A Dense Sensor Network to Monitor Natural CO_2 Emissions

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The Starzach site in the Neckar valley in the Northern Black Forest in Germany is known for its natural emissions of carbon dioxide (CO_2). During the last century, the gas has been mined for the carbonization of mineral water. But as productivity declined, some extraction wells were sealed. Still, the site features broad diffuse as well as punctual CO_2 degassing in form of so-called mofettes. The CO_2 concentrations and the emissions into the lower atmosphere of the Neckar valley have never been quantified scientifically before. There exist many 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.

This project aims to monitor the CO_2 concentrations in the Neckar valley continuously and investigate the spatial and temporal variability. To account for the spatial heterogeneity of the CO_2 outgassing, a dense sensor network is needed. Deploying several dozen stations requires each station to be of reasonable cost. Currently, commercially available deployable and self-sustaining measurement systems for CO_2 are very expensive. So to facilitate a network with a 10-meter scale mesh size we developed a system that meets our requirements. The network's modular setup permits flexible sensor extension or spatial expansion. Eventually, a Campbell Scientific IRGASON eddy-covariance station supplements the network as a punctual high-precision reference. Live gathered data is offered to the science community via the publicly accessible OpenSenseMap.org measurement data platform.

In the project's second phase, gas transport simulations with a numerical dispersion model will be used to assess the actual CO_2 emissions into the lower atmosphere. Ultimately, the developed methods may be exported to other regions with geological CO_2 emissions. In this talk, the sensor network is introduced and first data insights are presented.