Remote sensing data processing at the Institute of Electronics and Computer Science (EDI)

Ints Mednieks
mednieks@edi.lv

Facts and numbers about EDI

Founded:
1960

Location:
Riga, Latvia

Personnel:
130+

Building area:
16 000 m^2

No. of Labs:
6

Signal Processing Lab.
Space Technology Lab.
Robotics and Machine perception Lab.
Cyber-Physical systems Lab.
Integrated circuit and systems Lab.
Energy research center (Lab.)

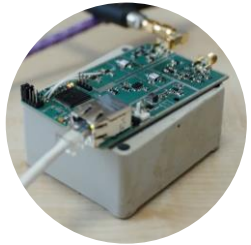
Equipment:
Multi-million state of the art equipment

International evaluation:
Highest rated institute in Latvia in the field of engineering and technologies

Collaboration:
500+ scientific and industrial partners worldwide

EDI expertise

Radar technologies

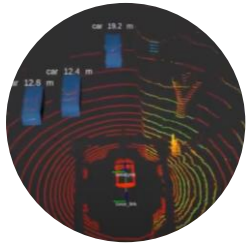


Custom HW

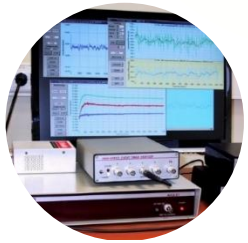
Drone technologies

Wearable devices

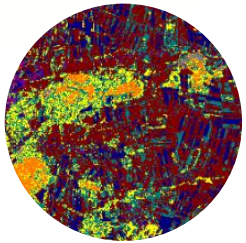
Intelligent Transport systems



Connected and automated driving



Space technologies



Remote sensing

EDI in HORIZON EUROPE

2022

- OPENDBL — 13 partners, 8 countries, 5.5M€ budget
- AUGMENTED CCAM — 26 partners, 12 countries, 11M€ budget
- Powerize D — 65 partners, 12 countries, 73M€ budget
- A-IQ-READY — 50 partners, 14 countries, 38M€ budget
- SustrOnics — 46 partners, 11 countries, 30M€ budget
- R-PODID — 33 partners, 11 countries, 24M€ budget
- AIMS 5.0 — 53 partners, 11 countries, 70M€ budget
- Cynergy4MIE — 44 partners, 16 countries, 38M€ budget
- **5 partners, 5 countries, 2M€ budget** — GoIT
- 11 partners, 6 countries, 5.8M€ budget — PRAESIIDIUM
- 11 partners, 9 countries, 1,44 M€ budget — ESCU LAPE
- 30 partners, 10 country, 30M€ budget — EDGE AI
- 48 partners, 10 countries, 40M€ budget — ARCHIMEDES
- 47 partners, 9 countries, 36M€ budget — AI EcoMobility
- 41 partners, 12 countries, 34M€ budget — SHAPEFUTURE
- 49 partners, 15 countries, 16M€ budget — MOSAIC

Infineon
SIEMENS
NXP
csem
zhaw
PHILIPS
VOLVO
Fraunhofer
SIOUX
CCM
DAIMLER
ON Semiconductor
Technolution
IISB
tecnalia
TTTech
THALES
iMinds
IK4 TEKNIKER
EPFL
ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE
ETH Zürich
indra
virtual vehicle
AVL
muRata
Innovator in Electronics
IXION
industry and aerospace
open engineering
IFEVS
AIRBUS DEFENCE & SPACE
acciona Engineering
IMA
Sustain Ability
Holst Centre
Open Innovation by imec and TNO
nexperia
TNO innovation for life
INL
INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY
Johnson&Johnson Vision Care
ROVIMATICA
ROBOTICA · VISION · AUTOMATIZACION
ZÁPADOČESKÁ UNIVERZITA V PLZNI
Centria
cea
gmv
METU
OKMETIC
ITRI
Industrial Technology Research Institute
DISTRICT
SOLBIAN
GEFRAN
TU Graz
Valeo
Consiglio Nazionale delle Ricerche
VTT
ADVANCED AUTOMOTIVE ANTENNAS
HUTCHINSON
TENNECO
OFFIS
TU/e
FICOSA
QinetiQ
reden
research development nederland
Ideas&Motion
ADEVICE
VILNIUS GEDIMINAS TECHNICAL UNIVERSITY
TALLINN UNIVERSITY OF TECHNOLOGY
MetisBaltic
TECHNISCHE UNIVERSITÄT DRESDEN
UCC
LANGE
ingeniamc
motion control
ENEA
SATSDIFACTION
9.9.2025

