Gembloux Agro-Bio Tech
Université de Liège

FÉDÉRATION WALLONIE-BRUXELLES

MEASUREMENT OF CATTLE METHANE EMISSIONS USING THE EDDY-COVARIANCE TECHNIQUE

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1. Objectives

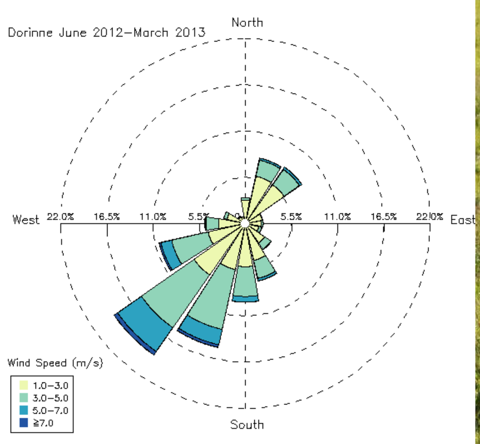
- ❑ Measurement of CH_4 fluxes over a pasture in Belgium
- ❑ Calculation of cattle emissions using geolocalization combined with a footprint model
- ❑ Identification of methane response to management practices

2. Material and Methods

The eddy covariance method measures fluxes emitted upwind from the measurement site (footprint). If we want to calculate cattle emissions (moving sources), cattle positions on the field must be known at all time.

Site Description

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



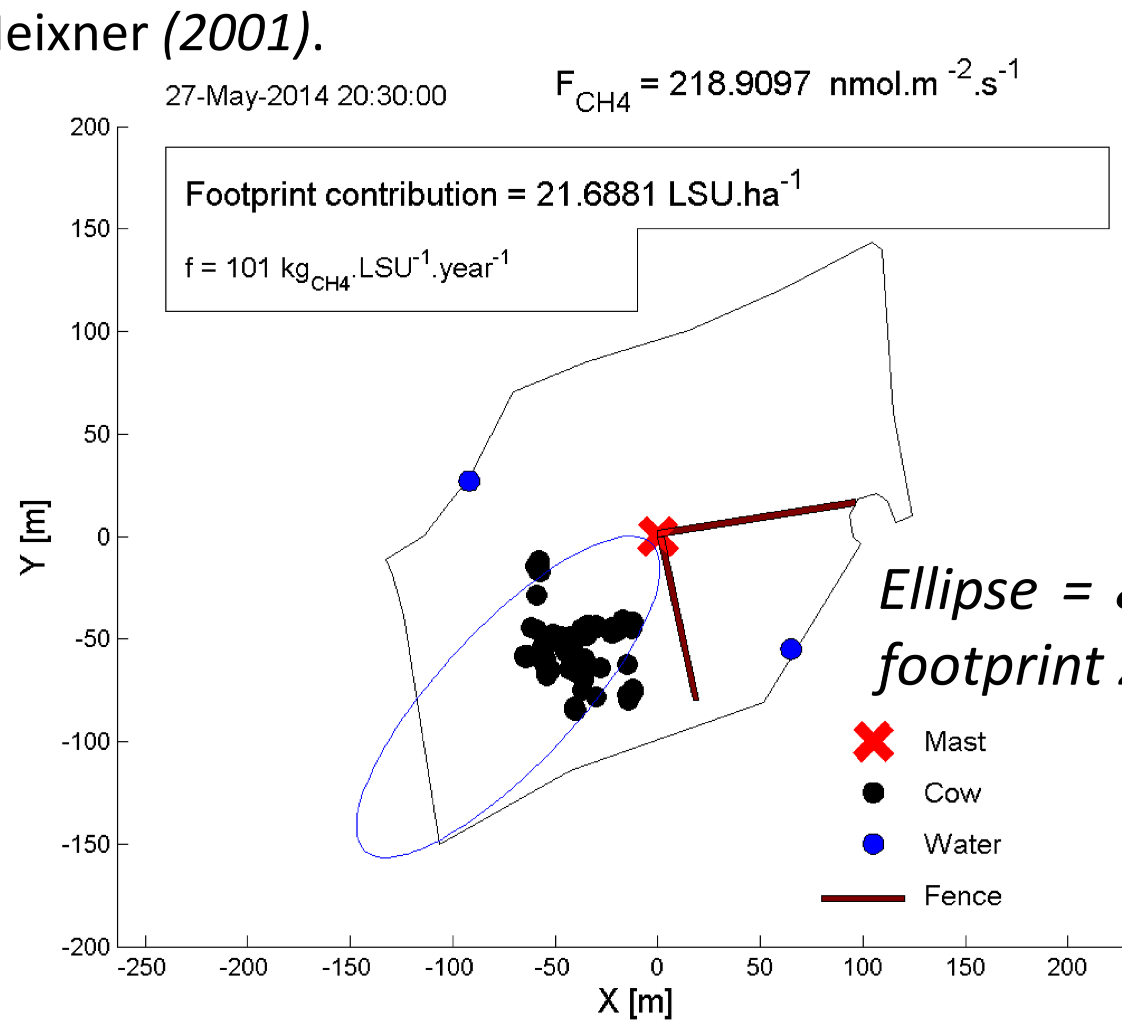
Each cow was equipped with a GPS (position) and accelerometer (behavior) device

