

Very Basic
Geographical Information System & Remote
Sensing Applications for the Environment

earthobservation.wordpress.com

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Image Interpretation



- Images of the earth are map like representations of the earth's surface based on reflections of electromagnetic energy from vegetation, soil, water, rocks, and structures.
- Yet such information is not presented to us directly-the information we seek is encoded in the various **tones and textures** we see on the image.
- To translate images into information we must apply a specialised knowledge-*knowledge that forms the field of image interpretation*, which we can apply to derive useful information from the raw, un-interpreted images we receive from remote sensing systems.

These definitions are taken from Campbell 2002:

http://books.google.com/books?id=VEFsebwUxDkC&printsec=frontcover&source=gbs_navlinks_s#v=onepage&q=&f=false

What are we looking for?

- Knowledge of the subject :Accurate interpretation requires familiarity with the subject of the interpretation.
- Image interpreters should be equipped with a broad range of knowledge and experince across earth and biological sciences.

- The Human Image Processing Continuum

- natural perception (*looking*) ->

- abduction (*hunch*) ->

- convention (*experience/teaching*)->

- cognitive (*Understanding*)

<http://spot.colorado.edu/~moriarts/reprsntn.html>

First Questions

- Where am I Looking?
- What system took the image?
- When was it taken?

Remember.

- (1) Remotely sensed imagery usually presents an overhead view.
- (2) Many remote sensing images use radiation outside the visible portion of the spectrum.
- (3) Remote sensing images often portray the earth's surface at unfamiliar scales and resolutions.

Elements

- Tone/Colour
- Size, Shape & Texture
- Pattern, Shaddow
- Location, Context

1. Image Tone



FIGURE 7: Aerial Photograph illustrating Proposed Landfill Site and Environs

2. Image Texture

two definitions>

Image texture refers to the apparent roughness or smoothness of an image in a region. Usually texture is caused by the pattern of highlighted and shadowed areas as an irregular surface is illuminated from an oblique angle.

Image texture depends on the surface itself and the angle of illumination, so it can vary as lighting varies. Good rendition of texture depends on favourable image contrast, so images of poor or marginal quality may lack the distinct textural differences so valuable to the interpreter.

*Alt:*Texture is the frequency of change and arrangement of tones. This is a micro image characteristic. The visual impression of smoothness or roughness of an area can often be a valuable clue in image interpretation. Still water bodies are typically fine textured, grass medium, brush rough. There are always exceptions though and scale can and does play a role; grass could be smooth, brush medium and forest rough on higher altitude aerial photograph of the same area.



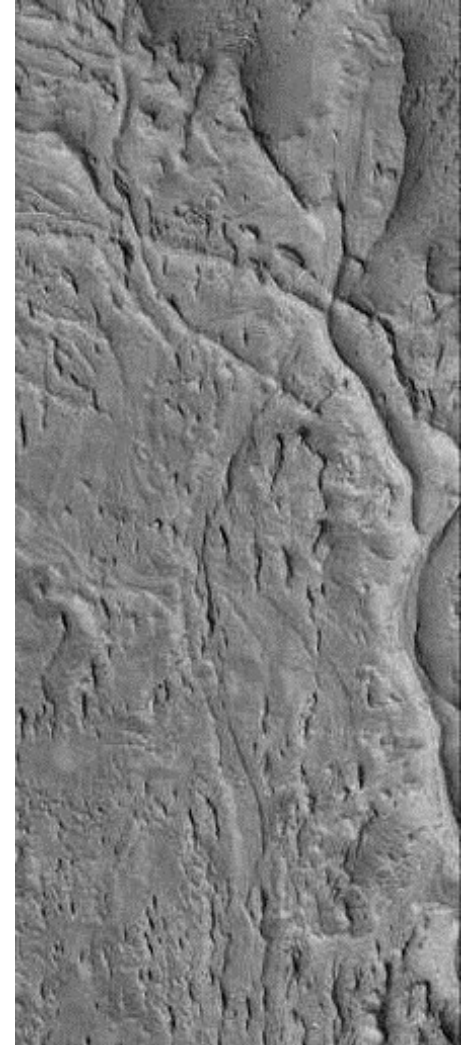
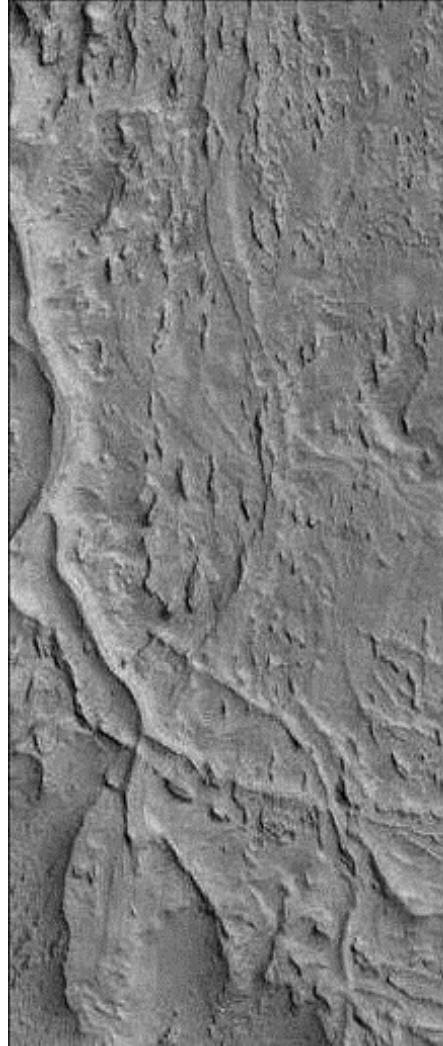
3. Shadow

