Measuring methane emissions using LMD in rural livestock systems: key considerations

Webinar GMG, 25-03-2026

M. Spoelstra, B. Gredler-Grandl, M. Chagunda, E. Rekik, R. Bore, E. Senatore

Global Methane Genetics initiative

Led by WAGENINGEN UNIVERSITY & RESEARCH

In Partnership with BEZOS EARTH FUND, Global Methane Hub

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Agenda

Agenda

09:00 Welcome & agenda webinar (Mirjam)

09:05: Intro GMG and Feed&Gas researchgroup & Wikipage (Birgit)

09:10 Mizeck Chagunda: Background and history of LMD

09:24 Emna Rekik: LMD Use in Sheep: Field Applications and Methodological Insights

09:38 Raphael Bore: Use of LMD in feed trials in barn or pasture in different species of ruminants

09:52 Elena Senatore: Methodology to compare GreenFeed and LMD on dairy ewes

10:06 Open discussion

10:30: End of webinar

Global Methane Genetics initiative

Birgit Gredler-Grandl, Y. de Haas, R. Banks, H. Montgomery, A. Jarvis, R. Veerkamp

March 25, 2026

Global Methane Genetics initiative
Led by WAGENINGEN UNIVERSITY & RESEARCH
In Partnership with BEZOS EARTH FUND, Global Methane Hub

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Global Methane Genetics initiative (GMG)

Accelerating genetic progress – research and implementation – to reduce methane in ruminants

BEZOS EARTH FUND

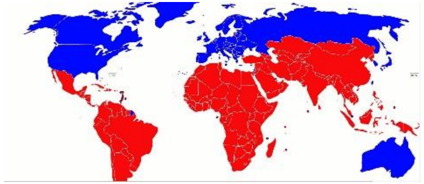
Global Methane Hub

Coordinators: Roel Veerkamp & Birgit Gredler-Grandl (WUR)

WAGENINGEN UNIVERSITY & RESEARCH

GMG@wur.nl

GMG: Why? How? What?



- Genetic progress can make a **permanent** and **impressive** contribution to reducing methane output from livestock systems globally
- Aim: **accelerate genetic progress** and to implement **breeding strategies** for reduced methane emissions in ruminants in the **global North and South** by supporting:
  - sharing of protocols and data
  - expanding phenotyping, breeding program design
  - genetic evaluations & development of

  Global Livestock Genetics and Genomics Programs

Global **M**ethane **G**enetics initiative

Investment of 27M US$
25 countries, 50 partners, 25 breeds
Methane pheno- & genotypes ~110k cattle & sheep, ~20k microbiome

Dairy:
Holstein (~42k)
Jersey (~8k)
(Nordic) Red Breeds (~7.3k)
Brown Swiss (~3.3k)

Beef:
North America (~6k)
Australia, Ireland, UK, NZ (~18.5k)

Sheep: world-wide reference population
Australia & New Zealand
UK & Ireland
Uruguay (~17k)

Africa
Local breeds & crosses (~4k)

Latin America
Beef (~7k)

Microbiome:
World-wide reference population
(~20k samples)

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Global Methane Hub

Global **M**ethane **G**enetics initiative

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Dairy:
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Brown Swiss (~3.3k)

Develop protocols
Phenotyping
World-wide sharing
Genetic evaluation

Africa
Local breeds & crosses (~4k)

Latin America
Beef (~7k)

Beef:
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Global Methane Hub

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Asia:
Cattle
Buffalo

Dairy:
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Microbiome:
World-wide reference population
(~20k samples)

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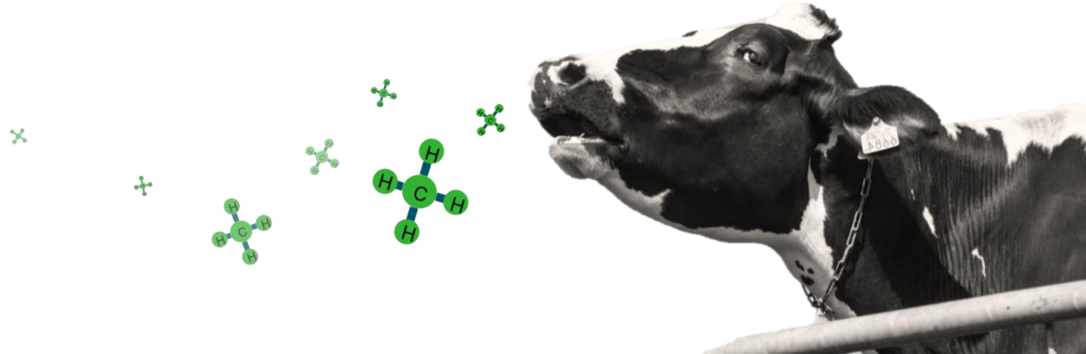
Global Methane Hub

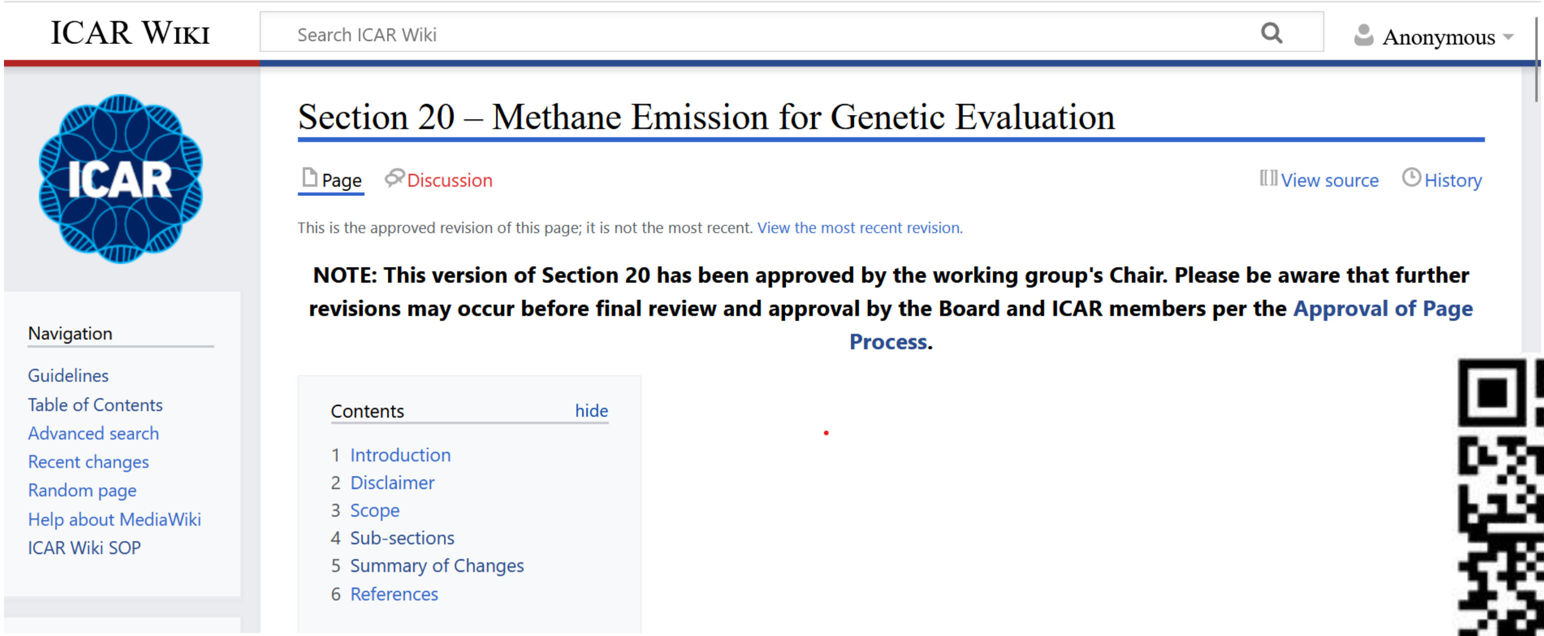
Open GMG working groups

- Dairy – Beef – Sheep – Africa – Latin America – Asia – Microbiome
- Network building
- Share: knowledge, experience, hurdles & issues
- Collaborate on key topics
- gmg@wur.nl



ICAR Feed&Gas guidelines

ICAR Wiki: https://wiki.icar.org/index.php/Guidelines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Section 20 – Methane Emission for Genetic Evaluation

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gmg@wur.nl

birgit.gredler-grandl@wur.nl

Newsletter:

https://www.wur.nl/en/news/methane-emissions-cows-and-sheep-can-be-reduced-25-using-breeding-programmes

Centre for Tropical Livestock Genetics and Health

Introduction to the LMD Technology

Prof Mizeck Chagunda

Director, CTLGH
Chair, Tropical Livestock Genetics
The University of Edinburgh

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Measurements/Estimation Methods

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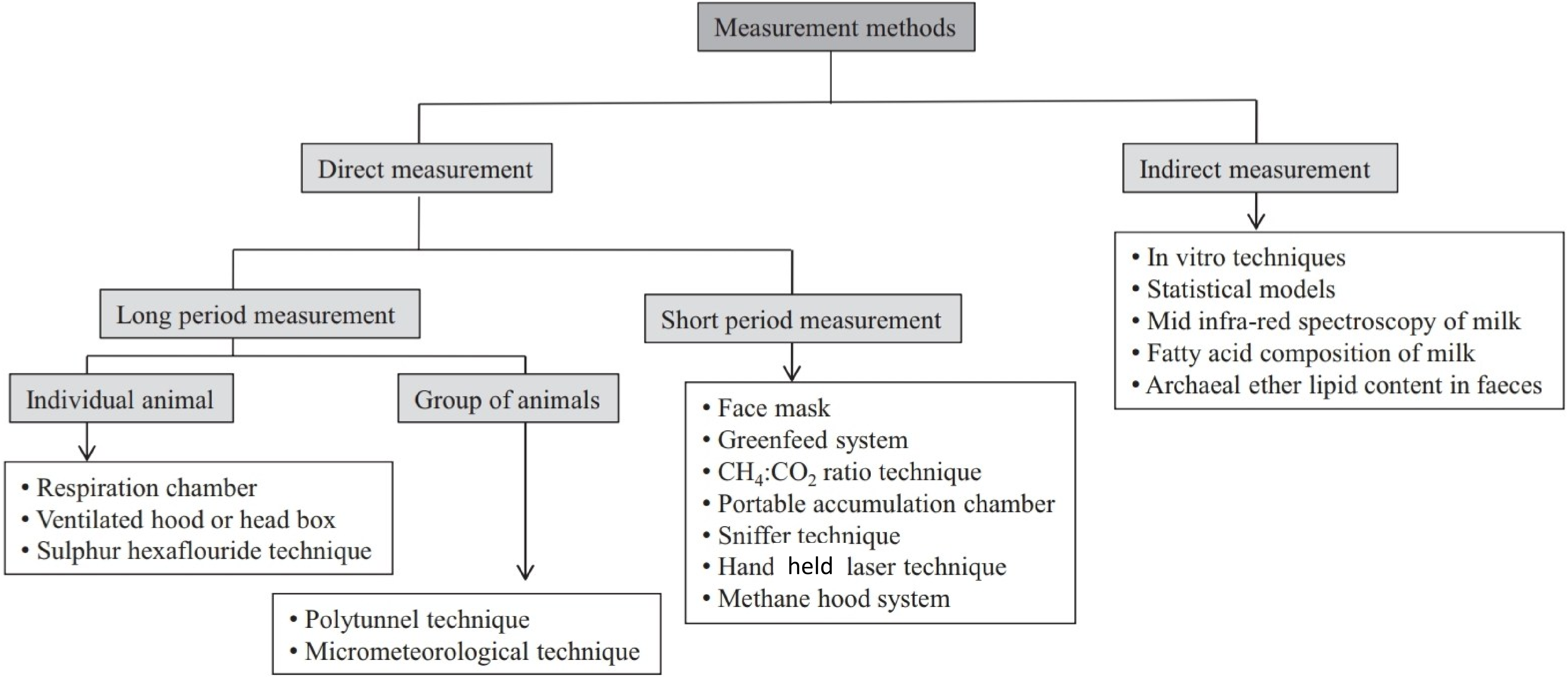

FIGURE 1 | **A schematic presentation of different CH_4 measurement techniques in ruminants using different approaches**.

Source: Patra, 2016

Measurements/Estimation Methods

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Direct Measurements

Invasive/ Change of normal behaviour

- Respiration chamber
- Sulphur hexaflouride technique
- Poly tunnel technique
- Face mask
- Portable accumulation chamber
- CH_4:CO_2 ratio technique

Emmino, 2013

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Laser Methane Detector (LMD)

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- Based on infrared absorption spectroscopy
- Using a semiconductor laser as a collimated excitation source
- Employs second harmonic detection of wavelength modulation spectroscopy to establish methane concentration

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A look at the laser technology

- Laser stands for **l**ight **a**mplification by **s**timulated **e**mission of **r**adiation)
- It is a coherent and amplified beam of electro-magnetic radiation
- The key element in making a practical laser is the light amplification achieved by stimulated emission due to the incident photons of high energy
- A laser comprises three principal components,
    - The lasing medium
    - The means of exciting the lasing medium into its amplifying state (lasing energy source)
    - Its optical delivery/feedback system
- Having photons of the same frequency, wavelength, and phase, makes laser light different from ordinary light and hence can be used to measure different elements with high level of specificity.
- Thus, unlike ordinary light, laser beams are highly directional, have a high-power density, and better focusing characteristics
- It is these principal components and characteristics that are applied in the LMD.

The Technology used

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- Tunable diode laser absorption spectroscopy (TDLAS)
- A laser-based optical technique to detect and measure the concentration of impurities in process gas streams
- TDLAS provides on-line, real-time measurements of impurities in process gas streams with low parts-per-million sensitivity.
- The technology is widely used by gas plant operators for measurements of moisture (H_2O), carbon dioxide (CO_2), hydrogen sulfide (H_2S), and more in gas processes and pipelines.
- By delivering accurate and robust measurements with fast response times, TDLAS offers higher safety, efficiency, and availability with low cost of operation.

Methane Detection

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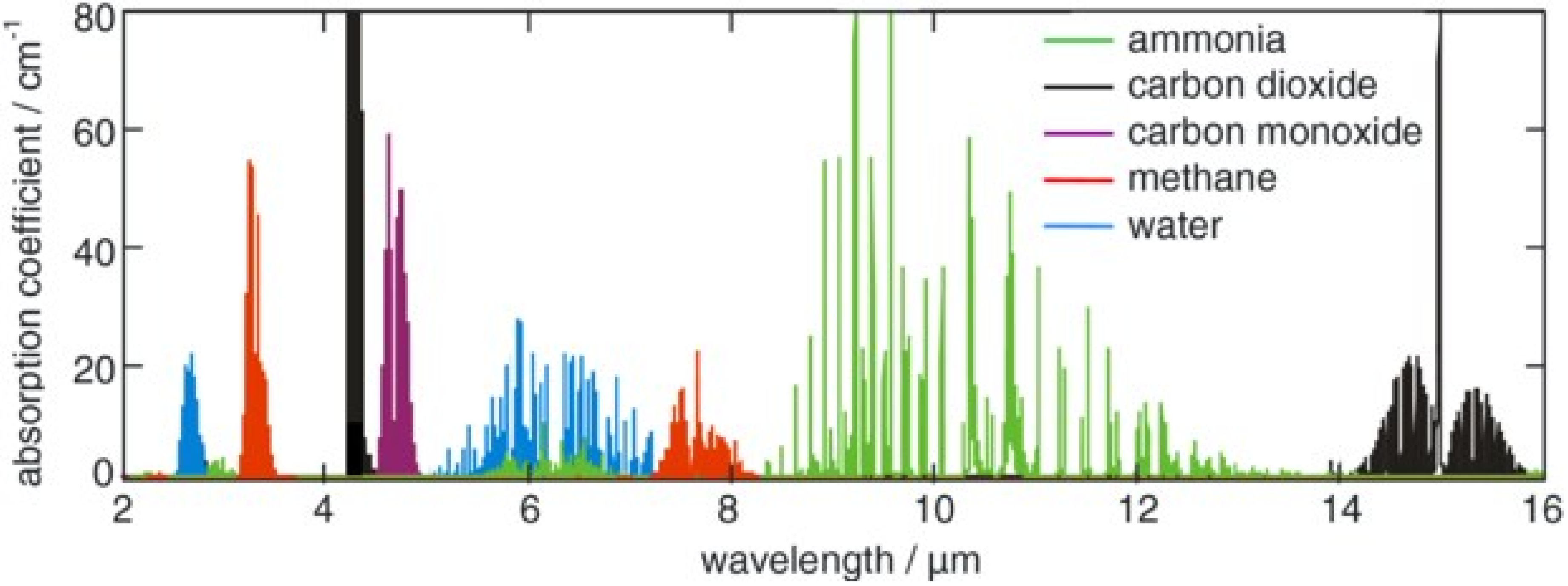


