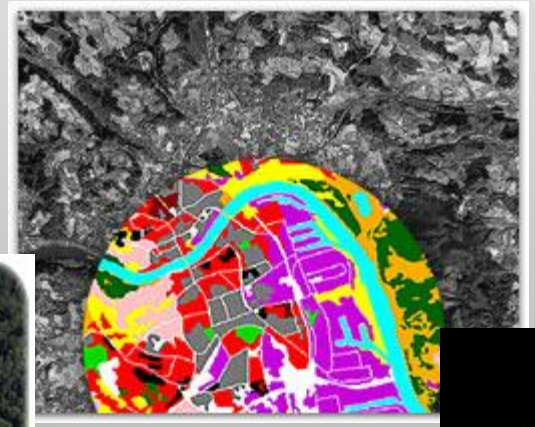
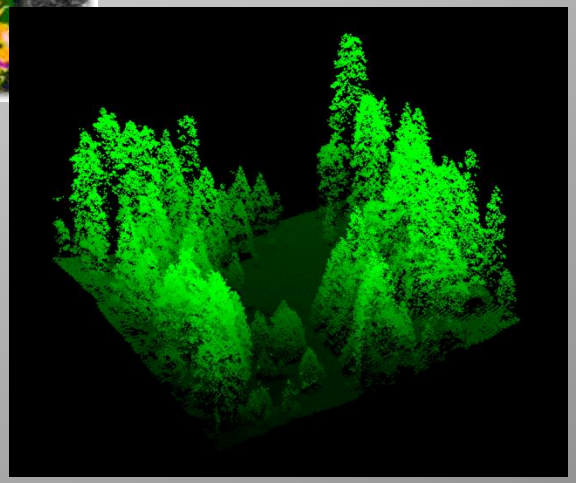
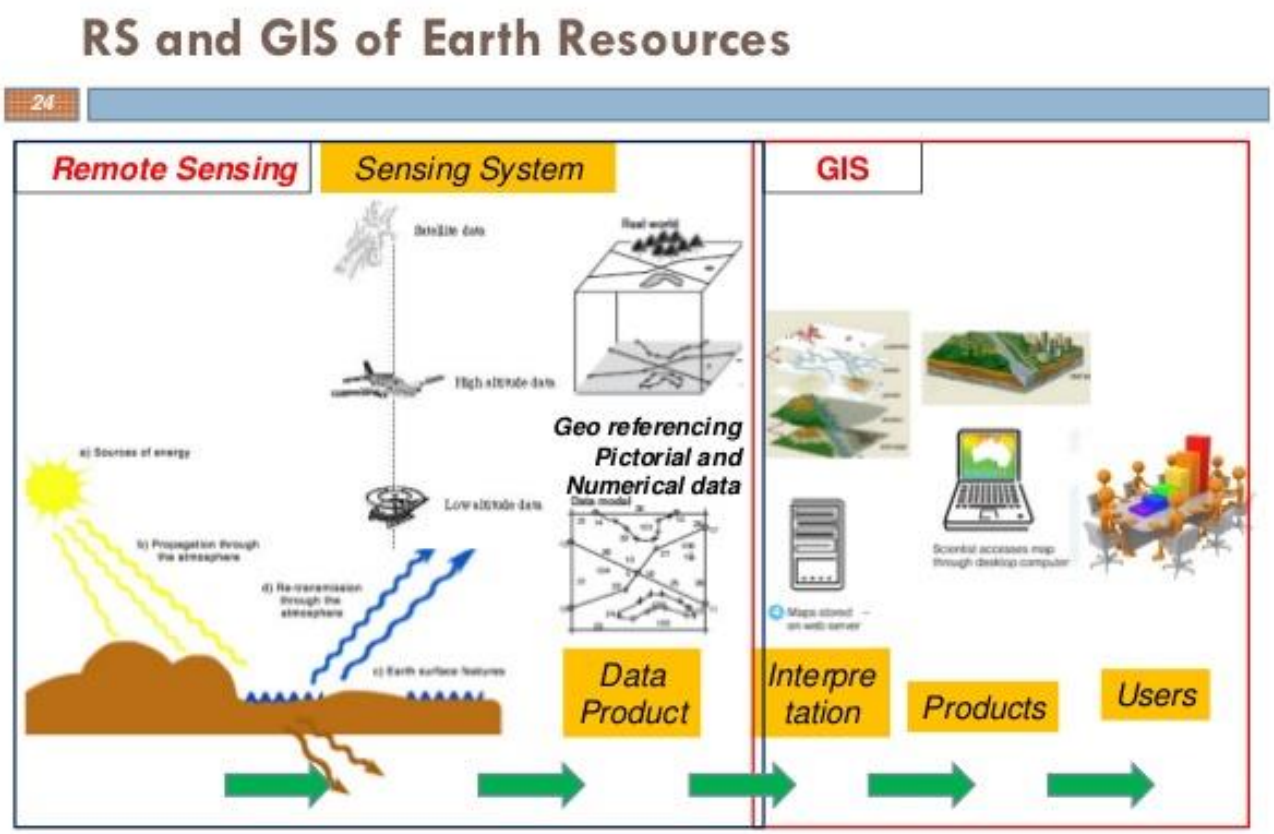
Remote sensing - Data - Capture - Image analysis & Products

Bjarne Fog
Geography section 1, IGN





Remote Sensing and Geographical Information System

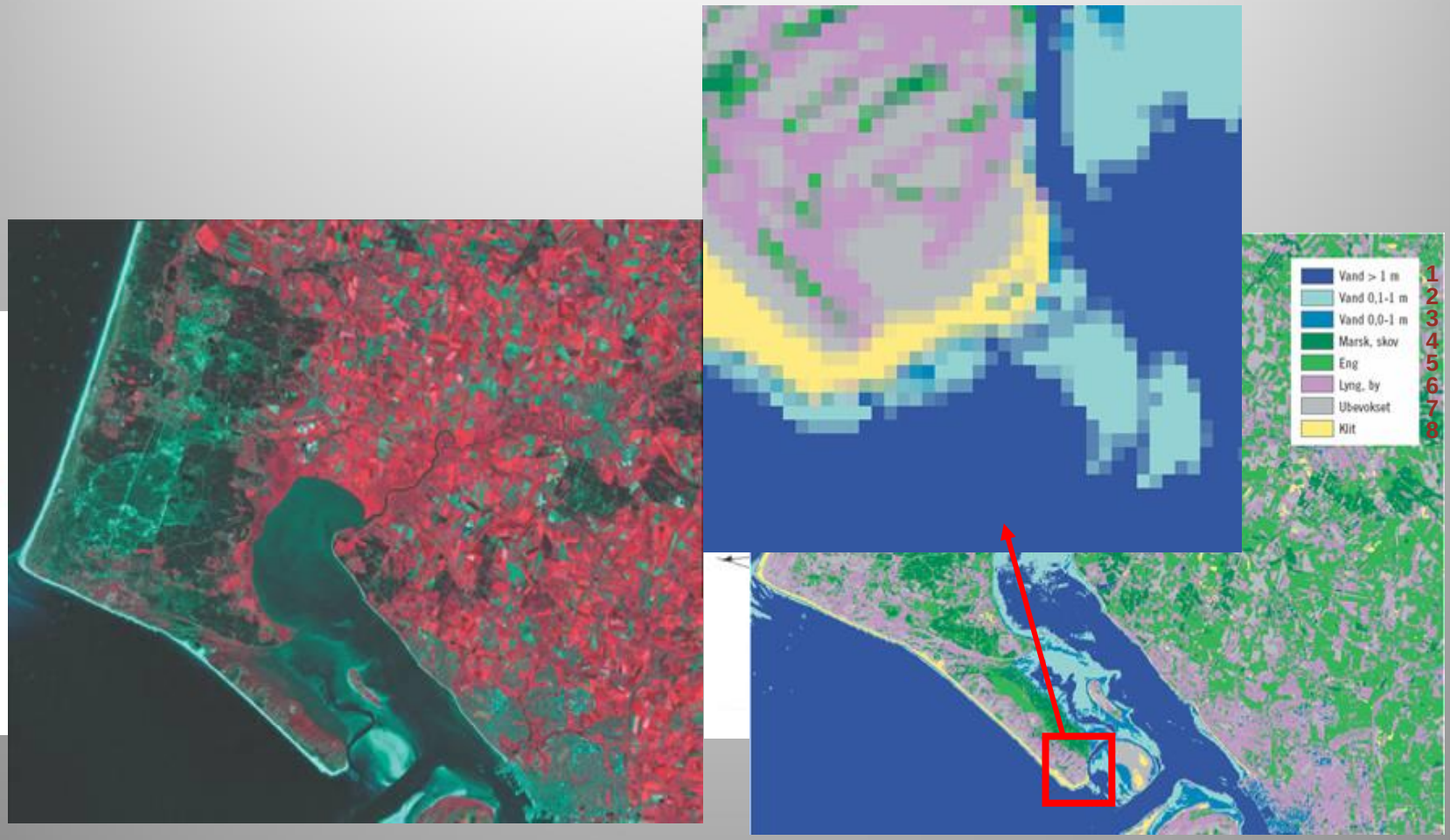


Electromagetic remote sensing of earth and its processing

The overview of this double lecture

- Remote sensing data from passive sensors
  - Satellite images (optical)
  - Aerial photos and Orthophotos
- Remote sensing data from active sensors
  - LiDAR data (point clouds)

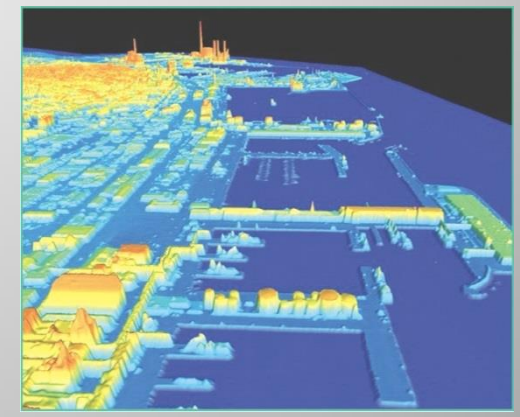
Data from passive sensors on a satellite is used to analyze the Earth's surface, - classification – thematic maps.

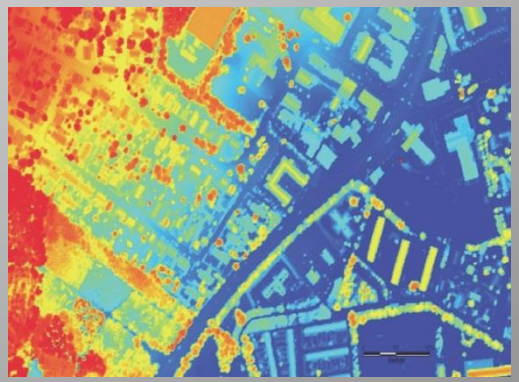


Data from Aerial photo/Orthophoto is used for topographic mapping or the extraction of objects on the ground surface.

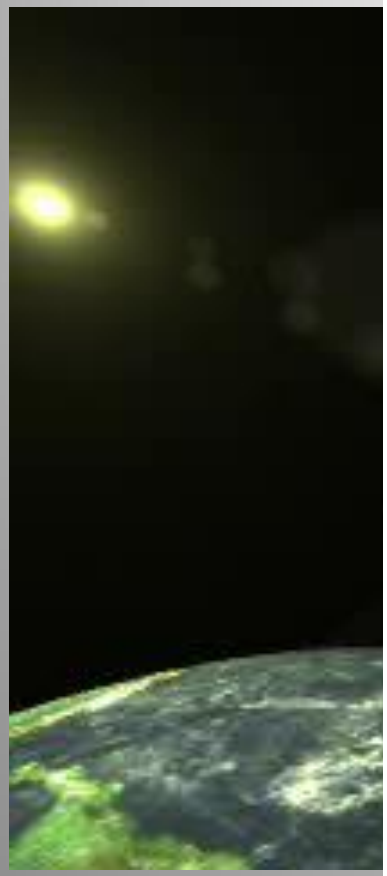
Data from the active LiDAR sensor generate a point cloud ie. used for the production of DTM, DEM, DSM

