

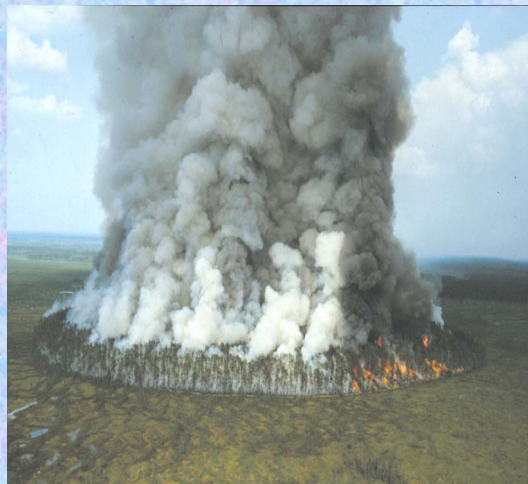


ATMOSPHERIC DEPOSITION AND NUTRIENT FLUXES IN AMAZONIA: FROM NATURAL BIOGENIC EMISSIONS TO BIOMASS BURNING IMPACTS

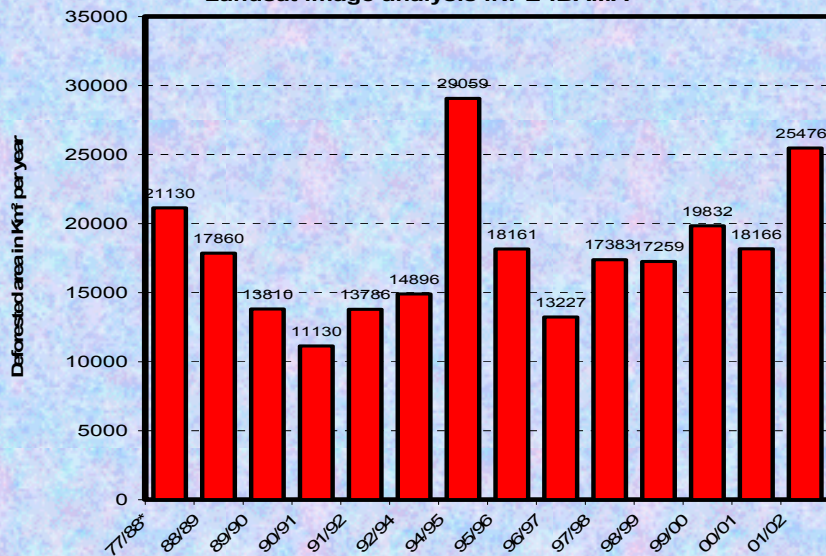
**L. Lara, P. Artaxo, M. L. Antunes, T. Pauliquevis, I.
Trebs, E. Holland, L. Martinelli**



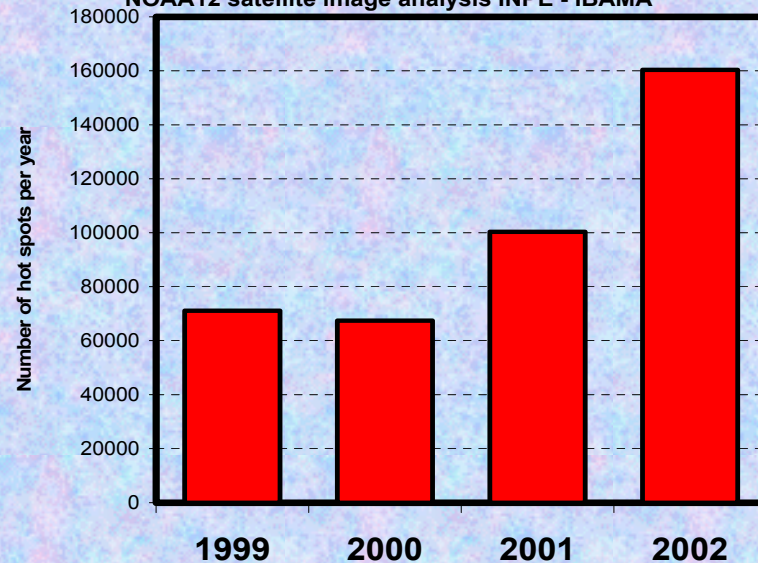
Changes in atmospheric deposition patterns due to land-use changes and biomass burning



Amazonia deforestation in km² per year 1977-2002
Landsat image analysis INPE-IBAMA



Forest fires in Amazonia 1999 - 2002
NOAA12 satellite image analysis INPE - IBAMA





AS A CONSEQUENCE...





Rain Acidity in Amazonian:

Pristine x Disturbed

pH

4.8 – 5.1

pH

4.4 – 4.7





Sources of Rain Acidity

Pristine areas:

- DOC (Carbon)
- Organic acids: 60 %

Disturbed areas:

- Inorganic acids
- DOC (Carbon)





Organic acids in disturbed and pristine regions in Amazonian

	Rondônia	Balbina		
	Season	Season		
	Dry	Dry	Wet	Annual
PH	4.6	5.1	4.8	4.9
H ⁺	26.6	12.9	18.3	14.7
Formate	4.3	2.9	2.1	2.5
Acetate	10.4	9.3	15.1	13.3
Oxalate	0.6	0.3	0.1	0.2
DOC	219	165	140	154
F/A	0.4	0.2	0.1	0.2
% H ⁺	54	38	60	47

