MAPPING DYNAMICALLY CHANGING MOUNTAIN VEGETATION FROM ABOVE

-how is it possible?-

UNIWERSYTET WARSZAWSKI

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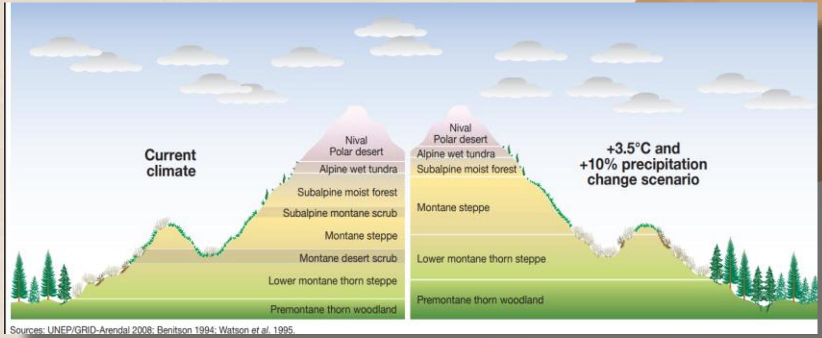
E-TRAINEE

„EnviLink – międzynarodowa platforma wymiany doświadczeń młodych naukowców w badaniach przyrodniczych”, Sękocin Stary, 15-17.05.2024 r.

MOTIVATION



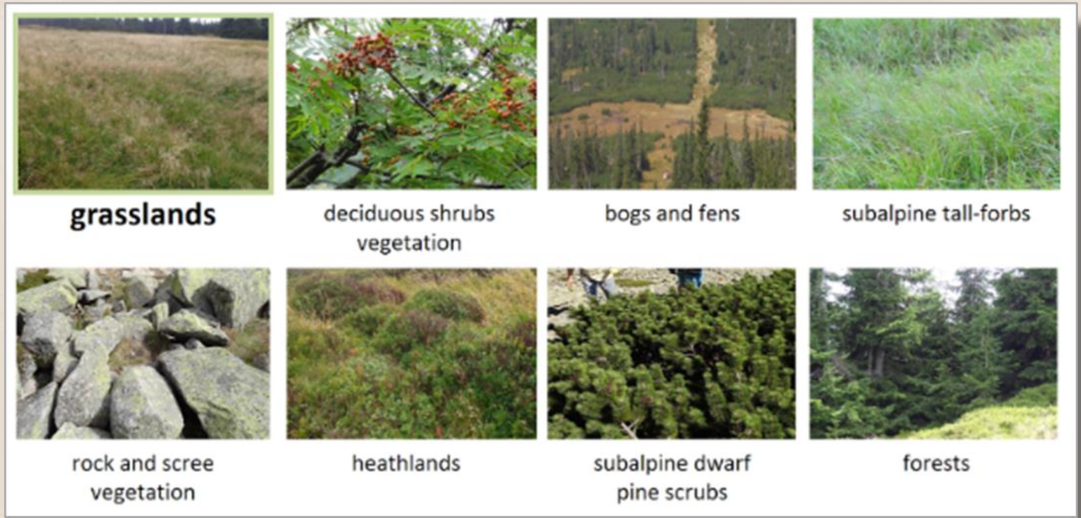
- Mountain vegetation is...
  - a great indicator of climate changes
    - upper treeline changes, dwarf pine shrubs expansion
  - unique
    - needs to be protected and monitored

- Field works are...
  - limited (height differences, weather conditions etc.)
- Remote sensing is...
  - the best
  - brings the possibility to monitor, regardless the limitations

Snow cover in the Sierra Nevada in California on March 27, 2010, left, and March 29, 2015. Credit Jesse Allen/NASA Earth Observatory

STUDY AREA

- Polish and Czech Karkonosze/Krkonoše Mountains.
- The highest parts of the mountains cover two plant floors: subalpine (1250-1450 m a.s.l.) and alpine (above 1450 m a.s.l.).