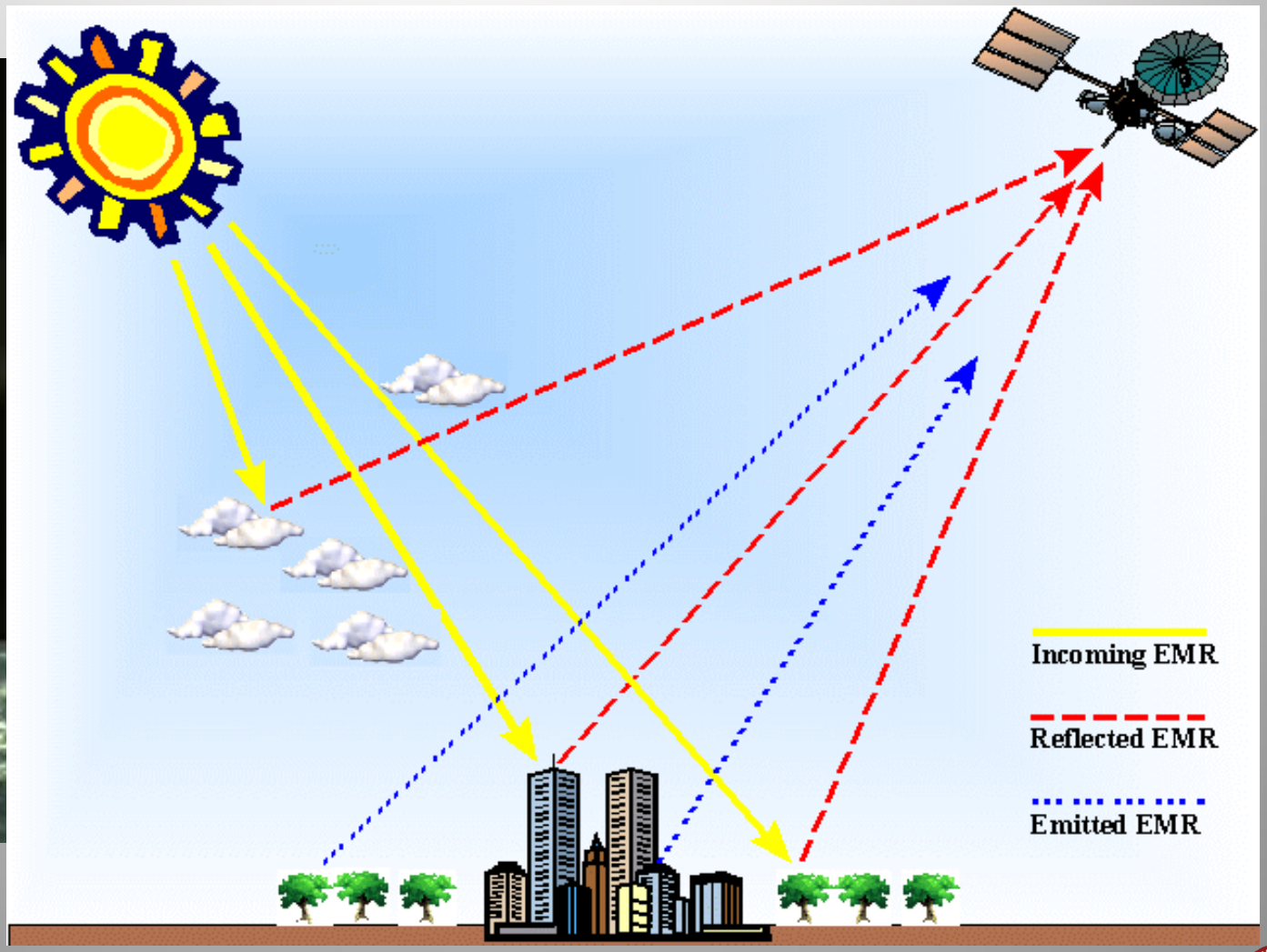
LiDAR = "Light Detection And Ranging"





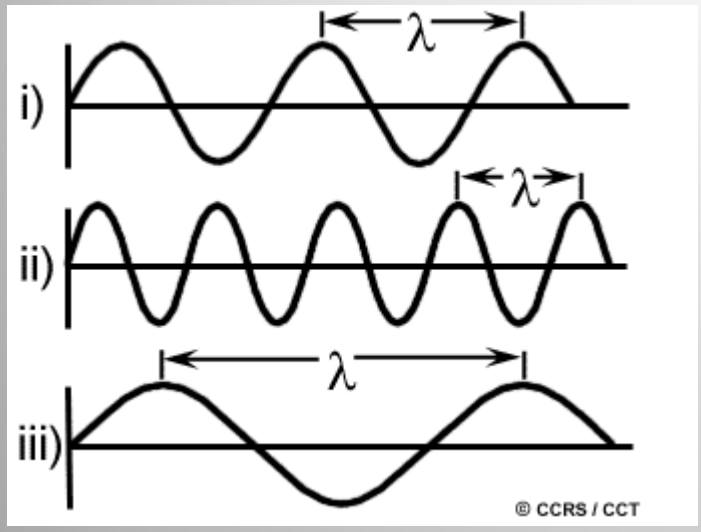
What does a satellite sensor measure?



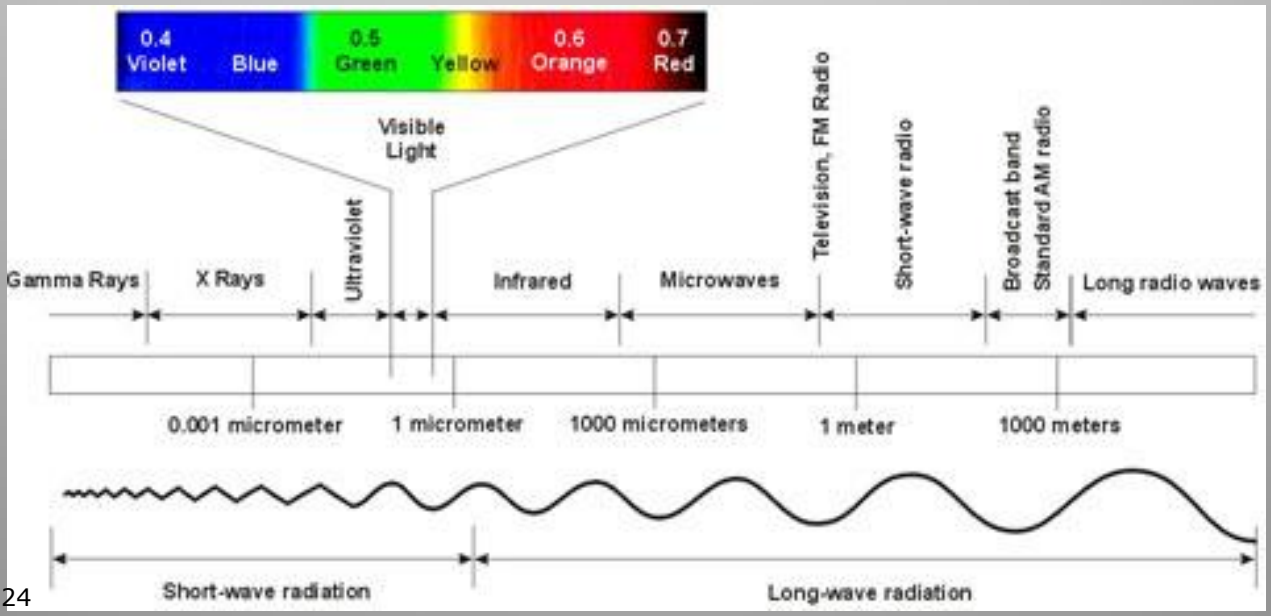


Electromagnetic radiation

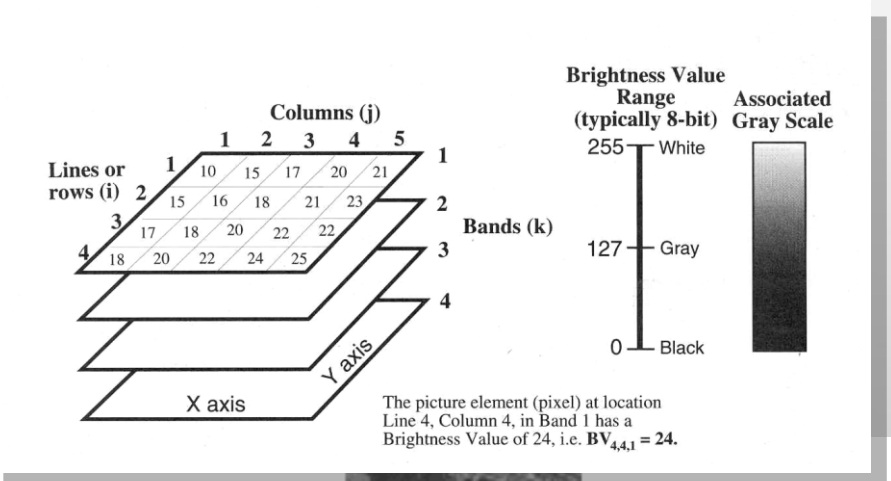
Electromagnetic radiation and the significance of wavelength



Visble light – 380 to 700 nanometers



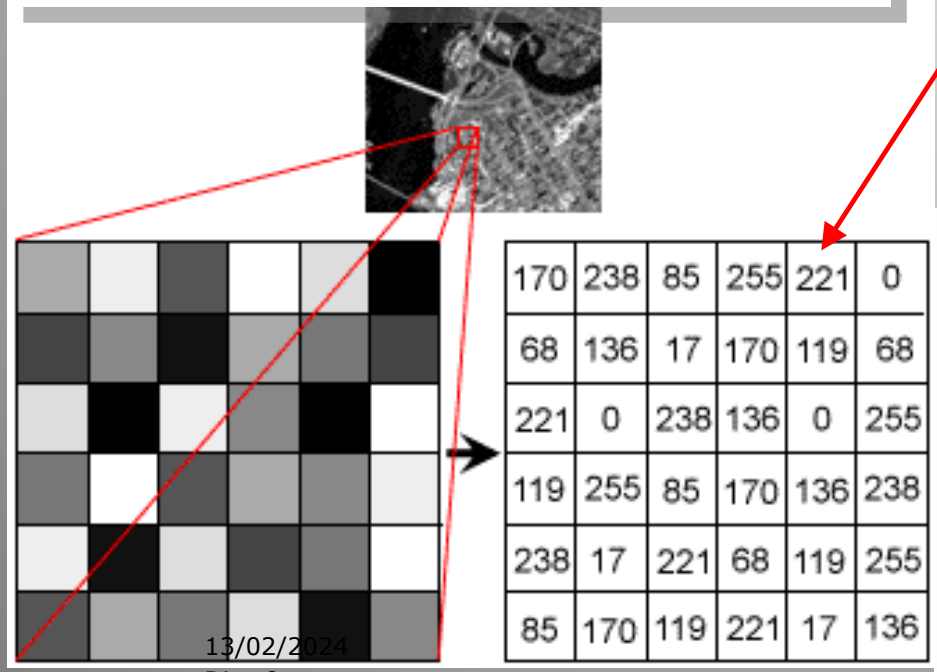
Satellite image characteristics



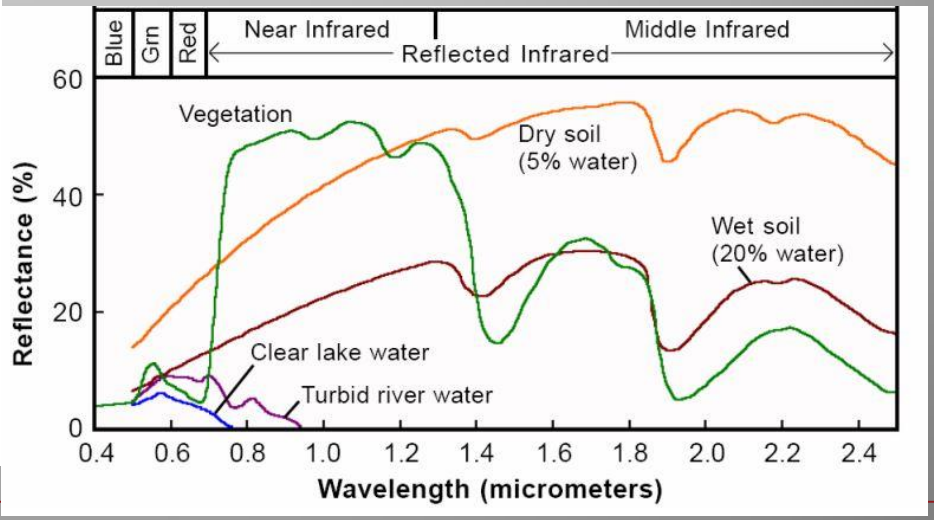
Every celle has a numeric value (0 – 255) this value is then converted into a colour (black – white) representing the size of the value

Like a digital camera, just more bands

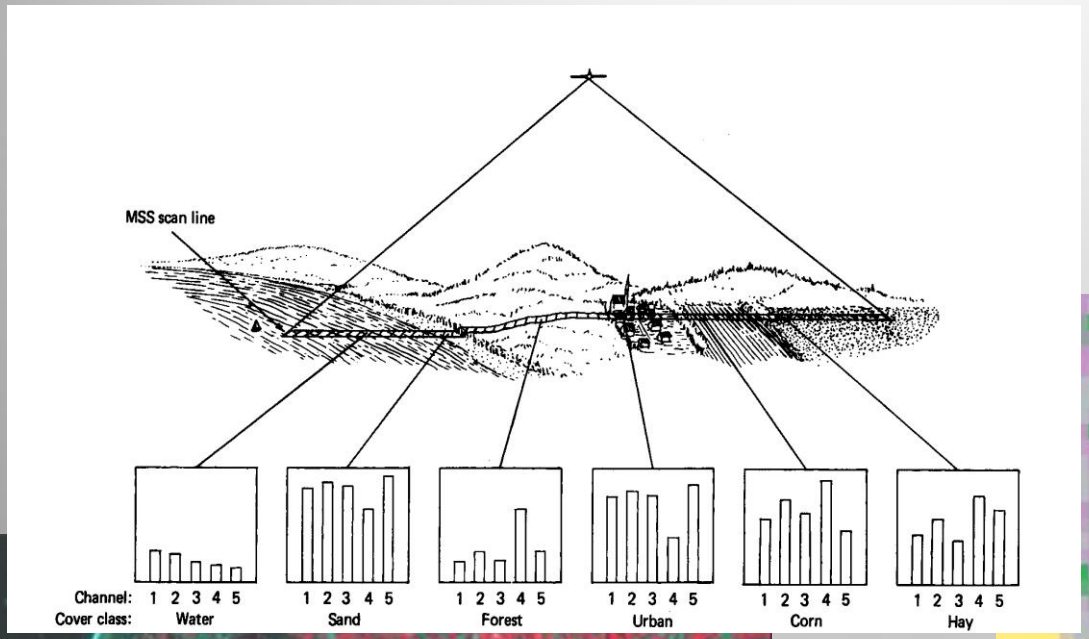
Spectral reflection from objects (surface) depends on wavelength (image bands)