CARBON IN RAIN WATER

Pristine areas



Biogenic Emissions

Disturbed Areas



**Biomass
burning**

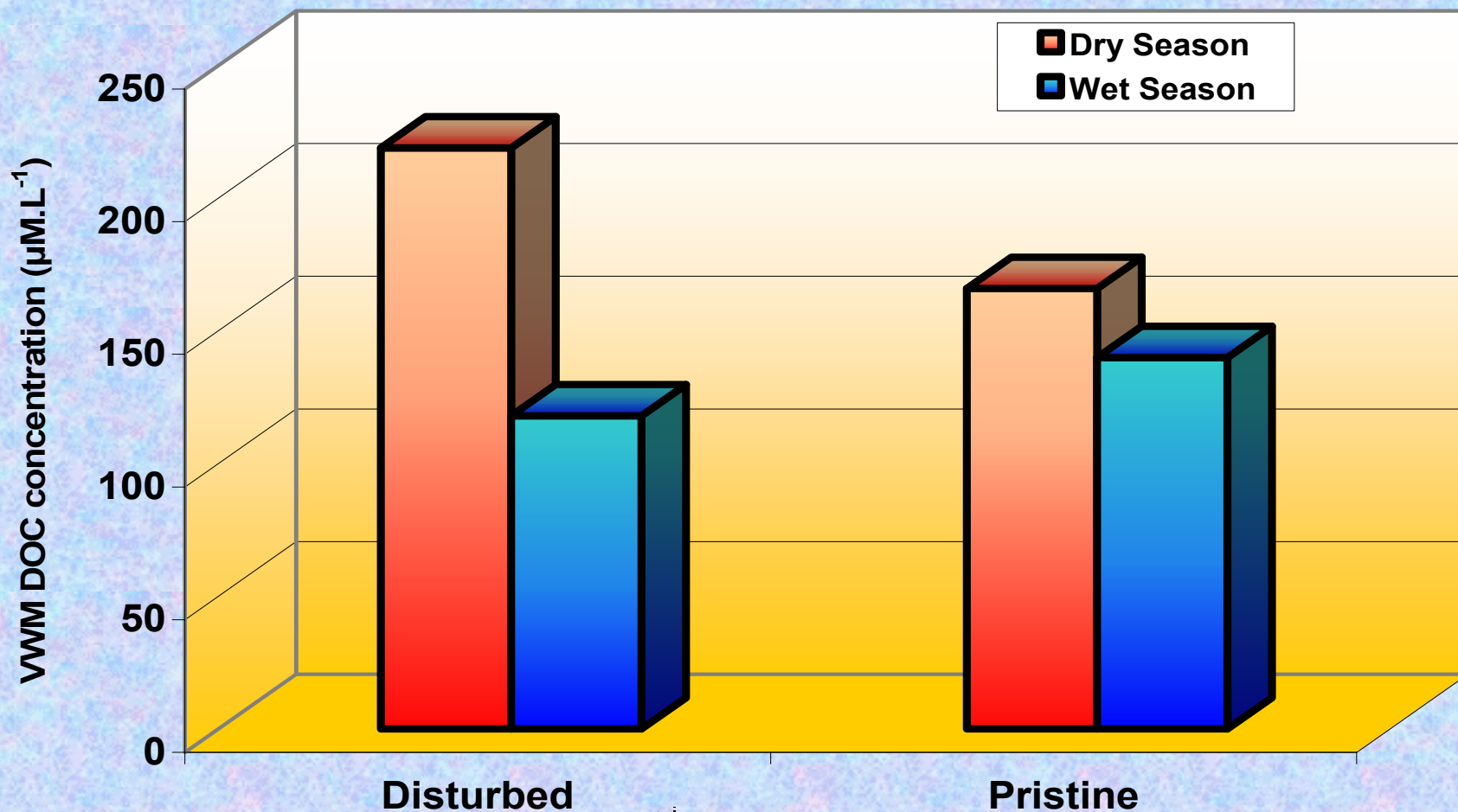


**Soil
Particles**





VWM concentrations of DOC in Pristine and Disturbed areas



**Disturbed areas: significant difference between
dry and wet seasons !!!**



N wet deposition (kg.N.ha⁻¹.yr⁻¹)

N wet deposition – kg N.ha⁻¹.yr⁻¹

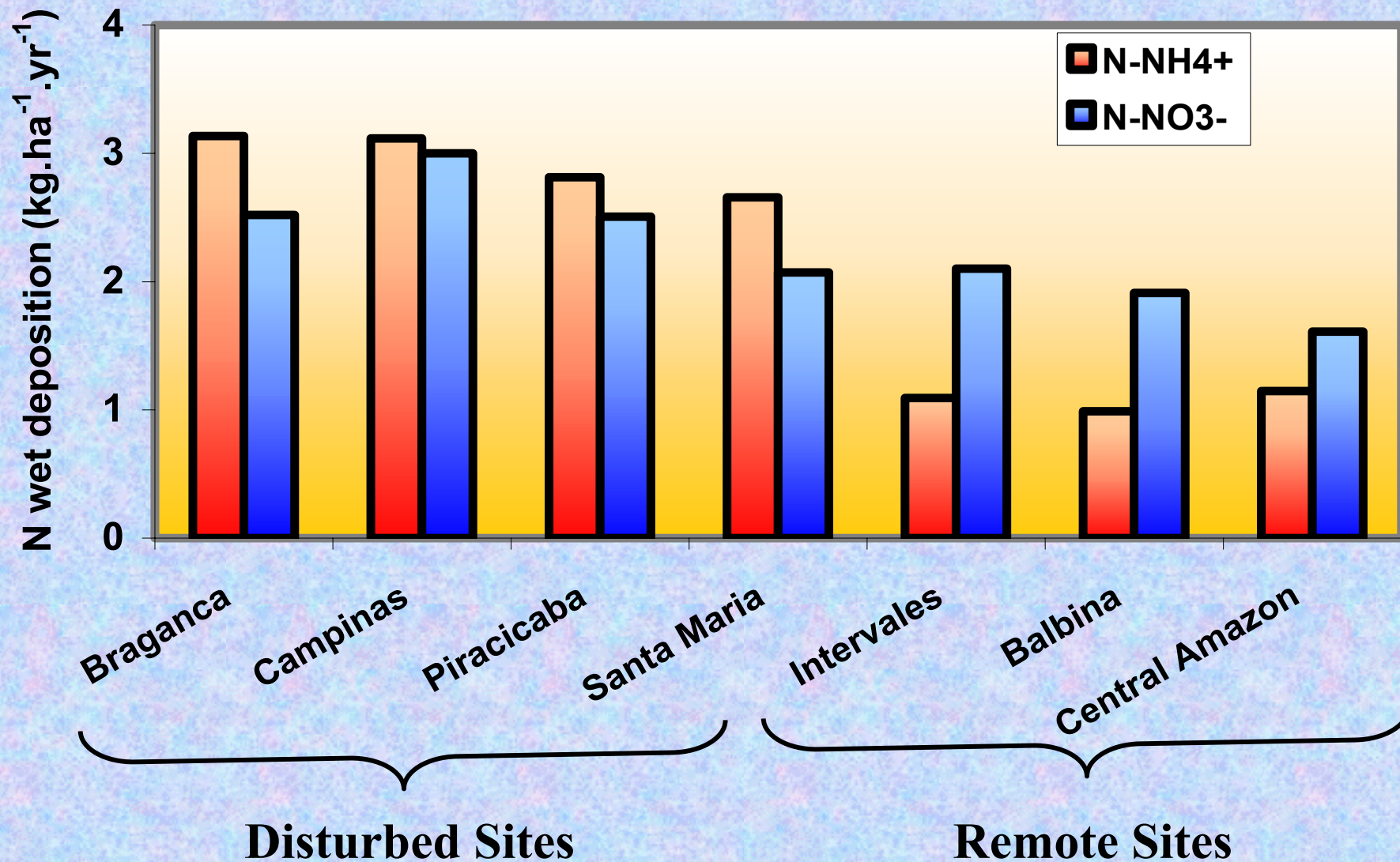
Balbina *	2.9
Central Amazon**	2.8
Remote Southeastern *	3.2
Rondônia *	5.7
Disturbed Southeastern***	5.6