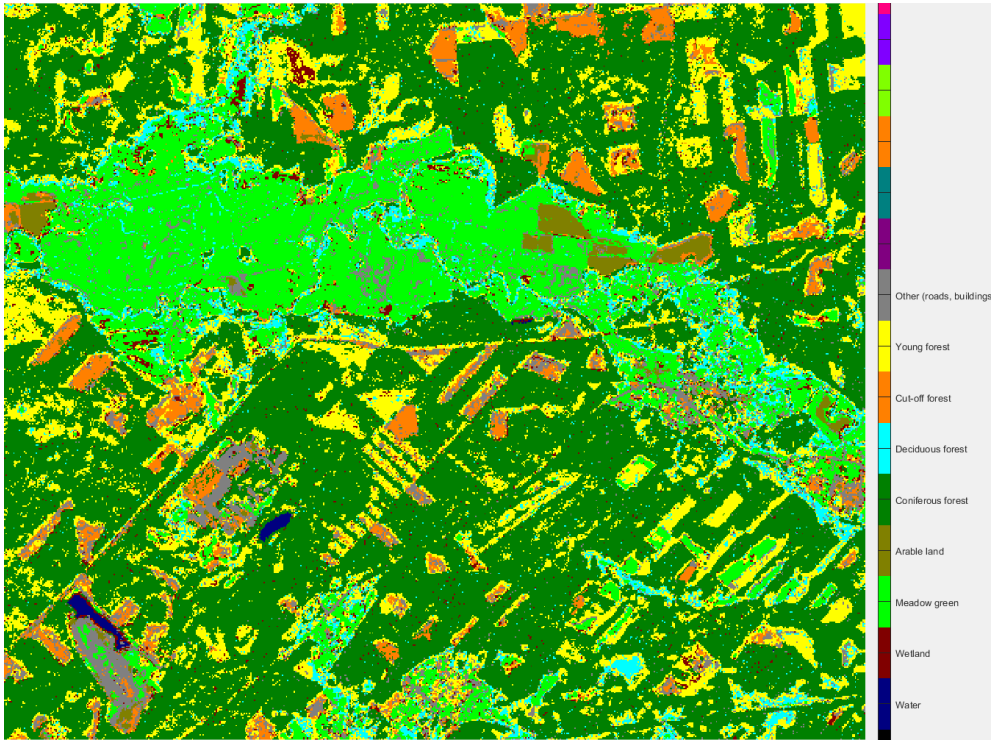
Remote sensing group of EDI

Development and software implementation of custom methods for image processing

- Finished projects
  - Identification of tree species by processing multispectral and LiDAR data (2009-2011) **Contracts with industry**
  - **Dviete** - Discrimination between meadow habitats (finding diversity of plants) (2011-2012) **EU LIFE+ project**
  - **InBiT** - Biomedical image processing (2013- 2015)
  - **GudPils** – remote sensing image processing for smart cities (2014-2017)
  - **DynLand** - Dynamic land use monitoring by fusion of satellite data (2016-2019) **European Space Agency (ESA) project**
  - **WoodStock** - Satellite remote sensing- based forest stock estimation technology (2019-2022) **ERDF**
  - **Dynland-2** - Object based context aware self-learning network for land cover classification (2021-2022) **ESA project**
  - **MireClass** - Automated identification of mires and peatlands using multi-temporal satellite data (2019-2021) **ESA project**
  - **ForestRisk -** Remote sensing based system for forest risk factor monitoring (2022-2023) **ERDF**
  - **SentiMap -** Sentinel for confidence in outdated maps (2022-2023) **ESA project**
  - **EO BALP -** EO Baltic Platform For Governmental Services (2023-2025) **ESA project**
- Ongoing projects
  - **Waterfront** - Monitoring urban waterfront and recreation territories (2024-2025) **ESA project**
  - **HYLIFORES** - Comprehensive analysis of hemiboreal forest structure, species composition and ecosystem services using VHR hyperspectral and LiDAR data (2025-2027) **grant from Latvian Council of Science**

European Space Agency

Dynland - Dynamic land use monitoring by fusion of satellite data (2016-2019)



Development of Dynland™ technology for semi-supervised classification of data

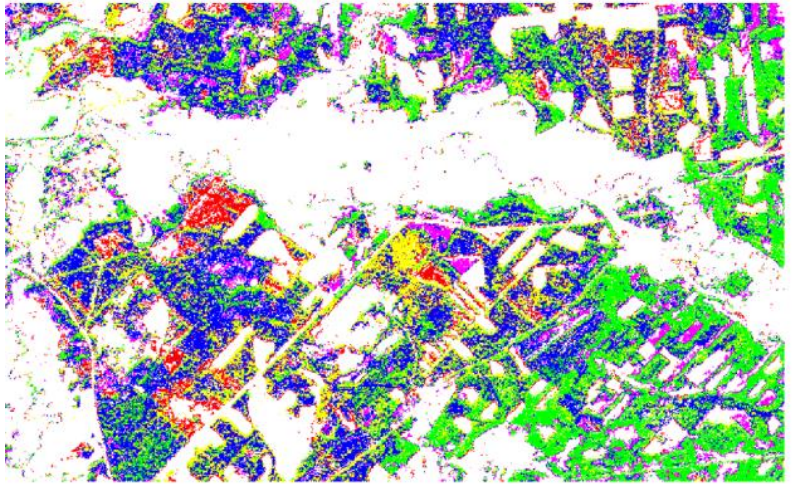
European Space Agency

Dynland classification

Step 1
Non-parametric iterative clustering of multidimensional data

Step 2
Automatic assignment of classes to clusters based on reference data or rules

Detailed classification of coniferous forest



White:
no coniferous forest

Coniferous forest:
- Spruces
- Pines
- Young coniferous trees
- Sparsely growing coniferous trees
- Sparsely growing pines with young forest underneath

Publication: R.Dinuls, I.Mednieks “Nonparametric Classification of Satellite Images.” Proceedings of the 2018 International Conference on Mathematics and Statistics. ACM, New York, NY, USA, 2018, pp. 64-68. DOI:10.1145/3274250.3274260.

