eurac research

Land cover mapping strategy

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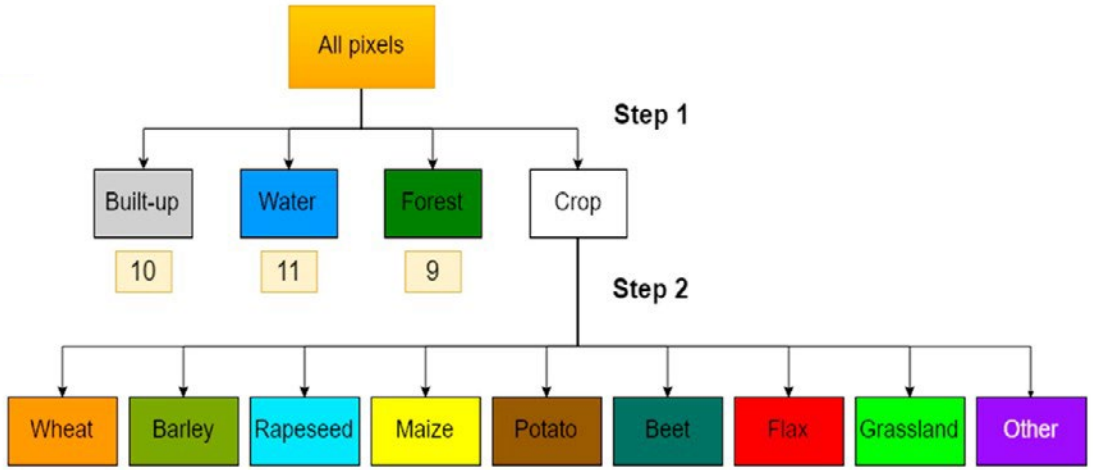
Classification scheme

Definition of classification scheme:

- All classes are clearly defined
- All classes are covered
- Classes are mutually exclusive
- Classes are not overlapping

Target classes:

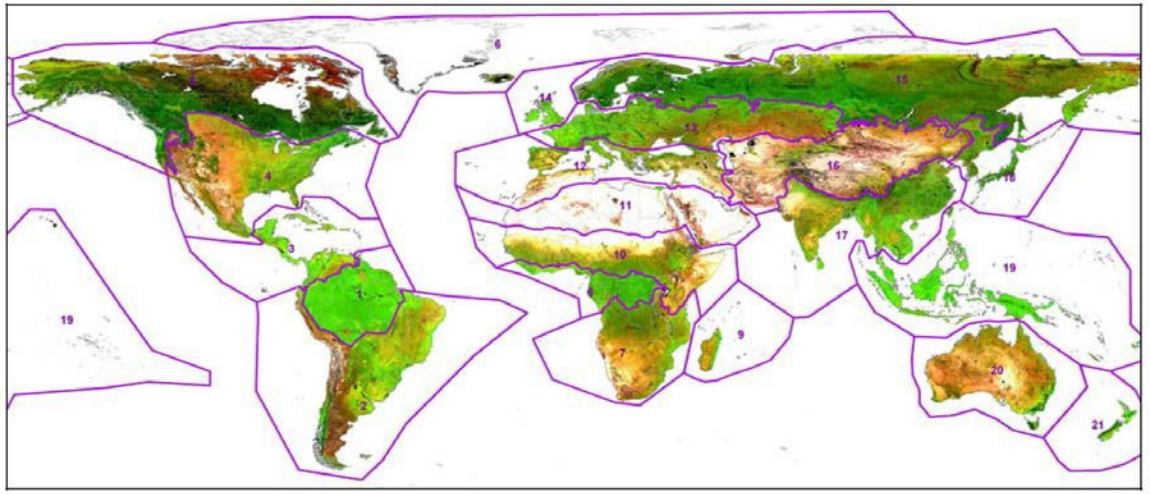
- All land cover classes
- Specific land cover classes of one main broad category



Van Tricht, 2018

Study region

- Site characteristics
  - Extent
  - Complexity and heterogeneity



Globcover 2005 stratification zones

- Site information
  - Availability of reference data
  - Availability of additional spatial information
  - Knowledge about land cover classes

Selection of EO data

- Data characteristics:
  - Spatial scale and extent
  - Temporal scale and extent
  - Radiometric scale (spectral vs backscatter)
- Availability
- Data costs
- Data level
- Data quality (e.g. cloud cover, artefacts)
- Accompanying information (cloud cover masks)

