Gembloux Agro-Bio Tech
Université de Liège

EAAP 2016
67th Annual Meeting of the European Federation of Animal Science
Belfast UK, 29 Aug – 2 Sept 2016

High rate monitoring of CH4 production dynamics and their link with behavioral phases in cattle

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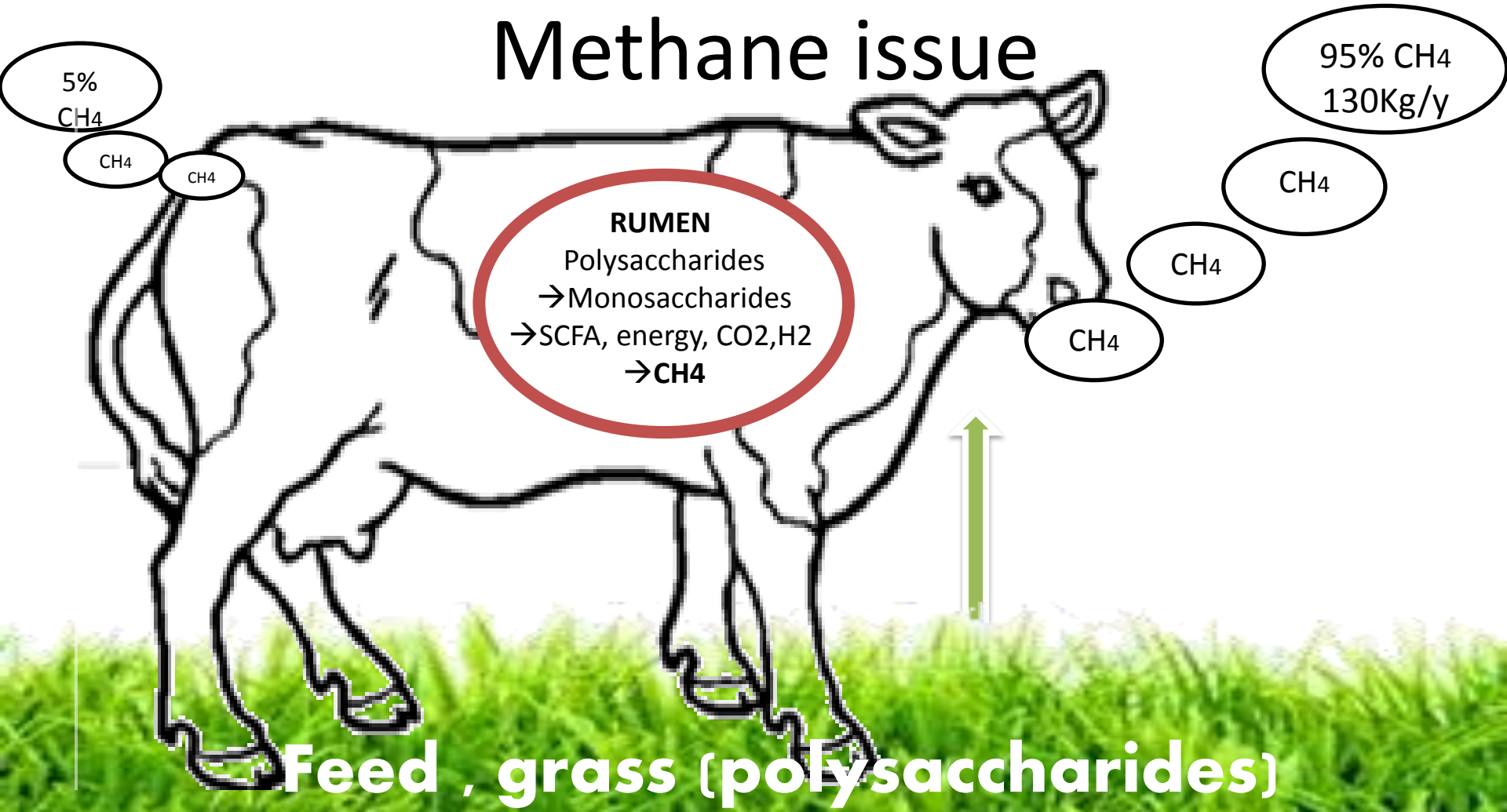
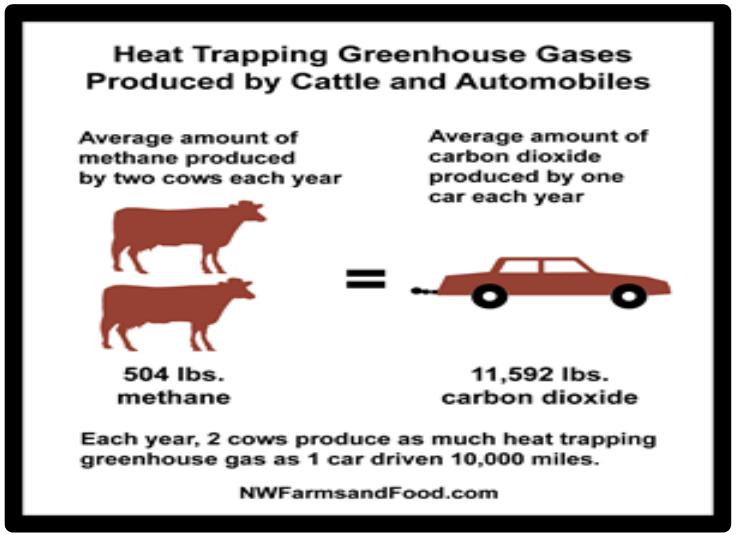
August 2016