European Union
European Regional Development Fund

WoodStock –

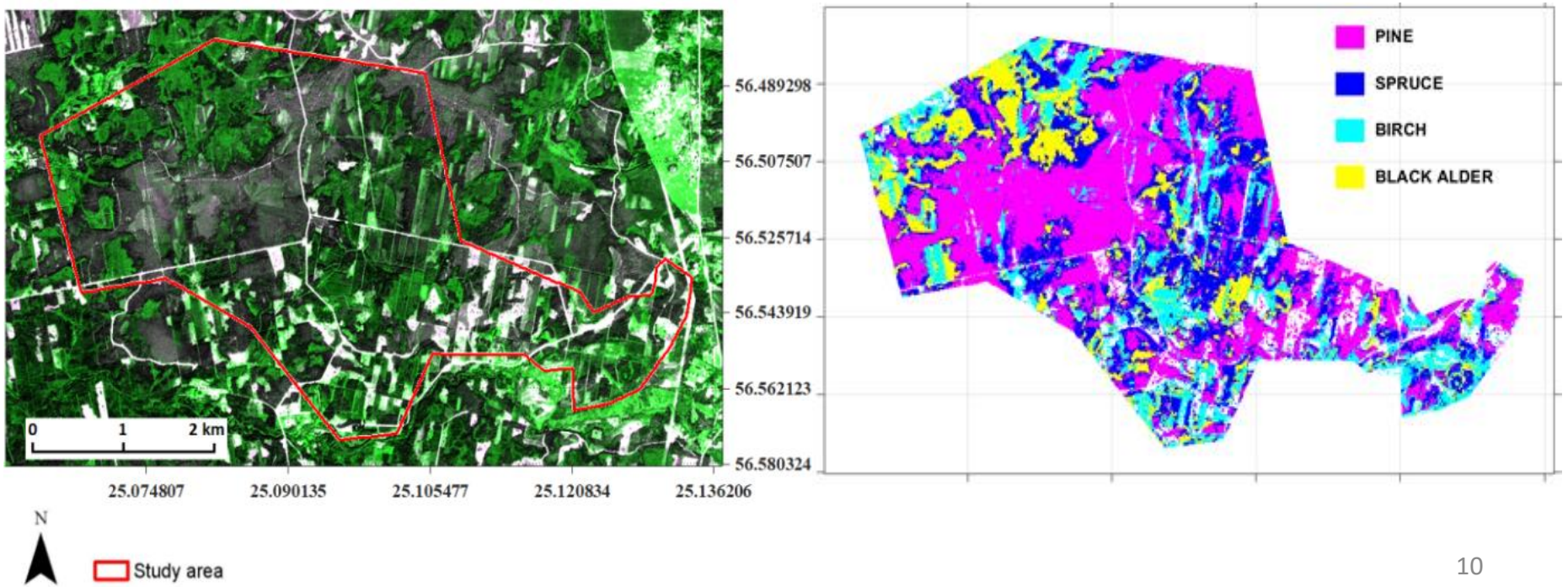
Satellite remote sensing- based forest stock estimation technology (2019-2022)

The project is focused on the development of the prototype technology for estimation of forest stock volume from high-resolution satellite data, including methods for:

- identification of **tree species**
- automated **delineation of microstands**
- estimating **stock volume**

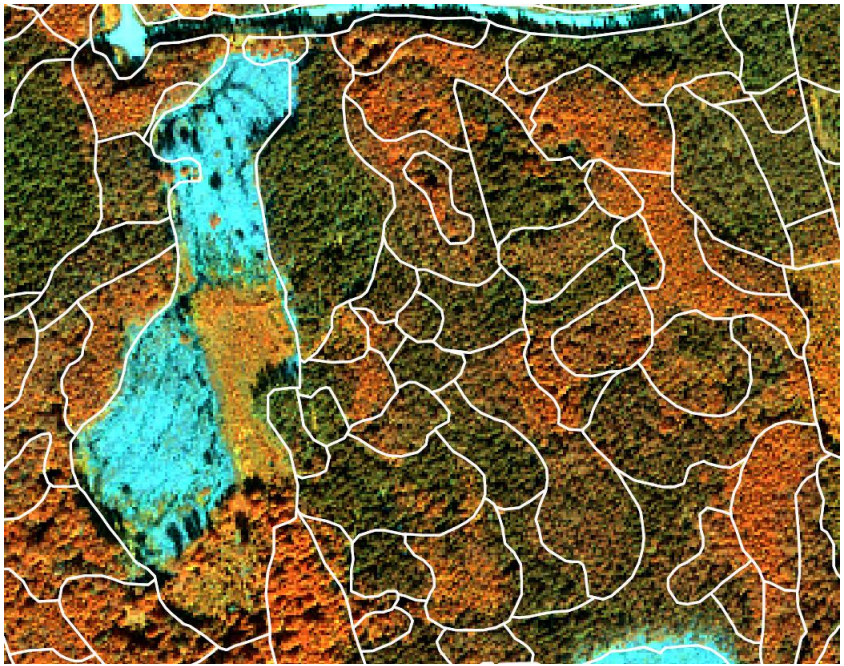
WoodStock

Tree species classification from Sentinel-2 data using deficient (sparse, outdated) inventory data

