Large scale tree species identification using AI-methods with very high-resolution remote sensing data

Project KIHBA

05/2021– 11/2023

Gefördert durch:

Bundesministerium für Wirtschaft und Technologie

aufgrund eines Beschlusses des Deutschen Bundestages

DLR

LWF Bavarian State Institute of Forestry

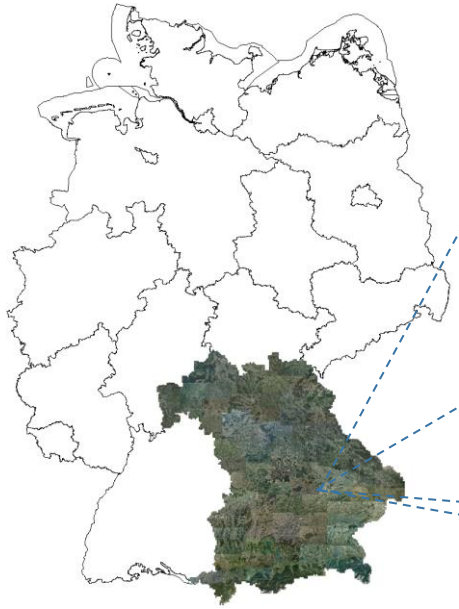
IABG

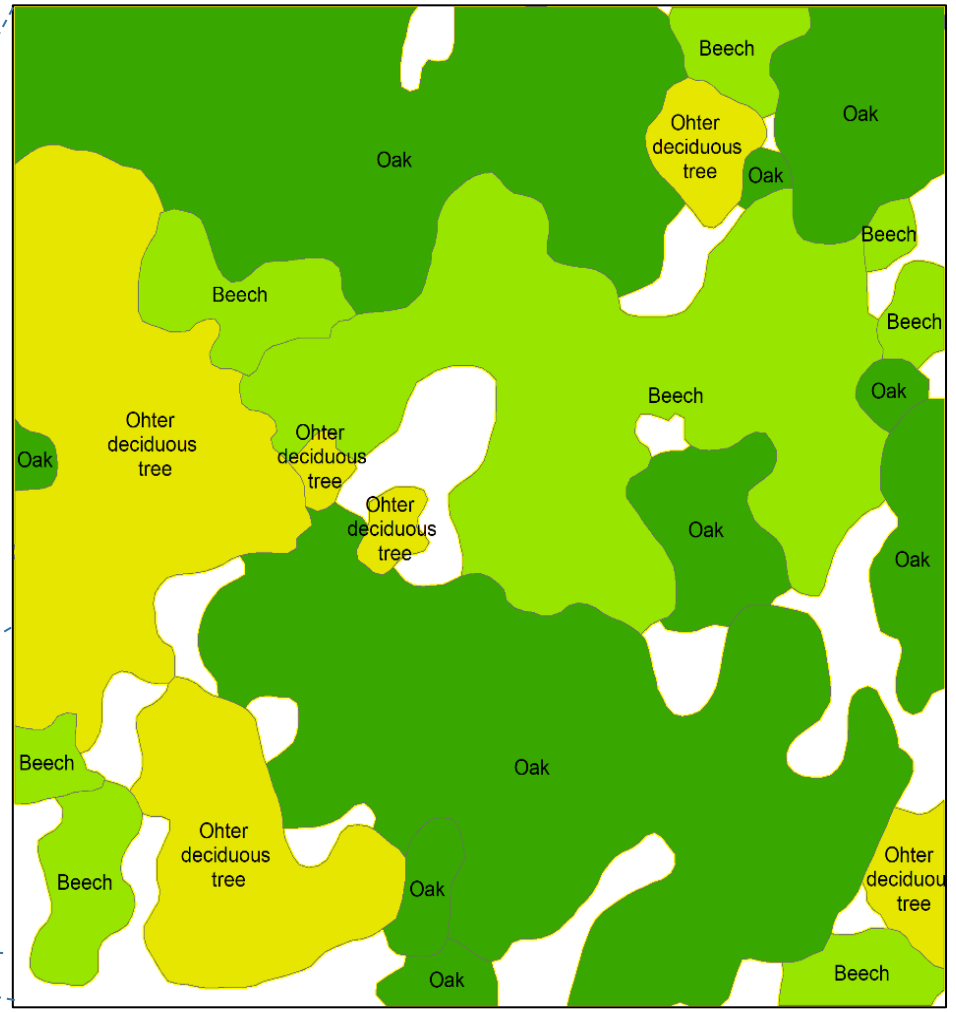
BAYERISCHE FORSTVERWALTUNG

ZENTRUM WALD FORST HOLZ WEIHENSTEPHAN

1 Motivation and Aims

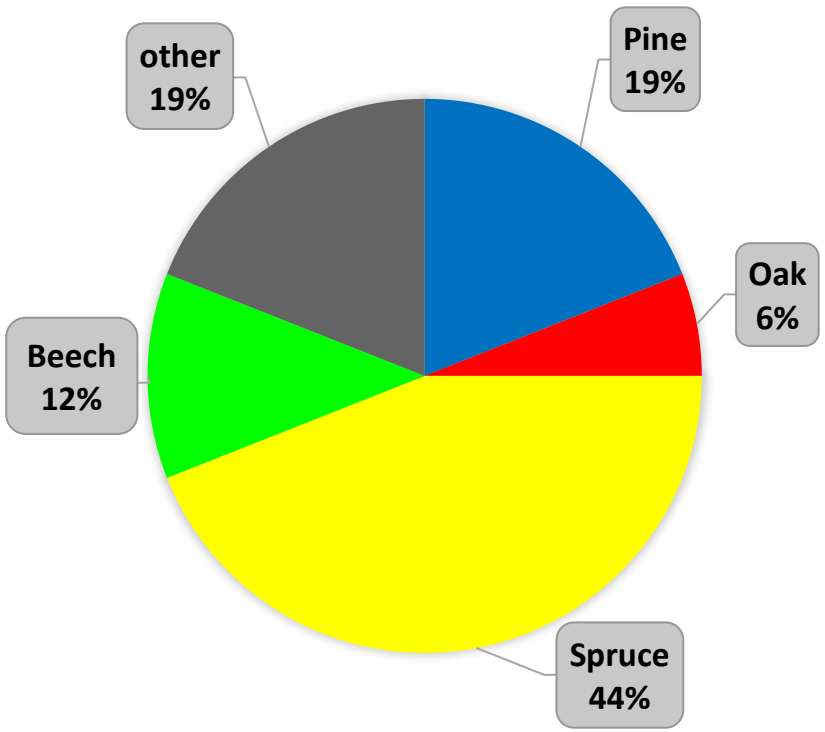
- develop AI model for species identification
- semantic segentation for 2.6m ha of forest



