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Supplement of

Technical note: Pondi – a low-cost logger for long-term monitoring of methane, carbon dioxide, and nitrous oxide in aquatic and terrestrial systems

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S1. Supplementary information

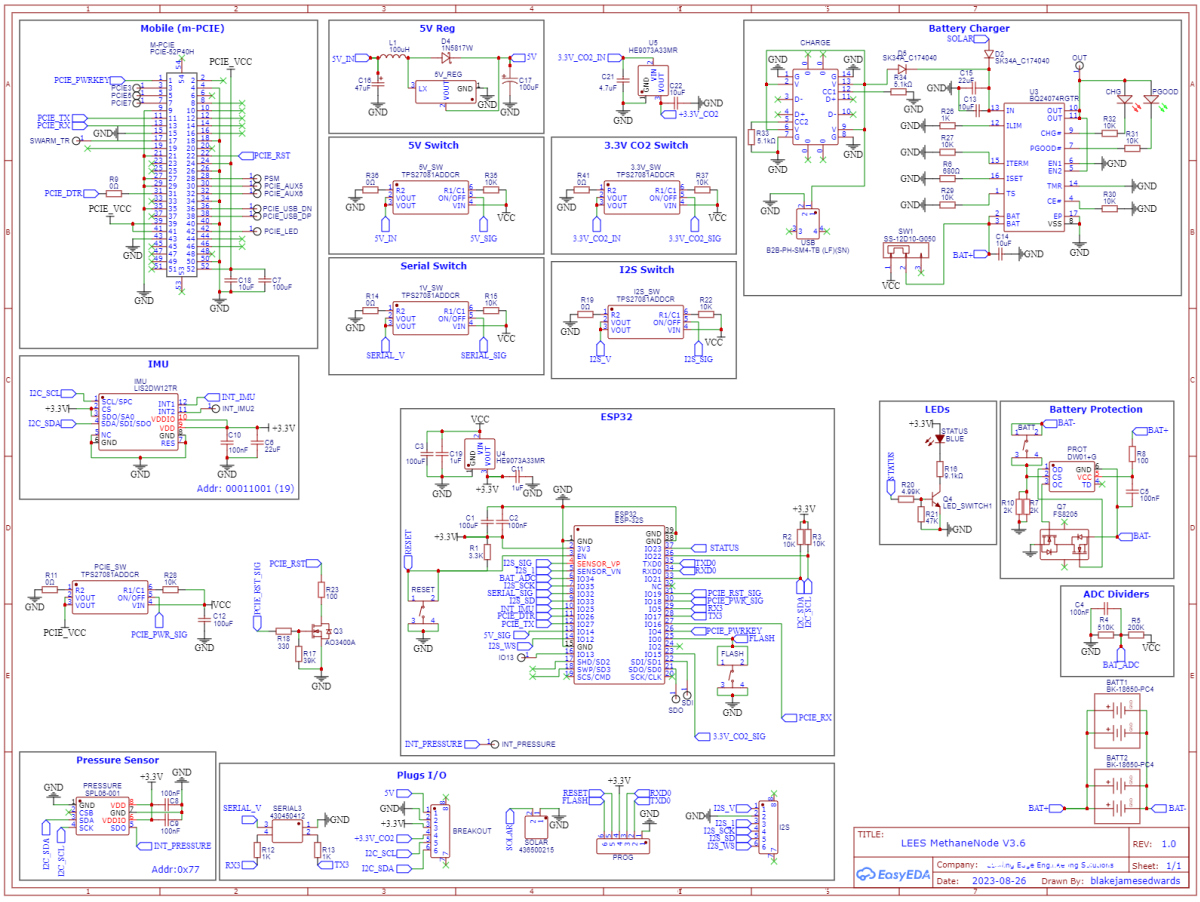


Figure S1: Electrical Schematic of the main *Pondi* PCB. To be used in conjunction with the Breakout PCB (see Fig. S2), connected via the 6-pin 'BREAKOUT' socket shown here.