GRASSLANDS

- Changes during growing season
- Discolouration of species

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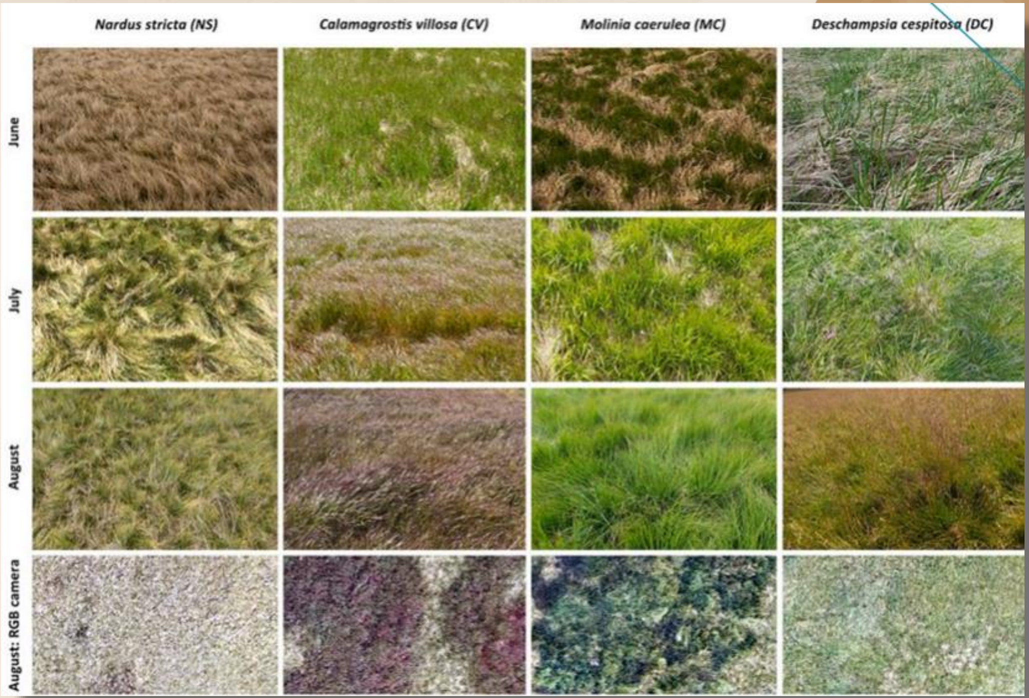


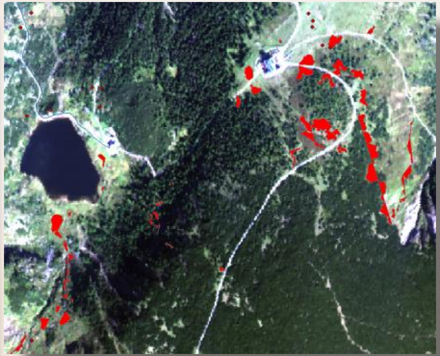
Kupkova et al. (2023)

DATA USED

https://www.esa.int/

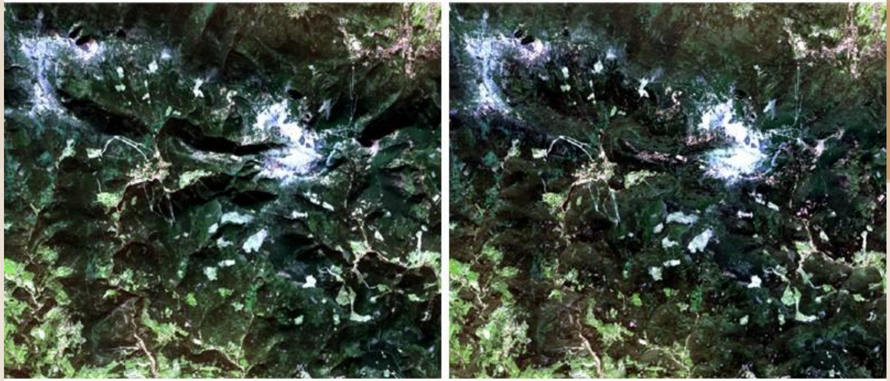
- Multitemporal European Space Agency **Sentinel-2** mission data, level 2A, 10 m
  - **2018**: 14 May, 31 May, 7 August, 27 August, 18 September
  - **2019**: 25 June and 30 June
- field data collected in 2013-2014
  - (updated to 2018-2019 based on high-res. data interpretation) for classification of vegetation types.