Sentinel-2 orbits over the Alps

General characteristics of classifiers

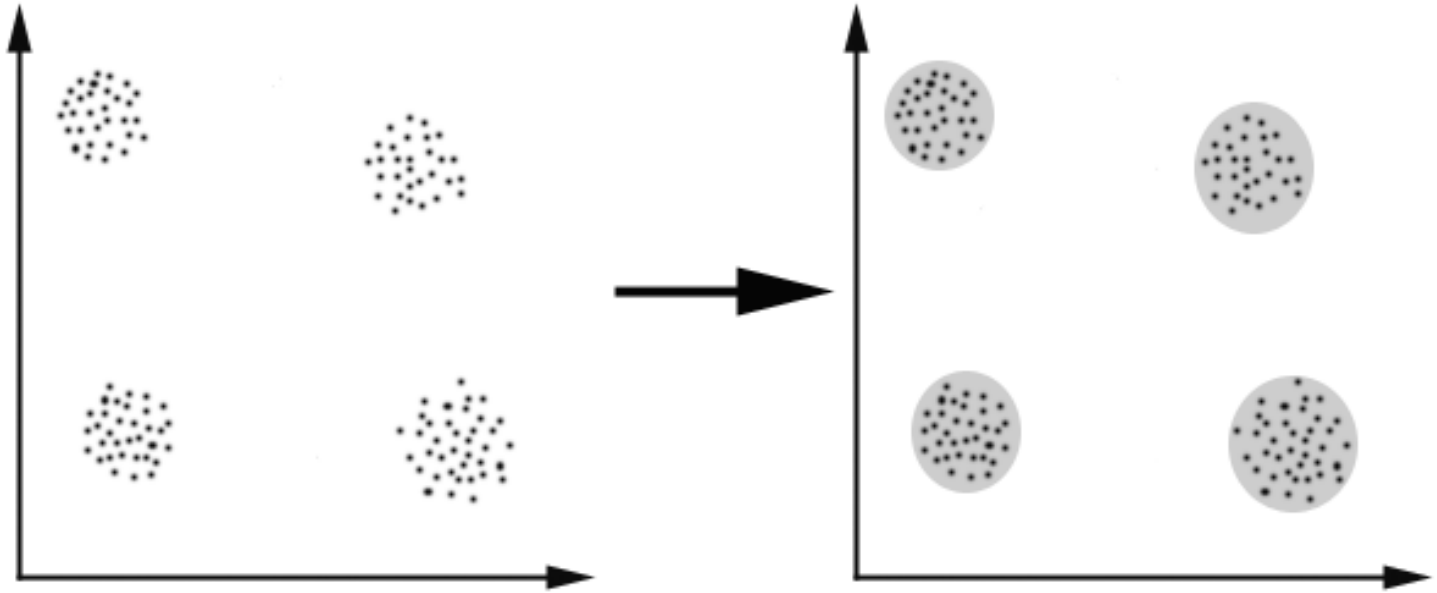
- EO information content:
  - Spectral pattern
  - Spatial pattern
  - Temporal pattern

- Main approaches:
  - Supervised classification vs unsupervised classification
  - Pixel-based approaches vs object-based classification
  - Parametric vs non-parametric classifiers
  - Hard or soft classification sets