- **Two strong absorption bands** 3.3 and 7.6

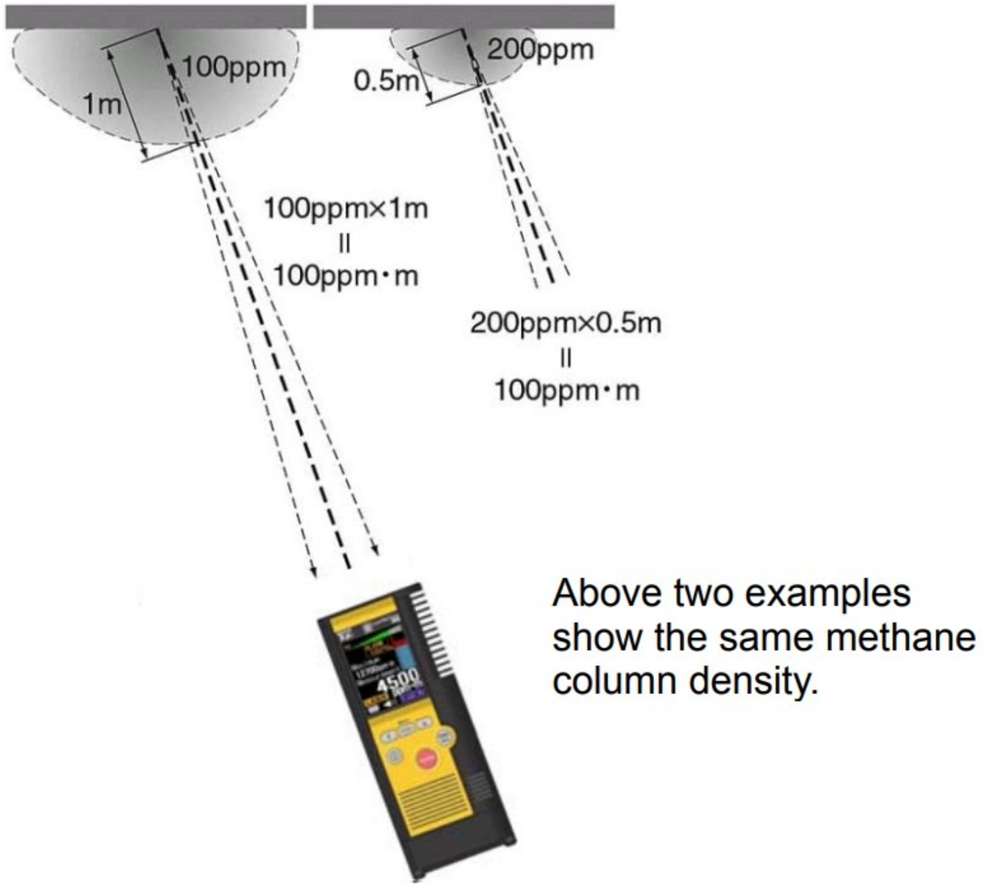
- **Two other bands**

  1.64 and 1.70 (2v3 band)

The Unit (ppm-m)

- Two important concepts to consider
  - Gas balls are three dimensional features
  - Gas movement follows the eddy-covariance phenomenon

- Methane concentration with the thickness of the plume
- ppm x 1m = 100 ppm-m
- 200ppm x 0.5m = 100 pmm-m



Data measuring frequency

Can be set by the user as to how often they record

Source: LMD Manual

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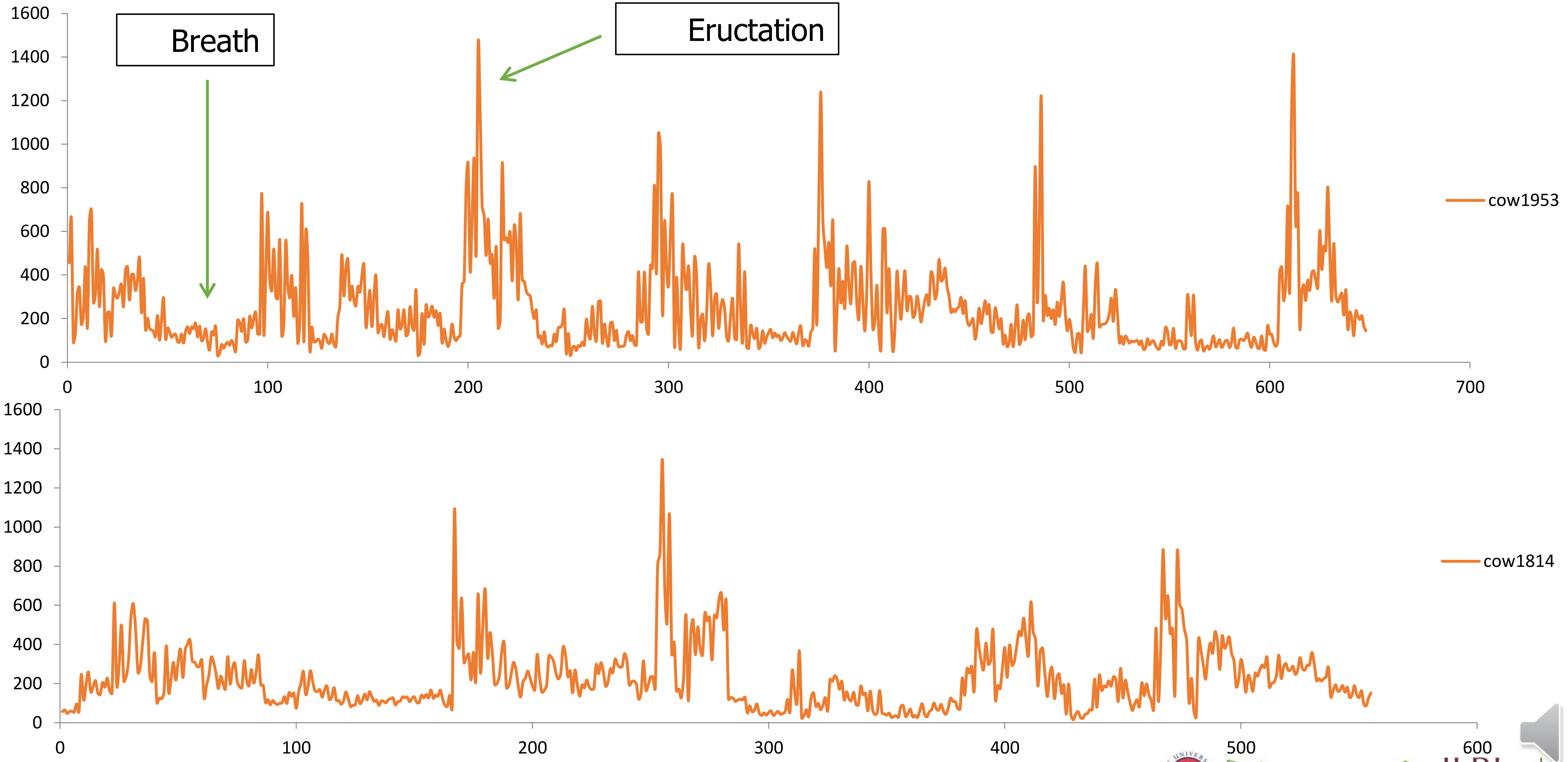
Genetics and Health

Profiles



Data Robustness

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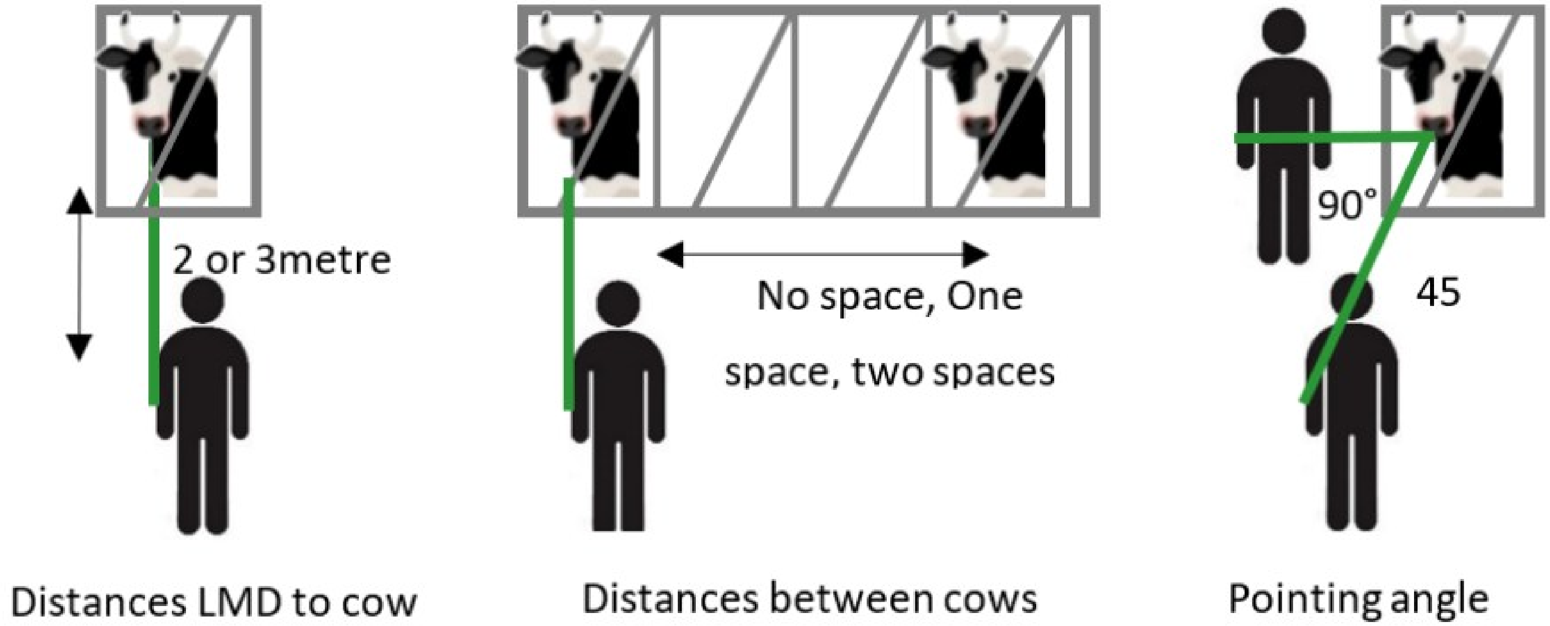

Figure 1. The measurement combinations that were applied during the systematic validation of measuring assumptions of the LMD as applied in dairy cattle.

Sorce: Bore et al

How do the data compared to Chamber data

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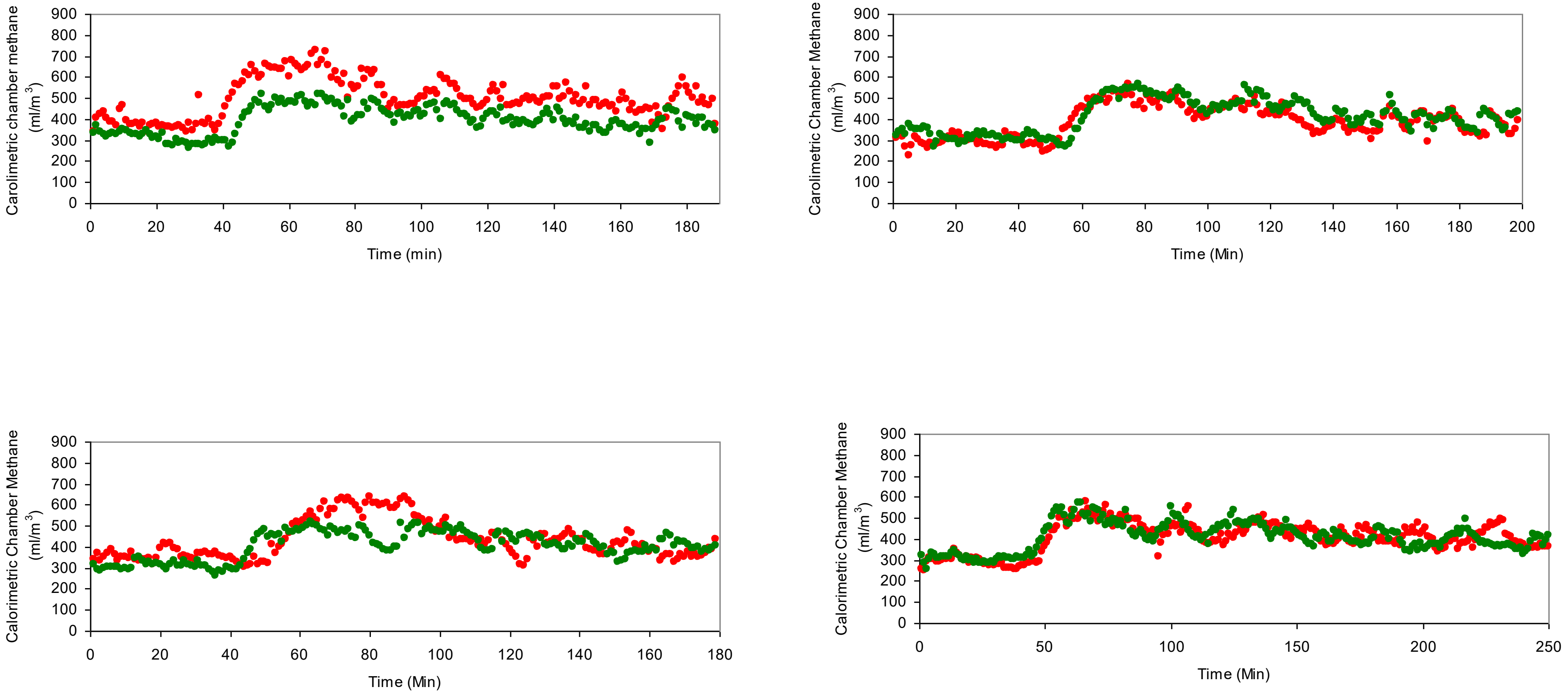
How does LMD data related to metabolic chamber data?



r = 0.8 P<0.001

Chagunda, M.G.G and Yan T. **2011**.

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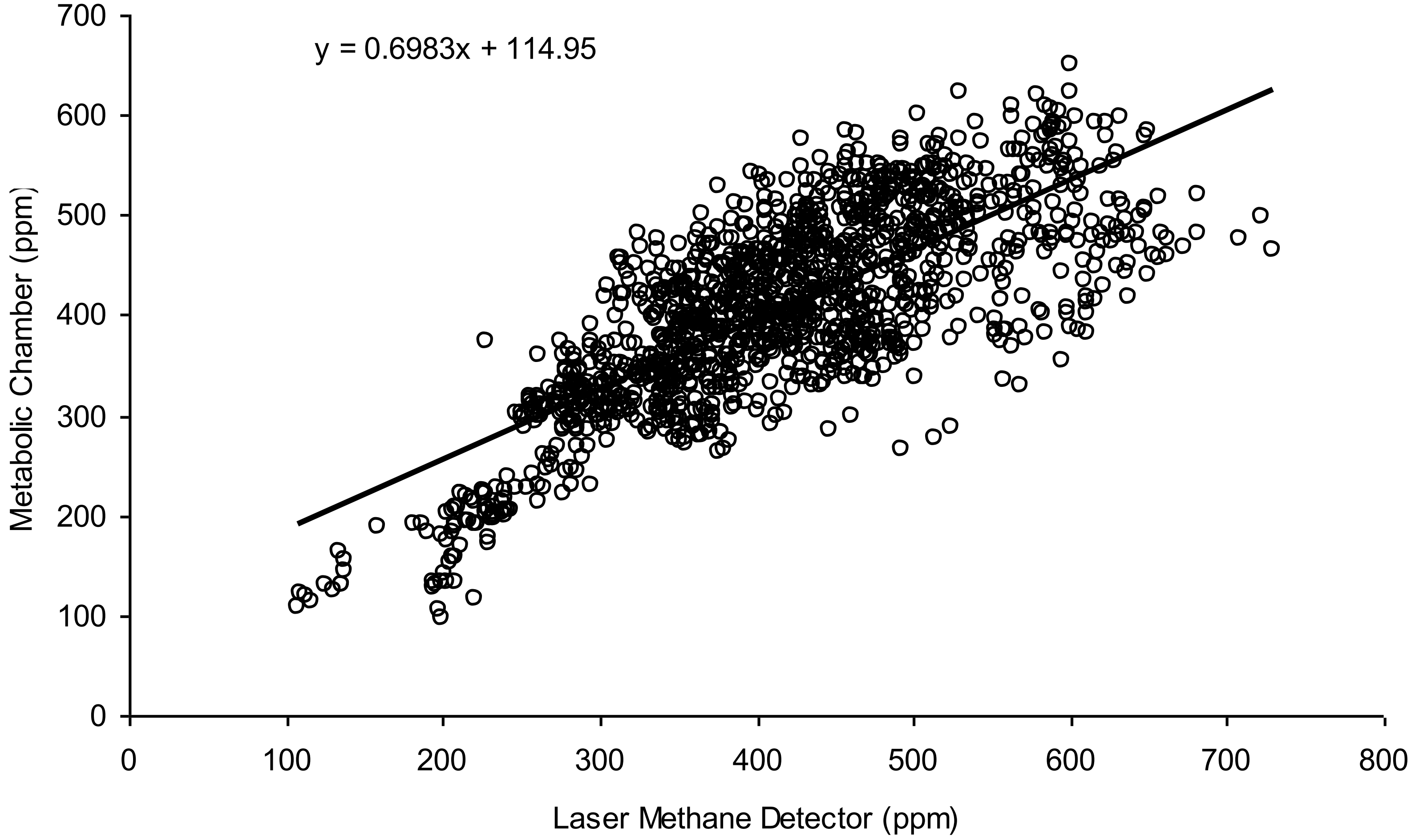
Relationship with chamber measurements



