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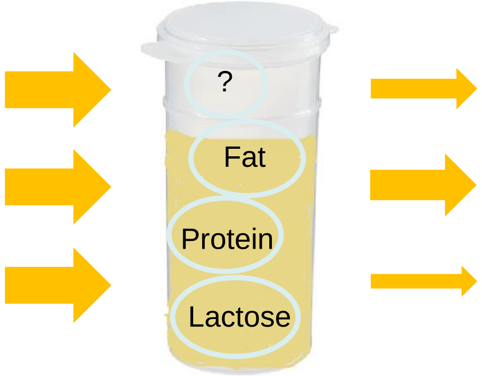
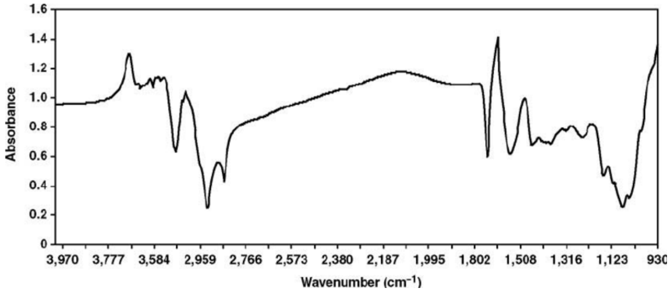
Agroscope

Overview of the methane equations developed from mid-infrared spectroscopy and their applications

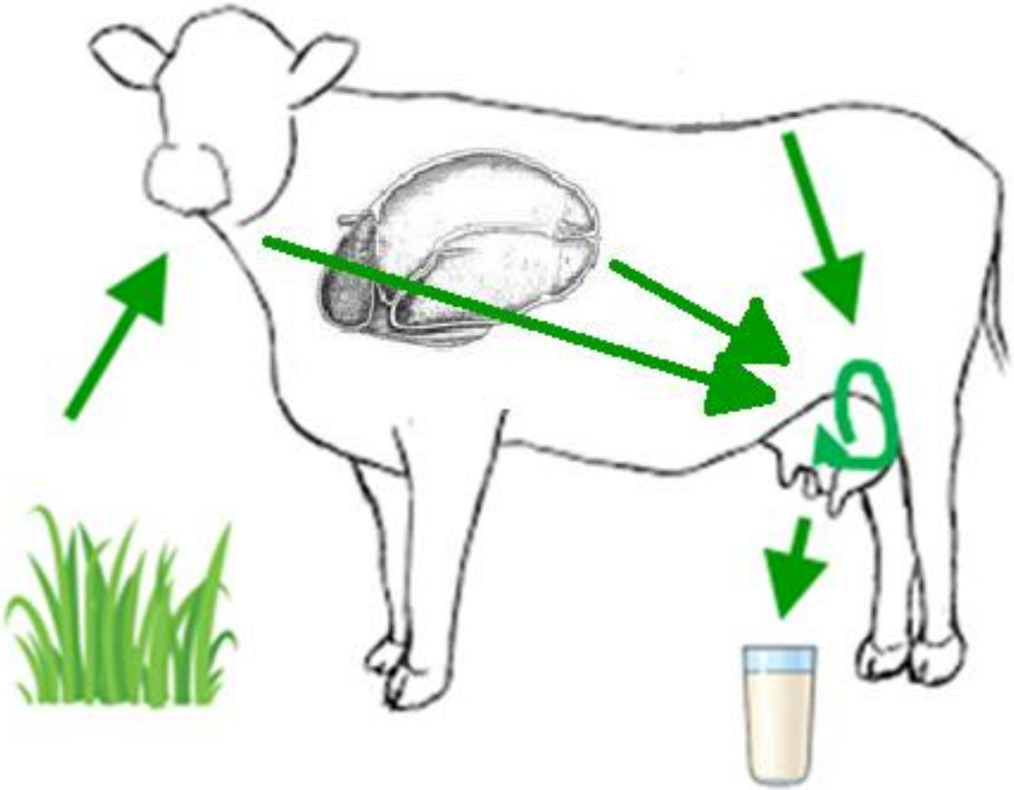
Maria Frizzarin

What is MIRS?

