Towards a robust protocol for enteric methane measurements using a hand held Laser Methane Detector in Ruminents

ThiphaineBruder, Benoit Rouille, Tianhai Yan, Mizeck G.G. Chagunda

Speaker: Mizeck Chagunda

Laser Methane Detector in Dairy Cows

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Leading the way in Agriculture and Rural Research, Education and Consulting

Why Methane?

- Methane (CH_4) is produced as part of the normal digestive process in ruminants.
- 89% of methane emitted from ruminants is produced in the rumen and exhaled through the mouth and nose
- Formed in the rumen by methanogens (archaea, protozoa, fungi and bacteria) using hydrogen and CO_2

Traditional Methods

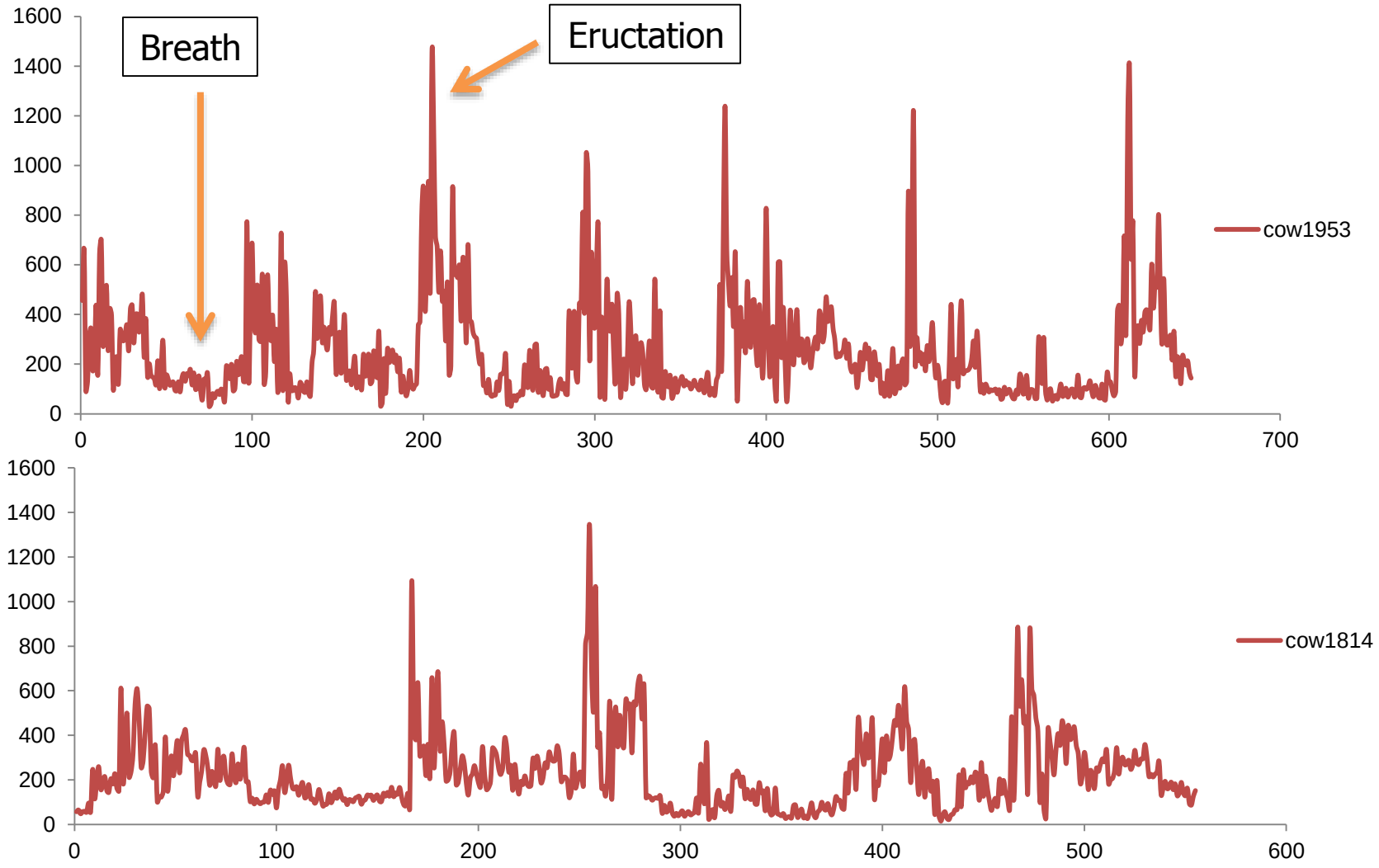
- Respiration calorimetry chambers
- Tracer Gas Techniques
- Sniffer technologies
- Micro Met Technique

