Laboratory for Essential Biodiversity Variables (EBV) Concepts – The “Data Pool Initiative for the Bohemian Forest Ecosystem”


Developing Remote Sensing Based EBVs

Biophysical and biogeocenotic vegetation parameters can characterize changes in biodiversity through changes in ecosystem structure and function. Acquisition of VIS/NIR hyperspectral, LiDAR, thermal and SAR remote-sensing data allows accurate retrieval of vegetation parameters (e.g., LAI, Chlorophyll, specific leaf area (SLA), nitrogen, water content, species occurrence and ED vegetation structural attributes) which have been recognized as Essential Biodiversity Variables (EBV) by GEO-BON – the Biodiversity Observation Network of GEO.

The Bohemian Forest Ecosystem is a perfect laboratory for studying biodiversity measures. Therefore, the idea was to establish a Data Pool Initiative to enable science for biodiversity, and to support interdisciplinary and international projects and development.

The Bohemian Forest Ecosystem

The two neighboring National Parks Bavarian and Saxon form a unique forest ecosystem with large non-intervention zones, which promote a large scale re-wilding process with less human interference. The Forest National Park offers services of clear water, carbon sequestration and recreation, and has unique habitats with endangered forest species. The Bavarian forest ecosystem is therefore a very suitable field of research to study natural and near natural processes.

Under the leadership of the Bavarian Forest National Park authority, experts from various European research institutions have joined forces to systematically establish a remote sensing data pool on the Bohemian Forest as a resource for their research. This collaborative effort provides an opportunity to combine various methodological approaches as well as data sources to optimize products by sharing knowledge and expertise.

Content of the Data Pool

1. Related contents and list of the research site

2. Different data available through the data pool

3. Data on site maps derived from HySpex imagery

4. Comparison between field-based and remotely sensed data:
   - HySpex (400-1000nm)
   - Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+)
   - WorldView-3 images

5. Table of Essential Biodiversity Variables and their remote sensing counterpart

6. Hyperspectral Data Ground Truthing

7. Classification: Single tree species (e.g., Norway Spruce, Silver Fir) and mixed mountainous forest

Derivation of Plant Traits

The estimation of plant functional traits (leaf dry matter content, LDMC; leaf carbon, C; leaf nitrogen, N) from remote sensing data is challenging. The Data Pool Initiative presents a new approach in this field. The first step is the interpretation of DAS Fritz transformation method. The results show that for tree species the LDMC and SLA are then characterized with a wavelet analysis.

Tree Species Classification

The development of advanced techniques for tree species mapping based on hyperspectral remote-sensing in combination with other remote sensing techniques (e.g., LiDAR, thermal) and aerial photography may contribute to the data pool initiative. The different studies aim at building a model transferable to an area wide data base about deadwood since 1990s including the different management types of deadwood areas. This visualization of the evolution of deadwood areas over a long period of time can be visualized with the help of different vegetation indices and LiDAR-derived parameters. The results of the tree species classification can be used as input data to determine the composition of tree species within the deadwood areas.

Outlook – Spaceborne Imaging Spectroscopy

With the support of both National Parks and with a comprehensive high-resolution EO and in-situ data base, EBV concepts using EO data of broader scale can be developed, tested and validated. This upcoming studies will foster the establishment of globally derived Essential Biodiversity Variables as currently in progress.

One of the most promising technique is based on spaceborne imaging spectroscopy. There are several spaceborne initiatives and missions ongoing such as EnMAP – The German Environmental Mapping and Analysis Program. It will be a contributing mission to the Copernicus program. EnMAP is expected to provide high-quality imaging spectroscopy data on an operational basis and will be suitable for the retrieval of high resolution plant traits at local scales. First studies within the data pool have focused on, e.g., derivation of plant traits like chlorophyll, LAI and vegetation and tree species classification with a special focus on rare species within the national park. Just to name a few, therefore, the synergistic use of imaging spectroscopy mission and the Sentinel platforms is in the focus of the data pool initiative.

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