Comparable non-invasive techniques for measuring animal-based enteric methane emission on farm.

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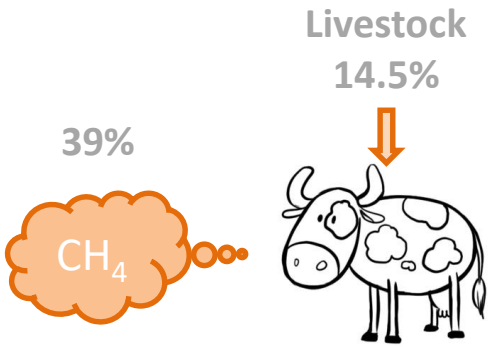
Introduction

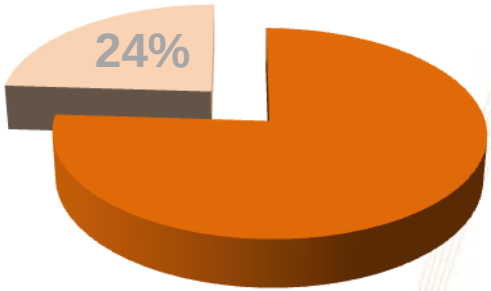
CH_4 = 2-12% gross energy loses

Total global greenhouse emissions



(Gerber et al., 2013)

Agriculture, forestry and other land use



(IPCC,2014)

GOAL= REDUCTION OF CH_4

- ✓ Dietary
- ✓ Management
- ✓ Breeding

LARGE NUMBER OF ANIMALS

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Introduction

How to measure CH_4?

- Respiration chambers (reference)
- SF_6
- Greenfeed

✓ More accurate

✓ Costly
✓ Time consuming
✓ Invasive

- Spot breath analysis sensors
  - FTIR
  - NDIR
  - Hand-held Laser methane detector

✓ Cheaper
✓ Non invasive
✓ More suitable for farm conditions
✓ Not as accurate

Possible interchangeability between methods for generating large-scale data of CH_4 emissions?

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Objetive

Are comparable the laser methane detector (LMD) and the sniffer for measuring animal-based enteric methane emission on farm?

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DEVICES FOR MEASURING ENTERIC METHANE

SNIFFER

- Guardian NG CH_4 monitoring system *(Edinburgh Instruments Ltd., Livingston, UK)*
- NDIR methane analyzer
- Range 0-10000 ppm
- Accuracy ±10% range
- Air sampled constinuosly (1L/min)
- CH_4 concentration logged at 1-sec intervals.
- Units: ppm (µL/L)

LASER METHANE DETECTOR (LMD)

- LaserMethane mini *(Tokyo Gas Engineering Solutions Corporation)*
- Remote measurement of column density for CH_4 containing gases
- Infrared absorption spectroscopy
- Range 1-50000 ppm-m
- Accuracy ±10% range
- CH_4 logged at 0.5-sec intervals.
- Units: ppm-m

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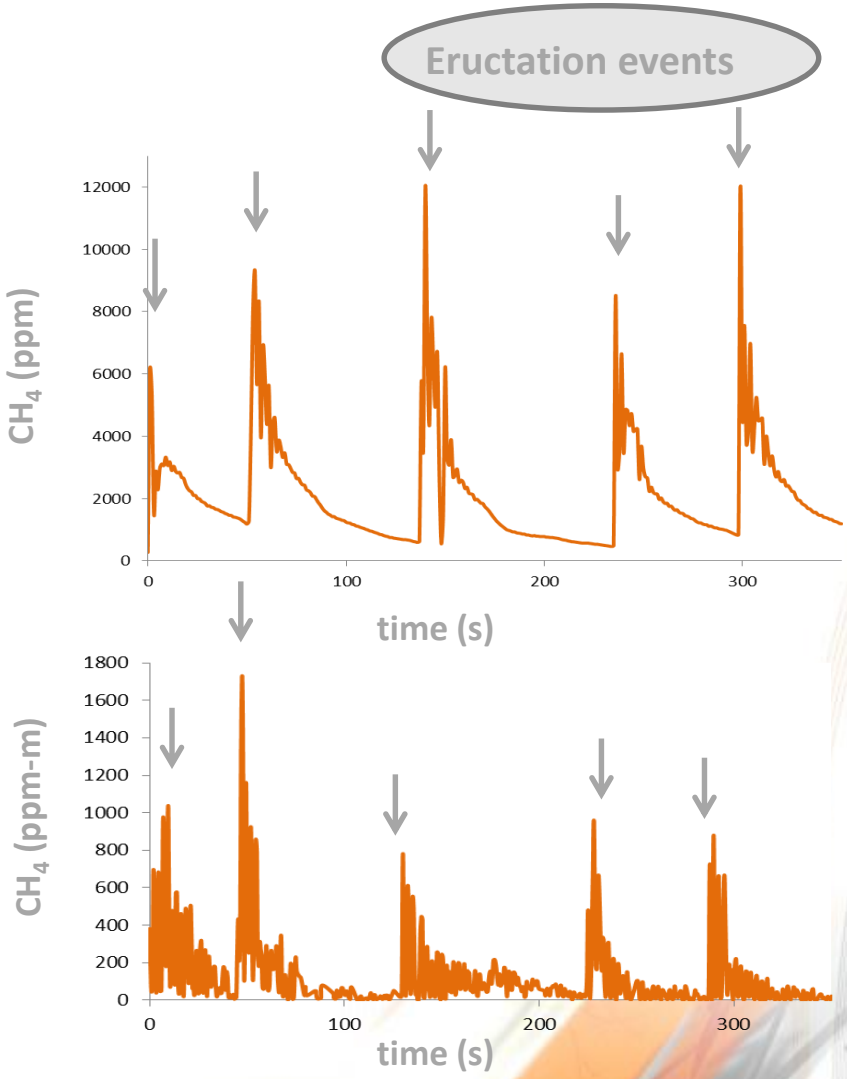
Material and Methods

