RestorEO

A TRANSPARENT EARTH OBSERVATION-BASED MONITORING SYSTEM FOR BIODIVERSITY AND ECOSYSTEM RESTORATION IN AUSTRIA

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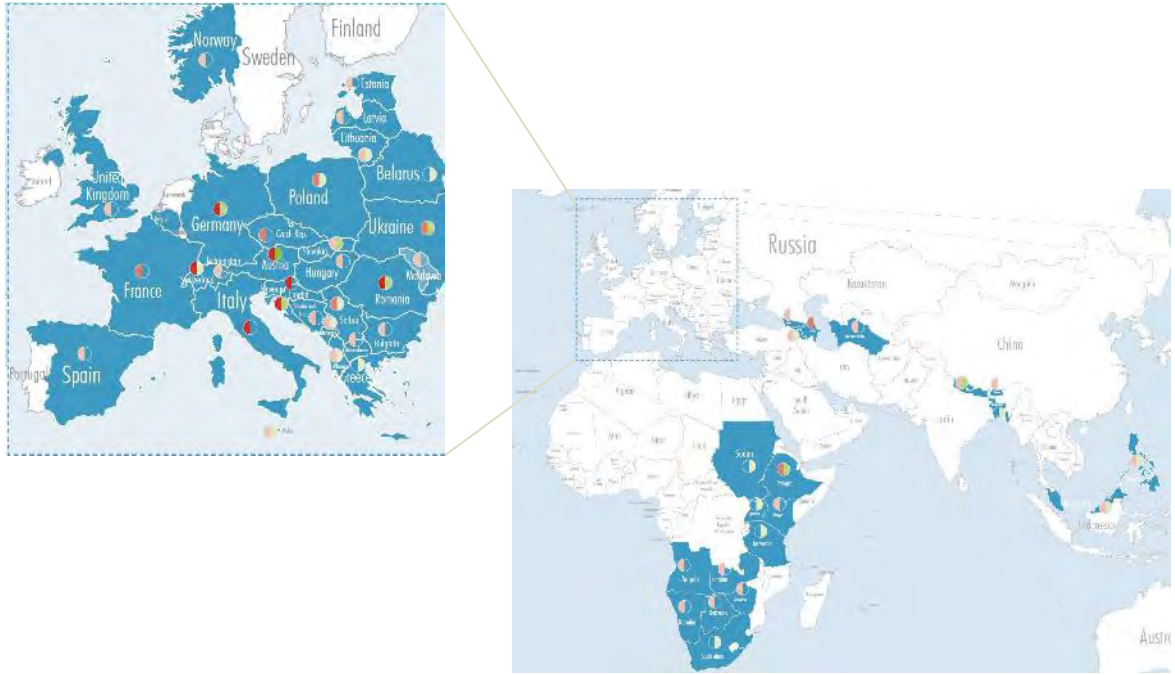
INSTITUTE OF ECOLOGY



WHO WE ARE

- Location: Klagenfurt, Austria
- Active for more than 25 years in over 50 countries
- Founded in 1997, 15 employees
- Focus: Protected areas and nature conservation

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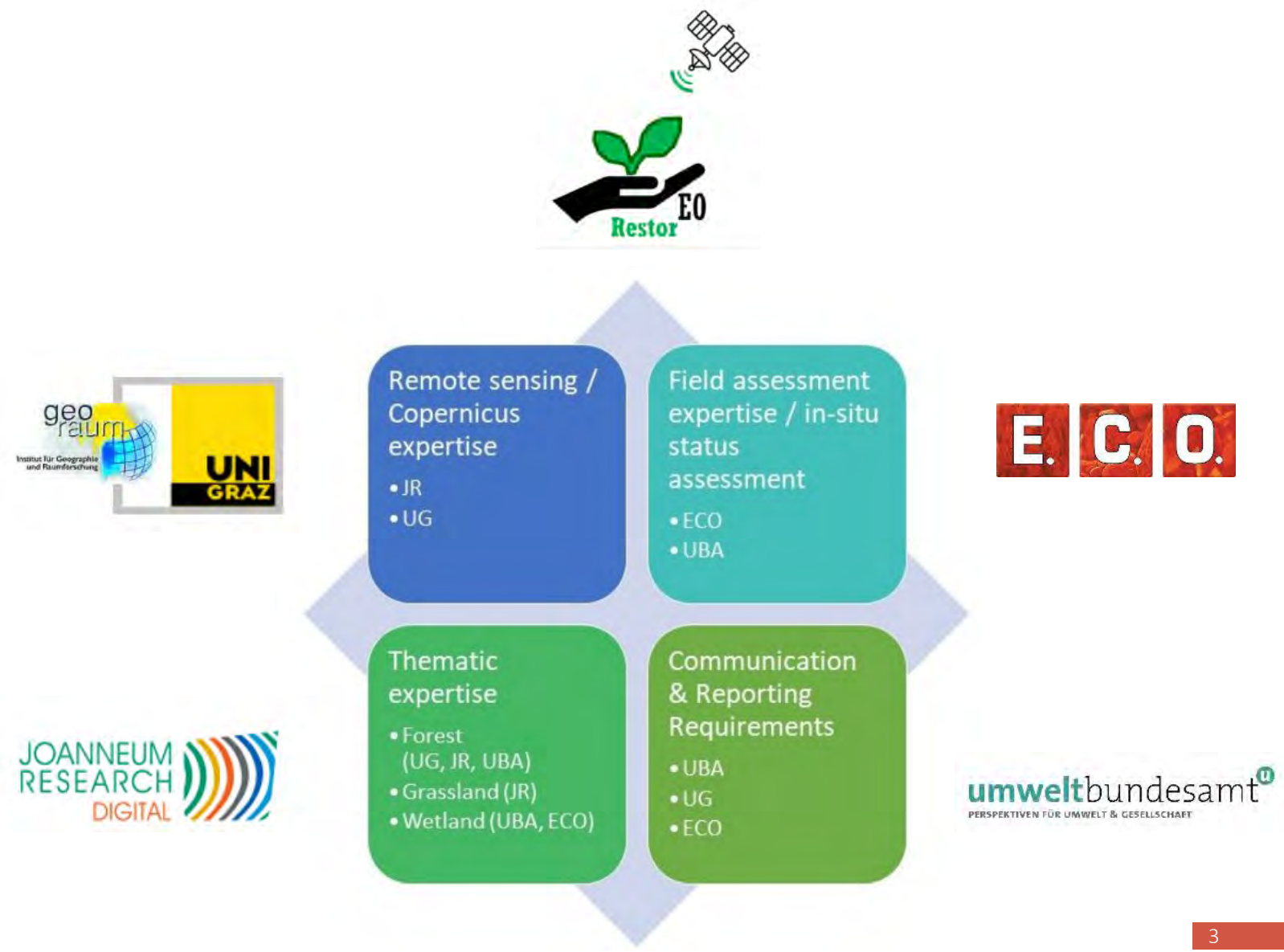
A TRANSPARENT EARTH OBSERVATION-BASED MONITORING SYSTEM FOR BIODIVERSITY AND ECOSYSTEM RESTORATION

→ Partly funded by the the Austrian Research Promotion Agency (FFG) project number FO999892628

