



DANISH  
TECHNOLOGICAL  
INSTITUTE

# AUTOMATION OF GHG EMISSION DATA ANALYSIS

Joint Symposium on Agricultural Greenhouse Gas Emissions

- Measuring and Monitoring

Field Emission Network and Nordic Field Trial Network, May 23<sup>rd</sup> 2023

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# A PART OF THE EUROPEAN R&D-NETWORK



The institute is a member of EUROTECH\*, along with nine of the biggest Research and Technology Organisations in Europe:

- CEA
- Fraunhofer
- TNO
- VTT
- SINTEF
- RISE
- IMEC
- TecNALIA
- AIT
- DTI

\*EUROTECH is a special interest group originating from EARTO (the European Association of Research and Technology Organisations)



# AUTOMATION OF GHG EMISSION DATA ANALYSIS

1. The importance of automizing GHG emission data collection and analysis
2. Automation of GHG emission data analysis – examples
  - a) Unique ID system
  - b) App for time sampling
  - c) Automized flux data analysis
3. Future perspectives



# THE IMPORTANCE OF AUTOMIZING GHG EMISSION DATA COLLECTION AND ANALYSIS



- Static chamber method acknowledged scientifically – however very time consuming and labor intensive
- Demand for large-scale setup for documentation of known and new mitigation technologies
- Demand for data-driven decision making for choice of mitigation strategies on the farm





An aerial photograph of a green field with several vertical strips of dark brown soil. Small white and grey squares are placed on the soil strips, representing data points. A person is visible in the lower-left area of the field, and a wooden marker is in the lower-right area.

# AUTOMATION OF GHG EMISSION DATA ANALYSIS – EXAMPLES





# INPUT DATA FOR FLUX CALCULATION



- GHG concentrations (ppm) sampled at 4 time points while gas accumulates in the closed chamber
- Analysis of samples in gas chromatograph (GC)
- Time of gas samplings
- Chamber volume
- Air pressure (weather station at site)
- Temperature (weather station at site)



# AGRO EMISSION PLATFORM

Unique ID  
system

Time sampling  
app

Automatic flux  
calculation



# UNIQUE SAMPLE ID SYSTEM





# UNIQUE SAMPLE ID SYSTEM



- Normal practice includes labels with no barcode and/or with handwriting
- Benefits with unique barcoding system:
  - Tracking of sample from field to final result
  - Optimizes preparation before sampling
  - Reduces risk of manual errors
  - Optimizes time use and sample handling at GC-lab
  - Automation of data upload for flux calculation





