SmartCow

an integrated infrastructure for increased research capability and innovation in the European cattle sector

Proxies to predict

feed efficiency and its determinants in cattle

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INRAE - CRAW

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement n°730924

6 April 2022, Brussels

Global objective

- **To reduce constraints** on **experimental** animals (3Rs rules) in research infrastructures (RIs)
- **To strengthen cattle phenotyping capacity** for large scale studies
- **To find alternative methods** to estimate **key phenotypes** measured with gold standard method (GSM)

➢ **To evaluate proxies* of feed efficiency and its determinants in dairy & beef cattle across diets and individuals**

**defined as indicators measurable in easily accessible matrices, and easier to implement than the GSM*

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Strategy

- **To build a large and representative database** with **individual observations** [phenotypes + proxies] for **beef** & **dairy cattle**

- **To share data (samples)** among SmartCow collaborators
  - **SRUC, UREAD, AU, CRA-W, INRAE, FBN Leibniz, IRTA, WUR**
  - **TNA applicants (including private companies)**
  - **Agroscope, Luke**

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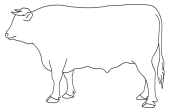
Which proxies for which phenotypes ?

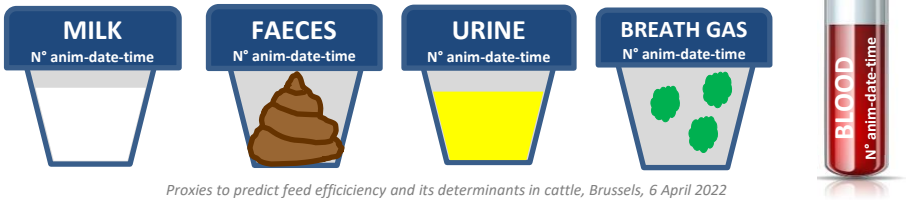


PHENOTYPES

- □ **Feed efficiency**
- □ N use efficiency & N excretion
- □ **Total tract OM digestibility**
- □ **CH_4 emission**
- □ Rumen parameters (VFA, ammonia, pH)

PROXIES

- □ **Natural ^{15}N abundance**
- □ **Urea-N**
- □ **Near-infrared spectra (NIRS)**
- □ **Mid-infrared spectra (MIRS)**
- □ Blood metabolites
- □ Volatile metabolome



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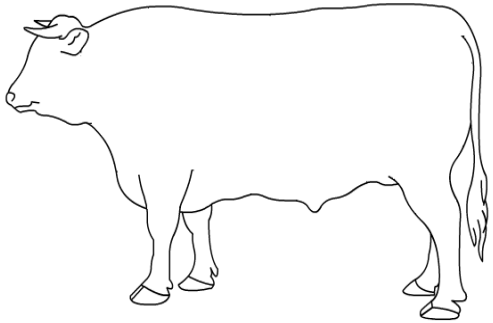
Proxies to predict Feed efficiency in beef cattle

Feed Conversion Efficiency (FCE)

Residual Feed Intake (RFI)

INDIVIDUAL INTAKE

BODY WEIGHT GAIN



15N abundance

Urea-N

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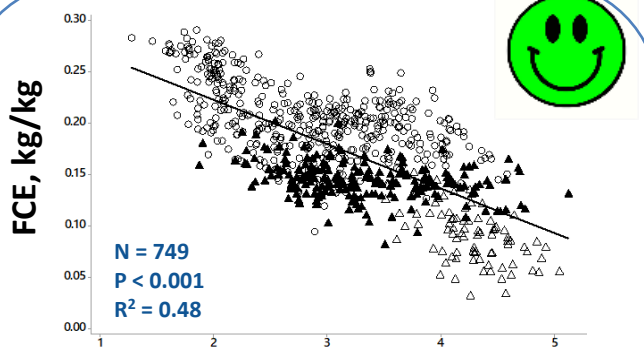
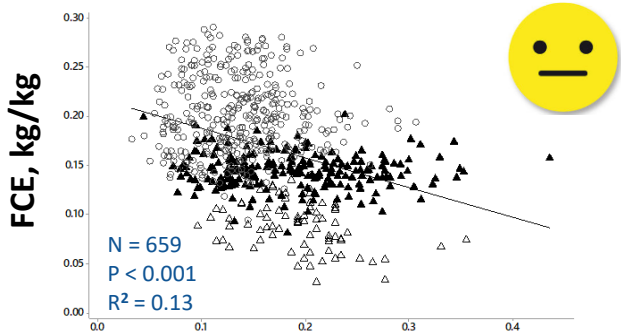
Proxies to predict Feed efficiency (FCE, RFI) in beef cattle