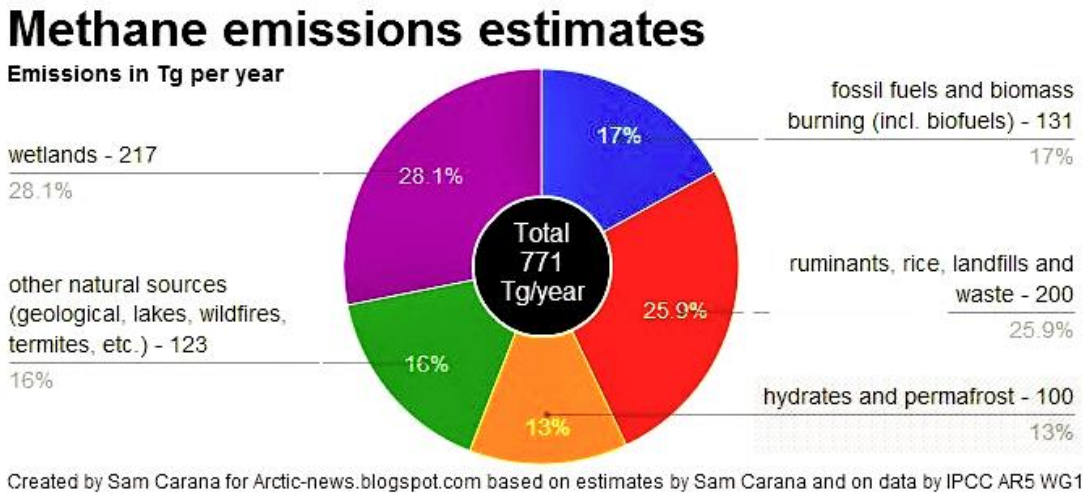
Methane issue



Environmental issue of dairy cows

- Livestock: 25% of total anthropogenic CH_4 sources
- CH_4 production: loss of dietary energy between 6 to 12%





Measurement methods on pasture

SF6 method

→ Individual daily production

GreenFeed

→ Individual short-term measurements

What about the CH4 dynamics?

Measurement methods on pasture

Eddy covariance:

→Herd CH4 daily production
→GPS
→Behaviors?

• *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 (behaviour) device

Questions

- ✓ What is the link between emission dynamics and feeding behavior?