Measurements

For each half hour we calculate a flux per Livestock Unit (LSU) using:

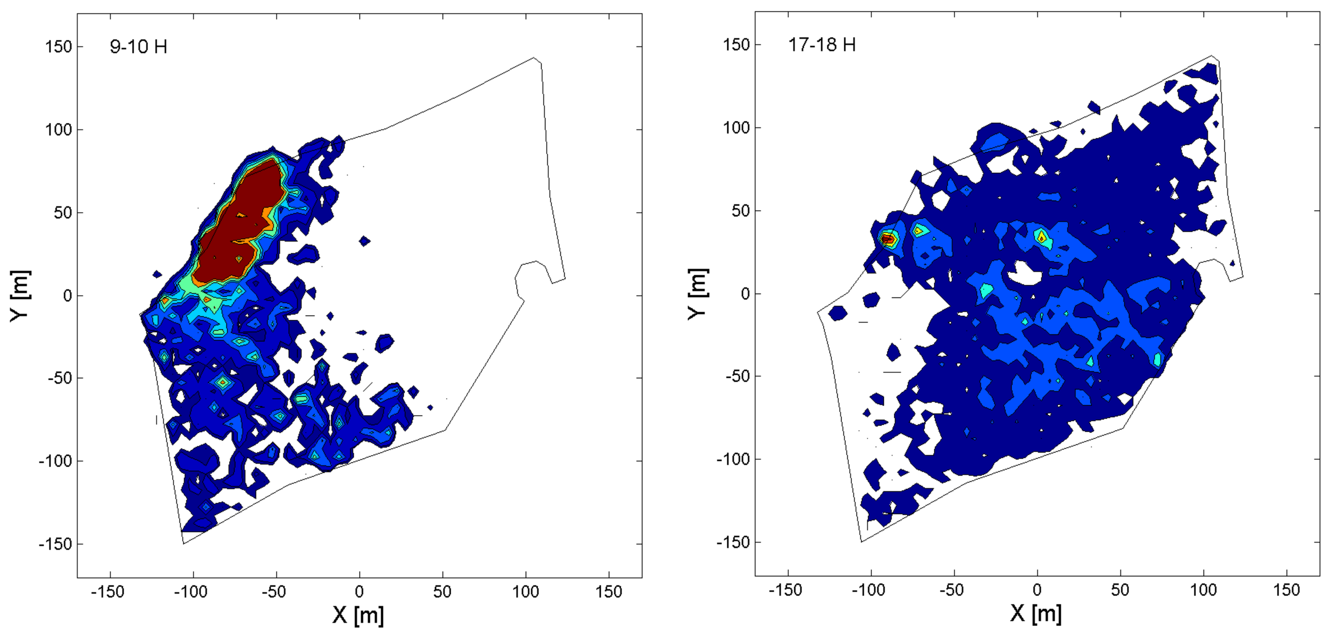
$$f = \frac{F_T}{\sum_i \sum_j n_{ij} \phi_{ij}}$$

Where f corresponds to a flux per LSU (nmole s^{-1} LSU^{-1}),
F_T is the half-hour measured flux (nmole m^{-2} s^{-1}),
n_{ij} the number of LSU in the cell ij (LSU) and
ϕ_{ij} is the footprint function in the cell ij (m^{-2}) calculated according to the model described by Kormann and Meixner *(2001)*.