Band	Resolution	Central Wavelength	Description
B1	60 m	443 nm	Coastal/Aerosol
B2	**10 m**	**490 nm**	**Blue**
B3	**10 m**	**560 nm**	**Green**
B4	**10 m**	**665 nm**	**Red**
B5	**20 m**	**705 nm**	**Visible and Near Infrared (VNIR)**
B6	**20 m**	**740 nm**	**Visible and Near Infrared (VNIR)**
B7	**20 m**	**783 nm**	**Visible and Near Infrared (VNIR)**
B8	**10 m**	**842 nm**	**Visible and Near Infrared (VNIR)**
B8a	**20 m**	**865 nm**	**Visible and Near Infrared (VNIR)**
B9	60 m	940 nm	Short Wave Infrared (SWIR)
B10	60 m	1375 nm	Short Wave Infrared (SWIR)
B11	**20 m**	**1610 nm**	**Short Wave Infrared (SWIR)**
B12	**20 m**	**2190 nm**	**Short Wave Infrared (SWIR)**



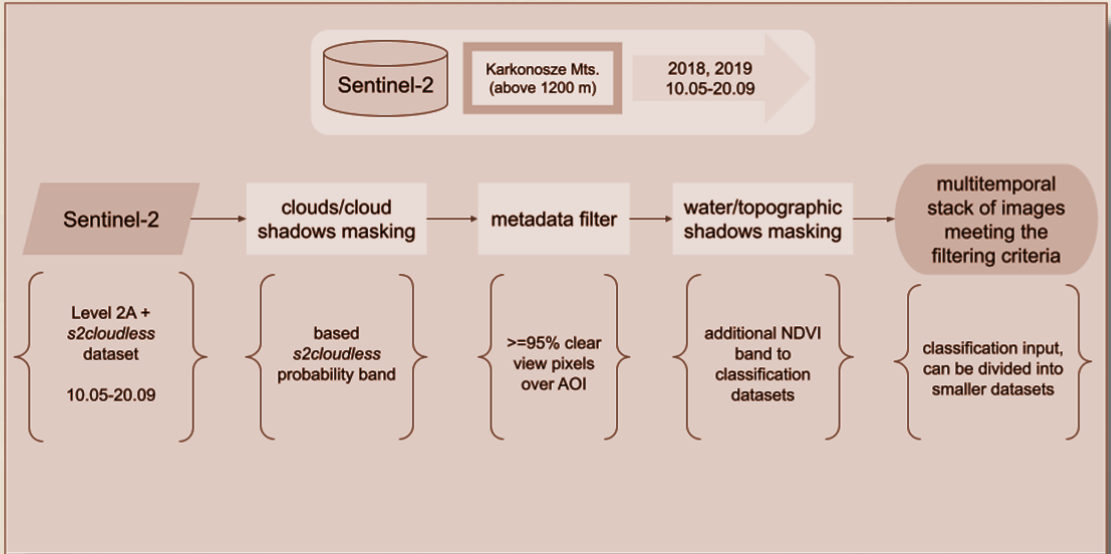
METHODS

- Selection of data
- Initial preprocessing →
  Google Earth Engine platform



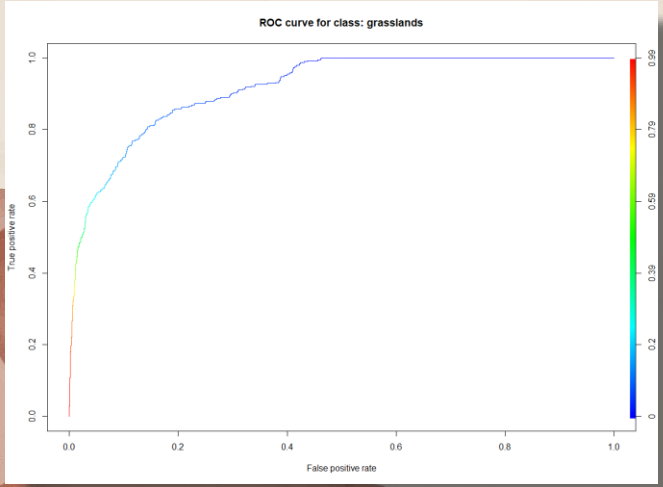
Before topographic correction After topographic correction