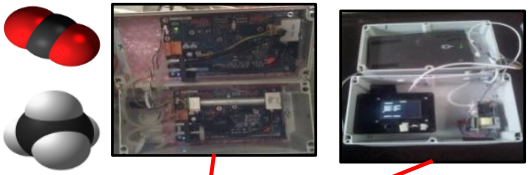
Rumination

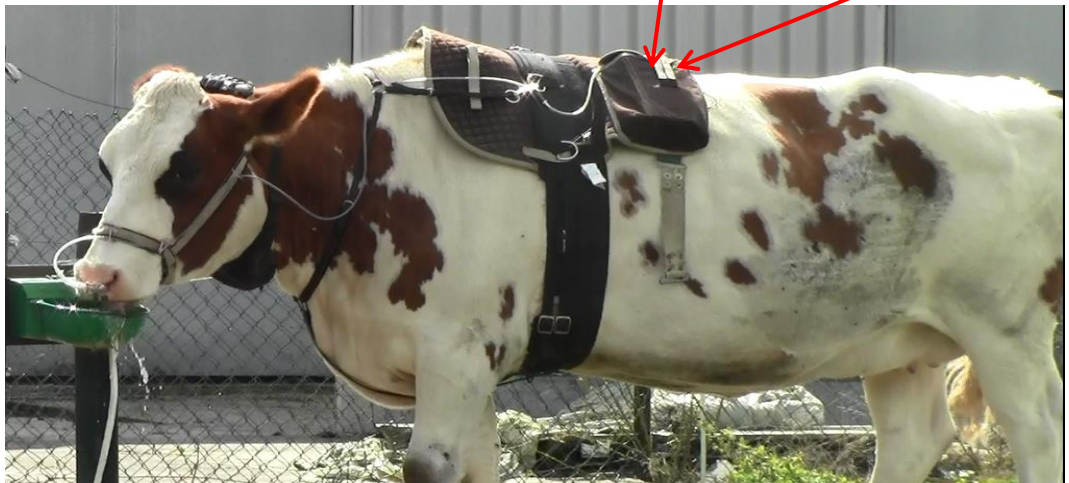
Grazing or eating

Rest

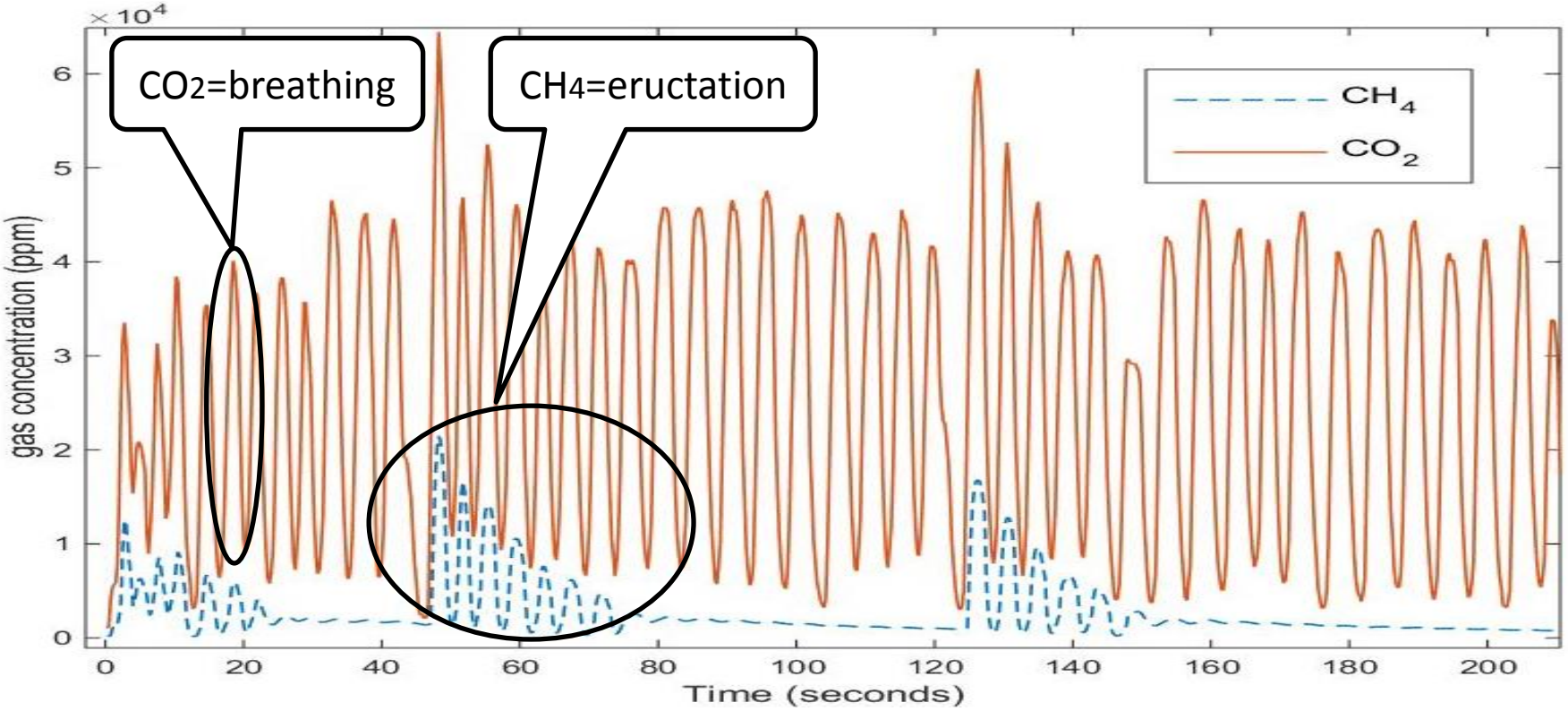
Methane measurement

- ✓ 2 infra-red gas analysers (CH_4 and CO_2 concentrations)
- ✓ Ratio CH4:CO2
- ✓ measurements in barn or on pasture
- ✓ continuous measurements





Methane measurement

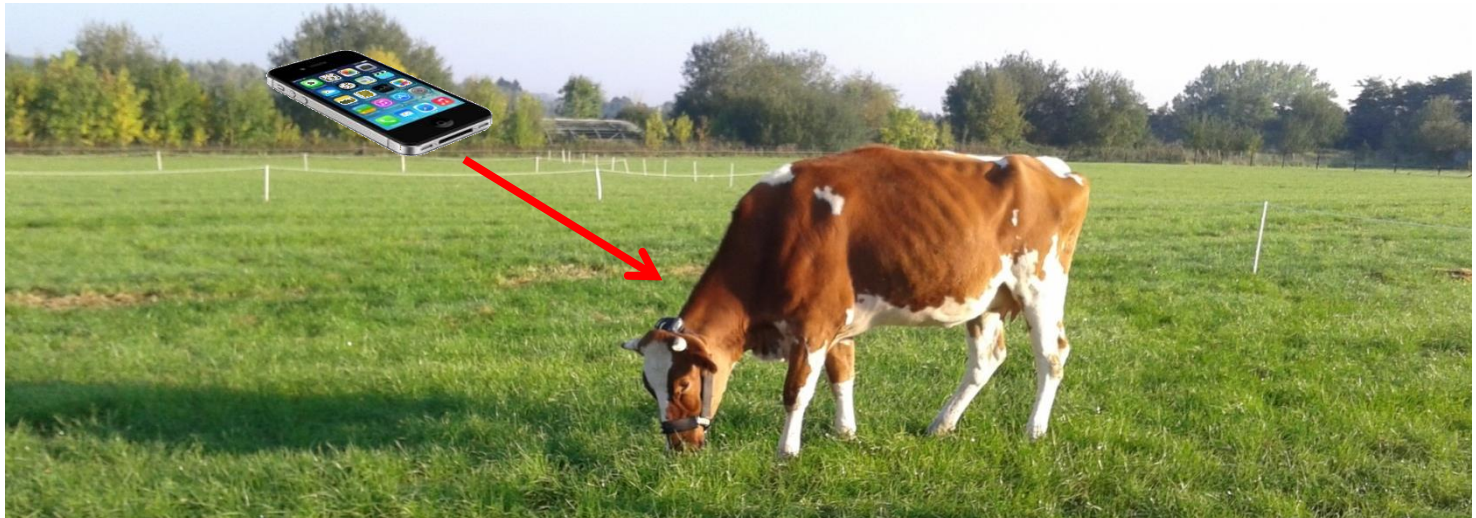


Inertial measurement unit of an iPhone to detect behaviors

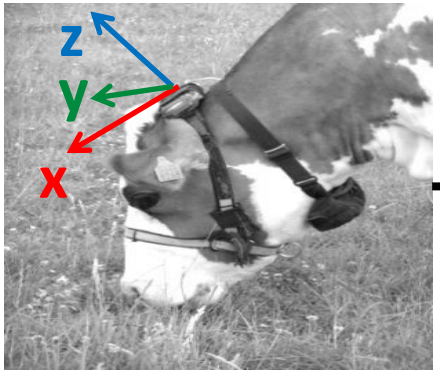
"*Development of an open-source algorithm based on inertial measurement units (IMU) of smartphones to detect cattle grazing and ruminating behaviors*"

