Is sensor technology ready for use in animal welfare assessments of gestating sows?

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29-08-2023, EAAP, Lyon, France

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 862919

Sensors technology and animal welfare

- Sensors are increasingly seen as important for animal welfare assessments
- Continuous and direct observations
- External validation: 5%
- No independent info about performance

83 sensor technologies in pigs for AW	%
Load cells/flow meter with/without RFID (feeder, drinker, scales)	45
Cameras (body weight, behaviour, thermal)	38
Microphones	6
Accelerometers	5
Body temp. devices	2
Other	4

Gomez et al., 2021*

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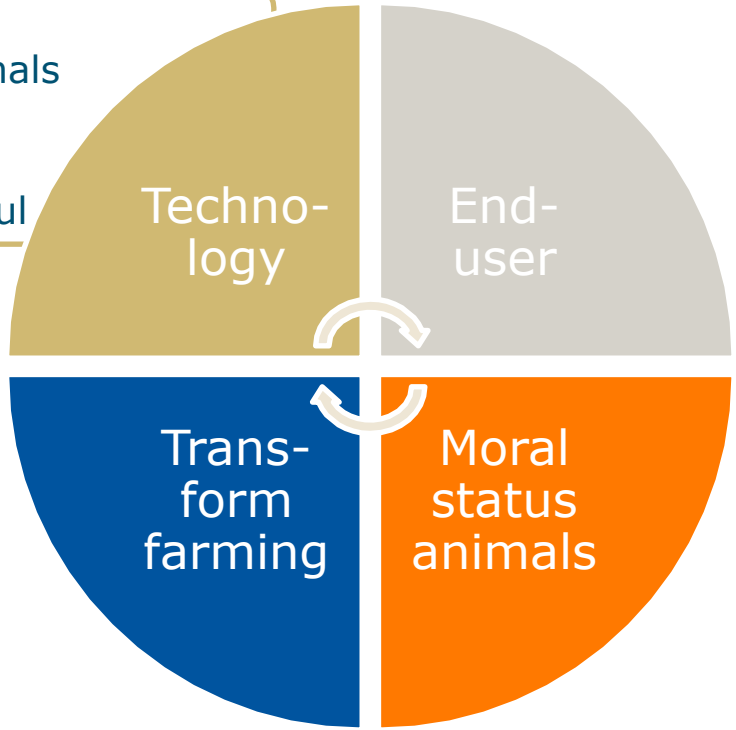
* This review excluded not directly related welfare aspects, e.g. oestrus detection or environmental measurements as climate

Threats of sensors for animal welfare

- Technical failures
- Adverse effects for animals
- Poor performance & validation
- Measurable ≠ meaningful



Tuyttens et al., 2022

Aim

- To what extent electronic sow feeders (ESF) and climate sensors are ready to be used for welfare assessment in gestating sows

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Data collection ESF, two farms, one year

Characteristics	Organic farm	Conventional farm
Breed	Landrace/Large White/Piétrain	Landrace x Large White
Av. group size in gestation	120 sows	640 sows
No. of Electronic Sow Feeder	3	12
Duration reproductive cycle (wks)	24	21
Type housing	Indoors and outdoors	Indoors
Type floor indoor	Concrete, straw bedding	Concrete and slatted
Additional feed	Silage (pasture if weather allows)	NA

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Photo: Iris Boumans

Photo: Iris Boumans

Data collection climate sensors on both farms

- DOL-sensors:
  - iDol139: ambient temperature (°C), air CO_2 (ppm), relative humidity (%)
  - iDol53: air NH_3 (ppm)
- 1.7 m above lying places
- Recording every 15 min.

- 1 year data collection
- Dataset cleaned for unrealistic values
- Aggregated at 24h (= feed cycle) level

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Results of potential welfare indicators ESF

Welfare indicator*	Organic farm	Conventional farm
Missed total feed allowance		
• Mean days per sow	0.3	2.5
• % sows with ≥ 1d	17	75
Average feeder occupation		
• Median occupation (min. per 24h)	690	1078

Why do they differ, welfare issue or .... ?

