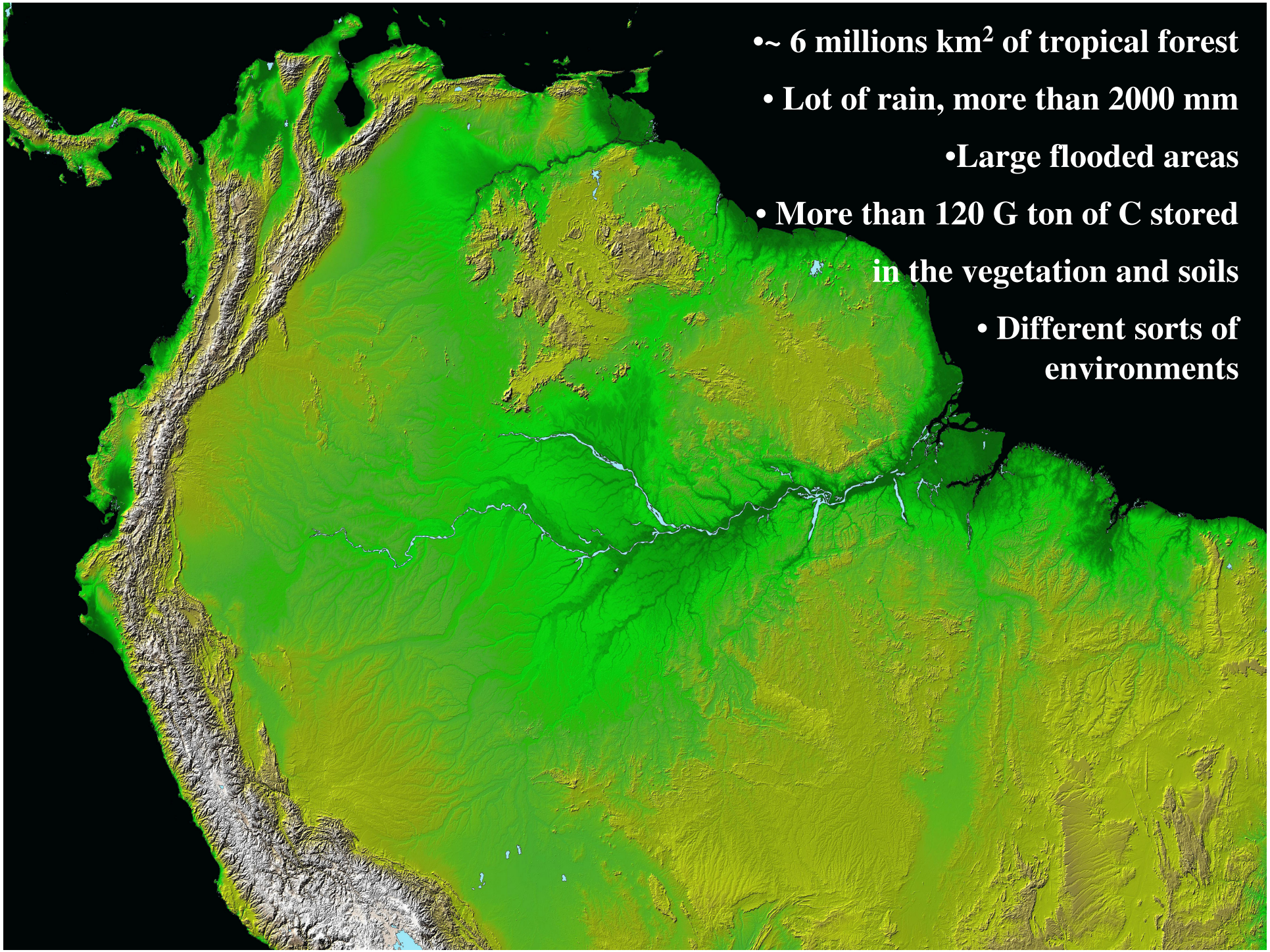
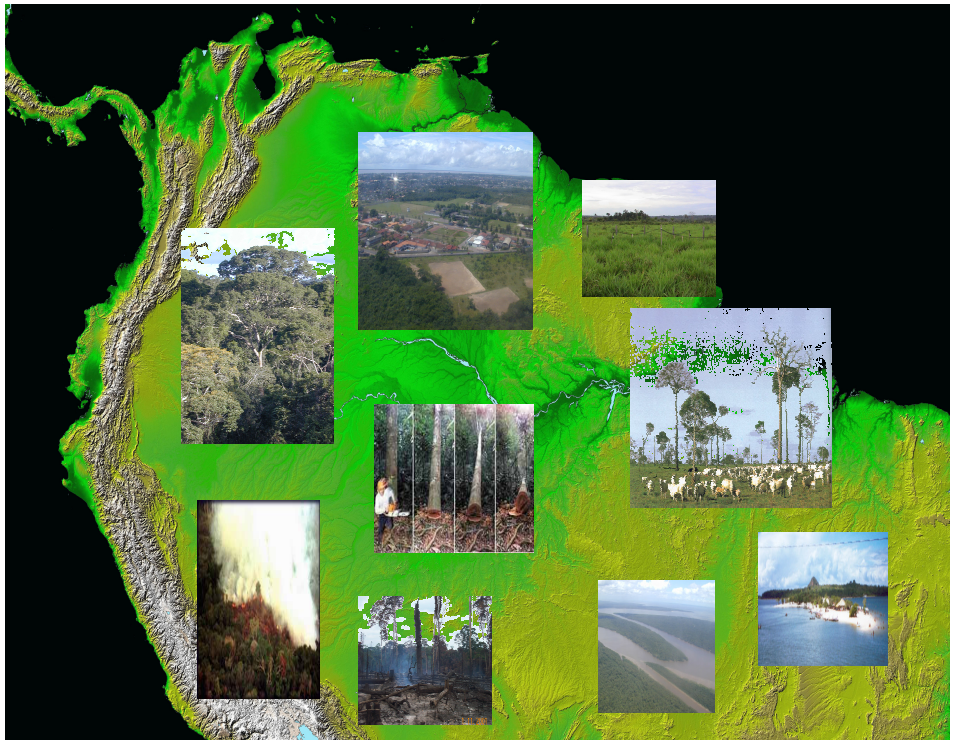


