

**The CAVEMONITOR International Workshop**  
**Microclimatic, biologic and radiation monitoring of caves**  
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**Analysis of high resolution and long time series for cave  
management: examples from French caves**

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Caves are complex systems where outside climate, surrounding karst environment, human activity and equipment interact. Most of the variations in time and space of underground physical and chemical parameters are tiny and cannot be resolved with our senses resulting a strong but often false feeling of stability and robustness. The help of measurement technology enhance the naturalistic observation by providing high resolution and quantitative data able to characterize cave microclimates. Data treatment and time series analysis generate pertinent information to modeling cave functioning. Cave monitoring is therefore considered as a prerequisite for an adequate evaluation and control in most operation that impact the natural system. We give examples of use of this information for reasonable cave management.

Present day temperature sensors provide high resolution, accurate and stable data. Formerly considered as a noise, fine temperature variations contain valuable information that characterize thermal exchange at the air rock interface and cave confinement properties. Examples of applications are given from Chauvet-Ornac, Bruniquel, Gargas caves. In Esparros, temperature data allowed to assess the effect of the light system. Long time series of temperature were also used for evaluation of conservation properties and control of remediation operation as shown in the Pech Merle and Gargas prehistoric caves.

Due to climate change, underground situations may turn problematic for some show caves. The CO<sub>2</sub> content of air in l'Aven d'Ornac increased to the 3% Vol. health threshold limit. The knowledge cave aerology and surface gaz fluxes allowed enhancing cave ventilation while preserving hydro-thermal balance and natural air flow pattern.

Radon activity in underground atmospheres is used as an environmental marker and helps to identify confined and open zones in cave and the successive ventilation regimes. But radon progeny exposure can be harmful for cave workers and radon survey is developed to assess its health impact.