NaturaSat

program na identifikáciu a monitoring biotopov Natura 2000 pomocou diaľkového prieskumu Zeme

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Vedecká konferencia ŠOP, 24. 11. 2021

Úvod

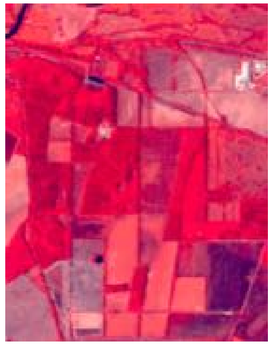
- Projektová výzva ESA PECS Slovakia
- Využitie dát družice Sentinel-2 novými spôsobmi
- Spolupráca s STU
- Diaľkový prieskum Zeme - využitie v poľnohospodárstve, lesníctve
- Biotopy Natura 2000 - komplexné spoločenstvá definované druhovým zložením

European Space Agency
...sky is not a limit

Úvod

- Sentinel-2 multispektrálne dáta
    - 12 spektrálnych pásiem
    - Snímky každých 10 dní - možnosť získania časových radov
    - Dáta dostupné pre celú Európu/svet
    - Pixel resolution 10x10m

- Natura 2000
    - Povinnosť monitorovať sústavu Natura 2000 každé 4-6 rokov
    - Mapy biotopov na Slovensku - odvodené z lesníckych máp, vegetačnej databázy (bodový výskyt), terénne mapovanie TML - presnosť je veľmi variabilná
    - Vyhliadky biotopu do budúcnosti…ťažko určiteľné na základe návštev v 4 ročných intervaloch



Ciele

- Presná detekcia hraníc
  - Semi-automatická
  - Automatická

- Automatická detekcia nových biotopov
- Kontinuálny monitoring biotopov

European Space Agency
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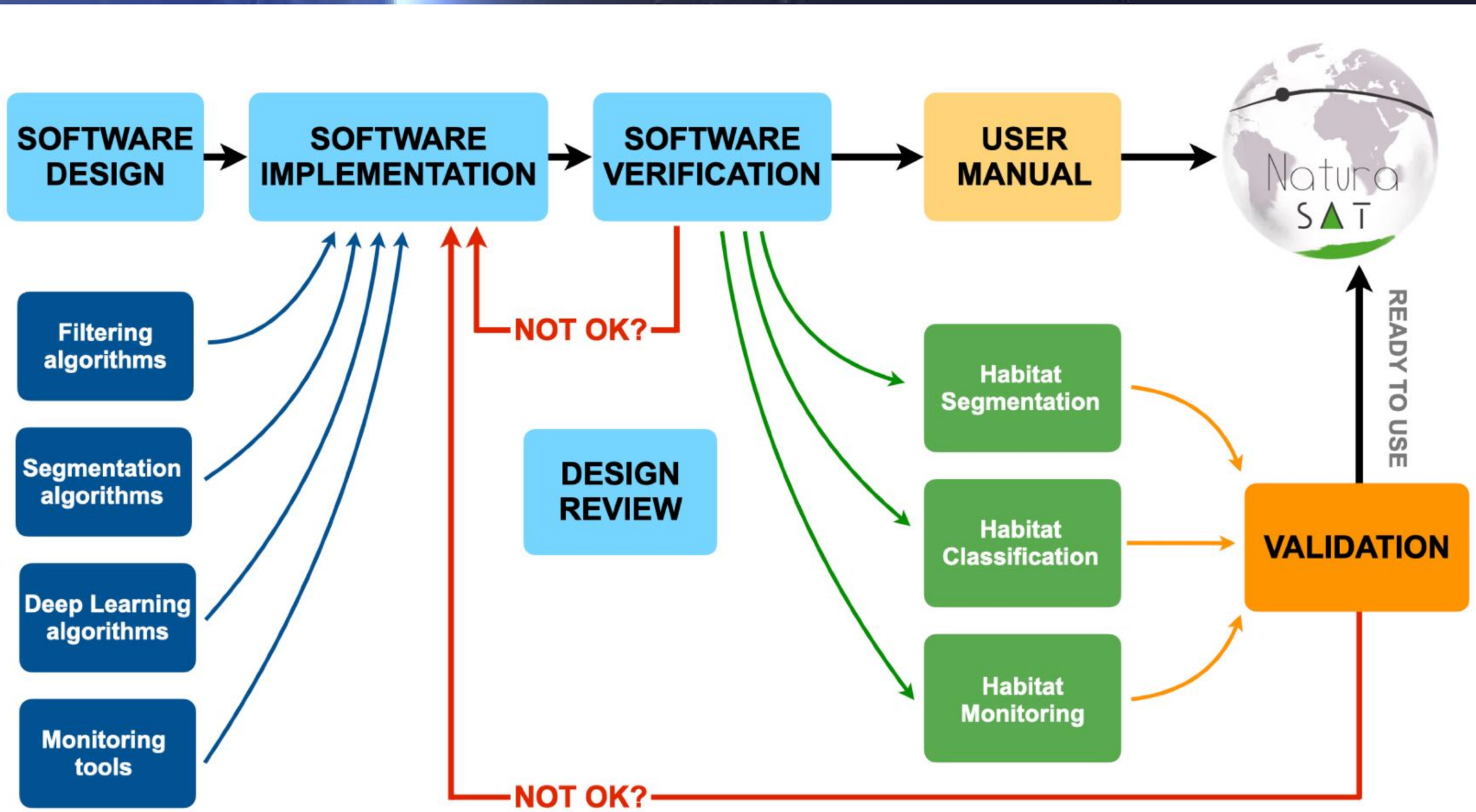
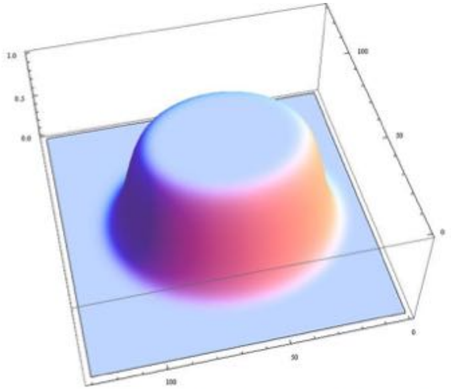
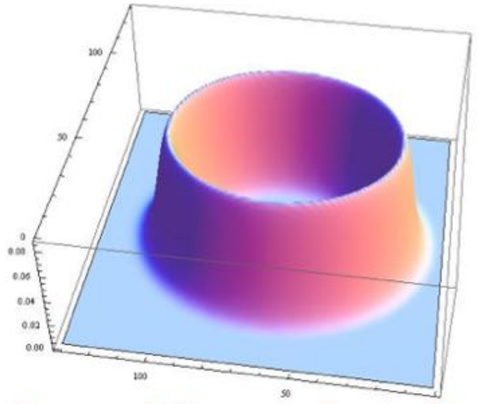

SOFTWARE DESIGN
SOFTWARE IMPLEMENTATION
SOFTWARE VERIFICATION
USER MANUAL
Natura SAT
Filtering algorithms
Segmentation algorithms
Deep Learning algorithms
Monitoring tools
NOT OK?
DESIGN REVIEW
Habitat Segmentation
Habitat Classification
Habitat Monitoring
VALIDATION
READY TO USE
NOT OK?

Detekcia hraníc

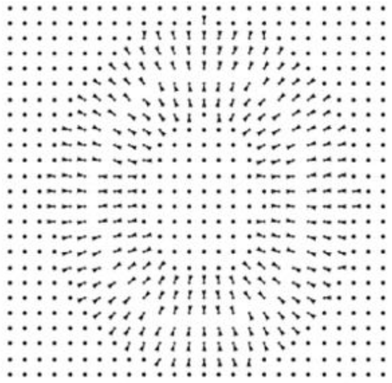
2D scalar function
of image intensity u: $\mathbb{R}^2 \rightarrow \mathbb{R}$

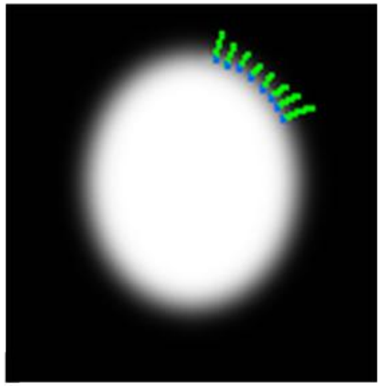


3D graph of image intensity function $u(x, y)$

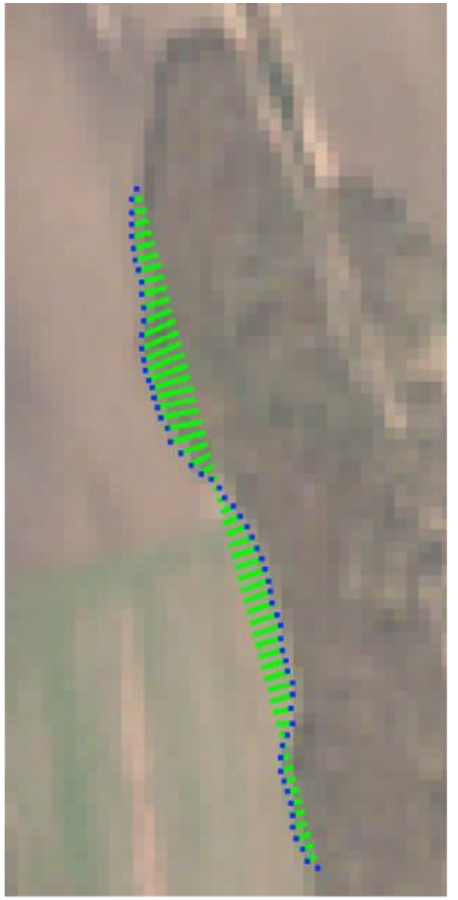


Norm of the gradient of u(x,y)



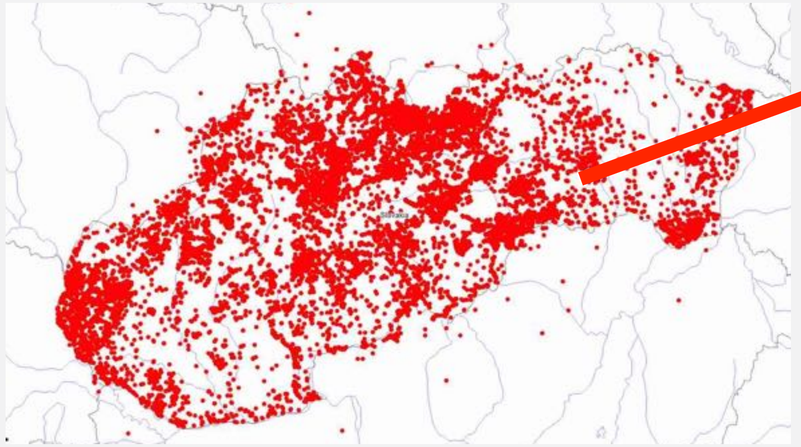


- Perona-Malik edge detector
- Velocity vector field was constructed as a gradient of edge detector
- It drives a curve to the object boundary



