

PREDICTION OF LEAF AREA INDEX USING HYPERSENSPECTRAL THERMAL INFRARED IMAGERY OVER THE MIXED TEMPERATE FOREST

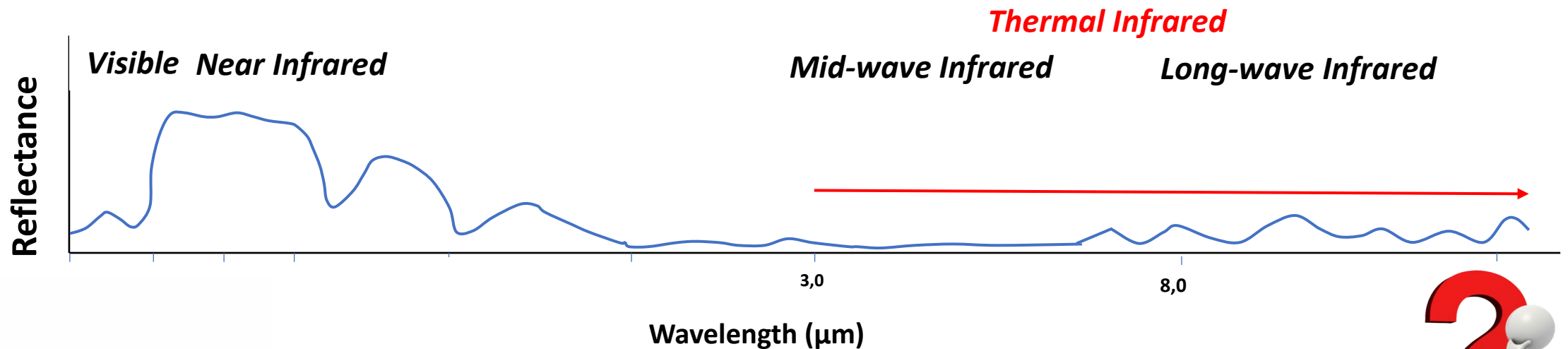
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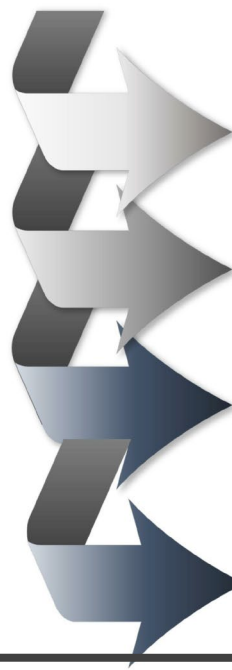


Introduction

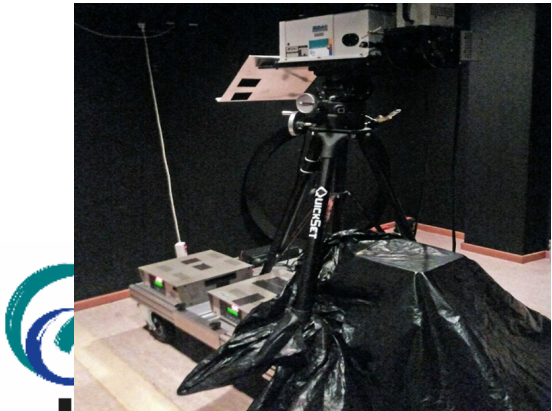
Leaf area index (LAI) is an extremely important variable of terrestrial ecosystems due to the strong correlation with many ecosystem processes such as water balance and evapotranspiration and its direct relation to the plant energy balance and gas exchanges.

- **Upscaling from leaf to canopy level**
- **Apply as an input in different model and for various applications.**





Level	TIR Hyperspectral Data	TIR Multispectral Data
Laboratory	✓	✓
UAV	—	✓
Air-borne	✓	✓
Spaceborne	—	✓

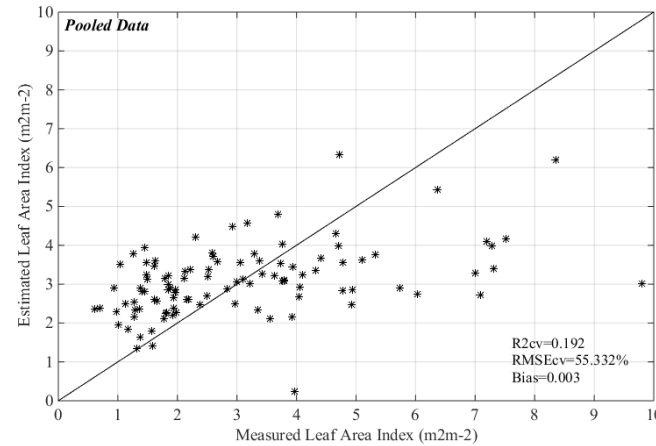


Retrieval of leaf area index in different plant species using thermal hyperspectral data

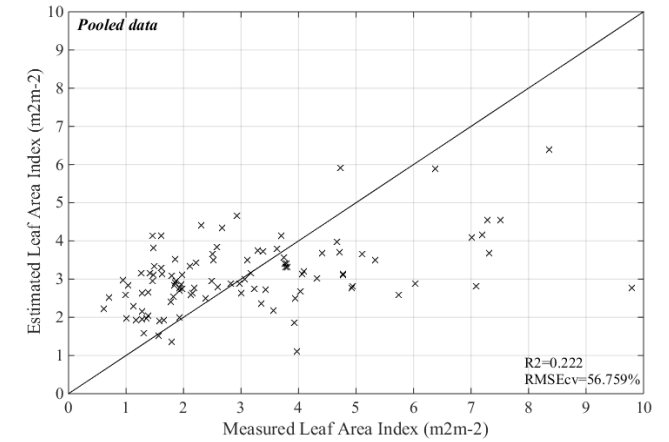
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LAI was predicted using univariate and multivariate as well as artificial neural network under laboratory-controlled condition using TIR hyperspectral data.