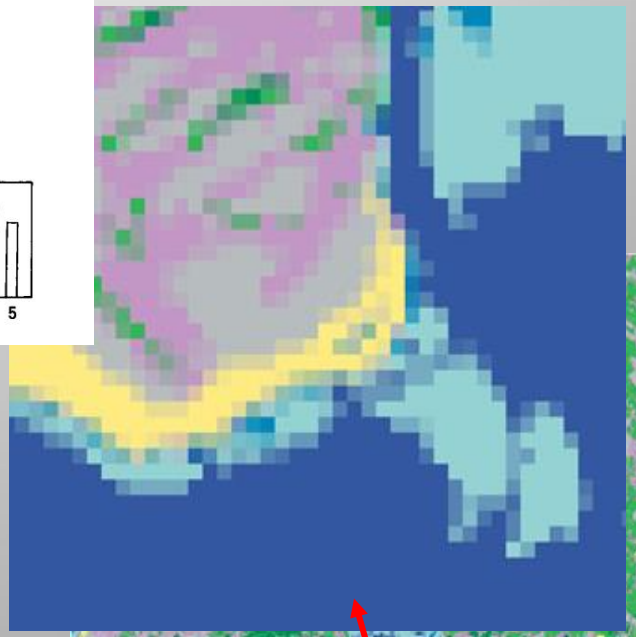


170	238	85	255	221	0
68	136	17	170	119	68
221	0	238	136	0	255
119	255	85	170	136	238
238	17	221	68	119	255
85	170	119	221	17	136



From satellite image to landuse/landcover map



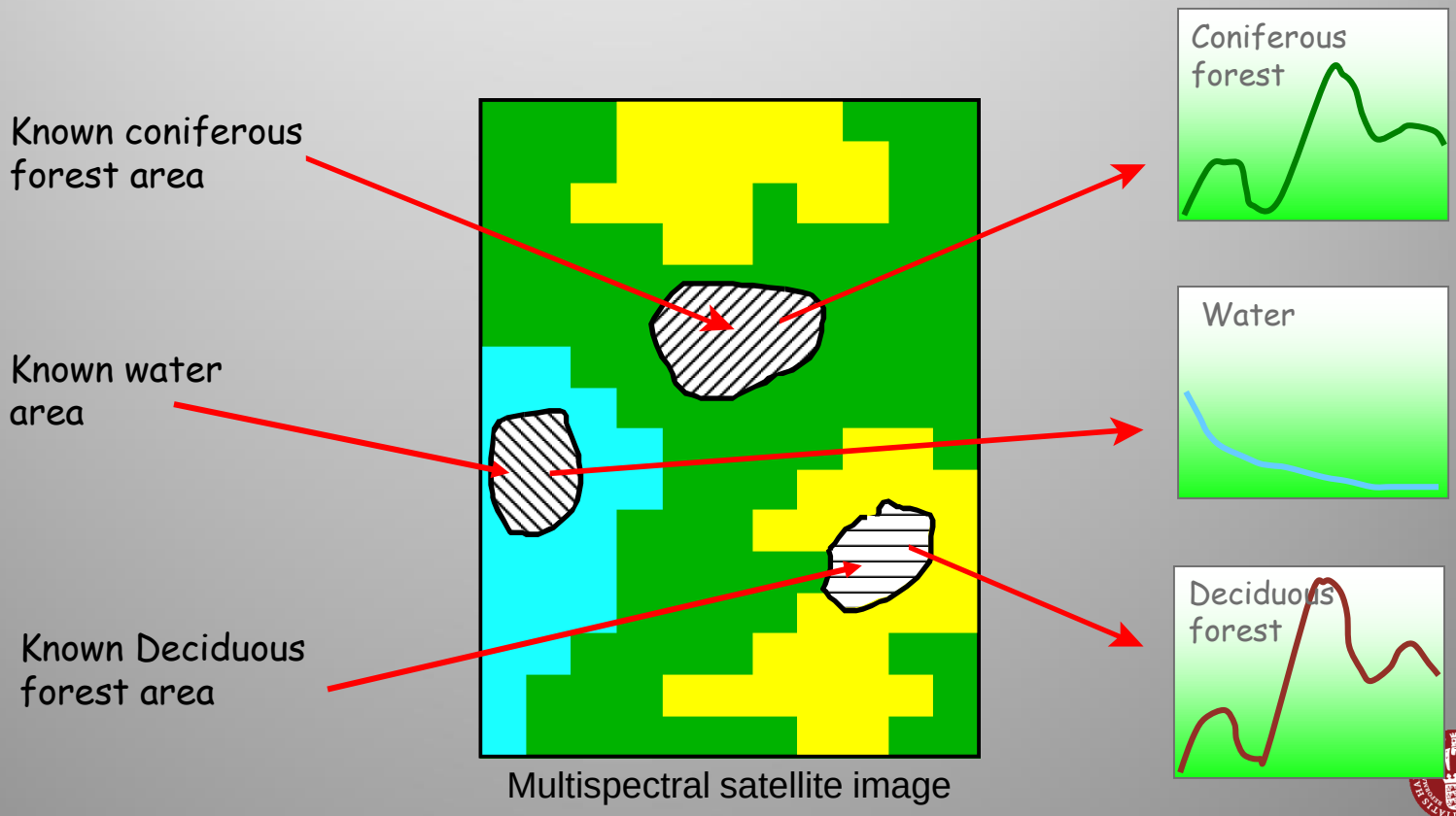


From satellite image to landcover/landuse map
Supervised classification

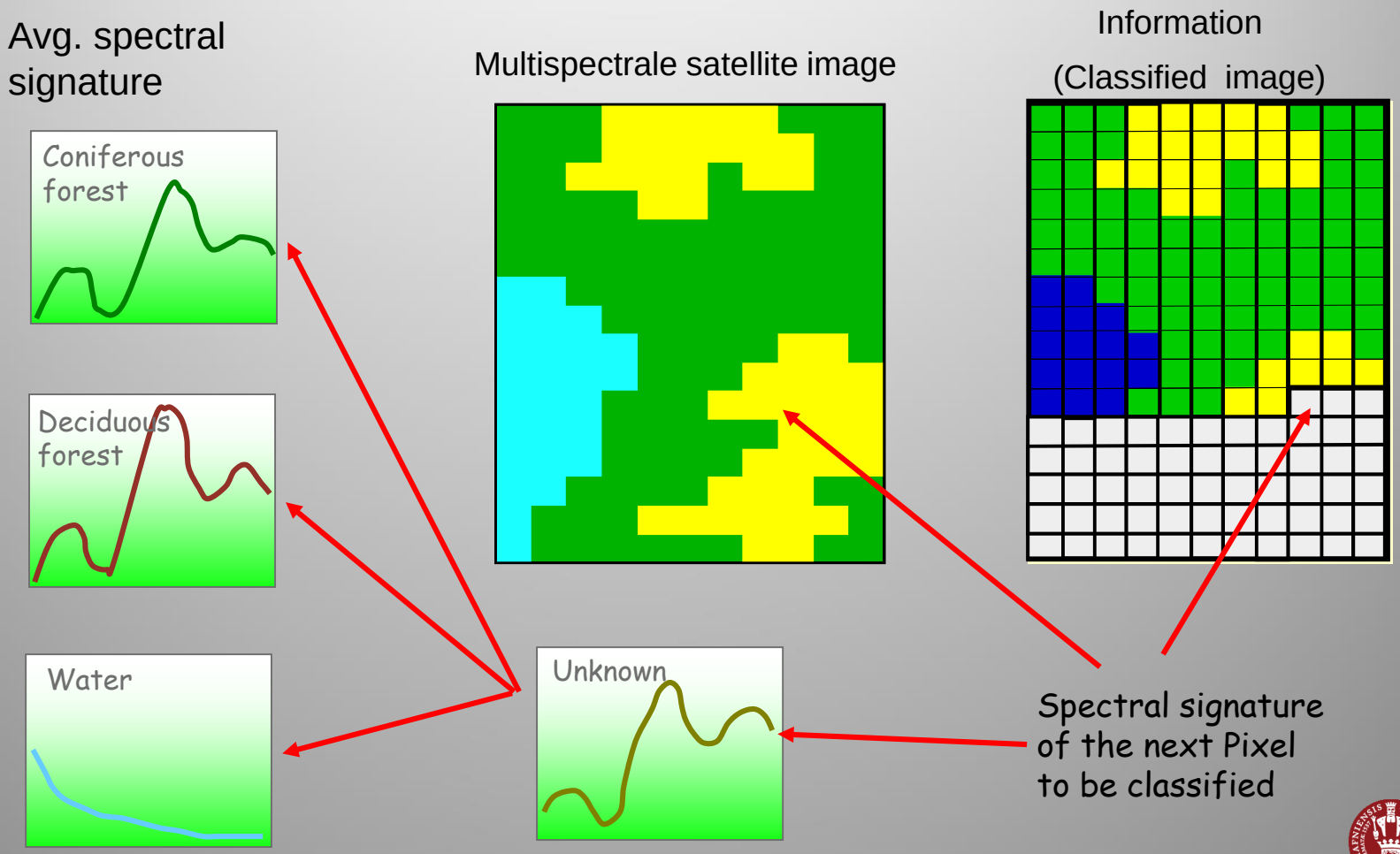
In a supervised classification the user need to select training areas, where the cover is known.

Computeren calculate then…

Avg. spectral signature

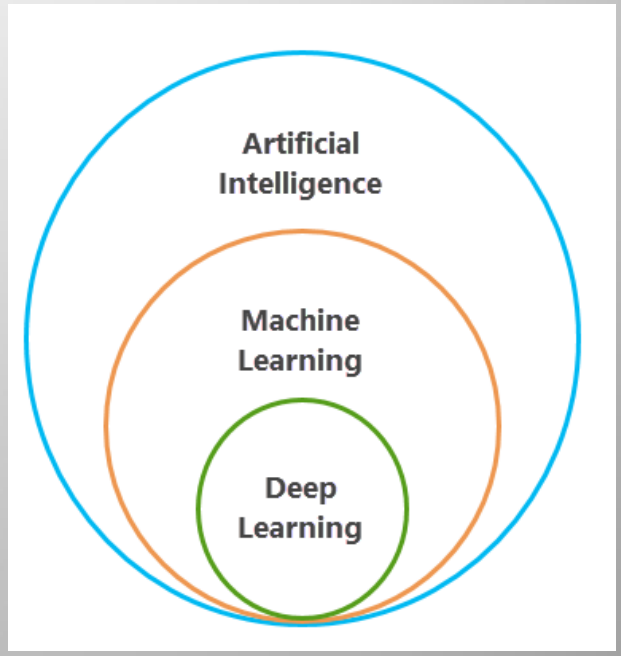


From satellite image to landcover/landuse map
Supervised classification



AI – Machine Learning – Deep Learning

Esri has developed tools that allow you to perform image classification, object detection, semantic segmentation, and instance segmentation.



