Subalpine and Alpine Vegetation Classification based on APEX and EnMAP Hyperspectral Data

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Introduction

Monitoring of vegetation is a very important issue in changeable environment, especially in sensitive mountain areas, as alpine regions often respond to small short-term variations of abiotic and biotic components as well as long-term global changes. Spatial techniques, like imaging spectroscopy, allow for detailed classification of different syntaxonomic categories of vegetation and their status. The goals of the study was to check the possibility of detailed classification of vegetation types offered by data with similar spectral but comparing to APEX – 10 times lower EnMAP spatial resolution and to asses the usefulness of APEX and simulated EnMAP data to classify the subalpine and alpine mountain vegetation types in Karkonosze National Park in Poland.

Study area and object of the study

Study area is located in eastern part of Polish Karkonosze National Park, in Sudety chain. It covers 9 type of subalpine and alpine vegetation classes.

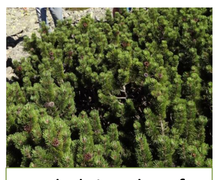

subalpine tall-forbs


grasslands


deciduous shrubs vegetation


forests


heathlands


subalpine dwarf pine scrubs

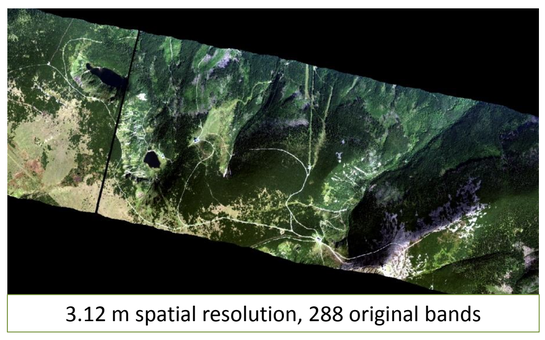

rock and scree vegetation

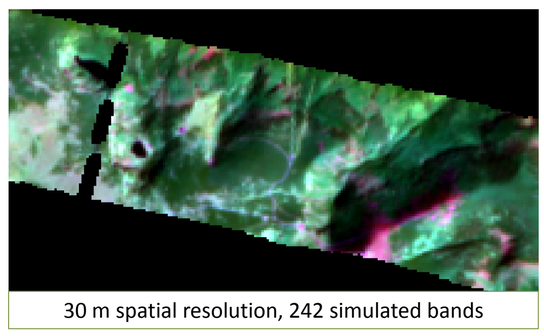

bog-springs, fens and bogs

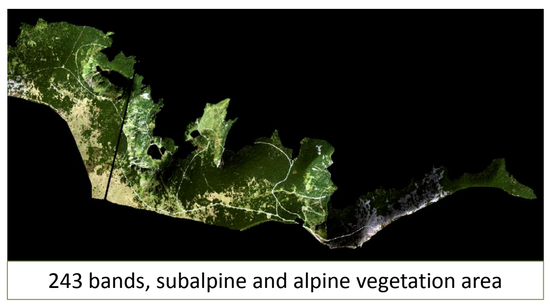

ruderal vegetation

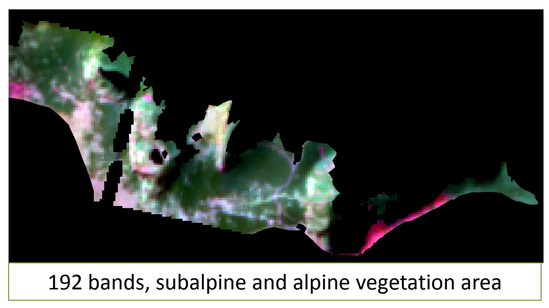
Image data

APEX data were acquired 10/09/2012 by DLR.
Simulation of EnMAP data were performed by GFZ based on APEX data.