Detekcia hraníc

Sentinel-2 data



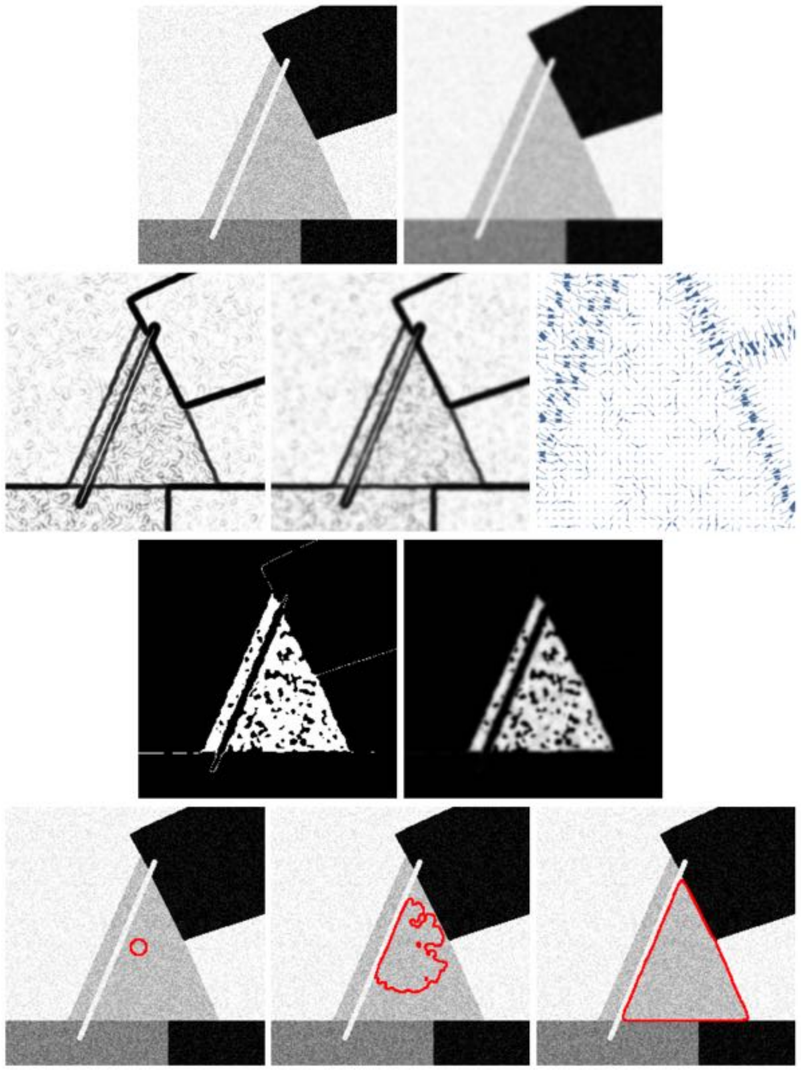
Slovak Vegetation Database

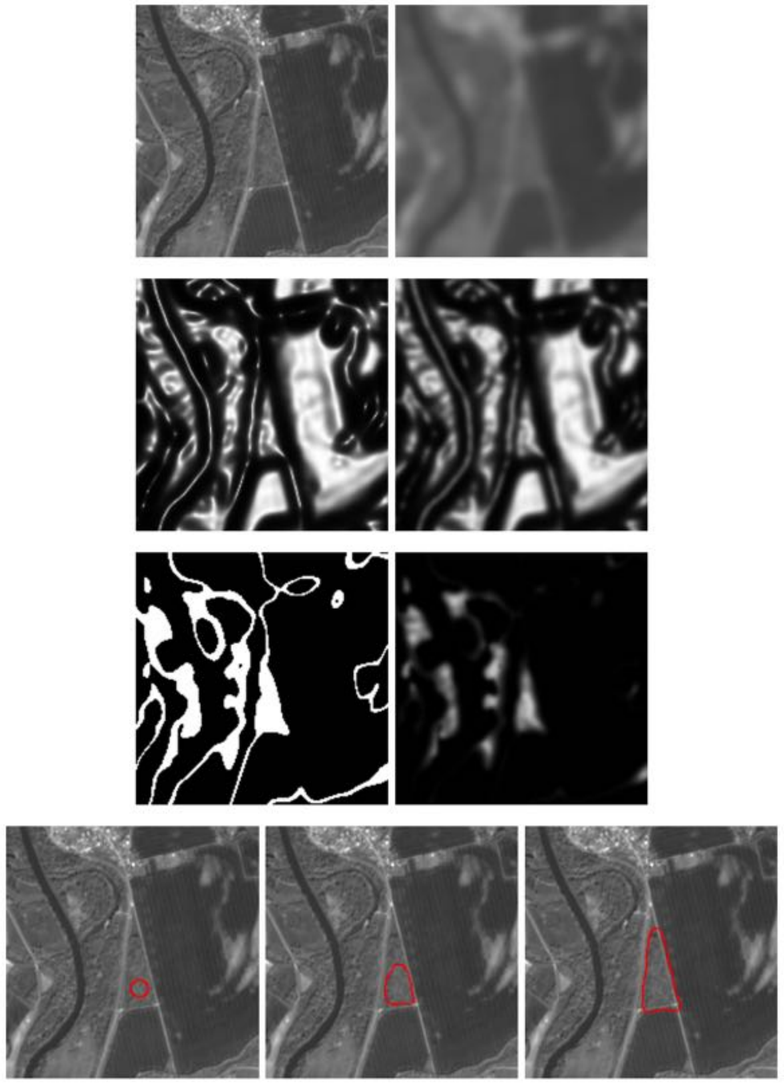
Optical data

Point data - habitat occurence

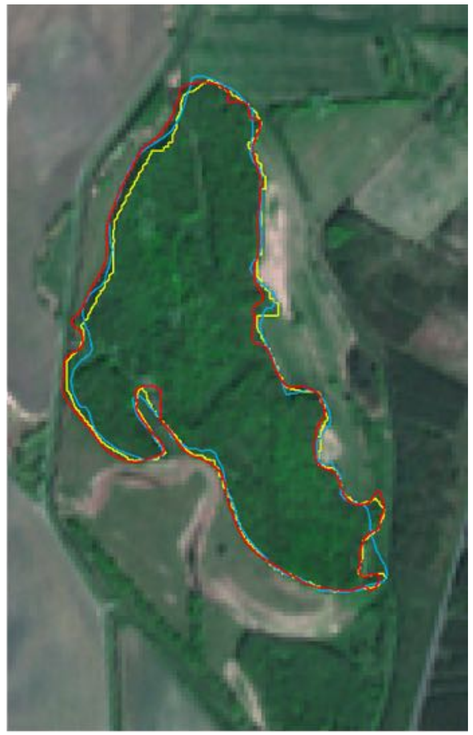
Semi-automatic segmentation

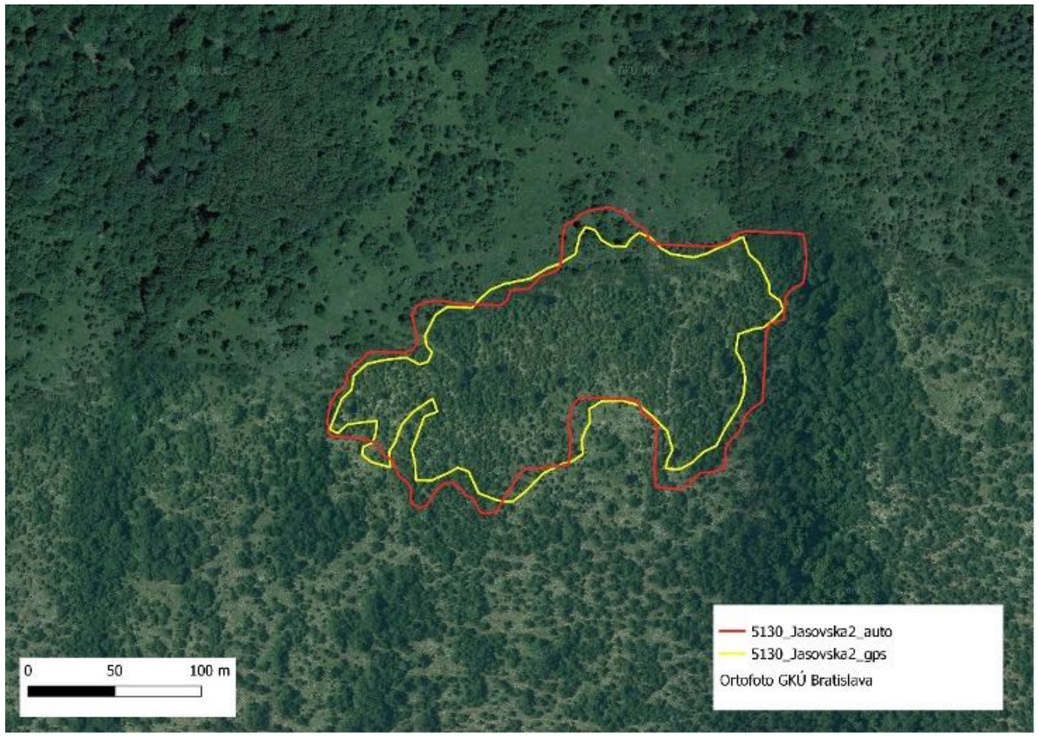
Automatická detekcia hraníc

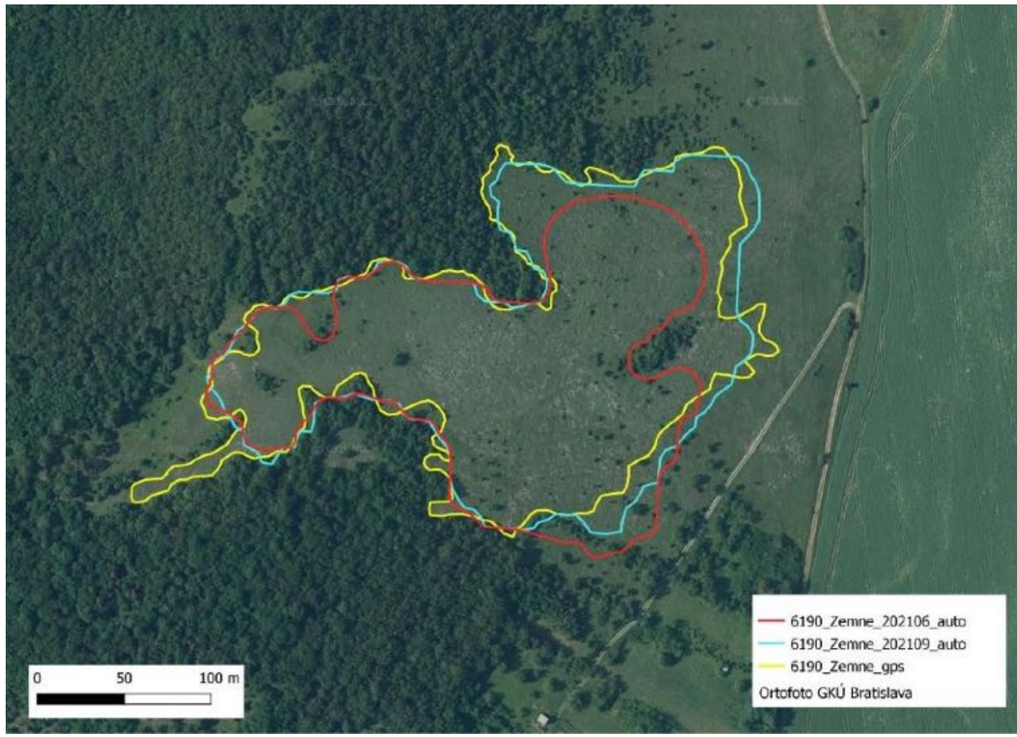




Automatická detekcia hraníc

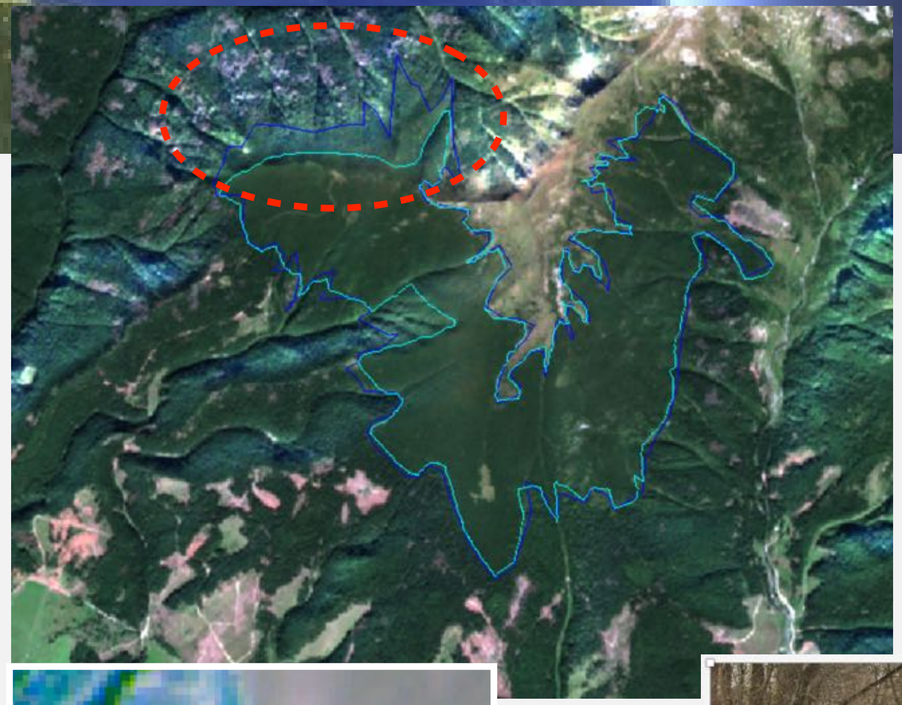


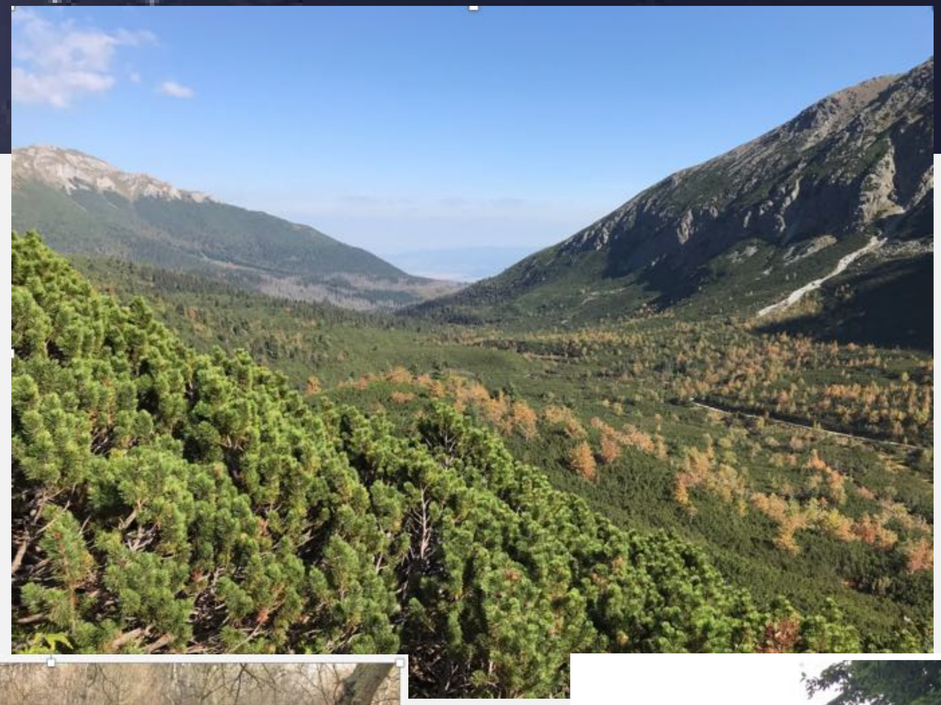


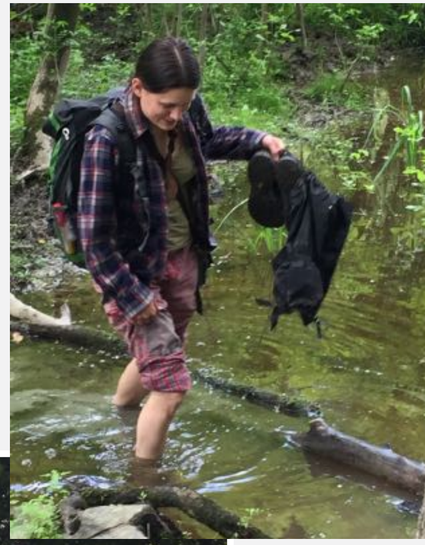


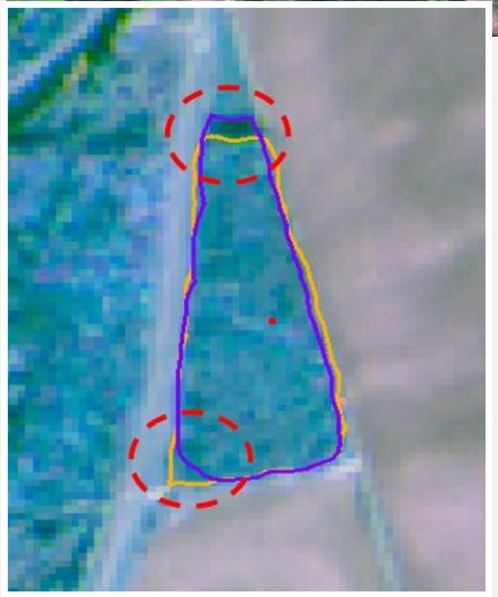
- 91FO - 10m
- 5130 - 10.1 m
- 6190 - 8.4 m

- Overenie hraníc v teréne - GPS trasy
- Hausdorff distance - vzdialenpsť dvoch kriviek - priemerná, maximálna



