Time series analysis of Lebanese crops

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Objectives

- Following Lebanese economic crisis and Ukrainian conflict, food safety has become a major national challenge

- Objectives:
  - create a 5-years Lebanese dataset for winter wheat
  - design and implement a deep-learning model to detect winter wheat parcels from Sentinel-2 time-series
  - generate a yearly map layer of winter wheat areas

sentinelhub API

- Relied on sentinelhub python API to:
  - split RoI into different BBox
  - request relevant tiles for each BBox
  - fetch best monthly image pixels for each tile (in terms of cloud ratio)
    - time-series of 9 timestamps per tile: November until July
    - 10 bands per image
  - store dataset images on GCP bucket

- Relied on a in-house winter wheat GT labels collected through on-field surveys

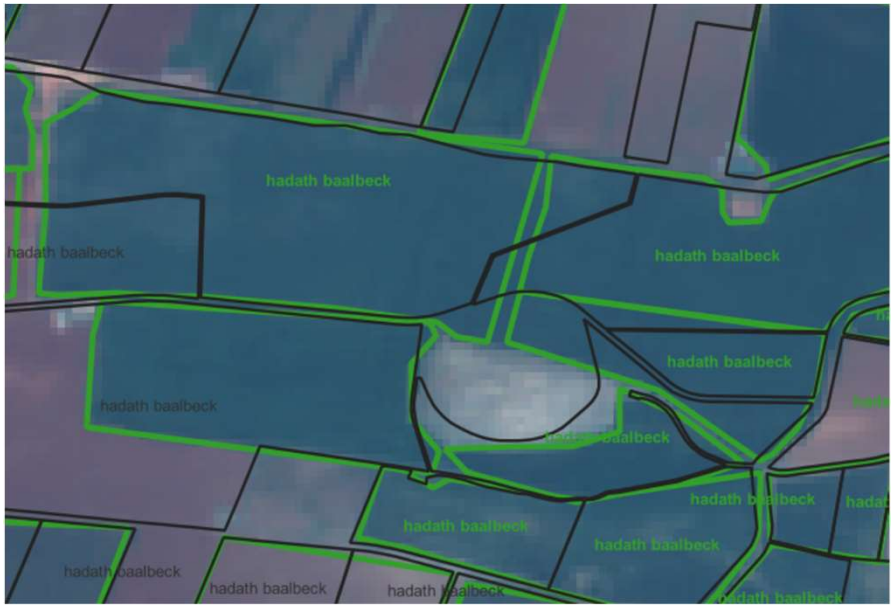
GT labels cleaning

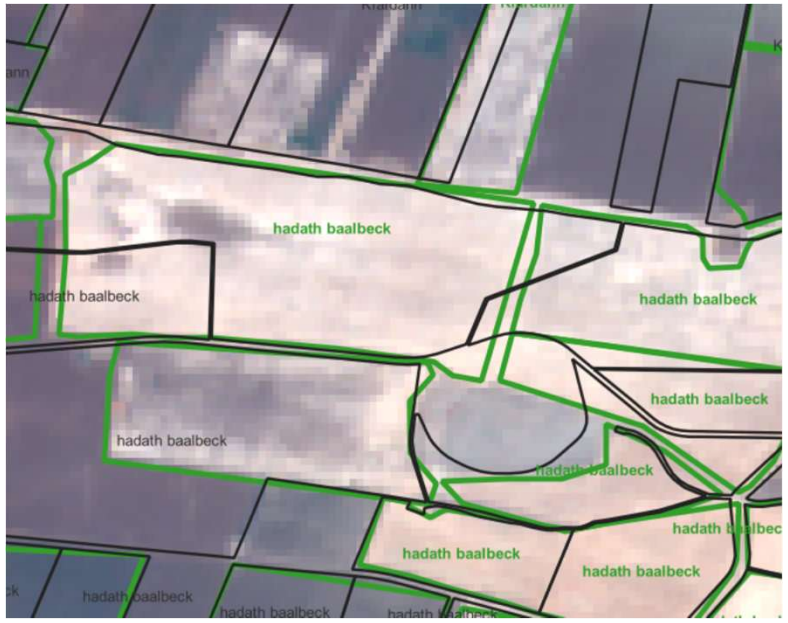
- Dataset split:
  - 2016 – 2019: training-set
  - 2020: test-set

- Winter wheat has planting period that makes it distinguishable from other Lebanese crops:
  - unique dark green color in March, as well as golden color before harvest time (~June-July)

GT labels cleaning

- Manually went through both training-set and test-set labels and verified all wheat fields



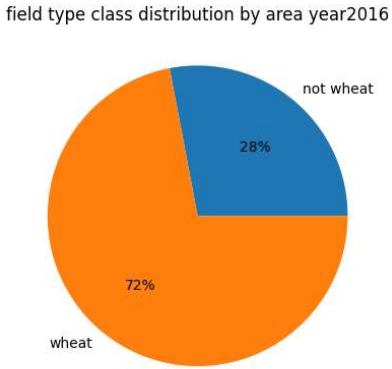


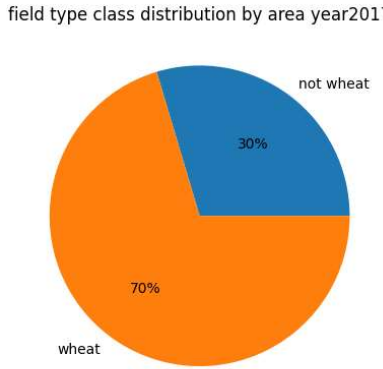
Training-set

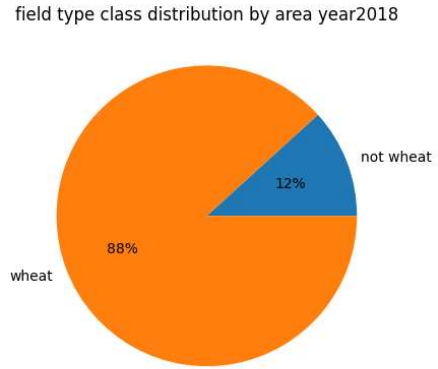
- GT labels highly imbalanced:
  - class wheat ~70%
  - class non-wheat ~30%

