Climate change in Amazonia caused by soybean cropland expansion, as compared to caused by pastureland expansion

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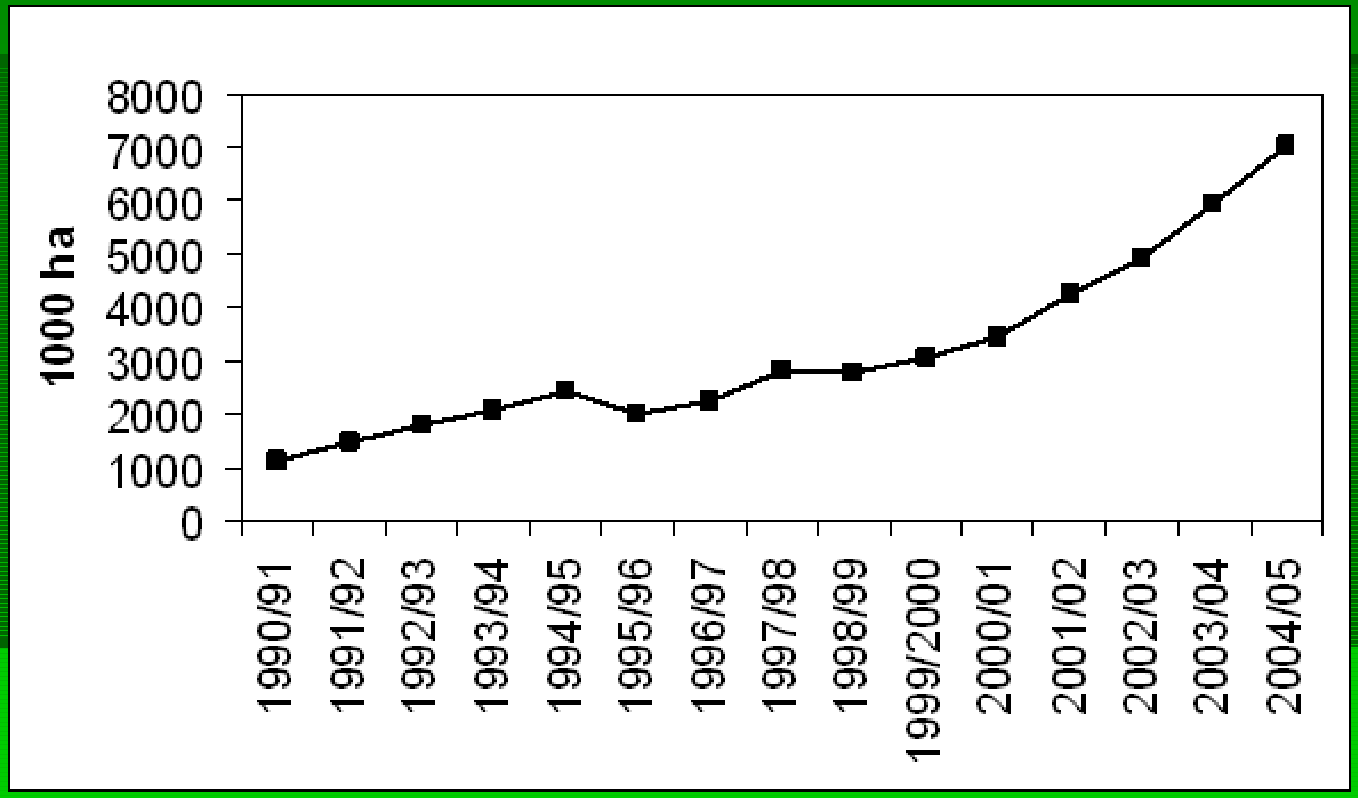
Introduction – Soybeans in Amazonia

- 2005: Brazilian Amazon deforestation = 560,000 km^2
- increasing at the average rate of 19,350 km^2 a year
- historically most of the changes in land cover are conversions from rainforest to pasturelands
- in recent years, the expansion of soybean croplands has been increasingly important in the agricultural growth in Amazonia