ALH **Andriamandroso**, F. Lebeau, Y. Beckers, E. Froidmont, I. Dufrasne, B. Heinesch, P. Dumortier, G. Blanchy , Y. Blaise, J. Bindelle

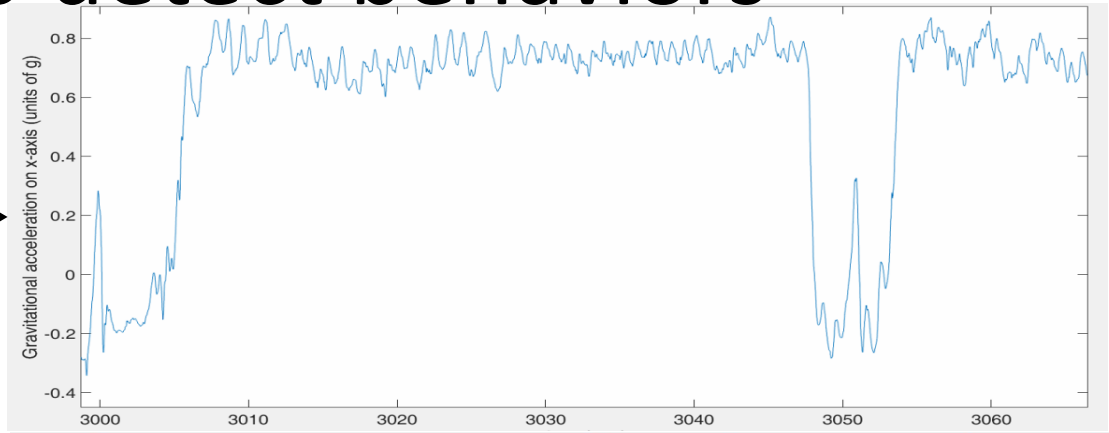
Submitted to **Computers and Electronics in Agriculture.**



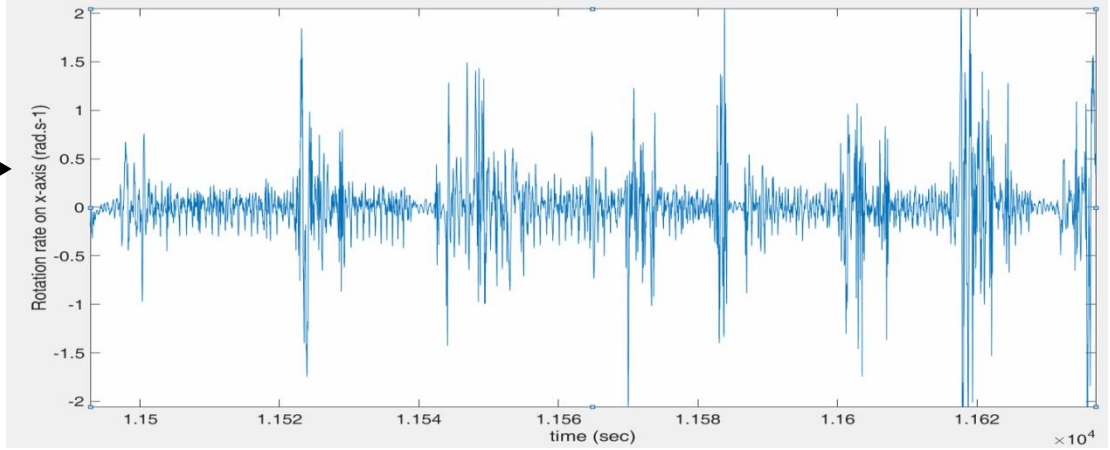
Inertial measurement unit of an iPhone to detect behaviors



