Special Topics in Applications (AIL861)
Artificial Intelligence for Earth Observation
Lecture 26

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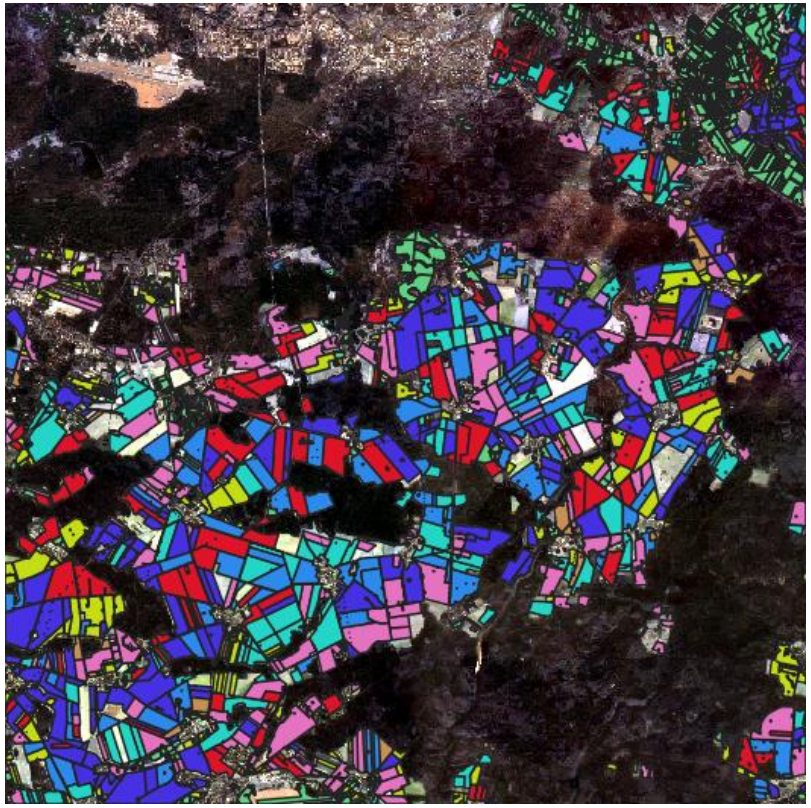
Agricultural Applications

Crop Time-Series Classification

DENETHOR: a dataset for crop type mapping from satellite imagery time-series

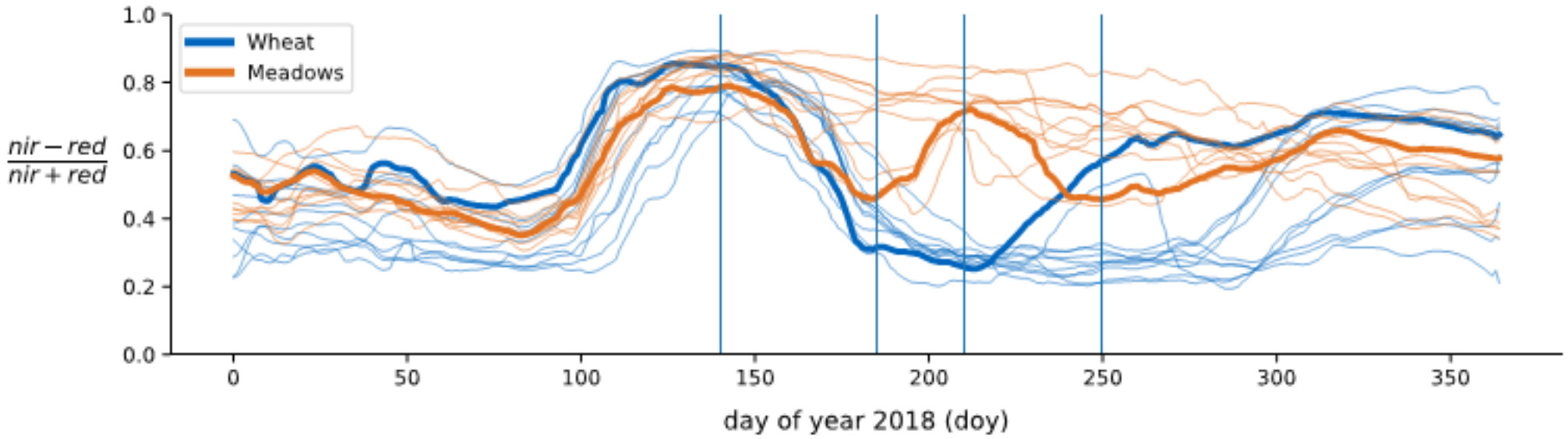
- Daily Time Series based on Planetscope Imagery (3m)
- Analysis-ready data
- Sentinel-1 and 2 data additionally provided

