PRI-8800 Automatic Varying Temperature Incubations and Continuous Soil Respiration Measurement System

A reliable and accurate estimate of the temperature sensitivity (Q_{10}) of Soil Organic Matter (SOM) decomposition is essential for predicting the feedback between the global carbon cycle and climate change. Traditional methods for estimating Q_{10} include the **C**onstant Temperature Incubation and **D**iscontinuous **M**easurements (**CDM**) mode and the **V**arying Temperature Incubation and **D**iscontinuous Measurements (**VDM**) mode. Robinson (2017) indicates that using more than 20 temperature points can provide a more precise Q_{10} estimate. Currently, no suitable instruments are available for this specific application. By integrating the rapid **V**arying Temperature Incubation and **C**ontinuous **M**easurement (**VCM**) mode, the patented PRI-8800 offers a novel approach to Q_{10} estimation. The VCM mode eliminates the underestimation errors associated with both the CDM and VDM modes, provides a more accurate and quicker estimate of the temperature response of SOM decomposition, and is suitable for large-scale Q_{10} assessments.

Introducing the PRI-8800, a ground-breaking solution for continuous soil respiration measurements. This innovative system combines laboratory incubations for disturbed and undisturbed soils at different temperatures. It seamlessly integrates with various greenhouse gas (GHG) and isotope analyzers. Specially designed soil sample bottles allow the loading of both disturbed and undisturbed soils. The optimized temperature threshold provides a significant advantage for conducting soil freeze-thaw experiments.

Key Features

- Varying temperature incubations and continuous measurements
- Excellent compatibility and extensibility with various analyzers
- Automatic temperature control (-15 to 60℃)
- The temperature fluctuation is better than 0.05℃

- Pre-treatment to eliminate the effect of the initial high concentration
- Inherent channels for isotope and concentration calibration

Specifications

Parameter	PRI-8800	PRI-8800 PLUS
Sample Bottle	50 mm D x 80 mm H 80 mm D x 200 mm H (Customizable within 200mm)	50 mm D x 80 mm H 80 mm D x 480 mm H (Customizable within 500mm)
Adapter Ring * (Options)	60 mm D x 35 mm H 90 mm D x 60 mm H	60 mm D x 60 mm H 90 mm D x 60 mm H
Heating Rate Cooling Rate (5-30℃)	1℃ / min	1℃ / 6 min
Dimensions of Water Bath (Inside)	460 mm W × 460 mm D × 260 mm H	460 mm W × 460 mm D × 530 mm H

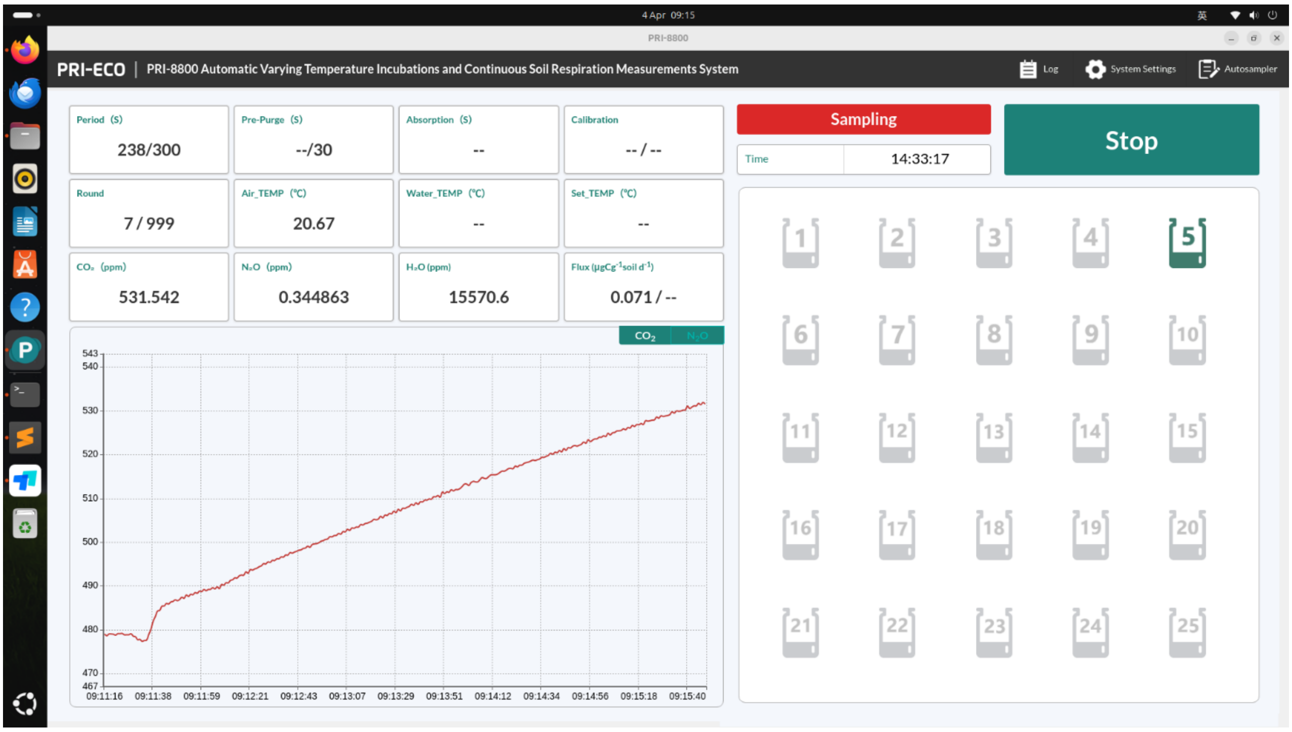
Parameter	Specifications
Tray Capacity	36 or 9 samples
Temperature Range	-15 to 60℃
Temperature Fluctuation	± 0.05℃
ACC Temperature	+ 40℃
Refrigerating Capacity @ 20℃ BT/20°C AT	2000 W (Standard), 400W (Option)
Autosampler Precision	0.02 mm
Air Temperature Precision	± 0.15℃
Pressure Precision	± 0.05%
Flow Rate	0.9 L/min
Gas Tube	1/8” Stainless or Teflon
System Response time	< 4 s
Calibration Channels	3
Power	100 ~ 240VAC，50/60 Hz， 1500 W(Heating); 1250 W (Cooling)
Dimensions	762 mm × 950 cm × 1700 mm

