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Agroscope

Daily methane emission predicted from milk MIR spectra: the time of model comparison

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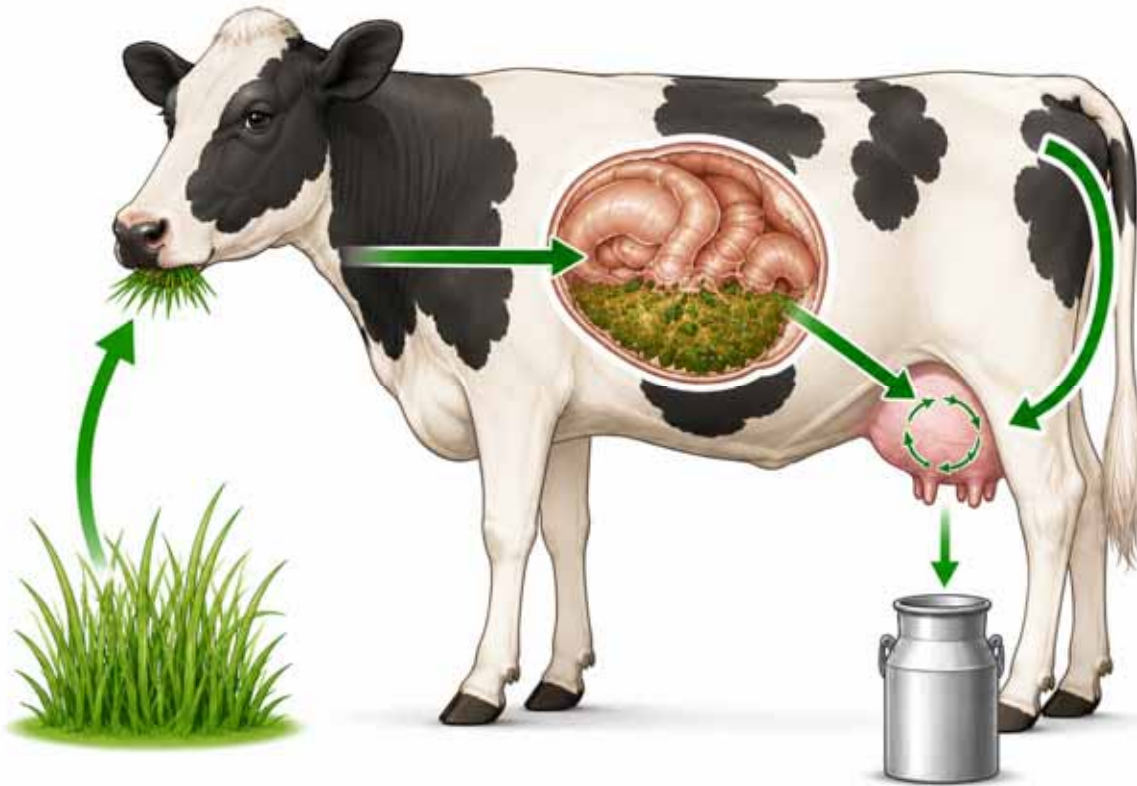
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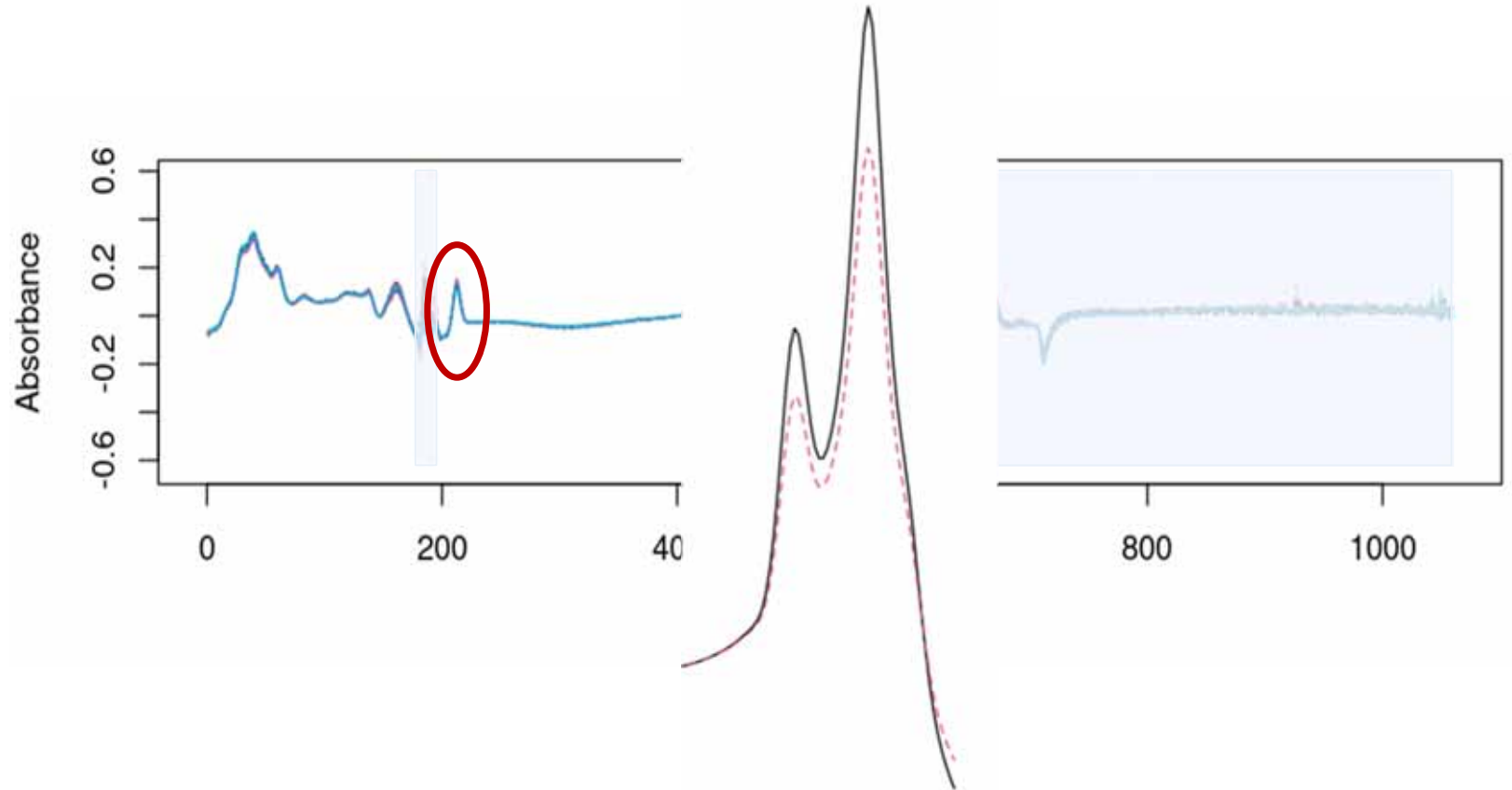


