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Monitoring of waterlogging in peatland under agricultural land use with Copernicus satellite data

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The majority of peatlands in Germany were drained for agriculture and other land use and therefore make a significant contribution to greenhouse gas (GHG) emissions from land use, land use change and forestry (LULUCF). In Germany, they correspond to around 7.5% of the total emissions and 44% of emissions from agriculture and agriculturally used land (UBA 2022). According to the Climate Protection Act, the LULUCF sector should have a sinking capacity of 40 million tonnes of CO2 equivalent by 2045 (German Federal Council 2021). If the water level is raised accordingly, peatlands have enormous GHG reduction potential. A comprehensive data basis is needed for monitoring and evaluating climate protection measures on peatlands. In this context, the project “Copernicus lights green”, which focusses on satellite applications in grassland monitoring, developed satellite-based indicators with Copernicus data that are suitable for characterizing the hydrological condition of peatland areas under agricultural use. In addition to the intensity of use, reflected by mowing events, overflowing or surface water caused by waterlogging was considered as an indirect proxy for the water level of the organic soils.

This contribution presents the method and results of an approach that estimates the duration and extent of waterlogged areas based on monthly composites of satellite data time series from Sentinel-1 and -2. The work builds on a random forest classifier using the Framework for Operational Radiometric Correction for Environmental monitoring (FORCE) (Frantz, 2020) that detects waterlogged areas in agricultural land on organic soils. Due to the heterogeneity of agricultural land use in Germany and its varying open ground frequency as well as the lack of availability of cloud-free images in the winter months, an approach considering a combination of two models according to the vegetation period was developed. It optimizes the selection of training data and input features in order to generate reliable information on a monthly basis. The chosen study area in Lower Saxony in Germany showed good prediction results in 2018 and 2019, whereas the resulting model predictions achieved an F1 score between 85-91% with a variability of 2-5%. This provides a methodological base for comprehensive monitoring.