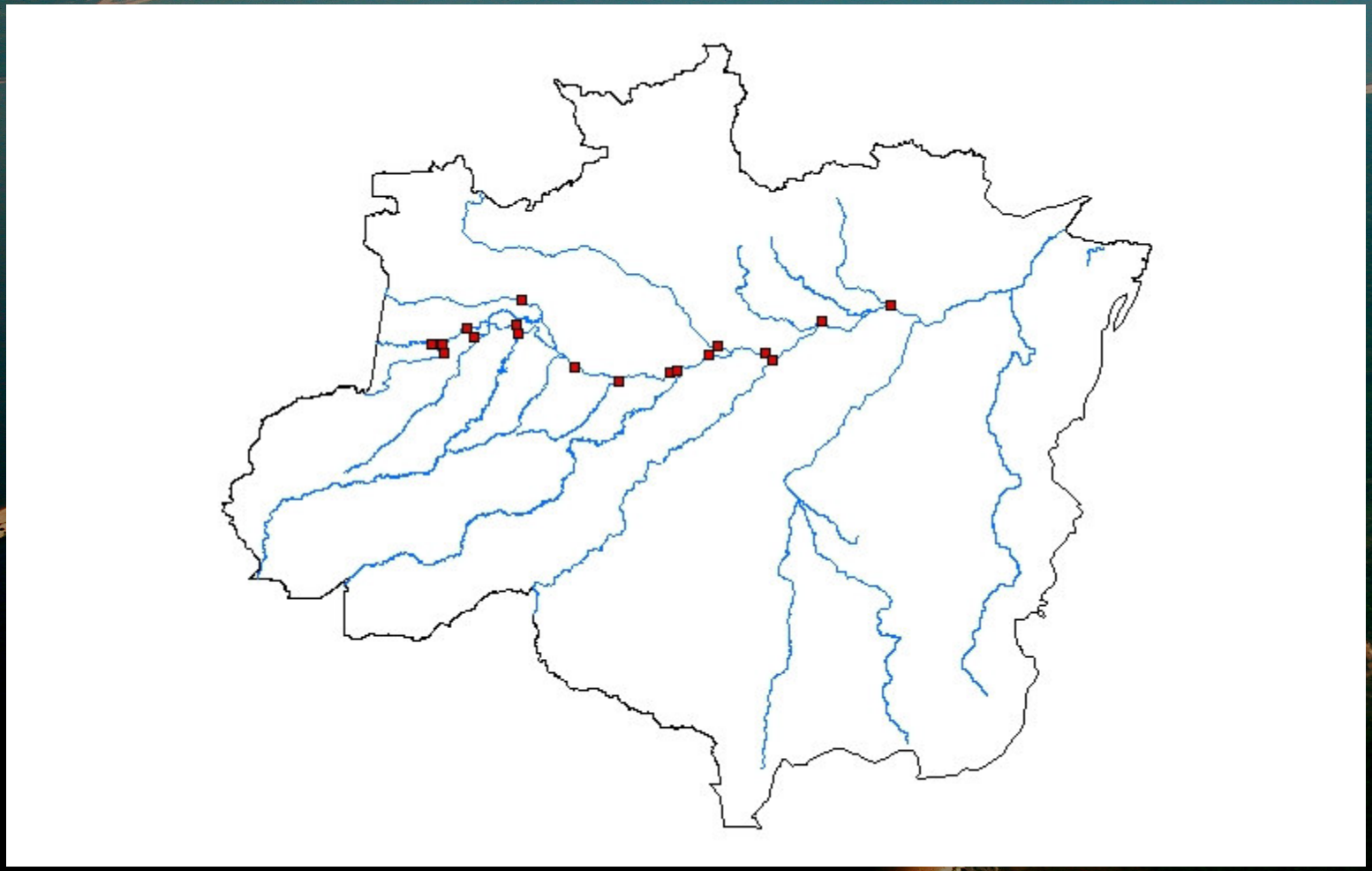
Fig. 1. Vostok ice core records of atmospheric temperature and methane concentration (volume mixing ratio) from 420,000 years BP to present (source: Petit et al., 1999).


•~ 6 millions km2 of tropical forest
• Lot of rain, more than 2000 mm
•Large flooded areas
• More than 120 G ton of C stored
in the vegetation and soils
• Different sorts of
environments

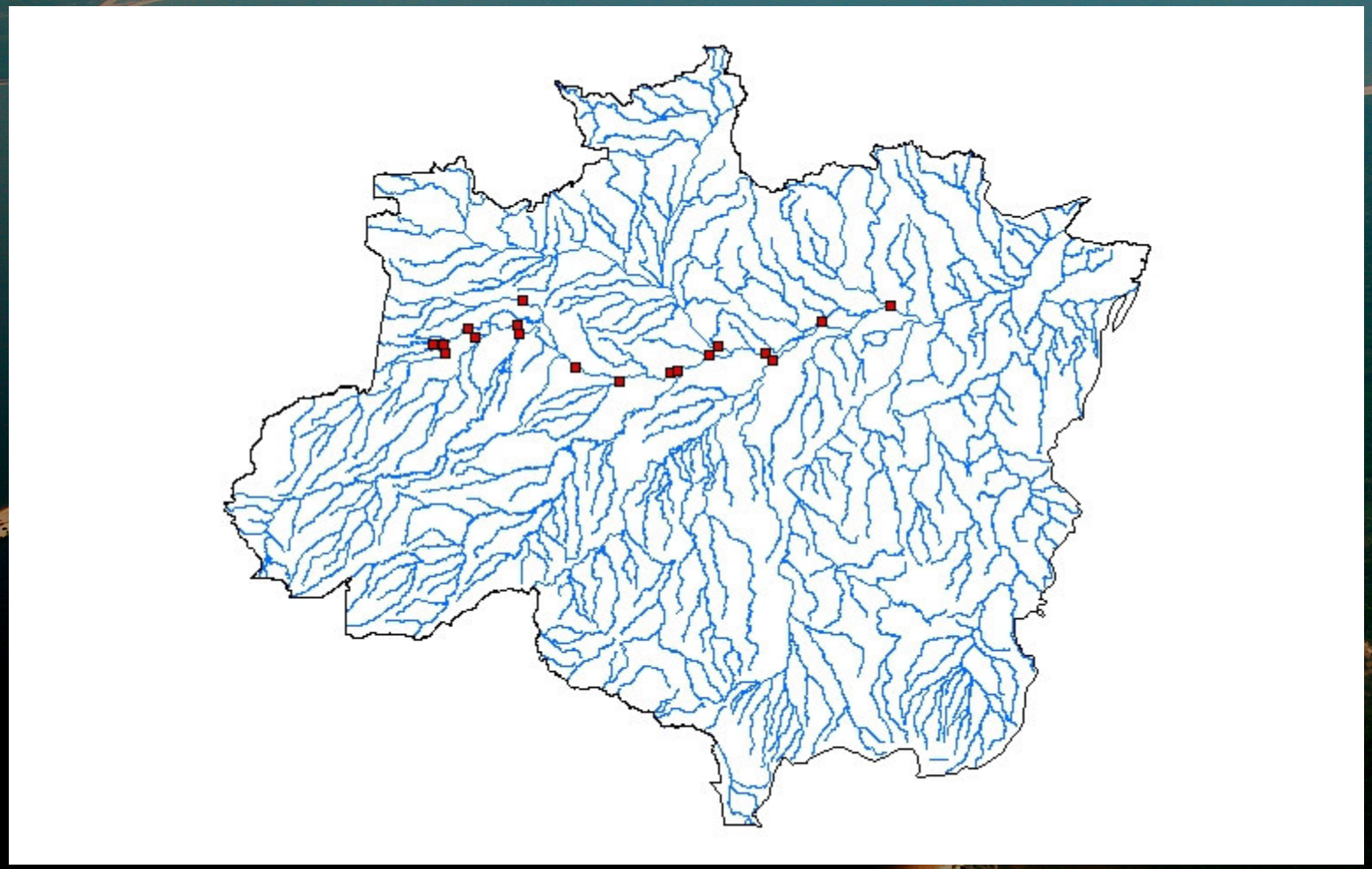
How the Amazon environments are related to the greenhouse effect?