Information classes vs spectral classes

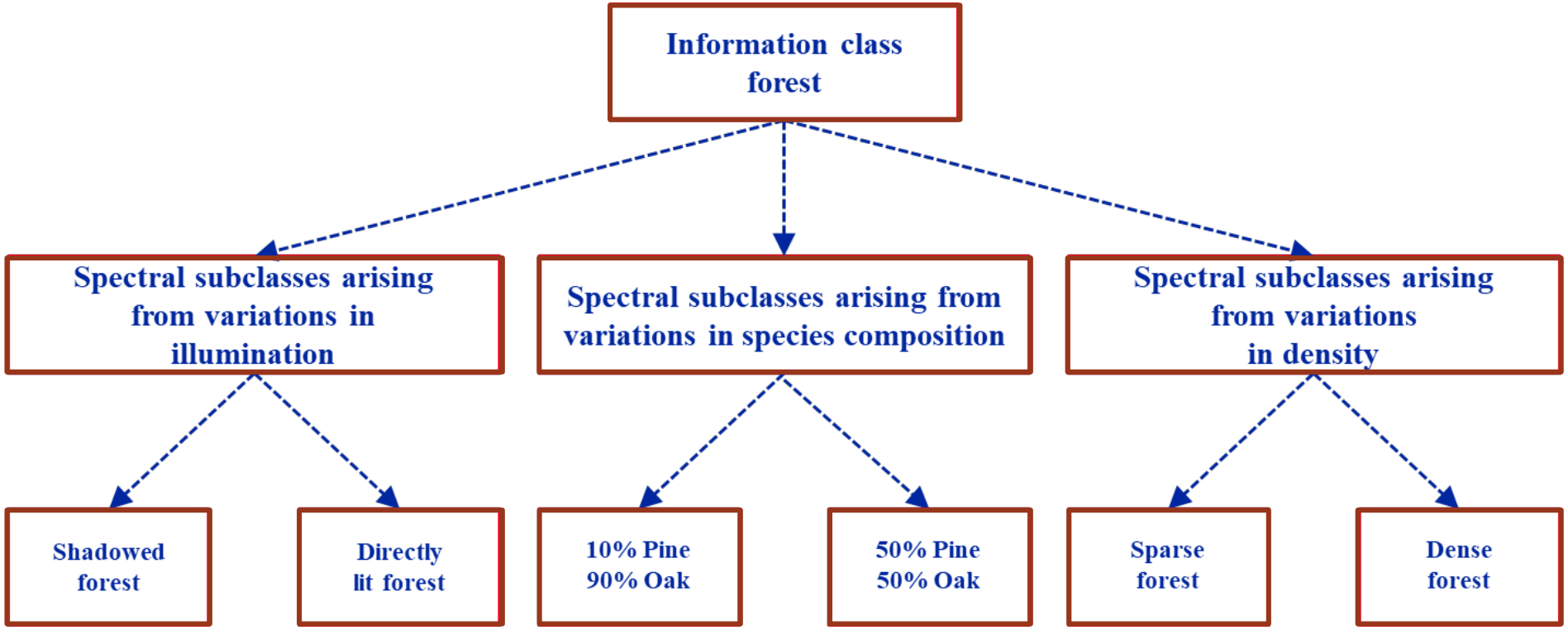
- Information classes: Categories of interest which define your classification scheme

- Spectral classes: Groups of pixels that are uniform with respect to the brightness values in several spectral bands



Information classes vs spectral classes

- In an ideal world, every spectral class would correspond to one (and only one) informational class. But the reality is not that simple!



