# Wastewater Gas Analyser – WGA v.020

## PRECISE AND RELIABLE MEASUREMENT SYSTEM TO MONITOR RELEVANT GREENHOUSE GAS EMISSIONS OF $N_2O$, $CH_4$, $CO_2$

NO GAS BOTTLES NEEDED

LOW MAINTENANCE

LOW POWER CONSUMPTION

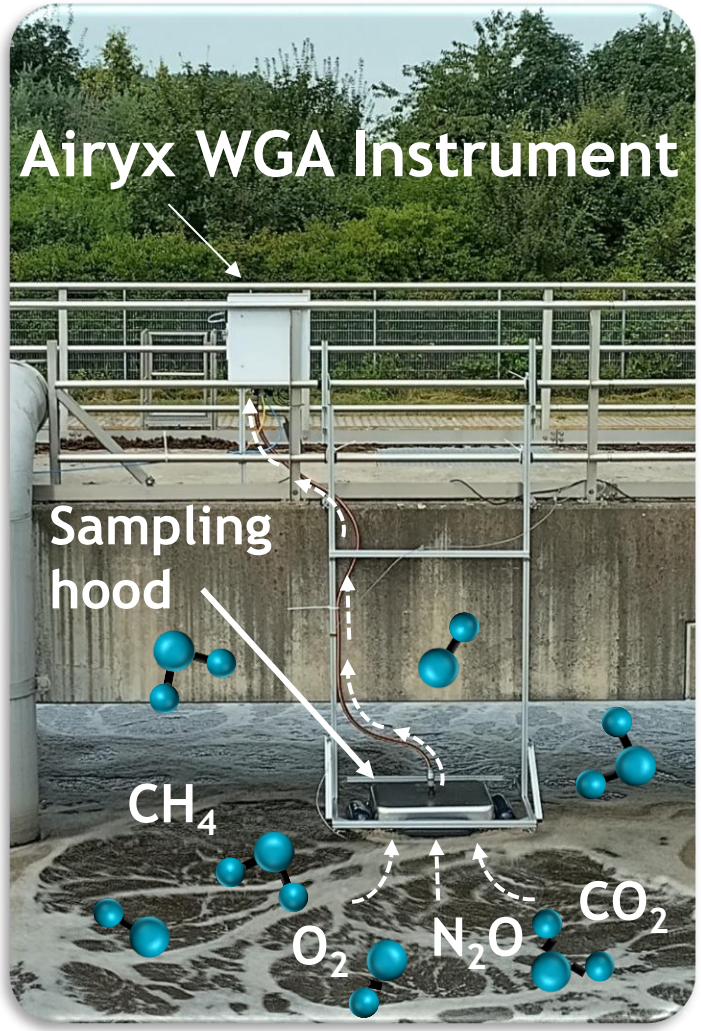
# Wastewater Denitrification Emits Greenhouse Gases

**Airyx WGA monitoring solution**


- $N_2O$ is a greenhouse gas with 265 × the impact of $CO_2$
- Improved denitrification cuts $N_2O$ emissions and may save power

## New EU regulation require monitoring

# Wastewater Gas Analyser (WGA)



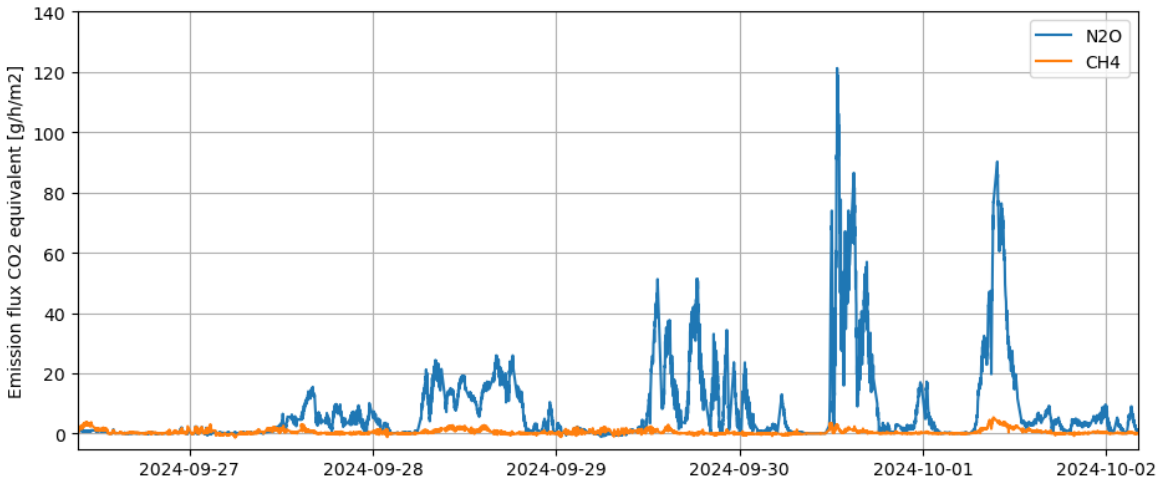


- Continuous monitoring: $N_2O$ – $CH_4$ - $CO_2$ – $O_2$
- Gas sampling with hood
- Automatic Emission calculation
- Auto-correction for: $H_2O$, cross interferences, zero point drift, temperature, background concentration, …

NO GAS BOTTLES NEEDED

LOW MAINTENANCE

LOW POWER CONSUMPTION



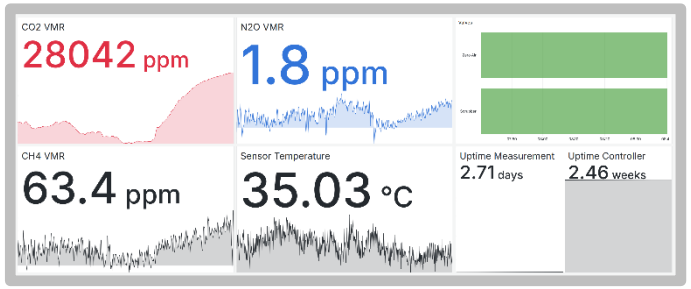

Airyx

*Airyx WGA technology applied for patent: PCT/EP2024/087231*

# Key Features

- **REAL-TIME CONTINUOUS MEASUREMENTS:** Accurate monitoring of $N_2O$, $CH_4$, $CO_2$ emissions
- **EMISSION RATE CALCULATION:** Integrated flow sensor
- **NO GAS BOTTLES REQUIRED:** Simplified operation and lower costs
- **AUTOMATED ZERO POINT CALIBRATION & CHECKS:** Internal automated zero-point and cross-interference checks
- **BACKGROUND MEASUREMENT:** Precise net emissions estimation by distinguishing between background and process-related emissions.
- **ROBUST SWIMMING SAMPLING HOOD:** Stable gas collection on dynamic water surfaces
- **TEMPERATURE STABILIZED:** Ensures accuracy under changing conditions
- **HUMIDITY RESISTANT:** Sample Gas drying prevents sensor degradation
- **OPTIONAL HEATED SAMPLING TUBE:** Prevents condensation losses
- **DESIGNED FOR LONG-TERM Field Deployment:** Rugged, Weatherproof IP64 enclosure with sun roof
- **SERVICE INTERVAL:** only every 6 to 12 month

*Web-Interface / Display*




# Technical Parameters WGA v.020

| | |
|---|---|
| **Measured Gases** | **$N_2O$, $CO_2$, $CH_4$, $O_2$** |
| **Measurement Principle** | Non-dispersive infrared (NDIR) for $N_2O$, $CO_2$, and $CH_4$;<br>Electrochemical sensor for $O_2$<br>Data cross-interference correction and water removal for high measurement accuracy |
| **Additional Parameters** | Ambient temperature, Ambient pressure, Total sample flow |
| **Time resolution** | 1 s internal, typ. averaging 60s, averaging adjustable |
| **Enclosure** | Rugged and weatherproof design, IP64 rating |
| **Power Supply** | 24 VDC, external power supply |
| **Power consumption** | 50 W nominal, 120 W peak |
| **Operating Temperature** | -10° C to +40° C |
| **Dimensions** | Analyser: 660 x 400 x 240 mm |
| **Weight** | Analyser (incl. staffing & sun shield): ~25 kg. Sampling hood unit: ~30 kg |
| **Mounting Options** | customer specific |
| **Data interfaces** | Ethernet, optional 4-20mA, additional data storage on USB memory stick, display |
| **Data format** | CSV files, Web interface on display and via Ethernet interface |

| Gas | Measurement Range | Limit Of Detection | Emission Rate Sensitivity |
|---|---|---|---|
| **$N_2O$** | 0–1000 ppm | 0.5 ppm | 0.8 mg/m²/h |
| **$CO_2$** | 0–100 000 ppm | 50 ppm | 84 mg/m²/h |
| **$CH_4$** | 0–1000 ppm | 5 ppm | 3 mg/m²/h |
| **$O_2$** | 0–100 vol % | 0.1 vol % or 0.5 % of reading | n/a |