- Shadow is crucial in telling us about relative size and position



Relief inversion

- We expect images to be illuminated from above and for images to be orientated with north at the top- this can cause problems



4. Pattern

- It must be noted here that pattern is highly scale dependent.



5. Association/context

Association is a functional relationship:

You can't have a railway station without a railway line



6.Shape & Size

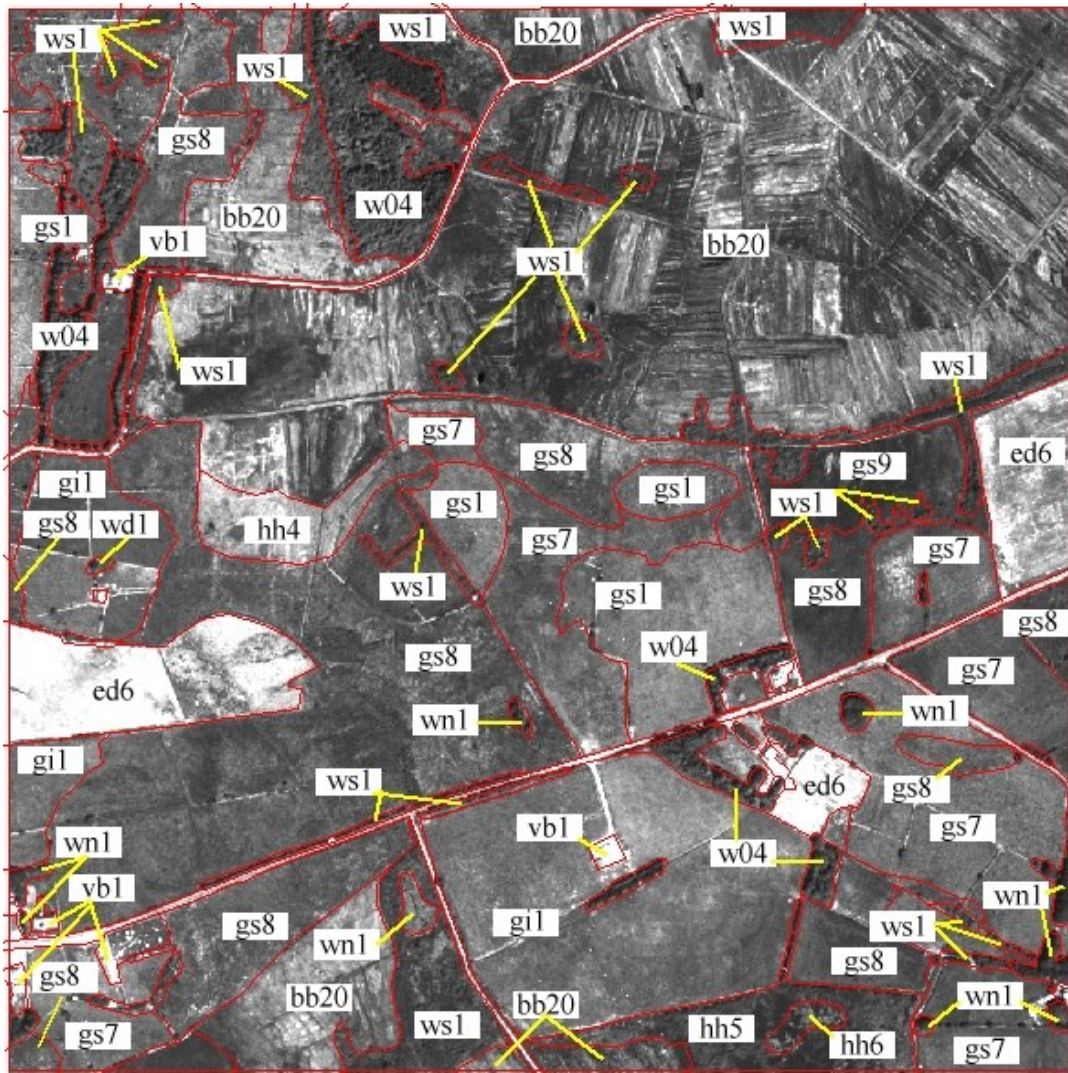
Size can be absolute if you have a scale or it can be relative; one thing is bigger than the other



