

Crop type mapping with Landsat and Sentinel in Scerin countries

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With contributions from:

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Yanghui Kang

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Our goal

- Derive agricultural attributes from remote sensing over large areas
 - Cultivated area, crop types, irrigation, cropping intensity ..
 - Regional, country scale
- Develop datasets at field scales
 - Has tremendous application potential
- Various challenges
 - Lack of field-level training/validation
 - Different cultivation practices

Our approach

- We take a hierarchical approach, deriving agriculturally relevant information of increasing complexity
 - LC > cultivated area > crop type > irrigation
- Develop datasets at field scales
 - Has tremendous application potential
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 - Different cultivation practices

VARIABLE

METHOD

Cultivated area

LC Classification



Crop type

Time series
Spectral difference
Canopy complexity



Cropping intensity

Peak counting



Irrigation

VI intensity
Climatic indices
Soil type



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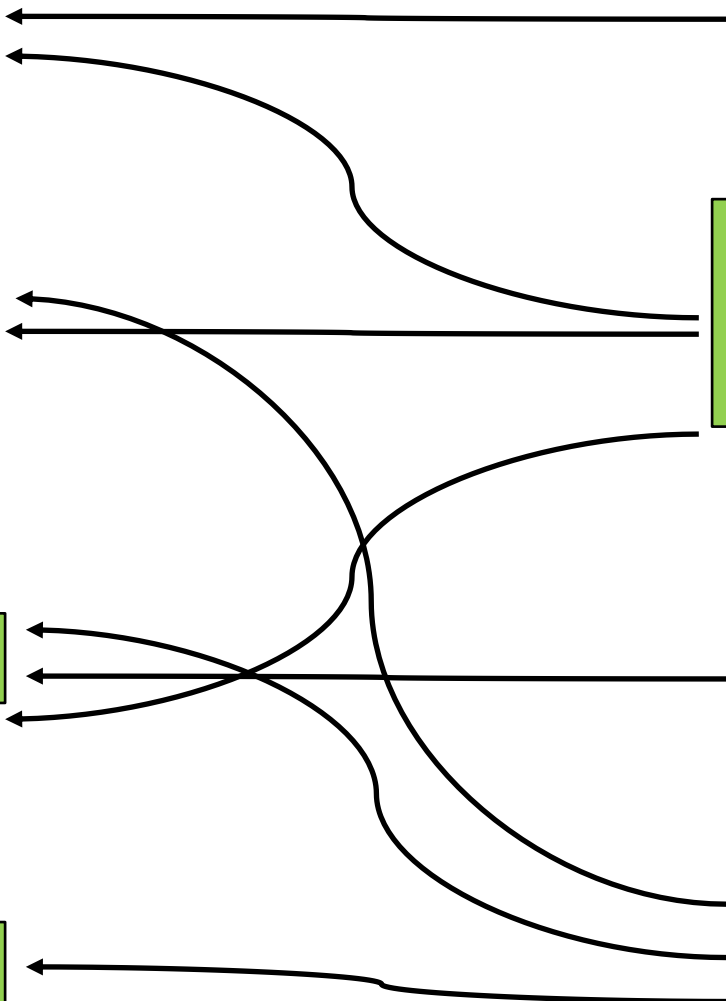
Cropping intensity

Peak counting

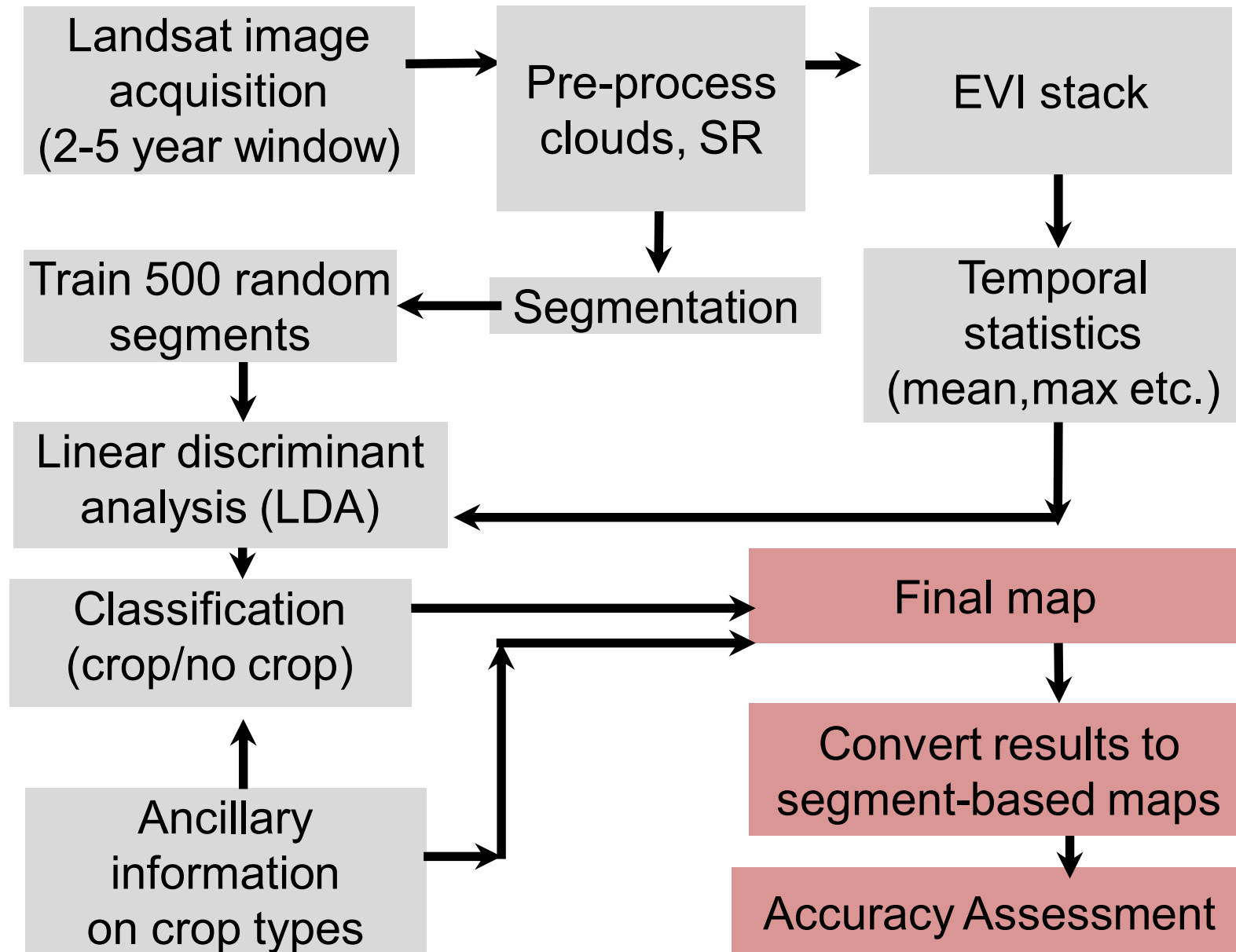


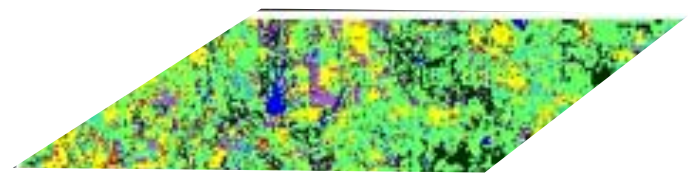
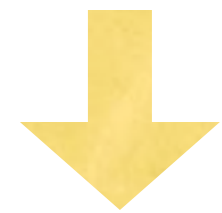
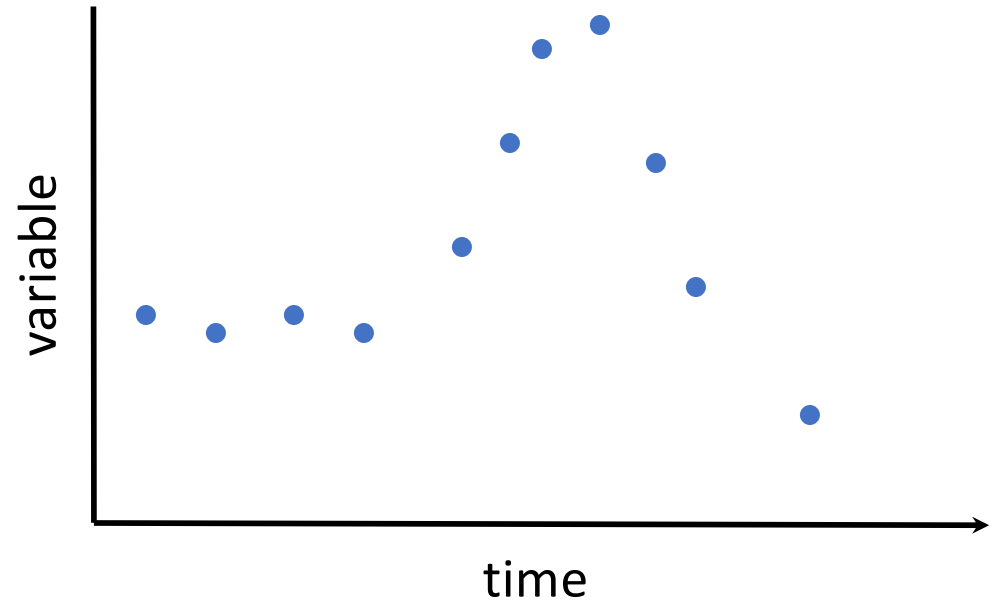
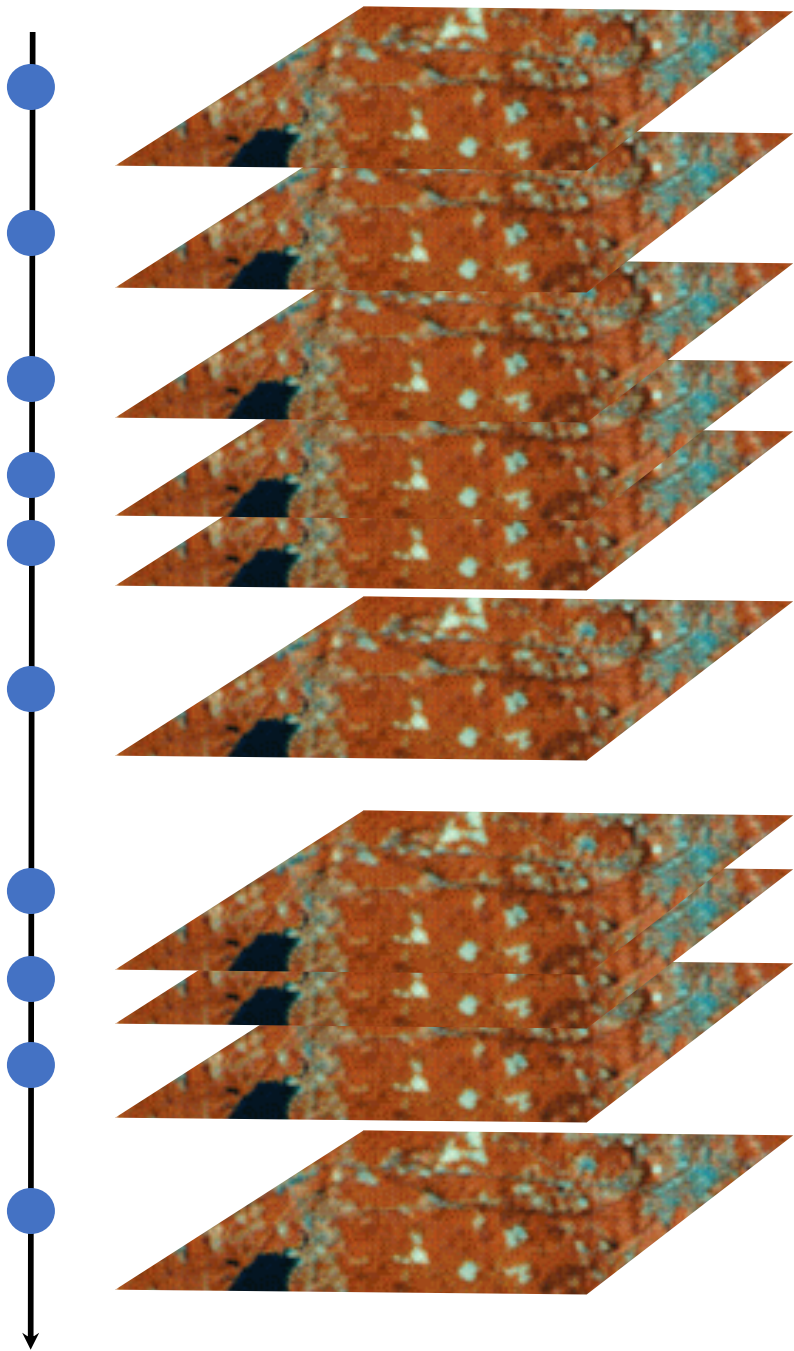
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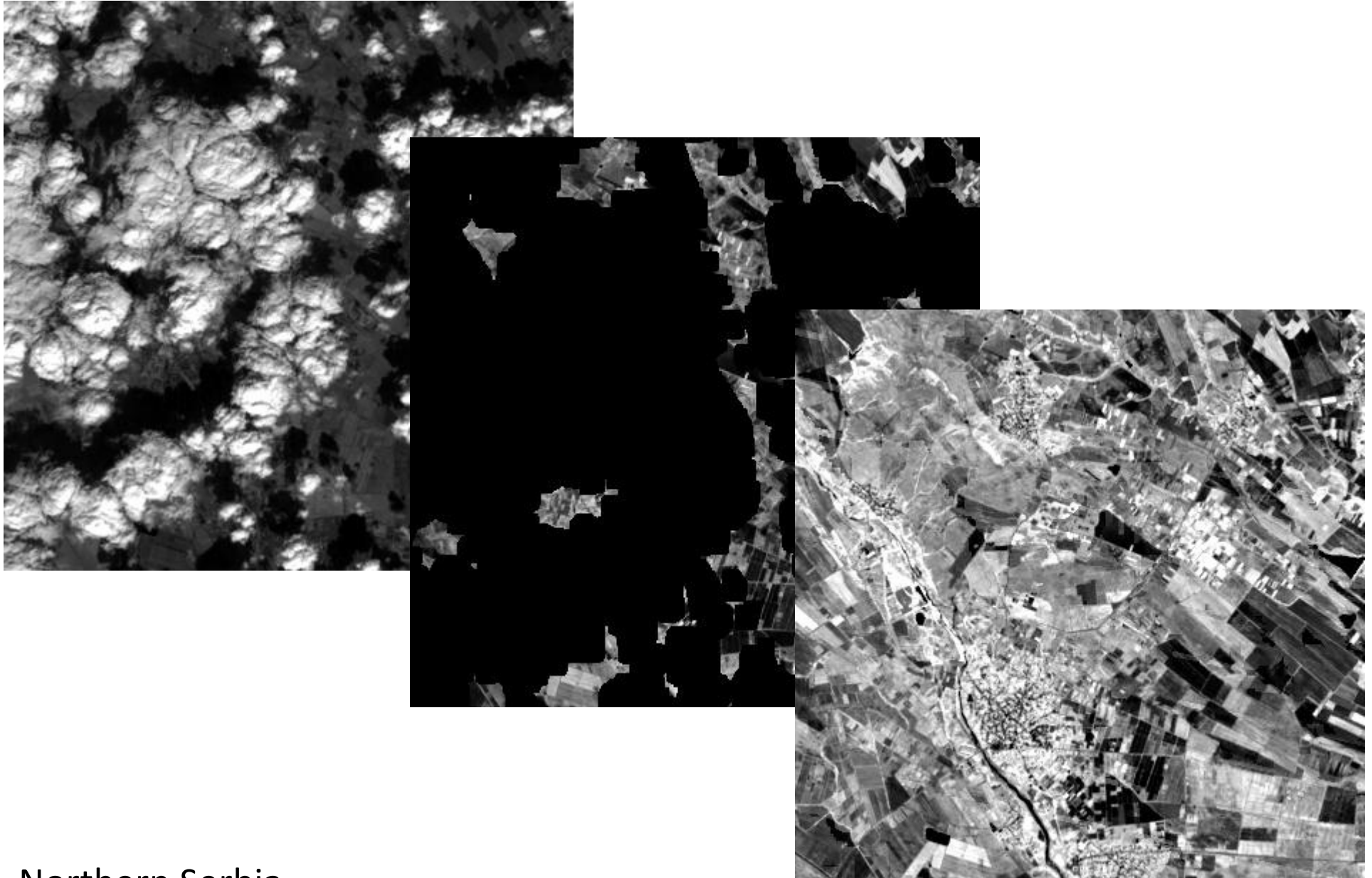


