SOIL EMISSIONS OF NO, N_2O AND CO_2 UNDER DIFFERENT CROPS AND PASTURE IN THE CERRADO REGION

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Soil trace gases emissions

NO **N_2O** **CO_2**

- O_3 precursor and green-house effect
- Soil microbial production
- N oxides_ products of nitrification and denitrification
- Soil source may be similar in magnitude to fossil fuel emissions
- CO_2_ microbial and root respiration

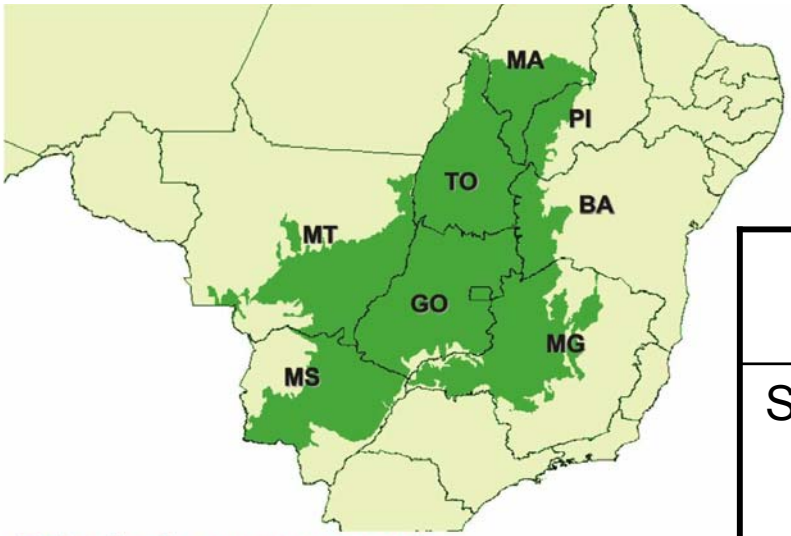
Factors that can influence emissions:

Soil N and C availability, moisture, texture and temperature

Agricultural management practices may alter these variables

Cerrado biome area (208 Million ha)

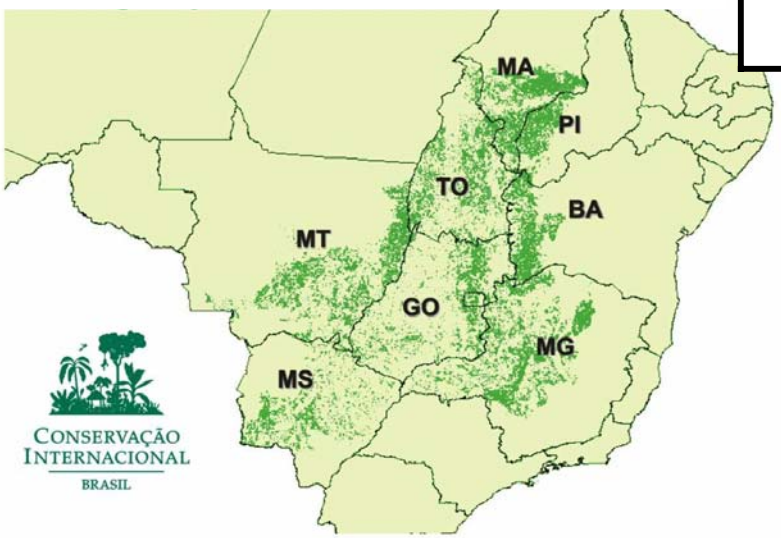
Original distribution of Cerrado vegetation

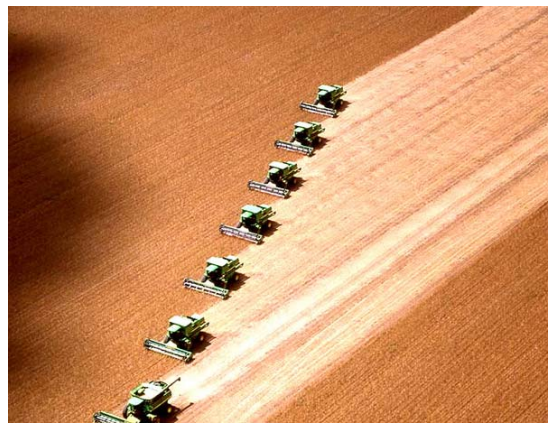


Pasture (100 million ha)
Crop areas (11 million ha)

Crop	Area (ha)	Prod (10^3 t)	Brazilian Prod (%)	Export (2004)
Soybean	6,960,722	57,028	48.6	1st
Corn	1,983,291	39,040	20.1	3rd
Bean	187,980	2,838	10.7	---
Cotton	476,472	2,233	73.9	8th

Remaining fragments (2002)

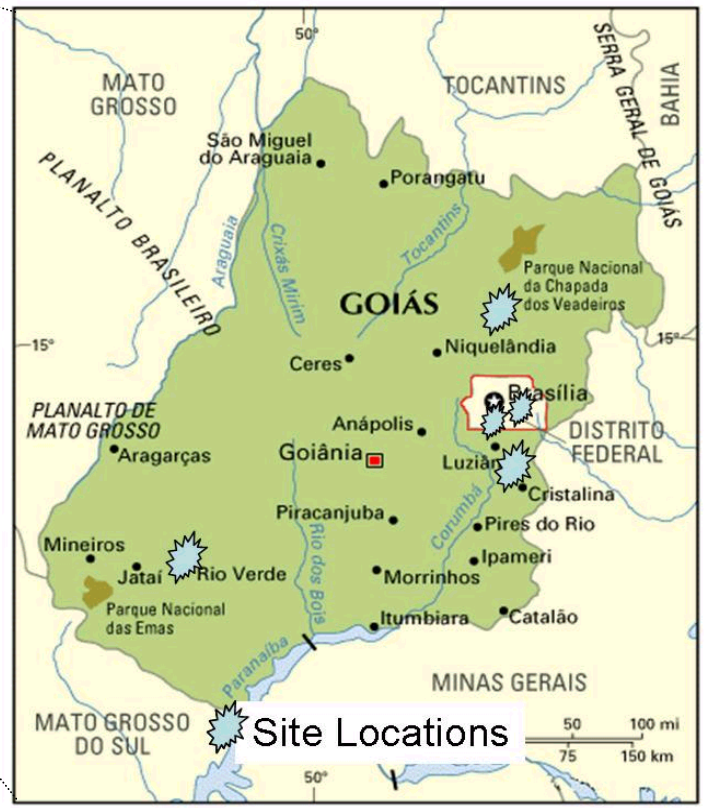




LBA 1st Phase (1999-2002)

*Native Cerrado *s.s.* and Campo sujo
(burned every 2 years, and unburned)

