Recording methane emissions of dairy cows
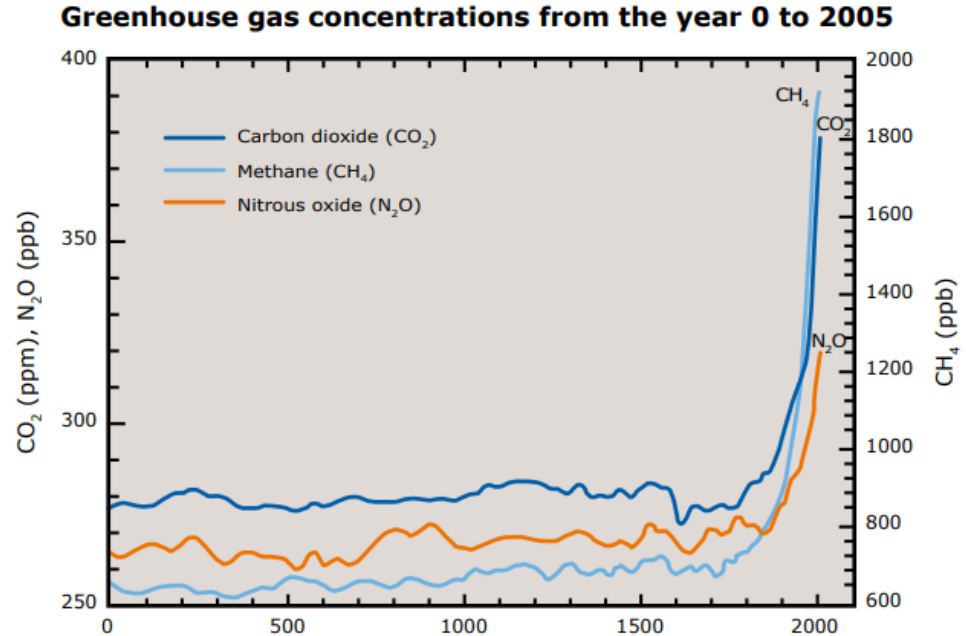
WHFF, Puy du Fou, 21-11-2023

A.E. van Breukelen, R.F. Veerkamp, M.N. Aldridge, Y. de Haas

anouk.vanbreukelen@wur.nl

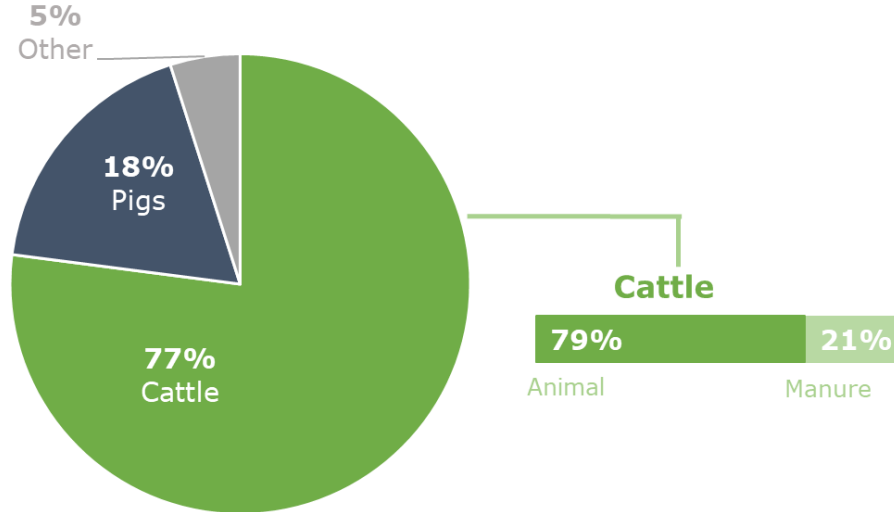# Methane (CH$_4$) – a potent greenhouse Gas

- 28 times as strong as CO$_2$ over 100 years

- Contributes to the formation of ozone

Greenhouse gas concentrations from the year 0 to 2005

- Carbon dioxide (CO$_2$)
- Methane (CH$_4$)
- Nitrous oxide (N$_2$O)

