Differentiation of weeds and crop plants from drone imagery

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Project overview

Problem

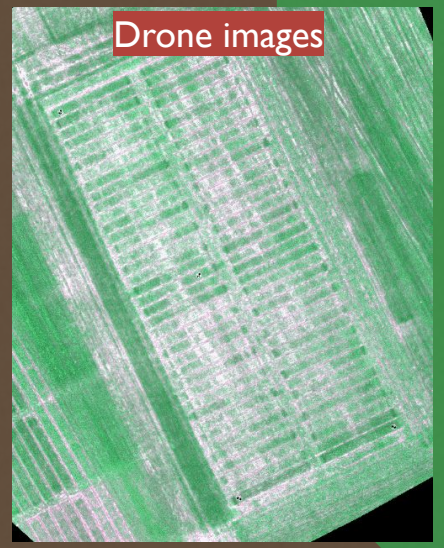
Recognize ***crops*** and ***weeds*** on drone images

Resources

Drone images (20 m)
Ground camera (2 m) images
RGB + NIR channels
Weed representatives

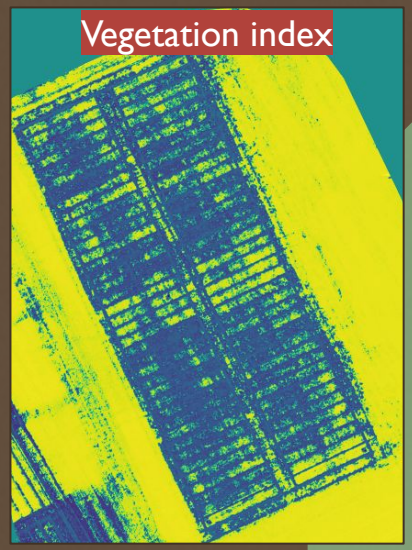
Goal

Weed locations on the field
Amount of weeds/crop plants (per unit area)



Our journey

1. Annotating (and matching) ground images
   - manual + vegetation indices
2. Annotating drone images
   - vegetation indices
3. Model training



Weeds (7 types)

Process and outcome

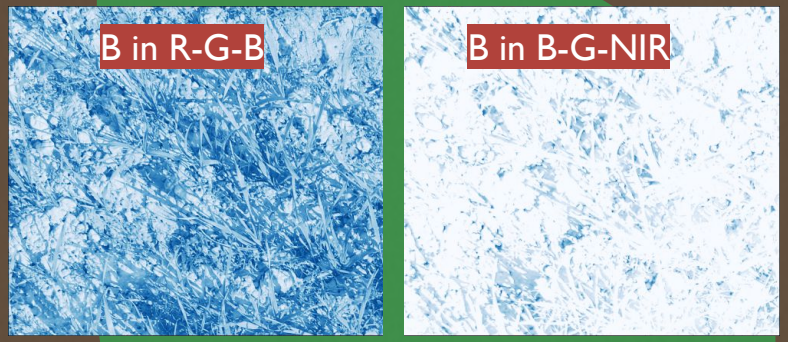
ANNOTATION + MATCHING
ground images

ANNOTATION
drone images

MODELS

Annotating ground images

- Manual - very time consuming
- Ground images
  - Image differences
  - Image channel differences
  - Timestamps differ
- Matching with drone images
  - Low resolution
  - Few ground images



Process and outcome

ANNOTATION + MATCHING
ground images

ANNOTATION
drone images

MODELS

Ground images
need serious
adjustments!

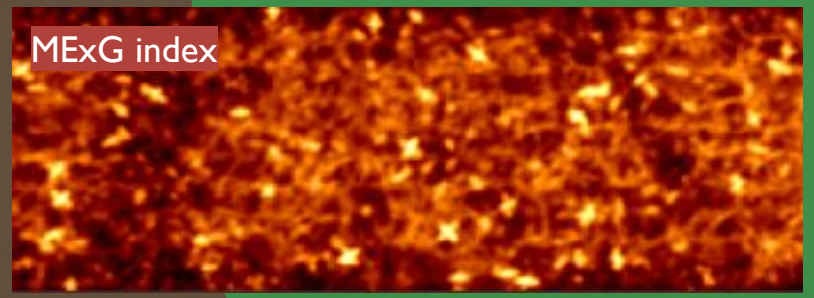
Annotating drone images

More than 25 possible vegetation indices - none of them is universal

Selected two most promising:

