Martin Luther University Halle-Wittenberg Germany
Institute of Agricultural and Nutritional Sciences
Animal Breeding

Agreement of two Laser Methane Detectors with respiration chambers and in a dairy barn

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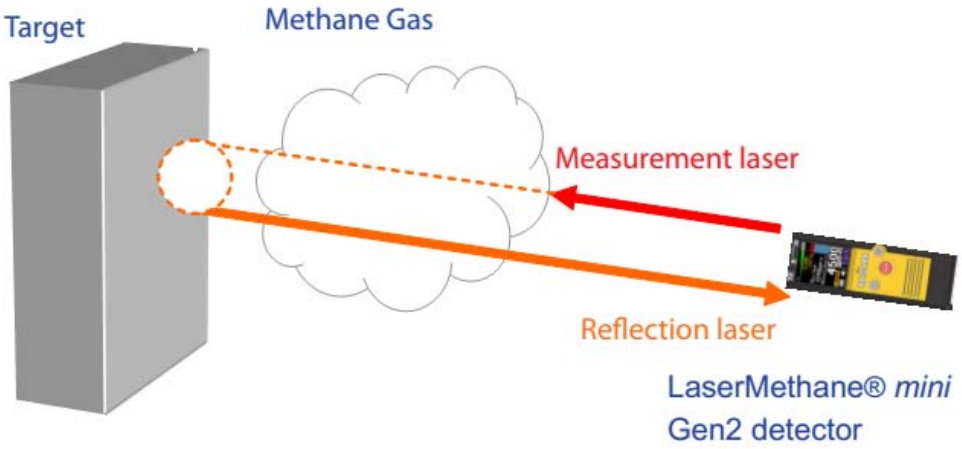
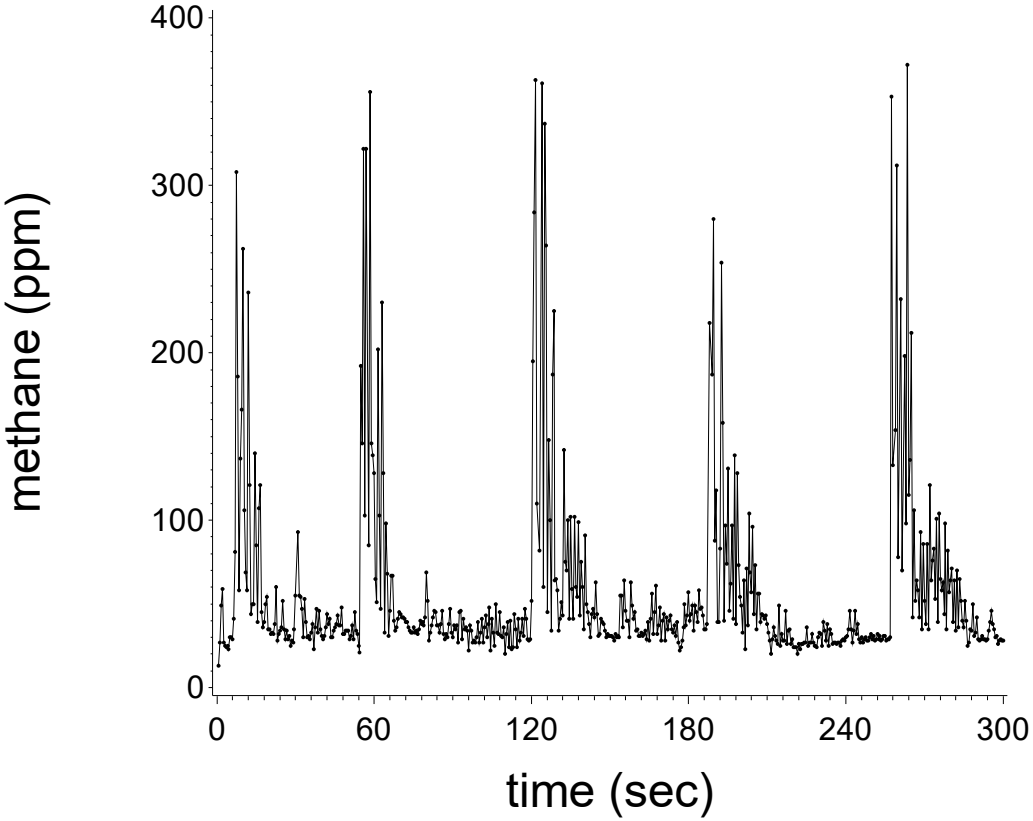
Laser Methane Detector (LMD)

- **for detection of gas leaks**
- wavelength specifically absorbed by methane (tunable diode laser absorption spectroscopy)
- mobile, portable, hand-held
- 2 data points/sec
- cumulative methane concentration along path in ppm-m
- data stored on smartphone



(Crowcon Detection Instruments Ltd.)

Our application of the LMD



Similar to Chagunda et al. (2009), Chagunda & Yan (2011), Grobler et al. (2014), Ricci et al. (2014), Pickering et al. (2015)

Questions

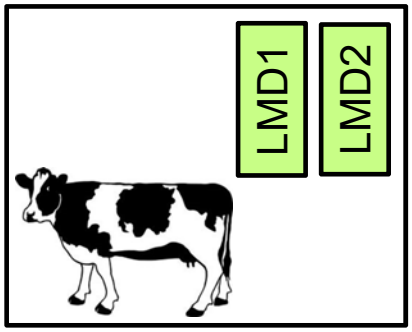
Can two LMDs be used in parallel when recording a large amount of data?

→ Agreement of two LMDs with each other in a closed room and under farm conditions

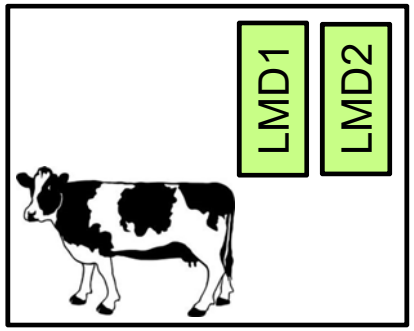
How accurate is this sensor?