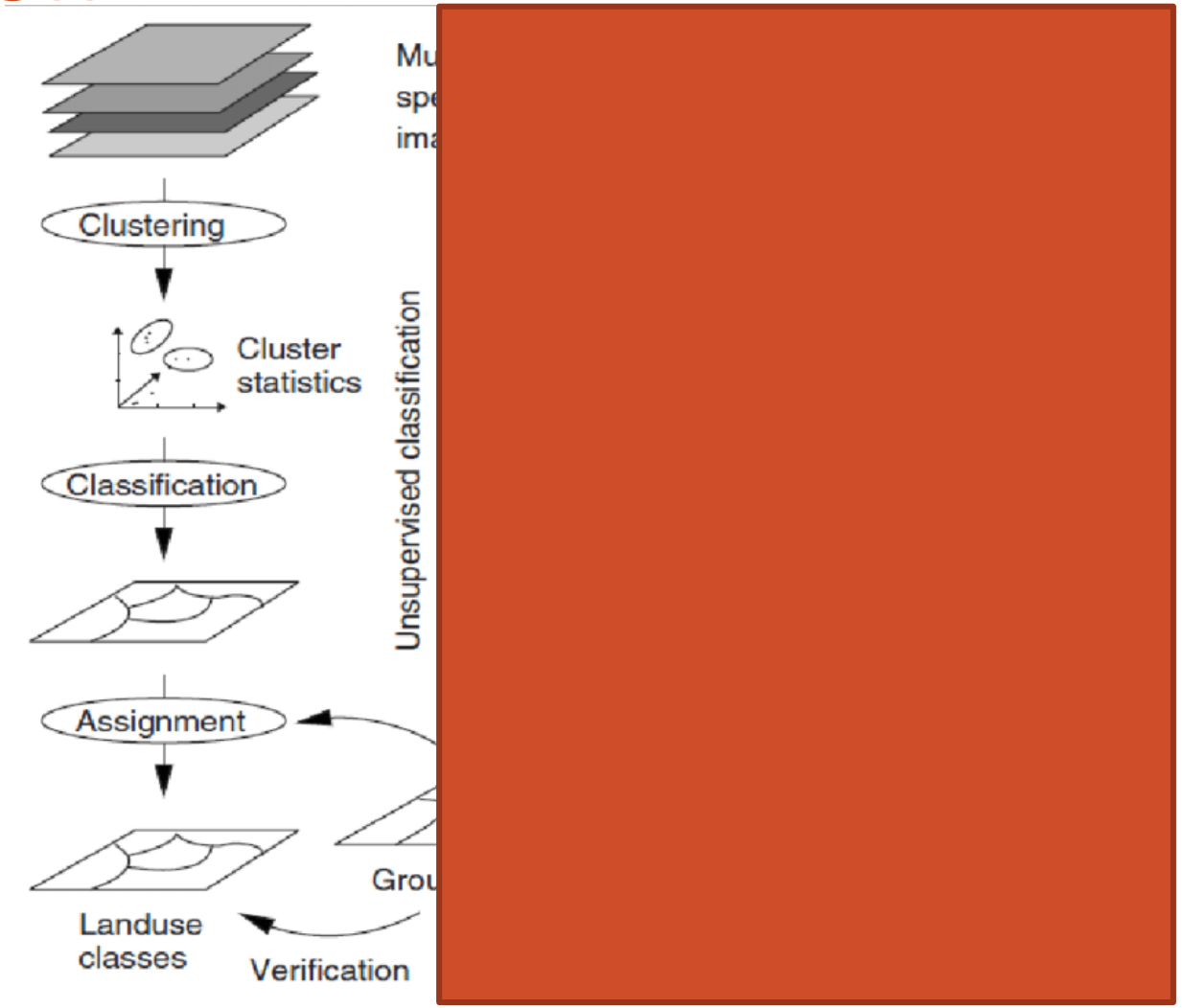
Supervised classification

Definition:

- The process of using samples of known classes to classify pixels of unknown identity

Stages:

- Definition of Information Classes
- Selection of Training Areas
- Generation of numerical/statistical parameters
- Classification
- Accuracy Assessment



Supervised classification - advantages

- The analyst has control control over the menu of informational classes, tailored to a specific purpose and geographic region
- Does not have to face problem of matching spectral classes to informational classes
- Does not have to face problem of matching spectral classes to informational classes

Supervised classification - disadvantages

- The analyst imposes a classification structure upon the data, i.e., operator-defined classes may not match the natural classes
- Training areas are often defined primarily on informational categories
- Training data selected by analyst may not be representative of conditions encountered throughout the image
- Selection of training areas may be time-consuming, expensive and tedious
- Supervised classification may not be able to recognize and represent special or unique classes