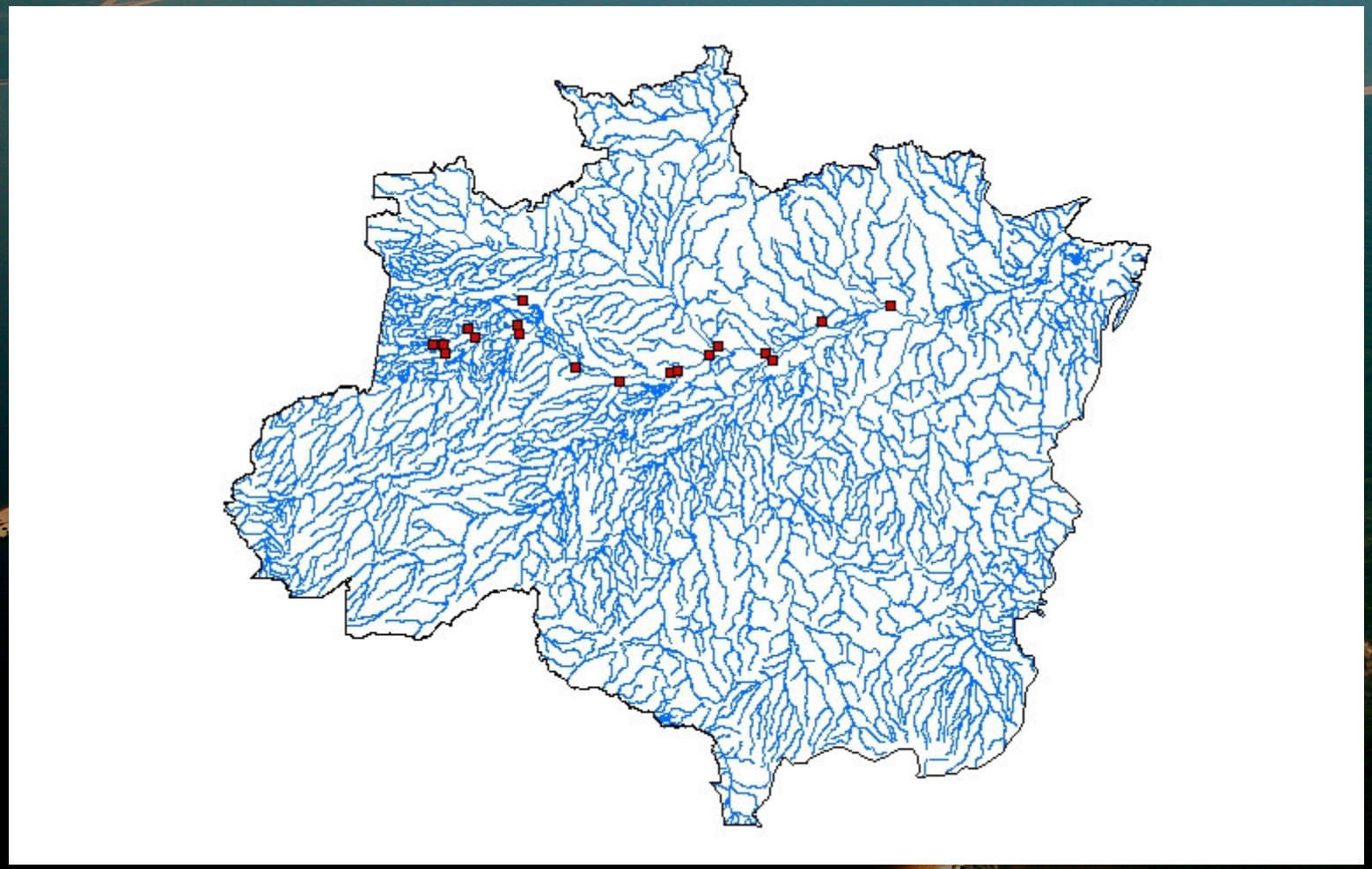


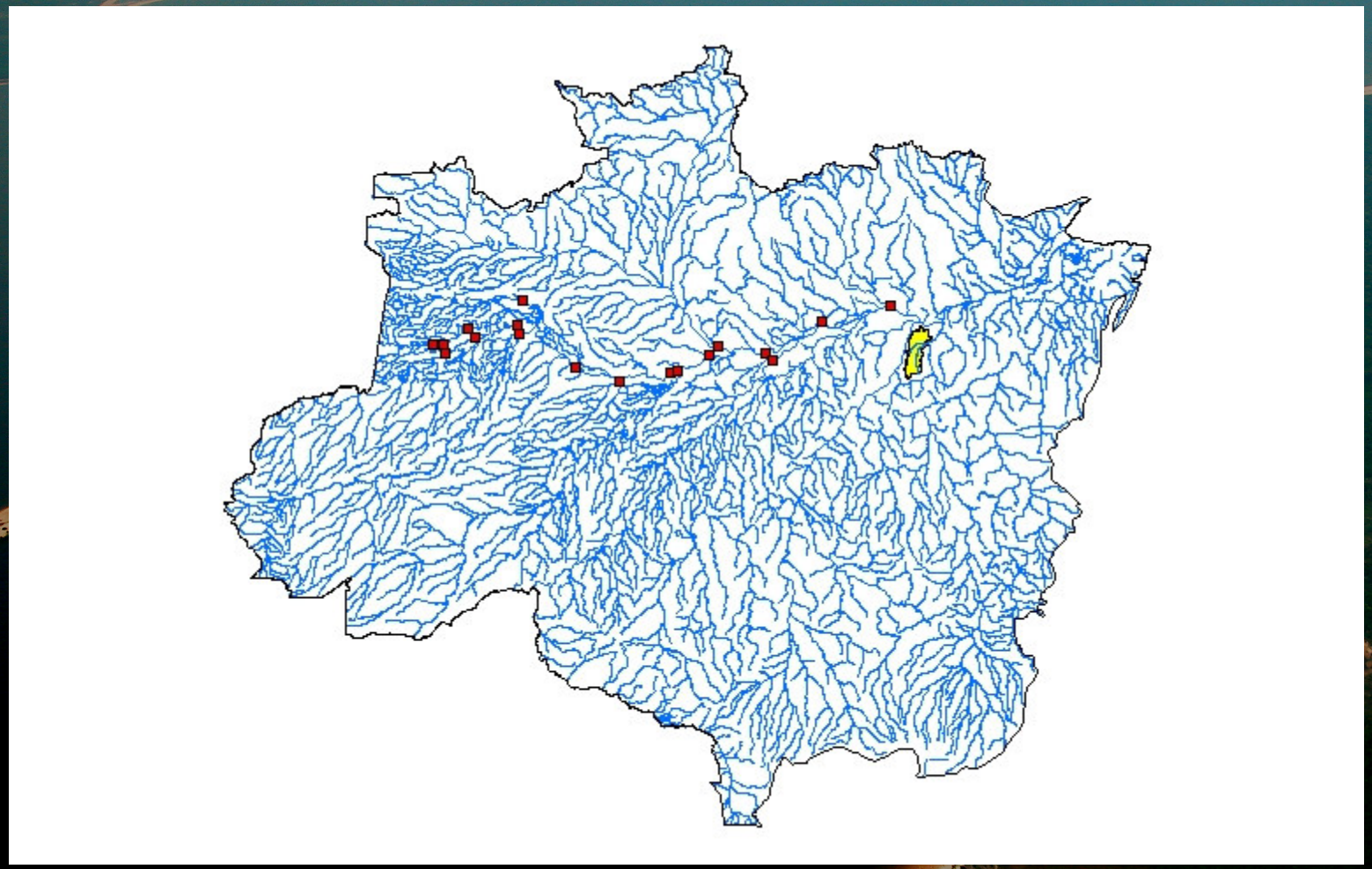
Most of the CH_4 studies in the region has been conducted only in Amazon River floodplain

