"Long term trends observed in temperature, pCO_2 and drip water isotopes from several south-France caves - Natural and anthropogenic causes"

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Cave air temperatures are not so quiet. Provided they are measured at a high resolution and over a long period, they display all kinds of variations on time scales from minutes for air-pressure constrains to years for heat wave transfer and aerology interface modification. Morphology, entrance orientations, depths, aerology combined with external climate, vegetation changes and human activity may explain the observed variations. We present monitoring data from eight French caves, some of which started twenty years ago (1996 AD): Villars, Chauvet, Orgnac, Niaux, Marsoulas, Esparros, Pech-Merle, Gargas. Long term temperature trends are tentatively explained using the external climatic signal: while most of the studied caves show a multi-annual temperature increase (i.e 0.05°C to 0.4°C/10yrs), some, on the contrary, display a great stability (< 0.1°C during 20 yrs). In a single cave, different temperature gradients can be found depending on the depth and average temperature differences for a multi-annual long period may be > 1°C. Superimposed to the temperature trends, there are long term changes in drip rates and drip water $\delta^{18}O$ that we try to explain using local precipitation amount and $\delta^{18}O$ recorded over long periods. We note a recent drip rate $\delta^{18}O$ increase trend in the Chauvet and Orgnac Caves (+0.15‰/yr since 2010). The most surprising is an abrupt +0.2‰ increase, after 15 years of great stability in the Villars drip $\delta^{18}O$ (σ<0.07‰) at three stations since April 2015. CO_2 concentrations variations also display long term changes (i.e. +0.5% for the last 8 yrs in Chauvet Cave) or, on the opposite, show a great stability during 20 years (i.e. in Esparros cave: ±0.2% for seasonal changes with no visible trend); they are interpreted with temperatures and other environmental factors variations. We conclude that at a multi-annual to a decadal scale, cave temperature and drip water $\delta^{18}O$ may change significantly, and, because we are able to measure these variations, it is possible to understand their causes thanks to long term monitoring of internal and external climatologic and environmental factors, which will be of help for the paleoclimatological interpretation of speleothems.