CO$_2$ (ppm), N$_2$O (ppb)

CH$_4$ (ppb)

Vellinga & Groenestein, 2022

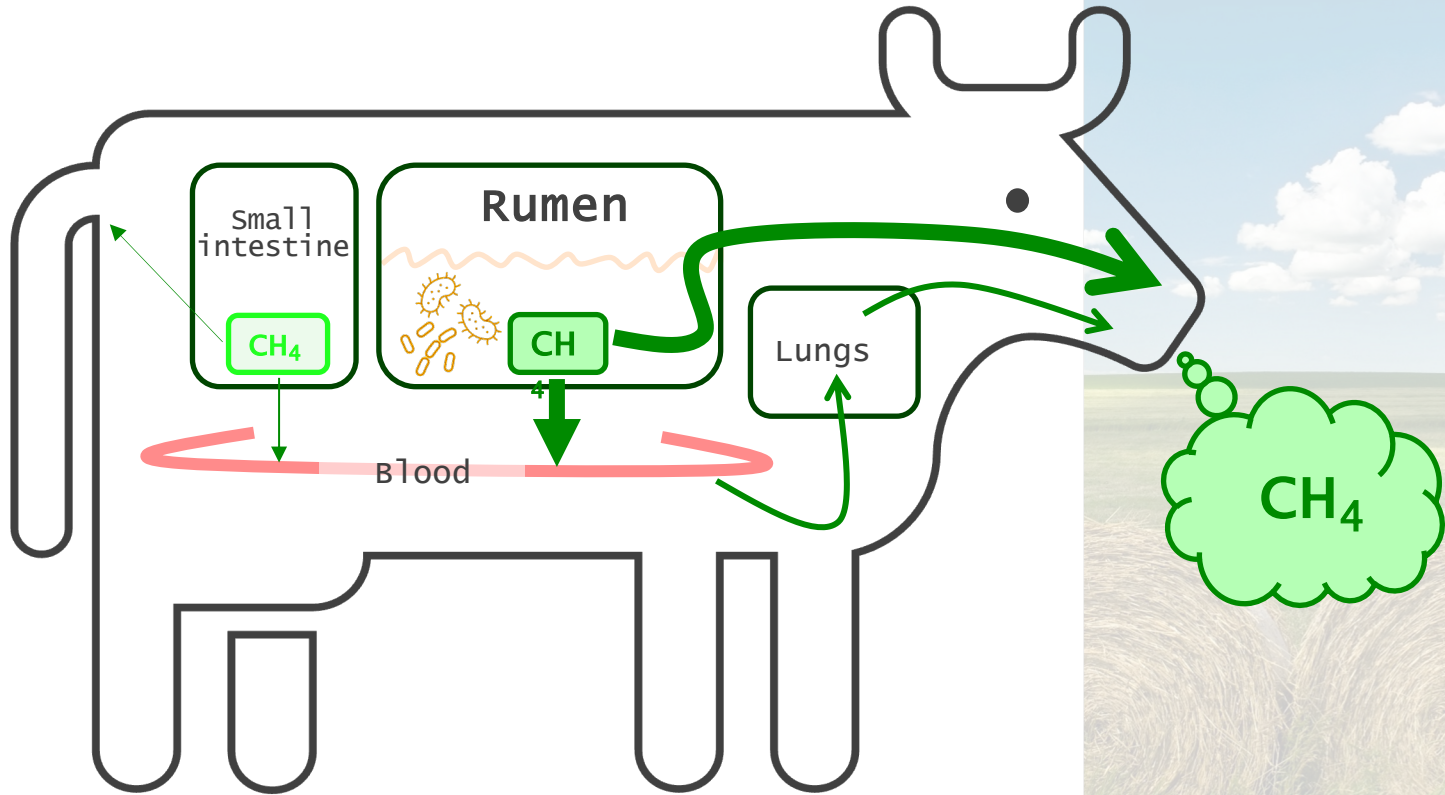# CH$_4$ in the Netherlands

- 55% emission mitigation by 2030 and climate neutral in 2050
- 2/3rd CH$_4$ from farming, most is enteric CH$_4$

