Evidence of increasing leakiness of the nitrogen cycle along a secondary forest chronosequence in Eastern Amazonia

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Foto: B. Kruijt

Investigating the N cycle in Secondary Forests…

OVERVIEW:

Increase in Amazon deforestation → Abandonment of areas → Increase in areas of secondary forests

Secondary forests:

Reservoir of genetic diversity of forests species; regulators of hydrologic function of the landscape; ecological corridors

Nitrogen: Cycling influenced by biotic interactions ; limiting nutrient for primary production

How do nitrogen cycling processes change during Amazonia's secondary succession?

Objective:

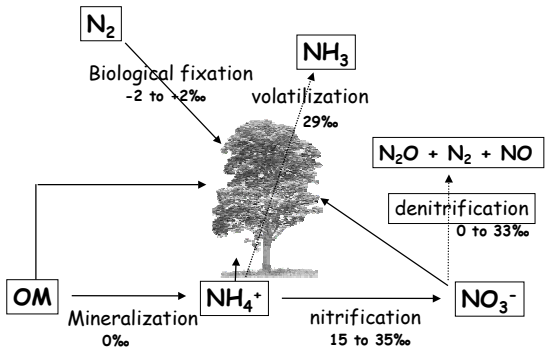
To investigate the nitrogen dynamics in a primary forest and along a chronosequence of secondary forests in Eastern Amazon

What we did ?:

Determination of $\delta^{15}N$, C and N concentrations in soil and vegetation

Measurements of N_2O and NO emissions from soil

Isotopic Fractionation in the Nitrogen Cycle

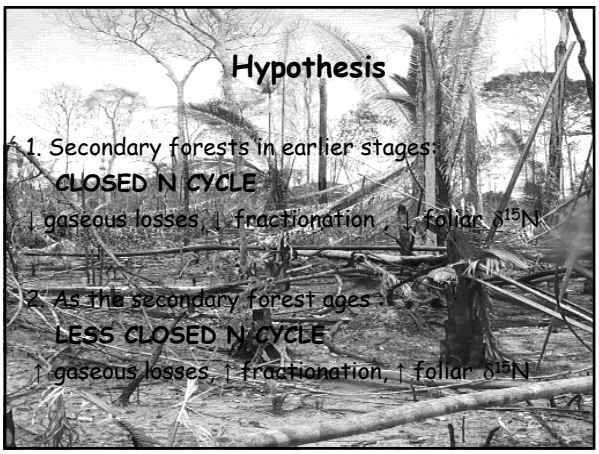


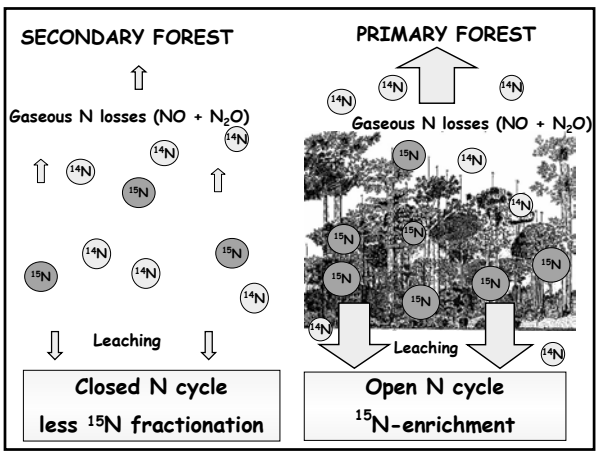
Source: Högberg, 1997

Hypothesis

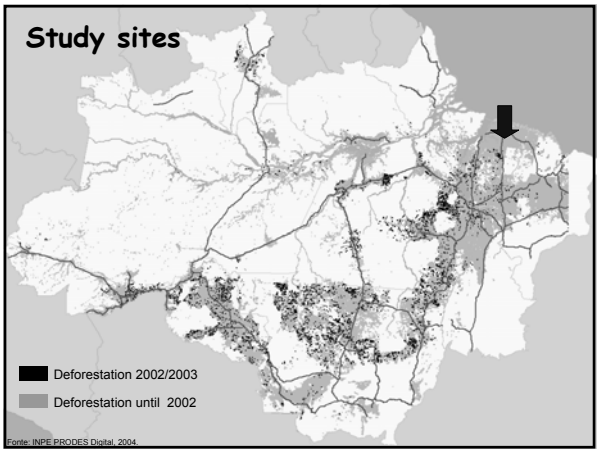
1. Secondary forests in earlier stages:
   CLOSED N CYCLE
   ↓ gaseous losses, ↓ fractionation, ↓ foliar $\delta^{15}N$

2. As the secondary forest ages:
   LESS CLOSED N CYCLE
   ↑ gaseous losses, ↑ fractionation, ↑ foliar $\delta^{15}N$





Study sites



Fonte: INPE PRODES Digital, 2004.

Secondary forests in São Francisco do Pará – State of Pará, Brazil

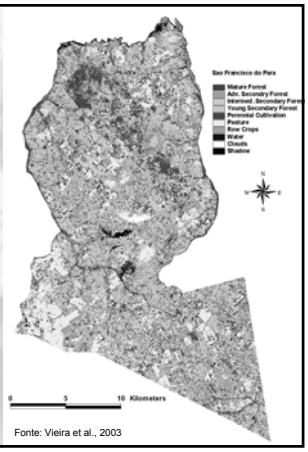
General aspects:

Predominant vegetation: secondary forest

Mean annual precipitation: 2500 – 3000 mm, with a distinct dry season from June to November.