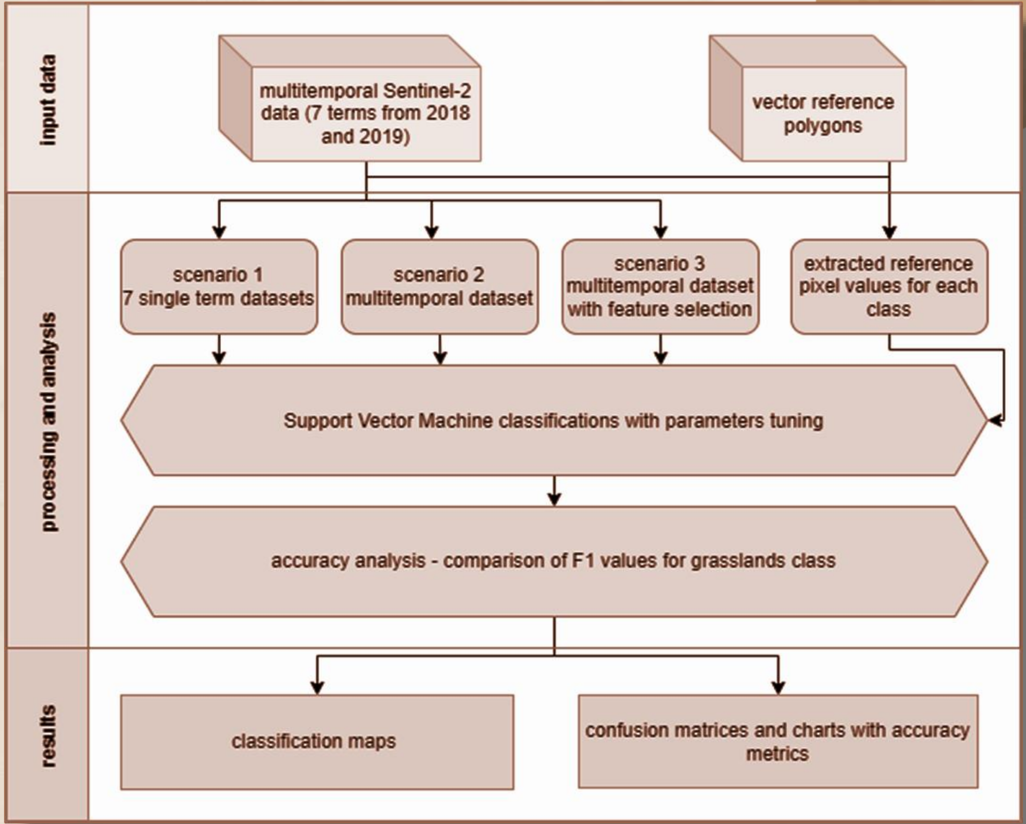
```
// Define AOI
var AOI = ee.FeatureCollection("projects/etrainee-module2/assets/aoi_karkonosze_sentinel"

// Pan to and display area of interest
Map.centerObject(AOI, 11);
Map.addLayer(AOI, {'color': 'darksalmon'}, 'Karkonosze');

// Define date ranges for filtering image collection
var startDate = '2022-06-01';
var endDate = '2022-10-31';
```



