

Online measurement of methane from dairy cows during milking

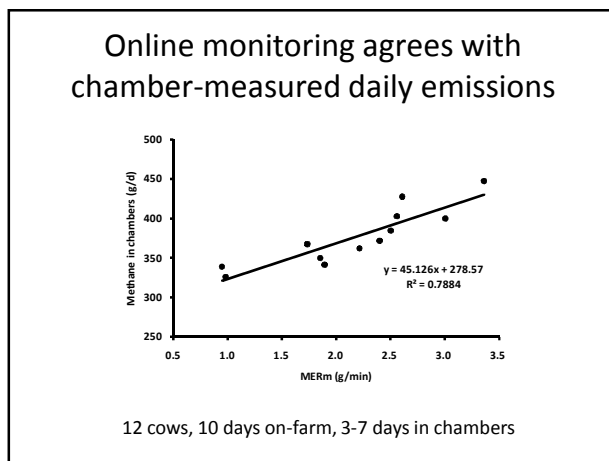
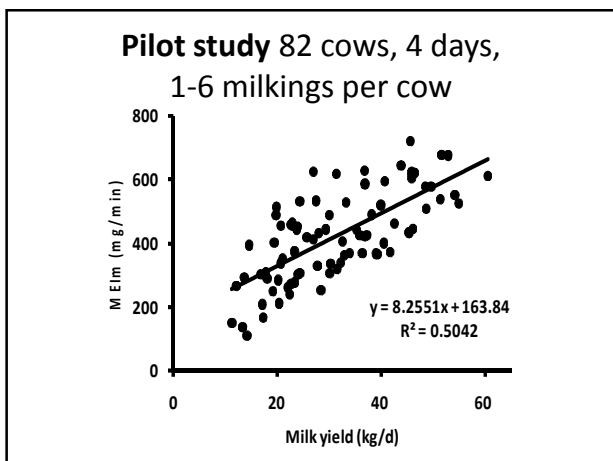
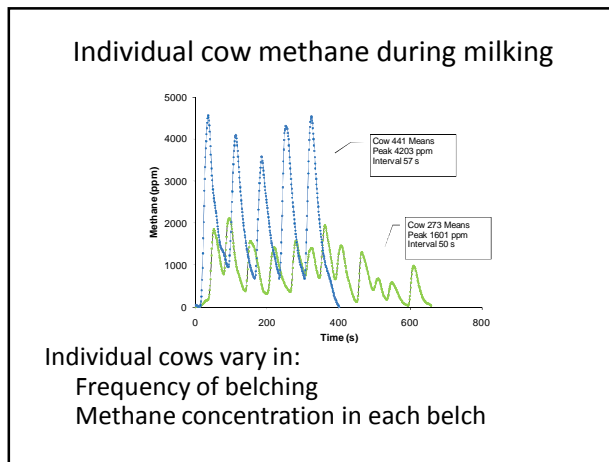
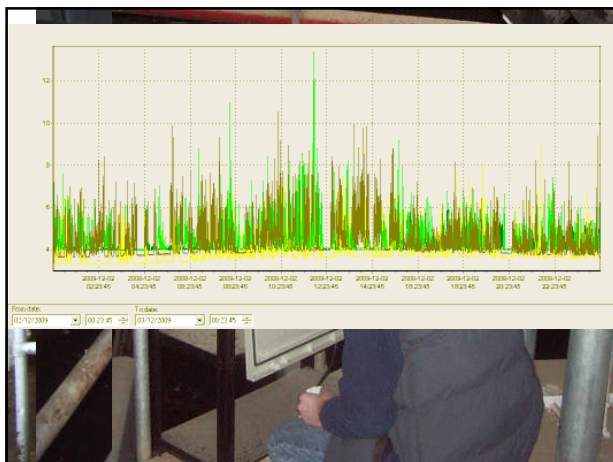
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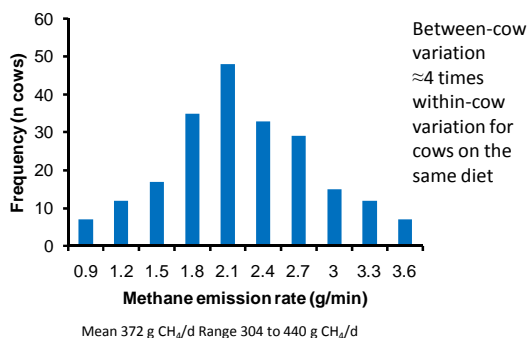
GRA 2011, Reading

Background

- Total methane emissions from a dairy herd = number of cows * methane per cow
- It is easy to count cows
- It is difficult to measure methane
 - Respiration chambers (cost, replication, realism)
 - SF₆ (animal handling, halters, bolus calibration)
 - Barn flow (ventilation, n per herd = 1)
- Why not measure methane during milking?