* Lara et al., 2004; 2005 , ** Willians et al., 1997, *** Lara et al., 2001





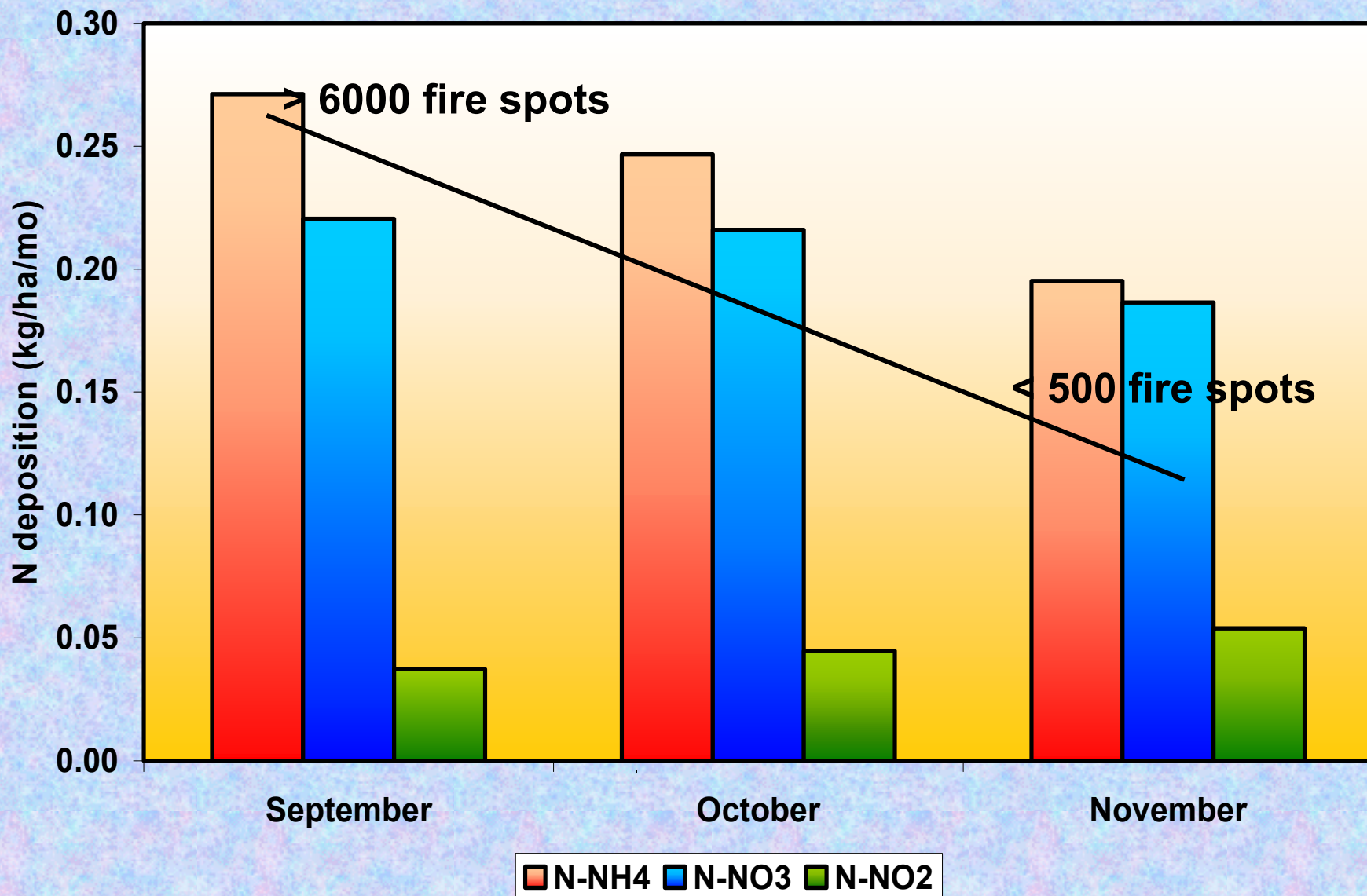
N wet deposition (kg.N/ha/yr) in Brazil



Data from: Lara et al., 2001; Williams et al., 1997;
Lara et al., 2003; 2005.