# APP FOR TIME SAMPLING IN THE FIELD





# TIME SAMPLING IN THE FIELD

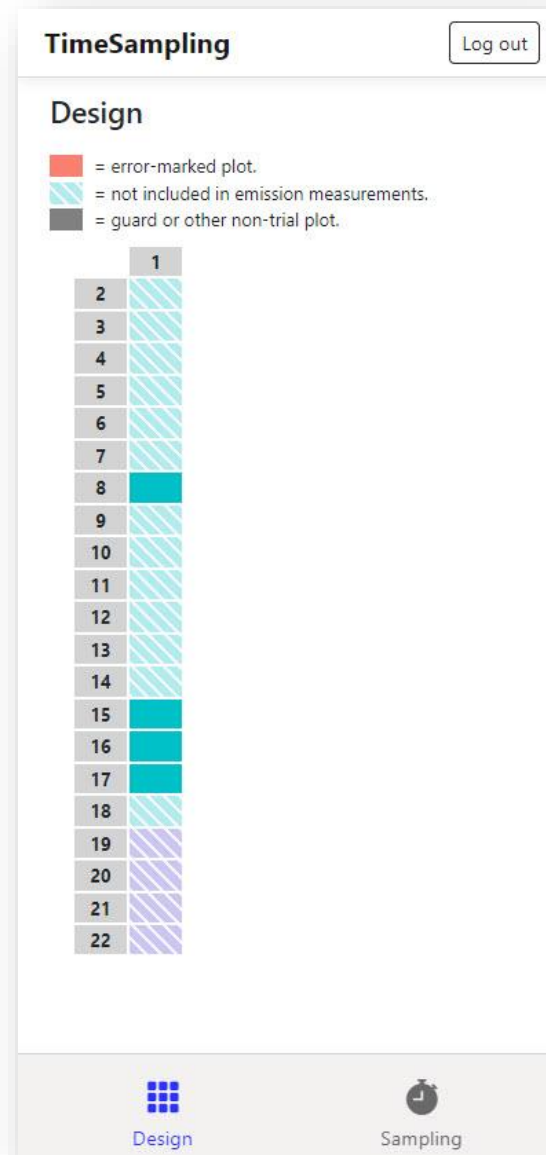
The image illustrates the transition from traditional paper-based time sampling to a digital mobile application. On the left, a paper form titled 'Tidsregistreringsark' (Time Recording Sheet) is shown. It includes fields for 'Forsøgsnummer: xxx002323-001 LFE 7', 'Navn på prøveudtager', 'Beskrivende tidspunkt (M-tid jf. labels)', 'Dato for prøvetagning', and 'Starttidspunkt for prøvetagning'. There are also checkboxes for 'Forlængelse af kammer' and a 'Generel kommentar' field. Below these is a table with columns for 'Parcel ID\*', 'Int.nr.', 'T0', 'T1', 'T2', 'T3', and 'Bemærkninger'. A pencil icon is drawn over the table. On the right, a smartphone displays the 'TimeSampling' app interface. The app shows the same 'Forsøgsnummer' and a 'Log out' button. Below is a 'General comment' text area and a large green 'Start' button. At the bottom, there are 'Back' and 'Next' buttons and a navigation bar with 'Design' and 'Sampling' icons. A blue arrow points from the paper form to the smartphone.

Parcel ID*	Int.nr.	T0	T1	T2	T3	Bemærkninger
Ambient 1	-					
Led 6 gent. 1	1					
Led 4 gent. 1	2					
Led 3 gent. 1	3					
Led 5 gent. 1	4					
Led 3 gent. 2	5					
Led 6 gent. 2	6					
Led 4 gent. 2	7					
Led 5 gent. 2	8					
Led 1 gent. 1	9					
Led 2 gent. 1	10					
Led 2 gent. 2	11					
Led 1 gent. 2	12					

- Normal practice is writing on paper and using a stopwatch
- Benefits with app:
  - Improves practical procedures in the field
  - Increases precision in time registration
  - Reduces risk of manual errors
  - Reduces time use for registration
  - Automation of time sampling for flux calculation

