Summary

Near-natural peatlands are generally stable carbon sinks. Over centuries, substantial amounts of carbon have accumulated at these sites. Today, a large fraction of the peatland in Baden-Württemberg is used for intensive agriculture. This is only possible by a massive intrusion into the water regime. The groundwater table has to be lowered significantly to enable economical efficient land management with heavy machinery. This process leads to an aeration of the peat body, which gets slowly degraded by microbes to carbon based greenhouse gases (GHGs), as CO_2 and CH_4, and released into the atmosphere. This transforms peatlands from GHG sinks to sources. This project aimed to improve the GHG inventory data base of Baden-Württemberg by closing data and knowledge gaps on carbon based GHG emissions from moors in agricultural use. Therefore, ten peatland sites, some in arable use and some grasslands, have been monitored for their CO_2 and CH_4 exchange from 2013 to 2016. The sites were located in the Upper Rhine Graben close to the village Graben-Neudorf, in Upper Swabia in the Pfrunger-Burgweiler reed, and within the reed beds of Federsee. At all sites GHG emissions were measured with the static chamber method. Additionally, continuous CO_2 flux measurements were taken using the eddy covariance technique in Graben-Neudorf and Federsee. On the basis of in total 34 balance years, this study comes to the result that the investigated agriculturally used peatland emits on average 42 □6 t CO_2-Eq ha^{-1} a^{-1}. Highest emissions were observed in the Upper Rhine Graben for both arable land and grassland. The emission of these two land use types varied over the same range. Environmental factors such as temperature and groundwater level play the central role in GHG emission. GHG emissions are dominated by the CO_2 flux. The covered peatland in Graben-Neudorf was a strong CO_2 source in all years, which indicates that a mineral cover cannot prevent peat degradation when the groundwater level is lowered. Comparing the static chamber method with the eddy covariance technique showed that measured CO_2 assimilation was consistently lower from the chamber technique, which results in an overall higher GHG budget. Nevertheless, also the eddy-covariance measurements confirmed the strong CO_2 source of covered peatland (2014: 28,3 t CO_2 ha^{-1}; 2016: 30,5 t CO_2 ha^{-1}). Overall, intensely used meadow is the most problematic use of peatland based on the highest CO_2 emissions along the investigated land use intensity gradient. At this meadow site 47,8 t CO_2-Eq. ha^{-1} were emitted in 2014. In contrast, the rewetted carex reed released only 15,9 t CO_2-Eq. ha^{-1} in the same year. In general, at the extensively used sites an adaptation phase following rewetting has to be expected. The CO_2 and CH_4 fluxes from the Federsee reed showed substantial inter-annual differences, which mainly originated from temperature and water level variations. Both gases showed a distinct diurnal cycle. The reed bed of Federsee was a CO_2 sink, However, due to the high emission of CH_4, the GHG balance is slightly positive with 7 □4 t CO_2-Eq ha^{-1} a^{-1}.