

A photograph of a vast, golden wheat field under a clear blue sky. The sun is low on the horizon, casting long shadows and creating a warm glow. In the foreground, the texture of the wheat is visible. A large, solid yellow rectangular overlay covers the middle portion of the image. Inside this yellow box, the text "Dude, where are my crops?" is written in a bold, white, sans-serif font.

Dude, where are my  
crops?

# Outline

1. Introduction & Business case
2. Data
3. Workflow
4. Results
5. Conclusion



## Our Team:

# Golden Crop Ltd.



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B. Sc. Water and  
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**Felix Behrendt**  
M. Sc. Geoinformatics  
Teacher



**Max Langer**  
M. Sc. Biology



**Kirmeier**



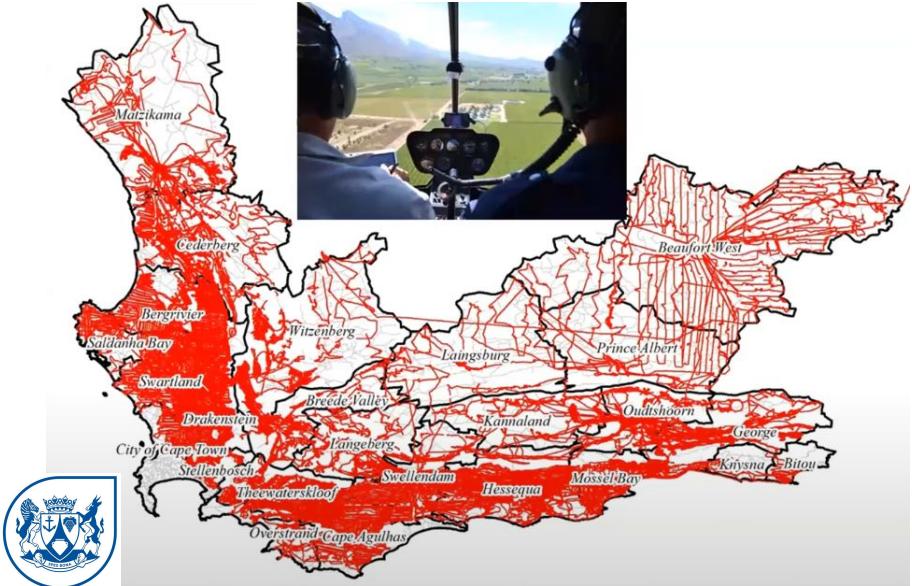
**Timo Fischer**  
Dr. rer nat. Neurophysiology



# Current Situation

- agriculture census reports are created with the aid of helicopters or on ground
- this is costly (1. Mio \$)
- and time-consuming (16 weeks)
- fields are overlooked

Helicopter flight path for the census



© Western Cape Government



# Why is an accurate census important!



Over 86000 fields with varying sizes in the area

- thus affecting planning & market price
- spatial planning and development

Example: average field size of 3.1 ha  
missing a single field means missing ca. 11.5 t  
of wheat in the census

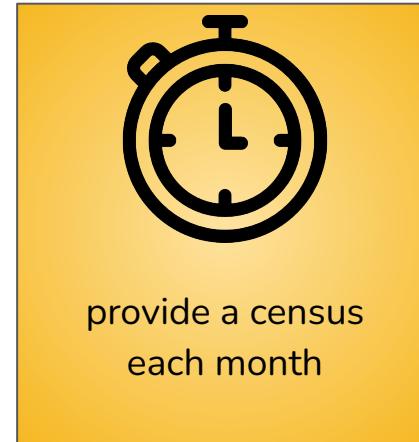
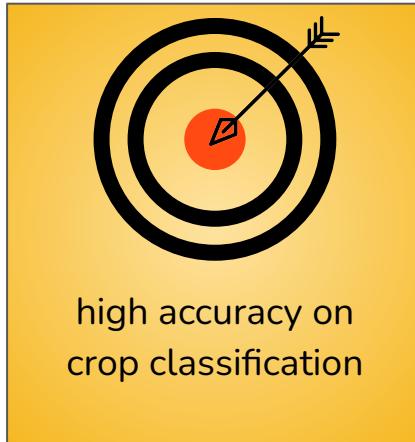