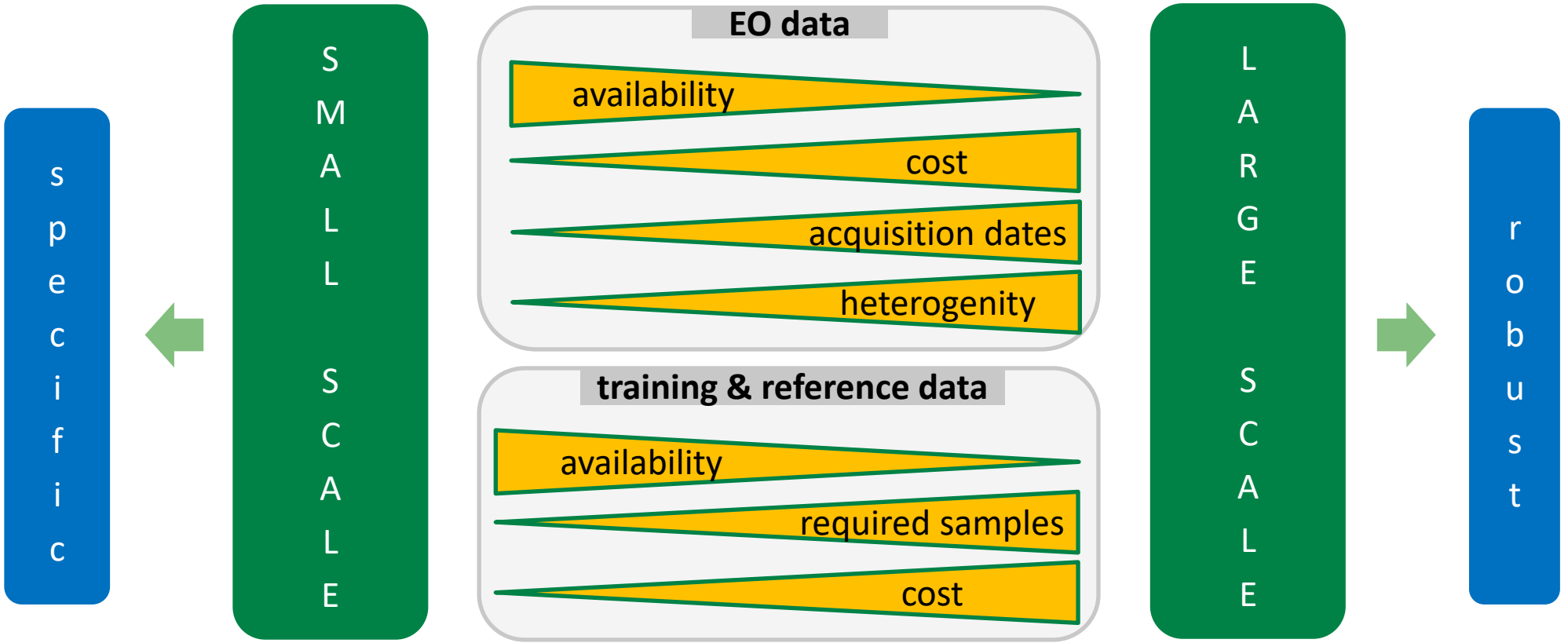


1 Motivation and aims

tree species estimates for Bavaria based on NFI 2012



2 Large scale implications

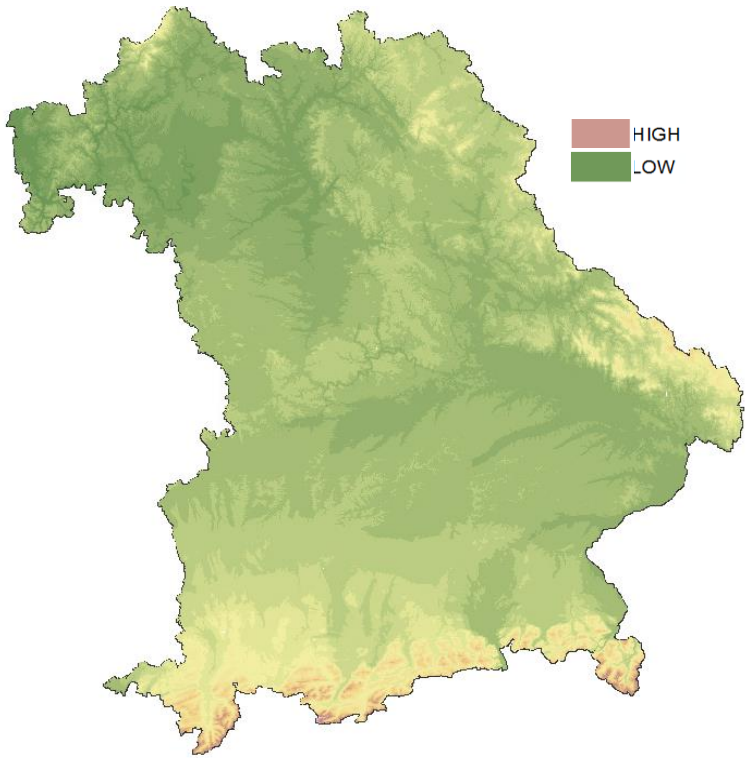


→ acquire lots of training data

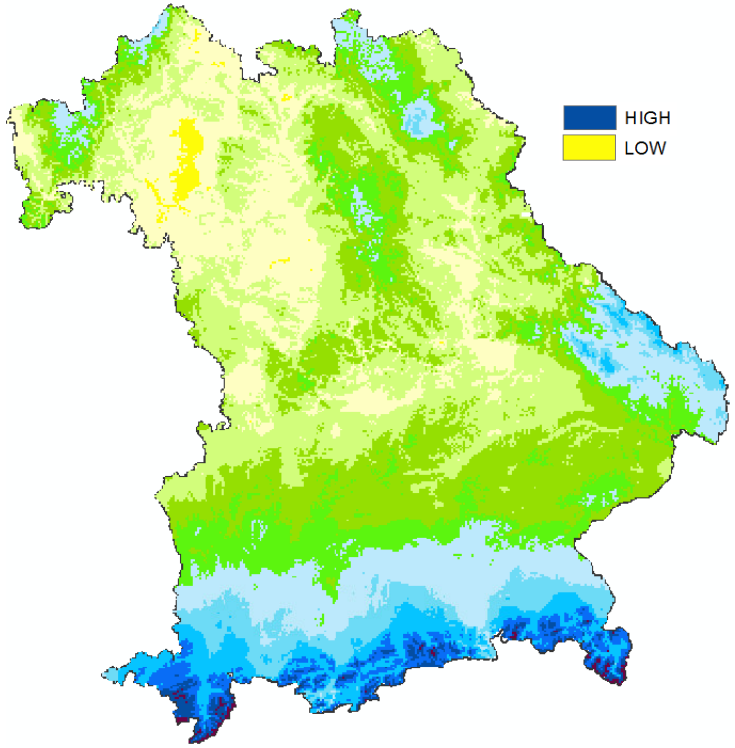
→ acquire robustness to heterogenity

→ applicable to large area & new regions/data

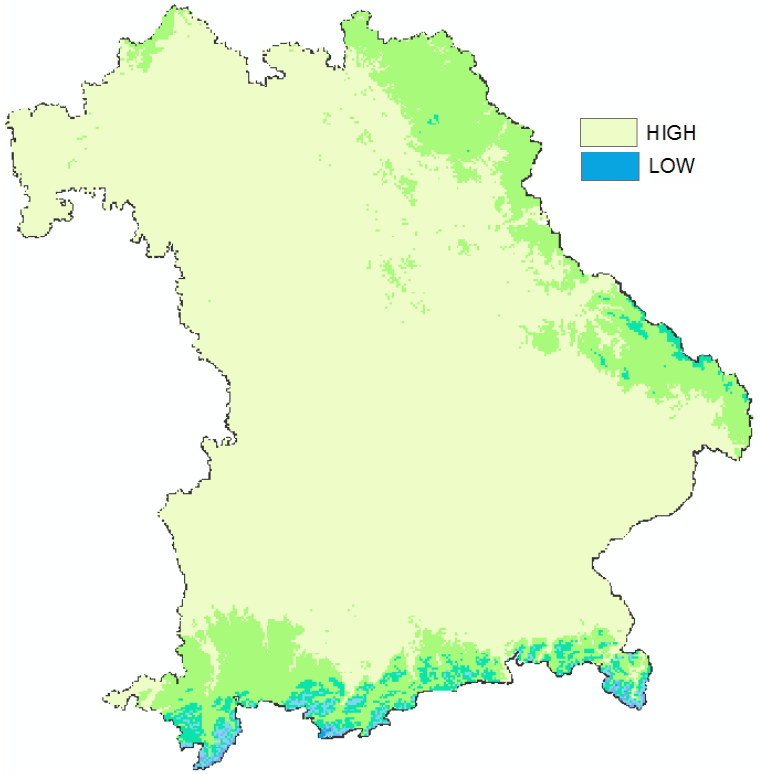
3 Large scale implications– regional differences