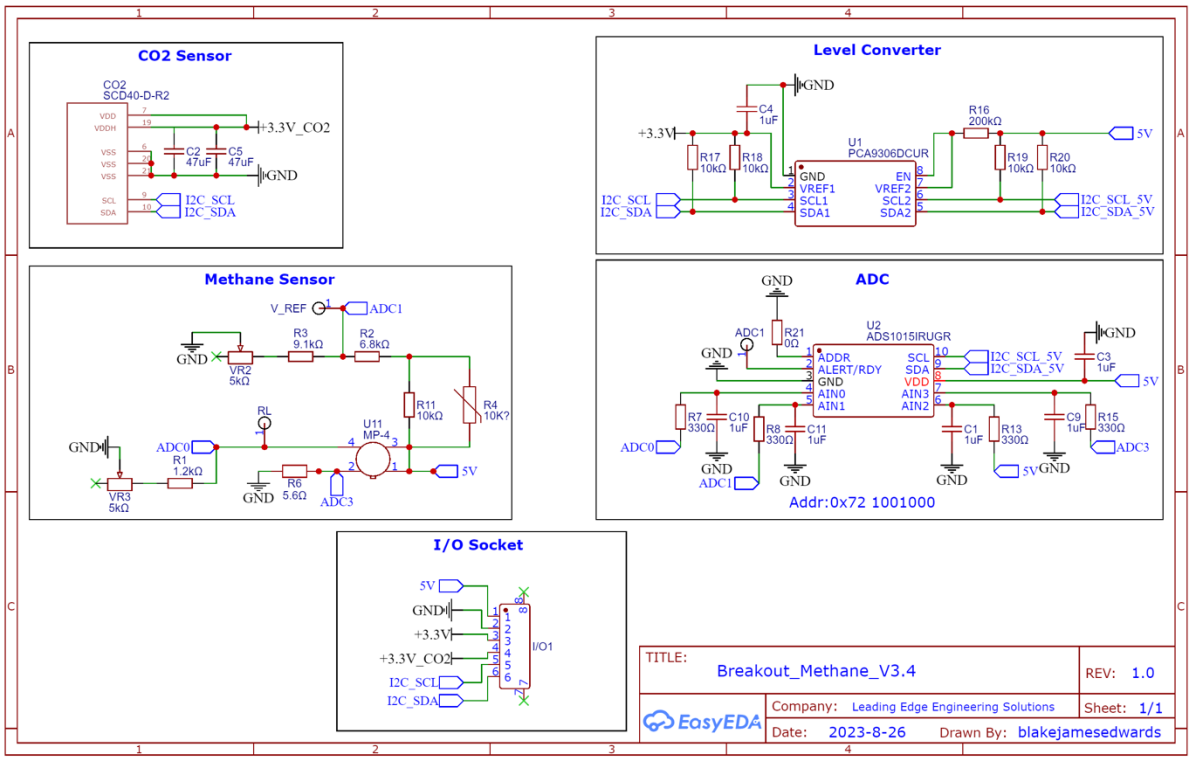


Figure S2: Electrical Schematic of the Breakout PCB located inside the chamber space.