*based on Vargovic et al., 2021a; Vargovic et al., 2021b; Brouns et al., 1994; Boumans et al. 2018

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..... effects of other factors!

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Missed total feed allowance		
• Mean days per sow	0.3	
• % sows with ≥ 1d	17	75
Average feeder occupation		
• Median occupation (min. per 24h)		

Management decision

Change of settings by farmer

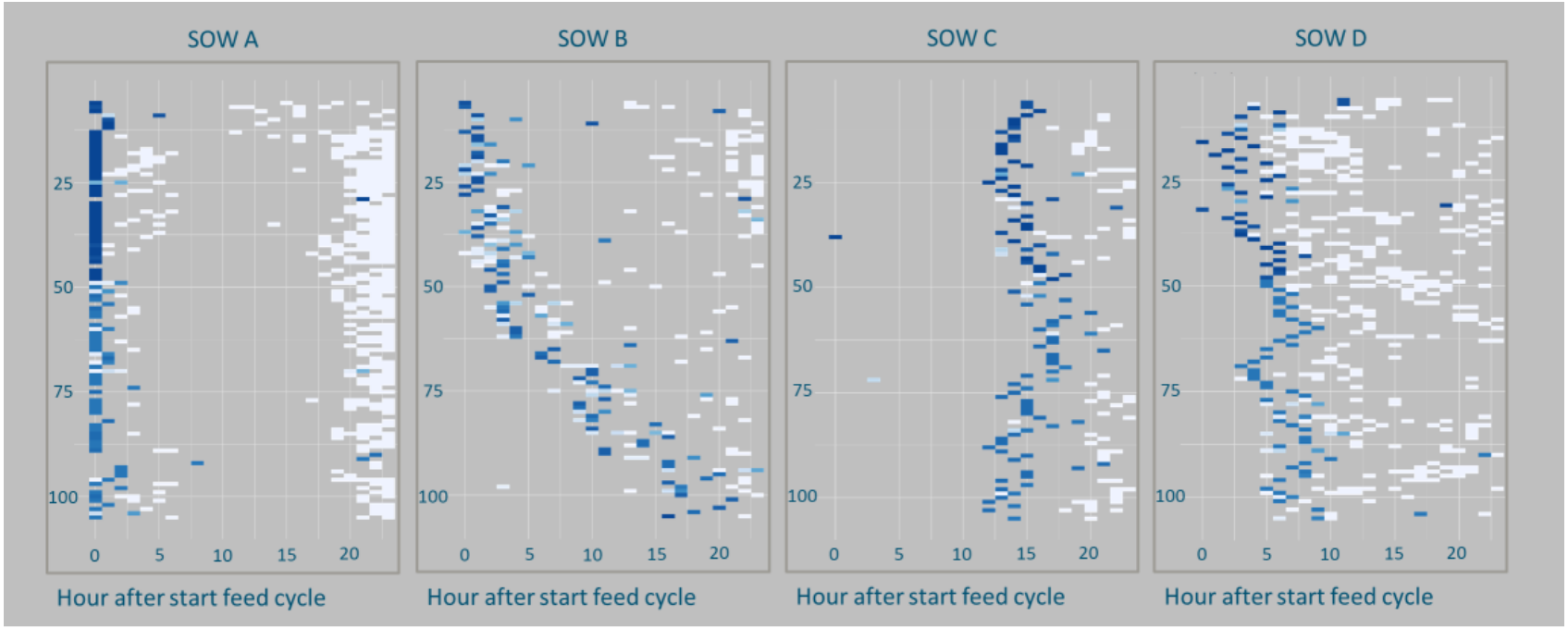
Competition

Decision of sows

Feeder out of order

System error

New potential welfare indicators based on ESF



Rewarded (blue) and unrewarded (white) ESF visits

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Examples of indicators based on ESF/sow/feed cycle?

