

DRIVERS OF NITROUS OXIDE EMISSIONS UNDER CROPS AND NATURAL GRASSLANDS IN THE PAMPA REGION, ARGENTINA



Tomás Della Chiesa ^{1,2}, Laura Yahdjian ¹ y Gervasio Piñeiro ¹

1. Dept. Ecology, Agricultural Plant Physiology and Ecology Research Institute (IFEVA CONICET) School of Agronomy, University of Buenos Aires

2. Dept. Agricultural Climatology and Fenology, University of Buenos Aires

Corresponde tomasdc@agro.uba.ar



INTRODUCTION:

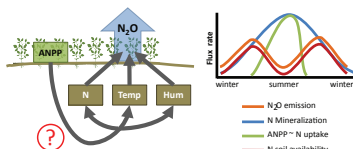
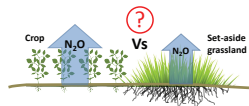
Nitrous oxide (N₂O) is the largest stratospheric ozone-depleting substance and one of the major greenhouse gases.

The main sources of N₂O from terrestrial ecosystems are soils under natural vegetation and arable lands.

Soil temperature, water filled pores space and inorganic nitrogen are well known drivers of N₂O emissions. However, vegetation productivity, which is closely related to these factors has received less attention.

The questions that guided our work were:

- Do soils under commercial crops release more N₂O than natural ecosystems set aside?
- Is Aboveground Net Primary Productivity (ANPP) an important driver of soil N₂O emissions?



MATERIALS & METHODS:

We performed an in situ manipulative experiment to estimate N₂O emissions from different land covers in 2 contrasting sites.

Methodology: static non-steady state chambers

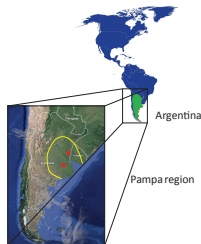
Response variables:

Soil temperature (0-10 cm)
NO₃- and NH₄⁺ content (0-10 cm)

N₂O emissions
WFPS (0-10 cm)

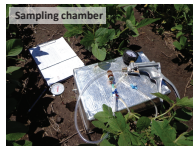
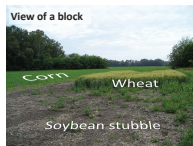
NDVI as a proxy of ANPP

STUDY SITE

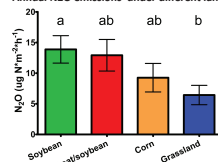


"Guaqueyachú" – Littoral Pampas
33,34°S; 58,70° W.
MAP=1070 mm – MAT= 17°
Soil: Aquic Argiudolls

"Carlos Casares" – Inland Pampas
33,94° S; 60,56°W.
MAP=997 mm – MAT= 15°
Soil: Thapto argic Hapludolls

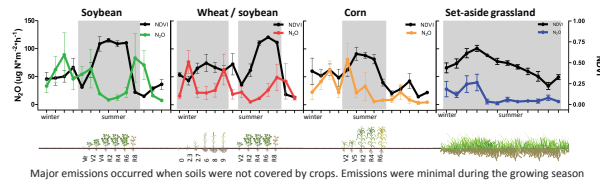


Annual N₂O emissions under different land uses

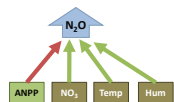


Soybean crops emitted significantly more N₂O than natural grasslands. Corn and wheat/soybean crops showed intermediate emissions.

Mean soil N₂O emission under different land uses including both study sites and all sampling dates analyzed with mixed effect models



Major emissions occurred when soils were not covered by crops. Emissions were minimal during the growing season



	NO ₂	Hum	Temp	NDVI	AIC
1 variable	1.75				4030
2 variable	1.42	0.37			4027
3 variable	1.82	0.48	0.48		4021
4 variable	1.74	0.52	0.80	-20.85	4009

Multiple regressions using mixed models showed that NDVI was negatively related with N₂O emissions in crop soils and enhance the N₂O models predictability.

CONCLUSIONS:

- N₂O emissions from natural ecosystems are not negligible compared with cropland emissions, so they need to be considered as a baseline for estimating anthropogenic emissions.

- Among the main crops produced in the Pampas region, soybean showed the highest emissions. Since soybean crops are not fertilized with nitrogen in this region, our results are probably related with the role of biological nitrogen fixation as a source of reactive nitrogen for N₂O production.

- Soil humidity, inorganic nitrogen content, and soil temperature were important drivers controlling N₂O emissions. In addition, net primary productivity was also a strong indirect driver, and therefore has the potential to be used to estimate N₂O emissions from large regions using satellite NDVI time series.

