Prediction of evaluated energy balance (NEL and ME) in dairy cows by milk mid-infrared (MIR) spectra

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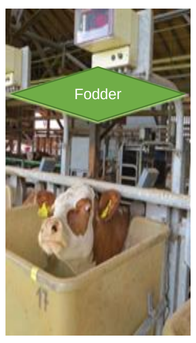
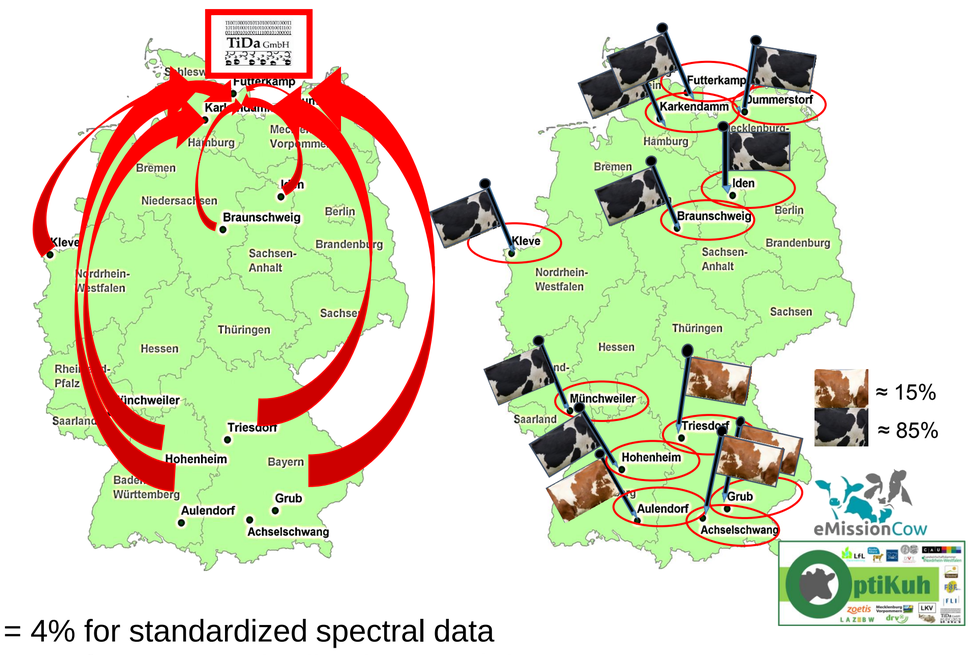
Background

Combined feeding and breeding experiments:
Interdisciplinary Examinations in
--- >> 12 experimental farms
--- >> about 1,500 dairy cows
with recording of feed intake
and energy balance in the single animal:
--- >> lactation
--- >> dry period





Material and Methods

Different feeding intensities through staggering of the energy concentrations in the coarse feed and in the concentrates.
The energy balance calculations:
--- >> NEL balances based on GfE (2001)
--- >> ME balances based on the proposal by Susenbeth (2018)
were created.
Outliers:
Deviation between laboratory fat value and MIR fat value
DiffFat = (MIRFat - LabFat) / LabFat * 100%
Use for the calibration: DiffFat <4%

Source	No. Farms	NEL-Spectra	ME-Spectra
LKV BW: (Hohenheim, Aulendorf)	2	3.347	2.386
LKV RF: (Neumühle)	1	874	554
LKV NRW: (Riswick, Braunschweig)	2	2.964	2.346
LKV BY: (Achselschwang, Grub, Triesdorf)	3	8.477	10.434
LKV SH: (Futterkamp, Karkendamm)	2	9.435	12.397
LKV SN: (Iden)	1	462	472
LKV MV: (Dummerstorf)	1	347	337
Total	**12**	**25.906**	**28.926**

Outlier data:
- with DiffFat> = 4% for standardized spectral data
- with DiffFat> = 1% for non-standardized spectral data
  => ~ 28% of the data