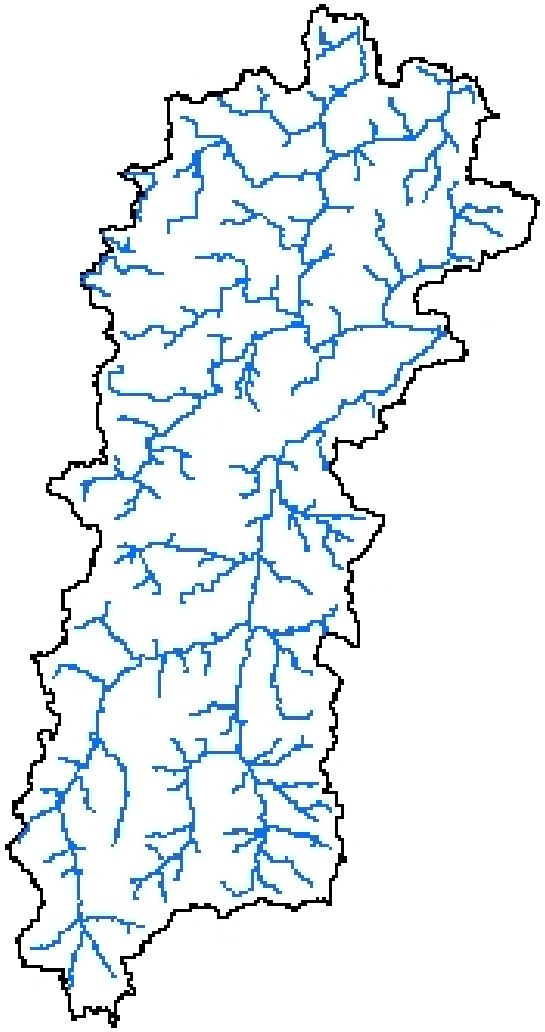


DEVOL, A. H.; RICHEY, J. E.; KING, L. S.; LANSDOWN, J.; MARTINELLI, L. Seasonal variations in the 13C-CH4 of Amazon floodplain waters. **Mitt. Internat. Verein. Limnol.**, v.25, p.173-178, February, 1996.









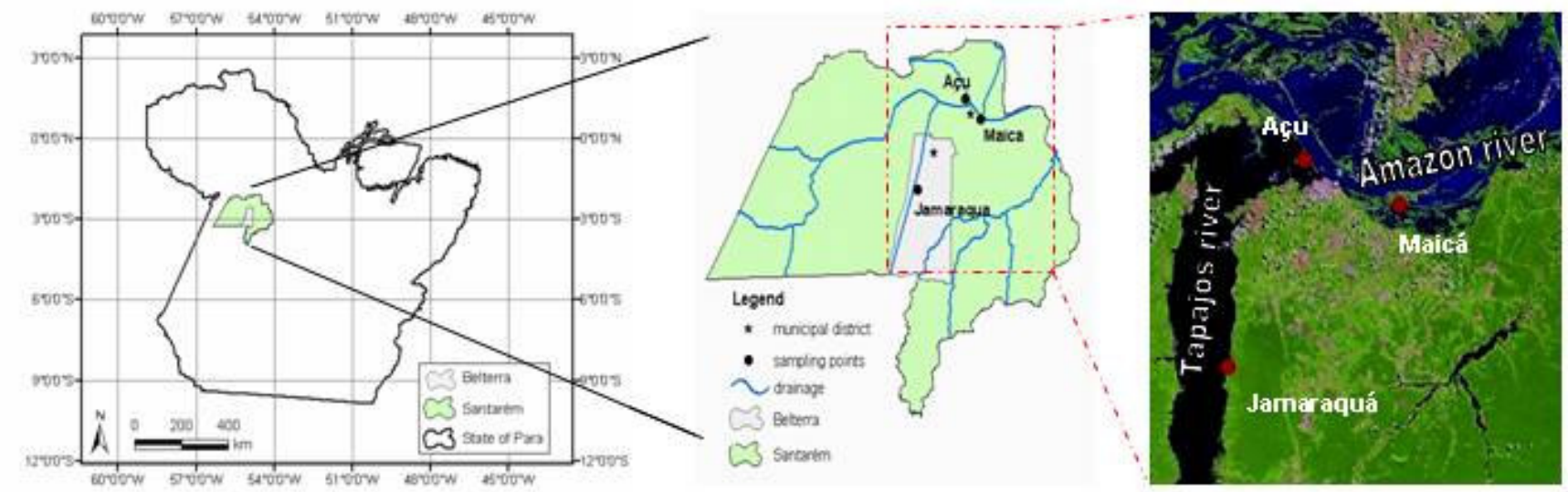
KRAMER M et al. Controls on stream DOC flux and composition in the Amazon region, Tapajos national forest. http://www.lbaeco.org/cgi-bin/web/fortal/fortal_ab_search.pl

Objectives

To investigate both spatial and temporal variations in methane stable isotopic composition and the mechanisms controlling these variations

To determine the $\delta^{13}C$ of vegetation surrounding the stream basins and the sedimentary organic matter (SOM) which allow us to infer the role of these sources to $\delta^{13}C$ of CH_4 released to the atmosphere