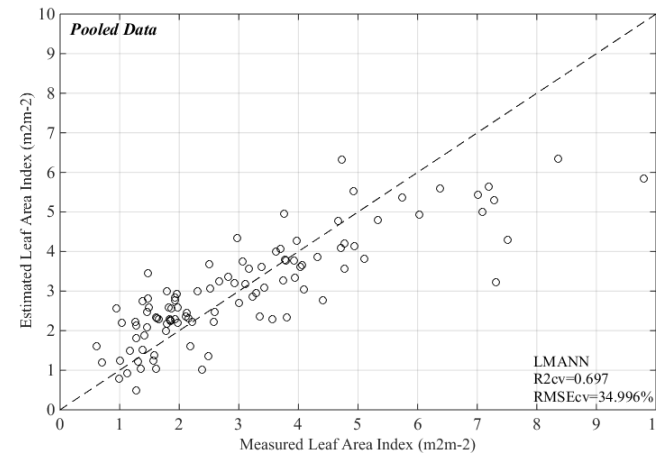
Vegetation indices



PLSR

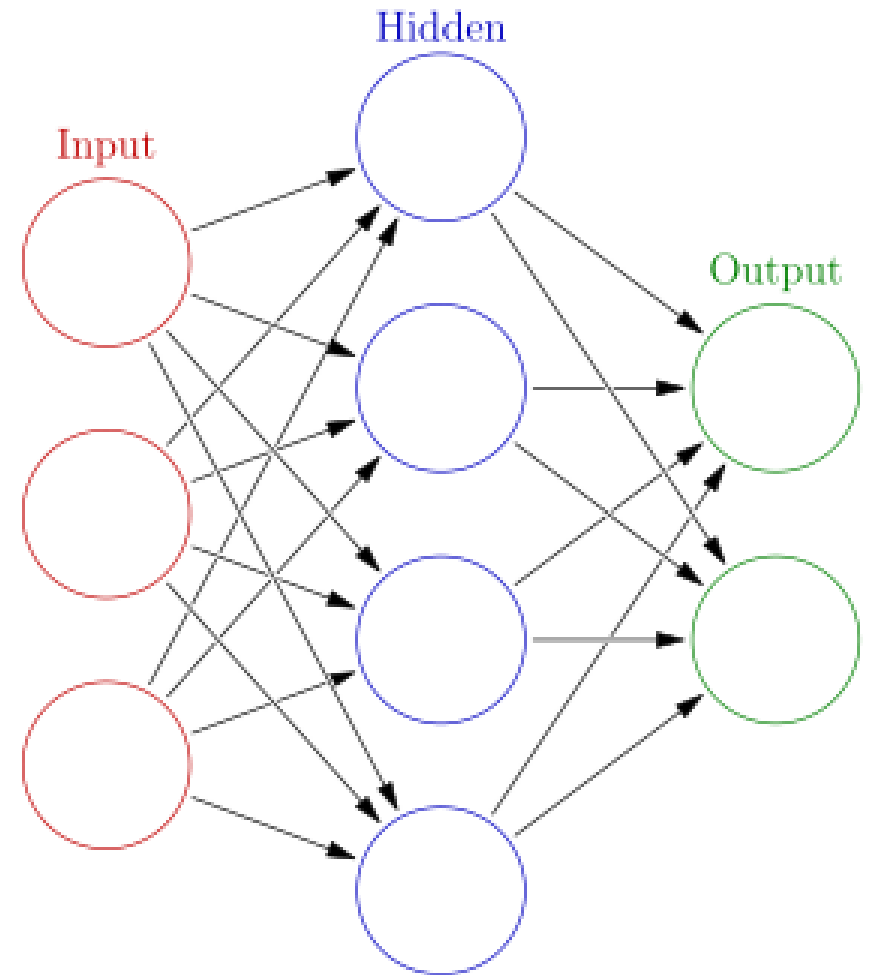


Artificial neural network



Research Objective

- ❖ Evaluate the retrieval of LAI applying artificial neural network using TIR hyperspectral remote sensing data.



Study Area

The study area is in Bavaria Forest National Park.

Elevation in this area ranges from 600 m to 1453 m above sea level.