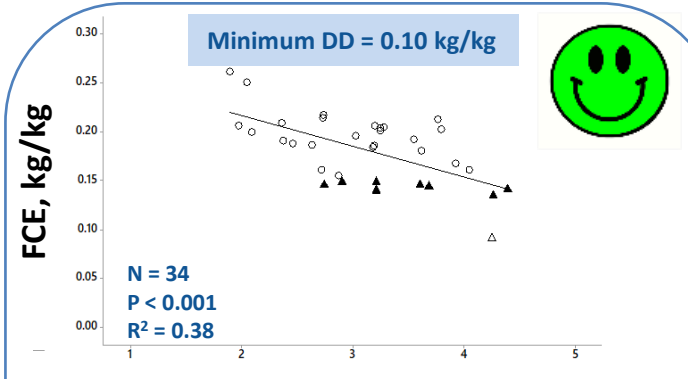
Better models with $\Delta^{15}N$ compared to plasma urea

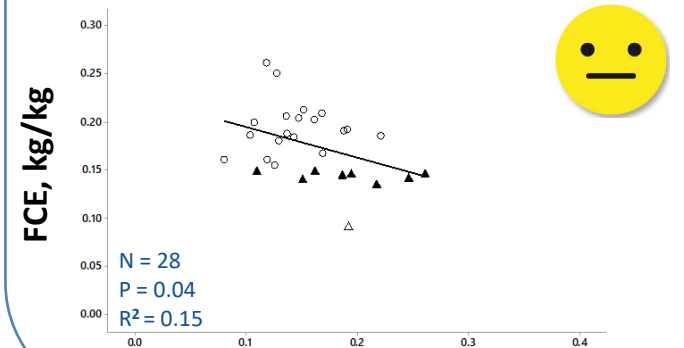
Overall





Dietary means

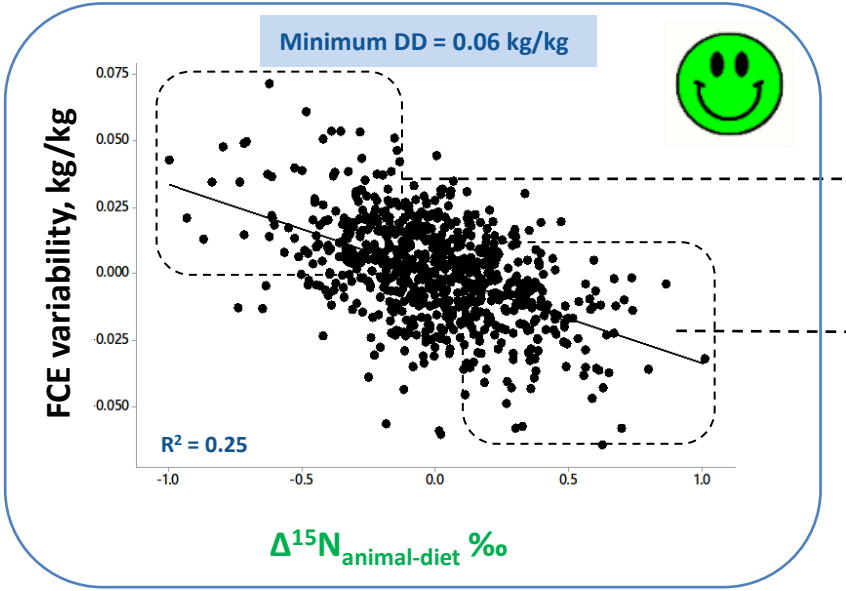




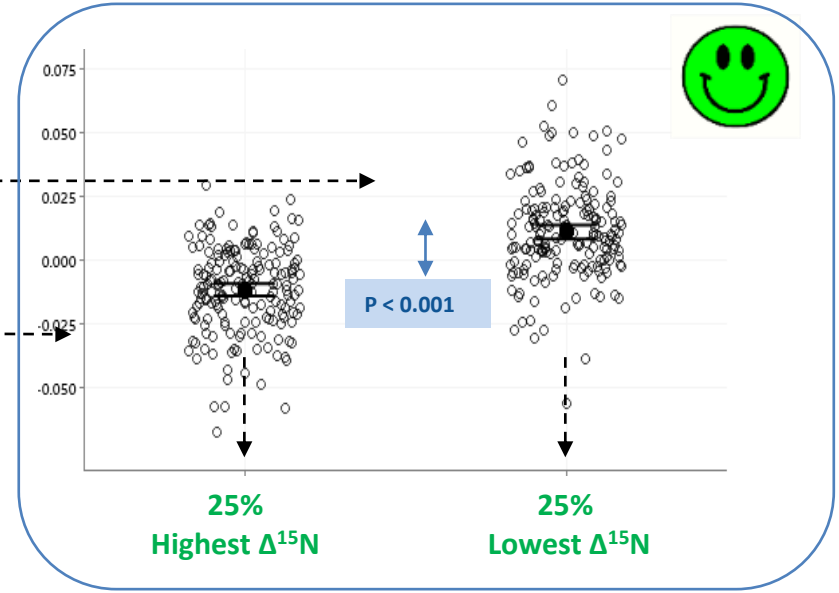
Proxies to predict Feed Efficiency (FCE, RFI) in beef cattle

$\Delta^{15}N$ allows to discriminate individuals

Individual variability



Forming groups



- The minimum detectable difference in FCE between 2 individuals from ^{15}N values was almost 0.06 kg/kg => too high for assisting genetic selection