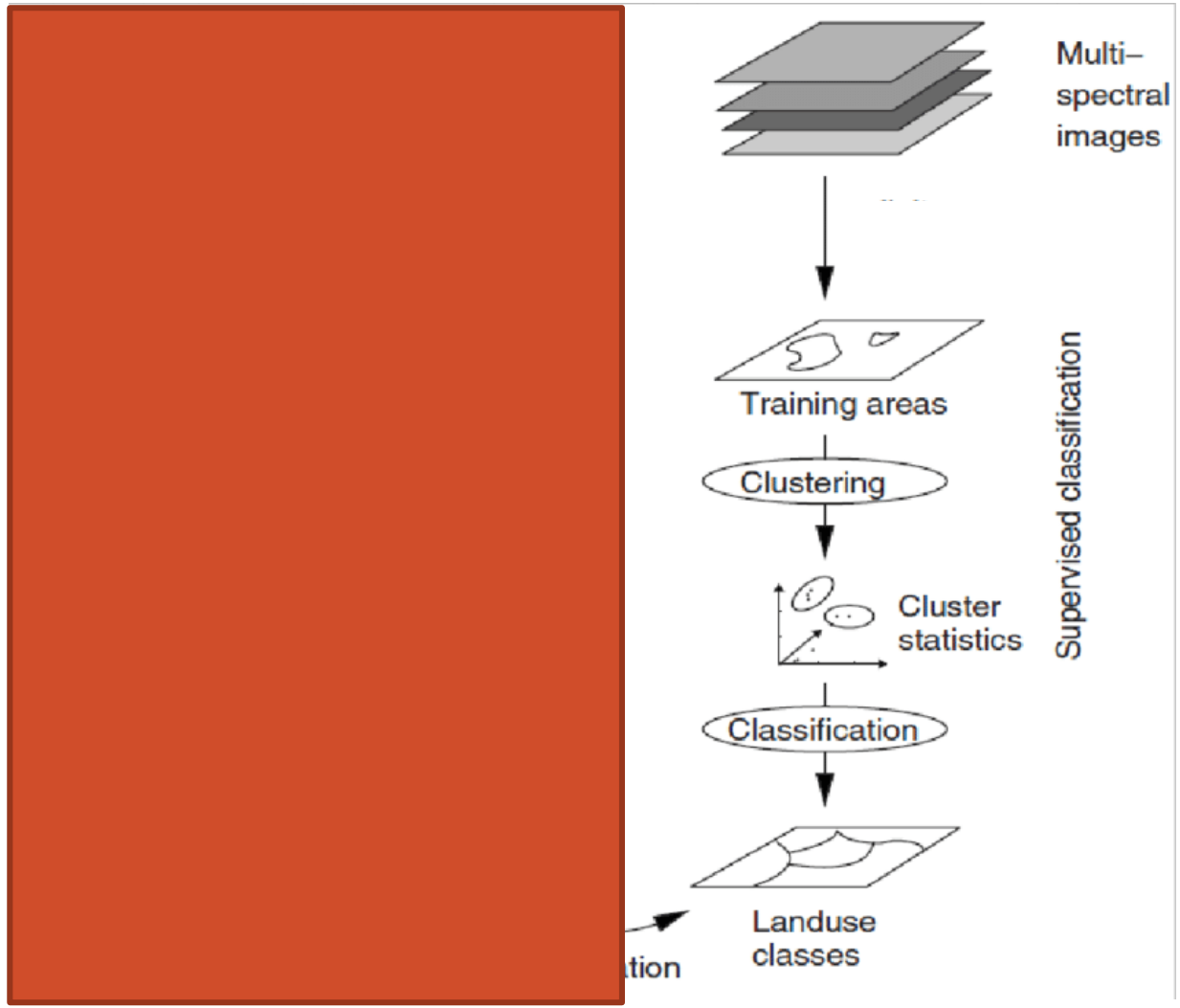
Unsupervised classification

Definition:

- The process of clustering the image content to then assign class labels

Stages:

- Definition of the number of spectral classes
- Generation of numerical/statistical parameters
- Classification
- Class assignment
- Accuracy Assessment



Unsupervised classification - advantages

- No extensive prior knowledge of the area (for choosing training areas) is required
- The opportunity for human error is minimized. (The human operator often only specify the number of spectral categories desired, and then group and label them). Inaccurate knowledge of the area, or heterogeneous training areas, will not affect the clustering
- Unique (often small) classes are recognized as distinct units.
- No need for complete training areas; all pixels in the scene will be classified (although some may be ”unknown” if you put a threshold value)

Unsupervised classification - disadvantages

- Identifies spectrally homogeneous classes that does not necessarily correspond to the information classes that are of interest to the analyst
- The analyst has limited control over the menu of resulting classes and their specific identities; often he/she can only set the number of spectral classes (which has to be higher than the number of information classes required)
- Spectral properties of a specific information class will often change over time, so the relation between spectral class and informational class does not remain constant and can not be extended from one image to another (as training areas may)

Object-based classification

High resolution data:

- Airborne data
- Drone data
- High resolution satellite data

Relation between object size and pixel size

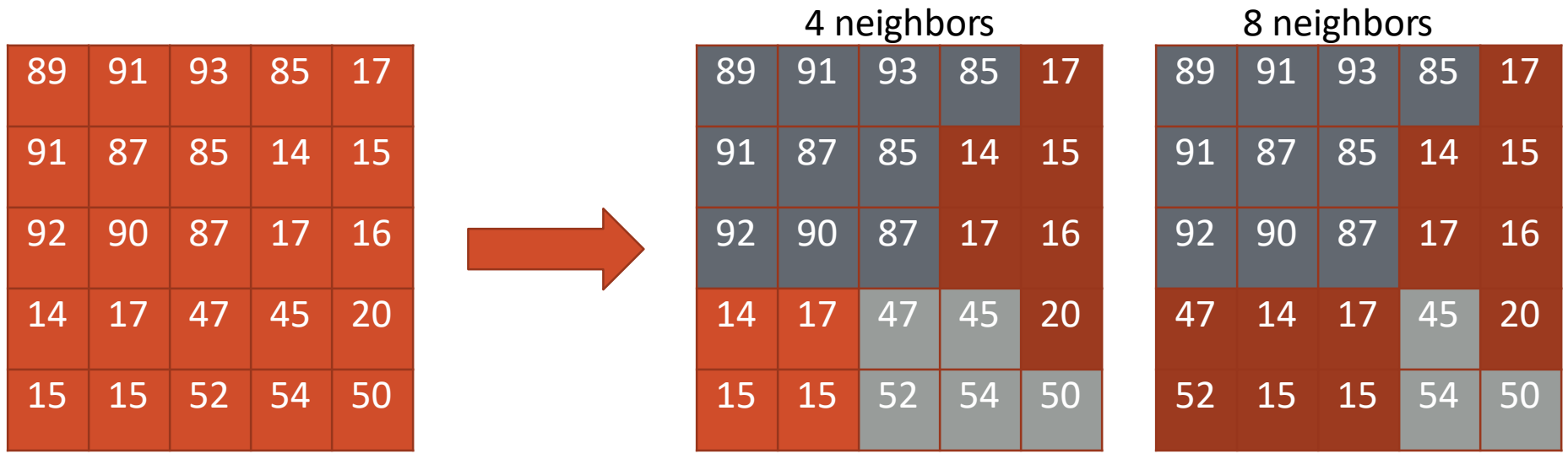
- 1 pixel covers more than 1 object
- 1 object is covered by more than 1 pixel

- Object-based approaches are superior to pixel-based approaches in this case

Object-based classification

Segment: A set of pixels that is:

- spatially conntected
- belong to the same object



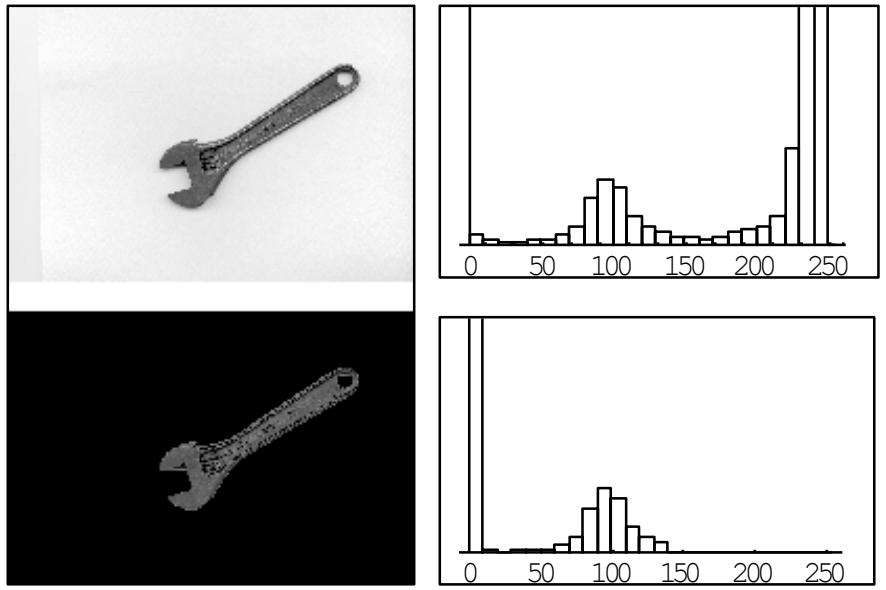
Generation of objects and their features

- Classic approaches:
  - Thresholding
  - Split and merge
  - Edge detection
  - Region growing and merging
- Recent development:
  - Combined approaches

- Object attributes:
  - Mean
  - Variance or standard deviation
  - Entropy
  - Area
  - Perimeter
  - Neighbors

