STUDY IN BIEBRZA WETLANDS USING OPTICAL AND MICROWAVE SATELLITE DATA

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INTRODUCTION

The study has been carried out in Biebrza Wetlands which is NATURA 2000 and Ramsar Convention test site situated in the Northeast part of Poland. It is one of the largest in Europe natural rich biotope with the large amount of unique spices of flora and important zone for nesting and wintering for fauna. Protection of wetlands which are very sensitive ecosystems are of great importance in nature conservation for carbon and water cycles. Changes in soil water content of a given site affects its plant cover and leads to the elimination or preference of certain species depending on their water needs. Both, drying and peat degradation processes occur in the Biebrza Wetlands due to anthropogenic drainage and fluviogenic feeding limitation. Controlling proper soil moisture content is essential for protection of peat-forming plant communities and slow down drying processes against mineralization and carbon exhaust. The paper aims at monitoring and mapping various soil-vegetation variables using optical and microwave satellite data. ENVISAT and ALOS images have been obtained from ESA for AOALO.3742 project.

RESULTS

The following satellite images have been used for the presented research: ENVISAT.ASAR (C-band), ENVISAT.MERIS, ALOS.PALSAR (L-band), ALOS.AVNIR-2, ALOS.PRISM, TERRA.ASTER and NOAA.AVHRR. Satellite images have been processed using BEST (microwave images), BEAM and ERDAS (optical and microwave images) software. Each image has been rectified to the previously geometrically corrected TERRA.ASTER image. Optical images have been used for classification of wetlands vegetation habitats and vegetation surface roughness expressed by LAI. Microwave images have been used for the assessment of soil moisture conditions for every habitat classified from optical images. The following soil–vegetation parameters have been measured at the test site during the satellite overpasses: volumetric soil moisture (SM, [%]), Leaf Area Index (LAI), biomass, height of vegetation, and type of vegetation habitat, it's development stage and growth conditions. Figure 1 presents the area of the test site (black curve) and measurement plots (red dots) located on ALOS.AVNIR-2 RGB (3,2,1) composition. Data from optical and microwave satellite images and soil-vegetation ground truth measurements have been analyzed to develop methods for monitoring and mapping soil-vegetation parameters over wetlands. For the supervised classification satellite images registered in optical spectrum have been used along with the ground truth data. Classification has been performed on the pixel-based approach for wetlands vegetation taken from Corine Land Cover Map. The results of classification are ten vegetation classes, which represent the most dominant wetland habitats. Figure 2 presents classified wetlands habitats using TERRA.ASTER image. Also, spectral signatures recorded in optical channels various satellite images have been analyzed for calculation of NDVI index, which is correlated with Leaf Area Index (LAI). Correlation between NDVI and LAI has been found and has been used for calculation and mapping of LAI, [1]. From microwave images backscattering coefficient (σ°) has been calculated and mapped for the test site. Figure 3 presents maps of σ° derived from ALOS.PALSAR (left) and ENVISAT.ASAR (right) data registered in nearly the same period of May 2008. Backscattering coefficient represents the integrated respond of soil moisture, surface roughness, and vegetation cover. Presentation of LAI as surface roughness indicator has been introduced in our investigation. For each of the wetlands vegetation classes and LAI classes [1] the relationship between soil moisture (SM) measured at the test site and σ° calculated from microwave images registered in various modes and polarizations (VV, HV, HH) has been examined. Backscattering coefficient derived from ENVISAT.ASAR IS2 HH gave the best results for SM estimation as the wave in HH penetrates more effectively vegetation, reaching the soil, and rather steep angle (23°) have been found to be more useful for examination of soil moisture by diminishing roughness effects and vegetation attenuation. Also, the best correlation with SM has been found using σ° derived from ALOS.PALSAR HH images. Developed algorithms have been applied for soil moisture mapping, figure 4. Calculating energy budget for wetlands is very important procedure for assessment of water balance. Therefore calculated latent heat from NOAA AVHRR for classified habitat classes was compared with soil moisture obtained from microwave data, fig 4. The advantage of using satellite observations is to deliver repetitive information about temporal and spatial changes of these variables in the wetlands area, very often impenetrable. Knowledge of wetlands biophysical properties retrieved from satellite images will improve monitoring of these unique areas, which is very essential task for better management and protection of the sensitive wetlands ecosystems which influence various factors of carbon and water cycles.