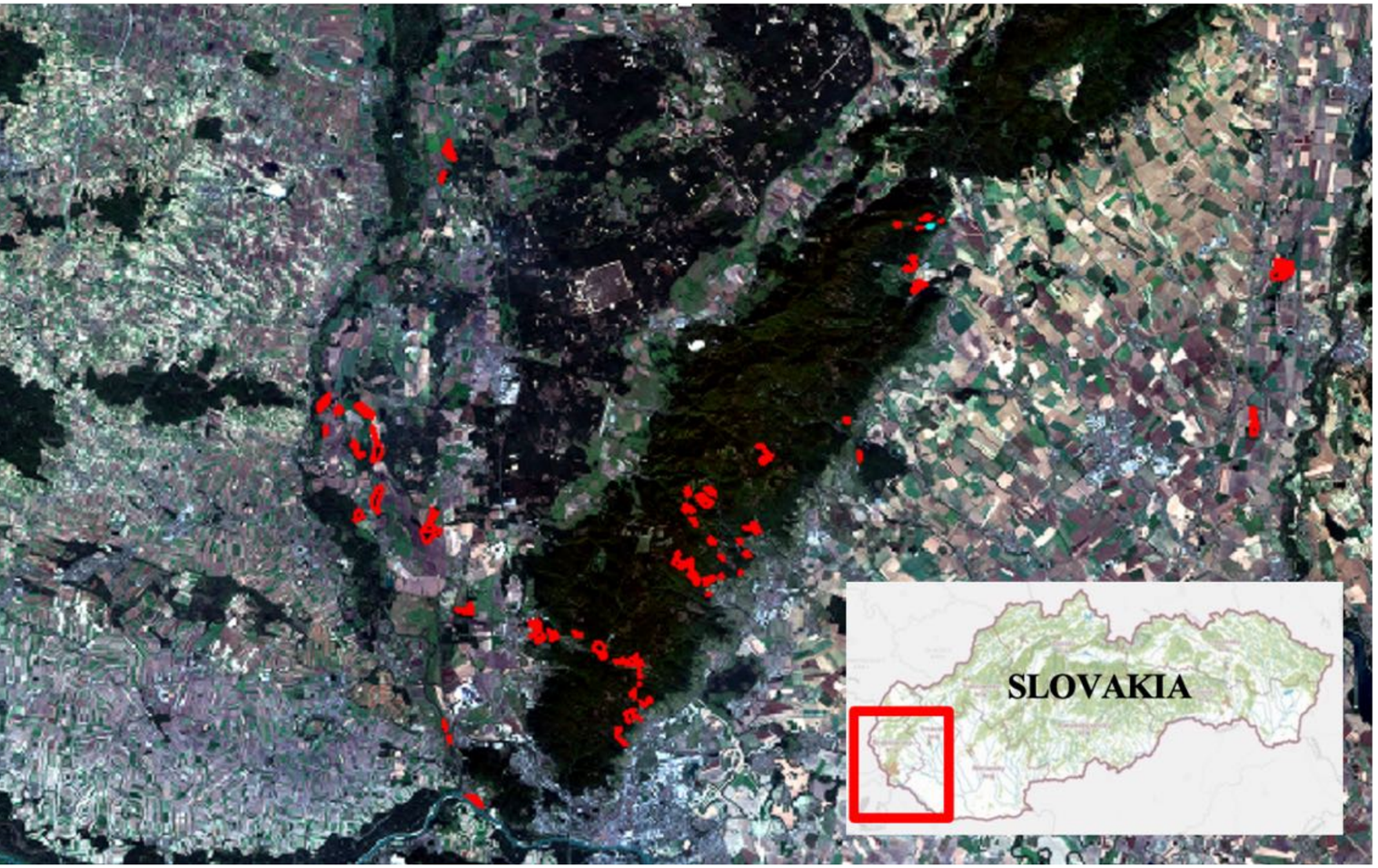


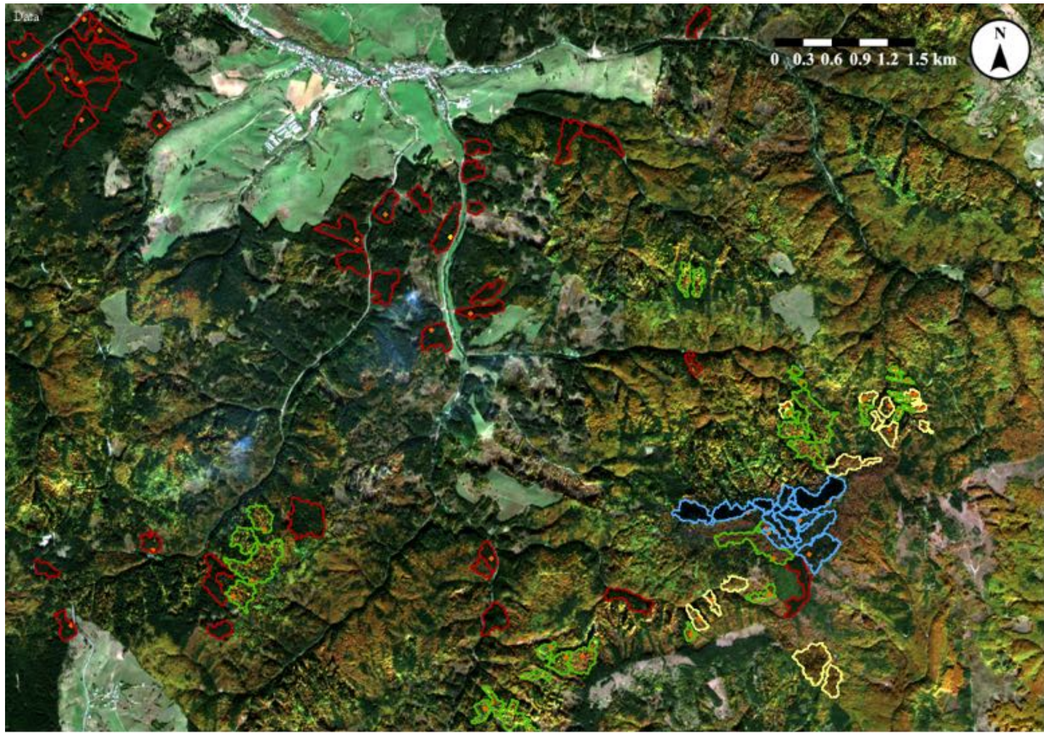




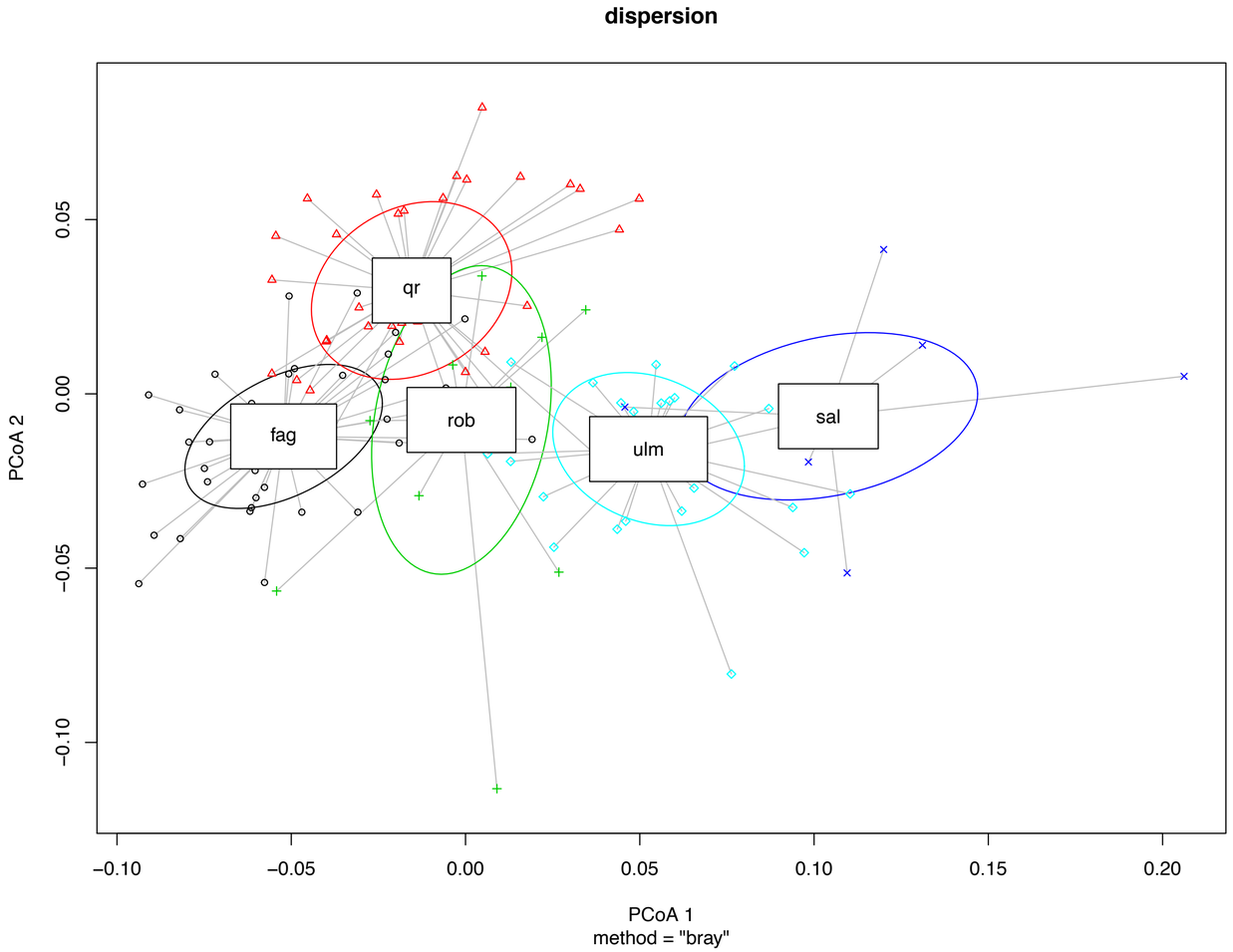
- Rozdiely spôsobené edge efektom a sťaženým pohybom v teréne

Klasifikácia biotopov

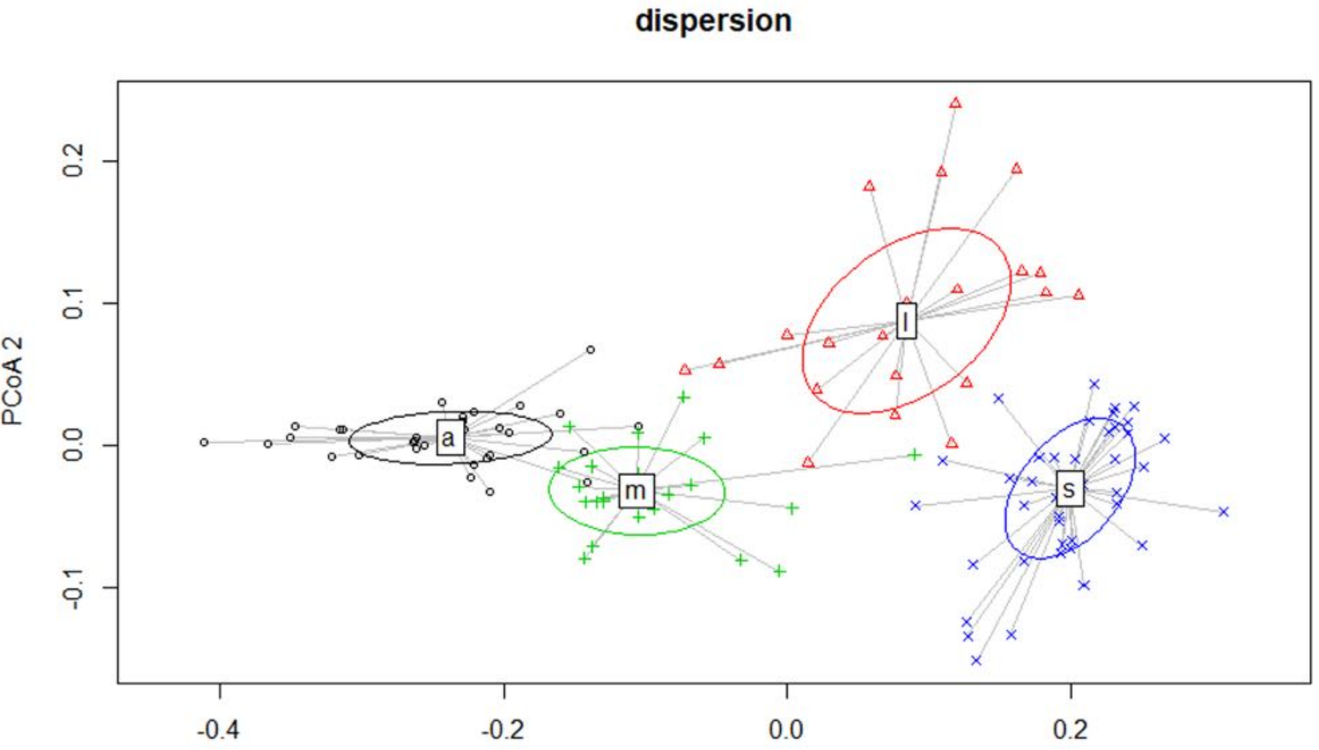




- Hodnoty intenzity jednotlivých pásiem (min, max, STD)
- Lesy západného Slovenska a okolia Čierneho Balogu



- sal - 91E0 Mixed ash-alder alluvial forests
- ulm - 91F0* Riparian mixed forests along the great rivers
- qr - 91G0 – Pannonic woods with Quercus petraea and Carpinus betulus
- fag - 9110 – Luzulo-Fagetum beech forests
- rob - Plantations of non-native Robinia pseudoacacia trees

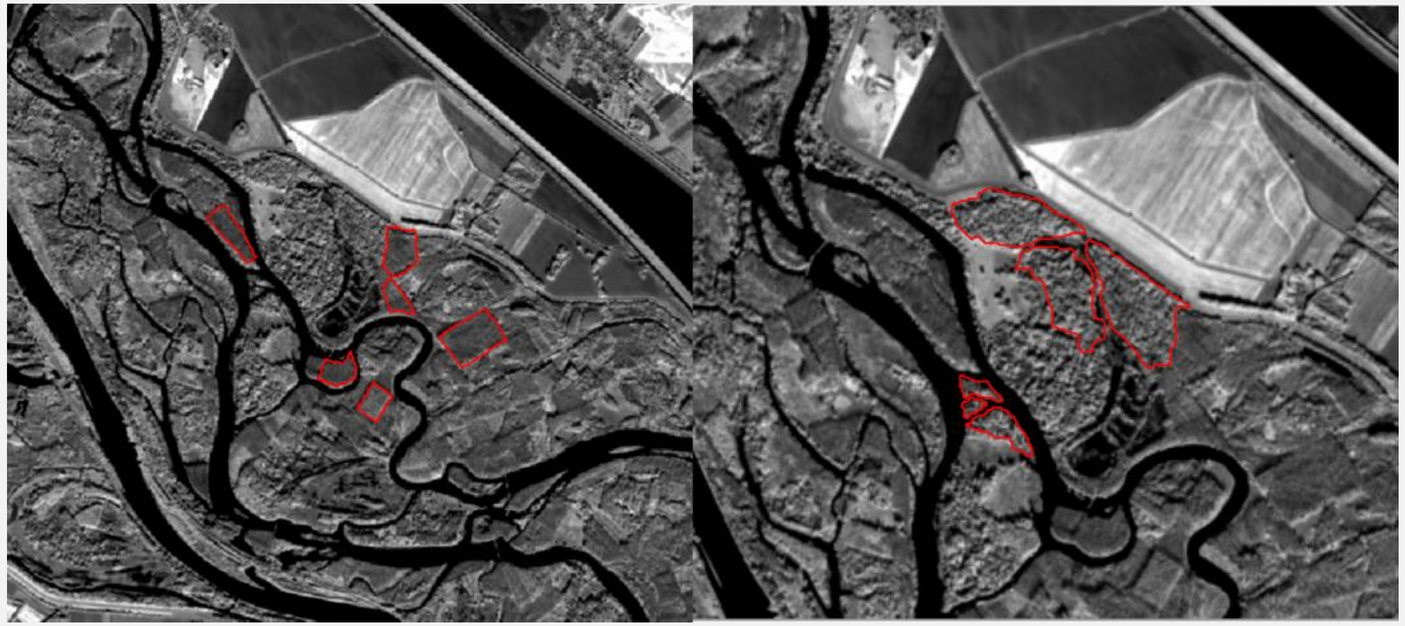


- *s - Acidophilous Picea* Mountains spruce forests
- *m- Asperulo-Fagetum* Mixed beech forests

