Cattle methane fluxes measurement over an intensively grazed grassland using eddy covariance

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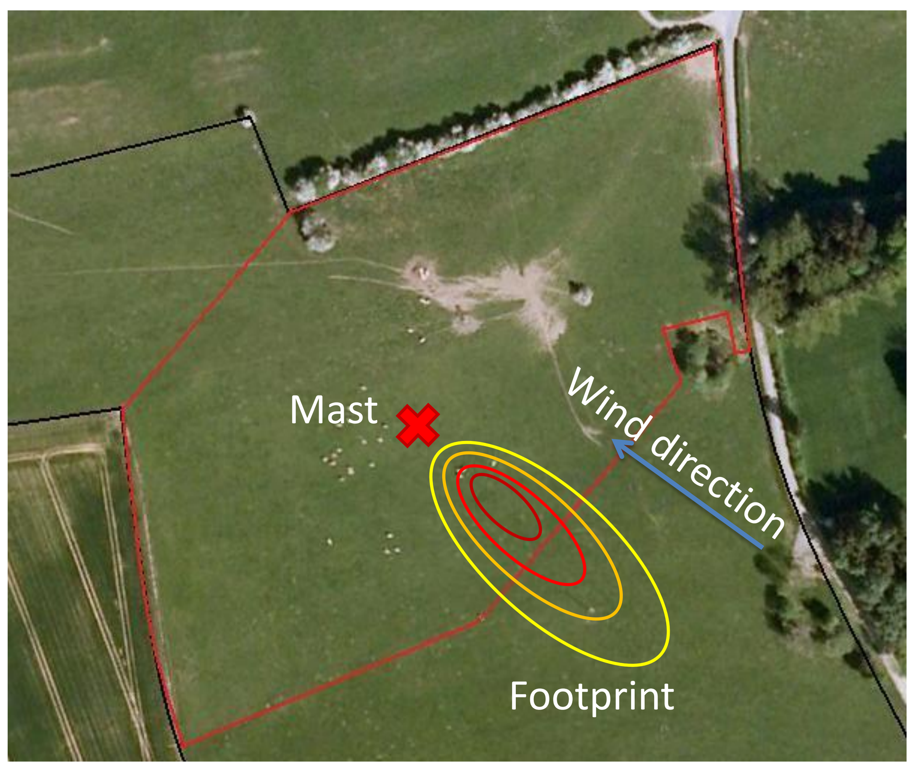
1. Objectives

- ❑ Measurement of CH_4 fluxes over a grazed grassland in Belgium
- ❑ Identification of CH_4 fluxes drivers on a grazed grassland