ESF data features per sow	Organic: average (range)	Conventional: average (range)
Time in feeding station (min/d)	15 (0-54)	20 (0-94)
Feeding rate (g/min)	200 (28-304)	154 (10-518)
No. visits with feed allowance (R-visit)	1 (1-12)	1 (1-24)
No. visits without feed allowance (NR-visit)	4 (0-65)	2 (0-43)
Hour first NR-visit	13 (0-24)	16 (0-24)

R = rewarded; NR = non-rewarded

Quality as indicators for sow welfare?

ESF data features per sow	Organic: average (	Conven	e
Time in feeding station (min/d)	1		
Feeding rate (g/min)	200 (28-304)	154 (10-518)	
No. visits with feed allowance (R-visit)	1 (1-12)	1 (1-8)	
No. visits without feed allowance (NR-visit)			
Hour first NR-visit	13 (0-24)	16 (0-24)	

Management decision

Change of settings by farmer

Social issues/ competition

Decision of sows

Feeder out of order

System error

R = rewarded; NR = non-rewarded

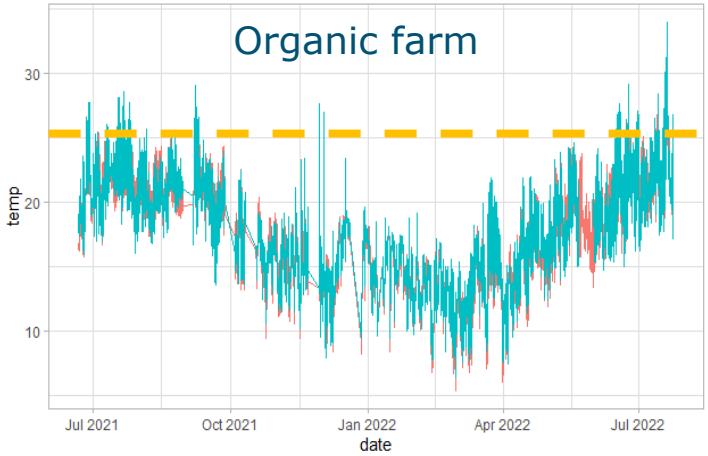
Potential welfare indicators from climate sensors

- No. of days/year
  - Ambient temp above Upper Critical Temp. (25°C)
  - Ambient temp below Lower Critical Temp. (10-14°C)
  - Temp. Humidity Index (THI) above critical level (≥74)
  - NH_3 concentration > 20 ppm
  - CO_2 concentration > 3000 ppm

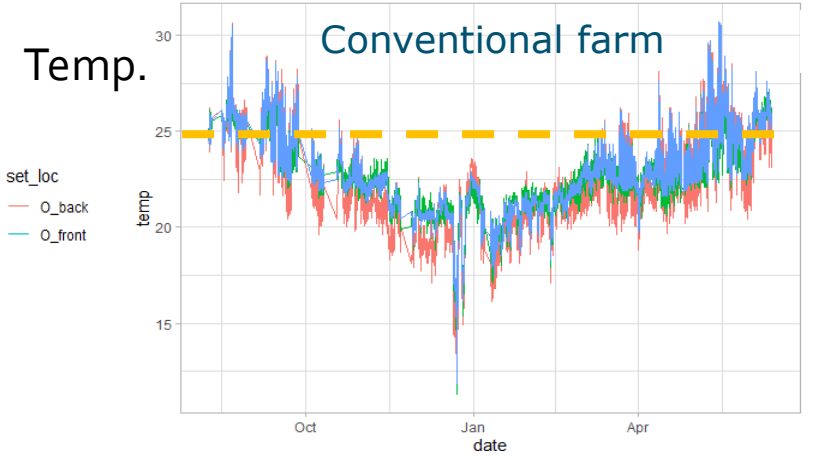
Wathes et al., 2003; EFSA, 2007; Kendall & Webster, 2009; Bloemhof et al., 2013; Wegner et al., 2016; Vermeer & Hopster, 2018