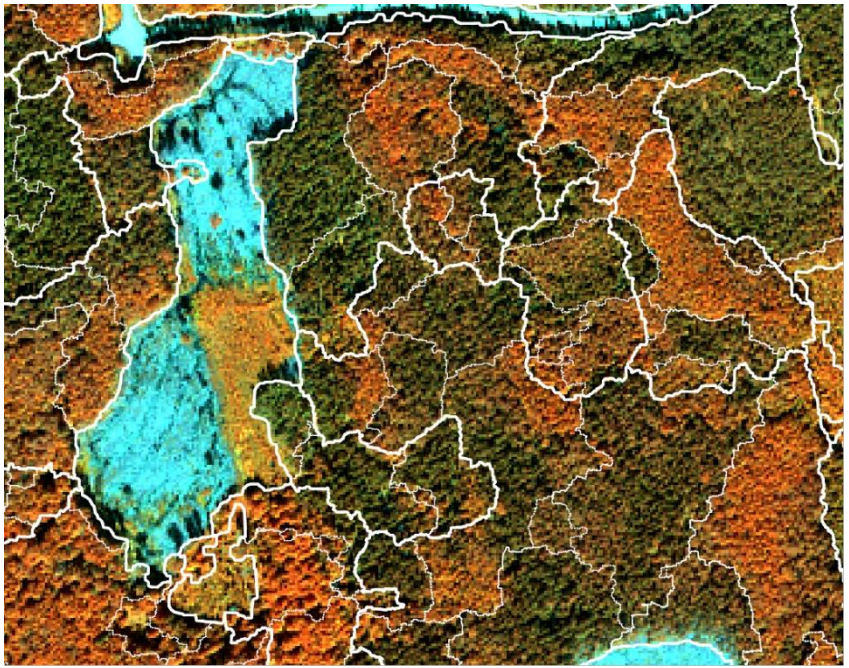


WoodStock

Automated delineation of microstands in hemiboreal mixed forests using GeoEye-1 data and a JSEG-based workflow



Manual delineation by an expert using orthophoto



Automatic delineation in 2 stages (CHM, MS data)

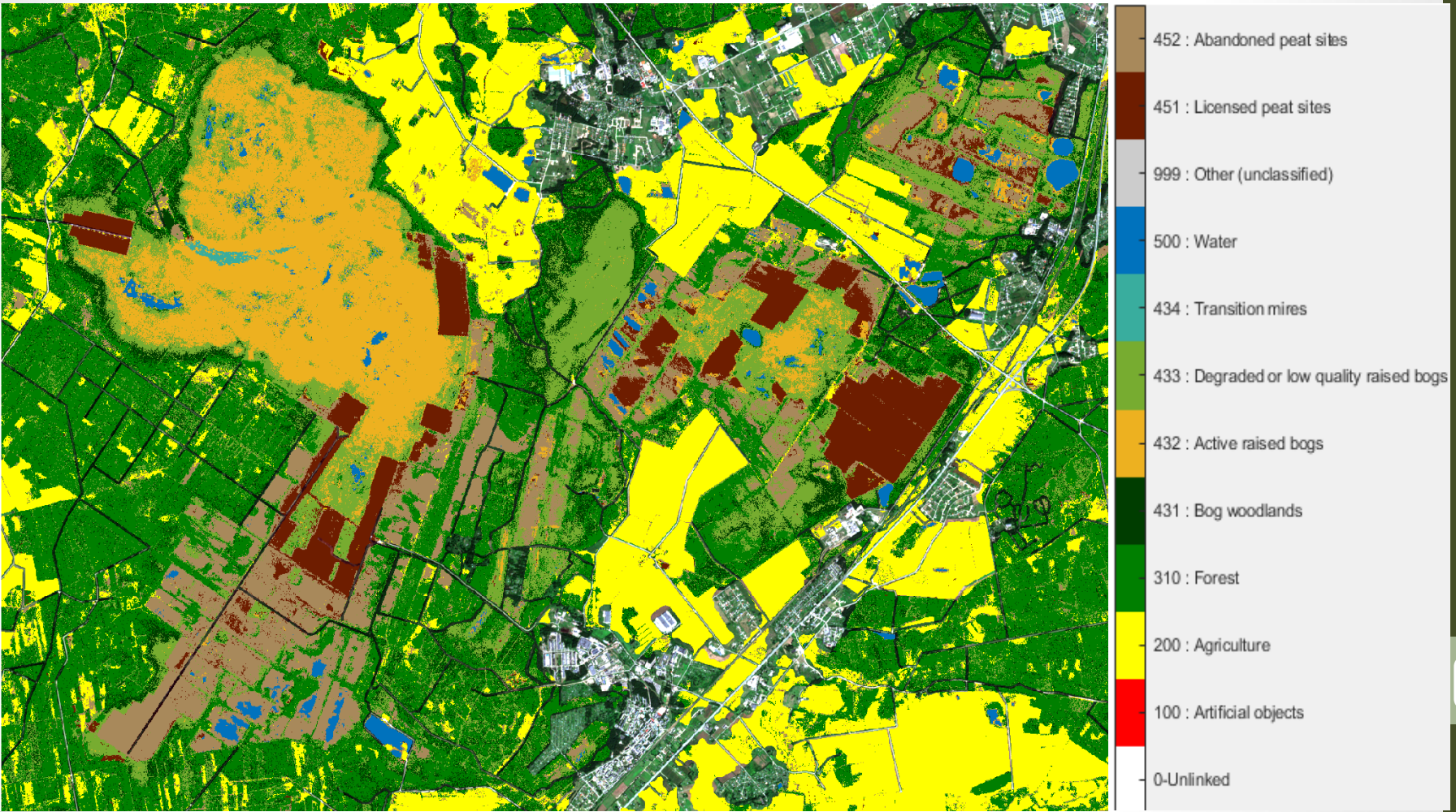
European Space Agency

Automated identification of mires and peatlands using multi-temporal satellite data (MireClass) 2019-2022

