Generating large scale on-farm methane measurements in exhaled air of individual cows

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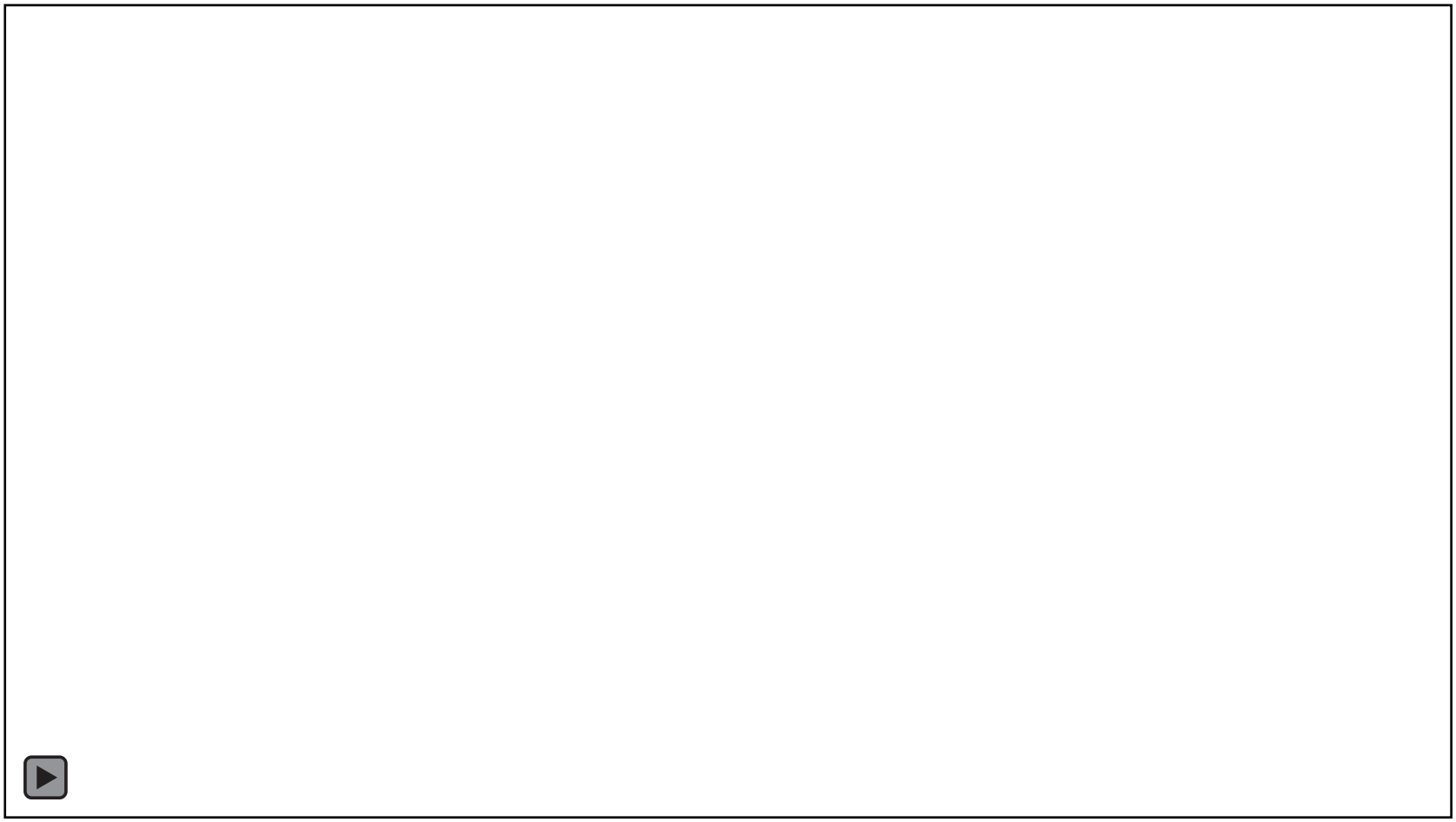
This is what we want a cow to do ...