→ 6/2022 – 11/2025

→ Project team and core competencies



OBLIGATIONS AND LEGAL FRAMEWORK

- → European Green Deal (EGD)
- → Climate Change – Paris Agreement
- → SDG 15 Life on Land
- → UN Decade on Ecosystem Restoration 2021-2030
- → EU Biodiversity Strategy, 2020
- → EU Nature Restoration Law
- → Austrian Strategic Framework for Ecosystem Restoration

PROJECT BACKGROUND

→ Currently monitoring conservation status throug field surveys

- E.g. Austrian National Forest Inventory
- E.g. Habitat monitoring and reporting under Article 17 of the Habitats Directive

→ Advantages

+ High quality of the data

+ Statistically accurate for larger areas

→ Shortcomings

- Less accurate at regional and local level

- Time consuming

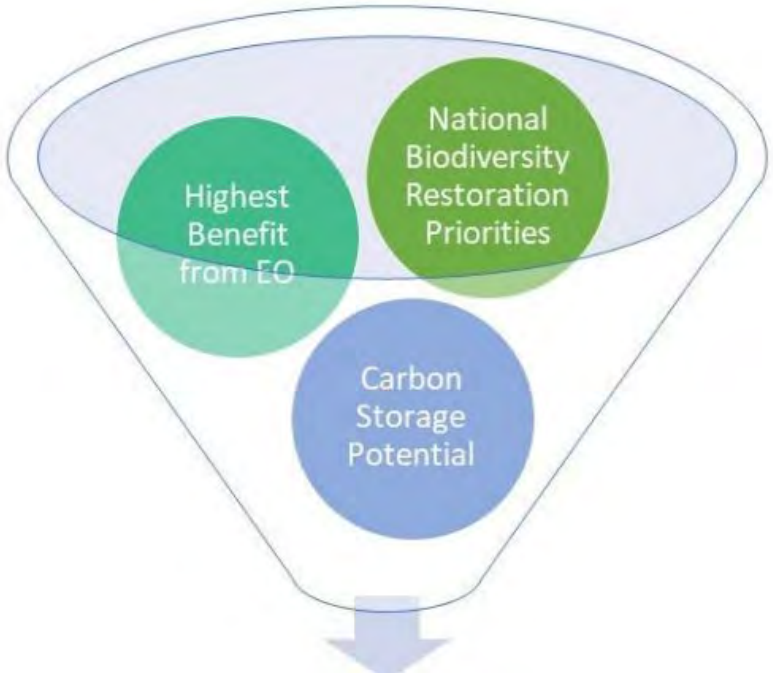
- High costs

PROJECT VISION

- → Use of Earth Observation data to monitor the conservation status and restoration success of habitat types
- → Provide quantitative data to public authorities
- → Identify areas in need of restoration or where restoration failed

RELEVANT HABITAT GROUPS

- → Grassland-dominated cultural landscapes
- → Wetlands
- → Forests



PEATLAND HABITAT TYPES IN AUSTRIA

- 7110* Active raised bogs
- 7120 Degraded raised bogs still capable of natural regeneration
- 7140 Transition mires and quaking bogs
- 7150 Depressions on peat substrates of the Rhynchosporion
- 7210* Calcareous fens with *Cladium mariscus* and species of the *Caricion davallianae*
- *7220* Petrifying springs with tufa formation (Cratoneurion)*
- *7230 Alkaline fens*
- *7240* Alpine pioneer formations of the Caricion bicoloris-atrofuscae*

INDICATORS FOR HABITAT TYPE 7230 ALKALINE FENS

→ Hydrology
- Drainage dichtes can be detected

→ Vegetation structure
- Cover of shrubs and trees can be derived from LiDAR data

→ Disturbance indicator species
- Very difficult to detect

Conservation status

A B C

Good Poor Bad

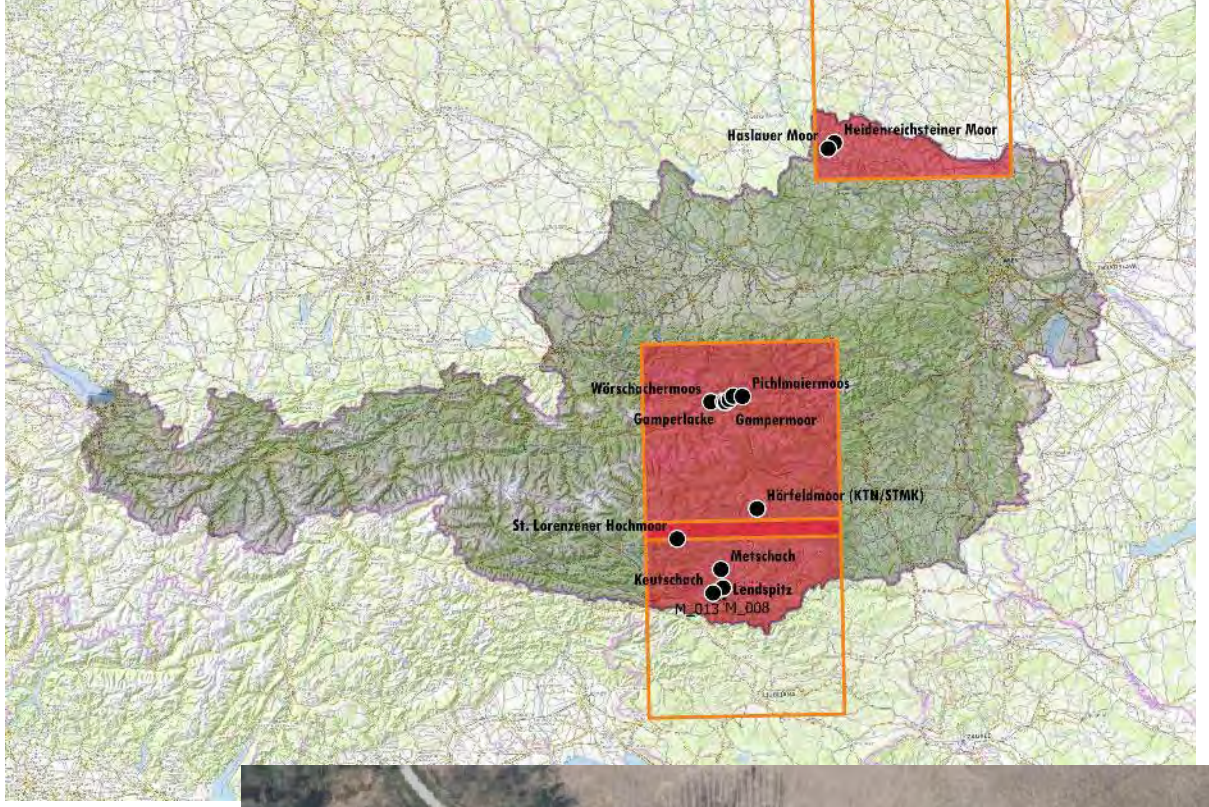
WETLAND CONSERVATION STATUS INDICATORS

→ Review and evaluation of existing indicators for peatland habitat types in Austria

Indicators wetlands	Frequency in 8 habitat types (number)	Assessment of applicability with remote sensing
Disturbance indicator species	7	Very difficult to detect; it may be possible to identify individual species by their colouration.
Species inventory	6	Not measurable
Vegetation structure	6	The indicator vegetation structures also includes a large number of sub-indicators for peatlands: - Proportion of vascular plants (difficult to distinguish from mosses) - Proportion of dwarf shrubs or other taller plants - Proportion of shrubs and trees (can be derived from LiDAR data) - Proportion of open peat soil (possible) - Proportion of open water (possible) --> for this, drone surveys are carried out and compared with evaluations from the sentinel data. Canopy cover is recorded in 10% increments. --> Evaluation of a ricopter survey for providing results.
Drainage ditches, peat digging	4	Automatic recognition in the laser scan model. It is to be investigated whether ditches (as linear structures) and their height can be detected automatically.
Groundwater level (distance to surface)	3	soil moisture from satellite data possible, but insufficient resolution (1x1 km)
Hydrology	3	Linear development structures are recognizable. Research into existing data is being carried out
Percentage of open peat	2	Measurable
Contact biotopes	2	Contact habitats could be identified with existing data.