Target to map: High quality cadastral data on crop types



- > 1000km² cadastral data from Brandenburg, Germany
- Years 2018 and 2019 available for training and test tiles
- 300+ Planet & 80+ Sentinel-2 Images per year as input

Differences in Temporal Pattern among Crops



Vegetation intensity (NDVI) of selected fields over 2018 season

Crop Maturity Date Prediction

Winter Wheat Maturity Date Prediction

- ✓ Using satellite images, can be modeled as a time-series problem.

- ✓ Additional input: weather (e.g., temperature data): the average cumulative temperature required for winter wheat to go to maturity date can be calculated based on historical data.

ET: Effective temperature

AET: Accumulated effective temperature

$$ET_i = \begin{cases} T_i - T_b, & T_i \geq T_b \\ 0, & T_i < T_b \end{cases}$$

$$\mathrm{AET} = \sum_{i=Start\_Day}^{End\_day} ET_i$$

Fine-Grained (Crop) Classification

Fine-Grained Classification

Some CV datasets (not in context of crop or EO):

- ✓ Flowers-102
- ✓ Aircrafts
- ✓ Stanford Dog
- ✓ CUB-200

Fine-Grained Classification

- ✓ Hierarchical Categorization

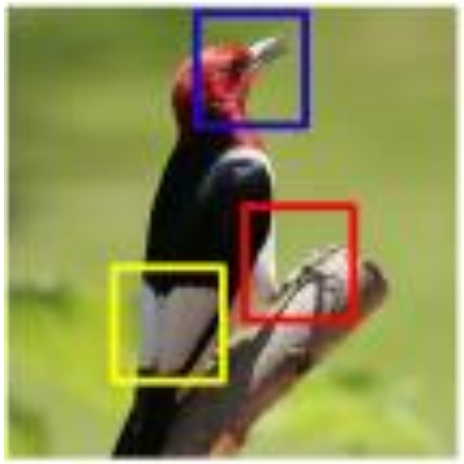
Fine-Grained Classification

- ✓ Pairwise confusion

Pairwise Confusion for Fine-Grained Visual Classification, 2018

Fine-Grained Classification

- ✓ Part detection and categorization.

