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Evaluating the value of ENVISAT ASAR Data for the mapping and monitoring of peatland water table depths

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The Advanced Synthetic Aperture Radar (ASAR) onboard ENVISAT collected C-Band microwave backscatter data from 2005 to 2012. Backscatter in the C-Band depends to a large degree on the roughness and the moisture status of vegetation and soil surface with a penetration depth of ca. 3 cm. In wetlands with stable high water levels, the annual soil surface moisture dynamics are very distinct compared to the surrounding areas, which allows the monitoring of such environments with ASAR data (Reschke et al. 2012). Also in drained peatlands, moisture status of vegetation and soil surface strongly depends on water table depth due to high hydraulic conductivities of many peat soils in the low suction range (Dettmann et al. 2014). We hypothesize that this allows the characterization of water table depths with ASAR data.

Here we analyze whether ASAR data can be used for the spatial and temporal estimation of water table depths in different peatlands (natural, near-natural, agriculturally-used and rewetted). Mapping and monitoring of water table depths is of crucial importance, e.g. for upscaling greenhouse gas emissions and evaluating the success of peatland rewetting projects. Here, ASAR data is analyzed with a new map of water table depths for the organic soils in Germany (Bechtold et al. 2014) as well as with a comprehensive data set of monitored peatland water levels from 1100 dip wells and 54 peatlands. ASAR time series from the years 2005-2012 with irregular temporal sampling intervals of 3-14 days were processed. Areas covered by snow were masked.

Primary results about the accuracy of spatial estimates show significant correlations between long-term backscatter statistics and spatially-averaged water table depths extracted from the map at the resolution of the ASAR data. Backscatter also correlates with long-term averages of point-scale water table depth data of the monitoring wells. For the latter, correlation is highest between the dry reference backscatter values and summer mean water table depth. Using the boosted regression tree model of Bechtold et al., we evaluate whether the ASAR data can improve prediction accuracy and/or replace parts of ancillary data that is often not available in other countries. In the temporal domain primary results often show a better dependency between backscatter and water table depths compared to the spatial domain. For a variety of vegetation covers the temporal monitoring potential of ASAR data is evaluated at the level of annual water table depth statistics.

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