TESTSITES WETLANDS

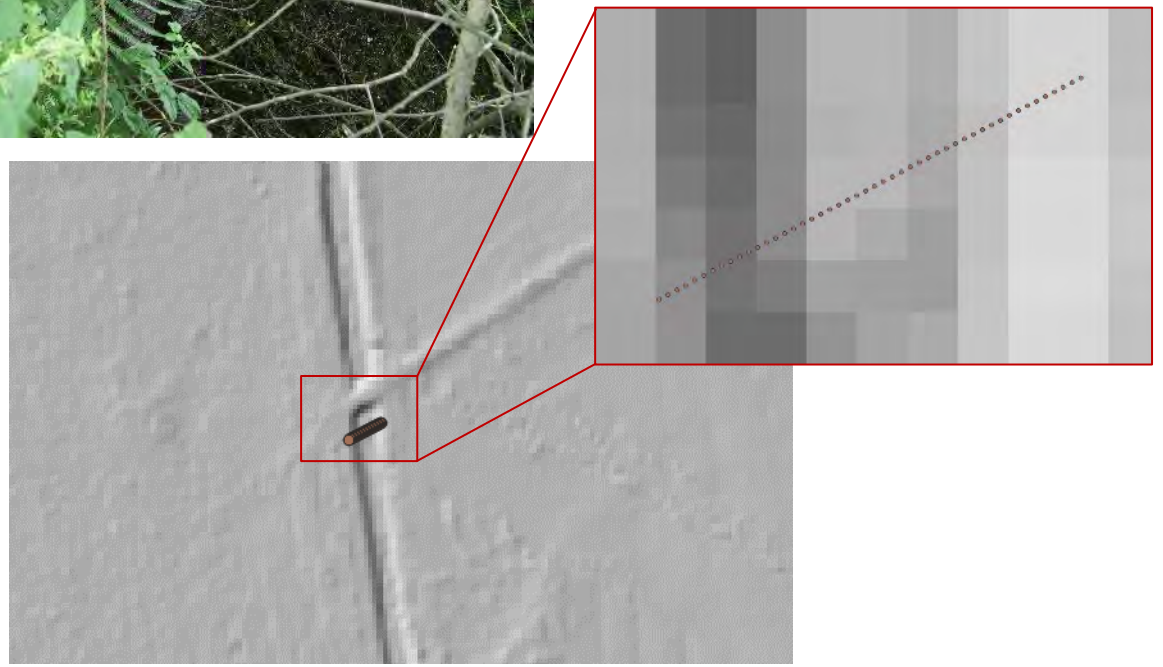
- → Remote sensing data (e.g. Sentinel)
- → Field Survey Sample Data



EXAMPLE WETLANDS:

INDICATOR HYDROLOGY (DRAINAGE DITCHES)

- → Drainage is a major threat to wetlands
- → Detection of depth of drainage ditches using a laser scan model (DTM)
- → Data validation by measuring of ditches in the field



EXAMPLE WETLANDS:

INDICATOR VEGETATION STRUCTURE

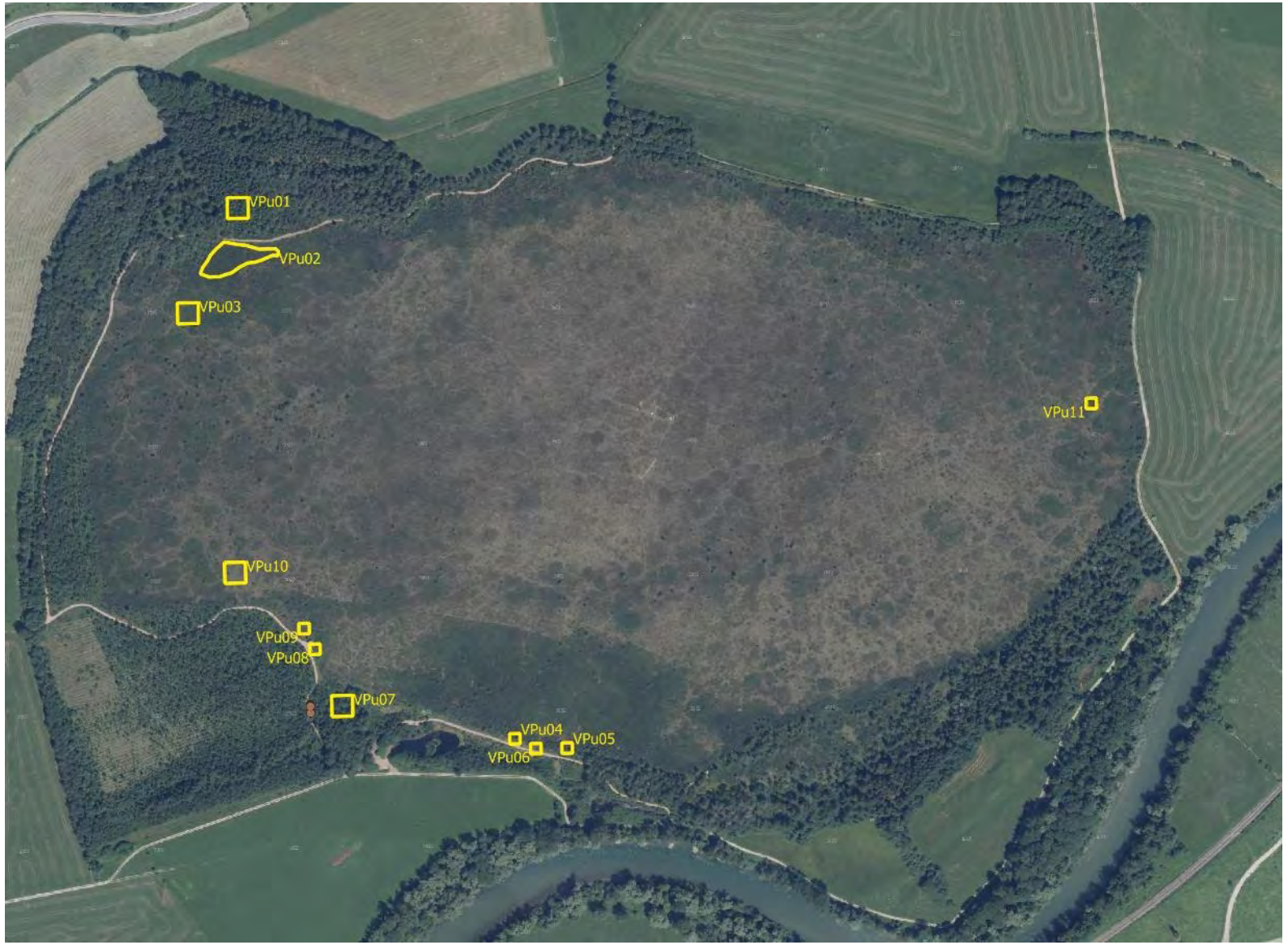
- → Scrub encroachment leads to the degradation of the habitat types and the disappearance of light-loving plant species
- → Detection of shrub and tree cover

