Land use effects on C-N-and P stocks and greenhouse gas fluxes in agroecosystems in southern Chile

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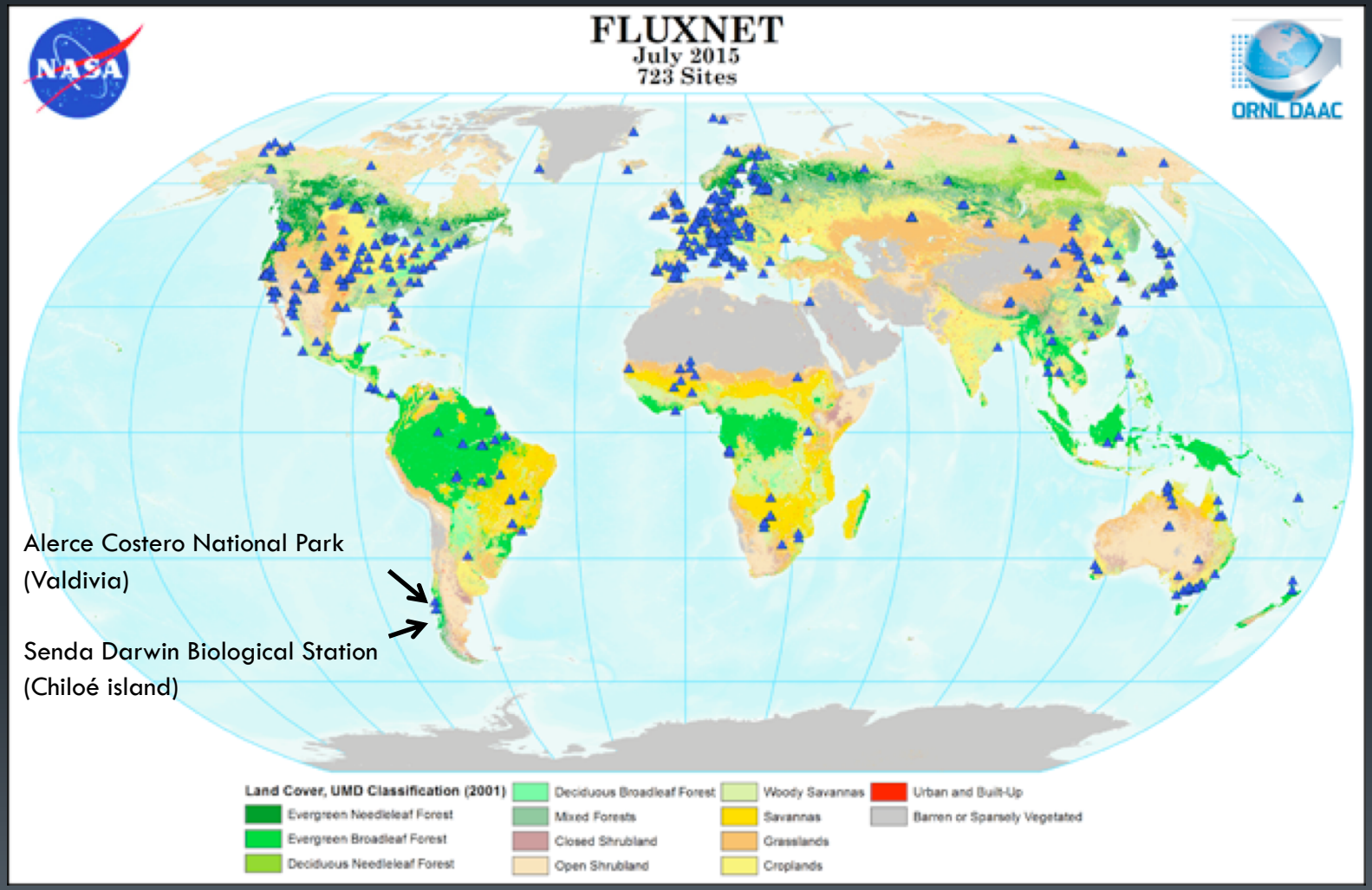
Introduction