Laser Methane Detector

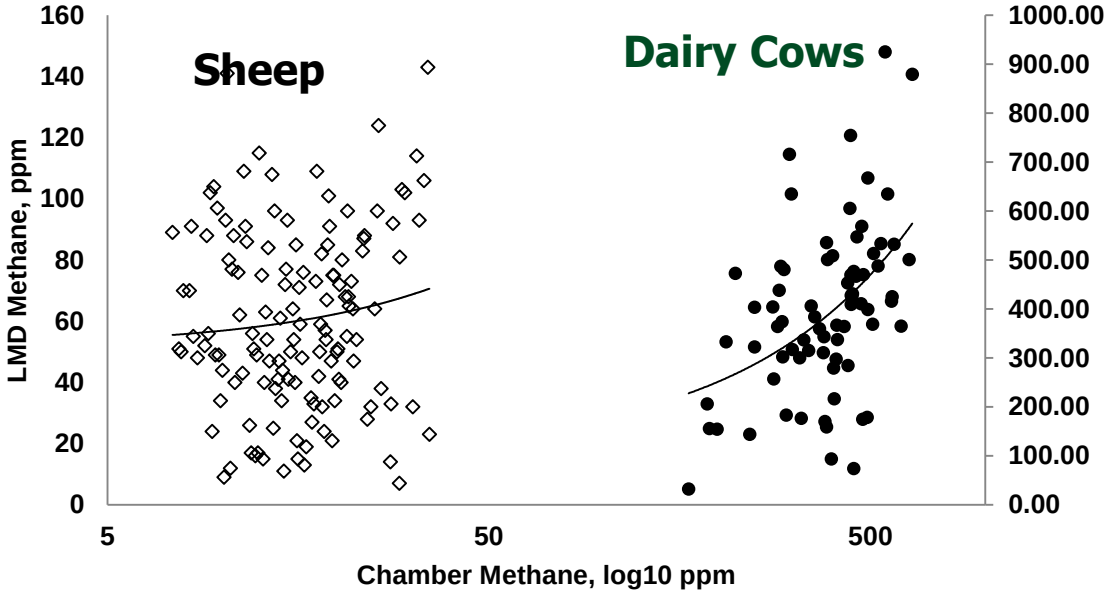
- Based on infrared absorption spectroscopy
- Using a semiconductor laser as a collimated excitation source
- Employs second harmonic detection of wavelength modulation spectroscopy to establish methane concentration

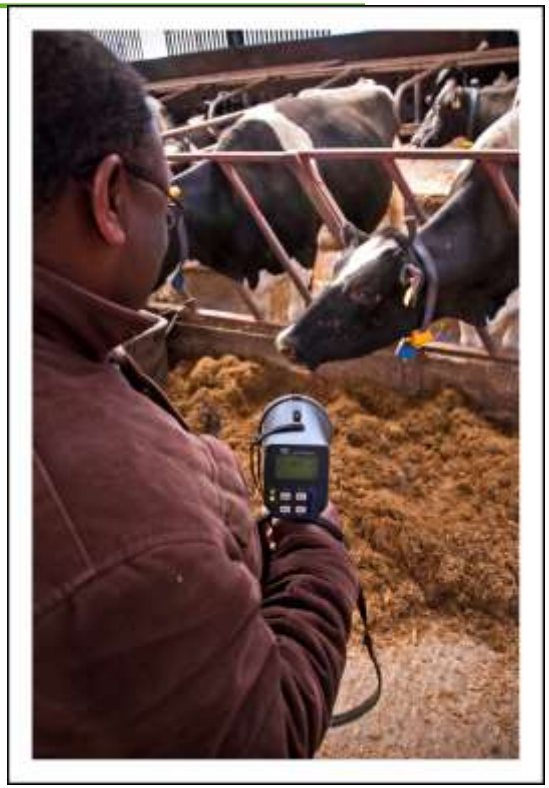
What we know so far?

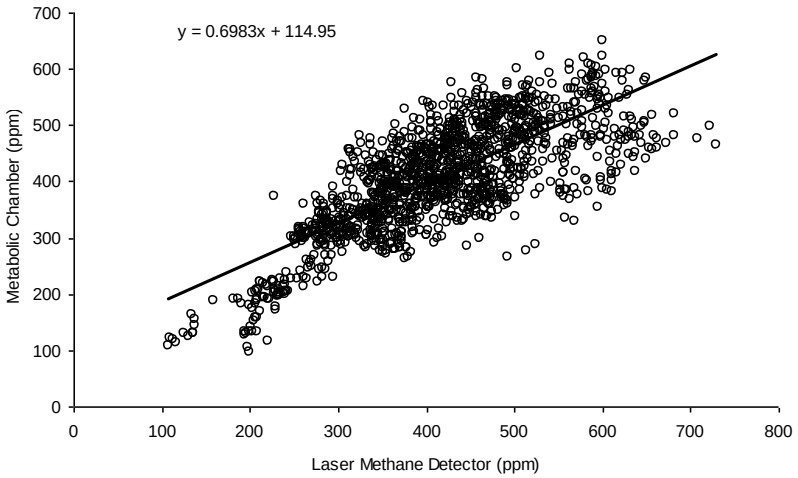
Breath cycles



Correlation with the Chamber







- Sensitivity and specificity for cows were 95.4% and 96.5%.
- For sheep, sensitivity was 93.8% and specificity was 78.7%.