Study Area



Várzea

Terra-firme

Açu

Maicá

Jamaraquá

Maicá Stream

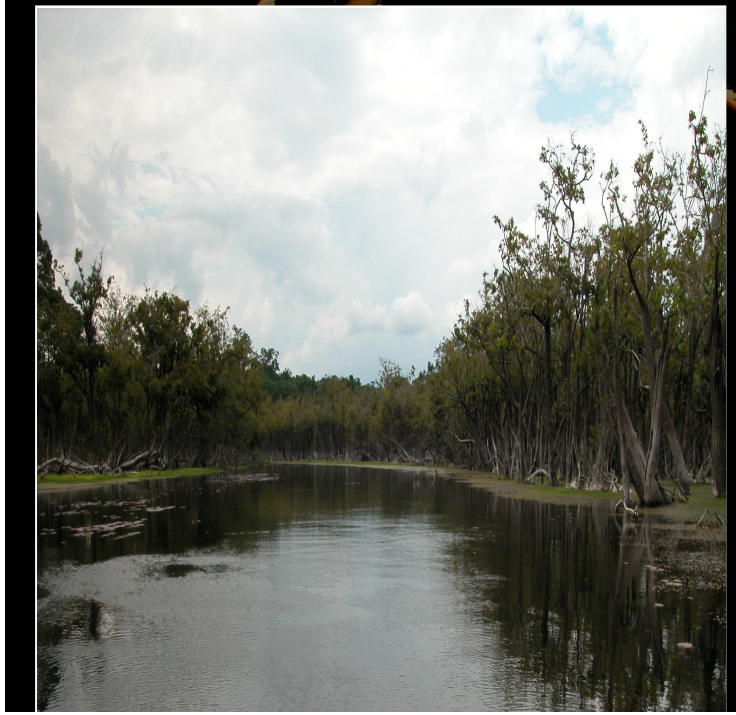
Igarapé Açu stream

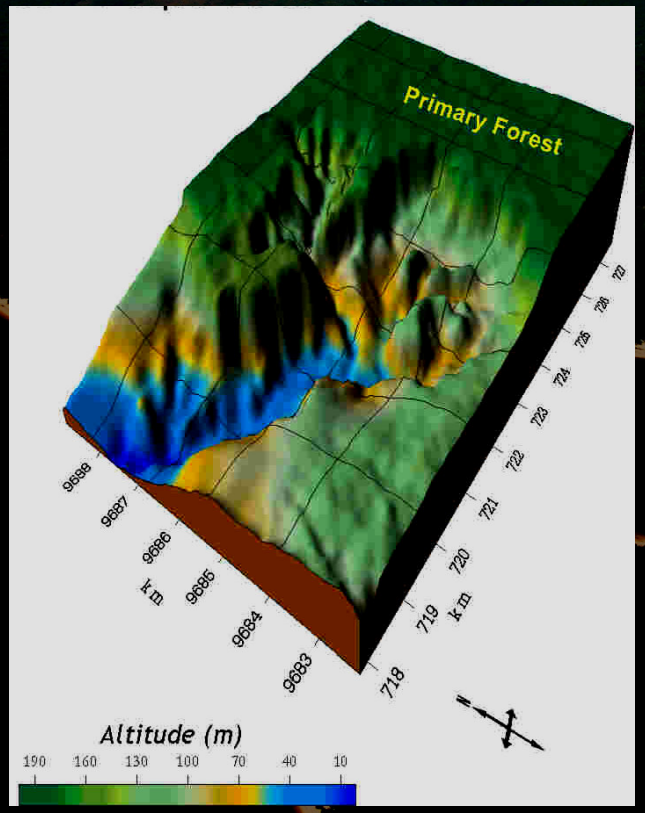
Tapajos River

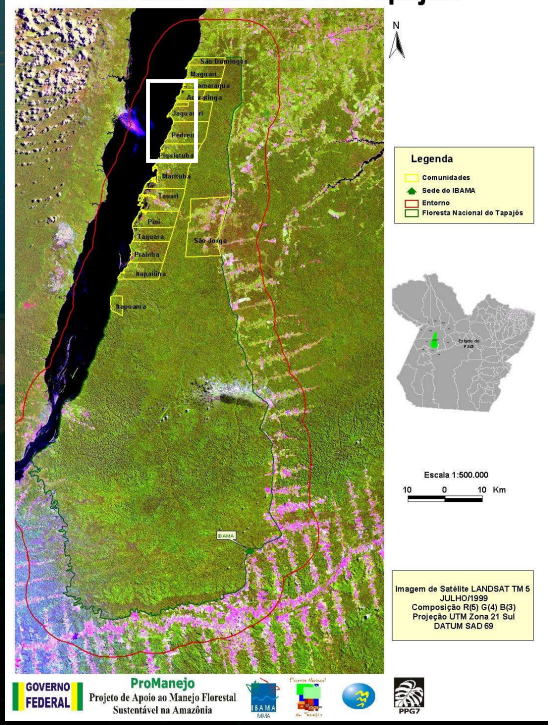
Amazon River

Sampling point

Jamaraquá Stream







Sampling CH_4 bubbles

We look at the sediment composition

Sampling sediment cores

Laboratory of Isotopic Ecology

Mass spectrometry

$$\delta^{13}C\text{-}CH_4 = 1000 \times \left(\frac{R_{sample} - R_{standard}}{R_{standard}} \right)$$