Methods

Image classification

Object detection

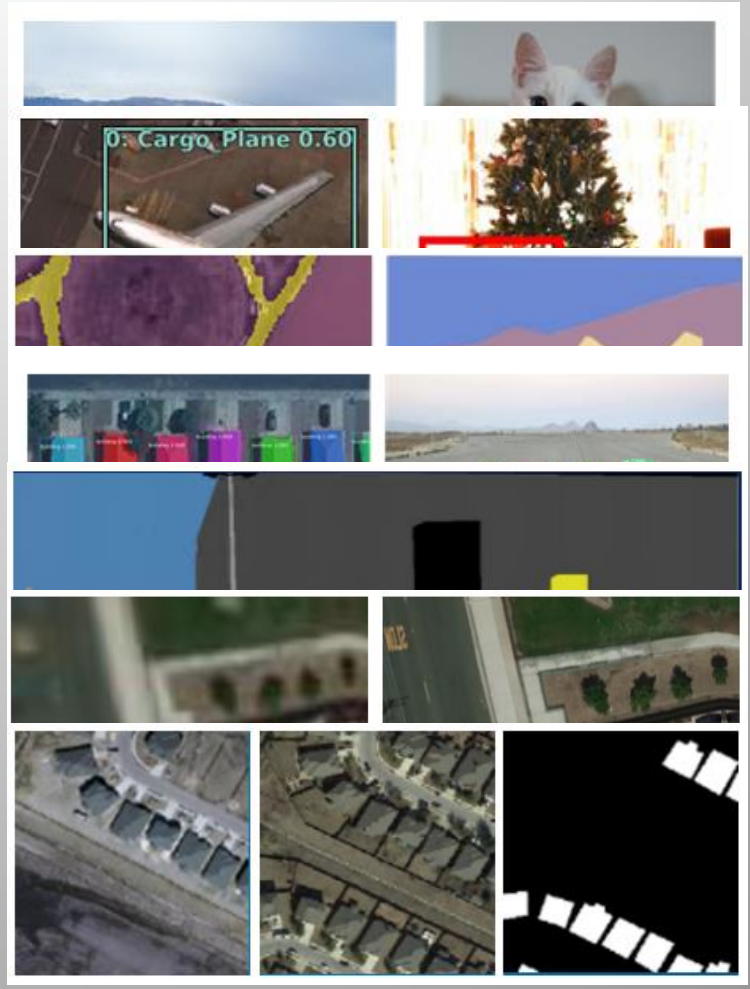
Semantic segmentation

Instance segmentation

Panoptic segmentation

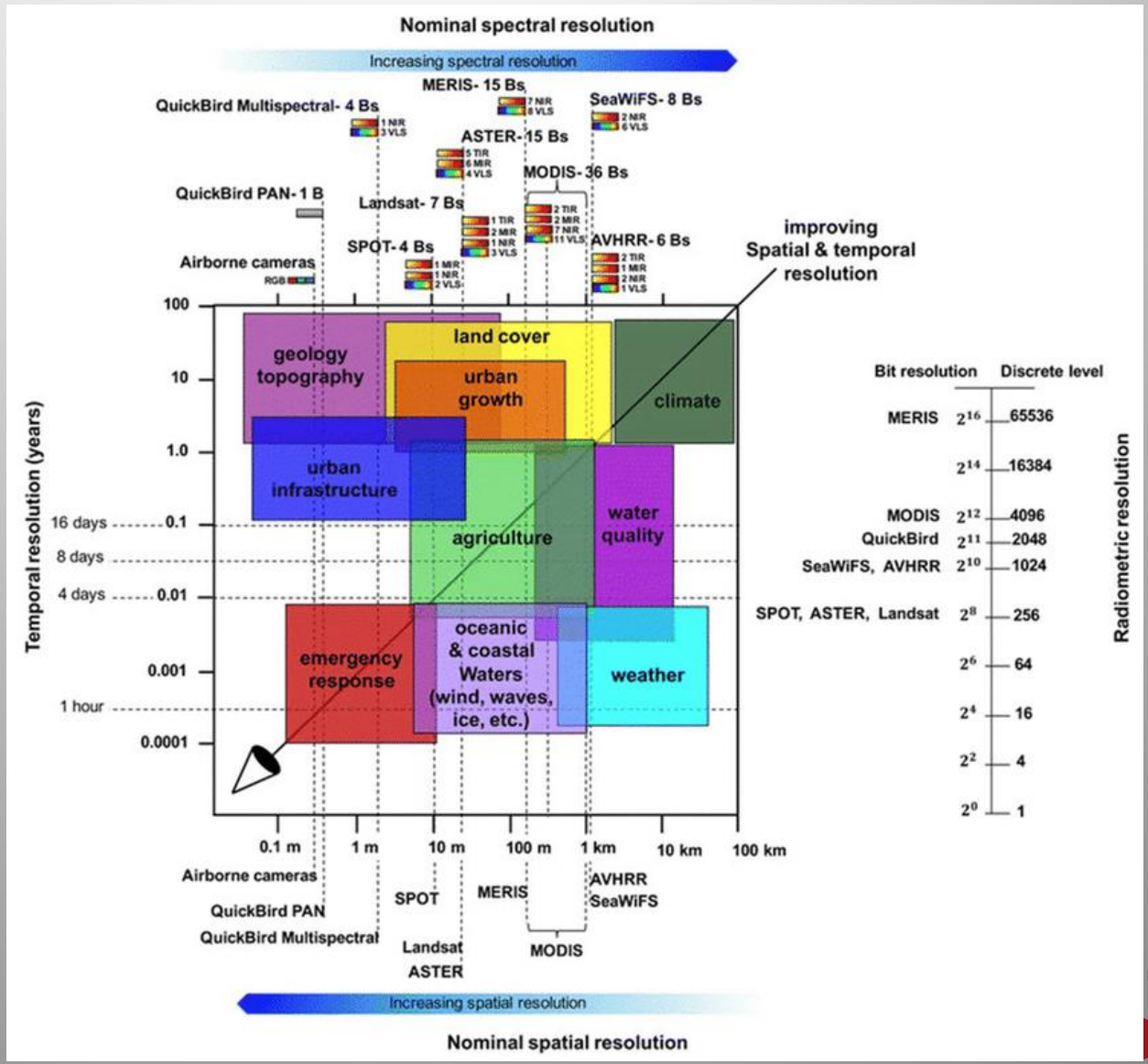
Image translation

Change detection



Satellite images – different characteristics –different applications

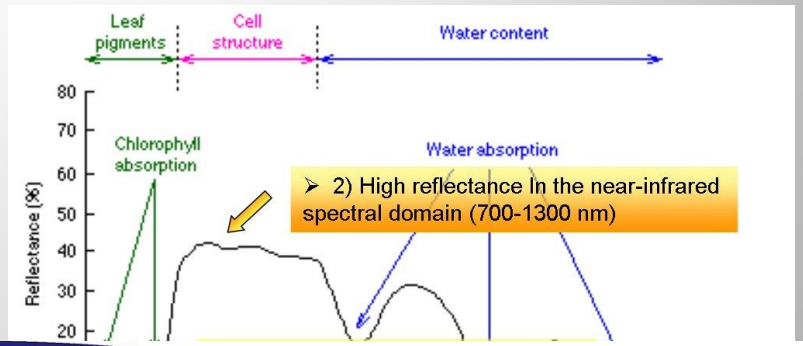
- Temporal resolution
- Spectral resolution
- Spatial resolution
- Radiometric resolution
- Leads to different applications



Vegetation index - NDVI

Typical spectral response
for vegetation covered surface

NDVI = (NIR – Red) / (NIR + Red)



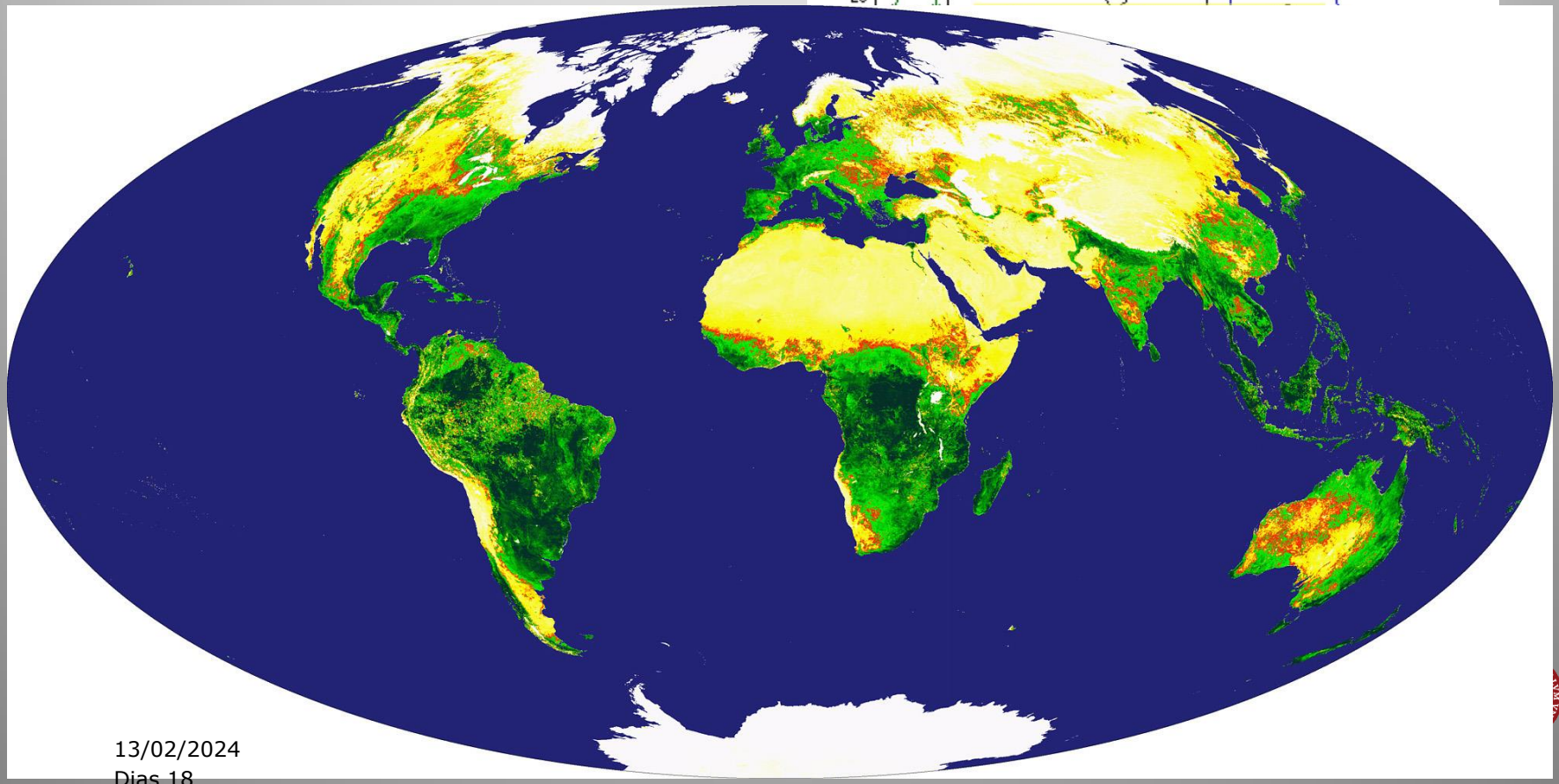
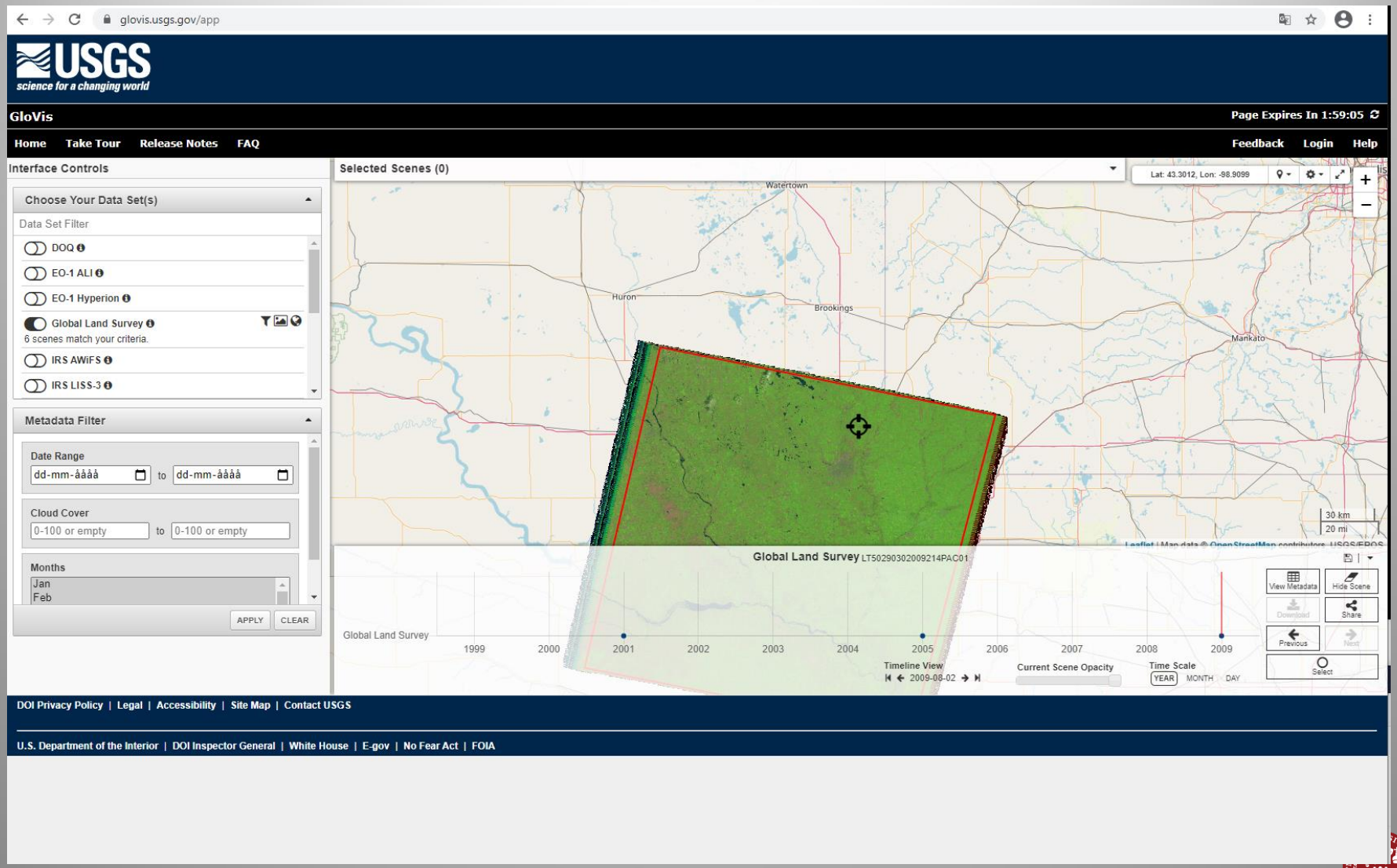