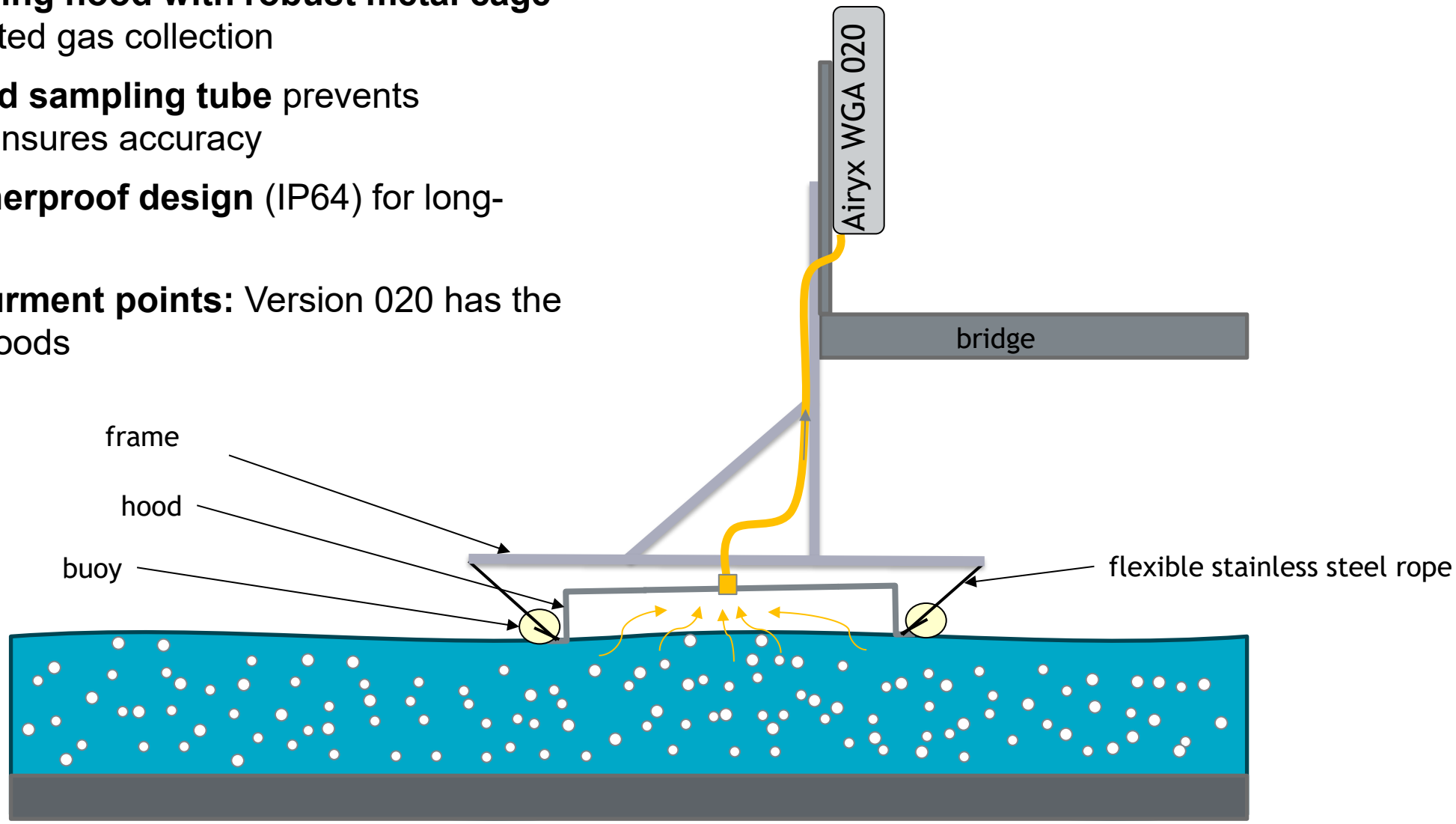
# Dimensions


500
693
590
70
400
28042 ppm
1.8 ppm
63.4 ppm
35.03 °C
Airyx
DIFFERENT THINKING.
BETTER MEASURING.

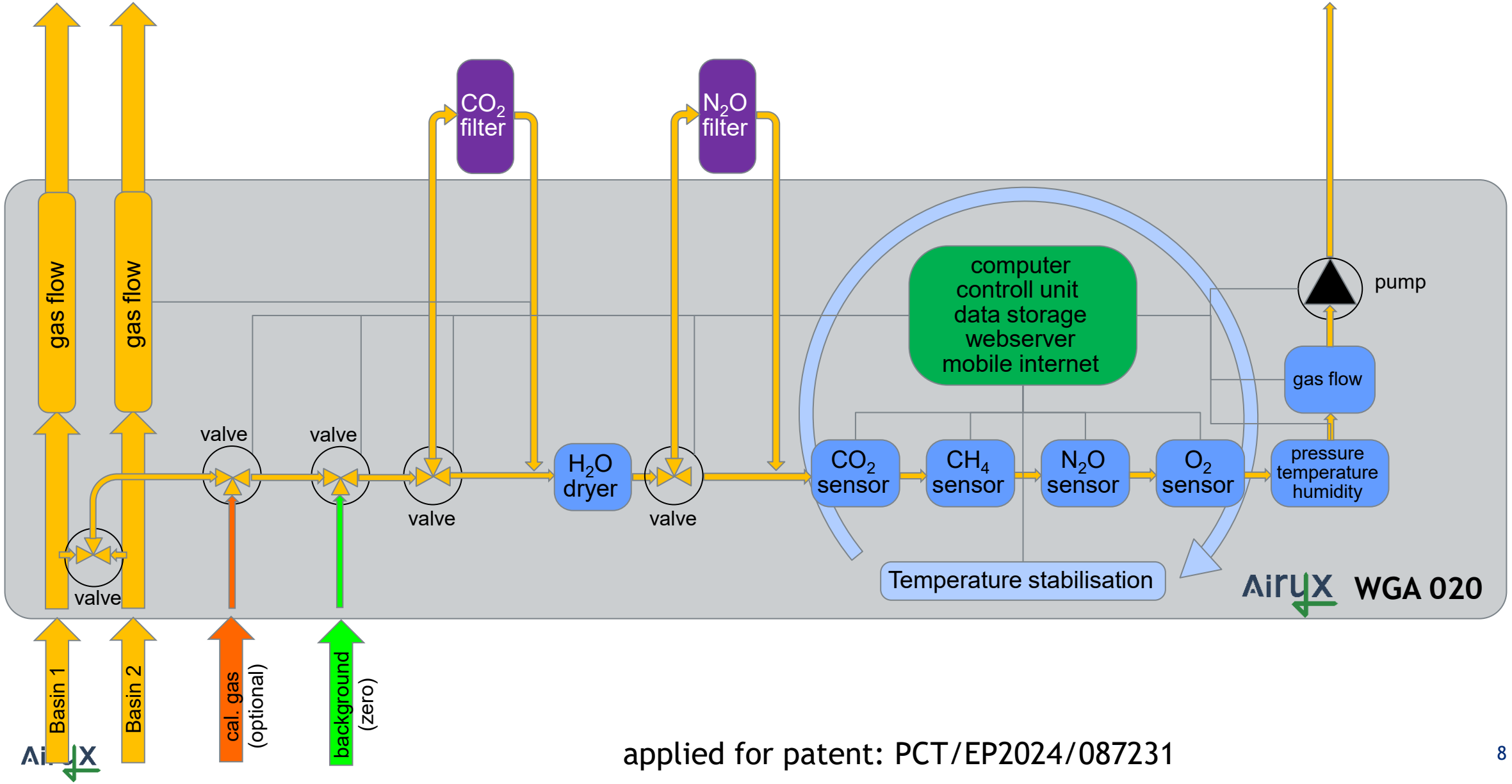

360
210
235

# Sketch Setup

- **Floating sampling hood with robust metal cage** for stable, targeted gas collection
- **Optional heated sampling tube** prevents condensation, ensures accuracy
- **Rugged, weatherproof design** (IP64) for long-term field use
- **Multiple Measurment points:** Version 020 has the option for two hoods