5%
Other

18%
Pigs

77%
Cattle

Cattle

79%	21%
Animal	Manure

Bruggen et al, 2020

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Enteric CH$_4$

A direct impact of lowering CH$_4$

- After 25.8 years 88% is broken down

- While CO$_2$ remains in the atmosphere long-term

- Lower the global warming peak on short scale

Development of the amount of gas in the atmosphere

Vellinga & Groenestein, 2022

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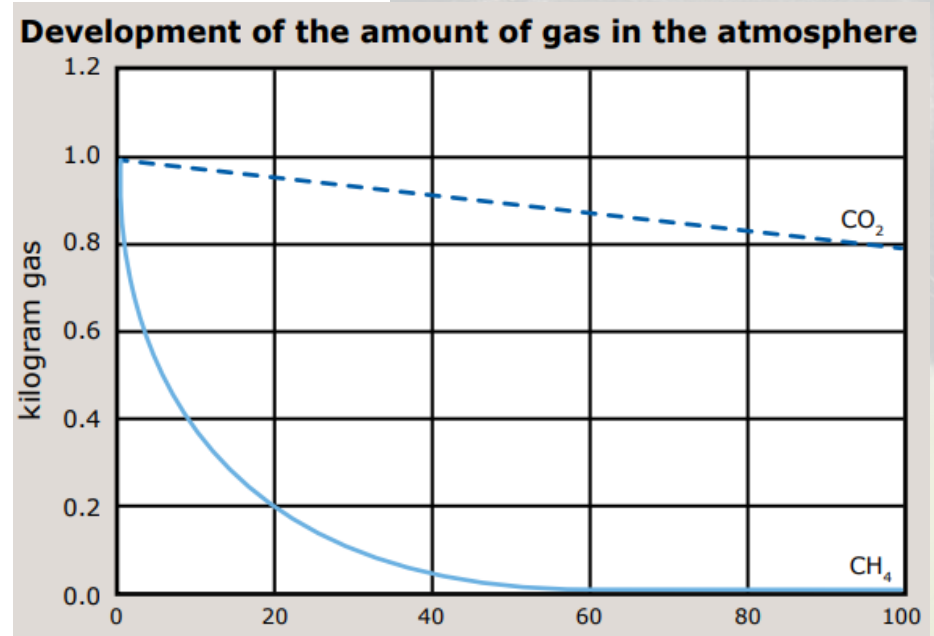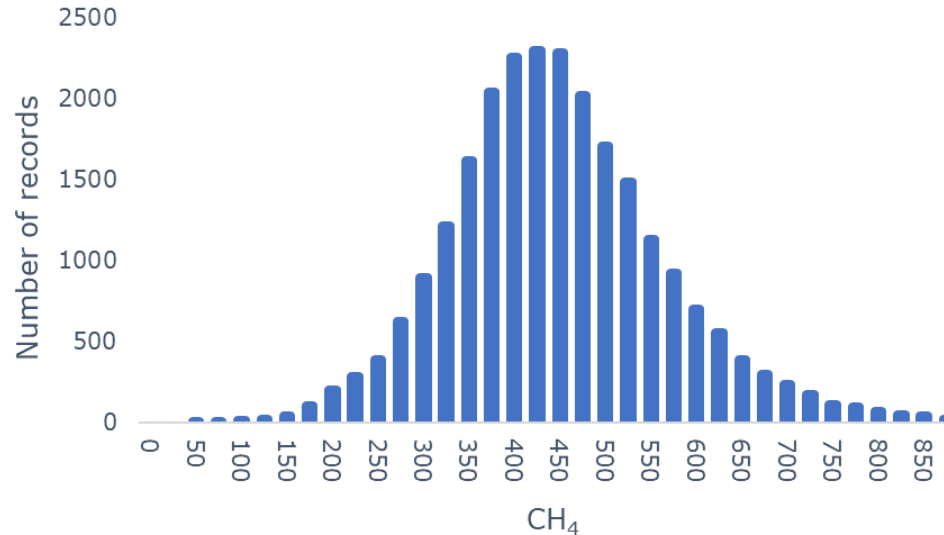
Can breeding play a role?