→ Agreement of LMDs with sensor of respiration chamber

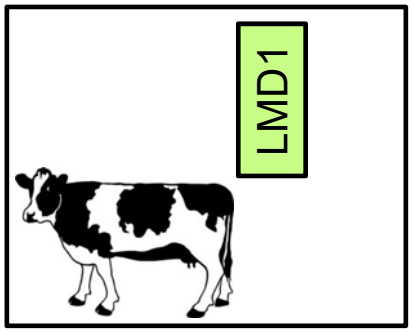
Experimental setup



chamber 1
1 day



chamber 2
1 day



chamber 3
2 days

chamber 4
2 days

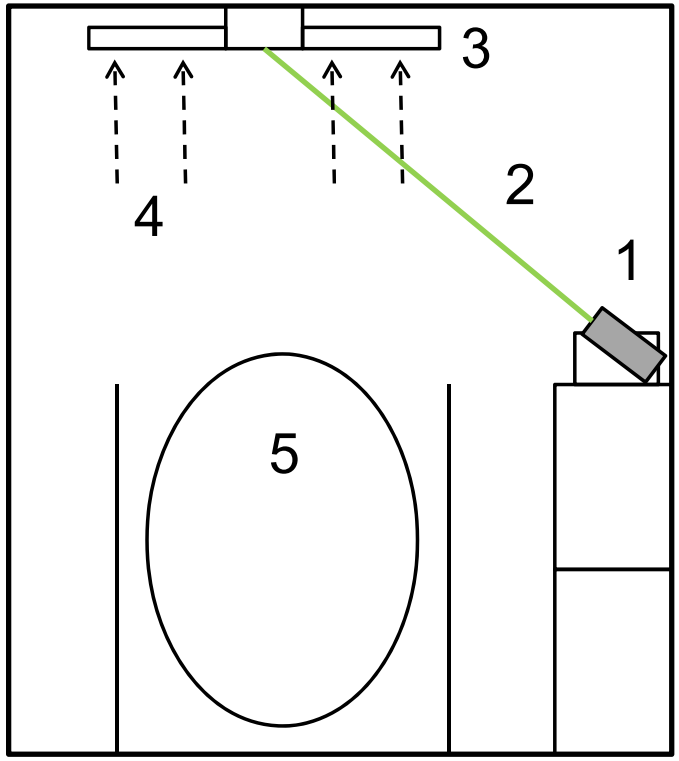
- placed inside chamber
- measuring through portion of air near outlet tube

→ technical accuracy compared with sensor of respiration chamber

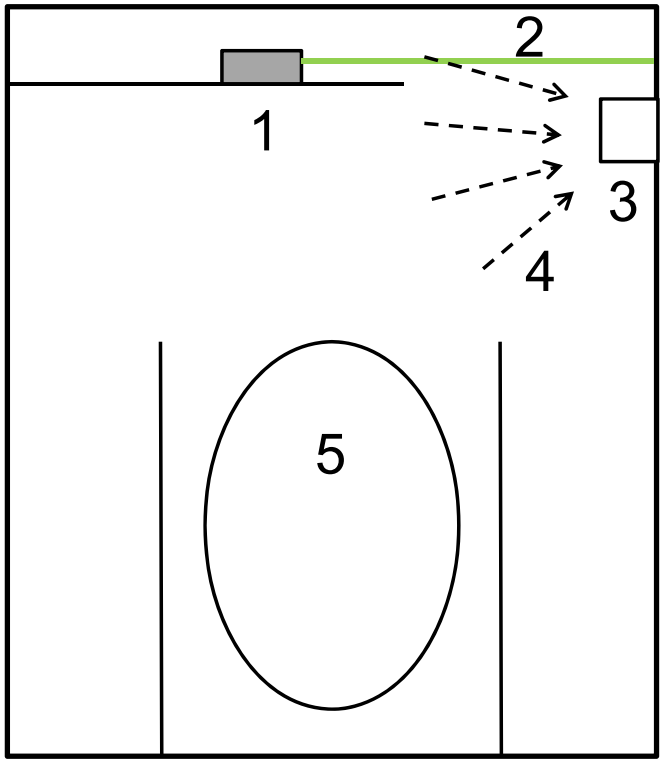
→ visual monitoring of cow activity to detect differences in methane concentration