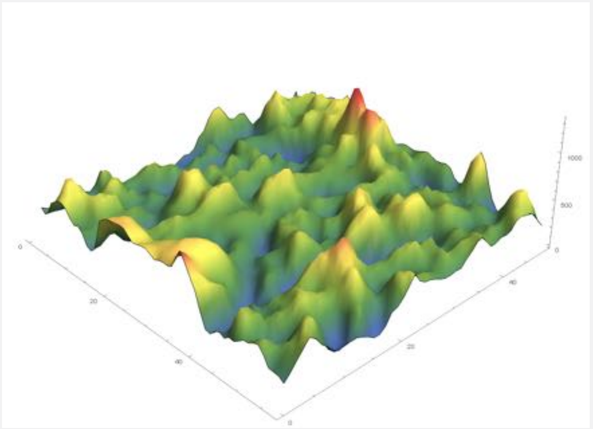
Forests with a large proportion of:

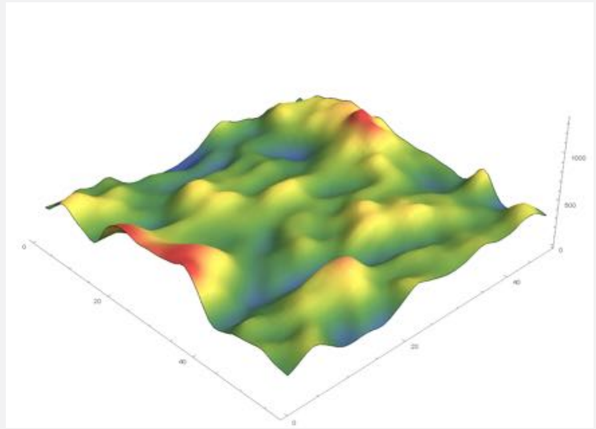
- *l - Larch Larix decidua*
- *a - Maple Acer sp.* *(assumption of scree and ravine forest habitats)*

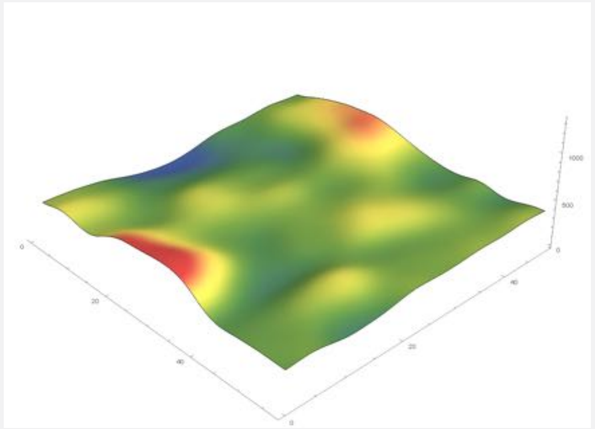
Klasifikácia biotopov

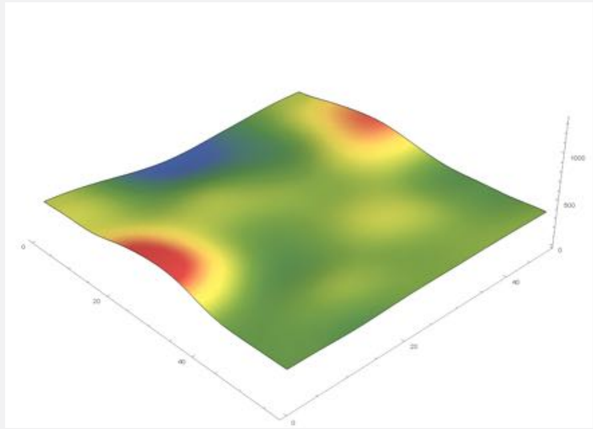


- Problém odlíšenia monokultúr a prirodzených lesov s rovnakou dominantnou drevinou
- Relative High Laplacian (RHL)
- Vľavo - vysoké RHL
- Vpravo - nízke RHL - homogénny porast