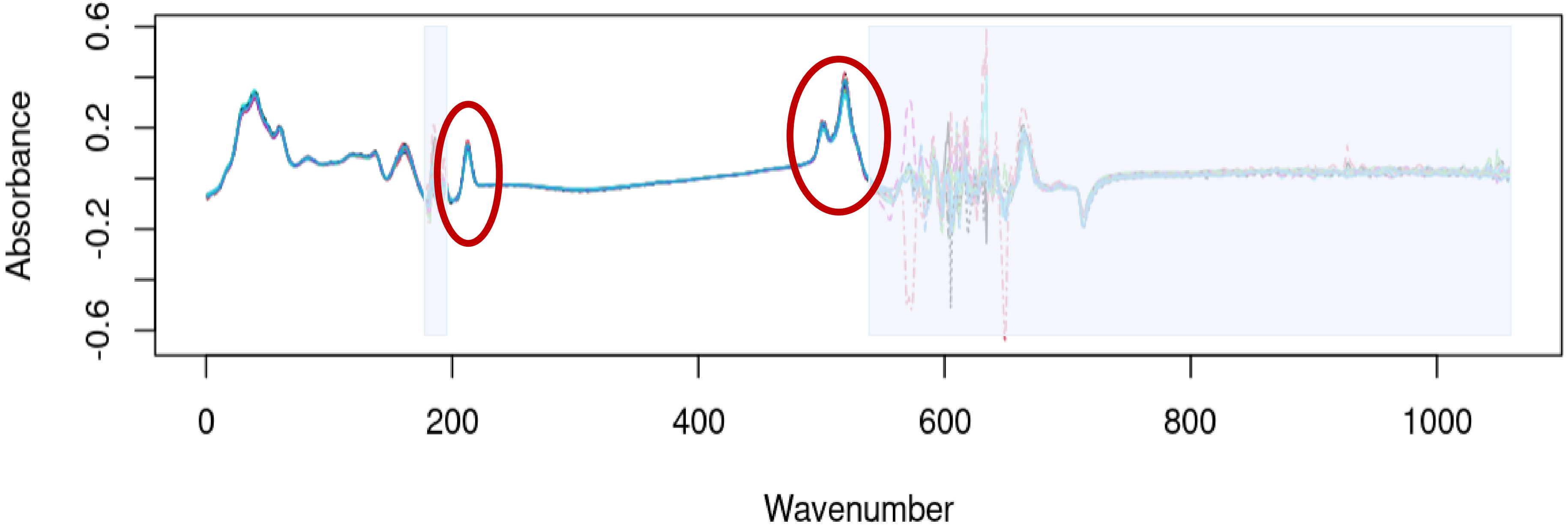

?
Fat
Protein
Lactose


1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
Absorbance
3,970
3,777
3,584
2,959
2,766
2,573
2,380
2,187
1,995
1,802
1,508
1,316
1,123
930
Wavenumber (cm⁻¹)

Why can MIR predict methane emissions?



Why can MIR predict methane emissions?



Developed equations

Country	Number of records	Number of cows	Breed	Methane measurements
EMR (Belgium, Ireland, UK, Germany, Switzerland, France, Denmark, Northern Ireland)$_1$	1089	299	HF, Jersey, Brown Swiss, Red Holstein, Swedish red cross, Norwegian Red, HF cross	SF6 and respiration chambers
Canada + Denmark$_2$	398	202	HF	GreenFeed
Ireland$_3$	3047 (*6500)		HF, Jersey, cross	GreenFeed
France$_4$	515	129	HF	GreenFeed