Thresholding

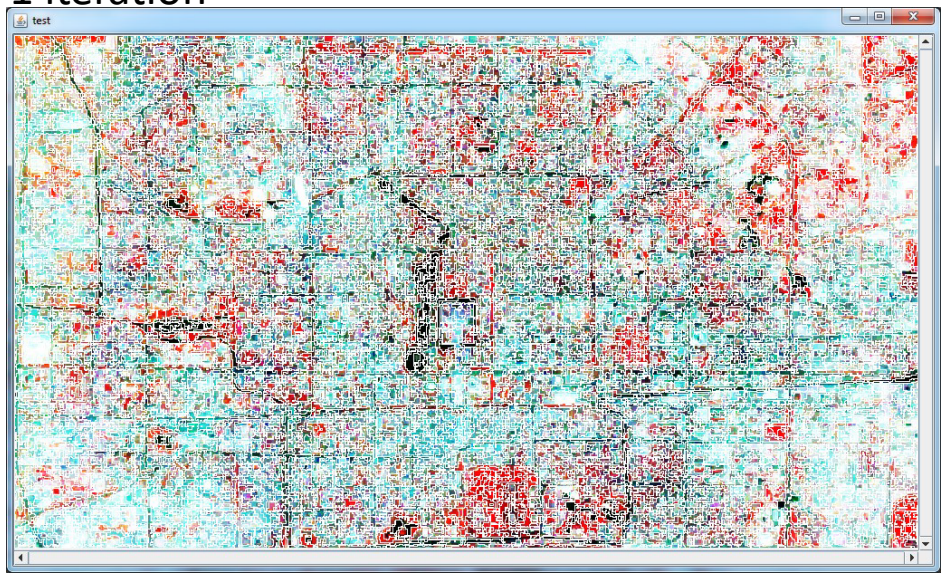
- Thresholding is a radiometric processing, you threshold the image guided by the histogram
- Works with distinct objects
- having a homogeneous background, like:
  - checking objects on a production line
  - scanned charts.



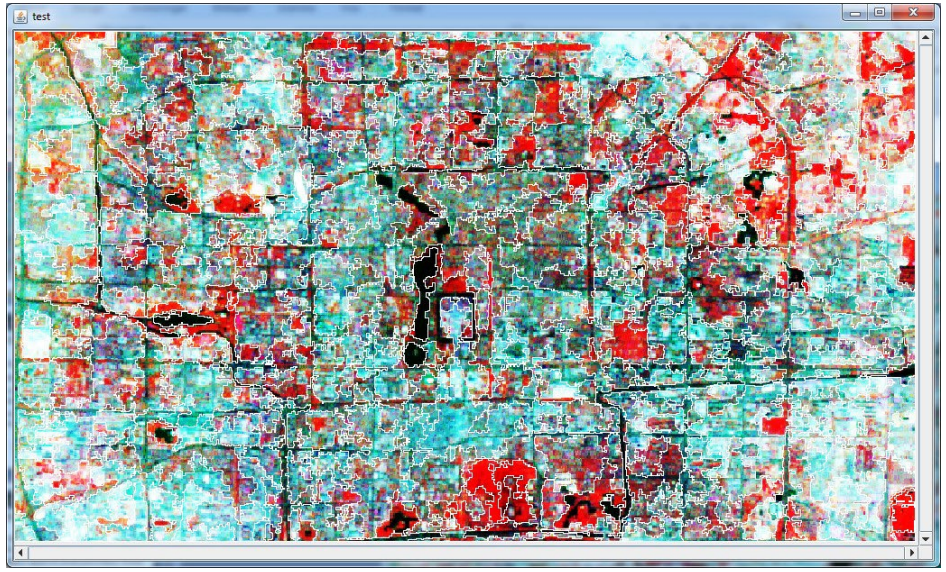
Region growing & merging

- Selection of seed pixels (every pixel or centroids of clusters)
- Define merging criteria (e.g. change in mean, variance, similarity in texture, shape)
- Define min & max size of a segment
- Grow regions around seeds
- Create polygons from pixel sets