EXAMPLE WETLANDS:

INDICATOR VEGETATION STRUCTURE

→ Pürgschachen Moor

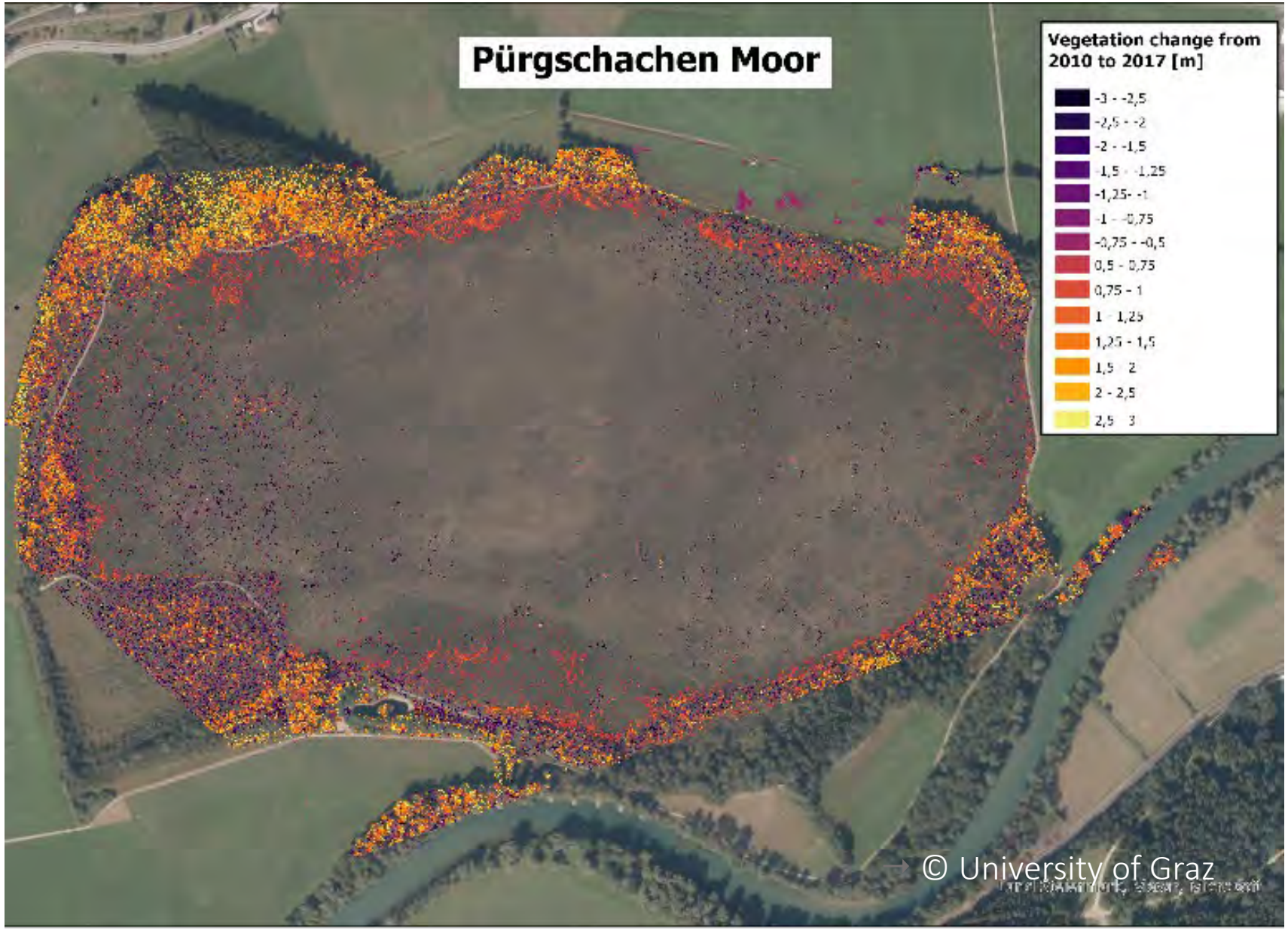
→ habitat type 7110* Active raised bogs



EXAMPLE WETLANDS:

INDICATOR VEGETATION STRUCTURE

→ bi-temporal LiDAR assessments (2010 and 2017) in testsite Pürgschachen Moor

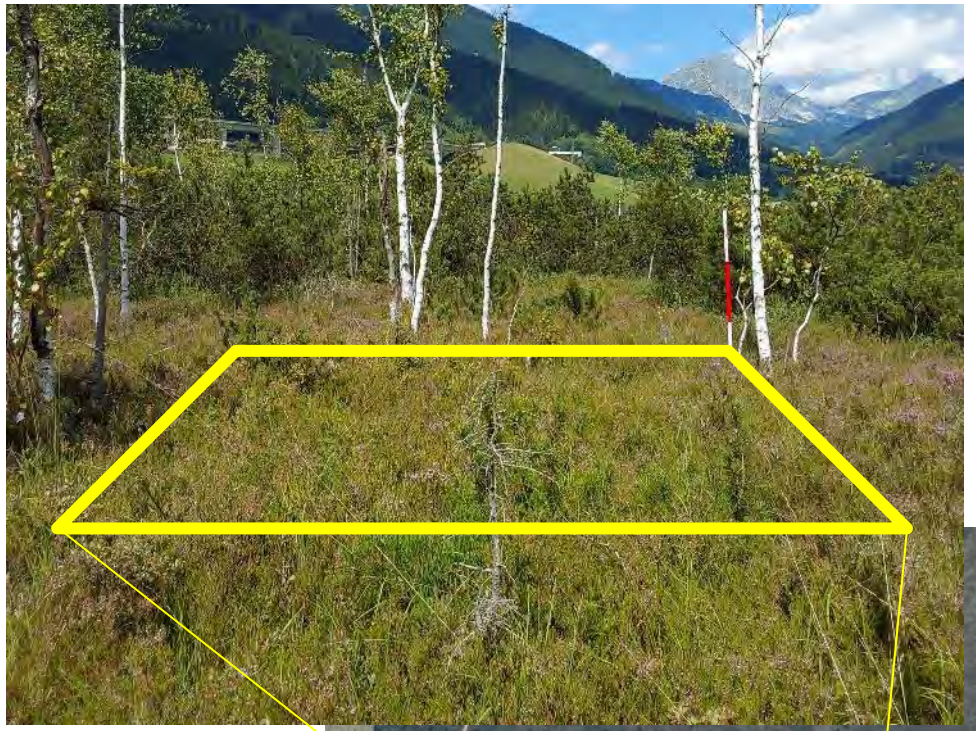


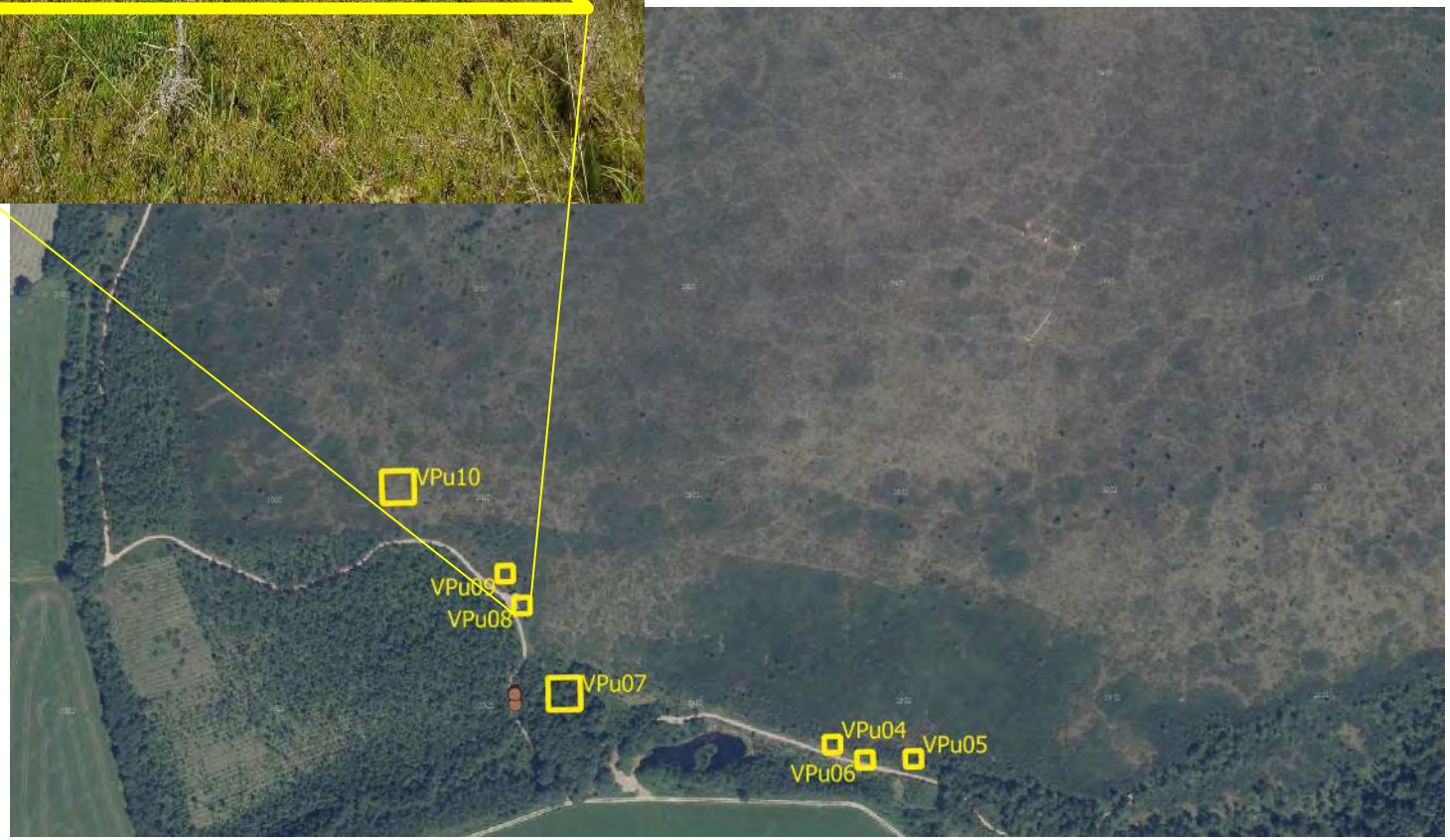
EXAMPLE WETLANDS:

INDICATOR VEGETATION STRUCTURE

→ Validation with field data

→ Shrub and tree cover





EXAMPLE WETLANDS:

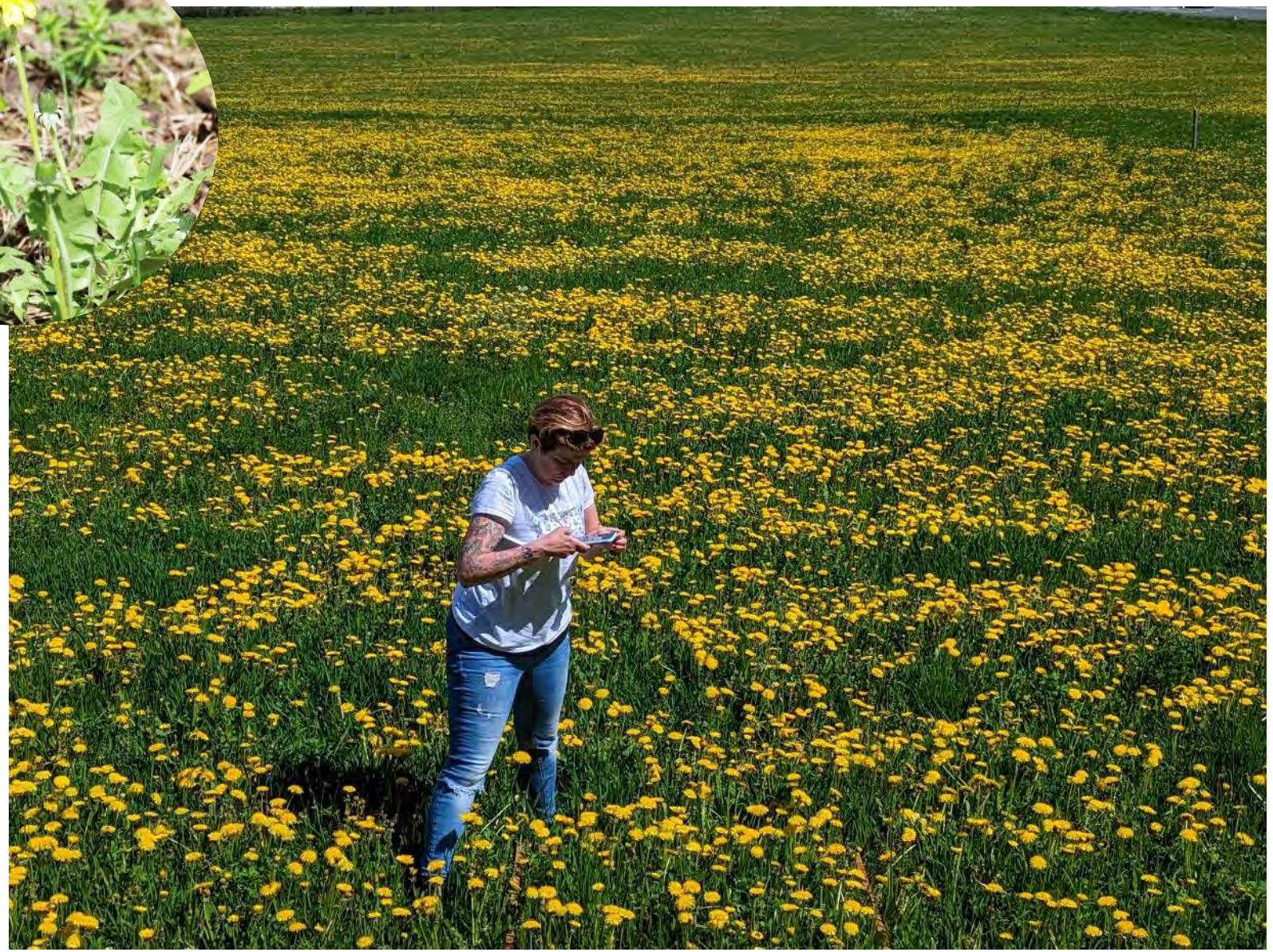
RESTORATION IN NATURA 2000 SITE LENDSPITZ IN KLAGENFURT

→ *7230 Alkaline fens*

SPECIES-RICH GRASSLAND

→ Habitat types e.g.