1. MExG: Modified Excess Green
2. DIRT: Difference Index with Red Threshold

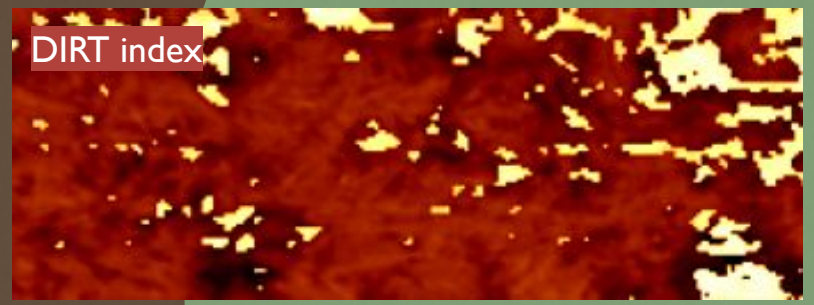
May-Early June



July

Could not found good index

August



Process and outcome

ANNOTATION + MATCHING
ground images

ANNOTATION
drone images

MODELS

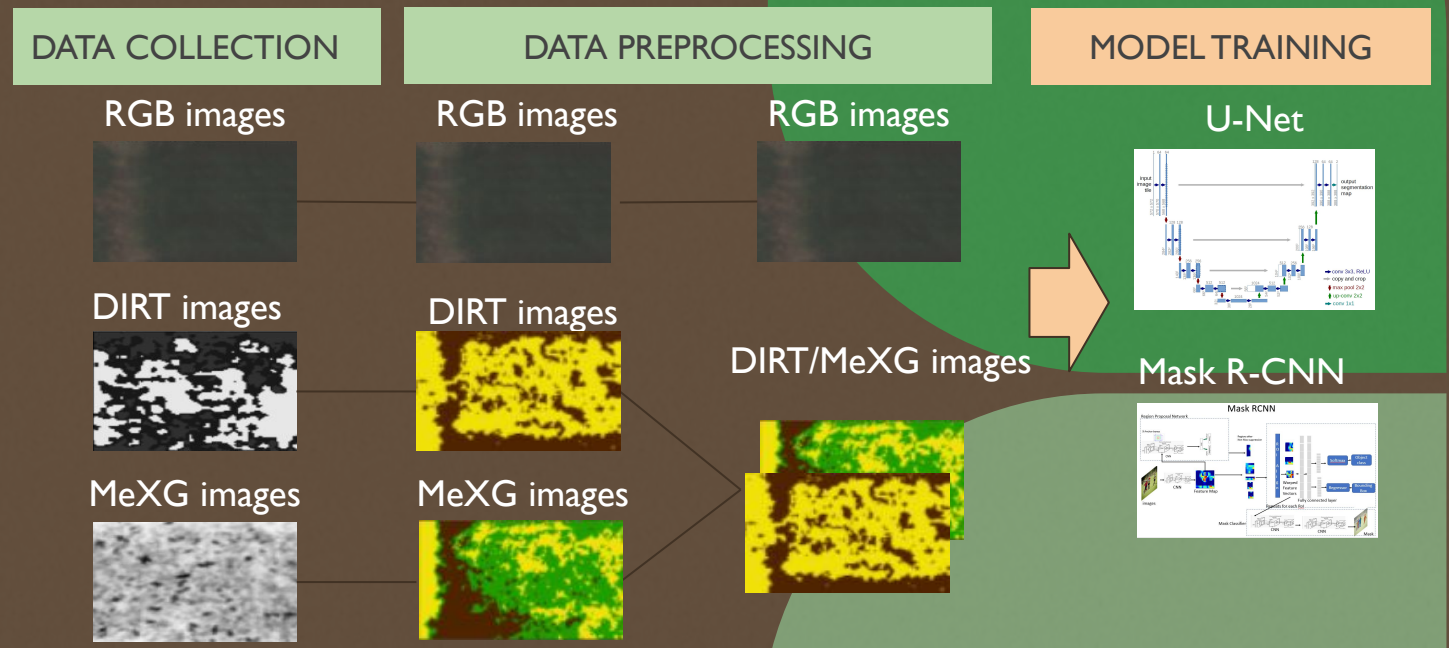
Ground images need serious adjustments!

Proper indices can differentiate weeds and crops!