# The Golden Crop Solution

## Objective:

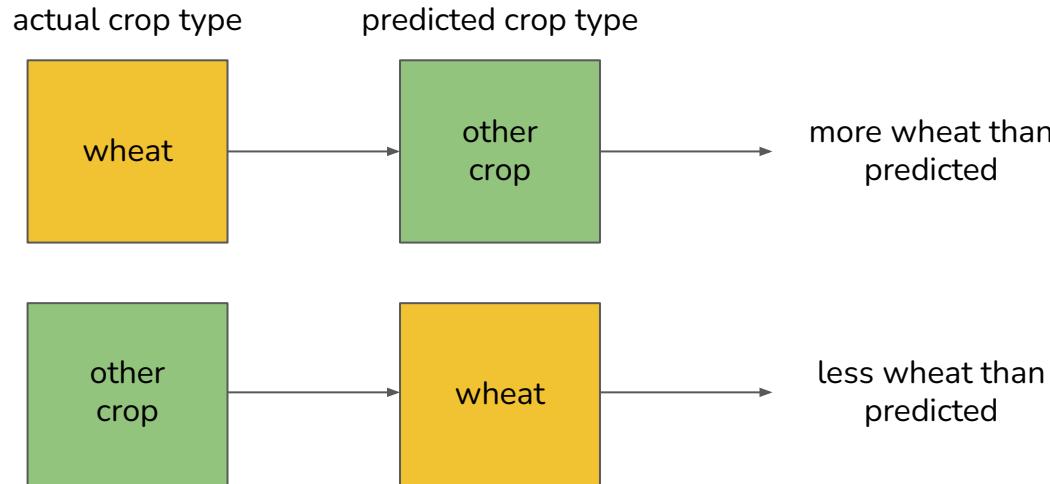
Classify crop type in fields in the Western Cape of South Africa based on satellite data

## Goals for the model:



# The Golden Crop Solution

Evaluation metric: F1 - score



→ both outcomes are equally problematic for the census

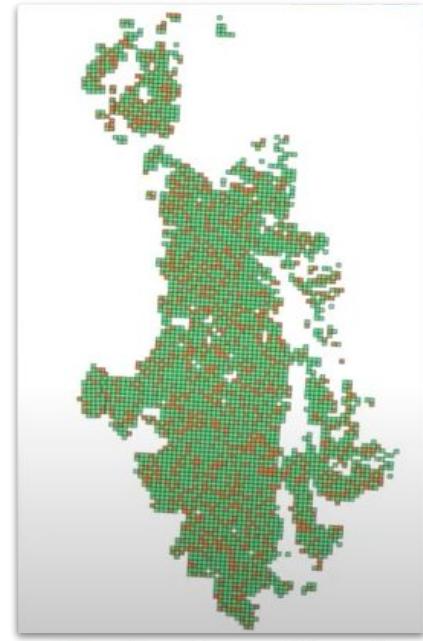
→ with the F1 score we try to minimize both