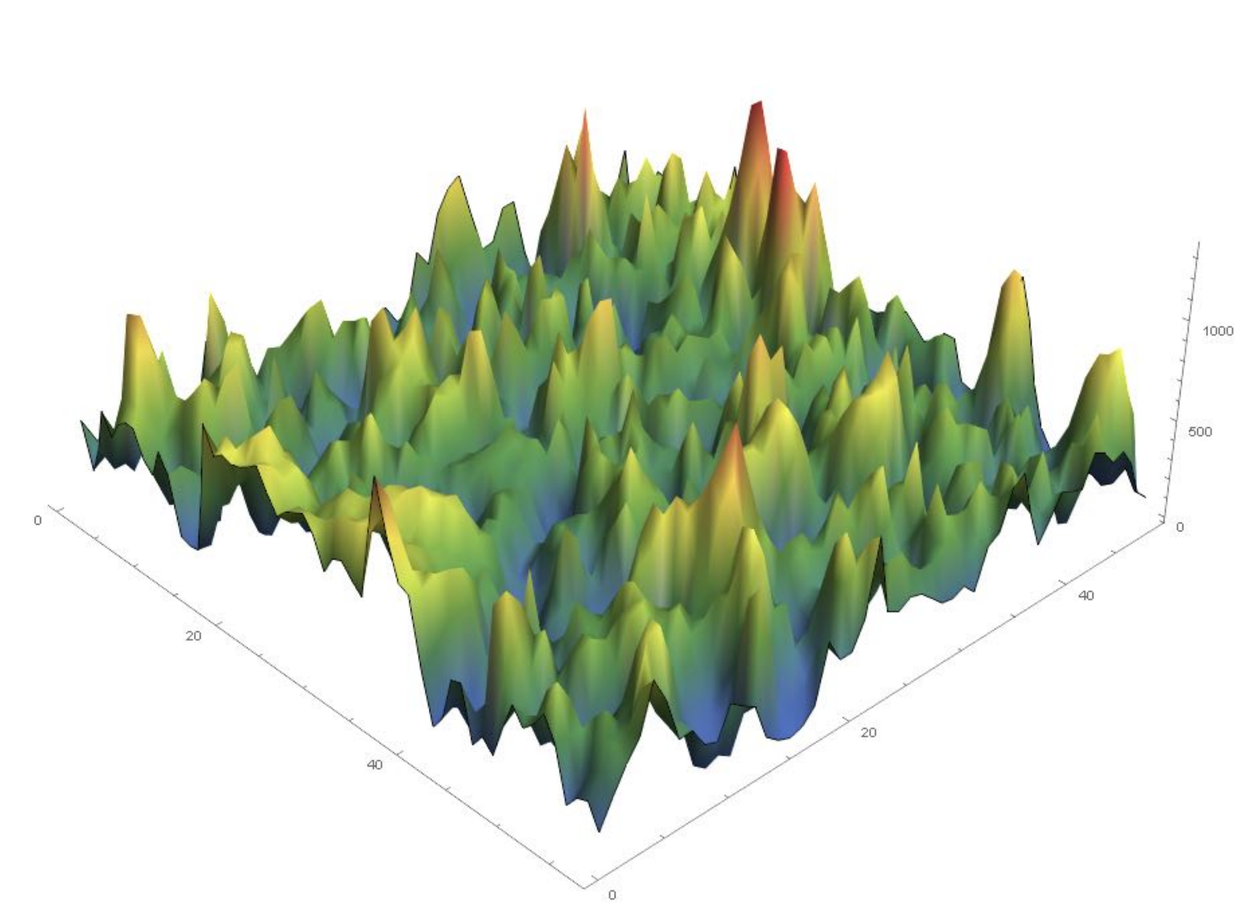




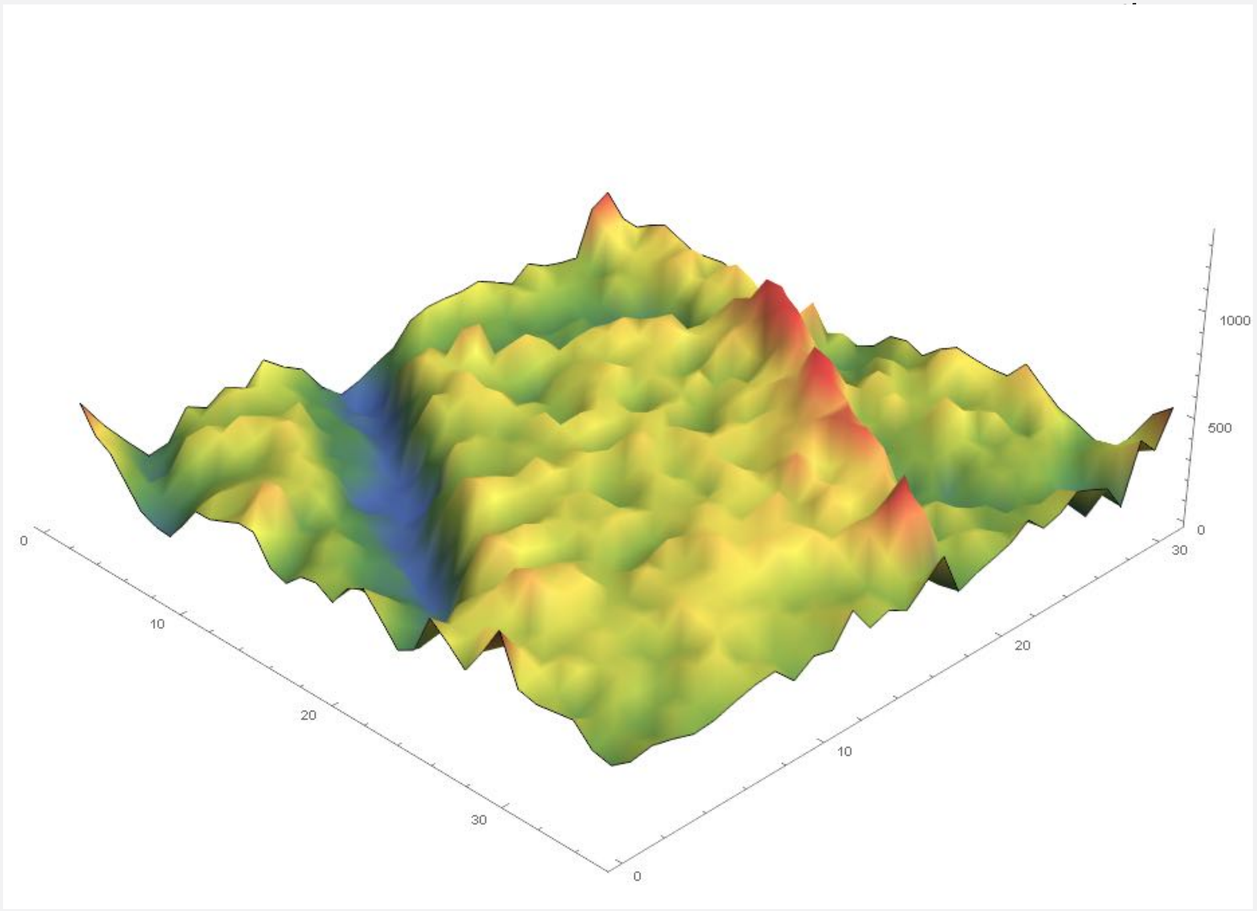




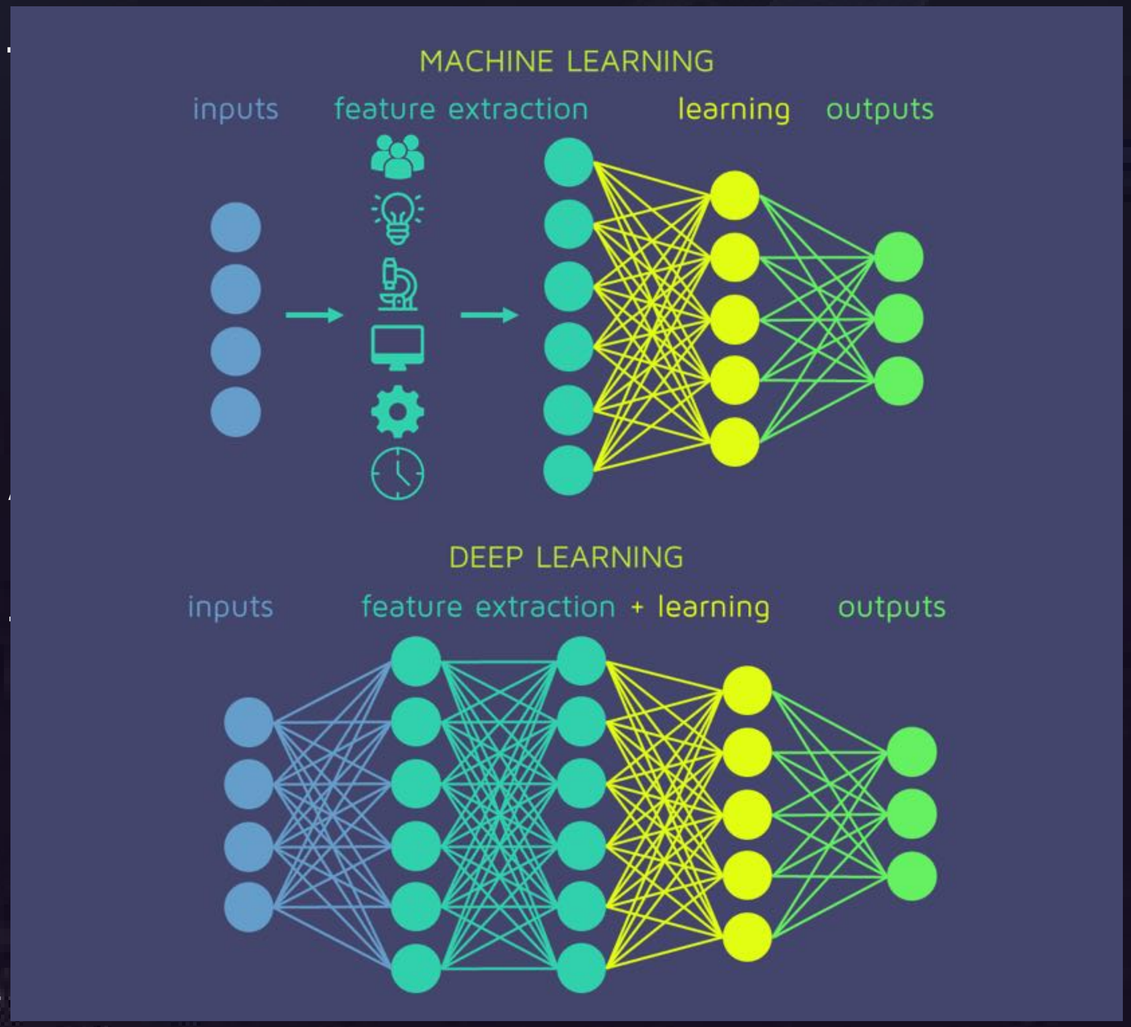
Mäkký lúžný les



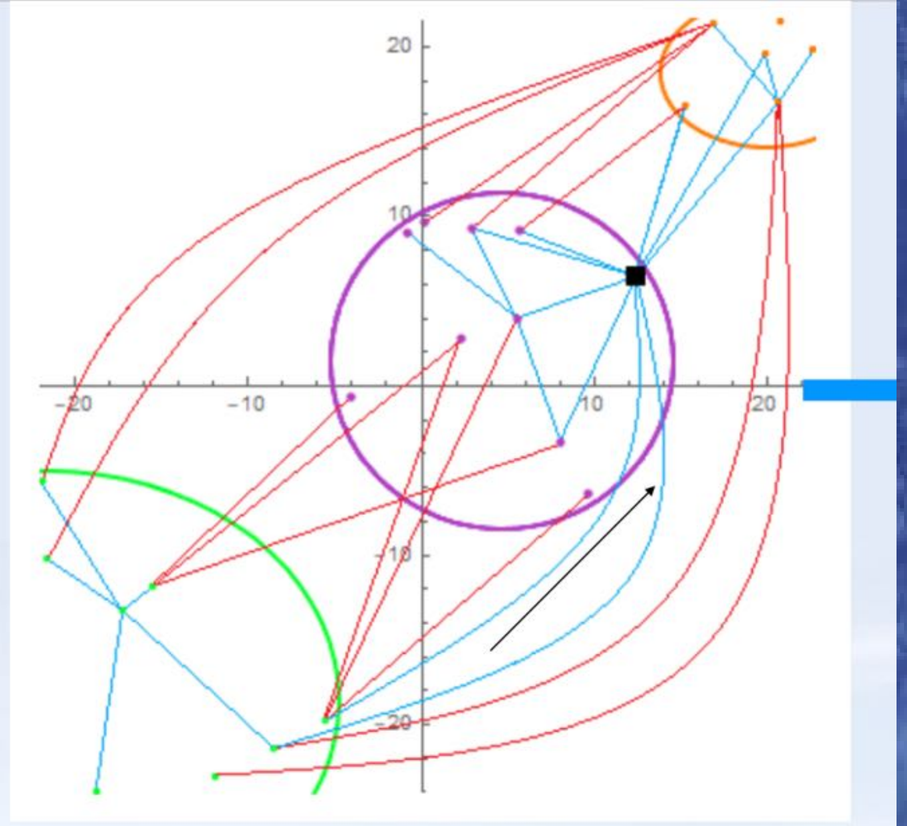
Monokultúra šlachtených topoľov



Relevancy mapa



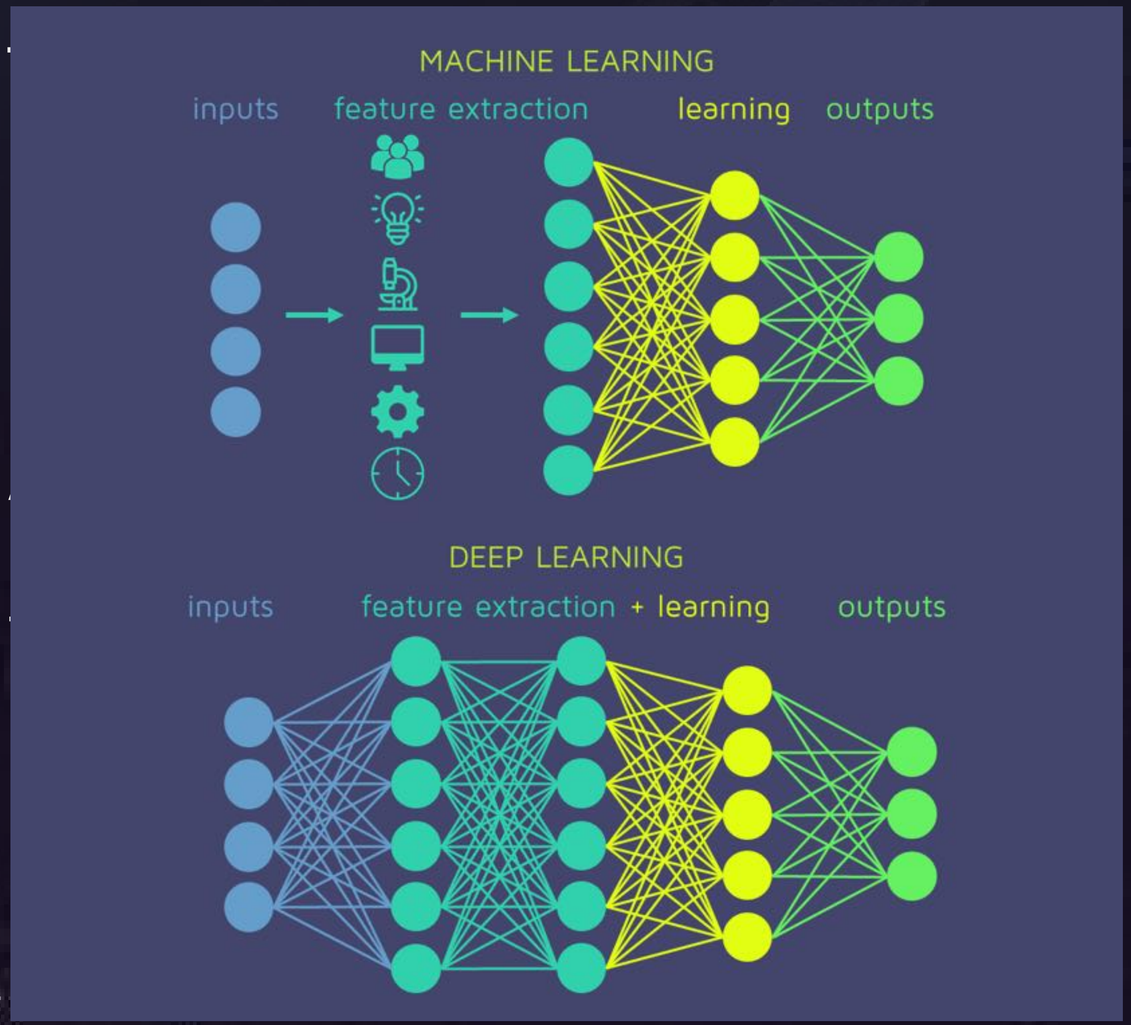
Relevancy mapa

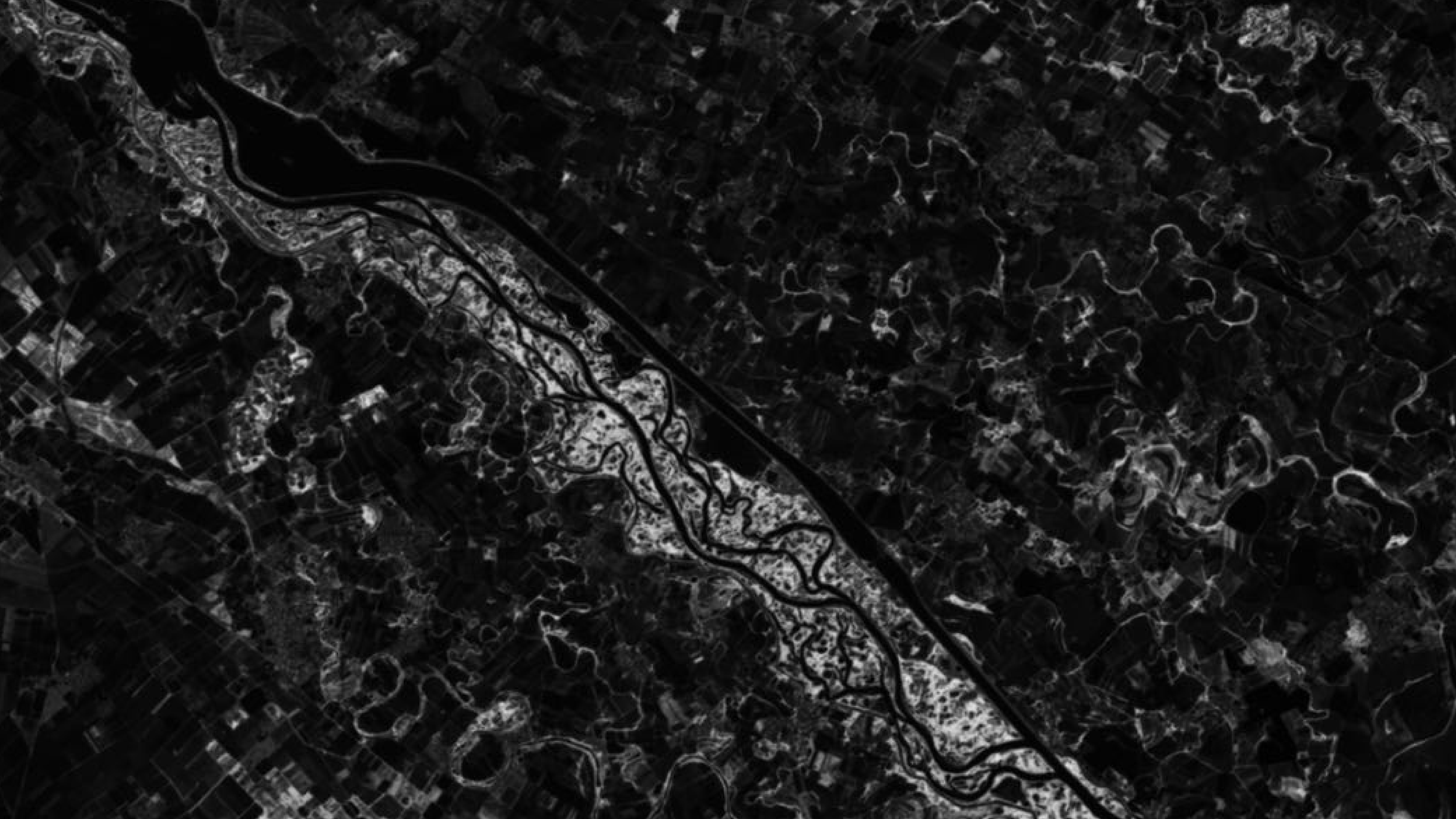


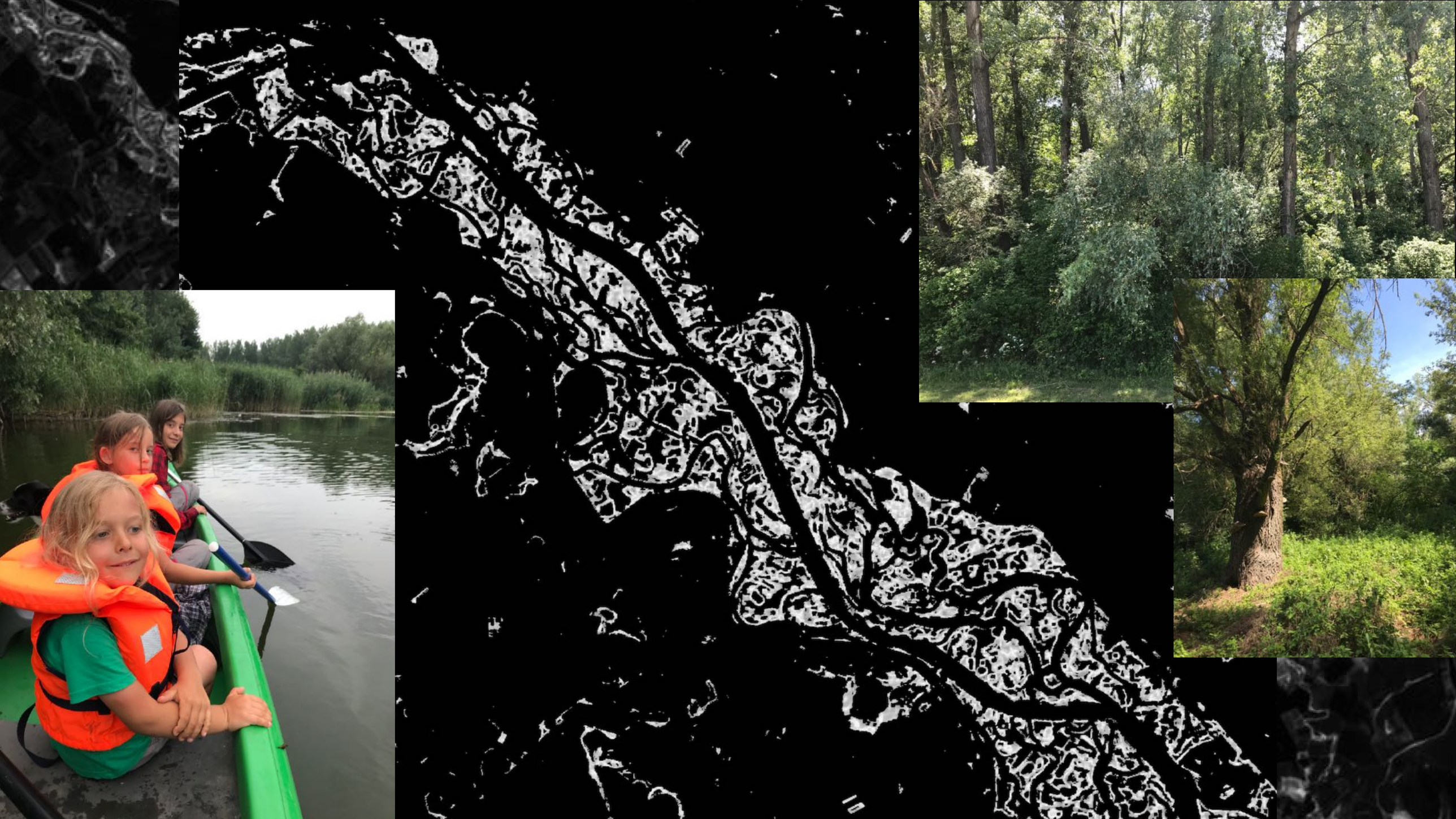
→ Forward diffusion causes the movement of points in a feature space toward each other.