8. Location

Location is about position in landscape, especially in relation to topography

Photomorphologic Regions



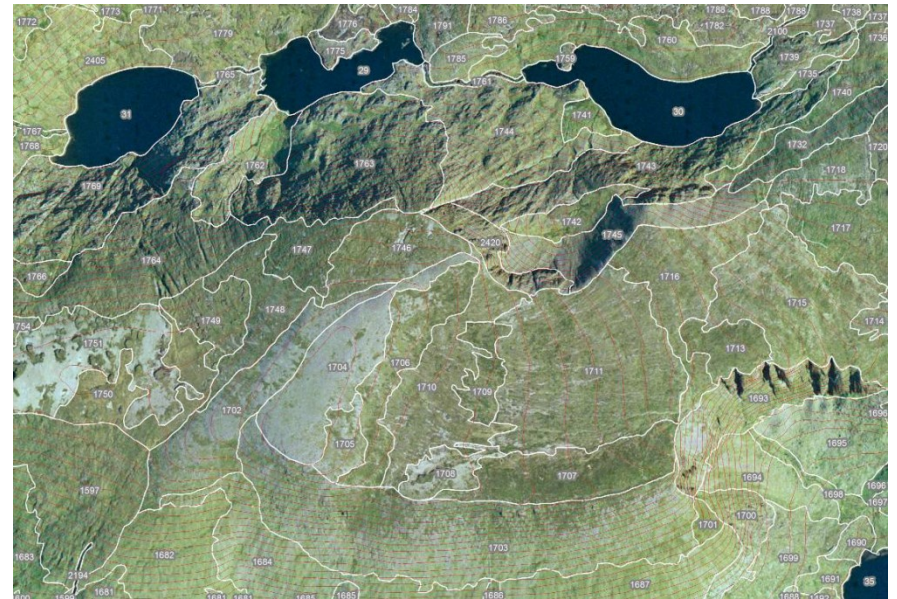
Photomorphic Regions

- In the first step the interpreter delineates regions of uniform image appearance, using tone, texture, shadow, and the other elements of image interpretation as a means of separating regions.
- In the second step the interpreter must be able to match photomorphic regions to useful classes of interest to the interpreter.

National Grasslands Survey

Done by hand
digitising of regions.

Now can do
automatically
through Image
Segmentation







High pressure dominated northern latitudes during August 2003, causing bright sunshine and intense heat over Ireland.

Here uncharacteristically devoid of cloud cover in this reduced-resolution Medium Resolution Imaging Spectrometer (MERIS) image

LIST of MAIN satellite imaging systems for Irish use in RS of Land



Landsat
Terra-aster
SPOT
EROS
IKONOS
QuickBird
Radarsat
ENVISAT
ERS
worldView
IRS
DMC

ESA has created the Copernicus program for earth observation- the main component is the Sentinel Constellation of satellites

We will be using SENTINEL 2

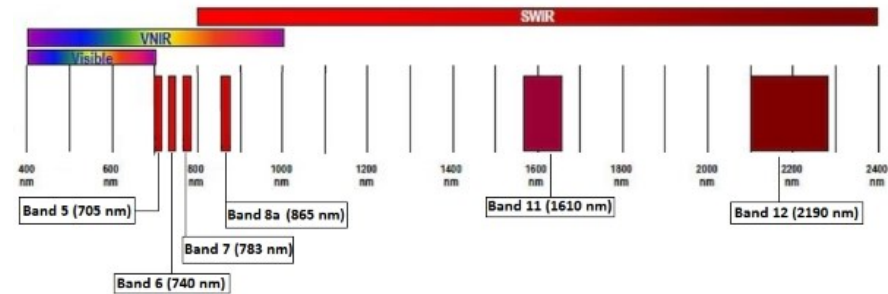
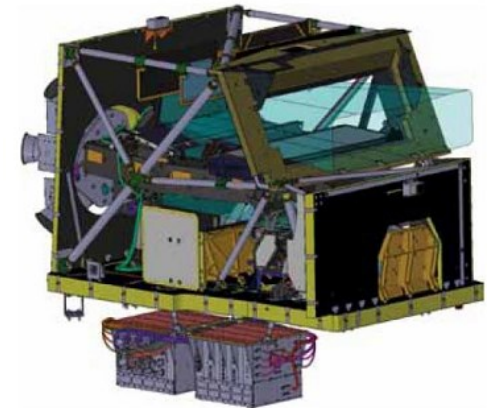