METHODS

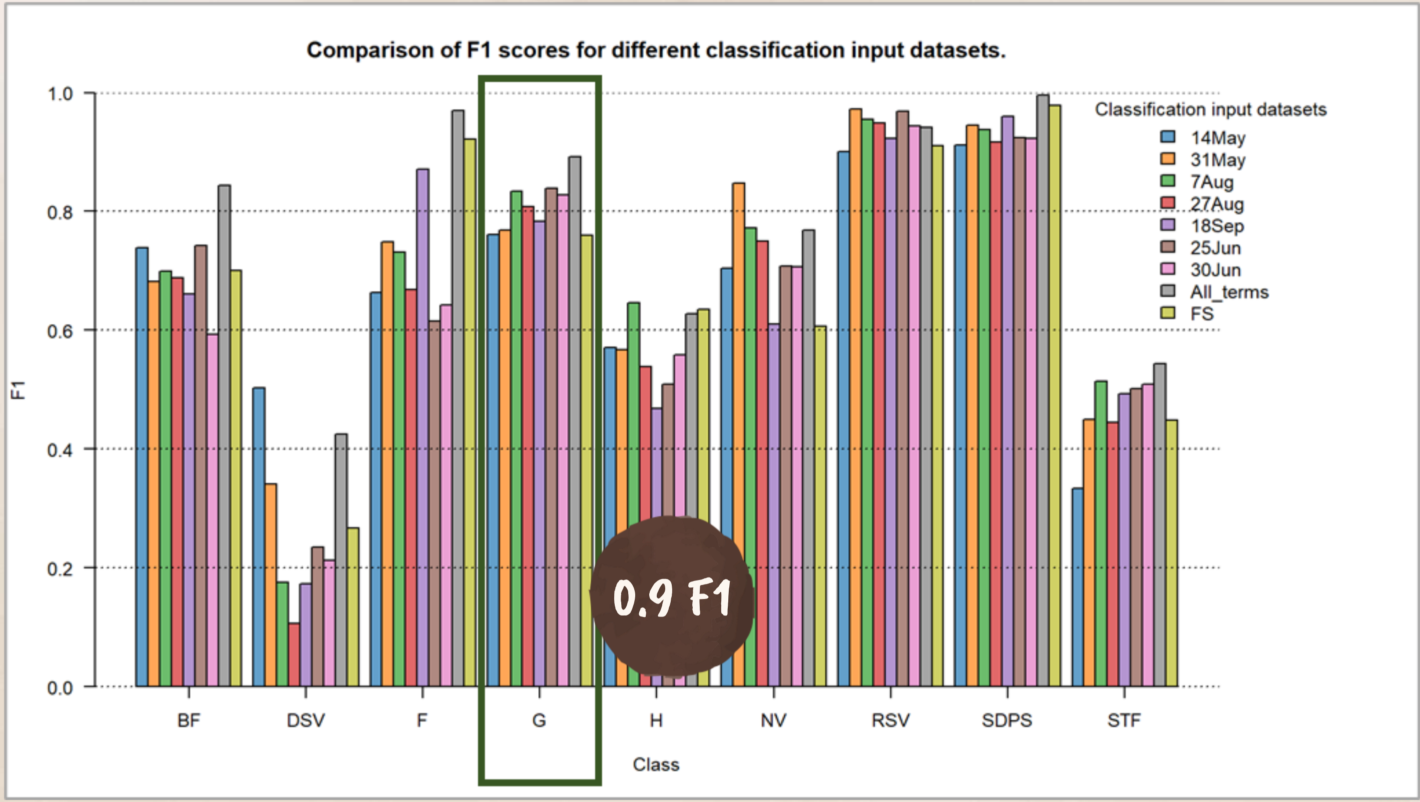
- Three scenarios of classification
- Feature selection using Receiver Operator Characteristic curves analysis, 10 features selected
- Evaluation by F1 score measure that combines precision and recall scores of a model for each class
- Rstudio