C_3 cycle plants

$$\delta^{13}C = -27$$

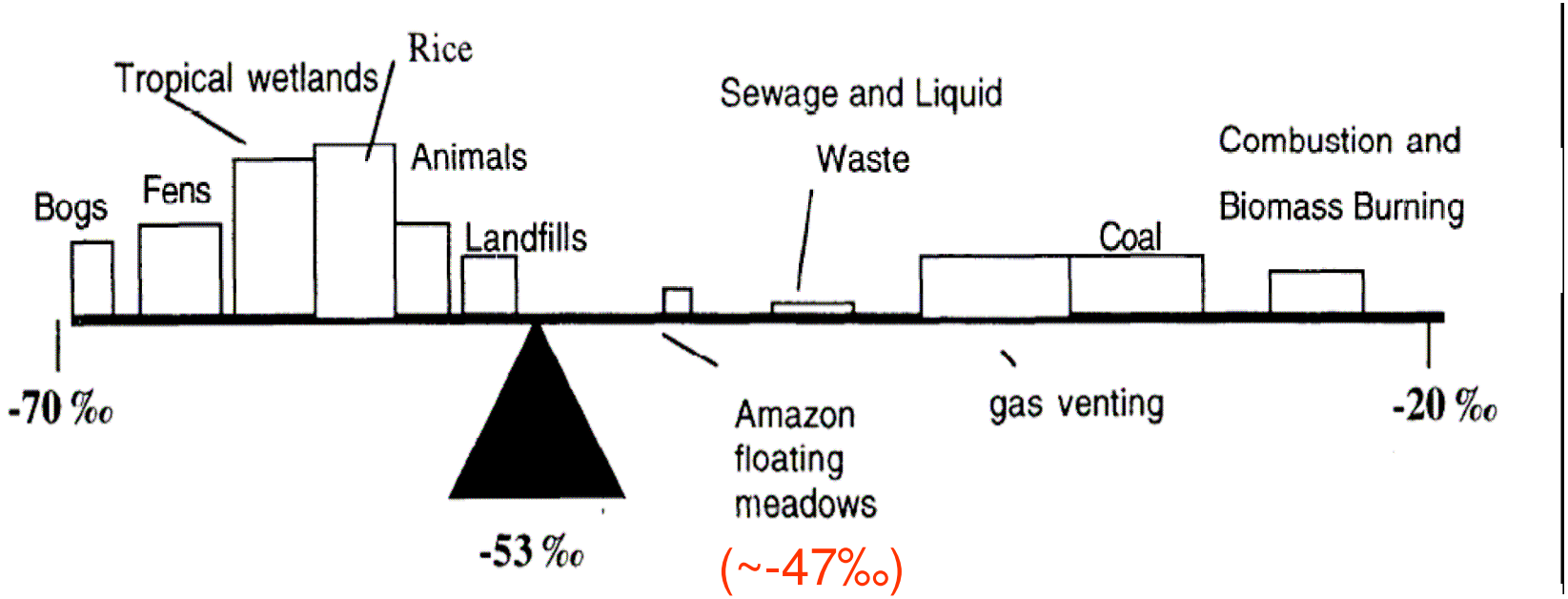
Lighter

C_4 cycle plants

$$\delta^{13}C = -13$$

Heavier

Mass-weighted isotope mass balance approach for atmospheric methane inputs



$\delta^{13}C(C_3 \& C_4 \text{ leaves}) \rightarrow \delta^{13}C(\text{bottom sed}) \rightarrow \delta^{13}C(\text{bubbles})$

