

Abstract

This dissertation thesis deals with the study of forest ecosystems in the central Europe with the time series of multispectral optical satellite data. These forest ecosystems have been influenced by biotic and abiotic disturbances for the last decade. The time series of the satellite data with high spatial resolution allow the detection and analysis of forest disturbances. This thesis is mainly focused primarily on free available Landsat and Sentinel-2 data, these two data types were compared. From methods, the difference time series analyses / algorithms were used. The whole thesis can be divided into two main parts. The first one analyses usability of classifiers for detection of forest ecosystems with per-pixel and sub-pixel methods. Specifically, the Neural Network, the Support Vector Machine and the Maximum Likelihood per-pixel classifiers were used and compared for different types of data (for data with high spatial resolution – Landsat or Sentinel-2; very high spatial resolution – WorldView-2) and for classification of protected forest areas. The Support Vector Machine were selected as the most suitable method for forest classifications (with most accurate outputs) from the list of selected per-pixel classifiers. Also, Spectral Unmixing methods were used for sub-pixel classification. Specifically, two Machine Learning Regression methods were selected to create forest cover fractions – the Support Vector Regression and the Random Forest Regression. Both studied methods were found as suitable for analyzing forest cover in detail, the Support Vector Regression method seemed more accurate. The second main part of this thesis is focused on using Landsat and Sentinel-2 data for creating time series charts. For this purpose, the difference and orthogonal vegetation indices were used. The main aim of this part was to find the most suitable vegetation indices for detection of disturbances and for evaluating of the different of recovery phases. For the detection of disturbances, the NDMI, the NDVI and the Tasseled Cap Wetness indices were suitable. For the recovery phase detection, the NDMI index was most suitable, thanks to the abilities of SWIR band. The NDMI index were found as universal for observing the disturbances / recovery phases. Additionally, the NDMI index was usable for detection of the initial stage of the bark beetle outbreak. For efficient time series processing, the cloud-based technologies can be used, which allow fast access to the data and pre-processed functions for creating time series charts and maps. From the cloud-based technologies, the Sentinel Hub platform was used and tested.

Key words: time series; Landsat; Sentinel-2; classification; vegetation index