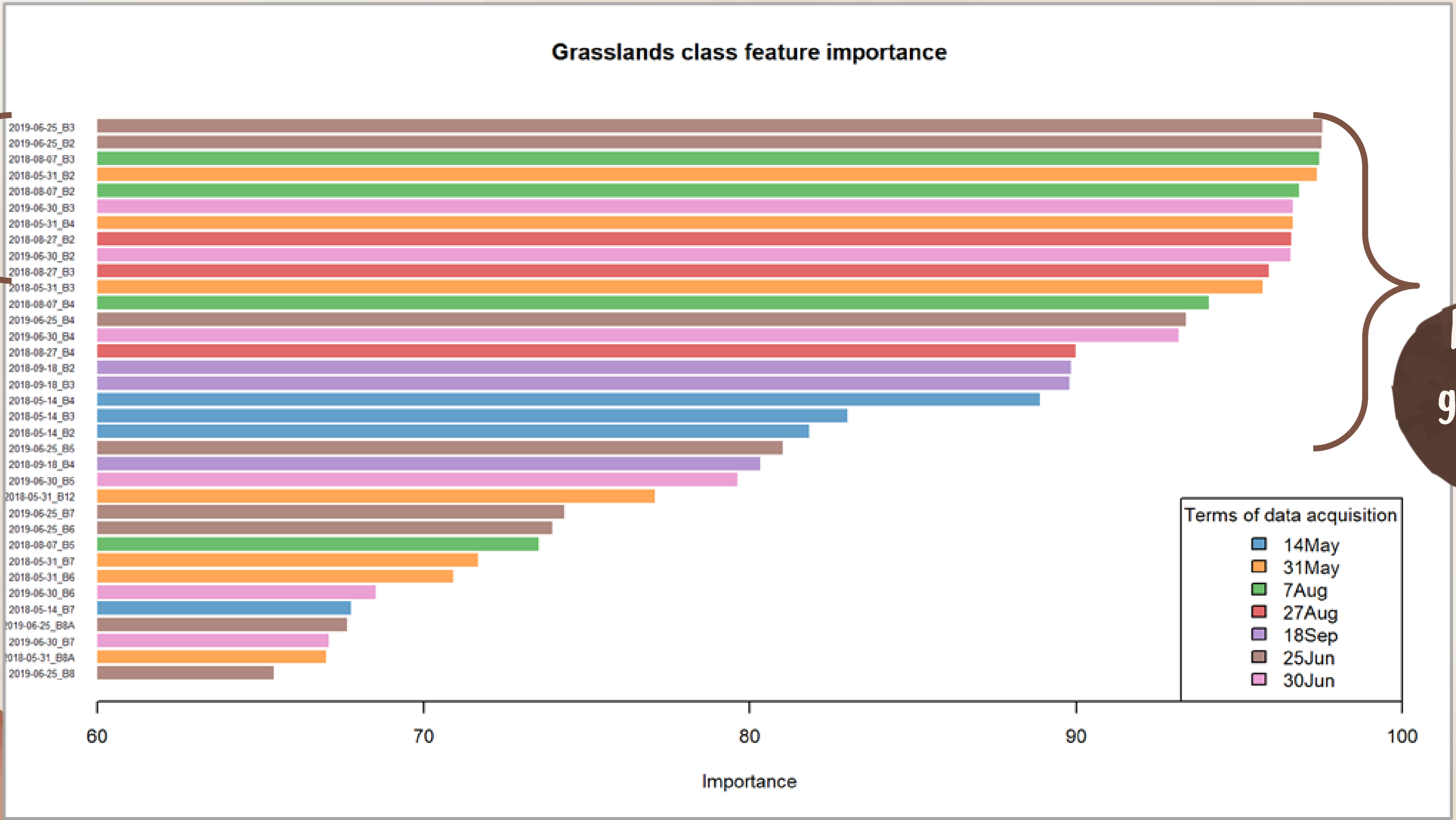
RESULTS

bogs and fens (BF),
deciduous shrubs vegetation (DSV),
forests (F),
grasslands (G),
heathlands (H),
non-vegetation (NV),
rocks and scree vegetation (RSV),
subalpine dwarf pine scrubs (SDPS),
subalpine tall-forbs (STF).