3. Results

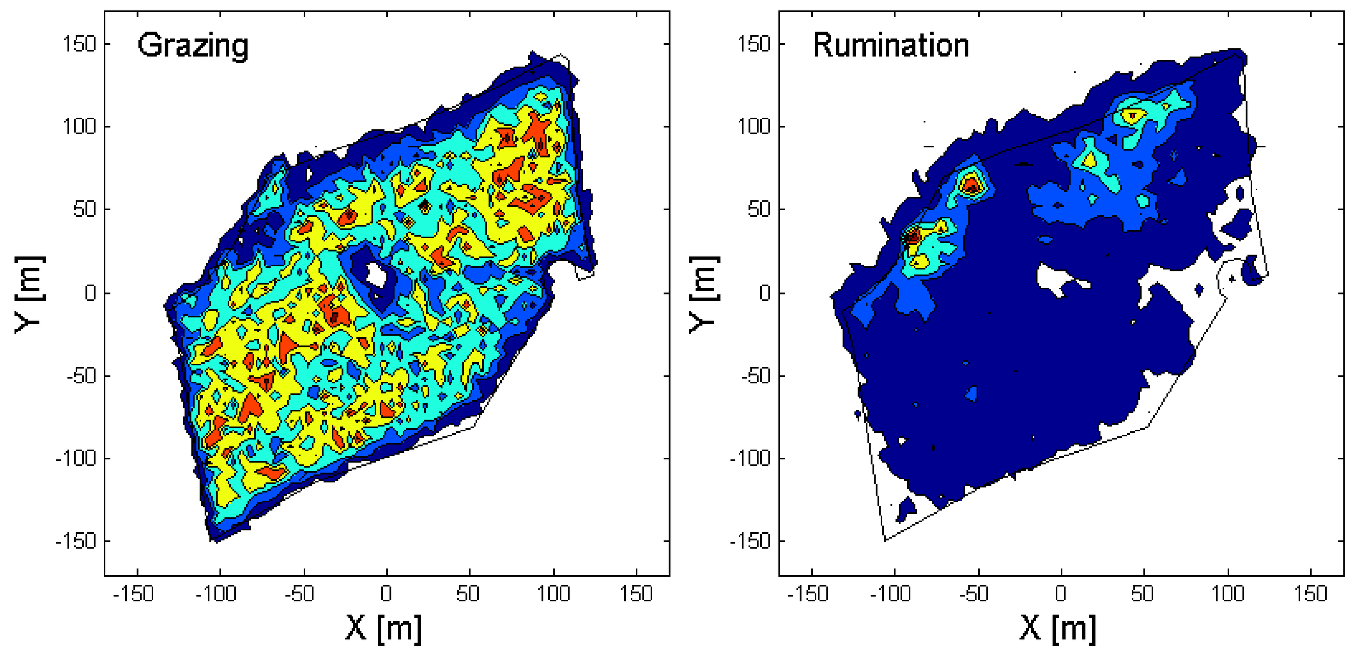
Cattle position



- ❑ Cattle positions were driven by a diurnal pattern
- ❑ Two times a day (around 5am and 7pm), cows appear to scatter across the whole pasture

