

Extreme monitoring in the Arctic with the LSI LASTEM weather station



In the field of **environmental research**, meteorological and greenhouse gas monitoring is critical to understanding global climate change. Recently, LSI LASTEM provided a **complex monitoring station that integrates greenhouse gas measurements with meteorological data to the CNR Institute of Geosciences and Georisources** for an ambitious research **project** on these issues, **to be installed at the CNR research base in the Svalbard Islands, just 1,300 km from the North Pole**. The project, called Winter-CZ (Winter Critical Zone), is funded by the Program for Research in the Arctic (PRA) INFRA (Research Infrastructure) 2021. This article explores the goals and modalities of the project, emphasizing the importance of **monitoring** in an **environment** of such **extreme conditions**.

Project objectives

- **Measurement of greenhouse gas flows**

The aim of the project is to measure **carbon dioxide emissions** in the months when the tundra is covered by snowpack. Winter emissions are small, but not negligible, and must be taken into consideration for a correct balance of

natural CO₂ fluxes, which is essential for correctly predicting the effects of climate change. The flow data, combined with meteorological variables and information on microbial processes in the soil, will be used to develop mathematical models to interpret the observed processes. Furthermore, the new measurement station enriches and complements the long-term observation infrastructures already present and integrates LSI LASTEM components with specific third-party sensors (e.g. for the measurement of CO₂ concentrations).

- **Weather monitoring**

The project also involves the measurement of **meteoclimatic variables**, necessary for the implementation of the model that interprets CO₂ emissions.

- **Data sharing**

The **data** collected will be made **available** through the **Italian Arctic Data portal** (IADC) and the **virtual laboratories** of the **PNRR Itineris project**. This will allow researchers from all over the world to use, compare and process the data collected in synergy with other sources, with a view to “Open Science” practices.

Installation and preliminary testing of the weather station

Before installation on the Svalbard Islands, the **weather station** was **tested** at the Botanical Garden of the University of Modena on the slopes of **Monte Cimone**, the largest relief in the northern Apennines and the Emilia-Romagna region. These preliminary tests made it possible to **evaluate** the **reliability** of the instrumentation. During a month of testing at the Esperia gardens, at around

1500 meters above sea level, valuable data was collected which will guide the next phase of the project.

Advanced Instrumentation

The weather station is equipped with two main units:

- **First unit:** dedicated to carbon dioxide detection, it is equipped with dedicated sensors to measure the concentration of CO₂ at various heights. In addition, it is equipped with temperature sensors, which make it possible to correlate temperature with CO₂ concentrations. Finally, the water and oxygen content of the soil is measured. This data is important for correlating CO₂ fluxes with moisture values in the Arctic soil.
- **Second unit:** equipped with a snow gauge to measure the height of the snowpack and an anemometer to measure the wind. In addition, a thermo-hygrometer measures air temperature and humidity, providing a complete picture of weather conditions.

Data collection and transmission

Data collection is handled by LSI LASTEM's **Alpha Log** data logger, which sends the acquired data every ten minutes via an Ethernet cable. The data is sent to an FTP server managed by IGG-CNR, from where it can then be collected, processed and shared.

Installation in Svalbard Islands

After the success of the preliminary tests, the weather station was transferred to the international research base in Ny Ålesund, where the CNR operates the "Dirigibile Italia" research base. In July, the IGG-CNR team will begin the

on-site testing procedures preparatory to the final installation, scheduled for August.



Photos taken by Dr. Giamberini Mariasilvia

Impact and future prospects

This project represents a significant step in measuring winter CO₂ fluxes from the Arctic tundra. The data collected will provide **essential information to understand the effect of climate change on the natural carbon balance** and the role of Arctic environments in the global greenhouse gas balance. The IGG-CNR's hope is that this information will guide future climate change mitigation strategies.