(4 to 9 hours/day - Hafez & Bouissou, 1975)



… but what also causes problems

Climate change

- International concern
- Greenhouse gases (GHG) great contributor
  - Methane (CH_4)
- Reducing GHG emissions
  - Nutrition
  - Microbes
  - Natural variation

How to measure natural variation?

Photos: Anne-Louise Hellwing

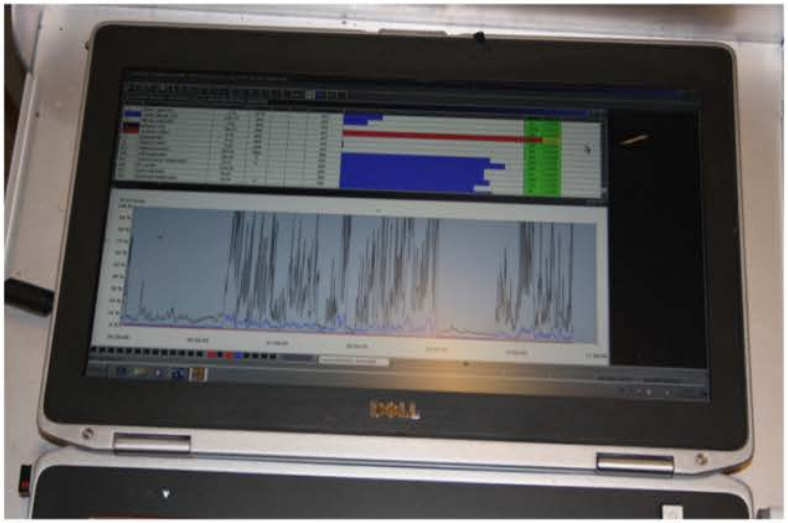
Animal breeding

- Successful breeding programs require large datasets of individual measurements
    - Cannot be generated through respiration chambers

<u>Aim of study:</u>

- To show whether realistic values for and individual differences in enteric CH_4 emission could be measured during milking, so that a large scale data collection can be set up for genetic evaluation of CH_4 production in dairy cattle

Equipment: FTIR in milking robot



Photos: Jan Lassen

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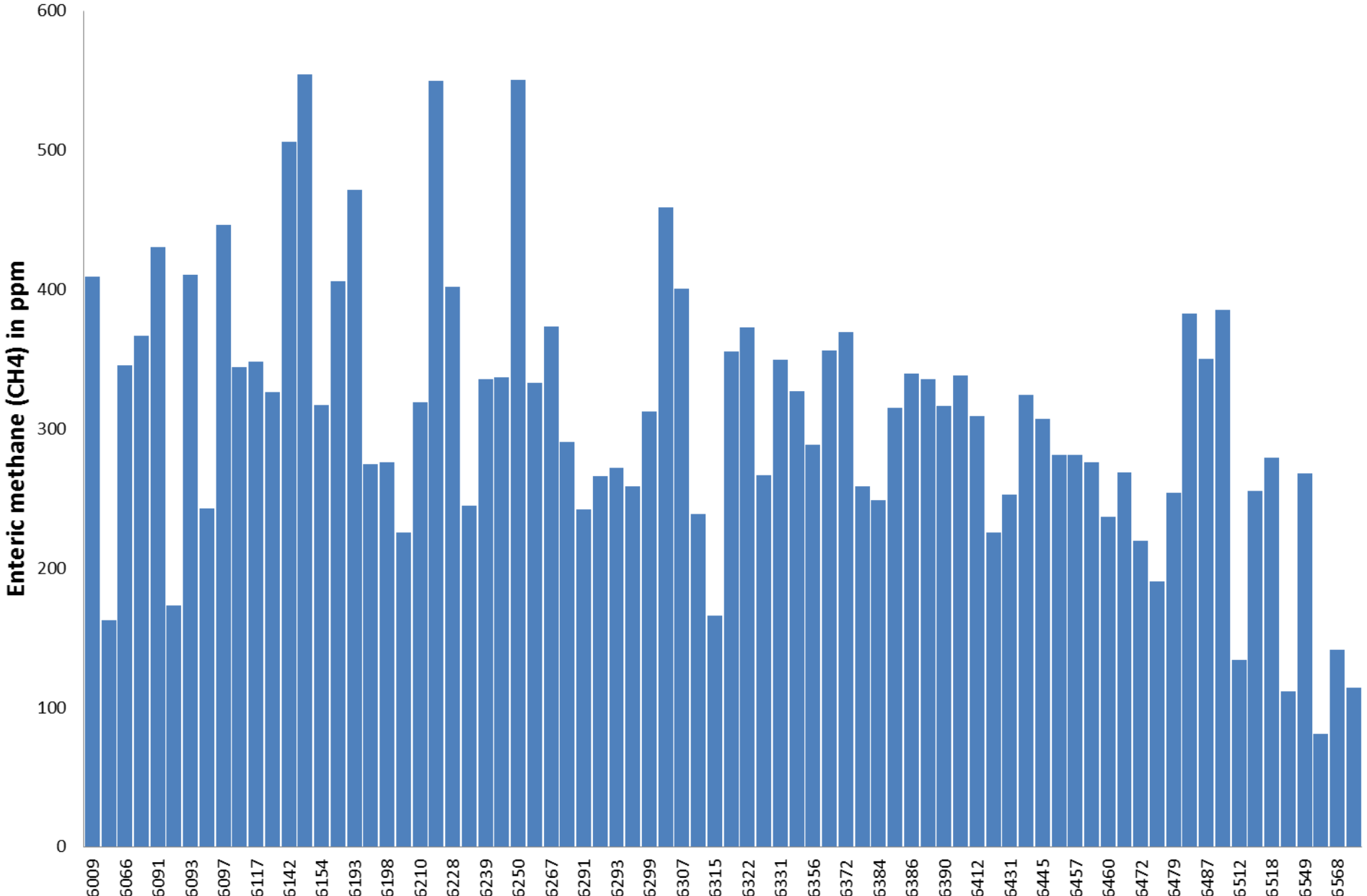
Collected data