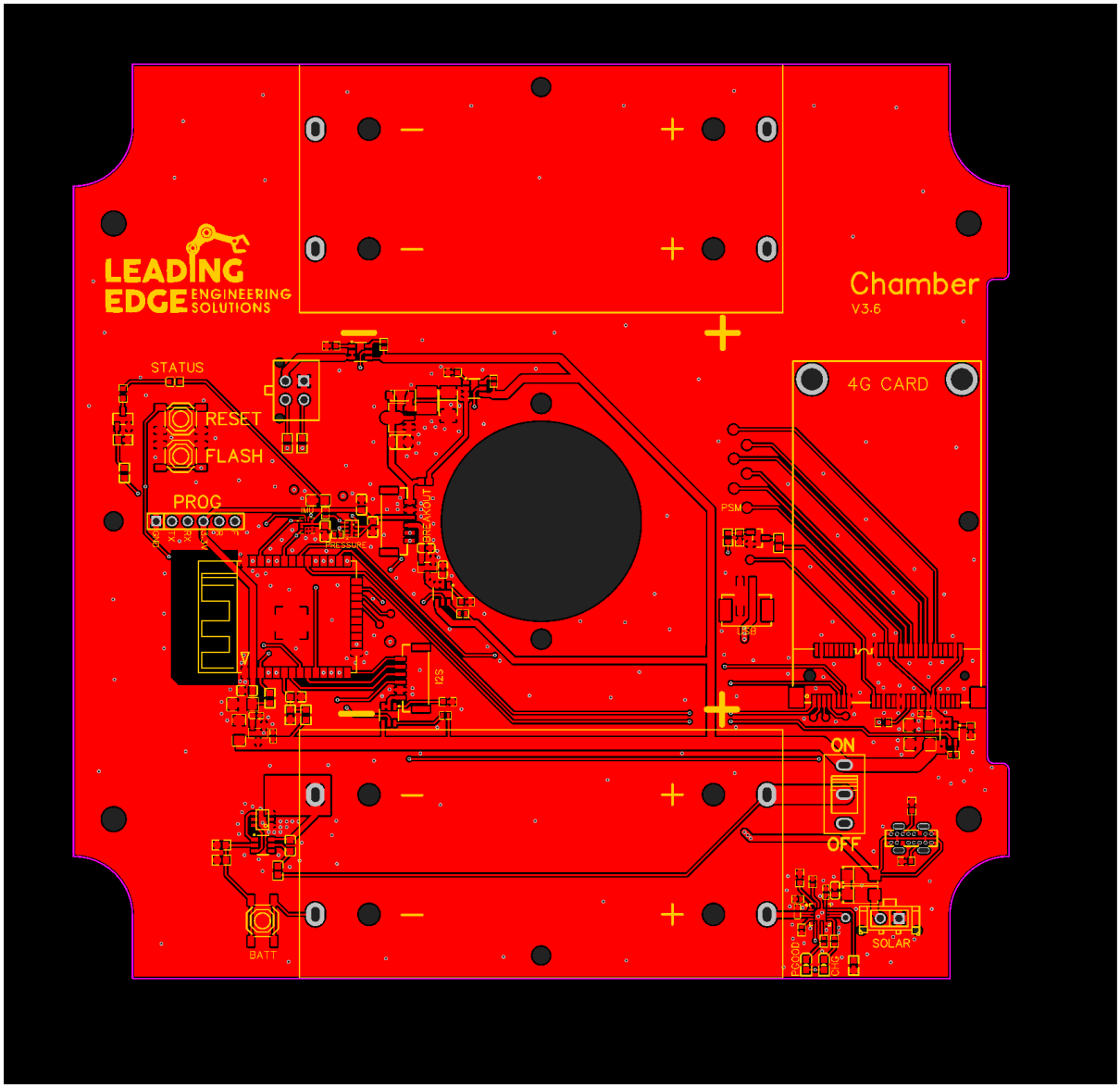
