

## APPLICATION OF LOW-RESOLUTION SATELLITE IMAGES FOR STUDYING IMPACT OF CHANGEABLE CLIMATIC CONDITIONS ON FOREST DEVELOPMENT

Maciej Bartold<sup>2,1</sup>, Zbigniew Bochenek<sup>1</sup>, Dariusz Ziolkowski<sup>1</sup>

<sup>1</sup> *Institute of Geodesy and Cartography, Remote Sensing Centre, Modzelewskiego 27, 02-679 Warsaw, Poland, email: [maciej.bartold@igik.edu.pl](mailto:maciej.bartold@igik.edu.pl); [zbigniew.bochenek@igik.edu.pl](mailto:zbigniew.bochenek@igik.edu.pl); [dariusz.ziolkowski@igik.edu.pl](mailto:dariusz.ziolkowski@igik.edu.pl);*

<sup>2</sup> *Department of Geoinformatics, Cartography and Remote Sensing, Faculty of Geography and Regional Studies, University of Warsaw, Poland*

### ABSTRACT

The goal of the presented work was to assess usefulness of low-resolution satellite images for analyzing impact of variable meteorological conditions on forest development and condition. In order to cover various environmental and climatic conditions in Poland six forest study areas were selected for the research works: Augustowska Forest, Białowiecka Forest, Knyszynska Forest, Borecka Forest in northeastern Poland, and forests in southern Poland in Karkonosze and Beskid Żywiecki Mountains.

1-km NOAA AVHRR images have been used as the basic satellite data for the research work. Two vegetation indices were derived from the study areas: Normalized Difference Vegetation Index – NDVI and Vegetation Condition Index – VCI, producing ten-day composites for both indices. In parallel, meteorological data were compiled from weather stations adjoining study areas – air temperature and precipitation. Both types of data were collected for 2000 – 2015 period, but finally three years, which differ much in meteorological conditions – 2006, 2013 and 2014 were selected for the detailed study. The methodical approach was based on comparative analysis of satellite-based indices and meteorological parameters for all study areas, applying statistical tools for assessment of strength of correlation.

The results of analyses revealed, that both aspects of forest variability – due to different environmental and climatic conditions – can be to a large extent monitored with the use of indices derived from low-resolution satellite data. Forest areas located in various climatic regions – under impact of continental climate in northeastern Poland and under impact of maritime climate in southwestern Poland are characterized by different NDVI curves, especially at the beginning and end of growing season. General species composition within the study areas – dominance of coniferous or deciduous / mixed forests – also has visible impact of NDVI levels.

Study of relationships between meteorological parameters and vegetation indices derived from NOAA AVHRR images also led to conclusion, that there is quite significant relation between these two types of data. Both indices – Normalized Difference Vegetation Index (NDVI) and Vegetation Condition Index (VCI) derived from first part of vegetation season correlate well with temperatures existing in wintertime, especially at the end of winter (in March). It means, that low-resolution satellite data can be applied for monitoring conditions of vegetation development at the beginning of growing season. Nevertheless, it should be mentioned, that significant impact of unfavourable conditions expressed by low winter / early

spring temperatures is not observed for the study areas, while analyzing vegetation indices in the whole growing season. It implies the conclusion, that Polish forests located in both climatic zones are quite resistant to anomalies of temperature at the onset of vegetation season.

## **ACKNOWLEDGEMENTS**

The research work has been conducted within the Polish-Norwegian Research Programme, Norway Grants, financed by the National Centre for Research and Development, as a part of the WICLAP project “ Ecosystem stress from the combined effects of winter climate change and air pollution – how do the impacts differ between biomes?”