# Sketch internal setup

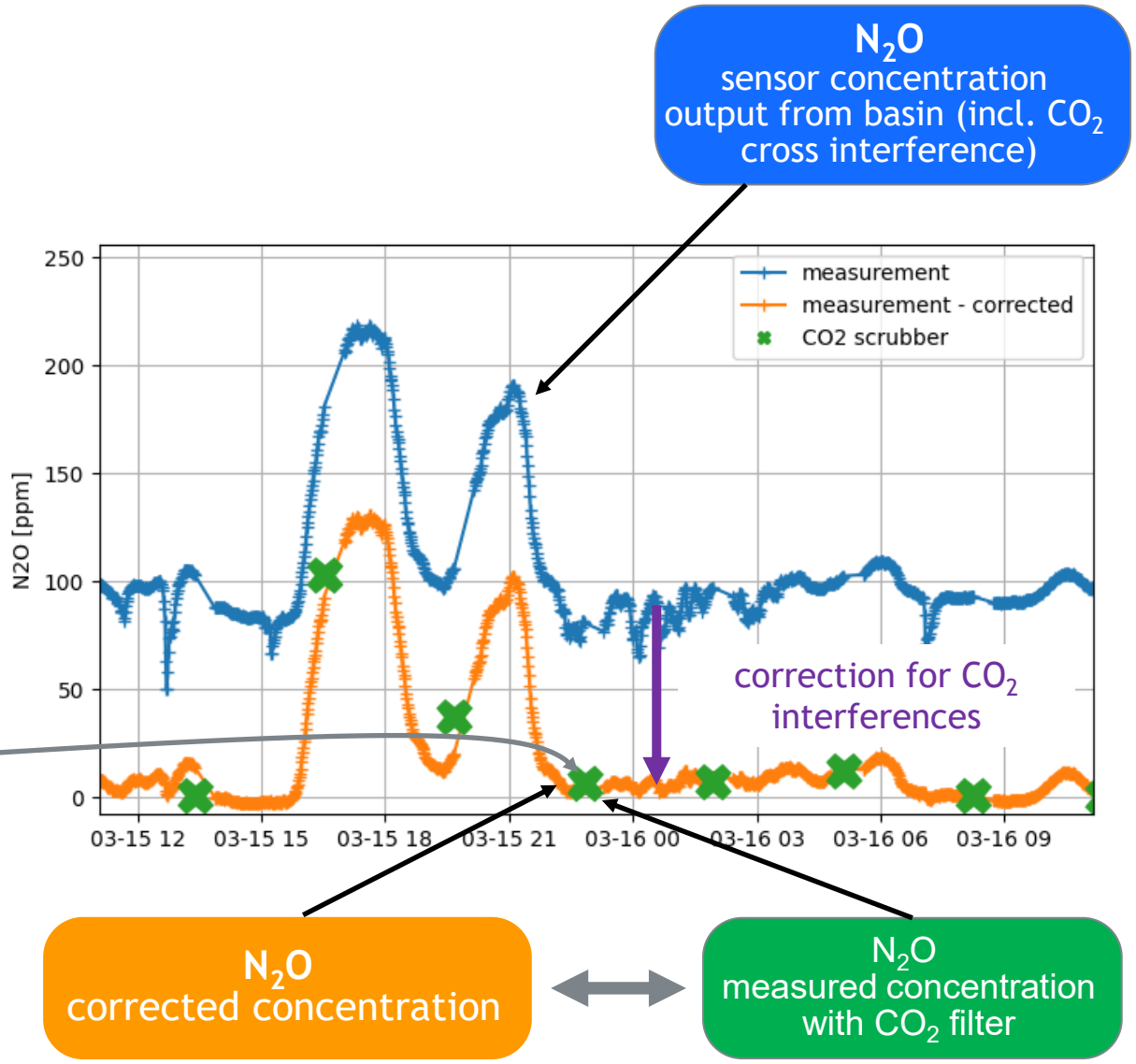



applied for patent: PCT/EP2024/087231

# Airyx WGA Unique Features - I

## $N_2O$ / $CH_4$ Correction of $CO_2$ Cross Interferences

- $CO_2$ causes on average >50% error in $N_2O$ measurement due to cross-interference in NIR sensors (without correction).
- Correction of $N_2O$ concentration using measured $CO_2$ concentration.
- Factory correction function derived from calibration gases.
- Daily check of interference correction with $CO_2$ filter measurement:
  - Remove $CO_2$ from sample air.
  - Compare $N_2O$ corrected concentration and $N_2O$ with $CO_2$ filter.
  - Adjust correction function to compensate for sensor aging
  - Long filter lifetime (~1 year) due to limited daily use (only a few minutes).

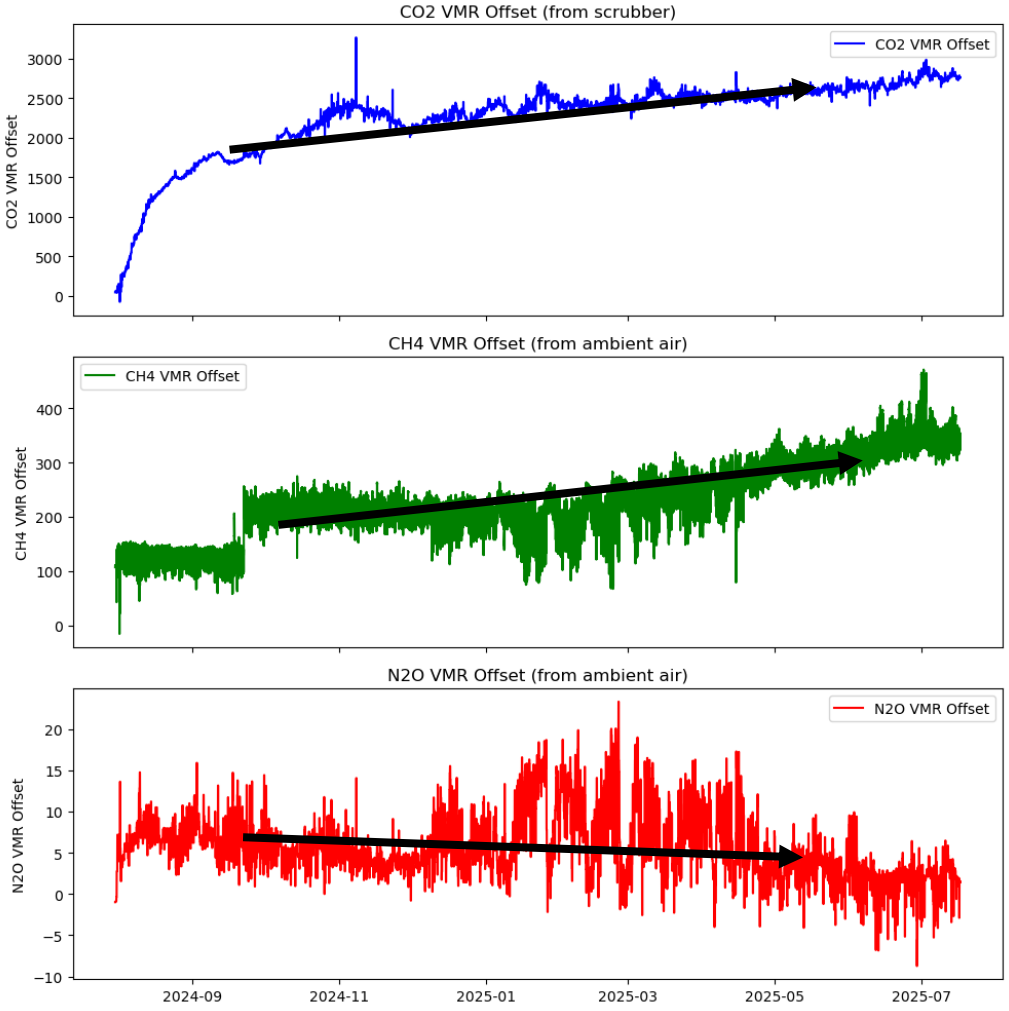



*If not equal,*
*correction function is adjusted*

# Airyx WGA Unique Features - II

- **Continuous Sensor Zero Point Drift Correction**
- Measures in pressurized or ambient air