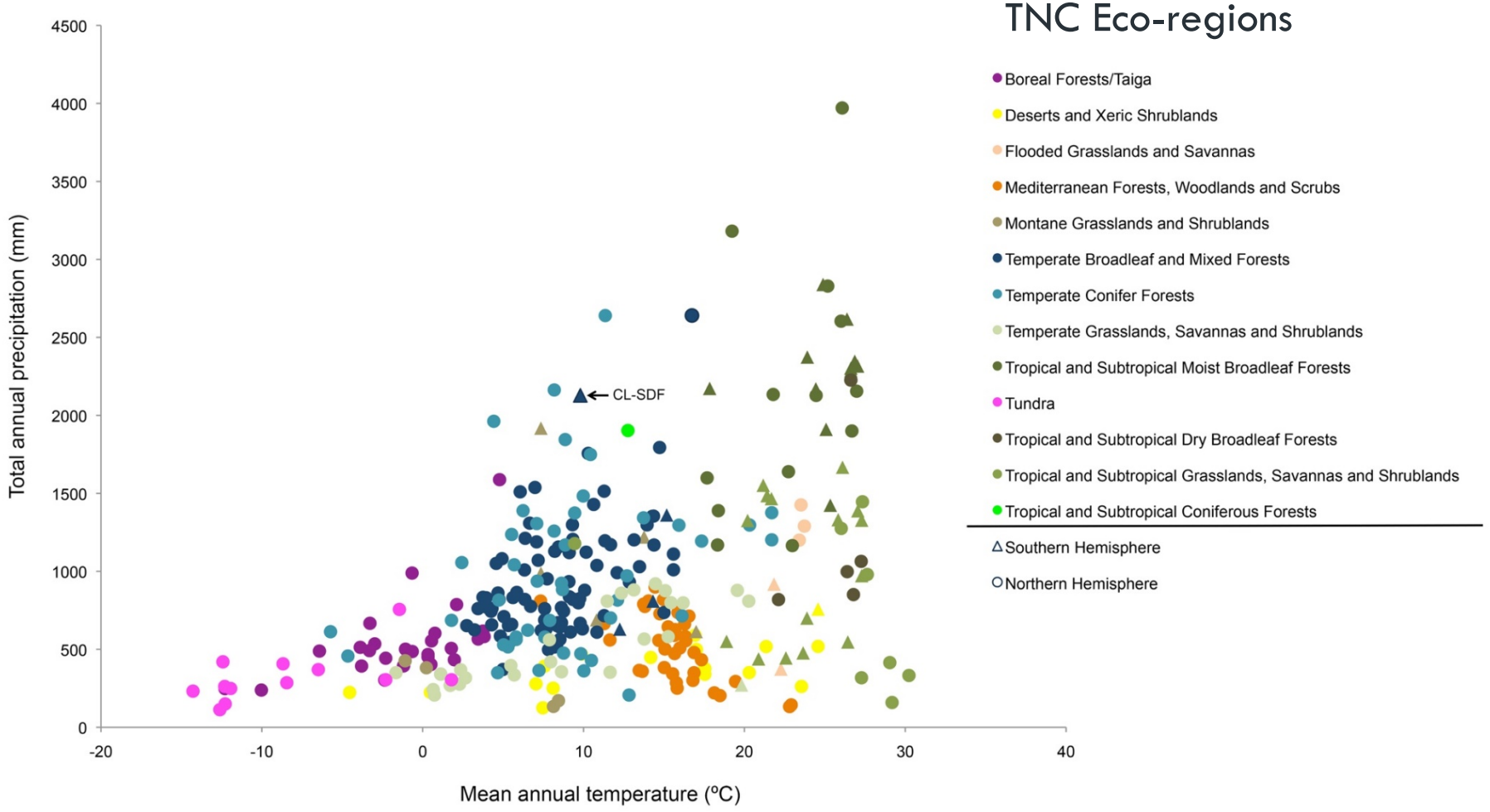
- Agricultural and animal production are normally considered activities that degrade soils and are sources of greenhouse gases (GHG), such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O).

- In southern Chile, one of the sites where GHG are being monitored is located at Chiloé island, where native forests are being replaced by agricultural lands.