# Area of Interest



Tile Distribution



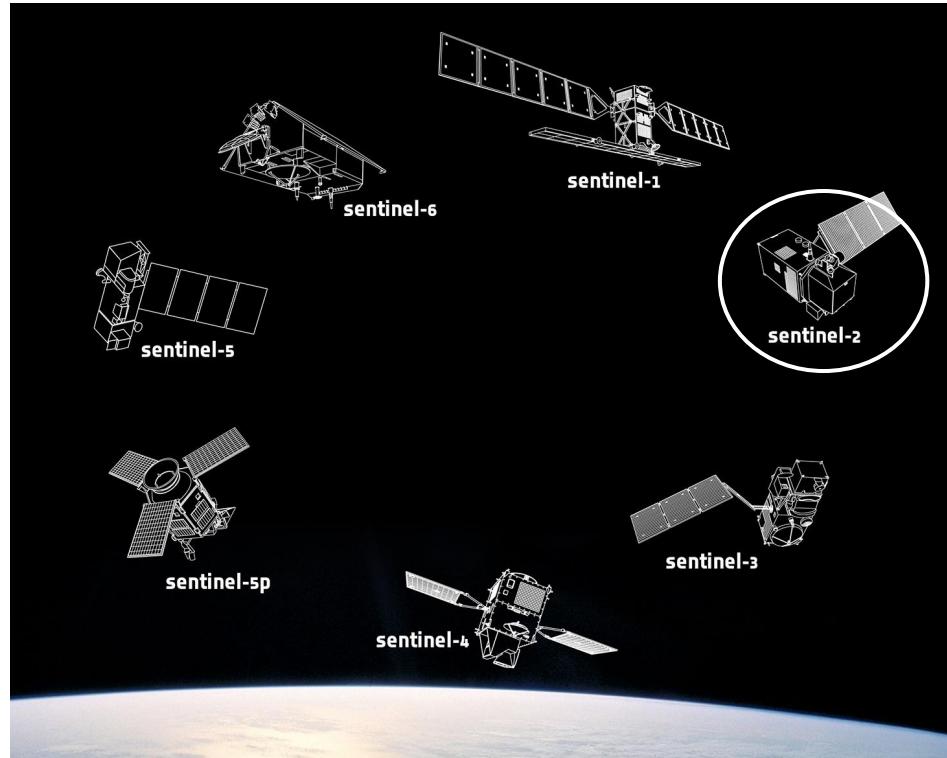
 **Radiant Earth Foundation**  
EARTH IMAGERY FOR IMPACT  
© Radiant Earth Foundation



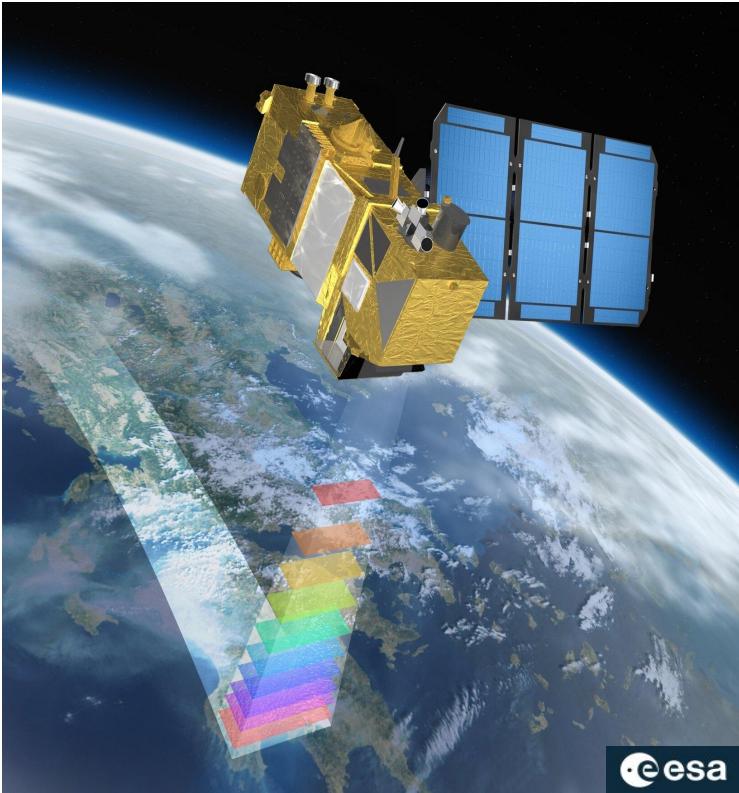
# Overview of the Sentinel project (ESA)

The Sentinel missions mark a new era in Earth observation

- focusing on delivering a wealth of operational data for decades to come.
- Our dataset belongs to earth observation of Sentinel, in particular, Sentinel-2B