3.12 m spatial resolution, 288 original bands

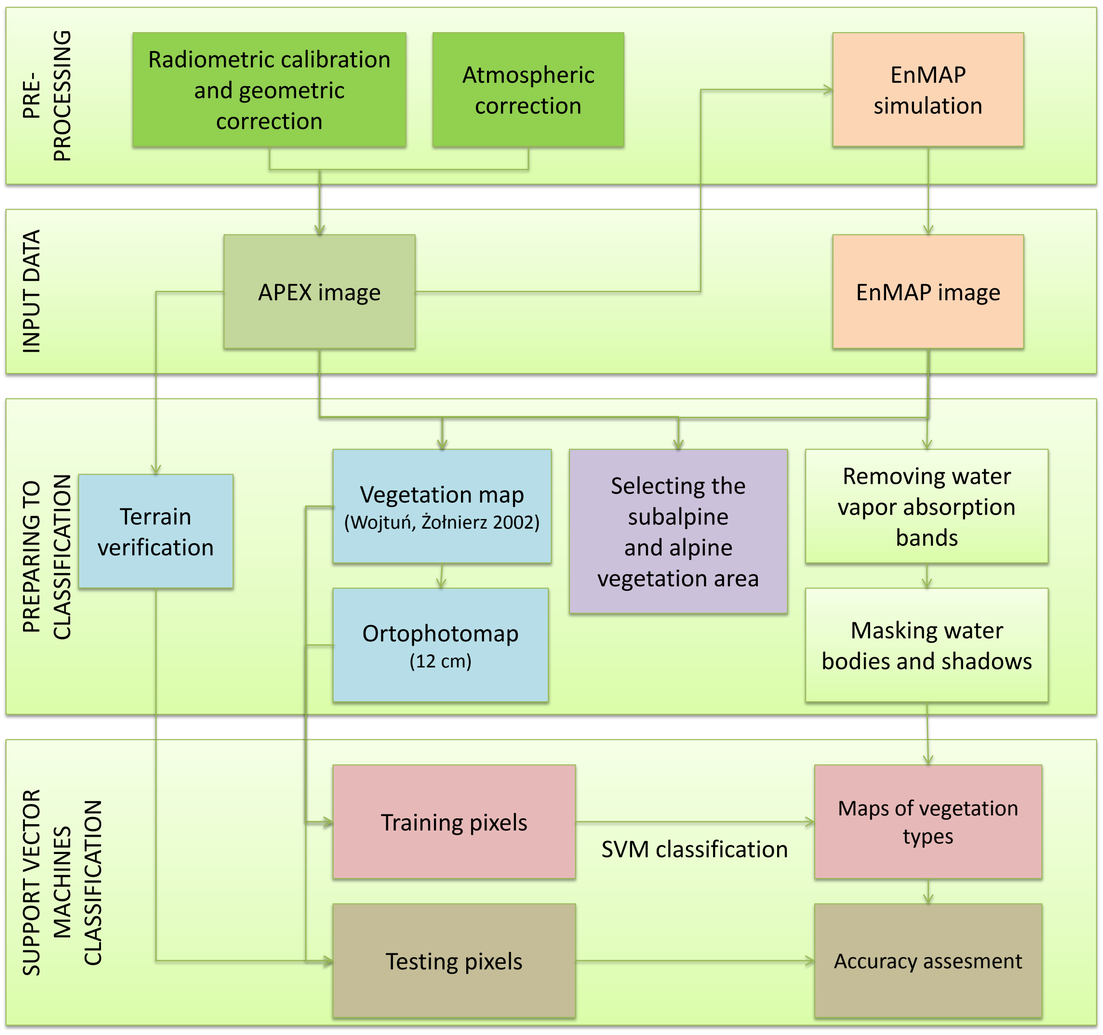

30 m spatial resolution, 242 simulated bands


243 bands, subalpine and alpine vegetation area


192 bands, subalpine and alpine vegetation area

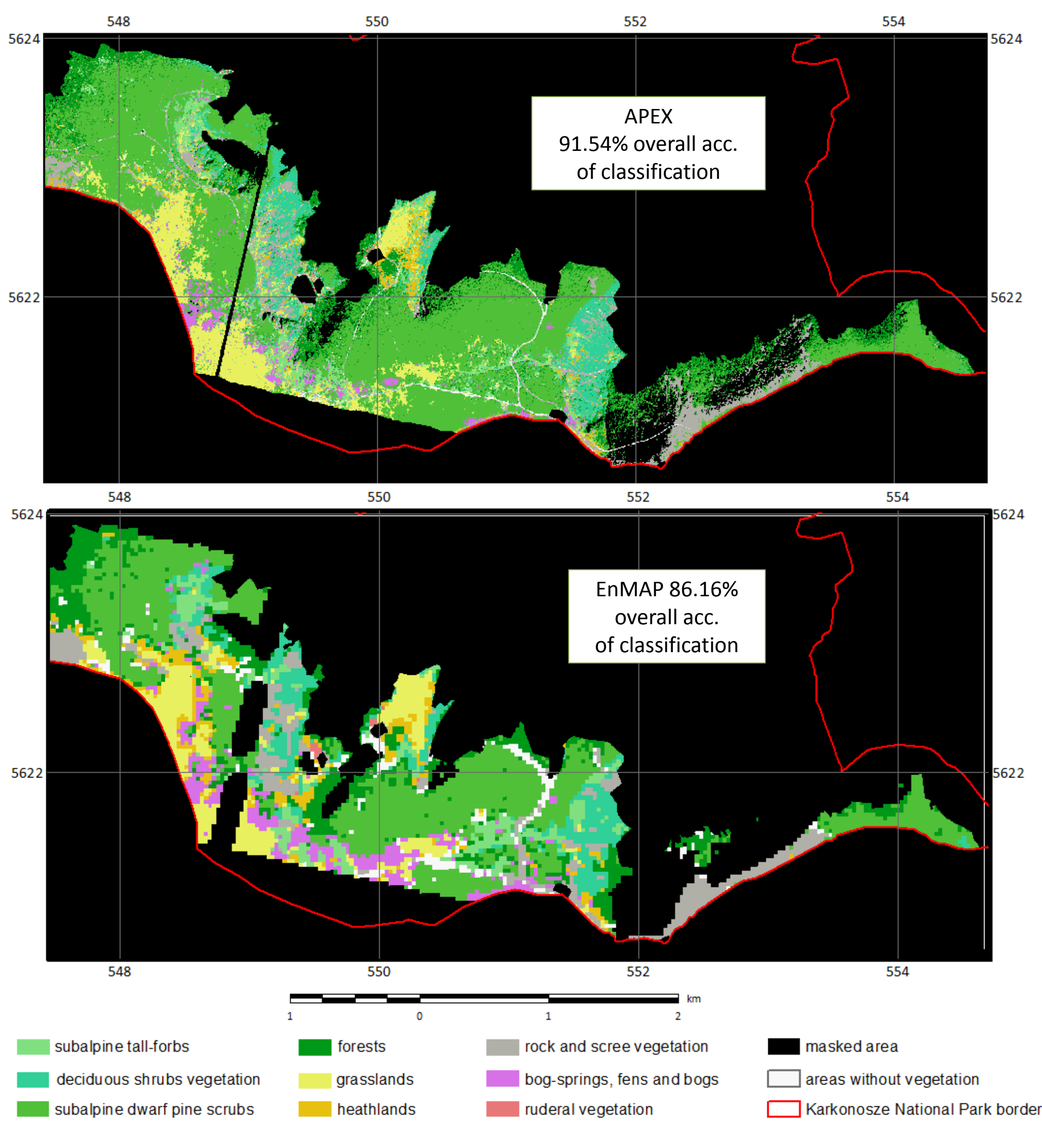
Methods

Pre-processed data were prepared to classification using Support Vector Machines method. Polygons for classification and validation were created based on vegetation map and ortophotomap.



Results

The results shows the maps of distribution of vegetation types in Karkonosze on APEX (top) and EnMAP (bottom) data and accuracies of each class.



	APEX classification		EnMAP classification	
	Producer acc. (%)	User acc. (%)	Producer acc. (%)	User acc. (%)
subalpine tall-forbs	69.93	57.56	83.42	66.11
deciduous shrubs vegetation	83.06	83.15	91.09	80.70
subalpine dwarf pine scrubs	99.31	95.45	97.09	89.20
forests	82.62	88.58	59.17	90.37
grasslands	97.03	94.74	89.34	90.14
heathlands	49.20	89.49	33.11	74.77
rock and scree vegetation	90.84	99.61	95.18	93.43
bog-springs, fens and bogs	89.47	78.56	79.52	75.86
ruderal vegetation	85.14	80.77	59.62	50.82
areas without vegetation	91.47	80.27	62.73	51.57

Conclusions

Hyperspectral APEX and EnMAP data can be used to subalpine and alpine vegetation types classification.
The overall accuracies of classifications reached very high values, most of classes were classified with more than 65% accuracy, in both cases.
Some classes reached higher values of accuracies for APEX (e.g. heathlands, ruderal vegetation), because of the complexivity and smaller range of these classes.
More homogenuous classes as rock and scree vegetation, deciduous shrubs vegetation or subalpine tall-forbs were classified better on EnMAP data.
Spatial resolution of EnMAP data don't have significant impact on accuracy of classification, it is only about 5% worse.
EnMAP will be powerful tool for vegetation identification and monitoring.

Special thanks to the DLR and VITO for execution of the flight campaign and obtaining and processing the APEX data, to GFZ for simulation of EnMAP data and to the Karkonosze National Park for the necessary data and help in leading the research.

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