Experimental setup

1	LMD
2	laser path
3	outlet tube
4	air flow
5	cow

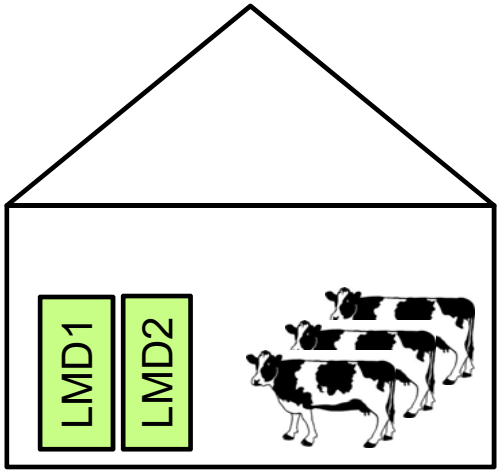


chamber 1 and 2



chamber 3 and 4

Experimental setup



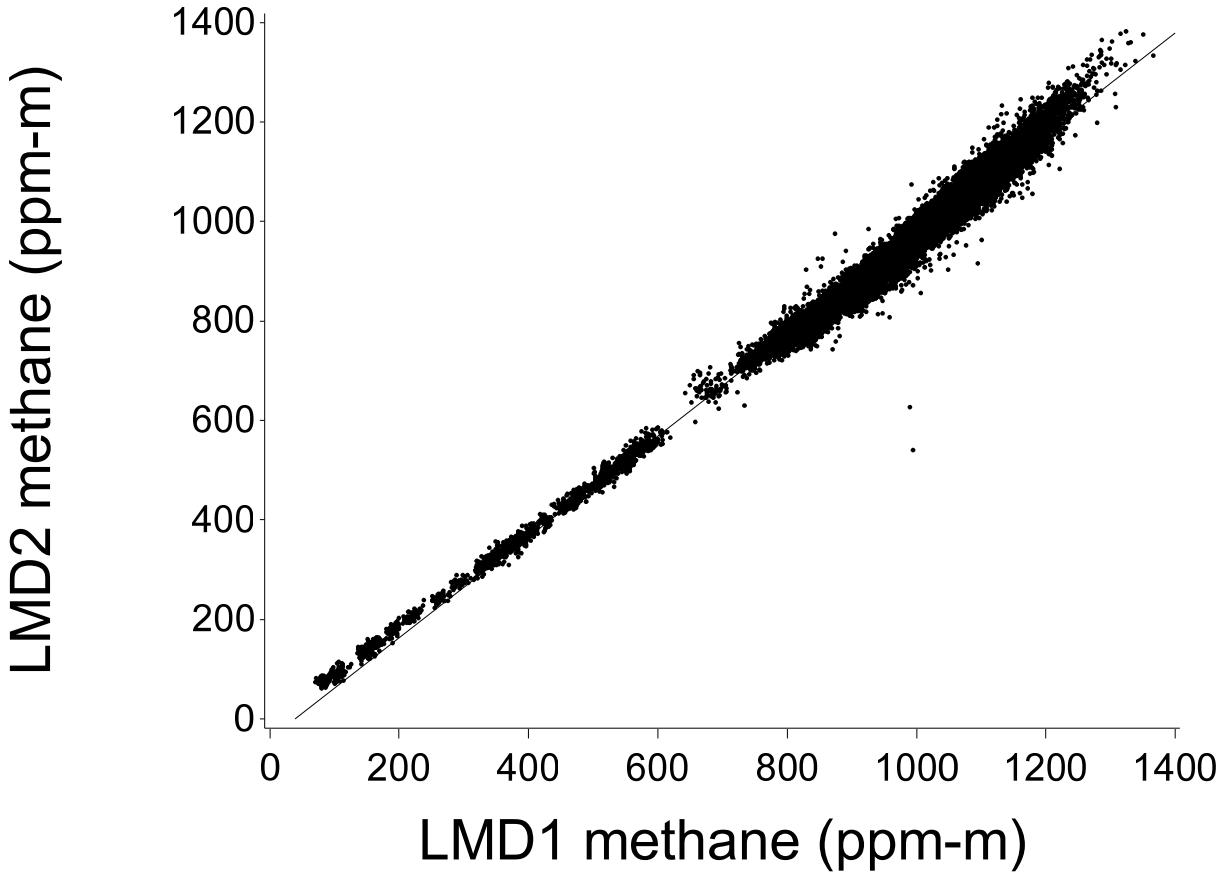
dairy barn
1 h

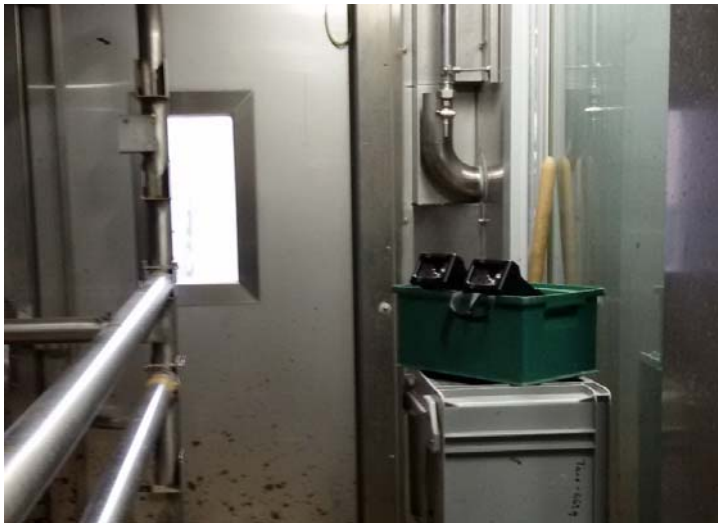
Simultaneous measurement at different locations for 10 min each:

feeding table
over straw bedding
pointing to ceiling
over slatted floor

→ elevated CH_4 concentration, but no cow profile

Agreement of two LMD in a respiration chamber





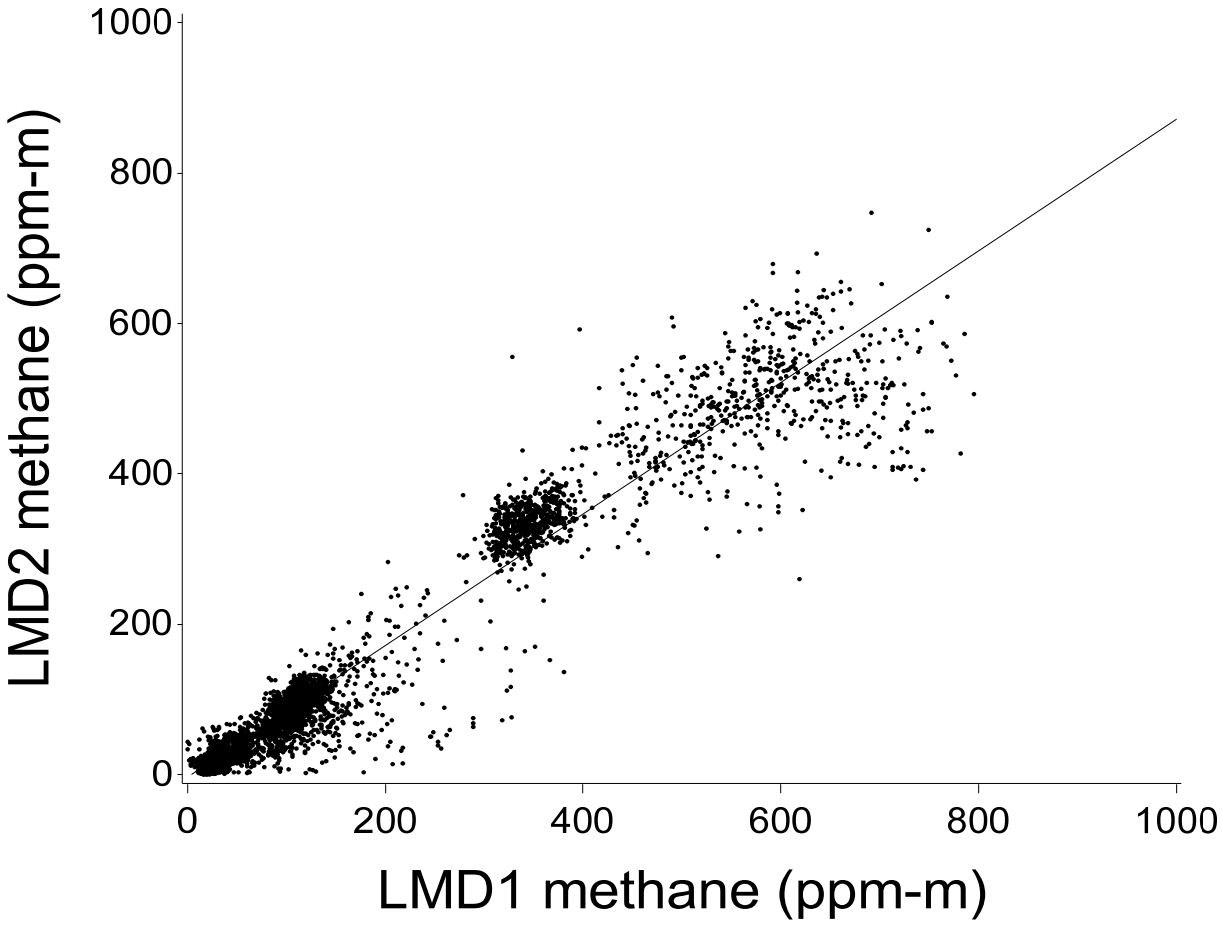
chamber 1

$R^2 = 0.99$

$r = 0.99^{***}$

n = 27280

Agreement of two LMD under farm conditions