Flux monitoring sites in Chile



Senda Darwin Forest (CL-SDF)



Source: www.fluxnet.ornl.gov

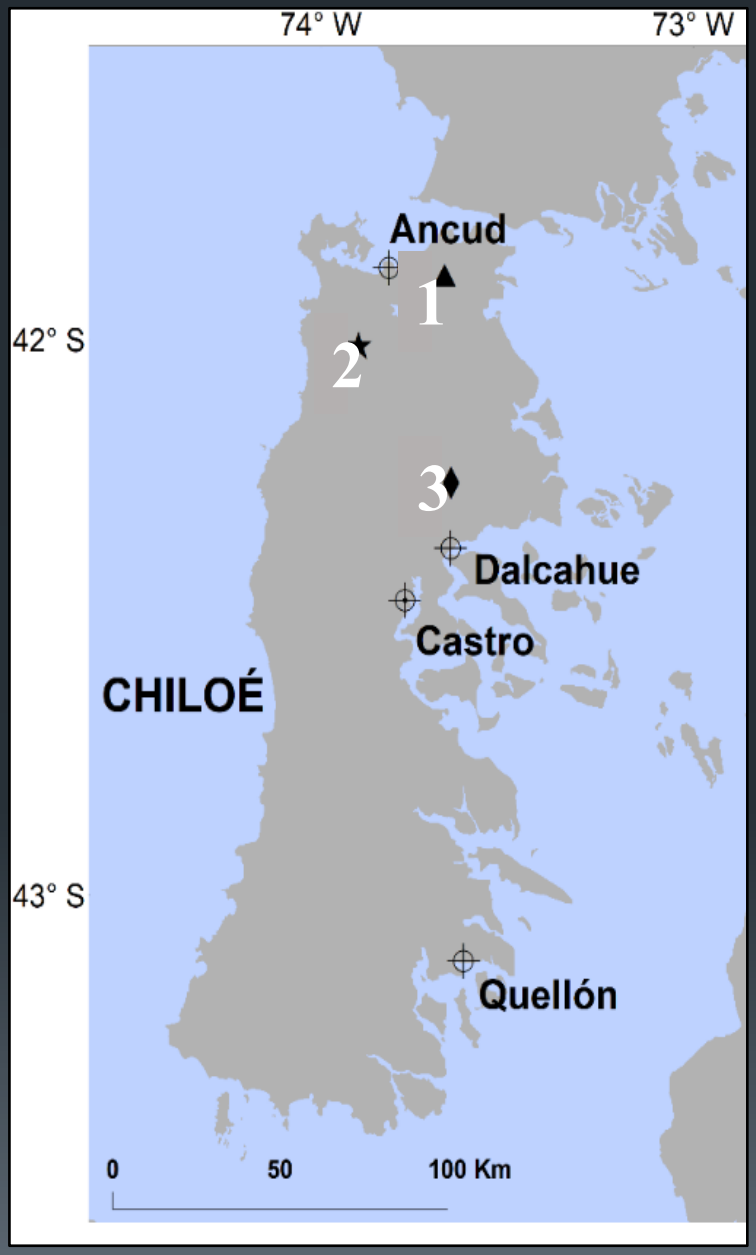
Perez-Quezada et al. (2018)

Objectives

- Estimate the C-N-P stocks of the most relevant agroecosystems in northern Chiloé island (croplands, grasslands, native shrublands and invasive shrublands)