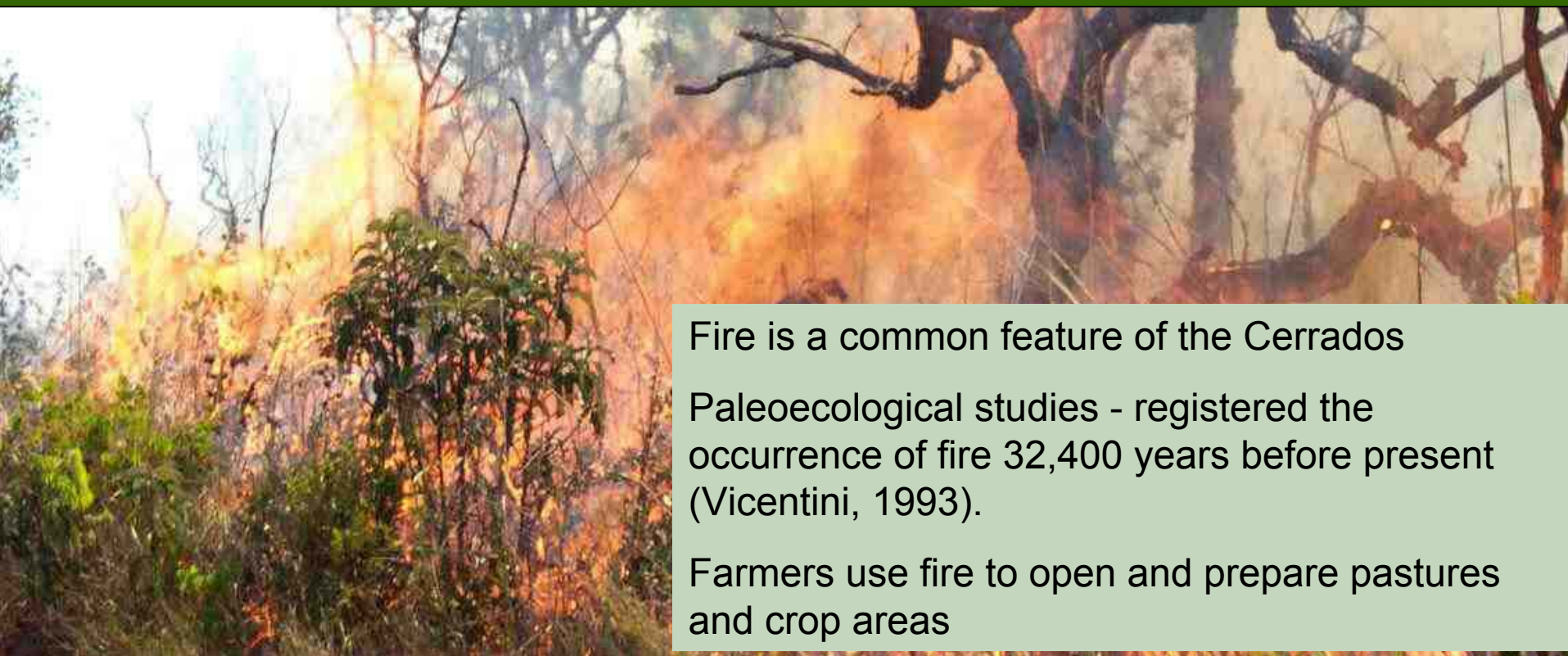
*Pastures (*Brachiaria brizantha*):
1.Degraded (9 year-old)
2.Young (2 year-old)
3.Fertilized (60 kg N ha^{-1})
4.Associated with legumes (*Stylosanthes*)



LBA 2nd Phase (2003-2005)

* Native Cerrado
* Crop areas: corn, bean, cotton
  (fertilized with N)
  Soybean (non-N fertilized)

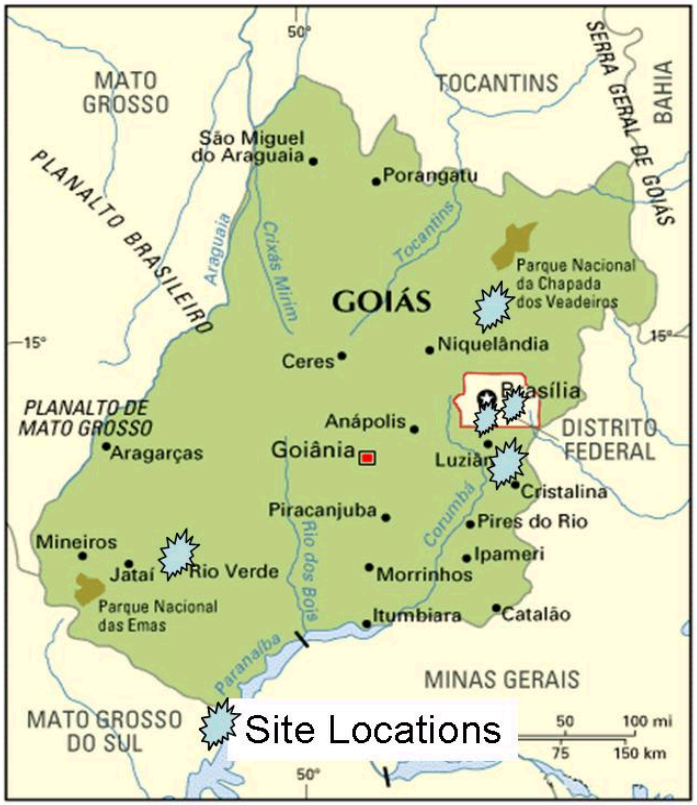
No-tillage since 1999



Fire is a common feature of the Cerrados

Paleoecological studies - registered the occurrence of fire 32,400 years before present (Vicentini, 1993).

Farmers use fire to open and prepare pastures and crop areas



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Measurement schedule

Pastures: Monthy – rainy season in 2001

Crops: Following farmer management
Just before and after sowing, fertilization events and harvest
Along the growing season independently of fertilization