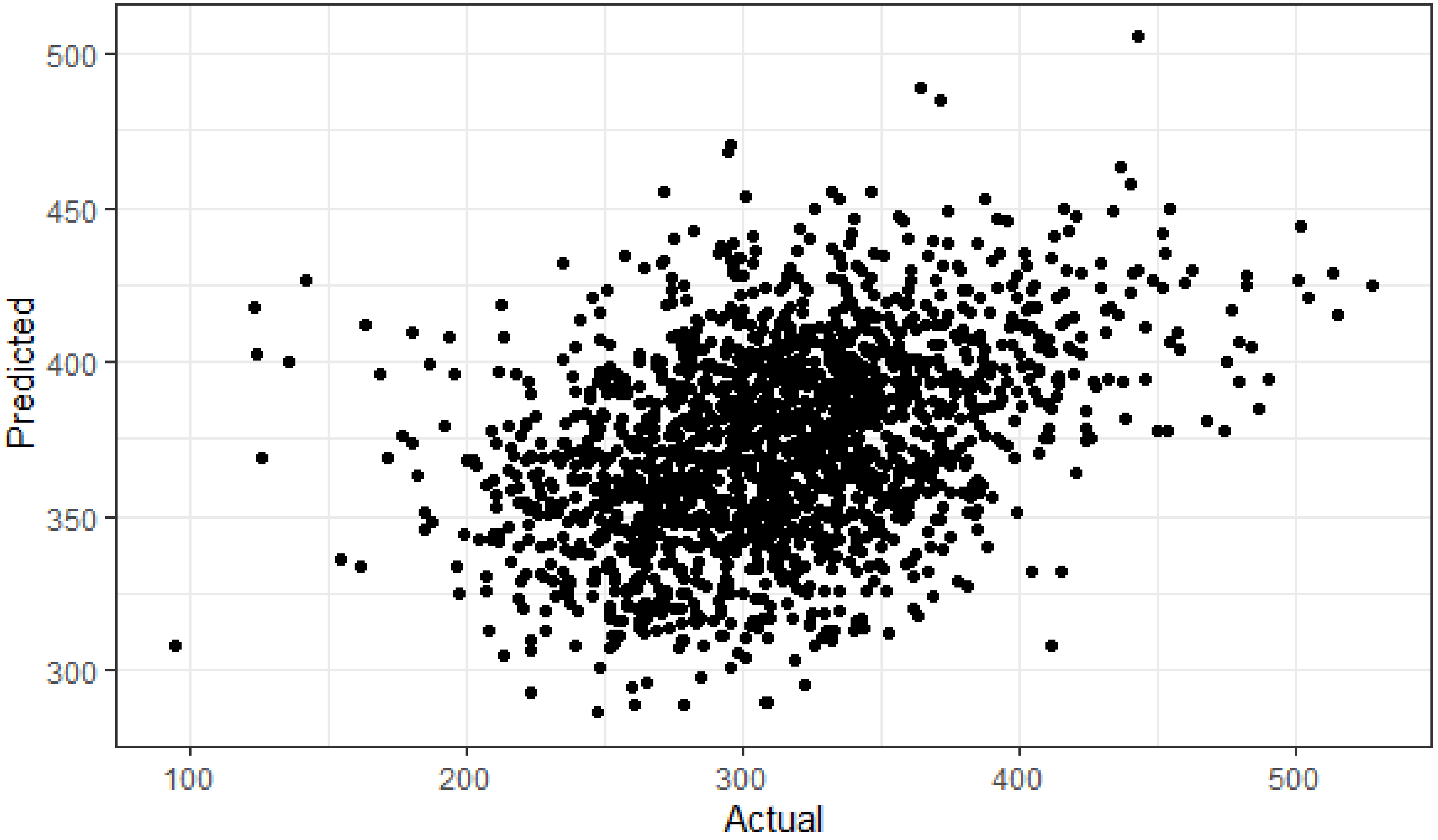
Developed equations

Country	Validation	Prediction variables	Prediction model	Accuracy
EMR (Belgium, Ireland, UK, Germany, Switzerland, France, Denmark, Northern Ireland)[1]	5-group cross-validation	MIR transformed based on DIM + MY + parity + breed	PLSR	R2 = 0.60 RMSE = 65 g/d
Canada[2]	Random cross-validation	MIR + age at calving + DIM + country + season of calving + parity	NN	R2 = 0.49 RMSE = 71.61 g/d
Ireland[3]	4-group cross-validation	MIR + MY	NN	R2 = 0.50 RMSE = 37.46 g/d
France[4]	Random cow allocation in calibration and validation (67/33)	MIR + parity	PLSR	R2 = 0.73 RMSE = 48.4 g/d