Cultivated area mapping



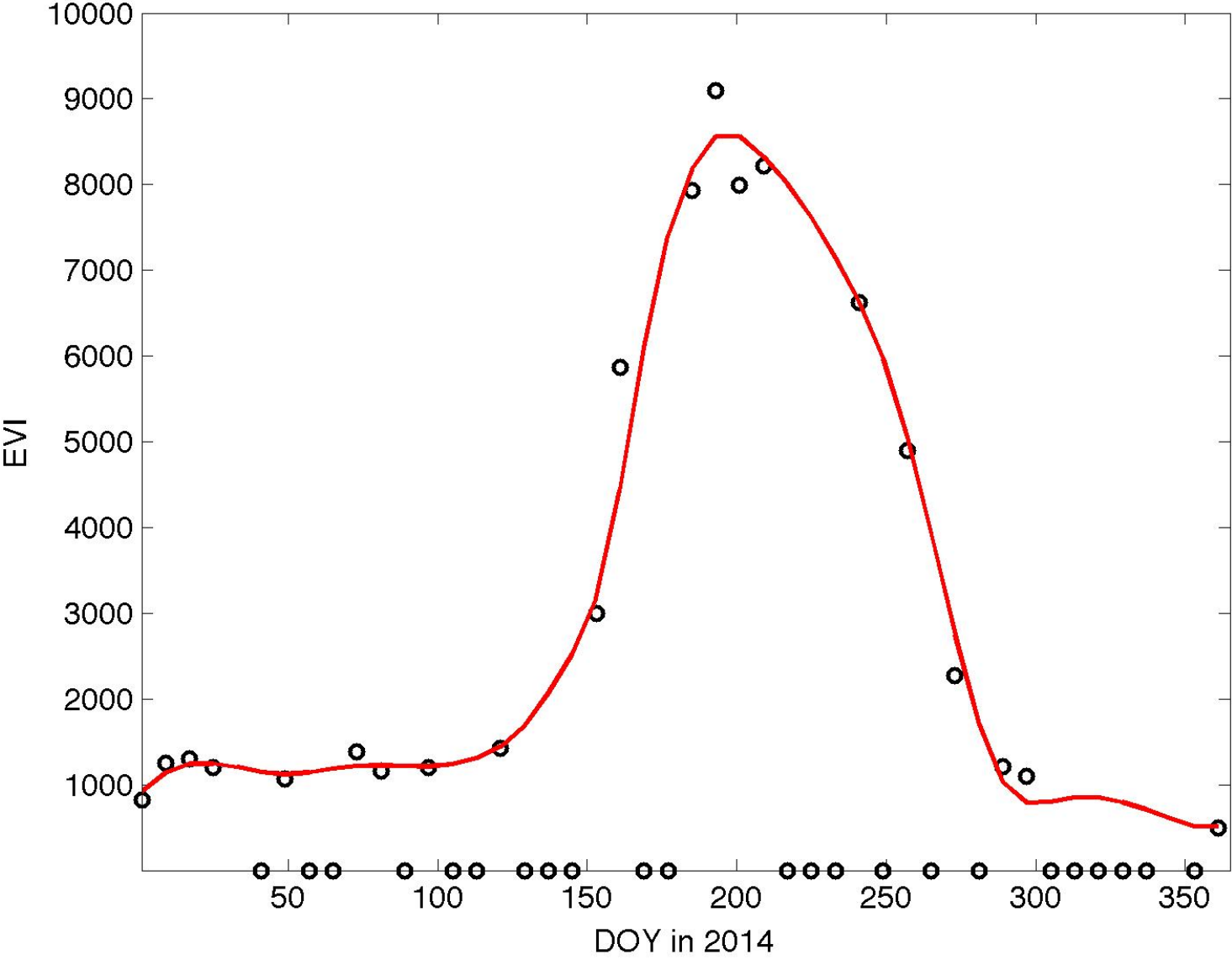


Cloud detection and gap filling

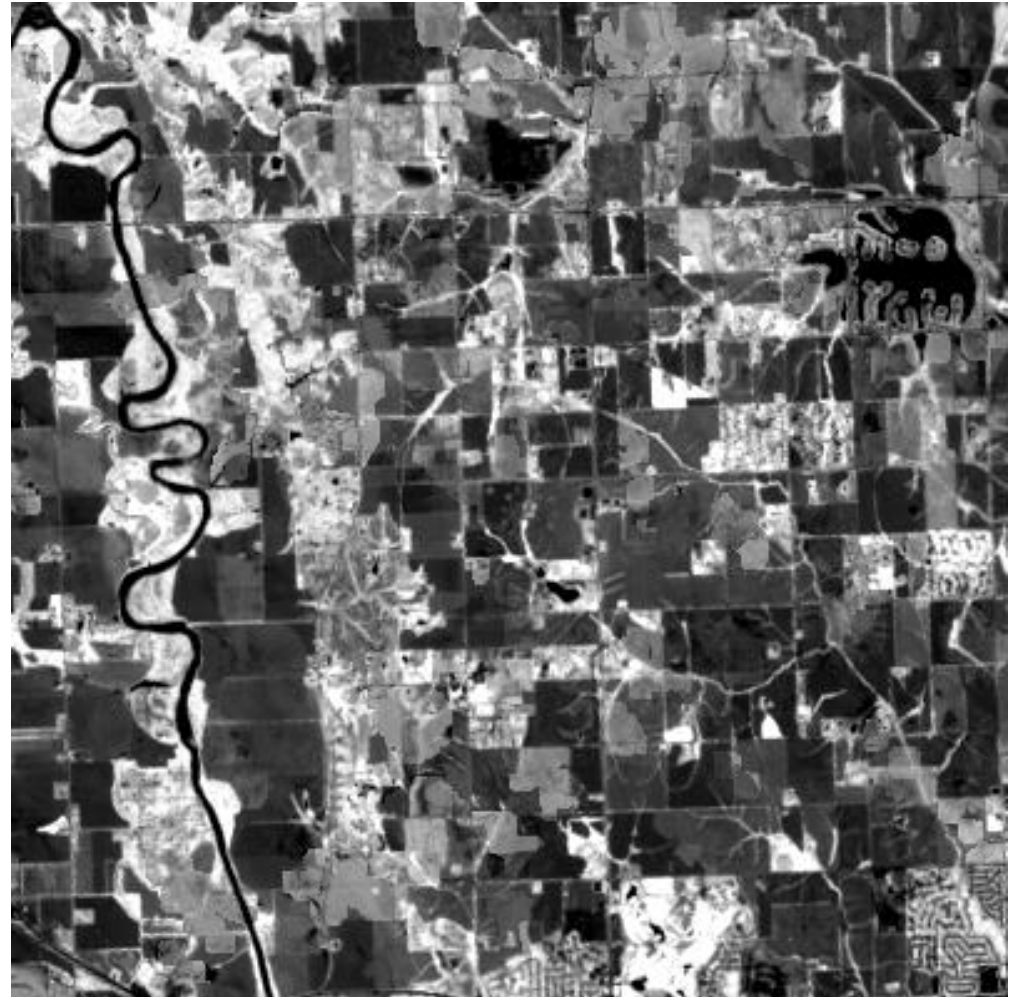
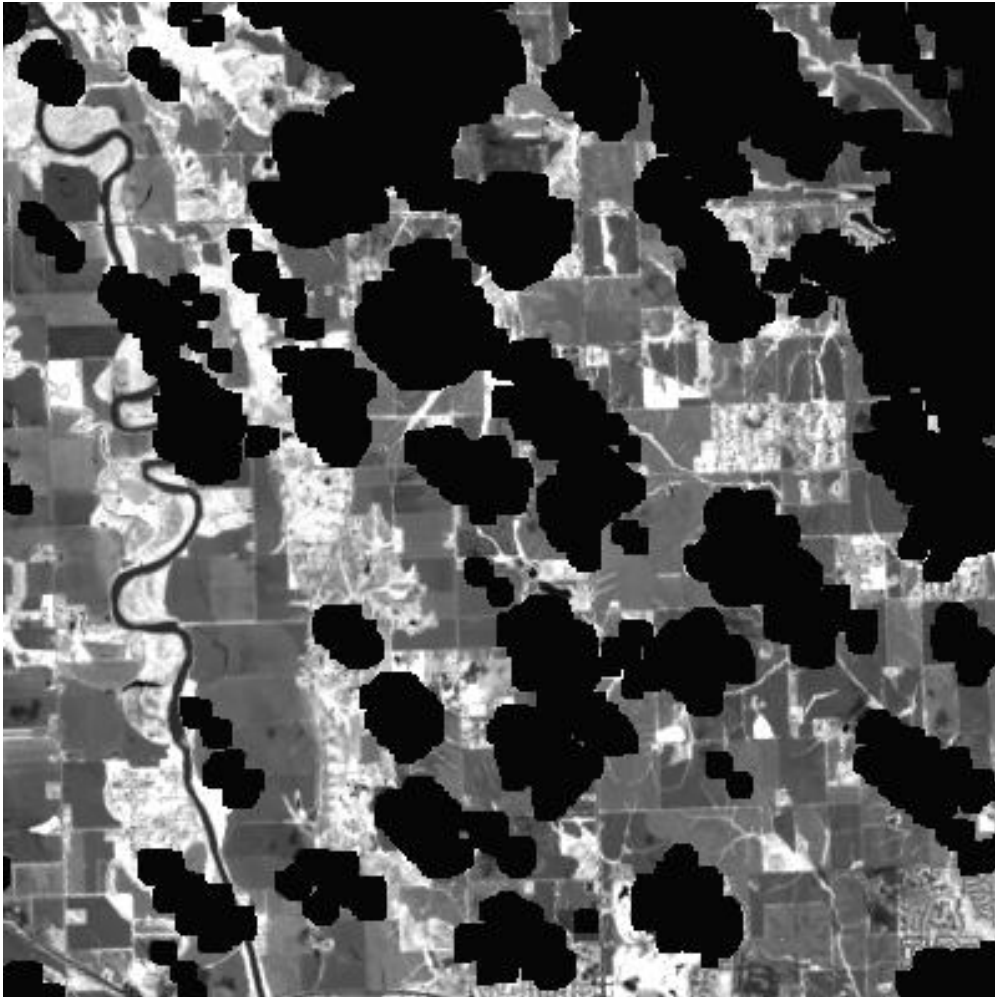