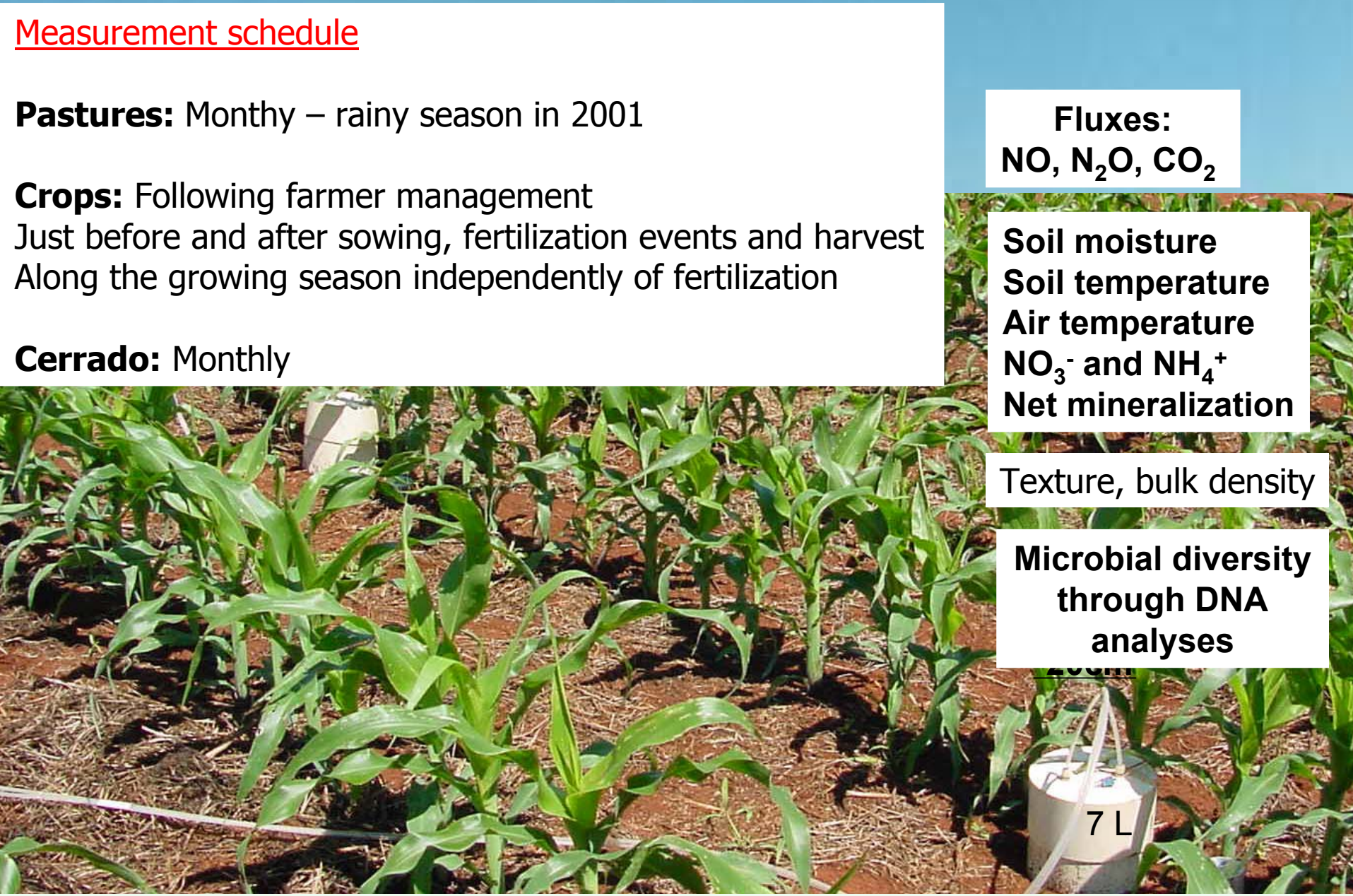
Cerrado: Monthly

Fluxes:
NO, N_2O, CO_2

Soil moisture
Soil temperature
Air temperature
NO_3^- and NH_4^+
Net mineralization

Texture, bulk density

Microbial diversity through DNA analyses

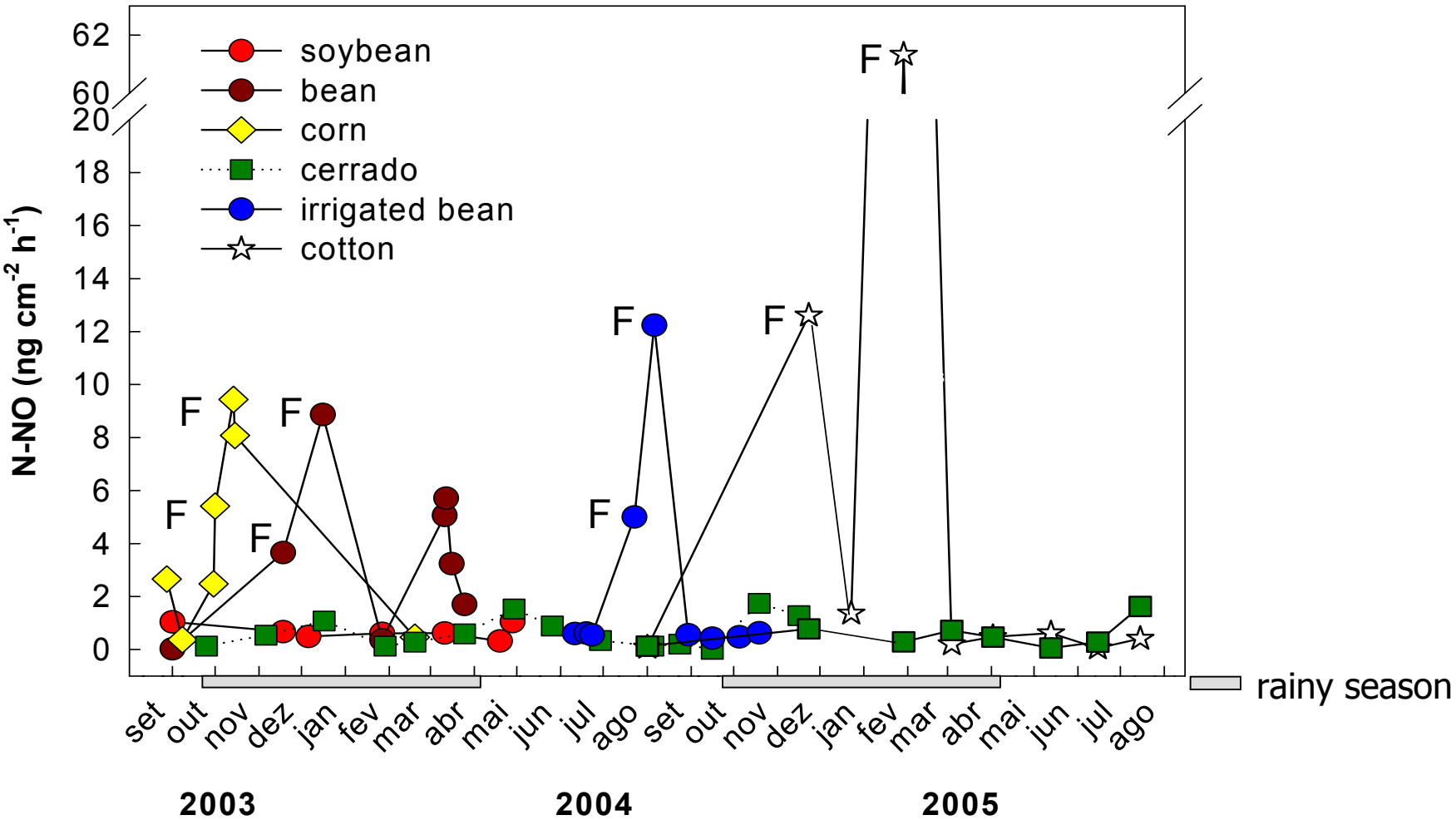


Contribution of the main kinds of land uses to the regional trace gas emissions

NO emissions

N-Fertilization (kg ha^{-1})
Corn – 76.6, 215.0
Irrigated bean – 46.0, 180.0
Cotton – 400.0, 200.0

F = fertilization



First approach for regional extrapolation...