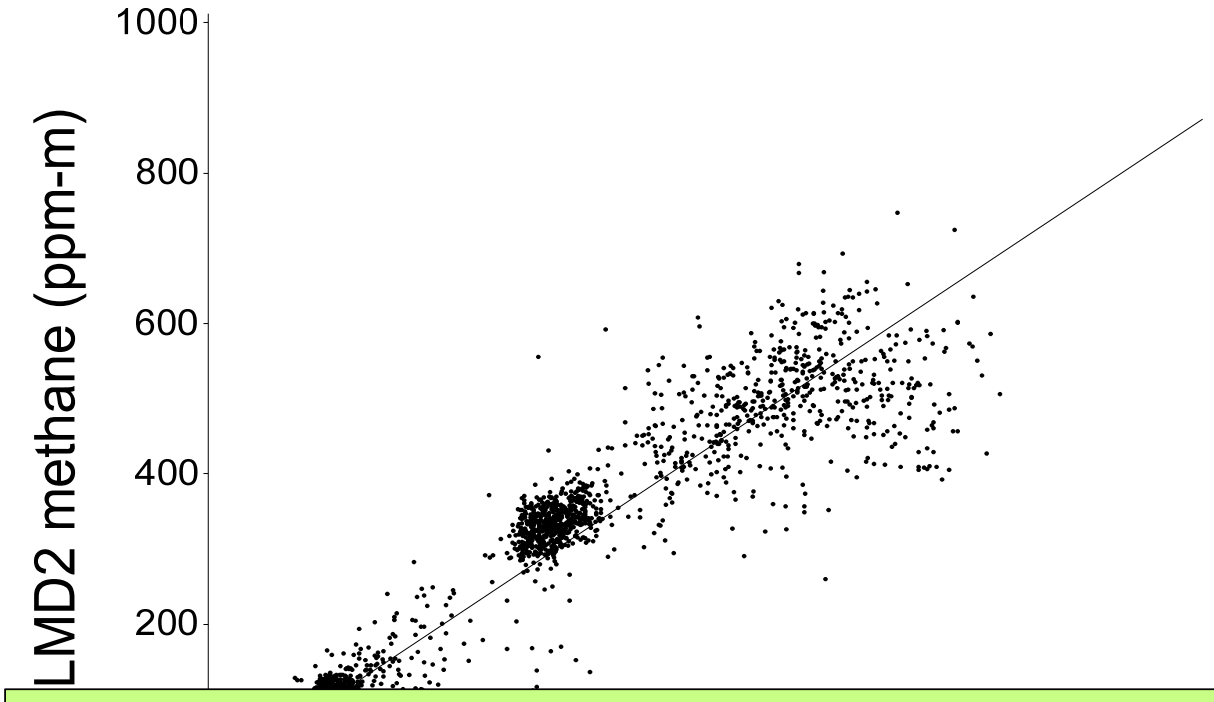


$R^2 = 0.94$

$r = 0.97^{***}$

$n = 4093$

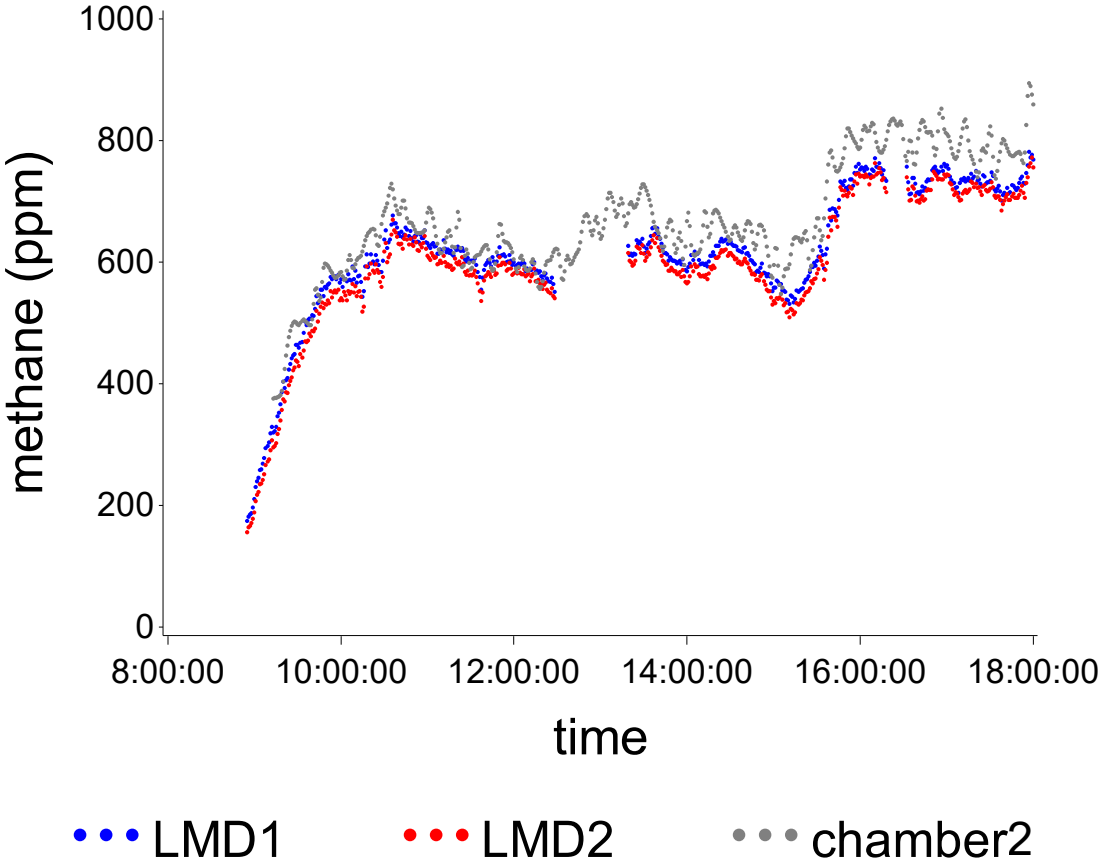
Agreement of two LMD under farm conditions

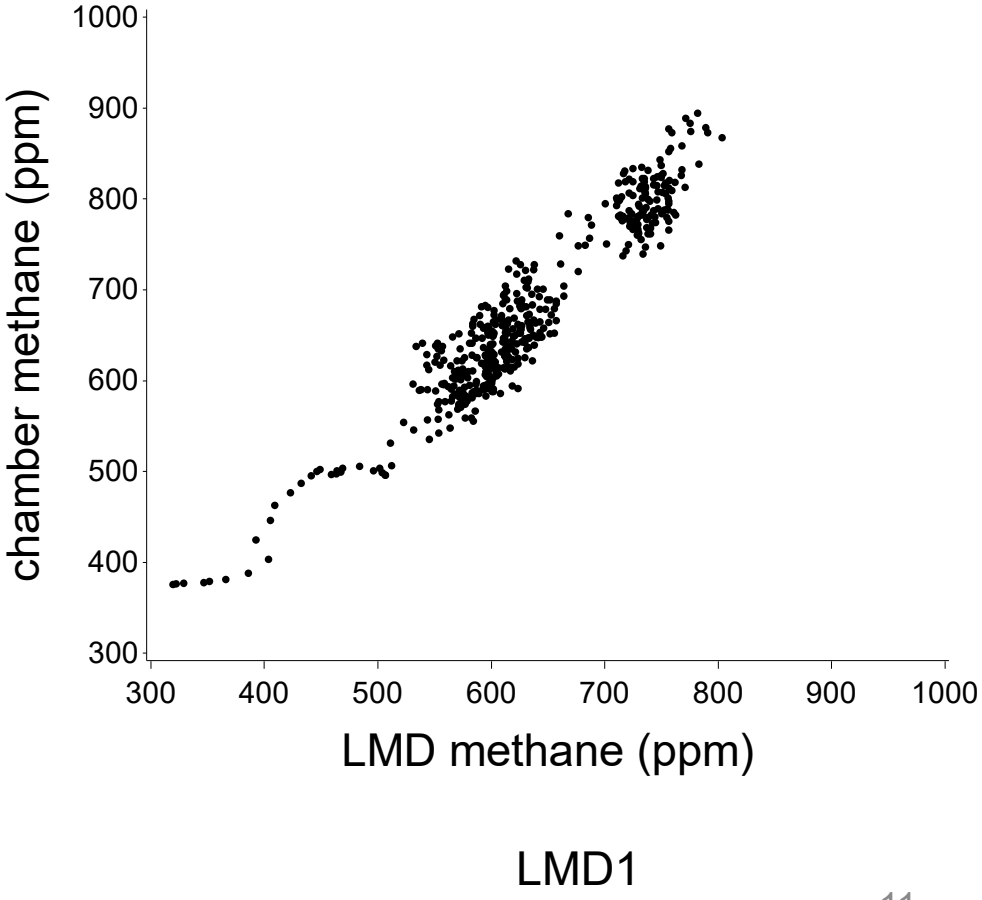


R^2=0.94***

→ good agreement under different conditions
→ in the barn probably influenced by environment

