Understanding patterns of biodiversity and forest structure is an important issue in ecological research and conservation in complex forest ecosystems. Spatially comprehensive assessments require the use of novel remote sensing techniques. We investigate biodiversity and forest structure of a mixed temperate forest in the Bavarian Forest National Park, Germany, using airborne hyperspectral (HyMap) and LIDAR data, which promise to provide the necessary resolution and accuracy.

**Background**

Understanding patterns of biodiversity and forest structure is an important issue in ecological research and conservation in complex forest ecosystems. Spatially comprehensive assessments require the use of novel remote sensing techniques. We investigate biodiversity and forest structure of a mixed temperate forest in the Bavarian Forest National Park, Germany, using airborne hyperspectral (HyMap) and LIDAR data, which promise to provide the necessary resolution and accuracy.

**Methods**

**Study Area**

**Forest Structure**
- 102 ground plots
- basal area
- fraction of basal area
- mean DBH

**Biodiversity**
- 106 ground plots (P/A for grasses, herbs, ferns, trees)
- α-diversity: Species number
- β-diversity: Sørensen multiple plot similarity

**Remote Sensing Data**

**HyMap**
- 7m²
- 125 bands
- MNF transformation
- pixel aggregation

**LIDAR**
- 25 points/m²
- full waveform
- penetration ratios
- canopy structure
- pixel aggregation

**Preprocessing**

**Data Analysis**

Random forest decision trees using HyMap and LIDAR derived variables as predictors and all plots as training samples.

**Model quality assessment:** $R^2$ based on “out of bag” samples.

**Results**

1. **Forest Structure - HyMap**

   ![Forest Structure - HyMap](image1.png)

   **Fig. 2:** Model performance on forest structure measures, modified by state and kind of vegetation.

2. **Biodiversity – HyMap & LIDAR**

   ![Biodiversity – HyMap & LIDAR](image2.png)

   **Fig. 3:** Model performance on α and β-diversity, modified by functional groups.

**Conclusions**

1. Forest β-diversity can be derived both from hyperspectral and LIDAR sensors. Optimal results were obtained combining both.
2. HyMap provides reliable information on the fractional basal area split into living, dead, deciduous and coniferous trees.
3. Forest α-diversity of most functional groups as well as mean DBH could not be derived successfully.

**Next steps**

1. Using hyperspectral indices as predictors (e.g. PRI).
3. Modelling bird, beetle and spider assemblages combining LIDAR & HyMap in comparison to previous studies using LIDAR only \cite{1,2,3}.
4. Determining spectral & spatial resolution requirements of remote sensing data for biodiversity modelling.

**References**


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**Fig. 1:** HyMap true color image of study area in the Bavarian Forest national park, Germany.