New Questions

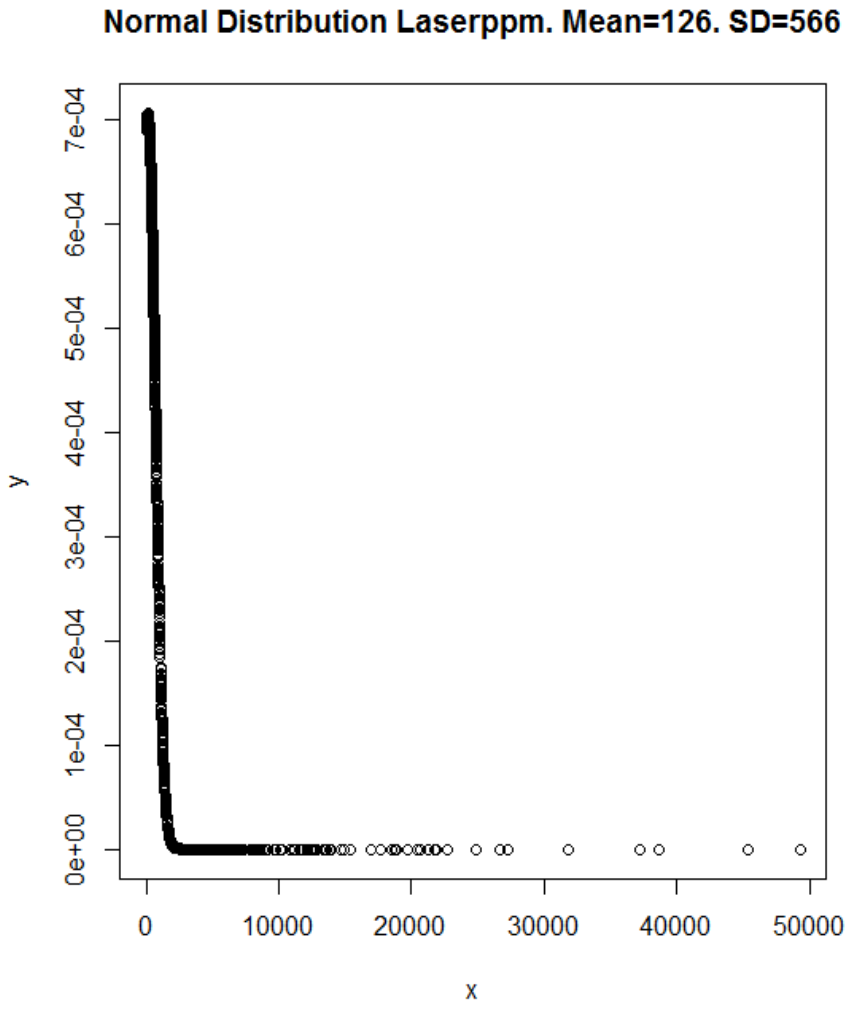
- Which data do we extract?
- When should we measure?
- How long should we measure?

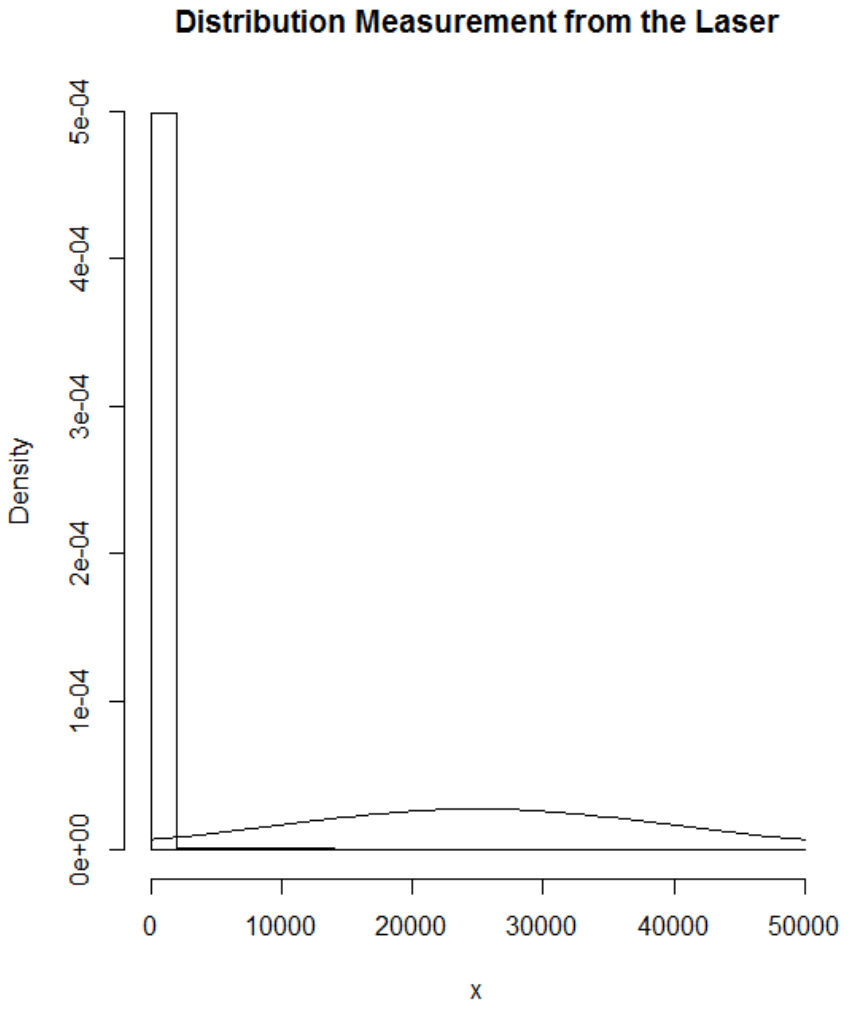
What data to extract?