Chagunda, M.G.G and Yan T. **2011**

Relationship to conc.(ppm) chamber methane

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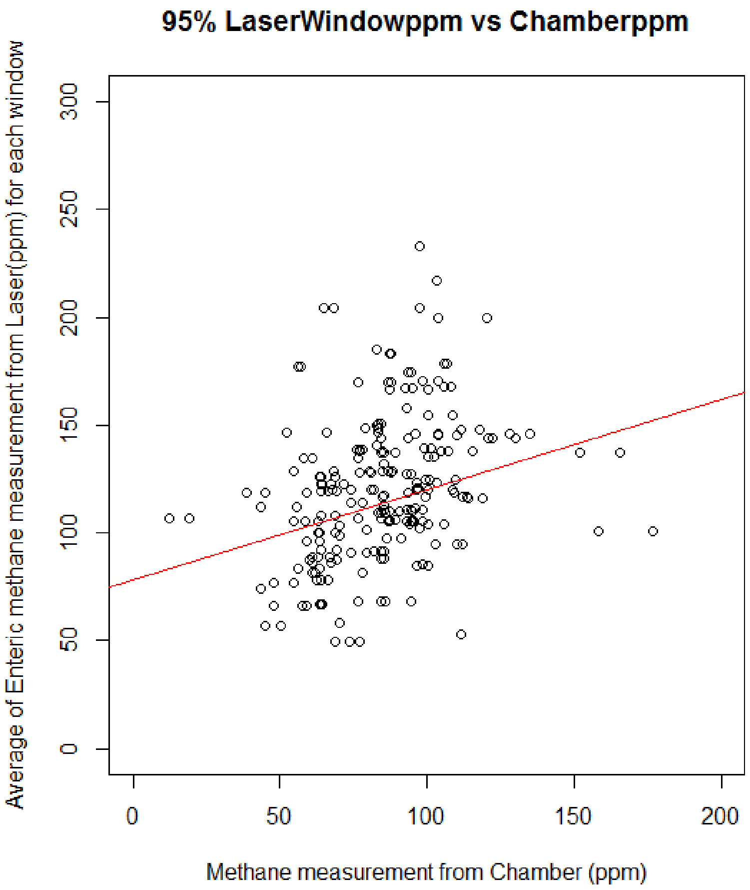

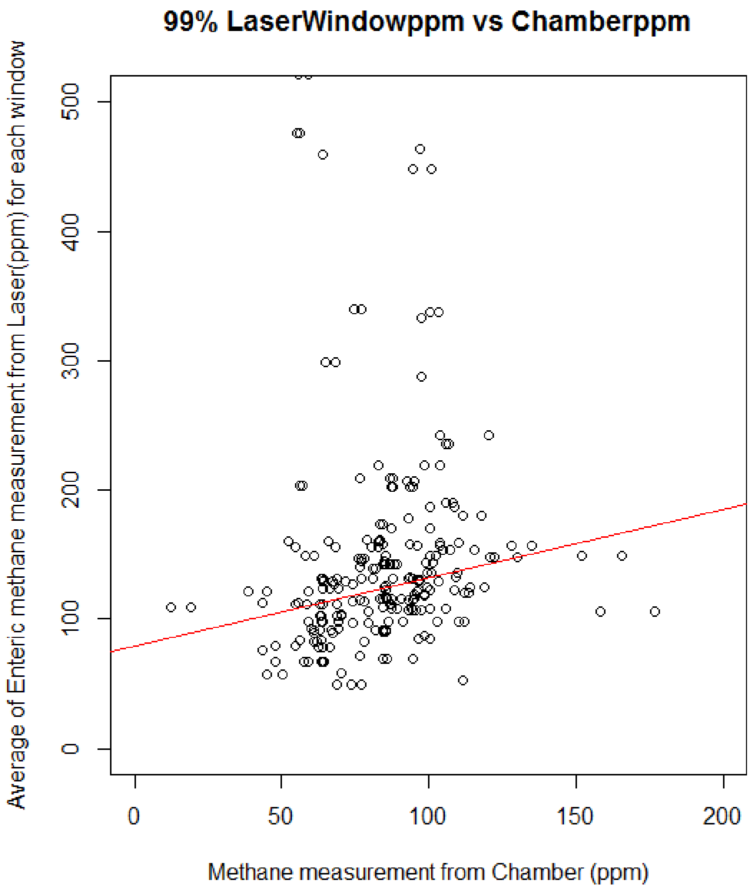

Source: Bruder et al, 2017

Relationship to output (g/day) chamber methane

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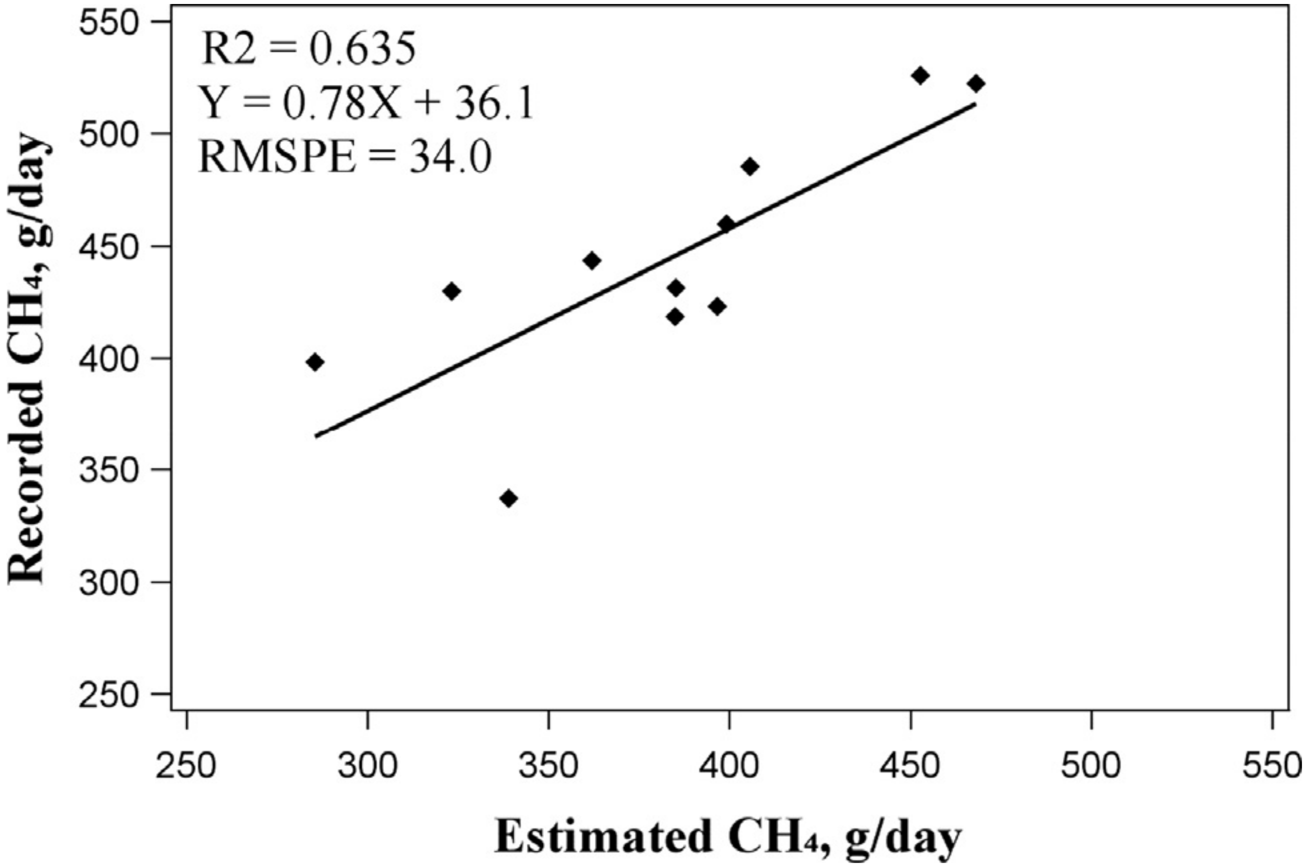

Source: Sorg et al., 2018

Correlation with the chamber

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Correlation	Point of data source	Source
0.86	Chamber expired air	Sorg et al, 2018
0.80	Chamber expired air	Chagunda and Yan, 2011
0.65	Animals in the chamber	Bruder et al, 2018
0.60	Animals in the chamber	Brockelhurst et al, 2019
0.47	Animals in the chamber	Chagunda et al., 2013

Can it be used in different species?

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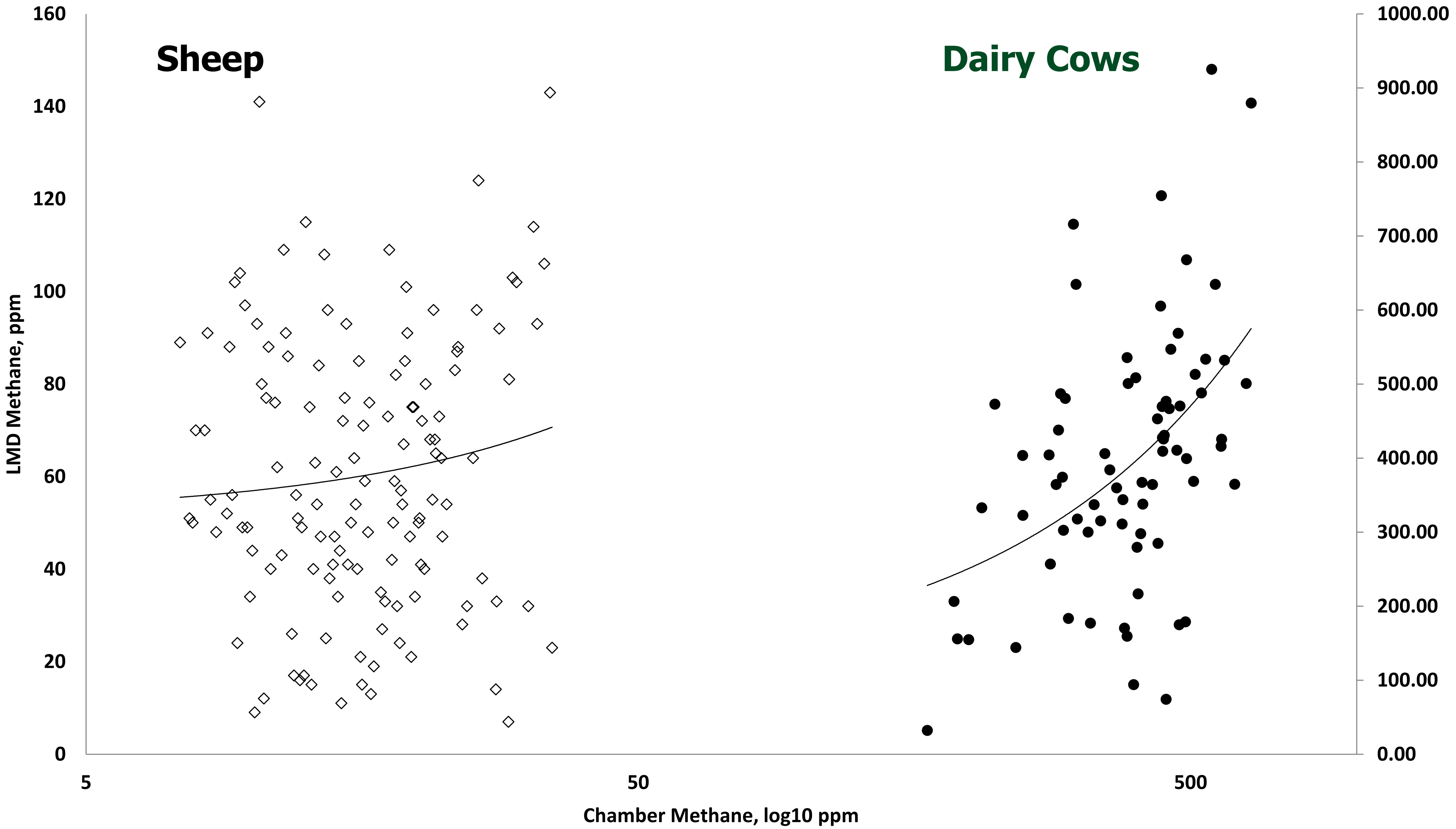

Chagunda et al., 2013

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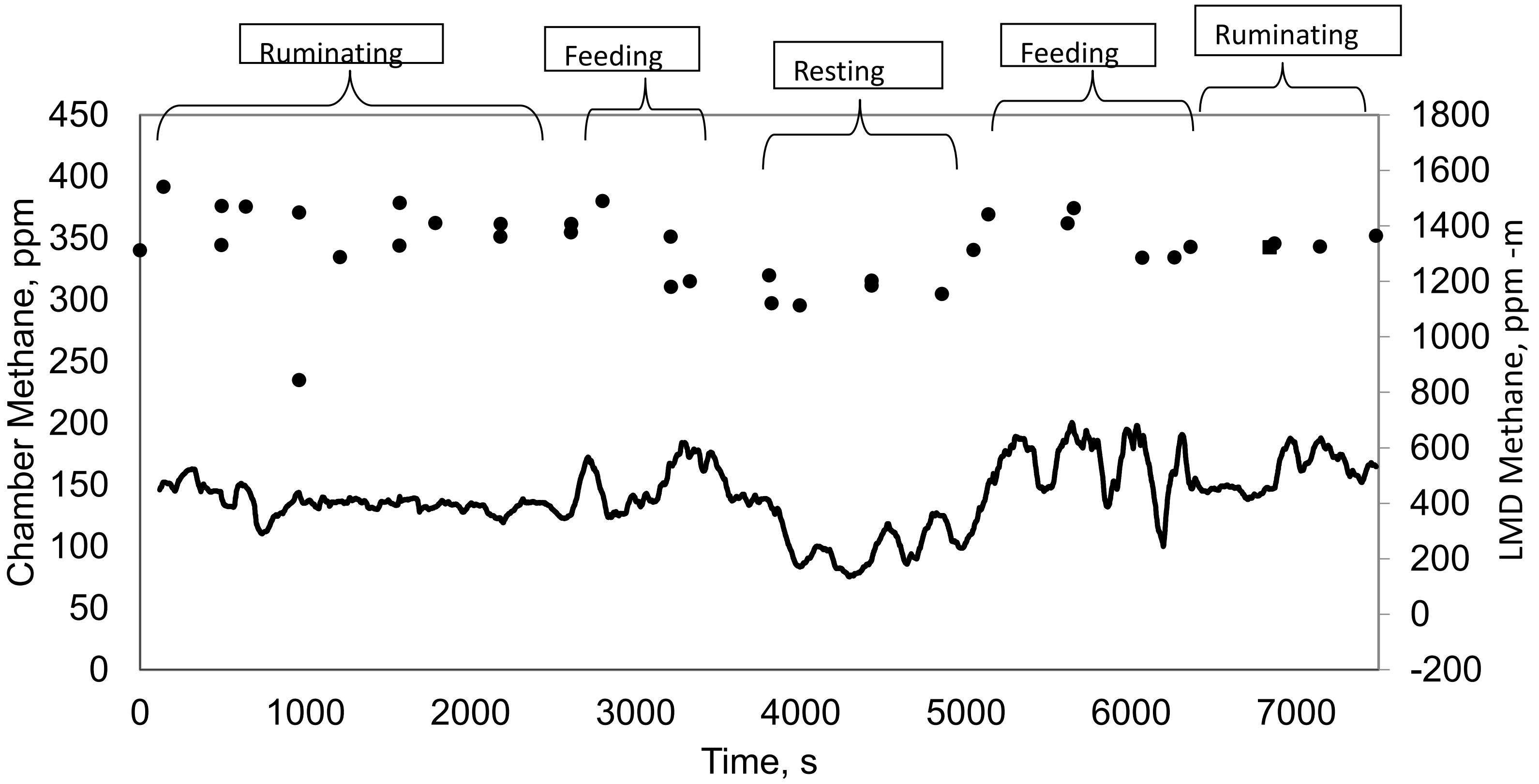
Do the measures reflect different animal activity?