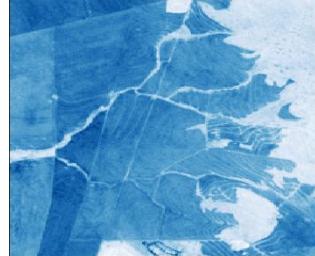


# Overview of the Sentinel project (ESA)

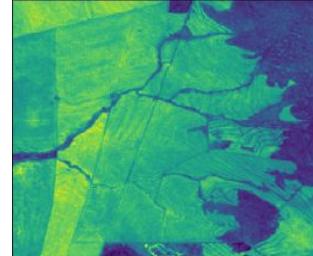


Sentinel-2 Bands	Central Wavelength ( $\mu\text{m}$ )
Band 1—Coastal aerosol	0.443
Band 2—Blue	0.490
Band 3—Green	0.560
<b>Band 4—Red</b>	<b>0.665</b>
Band 5—Vegetation Red Edge	0.705
Band 6—Vegetation Red Edge	0.740
Band 7—Vegetation Red Edge	0.783
Band 8—NIR	0.842
Band 8A—Vegetation Red Edge	0.865
Band 9—Water Vapour	0.945
Band 10—SWIR—Cirrus	1.375
Band 11—SWIR	1.610
Band 12—SWIR	2.190

B02



B11



Crop fields



# Dataset

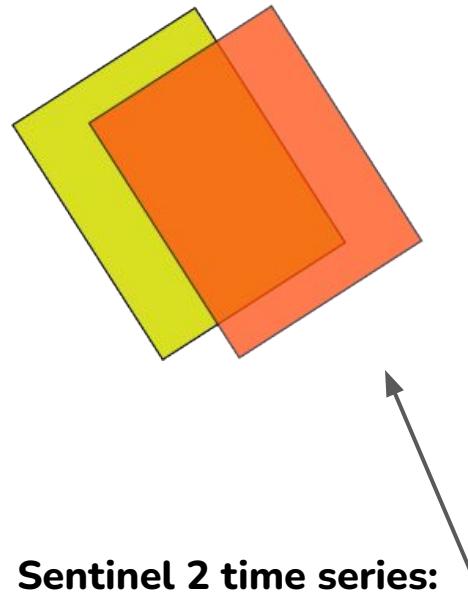
- area: West Cape of South Africa
- size: 48 GB
- creator: Radiant Earth Foundation
- time: growing Season 2017  
[Mai - November]
- time interval: 3 - 10 days



Radiant Earth  
Foundation

EARTH IMAGERY FOR IMPACT

© Radiant Earth Foundation

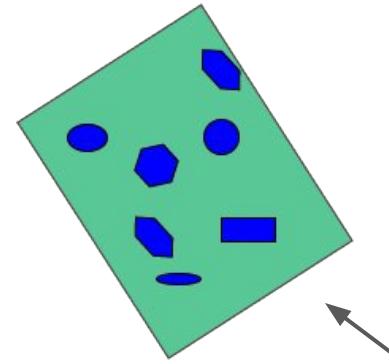
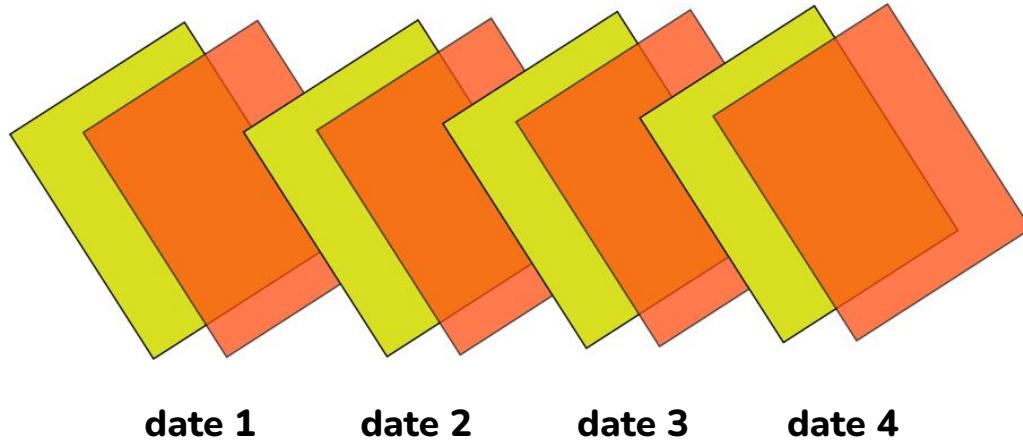