Collected data on individual methane measurements in Oct-Nov-Dec 2012 at an experimental dairy cow house of the Dairy Campus using a portable Fourier Transformed Infrared (FTIR) gas analyser

		Range	
No. of cows	77		
No. of CH_4 measurements	87,044		
Mean CH_4 (ppm)	347	196	1,367
Mean CO_2 (ppm)	6,380	4,280	14,500

Between-animal variation



Statistical analyses

Y = μ
+ lactation month
+ day
+ session (3 hours)
+ CH_4-measurement
+ animal
+ day*animal
+ day*session
+ day*session*animal
+ residual

Variance components

Y = log transformed methane output (ppm), or

	CH_4	
Animal	0.065	
Day*Animal	0.011	
Day*Session*Animal	0.045	
Residual	0.277	

Variance components

Y = log transformed methane output (ppm), or
Y = log transformed methane output per kg of milk

	CH_4	CH_4 / kg milk
Animal	0.065	0.081
Day*Animal	0.011	0.025
Day*Session*Animal	0.045	0.046
Residual	0.277	0.277

The estimated variance components for both methane output traits show that, independent of production level, differences between animals can clearly be indicated with a measuring strategy with an FTIR instrument in an AMS

Conclusions

- Using a portable FTIR measuring unit in a milking robot to measure individual cow methane concentrations gave realistic values and ranges.
- The FTIR instrument combined with a milking robot may therefore be useful to generate large scale data for genetic evaluation of methane production in dairy cattle.

- How can we get enough data for genetic evaluations?

METHAGENE

No. FA1302

Large-scale methane measurements on individual ruminants for genetic evaluations

- Define best trait for methane emission;
- Harmonise protocols for large-scale methane measurements using different techniques;
- Identify proxies for methane emissions to be used for genetic evaluations; and
- Quantify benefits for producers when incorporating methane emissions into national breeding strategies.

A network of European researchers

- 17 Countries

  AT; BE; CH; CZ; DE; DK; ES; FI; FR; IE; IT; NL; NO; PL; SE; SLO; UK

- >50 participants
- >30 institutions
  - Academic
  - Government
  - Industry

Welcome!