Milk MIR spectroscopy as predictor of methane emission





Milk MIR spectroscopy as predictor of methane emission





The proliferation of equations: overview

Authors	Year	Country	Ref. method
Dehareng et al.	2012	Belgium	SF6
Vanlierde et al.	2015	Belgium, Ireland, Switzerland	SF6
Shetty et al.	2017	Denmark	Sniffer
Vanlierde et al.	2018	7 countries (BE, IE, DE, CH, FR, DK, UK)	SF6 + RC
Vanlierde et al.	2021	Multi-country (BE, IE, DE, CH, FR, DK)	SF6 + RC



The proliferation of equations: overview

Authors	Year	Country	Ref. method	N animals	Model
Dehareng et al.	2012	Belgium	SF6	11 Holstein	PLSR
Vanlierde et al.	2015	Belgium, Ireland, Switzerland	SF6	142 (Holstein, Jersey, HJ cross)	PLSR
Shetty et al.	2017	Denmark	Sniffer	~700 Danish Holstein	PLSR
Vanlierde et al.	2018	7 countries (BE, IE, DE, CH, FR, DK, UK)	SF6 + RC	303 multi-breed	PLSR
Vanlierde et al.	2021	Multi-country (BE, IE, DE, CH, FR, DK)	SF6 + RC	~400 multi-breed	PLSR

The proliferation of equations: overview

Authors	Year	Country	Ref. method	N animals	Model	Included variables	Validation type
Dehareng et al.	2012	Belgium	SF6	11 Holstein	PLSR	MIR spectra (selected wavelength regions); spectra shifted 1.5 days relative to CH4 measurement	Cross-validation
Vanlierde et al.	2015	Belgium, Ireland, Switzerland	SF6	142 (Holstein, Jersey, HJ cross)	PLSR	MIR spectra + DIM via Legendre polynomials; lactation-stage-dependent model (DLS)	Cross-validation + independent set
Shetty et al.	2017	Denmark	Sniffer	~700 Danish Holstein	PLSR	MIR spectra only ($R^2=0.13$); MIR spectra + milk yield ($R^2=0.35$)	Validation set
Vanlierde et al.	2018	7 countries (BE, IE, DE, CH, FR, DK, UK)	SF6 + RC	303 multi-breed	PLSR	Standardised EMR MIR spectra; merged SF6 (n=532) and RC (n=584) reference datasets	5-group cross-validation
Vanlierde et al.	2021	Multi-country (BE, IE, DE, CH, FR, DK)	SF6 + RC	~400 multi-breed	PLSR	MIR spectra; DIM correction; MY/FPCM as optional covariates; parity and breed	Cross-validation + external validation