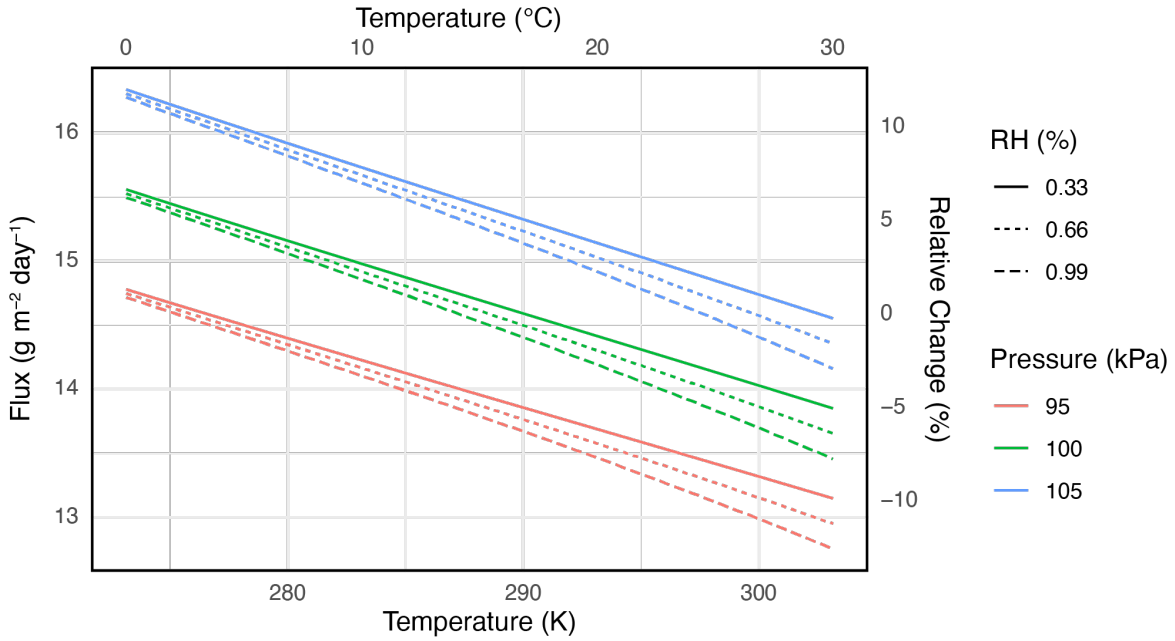