- 164 paired measurements
- 29 cows (Holstein-Friesian and Brown-Swiss)
- 6 days
- Measurement periods of 5 minutes
  - LMD: 0.5 sec; 1 m
  - SNIFFER: 1 sec

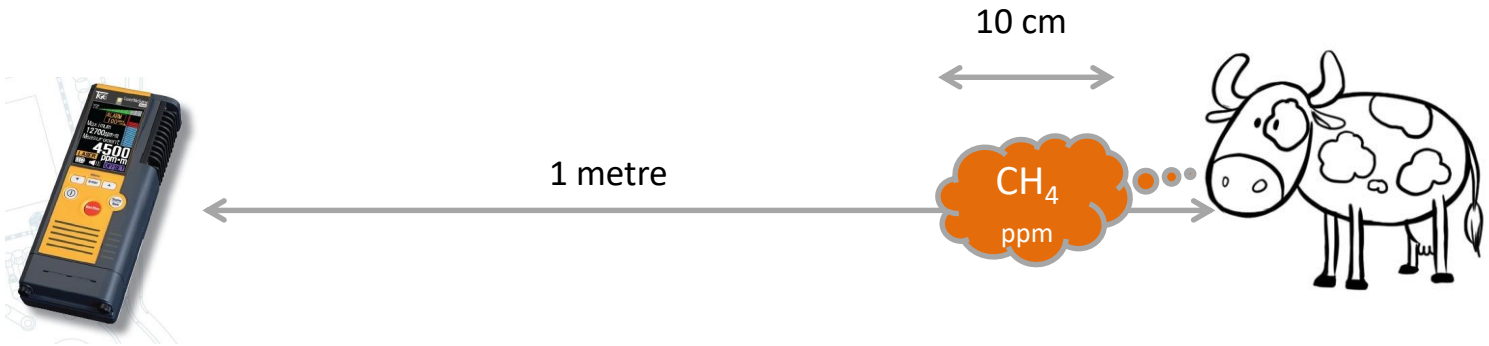
Agrarian school of Fraisoro (Gipuzkoa, Basque Country)

Material and Methods

- MeanSNIFFER= mean of all CH_4 values in a profile in **ppm**
- MeanLASER= mean of all CH_4 values in a profile in **ppm-m**



Material and Methods



- MeanLASER_cal= mean of all CH4 values in a profile in ppm
- Average CH4 in air accepted as 2 ppm
- $MeanLASER(ppm-m) = [0.1m \times CH_4(ppm)] + [1m \times 2ppm]$
- $MeanLASER\_cal\ (ppm) = \frac{MeanLaser\ (ppm-m) - 2(ppm-m)}{0.1\ m}$

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Material and Methods

- Correlation analysis: Pearson and Spearman (SAS)

- Bivariate repeated mesurements model

$$Y = Xb + Zu + e$$

Traits: Measurement pairs of	*Fixed effects: Intercept*	*Random effcts : Cow*
Sniffer CH_4 (ppm)	*Breed*	*Residual*
LMD CH_4 (ppm-m)	*Lactation number*	
LMD CH_4 (ppm)	*Stage of lactation*	

- Measurements of agreement: scaled correlation coefficients : CIA

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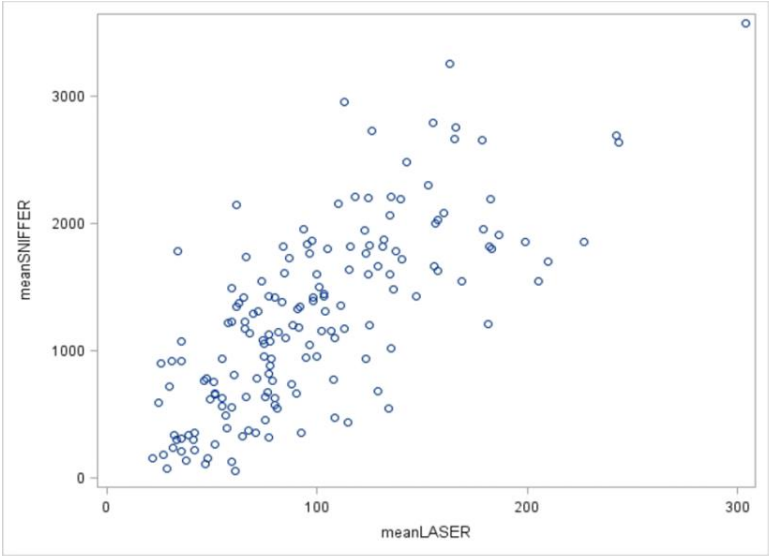
Results

- Pearson correlation coefficient

  R= 0.73; P< 0.001

- Spearman's rank correlation coefficient

  Rs= 0.74; P< 0.001



Results

Bivariate repeated measurements model	LMD	SNIFFER	LMD_cal
Unit	ppm-m	ppm	ppm
Permanent effect correlation between methods (SD)	0.93 (0.08)		
Variance of the permanent effect bivariate model	819	194003	81942
Repeatability (SD)	0.29 (0.10)	0.35 (0.11)	0.29 (0.10)
Coefficient of individual agreement (CIA) with sniffer			0.75

Conclusion

Data from LMD and Sniffer could be interchangeable to rank animals for breeding purposes or to evaluate methane reduction strategies.

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