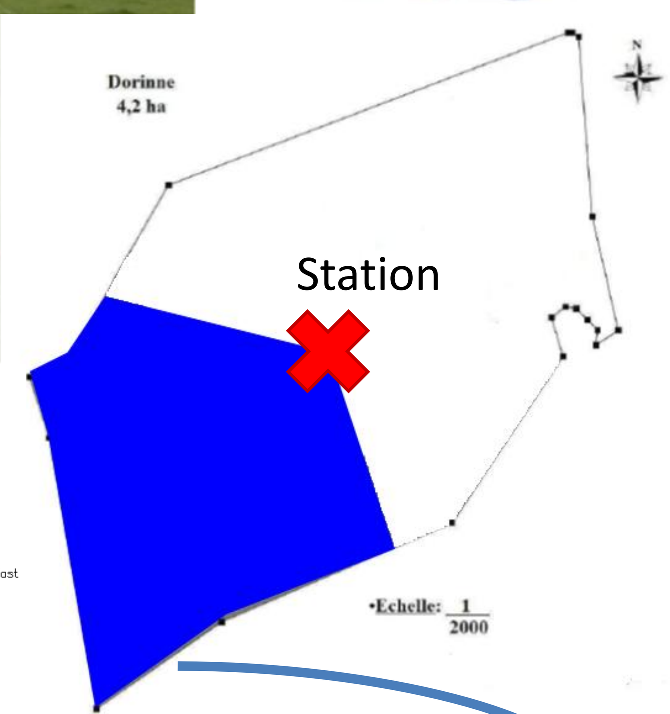
2. Material and Methods

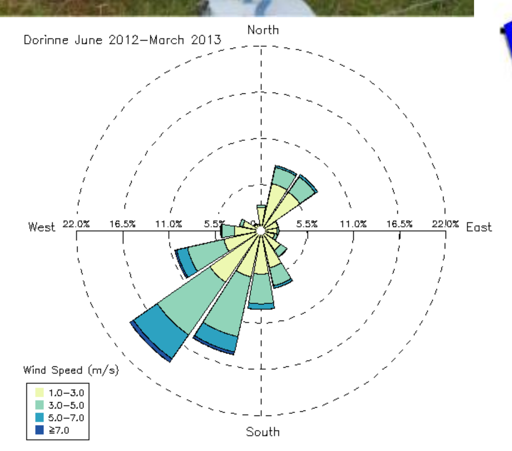
The eddy covariance method measures fluxes in a zone situated upwind from the measurement site (footprint). This method measures fluxes *in situ*, continuously and across broad areas. However, we are working with point sources (cattle) and their position on the field must be known if we want to calculate their emissions.



Site presentation

- *Measurement of CH_4 and CO_2 fluxes using eddy covariance (Picarro G2311-f)*
- *Measurement of micro-meteorological variables*





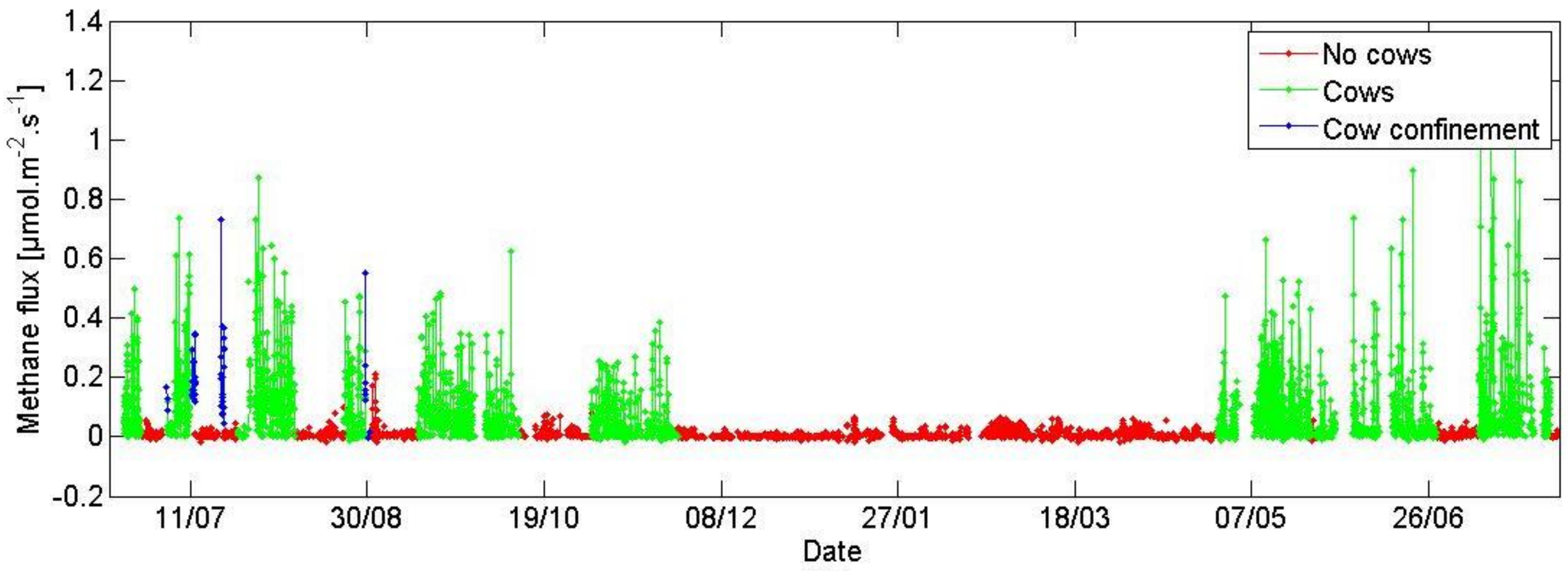
During confinement events, cows were confined in a smaller zone upwind from the measurement site (blue zone in the above figure) in order to achieve higher stocking rates.