elevation



precipitation



temperature

3 Training data generation - imagery

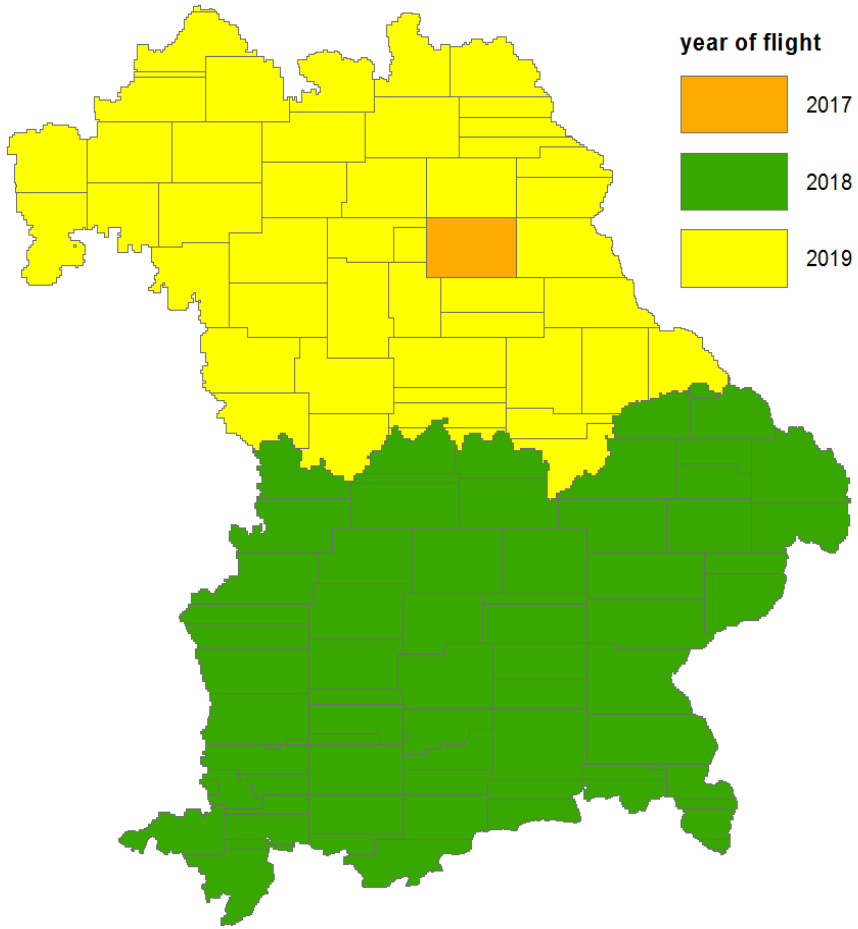
Digital orthophotos

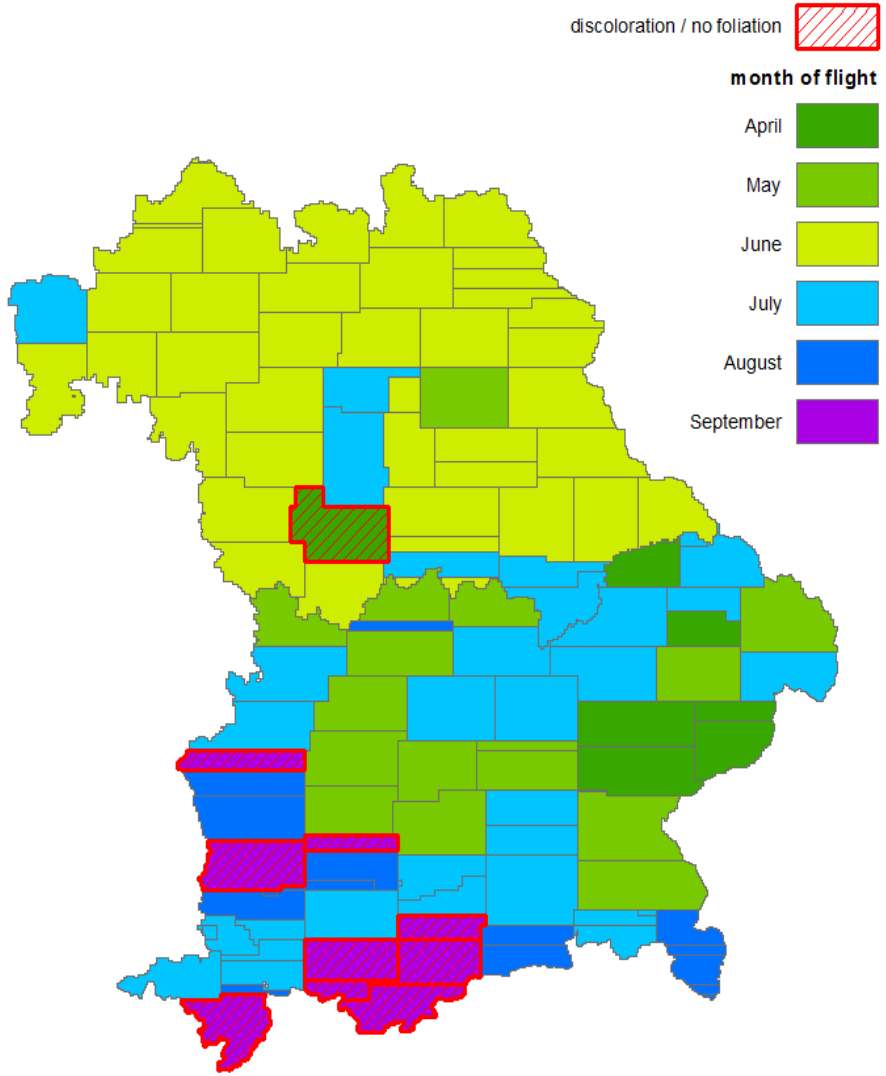
0.2x0.2m

4 bands (RGB+NIR)