REFERENCES

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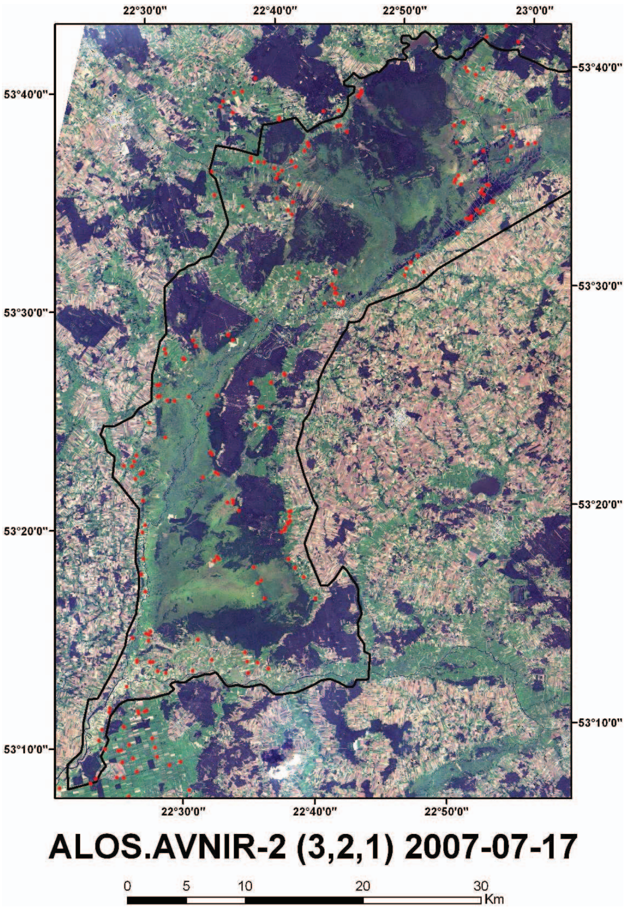

Figure 1. ALOS.AVNIR-2 RGB (3,2,1) composition.