NO GAS BOTTLES NEEDED




- **Calculates net emissions** by subtracting inlet air concentration
- No nitrogen gas cylinder needed during operation

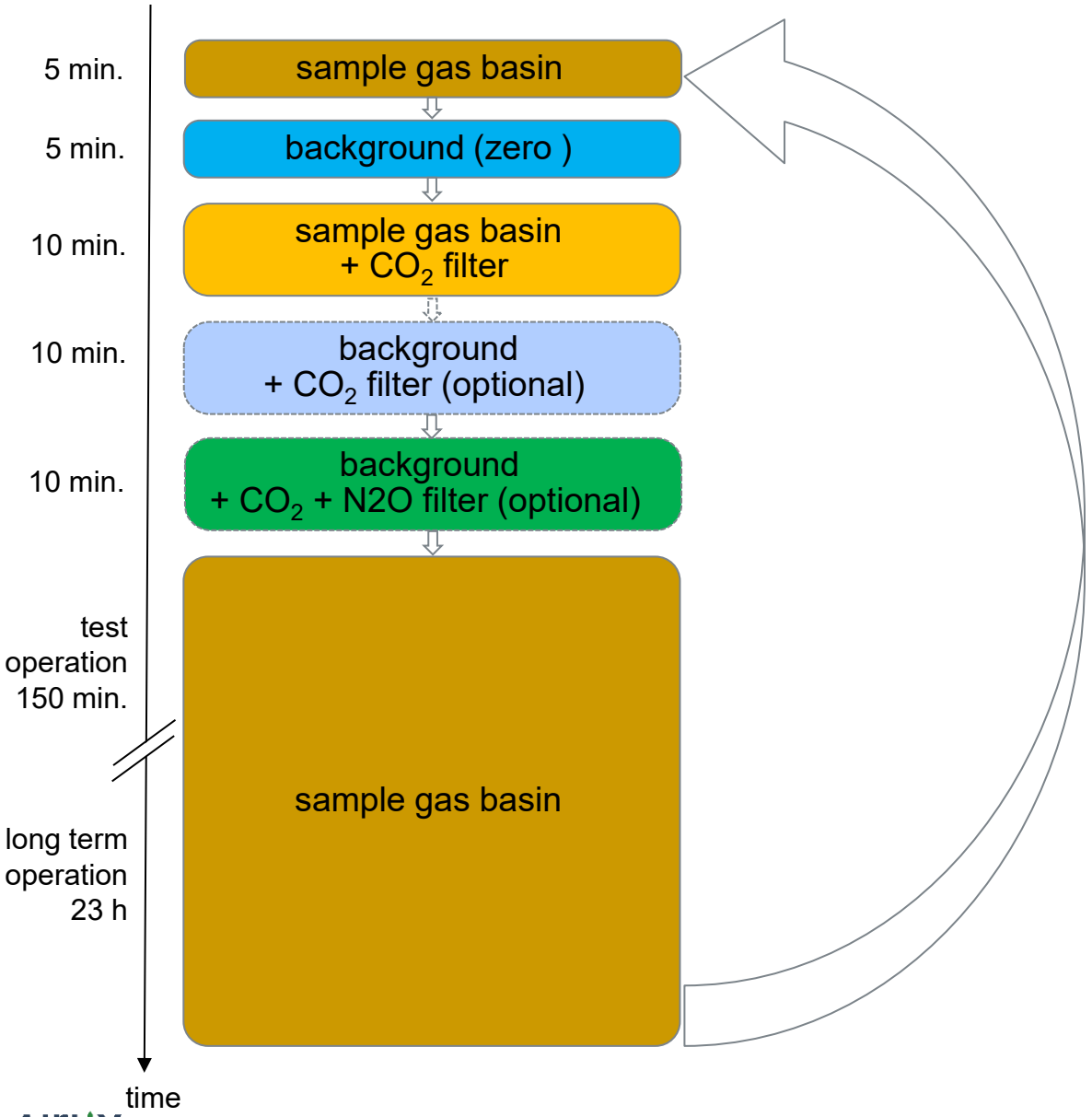


Pressurised air for basin ventilation:

# Airyx WGA Unique Features - III

- **Drying sample air below 5° C dew point** — minimizes water interference and condensation
- **Reduces $H_2O$ cross-interference** — improves $N_2O$ measurement accuracy
- **Prevents condensation and corrosion** — ensures system longevity
- **Maintenance-free operation** — reliable and easy to use
- **Particle filter included** — prevents contamination
- **Sensor stabilized at 50° C** — enhances sensor stability and accuracy, prevents condensation and chemical reactions

# Measurement routine (cycle)




- Measurement routine cycle test phase: 3h
- Long term measurement routine cycle: ~24h

→ filter replacement interval: ~1 year

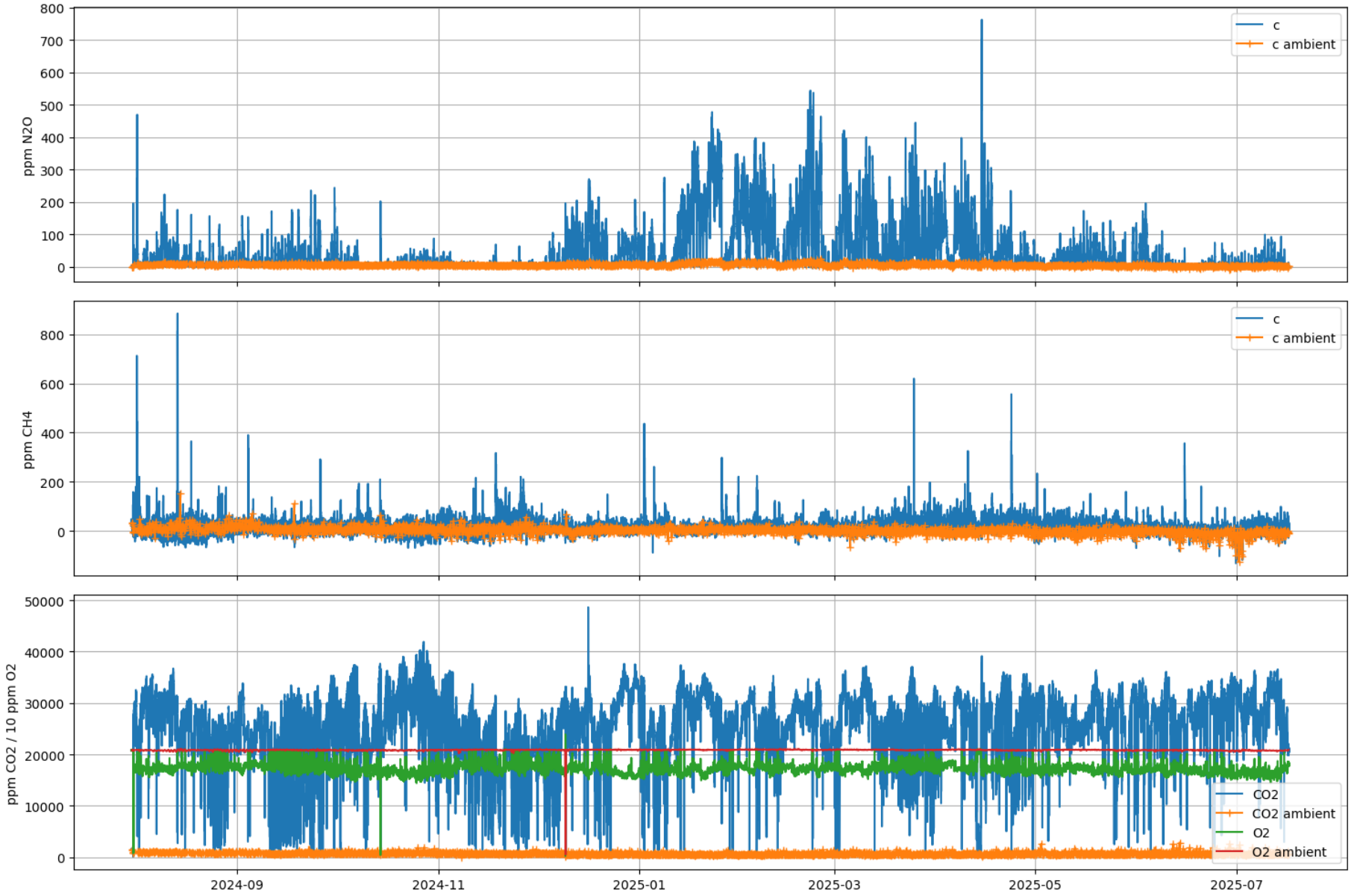
# Example Data Set (Mannheim)