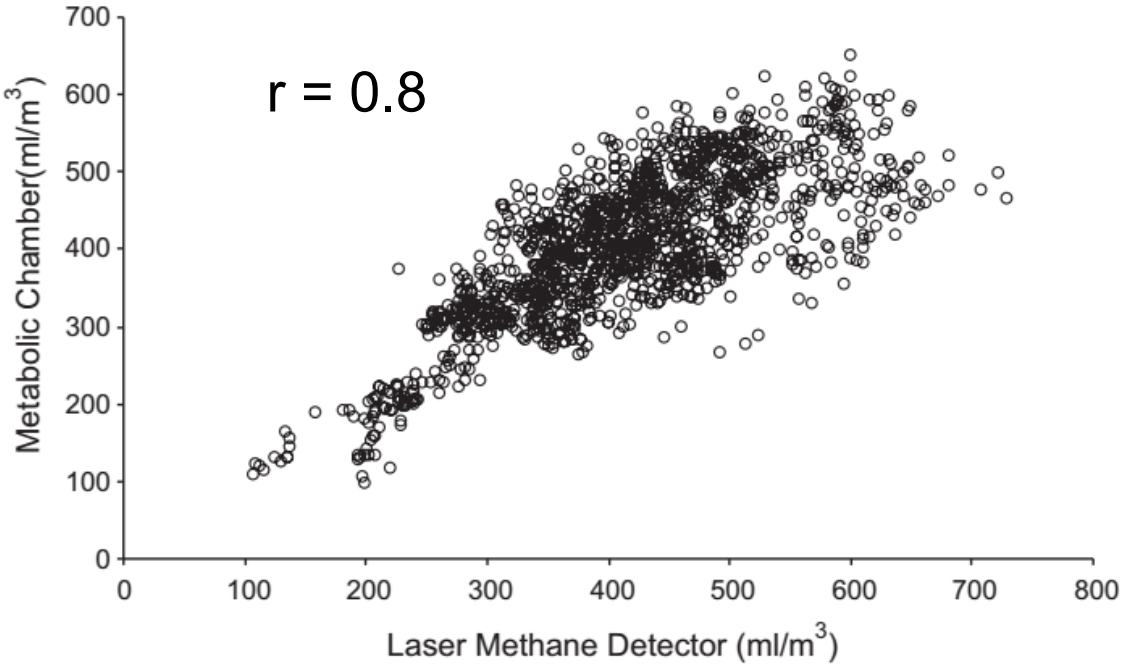
Agreement of LMD and respiration chamber





Agreement of LMD and respiration chamber

	LMD	chamber
mean (ppm)	613-1023	639-906
SD (ppm)	72-135	59-109
r = 0.86 - 0.98		



Chagunda and Yan (2011)

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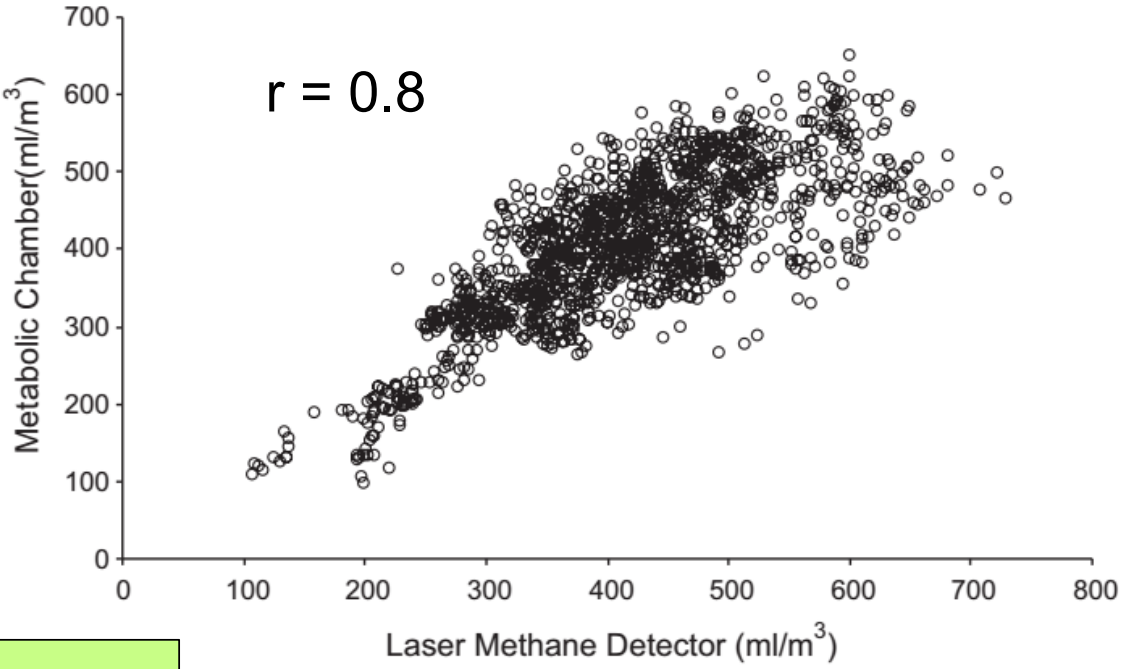
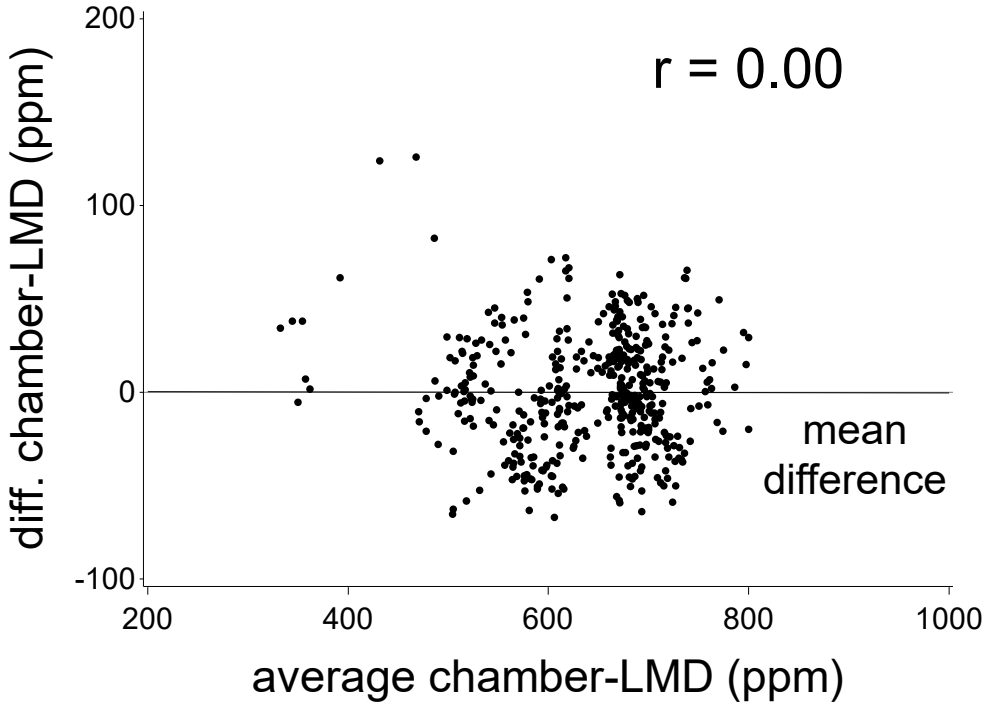