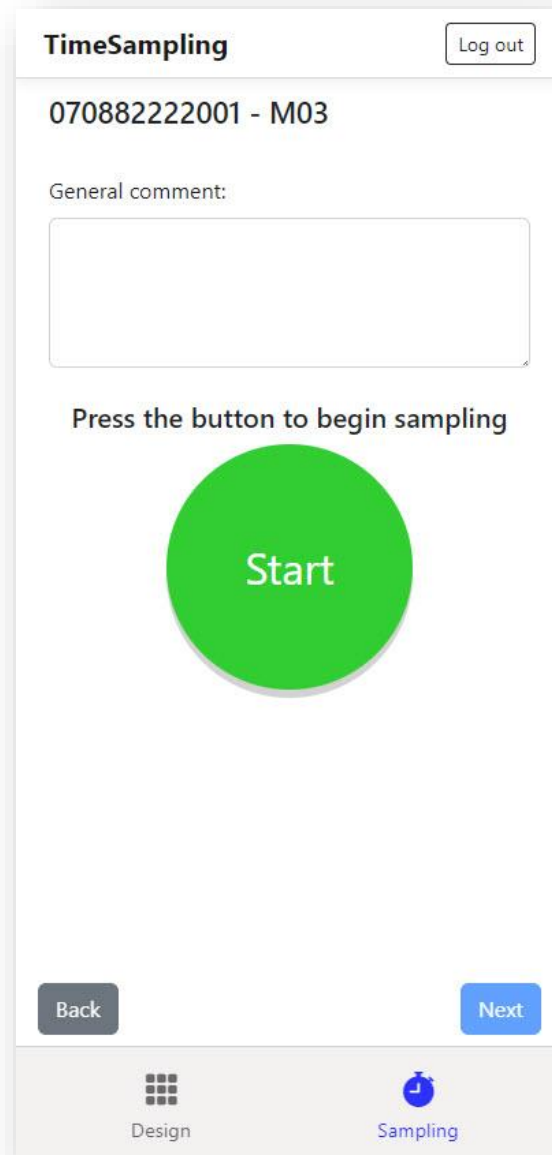


# FEATURES IN TIME SAMPLING APP

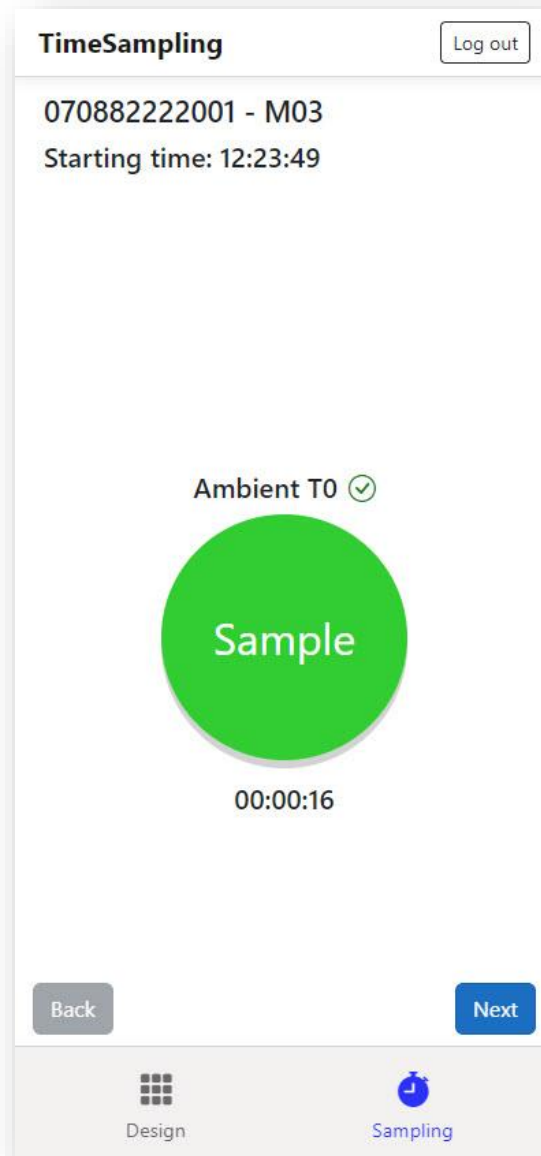




# FEATURES IN TIME SAMPLING APP

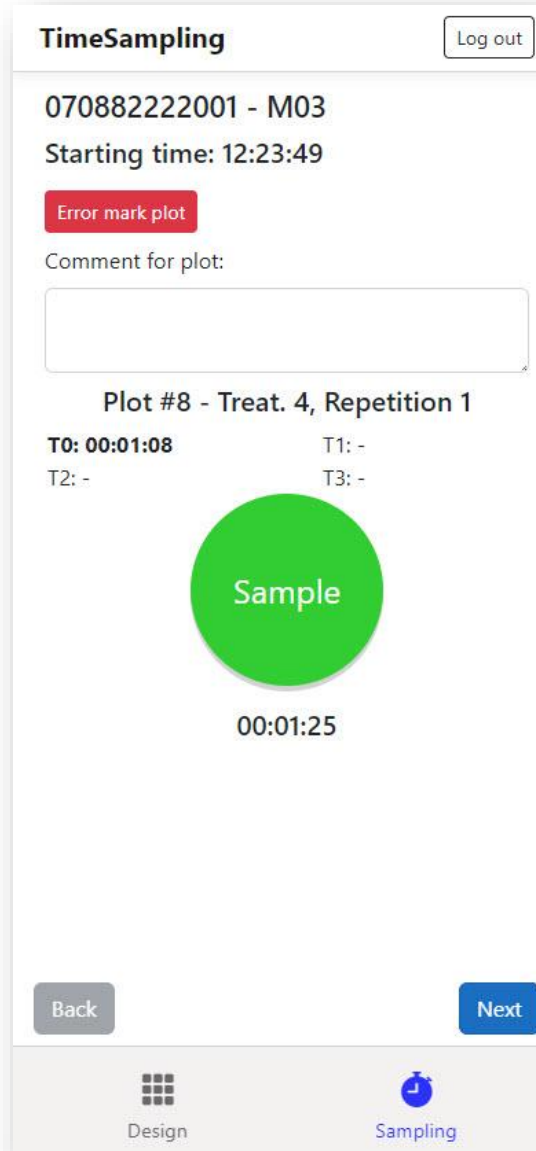


# FEATURES IN TIME SAMPLING APP





# FEATURES IN TIME SAMPLING APP



← Back 272212222001 ✎

Trial year: 2022

Location: LFE 18