- Mean difference in FCE, between 2 groups formed from ^{15}N values, was significant and around 0.03 kg/kg => for precision feeding ?

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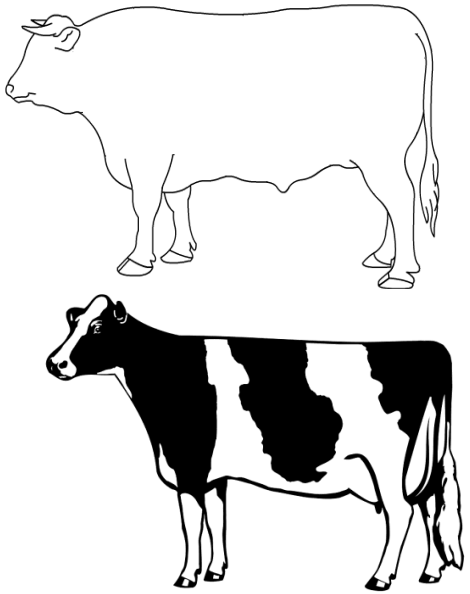
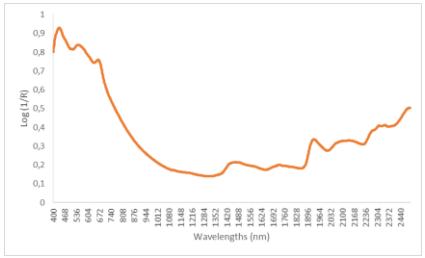
Proxies to predict Total tract digestibility in cattle

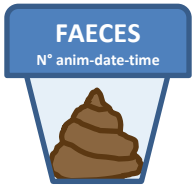
OM digestibility (OMD) = (ingested-excreted) / ingested

TOTAL TRACT DIGESTIBILITY





Faeces NIRS



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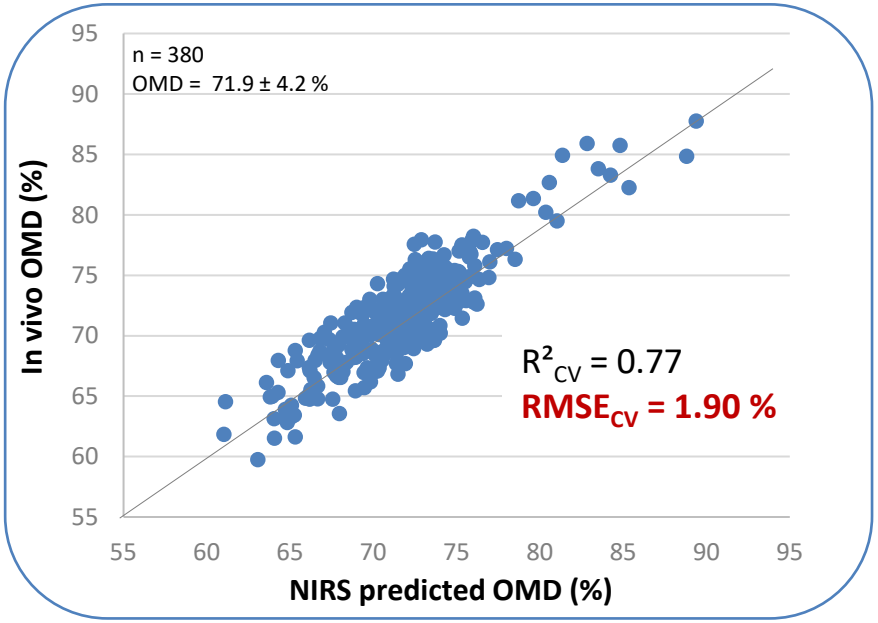
Proxies to predict Total tract digestibility in cattle