- 6510 lowland hay meadows
- 6520 mountain meadows

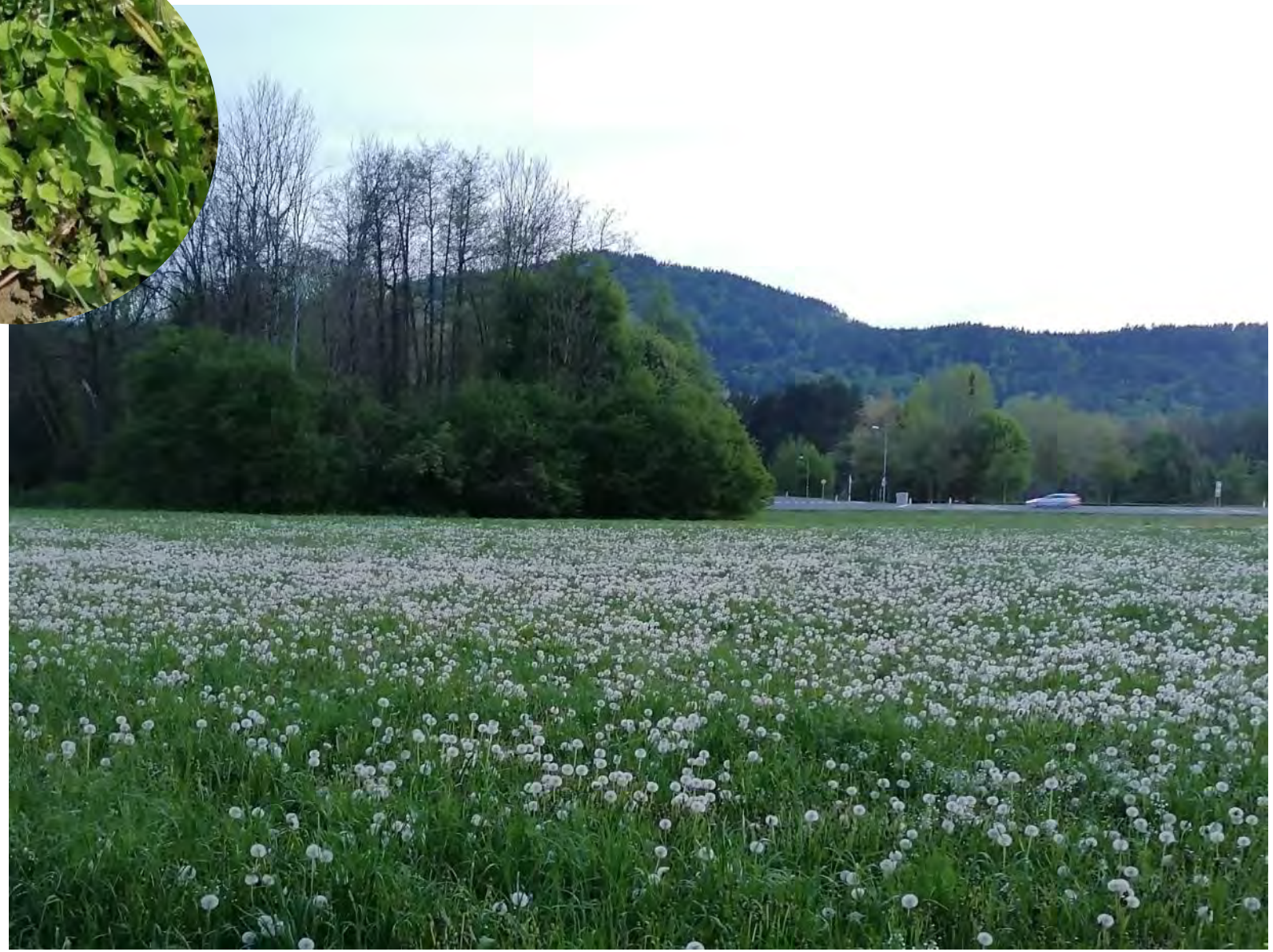


SPECIES-POOR GRASSLAND

- → No habitat type, restoration possible
- → Dandelion (*Taraxacum officinale*) as an indicator species for intensive meadows

SPECIES-POOR GRASSLAND

→ Dandelion ripe fruits



DETECTION OF SPECIES-POOR GRASSLAND

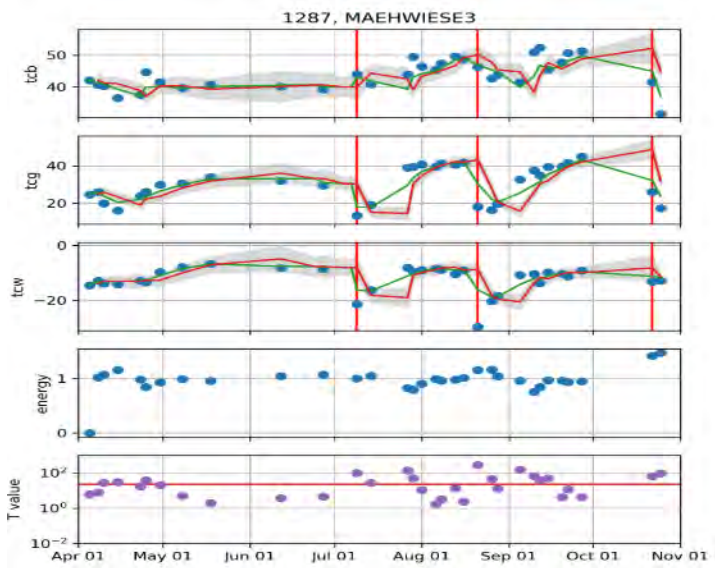
- → Dandelion (*Taraxacum officinale*) flower density
- → Phenological stage (beginning of flowering, full flowering, partially withered/fruiting)