Chagunda et al., 2013

Picking up feed differences

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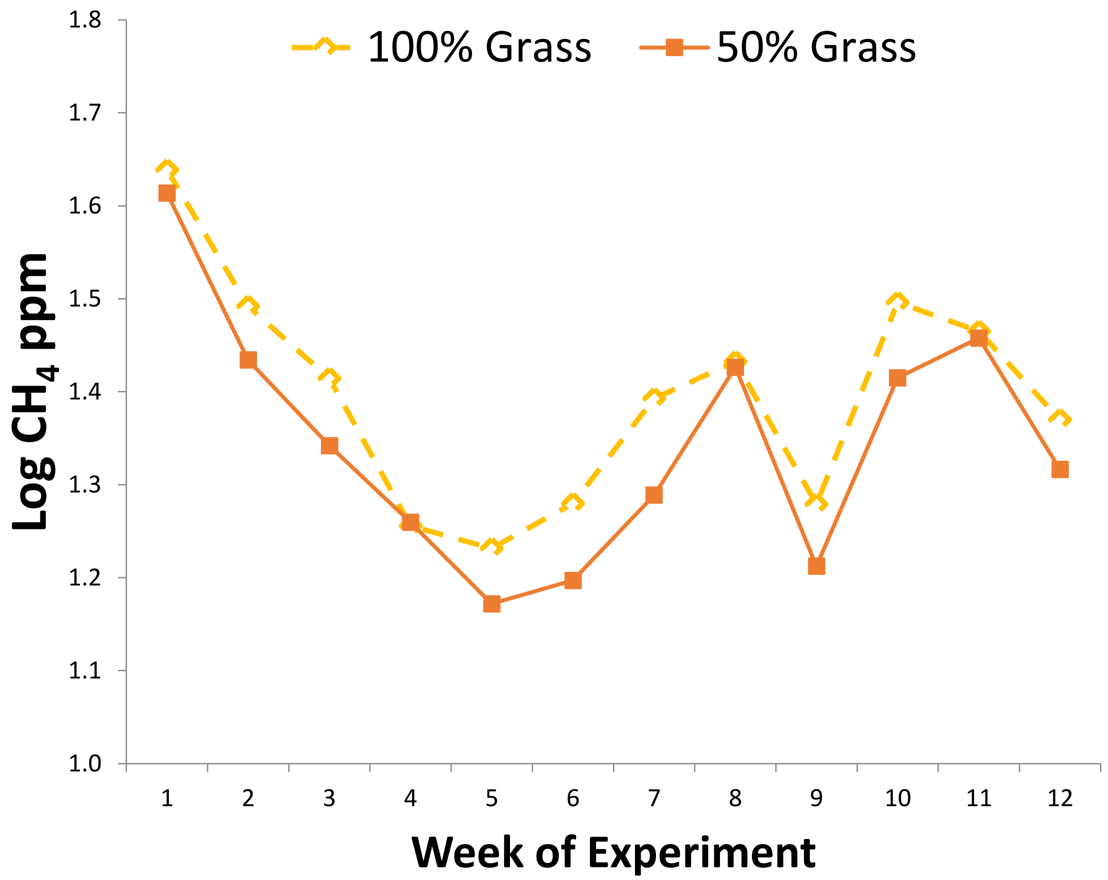

Source: March et al, 2019

Increased feeding rate results in increased methane emissions

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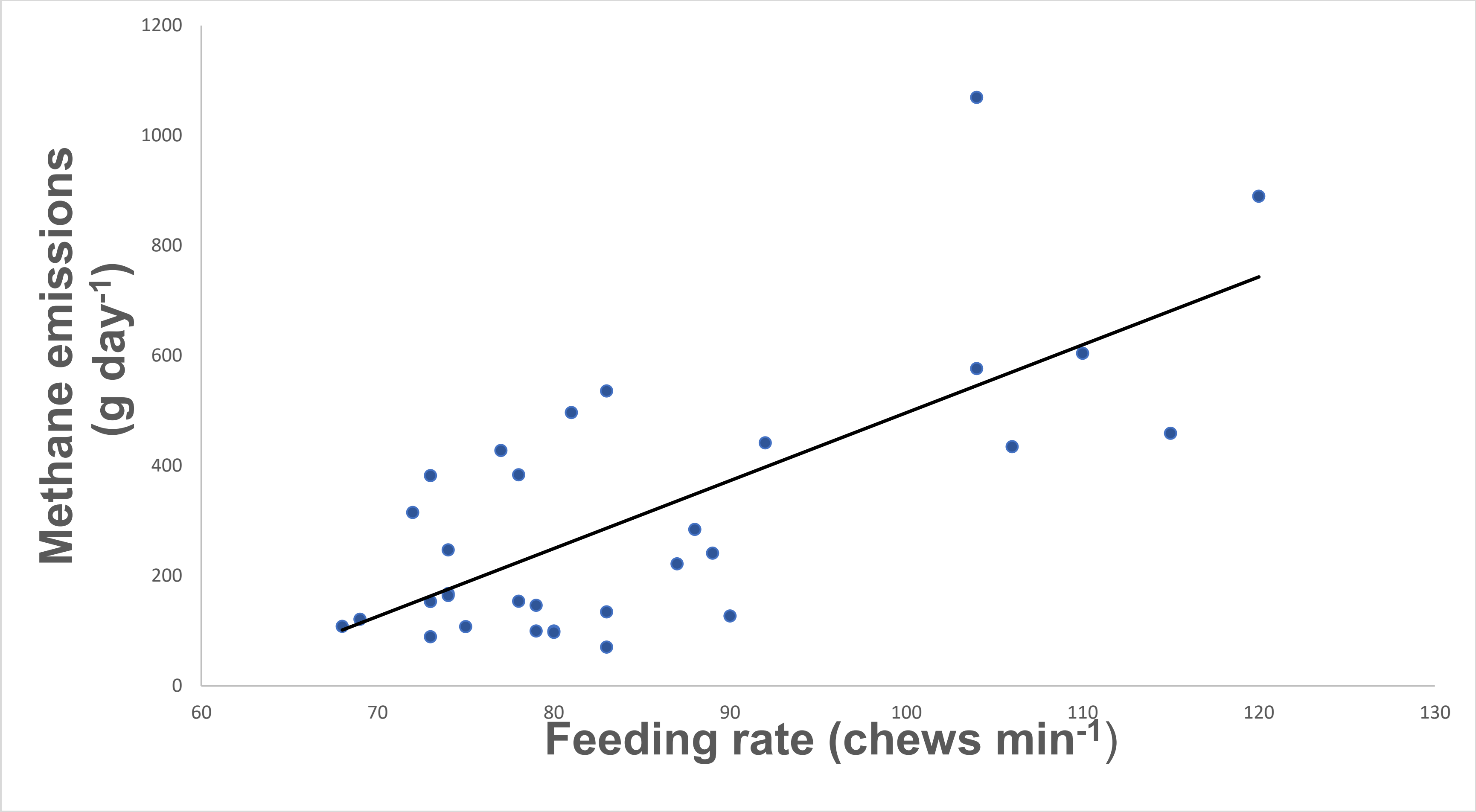

Source: Cameron, 2015

Health treatment groups

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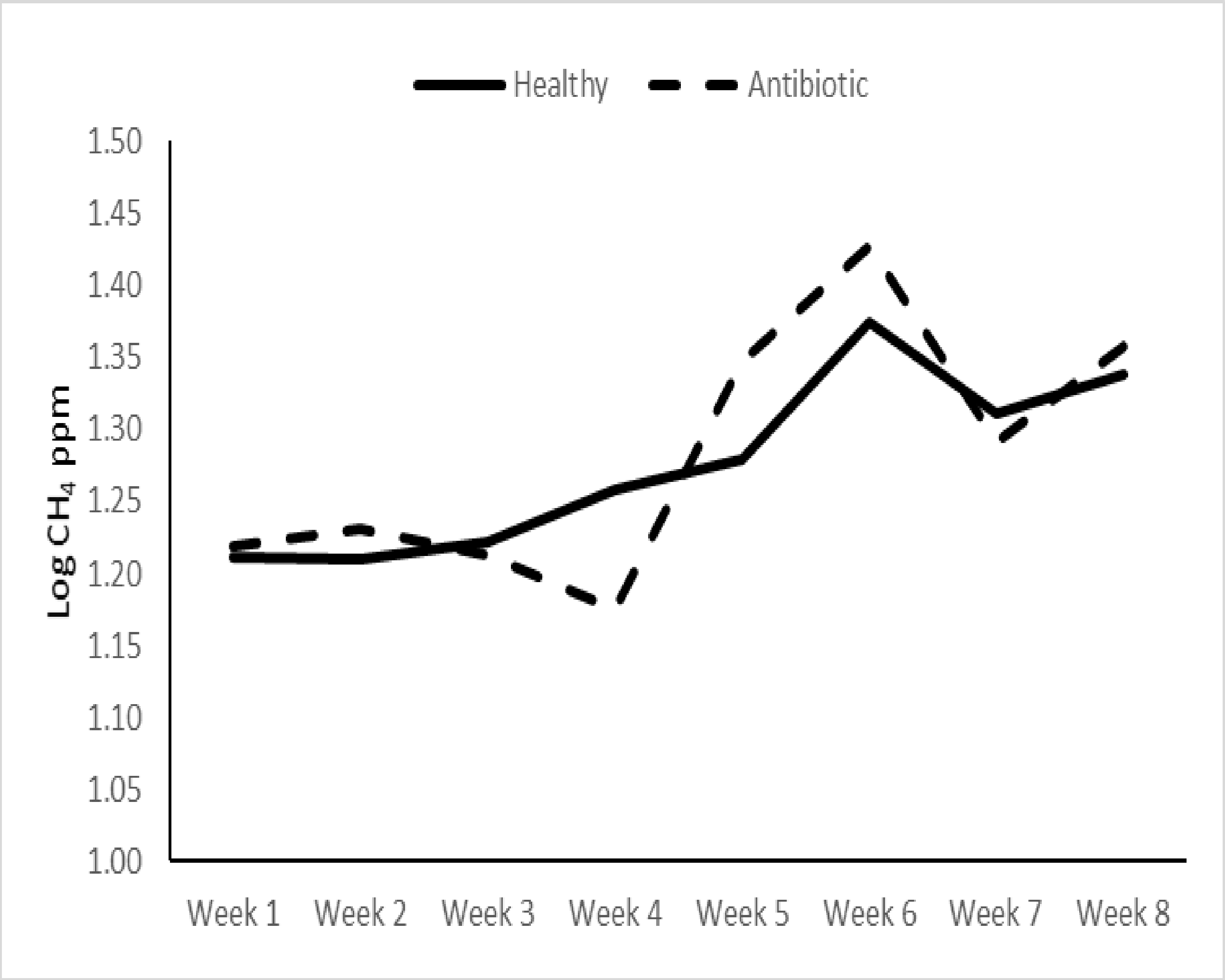

Source: Hargreaves et al., 2019

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Individual Animal variation

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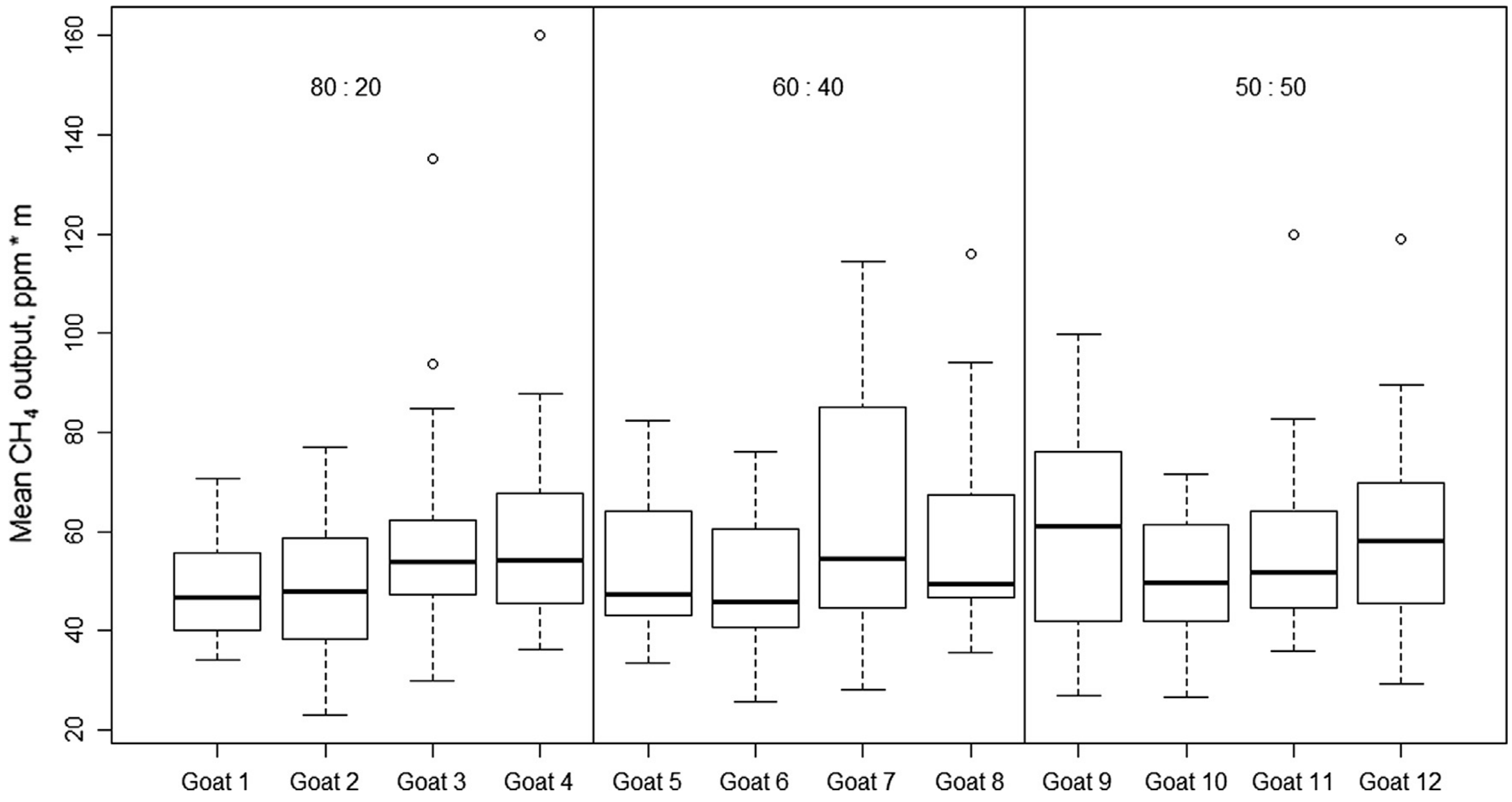

Source: Roessler et al., 2018

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In comparison with IPCC Equation

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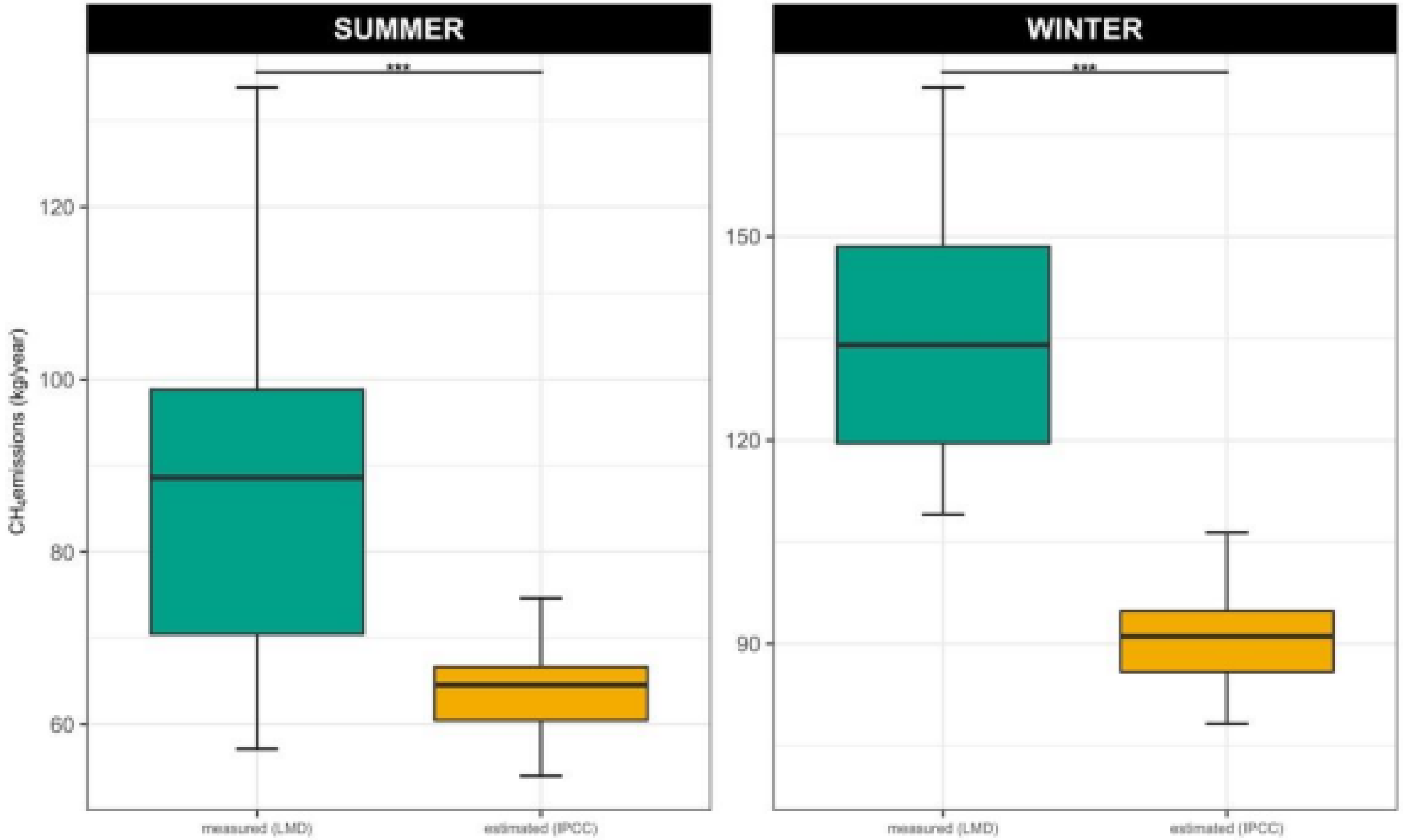


Figure 2. Seasonal CH_4 average values (kg/head/year) estimated with IPCC equation or measured with LMD (*** = $p < 0.01$ between estimated and measured values).

Sorce: Lanzoni et al., 2022

How sensitive and specific are the measurements?