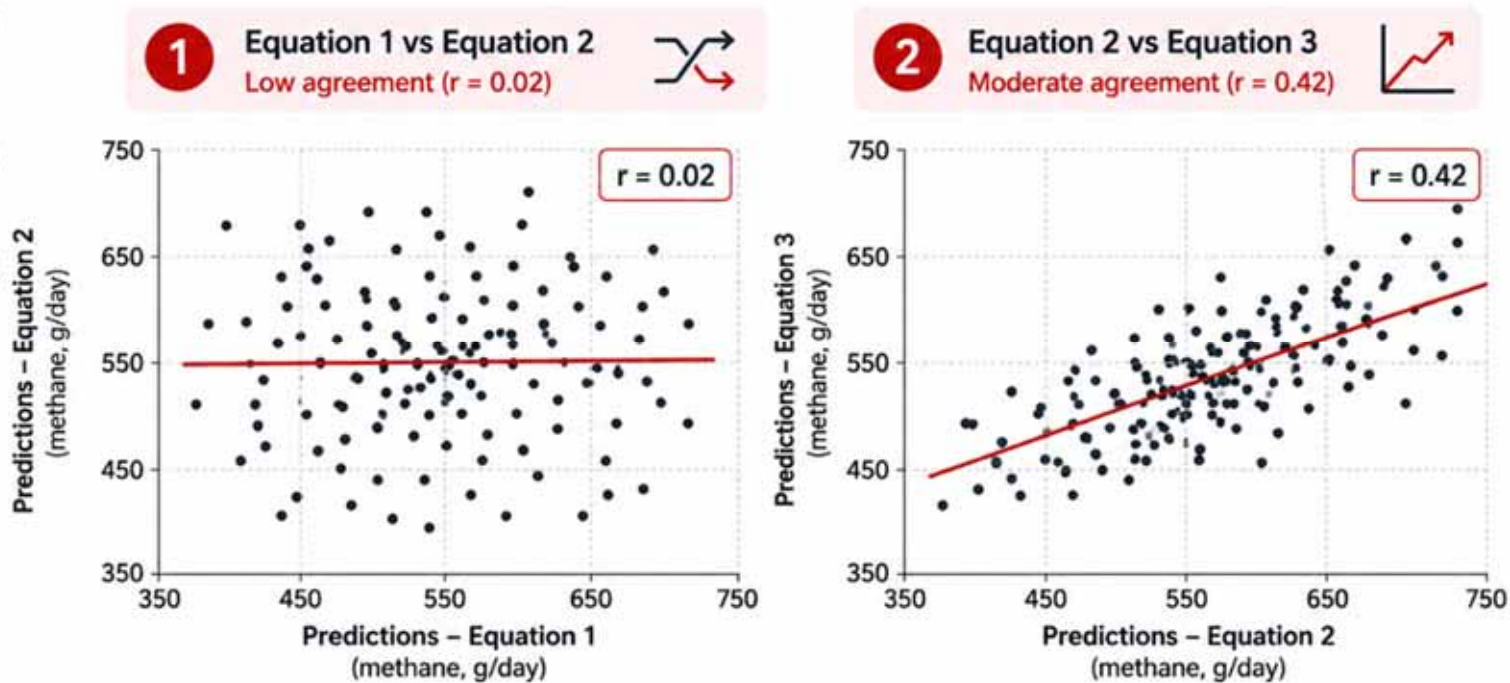


The proliferation of equations: overview

Authors	Year	Country	Ref. method	N animals	Model	Included variables	Validation type
Coppa et al.	2022	France	GreenFeed	~200 Holstein + others	PLSR	Day MIR spectra; DIM-corrected spectra; average spectra over GF measurement period; MY/FPCM as covariates	Cal./val. split + external 3-NOP set
Shadpour et al.	2022	Canada	GreenFeed	158 Canadian + 44 Danish Holstein	ANN	MIR spectra; MIR + milk yield, fat yield, protein yield, DIM; ANN outperformed PLSR	5-fold cross-validation
Fresco et al.	2024	France	GreenFeed	235 (Holstein, Montbeliarde, Abondance)	PLSR	MIR spectra; models for CH4 production (g/d), intensity (g/kg FPCM), yield (g/kg DMI); restricted to 70-200 DIM	Cross-validation
McParland et al.	2024	Ireland	GreenFeed	277 grazing (Holstein-Friesian, Jersey)	PLSR + NN	MIR spectra (a.m./p.m. average); MIR + milk yield + DIM	4-fold CV + leave-one-treatment-out