- Estimate the GHG balance (CO_2, CH_4 and N_2O) in all four agroecosystem types

Most common agroecosystems



Three true replicates (locations) of all four agroecosystem types

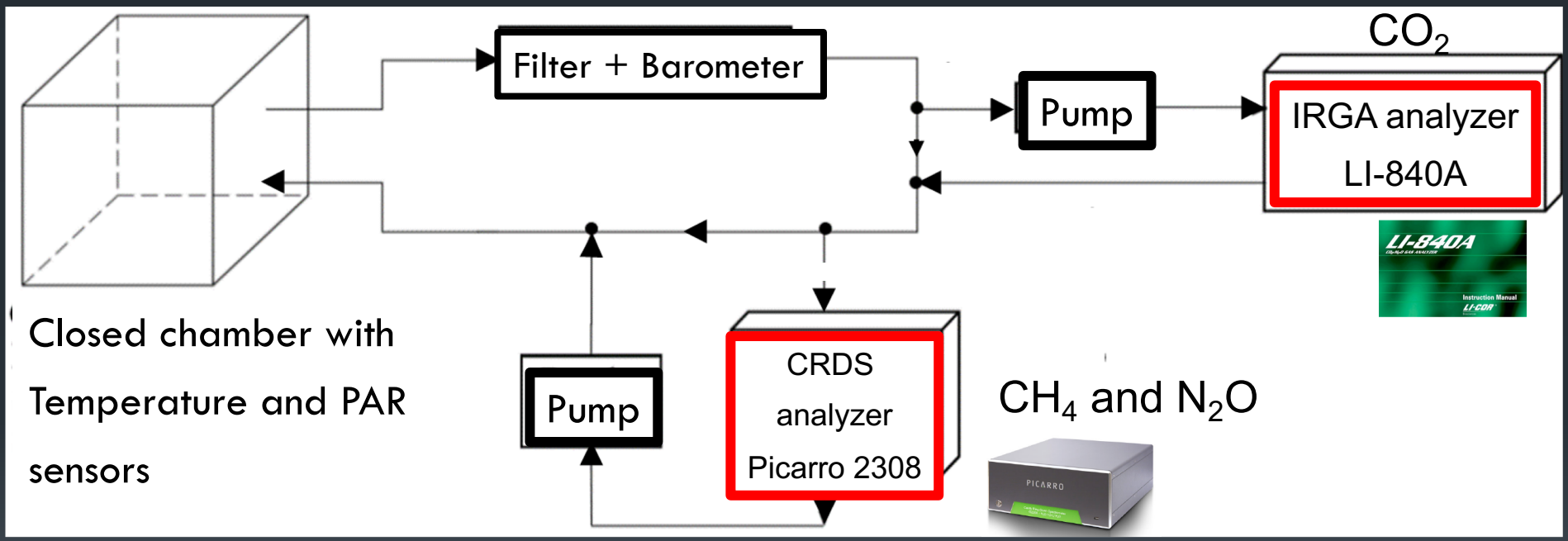
LOCATIONS:

L1: Senda Darwin

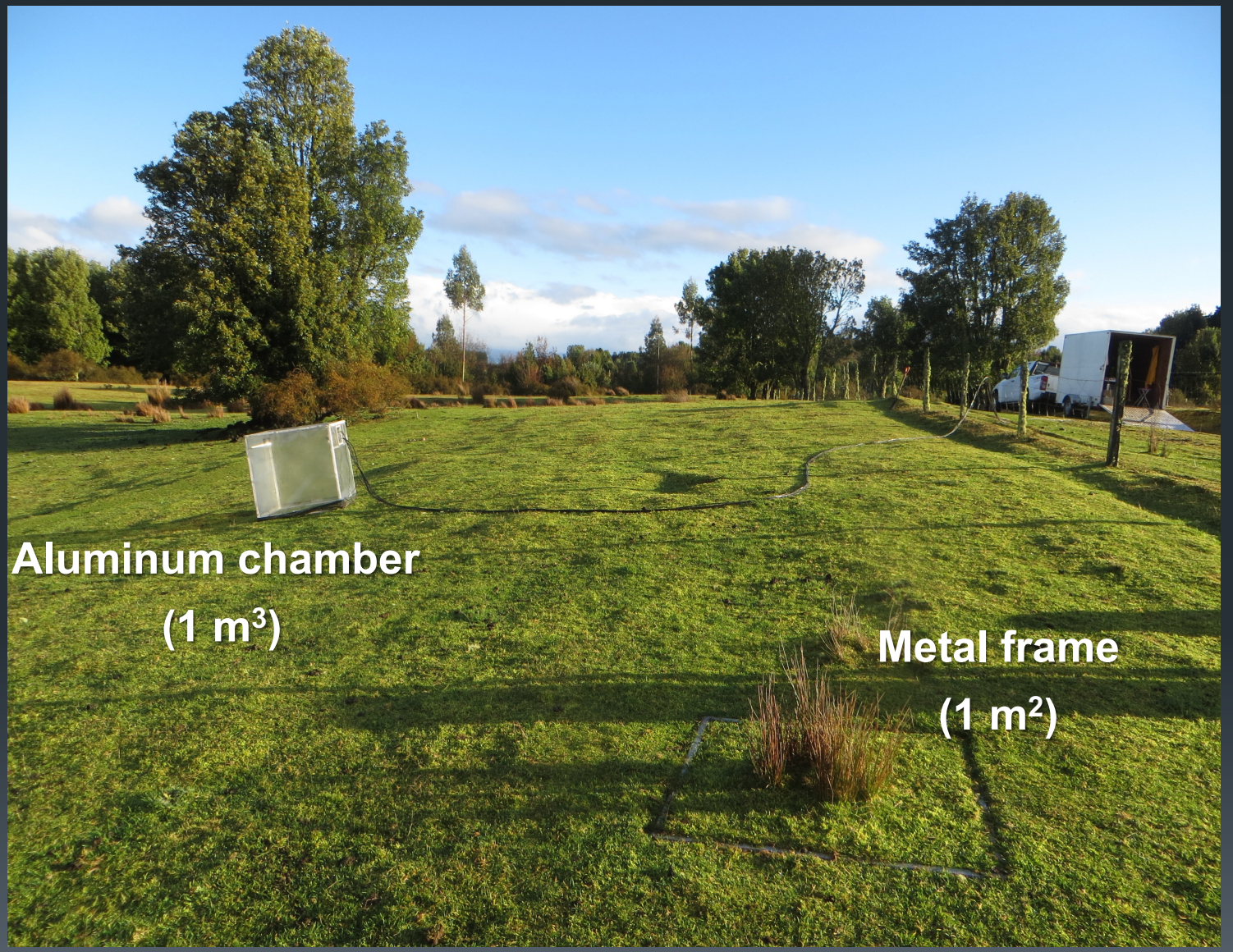
L2: Coipomó

L3: Butalcura

System for measuring GHGs



Mobile monitoring system



Mobile monitoring system

C-N-P stocks

Total stock (soil and biomass) of C, N, P (mean ± standard error) in agroecosystems of northern Chiloé island (Chile).

Stock	Agroecosystems				Forest*
	Crop (CR)	Invaded shrubland (IS)	Native shrubland (NS)	Grassland (GR)	
	---------- kg m^{-2} ----------				
C	43,85 ± 2,5	39,40 ± 6,6	50,53± 4,32	41,9 ± 2,36	106,2 ± 5,8
N	2,84 ± 0,07	1,66± 0,31	2,96 ± 0,54	2,76 ± 0,16	2,88 ± 0,15
P	0,49 ± 0,05	0,30 ± 0,02	0,39 ± 0,12	0,51 ± 0,08	0,0347 ± 0,08

*(Perez-Quezada *et al.*, Unpublished results).

- Larger total stocks of C and N were found at the NS sites,
- The larger stock of P was observed at the GR sites,
- Total ecosystem stocks showed no significant differences among agroecosystems, but differed from values reported for a native forest in Chiloé.

GHG balance in agroecosystems

Agroecosystem	CO_2	CH_4	N_2O	GHG BALANCE
	g CO_2-eq m^{-2} $año^{-1}$			
Cropland	374,0	5,0	8,9	388,1
Grasslands	-1248,5	5,6	-4,9	-1247,9
Native shrubland	-1090,3	-1,6	-5,0	-1097,0
Invaded shrubland	-1932,2	10,4	-6,5	-1928,3

Conclusions

- Compared to a native forest, agroecosystems represent a significant loss in C (58.6%) and N (11.1%) stocks in the agroecosystems, while the P stock increased by 92%.

- As net sources of CO_2 acted the CR sites; net sources of CH_4 were the CR, GR and IS sites; and net sources of N_2O were the CR sites. The GHG balance showed that the CR sites behaved as a net source, while GR, NS and IS acted as sinks.

- This indicates that croplands could make an important contribution to local and regional GHG emissions.

- In a wider context, these results indicate that the regulation of land use conversions for agricultural use might be an effective tool to combat climate change, potentially reducing GHG emissions.

Acknowledgements

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