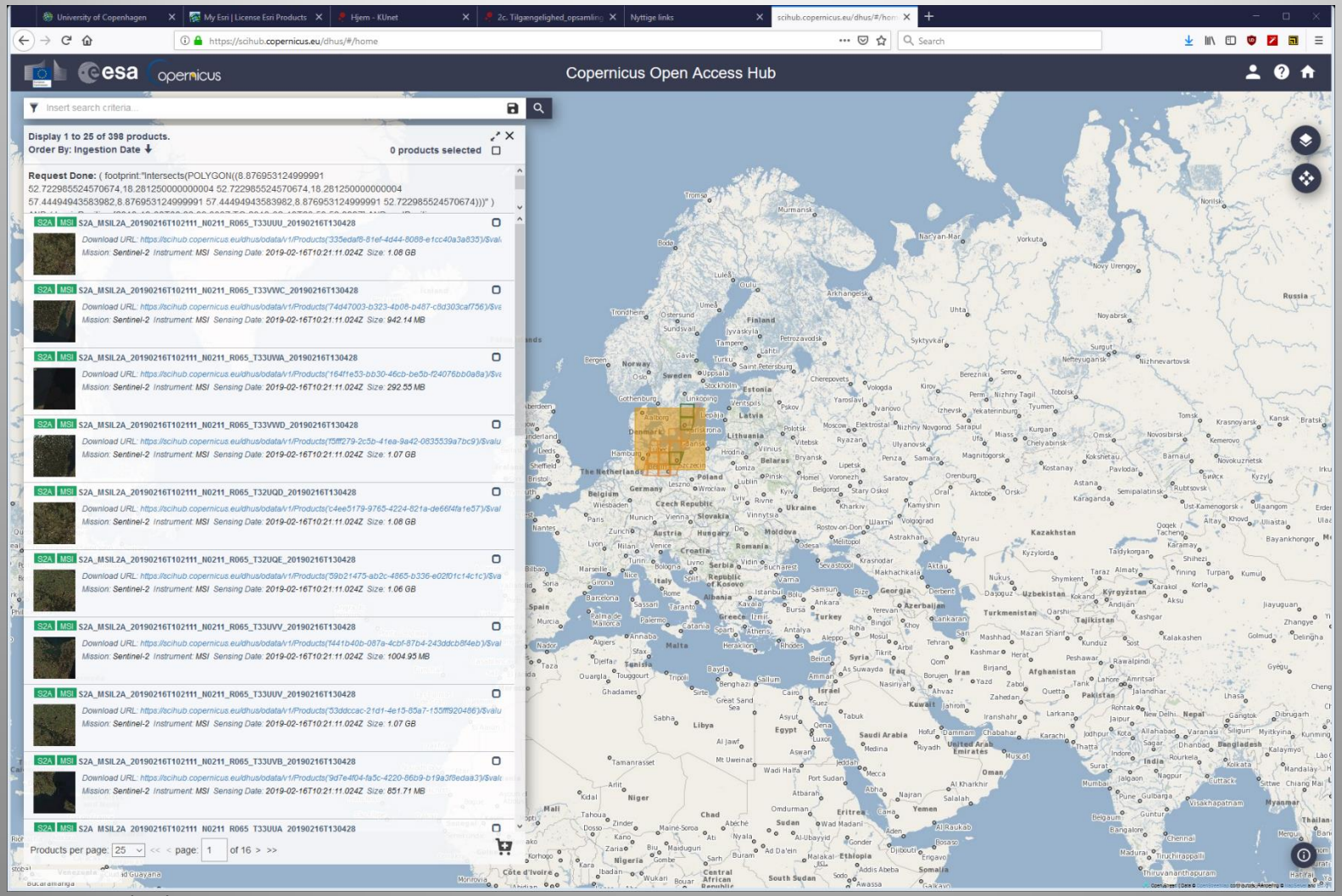
Image Classification & Object Based Image Analysis (OBIA)