Mean response to the fertilization * 5 days

+

Mean response to watering after a long dry period * 3 days (native Cerrado)

+

Monthly means of fluxes * number of days without any fertilization or watering

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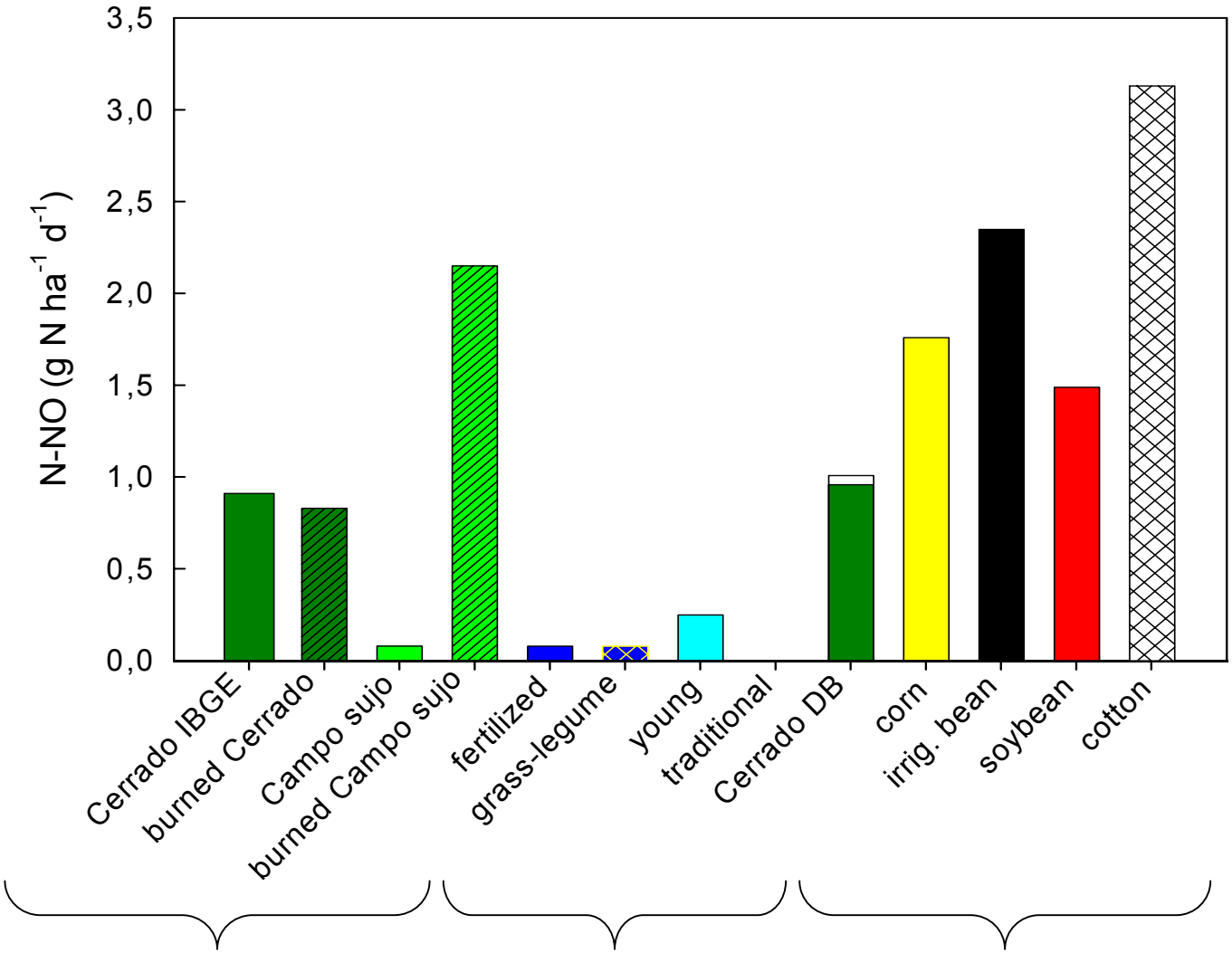
Days of crop period

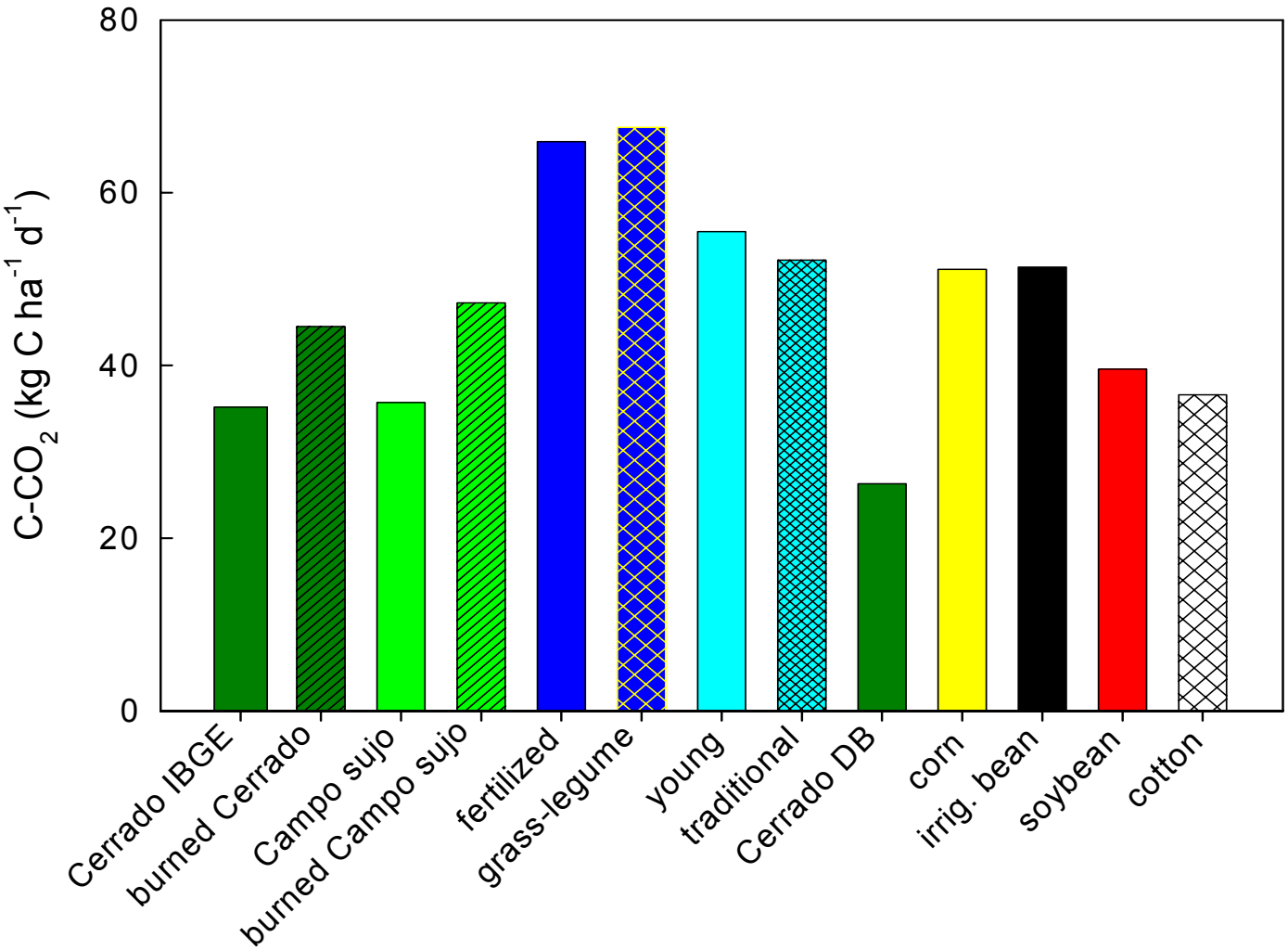
Mean daily fluxes for all studied areas

NO fluxes (g N ha^{-1} d^{-1})
rainy season, growth period



N_2O emissions from Cerrado soils are almost always under the detection limit.