4. Conclusions

- ❑ Methane emissions are correlated with stocking rate with a slope of 51.9 ± 2.5 kg CH_4 $year^{-1}$ LSU^{-1} (against 57 kg CH_4 $year^{-1}$ LSU^{-1} for IPCC tier 1 emission factor - IPCCC, 2006. Guideline for National Greenhouse Gas Inventories)
- ❑ In the absence of cows, no net methane sink has been observed.
- ❑ No obvious relation can be established between methane emissions and soil temperature or moisture at present

3. Results

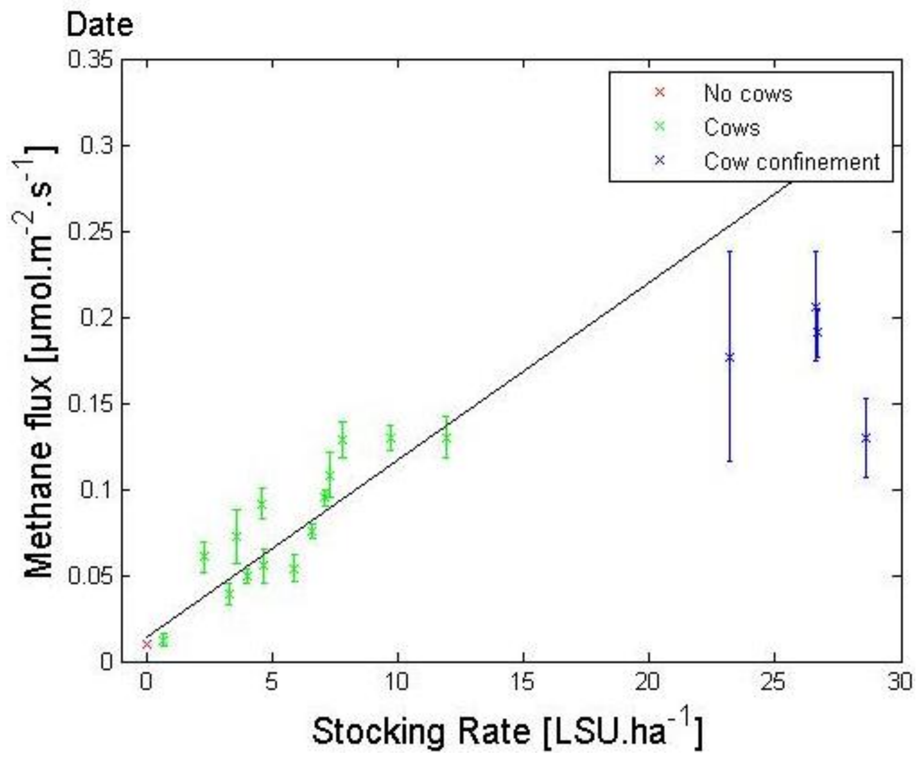
Right: Methane fluxes on our site for 3 different cattle configurations



Fluxes

❑ During cattle absence, fluxes were commonly found to range between 0 and 0.05 µmol m^{-2} s^{-1} and were only exceptionally negative

❑ When cattle was present on the grassland, emissions were much higher and were strongly linked to stocking rate with a regression line corresponding to the equation: F_{CH4}=[10.3 (±0.5) x SR + 14.4 (±3.1)] x 10^{-3}
This line is fitted assuming a random distribution of cows on the pasture

