

FSU activity report: 2015 - 2019

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LIFE Healthy Forest Meeting, Vitoria, 26-27 Mar 2019

Outline



1) Action A2 deliverables: "*Optimization of the integrated systems*"

- Assistance for acquisition of hyperspectral imagery
- Database of plot characterization
- Database of possible predisposing factors for spatial modelling

2) Action B1.1 deliverables: "*Spatial mapping using statistical and machine-learning data analysis*"

- Remotely sensed forest health map
- Maps of forest disease potential

3) Action D3: "*Complementary Actions*"

- Summer school Jena March 2017



Action A2.1.6: Acquisition of hyperspectral imagery



A2.1.1: Field monitoring and sampling



Pathogen presence/absence

NEIKER provided field sampling data for the following pathogens:

- *Armillaria mellea*: 1016 obs. (395/621) (after cleaning)
- *Diplodia sapinea*: 922 obs. (700/222) (after cleaning)
- *Fusarium circinatum*: 922 obs. (781/141) (after cleaning)
- *Heterobasidion annosum*: 1016 (785/231) (after cleaning)

A2.1.1: Field monitoring and sampling



Defoliation data

NEIKER gathered in-situ information in 2016 and 2017.

2016

- Demonstration plots (Luiando, Oiartzun, Laukiz 1-3, Hernani)
- Sampling of all trees in the plot
- Total amount of sampled trees: ~ 1800

2017

- Sampling of all 28 plots (Total # of obs.: 1400)
- 50 trees per plot
- Sampling scheme from FSU

A2.1.4: Envir. condi. as predisp. factors



The following variables were collected:

- Long-term **precipitation** (1950 - 2000)
- Long-term **temperature** (1950 - 2000)
- Long-term **PISR** (1950 - 2000)
- **Soil** type (at 250 m res.)
- **Lithology** type (at 1 km res.)
- **pH** value (at 1 km res.)
- Probability of **hail damage** at trees (200 m res.)

A2.1.6: Hyperspectral img acquisition



- Hyperspectral imagery was acquired by HAZI in September 2016 for all plots (28 in total)
- Unfortunately, one of the five "demonstration plots" ("hernani") was not covered by the flight mission
- FSU helped with the planning of the flight routes (Marco Pena)

A2.1.6: Hyperspectral img acquisition



- Hyperspectral satellite Hyperion-1 was decommissioned in January 2017 without prior notice
- Hyperspectral Airborne AVIRIS data as a replacement not suitable (price, flights only in US)
- No other spaceborne hyperspectral sensor available

A2.1.6: Hyperspectral img acquisition



→ We acquired spaceborne multispectral **Sentinel-2** data as an alternative for Hyperion-1 data.

Available cloud-free mosaics of the Basque Country for the vegetation period (April - September)

- 2017: 3
- 2018: ?

A2 Deliverables



- Acquisition of hyperspectral imagery
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B1.1: Spatial mapping



Defoliation mapping

1. Training of an **Extreme Gradient Boosting** (xgboost) model

- ~ 7500 Variables
 - 90 Vegetation Indices (VI)
 - 7400 Normalized Ratio Indices (NRI)

1. Extraction of the most important variables → 7

2. Prediction of defoliation (Basque Country; 2017 + 2018)

Defoliation mapping

Model Performance

RMSE: ~ 40 (defoliation)

Most Important Vegetation Indices

- "EVI",
- "GDVI_2", "GDVI_3", "GDVI_4",
- "mNDVI",
- "mSR",
- "D1"

B1.1: Spatial mapping



Defoliation mapping (prediction maps)

Pathogen modeling

Tuning and training of 7 classifiers for each pathogen

- Random Forest
- Support Vector Machine
- Boosted Regression Trees
- Generalized Additive Model
- Generalized Linear Model
- Extreme Gradient Boosting
- k-Nearest Neighbor

B1.1: Spatial mapping



Pathogen modeling

- Performance evaluation for all combinations (28)
- Creation of prediction maps for all combinations (28)

Best classifier (Performance)

- Armillaria: ()
- Diplodia: Random Forest ()
- Fusarium: ()
- Heterobasidion: ()

B1.1: Spatial mapping



Pathogen modeling (prediction maps)

B1.1: Deliverables



- Remotely-sensed forest health map
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D3: Complementary Actions



FSU hosted a training school on "**statistical analysis of hyperspectral data**".

Date: March 2017

Duration: 5 days (full-time)

Statistics

- 54 applications
- 28 (international) participants

Participant report: <https://www.r-spatial.org/r/2017/03/25/spring-school-jena.html>

Speaker list

- Marco Peña (Alberto Hurtado University, Chile)
- Aneta Modzelewska (Forest Research Institute, Raszyn, Poland)
- Dr. Henning Buddenbaum (University of Trier, Germany)
- Dr. Tim Appelhans (University of Marburg/GfK Geomarketing Nürnberg, Germany)
- Dr. Thomas Bocklitz (IPC Jena, Germany)
- Prof. Dr. Alexander Brenning (FSU)
- Dr. Jannes Muenchow (FSU)
- Patrick Schratz (FSU)

D3: Complementary Actions

