Wetland Vegetation Mapping Using X- and C- Band SAR Time Series Data

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Wetlands are some of the most productive ecosystems in the world and provide an important range of environmental, social and economic services, such as water purification, flood control, carbon sink and shoreline stability. They are very dynamic ecosystems and can change significantly within short times, e.g. dry and flooded state. Due to their all-weather, day-and-night sensing capability SAR systems provide a very helpful tool for frequent and consistent monitoring of wetlands. The potential of SAR data for the monitoring of wetlands is subject to intensive research as no well-established SAR methodology to map and monitor wetlands is available nowadays. The objective of the Wetland Radar project, funded by DLR within the joint C/X Band Initiative of CSA & DLR (FKZ 50EE1511, FKZ 50EE1512), is the integration of radar techniques into the satellite based monitoring of wetlands. The project aims to contribute to the development of reliable, operationally applicable radar-based methods. In this study the capability of X- and C-band SAR data for wetland land use / land cover (LULC) classification will be addressed. The test regions include RAMSAR sites in Canada, Europe and the Mediterranean area.

One very important step in the analysis of SAR data is the preprocessing of the radar scenes. In this study a novel and very promising technique developed at the German Aerospace Center (DLR) will be applied. The methodology is able to combine several SAR acquisitions (multitemporal) in arbitrary polarizations (multipolarized) and even of different sensors (multifrequency). The technique bases on the Kennaugh element framework, which is a very versatile polarimetric descriptor on the one hand and enables an effective image enhancement technique on the other hand. The output images are smooth, but rich in detail. They contain the backscattering intensity and several polarimetric channels related to backscattering mechanism.

The study will highlight the potential of dual-pol TerraSAR-X and quad-pol Radarsat-2 data for the mapping and monitoring of wetlands. Specific advantages of the different sensor data as well as their synergies will be revealed. Separability analysis as well as LULC classifications clearly indicate the value of SAR data for the mapping of important, wetland-specific land cover classes. For example, the polarimetric information content provided by the Kennaugh elements is a very valuable parameter to classify reed plant communities, occurring in most of the Wetland Radar test sites. Reed beds are indicated by the presence of strong double bounce scattering and could be mapped with high accuracies on base of the Kennaugh elements extracted from X- or C-band SAR data. By the combination of both frequencies the mapping of reed could be further improved.