- There is variation between individual cows
- 11% to 43% is estimated as genetic variation (heritability)
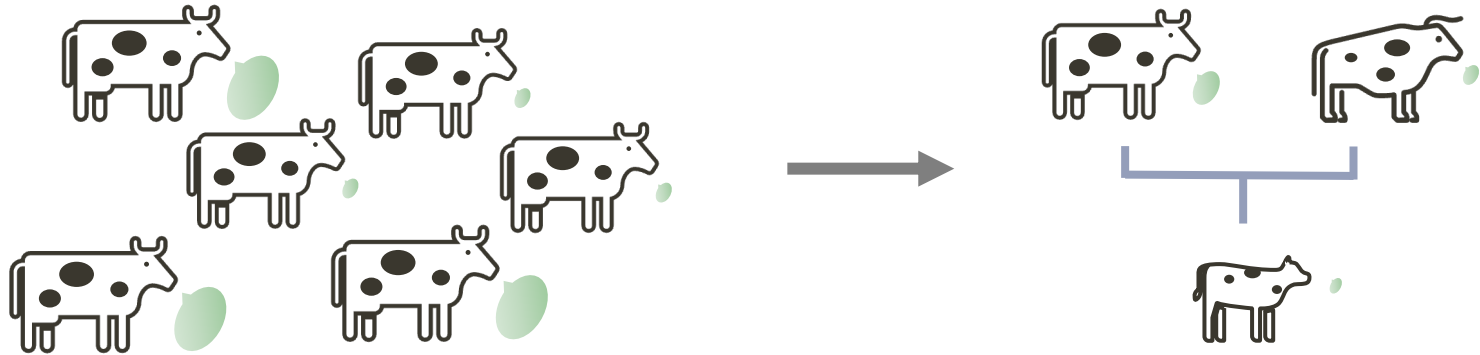
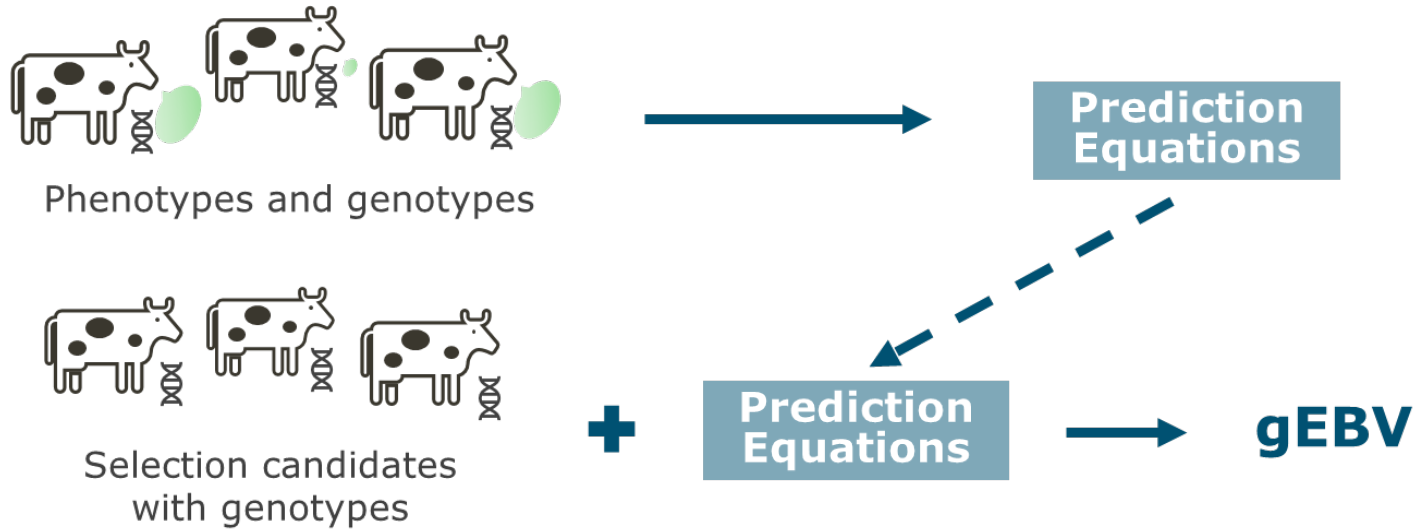**A promising mitigation strategy**