Figure S3: Top view of the custom *Pondi* PCB. All components are mounted on this top surface only. Gerber files for the PCB are available upon request.



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19 **Figure S4:** Sensitivity of gas flux estimates (F_g) to changes in temperature (T), atmospheric pressure (P), and
20 relative humidity (RH). Fluxes were calculated using Equation 1, with all variables held constant except for the
21 one being tested. We simulated a 30 °C change in temperature, a ±5 kPa change in atmospheric pressure, and a
22 shift in relative humidity from 33% to 99%. Results show that increasing temperature or decreasing pressure leads
23 to higher flux estimates, while increasing relative humidity slightly reduces fluxes.

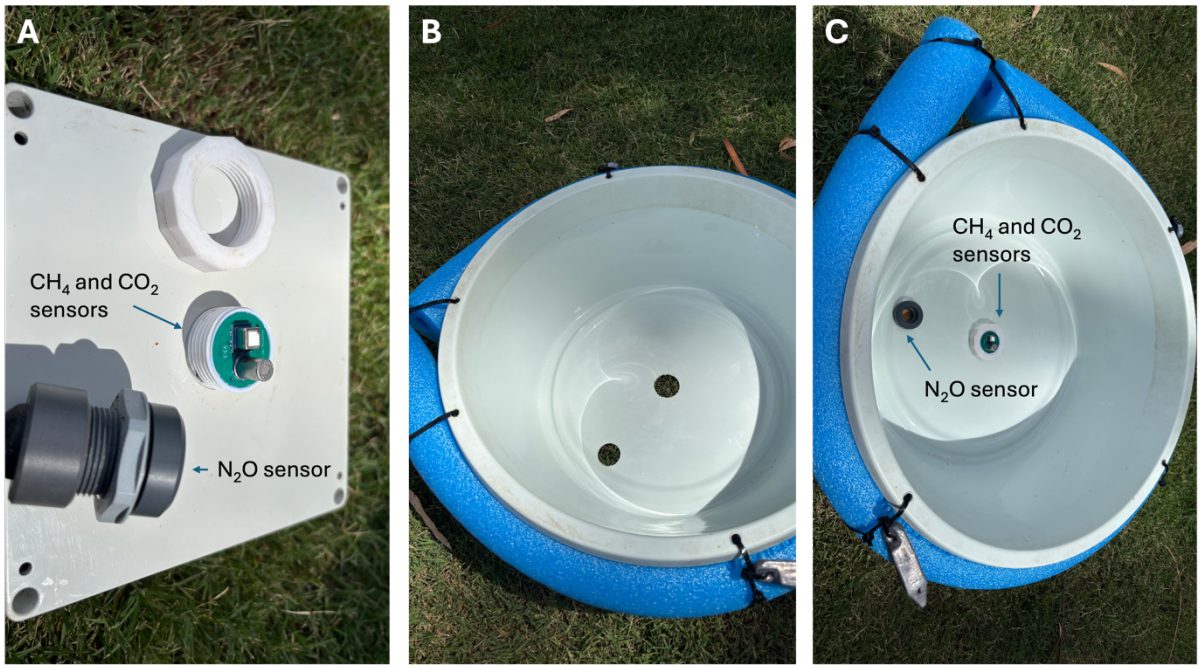

Figure S5: Sealing the *Pondi* to the plastic chamber. (A) The threaded connections of the *Pondi*, showing the CH_4 and CO_2 sensors secured with a plastic screw and O-ring, and the N_2O sensor with its dedicated threaded housing for a leak-proof connection. (B) The plastic chamber with pre-drilled holes designed to align with the positions of the sensors. (C) The *Pondi* installed on the plastic chamber, demonstrating the fully sealed setup with both the CH_4 and CO_2 sensors and the N_2O sensor properly secured to prevent gas leakage during flux measurements. The floating design with foam and weights ensures stability during aquatic deployments.