## Sentinel 2 time series:

- each color is a different band
- each pair is one time



# Dataset



**field boundaries  
and crop types**



Radiant Earth  
Foundation  
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## Summary:

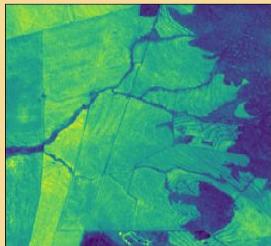
- 6 bands + cloud mask
- 76 timestamps
- area of 17231 km<sup>2</sup>



# Workflow

## Acquiring Spatial-Temporal Data

Metadata  
+



Tile: 1250

Band: 11

Date: 1. April

## Preprocessing

*data conversion*



*cloud - masking*



*spatial aggregation*



## Feature Engineering

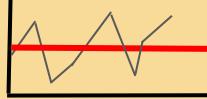
*spectral metrics*

$$NDVI = \frac{NIR - RED}{NIR + RED}$$

*texture metrics*

$$GLCM = \begin{pmatrix} 2 & 2 & 5 \\ 3 & 4 & 9 \end{pmatrix}$$

*temporal  
aggregation*



## Modeling

KNN

XGBoost

RandomForest

ANN

Extreme  
Random Forest

## Product



*Crop Types*



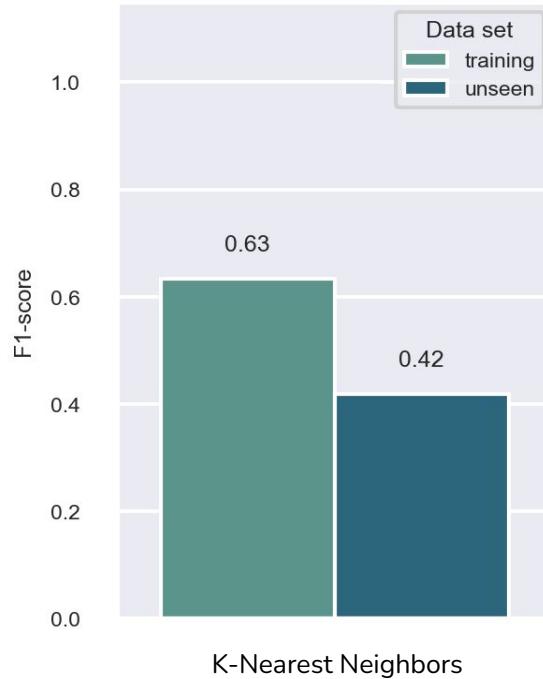
*Error*

*Analyses*

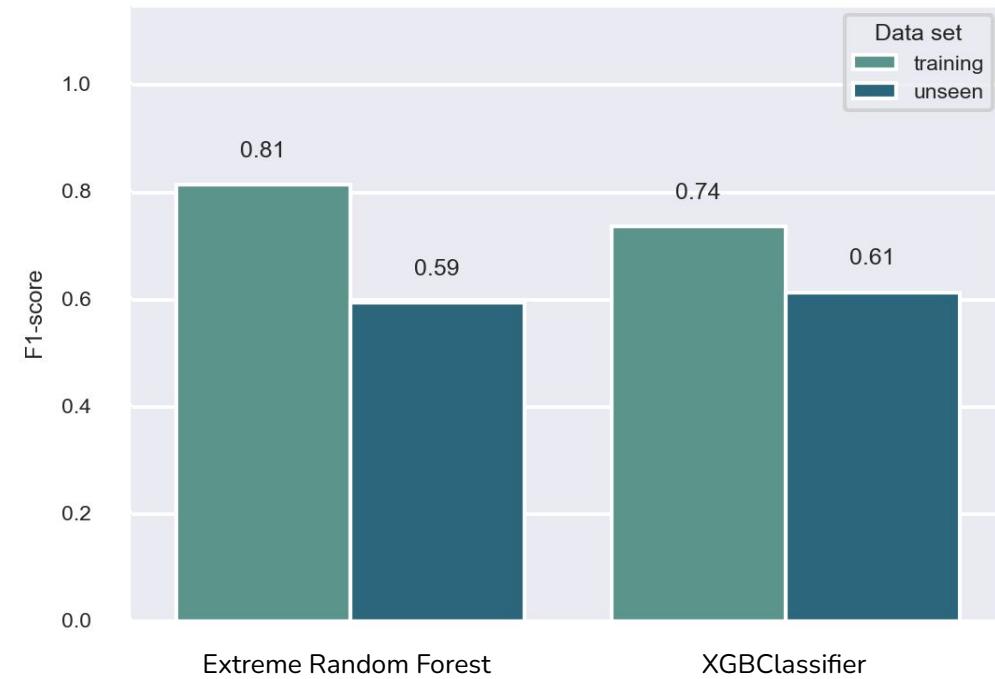


# Performance of the models

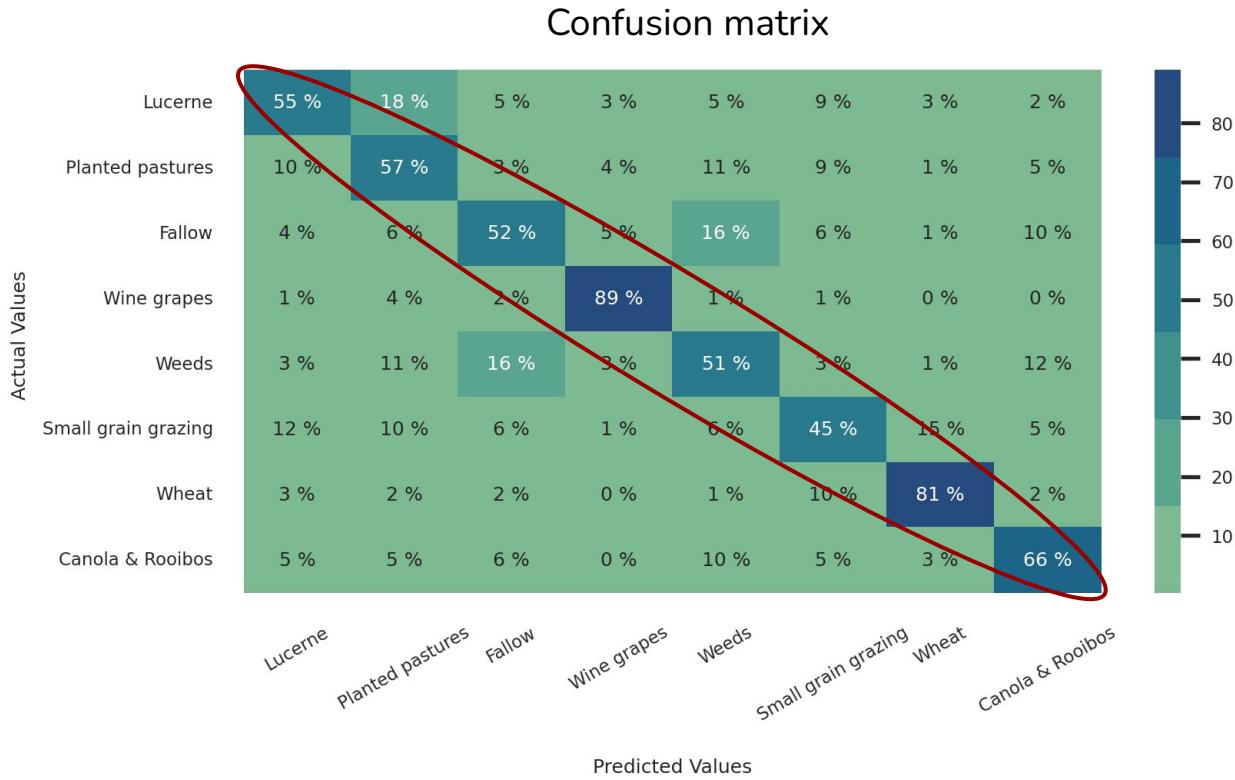
Scores of the baseline model



Scores of the models

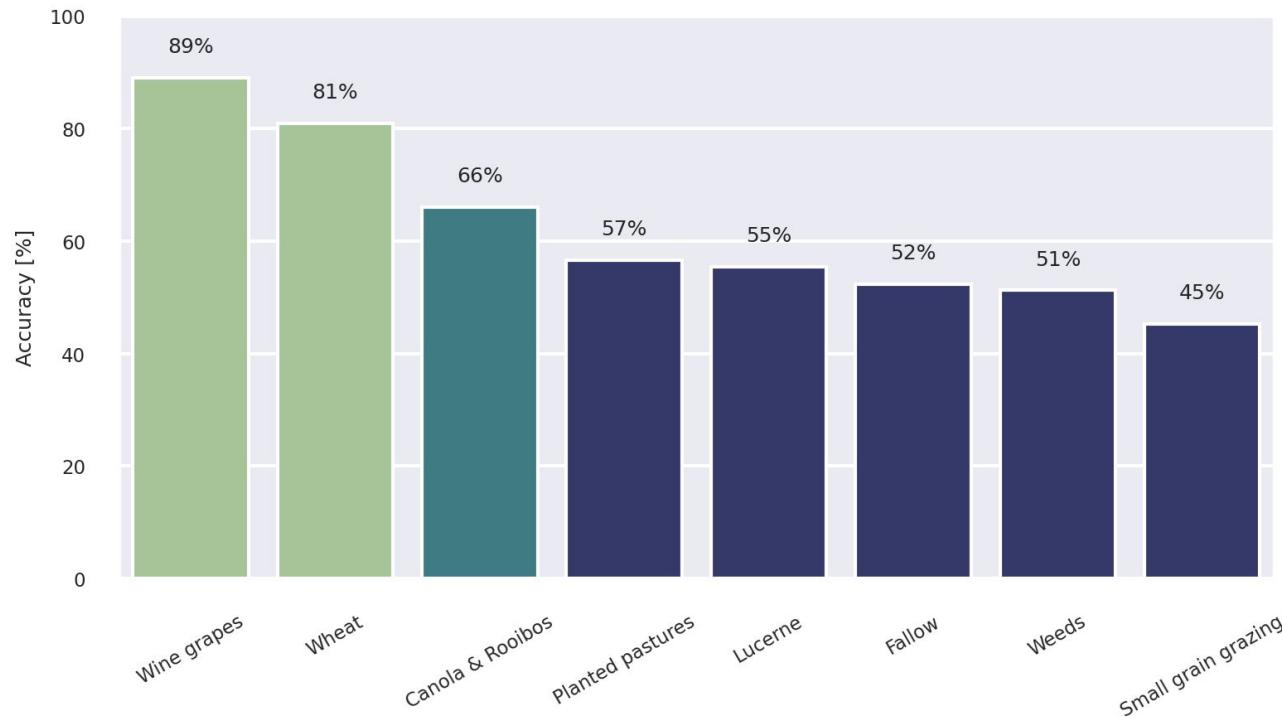


