AppNotes:
A meteorological station inside a cave for CO2 monitoring

Motivation

Karstic origin caves are very heterogeneous environments with complex hydrological and atmospheric processes. Water plays a crucial role braking the limestone base, eroding cracks and transporting CO2 that after crystallization form the well know structures of this kind of caves. The main source of CO2 in this environments is related with the interacting of water and organic matter present in soil, therefore, the concentration of CO2 vary spatially and temporally inside the cave.

From a thermal point of view, caves are also complex environments. Temperature is fairly constant inside but also suffers of certain fluctuations related with fluctuations in the outside. The analysis of the dynamic relationships between these two can give climatic signal very valuable.

Rain is an excellent indicator of climate variability. Rainfall monitoring outside the cave along with drops measurements inside the cave might also give valuable information about the climate fluctuations occurred in the past and fixed in the cave through its formations.

Objective

The objective of this project was to obtain reliable measurements of rain, temperature and relative humidity outside a karstic cave. Along with this outside regular meteorological station it was necessary to measure temperature, humidity and CO2 concentrations inside the cave.

Case Study Summary

Services:

Location:

Cuevas del Águila, Ávila, Spain.

Products Used:

Multi-parametric Vaisala probe WXT520, Vaisala HMP155 Temerature and Relative Humidity probe, Vaisala GMP343 CO2 probe, CR1000 Campbell Scientific Datalogger

Measured Parameters:

Precipitation, air temperature, relative humidity and CO2 concentrations.

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Methodology

The **outer station** was instrumented with a multi-parametric Vaisala probe WXT520 which is a compact, reliable sensor with reasonable price appropriate for a very visited area with some risk of vandalism. Communications were solved with GPRS as gateway using dynamic IP and our own DNS.

"The extremely humid environment of the cave was a challenge we had to overcome in order to have reliable measurements"

Inside the cave, the sitting criteria consisted in:

- Maximum representativity: well mixed CO2 concentrations, away from micro-atmospheres and interferences (like humans visiting the cave)
- Minimum visual impact: hiding cables, probes, cabinets since the cave is regularly visited, minimum civil work
- Minimum risks for personnel in installation and maintenance operations

For a portable solution datalogger and SAI were integrated inside a rugged suitcase with wheels. Campbell Scientific CR1000 was connected to a Vaisala GMP343 CO2 probe, using RS232 protocol for communications since logger and probe were some meters distant. For temperature and humidity we used a Vaisala HMP155.
For powering the unit we prepared a UPS using gel batteries and a Victron charger, since we had reliable 220VA power.

"Working in caves, with their slippery, sharp but delicate structures and surfaces requires a good training on labour security and environmental consciousness."

Results

The whole system, outside and inside the cave monitoring stations, have been running without problems for years. It is soon yet for the client to come with scientific conclusions, but it will surely help in the knowledge of the dynamics of CO2 in caves and in the understanding of climate.

Thanks to our excellent trajectory with projects like this and good procedures , professional competences and environmental commitment, interMET has accreditation on **ISO 14001:2004** for the activity: **"Design, installation and management of meteorological and environmental networks"**.

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