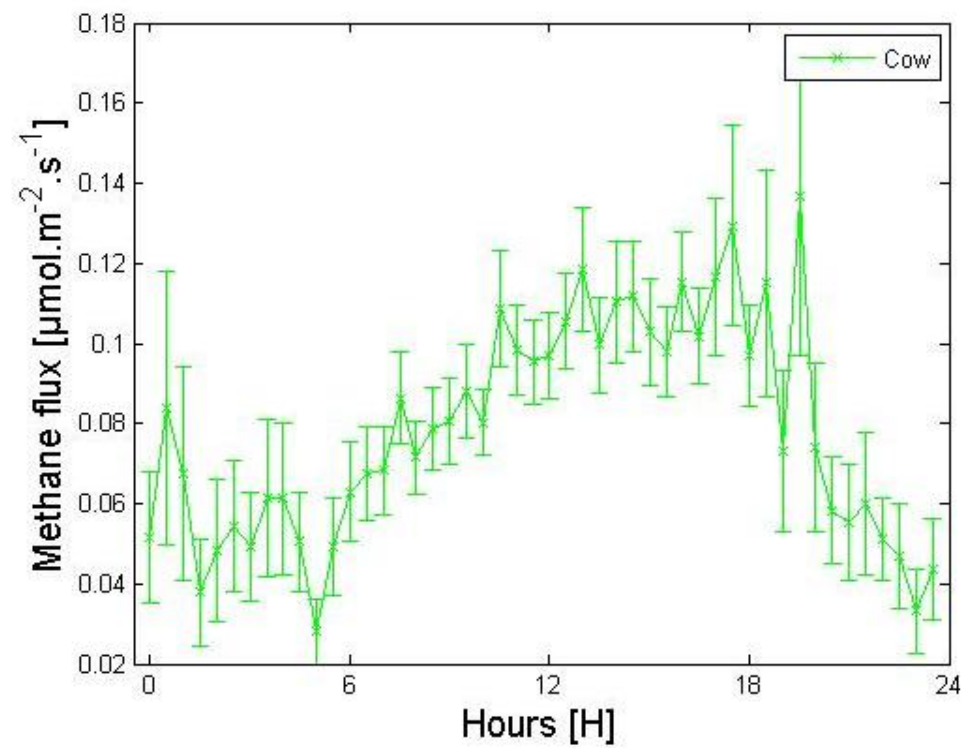


Up: Impact of stocking rate on methane fluxes with standard errors, assuming a random cattle distribution.

Daily cycle

❑ When cows are present, emissions reach a major peak in the afternoon and a minor peak between 1 am and 4 am

❑Without cows, no clear daily cycle was observed (not shown)



Left: daily evolution of methane fluxes during cattle presence with standard errors.