Chamber size: 50 cm \* 50 cm

[Generate sample labels](#) [Trial design](#) [Collar heights](#) [View temporal flux](#)

[Export daily flux values to NFTS](#) [Export GC standard data for trial](#)

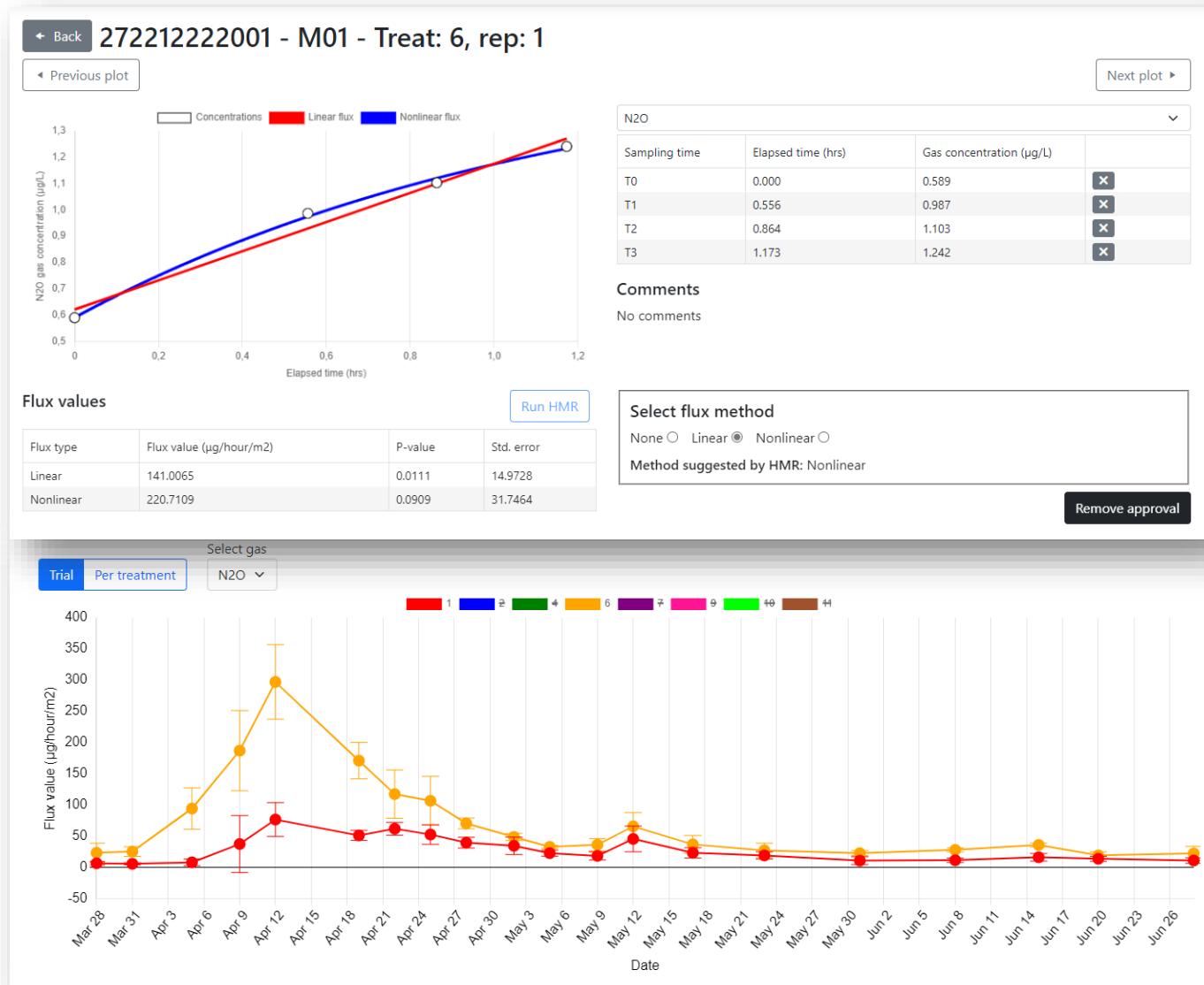
For selected M-days: [Fetch weather data](#) [Calculate µg/L conc.](#) [Export conc. data](#) [Export flux data](#)