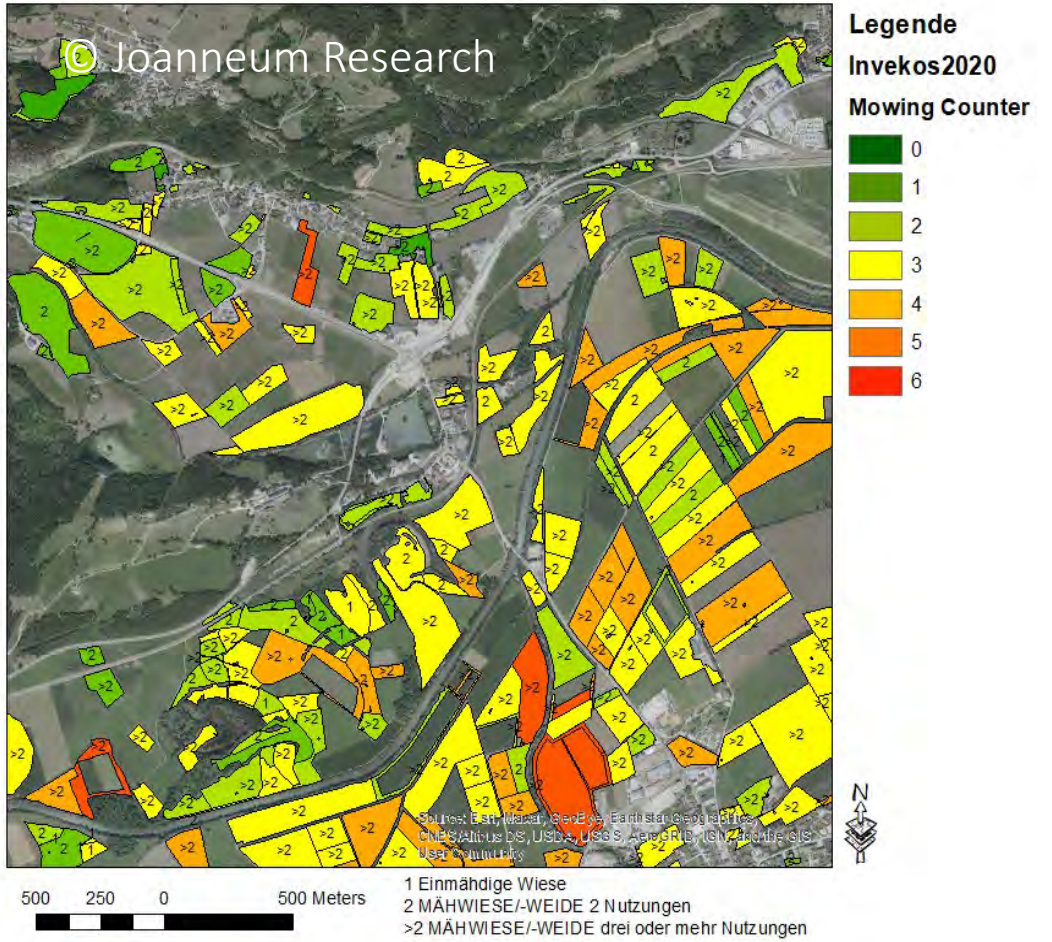
DETECTION OF SPECIES-POOR GRASSLAND

- → Dandelion flowering date and density recorded
- → Comparison with multi-temporal Sentinel data

INTENSITY OF GRASSLAND USE

Detection of mowing frequency as an indicator of land use intensity





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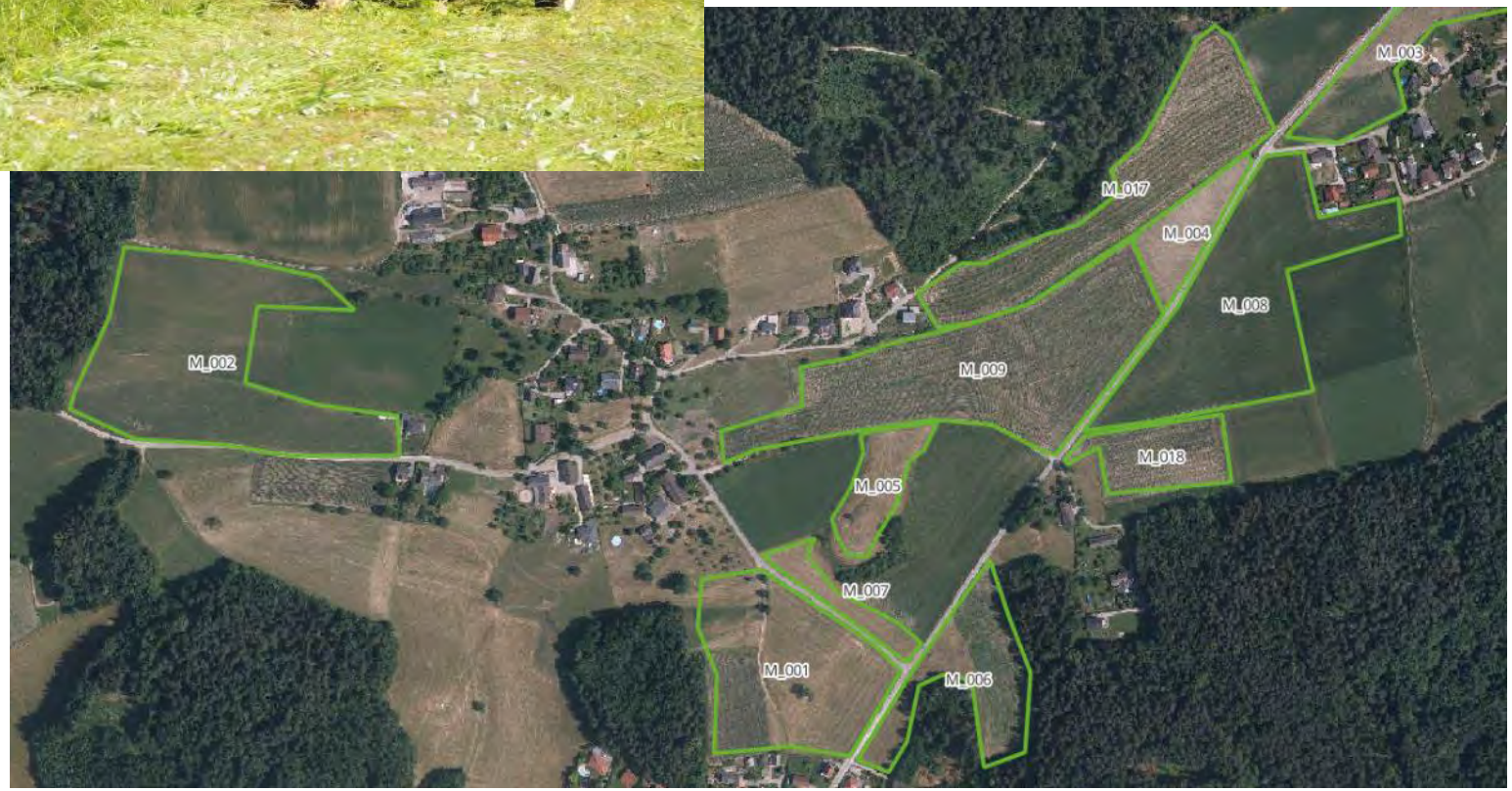


FORESTS

Different aproaches, e.g. detecting

→ lying deadwood from high-density LiDAR data

→ vertical forest structure parameters from LiDAR data (Foliage Height Diversity FHD)

→

Indicator (english)	Frequency in 18 habitat types (number)	Frequency (relative in %)	Assessment of applicability with remote sensing
Tree species composition	17	94	Highly accurate classification on a local to regional level is possible; intra-deciduous differentiation more difficult; difference between deciduous and coniferous often sufficient and accurate
Indicator species	17	94	Not possible, especially, if under the canopy
Coarse woody debris, deadwood	17	94	Standing deadwood well depicted in orthophotos as well as in infrared; automated recognition is challenging
Forest use	16	89	Possible through timeseries analysis
Influence of game	13	72	Not measurable at typical level
Area size	12	67	Can be easily derived. Should be expanded with fragmentation analysis, which is not (yet) a defined indicator
Forest Structure	11	61	Can be analyzed with laser scan data (e.g., FHD value)
Specific structures	2	11	Not measurable