	Raw LMD data (ppm)	Processed LMD data (ppm)	Chamber methane (ppm)	Chamber methane (g/day)
Min	0	24	12	85
Max	49287	237	177	170
Mean	125.3	114	84.7	127.8
Variance	294656.9	2020.0	519.3	240.2
SD	542.8	45	22.8	15.5

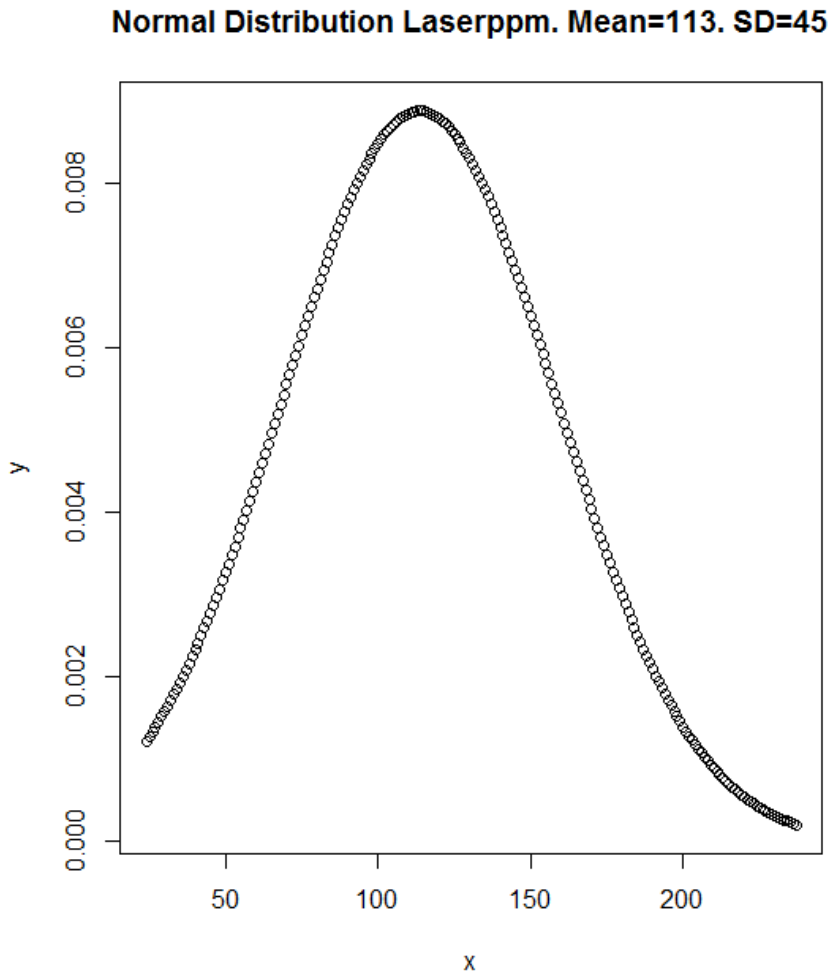
N = 44208 for LMD and 44208

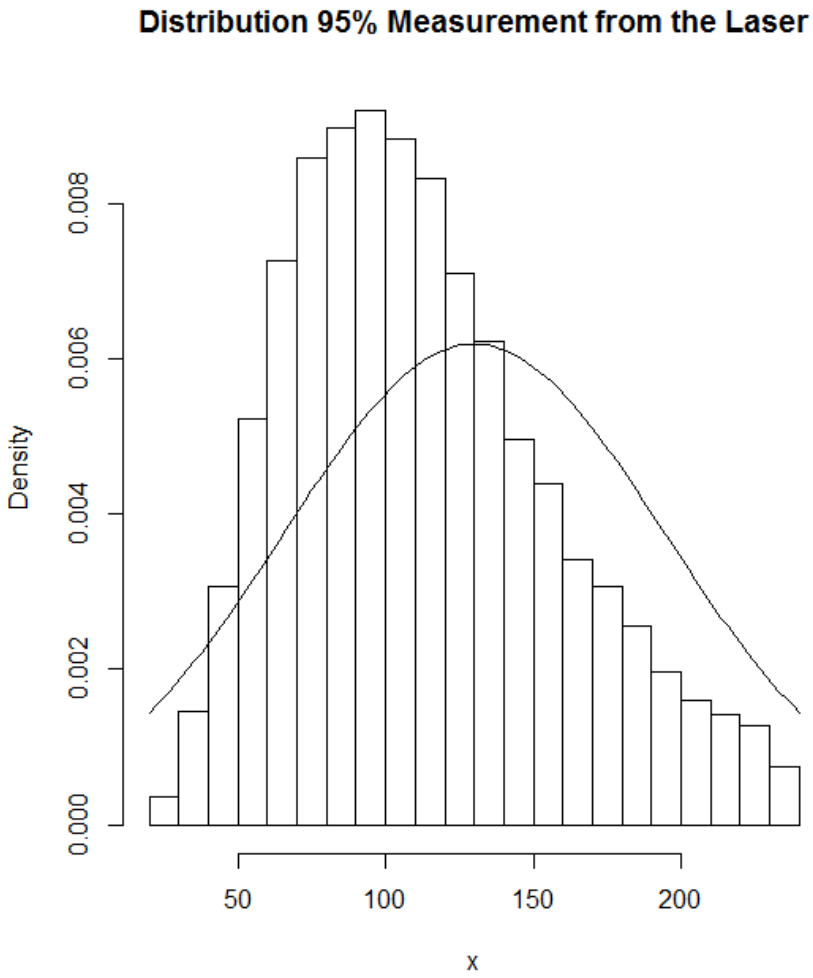