Grazing



Rumination



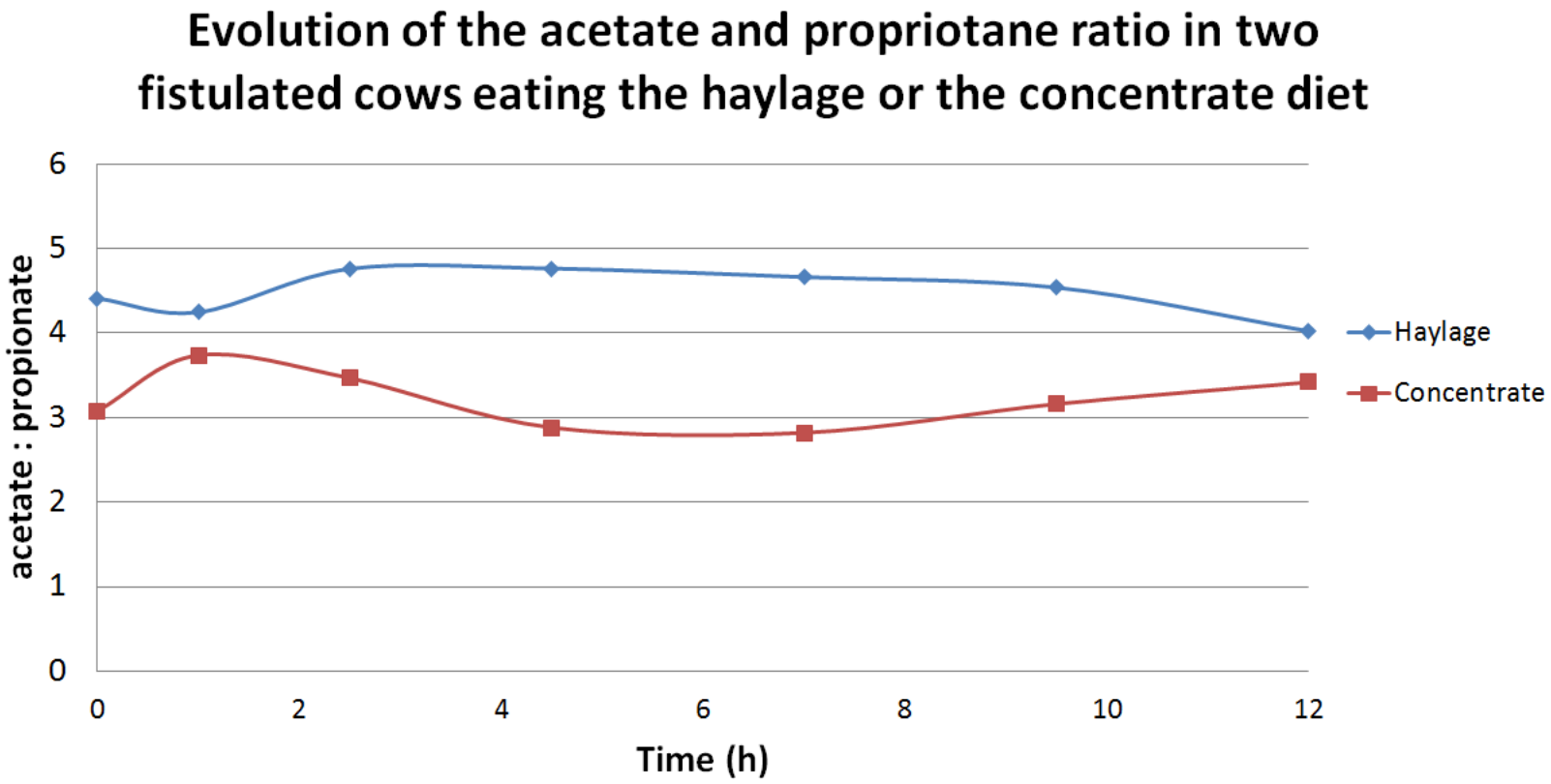
Experiment in barn

- ✓ 4 cows
- ✓ 2 diets: haylage v.s. concentrate diet
- ✓ **isoenergy and iso-nitrogen diets**
- ✓ 2 modalities: full diet v.s. 70% DMI
- ✓ Latin square

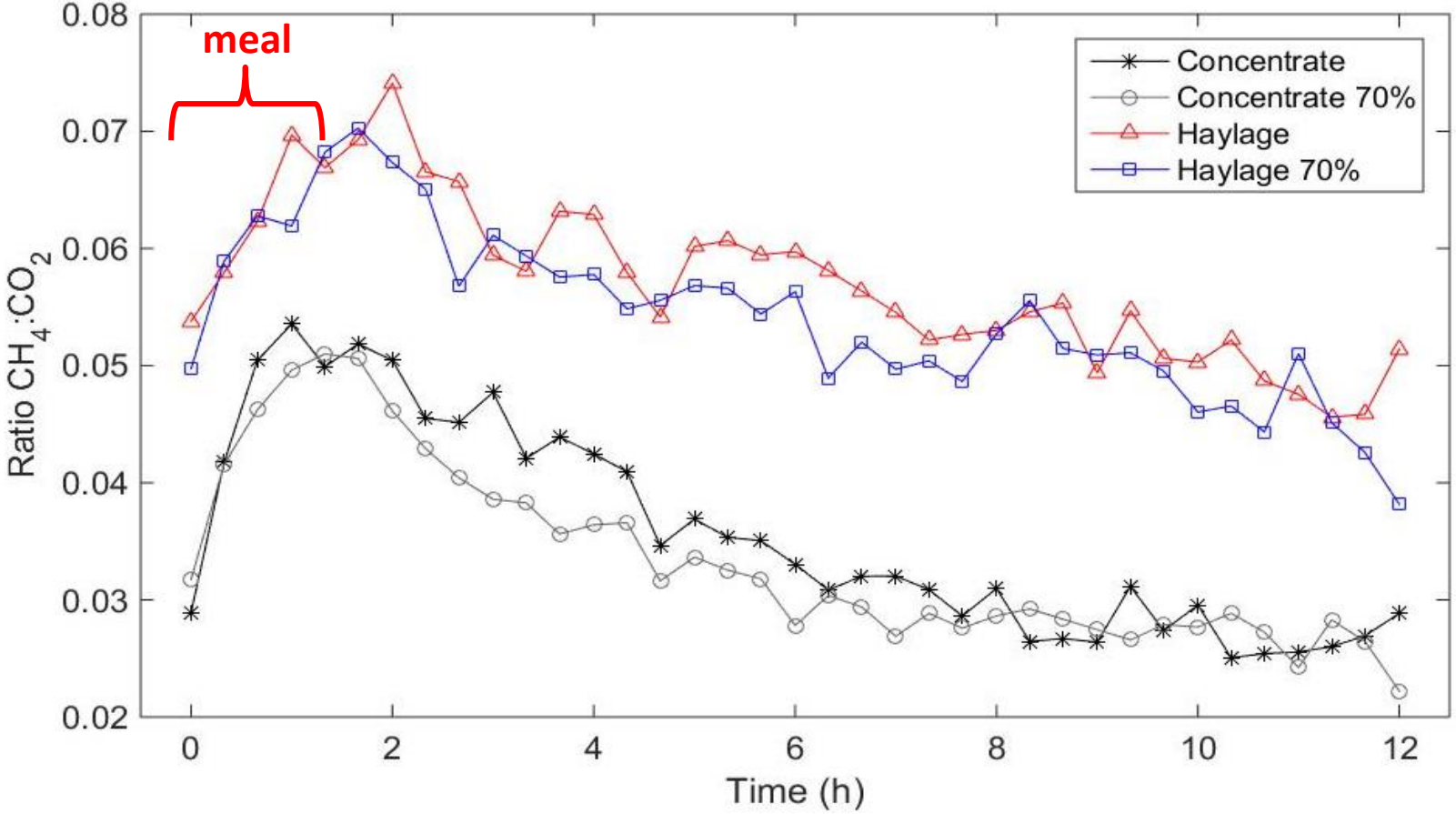
Composition	Diet tested		
		Haylage	Concentrate
Haylage	MS (Kg)	6.34	2.05
Linseed Nutex 68	MS(Kg)	0	1.80
Cracked wheat	MS(Kg)	0	0.90