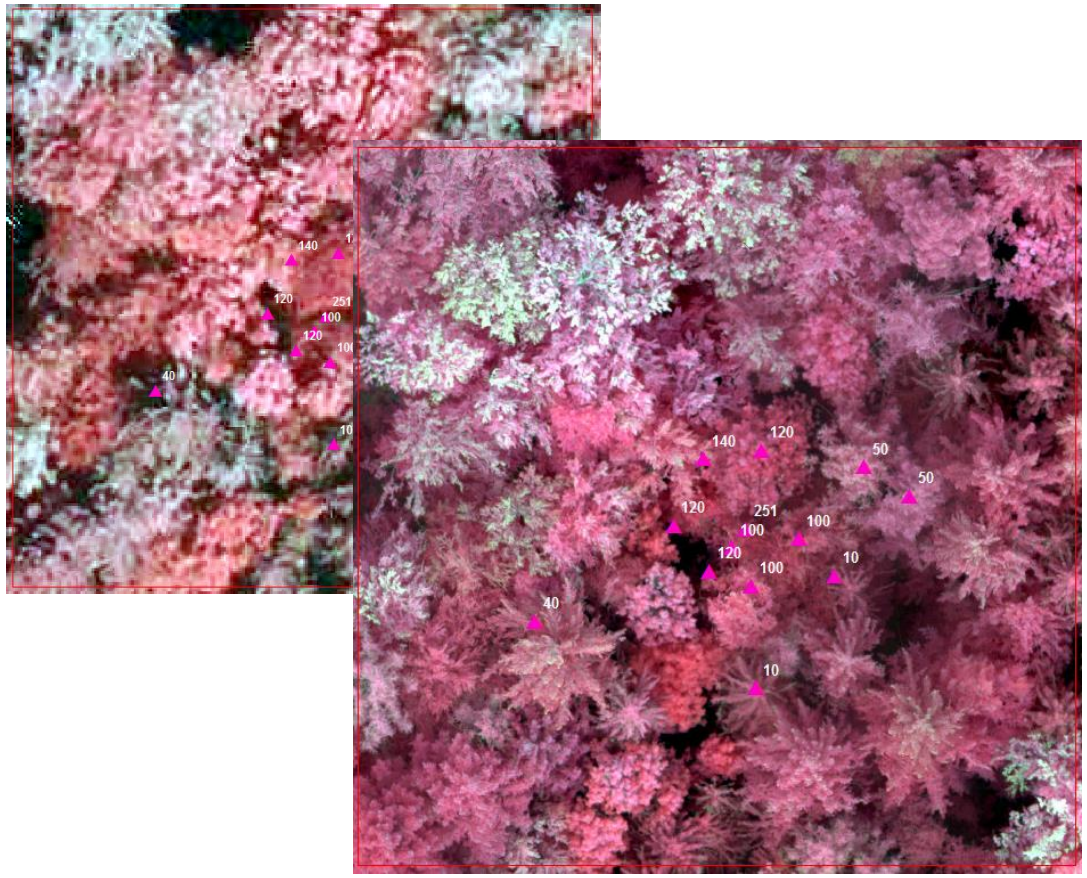
46 acquisition dates

3 years

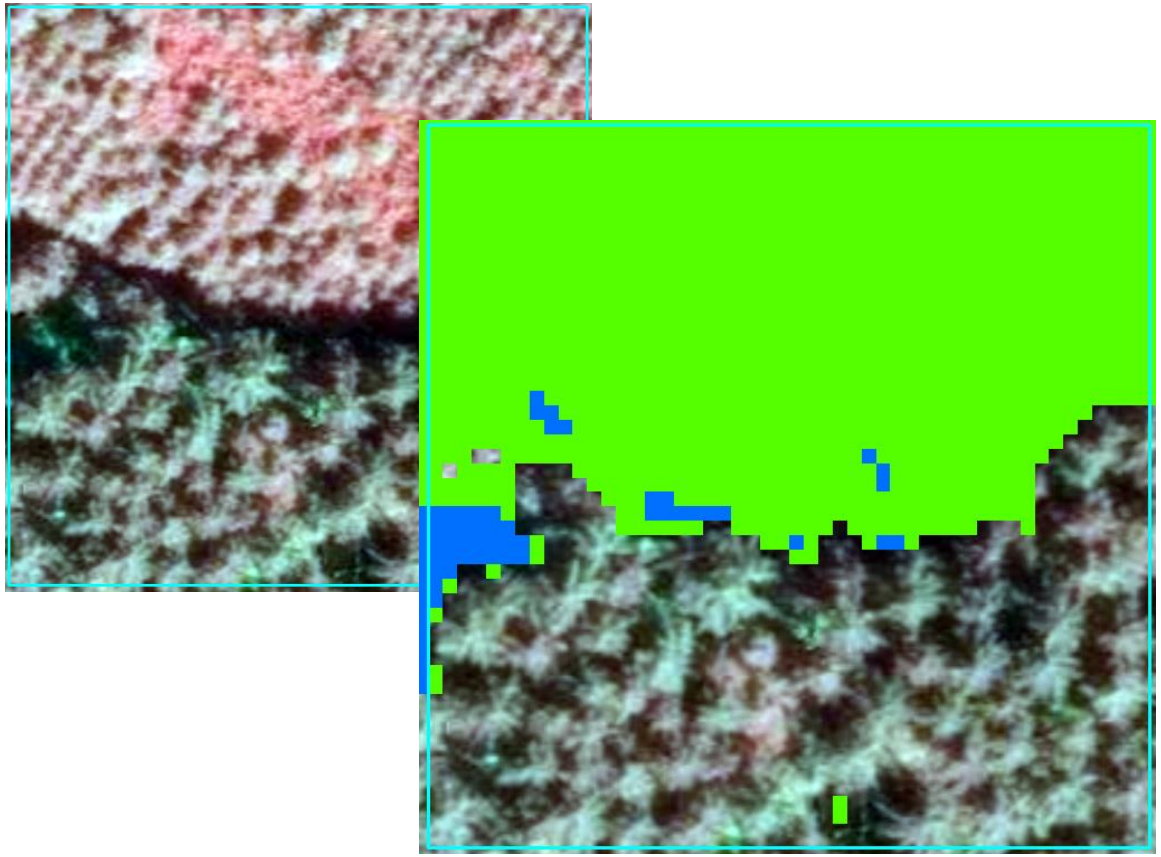




3 Training data generation – auxiliary data



forest inventory data & VHR UAV imagery



nDOM height mask (>12m,1x1m)