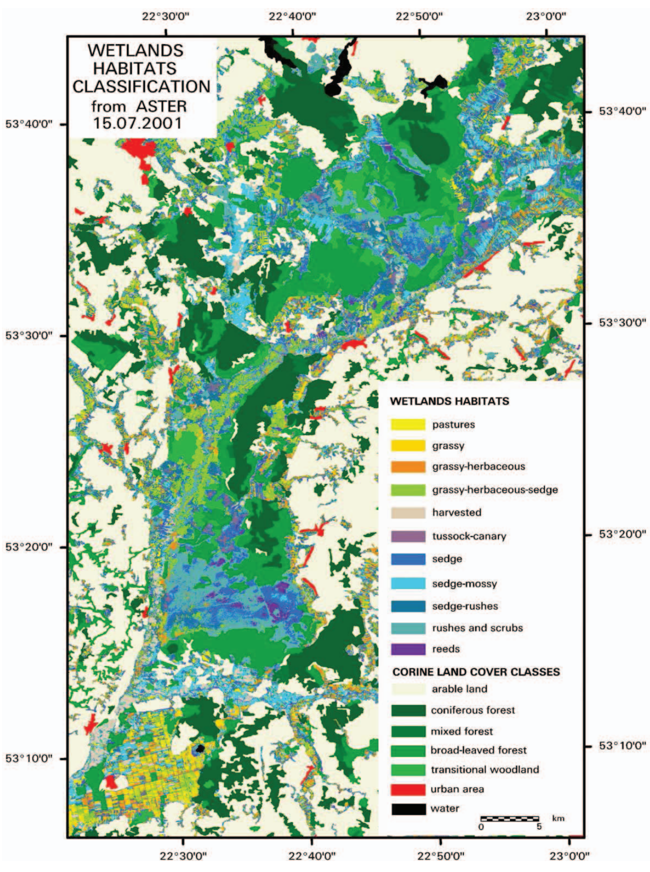

Figure 2. Classification of wetlands habitats.

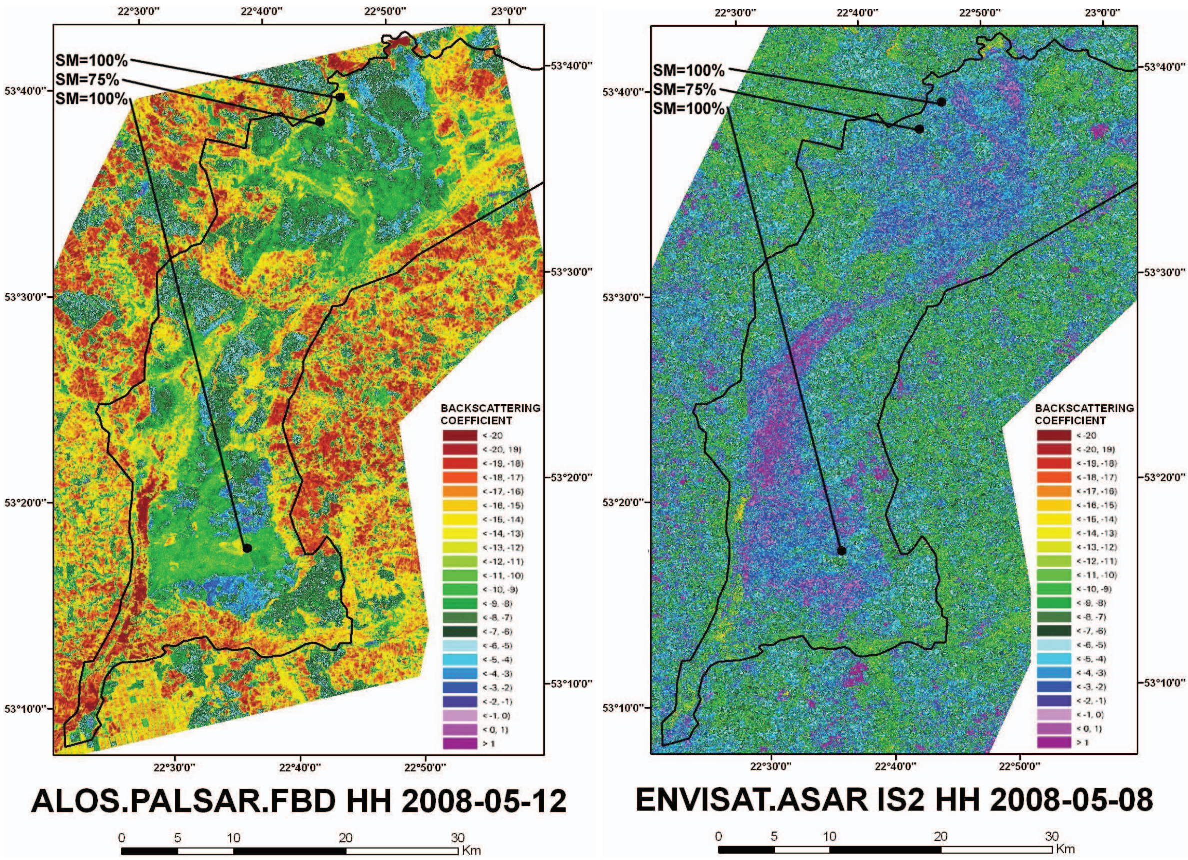

Figure 3. Map of σ˚ derived from ALOS.PALSAR HH (left) and ENVISAT.ASAR IS2 HH images (right).