Northern Serbia

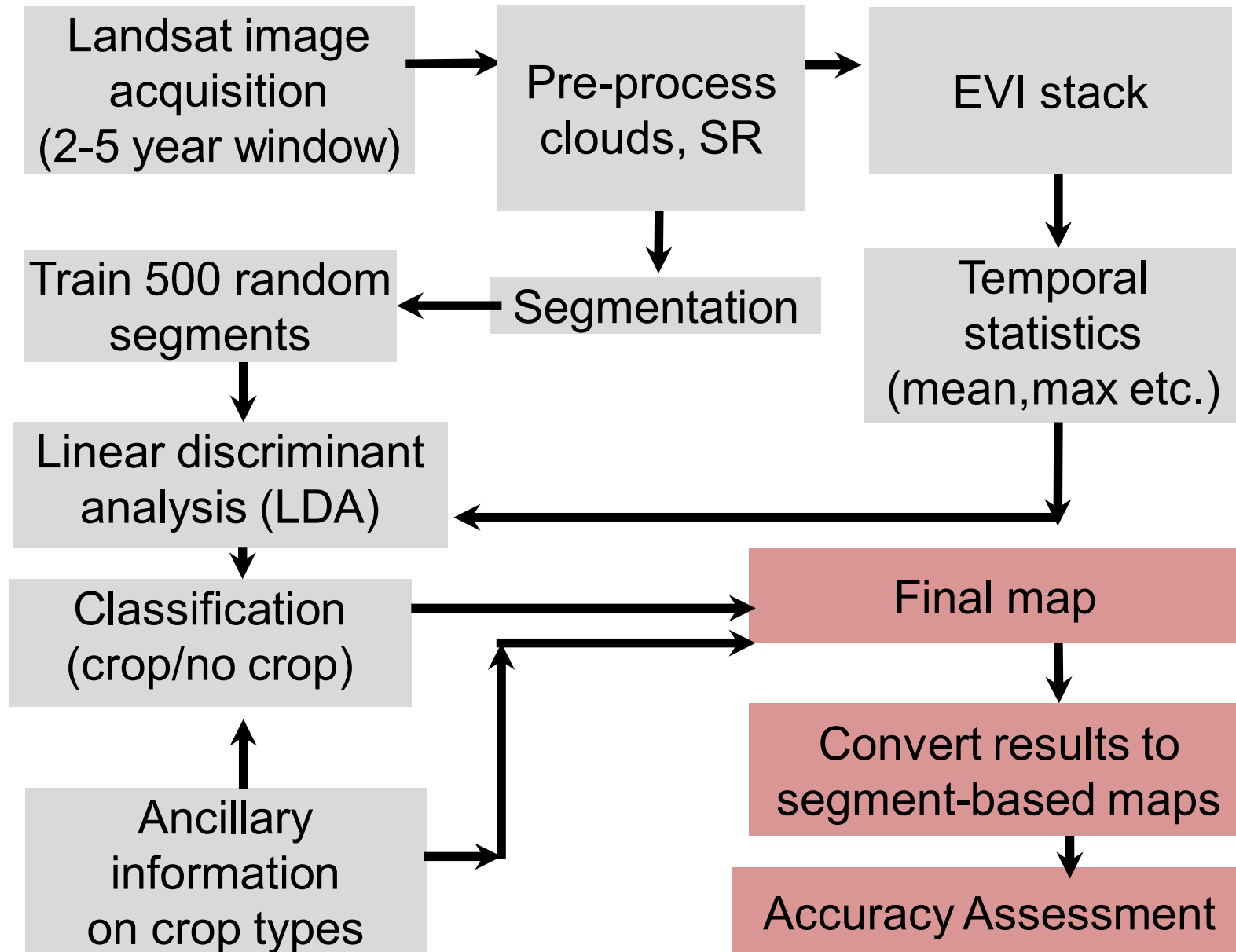
Strategy for seasonal crop mapping



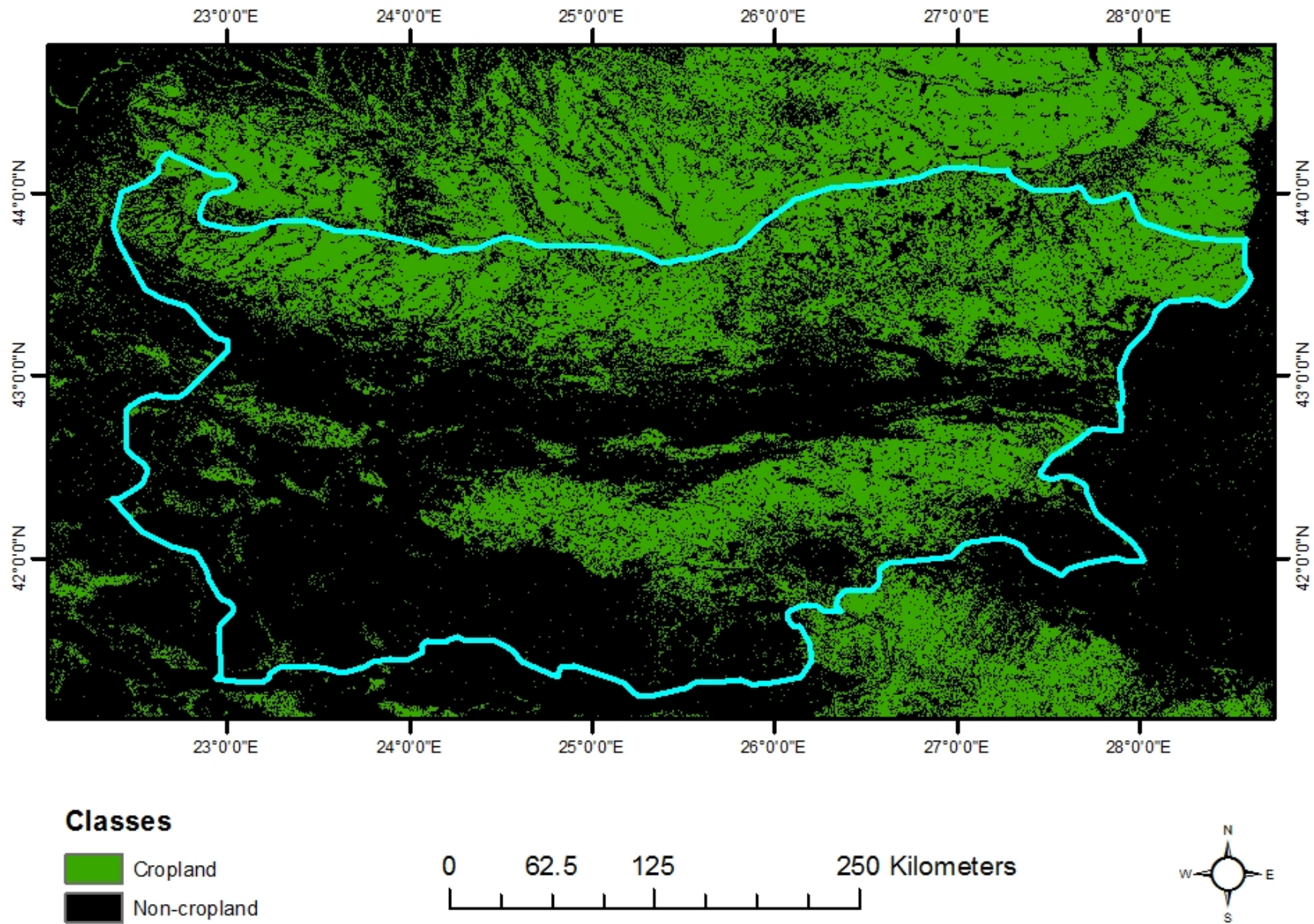
Gap filling example



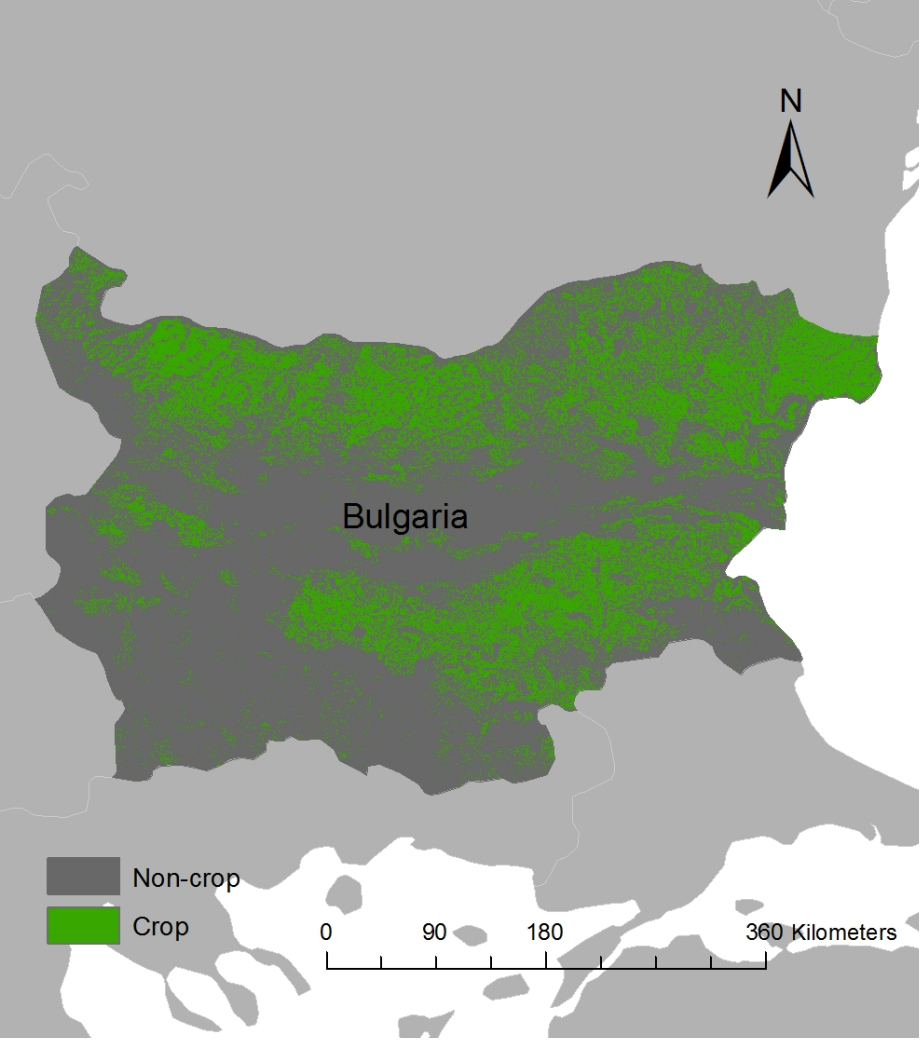
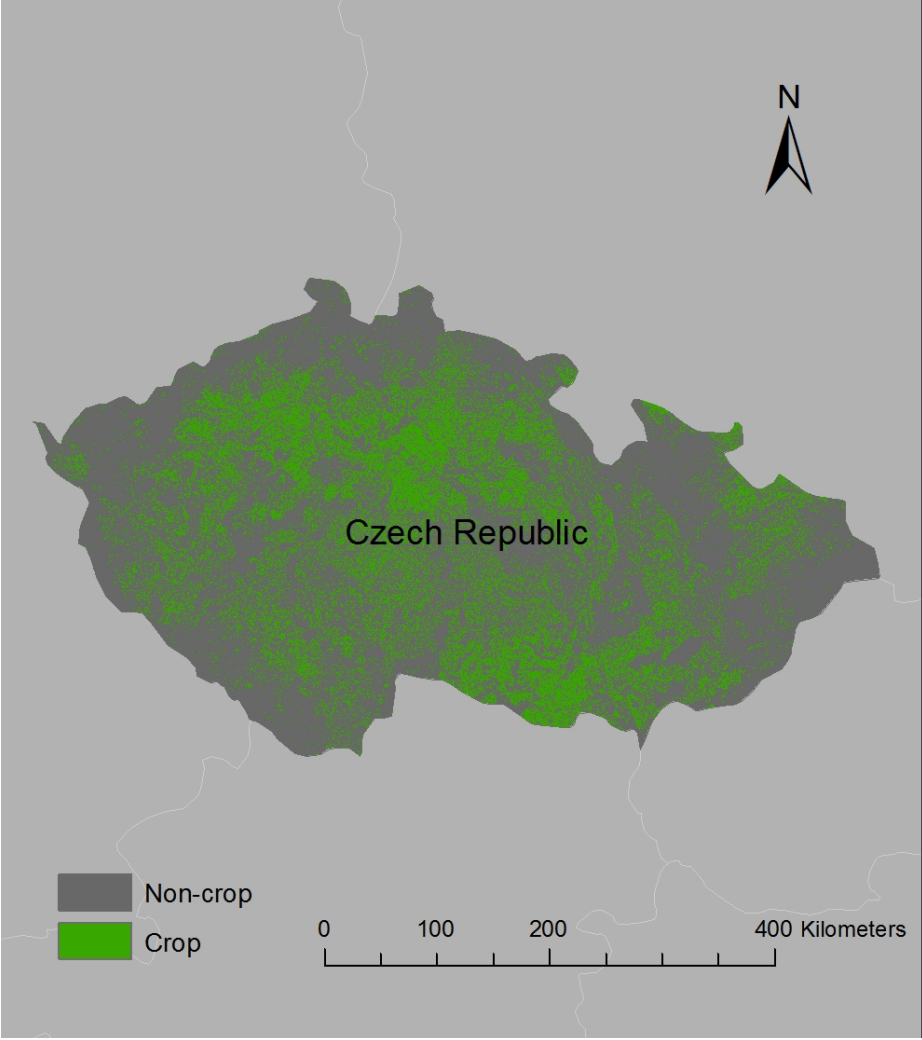
Cultivated area mapping



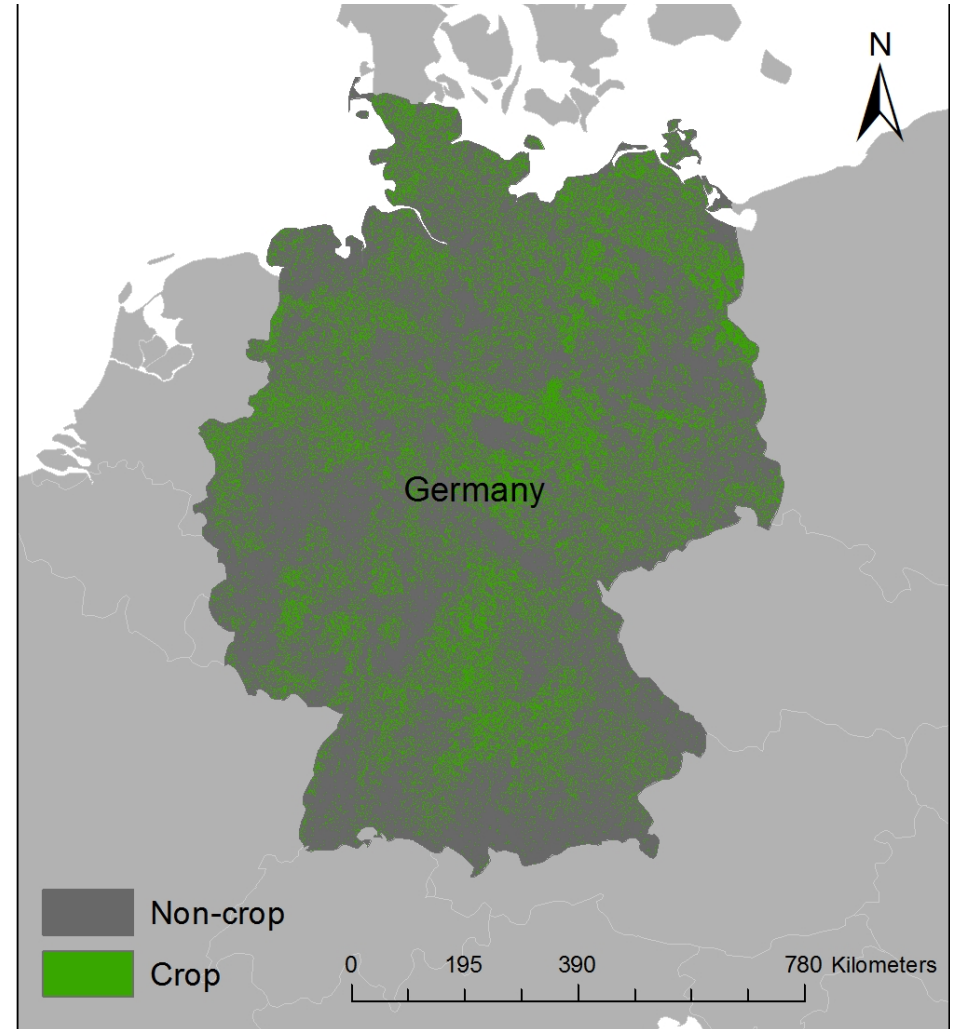
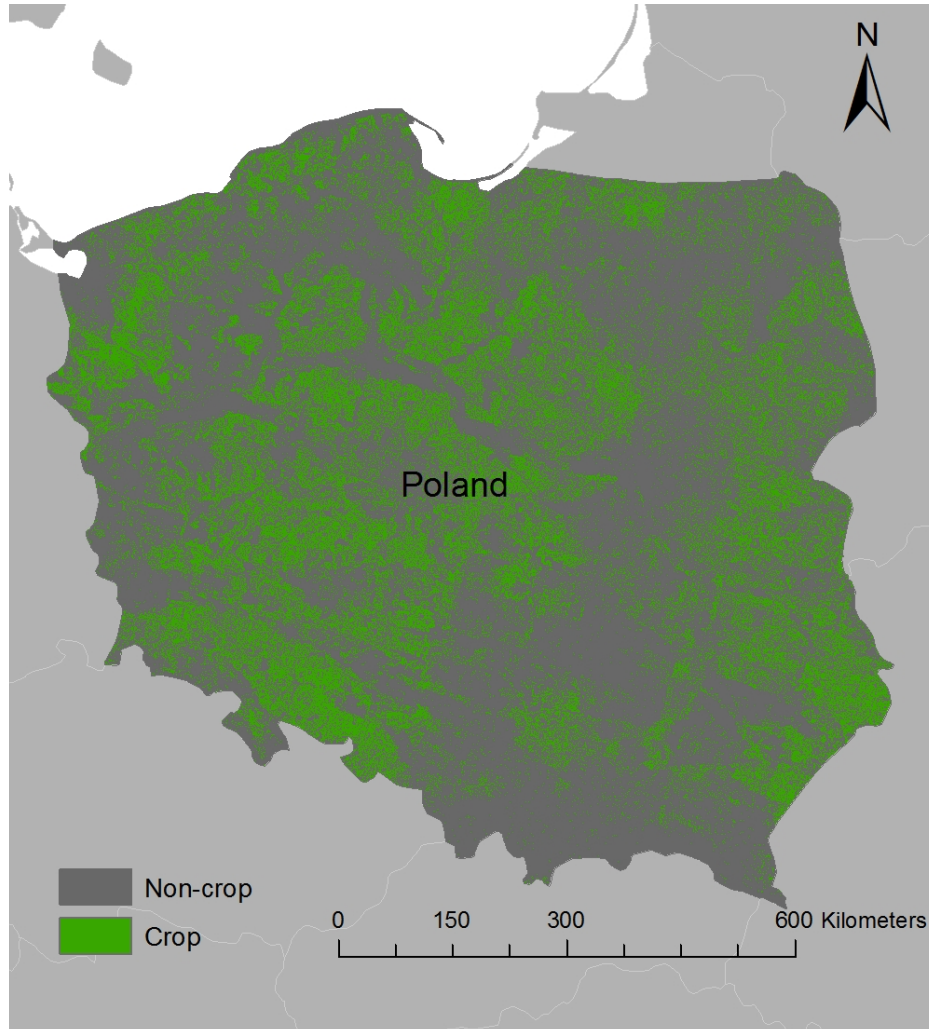
Bulgaria cropland map