# AUTOMATED FLUX DATA ANALYSIS

<input type="checkbox"/>	M-day	Date	Time registration	Weather data	Concentrations	Daily flux	GC data	Analysis date(s)
<input type="checkbox"/>	M01	02-05-2022	✓ View	👁️ ⬇️	📄 📄	📄 📄	👁️	12.07.2022
<input type="checkbox"/>	M02	05-05-2022	✓ View	👁️ ⬇️	📄 📄	📄 📄	👁️	16.07.2022 15.07.2022
<input type="checkbox"/>	M03	09-05-2022	✓ View	👁️ ⬇️	📄 📄	📄 📄	👁️	18.07.2022
<input type="checkbox"/>	M04	13-05-2022	✓ View	👁️ ⬇️	📄 📄	📄 📄	👁️	20.07.2022 21.07.2022
<input type="checkbox"/>	M05	17-05-2022	✓ View	👁️ ⬇️	📄 📄	📄 📄	👁️	21.07.2022
<input type="checkbox"/>	M09	07-06-2022	✓ View	👁️ ⬇️	📄 📄	📄 📄	👁️	29.07.2022 28.07.2022
<input type="checkbox"/>	M08	31-05-2022	✓ View	👁️ ⬇️	📄 📄	📄 📄	👁️	28.07.2022
<input type="checkbox"/>	M07	24-05-2022	✓ View	👁️ ⬇️	📄 📄	📄 📄	👁️	



# AGRO EMISSION PLATFORM



- Normal practice includes data in multiple excel sheets and calculation in statistical programs
- Benefits with Agro Emission Platform:
  - Simple user face and visualization of data
  - Management of GHG emission sampling strategies in e.g. field trials
  - Automized data compilation from multiple data sources: GC, weather station and time app
  - Build in quality control and reduced risk of manual errors
  - Choice of calculation methods and optimized time use for flux analysis
  - Easy to extract data