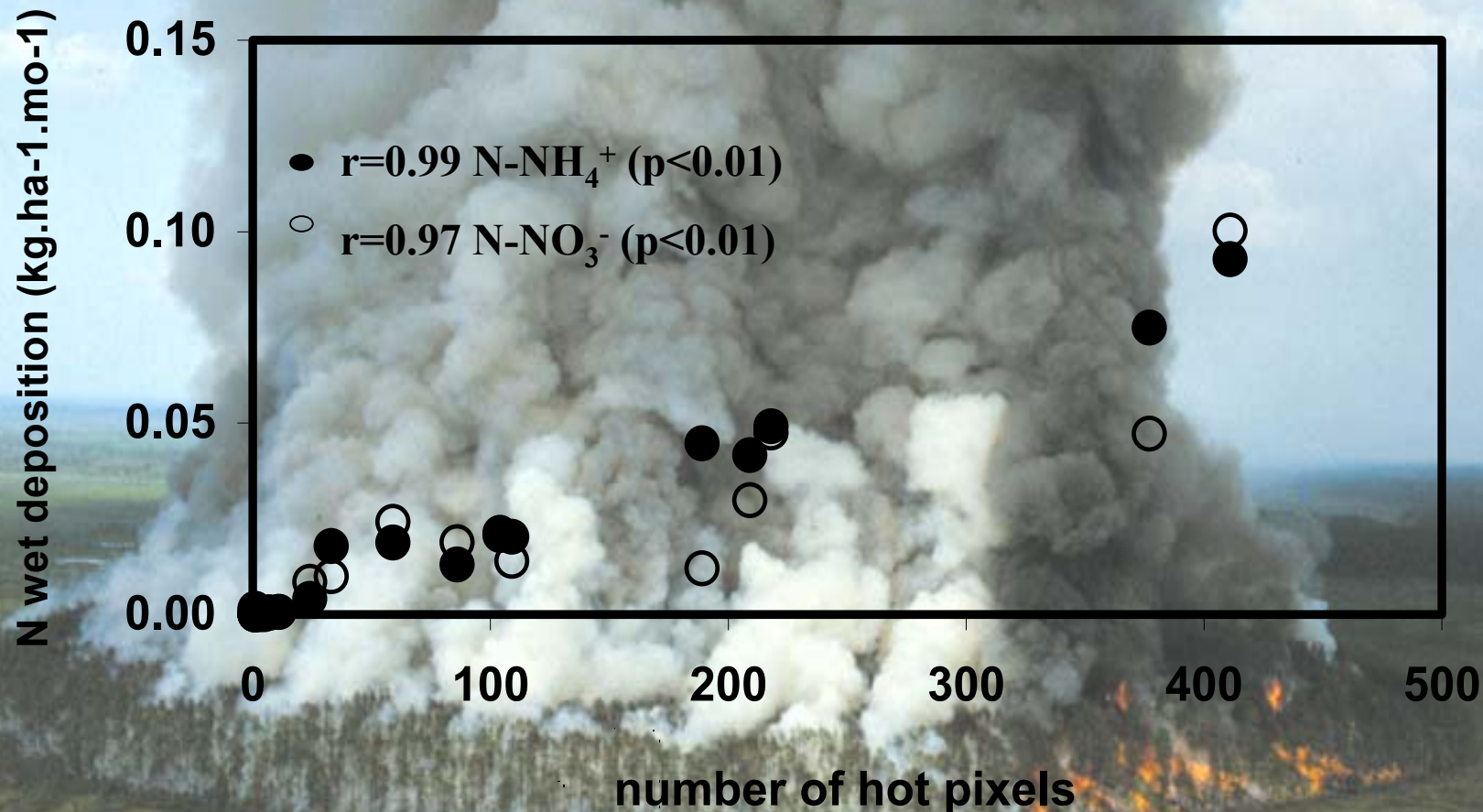


N deposition in a transition from dry to wet season in Rondonia





N deposition and fire spots



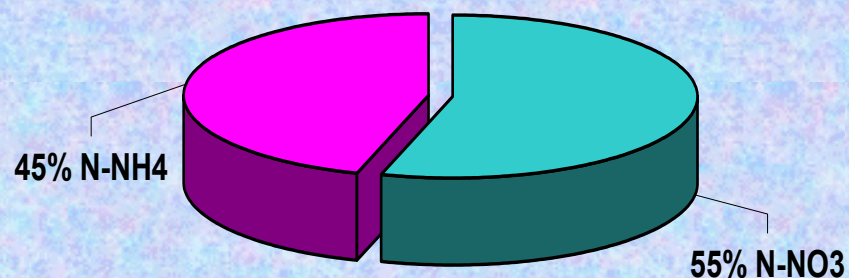
- N deposition is linked to biomass burning !!
- The main form of N deposition is NH₄⁺ !!



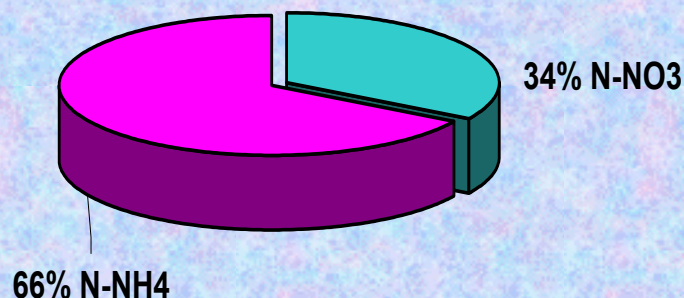
N wet deposition in Amazonian:

Pristine X Disturbed

Remote Areas in Brazil



Disturbed Areas in Brazil



N wet deposition:

2.9 – 3.2 kg.N/ha/yr

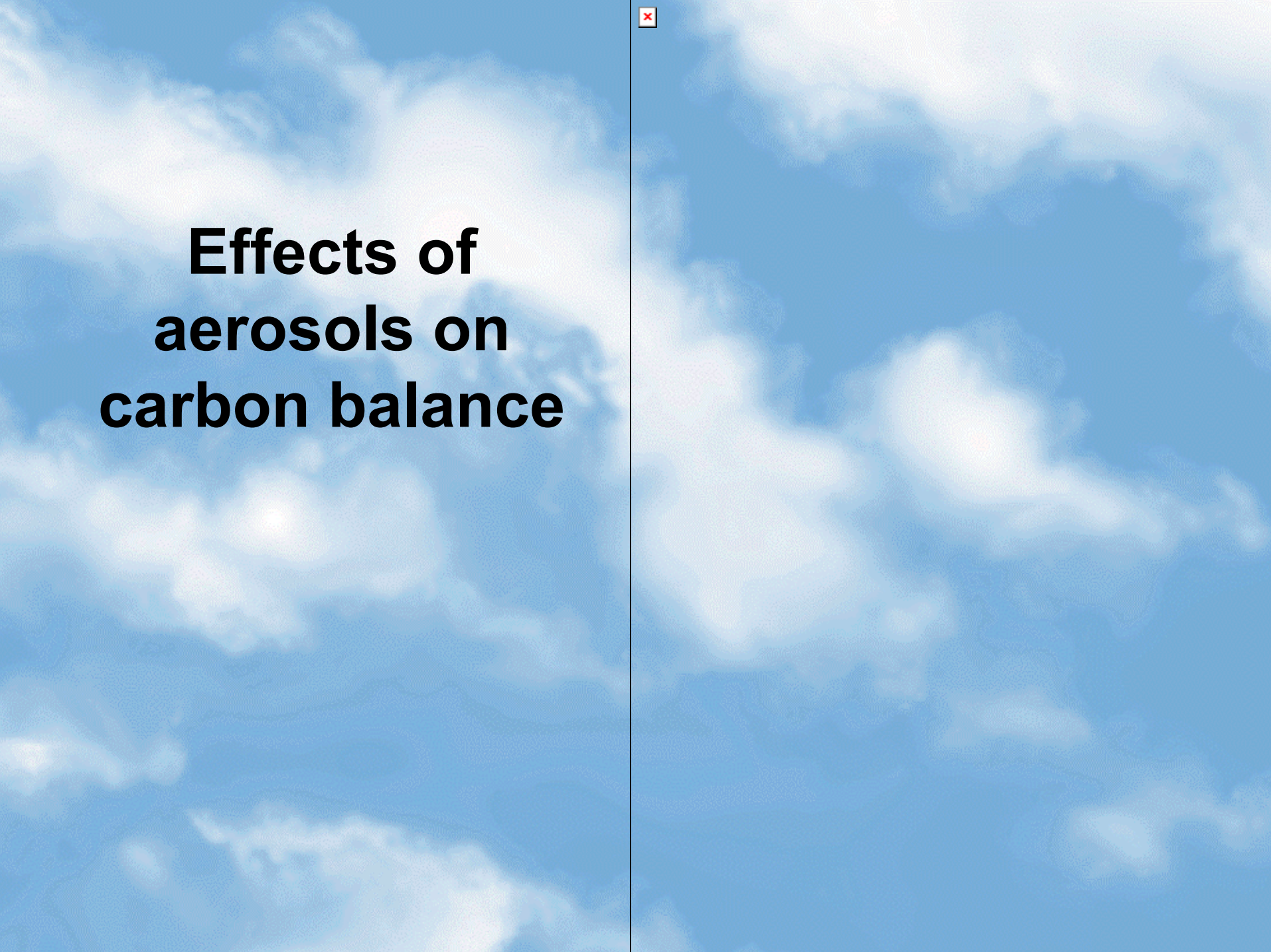
Dry season:

N-NH₄⁺ < 40%

N wet deposition:

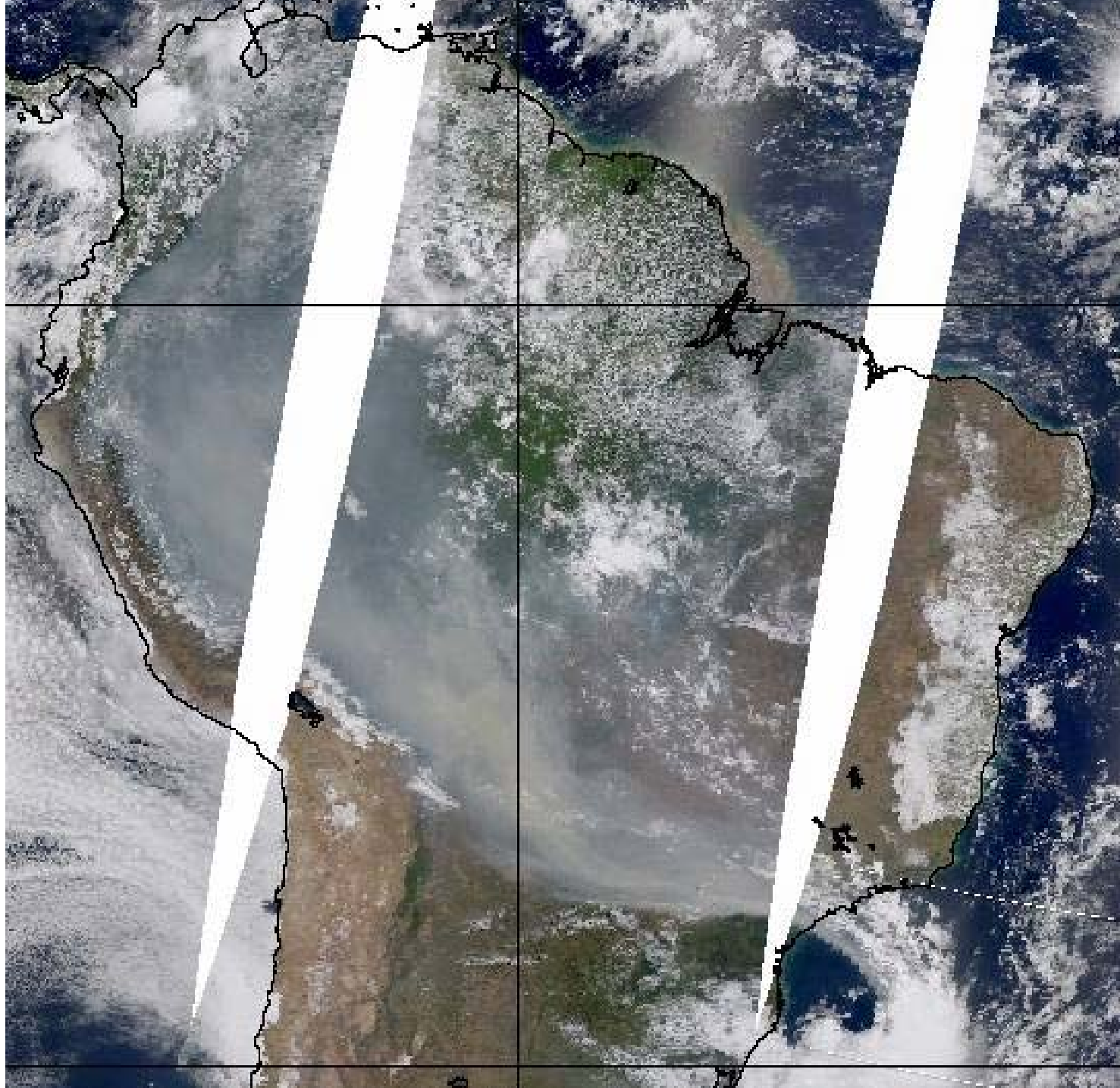
4.8 – 6.3 kg.N/ha/yr

Lara et al., 2003; 2005.

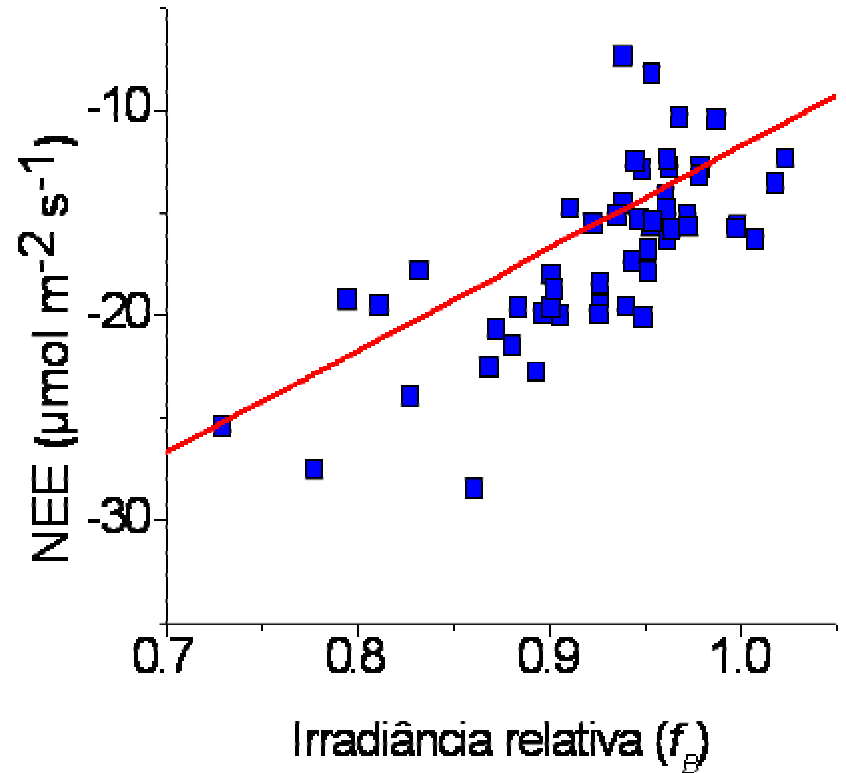
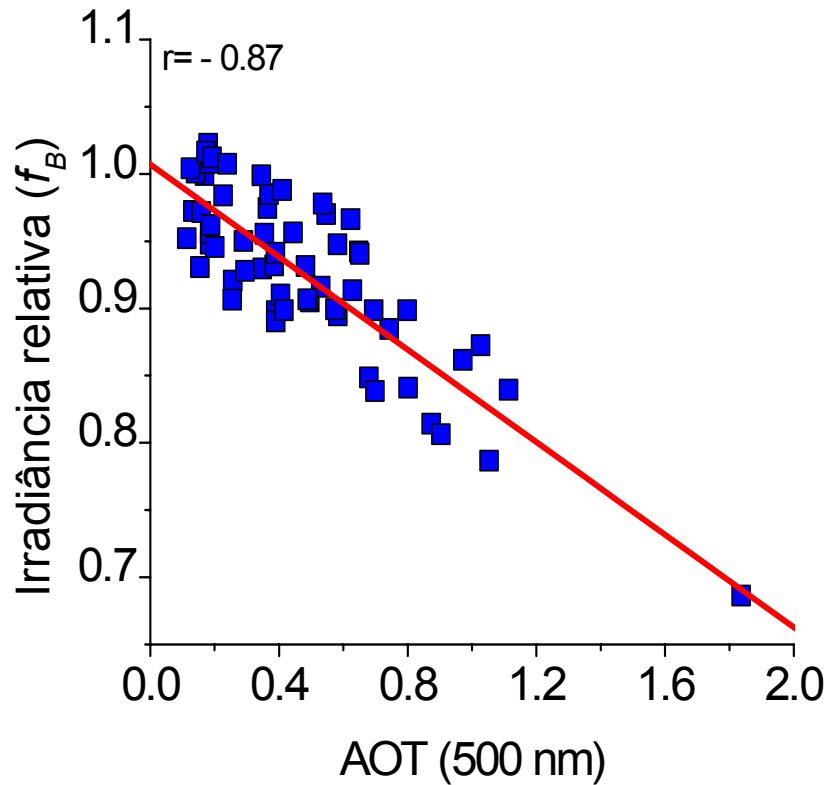