CO_2 fluxes (kg C ha^{-1} d^{-1})



Estimation of soil NO emissions from crop areas in Central-Brazil (2003/2004)

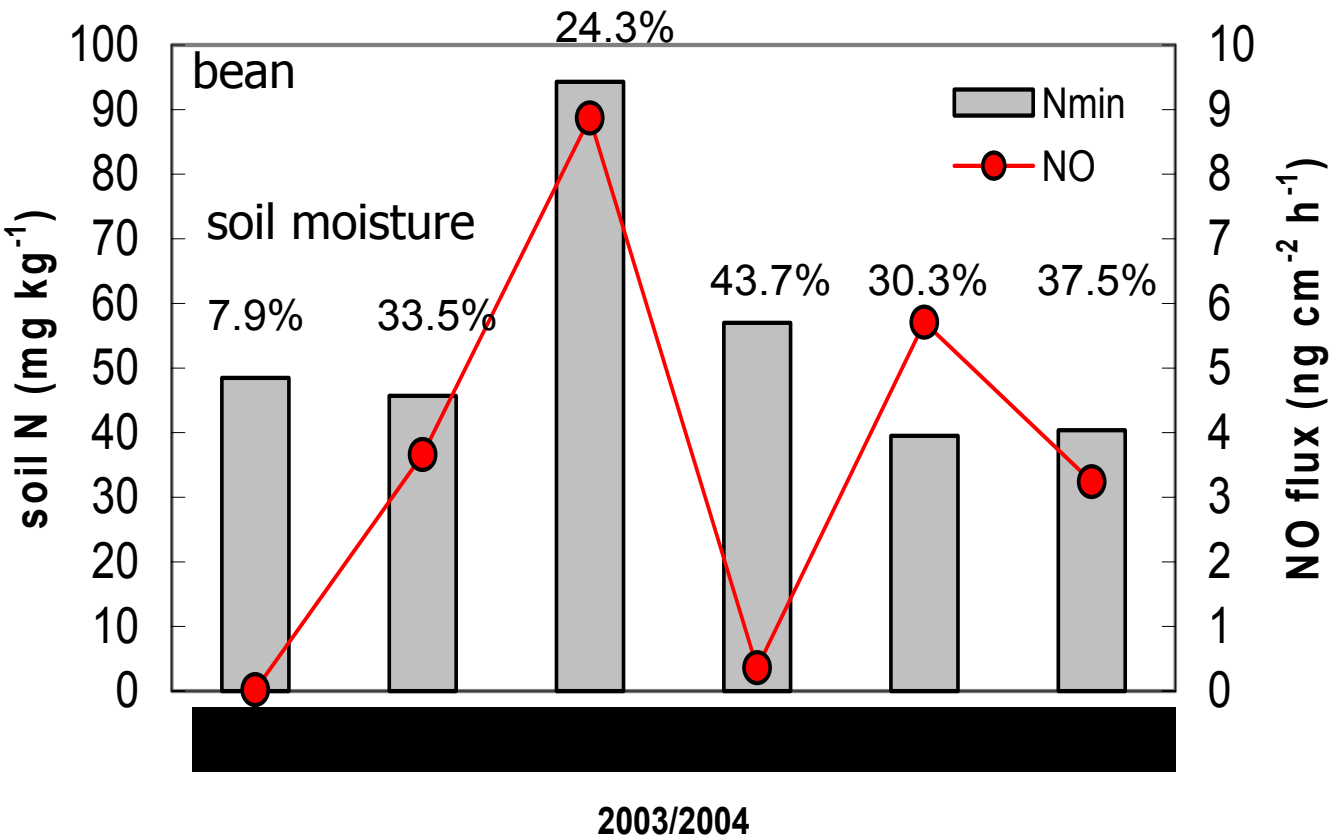
Crop	NO emission (kg N ha^{-1})	Crop period (days)	Planted area (ha)	NO emissions in Cerrado (Mg N $year^{-1}$)
Corn	0.30	173	1,983,291	595.0
Bean	0.32	135	187,980	60.2
Soybean	0.20	134	6,960,722	1,392.1
Cotton	0.81	258	476,472	385.9

Estimations...

- Based on monthly mean values of fluxes, only considering a five- or three-day effect of fertilization or watering.
- Daily, seasonal, annual variation on N-availability, soil temperature and humidity, compaction?
- Annual land cover change?