Introduction – Soybeans in Amazonia



Growth rate: 12.1% in the 1990s, 16.8% in the 2000s
Equivalent to 1/3 of agriculture land expansion in the 2000s

Introduction – Soybeans in Amazonia

- Area planted with soybeans decreased in 2006, but...
- Several factors may contribute to maintain the exponential expansion of soybean in Amazonia in the future:
  - improvements in infra-structure for soybean export (roads, harbors)
  - increasing demand for biofuels like biodiesel, which can be obtained from the soybean oil

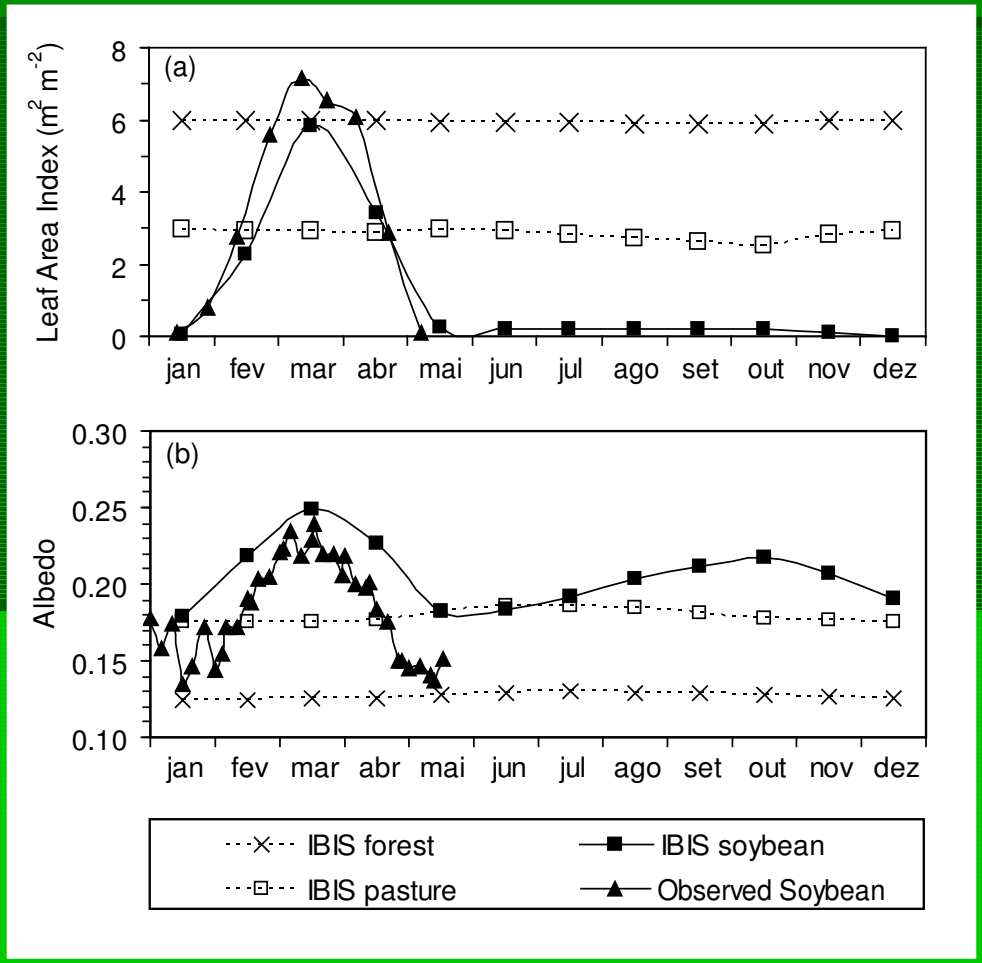
Objectives

- Climate change due to agricultural expansion in Amazonia have been studied by many scientists
- All studies considered a pastureland scenario
- This study investigates whether the climate change due to soybean cropland expansion would be any different than from the one due to pastureland expansion