concentrations

$N_2O$

$CH_4$

$CO_2$
$O_2$

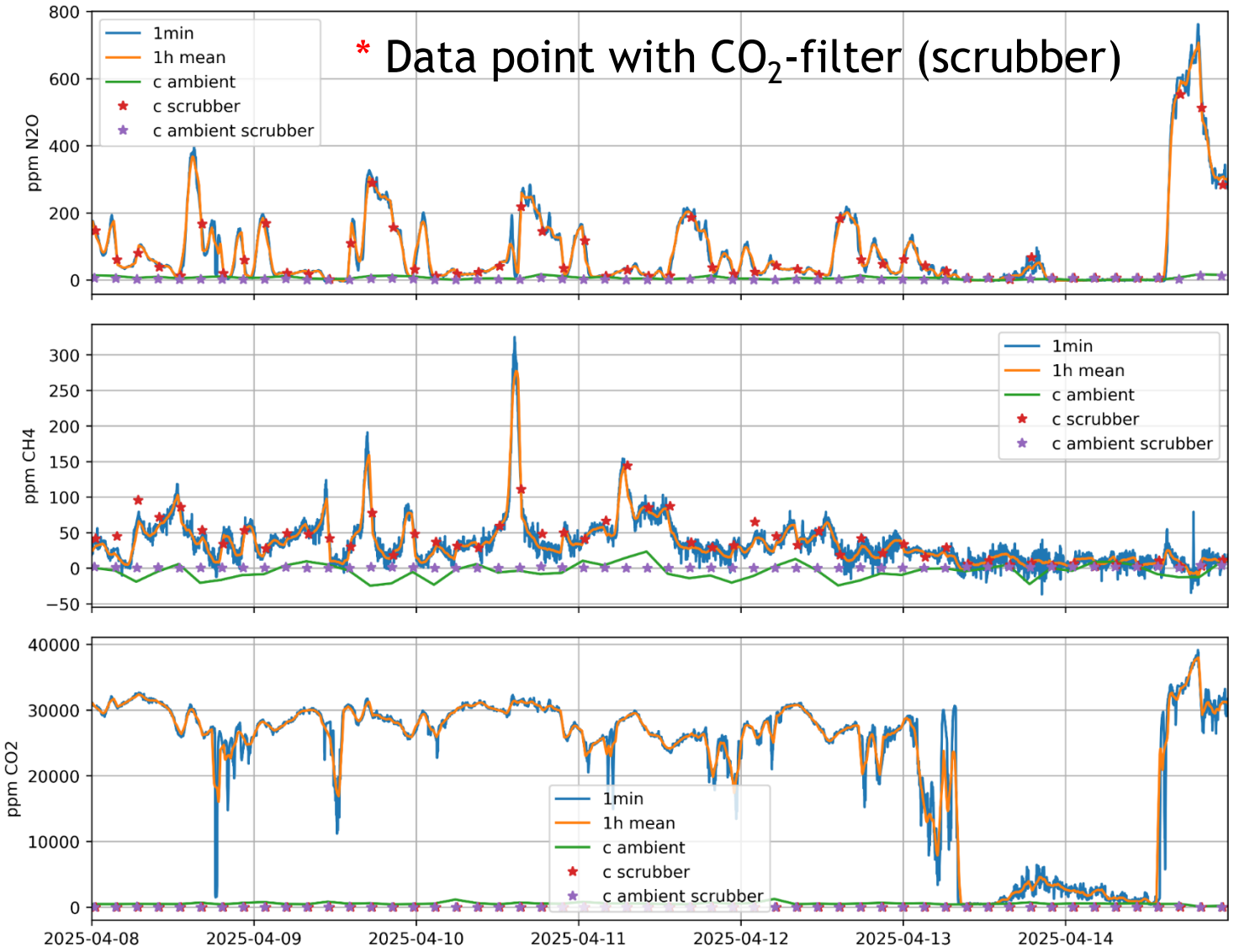


# Example Data Set (Mannheim) - Zoom

$N_2O$

$CH_4$

$CO_2$
$O_2$




-> if * data points are on blue line correction work good

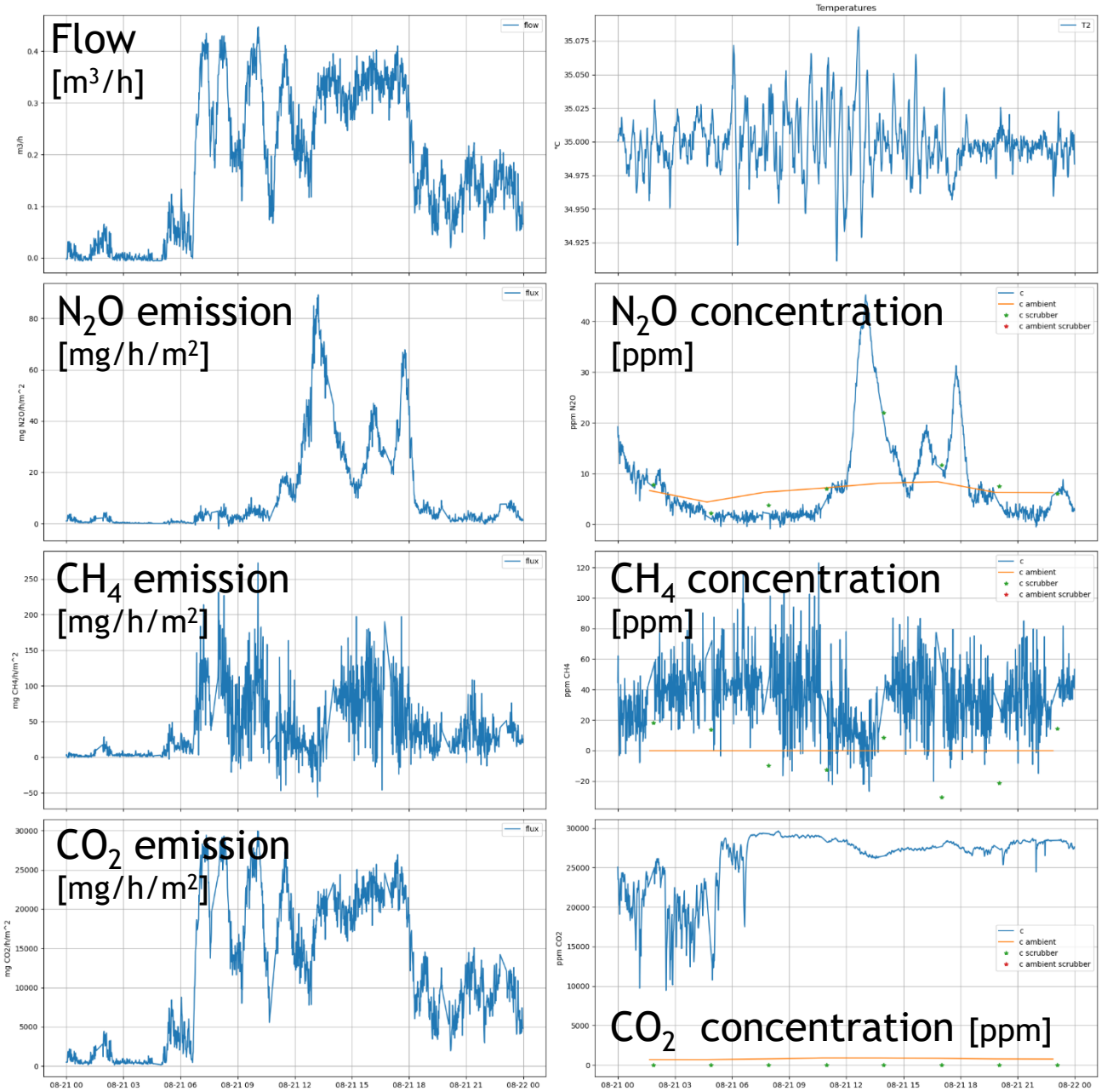
# Example Daily Concentrations & Emissions