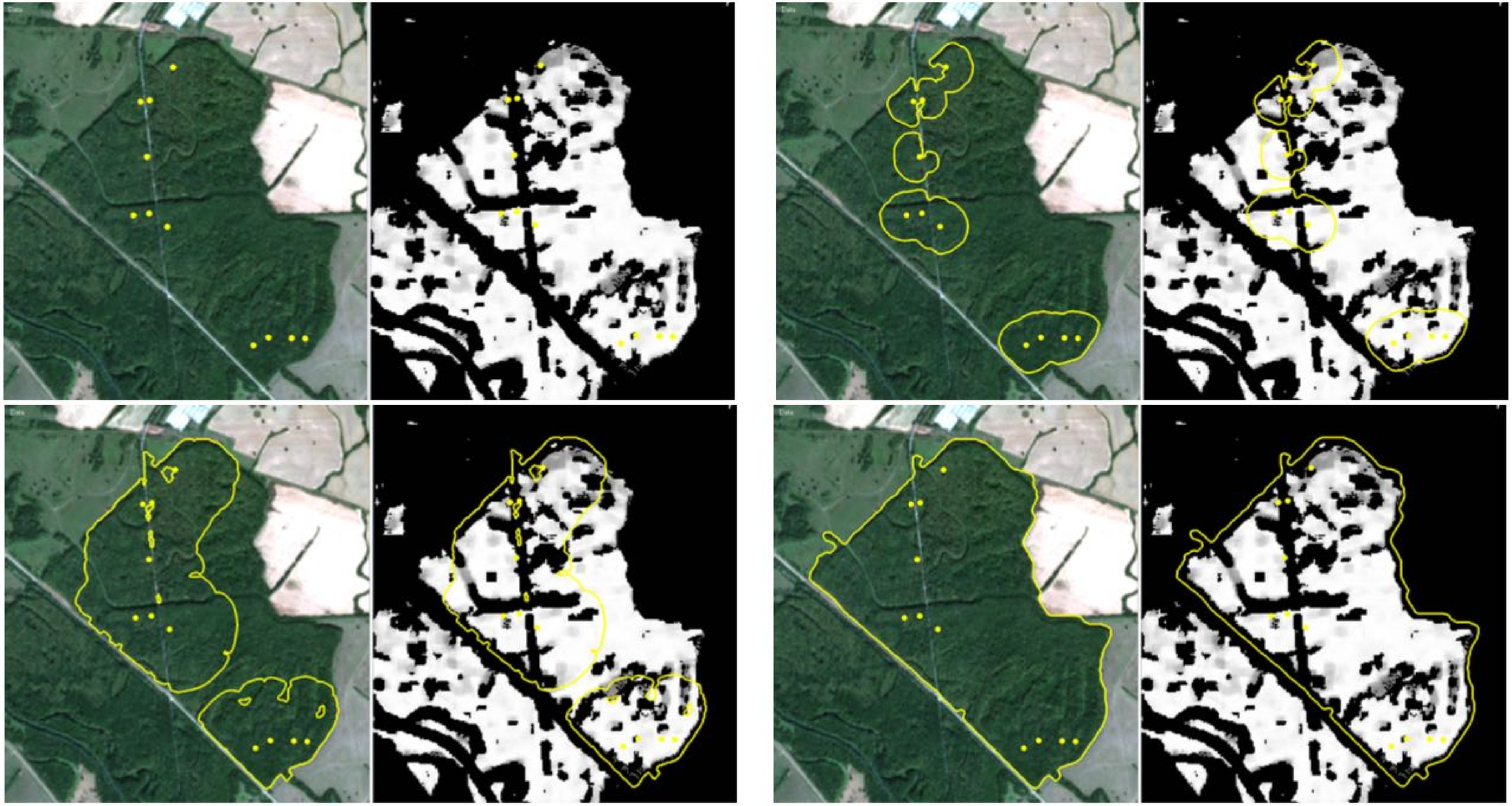
← The opposite effect - caused by backward diffusion

✓ This yields the desired classification.

