

Herd-test-day variability of methane emissions predicted from milk MIR spectra in Holstein cows

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Background

- Enteric methane (CH₄) emissions of cows
 - Losses of dietary energy
 - Contribution to global warming
- Need to mitigate these CH₄ emissions
- CH₄ production is affected by many & different categories of factors
(Taminga et al. 2007, Feeding strategies to reduce methane loss in cattle, 46 p.)

Material & Methods

Data

- Prediction of daily CH₄ emissions from milk mid-infrared (MIR) spectra (R² of cross-validation = 0.70)
(Vanlierde et al., 2013, Presentation 2, Session 4, EAAP, Nantes)
- 412,520 milk MIR spectra & test-day (TD) records collected between January 2007 & January 2012:
 - Milk yield, fat & protein content
- 69,223 primiparous Holstein cows from 1,104 herds
- 2 CH₄ studied traits:
 - g of CH₄ per day
 - g of CH₄ per kg of milk
- Descriptive statistics of the dataset

Trait (N = 412,520)	Mean	SD
Milk (kg/day)	23.44	5.97
Fat (g/dL of milk)	3.97	0.66
Protein (g/dL of milk)	3.34	0.34
MIR CH ₄ (g/day)	545.91	109.34
MIR CH ₄ (g/kg of milk)	25.01	8.88

Model

- Bivariate random regression TD models
 - Resolved using REML
 - A CH₄ trait & a milk production trait

$$y = Xb + Q(Zp + Za) + e$$

where y = Vector of observations

b = Vector of fixed effects

→ HTD, classes of days in milk, & age at calving

p = Vector of permanent environmental random effects

a = Vector of additive genetic random effects

Q = Covariate matrix for 2nd order Legendre polynomials

X & Z = Incidence matrices

e = Error

Objective: Estimation of herd-test-day effect on milk production traits & CH₄ emissions

Conclusions

- Herd & test-day (HTD) have large effects on CH₄ emissions & milk production
- HTD effects varied through herds & seasons

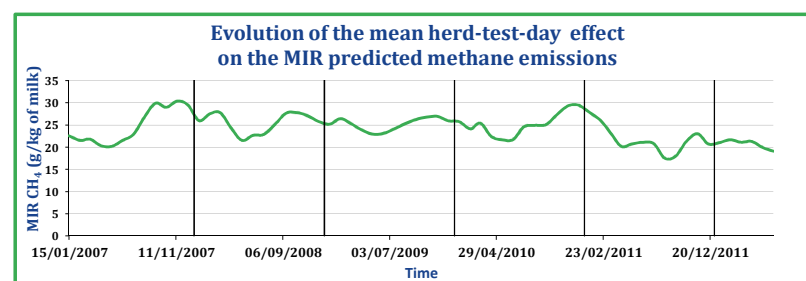
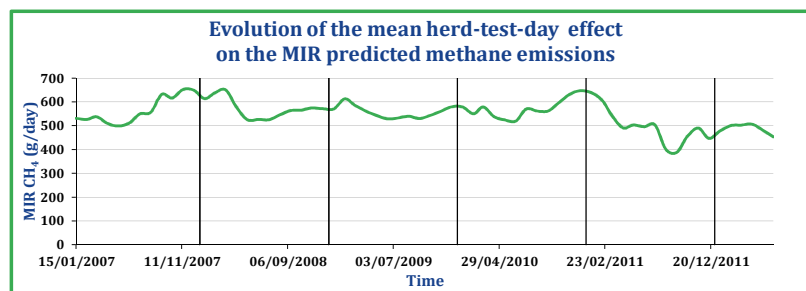
Results

Coefficient of variation (CV) of HTD solutions for studied traits (N= 33,159)

Trait	CV
Milk (kg/day)	17.54 %
Fat (g/dL of milk)	8.93 %
Protein (g/dL of milk)	4.68 %
MIR CH ₄ (g/day)	15.51 %
MIR CH ₄ (g/kg of milk)	23.18 %

Large differences between herds for milk yield & MIR CH₄

Evolution of the mean HTD effect on studied traits across time



MIR CH₄ (g/day)

Max. values in winter
Min. values in summer

Similar pattern as fat & protein content

MIR CH₄ (g/kg of milk)

Max. values in autumn
Min. values in spring

Opposite pattern as milk yield