RSHS18-14-1
Remote Sensing and Hydrology Symposium (ICRS-IAHS)

Monitoring Environmental Supporting Conditions of a Raised Bog using Remote Sensing Techniques

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Conventional methods of monitoring wetlands and detecting their changes over specified time periods can be time-consuming and costly. Inaccessibility and remoteness of many wetlands is also a limiting factor, hence, remote sensing techniques are potentially effective in mapping wetlands, vegetation and in detecting their changes [1]. Wetlands can be of various kinds for example fens, bogs, marshes, swamps etc. In this study, we concentrate on a natural wetland –Clara Bog, a distinctively large raised bog situated in the Irish midlands. The aim of the study is to monitor the environmental supporting conditions of the bog using remote sensing techniques.
The environmental conditions in this study refer to vegetation, the presence of water (soil moisture) and topography. Vegetation indices (VIs) derived from satellite data have been widely used to assess variations in properties of vegetation [2]. This study uses mid-resolution data from Sentinel-2 MSI, Landsat 8 OLI for VI analysis. The topography of an area can be studied using digital elevation model (DEM). A competent elevation model was derived using airborne-LiDAR data. The objective is to deploy the knowledge gained from the VIs, DEM and interpreting the same for defining appropriate metrics to evaluate changes in environmental supporting conditions for the bog.
Identification of correct bog area is of key importance. An initial study to delineate the boundary of the bog using the combination of edge detection and segmentation techniques namely, canny edge detection, entropy filtering and graph-cut segmentation is performed. Once the bog boundary is defined, spectra of the delineated area are studied. VIs like NDVI, ARVI, SAVI, MCARI, NDWI, derived using Sentinel-2 MSI and Landsat 8 OLI are analysed. A further LiDAR-derived DEM was used for better classification. All of these characteristics (features) serve as a basis for classifying the bog into broad vegetation communities (termed ‘ecotopes’) that indicate local hydrological conditions and quality of raised bog habitat. This analysis is validated using field derived ecotopes.
The results show that, by using spectral information and vegetation index clustering, an additional metric can be created establishing linkages between spectral RS signatures and wetland ecotopes. Therefore, by using a-priori information on location, any ecosystem can be further analysed to detect its conditions. Hence, the benefit of the study is in understanding ecosystem (bog) environmental supporting conditions and in defining appropriate metrics by which changes in the conditions can be monitored. Remote Sensing metrics can also serve as a screening tool to determine potential impacts on the bog and as a means of upscaling the supporting condition metrics to wider wetland habitats.
[1] Xie et al (2008)
[2] Psomiadis et al (2017)