Results

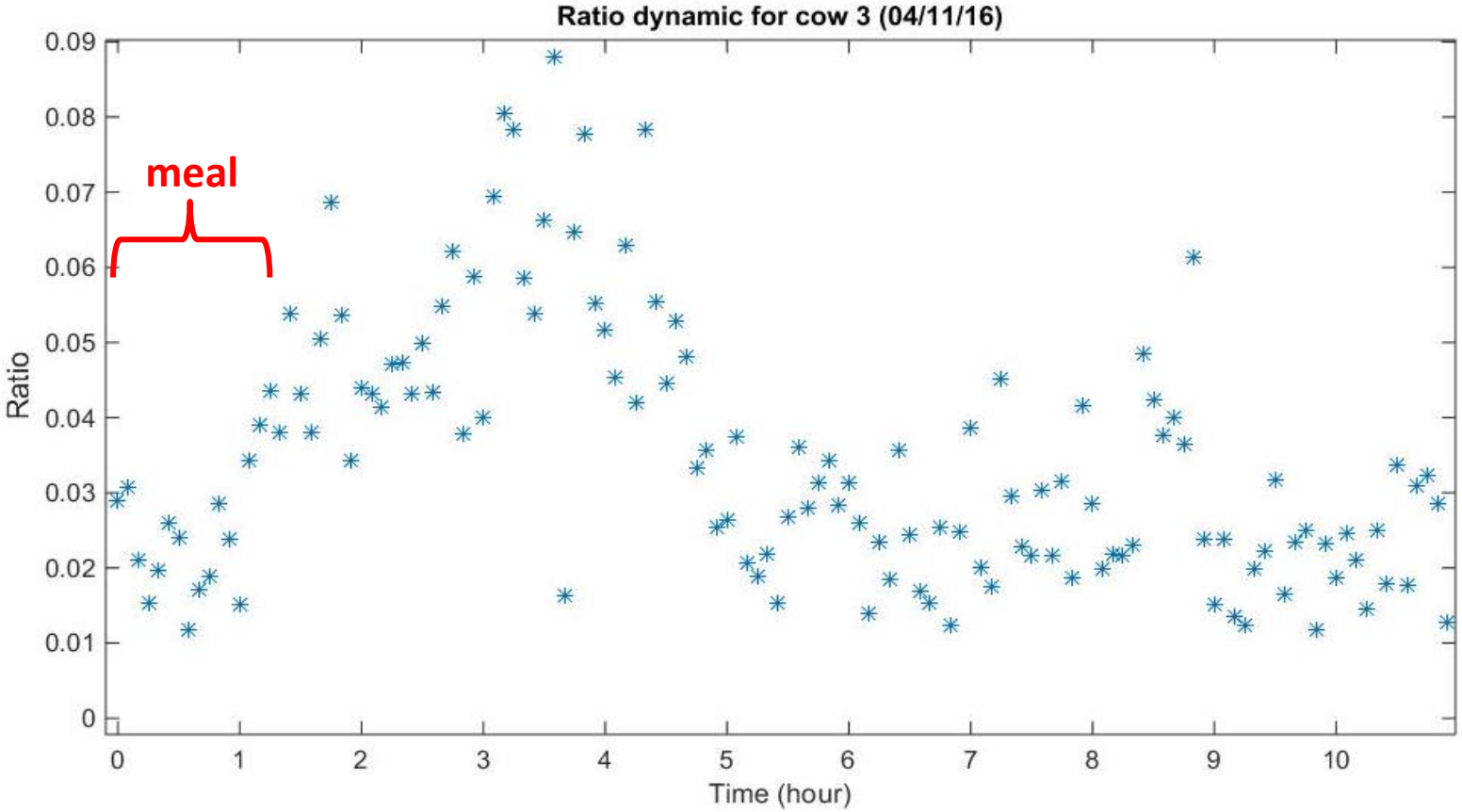
Measurement	Diet			
Diet	Haylage 100%	Haylage 70%	Concentrate 100%	Concentrate 70%
N	2822	2997	2998	2826
Ratio CH_4:CO_2 (Mean±sd)	0.058±0.019 a	0.056±0.020 b	0.036±0.018 c	0.035±0.017 d
Eructations /min (Mean±sd)	0.462±0.221 a	0.391±0.191 b	0.260±0.187 c	0.228±0.170 d


Evolution of the acetate and propriotane ratio in two fistulated cows eating the haylage or the concentrate diet
acetate : propionate
0
1
2
3
4
5
6
0
2
4
6
8
10
12
Time (h)
Haylage
Concentrate