Theory behind animal breeding

- Continuous variation -> quantitative genetics theory

- many genes with a small effects, exact drivers of genetic variation largely unknown
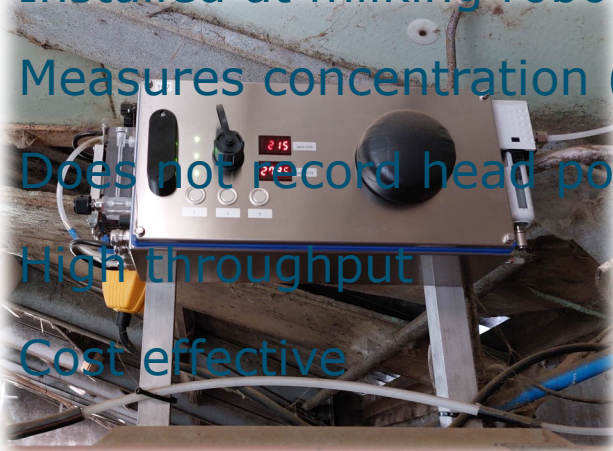
Genomic prediction

Measuring CH$_4$ of individual cows

Sniffer
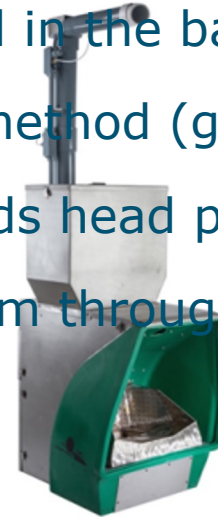(WD-WUR v1.0/ v2.0, Carltech BV, NL)

- Installed at milking robot
- Measures concentration (ppm)
- Does not record head position
- High throughput
- Cost effective

GreenFeed
(C-lock Inc. Rapid City, SD, US)

- Placed in the barn/ pasture
- Flux method (g/day)
- Records head position
- Medium throughput
- Costly

Other measurement methods/ proxies

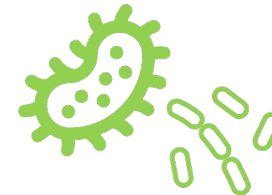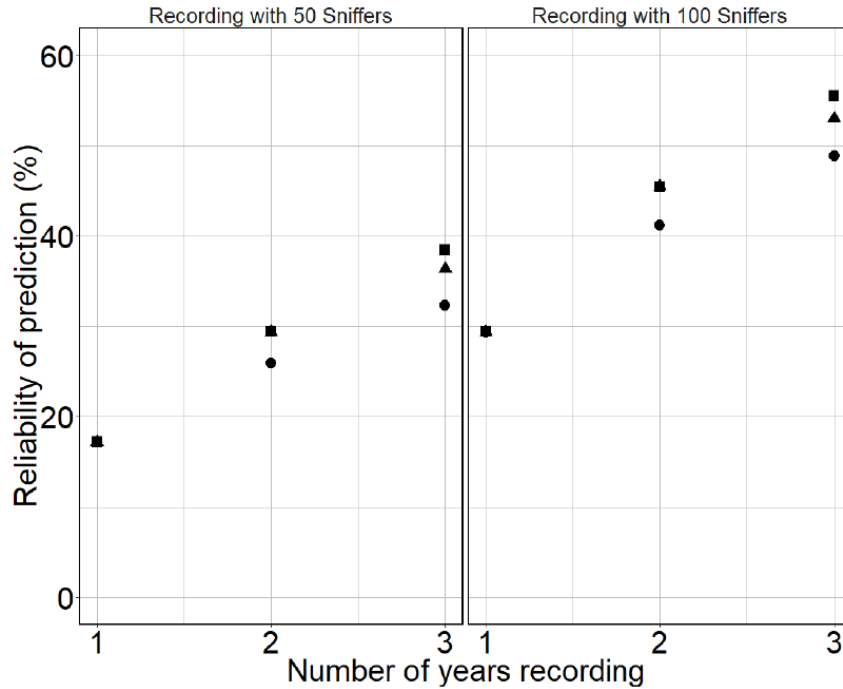**Laser methane detector**

Respiration chamber

SF$_6$

MIR

Portable accumulation chamber

Microbiome

How much data do we need?

