Crop mapping using Sentinel-2

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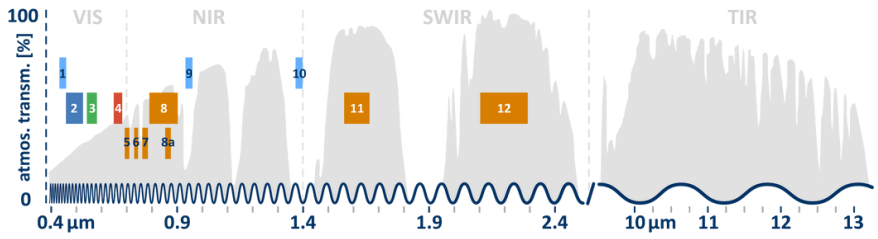
Definition [5]:
Crop mapping is defined as the process of gathering information about the distribution and types of crops across agronomic lands.

Browse Copernicus data here !

ESA Copernicus Programme [8]:

- **Setting**: 2 polar-orbiting satellites, phase difference of 180°
- **Revisit time**: Individual: 10 days, Combined: 5 days
- **Coverage:** Swath: 290km, Altitude: 786km
- **Bands**: 13, from the visible to the short-wavelength infrared



Methods [1,5]

Mapping strategies:

- Processing unit: sub-pixel analysis, pixel-based analysis, object-based analysis, or scene-based analysis
- Phenology-based: study of periodic events in the crop's life cycle, e.g., using vegetation index to define start and end of season
- Feature-based: study of reflectance properties of crop covers, e.g., using NDVI, EVI, SAVI, etc.

Classification algorithms:

1. **Tree-based methods:** segmentation of data, e.g., decision trees, classification and regression trees, random forests
2. **Probabilistics methods:** parametric, e.g., bayesian networks and maximum likelihood algorithms
3. **Neural network and kernel methods:** non-parametric, e.g., support vector machines or active kernel learning

Challenges of Crop Mapping [1, 6]

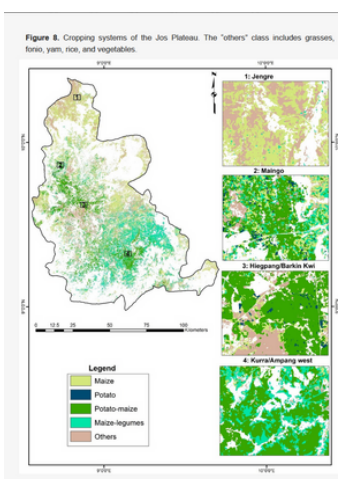
1. **Cloud cover & data gaps:** Frequent cloudiness reduces usable imagery, especially in tropical regions → high temporal resolution necessary
2. **Mixed pixels issues**: Small or fragmented fields may contain multiple crops in a single pixel → high spatial resolution necessary
3. **Spectral similarity of crops**: Some crops look similar at certain growth stages, making classification harder → multiple spectral bands necessary
4. **Transferability of classification models:** Climate variations between regions can lead to differences in crop varieties; temporal disparities in planting schedules for the same agricultural crops can introduce additional complexities

Advantages of Sentinel-2 [7]

1. **High spatial resolution (10 m)**: Captures field-level variability
2. **High temporal resolution**: Captures phenological cycles (growth stages)
3. **Red edge bands**: Sensitive to vegetation chlorophyll & useful for crop differentiation

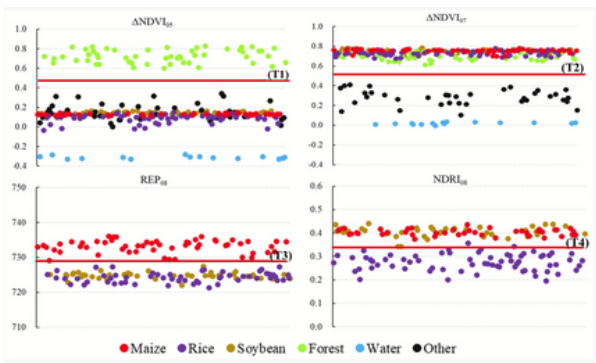
Examples [2,3,4]

Mapping crop types and cropping systems in Nigeria [3]:
Provision of a mapping scheme to map maize and potato and intercropping systems



Measuring nutrition in crops in Italy [2]:
Estimation and prediction of micro-and macro-nutrient concentration of staple crops for some nutrients, such as potassium, phosphorous, magnesium and iron

Large-scale and high-resolution crop mapping in China [4]:
Establishment of crop classification models for specific cropping systems using decision trees method and monitoring of distribution of major crop species



Sources:
[1] Belgiu, Mariana, and Ovidiu Csillik. "Sentinel-2 cropland mapping using pixel-based and object-based time-weighted dynamic time warping analysis." Remote sensing of environment 204 (2018): 509-523.
[2] European Space Agency. "Measuring nutrition in crops from space." ESA Application – Observing the Earth / FutureEO, 10 October 2023. Accessed [16.09.2025]. https://www.esa.int/Applications/Observing_the_Earth/FutureEO/Measuring_nutrition_in_crops_from_space
[3] Ibrahim, Esther Shupel, et al. "Mapping crop types and cropping systems in Nigeria with Sentinel-2 imagery." Remote sensing 13.17 (2021): 3523.
[4] Jiang, Yulin, et al. "Large-scale and high-resolution crop mapping in China using Sentinel-2 satellite imagery." Agriculture 10.10 (2020): 433.
[5] Khosravi, Iman. "Advancements in crop mapping through remote sensing: A comprehensive review of concept, data sources, and procedures over four decades." Remote Sensing Applications: Society and Environment (2025): 101527.
[6]Song, Xiao-Peng, et al. "An evaluation of Landsat, Sentinel-2, Sentinel-1 and MODIS data for crop type mapping." Science of Remote Sensing 3 (2021): 100018.
[7] Tufail, Rahat, Patrizia Tassinari, and Daniele Torreggiani. "Assessing feature extraction, selection, and classification combinations for crop mapping using Sentinel-2 time series: A case study in northern Italy." Remote Sensing Applications: Society and Environment 38 (2025): 101525.
[8] https://blogs.fu-berlin.de/reseda/sentinel-2/