Model A - Segmentation

Planned approach

1. Data annotation
   - KMeans clustering
   - Thresholding
2. Transfer learning (Supervised)
   - Mask R-CNN
   - U-Net



Model A - Results

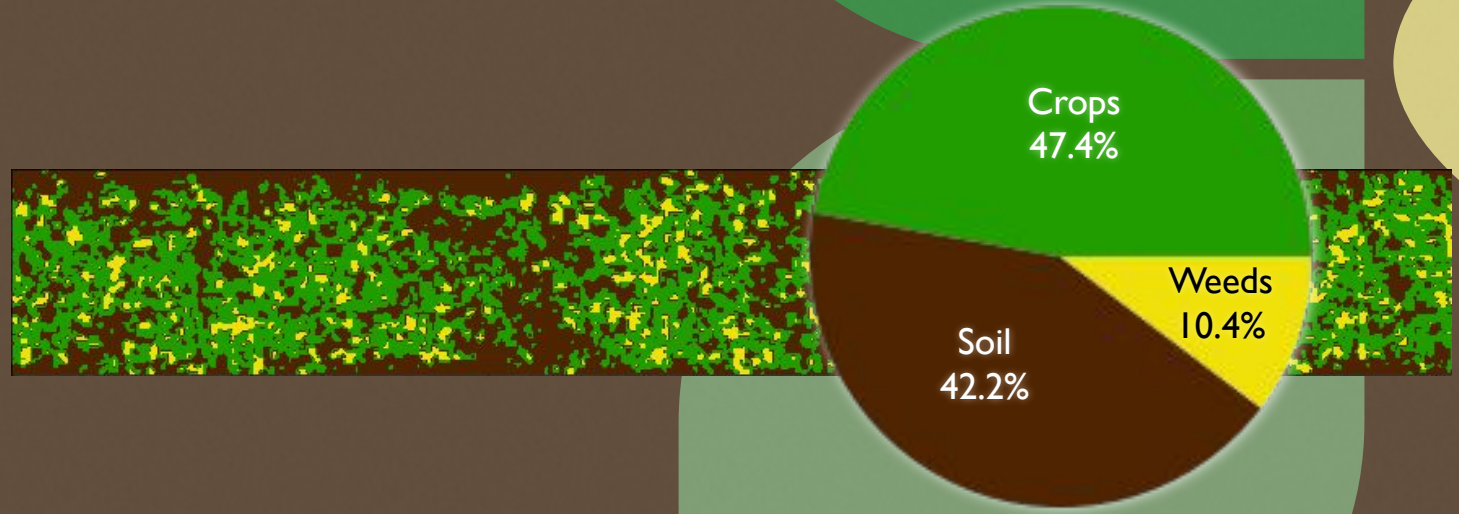
Problems with automatic annotation (KMeans and thresholding)

Key takeaways

- ML model training is not reasonable because of high variance over the entire dataset
  - difficult normalization
  - environmental conditions
- Clustering (segmenting for supervised learning) has to be more adaptive
- Focused on extracting the features

Business Goals

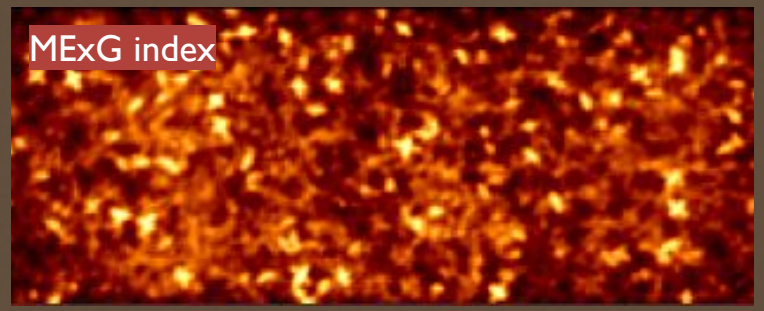
1. Locate weeds in the fields
2. Estimate the amount of weeds (per unit area)
3. Estimate the amount of crop plants (per unit area)



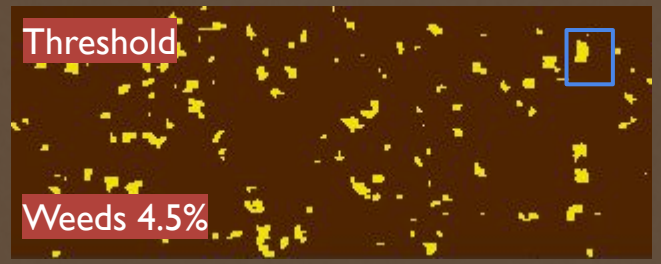
Model B - predicting N_2-rate

Does weed amount depend on fertilizer nitrogen amount?

DATA COLLECTION (EARLY JUNE)



DATA PREPROCESSING



24k points for whole field

Weed database
Area
Perimeter length
Inertia tensor
Weed density around
Weed area around
Crop ID
N_2 rate

MODEL TRAINING

GradBoost Classificator

prediction accuracy 64.5%

Process and outcome

ANNOTATION + MATCHING
ground images

ANNOTATION
drone images

MODELS

Ground images need serious adjustments!

Proper indices differentiate weeds and crops!

Classification works for certain months/index!

Lessons learnt

- Role of data collection
- Difficulty of annotation
- Technical hurdles of data pre-processing

Thank you!