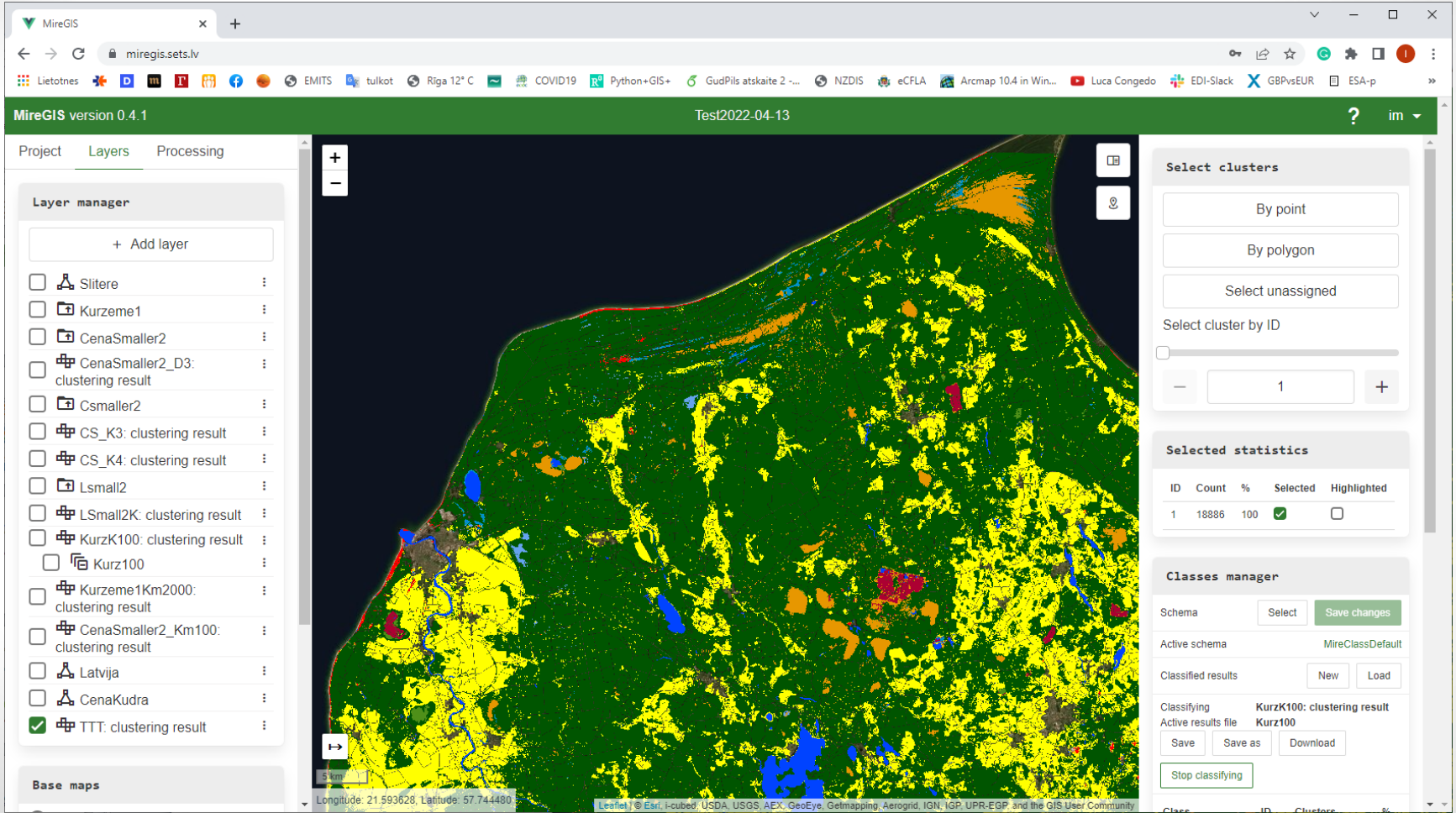
Goal: To develop MireGIS system for classification of mires and peatlands

Prime contractor: Institute of Electronics and Computer Science
Subcontractor: SIA «SWH SETS» (SETS)