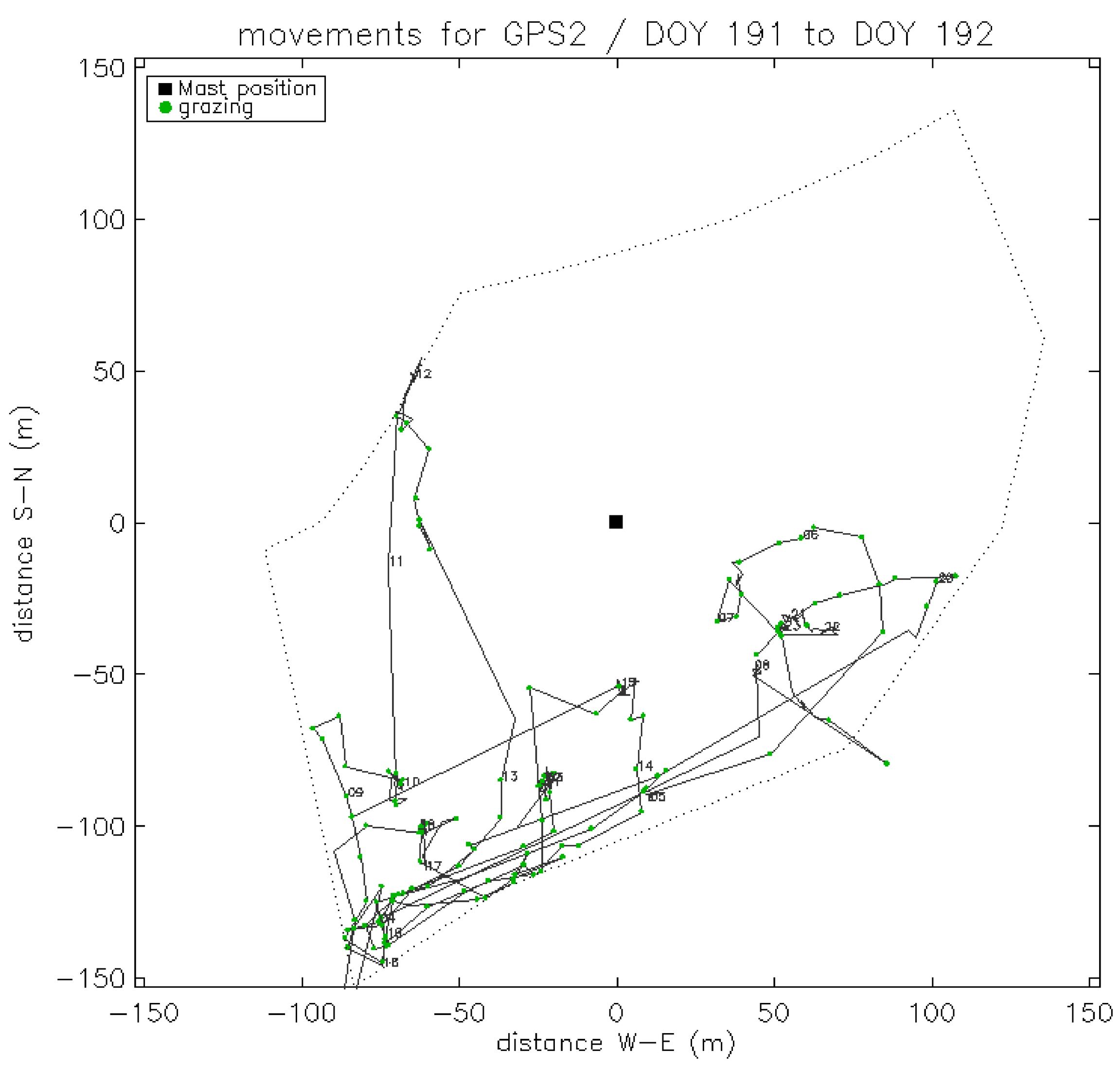
5. Perspectives

We are considering three options to calculate fluxes per livestock unit:

❑ Random cattle distribution: Assuming a random cattle disposition, we can use the cattle density to calculate a flux per livestock unit. This method is easy to implement but the fundamental assumption is never met. However, the use of this method is defensible on large datasets and is currently applied to our data.

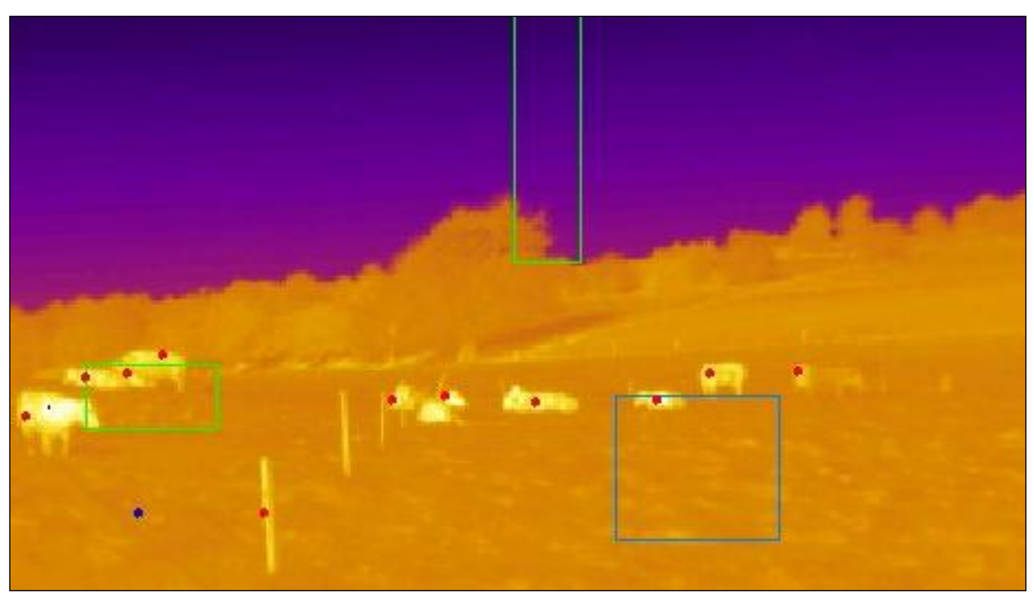
❑ GPS: A GPS and accelerometer device is attached on each cow. Cow positions and footprints will be measured/modeled on a half-hour basis. For each half-hour, fluxes will be linked to cow positions and to their eating behavior (e.g. time since last meal). This method is currently tested on our site with 2 cows.

❑ Thermal camera: A thermal camera is automatically oriented in order to face the footprint. Recorded pictures are processed to detect the number of animals and their position. This method is under development.



One day GPS record for one cow. Each hour is written in a caption and green dots correspond to a grazing activity.

Cow positions and behavior are measured with a home-made GPS and accelerometer device attached around cows neck's



Thermal infra-red image from the pasture

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