Recording with 50 Sniffers | Recording with 100 Sniffers

Reliability of prediction (%) vs Number of years recording

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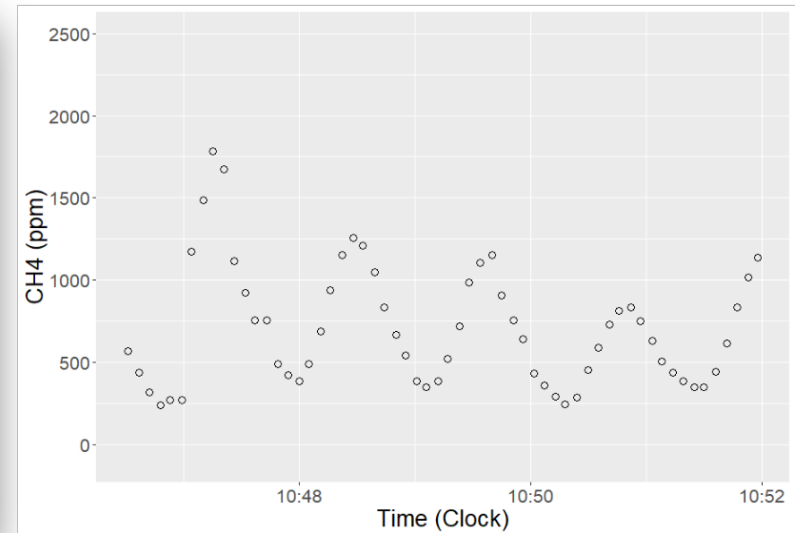