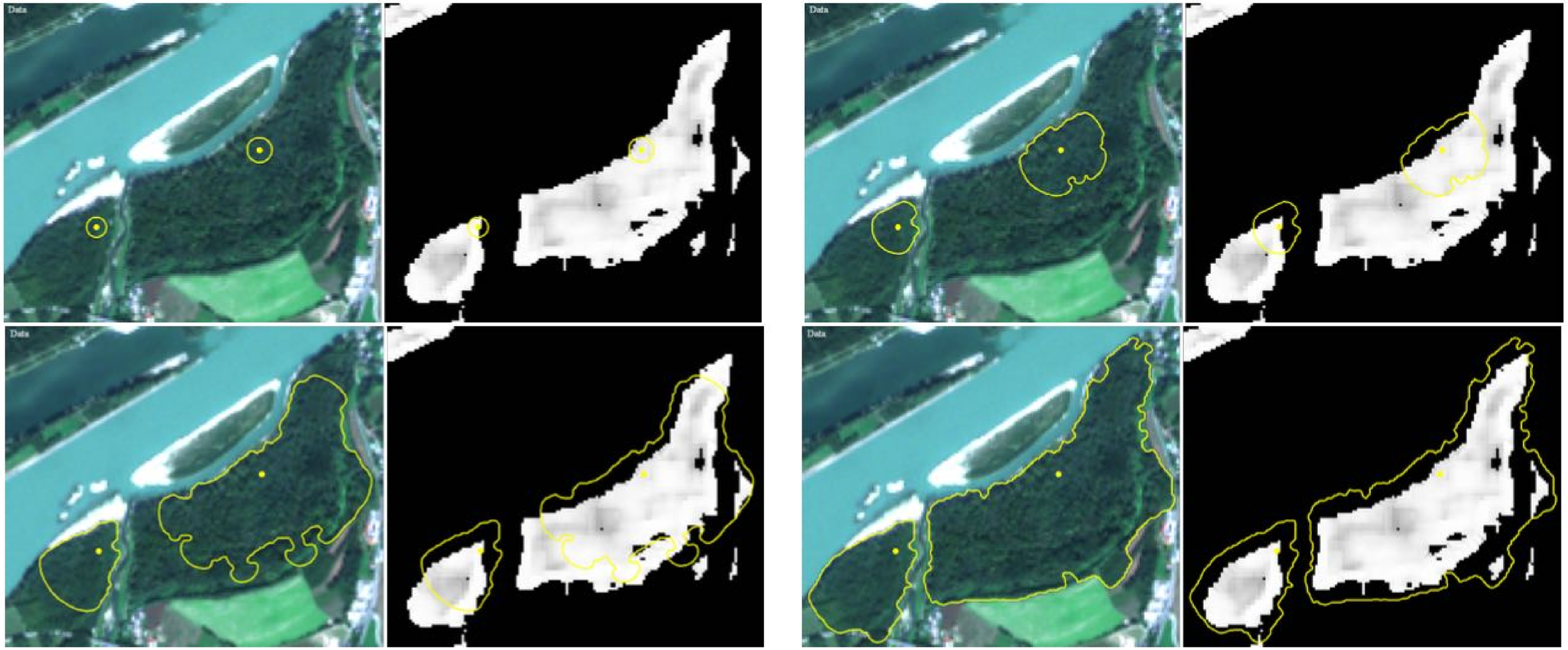




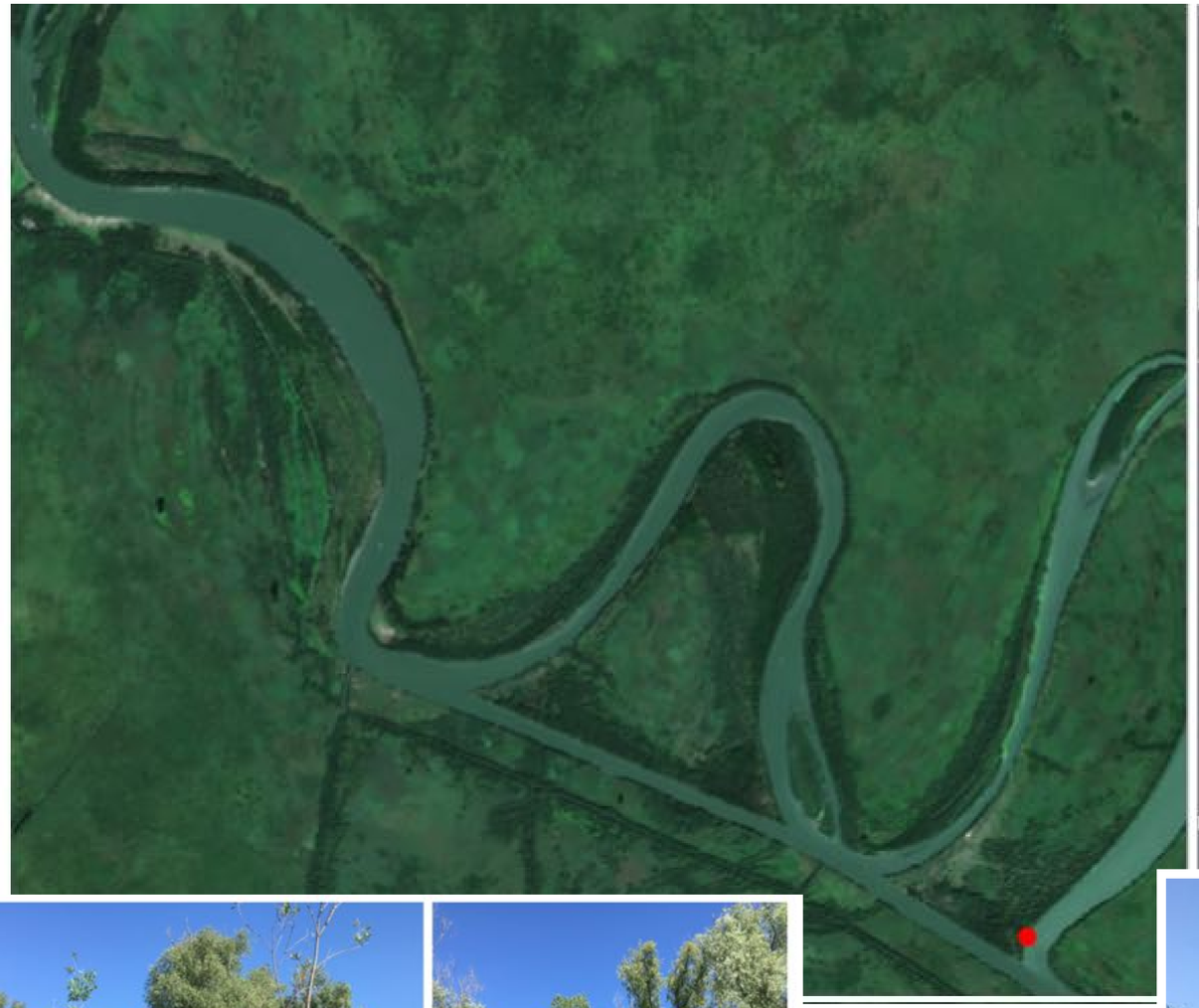


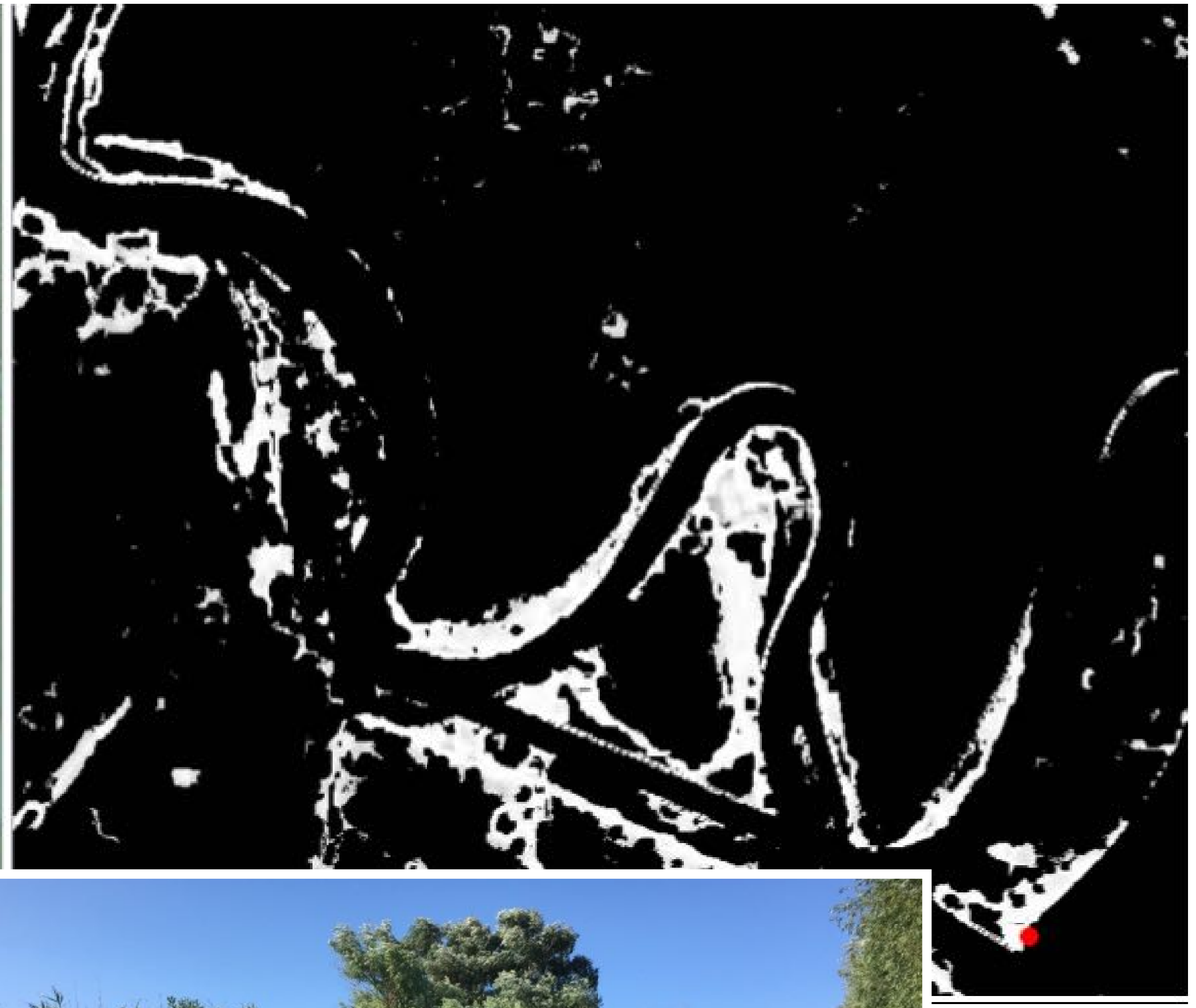


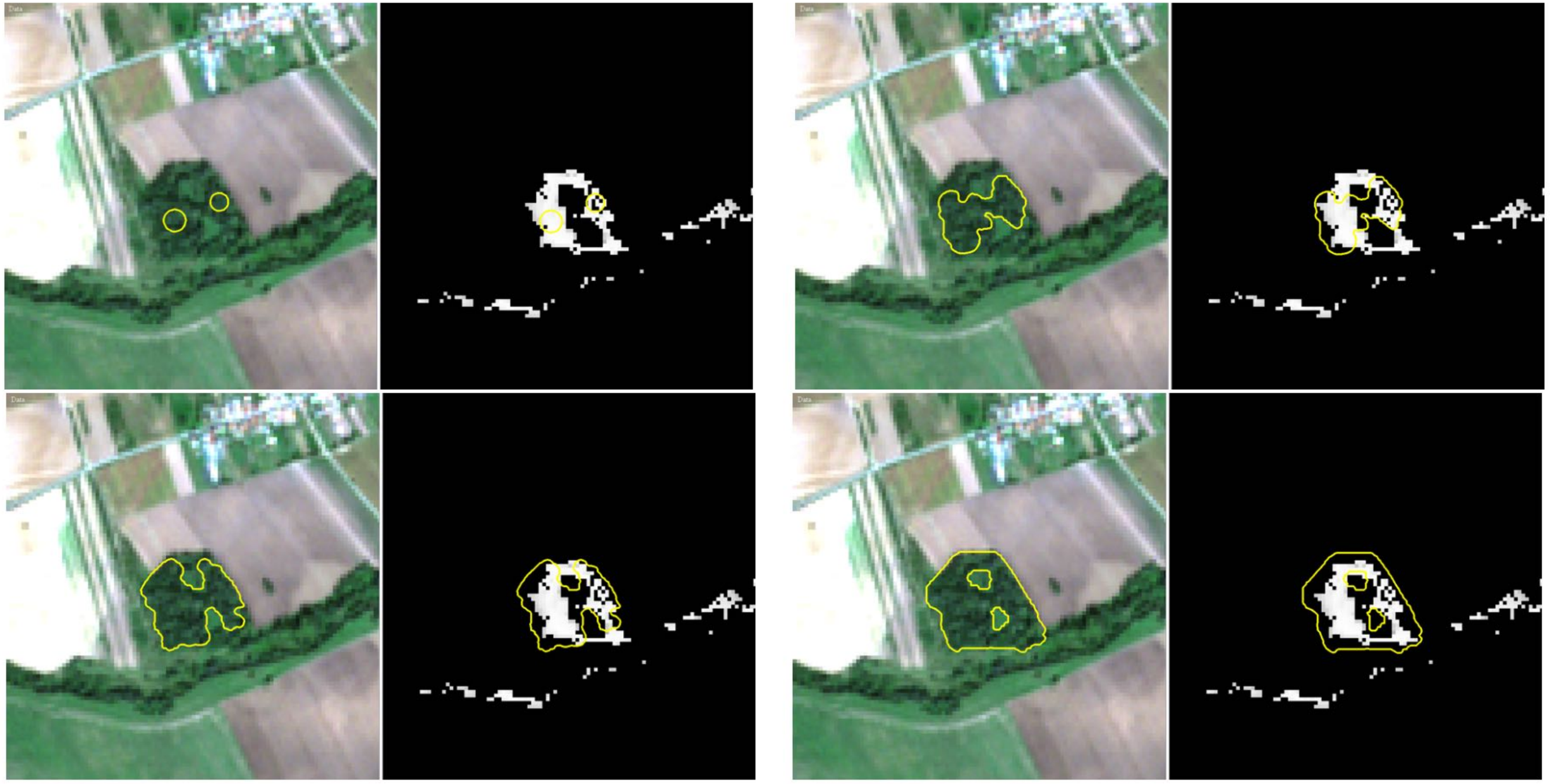
- Tvrdý lužný les v CHKO Latorica



- Mäkký lužný les (91E0) v Rakúsku pri meste Linz





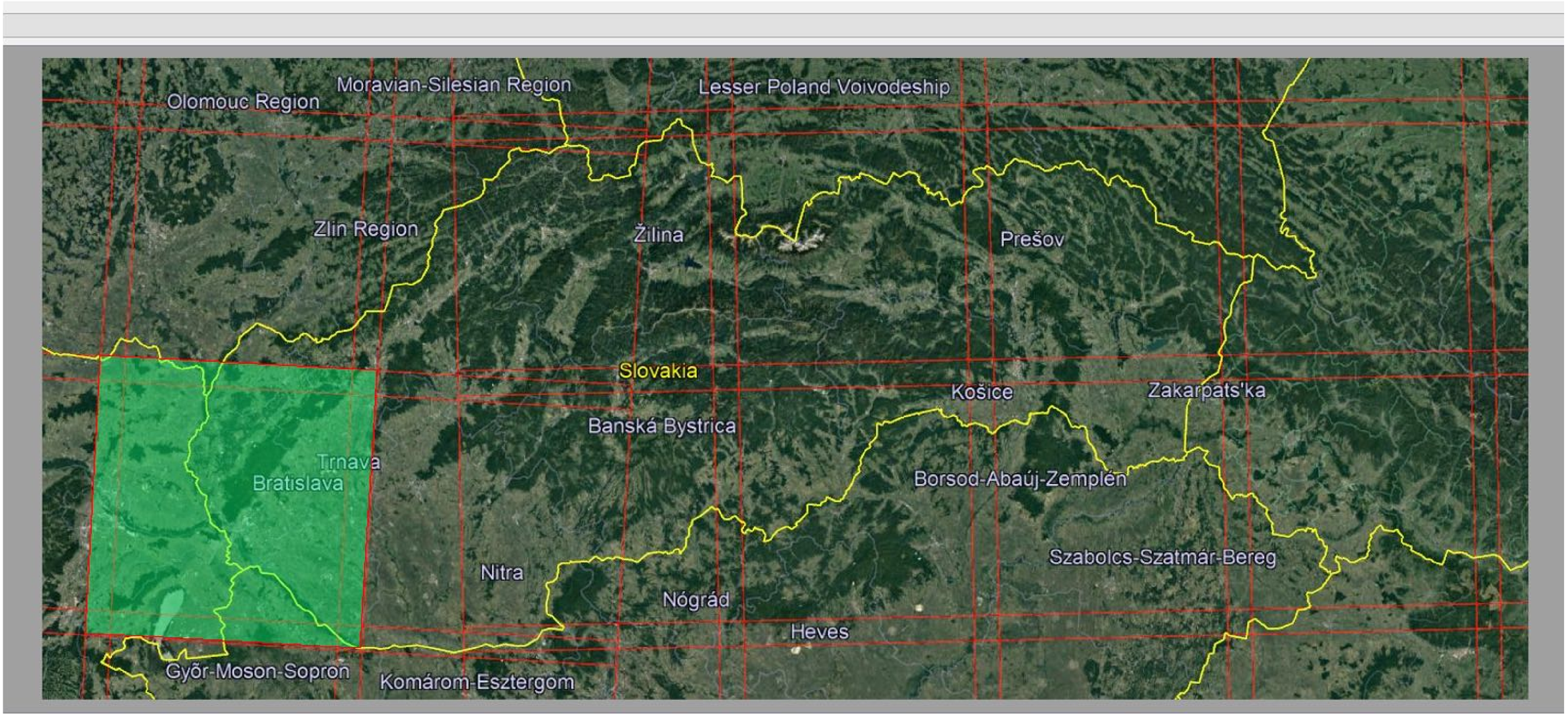


- Mäkký lužný les (91E0) v povodí Rimavy (Dubovec)

Natural Numerical Networks

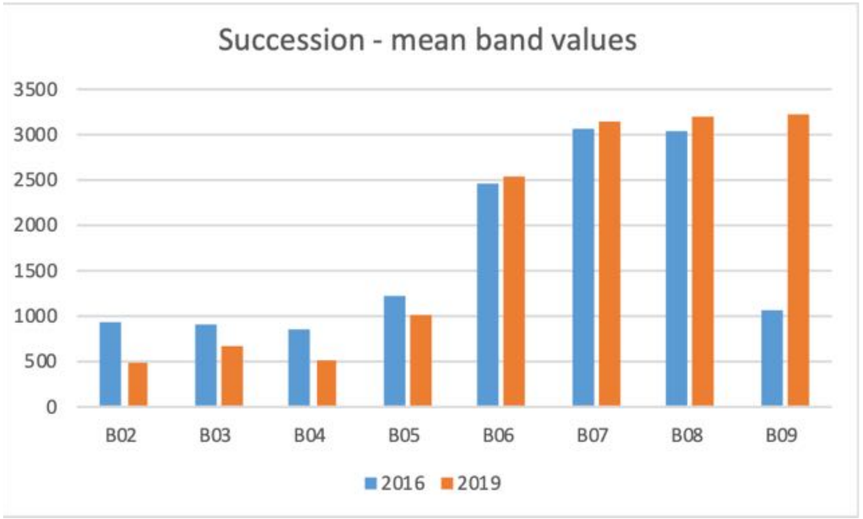
- **Detection**
  - Forests
  - Grasslands
  - Aquatic habitats
- **Diversity**
  - Spectral diversity
  - Species diversity
  - Functional diversity
  - Phylogenetic diversity
  - Acoustic diversity
- **Dynamics**
  - Habitats
  - Populations

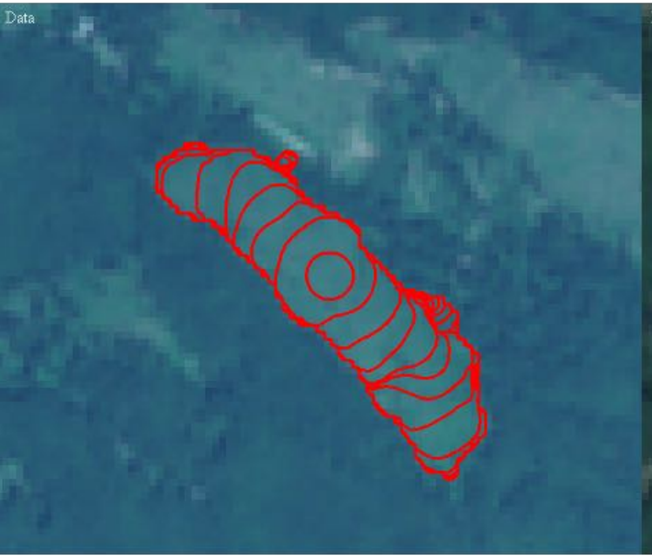
Monitoring biotopov

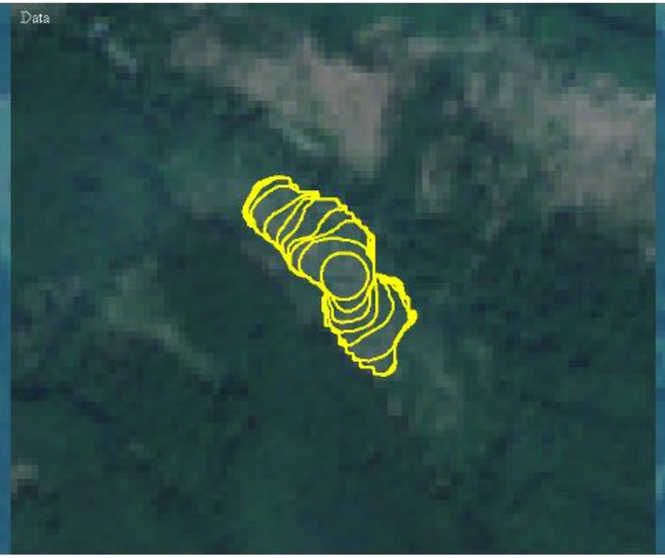


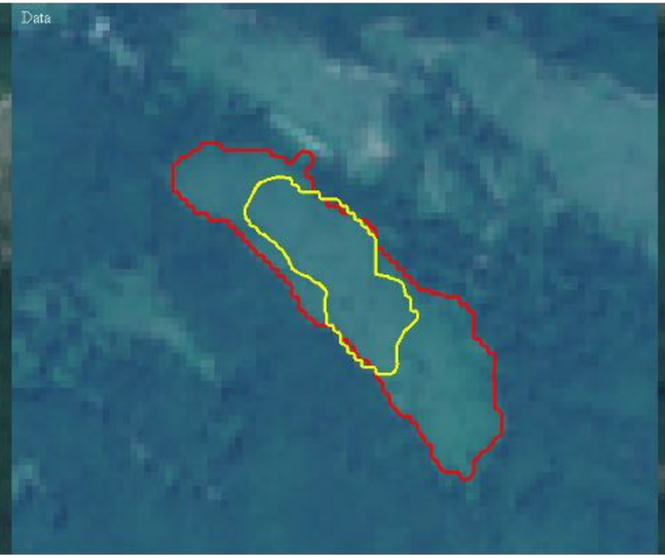
Monitoring plochy biotopov

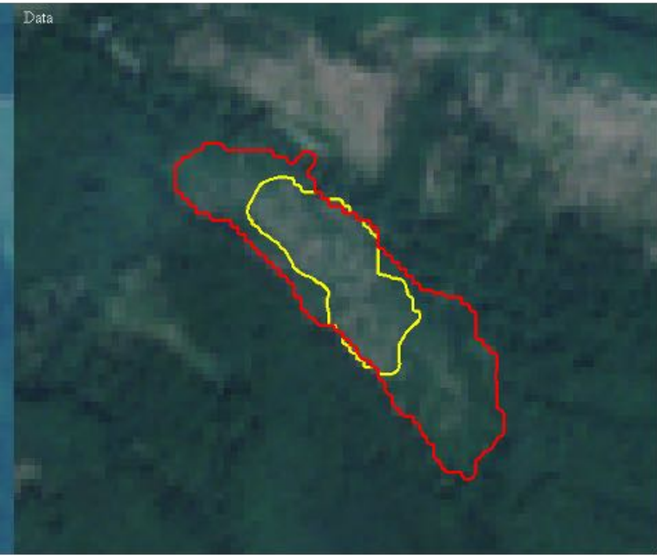
- Automatická segmentácia rovnakého biotopu v roku 2015 a 2019
- Zarastanie biotopu prirodzenou sukcesiou