The unresolved issue: do equations agree?

- Two
- For
- No (



values.



BWYPEX: Connection with many research teams



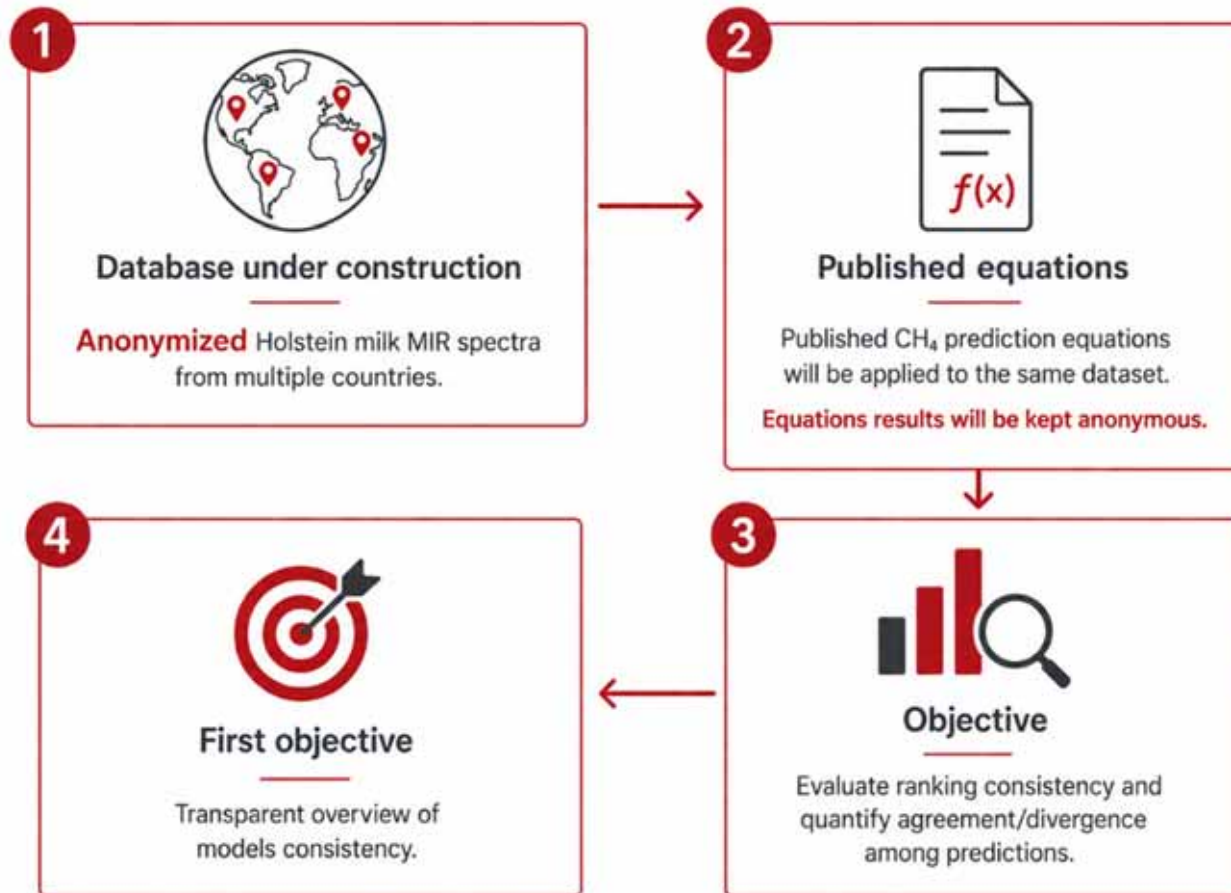


BWYPEX: what I learned while travelling

- BWYPEX (ICAR Young Person Exchange) enabled exchanges with multiple research teams.
- Visits across different countries revealed substantial methodological diversity.
- Differences concern both technical approaches and intended applications.
 - Genetic evaluation and farm-level monitoring do not necessarily require the same type of prediction model.



