CH4 and N2O emission from cattle in a semi natural grassland.

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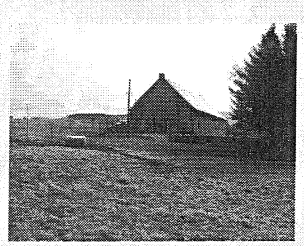
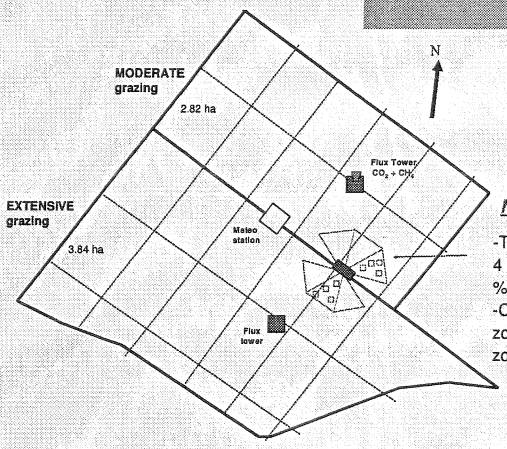
CarboEurope IP site Laqueuille(France)

- Semi-natural grassland site of 6.65 ha at 1040m a.s.l.
- Basaltic bedrock at depths from 35 to 80 cm, Andosol (16% clay, 56% silt, 28% sand)
- Mean annual precipitation 1200 mm
- Mean annual temperature 8 C° (mini 0.7 C in January and a maximum of 14.8 C° in August)
- Frost 115 days per year
- Land use: start of the 20th century with arable crops and convertion to grassland 55 years ago. The past 30 years mowing/cattle grazing with organic fertiliser application.
- Since spring 2002, the experimental field is subdivided and CO2 is mesured continuously by eddy covariance method..
- Management: grazing from May and October Holstein-Friesian heifers with
  - -moderate stocking rate: 1.2 live stock unit $ha^{-1}yr^{-1}$ (LSU) and annual fertilizer application of 175kg N $ha^{-1}yr^{-1}$
  - -extensive stocking rate: 0.5 LSU, no fertilizer application

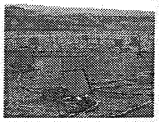
Experimental Setup

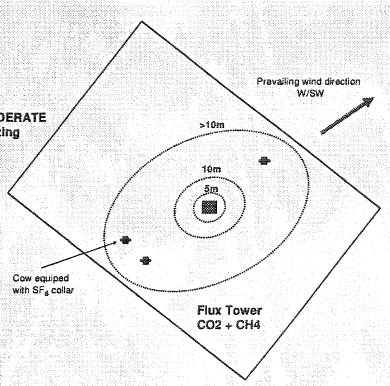




N_2O measurements

-Three measure-zones per paddock with 4 chambers each, comprising different %presence (0-25%) of legumes.
-Chambers will be moved between zones every 4 weeks, while un-used zones are grazed by cattle.



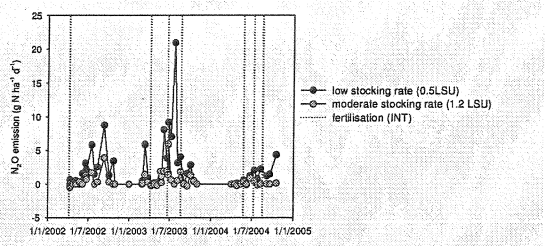


CH_4 measurements

Measure-zones, where CH_4 emission will be compared between the fast methan analyser and animal-scale SF_6 method. Comparision will be done in two intervals: animals within a distance of 5-10m, and >10m. A minimum radius of 5m was set to exclude CH_4 'plumes' which are not captured by the analyser (Laubach et al 2008 Aust J Exp Agri, 48, pp132). During daytime, distance between "SF_6 equiped" animals and analyser will be monitored hourly.

Background

N_2O measure campaigns with automated chambers



From measure campaigns between 2002 and 2004 we know, that N_2O fluxes are lower at low than at moderated stocking rate and fertilizer application. Moreover, at low stocking rate N_2O emissions were lower (0.04 g N m^{-2} yr^{-1}, on average) than the 'agricultural background' value of 0.1 g N m^{-2} yr^{-1} (IPCC, 2001).

CH_4 measure campaigns with SF_6 tracer technique

From measure campaigns using the hexafluoride (SF6) tracer technique, to quantify CH_4 and CO_2 emissions from cattle we know, that CH_4 emissions per unit ground area are about two times higher at moderate than at low stocking rate (9.8 and 5 g CH_4-C m^{-2} yr^{-1}) (Allard et al. 2007 AGEE). In 2003, CH_4 emissions represented 10 and 6% of the annual NEE, hence, continuous measurements of CH_4 emission may contribute to determine better ecosystem carbon storage (i.e. NBP).

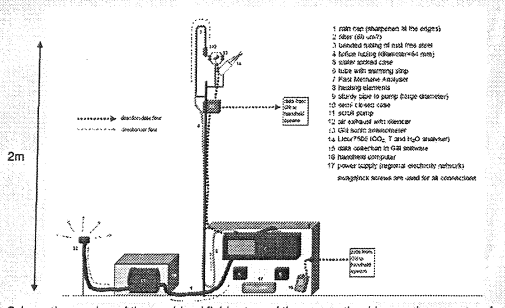
Objectives

N_2O measurements with automated chambers

Since 2002, the percentage of legumes has doubled (12% in 2007). Accordingly, the role of legumes on N_2O emissions will be studied by continuous measurements with automated chambers.

CH_4 measurements with fast methan analyser (Los Gatos)

Early this summer, we will install a fast methane analyser (FMA) in the closed path eddy covariance field set-up of the moderate grazed paddock. The accuracy of the analyser will be assessed by comparison of paddock (FMA) and animal-scale (SF_6) method.



Schematic overview of the combined field set-up of the openpath eddy covariance system for CO_2 and water vapour and the closed eddy covariance system CH_4 (Hendricks et al. 2008, AC)