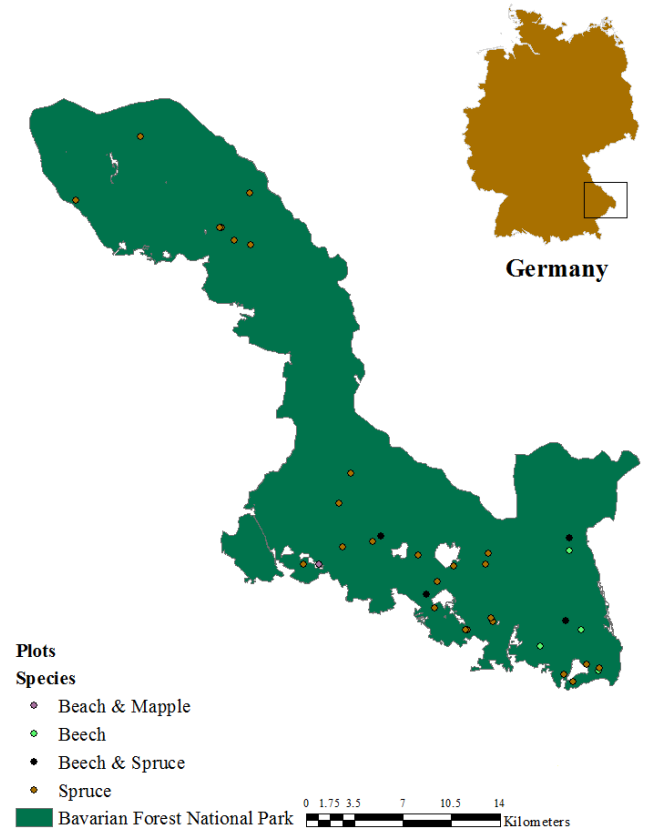
The climate of the region is temperate.

Precipitation varies from 1200 to 1800 mm/year (of which 50% is snow)

Above 1100 m, at high altitude, there are sub-alpine spruce forests with Norway spruce (*Picea abies*) and some Mountain ash (*Sorbus aucuparia*).

On the slopes, between 600 m and 1100 m, mountain mixed forests with Norway spruce, Silver fir (*Abies alba*), European beech (*Fagus sylvatica*), and Norway maple (*Acer pseudoplatanus*) can be found.

In wet depressions in the lower valley (i.e. valley bottoms), Spruce forests mixed with Norway spruce, Mountain ash, and Birches (*Betula pendula*, and *Betula pubescens*) occur.





NATIONALPARK
Bayerischer Wald

Flight Campaign: European Facility for Airborne Research (EUFAR)

Airborne Remote Sensing
for Monitoring Essential
Biodiversity Variables in
Forest Ecosystems
(RS4forestEBV)



Deutsches Zentrum
für Luft- und Raumfahrt



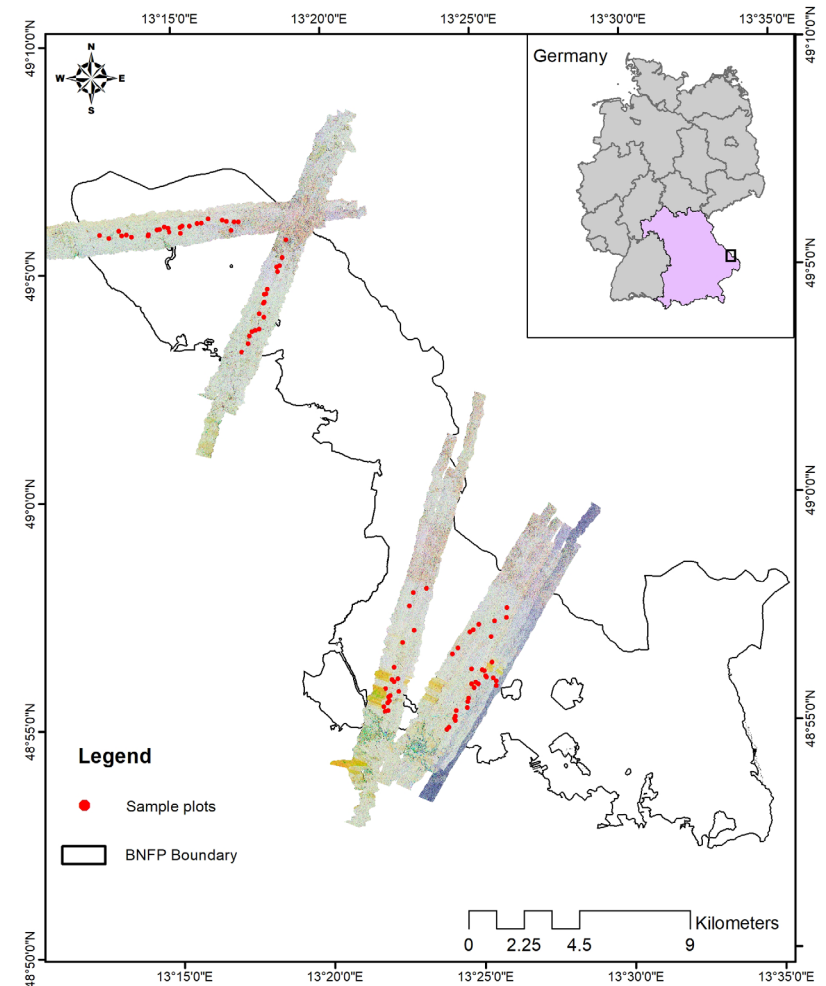
UNIVERSITY OF TWENTE.

TIR hyperspectral images of the study area were acquired under clear skies on the 6th of July 2017.

The data was collected based on 30 flight lines over the Northern and Southern parts of the BNFP operated by NERC-ARF.

Specim's AISA Fenix and AISA Owl were mounted on the aircraft.

During the flight a pair of internal blackbodies that were mechanically switched consecutively for calibration of the sensor.




Specim's Thermal Sensor Aisa-OWL

Specim's thermal sensor OWL is a fast push-broom hyperspectral system designed to provide high-quality remote sensing data.