## Calculation of Emissions:

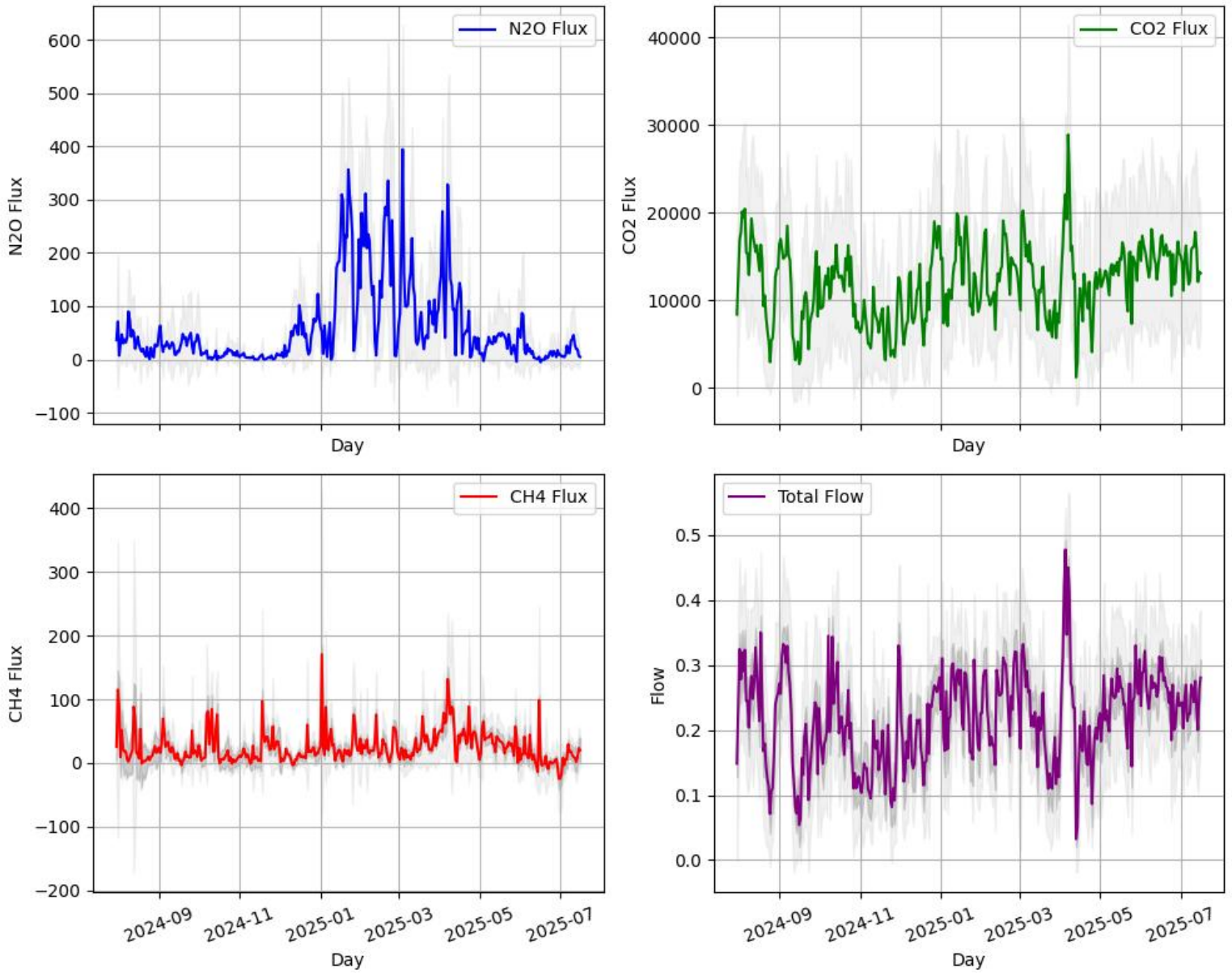
- Measure emission gas flow from the hood
- Calculate total emissions based on measured concentrations
- Correct net emissions using pressurized air concentration
- Generate daily emission plots for monitoring

## Further possible data analysis steps:

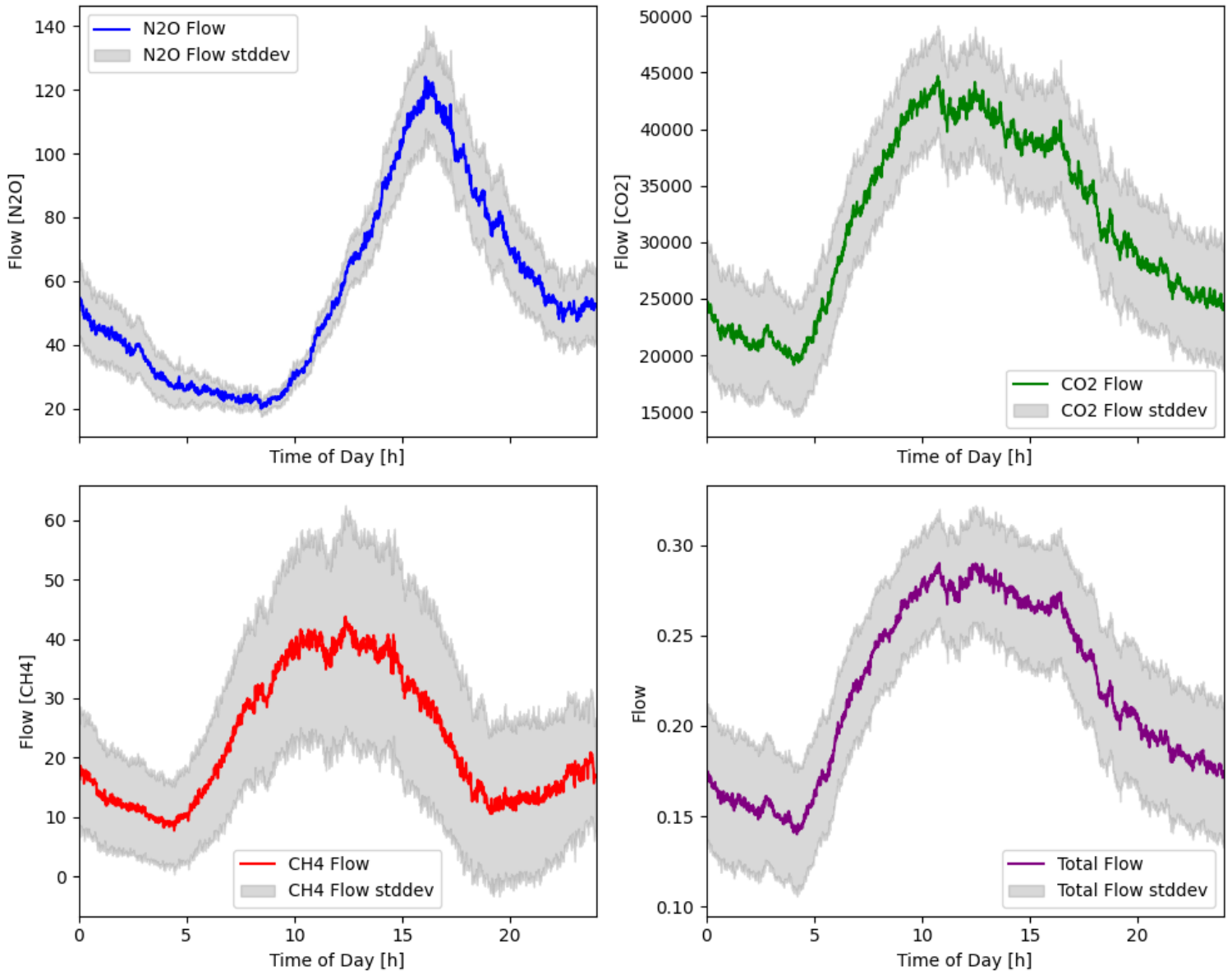
- Improve data with wastewater plant operation parameters
- Use total air flow of plant to scale emissions
- Enhance accuracy with multiple measurement systems at different basin locations