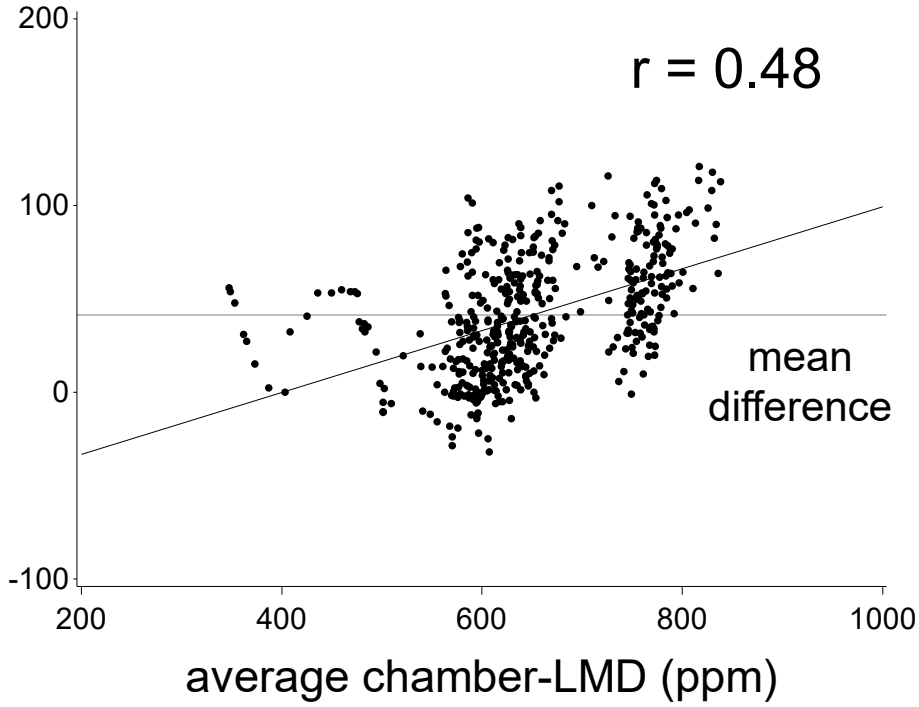
→ agreement similar/better than in a study with previous model of LMD

Chagunda and Yan (2011)