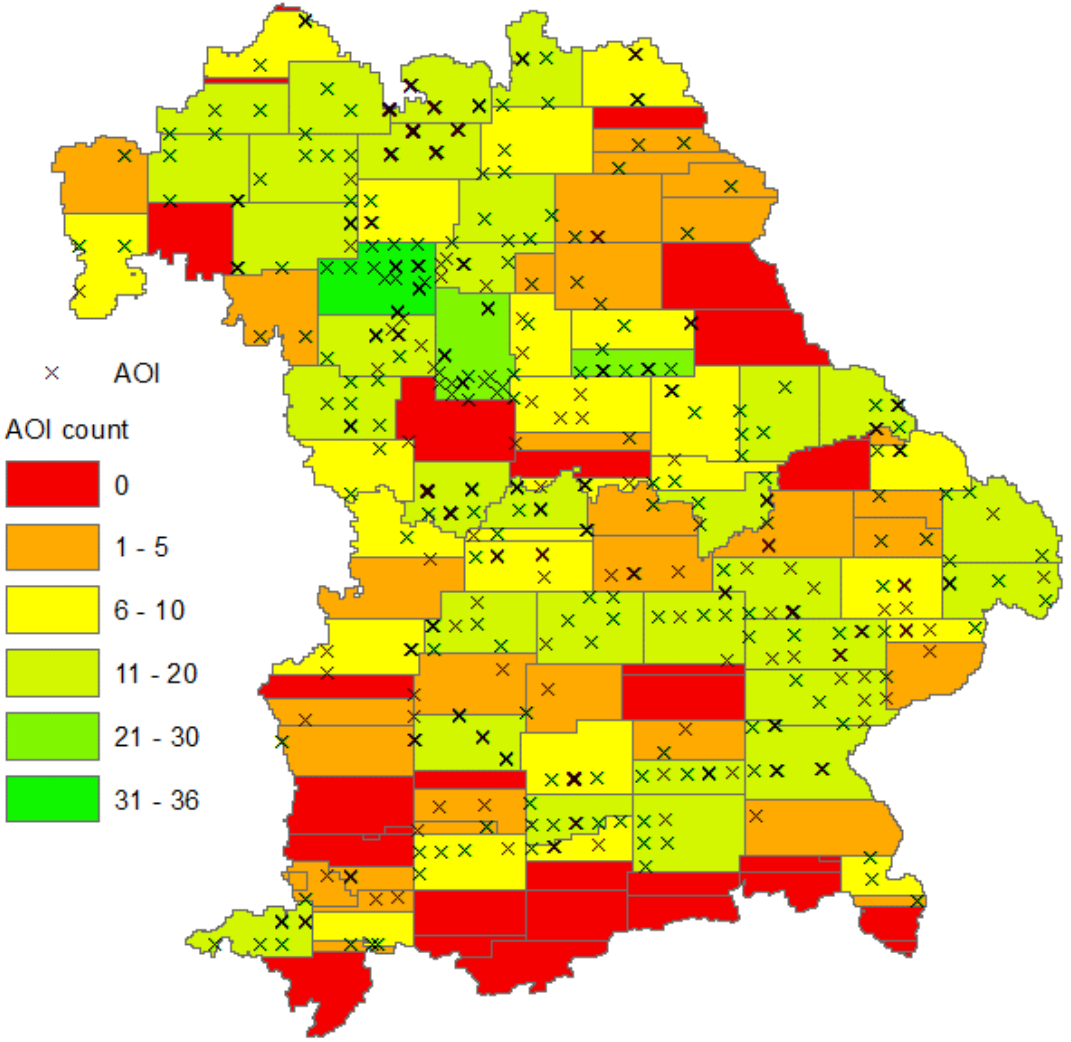
3 Training data generation - AOIs

AOI

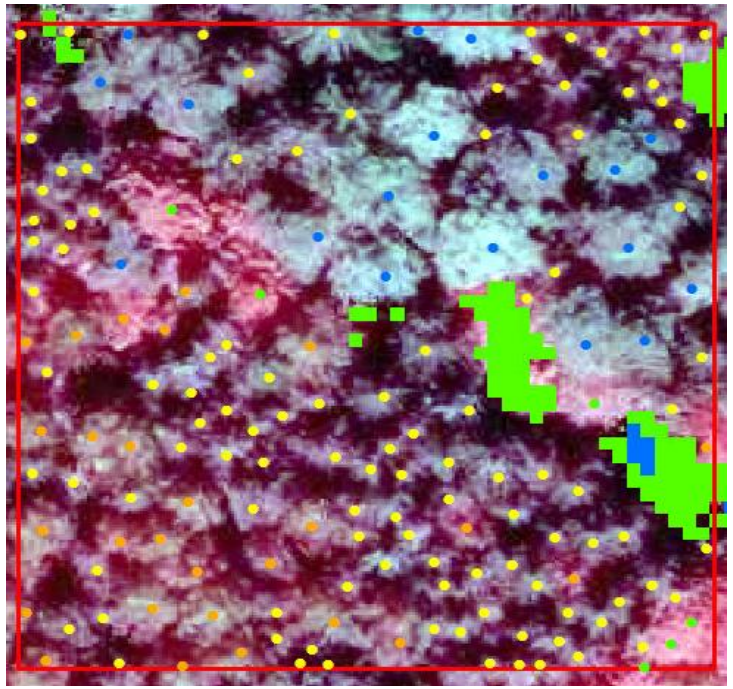
Requirements:
- NFI/SFI plots
- UAV Imagery

-50m x 50m squares around NFI plot centers

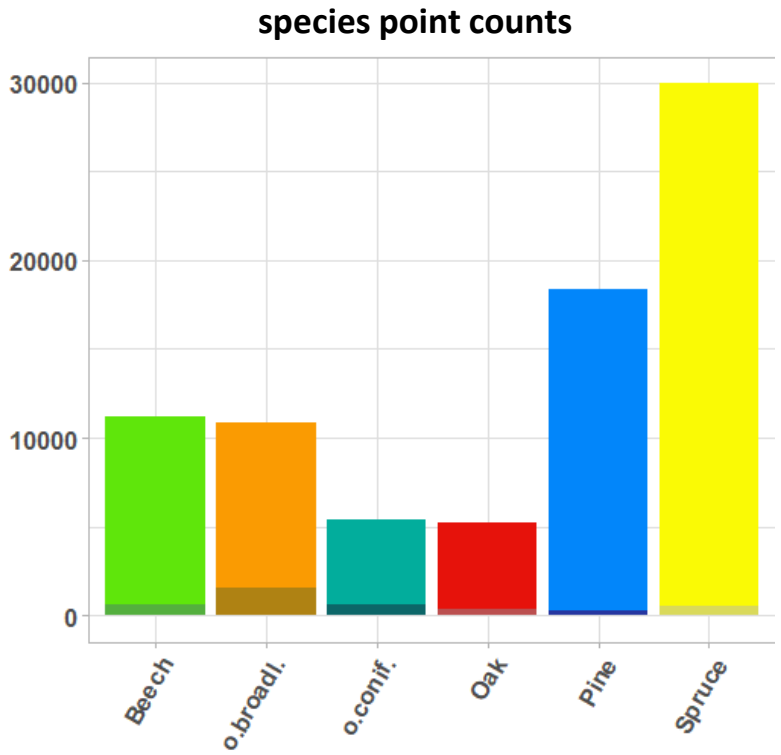
- 809 total plots (~202ha)