Average air temperature: 26 ^{0}C

Land-use change : shifting cultivation (slash and burn agriculture):



Fonte: Vieira et al., 2003

Field sampling

Secondary forests areas previously used by shifting cultivation (slash and burn agriculture):

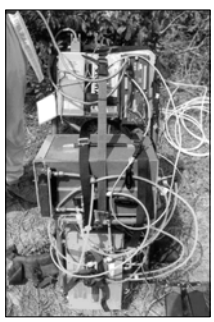
- Young secondary forests: 6 years
- Intermediate secondary forests : 20 years
- Advanced secondary forests : 40 years
- Primary forest

Leaf Sampling

Leaves: ~ 30 trees per site

Chemical analyses :
- determination of total N and C by elemental analyzer
- Nitrogen isotope ratios ($\delta^{15}N$) – isotopic ratio mass spectrometer

Trace gases measurements



Y. Ishida

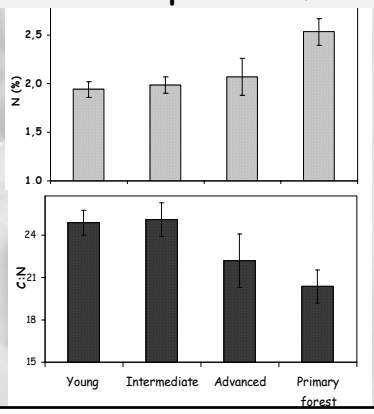
Results

Physical-chemical characterization of the superficial soils (0-10cm deep) from the studied sites

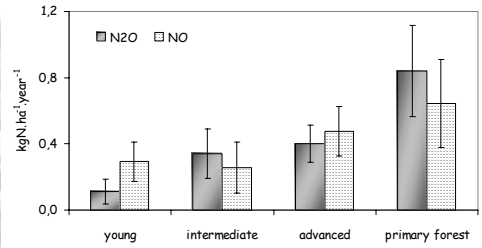
Study Site	Sand %	pH	Org. C - g kg^{-1} -	Total N - g kg^{-1} -	C:N	δ^{15}N ‰	Total P mg dm^{-3}	Ca^{2+} - mmol dm^{-3} -	SB[1] - mmol dm^{-3} -
Young	74	3.9	15.6	1.1	15.0	4.2	6	5	8.8
Intermediate	80	3.5	12.6	0.9	14.2	3.3	5	3	6.7
Advanced	80	3.5	13.2	1.0	13.6	3.7	5	1	3.1
Mature	72	3.5	16.5	1.2	14.4	5.6	7	2	4.9

[1]SB = sum of exchangeable bases (Ca^{2+} + Mg^{2+} + K^{+} + Na^{+})

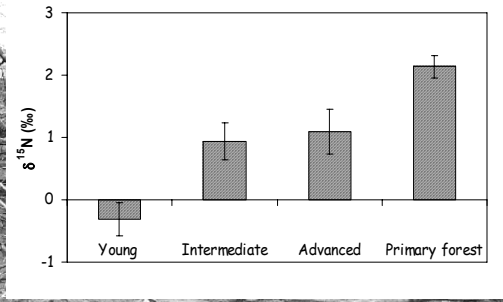
Nutritional composition of leaves



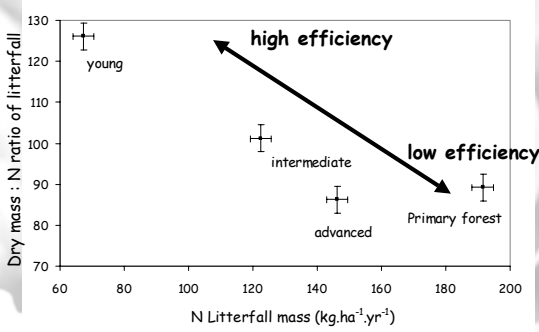
Nitrogen trace gas emissions from soils

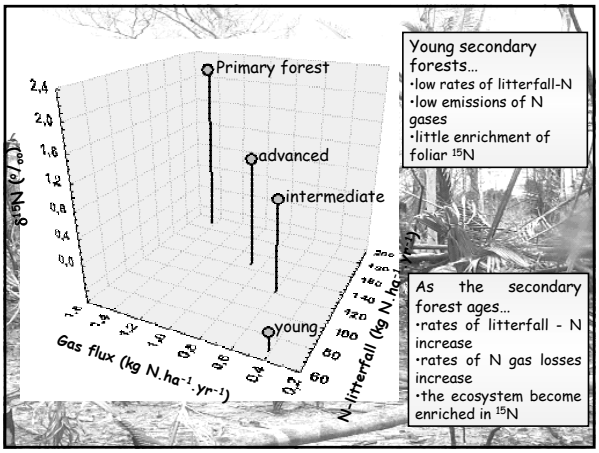


Variation in the foliar $\delta^{15}N$



Efficiency of nutrient use a la Vitousek





Conclusion

Nitrogen cycle is more closed during the first stages of secondary succession and becomes more open as the secondary forest ages

Muito obrigada!