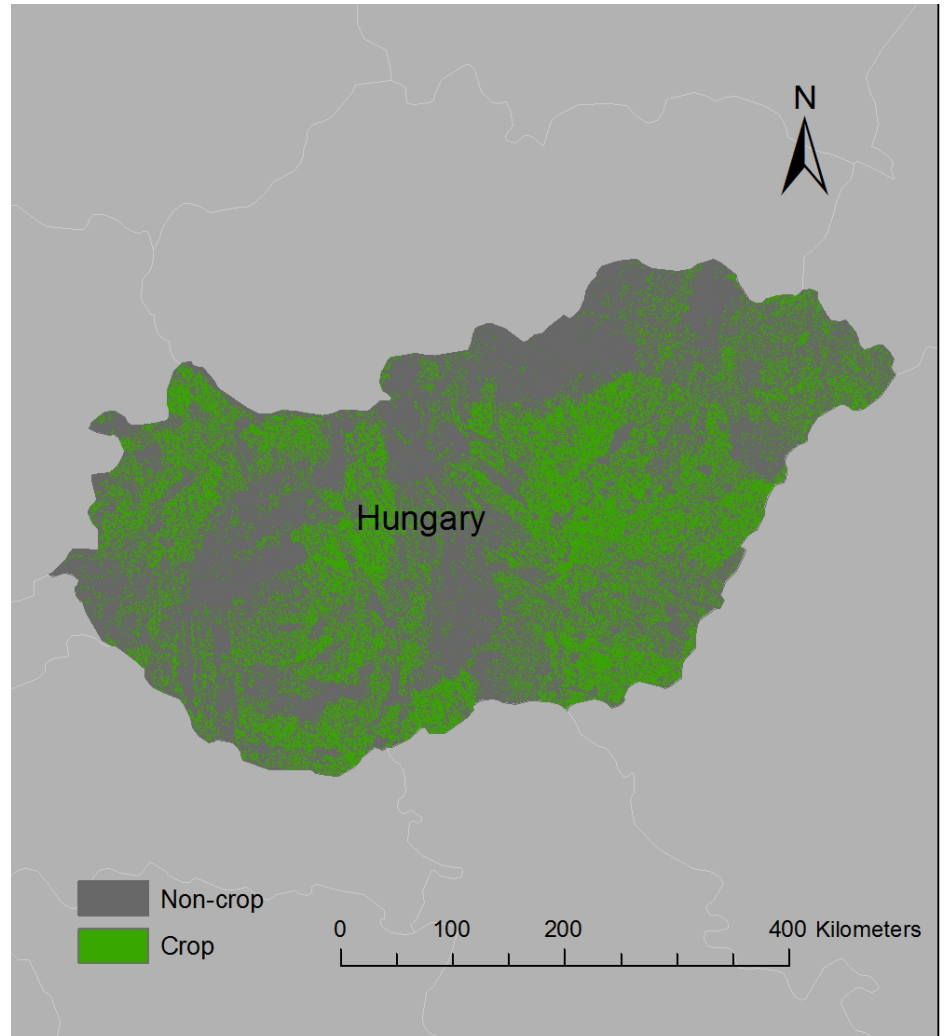
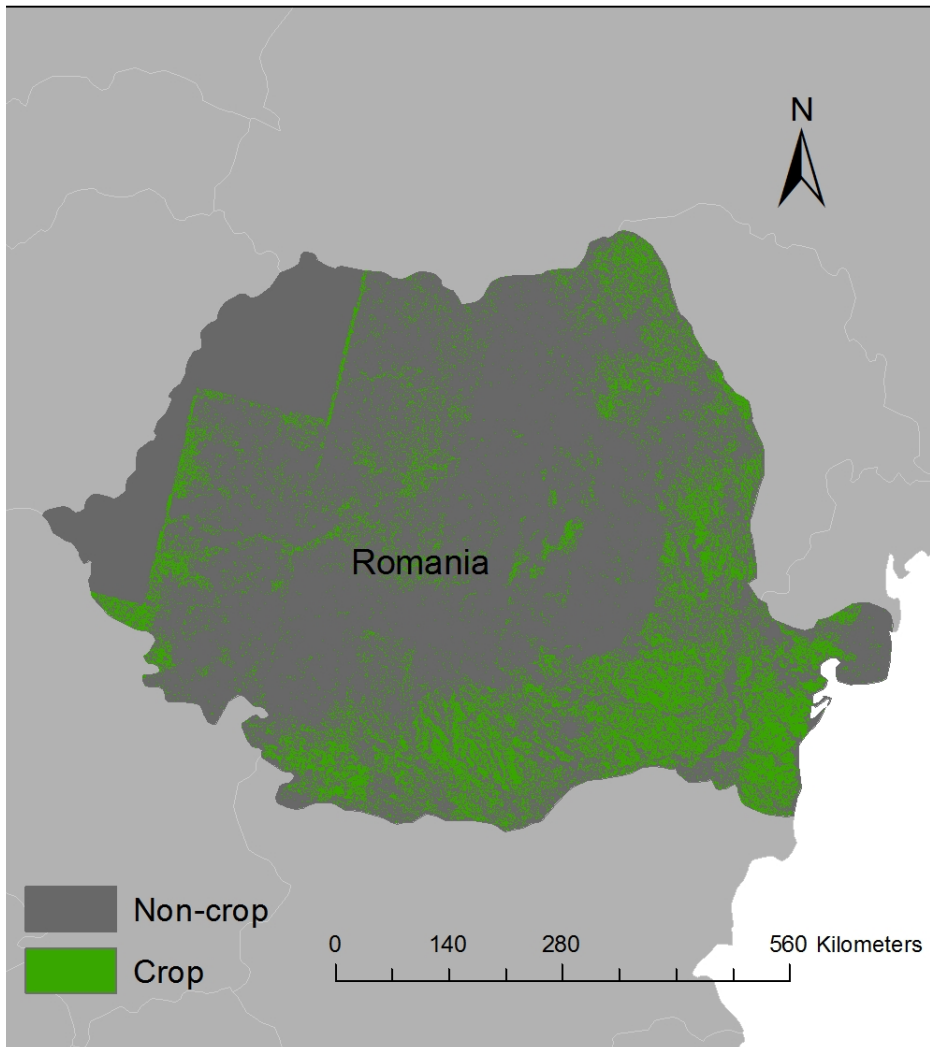
Results for sample countries in Europe

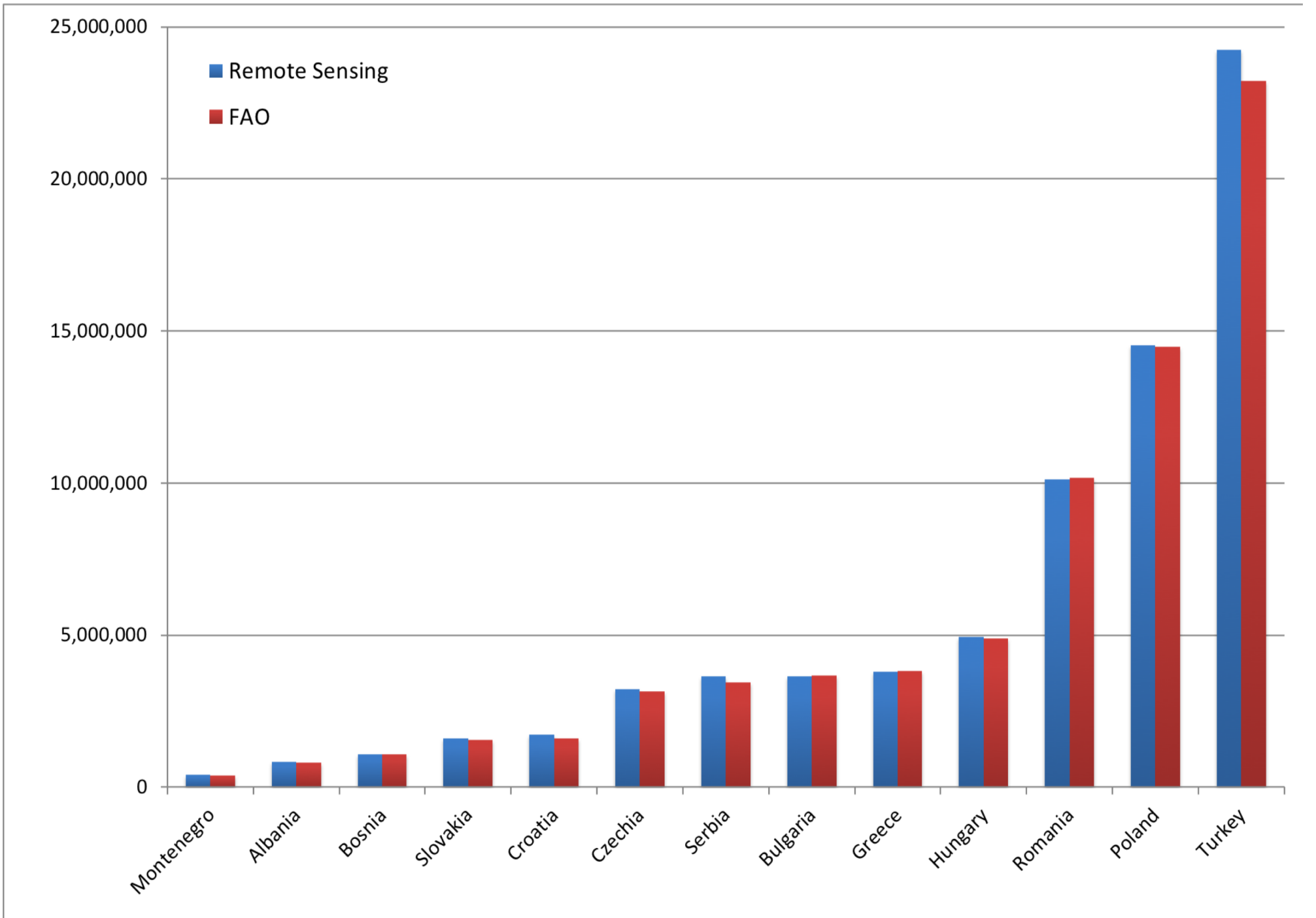


Results for sample countries in Europe



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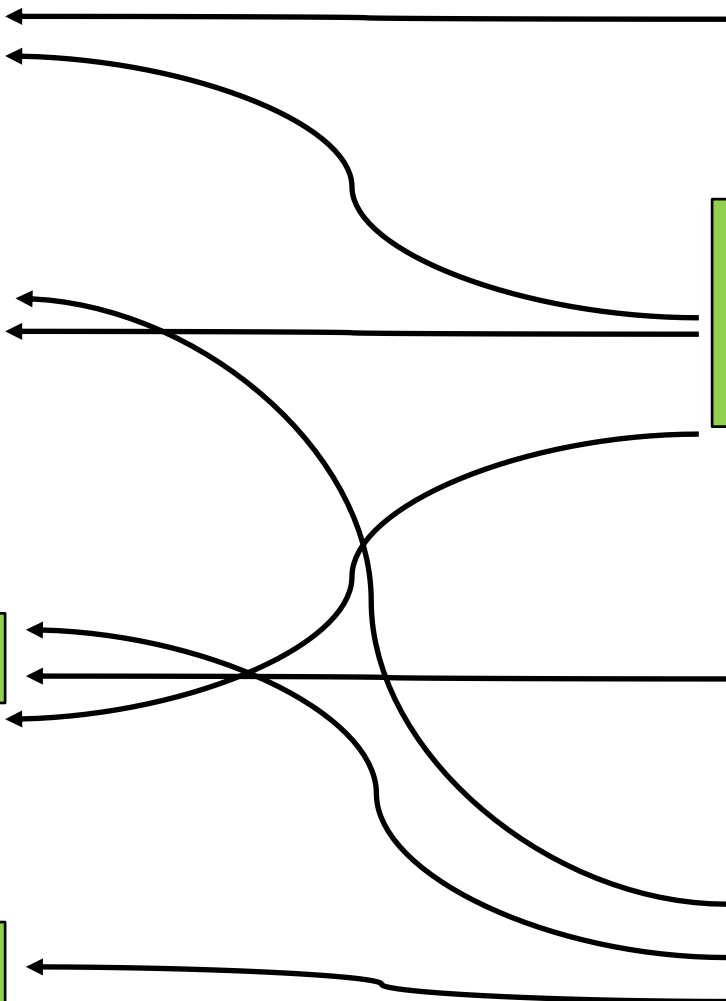
Cropping intensity