Production process

Methanogenic pathway

CO_2 Reduction

$$CO_2 + 4H_2 \rightarrow CH_4 + 2H_2O$$

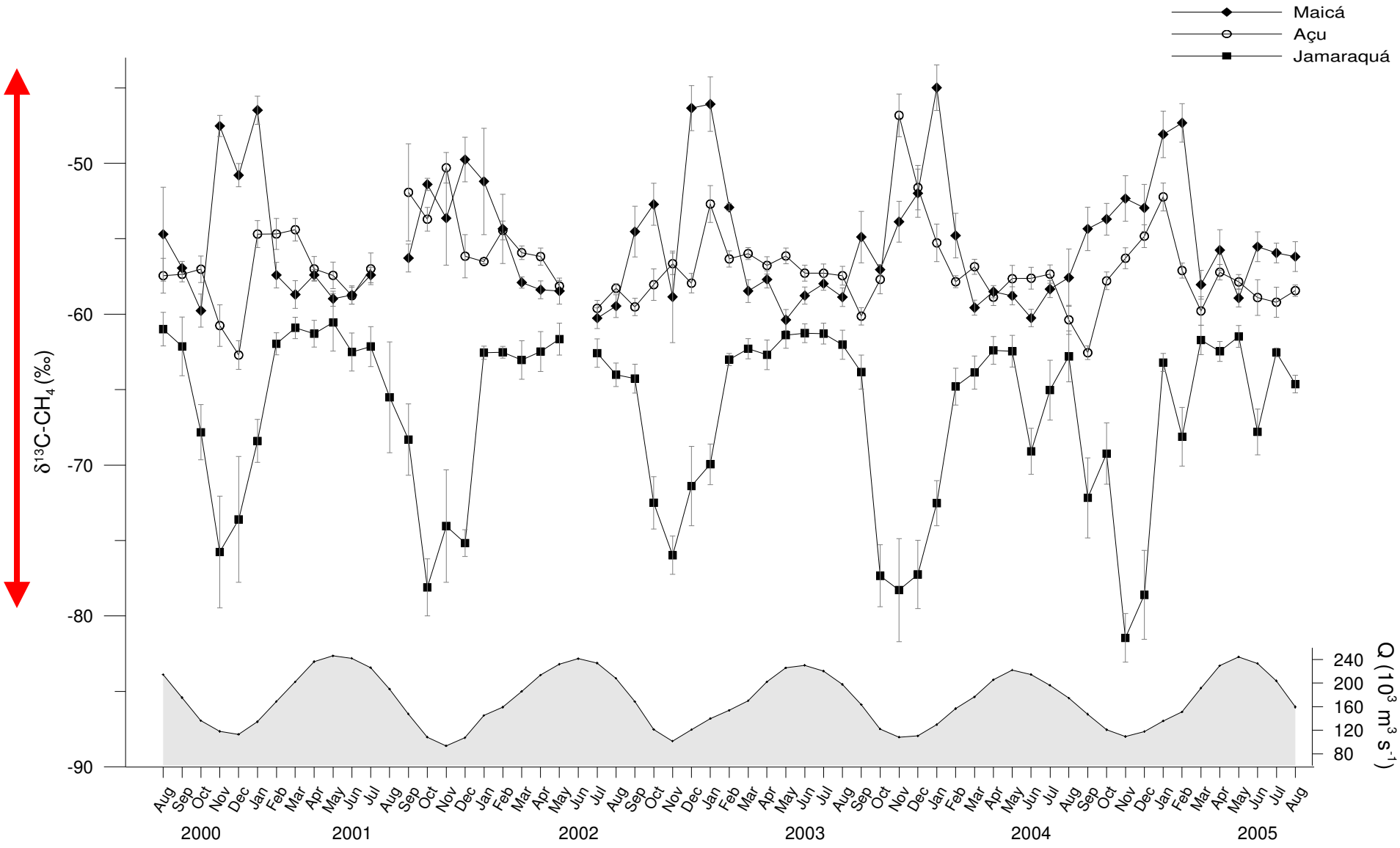
lighter

Acetate fermentation

$$CH_3COOH \rightarrow CH_4 + CO_2$$

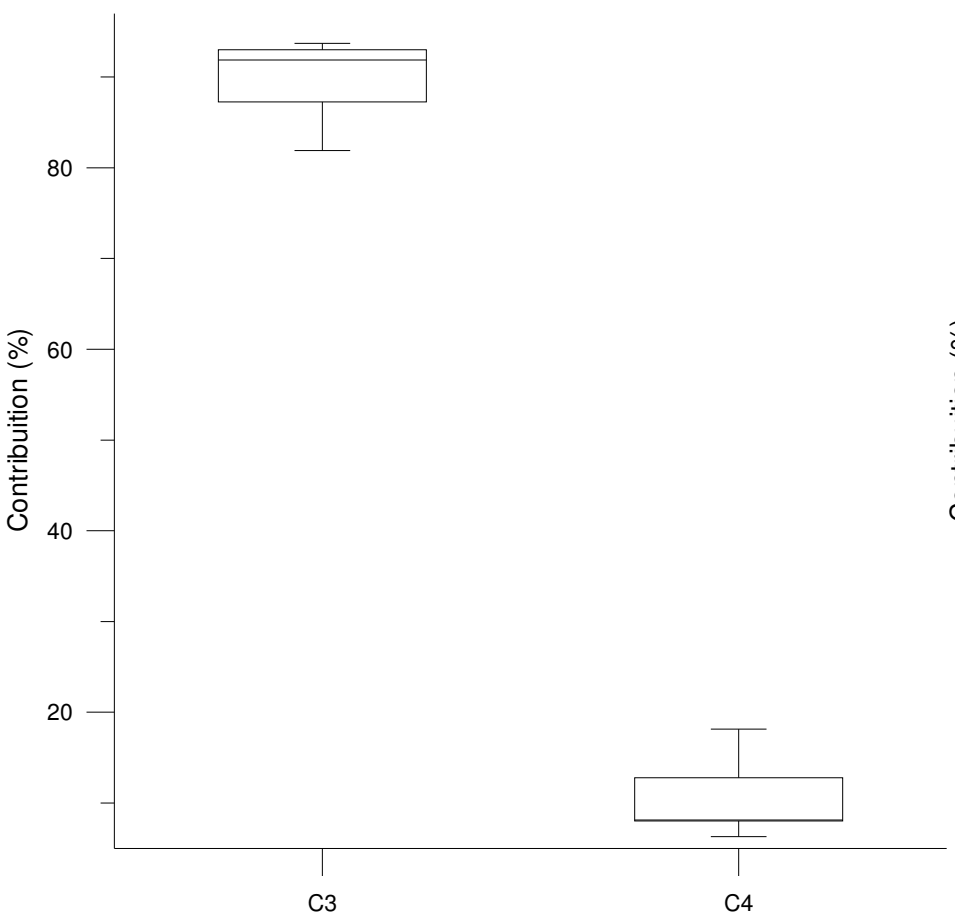
Heavier

$\delta^{13}C\text{-}CH_4$ over the five-year period



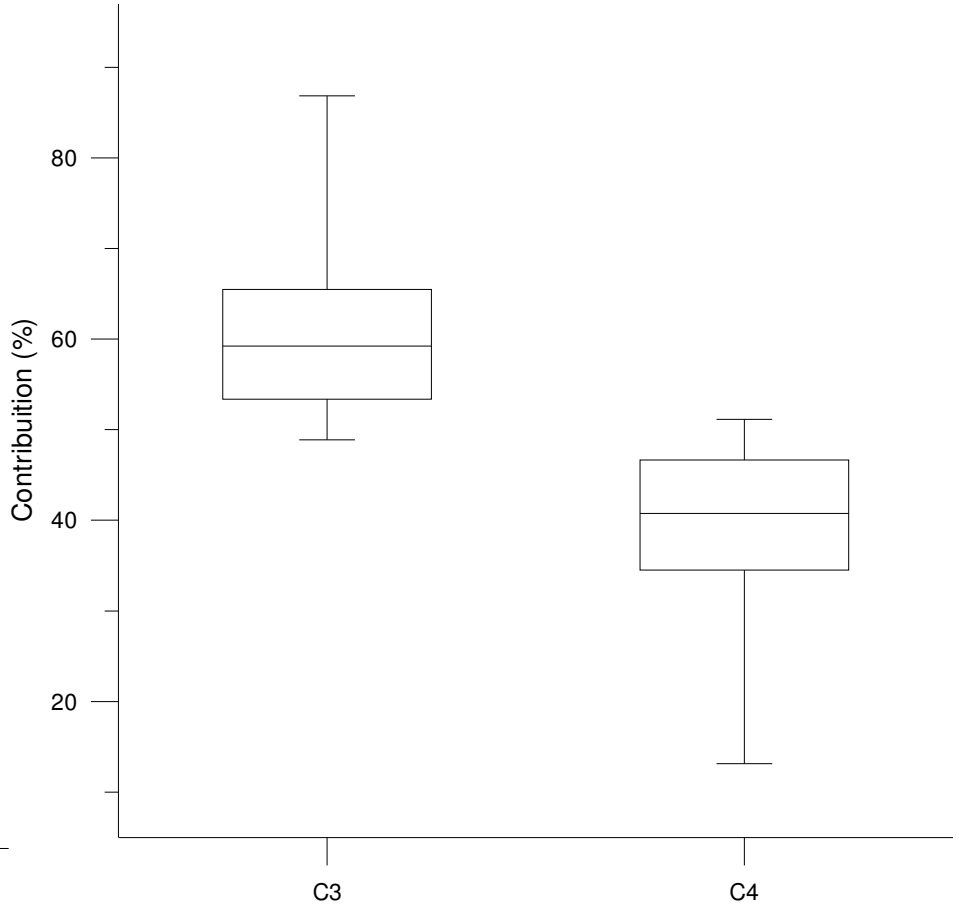
Contributions of C3 and C4 plant material to OM present in bottom sediment

terra-firme stream (Jamaraquá)