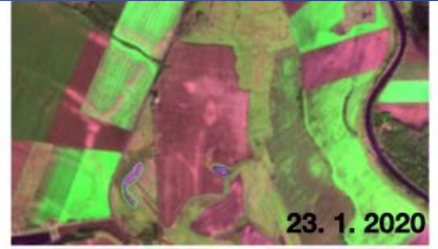


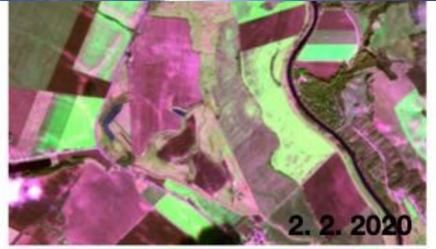


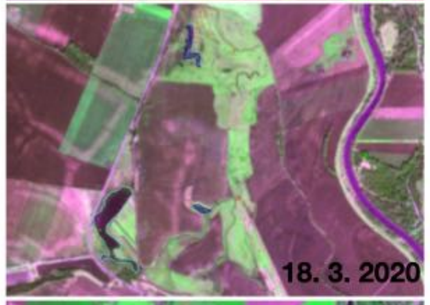


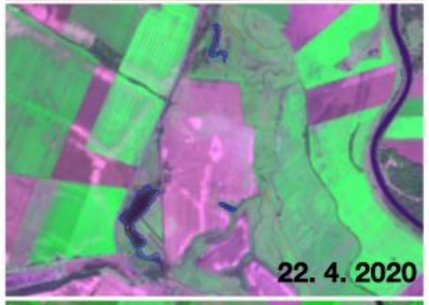


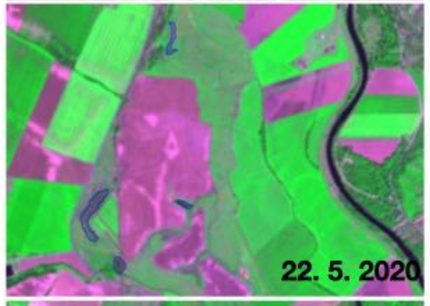


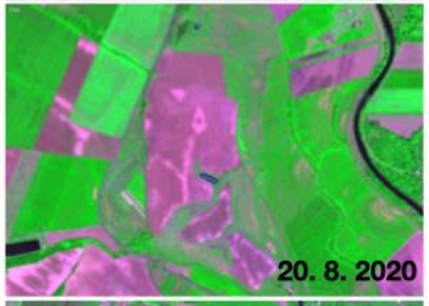


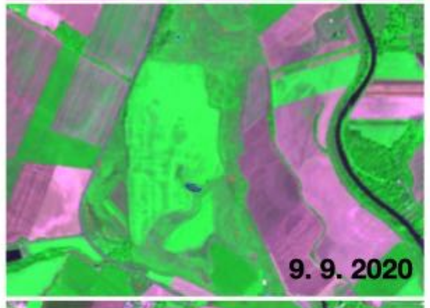


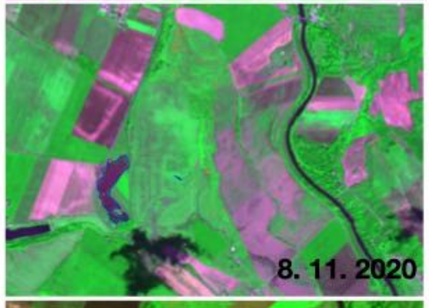


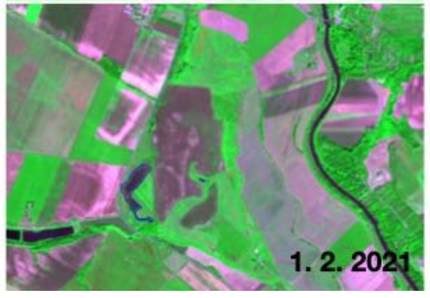


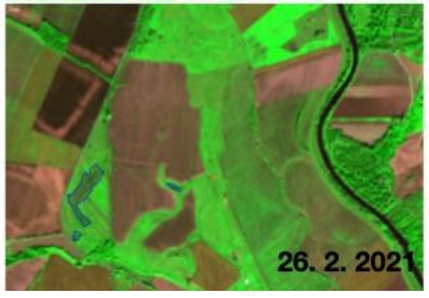


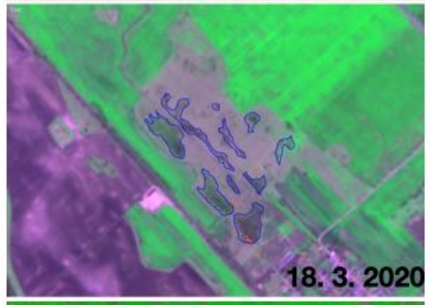


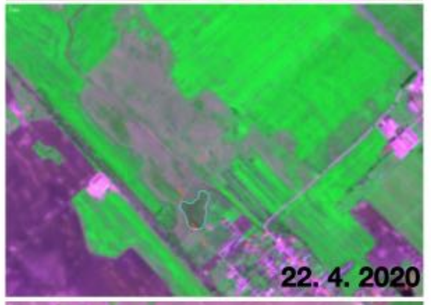


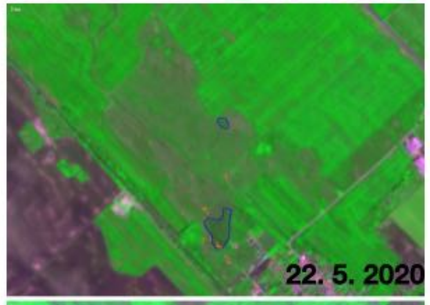


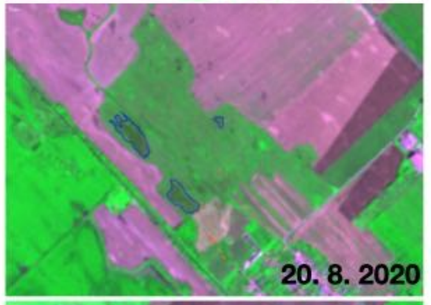


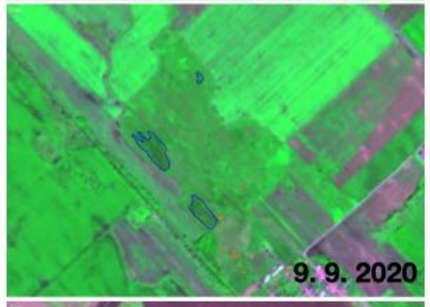


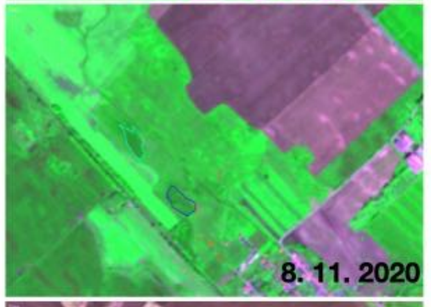


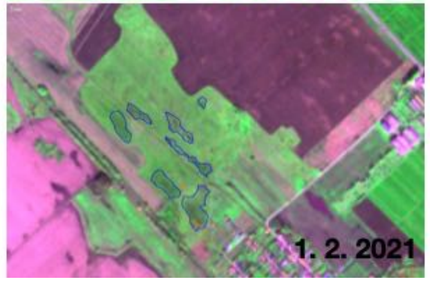


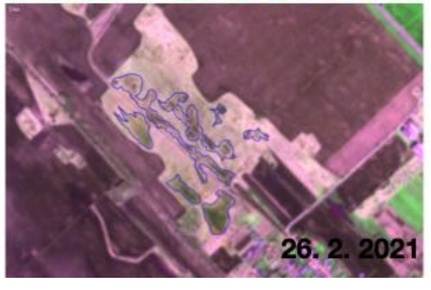






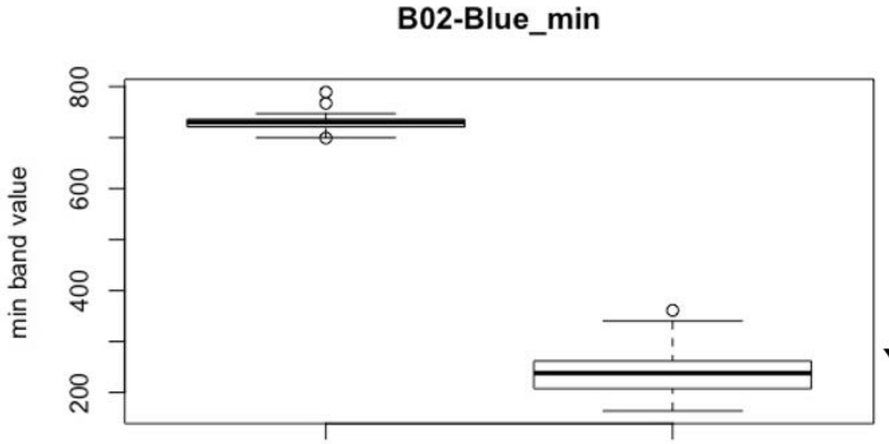


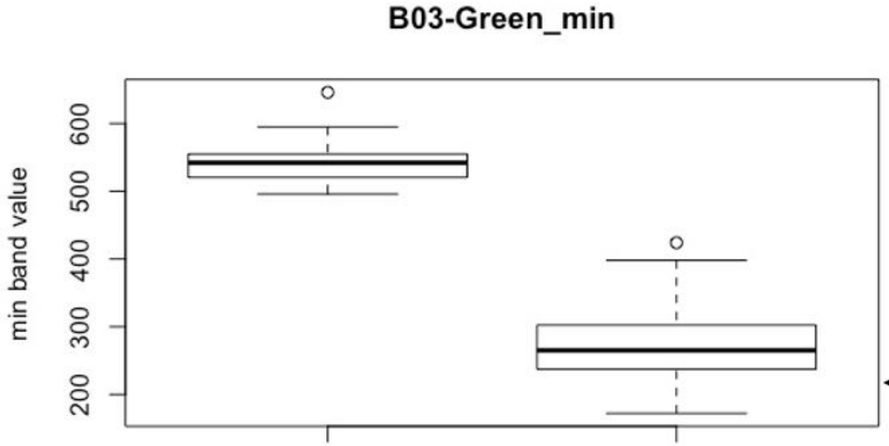


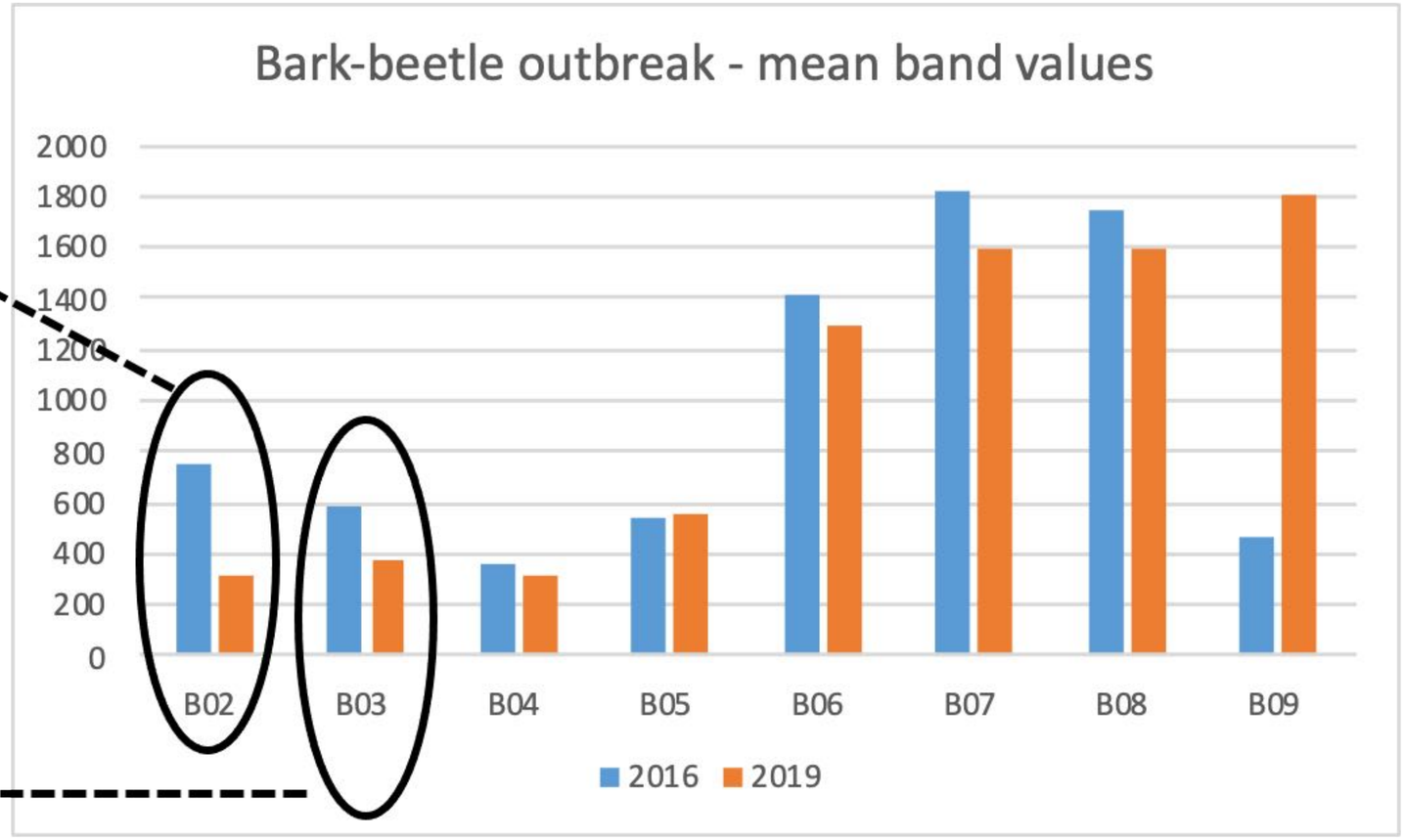


- Pedo-hydrologický režim slanísk počas roku
- Kamenínske slanisko
- Panské lúky
- Sledovanie úspešnosti menežmento vých zásahov

Monitoring kvality biotopov

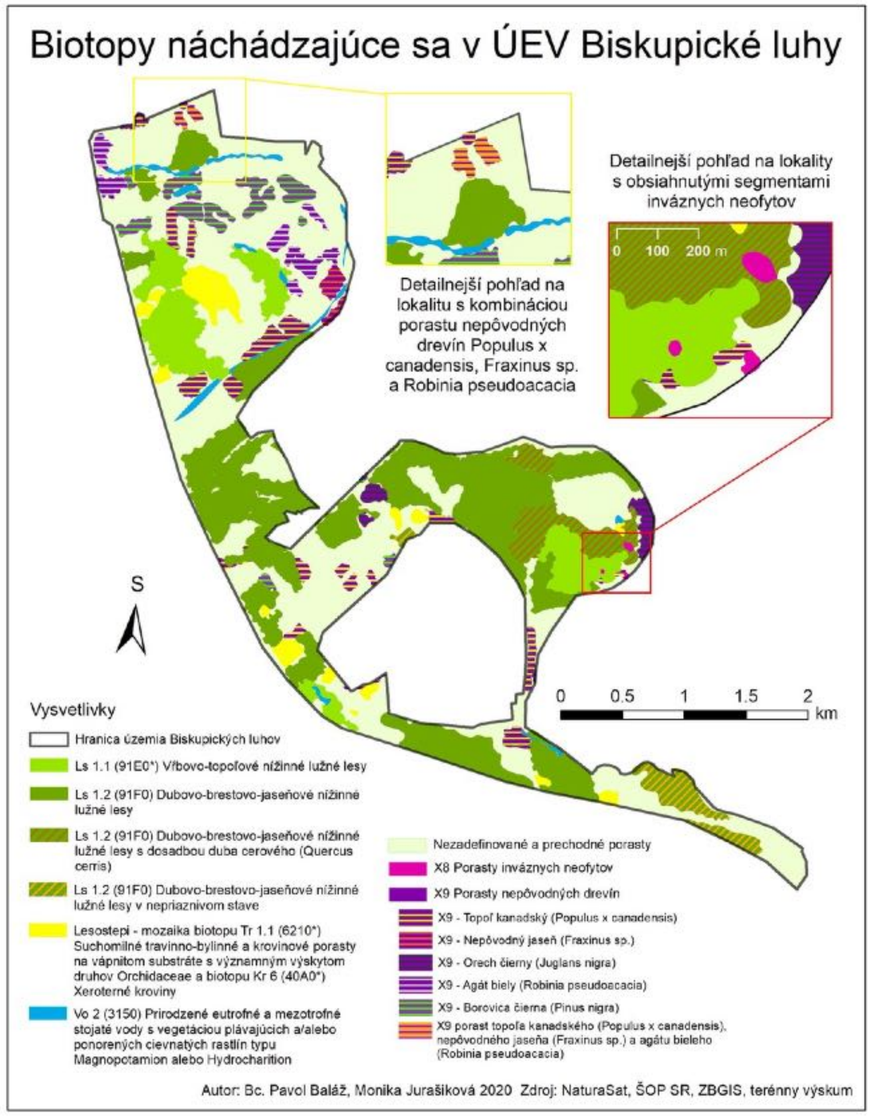






Significant differences in band values B02 and B03 after bark-beetle outbreak

Príklady z praxe



Ďakujeme za pozornosť