Results based on Sentinel-2 imagery from 3 different seasons + CHM + TreeCover



MireGIS – Web application for land cover classification



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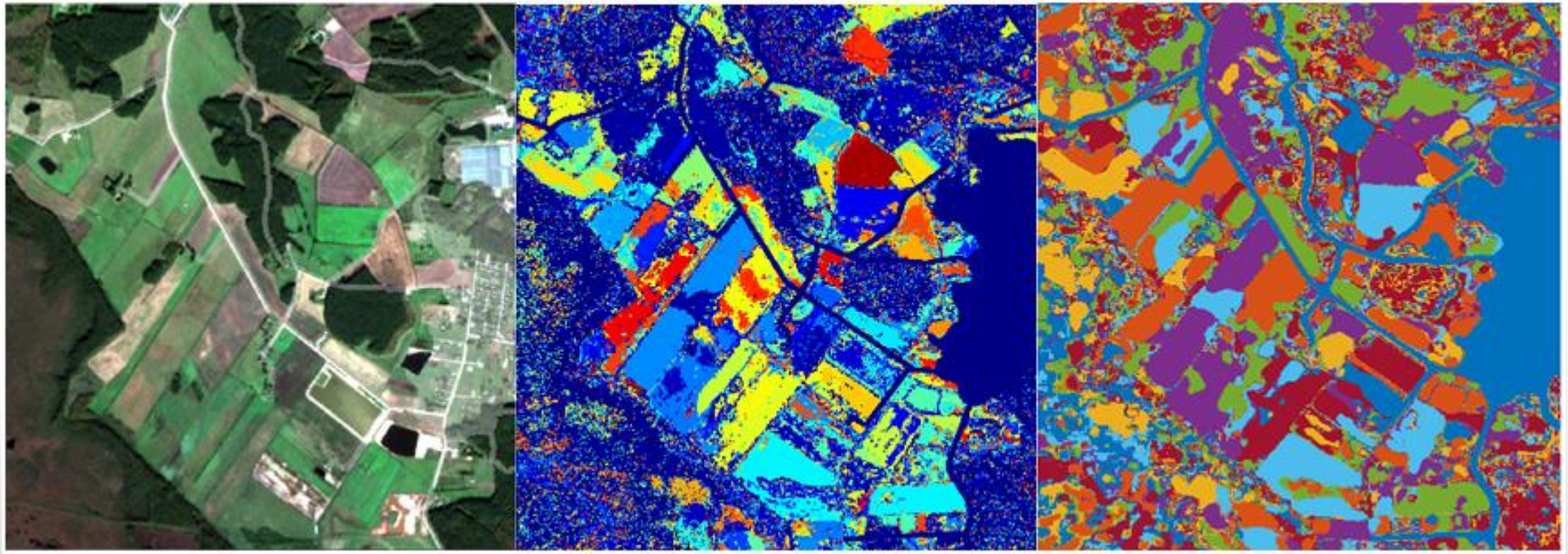
Object based context aware self-learning network for land cover classification (Dynland-2) 2021-2022



European Union
European Regional Development Fund

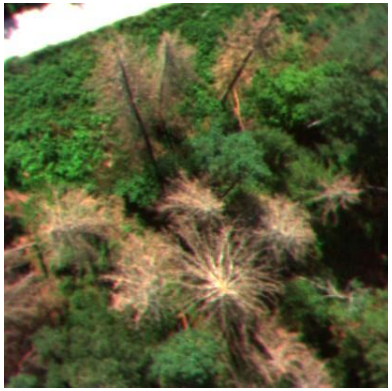
ForestRisk –

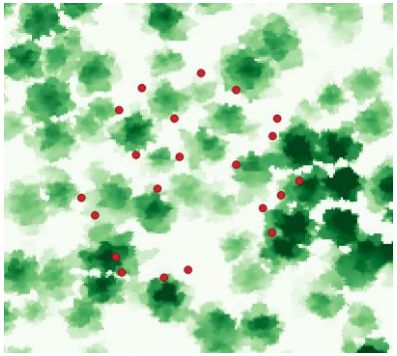
Remote sensing based system for forest risk factor monitoring (2022-2023)

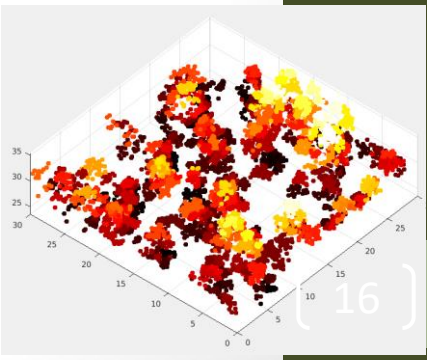
Objective: to develop software tools for assessment, monitoring and alerting of forest risk factors using satellite and unmanned aerial vehicle (UAV) based remote sensing

Main directions:

1. **Monitoring** of forests from satellites
2. Detection of risk areas from **VHR** remote sensing data (NIR-RGB, LiDAR, Hyperspectral)







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Sentinel for confidence in outdated maps (SentiMap) 2022-2023

Objective: to build a technology prototype for detection of outdated areas in aerial images and land cover maps using satellite and VHR imagery

Directions:

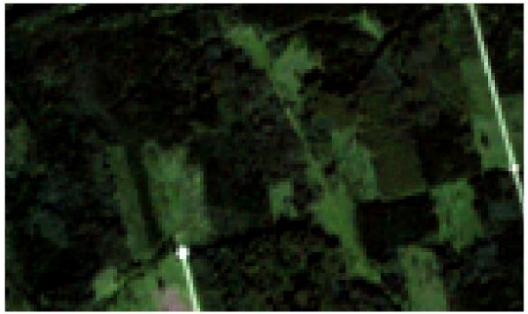
1. Identifying outdated areas in VHR aerial imagery
2. To detect change probability

European Space Agency

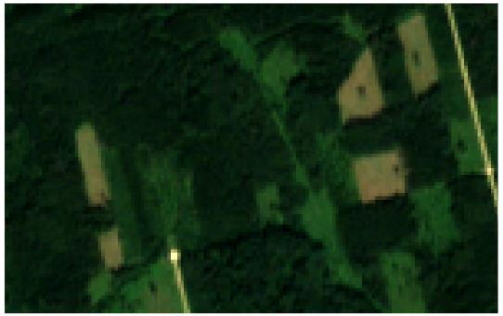
SentiMap tool for change detection as anomaly

- **Use unsupervised anomaly detector to create outdated information layer**
- **Calculate probability that the area mapping is outdated & apply threshold**