Developed equations

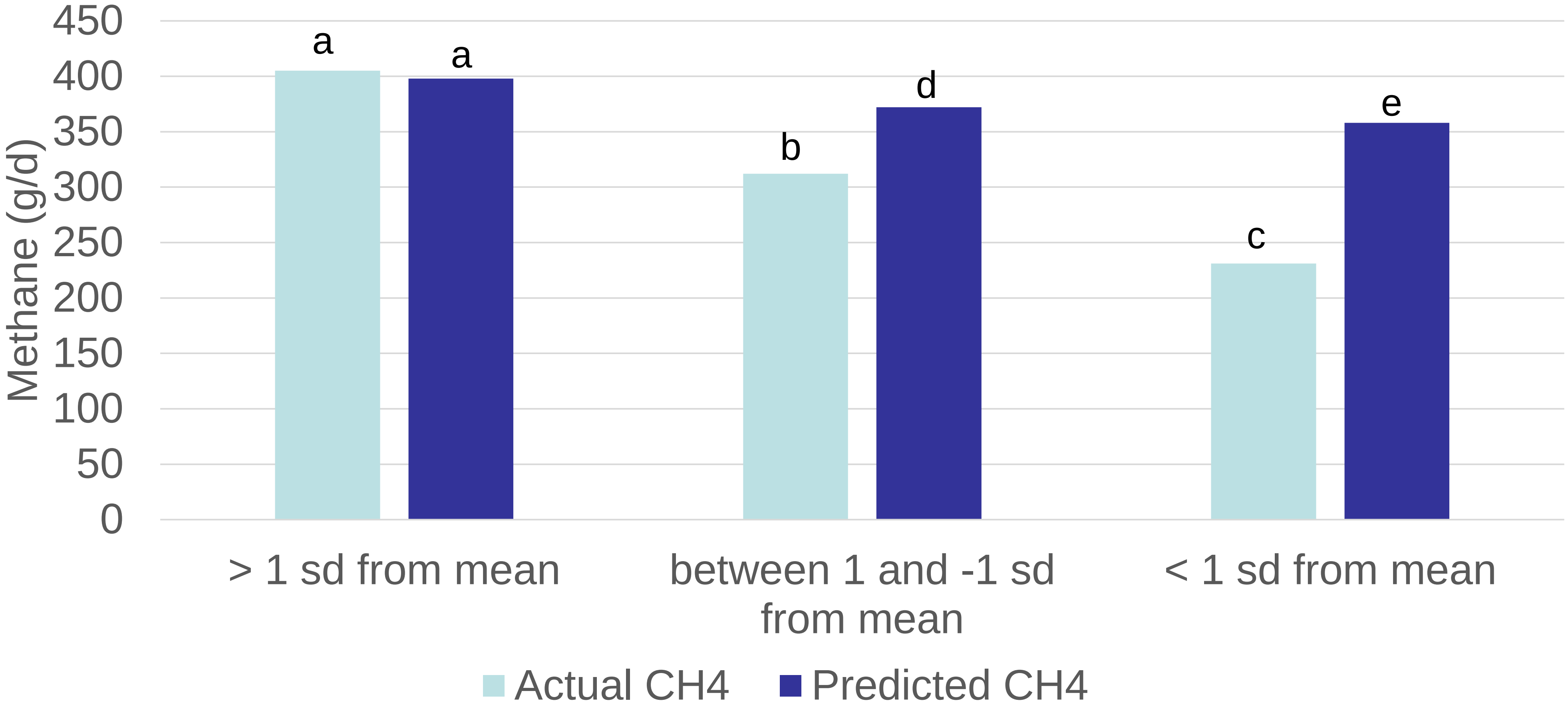
Country	Number of records	Number of cows	Methane measurement	Validation	Accuracy
[5]Netherland	218		Respiration chambers	Cross-validation	R2 = 0.30
[6]Sweden	593	37	Sniffer	Leave-one-cow-out cross-validation	R2 = 0.05