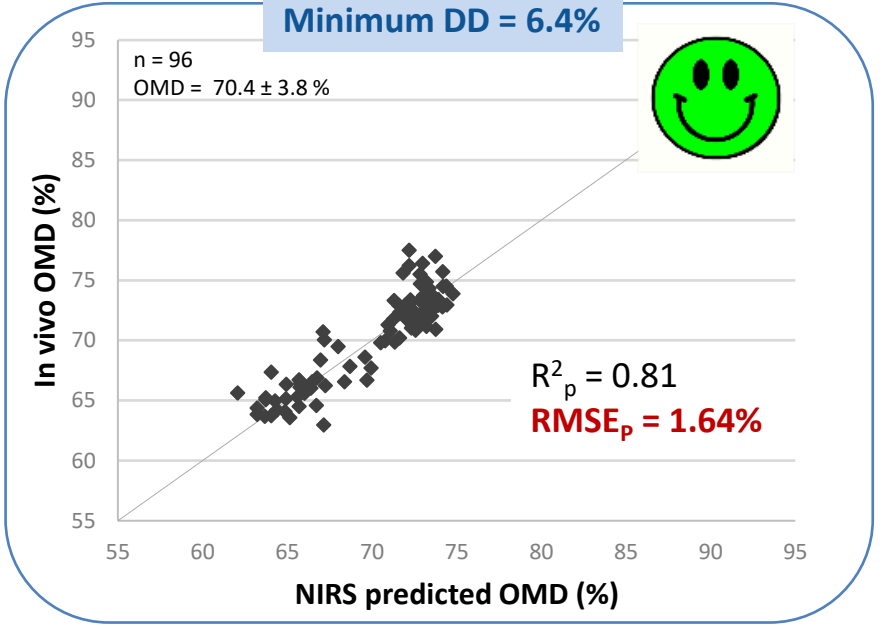
Accuracy of faecal NIRS is close to that of GSM

Smartcow calibration model



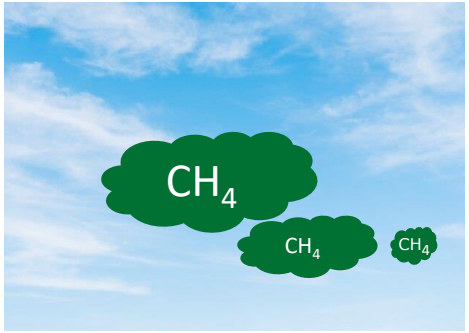
Validation dataset

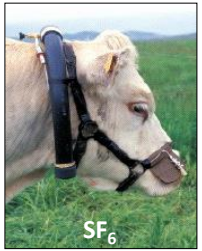
Minimum DD = 6.4%

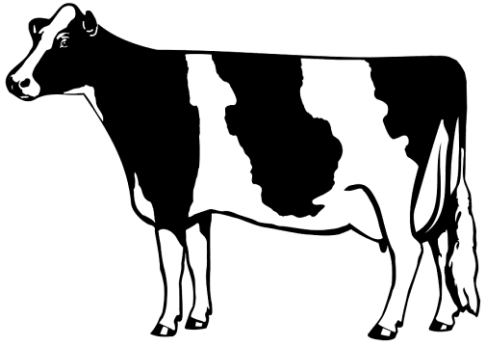


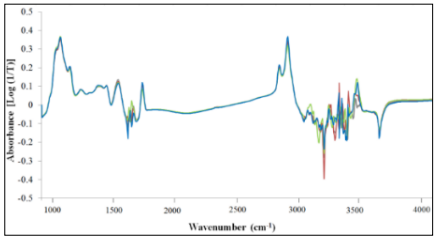
- Minimum DD (6.4%) is close to that of GSM (5.2%)
- Good potential of fecal NIRS as proxy for OMD prediction in cattle
- Good alternative to GSM (stalls)