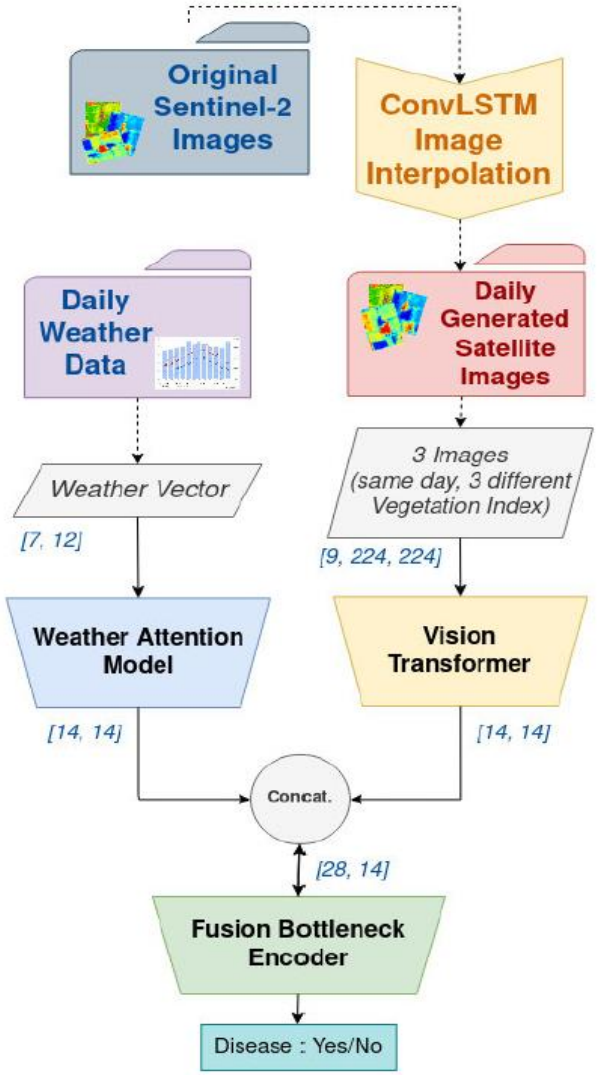


Crop Disease Detection

Additional Modality?

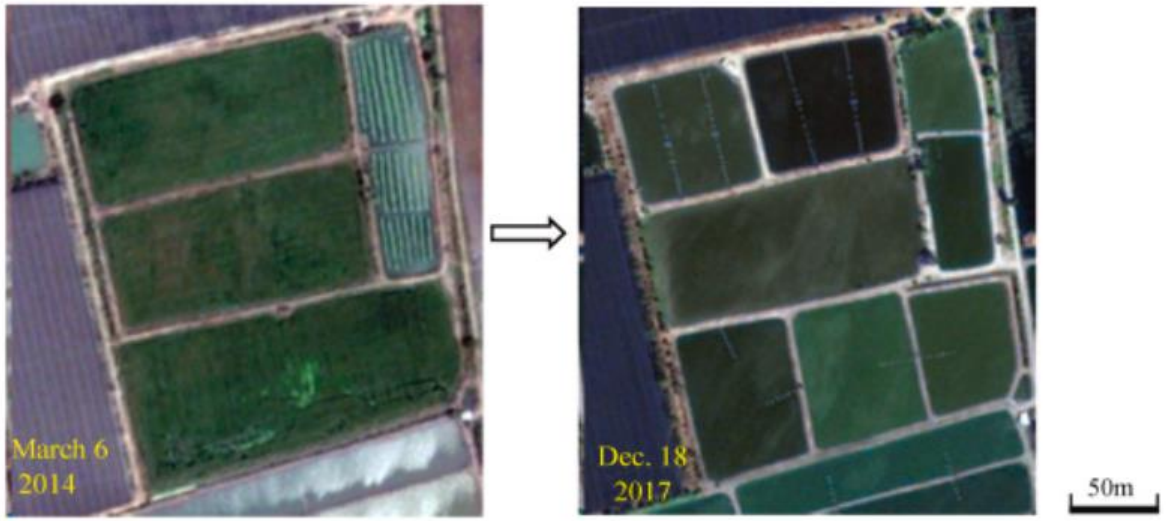
- ✓ Disease are often weather dependent.
- ✓ Thus, weather can be fed as an additional input to the model.
- ✓ However, weather and images – two different modalities.
- ✓ Furthermore, different temporal resolution.

Satellite + Weather Data for Crop Disease Detection



Fusion of Satellite Images and Weather Data With Transformer Networks for Downy Mildew Disease Detection, 2023

Aquaculture Pond Detection



Download : Download high-res image (491KB)

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Fig. 3. Google-Earth images showing an example of transition from rice paddies in 2014 (left) to shrimp ponds in 2017 (right) for a 250×290m area in Sa Phatthana subdistrict, Nakhon Pathom Province, Thailand, centered at 14°3′5″ N, 100°3′29″ E.

Problem can be modeled as either change detection or target detection

Automated extraction of aquaculture ponds from Sentinel-2 seasonal imagery – A validated case study in central Thailand

Soil Tillage Change Detection

Soil Tillage

- Tillage increases agricultural productivity but typically increases CO2 emissions 20-60% because it heavily disturbs soils
- The negative climate externality would be more then sufficient to offset the marginal productivity gains