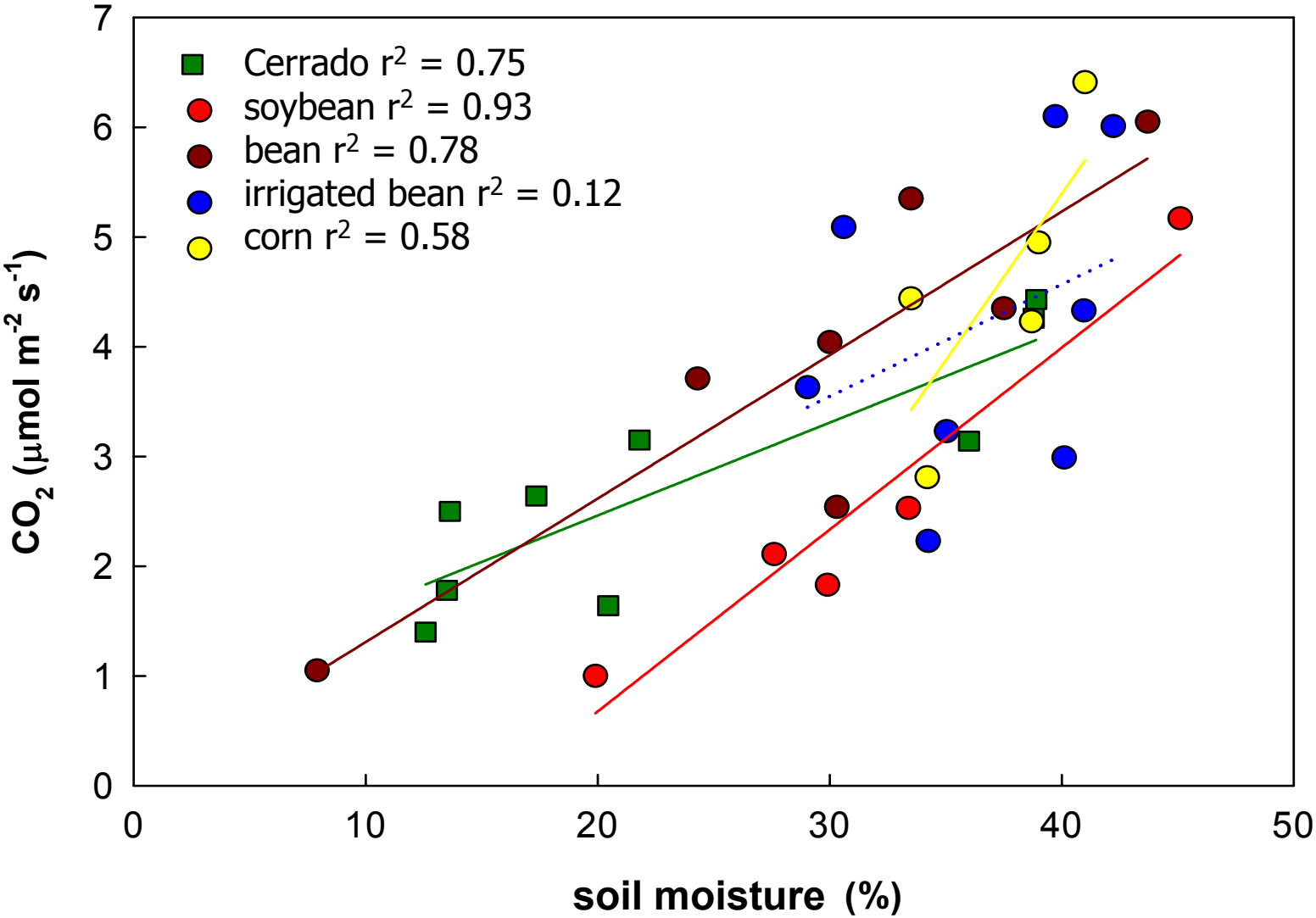
Soil N - availability

NO emission depends on multiple factors at the same time:

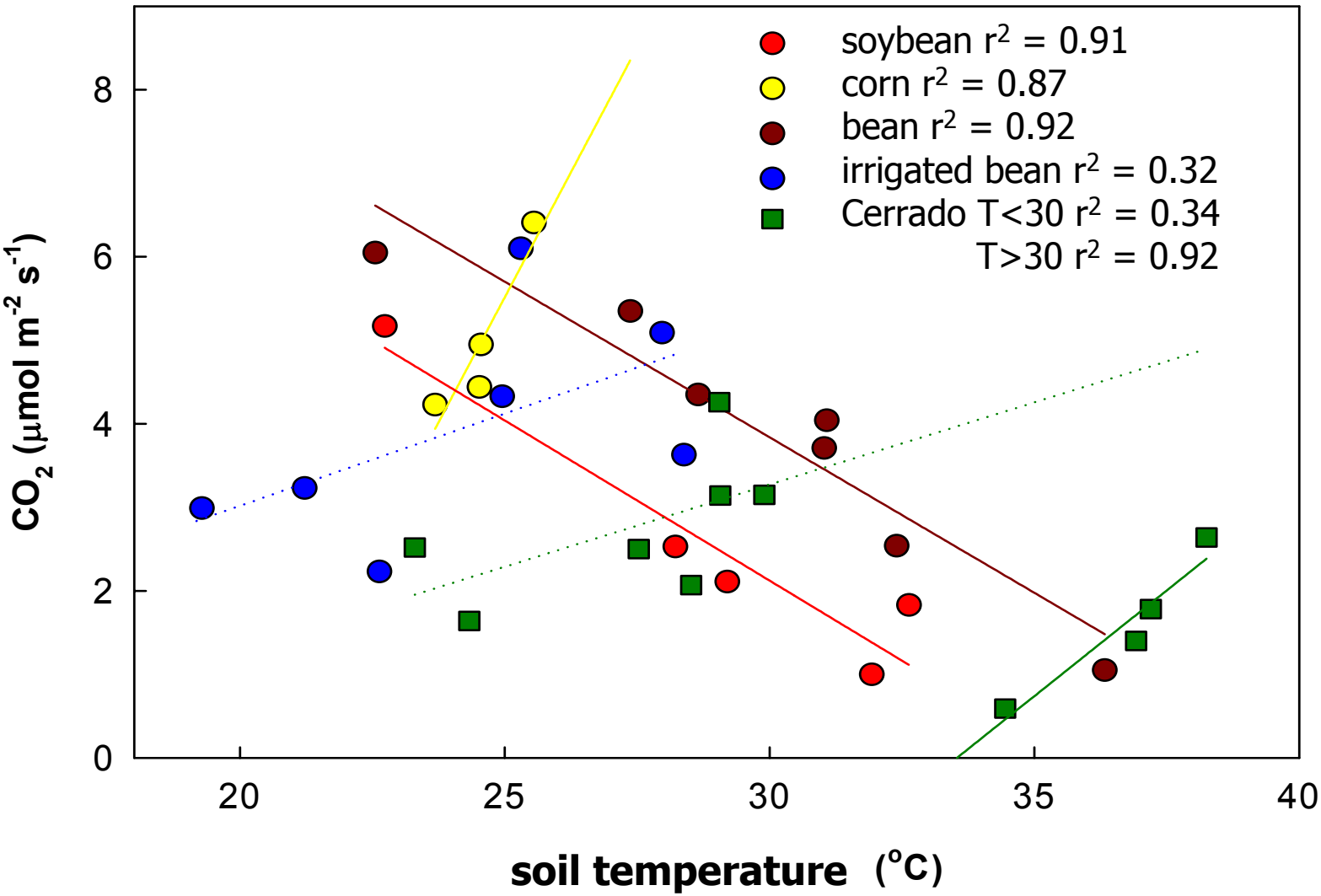


Soil N
Moisture
Temperature

CO_2 x soil moisture



CO_2 x soil temperature



Summary

- The replacement of native Cerrado vegetation by pastures and crop fields alters soil trace-gas emissions.
- Pastures soils tended to produce less NO but more CO_2 in comparison to native Cerrado and crops. Fire might lead to higher fluxes.
- The highest NO fluxes were found in the crop areas fertilized with N (corn, bean, cotton) in comparison to native Cerrado and pasture areas.
- Soybean - lowest NO and CO_2 fluxes (per ha) are compensated by the large planted area - higher regional NO emissions.
- There is a need for more complex models: combined effects of soil water content, temperature, N availability