- Sensitivity: the ability of the LMD to recognise actual high CH4 measurements i.e. TP/(TP+FN) * 100

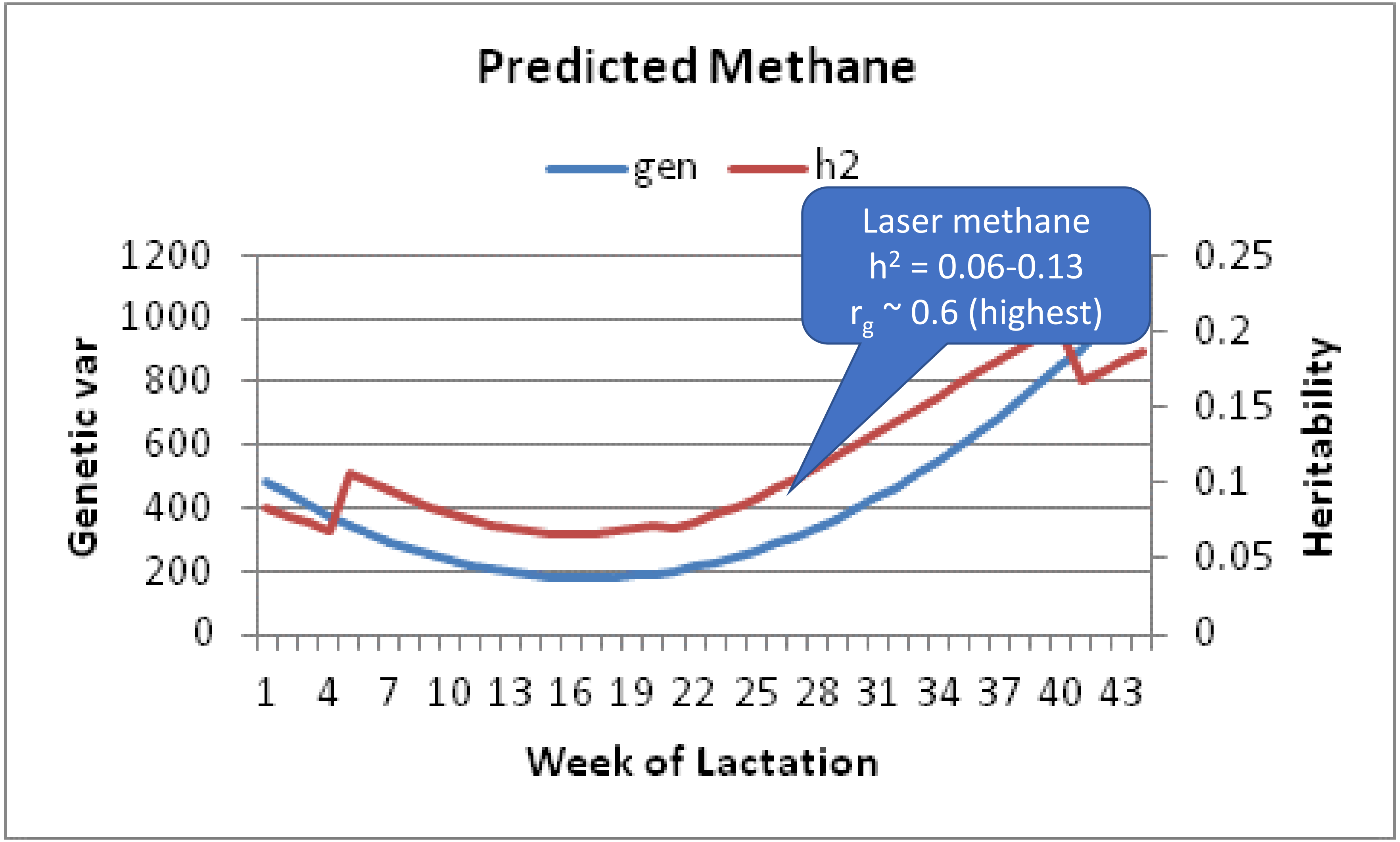
- Specificity: ability of the LMD to recognise actual low measurements; i.e. TN/(TN+FP) * 100.

- Sensitivity and specificity for cows were 95.4% and 96.5%.

- For sheep, sensitivity was 93.8% and specificity was 78.7%.

Chagunda et al., 2017

Any Genetic Component?



Pickering et al, 2015

Heritability estimates, phenotypic correlations and genetic correlations

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model[1]	single			mean		
phenotype[2]	pmean	emean	eME	pmean	emean	eME
pmean	**0.05**	0.91	0.77	**0.18**	0.95	0.83
emean	0.83	**0.04**	0.70	0.85	**0.08**	0.78
eME	0.92	0.77	**0.08**	0.87	0.76	**0.18**

[1] model: single = repeatability model, mean = animal model

[2] phenotype: pmean = mean of all peaks, emean = mean of the maxima of the eructation events, eME = estimation of the daily CH_4 emission

N = 1,660 profiles from 622 Holstein cows

Source: Mühlbach et al., 2018

Genetic parameter estimation

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- Repeatability model using pedigree only (PBLUP) or plus genotypes (HBLUP)

	HBLUP		PBLUP	
model	h2	pe	h2	pe
Cow status, year-season, avgfarmMY (fixed)+ pe	0.10 (0.02)	0.06 (0.01)	0.09 (0.03)	0.08 (0.02)

- Repeatability based on year-season means

	HBLUP		PBLUP	
Model	h2	pe	h2	pe
year-season, avgfarmMY (fixed)+ pe	0.19 (0.04)	0.12 (0.04)	0.14 (0.06)	0.17 (0.06)

- Heritabilities varied from 0.10 to 0.19

Mrode et al., 2025

Number of LMD records per cow needed for prediction from MIR

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Based on 464 cows with at least 12 records on methane

Average records	Accuracy	RMSE
1	0.24	168
2	0.28	149
3	0.29	133
4	0.37	124
5	0.39	122
6	0.45	116
7	0.47	116
8	0.45	109
9	0.45	107
10	0.45	106
11	0.46	105
12	0.45	106

Insights

- The Laser Methane Detector has a very good potential as a proxy for methane measurements

- Data can help even in developing robust inventories in the whole system analysis applying Life Cycle Analysis

- Has demonstrated that enteric methane emissions are a heritable trait

https://climate.nasa.gov/effects/

CTLGH Funders

Laser Methane Detector (LMD) Use in Sheep: Field Applications and Methodological Insights

Presenter: Emna Rekik

PhD candidate at BOKU, Vienna
Institute of Livestock Sciences.
Fellow at ICARDA, Ethiopia.

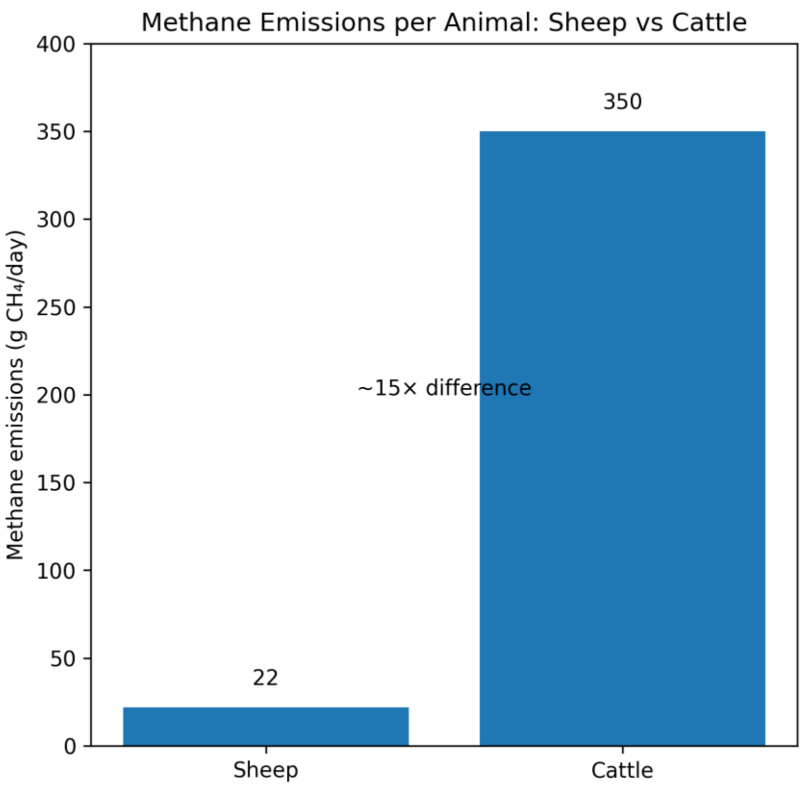
BOKU UNIVERSITY

ICARDA

Laser Methane Detector (LMD)

- The device has been originally designed to detect CH_4 from gas leaks in mining, the petrochemical industry, and landfills.
- The L-TEK P100 utilises TDLAS technology to monitor methane and methane-containing gas concentrations in a target area by leveraging the specific absorption characteristics of methane at certain laser wavelengths of wavelength at 1.64 to 1.70 µm
- there is little interference from other gases at this wavelength.

Methane Emissions per Animal: Cattle vs Sheep



Compared to cattle, sheep emit roughly an order of magnitude less methane, around 20 grams per day versus 300–400 grams in cattle. This has direct implications for LMD measurements, as the methane plume in sheep is much weaker, requiring more sensitive protocols, longer measurement durations, and stricter control of measurement conditions

Practical Considerations in Field Deployment

No standard protocol yet:
To date, there is no universally accepted protocol for using the LMD. The methodology often depends on:

- The **type of animal** being studied
- The **objective** of the research
- The **production system** (e.g., intensive farming vs. extensive)
- The **environmental context** (e.g., open field vs. barn)

However, based on accumulated experience from multiple studies, we now understand what factors can affect LMD accuracy and what conditions improve measurement quality.

Key aspects to standardize in any study:

- Measurement duration
- Number of repetitions
- Distance from the animal
- Animal handling
- Time of the day
- Season
- Interval between feeding and measurement

Measurement Duration

🎯 **Measurement Duration Challenge in Sheep**

⚠️ **Observation**

- Animals measured for **5 minutes over 3 consecutive days**

After data processing:

  - **~30% of animals showed no eructation event** within 5 minutes

Why This Matters

- **Eructation = main pathway of methane release**
- Provides the **most representative signal** of emissions
- If absent:
  - Signal is dominated by **respiration**
  - → **Underestimation of methane emissions**

Measurement Duration

- Each measurement should include at least three eructation events, identified by the acoustic ‘beep’ of the LMD. While an eructation may occur within the first 5 minutes, in some cases it can take up to 30 minutes to observe one.
- To avoid excessive time spent on a single animal, if no eructation is detected within 10 minutes, the measurement is stopped and the animal is revisited later.

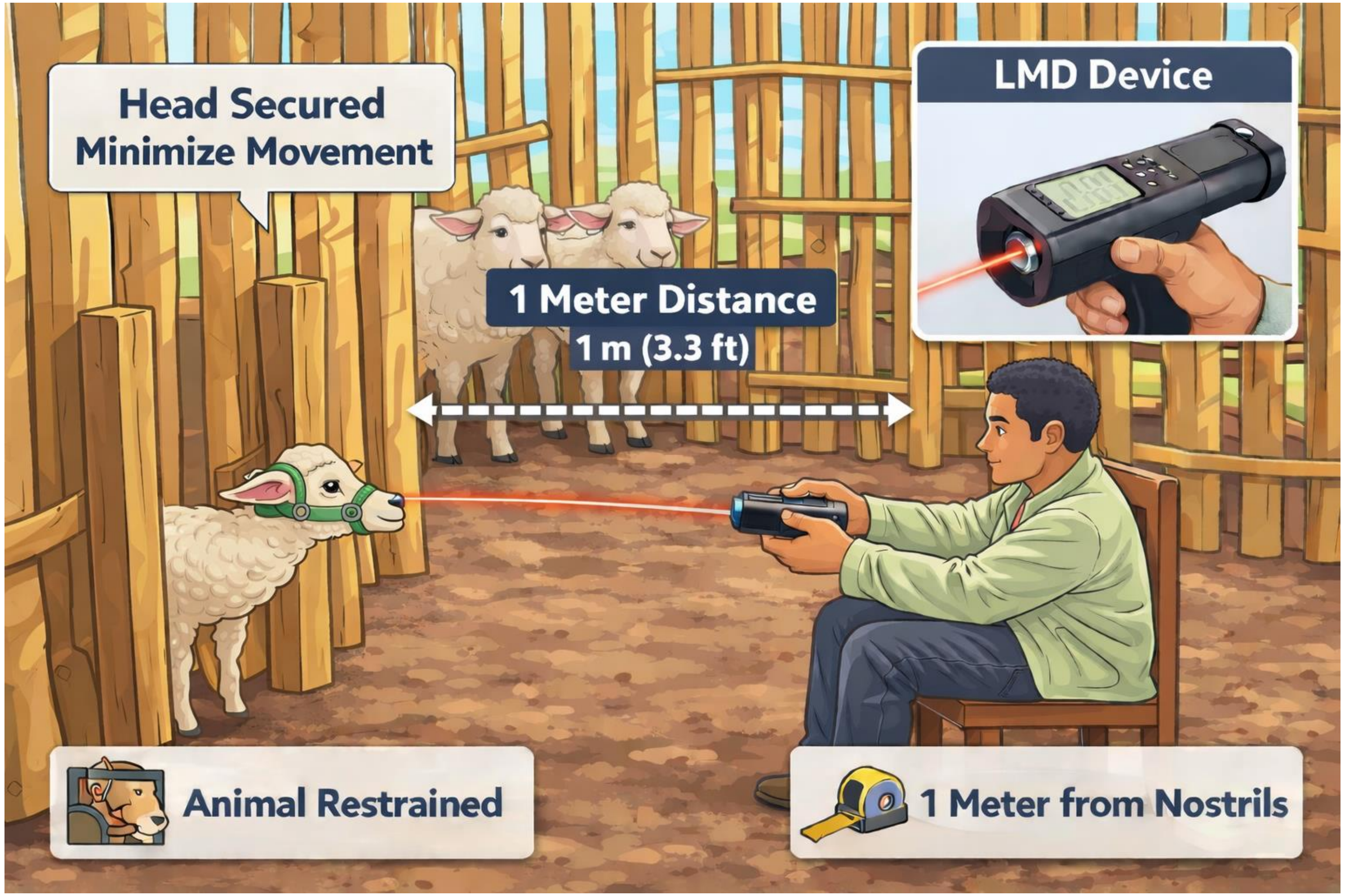
Number of repetitions

“Why 3 days per round?”

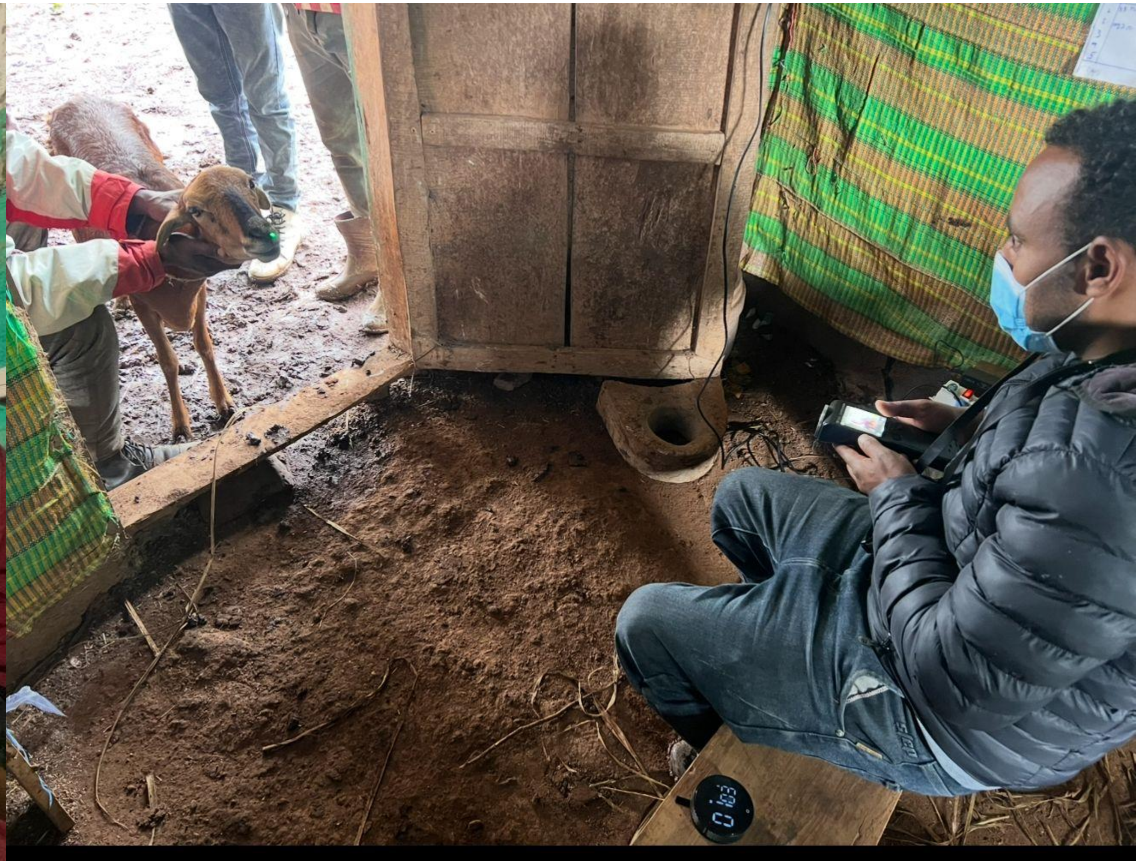
- Spot methane measures show large within-animal day-to-day variability.
- LMD guidance recommends measurements on **≥3 consecutive days** under consistent conditions.
- Multi-day averaging is standard in methane methods (respiration chambers 2 days; SF_6 5–8 days…).

Distance from the animal

- Based on our field experiments, a distance of 1 m between the LMD and the animal's nostrils represents an optimal compromise, minimizing environmental interference (e.g. wind dilution) while remaining sufficiently distant to avoid disturbing or stressing the animal.