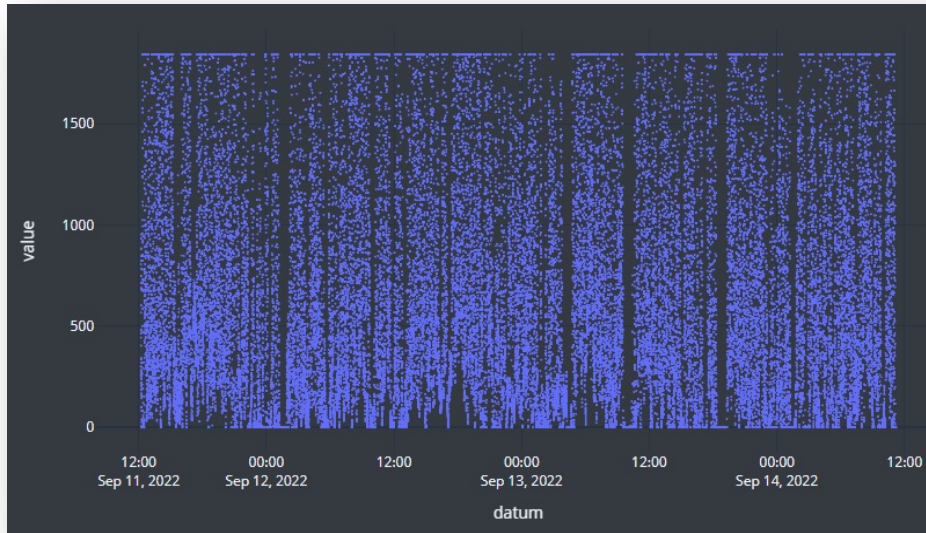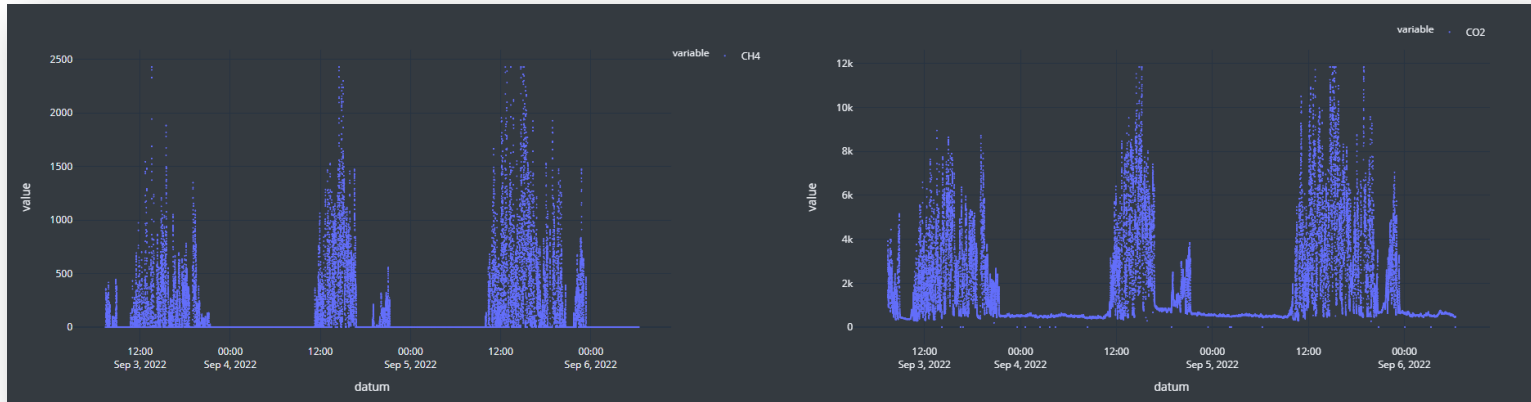
Measuring on 100 farms across NL
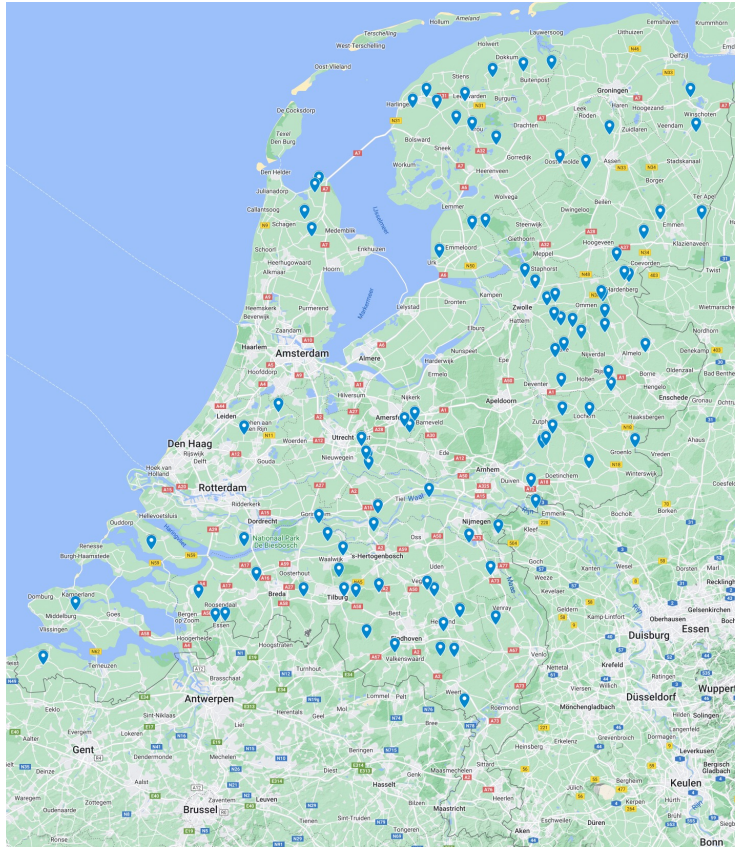
Data recorded by the sniffers