Effects of aerosols on carbon balance

Smoke
cloud over
Amazonia



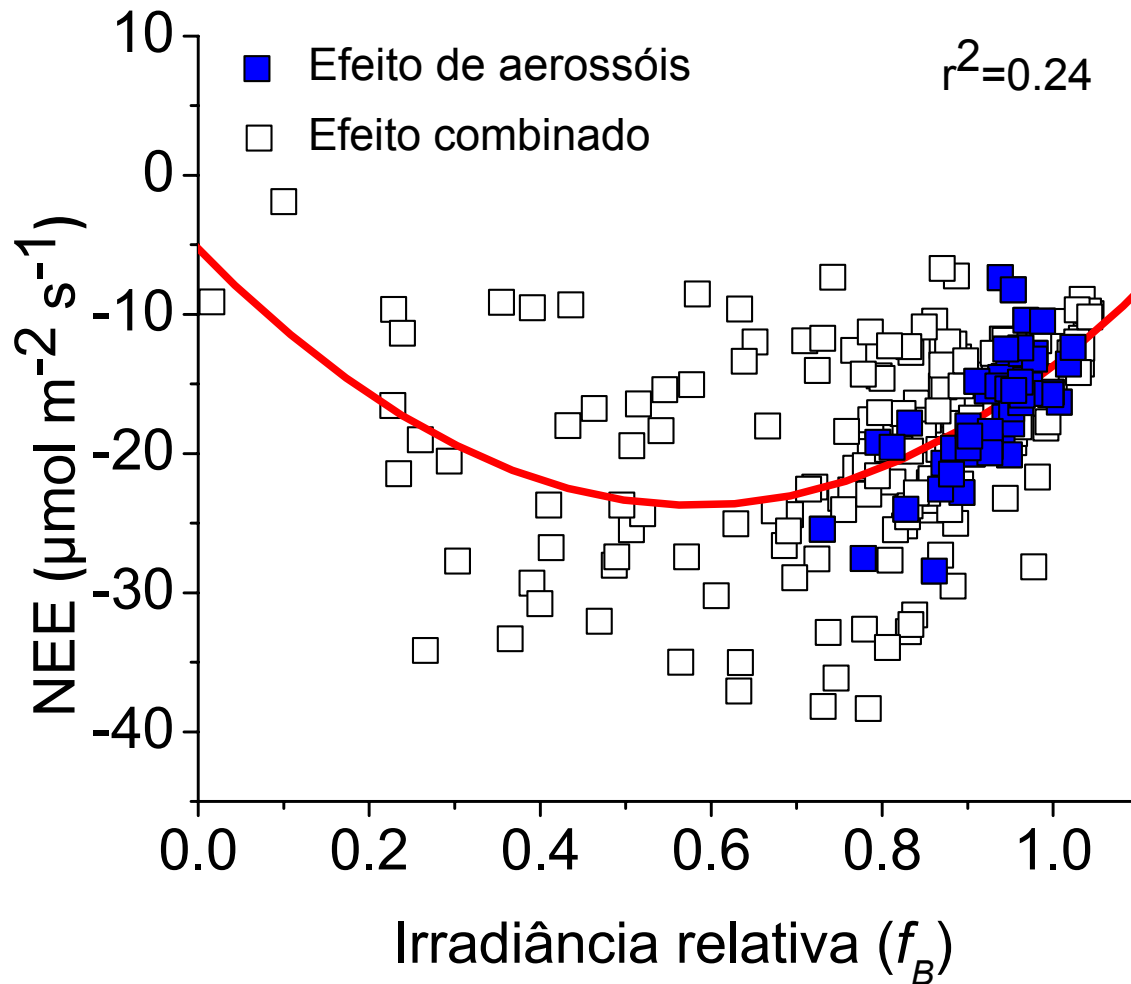
Rebio Jaru Rondonia - Forest area



$\Delta\text{AOT: } 0.1 \text{ a } 1.2 \rightarrow \Delta f_B: -20 \% \rightarrow \Delta \text{NEE: } +50 \%$

Effects of aerosols and clouds over NEE

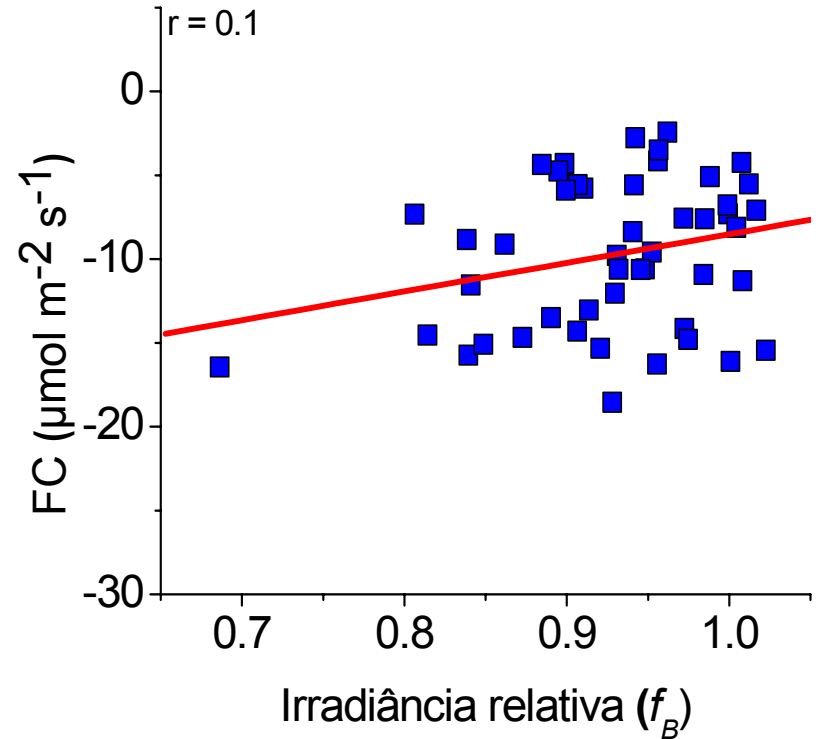
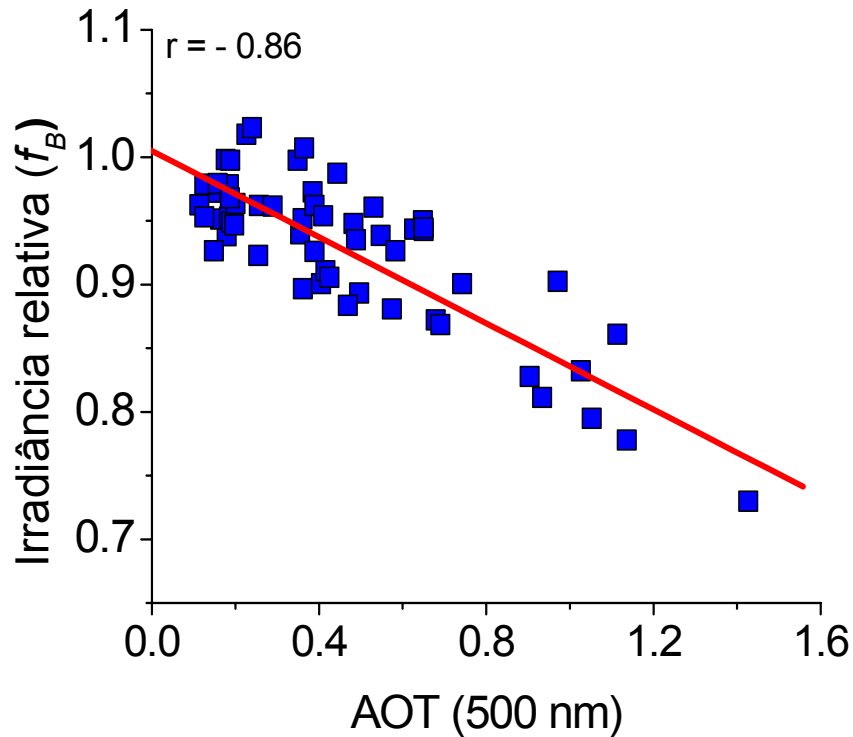
Rebio Jaru Forest area