Source: http://usda-ars.nmsu.edu/PDF%20files/laliberteAerialPhotos.pdf

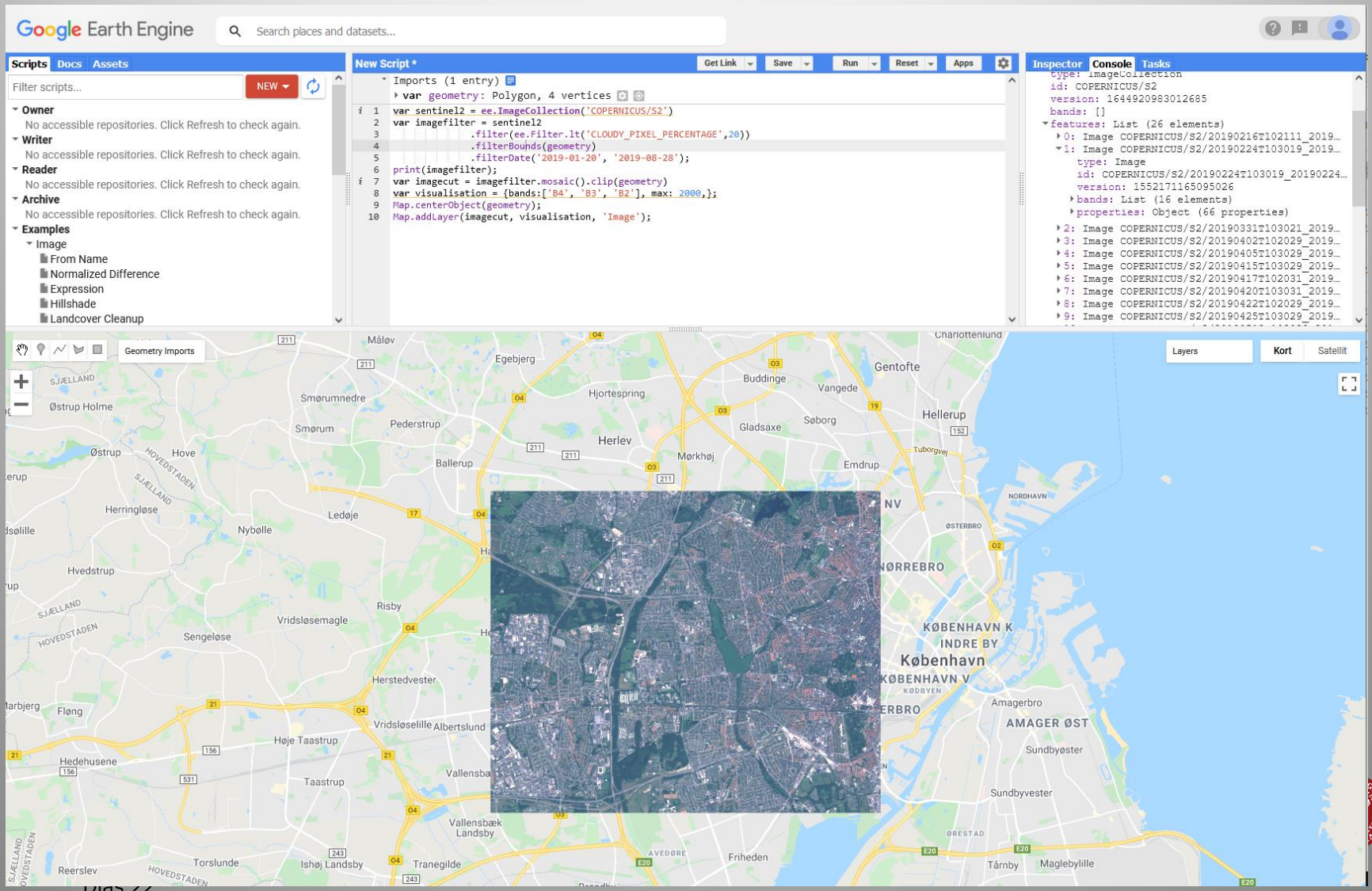
Data archives - http://glovis.usgs.gov/

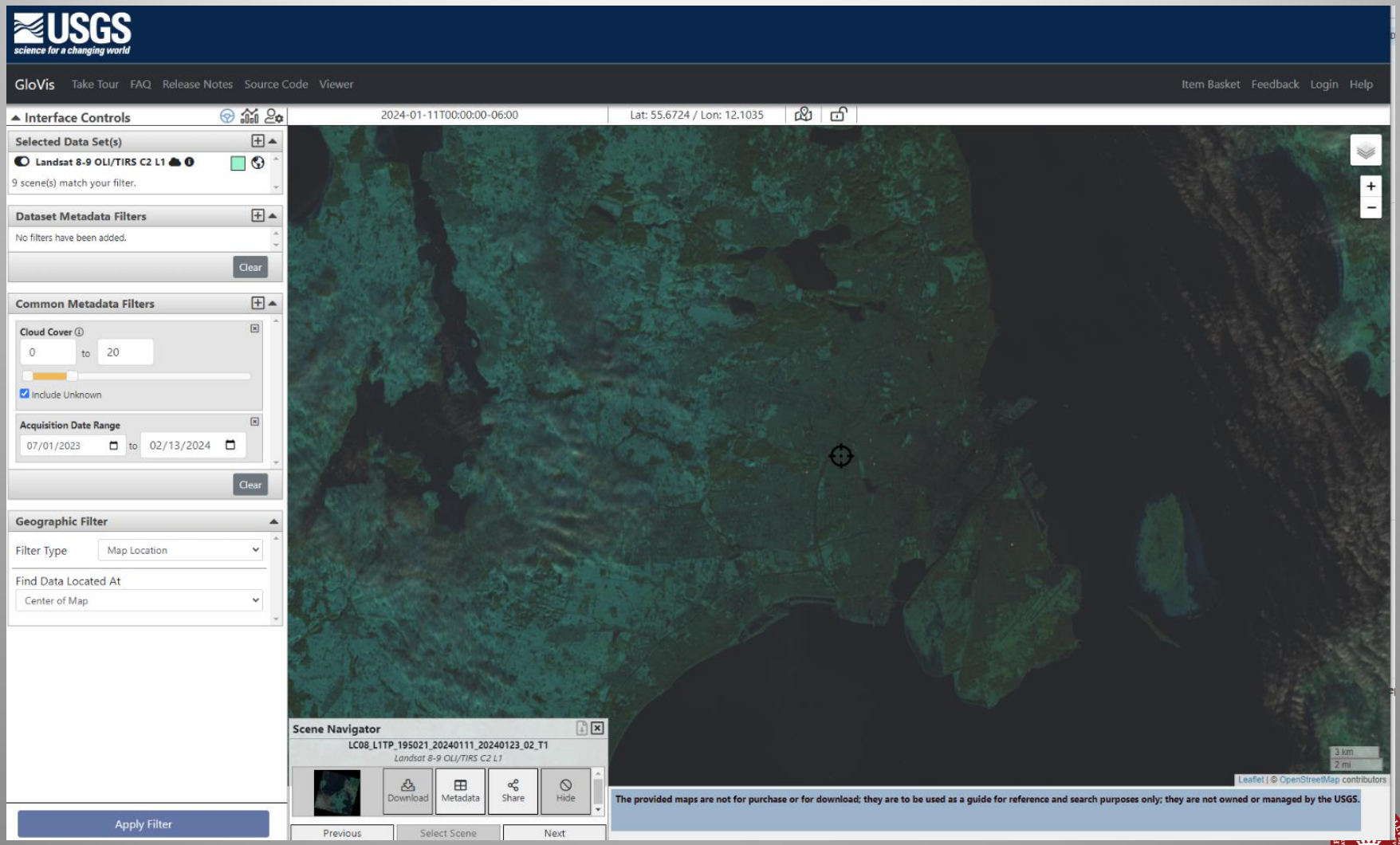


Copernicus archives - https://scihub.copernicus.eu



Google Earth Engine – an advanced cloud-based processing platform




USGS
science for a changing world
GloVis
Take Tour
FAQ
Release Notes
Source Code
Viewer
Item Basket
Feedback
Login
Help
Interface Controls
2024-01-11T00:00:00-06:00
Lat: 55.6724 / Lon: 12.1035
Selected Data Set(s)
Landsat 8-9 OLI/TIRS C2 L1
9 scene(s) match your filter.
Dataset Metadata Filters
No filters have been added.
Clear
Common Metadata Filters
Cloud Cover
0
to
20
Include Unknown
Acquisition Date Range
07/01/2023
to
02/13/2024
Clear
Geographic Filter
Filter Type
Map Location
Find Data Located At
Center of Map
Apply Filter
Scene Navigator
LC08_L1TP_195021_20240111_20240123_02_T1
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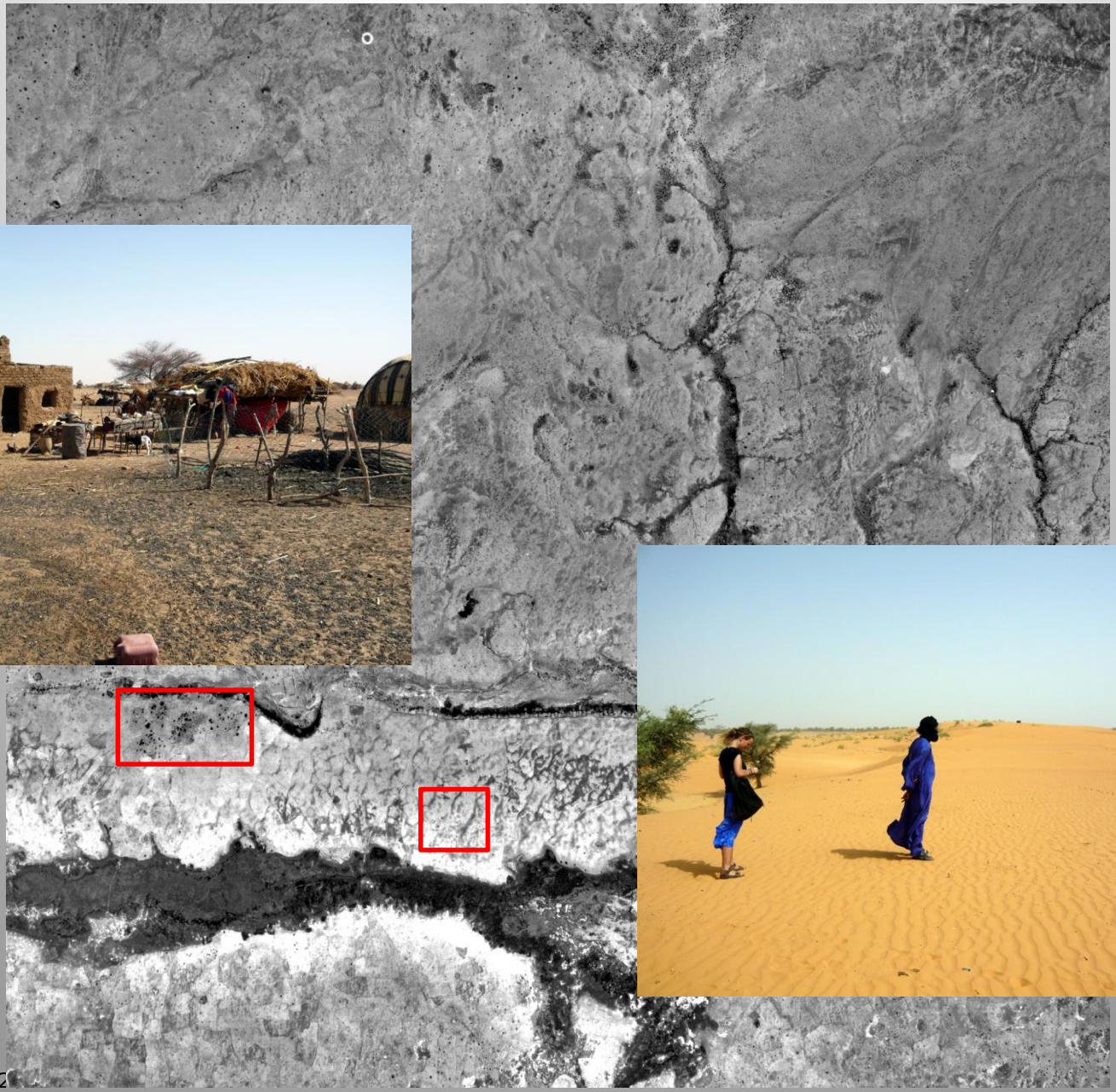
Aerial photography

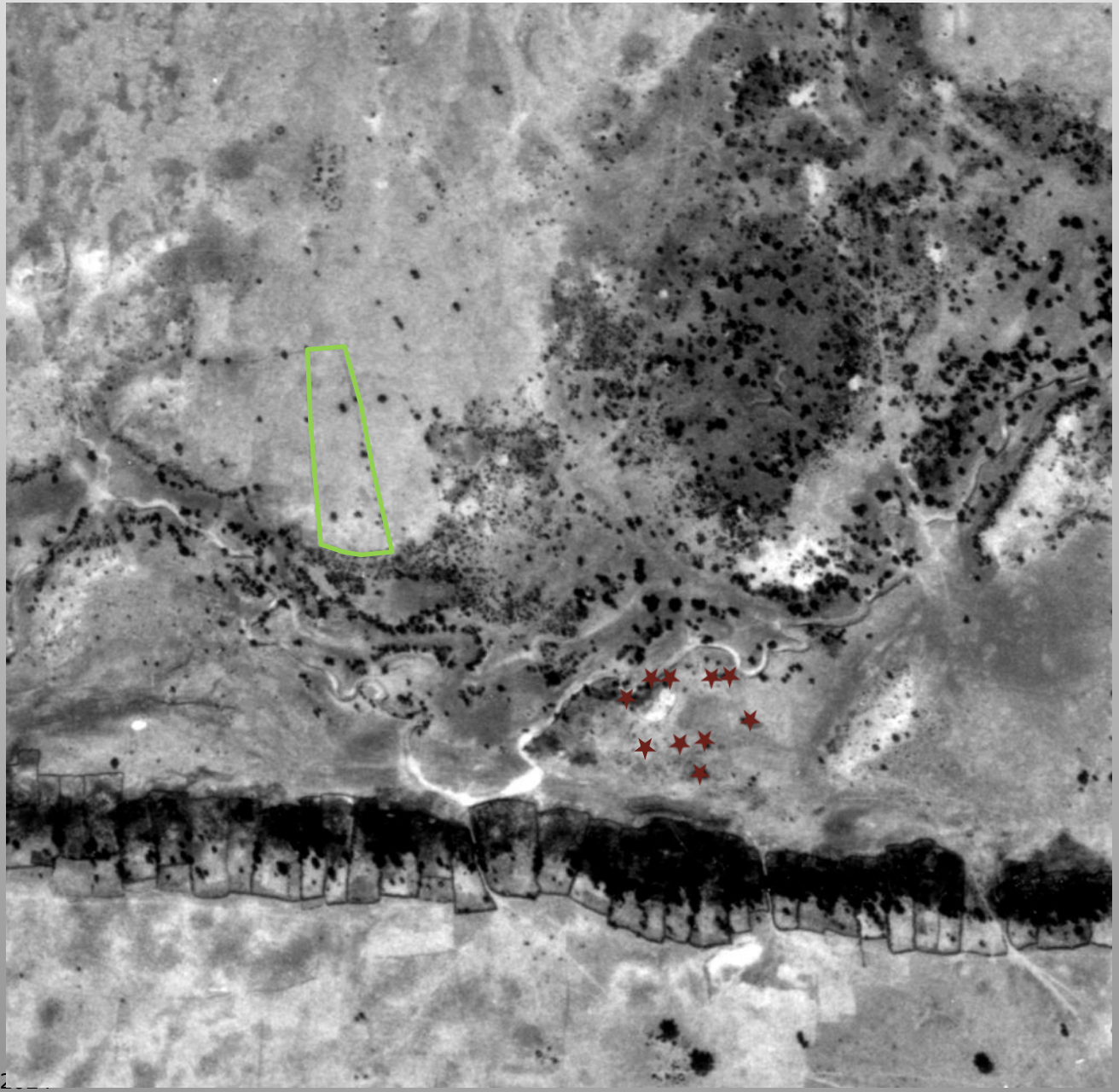
Aerial photos as source for extraction of features. Change detection

Geometric ”problems” in the aerial photo

How to go from aerial photos to orthophotos.