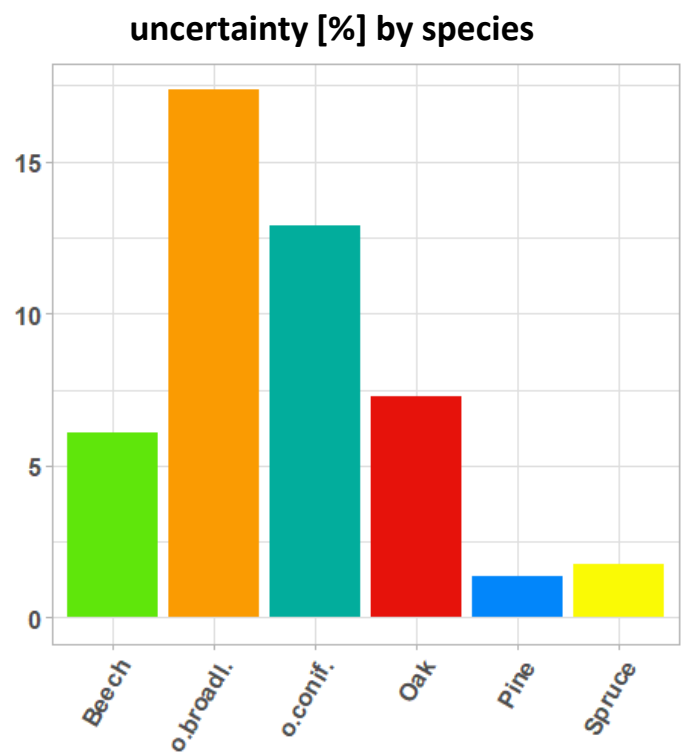


3 Training data generation - workflow



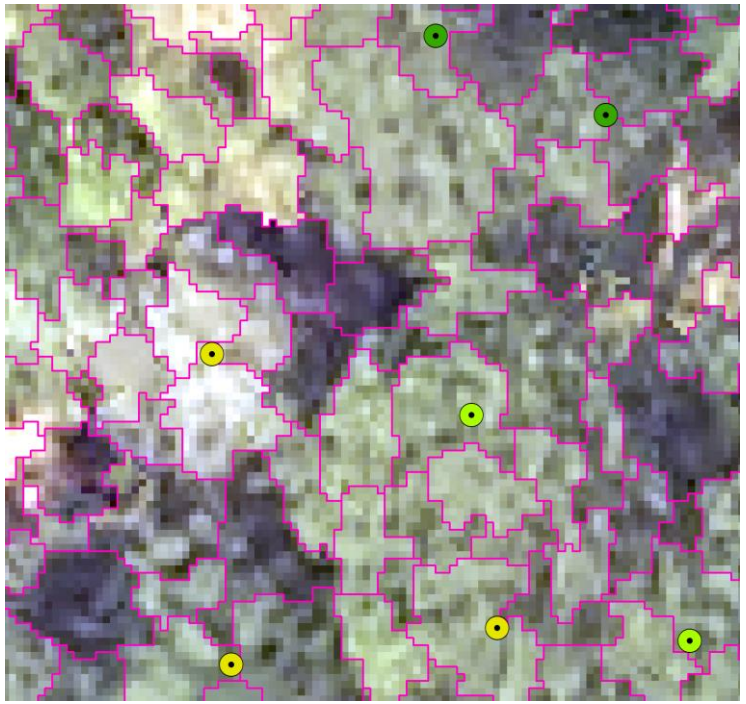
DOP (NIR,R,G)

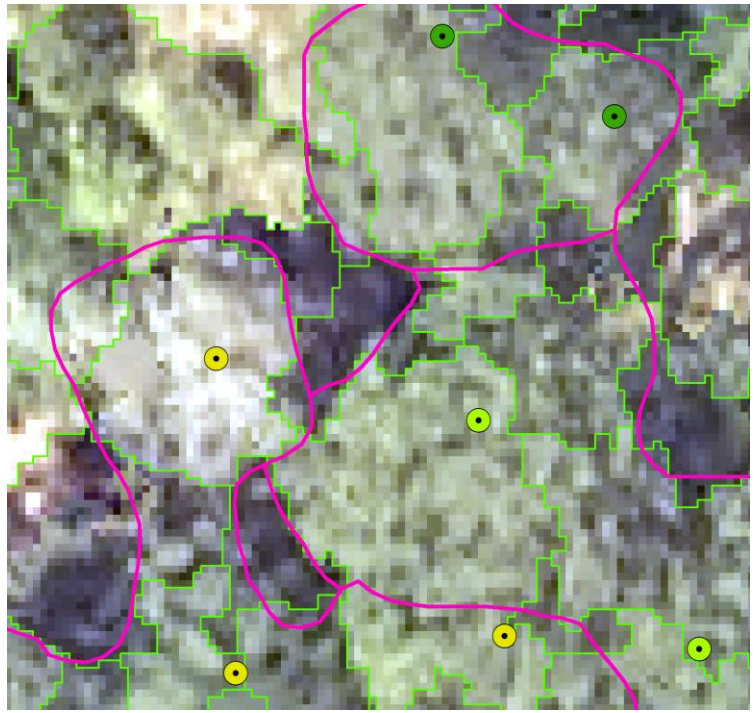




~82000 points !

3 Training data generation - workflow





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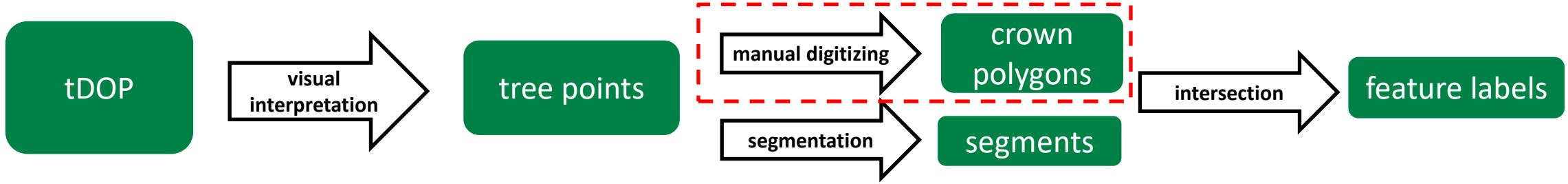
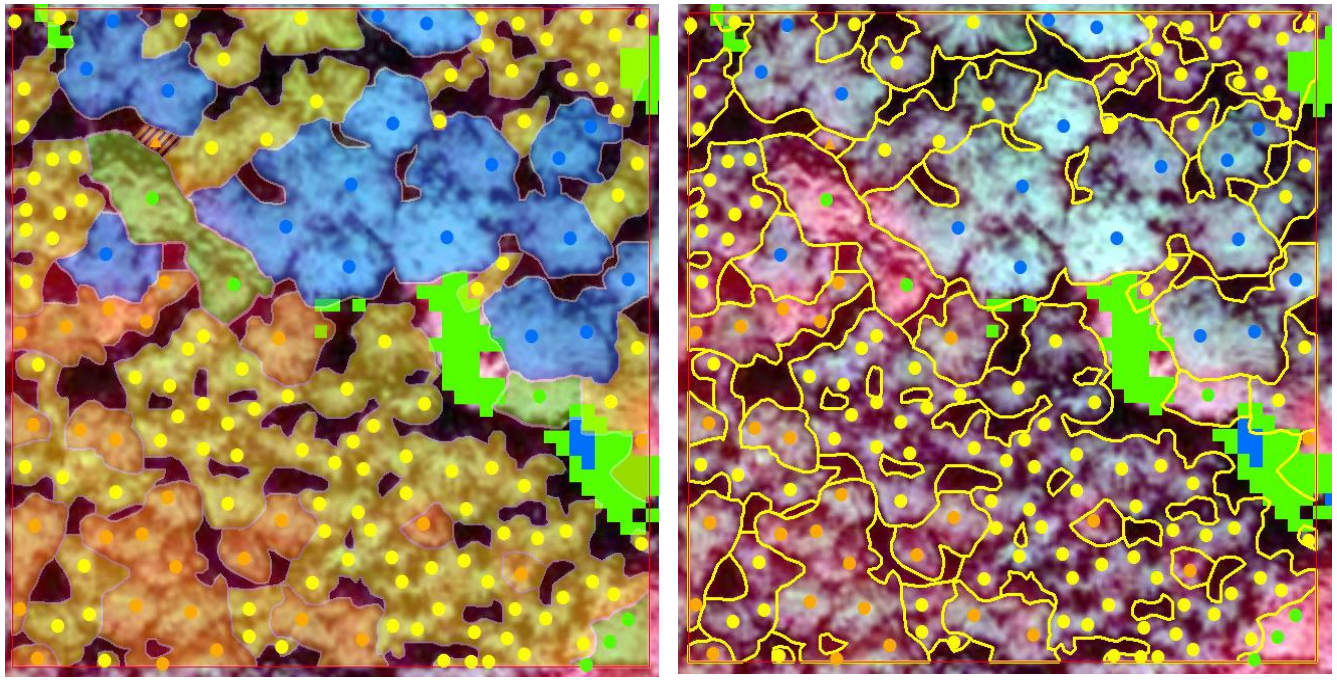
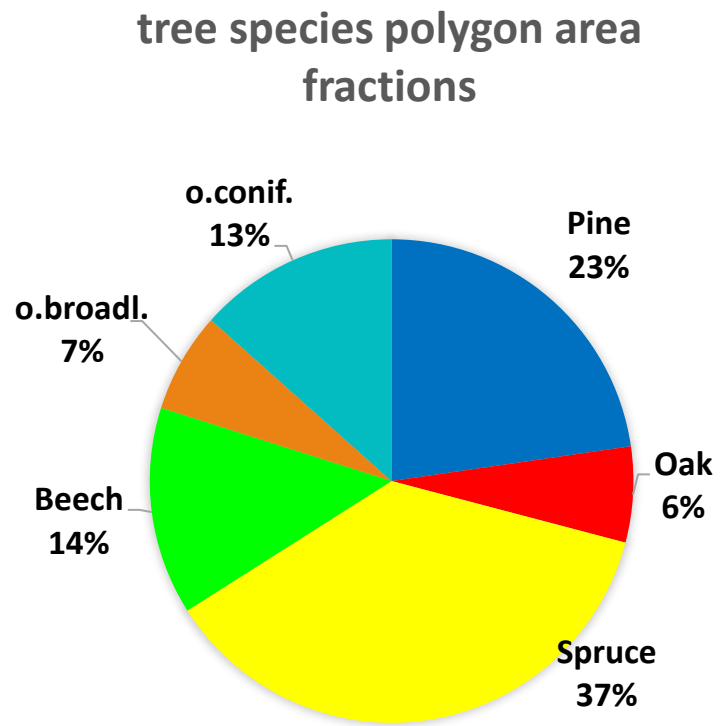
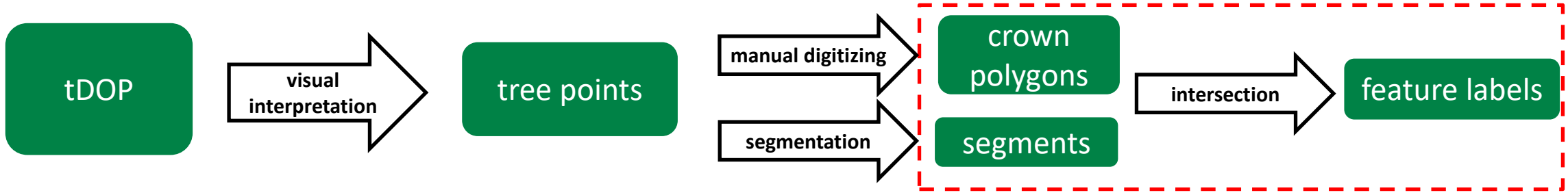


