Development of Land-Cover Classification Focusing on Wetlands Impacted by Subsistence Farming Using Satellite Remote Sensing

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Abstract

Wetlands provide essential ecosystem services, especially in countries affected by drought. They are often the only habitats for subsistence smallholder farming within barren landscapes. On the other hand non-sustainable farming causes their irreversible degradation. In a study area within the Maputaland Coastal Plain in KwaZulu-Natal, South Africa, the international interdisciplinary project AllWet-RES (Alliance for Wetlands, 2012–2015) aims at the development of intervention strategies for restoration and wise use of wetlands (mainly interdunal peatlands) under pressures of farming and urban development. Using a broad holistic approach AllWet-RES investigates socio-cultural acceptance and economic viability of restoration measures and adapted farming practices that are necessary for the sustainable use of natural resources and biodiversity conservation.

One significant part of the project is the development of tools for the assessment and evaluation of existing human interventions, especially smallholder farming, on wetlands on the landscape level. Hence, a study has been carried out to assess the possibility of delineating different wetland types (amongst other land-cover classes) according to an adapted classification system based on commonly used systems of South Africa. Supervised classification of multi-temporal, multispectral and multisource satellite imagery (SPOT 4/5, WorldView2) was carried out using the machine learning algorithm "Random Forests" on the open statistic platform R. About 900 individual training points at different sites spread over the project area were on-site recorded and classified to train the algorithm. The classification system was also reviewed during field work to coincide with on ground conditions.

The classification method allows distinguishing between three wetland types and an approximated spatial extent of the impact caused by farming. Possibilities and limits of the utilisation of multispectral, multi-temporal satellite data for the land-cover classification and the evaluation of wetlands are discussed. In combination with the results obtained from the socio-economic studies as well as from the investigations on soil characteristics and the restorability of the wetland habitats, the landscape analyses based on remote sensing allow the development of scenarios and recommendations for sustainable use of wetlands and other natural resources. These should be further developed and implemented in close cooperation with the local community and tribal authorities.

Keywords: Land use classification, machine learning, organic soil, peatland, remote sensing, socio-economic, South Africa, SPOT, subsistence farming, swamp forest, WorldView2

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