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Monitoring of natural carbon dioxide emissions using a network of low-cost sensors

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The natural carbon dioxide (CO_2) emission of the Eyach valley (between Horb and Rottenburg, Northern Black Forest, Germany) is observed and analysed in the presented project. CO_2 can accumulate near the surface and become hazardous for animals and humans. Also, CO_2 is a climate-active greenhouse gas and contributes to the climate change.

The CO_2 concentrations in the Eyach valley have never been quantified with scientific methods. Similar and much larger areas with CO_2 mofettes exist in various regions of the world and are not quantified. Thus the contribution of natural CO_2 emission from geological sources to the atmospheric gas budget is unknown.

Goal of the project is the monitoring of the geological CO_2 emission into the lower atmosphere in the Eyach valley and its surrounding. The experimentally gathered data will be used to quantify the amount of emitted CO_2 and to specify the horizontal and the vertical gas fluxes, including temporal (diurnal and seasonal) variations.

In order to reach this goal, a network of low-cost sensors is deployed, supported by a reference station. The low costs of a single sensor allow for the deployment of a larger number of sensors. The network is intended to provide both data with horizontal resolution and (after integration) area-representative numbers, including high temporal resolution.

The usual disadvantage of low-cost equipment compared to high-grade sensors is a reduced absolute accuracy. Therefore, the sensor network will be regularly calibrated using test gases and a reference sensor to evaluate the reliability and long-term stability of the low-cost sensor modules.

In addition to the CO_2 measurement, the low-cost sensors will also be equipped with air temperature and air humidity sensors. Within the project, all sensors are funded by the Alfred Teufel foundation. Finally, the measured data will be added to a data base and offered to the science community via an internet interface.

The project is structured in two phases of three years duration each. Here only the first phase is presented, preliminary results of the field deployment are shown. During the second phase, the measured data are used for the initialisation and verification of a numerical dispersion model. Furthermore, the developed methods will be exported to other regions with geological CO_2 emission.