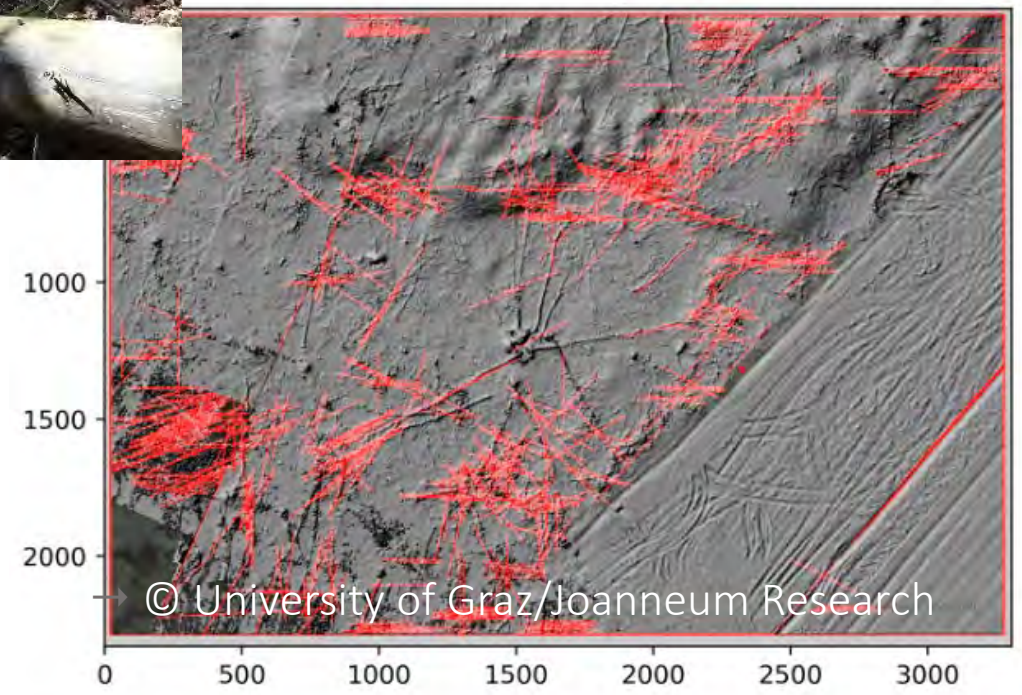
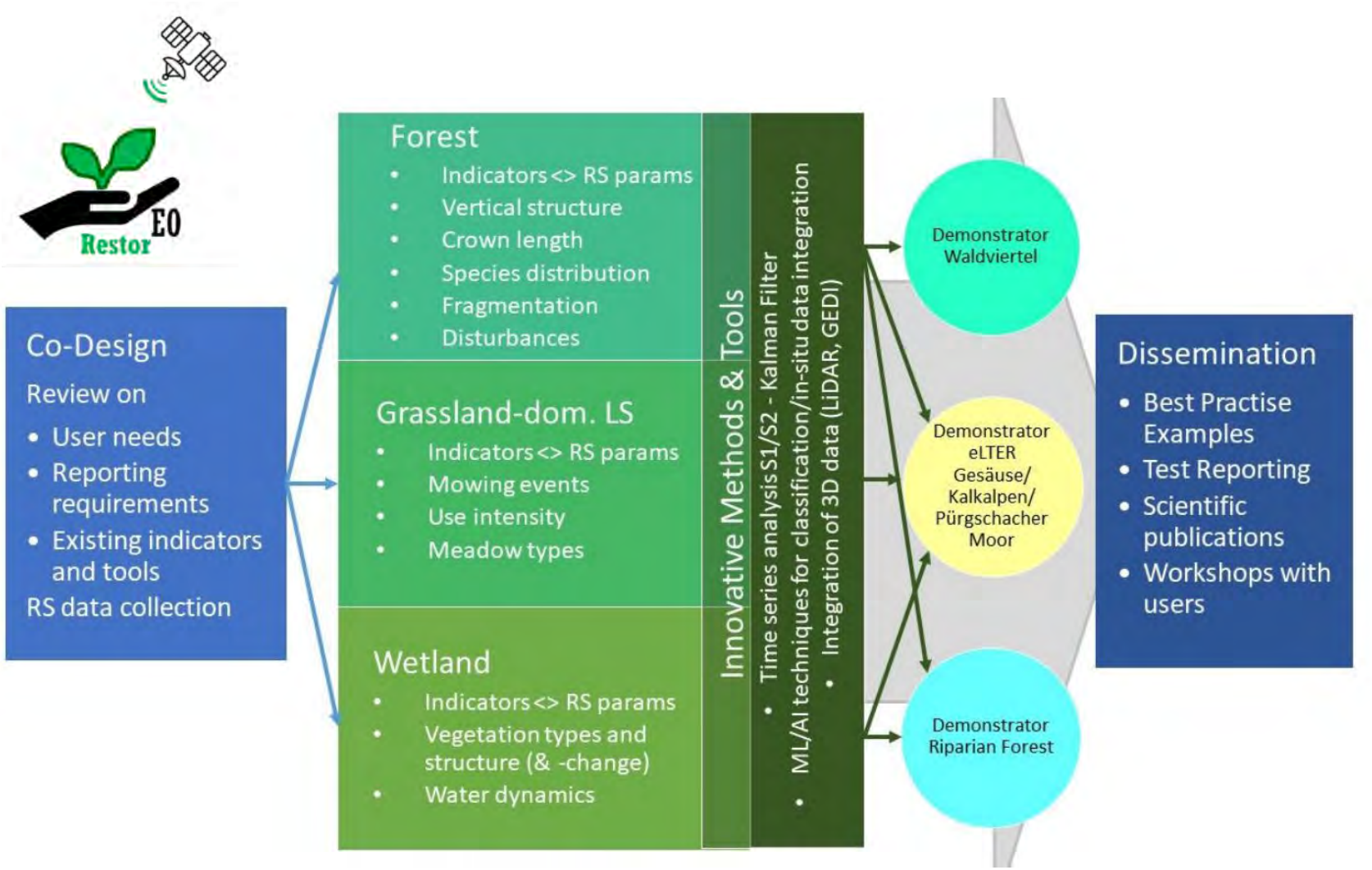


Abbildung 2.3.1: Example of Hough Transformation for the detection of lying deadwood

NEXT STEPS


Restor EO
Co-Design
Review on
• User needs
• Reporting requirements
• Existing indicators and tools
RS data collection
Forest
• Indicators <> RS params
• Vertical structure
• Crown length
• Species distribution
• Fragmentation
• Disturbances
Grassland-dom. LS
• Indicators <> RS params
• Mowing events
• Use intensity
• Meadow types
Wetland
• Indicators <> RS params
• Vegetation types and structure (& -change)
• Water dynamics
Innovative Methods & Tools
• Time series analysis S1/S2 - Kalman Filter
• ML/AI techniques for classification/in-situ data integration
• Integration of 3D data (LiDAR, GEDI)
Demonstrator Waldviertel
Demonstrator eLTER Gesäuse/ Kalkalpen/ Pürgschacher Moor
Demonstrator Riparian Forest
Dissemination
• Best Practise Examples
• Test Reporting
• Scientific publications
• Workshops with users

CONCLUSIONS

- → Field visits still needed
- → EO to detect changes
- → EO to provide quantitative data on conservation status

THANK YOU FOR YOUR ATTENTION

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RestorEO - A transparent Earth Observation-based monitoring for biodiversity and ecosystem restoration

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