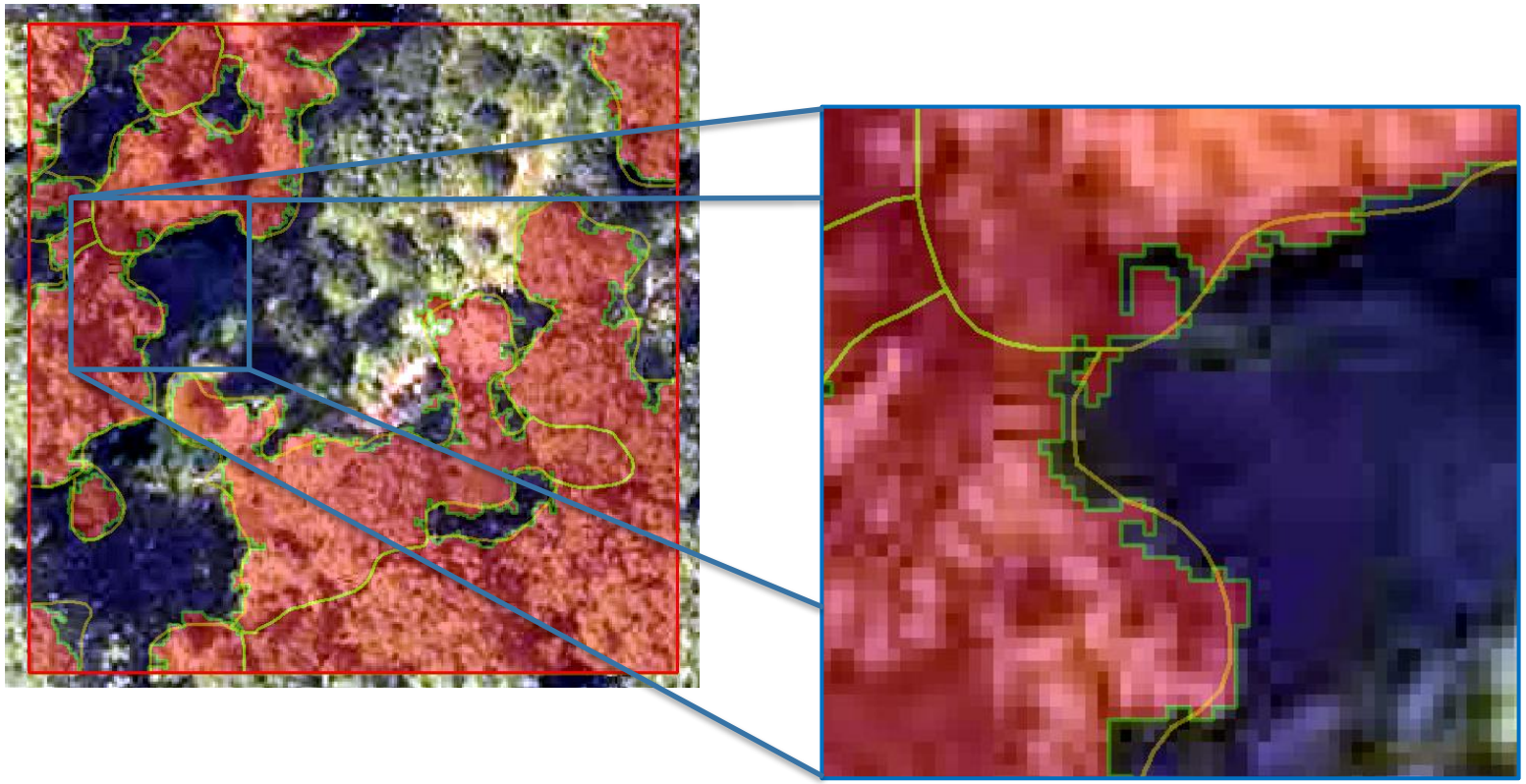




~15500 polygons
>125ha polygon area

3 Training data generation – crown polygon and segment intersection





4 AI model – selection and architecture

- Choosing the right computer vison task:
  - Instance Segmentation
    - too much effort for training data acquisition
    - difficult to distinguish individual trees in each case (label uncertainty)
  - **Semantic Segmentation (our approach)**
    - pixel based image classification (beech, oak, etc.)
    - no objects