Distribution of Raw LMD data



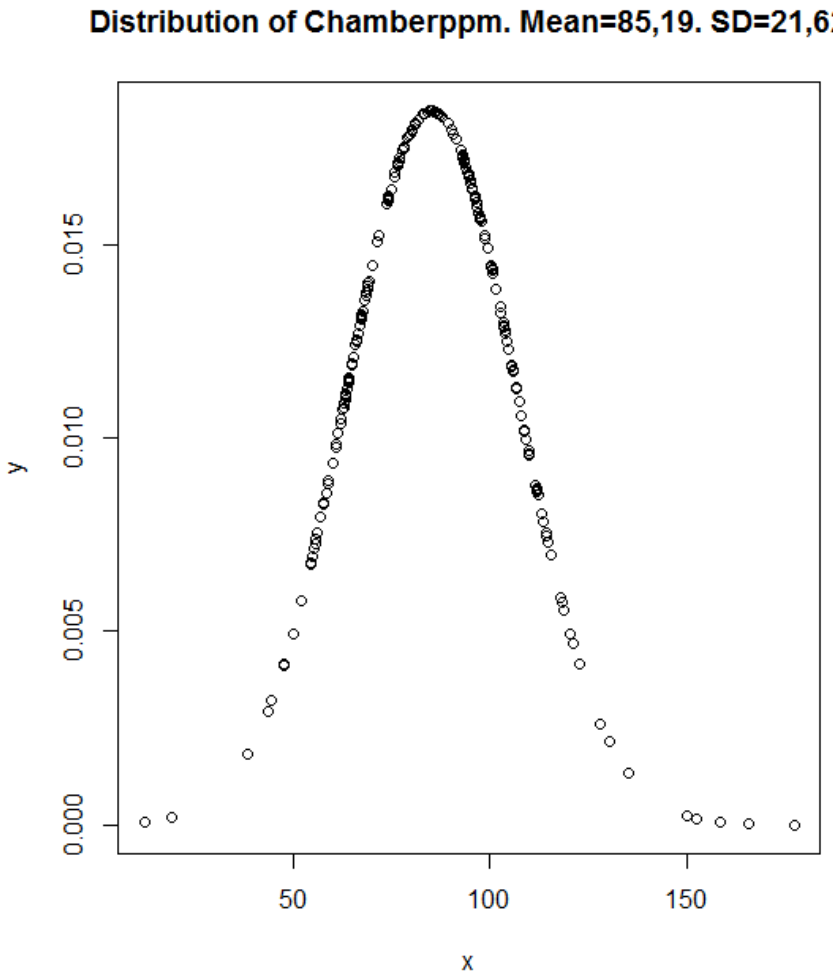


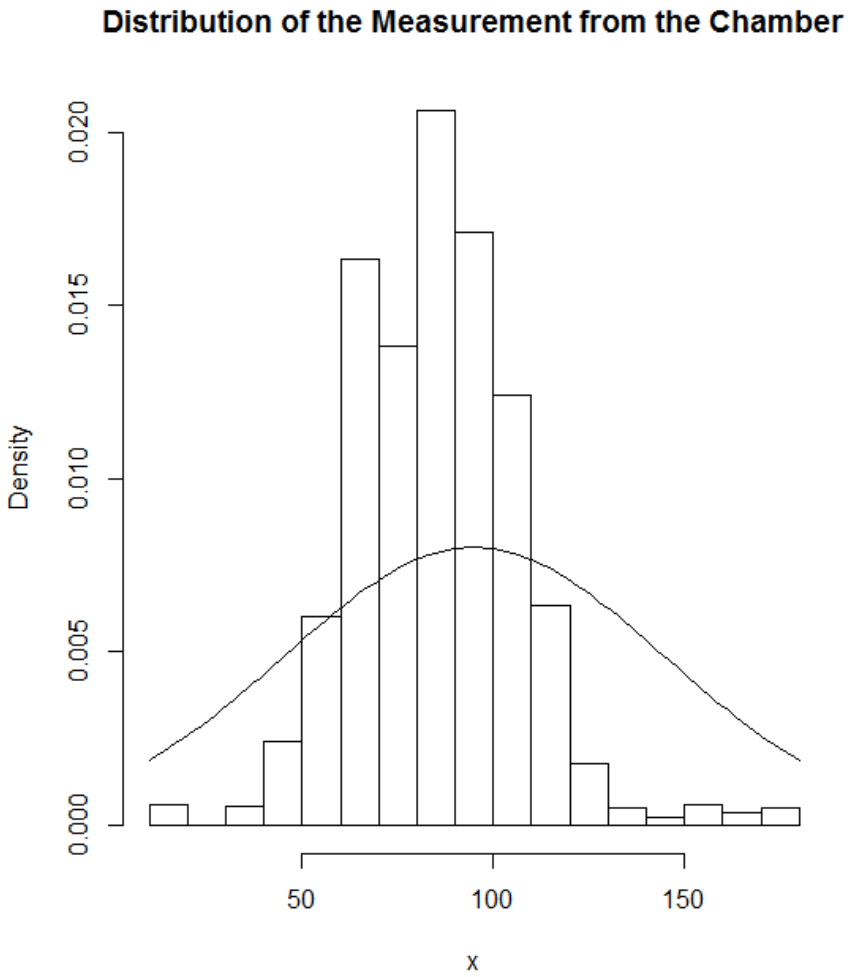
Distribution LMD after Outliers