The AISA Owl covers the contiguous spectral range from 7.6 to 12.3 μm in 102 spectral channels.

The spatial resolution is approximately 3m based on the flight height of 2083m.





**Pre-
processing**

Radiometric characterization and radiance calibration

Data masking, and Geo-correction

Reprojection and Resampling

Temperature emissivity separation



Field Data Collection

The coordinates of 36 plots (30m X 30m) were collected.

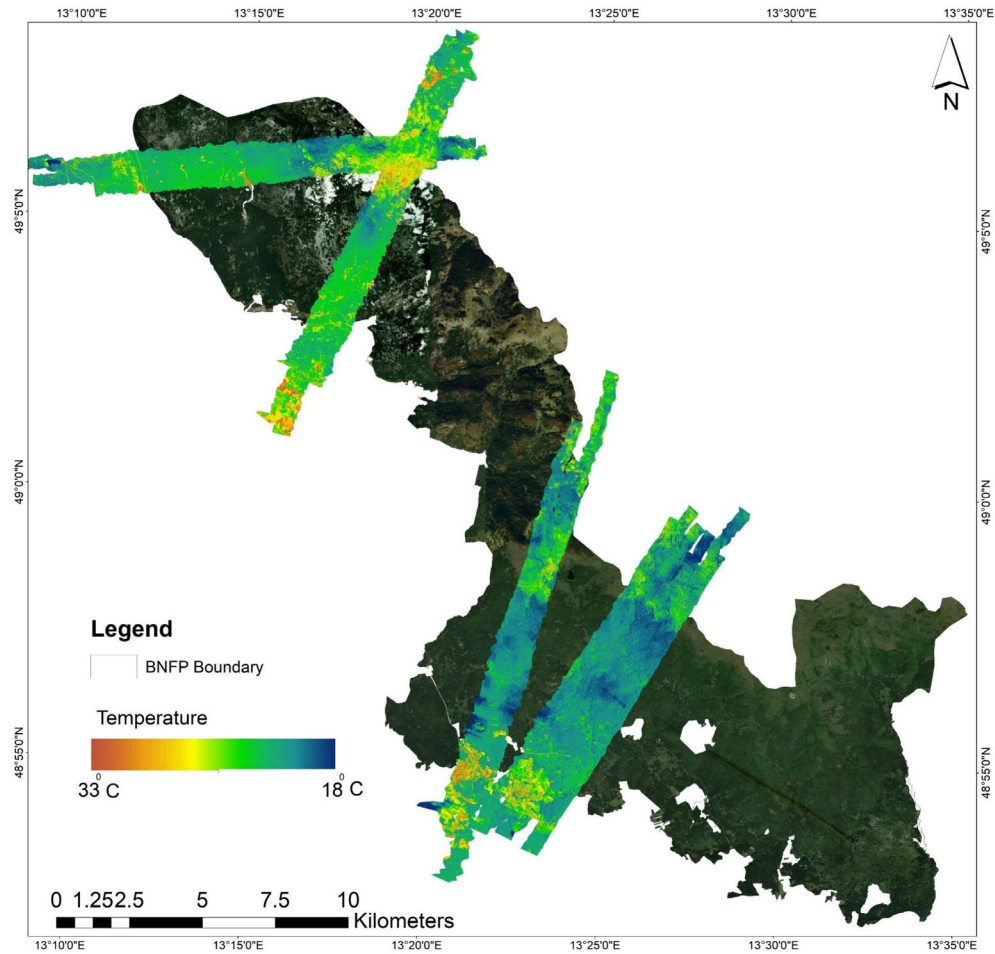


Differential Global Positioning System (Leica 1200) was used to record the center location of each north-oriented plot.