- Animal ID recorded by milking robot

Data recorded by the sniffers

- Labour required for checking functioning of sensors
  - Blocked sampling tubes
  - calibration needed every +- 6 months
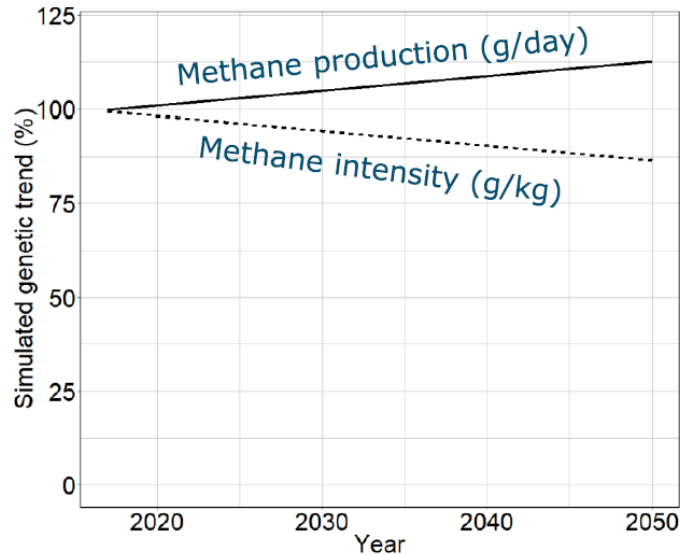 - Automatic filtering of data

Recording with sniffers

- Genetic correlation of **0.76** ± 0.15 between CH_4 (ppm) recorded by sniffers and CH_4 (g/day) recorded by GreenFeed units

  - Selection for lower CH_4 with either method will have the same directional effect
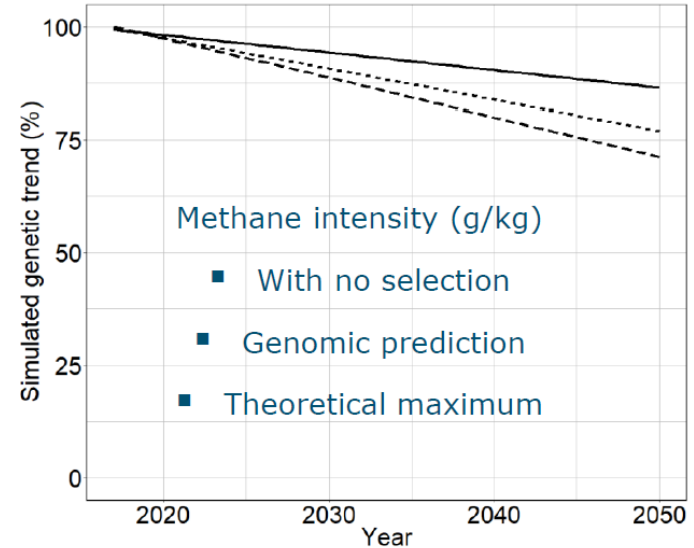
https://doi.org/10.3168/jds.2022-22735, van Breukelen et al. (2023)

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What can breeding bring us?

Current trends

With CH$_4$ selection

https://doi.org/10.1016/j.animal.2021.100294 (de Haas et al. 2021)

Breeding for low CH_4 in other countries

- World-wide interest in CH_4 mitigation by breeding

- Application in sheep in New-Zealand

  - 4 year experiment, difference of 1.3 g CH_4/ kg DMI (12%) Rowe et al, 2022

  - Applied in breeding program since 2018

- Canada, breeding values for MIR predicted CH_4

Adding CH$_4$ to breeding goals

- Balanced breeding
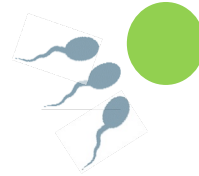
- Relationships largely unknown, more research ongoing

Take home messages

- Animal breeding can contribute to a permanent reduction in livestock emissions

- The first results of application will be measurable in the coming years

- A lot of research on-going

  - Correlations with other traits

  - Accuracy of different methods

  - Sharing data between countries

  - Developing selection indices

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