Peak counting



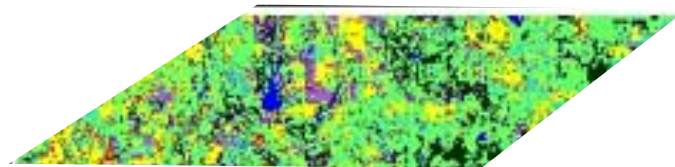
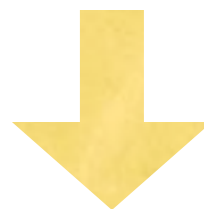
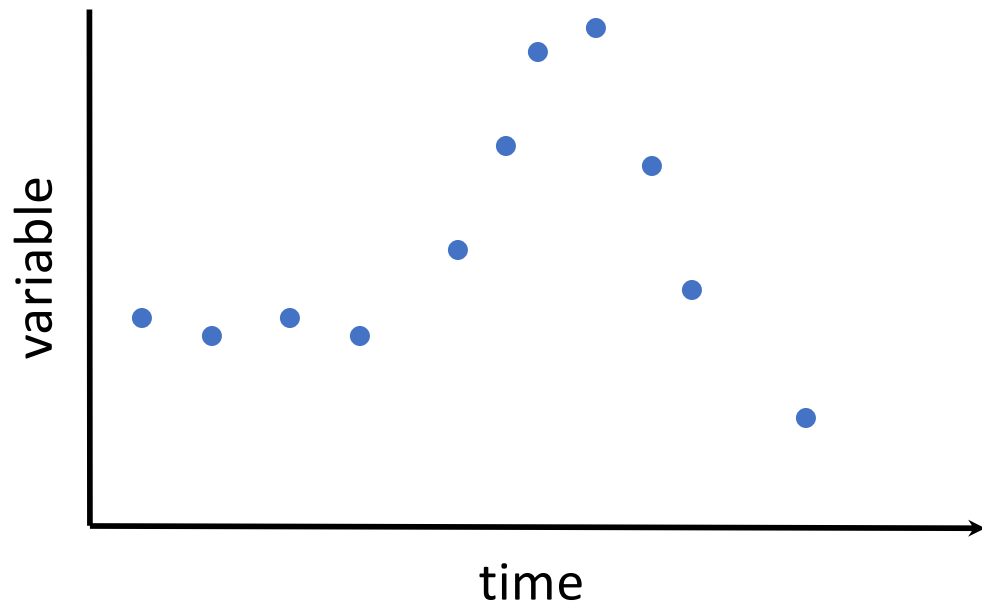
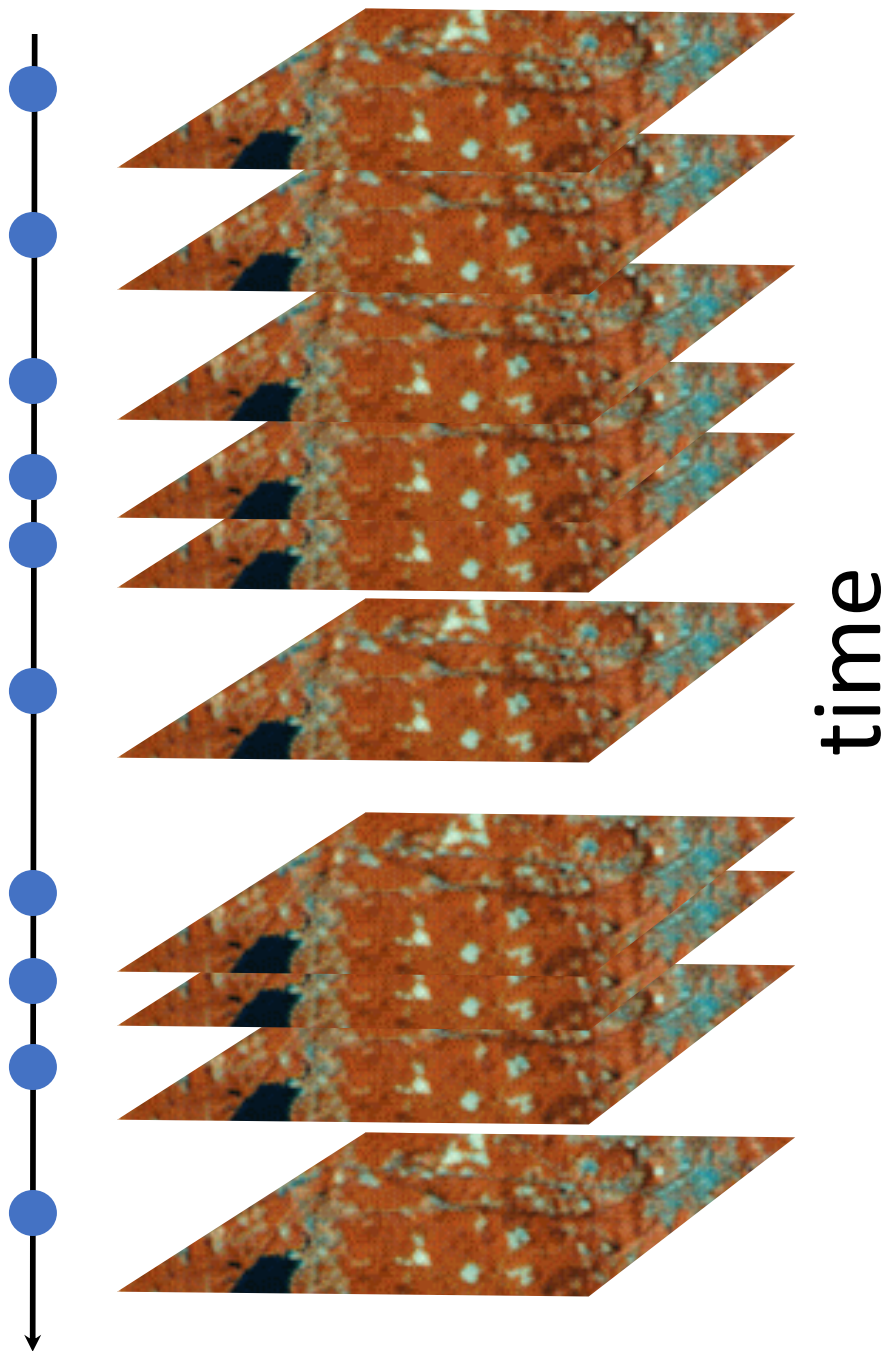
Irrigation

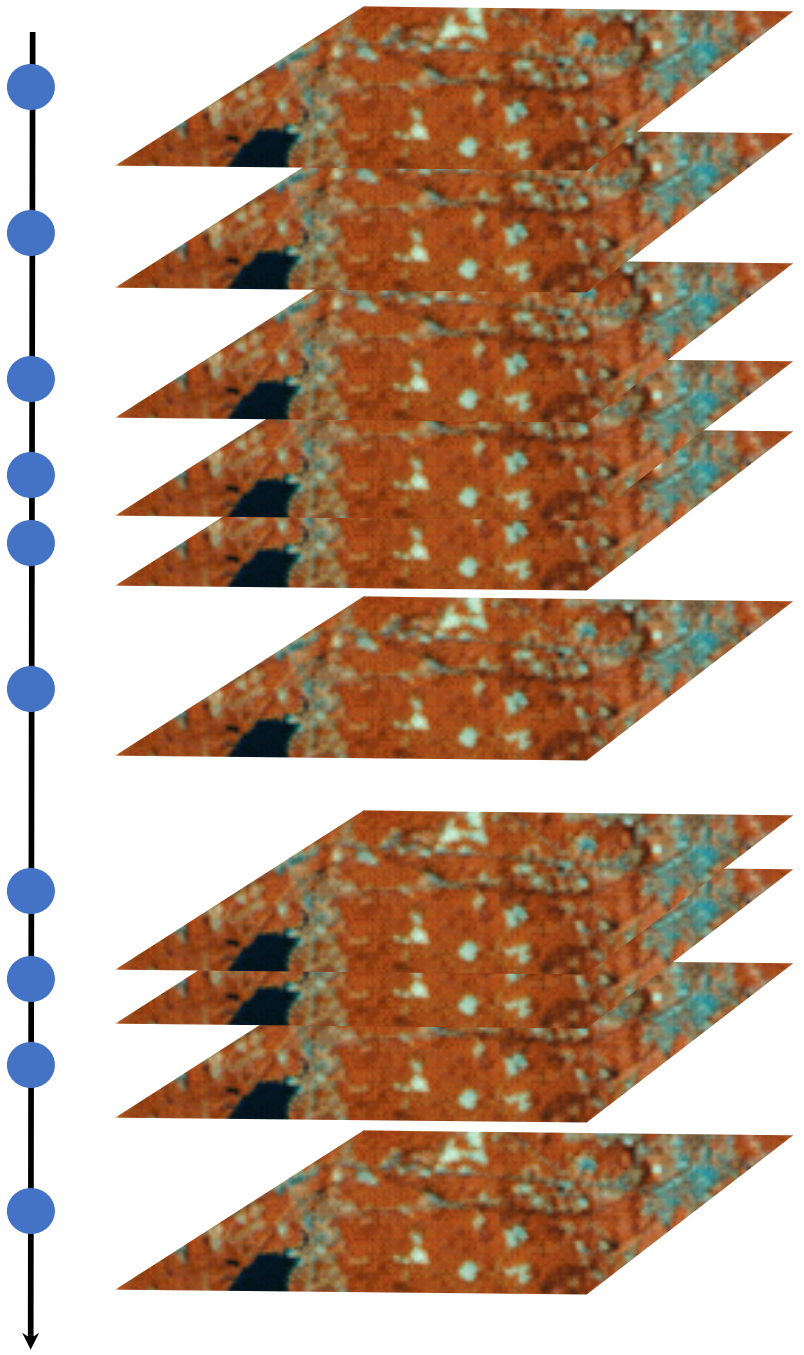
VI intensity
Climatic indices
Soil type



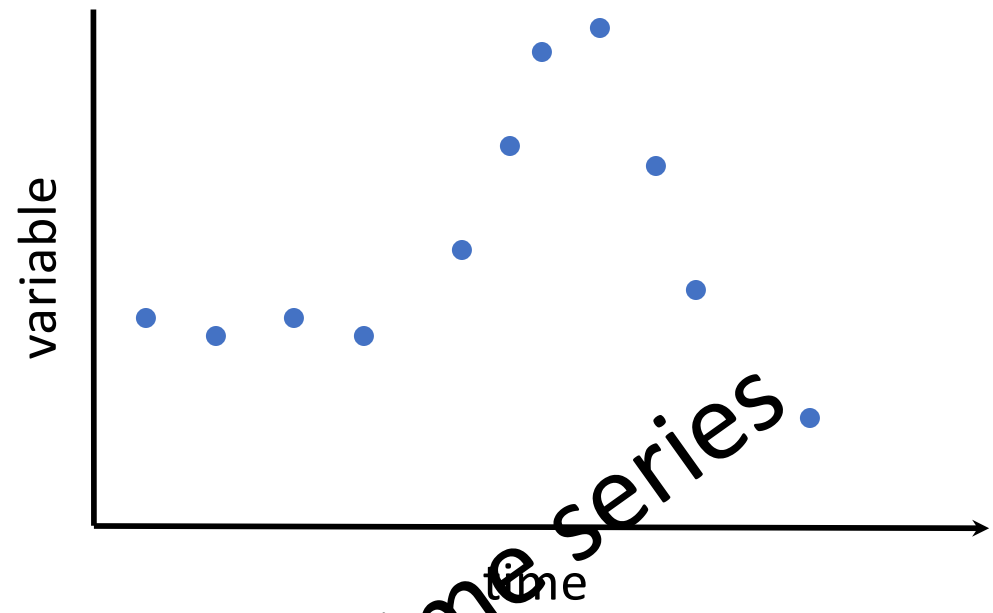
Crop type mapping

- Timing of peak vegetation index (optical)
 - Identify the timing of max VI and associate with crop type [must know crop calendars]
- Maximum VI value (optical)
 - Maximum biomass indicative of crop type (e.g. wheat vs. maize) [must use an appropriate VI]
- Structural complexity (microwave)
 - Derive a backscattering index at the appropriate time [must know peak location]

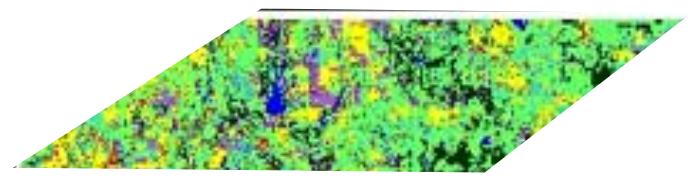
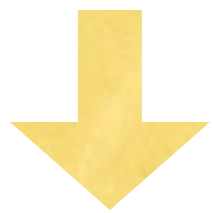