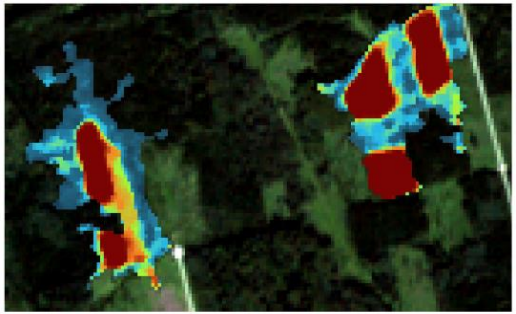
Sentinel-2 image (outdated) - Sentinel-2 image (up-to-date) sample



(a) 2016



(b) 2020



(c) Outdated information layer

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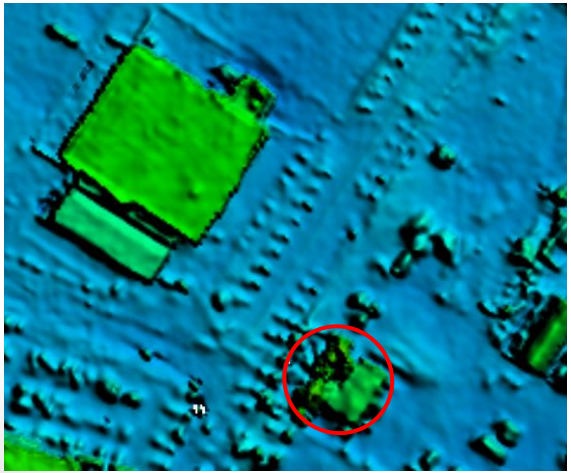
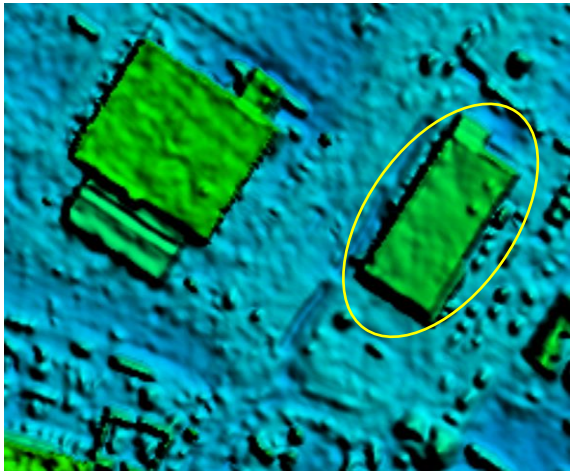
SentiMap tool for change detection by using image-based DSMs height differencing

The tool applies a morphological filter for height differencing between any (LiDAR, image-based) digital surface models with the goal of change detection mask creation for urban and rural areas for topographic map updating.



DSM (1m GSD) 2019



DSM (1m GSD) 2022

Change detection mask (Orto 2022)

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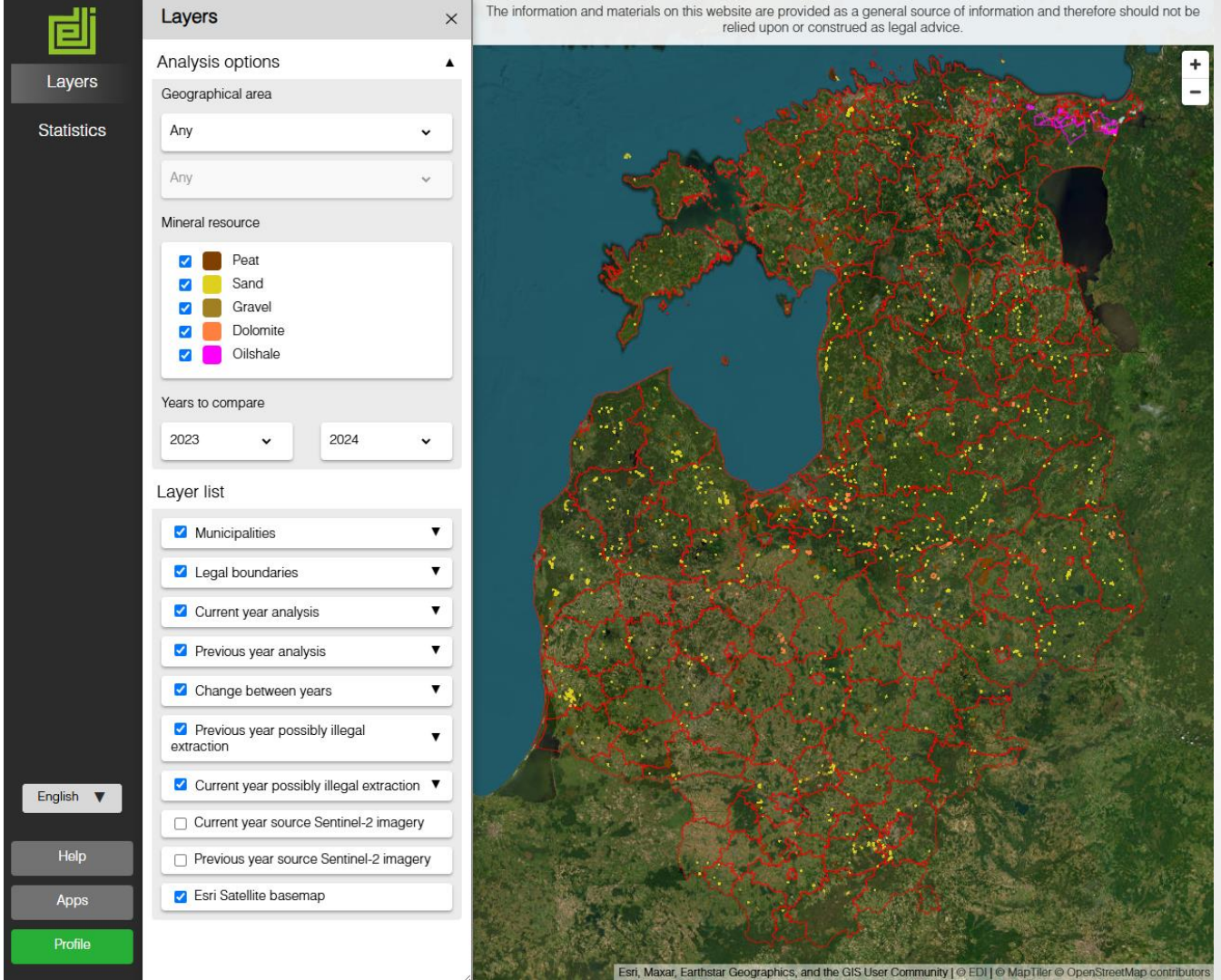
EO BALP - EO Baltic Platform For Governmental Services (11.2023-05.2025)