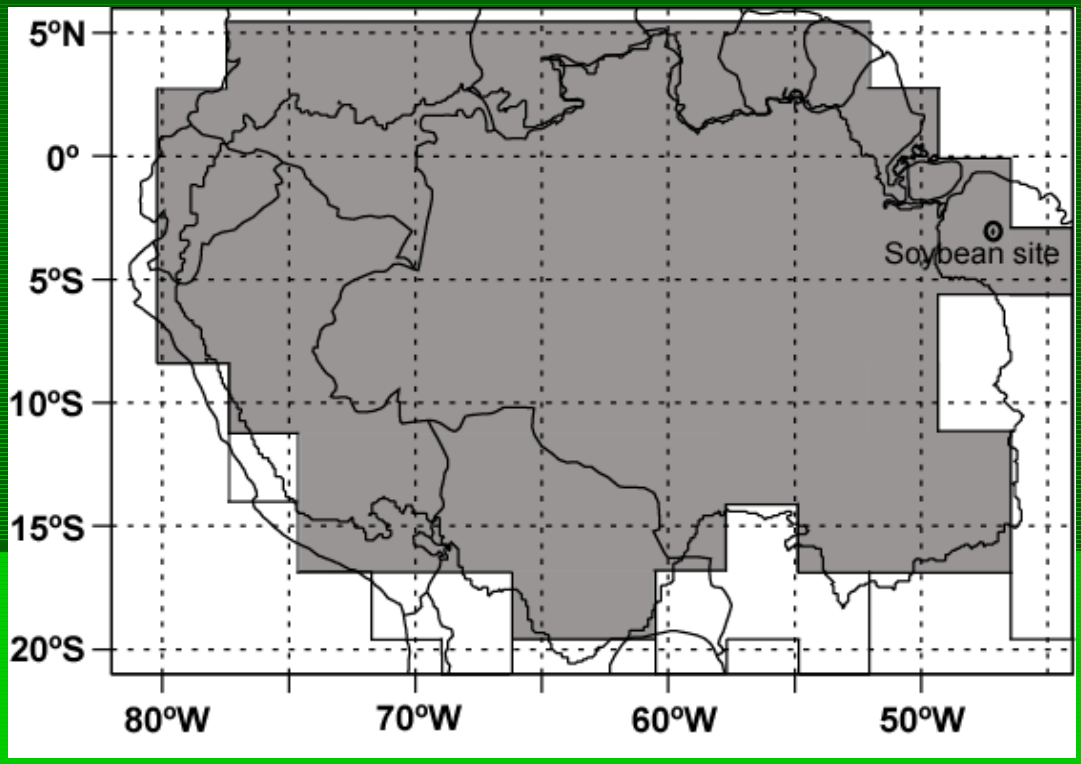
Methodology – model used

- Climate experiment using the NCAR CCM3 coupled to IBIS
- CCM3 at T42 L18 resolution
- IBIS calibrated against data from four LBA primary forest sites and one soybean site