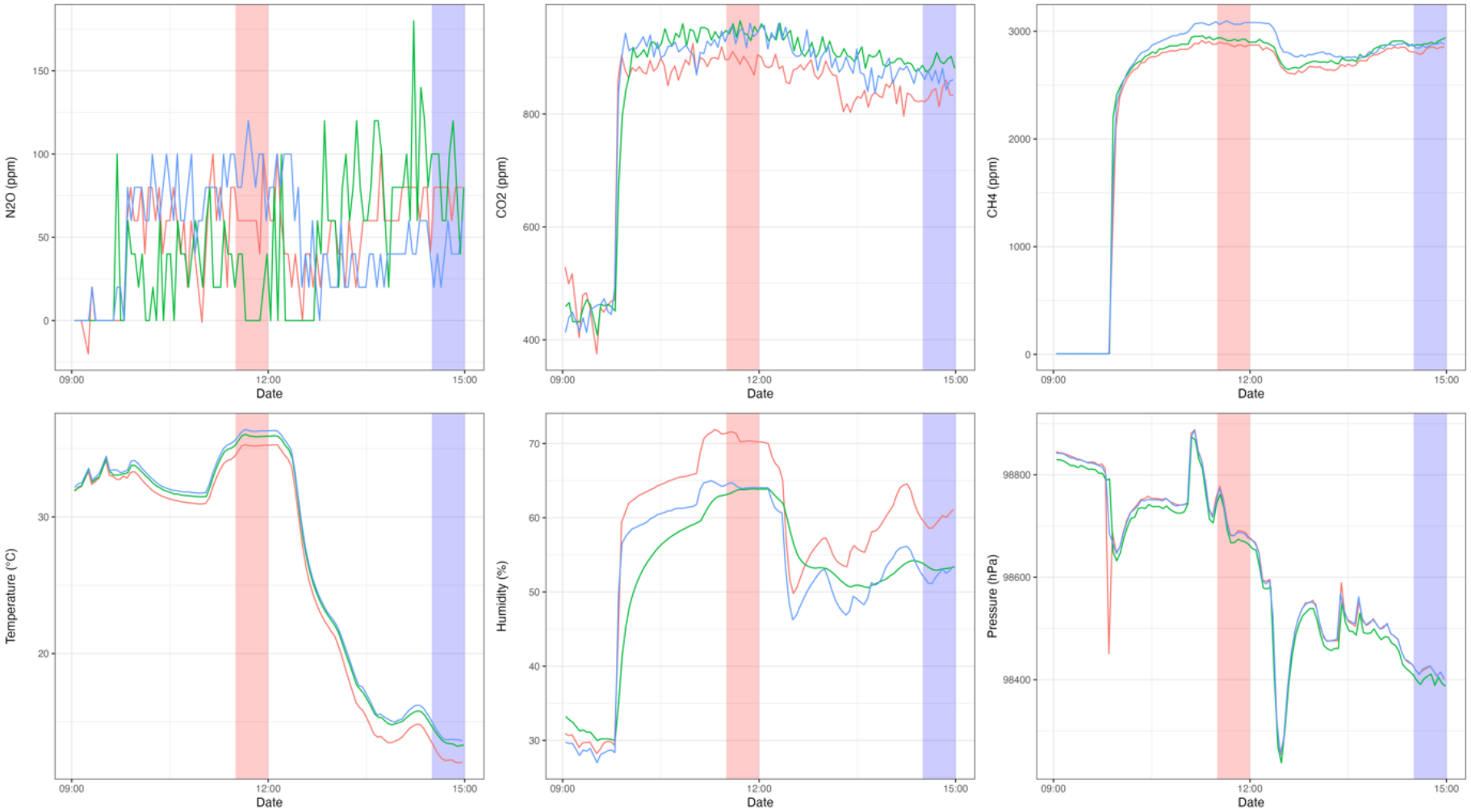

Figure S6: Impact of environmental conditions on gas sensor readings as three *Pondi* (coloured lines) transitioned from hot and humid (36°C, 75%) to cold and dry (15°C, 50%) conditions. Shaded areas indicate periods when the system reached equilibrium: red for hot and humid conditions, blue for cold and dry conditions. Refer to Figs. 4 and S7 for mean values and confidence intervals calculated from equilibrium data in these conditions.