Specifications subject to change without notice.

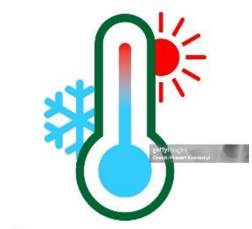
Configuration

The PRI-8800 includes a water bath with a refrigerator and heater system, an autosampler, a sample tray, and 36 sample bottles. It also features a standard CO_2 H_2O analyzer with a 2% CO_2 accuracy.

CE certificate

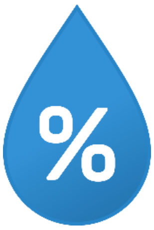


Experimental Design



1) Temperature Dependency Research: Temperature changes significantly affect soil respiration. Q_{10} studies are a key focus for many researchers. Robinson (2017) indicates that using more than 20 temperature points can provide a more precise Q_{10} estimate. This approach addresses the limitation of previous practices where researchers set only 3-5 temperature points (approximately 5-10°C apart) for respiration measurements. This recommendation resolves the issue of high similarity in fitting soil respiration to temperature changes due to fewer temperature gradients in traditional methods, thereby improving the accuracy of different theoretical models or subsequent model predictions.

The PRI-8800 program facilitates the efficient setup of 20 temperature points and measures soil respiration automatically, boosting researchers' productivity. It also allows for the simulation of daily, monthly, seasonal, or annual temperature variations, further streamlining the experimental process. Additionally, PRI-8800 supports both isothermal cultivation and the transition between isothermal and varying temperature conditions, increasing its versatility for various research needs.

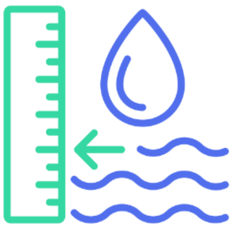


2) Moisture Dependency Research: Numerous studies have shown that, under constant temperature, Q_{10} is easily influenced by soil moisture levels, exhibiting certain moisture-dependent characteristics. PRI-8800 allows manual adjustment of soil moisture levels and, in its rapid continuous measurement mode, achieves precise soil respiration measurements under different moisture gradients. The logical design of PRI-8800 enables continuous, high-quality measurements of soil respiration under short-term, medium-term, and long-term humidity control conditions.

3) Substrate Dependency Research: The quality of the substrate is closely linked to the Q_{10}. Substrates include natural soils, characterized by factors such as carbon content, nitrogen content, the ratio of easily decomposable to recalcitrant carbon, soil clay content, pH, and salinity. Additionally, external substrates may consist of biomass carbon, microbial populations, various fertilizers, respiration promoters or inhibitors, and isotopic reagents. The rapid online varying temperature cultivation and measurement capabilities of PRI-8800 can expedite certain research processes and yield reliable outcomes. Examples include studies on soil respiration during soil improvement with biochar, the ongoing effects of slow-release fertilizers at various stages on soil respiration, and the response of soil respiration to different improvement measures in saline-alkali soils.

4) Biological Dependency Research: Soil respiration is primarily composed of soil microbial respiration (over 90%) and respiration from soil fauna (1-10%). The soil microbial community significantly influences Q_{10}. It is essential to understand how microbial populations and their quantities change before and after cultivation and the corresponding shifts in soil respiration rates in response to temperature. Additionally, introducing external microbial populations may aid scientists in gaining a better understanding of how biological dependencies affect Q_{10} in soil.

5) **imulation of the Freeze-Thaw Process of Undisturbed Soil:** Climate change has altered the frequency and intensity of soil dry-wet and freeze-thaw cycles. These fluctuations impact soil microbial activities, namely soil water utilization efficiency. While these changes have slightly affected the structure of soil microorganisms, it remains unclear whether a single climate fluctuation, such as the alternation between dry and wet conditions, influences responses to another climate factor, such as freeze-thaw cycles, and how this, in turn, affects greenhouse gas emissions. By conducting a freeze-thaw simulation using PRI-8800 Plus, we aim to obtain clear answers to these questions.



6) **Simulation of Wetland Inundation Depth:** On a global scale, the sensitivity of wetland methane (CH_4) emissions to temperature largely depends on fluctuations in water table levels. In contrast, the sensitivity of carbon dioxide (CO_2) emissions to temperature is not influenced by water levels. How do varying water levels and temperature changes in different wetland ecosystems impact and regulate greenhouse gas emissions from wetlands? Additionally, what methods can we use to quantify wetland greenhouse gas emissions under different water levels and temperature variations? By using the PRI-8800 Plus and conducting controlled experiments focused on water depth and temperature changes, we can explore these relationships more effectively.

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