Methodology – Land surface parameterizations



Methodology

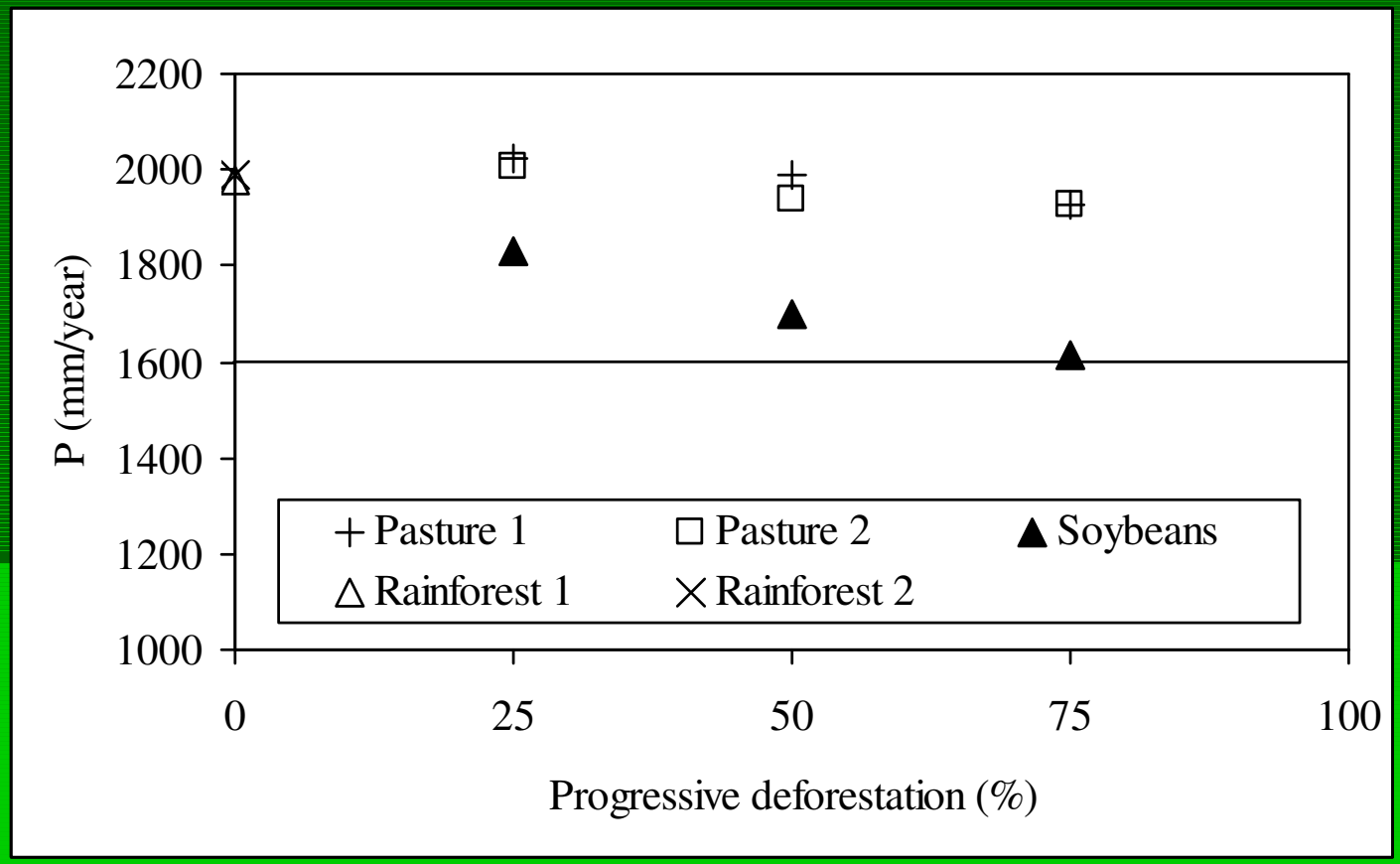


Classical, full deforestation experiment

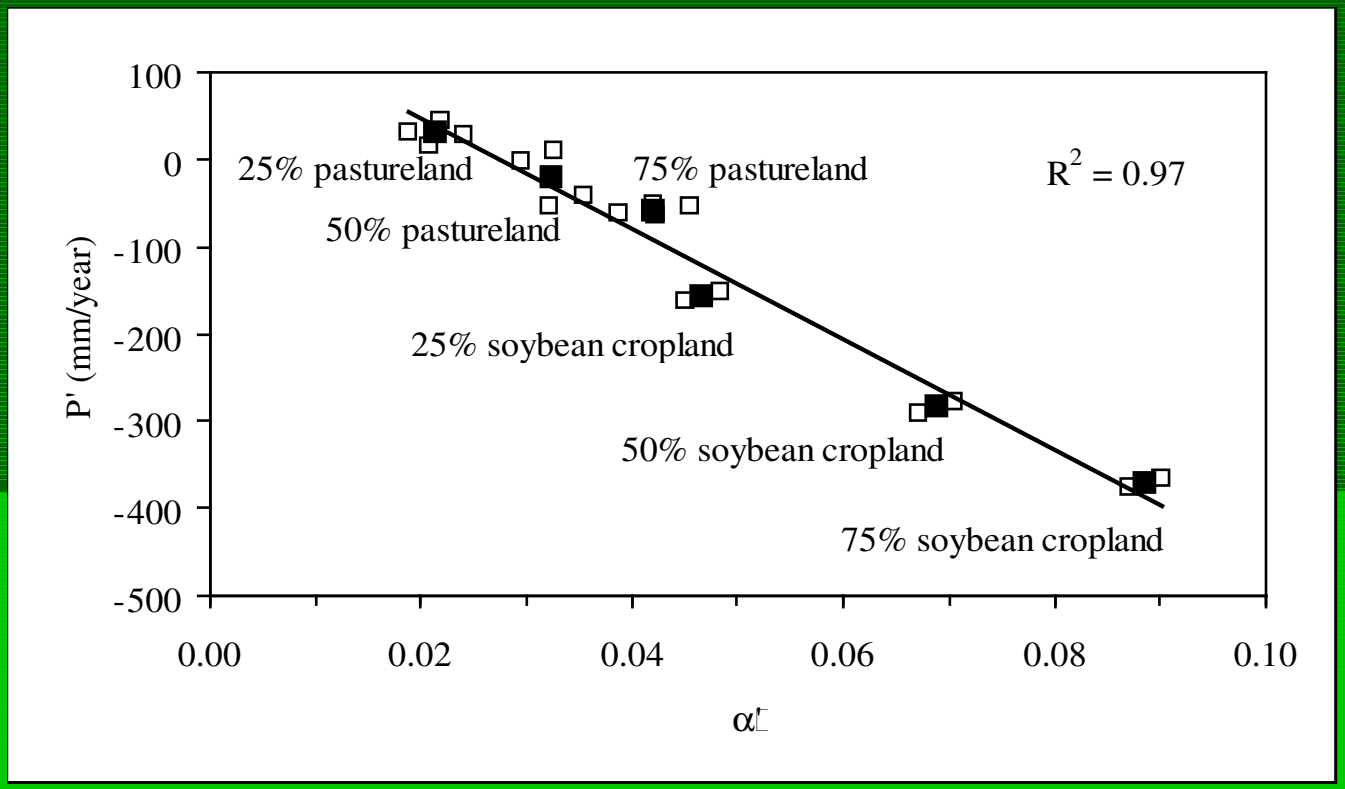
Methodology – experiment design

- Control run
  - 2 repetitions
- Pastureland expansion: 25%, 50%, 75%
  - 2 repetitions
- Soybean cropland expansion: 25%, 50%, 75%
  - 1 ensemble

Results


2200
2000
1800
1600
1400
1200
1000
P (mm/year)
0
25
50
75
100
Progressive deforestation (%)
Pasture 1
Pasture 2
Soybeans
Rainforest 1
Rainforest 2

Results


100
0
-100
-200
-300
-400
-500
P' (mm/year)
0.00
0.02
0.04
0.06
0.08
0.10
25% pastureland
50% pastureland
75% pastureland
25% soybean cropland
50% soybean cropland
75% soybean cropland
R2 = 0.97

Conclusions

- Precipitation change after a soybean expansion is much larger than after a pastureland expansion
- Difference must be attributed to soybean albedo – much higher than pastureland albedo
- We suggest studies at the state level