Proxies to predict daily CH_4 emissions in dairy cows

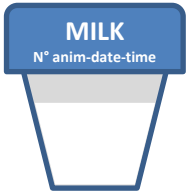








Milk MIRS



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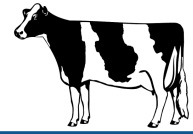
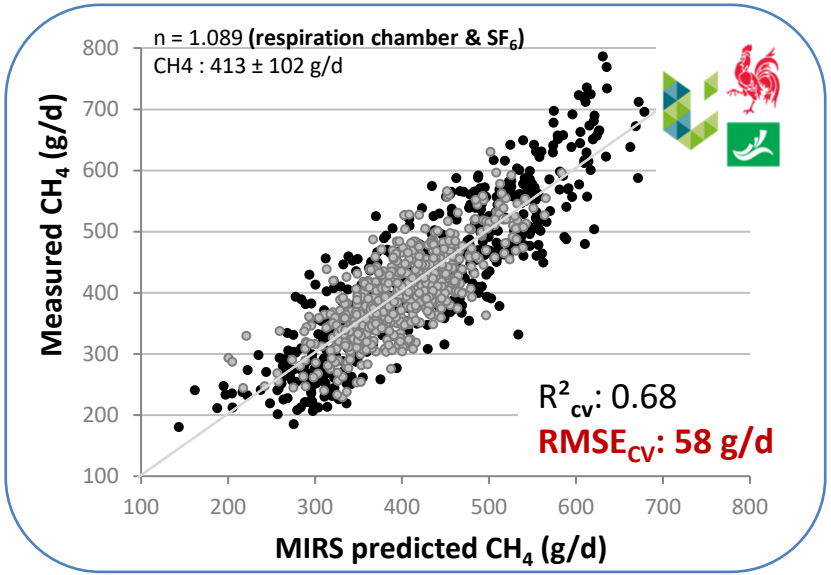
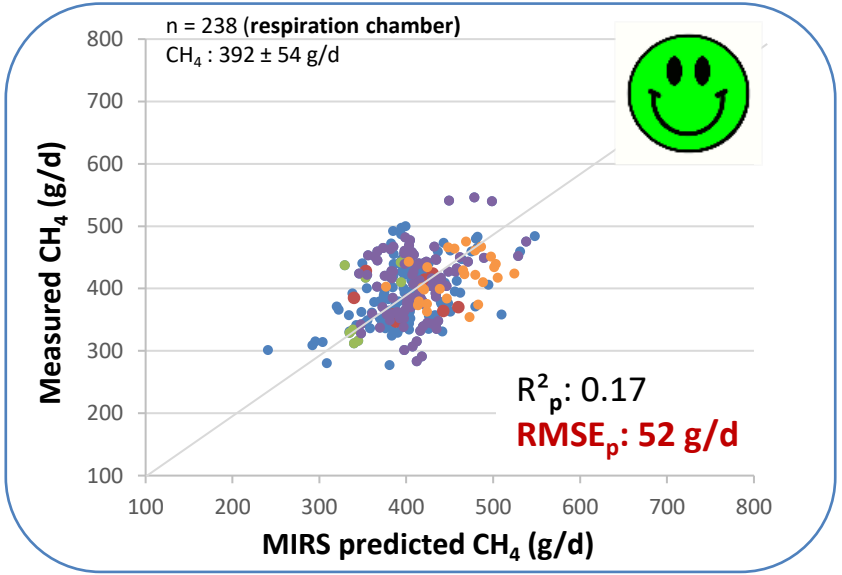
Proxies to predict daily CH_4 emissions in dairy cows
Model based on milk MIRS : validation and next steps



Existing predictive model
Vanlierde et al, 2021 (JSFA)