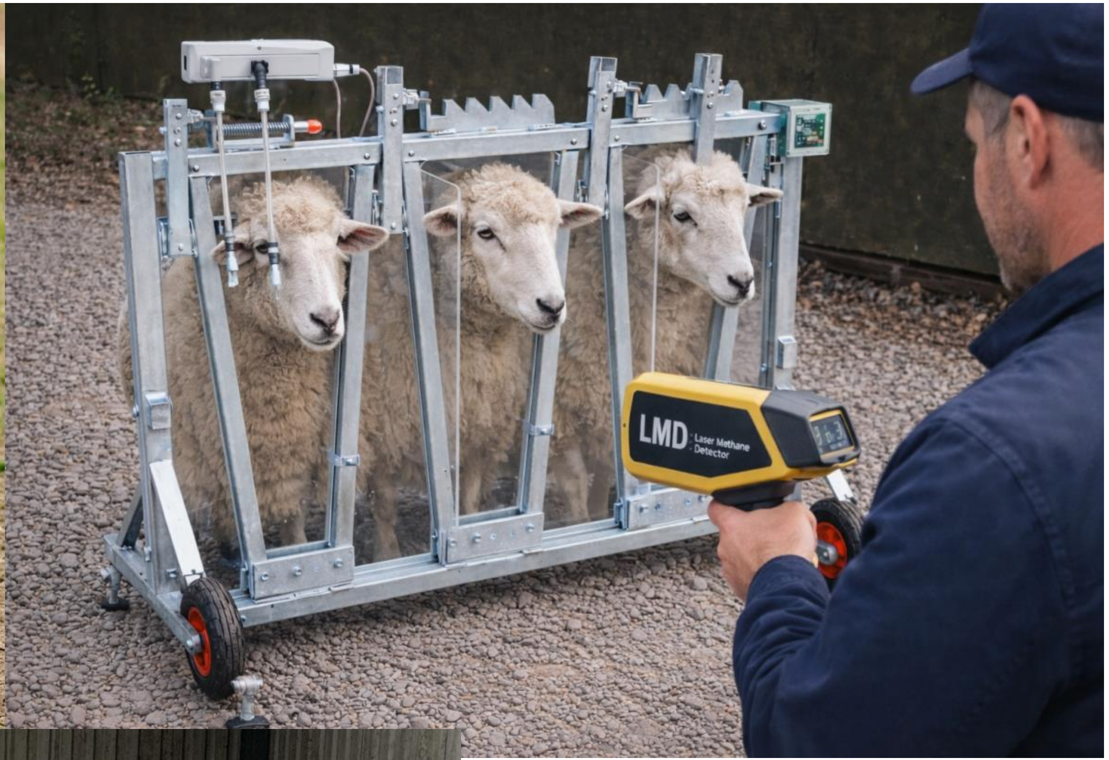
Animal handling



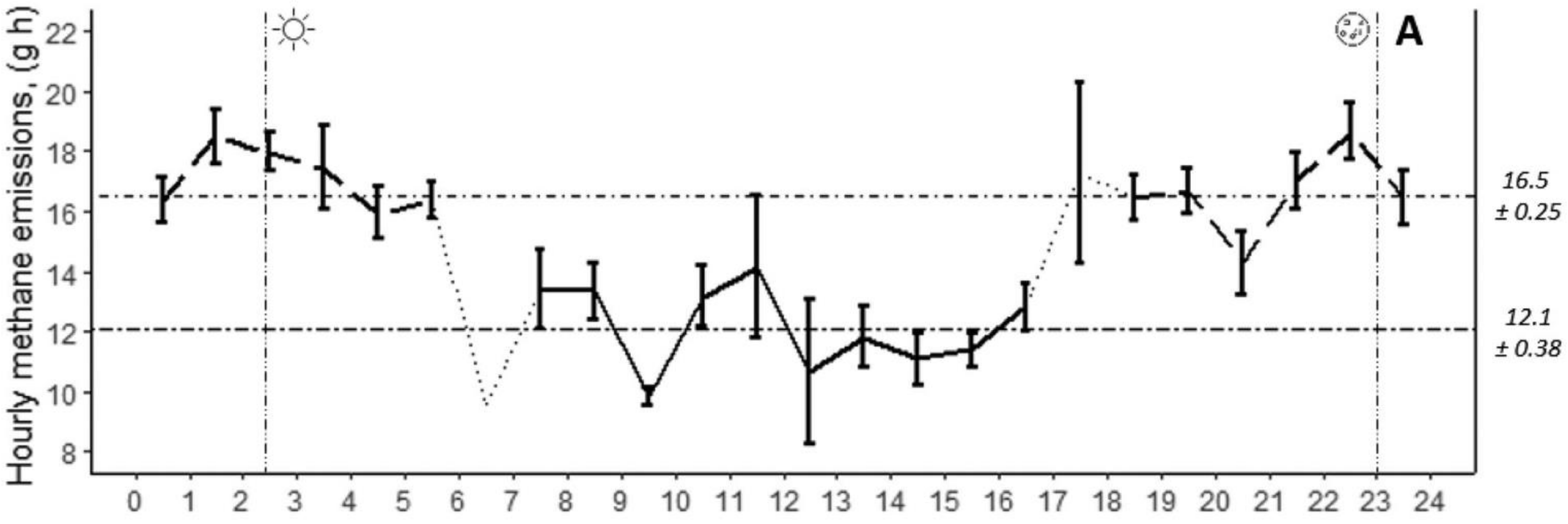
Not favorable causes stress to animal, but sometimes it’s necessary when animal is agitated


14
ppm-m
B

Keeping other animals nearby helps maintain calm behavior in the measured sheep and improves operational efficiency, as the next animal can be measured immediately without additional handling or relocation.


LMD
Laser Methane
Detector

Time of the day



Diurnal variation is important in methane studies because emissions from ruminants fluctuate throughout the day in response to feeding and rumination cycles. Methane production typically increases after feed intake and during periods of active rumination, leading to distinct peaks at specific times of the day. As a result, measurements taken at a single time point may not accurately represent an animal's daily methane output.

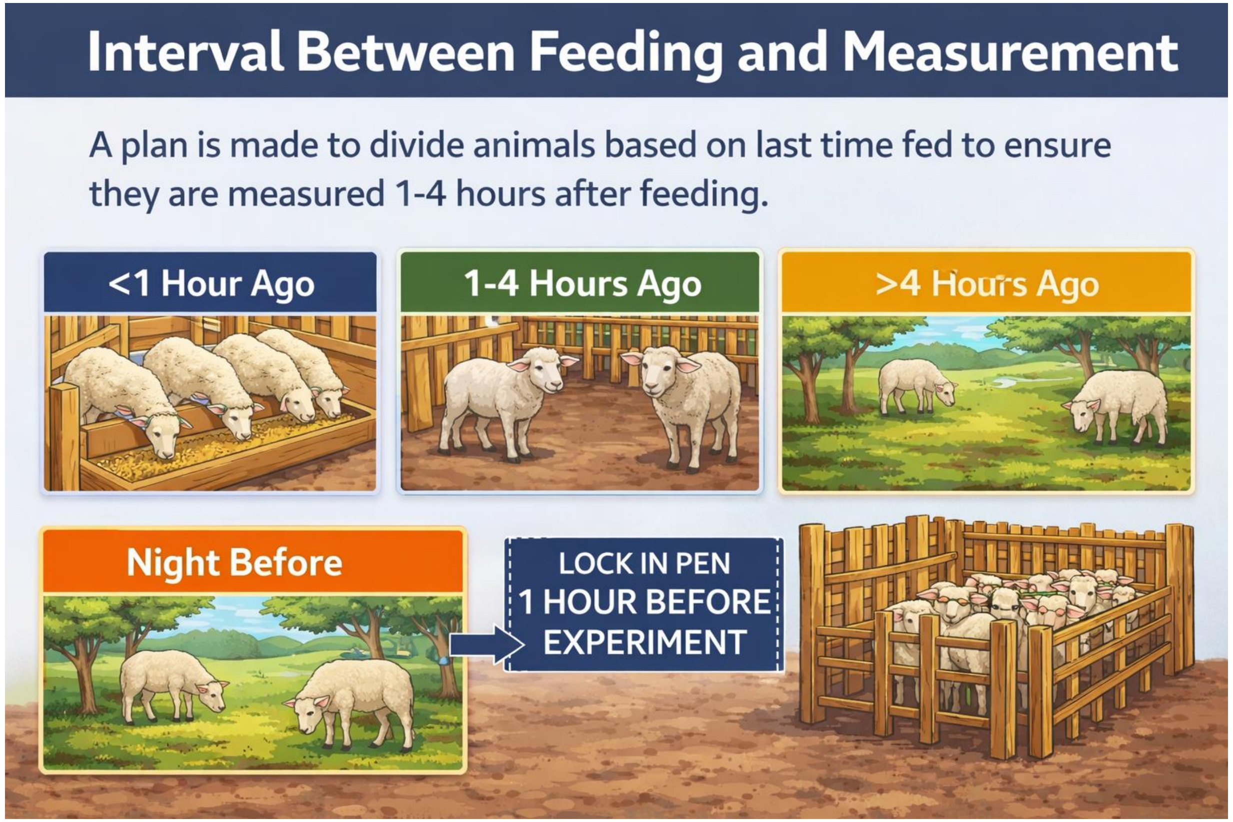
Season

“Why repeat each season?”

- Methane is environment-sensitive (diet quality, intake, heat stress, water/forage constraints).
- EBVs require phenotypes that represent the animal across its typical production environments.
- Sheep and goats are highly influenced by seasonal changes, so it is important to include repeated measurements across different seasons to capture this variability accurately.

Interval between feeding and measurement

Animals should be measured 1–4 hours after feeding. While this is manageable in controlled research farms, it is more challenging when animals are brought by farmers; therefore, animals must be grouped according to their last feeding time, and those fed the night before should remain grazing and then be locked in a pen one hour prior to the experiment.



Field Team Organization and Data Recording

Precise recording of the time of measurement is critical, as it will later be linked to the animal ID during data handling. The field team should consist of at least three people: one responsible for operating the LMD, one dedicated to recording all relevant information (time, animal ID, farmer name, age, physiological status, weight, number of beeps, and measurement duration), and a third person to rotate with the operator. Although the task may appear simple, holding the device in a fixed position for extended periods is physically demanding, and regular breaks are necessary, particularly to avoid back strain

Data sheet:

bloodsampleID	order day1	Farmer Name	Village	AnimalID	Animal Type	Sex	Colour	Breed	Weight	Feed time	Status	dateday1	tartingtimeday	E
BQ2001	1	Tarekegn Legesse	Boka	BQ0025222	Ewe parity 4 dry	F		Bonga	35.00	Recent		28/07/2025	09:24:00	
BQ2003	2	Tarekegn Legesse	Boka	BQ0033823	Ewe parity 1 dry	F		Bonga	30.50	Recent		28/07/2025	09:33:00	
too young	3	Tarekegn Legesse	Boka	BQ0010725	Ewe lamb	F		Bonga	18.50	Recent		28/07/2025	09:40:00	
BQ2009	4	Tarekegn Legesse	Boka	BQ0004125	Lamb 3month	M		Bonga	21.00	Recent		28/07/2025	09:50:00	
BQ2012	5	Tarekegn Legesse	Boka	BQ0001823	Ram 1.5 year	M		Bonga	48.00	Recent		28/07/2025	09:58:00	
BQ2005	6	Admasu Abera	Boka	BQ0000822	Ewe parity 3	F		Bonga	33.50	Recent		28/07/2025	10:18:00	
BQ2004	7	Admasu Abera	Boka	BQ00062821	Ewe parity 8 lactating	F		Bonga	35.40	Recent		28/07/2025	10:24:00	
BQ2002	8	Admasu Abera	Boka	BQ0006422	Ewe parity 5 lactating	F		Bonga	32.00	Recent		28/07/2025	10:31:00	
BQ2006	9	Admasu Abera	Boka	BQ00045722	Ewe parity 2 pregnant	F		Bonga	34.50	Recent		28/07/2025	10:38:00	
BQ2007	10	Admasu Abera	Boka	BQ00010825	Lamb 6month	F		Bonga	23.00	Recent		28/07/2025	10:44:00	
BQ2008	11	Aster Abebe	Boka	BQ00011025	Ewe parity 5 lactating	F		Bonga	34.50	Recent		28/07/2025	11:04:00	
BQ2010	12	Aster Abebe	Boka	BQ0010925	Ewe parity 1 pregnant	F		Bonga	28.00	Recent		28/07/2025	10:58:00	
BQ2011	13	Aster Abebe	Boka	BQ00011125	Lamb 4month	M		Bonga	16.30	Recent		28/07/2025	11:11:00	
BQ2024	14	Aster Abebe	Boka	BQ00012225	Lamb 4month	F		Bonga	12.30	Recent		28/07/2025	11:17:00	
BQ2015	15	Ayalew Aremu	Boka	BQ00035222	we parity 3 and pregnan	F		Bonga	34.80	Recent		28/07/2025	11:25:00	
BQ2013	16	Ayalew Aremu	Boka	BQ00027123	Ewe parity 3 lactating	F		Bonga	27.80	Recent		28/07/2025	11:35:00	
BQ2016	17	Ayalew Aremu	Boka	BQ00011325	Lamb 5 month	F		Bonga	18.80	Recent		28/07/2025	11:42:00	
BQ2014	18	Ayalew Aremu	Boka	BQ00011225	Ewe lamb, pregnant	F		Bonga	29.00	Recent		28/07/2025	11:47:00	
BQ2045	19	Ayalew Aremu	Boka	NC0012525	Ram 10month	M		Bonga	32.50	Recent		28/07/2025	11:55:00	
BQ2019	20	Kero Gaweto	Boka	BQ0004123	Ram 2 years old	M		Bonga	45.20	Recent		28/07/2025	12:01:00	
BQ2017	21	Kero Gaweto	Boka	BQ0063921	Ewe parity 4, pregnant	F		Bonga	38.40	Recent		28/07/2025	12:07:00	
BQ2020	22	Kero Gaweto	Boka	BQ0011425	Ewe lamb, pregnant	F		Bonga	29.00	Recent		28/07/2025	12:13:00	
BQ2018	23	Kero Gaweto	Boka	NC0011525	Ewe parity 2 lactitating	F		Bonga	27.40	Recent		28/07/2025	12:21:00	
BQ2021	24	Gebabo Geykisho	Boka	BQ0062225	Ewe parity 4, lactating	F		Bonga	33.60	Recent		28/07/2025	12:29:00	
BQ2022	25	Gebabo Geykisho	Boka	BQ0079418	Ewe parity 4, lactating	F		Bonga	36.00	Recent		28/07/2025	13:42:00	
BQ2023	26	Gebabo Geykisho	Boka	BQ0037820	Ewe parity 5, pregnant	F		Bonga	36.00	Recent		28/07/2025	13:48:00	
BQ2034	27	Gebabo Geykisho	Boka	BQ0004524	Ewe lamb, pregnant	F		Bonga	24.00	Recent		28/07/2025	13:55:00	
BQ2035	28	Gebabo Geykisho	Boka	BQ0010224	Lamb 6 month	F		Bonga	17.60	Recent		28/07/2025	14:00:00	
BQ2025	29	Alemayehu Adelo	Boka	BQ0018623	Ewe parity, lactating	F		Bonga	28.30	Recent		28/07/2025	14:08:00	

Weighing and Blood Sampling Protocol

Animals should be weighed at each measurement round, and blood sampling must be conducted only after methane measurements to avoid stress-induced bias in the recorded emissions

Challenges & Limitations

Since its first exploratory use in 2009, the LMD has gained attention as a promising tool for measuring enteric methane. Still, that knowledge is not yet systematic but rather fragmentary.

Despite this, the LMD offers clear strengths:

✓ **Flexible and portable**
✓ **User-friendly** and does not require external power
✓ **Cost-effective** for large-scale use in both research and field settings
✓ Proven to deliver **biologically meaningful data** under diverse conditions

Thank you!

Any questions?

Use of LMD in feed trials in barn or pasture in different species of ruminants (dairy and meat)

Raphaël Boré, French Livestock Institute, raphael.bore@idele.fr

FACCE ERA-GAS MONITORING & MITIGATION OF GREENHOUSE GASES FROM AGRI- AND SILVI-CULTURE

SmartCow

LIFE GREEN SHEEP

Carbon Farming

Méthane 2030

Adapting LMD for livestock farming and provide references

2009 — **1st publication on LMD by Mr. Chagunda**

2014 — **Idele Internship**
Is the Laser Methane Mini-Green suitable for measuring enteric methane emissions from dairy cows?