Density Distribution Chamber





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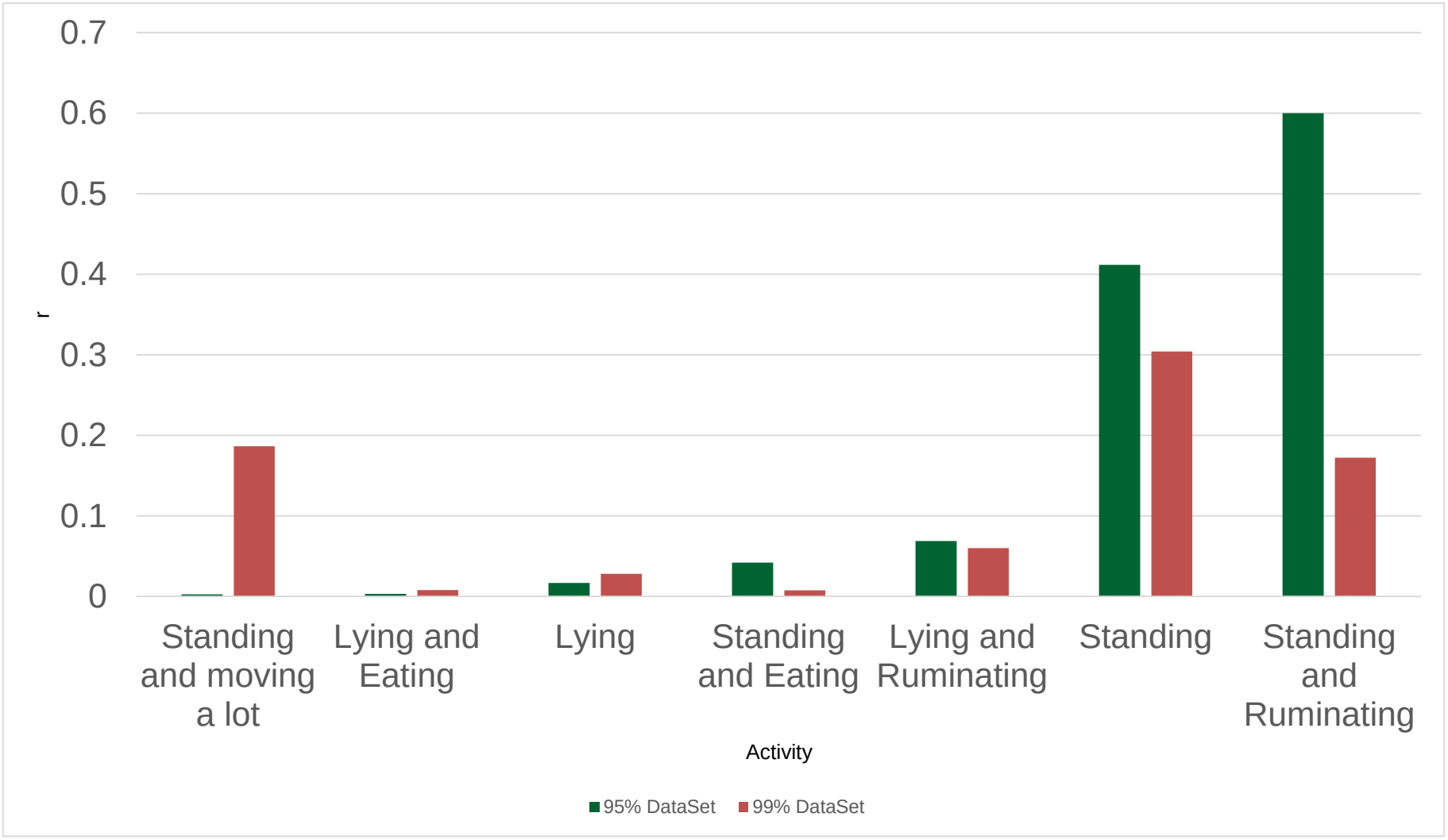
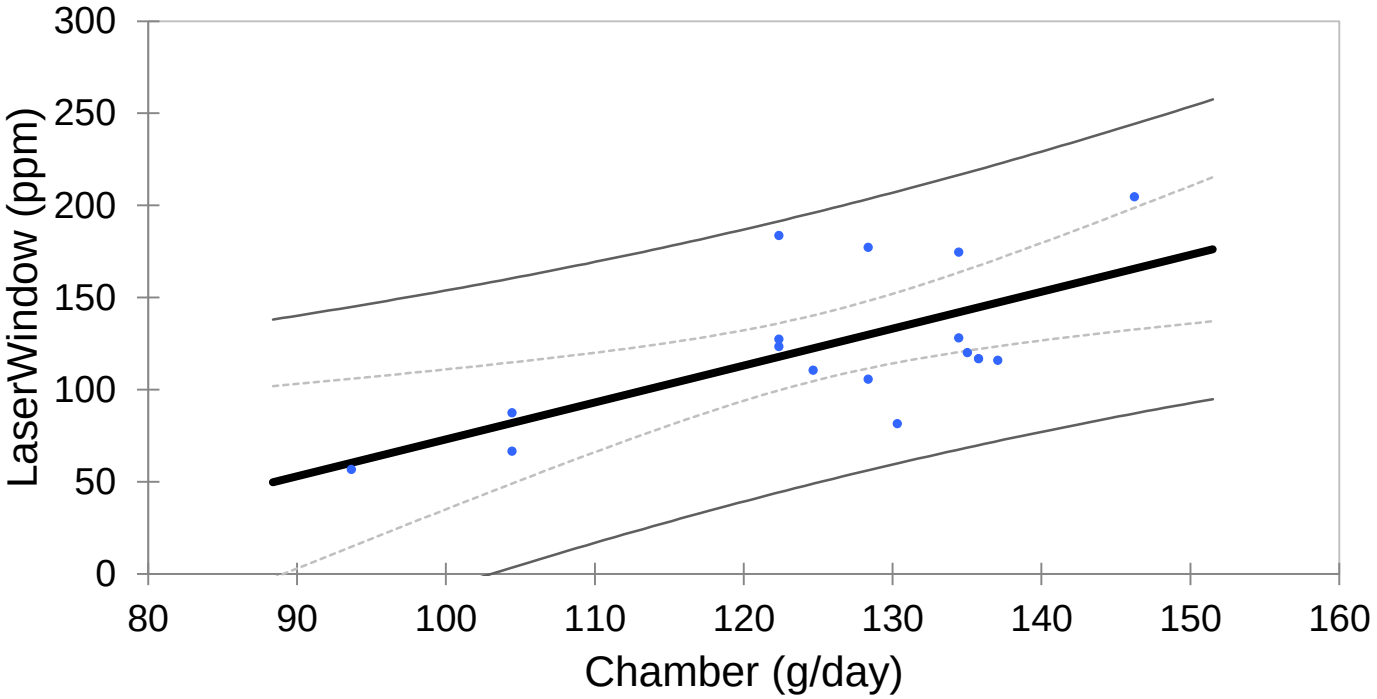


