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Environmental influences on a network of low-cost CO_2 sensors

Yann Büchau, Uwe Putze, and Jens Bange
Eberhard Karls Universität Tübingen, Center for Applied Geoscience, Environmental Physics, Germany
(yann-georg.buechau@uni-tuebingen.de)

Low-cost sensor equipment has the great advantage of facilitating the deployment of larger sensor networks. However, the usual downside of such equipment compared to higher-grade sensors is a reduced absolute accuracy. Building on the existing carbon dioxide (CO_2) sensor prototype network introduced during the last EMS Annual Meeting 2017, the current progress update focusses on the quantification of environmental influences on the CO_2 sensors in use. The aim is to understand what level of sensor accuracy can be expected and how environmental influences on the CO_2 measurement - e.g. temperature, humidity, ventilation, etc. - can be accounted for.

To achieve this, the sensors are calibrated both under laboratory conditions with test gases and during field experiments alongside well-known high-quality reference sensors. The gathered insights are then used for a more in-depth examination of prominent phenomena observed during previous field studies in the experimental site. For example, under calm conditions CO_2 can accumulate near the surface, leading to high concentrations which can become hazardous for animals and humans.

The CO_2 concentrations in the Eyach valley (between Horb and Rottenburg, Northern Black Forest, Germany) have never been quantified scientifically before. There exist various other and also much larger areas with unquantified CO_2 outgassing in various regions across the globe. Thus the local contribution of natural CO_2 emission from geological sources to the atmospheric gas budget is unknown. Since CO_2 is a climate-active greenhouse gas that contributes to the climate change and furthermore can have severe impacts on health, its quantification is of biometeorological relevance.

The overall goal of the project is the construction of a sensor network to monitor the geological CO_2 emission into the lower atmosphere in the Eyach valley and the runoff into its surroundings. This involves the total amount of emitted CO_2 as well as the horizontal and vertical gas fluxes, including temporal (diurnal and seasonal) variations.

The network's modular setup permits easy extension by more or different sensors such as air temperature and air humidity sensors which by this time are part of the sensor units as well. All sensors used within the project are funded by the Alfred Teufel foundation. The measured data will be offered to the science community via a publicly available internet interface.

Eventually, in the project's second phase, the gathered data will be used for the initialisation and verification of a numerical dispersion model. Ultimately, the developed methods may be exported to other regions with geological CO_2 emissions.