The project: comparison on a common database



Call for collaboration



Data collection phase
is currently active



**Deadline for data agreement
signature: end of the year**

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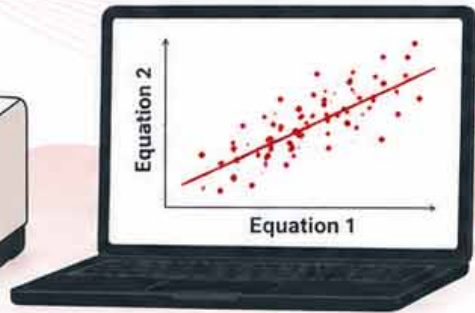
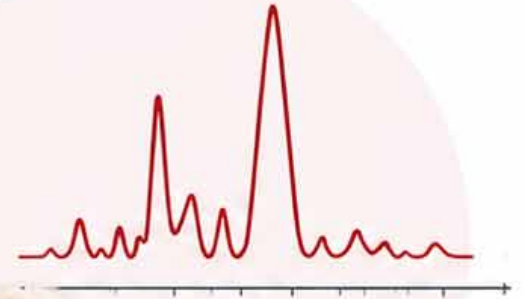
prediction equation to
the common dataset.

Conclusions

- The number of methane prediction equations has grown substantially since 2012.
- This reflects broad and sustained international interest in MIR-based methane prediction.
- Ensuring consistency and comparability across predictions is now the next step.

Thank you for listening!

Thank
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For further questions contact

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The proliferation of equations: overview

Authors	Year	Country	Ref. method	N animals	Model	Included variables	Validation type	R ²
Dehareng et al.	2012	Belgium	SF6	11 Holstein	PLSR	MIR spectra (selected wavelength regions); spectra shifted 1.5 days relative to CH4 measurement	Cross-validation	0.79 (g CH ₄ /kg milk)
Vanlierde et al.	2015	Belgium, Ireland, Switzerland	SF6	142 (Holstein, Jersey, HJ cross)	PLSR	MIR spectra + DIM via Legendre polynomials; lactation-stage-dependent model (DLS)	Cross-validation + independent set	0.68 (g CH ₄ /day, DLS)
Shetty et al.	2017	Denmark	Sniffer	~700 Danish Holstein	PLSR	MIR spectra only (R ² =0.13); MIR spectra + milk yield (R ² =0.35)	Validation set	0.13 (L CH ₄ /day)
Vanlierde et al.	2018	7 countries (BE, IE, DE, CH, FR, DK, UK)	SF6 + RC	303 multi-breed	PLSR	Standardised EMR MIR spectra; merged SF6 (n=532) and RC (n=584) reference datasets	5-group cross-validation	0.63 (g CH ₄ /day)
Vanlierde et al.	2021	Multi-country (BE, IE, DE, CH, FR, DK)	SF6 + RC	~400 multi-breed	PLSR	MIR spectra; DIM correction; MY/FPCM as optional covariates; parity and breed	Cross-validation + external validation	0.60 (g CH ₄ /day)



The proliferation of equations: overview

Authors	Year	Country	Ref. method	N animals	Model	Included variables	Validation type	R ²
Coppa et al.	2022	France	GreenFeed	~200 Holstein + others	PLSR	Day MIR spectra; DIM-corrected spectra; average spectra over GF measurement period; MY/FPCM as covariates	Cal./val. split + external 3-NOP set	0.67–0.73 (g CH ₄ /day; avg spectra + MY)
Shadpour et al.	2022	Canada	GreenFeed	158 Canadian + 44 Danish Holstein	ANN	MIR spectra; MIR + milk yield, fat yield, protein yield, DIM; ANN outperformed PLSR	5-fold cross-validation	0.45–0.55 (g CH ₄ /day; ANN best)
Fresco et al.	2024	France	GreenFeed	235 (Holstein, Montbeliarde, Abondance)	PLSR	MIR spectra; models for CH ₄ production (g/d), intensity (g/kg FPCM), yield (g/kg DMI); restricted to 70-200 DIM	Cross-validation	0.22–0.36 (MIR spectra only)
McParland et al.	2024	Ireland	GreenFeed	277 grazing (Holstein-Friesian, Jersey)	PLSR + NN	MIR spectra (a.m./p.m. average); MIR + milk yield + DIM	4-fold CV + leave-one-treatment-out	0.43–0.55 (g CH ₄ /day; NN best)