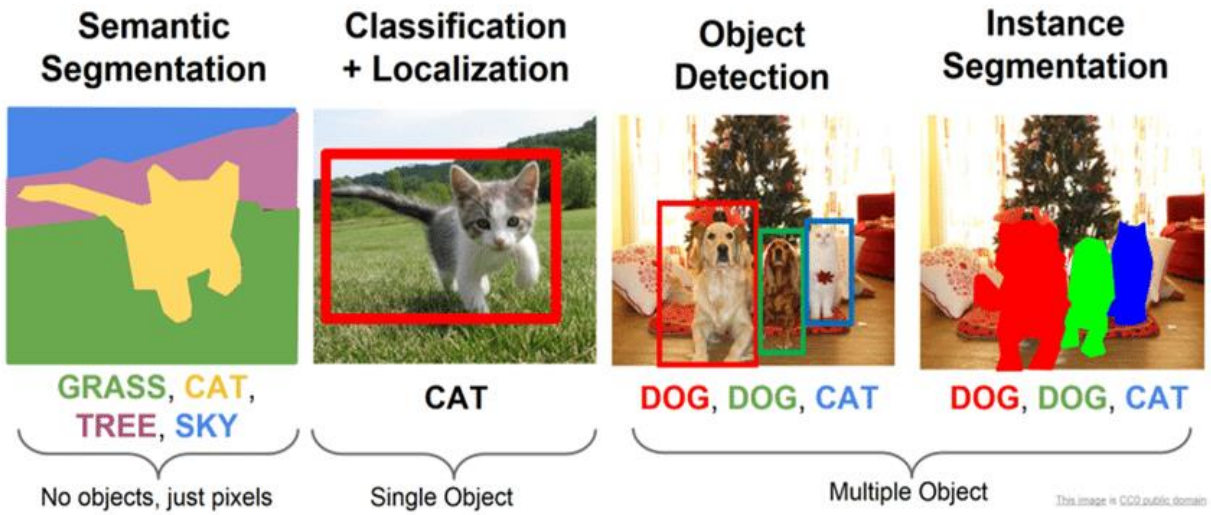
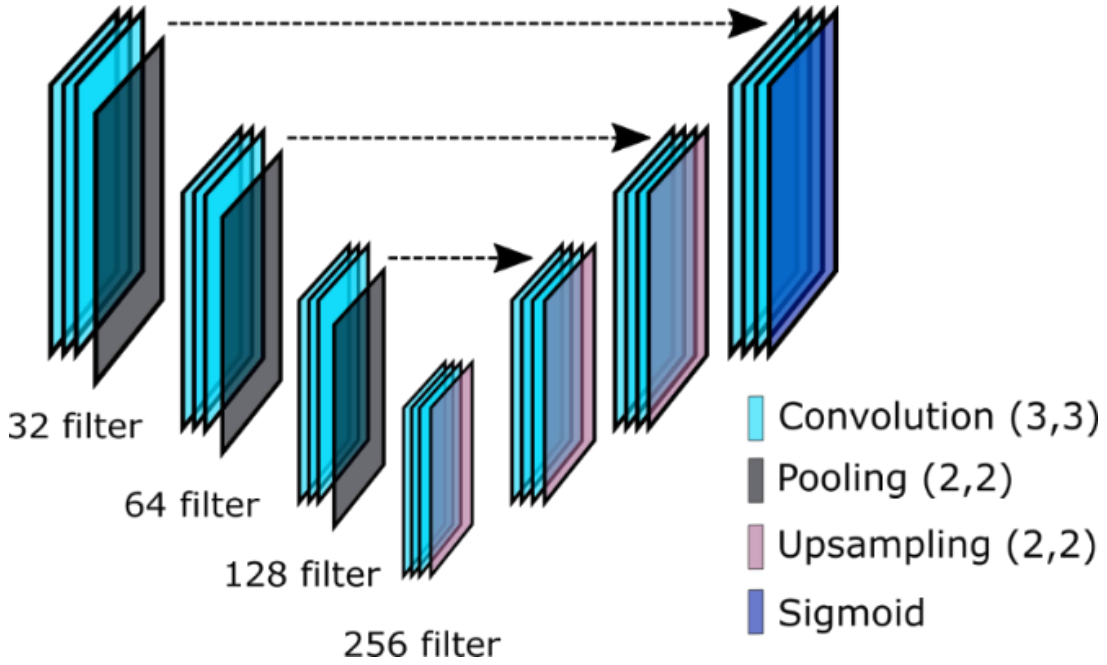


Image source: Rieder, Mathias & Verbeet, Richard. (2019). Robot-Human-Learning for Robotic Picking Processes. 10.15480/882.2466.

4 AI model – selection and architecture

- Selection of the Deep Learning architecture
  - Architecture has to address the characteristics of the training data set (images and labels)
  - CNN as AI model for image segmentation & classification
  - utilize structural information

→ U-Net based architecture



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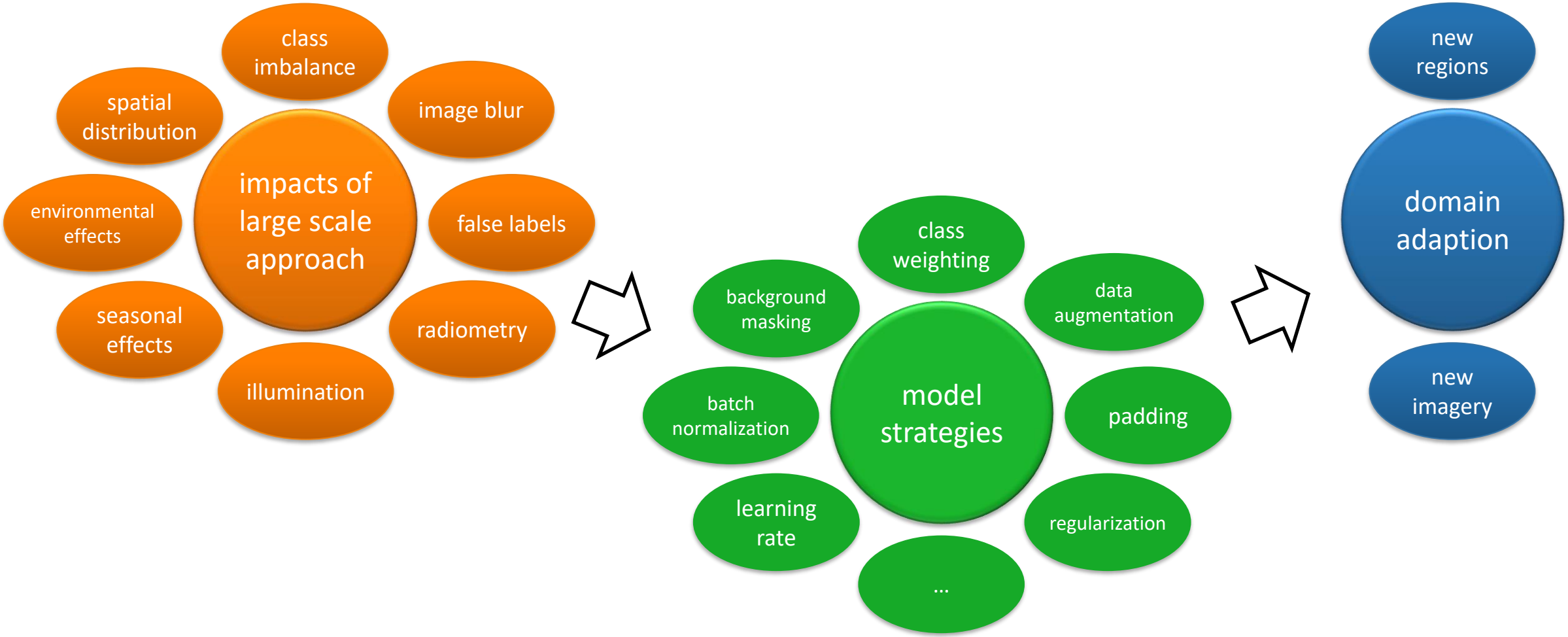
4 AI model – modelling strategies



5 Outlook

- What's up next?
  - sample splitting into training, test and validation
  - model training, tuning & validation
  - model transfer / domain adaption

Image source: https://www.boredpanda.com/dog-food-comparison-bagel-muffin-lookalike-teenybiscuit-karen-zack/

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Thanks for listening!