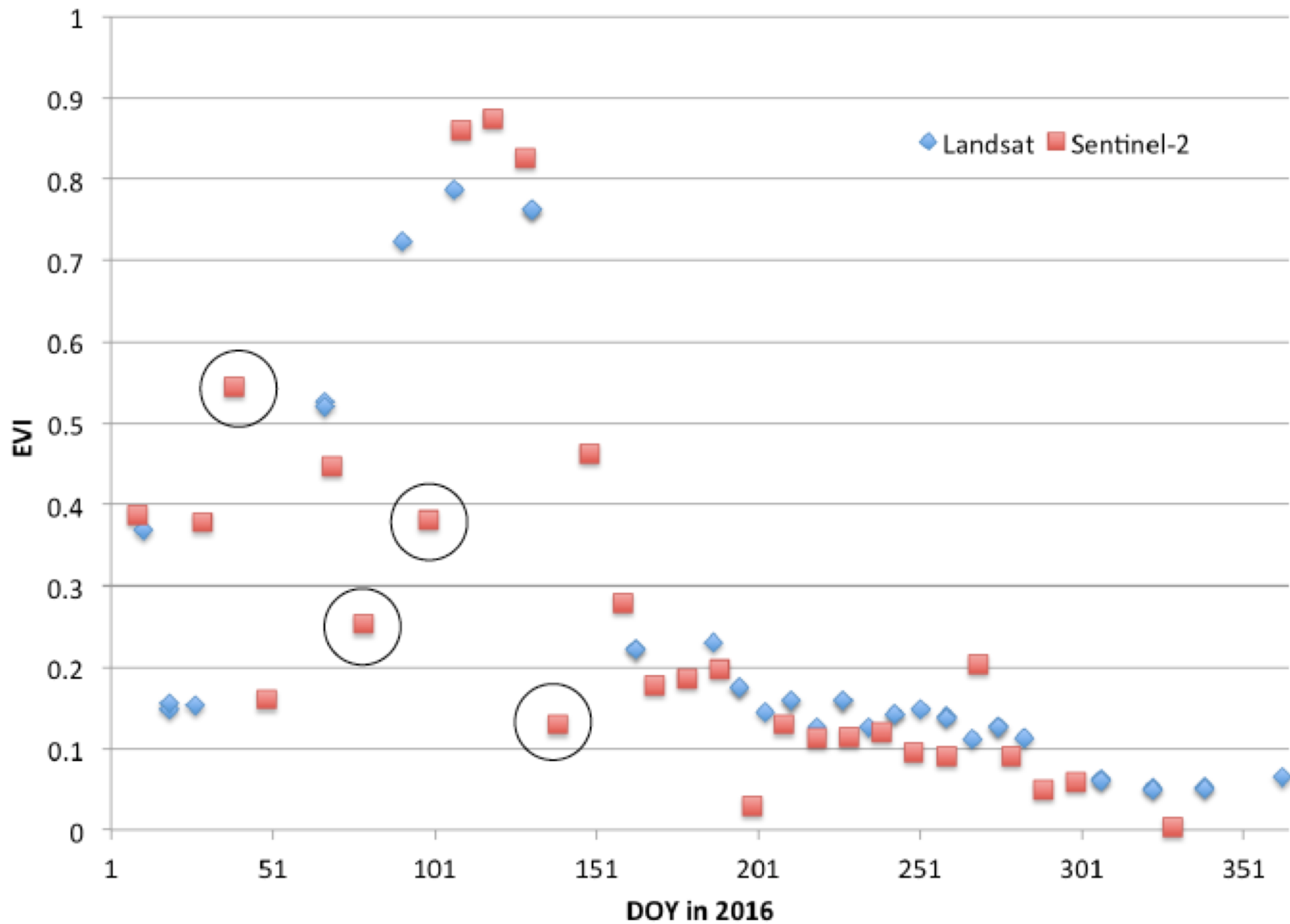


time

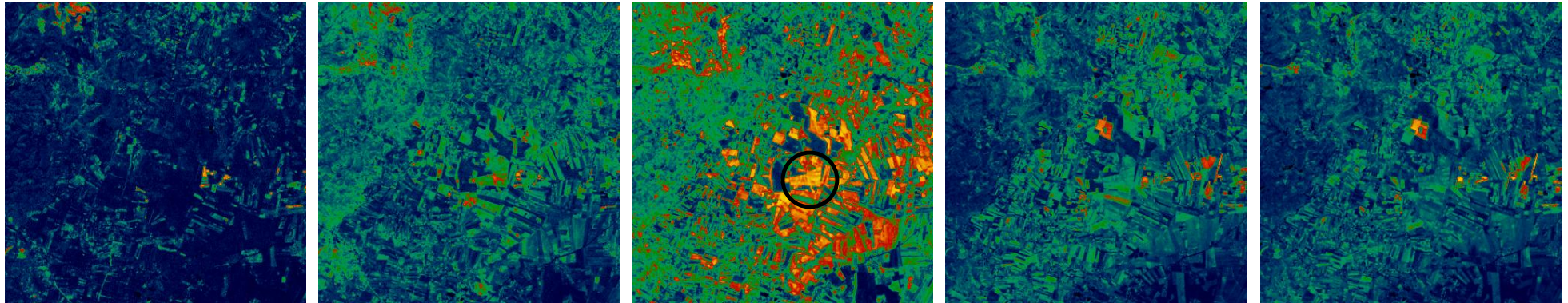


Assemble time series



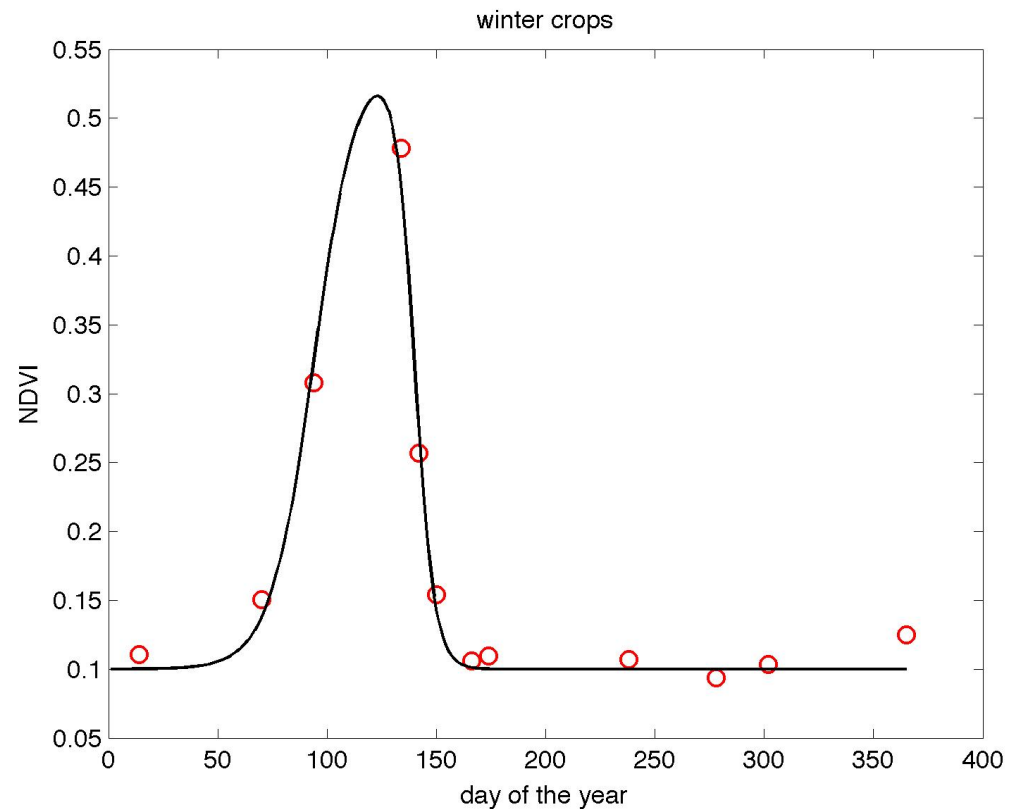


Winter crops (wheat)

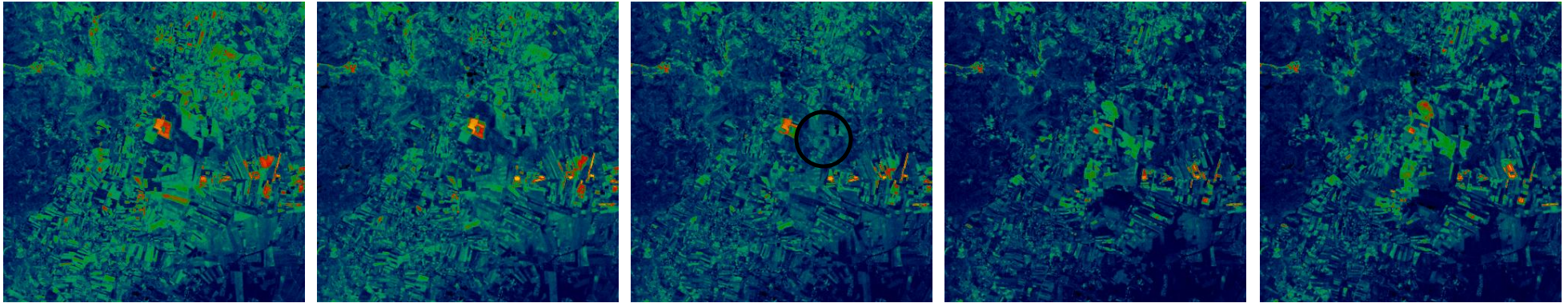


By assembling a time series of vegetation index data, we have the ability to map crop types and their irrigation status

In this case, the winter crops (winter wheat) are visible by their early green-up time period

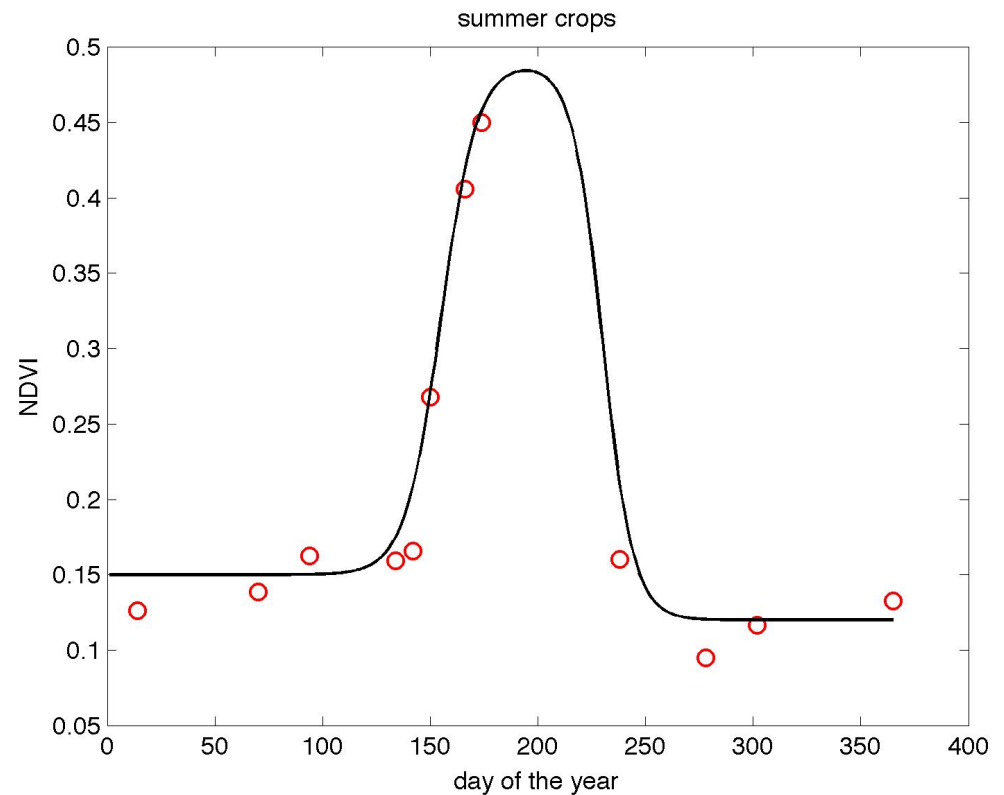


Summer crops (maize)

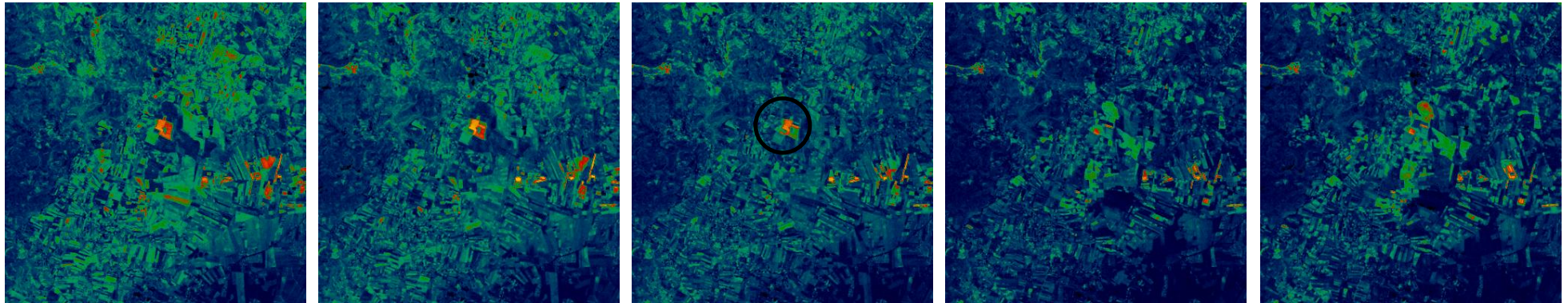


By assembling a time series of vegetation index data, we have the ability to map crop types and their irrigation status

In this case, the summer crops (maize?) are visible by their late green-up time period