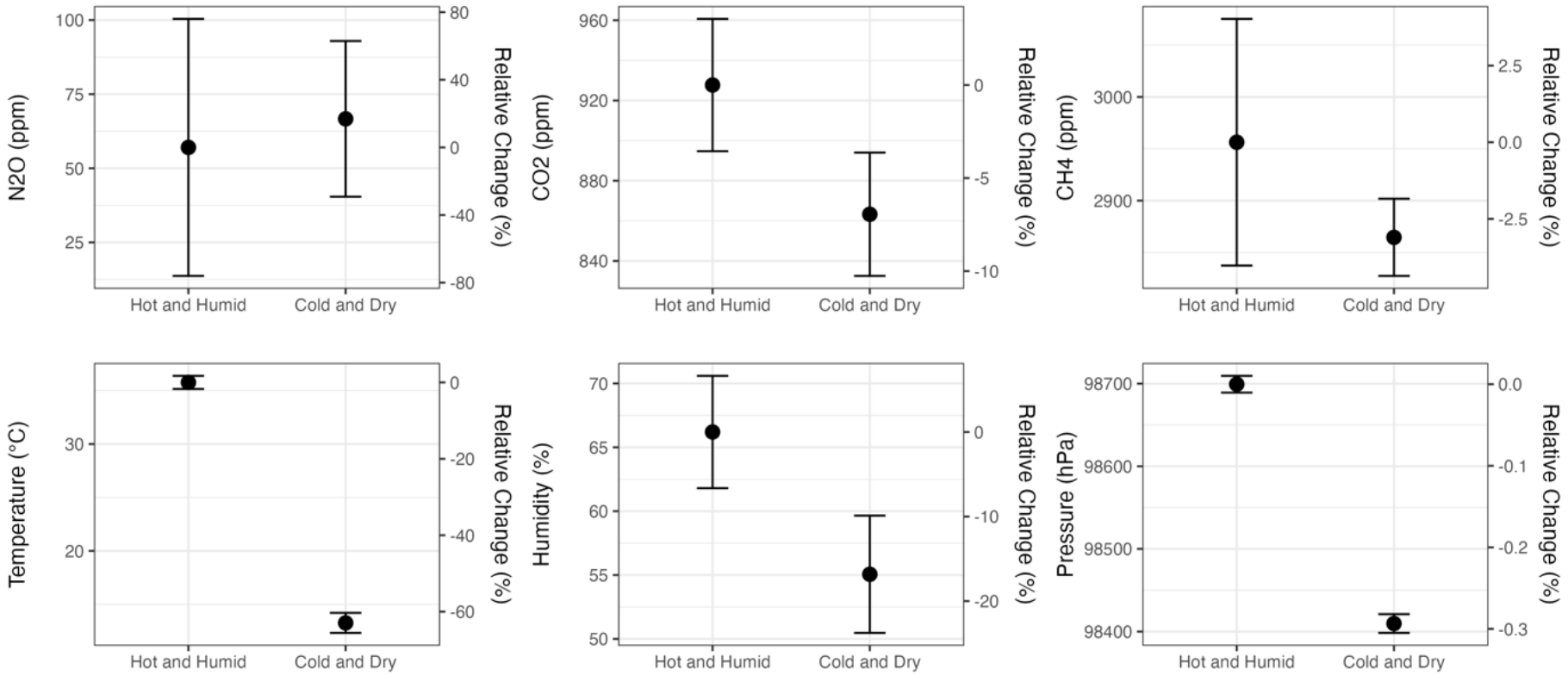

Figure S7: Impact of environmental conditions on gas sensor readings, comparing hot and humid conditions (36°C, 75%) with cold and dry conditions (15°C, 50% RH). Means and confidence intervals are based on data from three *Pondi* units after reaching equilibrium. Refer to Fig. S6 for a detailed time series of all measured parameters during the trial.

Table S1: List of the primary components used in the construction of the *Pondi*. It includes both core and optional parts. The approximate cost of the components for a *Pondi* is US$ 750 (or AU$ 1,166) and requires around six hours of specialised labour to assemble. "Component": Major subsystem or category of parts (e.g., Enclosure, Solar, Sensors). "Description": A brief explanation of the role of each component within the system. "Sub-Component": Specific item within the component group. "Units per Device": Number of units of that item required for the construction of one *Pondi* unit. "Manufacturer": The company or brand providing the component. Generic items indicate cases where the brand is unimportant. Custom-designed parts (e.g., 3D-printed sensor mounts) were produced by Leading Edge Engineering Solutions (LEES). Items marked as optional (e.g., N_2O sensor, external solar panel) can be omitted to reduce cost or power demand, depending on deployment context.

Component	Description	Sub-Component	Units per Device	Manufacturer
Enclosure & Mounting	Protects the internal electronics and sensors from environmental exposure. Provides a secure housing and mechanical structure for field deployment, including mounting points for floating or terrestrial use.	Enclosure	1	Hammond Manufacturing, 1555RGY
		Vent	1	Amphenol LTW, VENT-PS1YGY-O8001
		Chamber	1	Ezy Storage, 16L Round basin
		Pool Noodle	1	Generic item
		Zip ties	7	Generic item
		Label - waterproof sticker	1	Generic item
		Foam seal - Enclosure to PCB (internal)	1	LEES custom design
		Foam seal - Enclosure to chamber (External)	1	LEES custom design
		USB-C panel mount waterproof socket & cap	1	Waterproof IP68 Type C Female to Male PFC Flat Cable 10cm
Solar	Onboard solar module that recharges the system's battery, enabling long-term autonomous operation without the need for	Panel	1	First Solar, 5V 150mA
		Panel adhesive sealant	1	Generic item
		Micro-Fit 2 Pin Plug	1	Molex, 0436450200