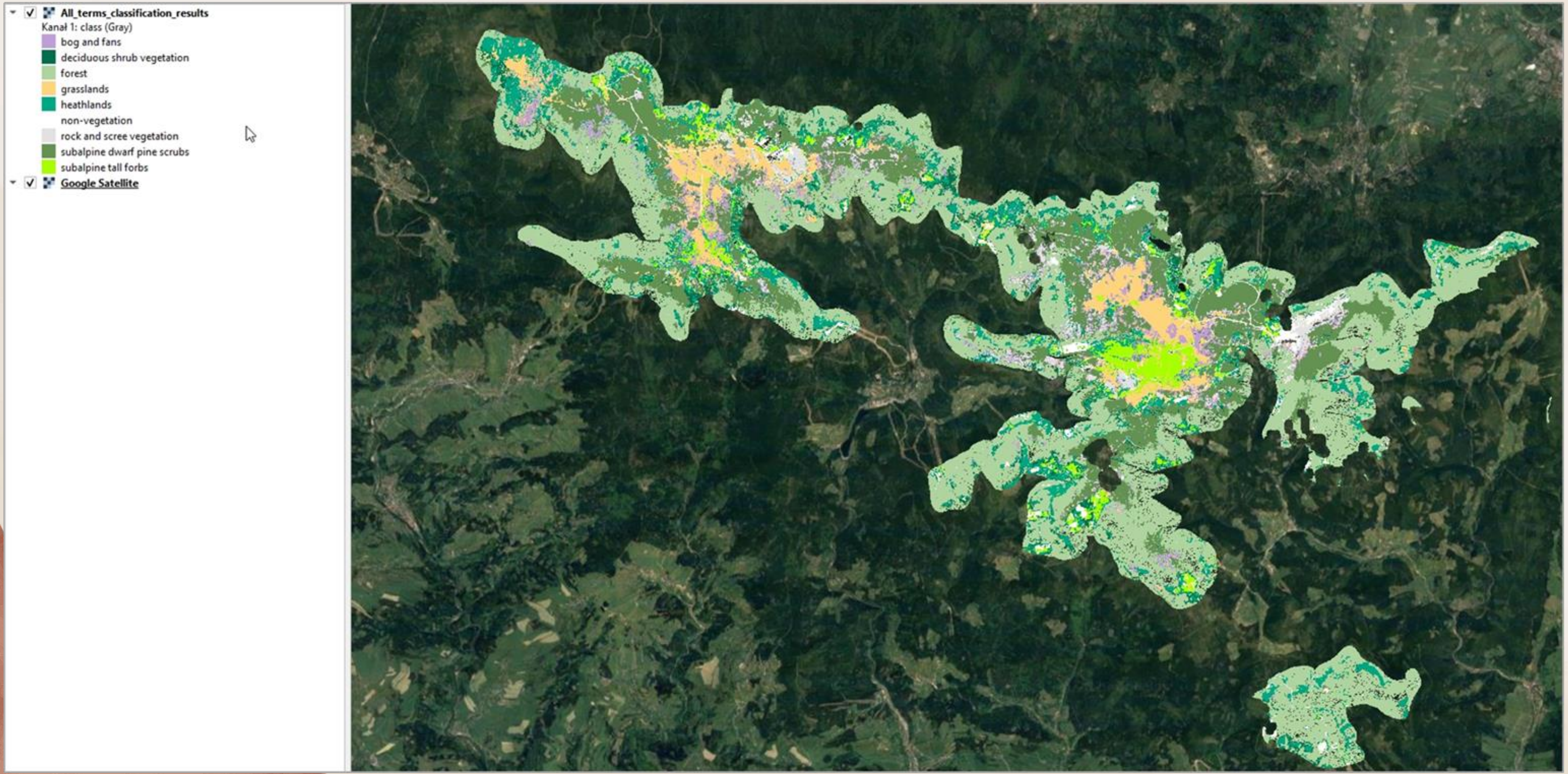
RESULTS

10 selected



blue, green, red

RESULTS



All_terms_classification_results
Kanał 1: class (Gray)
bog and fans
deciduous shrub vegetation
forest
grasslands
heathlands
non-vegetation
rock and scree vegetation
subalpine dwarf pine scrubs
subalpine tall forbs
Google Satellite