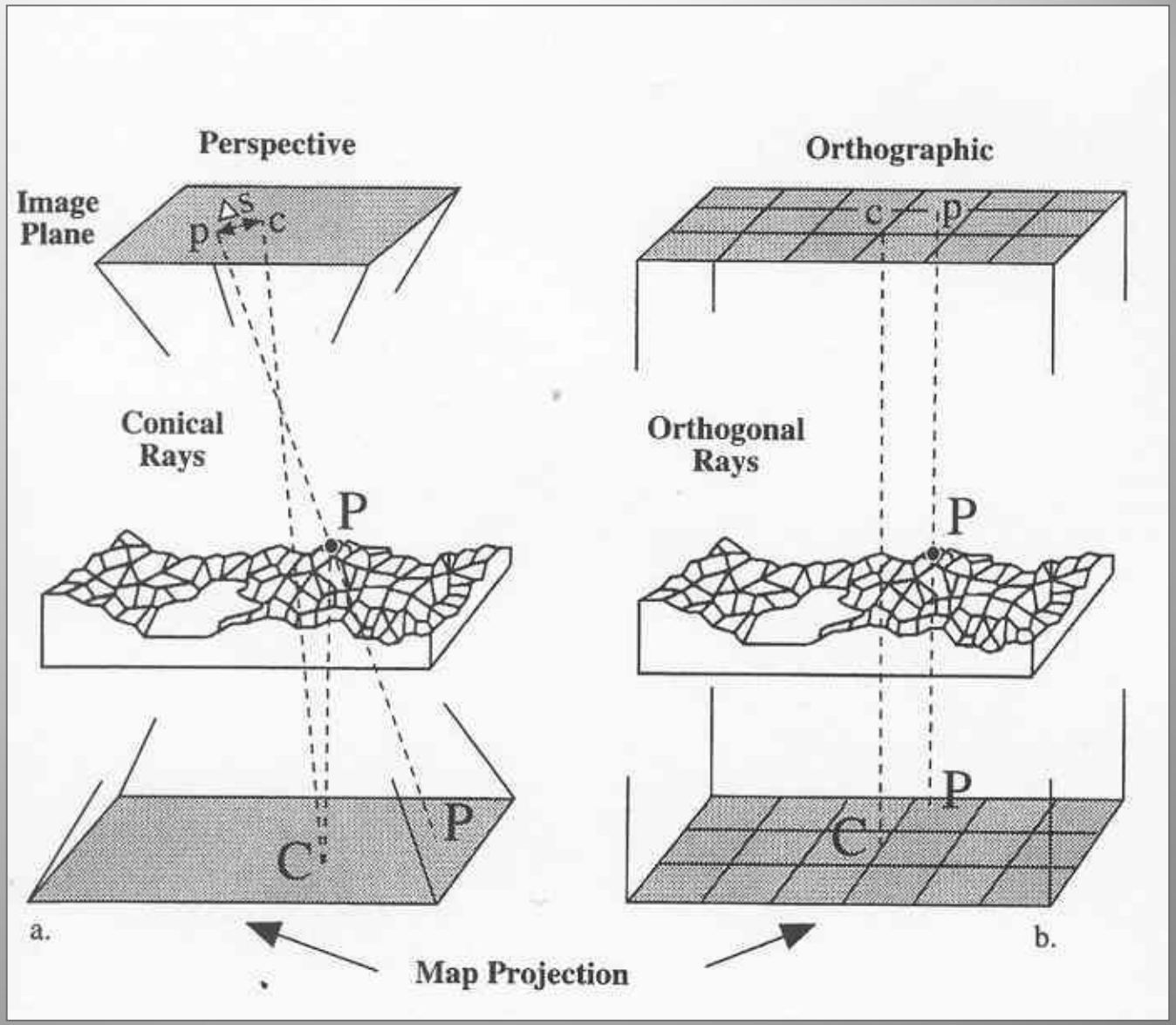
Aerial photo



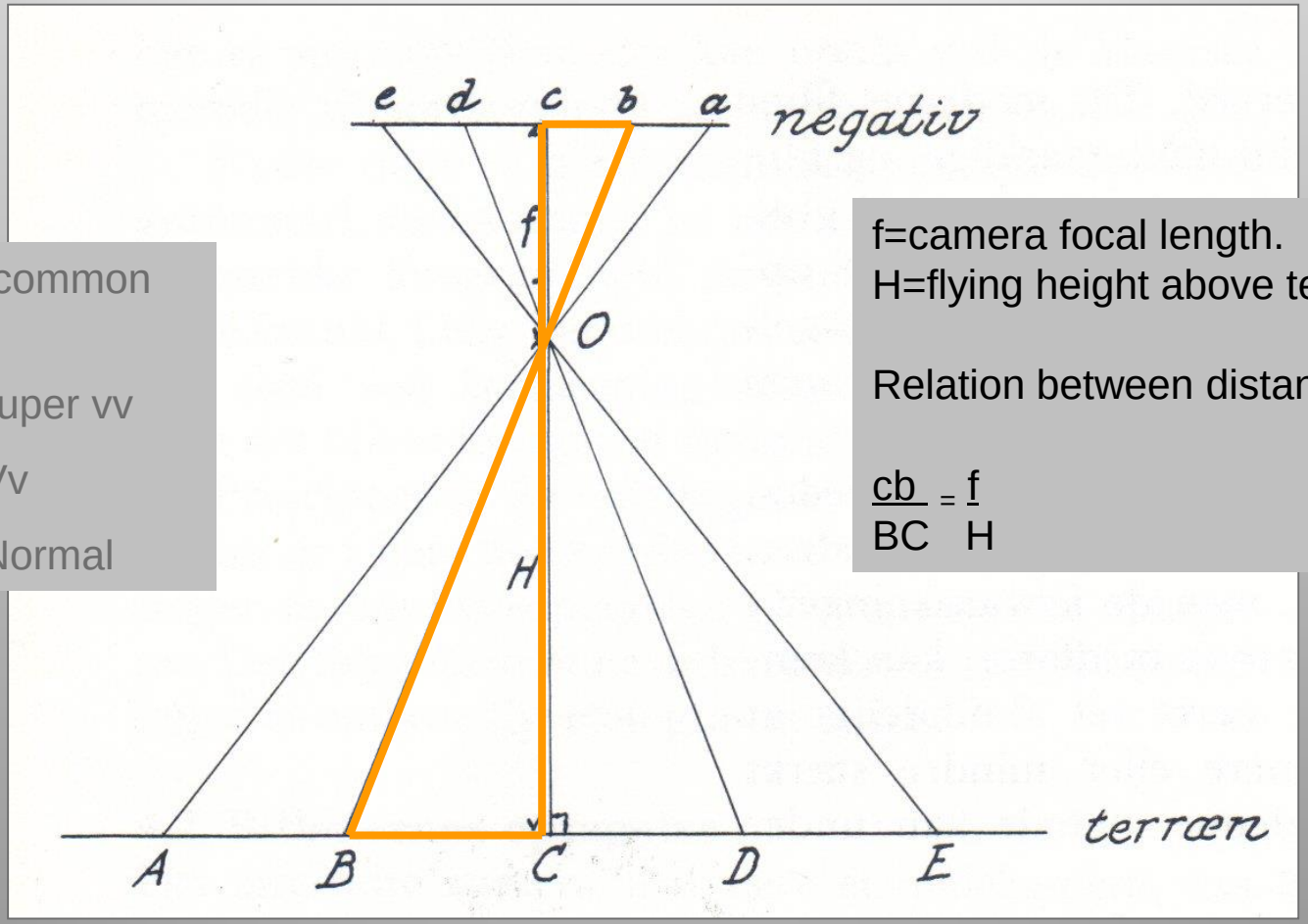


Aerial photo:
central perspective projection

Orthofoto:
plane perspective projection



The ideal aerial photo



The most common lenses

88 mm Super vv

153 mm Vv

300 mm Normal

f=camera focal length.
H=flying height above terrain

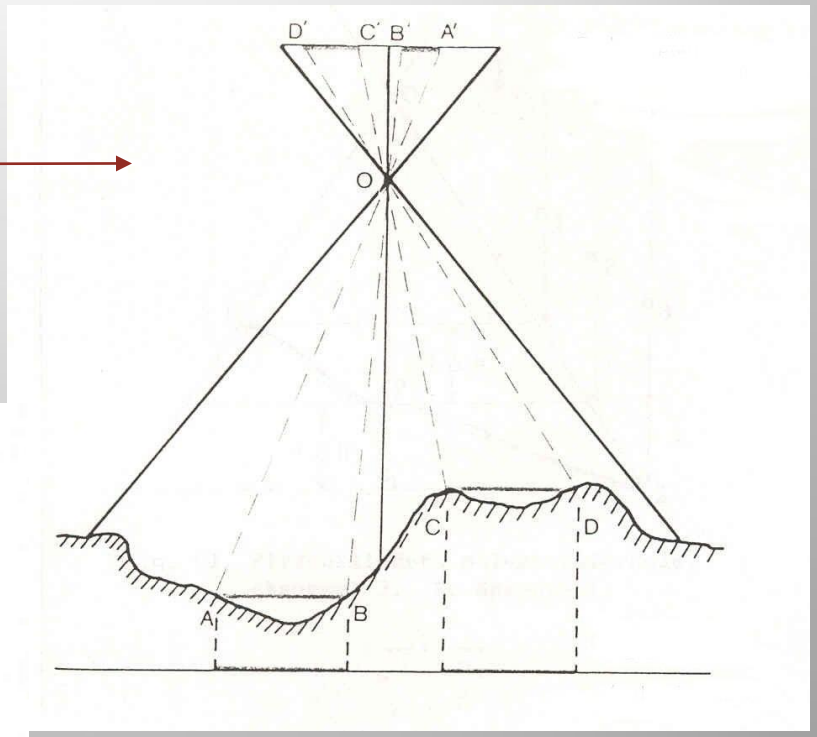
Relation between distances.

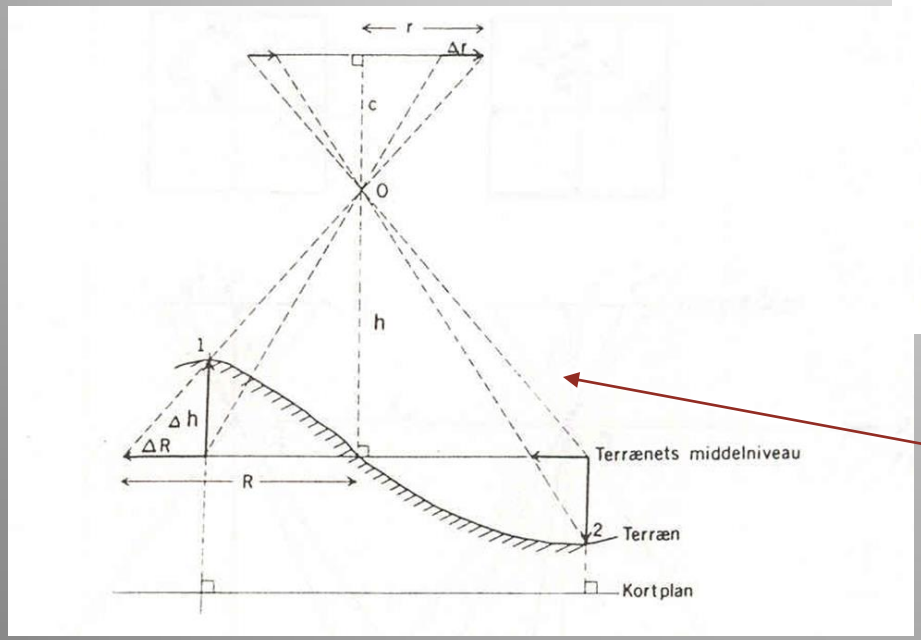
$$\frac{cb}{BC} = \frac{f}{H}$$

Simpel relation between a distance in the aerial photo and the distance on the ground

Errors in aerial photos caused by relief.

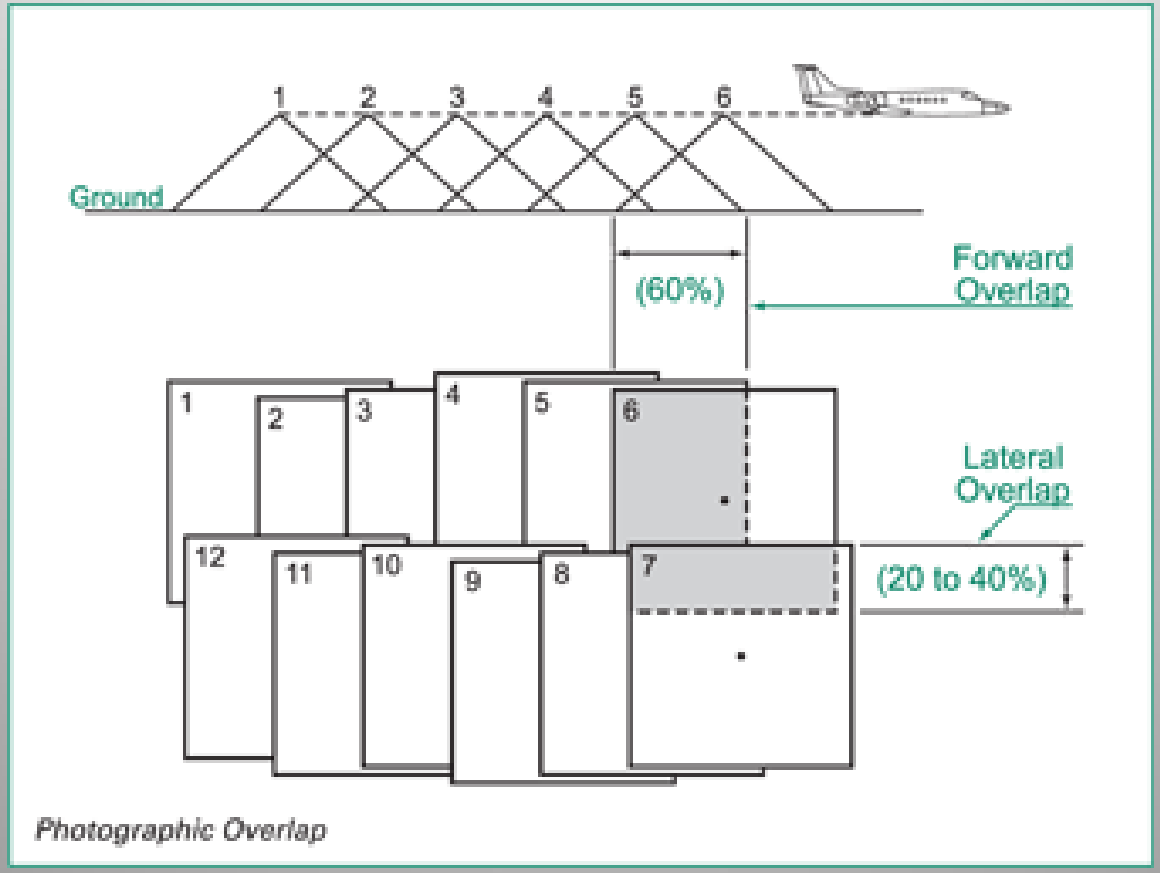
Distances





Displacement

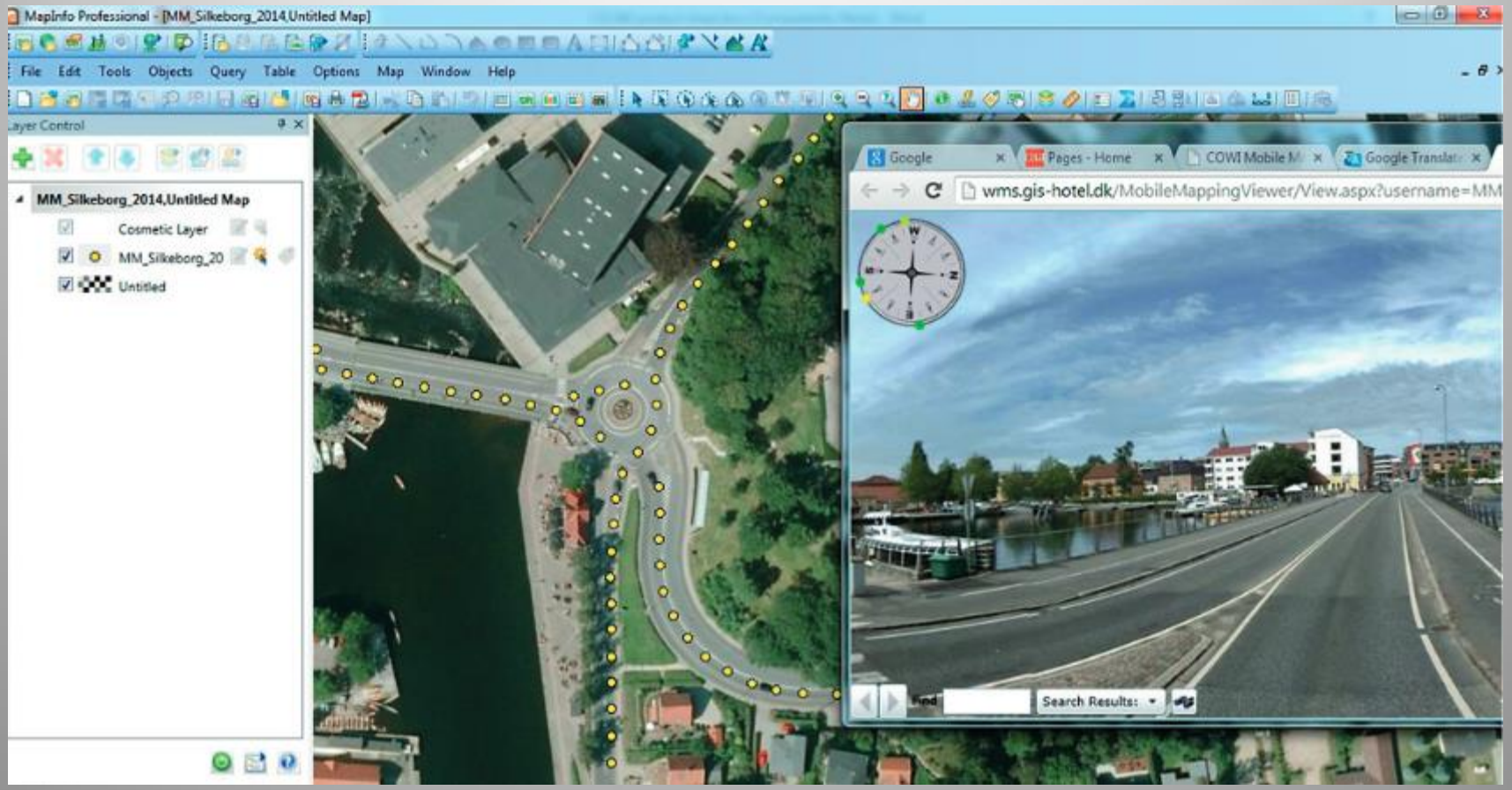
Flight lines and overlap in flight direction