Agreement of LMD and respiration chamber

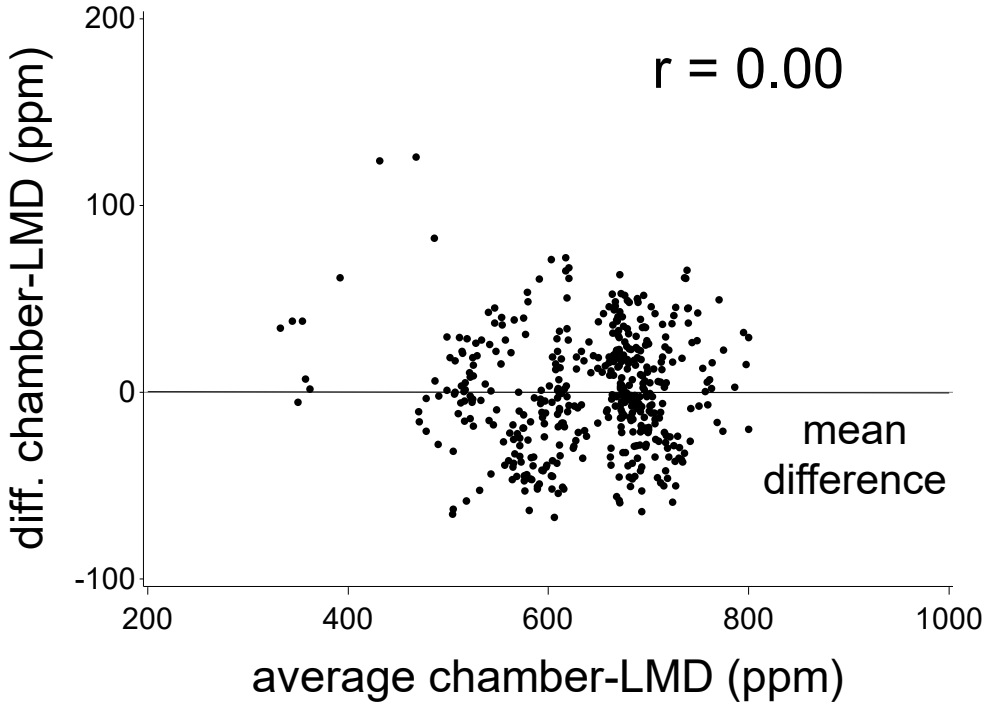


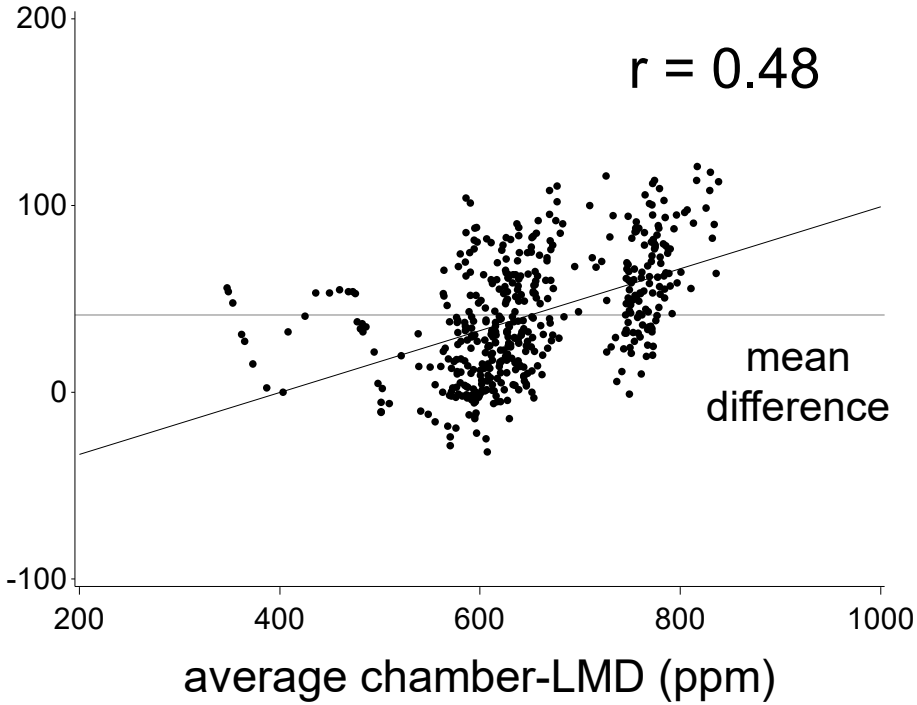
chamber 1 – LMD1



chamber 2 – LMD1

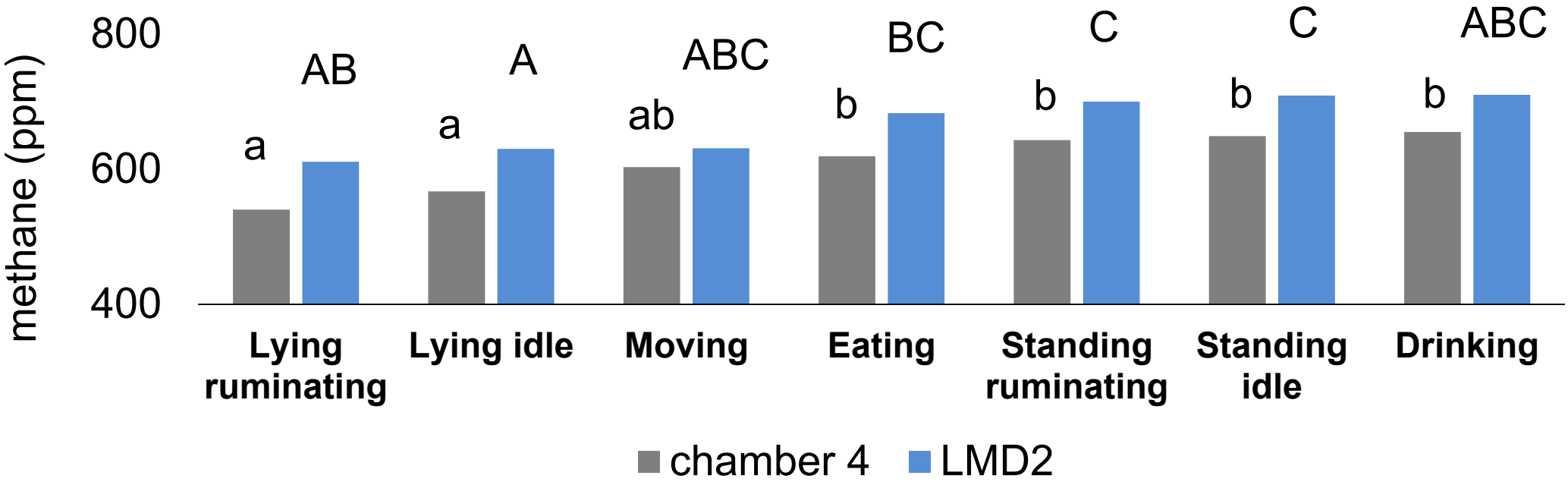
Agreement of LMD and respiration chamber





→ at higher concentrations methods tend to drift apart, but cow profiles have usually much lower concentrations

Agreement of LMD and respiration chamber



→ both detect differences in methane concentration due to cow activity

Conclusion

- two LMD have good agreement and can be used in parallel
- LMD suitable to measure low physiological methane concentrations in air
- LMD can detect differences in cow activity in a respiration chamber
- its use to measure methane emissions from dairy cows should be further analyzed

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