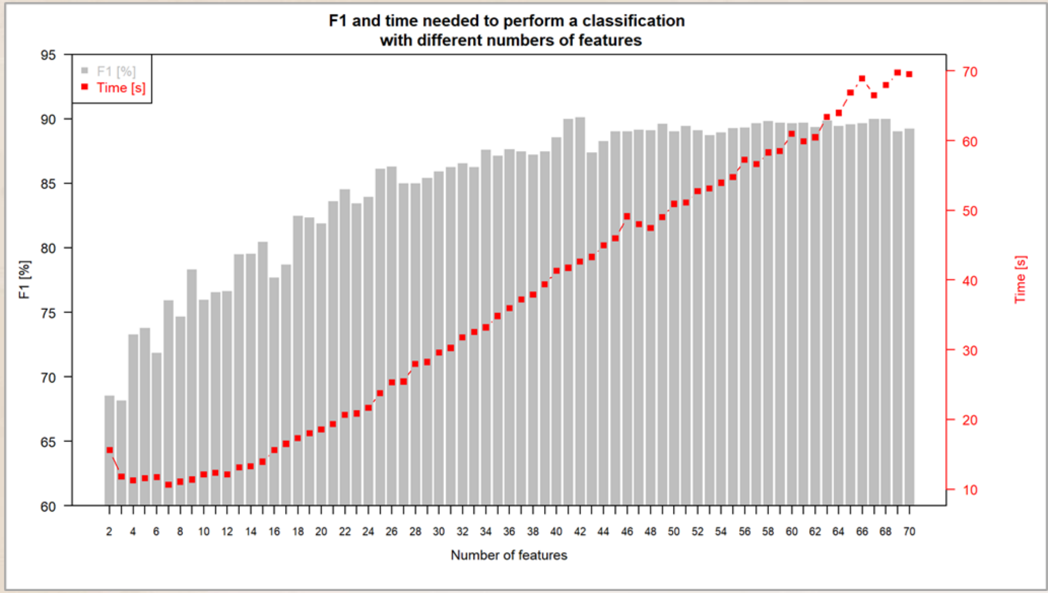
CONCLUSIONS (1)

- **Multitemporal Sentinel-2 data** allowed to distinguish grasslands with high F1 accuracy.
- Separate classification of terms identified data acquired in **June and August** as the best for grasslands mapping. This is confirmed by the top of variable importance plot analysis conducted on the **entire multitemporal dataset**.
- However, the differences in accuracies obtained for individual terms do not exceed 0.1 F1 score value.

- In the analysis of variable importance for grasslands, a clearer advantage was observed for **bands in the visible range** (B2, B3, B4) than for any particular term.
- This may be related to the **dynamics of this class**, as seen through the changing colors of species during the growing season.

CONCLUSIONS (2)

- The set consisting of **all terms** yielded the best results.
- In further steps, it might be considered to **increase the number of variables** used in the selection process.
- While selecting 10 variables for the case study did not improve accuracy, an analysis of the graph showing the relationship between time, number of variables, and accuracy suggests that increasing the number of significant variables could **lead to obtain more satisfactory results**.



THANK YOU FOR YOUR ATTENTION

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E-TRAINEE Erasmus+

Presented research is based on the first case study presented within Module 2 of an open E-learning course on Time Series Analysis in Remote Sensing for Understanding Human-Environment Interactions (E-TRAINEE, Erasmus+Strategic partnership, ID 2020-1-CZ01-KA203-078308) developed within collaboration of four research groups from Charles University, Heidelberg University, University of Innsbruck, and University of Warsaw.

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E-TRAINEE Course

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Prerequisites

Module 1

Module 2

Overview

Principles of multispectral imaging

Temporal information in satellite data

Image processing

Multitemporal classification

Vegetation change and disturbance detection

Case studies

Case study: Monitoring tundra grasslands (Karkonosze/Krkonoše Mountains)

Case study: Effects of pollution in Ore Mountains

Case study: Forest disturbance detection (Tatra Mountains)

Module 3

Module 4

E-TRAINEE

E-learning course on Time Series Analysis in Remote Sensing for Understanding Human-Environment Interactions (E-TRAINEE) was developed by collaboration of research groups from four partner universities – Charles University, Heidelberg University, University of Innsbruck, and University of Warsaw within the ERASMUS+ Strategic partnership project (ID 2020-1-CZ01-KA203-078308).

E-TRAINEE

The course provides a theoretical background to methods used for information extraction from time series of remote sensing data. It consists of the following Modules:

- Module 1: Methods of Time Series Analysis in Remote Sensing
- Module 2: Satellite Multispectral Images Time Series Analysis

remote sensing

MDPI

Article

Multi-Temporal Sentinel-2 Data in Classification of Mountain Vegetation

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Received: 30 June 2020; Accepted: 19 August 2020; Published: 20 August 2020