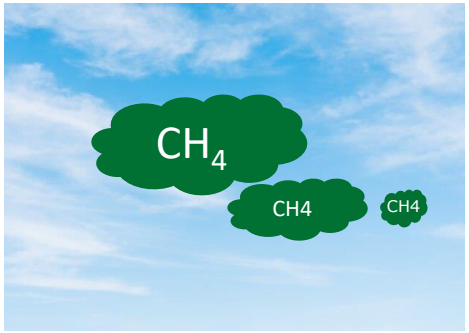
Validation dataset
FBN and WUR data



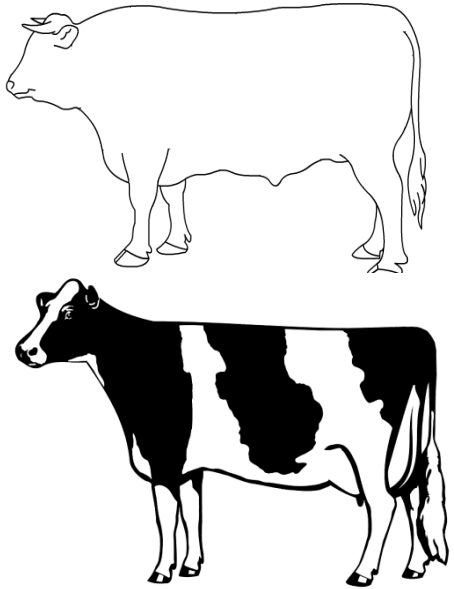
- **Good potential of milk MIRS as proxy for CH_4**
- **High throughput approach allows CH_4 phenotype to be incorporated in dairy cow breeding programs**

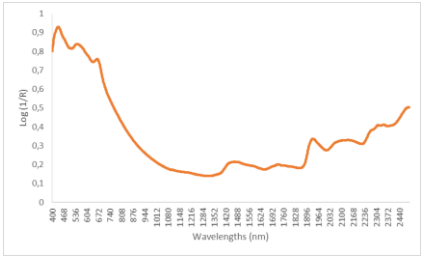
- **Next steps**
  - To include Ref data not yet represented
  - Not possible to merge GF data with other Ref datasets (RC, SF_6) → noise in the model
  - A specific model based on GF values is on progress

Proxies to predict daily CH_4 emissions in cattle

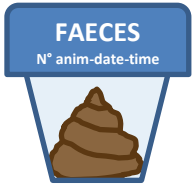


CH_4 EMISSIONS





Faeces NIRS



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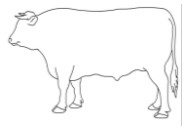
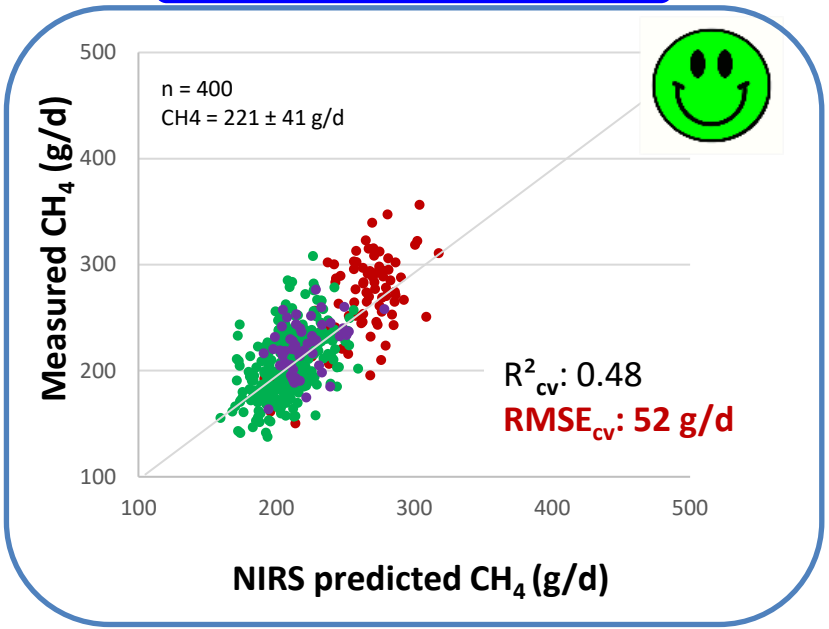
Proxies to predict daily CH_4 emissions in cattle

Faecal NIRS : an innovative proxy



First model



- **A good example of complementary dataset**
  - **BE -> Belgian Blue; grass, grass silage**
  - **FR -> Charolaise; grass, grass silage**
  - **CH -> Simmental – Angus – Limousine; corn silage**
- **Promising proxy especially for an indirect proxy**
- **Useful for non-lactating cattle :** beef, calf heifers, dry dairy cows
- **More Ref data not yet represented are needed**
  - Other breeds, diets, physiological status, etc.
  - Standardized protocols for sampling and dataset management