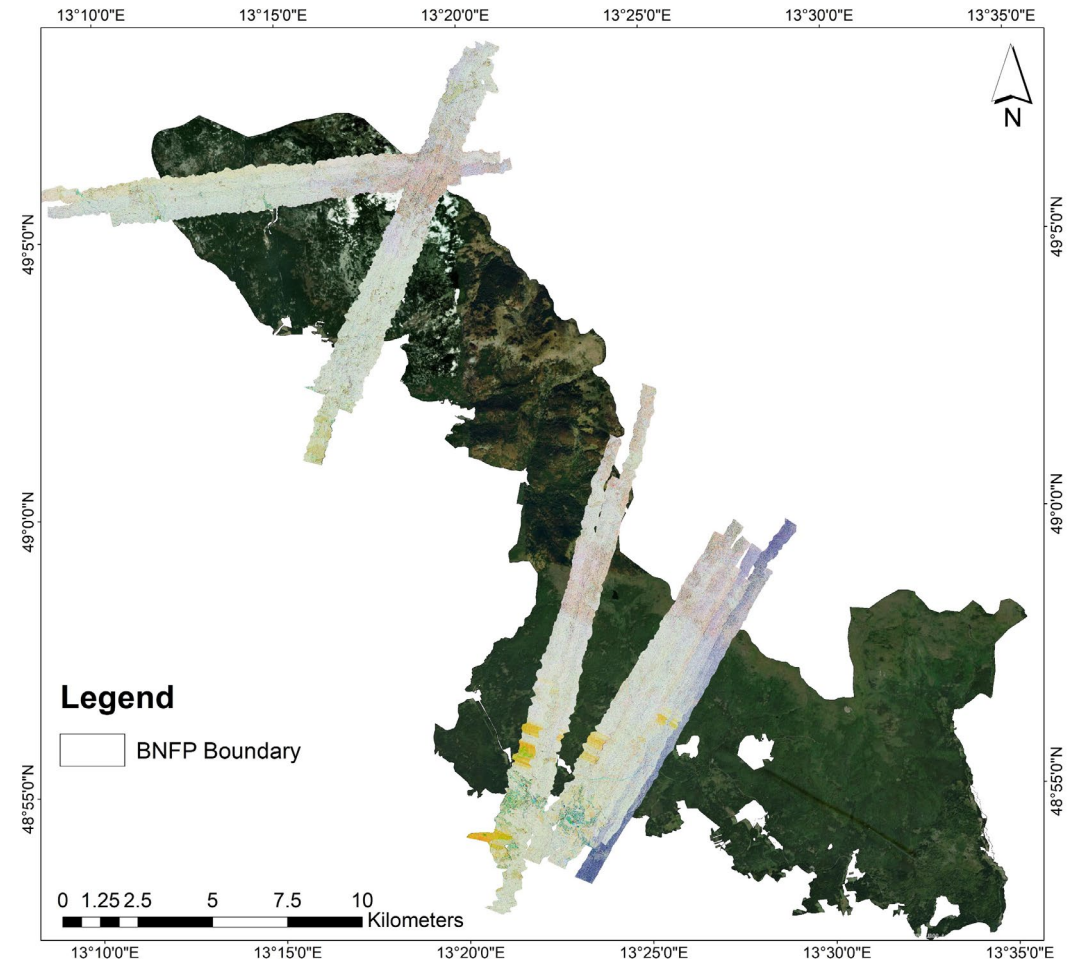
Leaf area index was measured using LI-COR 2200C Canopy Analyzer

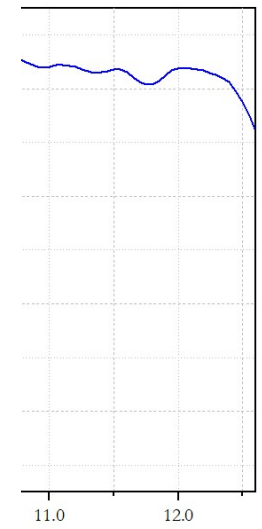
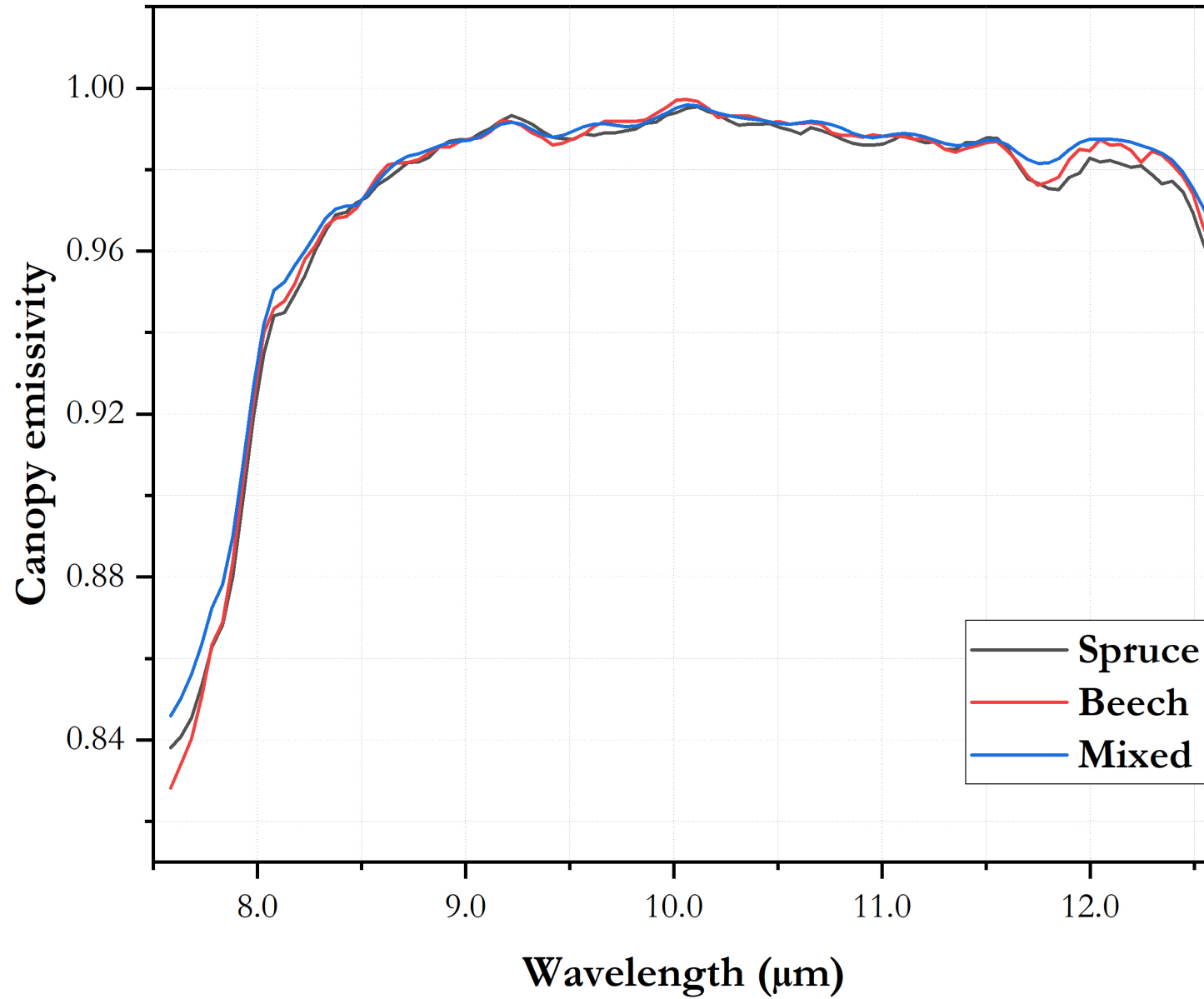
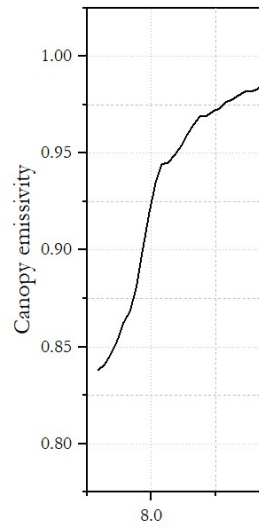


