



Results from twelve years of continuous monitoring of the soil CO₂ flux at the Ketzin CO₂ storage pilot site, Germany

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Under the coordination of the GFZ German Research Centre for Geosciences the complete life-cycle of a geological storage site for CO₂ has been investigated and studied in detail over the past 12 years at Ketzin near Berlin, Germany. The test site is located at the southern flank of an anticlinal structure. Beginning with an exploration phase in 2004, drilling of the first three wells took place in 2007. From June 2008 to August 2013 about 67 kt of CO₂ were injected into Upper Triassic sandstones at a depth of 630 to 650 m overlain by more than 165 m of shaley cap rocks. A comprehensive operational and scientific monitoring program forms the central part of the Ketzin project targeting at the reservoir itself, its overburden or above-zone and the surface. The surface monitoring is done by continuous soil CO₂ flux measurements. These already started in 2005, more than three years prior to the injection phase using a survey chamber from LI-COR Inc. Twenty sampling locations were selected in the area of the anticline covering about 3 x 3 km. In order to obtain information on seasonal trends, measurements are performed at least once a month. The data set obtained prior to the injection serves as a basis for comparison with all further measurements during the injection and storage operations [Zimmer et al., 2010]. To refine the monitoring network, eight automatic, permanent soil CO₂ flux stations were additionally installed in 2011 in the direct vicinity of the boreholes. Using this system, the CO₂ soil flux is measured on an hourly basis. Over the whole monitoring time, soil temperature and moisture are recorded simultaneously and soil samples down to 70 cm depth were studied for their structure, carbon and nitrogen content. Over the whole monitoring time. Both, diurnal and seasonal flux variations can be detected and hence, provide a basis for interpretation of the measured data. Detailed analysis of the long-term monitoring at each station clearly reveals the influence of the soil composition. As most of the sampling positions are located next to agricultural roads and fields, the use of chemicals and harvesting may have an influence on the soil structure and the biology. Soil temperature, rain events and dry periods additionally affect the CO₂ flux. Moreover, the microbial controlled increased CO₂ production in early fall is also observed to depend on the actual location. Annual mean values of CO₂ fluxes range from 10 to 82 t ha⁻¹ a⁻¹. As the CO₂ flux measurements significantly reflect the specific site conditions, which can vary locally and over time, long-term trends must be carefully interpreted. Hence, complementary measurements of the soil gas composition were performed at selected locations.

Zimmer, M., Pilz, P., Erzinger, J. (2011): Long-term surface carbon dioxide flux monitoring at the Ketzin carbon dioxide storage test site. *Environmental Geosciences*, 18, 119-130, doi:10.1306/eg.11181010017.