CH_4 dynamics



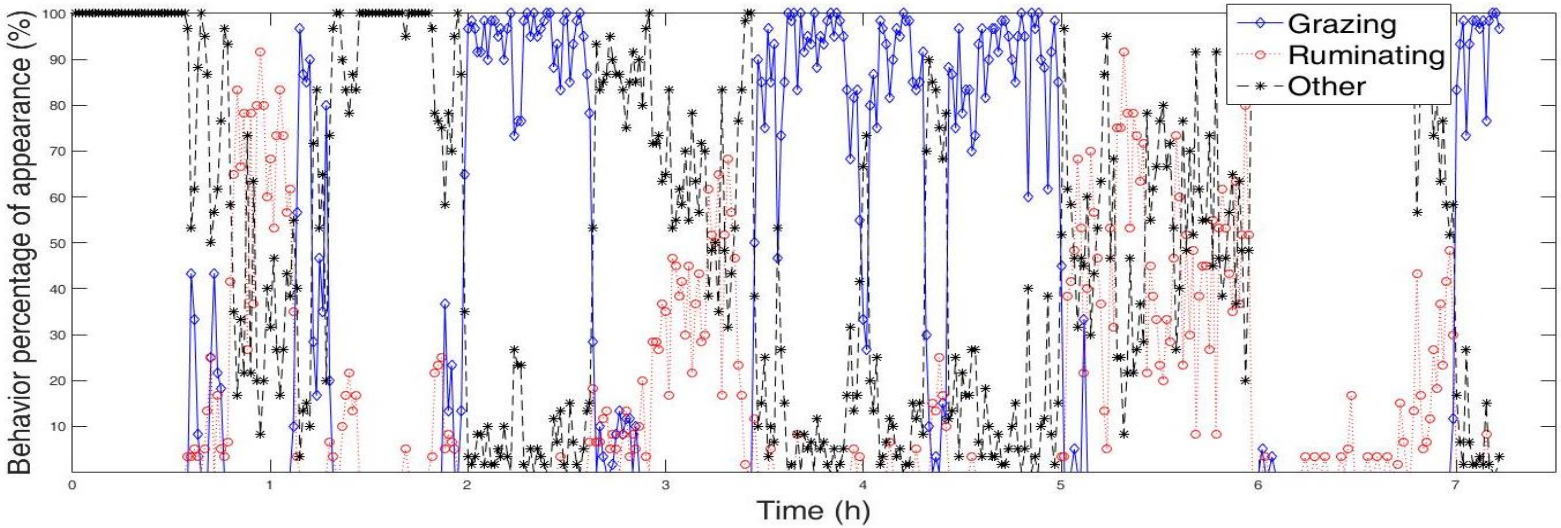
CH_4 dynamics

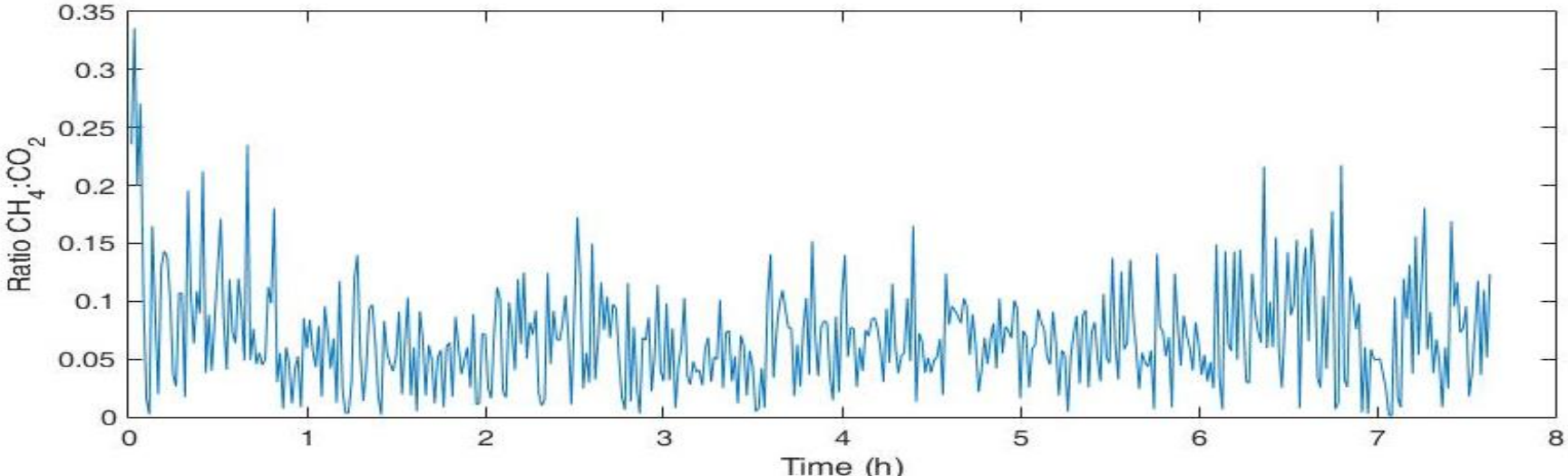


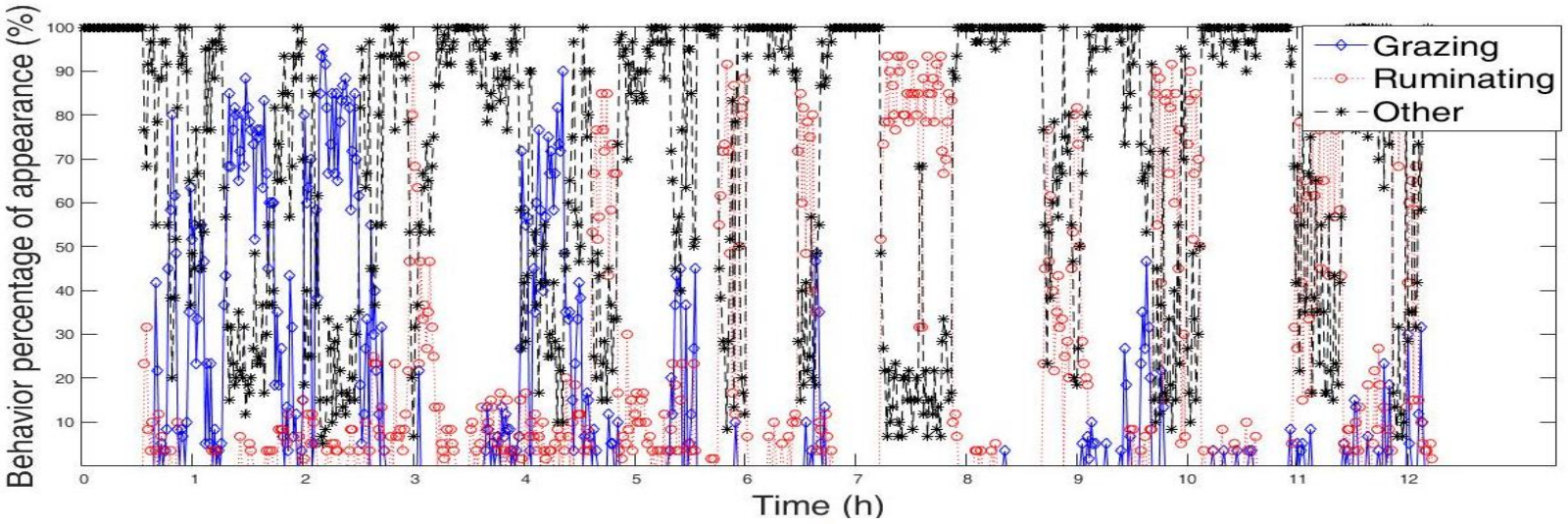
Preliminary results on pasture

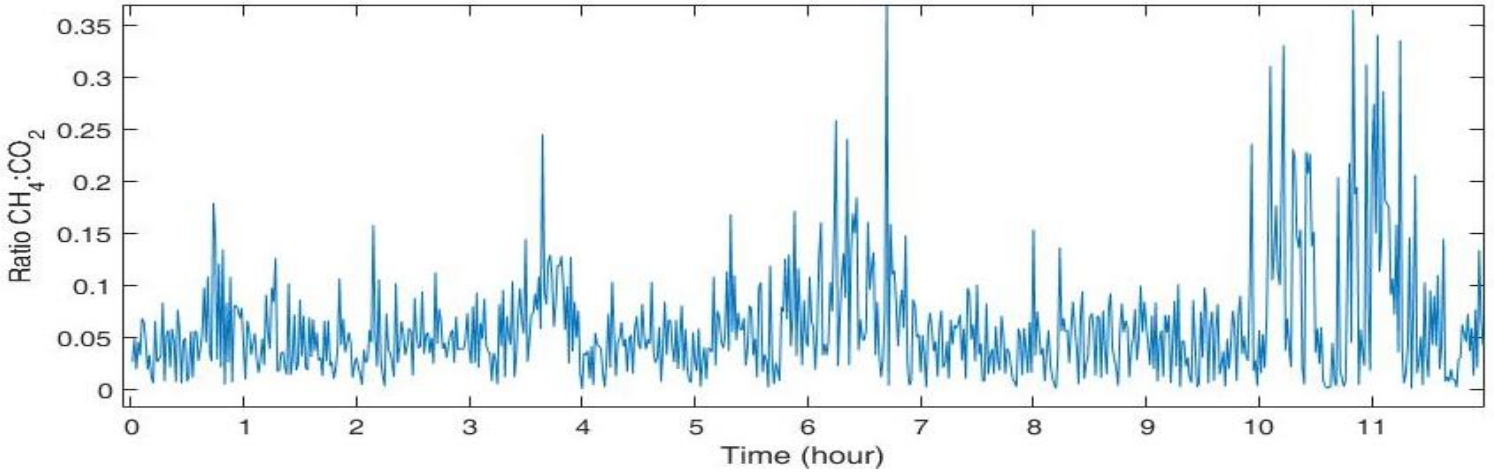
- ✓ 6 cows
- ✓ diets: grass 15 cm high
- ✓ 24 hours measurement

Measure	Behavior		
	Meal	Rumination	Rest
N	693	441	2684
Ratio CH4:CO2 Mean±sd	0.051±0.039	0.053±0.047	0.054±0.038


Grazing
Ruminating
Other
Behavior percentage of appearance (%)
Time (h)


Ratio CH_4:CO_2
Time (h)


Behavior percentage of appearance (%)
Time (h)
Grazing
Ruminating
Other


Ratio CH4:CO2
Time (hour)

Conclusion

Device

- All-terrain device
- Continuous measurement system
- No lab analysis

Conclusion

Knowledge enhancement

- In barn: More CH4 after the meal and during rumination
- On pasture: dynamics of the CH4 excreted linked to the post-feeding and less to the animal behavior
  - Effect of the day/night?
  - Effect of supplemented diet?
- For eddy-covariance: geo-localize the animal and the meal period

Acknowlegment

- Project AgriGES financed by Gembloux Agro Bio-Tech, University of Liège Ulg, Belgium
- FNRS

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