2017 — **Idele Internship**
Testing the measurement protocol and comparing the tool with thebreathing chamber for enteric methane emissions in dairy cows

2019 — **Consortium CH4**
Repetability test between measurement
- Comparison of LMD measurements in the respiratory chamber and on the GreenFeed

2020 — **Smartcow** :
Test of measurement conditions (distance, angle, proximity to other animals)

2021 — **ERA GrasTech :**
1st references on dairy cows in barn and pasture

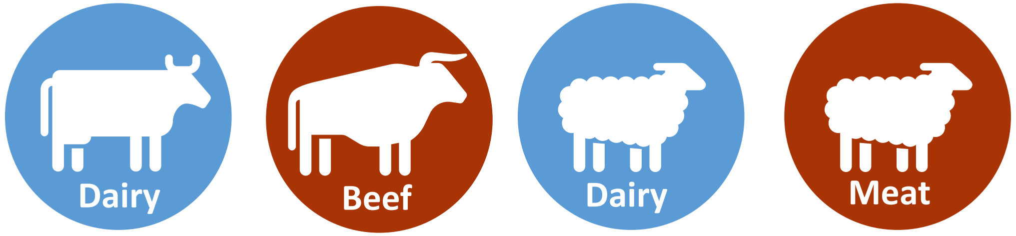
2022 — **GreenSheep & Life Carbon Farming :**
1st References on sheep and beef cattle in barn

2025 — **MethaCapradel:**
1st References on goats in barn

2027

2021–2027: Development of a cattle GF-Laser database for a development of a predictive equation in g/d

Species



Feeding strategies

Rations

Pastures

Additives

Differencies on protocol between species and rearing conditions

The use of LMD: a balance between feasibility and accuracy

1. Make sure not to disturb the animal while it is engaged in its activity
2. Adapting to the realities of on-site measurements at commercial farms
3. Minimize the impact of environmental conditions and limit bias

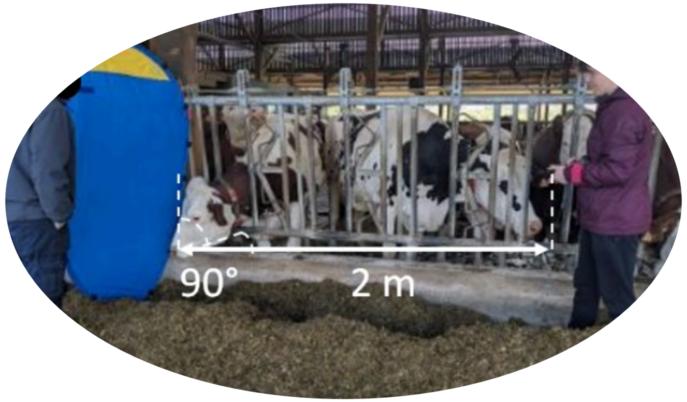
Sorg et al. 2021

Measuring Livestock CH_4 Emissions with the Laser Methane Detector: A Review

Bore et al. 2022

Measurement Duration but Not Distance, Angle, and Neighbour-Proximity Affects Precision in Enteric Methane Emissions when Using the Laser Methane Detector Technique in Lactating Dairy Cows

Examples of « in barn » protocols used in cows and sheep



2 measures per day

Morning and afternoon when cows are eating

4 minutes

1 to **2** meter

Front or **90°**

Example of « in pasture » protocol used in dairy cows

2 measures per day

Morning and afternoon when cows are eating

4 minutes

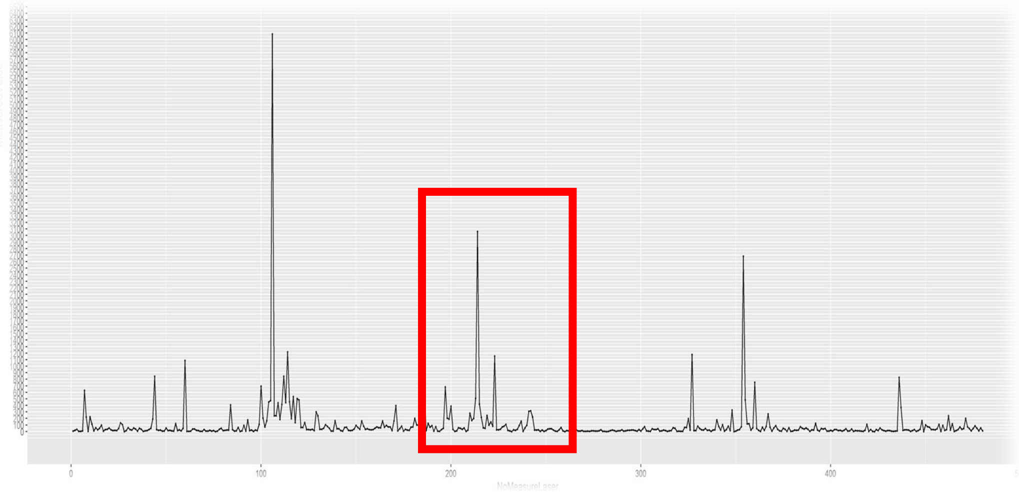
2 meter

90°

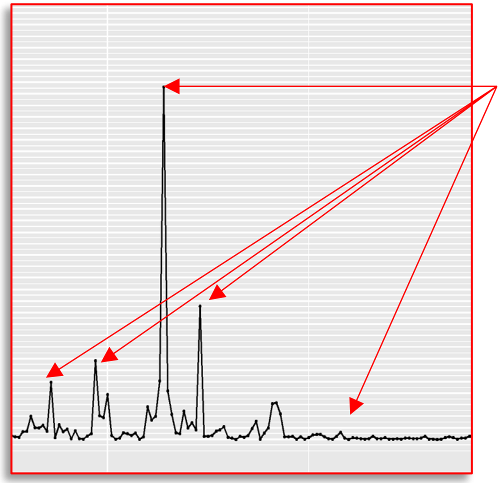
To not to disrupt grazing behavior

Use of the Sorg variable : Pmean most of the time

Methane concentrations (in ppm.m)



Time (in ½ seconds)



PMEAN

Mean of all **methane values (in ppm*m)** measured at each **peak** of each 4 min measurements

Peak value = ppm value whose previous and next values are smaller than it https://life-carbon-farming.eu/

Pmean concentrations values range from 55 ppm.m to 306 ppm.m

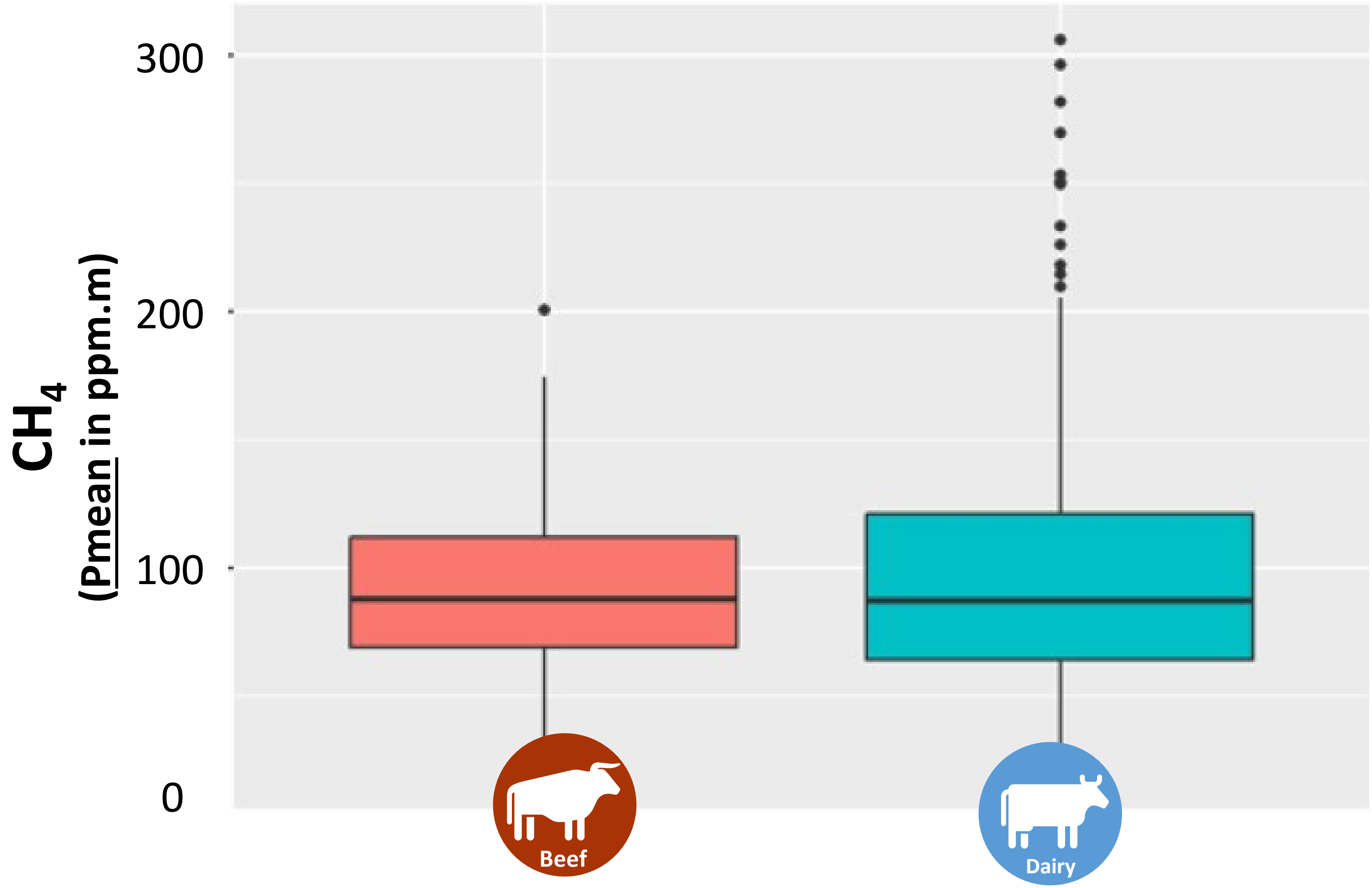
Beef

139 **cows**
(from 7 farms)

Dairy

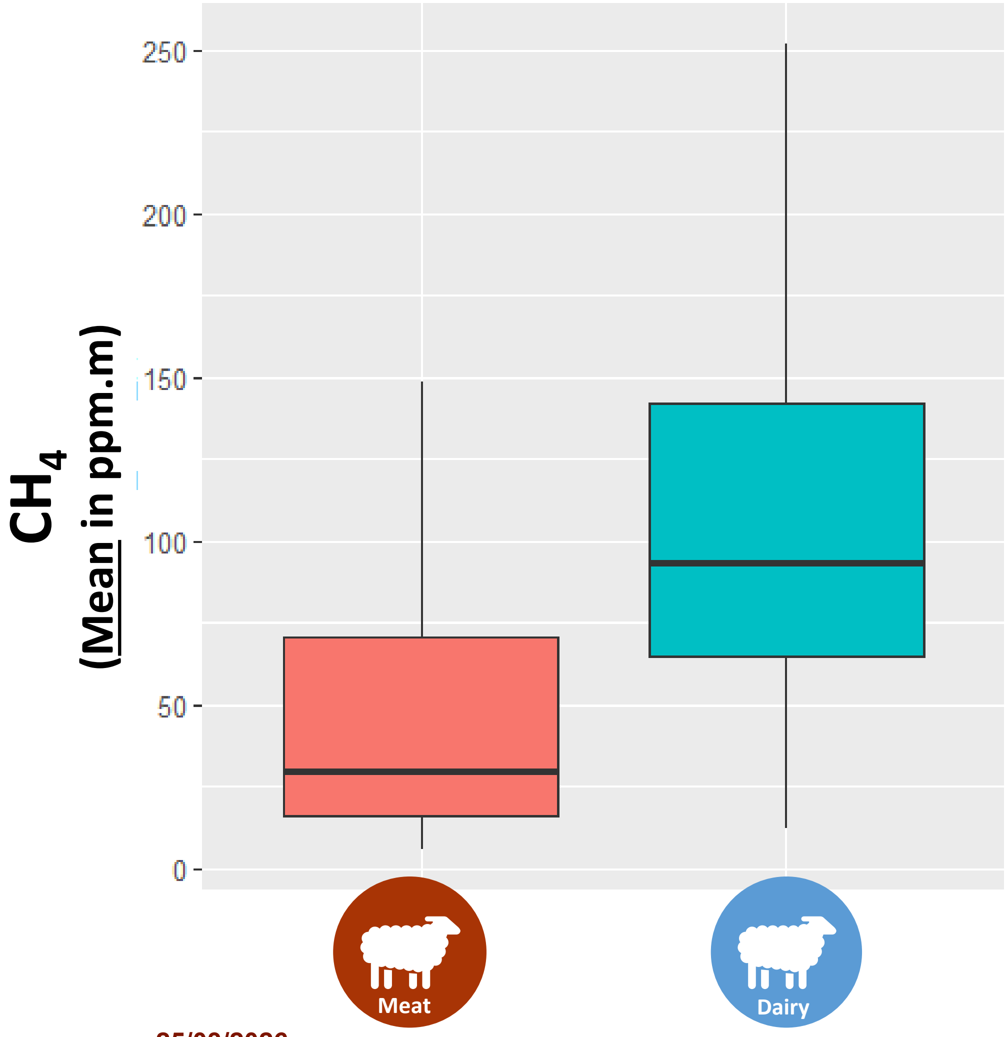
322 **cows**
(from 16 farms)

Mean	SD
96 ppm.m	39 ppm.m



LIFE GREEN SHEEP
https://life-green-sheep.eu/fr/

Mean concentrations values range from 6 ppm.m to 252 ppm.m



Meat

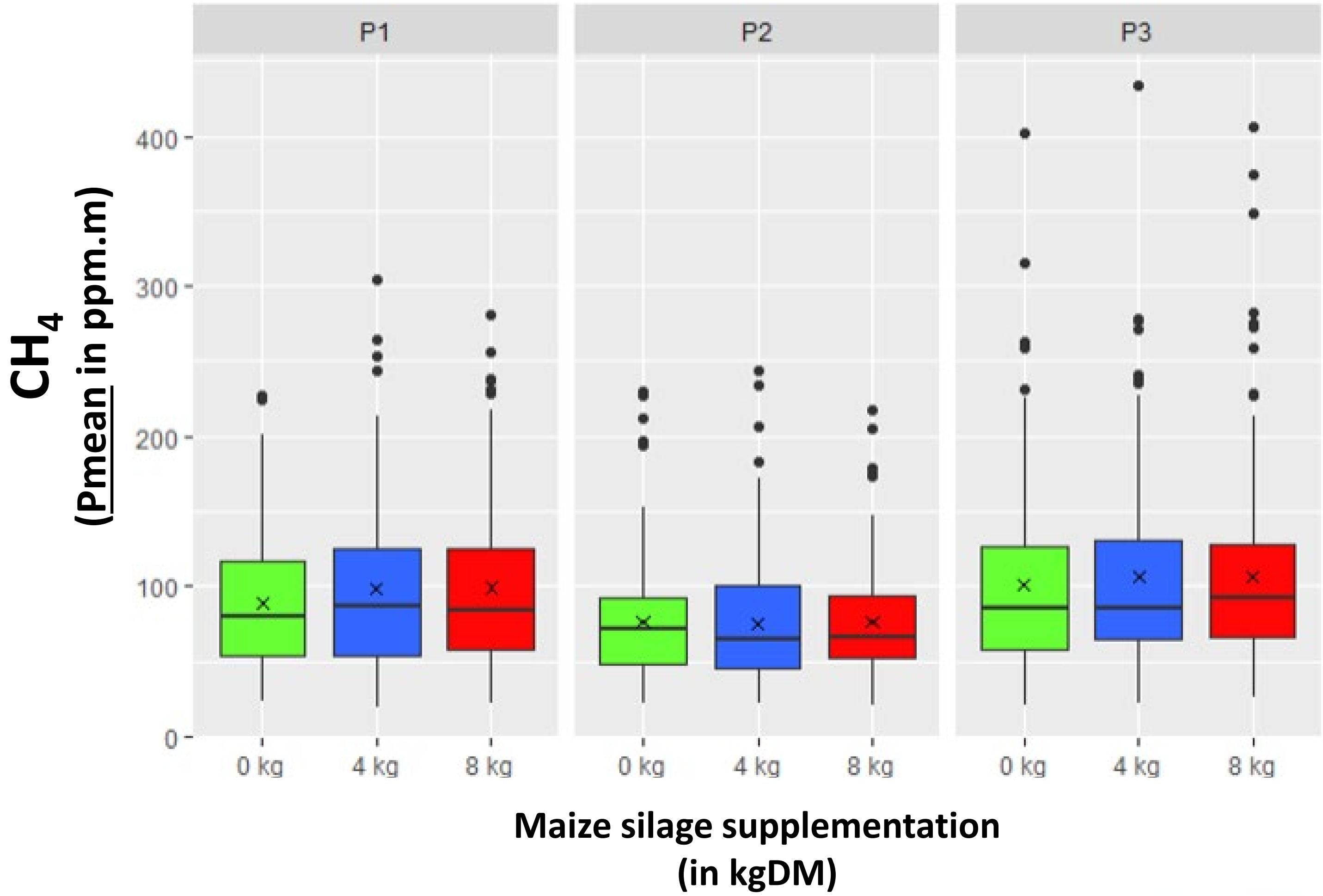
271 ewes
(from 14 farms)

Dairy

141 ewes
(from 7 farms)

	Meat	Dairy
Mean	44	103
SD	33	54

A tool which can capture significant reductions in enteric methane emissions on dairy cattle between amount of maize silage in addition to grazing.