Aerial photos and orthophoto generation

Oblique aerial photos

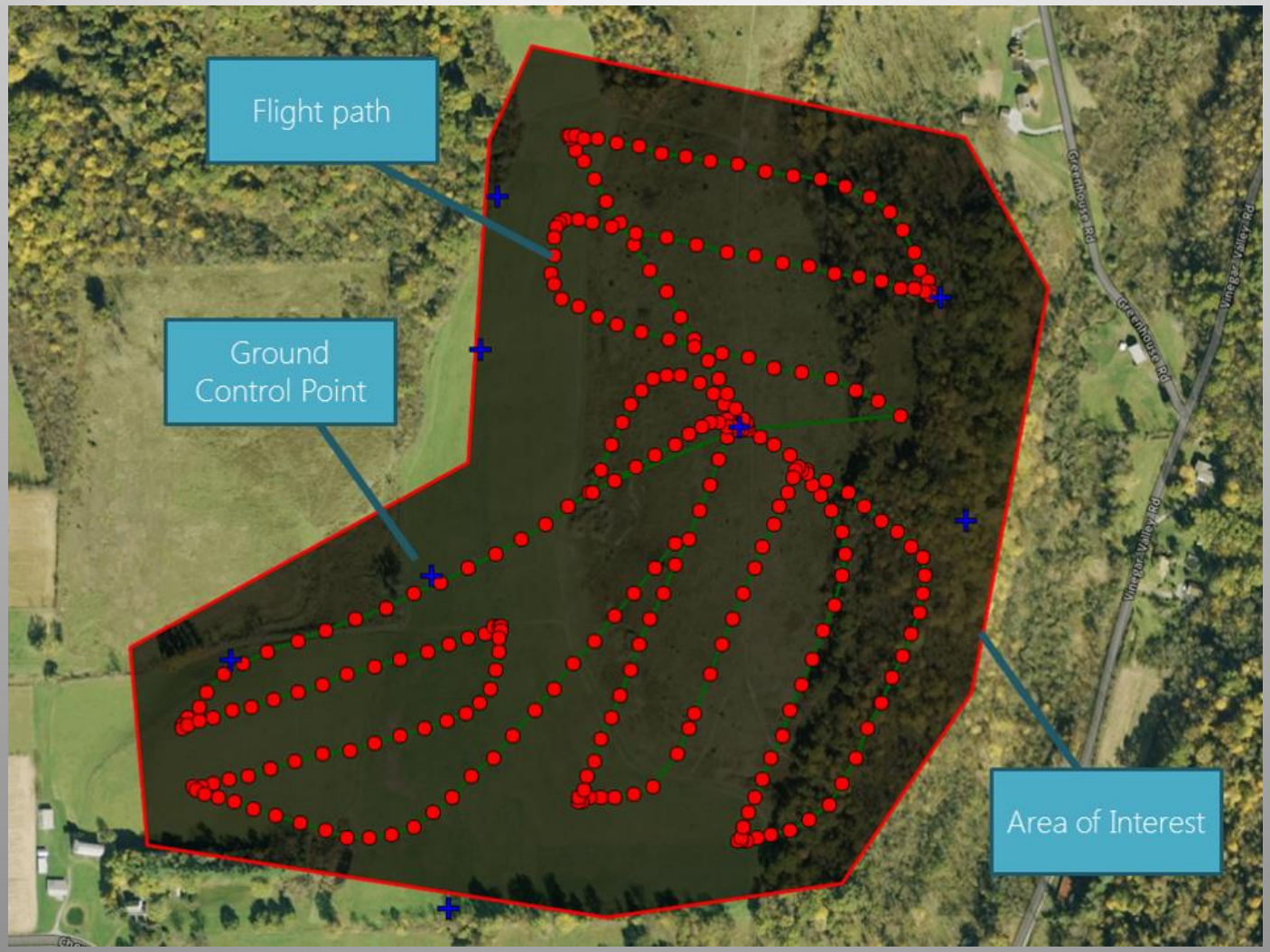
Street view – Google & "Gadefoto" - COWI



Drones

Konfiguring the drone and flight path

Flight path and area of interest



Digitale orthophoto

How to create orthophotos from satelite images, aerial photos from planes and drones?

- The images – must have overlab
- Ground control points (GCPs)
- Digital elevation model
- Software and computer power

Photo

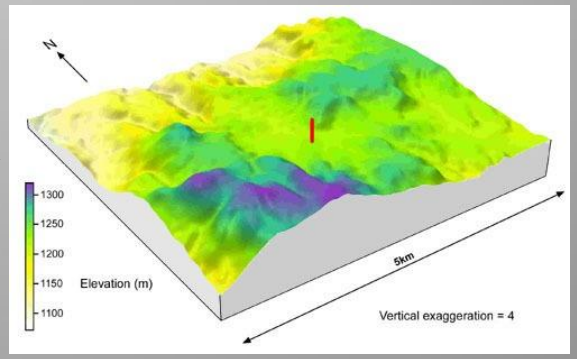
- digital photo, satellite images

Ground Control Points (GCP)

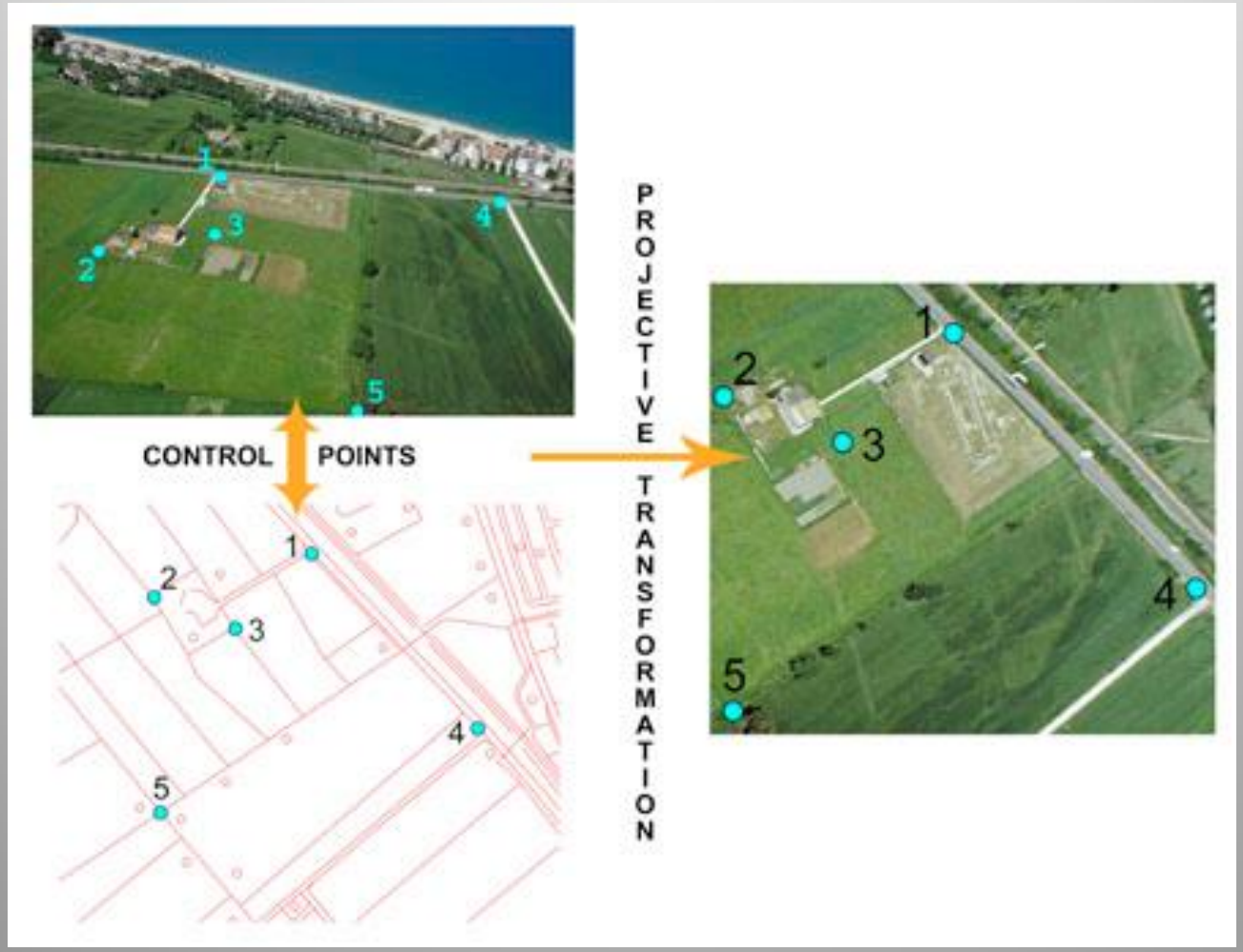
- Create GCP by the use of GPS
- GCPs from older orthophotos

Digital elevation model

- Measured in the images (manually)
- Automatic correlation + manual check (parallax)
- Existing digital elevation model



Orthophoto production -georeferencing



The advantages using Orthophotos as background in GIS

Un-interpreted information
- It is not a map

Easy to understand for an untrained map reader
- Better communication of spatial information

Flexible in use - digital format
- GIS and other software.

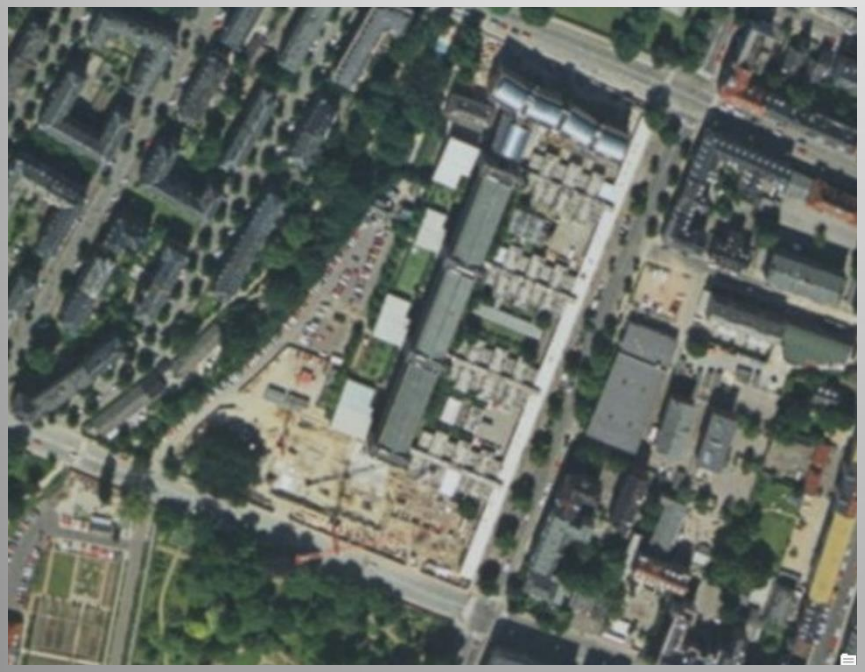
Useful as background for other layers
- It looks like the "real" World

Problems with buildings and other tall objects
- Orthophotos are normally not "true" orthophotos"

Digitale orthophotos and spatial resolution available in Denmark

Nation coverage: DDO95: 80cm; DDO99land: 40cm; DDO99by: 10cm DDO 2004: 25cm, SCANKORT 2005; 40cm, DDO 2006: 25cm, DDO 2008:12,5cm, DDO 2010: 12,5cm, DDO 2012: 10 – 20cm, DDO 2016: 10 – 20cm, DDO 2018: 30cm, DDO 2020: 12,5 cm, DDO 2022: 12,5 cm

Urban areas or municipality – down to 3cm



DDO95: 80cm

DDO2022: 12,5cm

Digitale orthophoto from the commercial market

Private Danish companies like COWI, SWECO and NIRAS can produce/deliver orthophotoes on demand.

Alternatives from satellites:

- IKONOS 1m panchromatic, 4m coulor.
- Planet panchromatic 2 m
- SPOT 10m panchromatic
- Indian IRC-1C 5m panchromatic
- Quickbird 0.65m panchromatic
- Pleiades 0.50 m panchromatic
- WorldView 1 og 2: 30cm pancromatic, 2m MS

Examples

Background as images in GIS

3D flightsimulator

3D models of cities