# Daily Averages

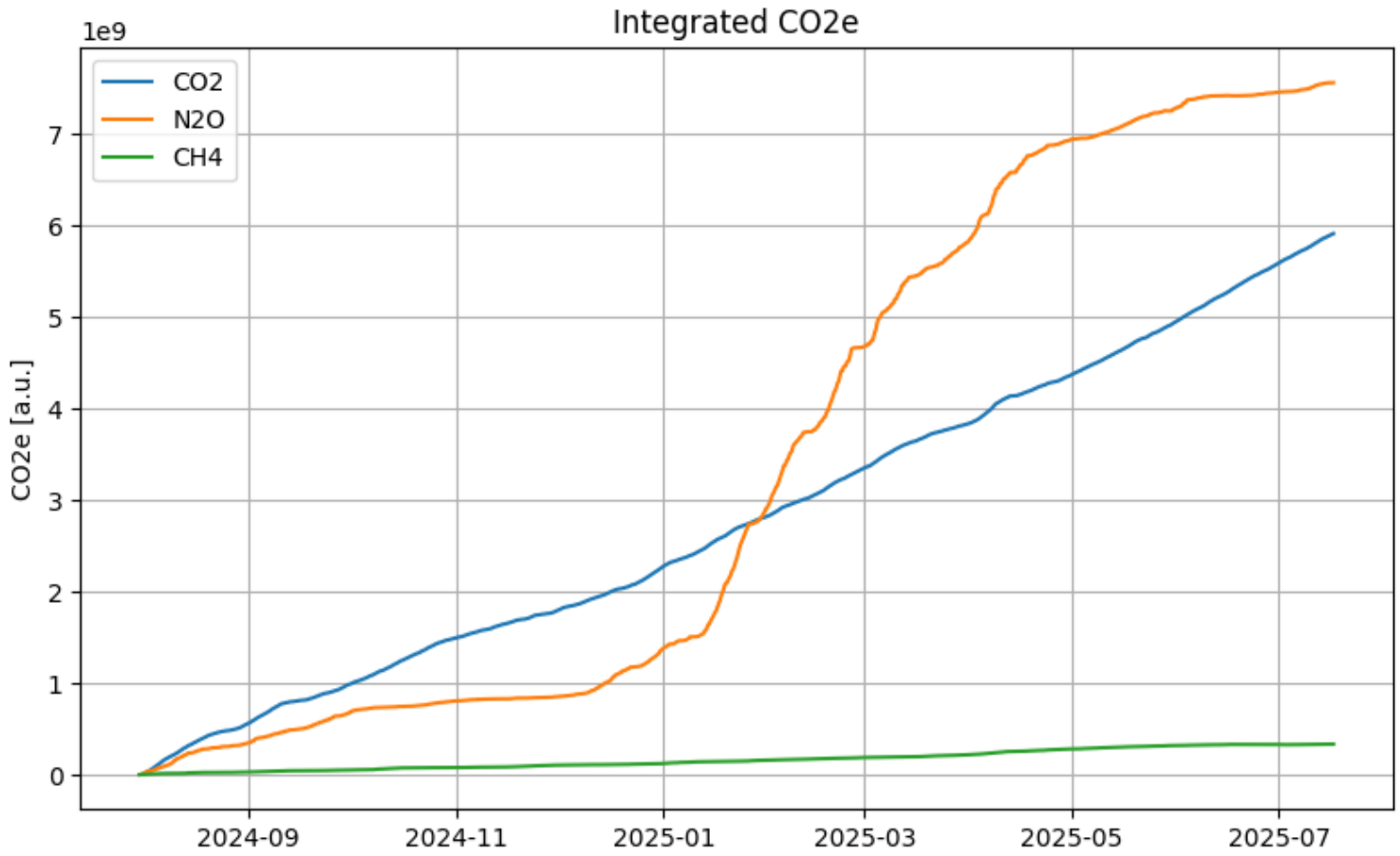


# Average Daily Cycle



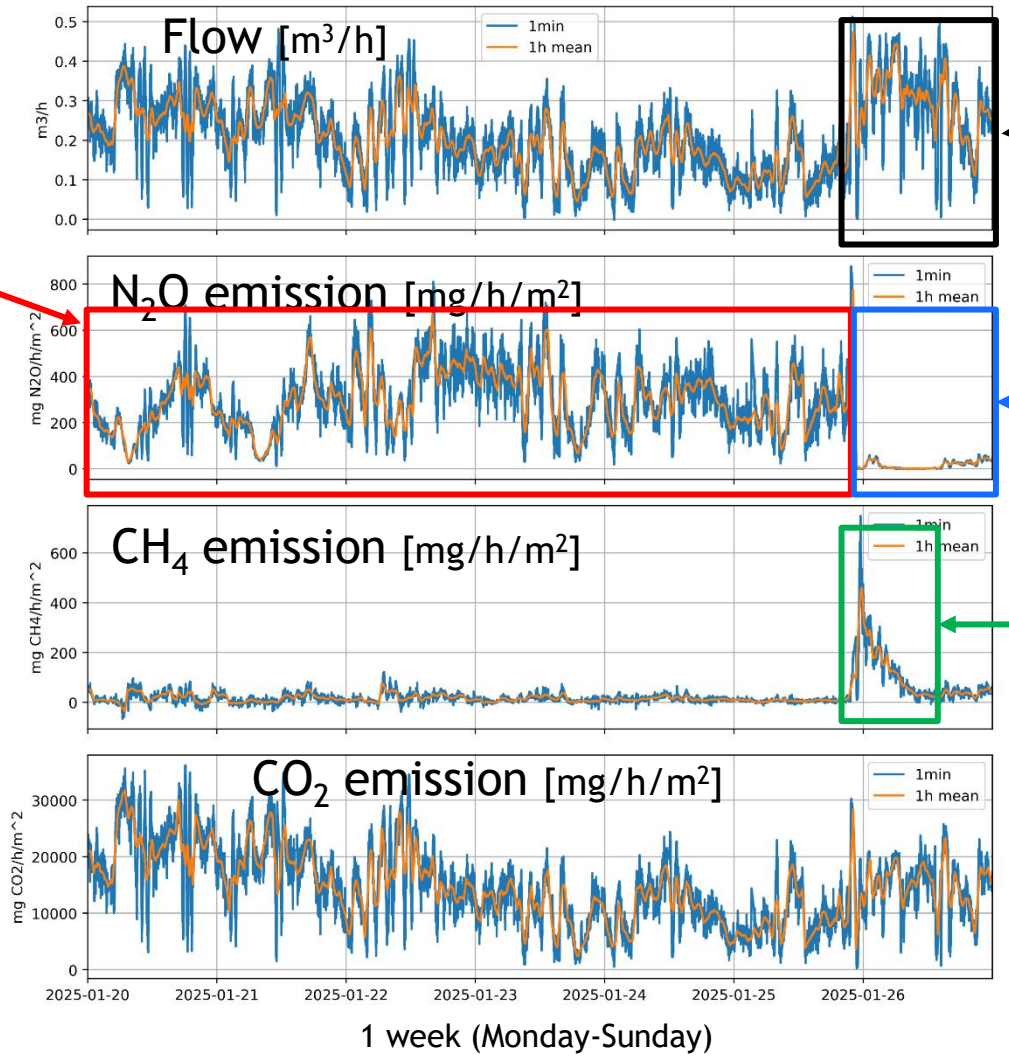
# Accumulated $CO_2$ Equivalent with GWP (according IPCC AR5, 100 years)

- **GWP comparison of emissions:**
  - $CO_2$: 1
  - $N_2O$: 265 times more potent
  - $CH_4$: 28 times more potent
- $CO_2$ emissions are considered climate neutral as they originate from organic sources