**Main survey 215 cows; 5 months;
66,734 milkings; 14,533 daily means**

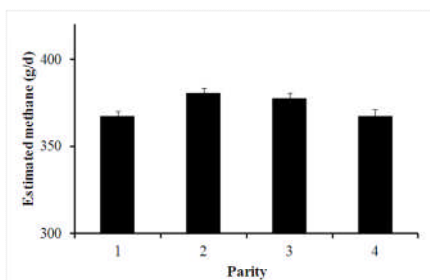


Variation in methane (g/d) estimated from MERm

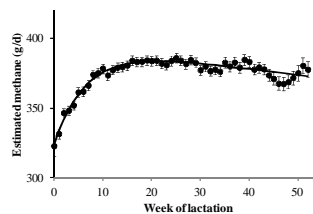
Source	Parameter	SE	F	prob
Live weight (kg)		0.12	0.02	<0.001
Milk yield (L)		0.72	0.11	<0.001
Parity (1-4)				0.002
Pregnancy ¹				NS
Week of lactation (1-52)	$396 - 72 \times (0.86^{WL}) - 0.44 \times WL$	3.3		0.016
Sire ²	Fixed			0.025
	Random			0.136

¹ 130 pregnant/215 cows during 5-month study
² 72 sires, 164 daughters, 1-15 daughters per sire

Parity

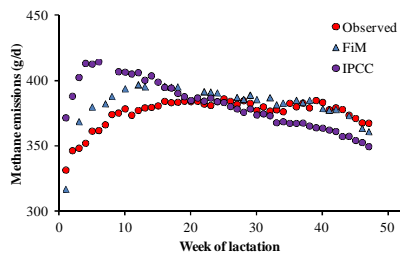


Week of lactation



$396 - 72 \times (0.86^{WL}) - 0.44 \times WL$ (P=0.016)

Comparison with IPCC and FiM predictions



Lin's concordance:
IPCC, -0.14 (95% CI -0.37 to 0.09; r -0.18; bias 0.81; P>0.05)
FiM, 0.68 (95% CI 0.53 to 0.79; r 0.81; bias 0.84; P<0.05)

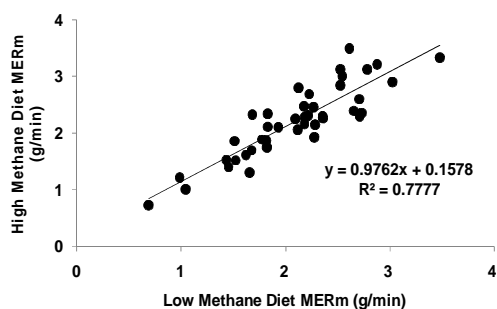
Effect of low and high methane diets on MERm

	Methane Diet			P
	Low	High	sed	
Dry matter intake (kg/d)	23.6	20.3	0.31	<0.001
Milk yield (kg/d)	32.7	32.1	0.28	0.034
Methane emission rate (g/min)	2.08	2.18	0.05	0.024
(mg/min per kg DMI)	91	110	3.02	<0.001

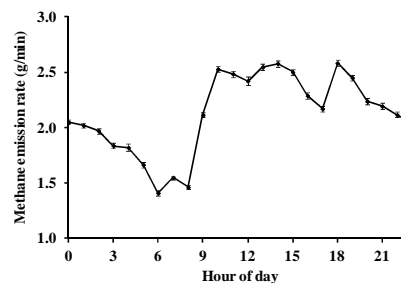
42 cows, 14 days per diet, crossover design

Diets:
Low = commercial TMR (maize, grass & whole-crop silages; SBP, rape, soya, fat, M&V)
High = Low + double grass silage (13% → 30%) + peas (2kg/d)

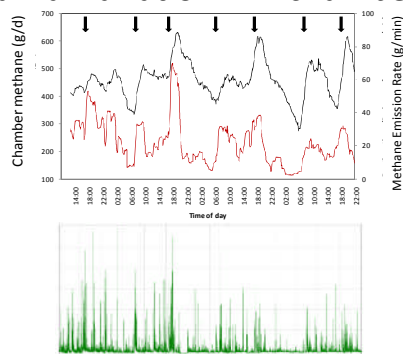
Repeatability within cows



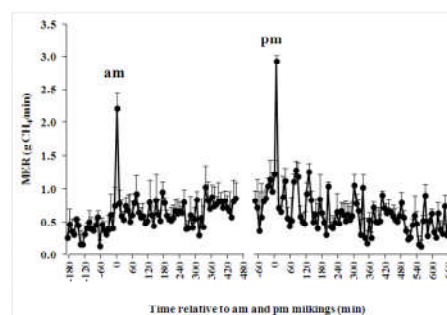
Diurnal Variation – milking times



Diurnal variation – in chambers



Diurnal Variation – relative to milking



Conclusions - technique

- MERm provides a low-cost technique for monitoring large numbers of cows
- Non-invasive, so does not affect cow behaviour under commercial conditions
- Noisy data, but repeated measures are easy
- MERm is related to chamber methane values
- Technique can detect diet differences

Conclusions - findings

- Methane emissions vary considerably between cows
- Individual cow differences are consistent and related to known methane drivers
- Cows eating equal amounts of the same diet can have different emissions
- Maybe we can select cows for low methane emissions