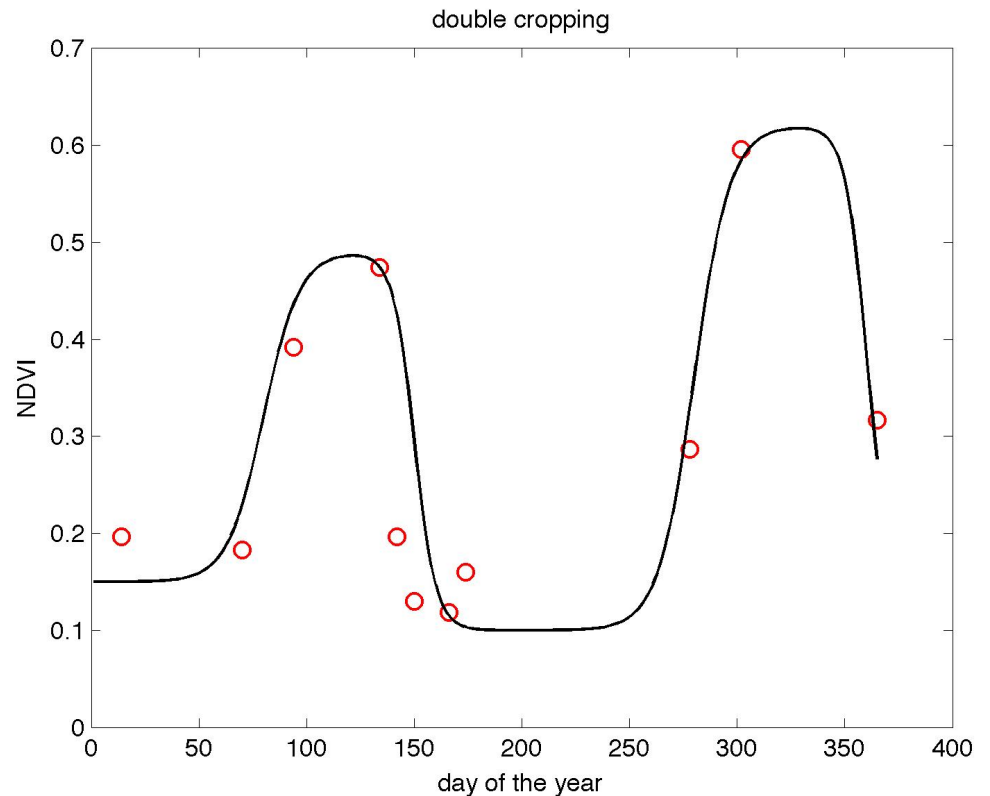


Double cropping

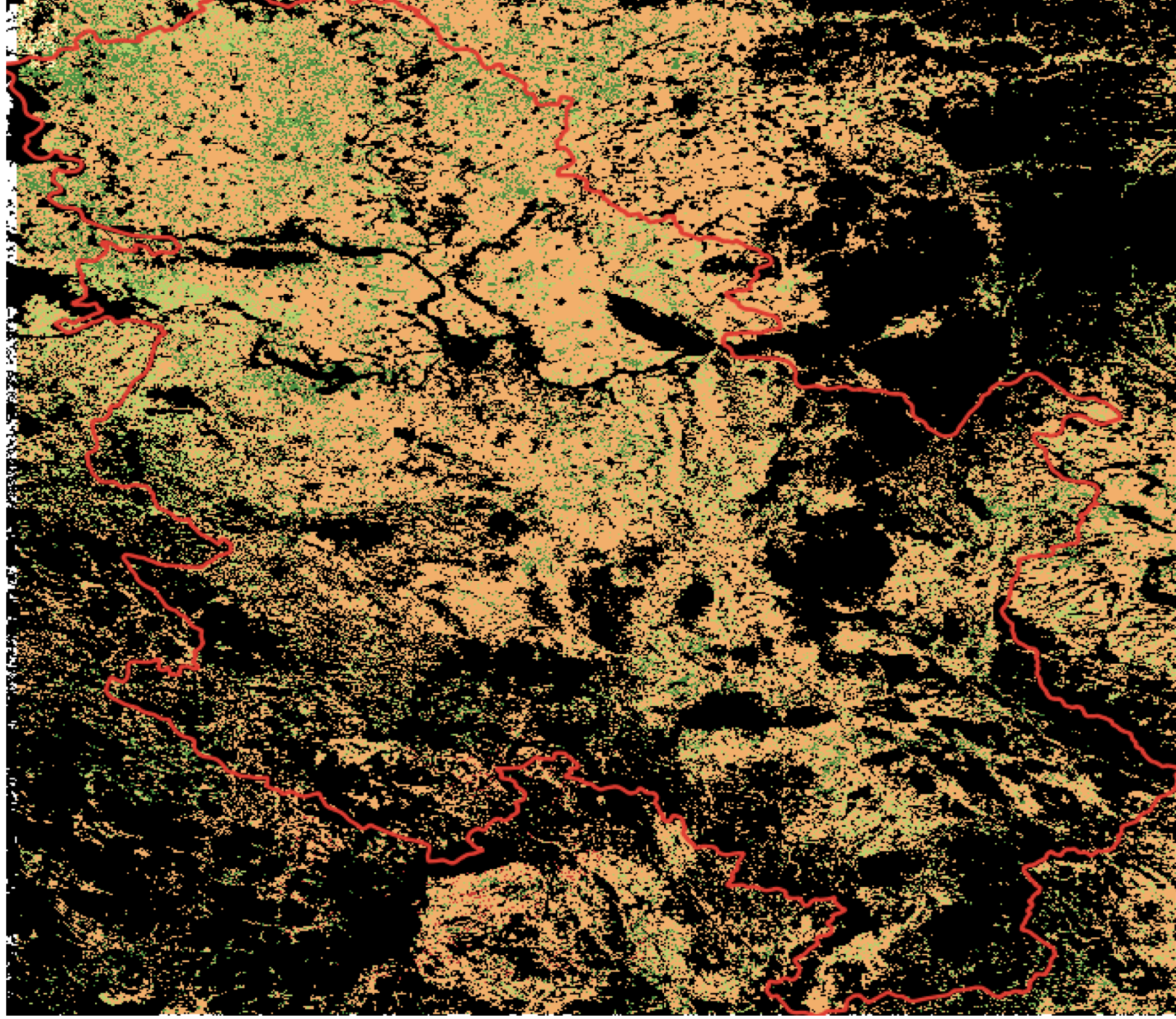


By assembling a time series of vegetation index data, we have the ability to map crop types and their irrigation status

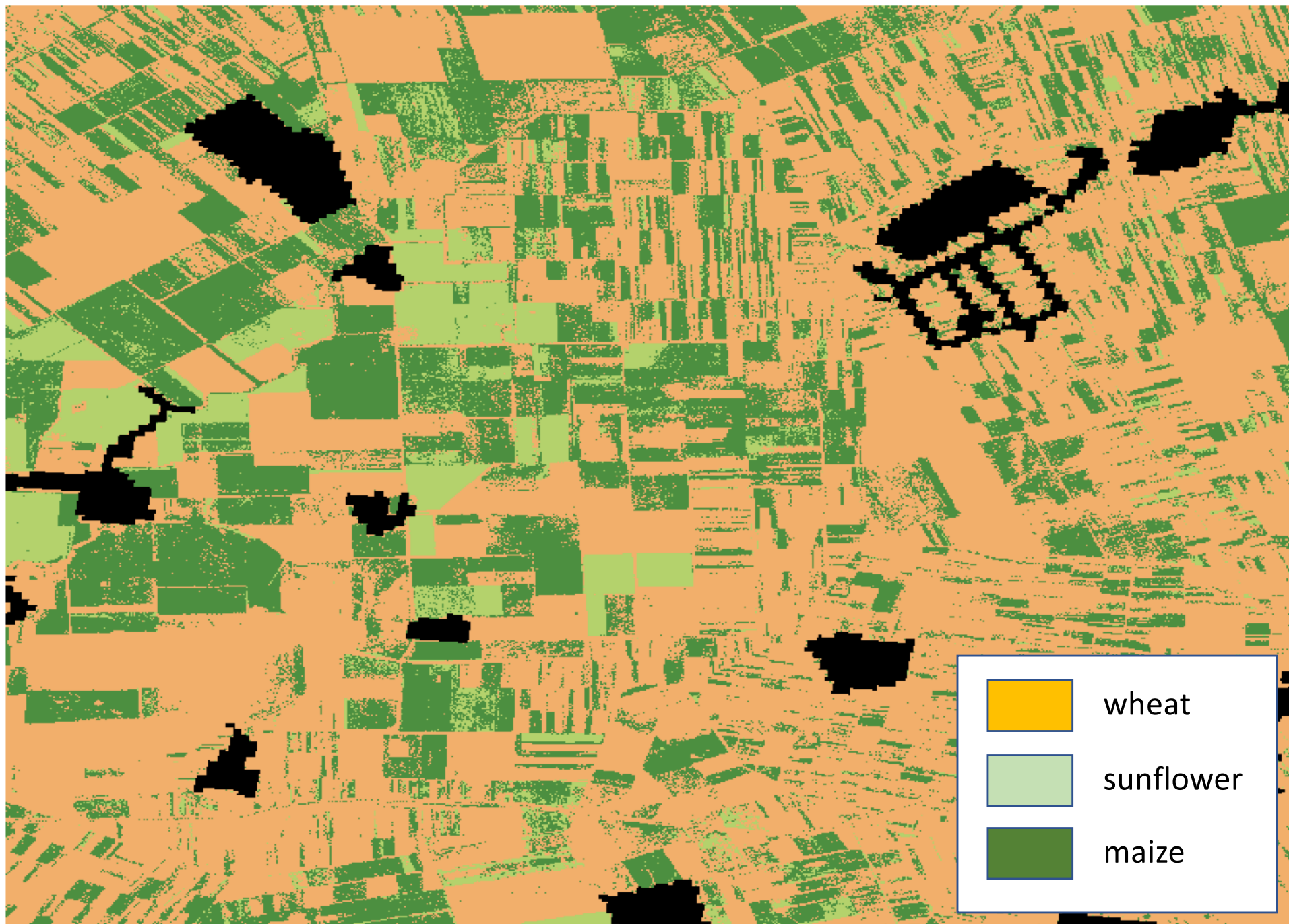
In this case, the double cropping is visible by distinct two growing cycles



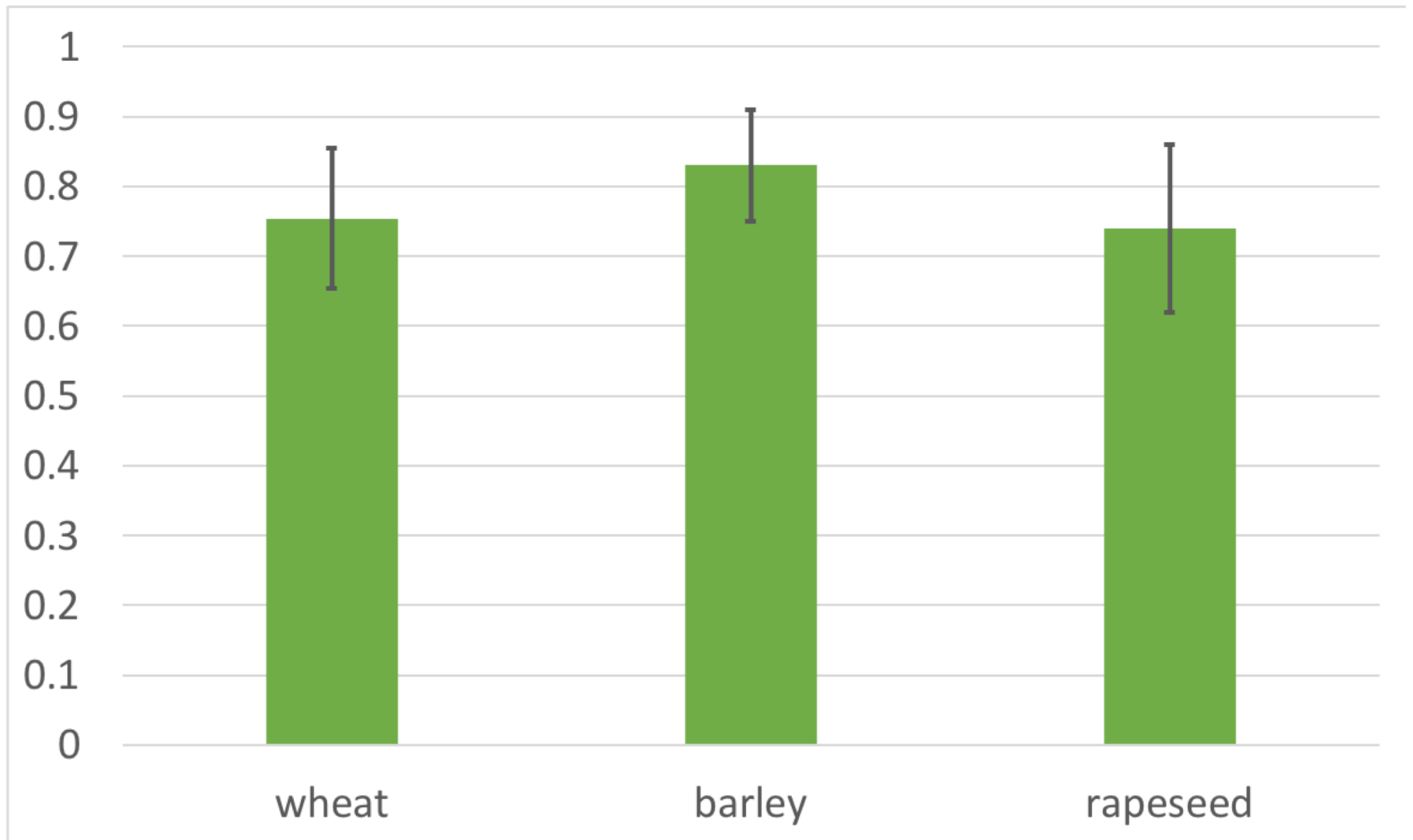
Major crop type map of Serbia



Northern Serbia



Canopy complexity derived from Radar data at the time VI peak



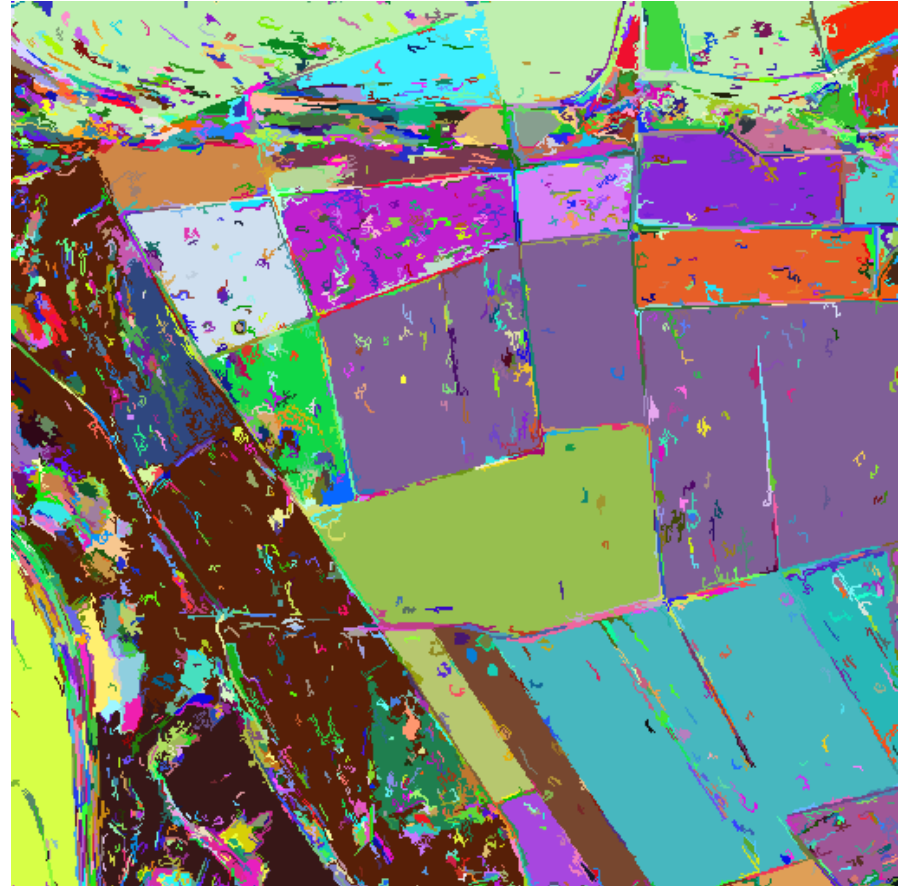
Central Bulgaria

Hierarchical segmentation approach (HSeg)

Subset of object labels map at 40000 regions (full scene):



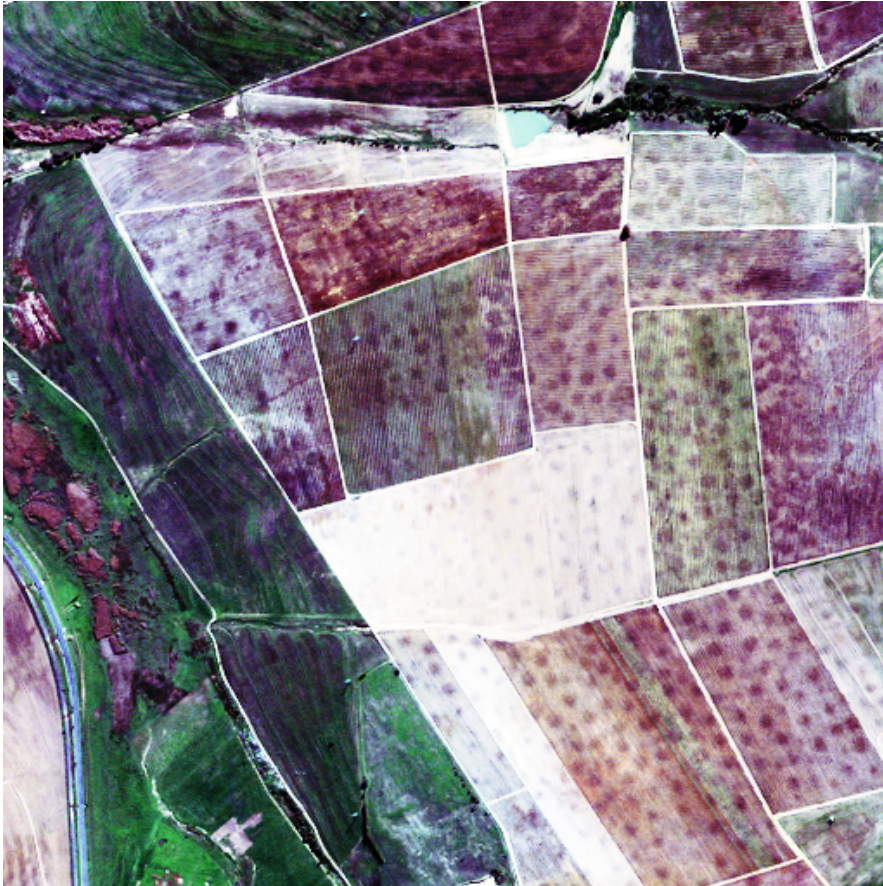
Bands 3, 2 and 1 of a 512x512 pixel subset of a Quickbird image over South Africa.