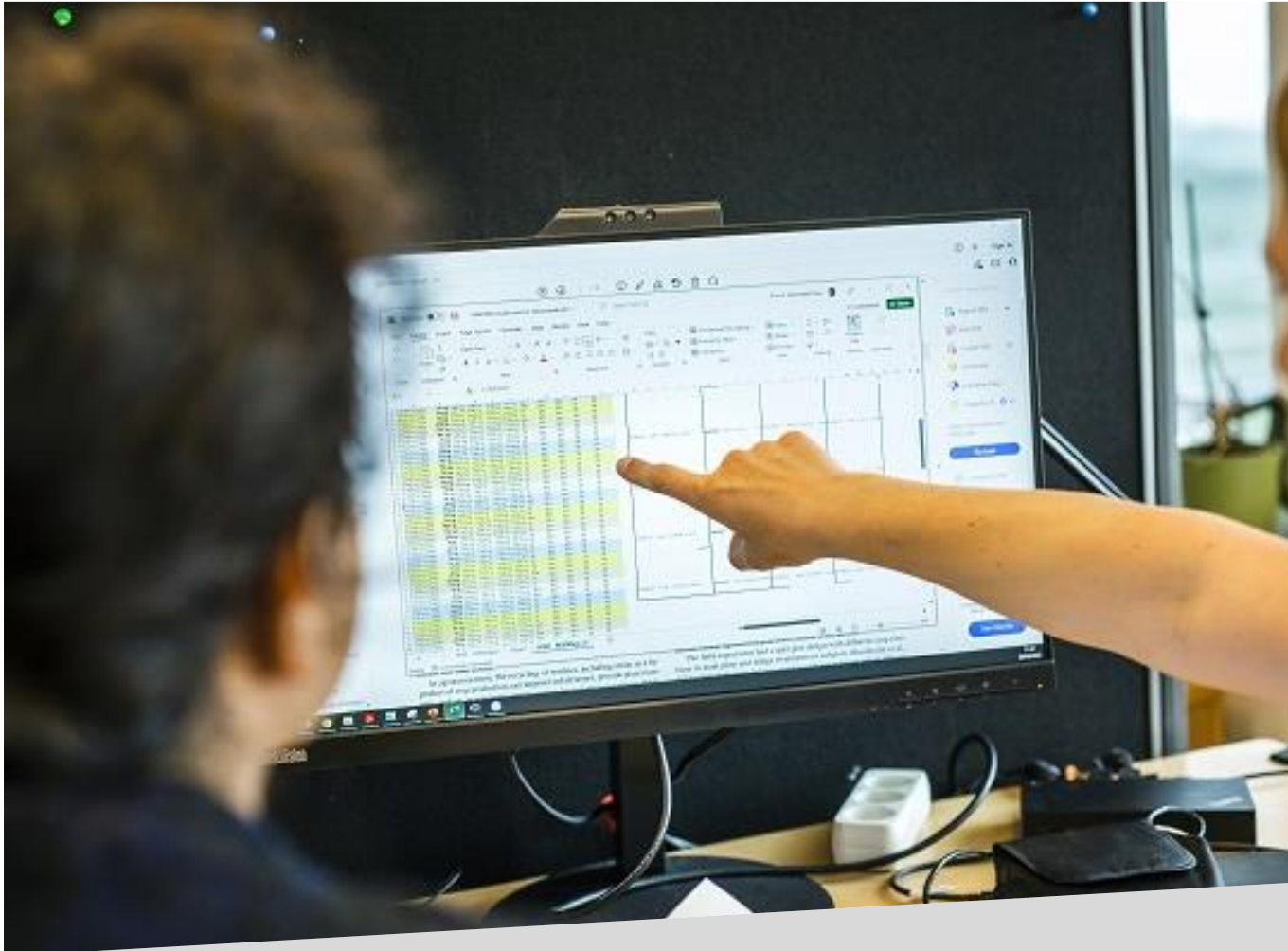


# FUTURE PERSPECTIVES





# COLLABORATION IS KEY



- Sharing of knowledge and experience to build on top
- Collaboration between different stakeholders nationally and internationally
- Sharing of data to accelerate the green transition





# THANK YOU!



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