# Example High Variability Between Emission Events

Long period of high $N_2O$ Emissions




Slightly increased gas flow

Sudden drop to low $N_2O$ emission

$CH_4$ emissions event during low $N_2O$ emissions

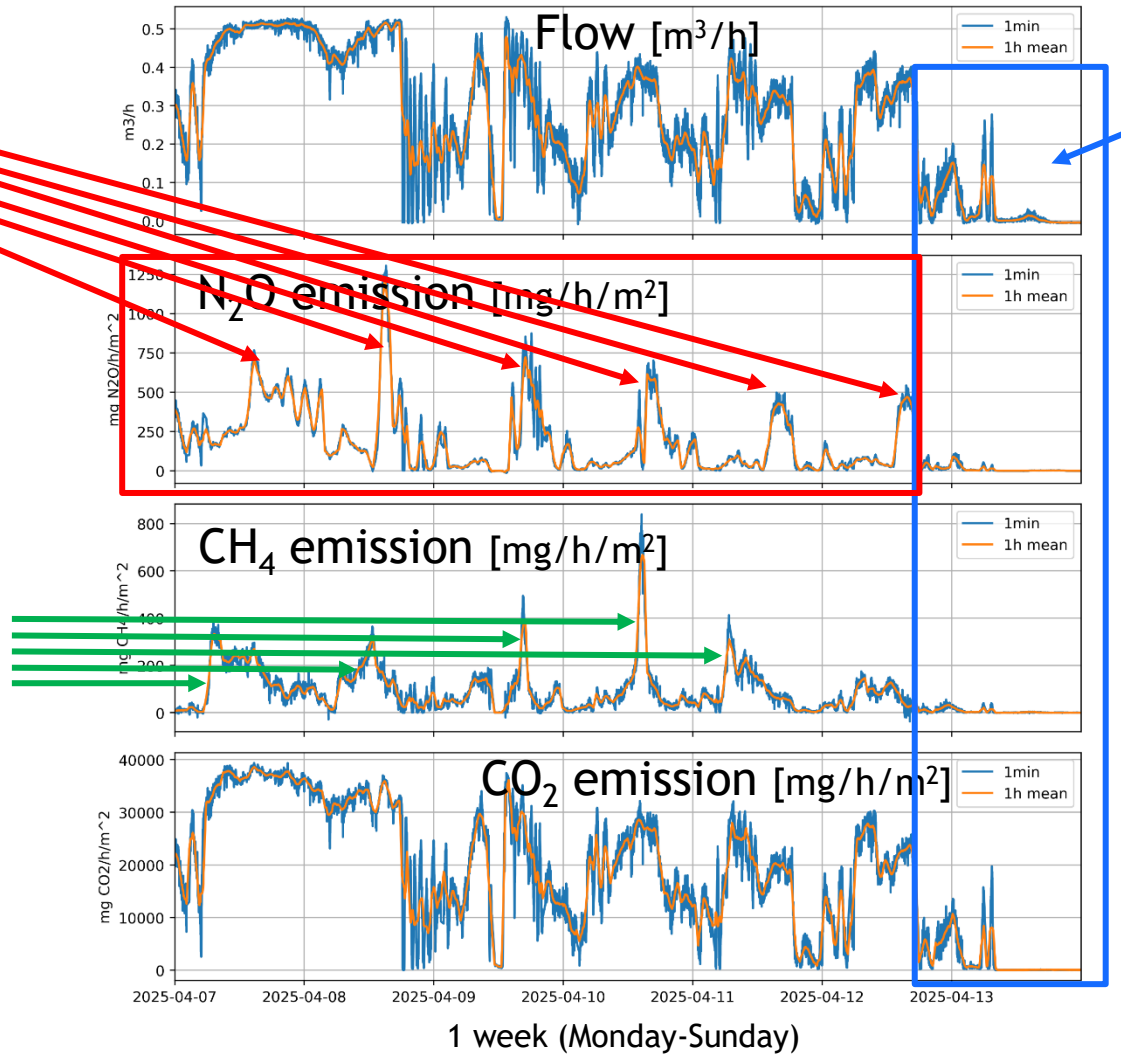
No large change in $CO_2$

Several days of low $N_2O$ emission followed

# Example Periodic high Emission Events

Daily high emission periods

$CH_4$ emission periods before / in between $N_2O$ emission periods

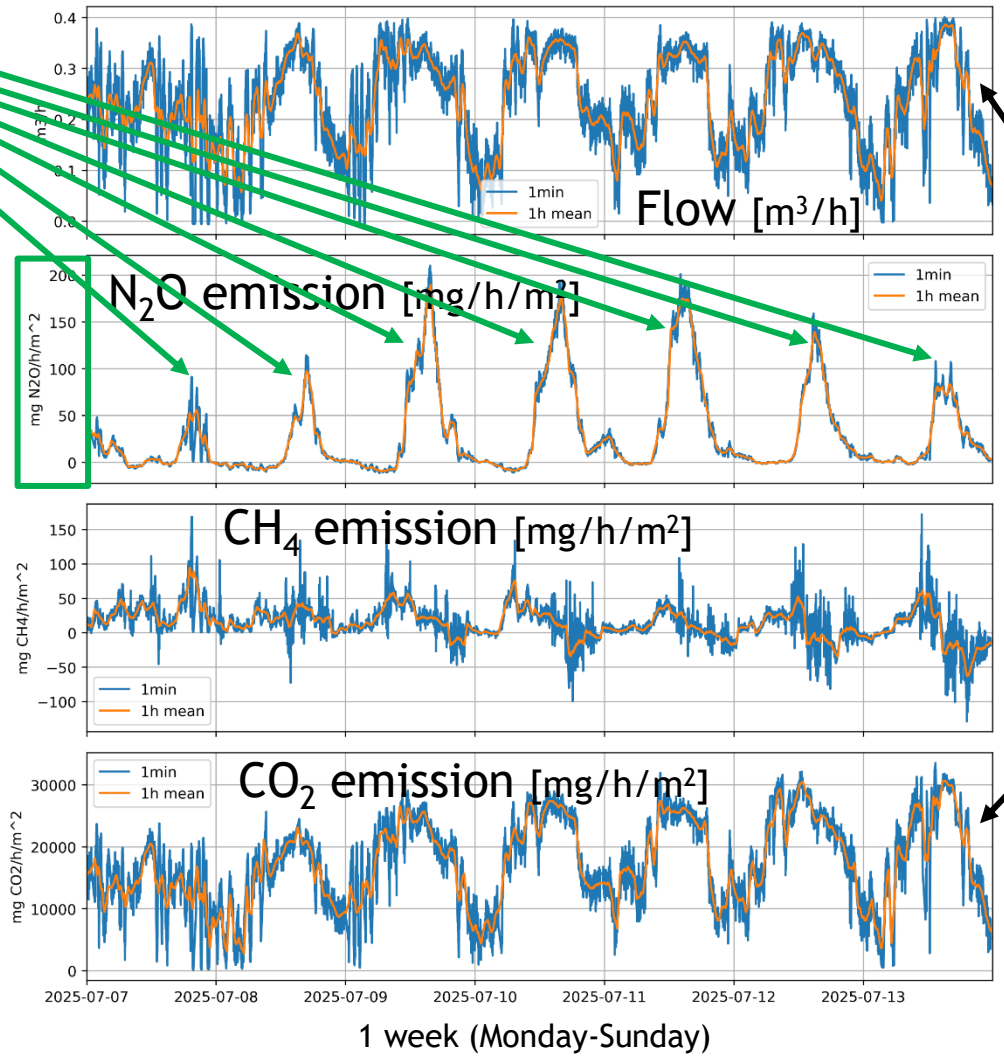



Low Gas flow
→ Low emissions

# Example Characteristic Diurnal Cycle

Characteristic diurnal cycle with peak in the afternoon

At medium concentration




Partial correlation of increased emission in $CO_2$ with higher flow

# Summary

- The WGA measuring device reliably conducted continuous measurements over one year
- Measured concentrations and emission flows for $N_2O$, $CH_4$, $CO_2$, and $O_2$
- Remote maintenance via GSM, no onsite maintenance required
- Data coverage greater than 99%
- Significant $N_2O$ emissions observed with high hourly variability
- Highest $N_2O$ emissions in winter through late spring (up to 1000 mg/h/m$^2$), lowest in autumn
- Emissions vary greatly day-to-day, with average daily peak around 16:00
- $CH_4$ emissions detected sporadically, showing inverse correlation to $N_2O$
- Data indicate long-term measurements at multiple points are necessary for reliable emission assessment

# Thank You