NEE increases
to f_B values
around 0.7 or
 $\text{AOT} = 1.4$

Rondonia Fazenda Nossa Senhora Pasture

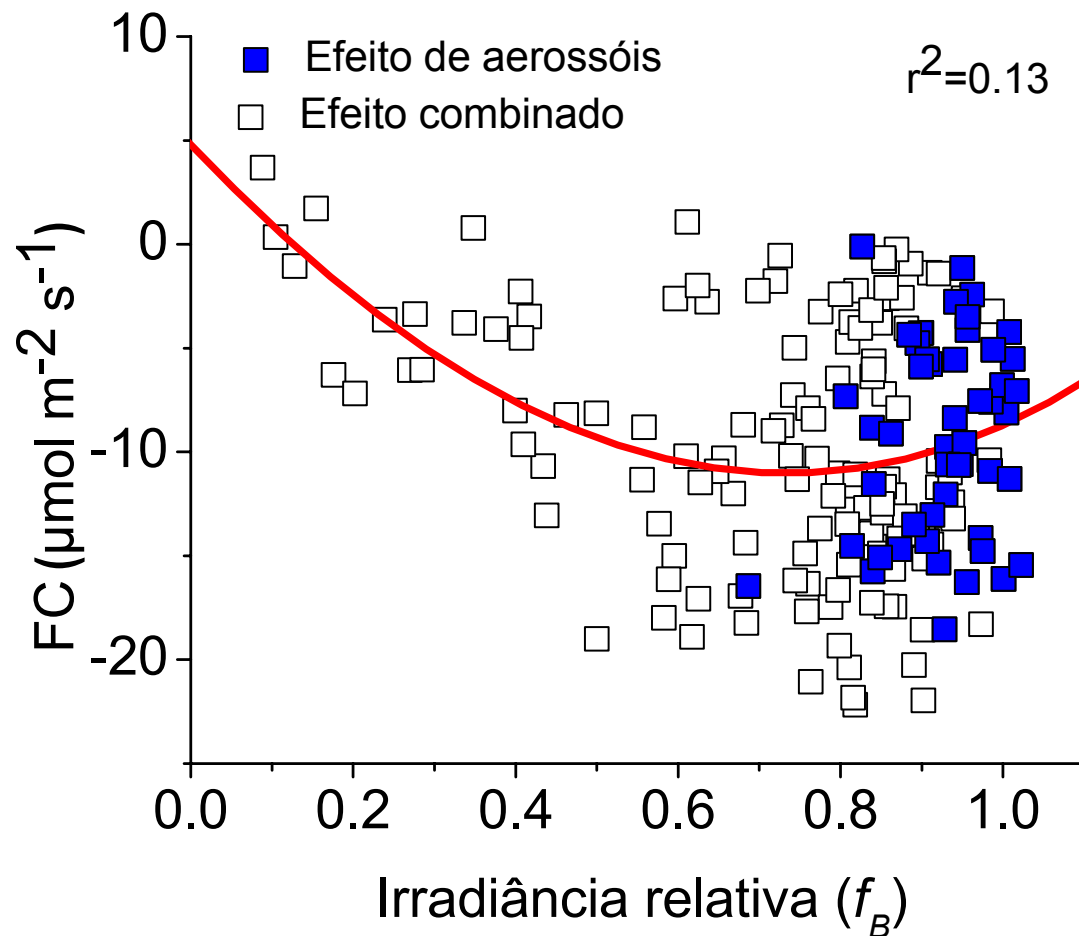
Carbon Flux (FC)



$\Delta\text{AOT: } 0.1 \text{ to } 1.2 \rightarrow \Delta f_B: -20\% \rightarrow \Delta\text{FC: NOT statistically significant}$

Effects of aerosols and clouds over NEE

Pasture area



It is NOT possible to observe increase in FC for f_B between 1.0 and 0.7



Conclusions

- N and C deposition is closely linked to land use changes
- N and C deposition is increasing in the tropics (more than predicted)
- Biomass burning is changing the pattern of organic acids
- *Changes in the main form of N deposition from NO_3^- to NH_4^+ (first data supporting this hypothesis)*
- Aerosols influence strongly the carbon fluxes in the Forest site in Rondonia, and maybe in other areas in Amazonia