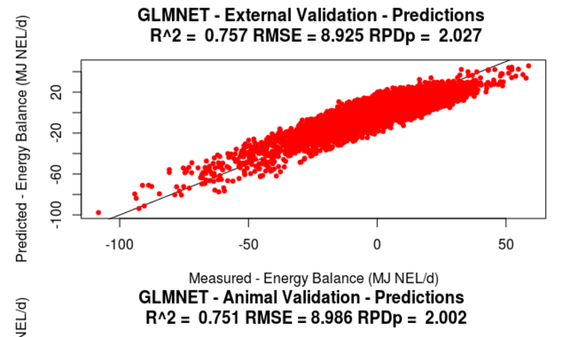
Models:
Model1 - based on a selection of spectral data using the Mahalanobis distance.
Model2 - based on a selection of different animals. Animals that are in validation, are not in the calibration!
FinalModel - Calibration and Validation data together

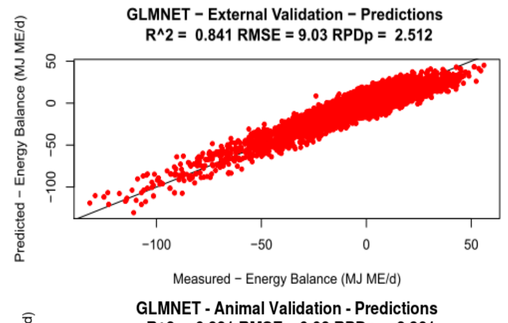
Methods:
Standard OptiMIR method:
- Conversion of FOSS and Bentley spectra into Foss spectra (interpolation)
- Standardization on EMR / OptiMIR master
- 1st derivative, (gap = 4)

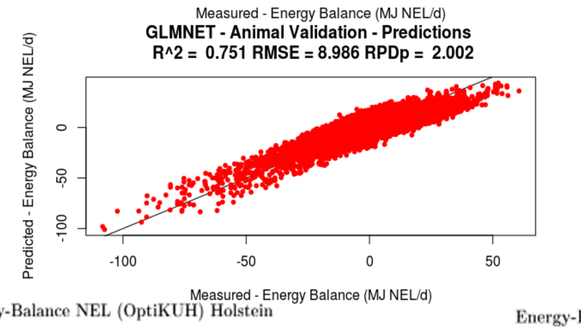
Use of the absorption values of 212 significant wavelengths
For modeling the fixed effects were used: *breed, milking time, lactation, classes of daily milk amount kg of the trial milking and the Legendre polynomials* (the corrected spectral data with days in milk 5 - 365).

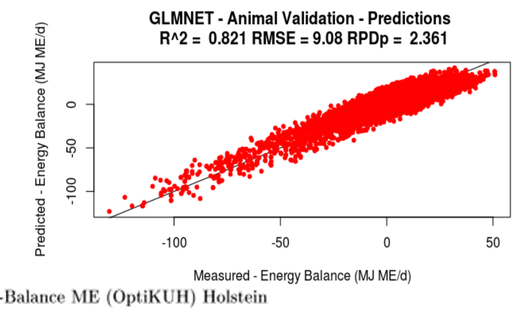
Results

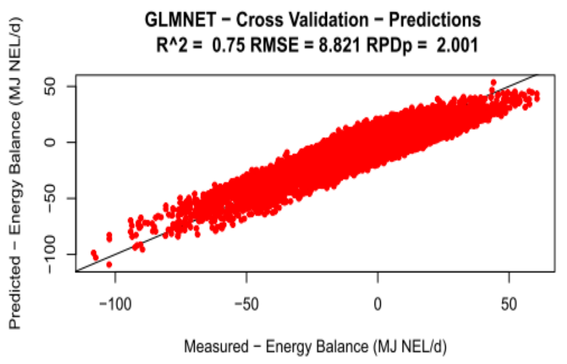
Models	Calibration		Validation		
	R^2calib	RMSEc	R^2valid	RMSEp	RPDp
NEL - Model 1	0.75	8.797	0.76	8.925	2.027
NEL - Model 2	0.75	8.780	0.75	8.986	2.002
NEL - FinalModel	0.75	8.827	0.75	8.821	2.001
Standardized			0.84	7.531	2.502
Not Standardized			0.76	8.078	2.007
ME - Model 1	0.85	8.916	0.84	8.998	2.520
ME - Model 2	0.86	8.931	0.82	9.080	2.361
ME- FinalModel	0.85	8.991	0.85	8.944	2.580
Standardized			0.89	8.416	3.049
Not Standardized			0.84	9.058	2.475