Irish equation– new validation



- R2 of 0.14
- Root mean square error of 78.76 g/d

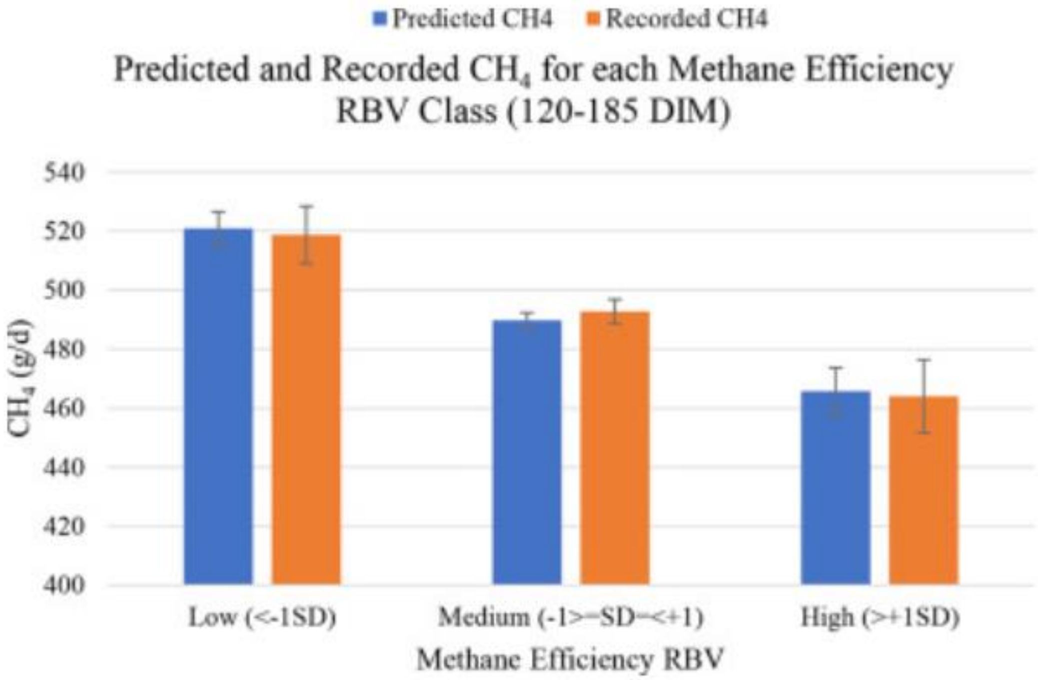
Irish equation – new validation



How are these equations used?

Country	Use	Equation used
Canada	Methane EBVs and genomic prediction	Canadian
Belgium	Methane EBVs and genomic prediction	EMR
France	Methane EBVs	EMR

Canadian Breeding values - validation



7Mid-infrared predicted CH_4 and recorded CH_4 (g/d) for low, medium, and high classes (120–185 DIM) of methane efficiency relative breeding values (RBV; n = 471)

Future projects

Country	Project	Project aim
France	Methane2030	National wide application of methane predicted values and methane EBVs
Austria		Development of MIR equations for Flieckvie cows
Netherland		Development of MIR equations
Norway		Development of MIR equations for Norwegian red cows
Switzerland	EffNMilk	Development of equations for Holstein cows combining milk MIR and feces NIR

Conclusions

- MIR equations for methane already developed in different countries with different levels of accuracies
- Predicted MIR-methane already used for EBVs quantification and development of genomic predictions
- New projects on developing MIR prediction equations for methane currently starting

References

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Thank you for your attention

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