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Thank you for your attention

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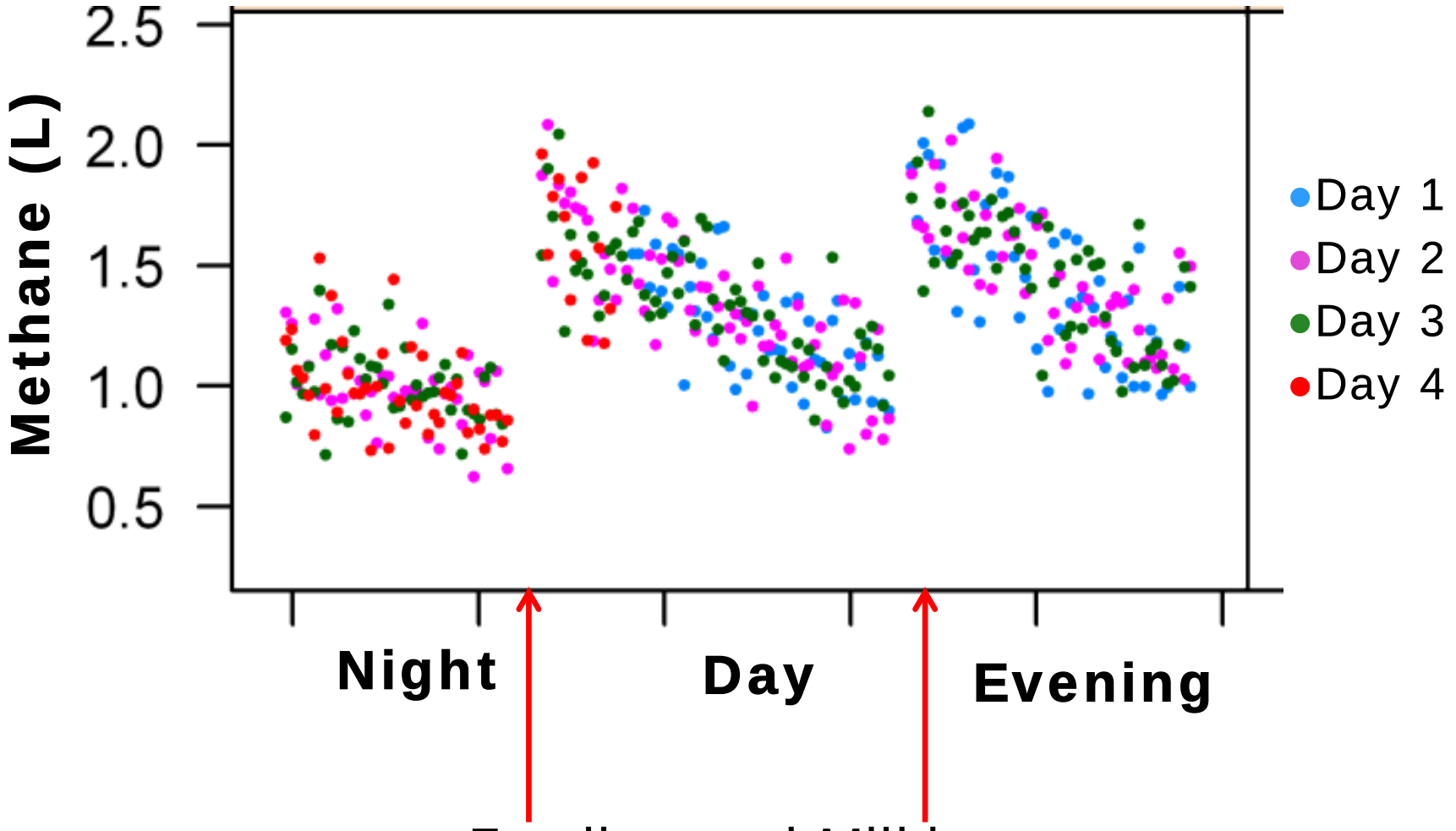
Methane production for 1 trial



3 scenarios

- Measuring

  (1) during milking (i.e. twice daily, for 15 minutes);

  (2) in concentrate feeder (i.e. 5x per day for 6 min.);

  (3) in cubicles (i.e. 4 hours continuously).

- Scenarios were simulated by omitting samples

Accuracies compared to resp. chambers

Scenario	CH_4	CH_4 / CO_2
During milking	0.85	0.31
In concentrate feeder	0.89	0.33
In cubicles	0.96	0.39