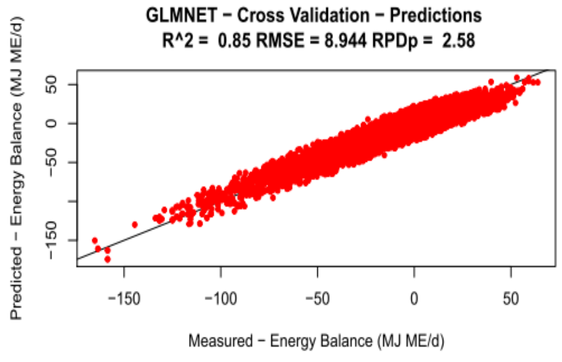


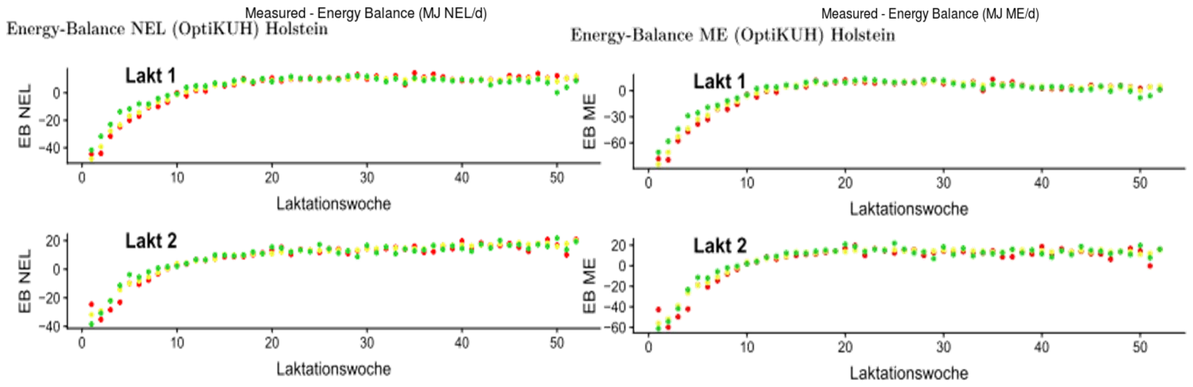




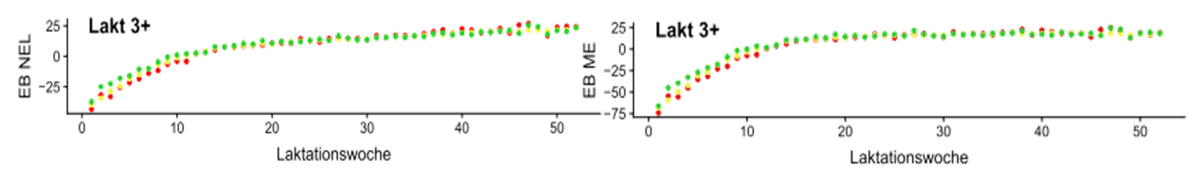








Milk Biomarkers	Unit	#LV	ϕ	SD	SEC	R^2c	SECV	R^2cv	RPDcv	Use
Energiesalden - NEL	[MJ /d]	12	2.47	17.29	8.27	0.75	8.27	0.75	2.001	0
Energiesalden - ME	[MJ /d]	12	0.08	23.54	8.99	0.85	8.94	0.85	2.580	0



Conclusion

The Legendre methods of energy balance NEL and ME: Legendre + GLMNET are acceptable.

Legendre + GLMNET can show the energy balance well, but with a lower energy balance

R2cv: 0.75-EB_NEL and 0.85-EB_ME

and RPDp: 2.001-EB_NEL and 2.580-EB_ME

100 Farms with lowest KetoMIR-2-Index
Population Mean
100 Farms with highest KetoMIR-2-Index

Acknowledge

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