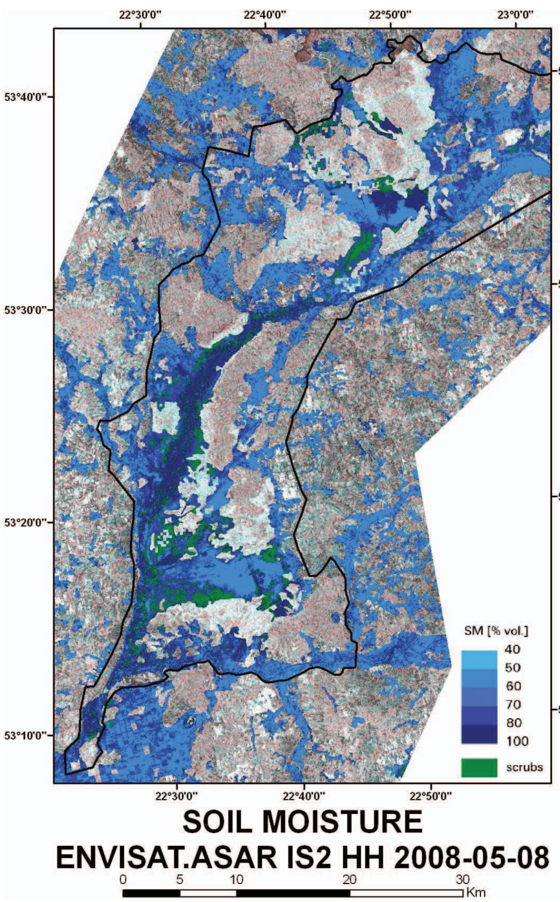

Figure 4. Map of soil moisture in May 2008

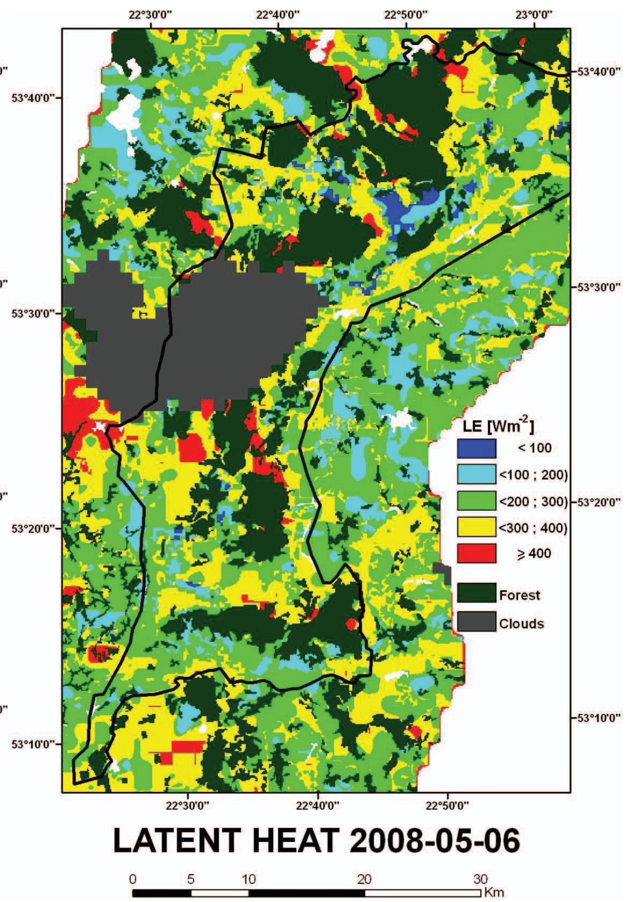

Figure 5. LE derived from NOAA.AVHRR