Temperature and Humidity level in barn over a year

Av: 17.1°C

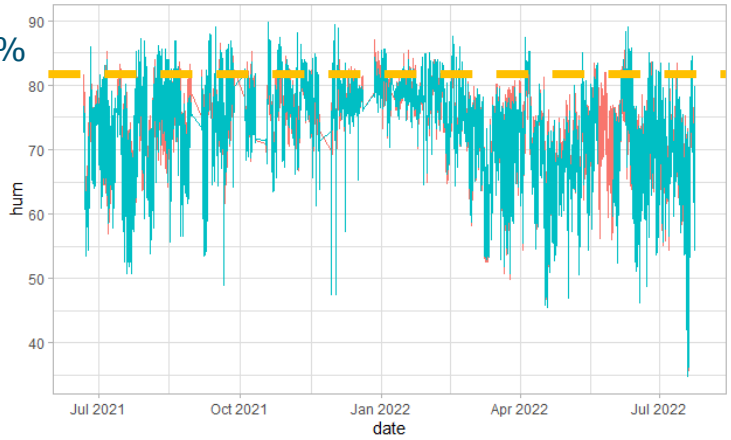


Temp.

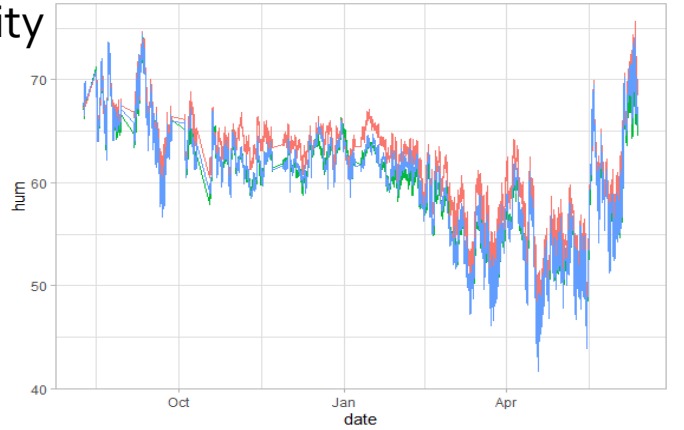


AV: 23.1°C

AV: 73.6%



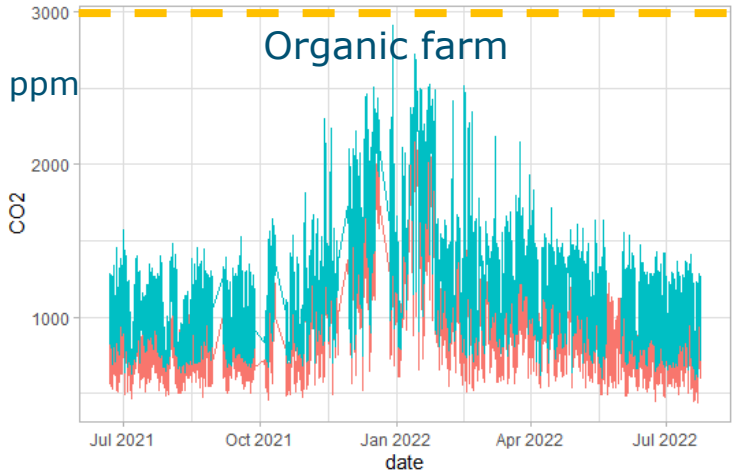
Humidity



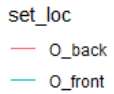
AV: 61.5%

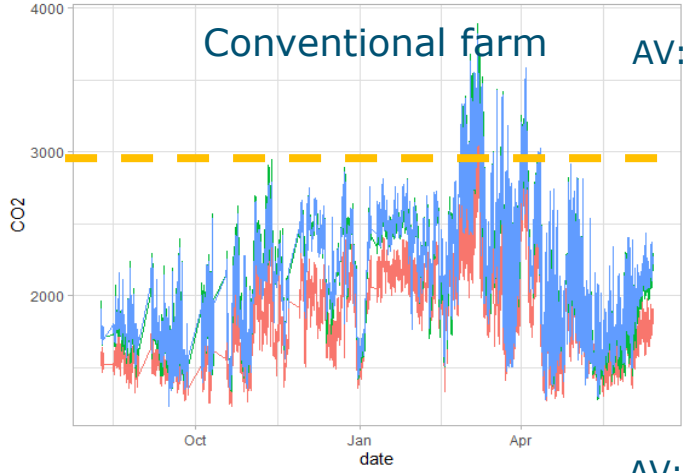
CO_2 and NH_3 level in barn over a year

AV: 1088 ppm

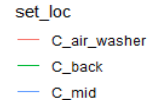


CO_2

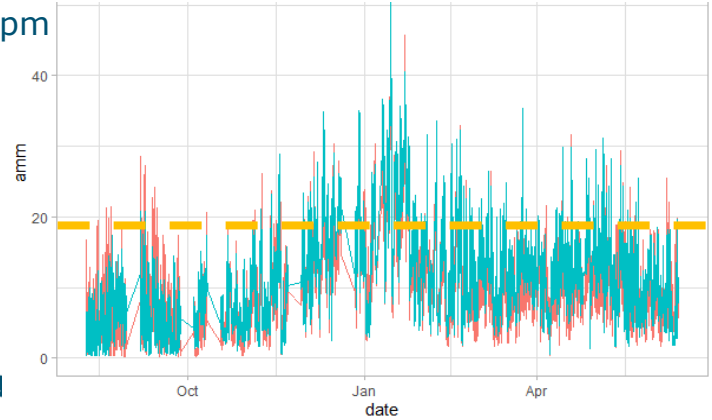




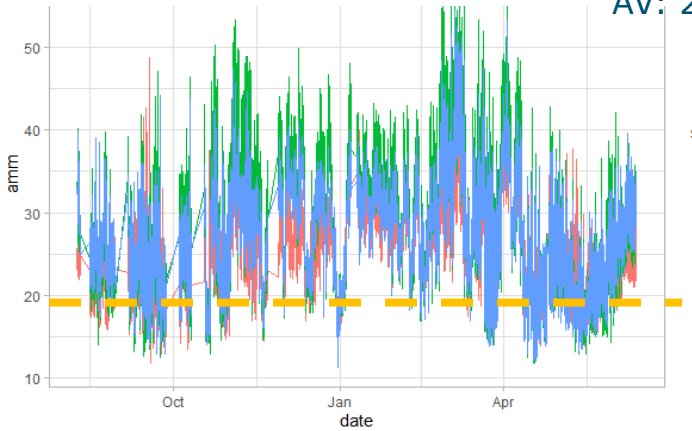
AV: 1961 ppm



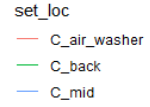