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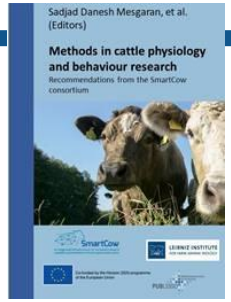
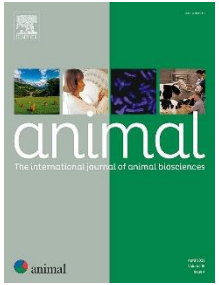
Impact



- **For RI:** improvement of the cattle phenotyping capacity while implementing 3Rs principles & research recommendations

-> instructions for using proxies according to common and standardized protocols / open access guidelines



- **For stakeholders:**
  - **Academic : production of knowledge (publications) and innovating concepts to test in pilot studies**
  - **Industry : development of phenotyping tools for feed and breeding industry**

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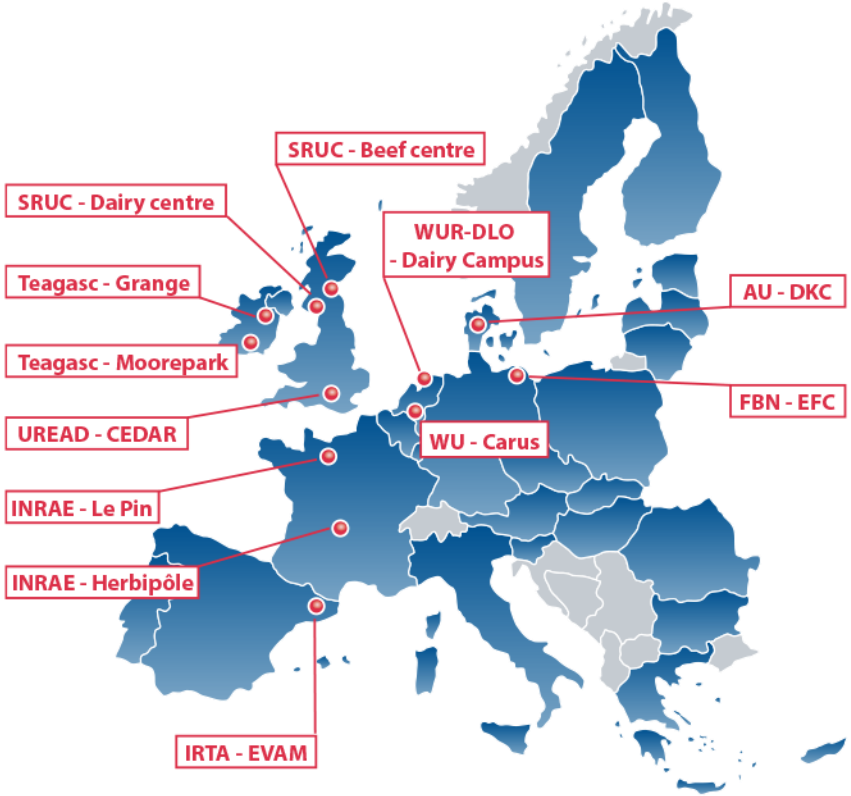
Future prospects

- **To enlarge diversity of the reference databases to update models following research recommendations**
- **To continue investigating new proxies and their combinaison to improve predictions**
- **Adoption and implementation of these research proxies by the different actors of the livestock production**

➢ **Key of success : collaboration network / common guidelines for measurements and data recording**

Thank you for your attention



First-class Cattle Research Infrastructures (RIs) across Europe:

- 11 major RIs distributed in 7 EU countries
- 12 locations, which include 18 installations
- 2500 dairy and 1000 beef cows

- **Networking of RIs** to inventorize resources, harmonize procedures, and share data
- **Joint research activities** to improve experimental methods and phenotyping capability
- **Interaction with stakeholders** to stay in line with industry needs and improve dissemination

http://www.smartcow.eu/stakeholders/

TRAINING PROGRAM

For Scientists, Technicians, Stakeholders, PhD students

- Face-to-face training courses
- Free web-conferences
- One-day study tours in 4 different countries

http://www.smartcow.eu/resources/training/

TRANSNATIONAL ACCESS CALLS

Offers external users (academic and industry) free access to SmartCow RIs

- 30 projects during the 4 years of SmartCow
- Access to around 10,000 cow-weeks

http://www.smartcow.eu/calls/

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Grant Agreement n°730924.

Questions

- For more information:

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