	external power sources.			
Solar - External (optional)	An optional, larger solar panel for use in shaded environments or when higher energy capacity is needed (e.g., powering active ventilation or telemetry in low-light areas).	External Panel	1	Voltaic Systems P126
		External Panel - USB C plug	1	LEES custom design
		External Panel - Bracket, 1mm aluminium	1	LEES custom design
		External Panel - Double-sided tape	1	LEES custom design
		External Panel - 6mm heat shrink double wall	1	LEES custom design
PCBs & Components	Core electronics, including custom-assembled circuit boards, microcontrollers, data storage, and power management systems that run *Pondi*'s operations, read sensors, and handle logging or telemetry.	PCB - Main	1	LEES custom design
		PCB - Breakout	1	LEES custom design
		PCB - Antenna	1	LEES custom design
		u.Fl cable	2	TE Connectivity AMP Connectors, 2410329-2
		Battery holders 18650	2	Generic item
		Battery cells	4	INR18650B
		BG96 mPCI-e	1	Quectel, BG96
		mPCie Standoffs	2	Wurth Elektronik, 9774015151R
		SIM card (cost of each card before data charges)	1	Generic item
		Micro-Fit 2 Pin Socket	1	Generic item
		6-pin sensor cable to breakout PCB	1	INR18650B
Other Sensors	Sensors to measure CO_2, CH_4, temperature, and humidity, critical for calculating gas fluxes.	Methane (CH4)	1	Figaro TGS2611-E00
		Carbon Dioxide (CO2)	1	Sensirion AG, SCD40-D-R2
Fasteners		M2.5x4 (mPCIe)	2	Generic item

	Includes bolts, nuts, and screws required to assemble the chamber, secure electronics, and mount components within the enclosure.	M3x6	4	Generic item
		M3x12	2	Generic item
Printed Parts	3D-printed or custom-fabricated parts used to hold sensors, guide airflow, or support other mechanical and structural elements of the system.	Stem	1	LEES custom design
		nut	1	LEES custom design
		Battery holders	2	LEES custom design
		Antenna mount	1	LEES custom design
Other Consumables	Miscellaneous materials needed for assembly and maintenance, such as adhesives, sealants, tubing, or cable ties, that ensure secure, leak-proof operation.	Micro-Fit Pins		Generic item
		Filament - ABS (kg)		Generic item
		Conformal coating		Generic item
N_2O (optional)	Optional N_2O sensor and associated components for measuring nitrous oxide fluxes. May be excluded to reduce cost or power demand if only CH_4 and CO_2 are of interest.	N2O Sensor	1	Dynament Platinum P/N2OP/NC/4/P
		N2O - PCB	1	Dynament
		N2O - Panel mount	1	Dynament
		N2O - Cable	1	4-core flexible cable
		N2O - 4pin molex plug	1	Molex, 0430250400
		N2O - Gland	1	12mm cable gland
		N2O - Silicon mix	1	MG Chemicals Black Flexible Epoxy
		N2O - Petrolium jelly		Generic item
		Printed mold	2	LEES custom design

Active Venting (optional)	An add-on module that includes a small pump and microcontroller for periodically flushing the chamber with ambient air to reset internal gas concentrations between measurements.	Pump	1	Adafruit Industries LLC, 4700
		Solenoid	1	DFRobot, DFR0866
		Control PCB	1	LEES custom design
		Printed frame	1	LEES custom design
		Tubing	1	Generic item
		Gland	1	12mm cable gland
		Vent	1	12mm mesh vent
		Vent O-ring	1	Generic item