Results for June 2014
Hotter colors indicate higher cattle presence

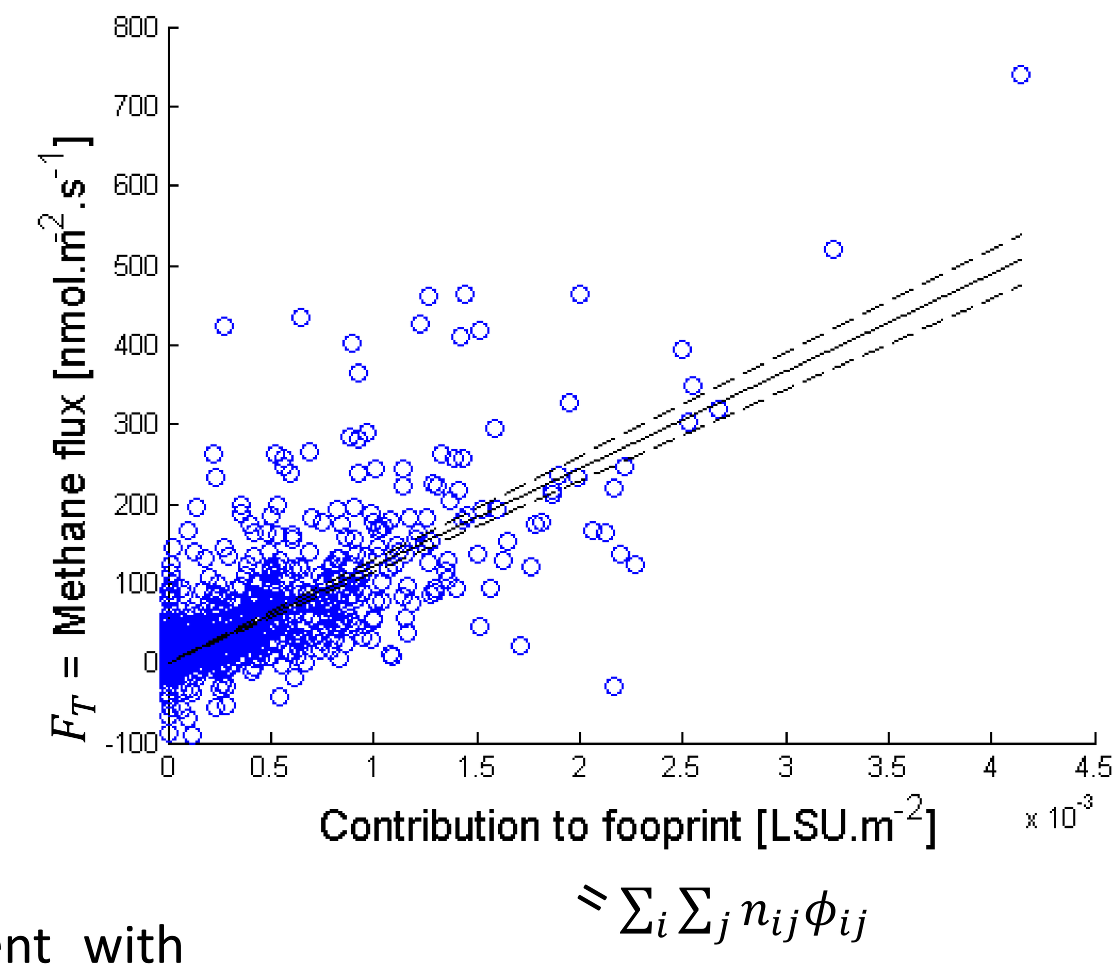
Cattle behavior



- ❑ Cattle behaviors were coherent with positions. When cows were grazing, they were spread through the pasture and when they were resting or ruminating they herded together

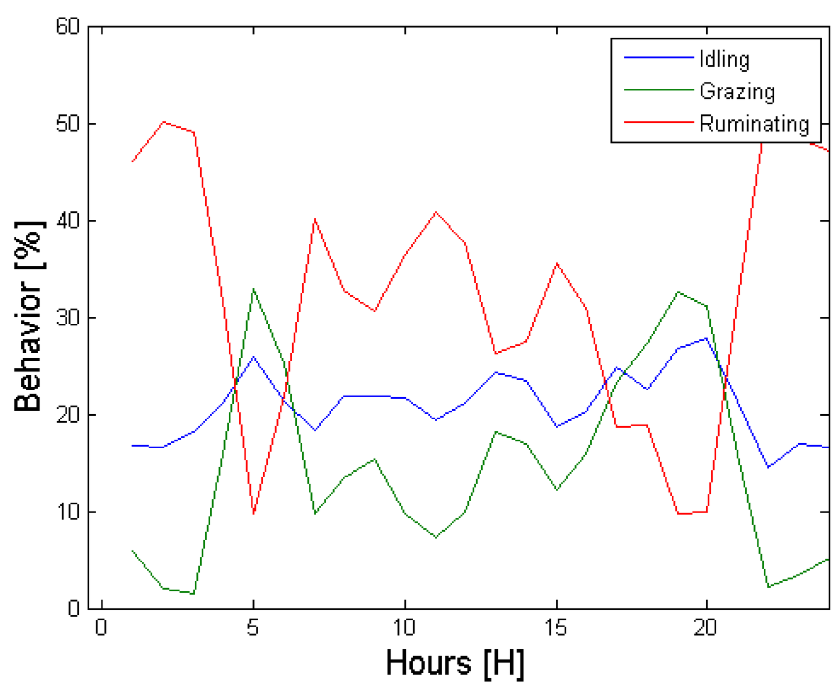
Methane flux per cow

- ❑ Methane fluxes were related to cow positions in the footprint. When more cows were present in the footprint, methane fluxes were higher
- ❑ The slope of the regression curve indicate a flux per cow (f) of 62 ± 4 kg CH_4 LSU^{-1} $year^{-1}$