A mosaic of flight lines showing the retrieved land surface temperature from TIR hyperspectral data.

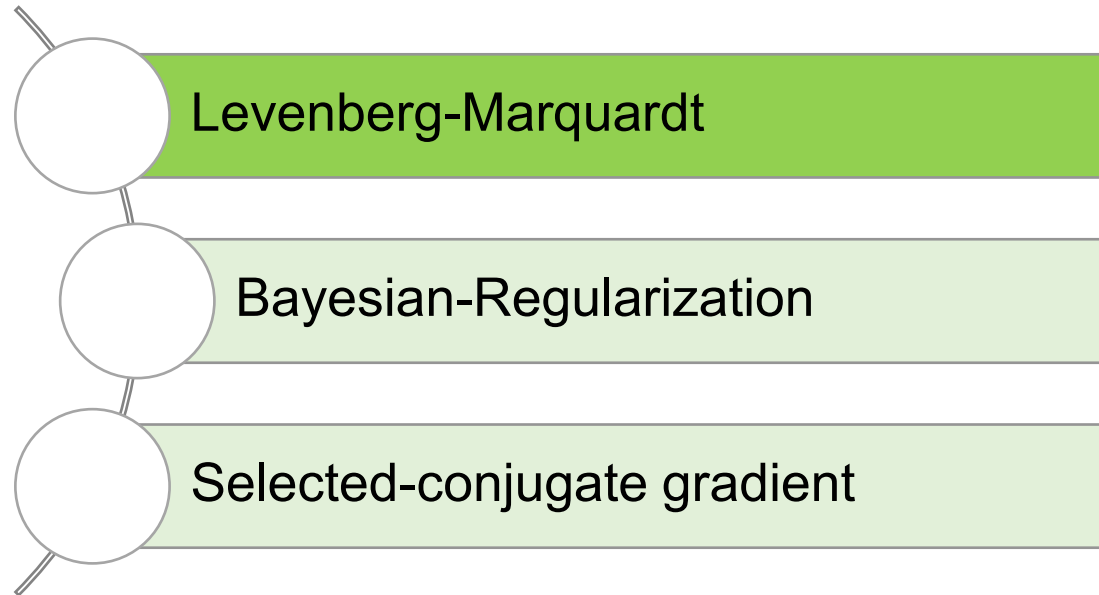


A mosaic of all flight lines showing the retrieved emissivity from TIR hyperspectral data.



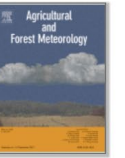


Training algorithm:



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Research Paper

Retrieving vegetation canopy water content from hyperspectral thermal measurements