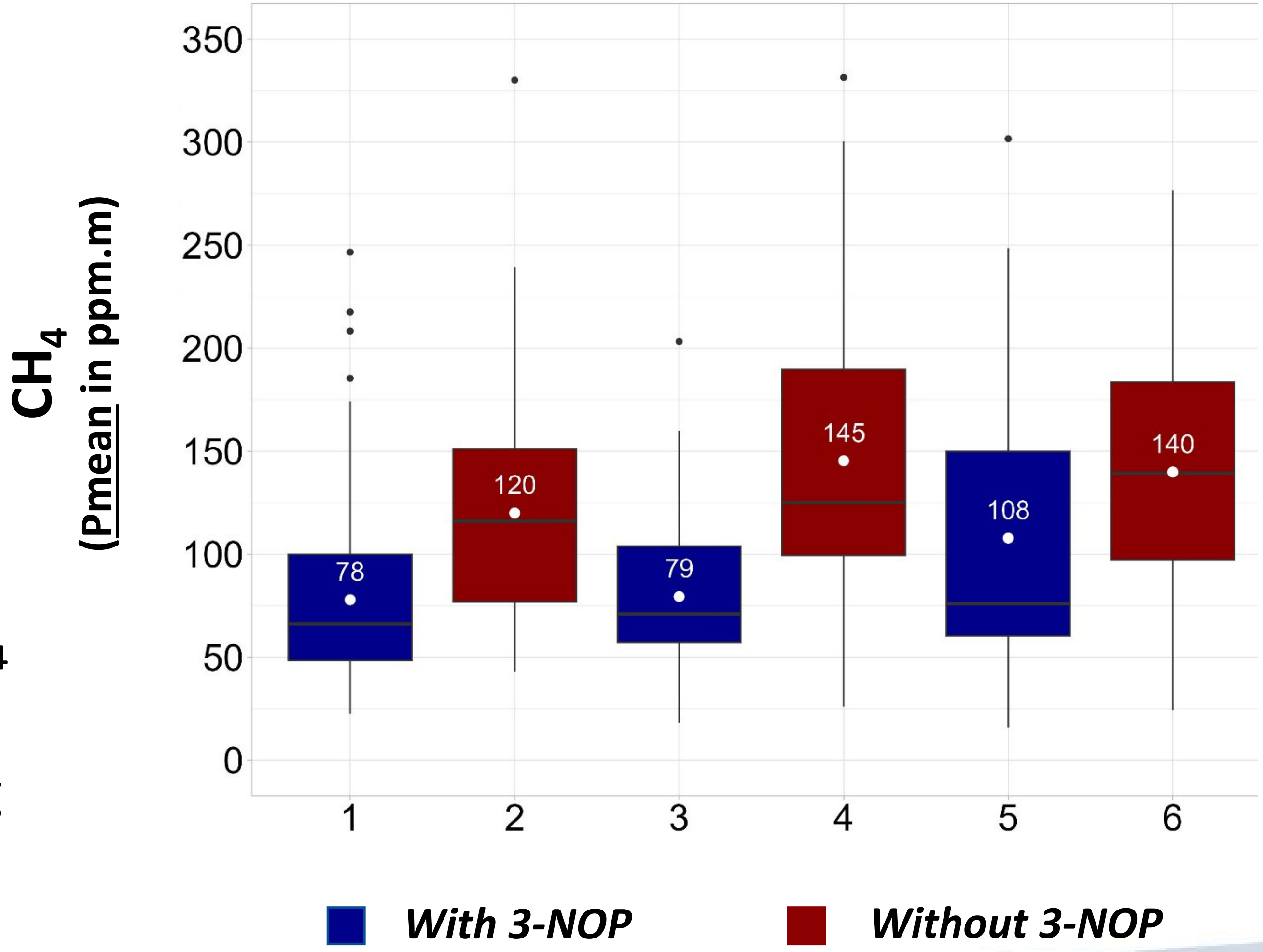
- **Differences** in emissions between the **3 periods**
- **Differences** in emissions between the **3 feed treatments**
- **Higher** emissions for lots receiving **8 kg of CSSM** and **lower** for batches without **CSSM** in **P1** and **P3**

A tool which can capture significant reductions in enteric methane emissions on dairy cattle.

5 farms
(20 cows per farm)

Alternate delivery of 3-NOP per month

A reduction of approximately 30% in CH_4 concentration between periods, **consistent** with estimates obtained using the DSM equation



Joint measurements by GreenFeed and LMD on approximately 2,000 cattle (dairy and beef)

Méthane 2030

https://methane2030.com/

1. Comparison of GreenFeed and LMD measurements
2. Development of a prediction equation for LMD measurements in g/day

<!-- page header -->
FEEDBACK ON THE USE OF LMD ON RUMINANTS

Measurement environment affect values (wind, presence of other animals)

Necessity to validate a standard protocol

First references on CH_4 concentrations with LMD are available in ruminant, under various conditions (barn, pasture)

CH ≠ CH_4

LMD **is able of distinguishing differences in CH_4** emissions based on feeding reduction strategies

Méthane 2030

Numerous measurements are currently being collected to develop a **prediction equation in g/day**


Rejoignez nos 42 000 abonnés sur nos réseaux sociaux.

Methodology to compare GreenFeed and Laser Methane Detector on dairy ewes

Elena Senatore[1,2], Giulia Foggi[1], Alina Silvi[1], Alberto Mantino[1,2], Marcello Mele[1,2]

[1] *University of Pisa, Department of Agriculture, Food and Environment*

[2] *University of Pisa, Centre of Agro-environmental research "Enrico Avanzi"*

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Pisa Livestock farming, Animal food quality, and Sustainability

In supremæ dignitatis 1343

Dipartimento di Scienze Agrarie Alimentari e Agro-ambientali Università di Pisa 180 1840-2020

Background

Recent literature shows that LMD is able to measure enteric methane and the effect of different treatments on livestock emissions.

Effectiveness, reproduceable and repeatability of spot individual methane measurements are strictly related to:

1. Equipment
2. Measurement protocol
3. Data processing

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Equipment for non invasive methane measurement

GreenFeed and LMD

C-lock Inc.

Tokyo-Gas Engineering Solutions

GreenFeed®– SILVER STANDARD

GreenFeed system is considered the **silver standard** for measuring enteric methane emissions in ruminant on **real farm** conditions

The measurement is taken as a **“spot measurement”, as voluntary visit.**

do not interfere with the animals’ normal behaviour

Laser Methane Detector®

Laser methane detector is a device to be **validated** that could be used in **real farm** conditions

The measurement is taken as a **“spot measurement”, as controlled visit**

do not interfere with the animals’ normal behaviour

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Equipment for non invasive methane measurement

GreenFeed and LMD

First step of validation: evaluation of the ranking **concordance of GF measurements** vs. **Laser Methane Detector Mini®** (LMD)

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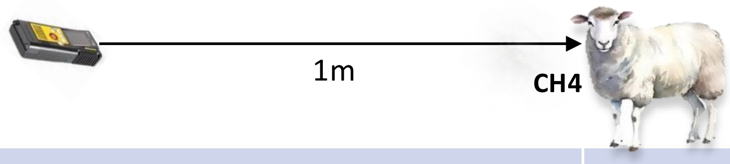
Measurement protocol

LMD Experimental design



Environment measurement	Indoor, permanent bedding (straw), Central Italy	
Animals	2 boxes with an average of 8 lactating dairy sheep per box, trained to use GreenFeed (> 2 weeks)	
Laser model	Laser Methane Detector mini	© Tokyo Gas Engineering Solutions Corporation
Laser distance from the animal	1 m	*Chagunda et al. (2013)*
Distance between animals	At least 1.5 m	*Borè et al. (2022)*
N. of consecutive days of measures	3	*Chagunda et al. (2009); Ricci et al. (2014); Mühlbach et al. (2018)*
Measuring per day	2	
Measuring time	2 hours – 6 hours after a.m. feed distribution	*Chagunda et al. (2013)*
Measuring duration	5 minutes	*Sorg et al. (2022)*
Total n. sessions	4	

Measurement protocol

GF Experimental design

Environment measurement	Indoor, permanent bedding (straw), Central Italy	
Animals	2 boxes with on average 8 lactating dairy sheep per box, trained to use GreenFeed (> 2 weeks)	
Number of greenfeed	2 small ruminant GF with entry corridor (one per box)	*C-Lock Inc.*
Max number of visit per day	6	*C-Lock Inc.*
Minimum time interval between two consecutive visit	4 hours	*C-Lock Inc.*
Bait feed	Energy concentrate pellet	*C-Lock Inc.*
Amount of bait feed	7 g per drop	*C-Lock Inc.*
Max number of drop per visit	8	*C-Lock Inc.*

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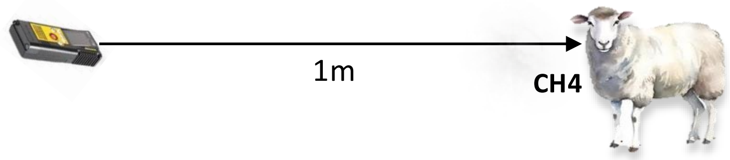
Data processing

LMD



Measurement frequency	10 measurements per second	
Measuring duration	5 minutes per session	
Total data per measurement	3000 data	
Unit	ppm x m	
Method adopted for identifying data emissions	Mean of all values ± 2SD (threshold) Peaks $\{X_i \mid X_i > X_{i-1} \wedge X_i > X_{i+1}\}$	*Chagunda et al. (2013)* *Sorg et al. (2018)*
Methane emitted	Values above threshold Mean of the peaks (Pmean)	*Chagunda et al. (2013)* *Sorg et al. (2018)*

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Data processing
GreenFeed

Minimum visit duration	2 minutes	*C-Lock Inc.*
Minimum visit per day	2	*Global Research Alliance, GreenFeed SOP*
Data averaging	Daily mean	*Global Research Alliance, GreenFeed SOP*
Unit	Grams x day^{-1}	

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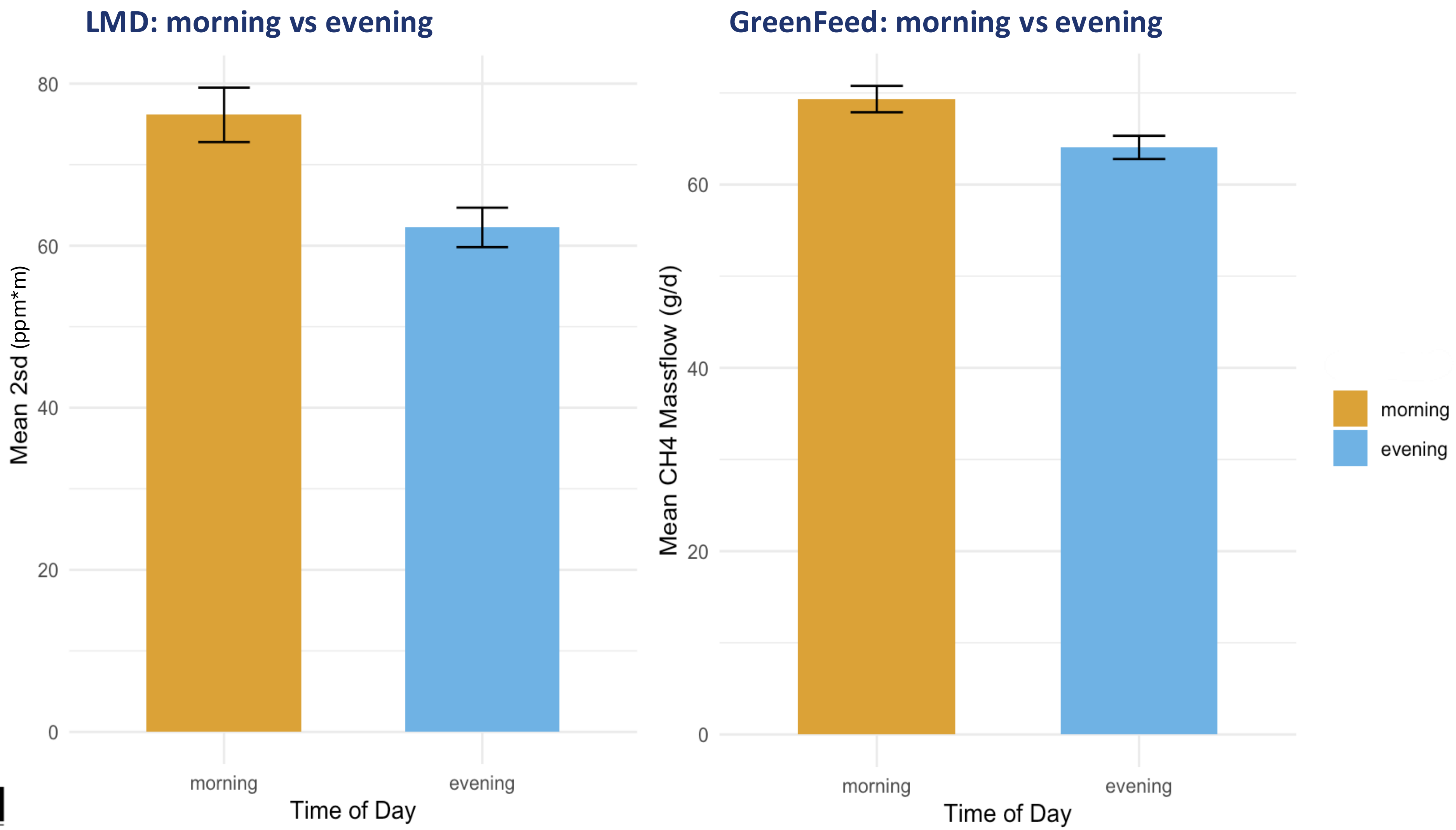
Data processing

First Results

Average flock emissions



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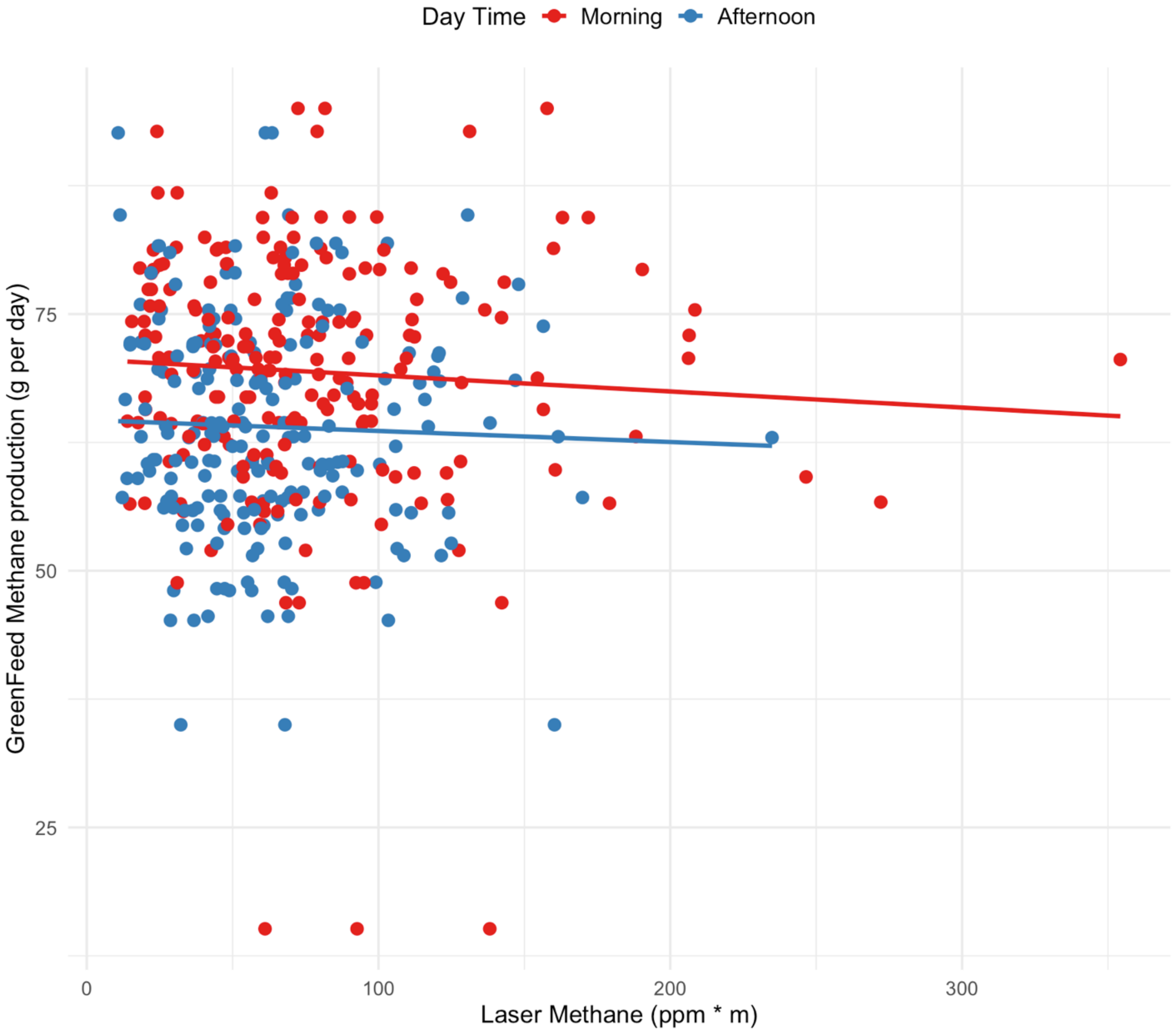
Data processing
First Results

Linear regression on the mean GF value during laser measurements



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Discussion

Flock Perspective

LMD seems to be aligned with GF measurements

Individual Perspective

No match between LMD and GF

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Conclusion

Findings

No match between LMD and GF measurements on individual animals

Possible Reasons

Cattle protocols may not be suitable for small ruminants due to:

- Behavioural differences
- **Housing differences**
- Air humidity
- Air temperature
- Interactions with other gases

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Future perspectives

Further develop LMD measurement protocol for small ruminants.
Investigate measurement differences among devices and/or operators

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Thanks for the attention!

elena.senatore@unipi.it

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