APPLICATION OF HYPERSPECTRAL METHODS IN CONDITION MONITORING OF NORTH-EASTERN POLAND ARBORESCENT SPECIES

Karolina Orłowska[1,2], Adrian Ochtyra[1,2], Marlena Kycko[1], Zbigniew Bochenek[3], Dariusz Ziółkowski[3], Bogdan Zagajewski[1]

1. *University of Warsaw, Faculty of Geography and Regional Studies, Department of Geoinformatics, Cartography and Remote Sensing, Warsaw, Poland; e-mail karolina.orlowska@uw.edu.pl, adrian.ochtyra@uw.edu.pl, marlenakycko@uw.edu.pl, bzagajew@uw.edu.pl*
2. *University of Warsaw, College of Inter-Faculty Individual Studies in Mathematics and Natural Sciences, Warsaw, Poland*
3. *Institute of Geodesy and Cartography, Remote Sensing Department, Warsaw, Poland; e-mail zbigniew.bochenek@igik.edu.pl, dariusz.ziolkowski@igik.edu.pl*

ABSTRACT

Remote sensing techniques are based on analysis of electromagnetic spectrum and its behaviour in contact with different types of objects and land cover. Electromagnetic wavelengths, which can be absorbed, scattered or reflected, provide information on specific features of the object of research. Hyperspectral remote sensing focuses on analysis of the reflected electromagnetic spectrum in detail, taking into consideration wavelengths down to 1 nm. In case of plants, wavelengths of 350 up to 2500 nm show even minuscule changes, present both in physiological and morphological aspects of the vegetation (chlorophyll content, cell structure, water content). The aim of the research was to use hyperspectral field equipment and methods of analysis to monitor changes in vegetation.

The object of research were woods of north-eastern Poland: Białowieża National Park (UNESCO heritage site), Knyszyńska and Borecka forests. For three years (2014 - 2016) the data were collected during field campaigns at the beginning (May), during (July) and at the end (September) of each vegetative year. During the campaigns following arborescent species were investigated - deciduous: hornbeam (*Carpinus betulus*), oak (*Quercus robur*), alder (*Alnus glutinosa*), birch (*Betula pubescens*) and coniferous: spruce (*Picea abies*) and pine (*Pinus sylvestris*). Using remote sensing field equipment information on vegetation spectral response were acquired (with a ASD FieldSpec 3 and 4 spectroradiometer with Plant Probe) as well as chlorophyll content (Dualex Scientific+ Polyphenol & Chlorophyll-Meter).

Recorded information on spectral response of each species were visualized as a spectral reflectance curves and analyzed statistically (ANOVA) to show which parts of the curve depicted phenological and conditional changes occurring in plants. Additionally, the data were used to calculate remote sensing vegetation indices describing condition of vegetation in general or in detail - amount of light used by plant in the process of the photosynthesis, amounts of photosynthetically active pigments such as chlorophyll, carotenoids or water and lignin content. Calculated vegetation indices allowed to depict how the condition of the vegetation changed between years and measurement periods in one year. The indices were correlated with chlorophyll content as a mean of data verification and analysed statistically (Kruskal-Wallis ANOVA or ANOVA) to select only those which were significant for the purpose of research.

The result of the analysis were a set of wavelengths for each species that showed occurring plant's phenological and conditional changes in the highest detail as well as a set of vegetation indices most suitable to monitor condition of arborescent species of this area.

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