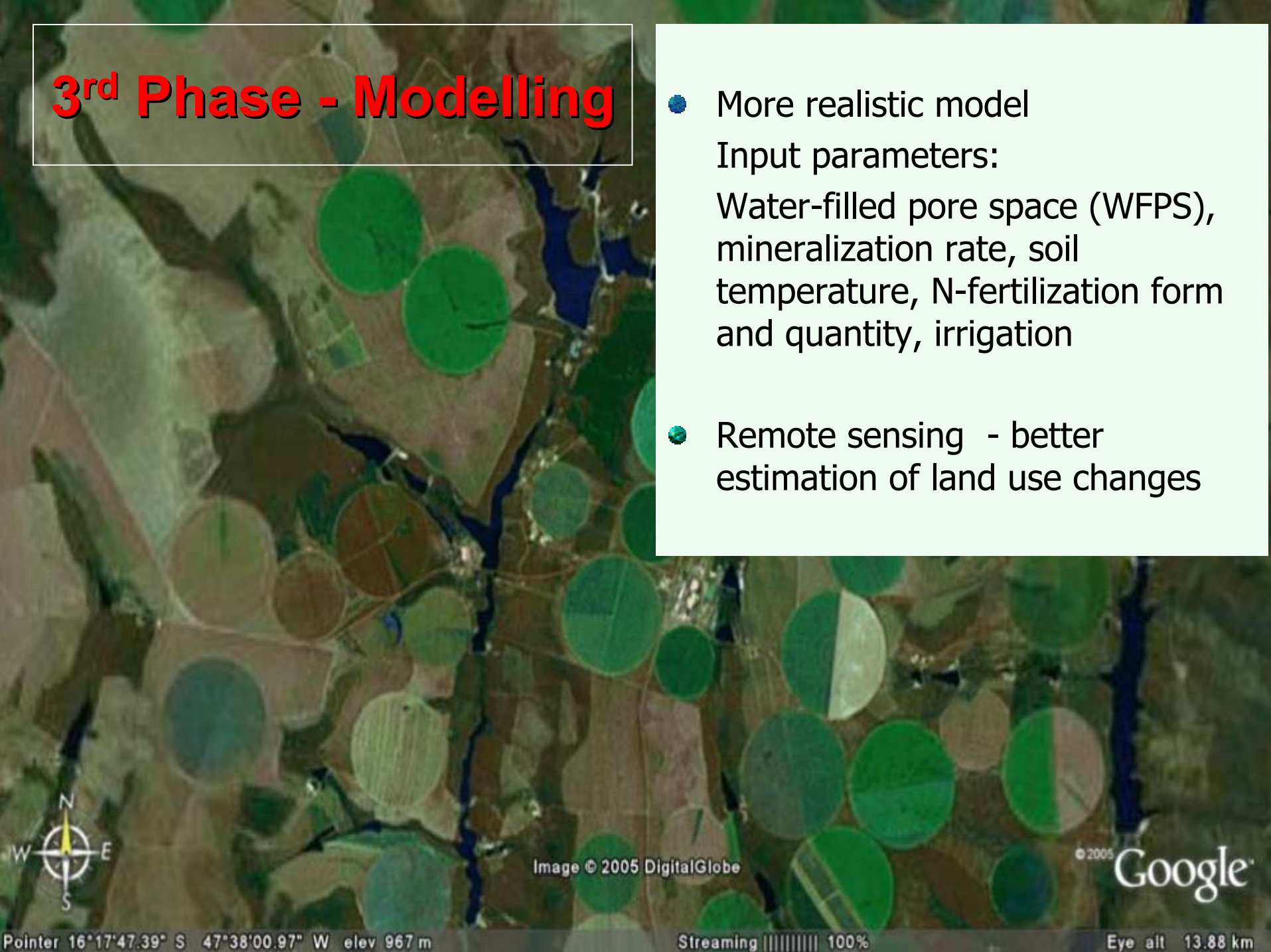
3rd Phase - Modelling

- More realistic model

  Input parameters:

  Water-filled pore space (WFPS), mineralization rate, soil temperature, N-fertilization form and quantity, irrigation