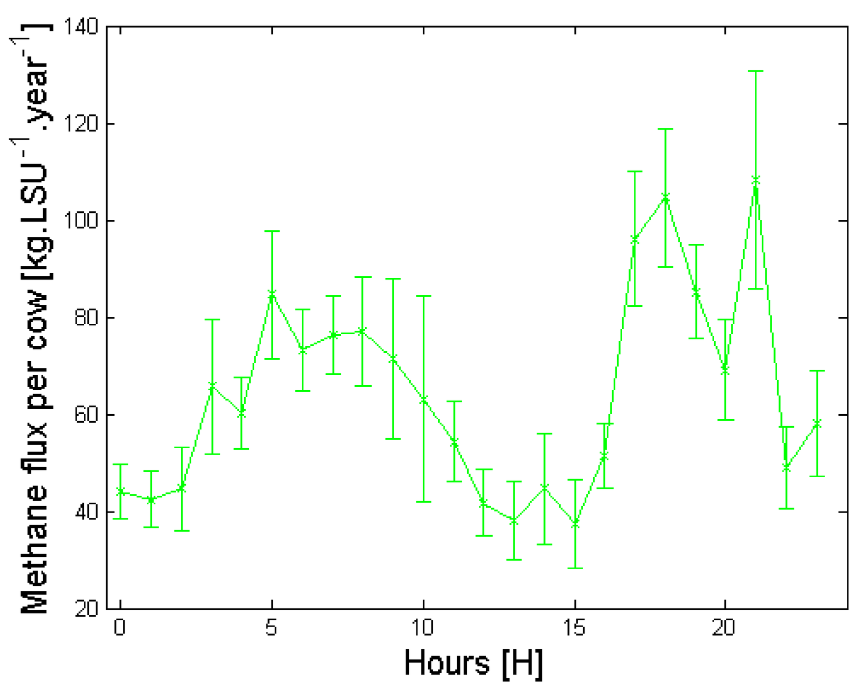


Daily evolutions

- ❑ Two grazing peaks were observed daily
- ❑ Methane fluxes per cow were consistent with cattle behavior. Grazing periods were associated / followed by higher methane emission rates.

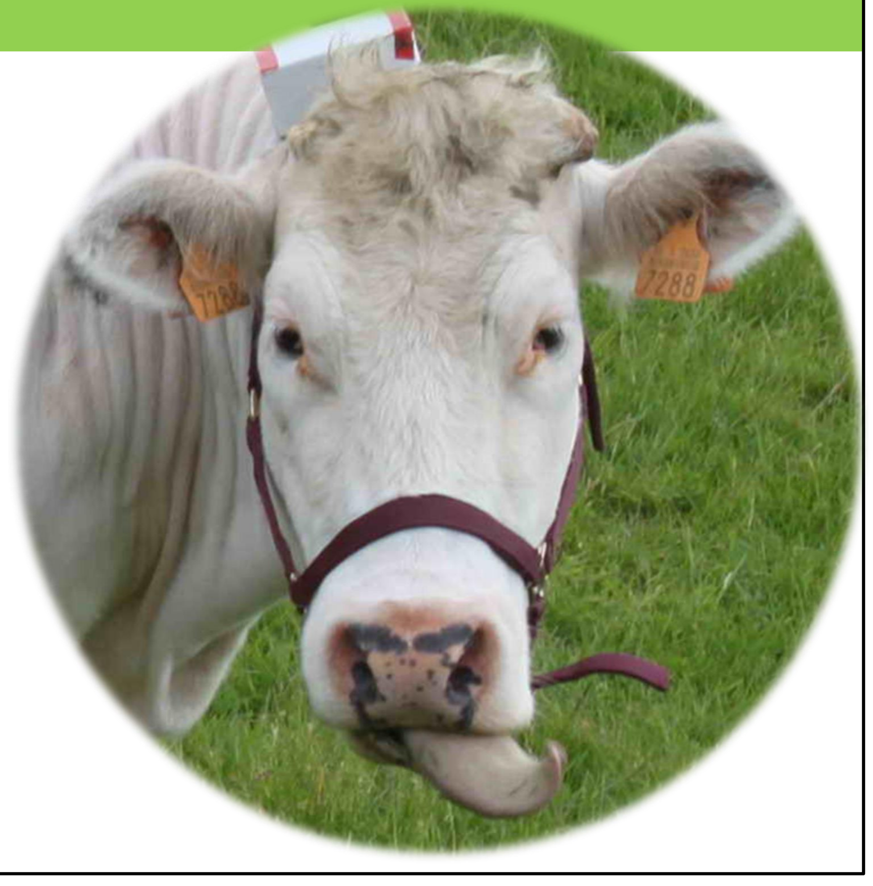


Daily behavior and emissions per LSU evolution during June 2014



4. Conclusions and perspectives

- ❑ Methane emissions were correlated with the stocking rate in the footprint.
- ❑ We obtained a mean flux per cow of 62 ± 4 kg CH_4 LSU^{-1} $year^{-1}$ (against 57 kg CH_4 LSU^{-1} $year^{-1}$ for IPCC tier 1 emission factor - IPCC, 2006)
- ❑ An obvious diurnal pattern can be found in cattle behavior and methane emissions. This pattern is in agreement with literature (Judd *et al.*, 1999)
- ❑ In the future, emissions could be linked to cattle behavior and forage quality



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