# XGBClassifier - Error analysis



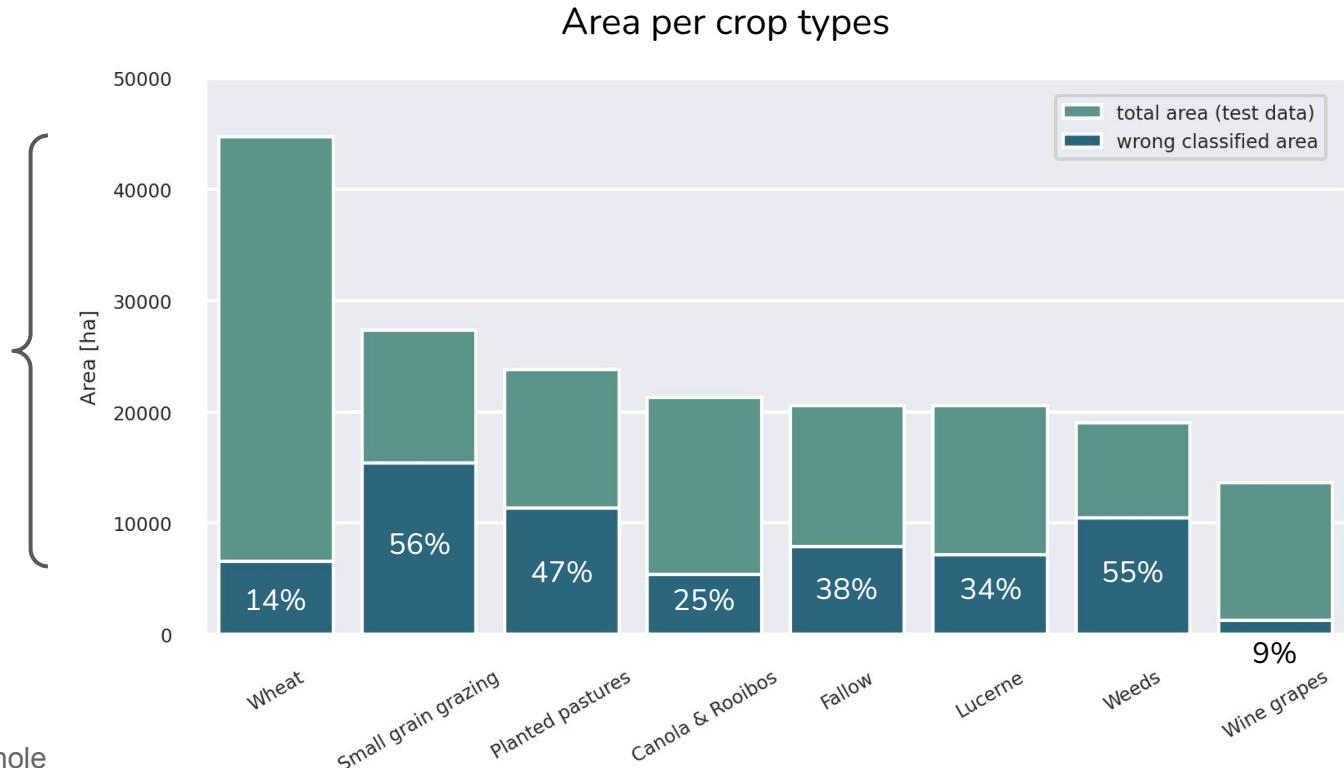
# XGBClассifier - Error analysis: accuracy of each label

Accuracy on the different crop types



# XGBClassifier - Error analysis: area of each label

saved survey costs  
for wheat: 70.000 \$\*



\*this represents only  $\frac{1}{3}$  of the whole



# Conclusion

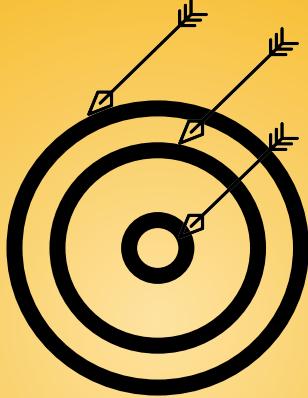
- Decision Tree Ensemble Models perform well with the task
- Crop identification
  - wine grapes and wheat can be classified with a high accuracy
  - the other crop types are often misclassified



Photo by Matteo Raimondi on Unsplash



# Conclusion



high accuracy estimation  
for two of eight crop types



reducing the cost  
by 270.000 \$

reducing time to 3 h  
for the entire area



no monthly census update



# Outlook

- **possible improvements**
  - adjusting the model (better generalization)
  - a dashboard predicts crop type of any given data
  - dockerization of the project
- **our model could be used for other regions as well**
  - using Sentinel-2 data
  - probably also on other crop types



Photo by Matteo Raimondi on Unsplash



# The End

Thank you for your attention