- Remote sensing - better estimation of land use changes



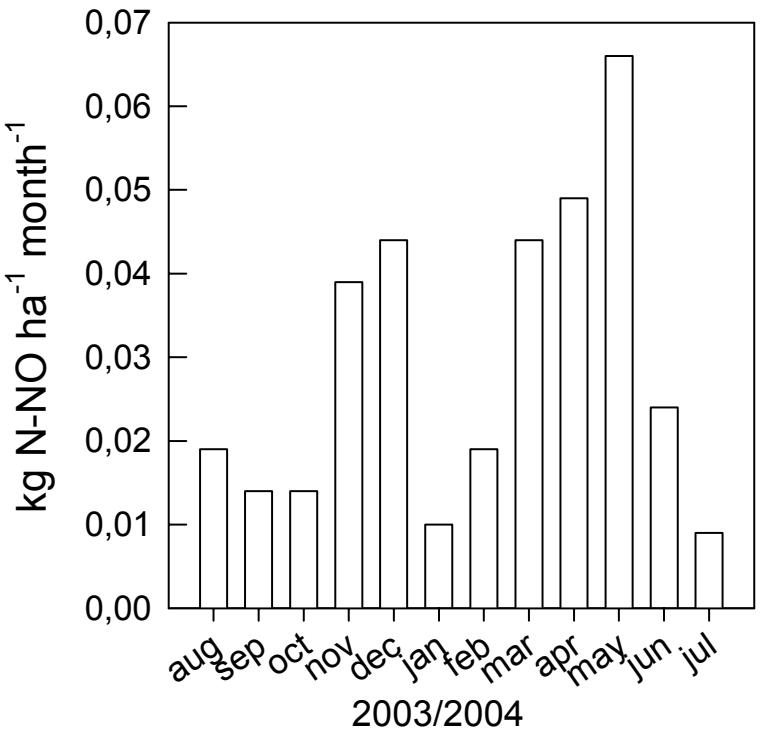

Unburned cerrado
1/24/2001

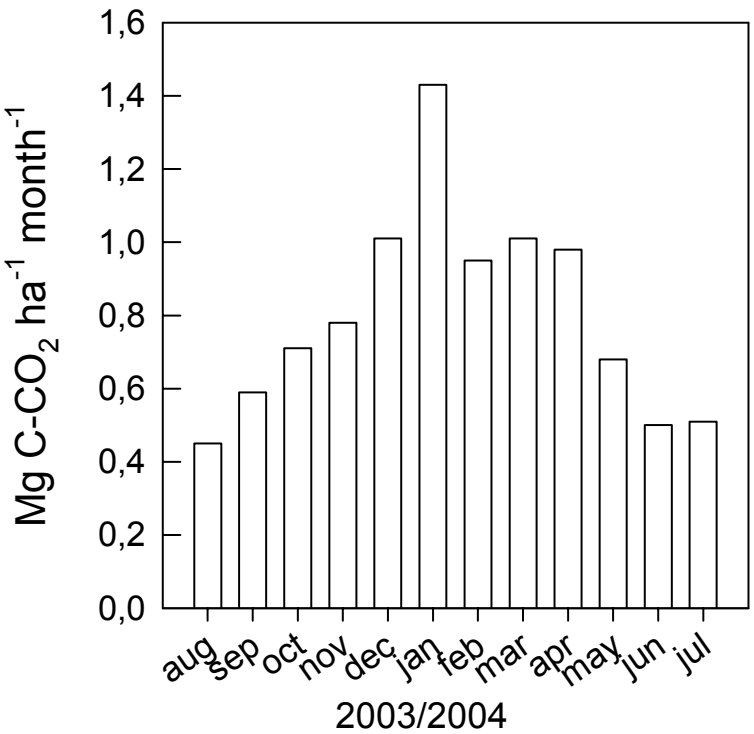

Burned cerrado


Unburned campo sujo
1/24/2001


Burned campo sujo

Monthly NO and CO_2 fluxes from native Cerrado soils






N
W
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S
Image © 2005 DigitalGlobe
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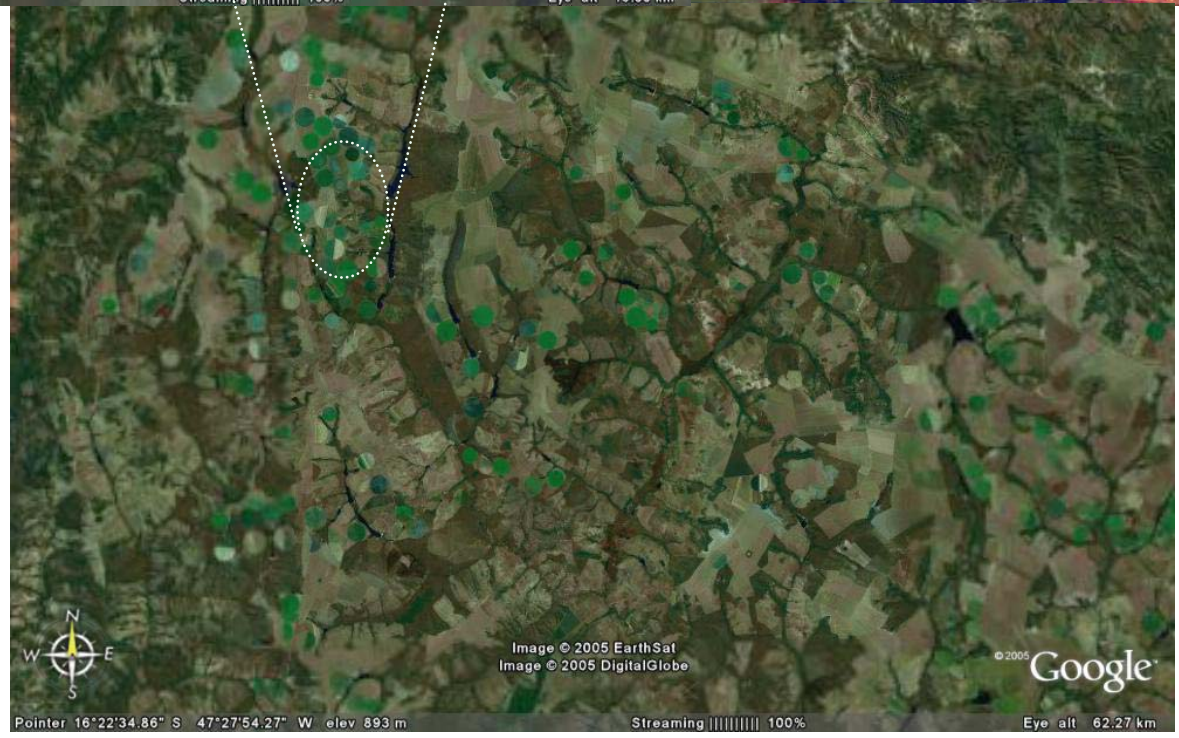
Pointer 16°17'47.39" S 47°38'00.97" W elev 967 m
Streaming 100%
Eye alt 13.88 km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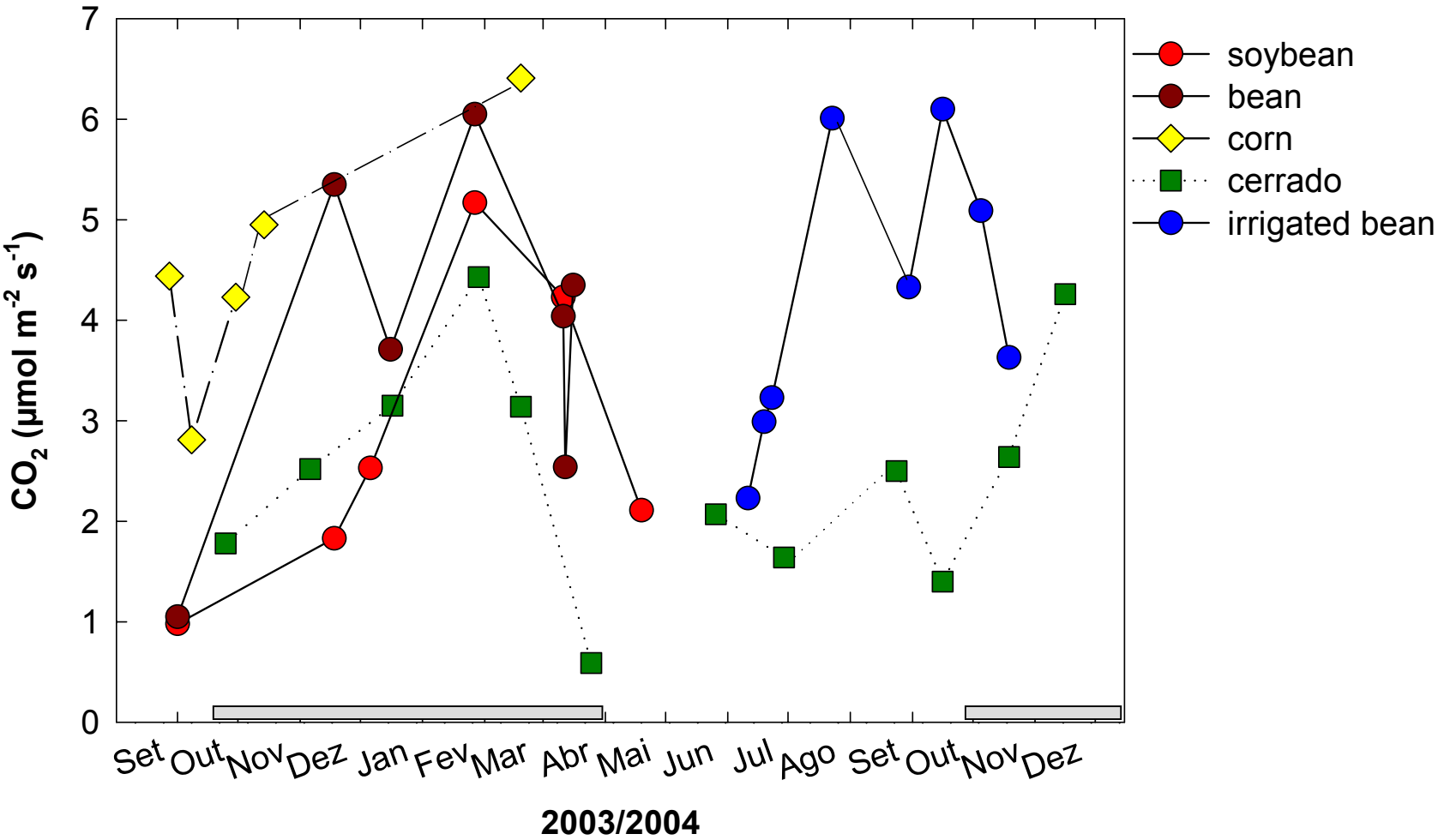
Pointer 16°22'34.86" S 47°27'54.27" W elev 893 m
Streaming 100%
Eye alt 62.27 km

Soil respiration



1st Phase

Native Cerrado and Campo Sujo – Reserva Ecológica do IBGE – Jan – Apr 2001

Pastures: Fazenda Rio de Janeiro - 9-year old pastures and one 2-year old

- Traditional
- Fertilized
- Grass-legume consorption
- Young

2nd Phase

Fazendas Dom Bosco, Plamplona and DoisJ1(2003-2005)

Native Cerrado

Conversion from native cerrado to crops and pasture in 1974

- Soybean: since 1977
- Bean: since 1999
- Corn: since 2000
- Cotton: since 2000

} *no-tillage (1999)*

- Corn, bean and cotton - fertilized with inorganic N
- Soybean - no N fertilization (efficient biological N-fixation)