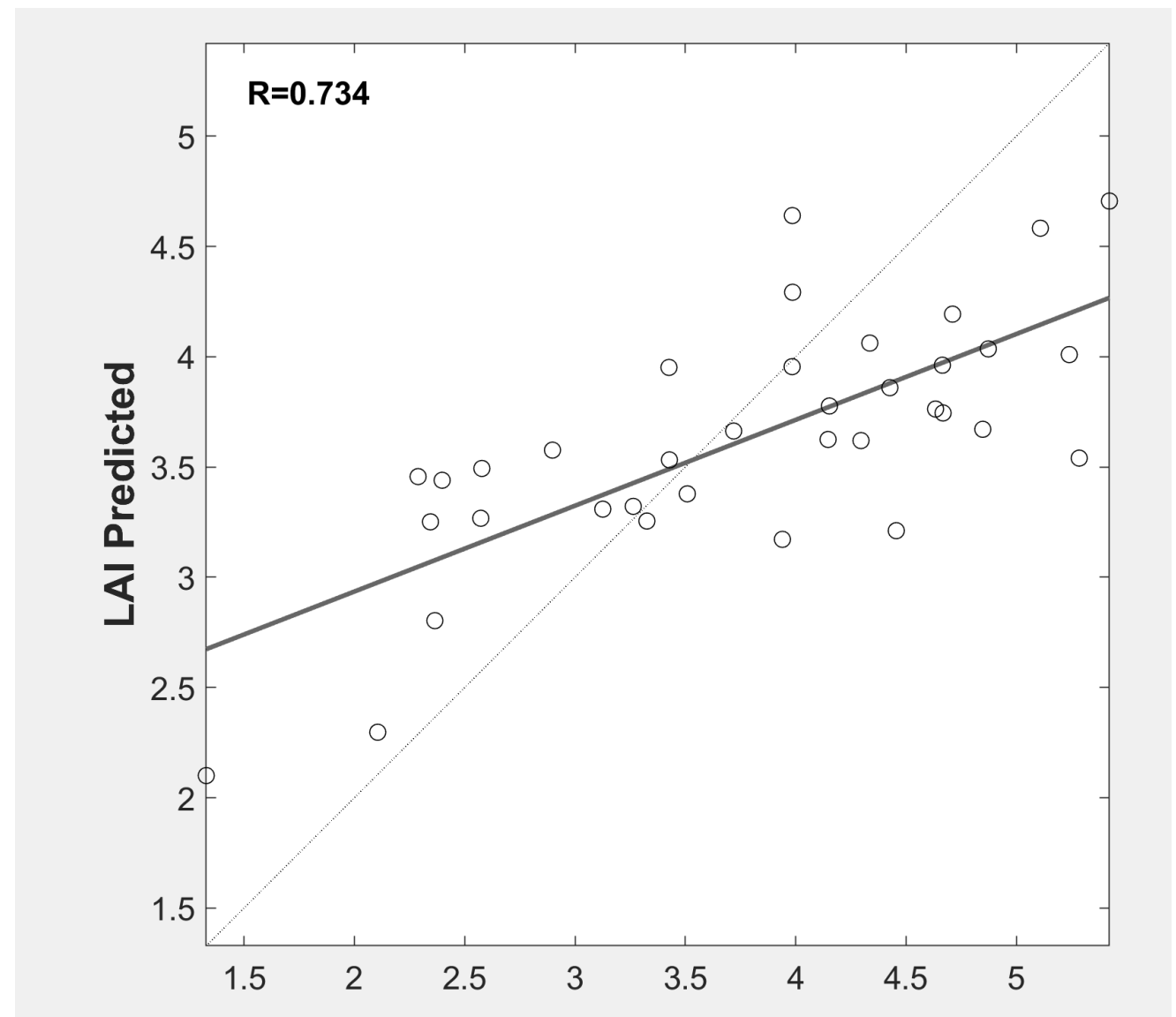
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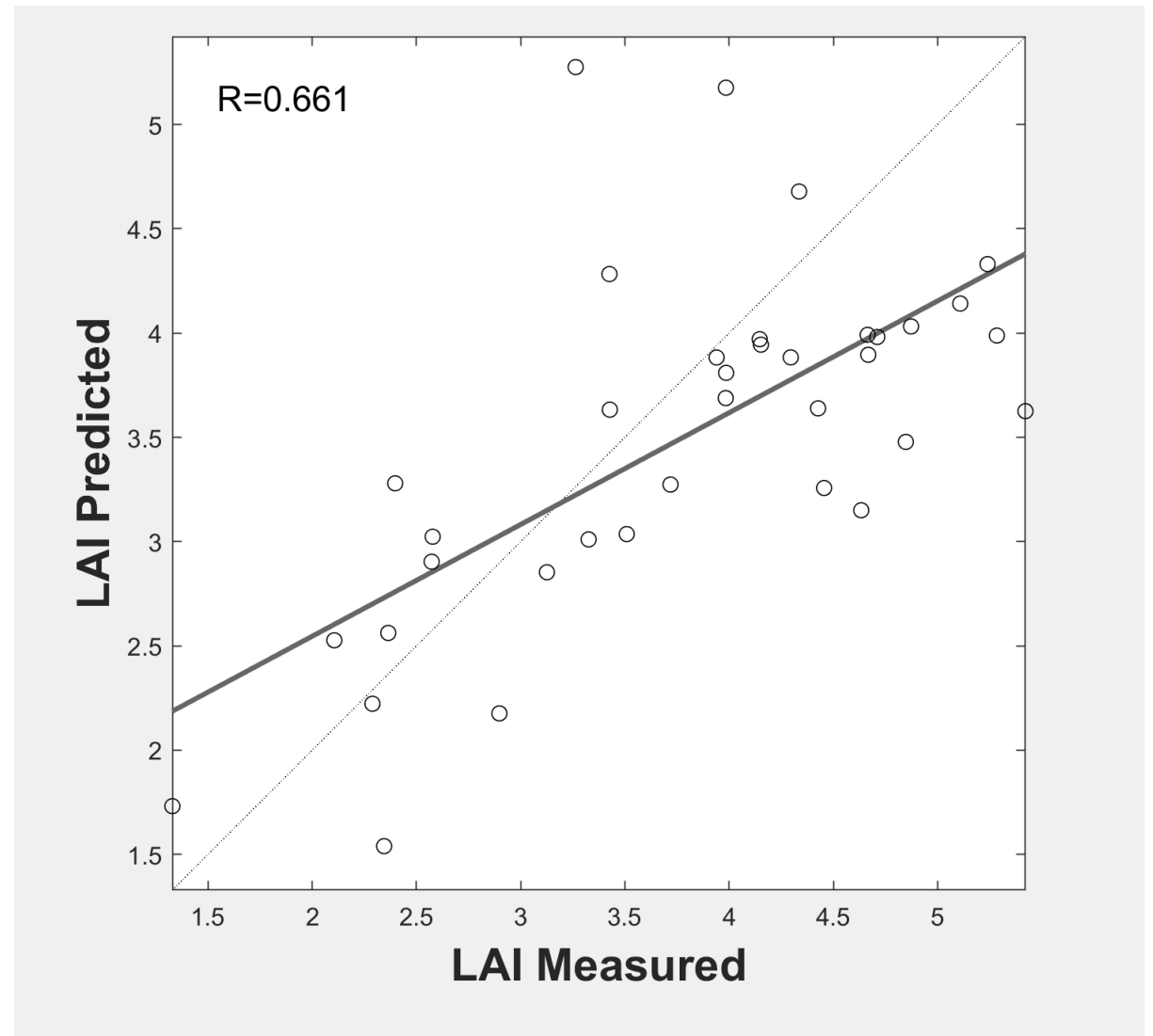
Results