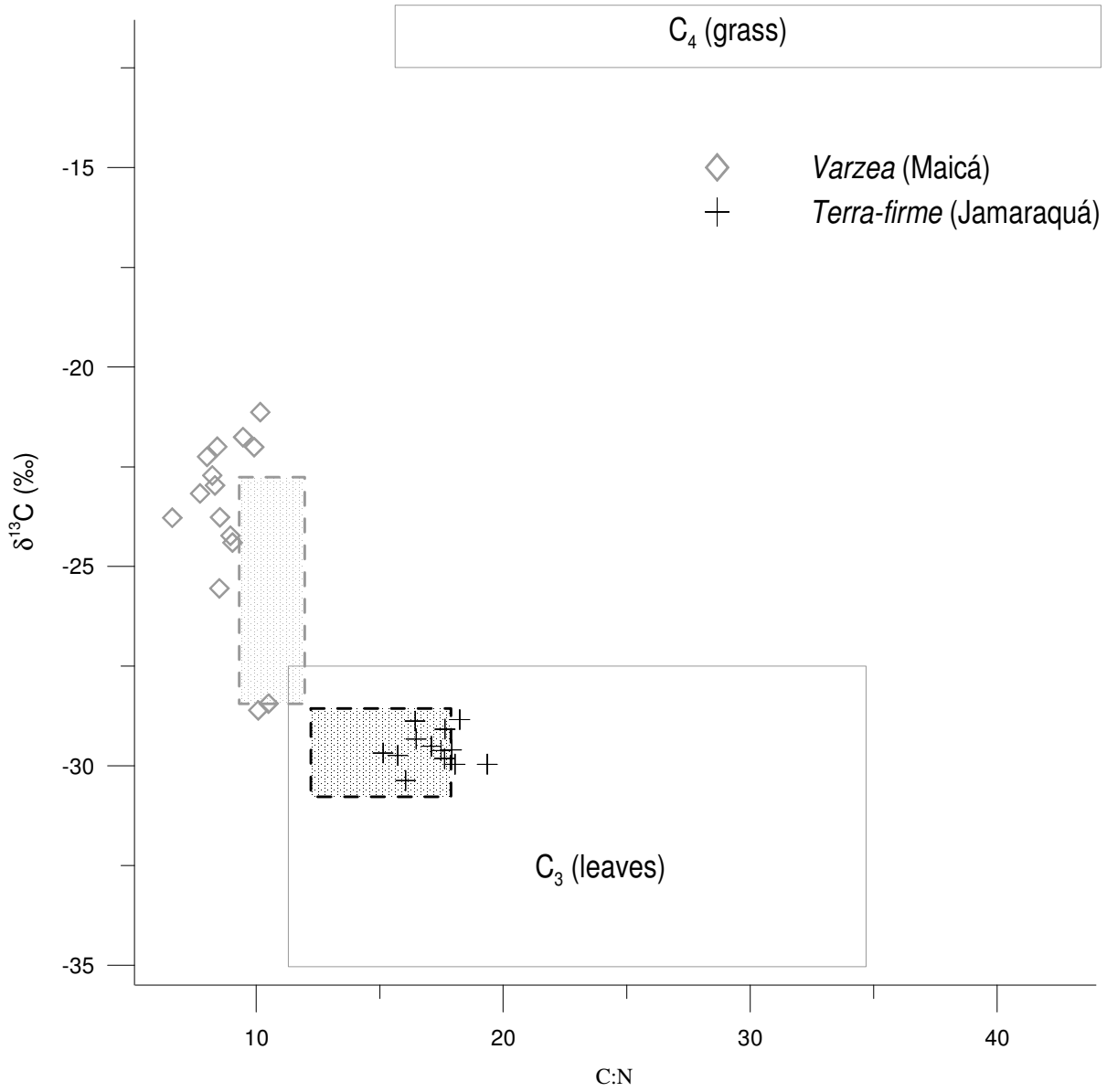
Lighter

várzea stream (Maicá)



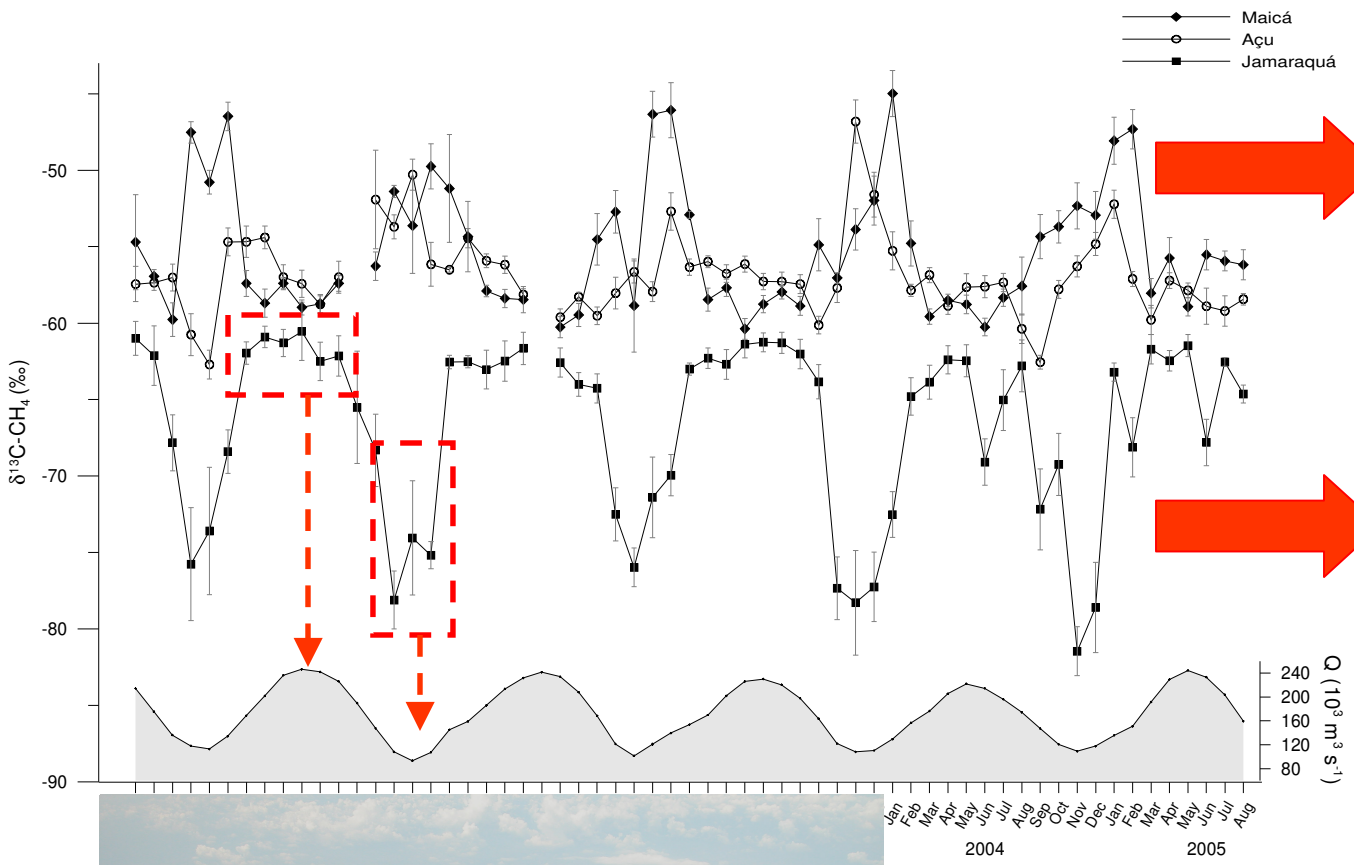
Heavier

OM $\delta^{13}C$ values *versus* C:N for the sediments from the *várzea* and *terra-firme* streams



Seasonal variation on the isotopic composition sediment organic matter

Site	Phase	$\delta^{13}C$ (‰)	C (%)	N (%)	C:N
Jamaraquá	HW	-29.7	15.8	0.9	18.2
	LW	-29.5	14.1	0.8	16.5
Maicá	HW	-27.5	2.5	0.3	9.7
	LW	-22.8	0.8	0.1	8.6



C_4 plants decomposition

????

CO_2 Reduction

$CO_2 + 4H_2$

$CH_4 + 2H_2O$

lighter

Conclusions

There is a systematic seasonal variations in the stable isotopic composition of methane from the sediments of three stream sites.

The observed variations occur as a consequence of the differences in physical environmental characteristics of each site, the contribution of different sources of organic matter, and the processes by which this organic matter is decomposed

The heavy values found in *várzea* stream during the low water period appear to result primarily from degradation of massive amounts of a freshly produced C_4 grass. On the other hand, the *terra-firme* stream exhibit lighter values during this period. This behavior could possibly result from a change in the methanogenic pathway, from acetate fermentation to CO_2 reduction.

Acknowledgements

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Obrigado!