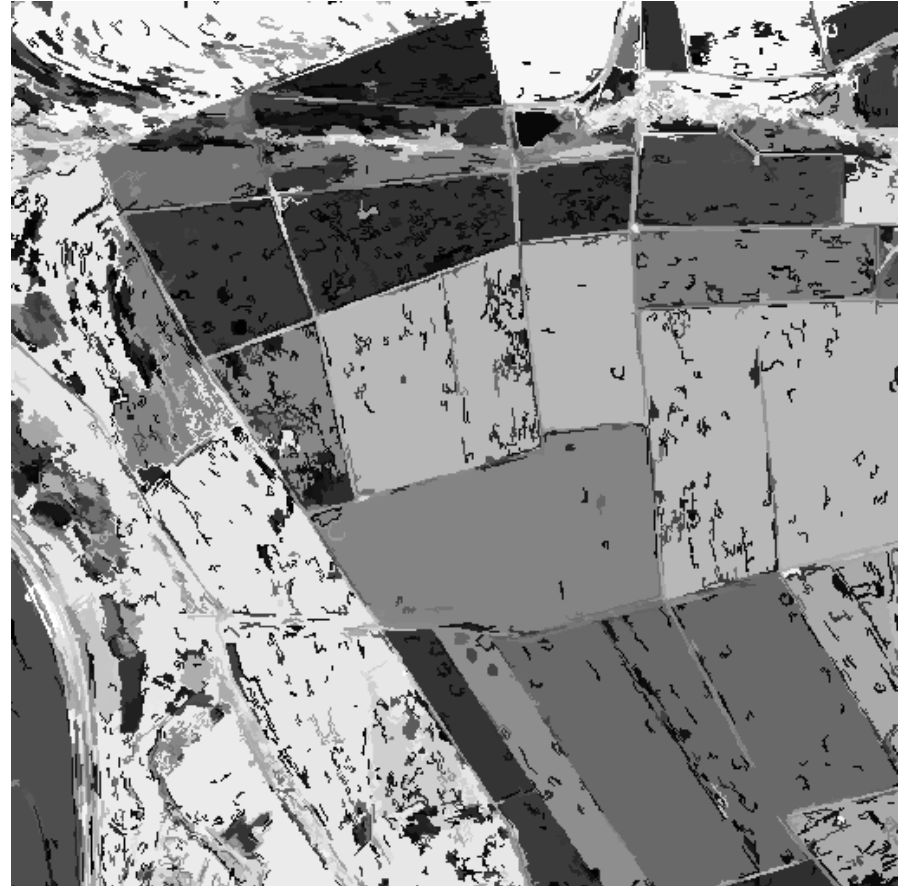
Object labels map.

Hierarchical segmentation approach (HSeg)

Subset of standard deviation map at 40000 regions (full scene):



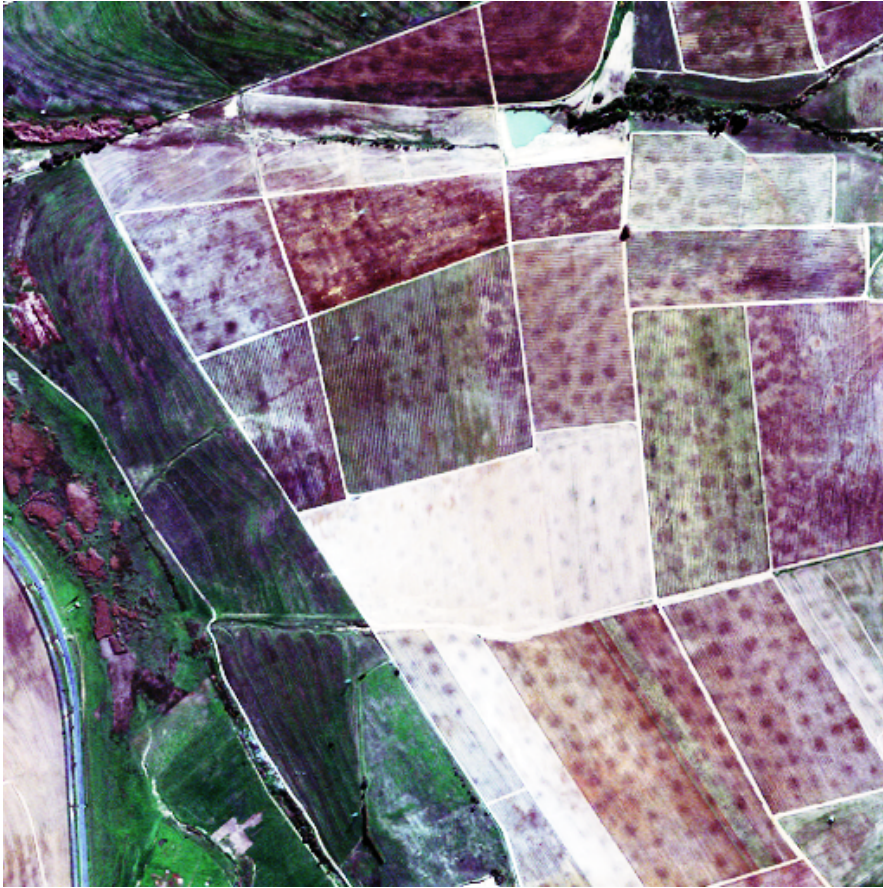
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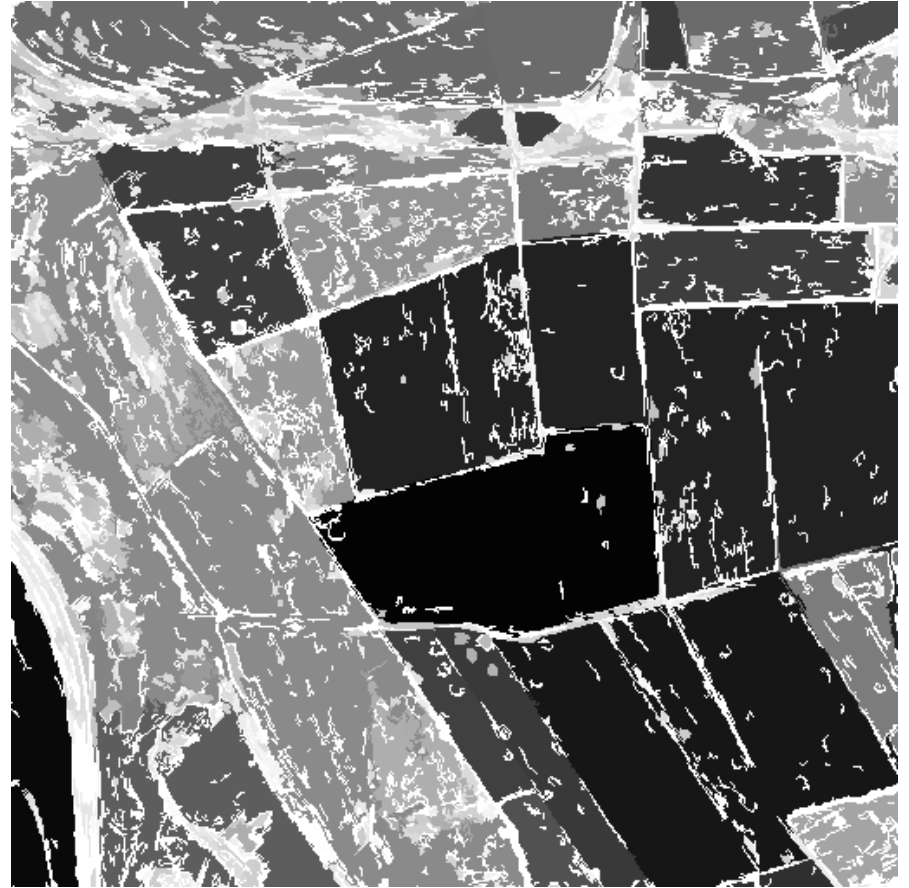
Standard deviation map

Hierarchical segmentation approach (HSeg)

Subset of boundary npix to total npix map at 40000 regions (full scene):



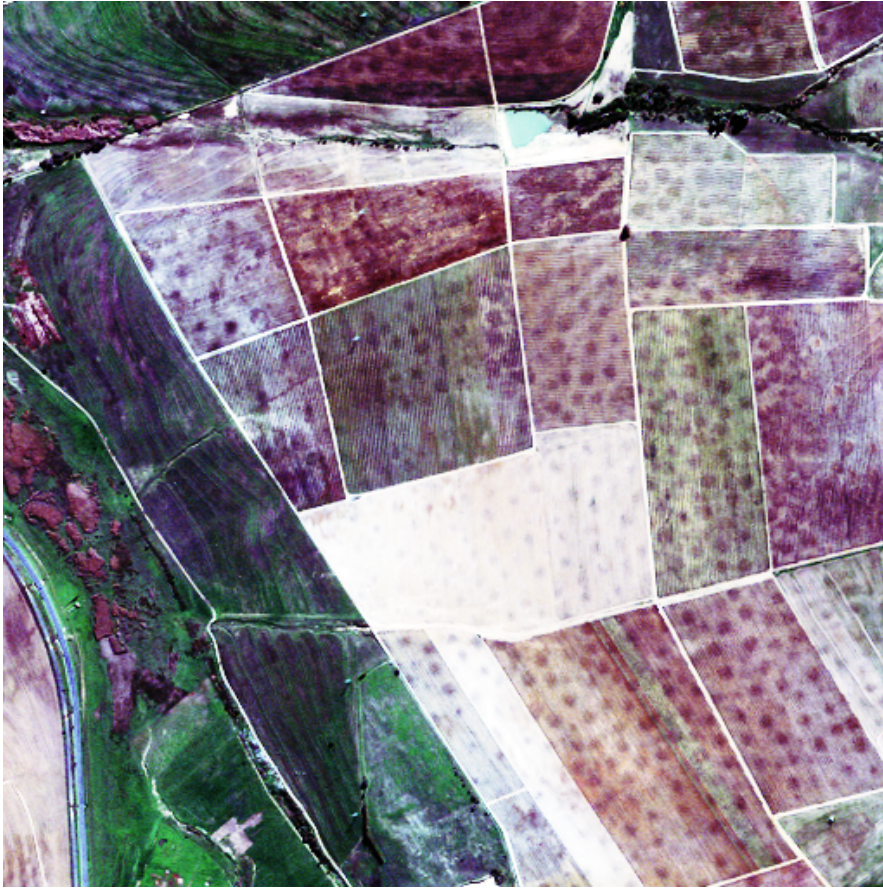
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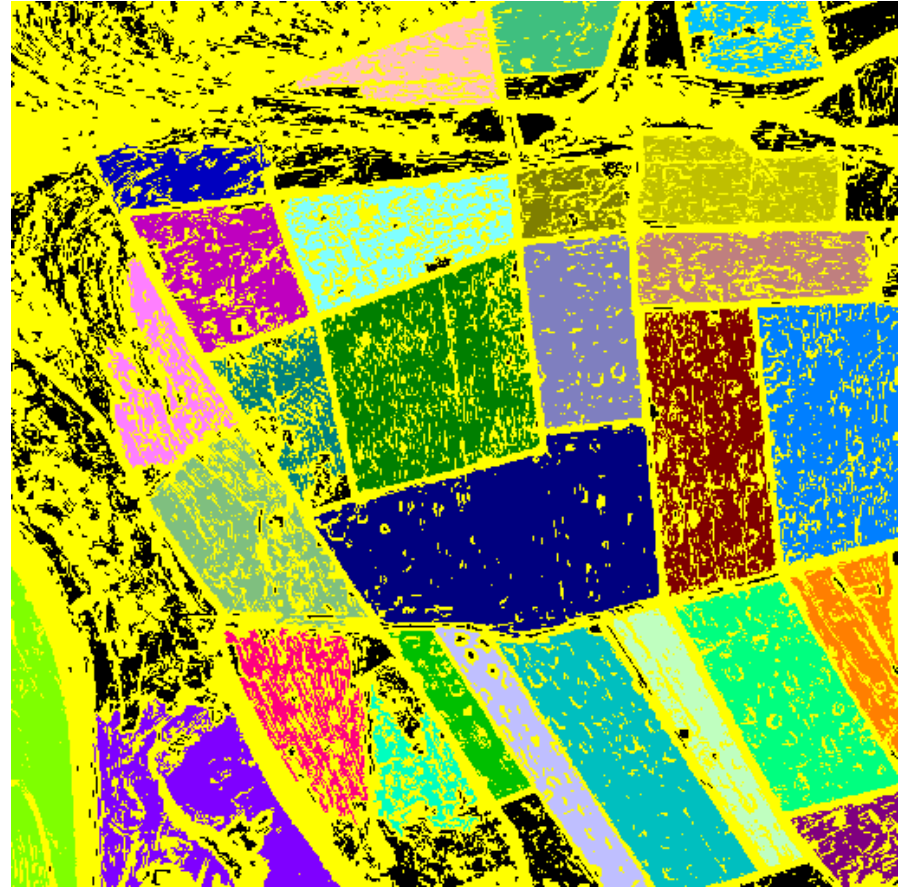
Number of boundary # pixels to total # pixels.

Hierarchical segmentation approach (HSeg)

Regions with at least 1400 pixels after initialization:



Bands 3, 2 and 1 of a 512x512 pixel subset of a Quickbird image over South Africa.



Regions with at least 1400 pixels after initialization.

Improvements with RHseg

Central Bulgaria



Improvements with RHseg

Central Bulgaria



Conclusions

- Desire to derive multiple agricultural variables from remote sensing (crop type is one of them)
- Take a hierarchical approach (eliminate as you go)
- Many challenges remain
- Combination of Landsat/S2 optical and S1 microwave appears to help
- Collaboration is key

Thank you

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