Goal: to develop EO Baltic Platform For Governmental Services and provide six main platform components

EDI task: develop Natural Resource Extraction Monitoring service

Main contractor:	**Baltic Satellite Service (Latvia)**
Subcontractors :	**DATEL (Estonia)**
	Klaipeda University (Lithuania)
	Institute of Electronics and Computer Science (Latvia)
	Rural Support Service (Latvia)

Natural Resource Extraction Monitoring in Baltic states



https://app.geohub.net/edi-nrem/

Waterfront - Monitoring urban waterfront and recreation territories (10.2024 – 12.2025)

Goal: To provide tools for more frequent and more precise monitoring of urban waterfront territories compared to Copernicus services

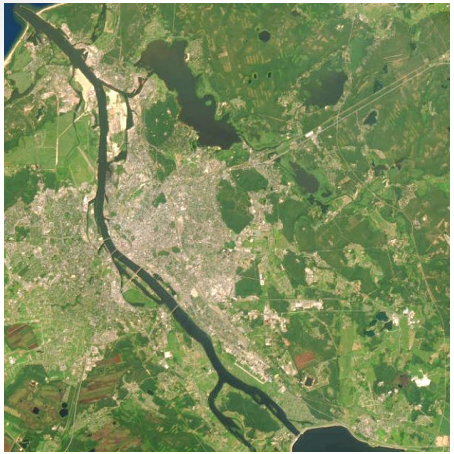
Objectives:

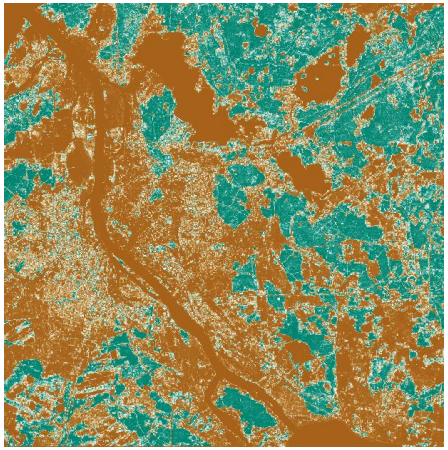
- **To develop and evaluate deep learning-based land cover class fraction estimation from Sentinel-2 data**
- **To develop a tool for reed and algae detection in water basins**

Prime contractor: Institute of Electronics and Computer Science

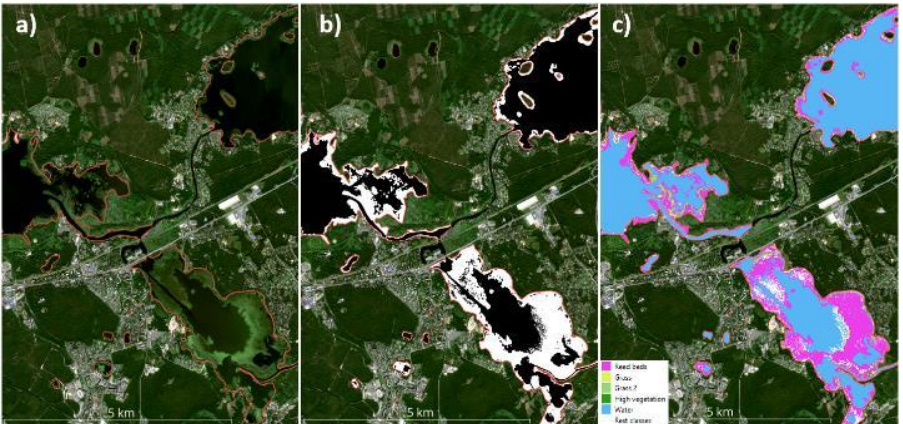
Subcontractor: SIA Rīgas meži

Custom CNN for Tree Cover Density fraction estimation





Water/Non-water classifier



Chlorophil *a* content estimator

HYLIFORES - Comprehensive analysis of hemiboreal forest structure, species composition and ecosystem services using VHR hyperspectral and LiDAR data (2025-2027)

Main contractor: LSFRI Silava

UAV DJI Matrice 350 RTK

Hyperspectral snaphot camera Cubert Ultris X20 Plus

Our competence

1. **Object detection and classification in images**
2. **Processing data from various sensors including fusion (RGB, multspectral, hyperspectral, LIDAR)**
3. **Custom solutions based on dedicated remote sensing data processing methods and software**

Contacts: **Ints Mednieks**

E-mail: mednieks@edi.lv