AV: 10.2 ppm



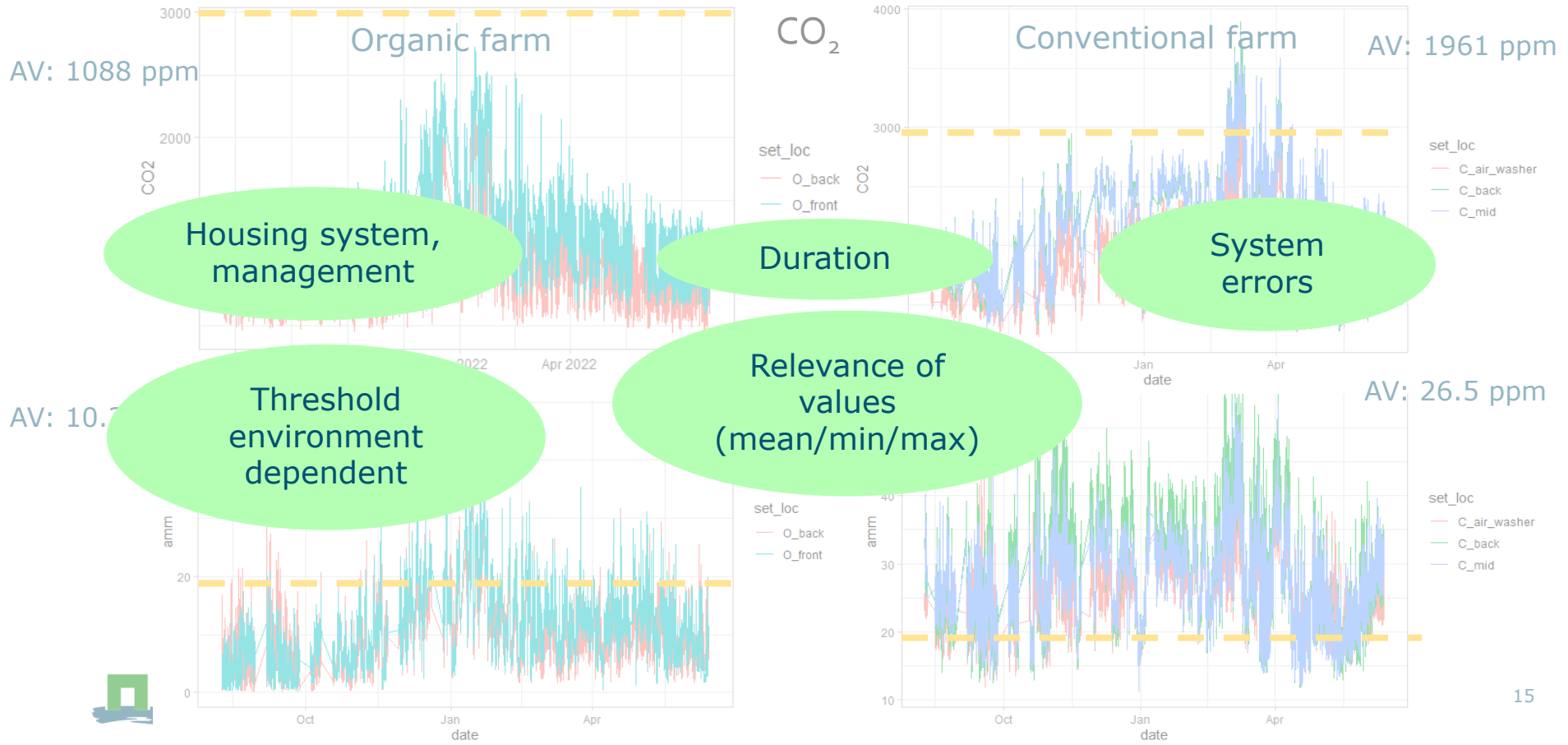
NH_3



AV: 26.5 ppm



Quality as indicators for sow welfare?



Conclusion: “Is sensor technology ready for use in animal welfare assessments of gestating sows?”

- Sensor-based data can provide valuable information about welfare
- Limited number of welfare aspects are covered
- Relation sensor output and welfare of sows needs further study
- Challenges are:
  - Erroneous data (power failures, bad internet connection, broken sensors)
  - Functioning technology (lifespan, maintenance, calibration, validation)
  - Data cleaning (tailor-made, difficult to automate, presence of outliers)
- Background info about farm and management is required for interpretation

Sensor technology is not yet ready for welfare assessments in sows

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This study is part of the EU project ClearFarm and funded by the European Union's Horizon 2020 research and innovation program under grant agreement no. 862919. We thank NEDAP and the farmers for sharing ESF data and access to their farms.

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