How long should we measure?

- Measurement duration had a significant effect ($p<0.01$) on the concentration of methane measured by LMD
- 60s measurements significantly low ($p<0.001$)
- LMD measurement window of at least 3 minutes long, recommended

Relationship to g/day chamber methane



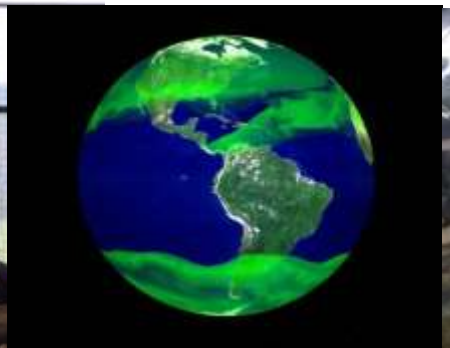
R^2 = 0.42 and r = 0.65

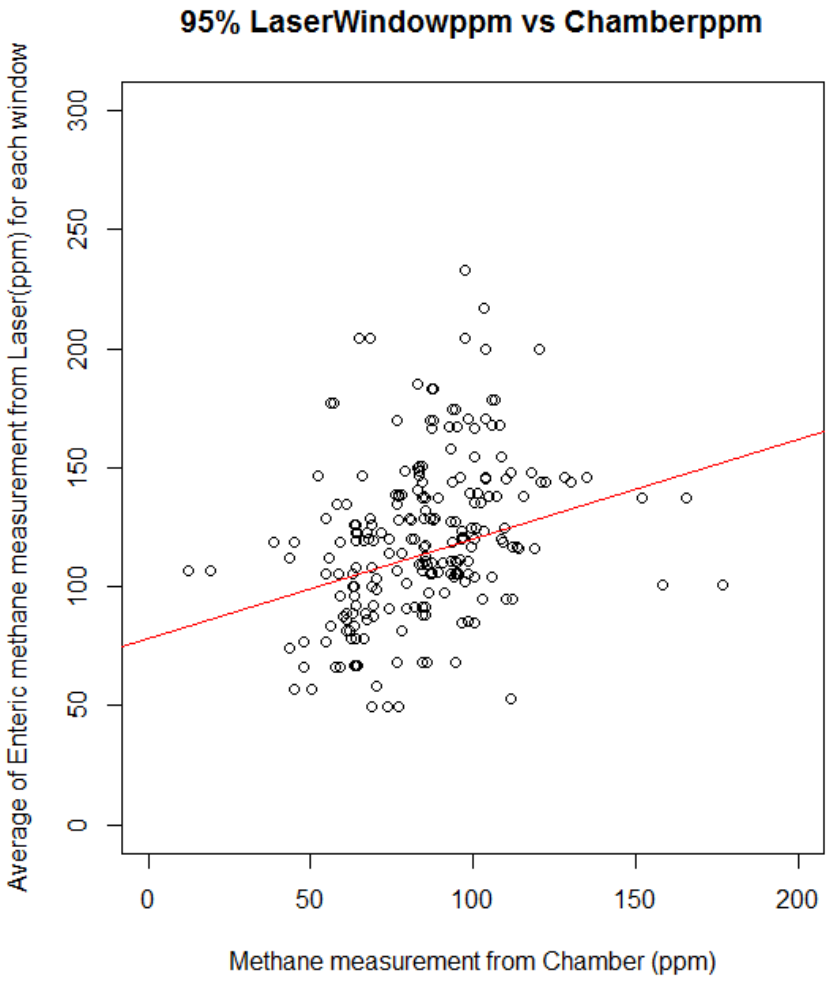
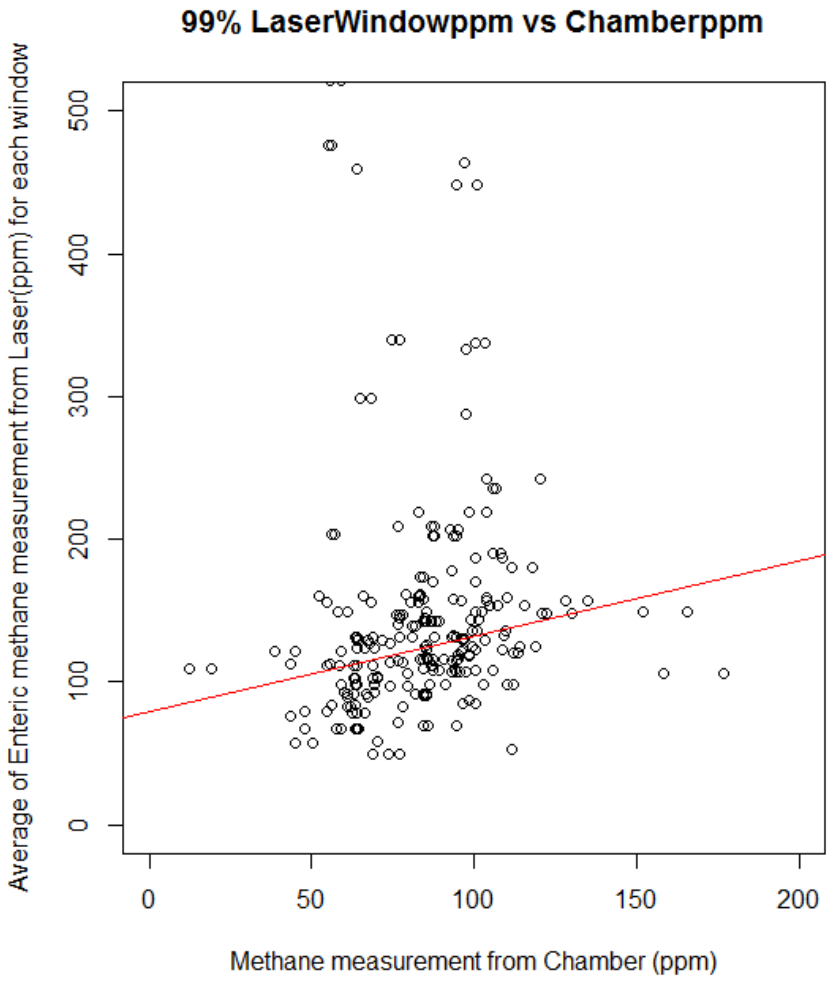
$$\mathbf{Chambergday} = \frac{\mathbf{LaserWindow} + \mathbf{127.21}}{\mathbf{2.00}}$$

Conclusion

- LMD is a promising proxy for measuring enteric methane
- Need to understand the data
- Build on what we know to develop a robust protocol for measuring enteric methane using LMD.

…thank you for your attention



SRUC

Relationship to conc.(ppm) chamber methane