1 iteration

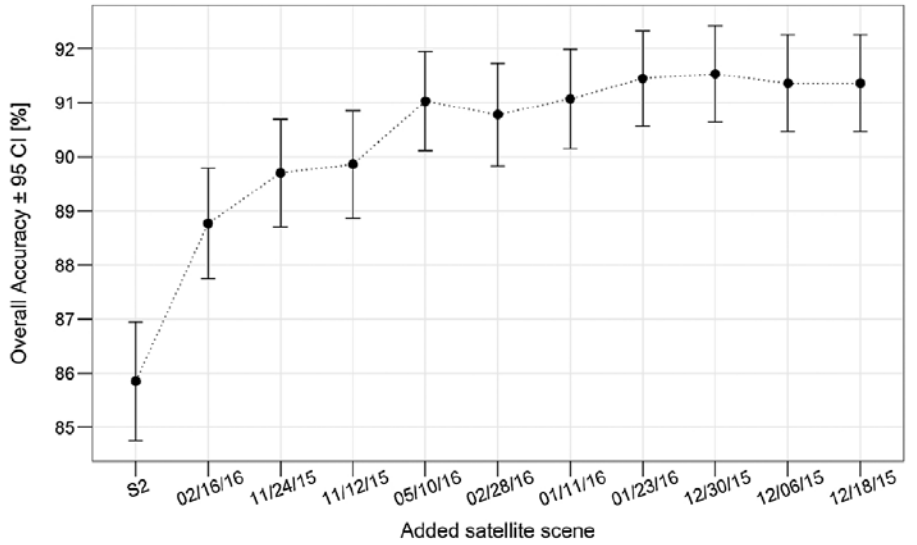


10 iterations

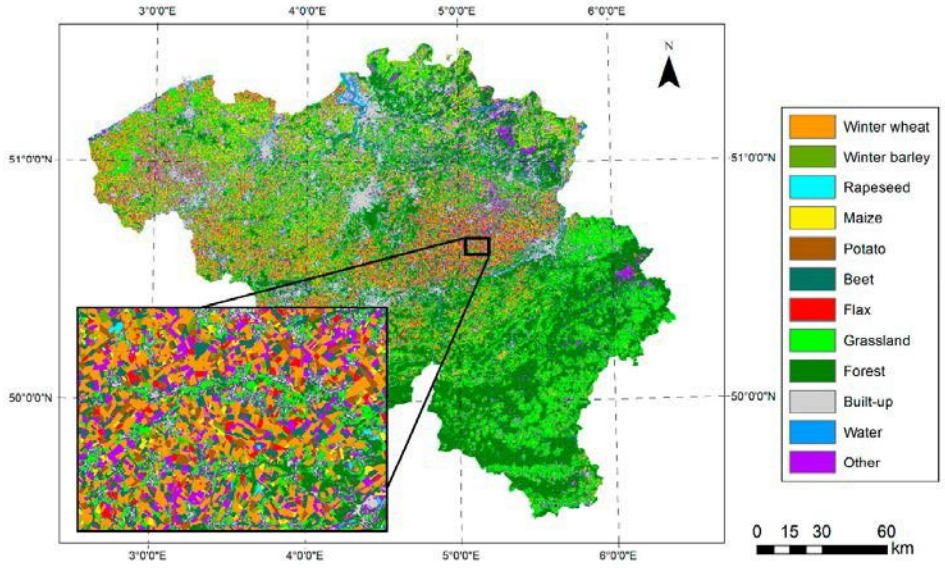


Selection of EO data

- Multi-temporal and multi-sensor classifications improve the accuracy
- Additional costs in radar preprocessing small in relation to accuracy increase
- Not only important for cloud prone regions



Steinhausen, 2018



Van Tricht, 2018

	Sentinel-2						Sentinel-1							
#	March	April	May	June	July	August	March	April	May	June	July	August	OA	κ
1							X						0.47	0.31
2							X	X					0.62	0.49
3							X	X	X				0.70	0.60
4							X	X	X	X			0.74	0.66
5							X	X	X	X	X		0.75	0.67
6							X	X	X	X	X	X	0.76	0.68
7	X												0.39	0.22
8	X	X											0.54	0.39
9	X	X	X										0.66	0.55
10	X	X	X	X									0.72	0.63
11	X	X	X	X	X								0.76	0.68
12	X	X	X	X	X	X							0.78	0.70
13	X						X						0.53	0.38
14	X	X					X	X					0.66	0.55
15	X	X	X				X	X	X				0.75	0.66
16	X	X	X	X			X	X	X	X			0.79	0.73
17	X	X	X	X	X		X	X	X	X	X		0.82	0.76
18	X	X	X	X	X	X	X	X	X	X	X	X	0.82	0.77

Feature selection

- Bands
- Spectral indices (vegetation indices)
- Temporal information:
  - Temporal metrics (minimum, mean, median, maximum)
  - Phenological metrics (start of season, peak of season, end of season, timing of peak of season)
- Auxiliary information:
  - DEM (elevation, slope, aspect)
  - Canopy height
  - Soil map
  - …