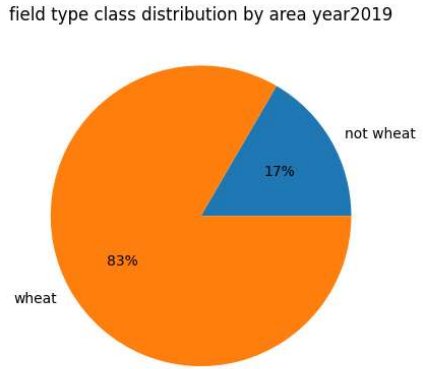
- Used fetched images to manually label negative samples (non-wheat) to reach following goals:
  - equal total area for the 2 classes
  - comparable mean area for the 2 classes
  - normal distribution over all the RoI

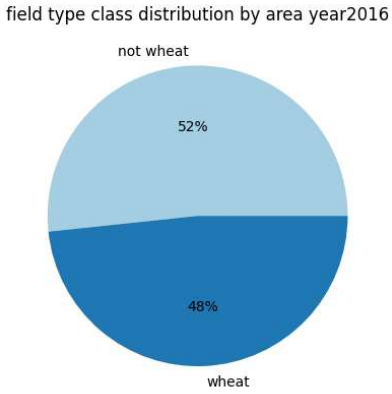
Training-set

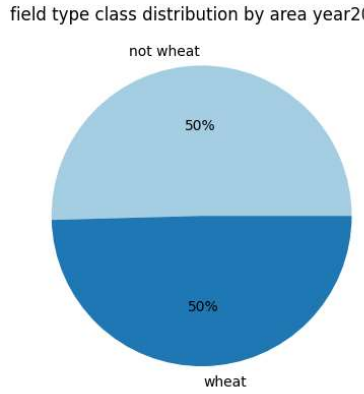


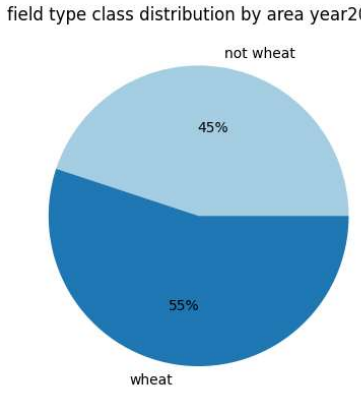


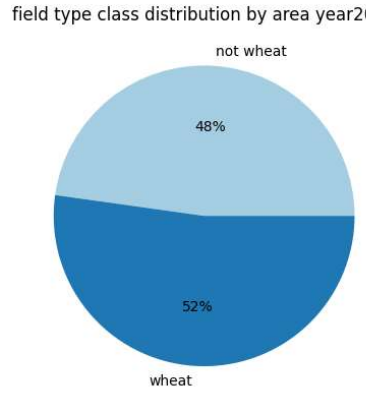








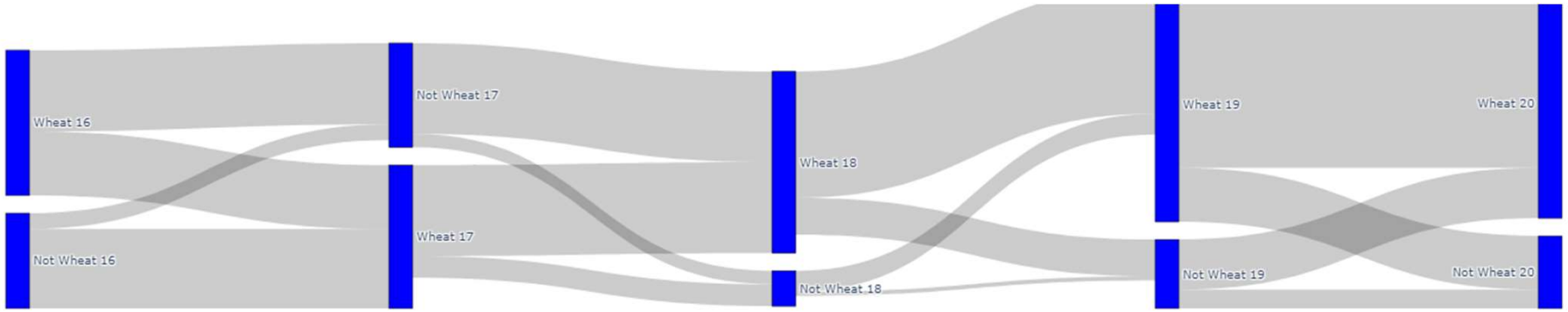




Test-set

- It is fine to have some mislabeled wheat fields in the training-set

- But cannot tolerate this in the test-set:
  - every pixel should be labeled as wheat or non-wheat
  - comprehensive manual labeling performed



DL-models

- Trained 3 different CNN architectures
- Currently training 1 transformer-based model
- Best model will be adopted to generate annual wheat crop map
- Map will be shared with stakeholders and interested researchers

Future

- Develop a yield estimation model and publish a national wheat production map

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  - Hasan Nasrallah
  - Ali J. GHANDOUR
  - www.geogroup.ai