Training algorithm:
Levenberg-Marquardt



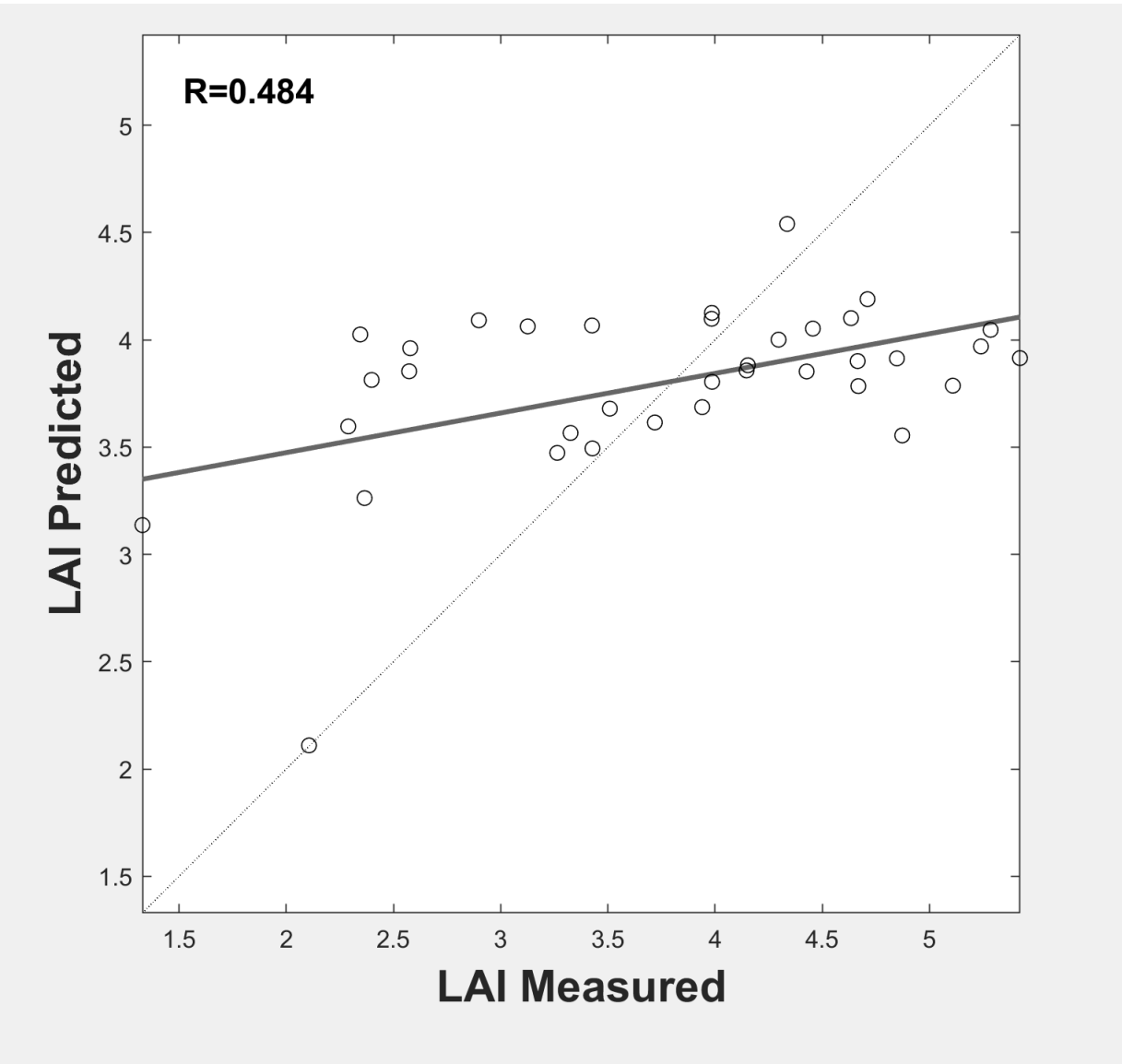


Training algorithm: Bayesian-Regularization





Training algorithm: Selected-conjugate gradient



Conclusion

Leaf area index can be retrieved using airborne TIR hyperspectral data with moderate accuracy by means of artificial neural network.

The results of the LAI prediction accuracy using airborne TIR hyperspectral data rely on selected training algorithm.

Developing TIR based vegetation index

Further investigation needs to be done using Physical model.

Fusion of TIR hyperspectral and LiDAR data



THANK YOU!

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