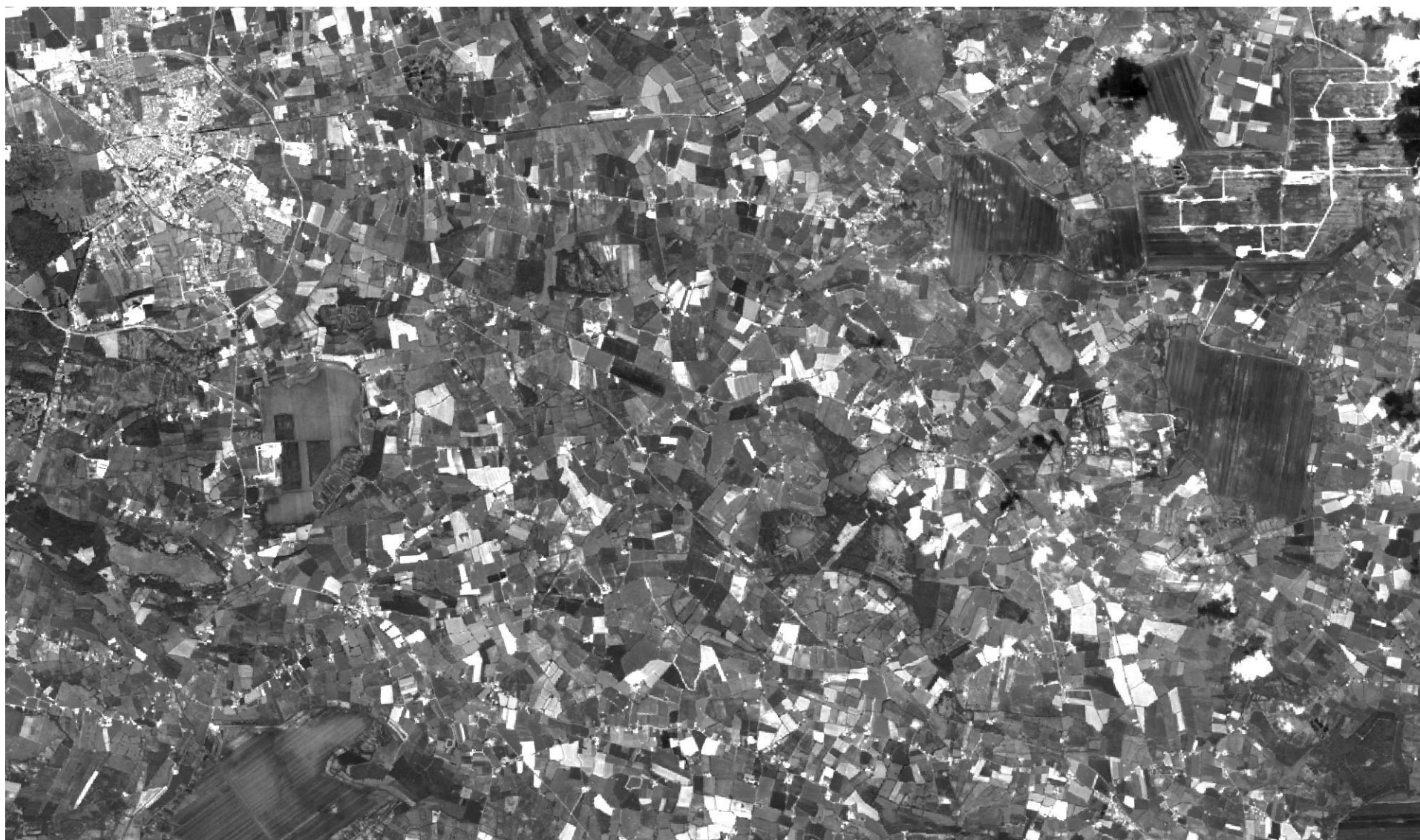
Multiple Bands

- Remember a satellite doesn't just record an image in RED, GREEN and BLUE light. The satellite is able to record information across a wider spectrum and with more discrimination

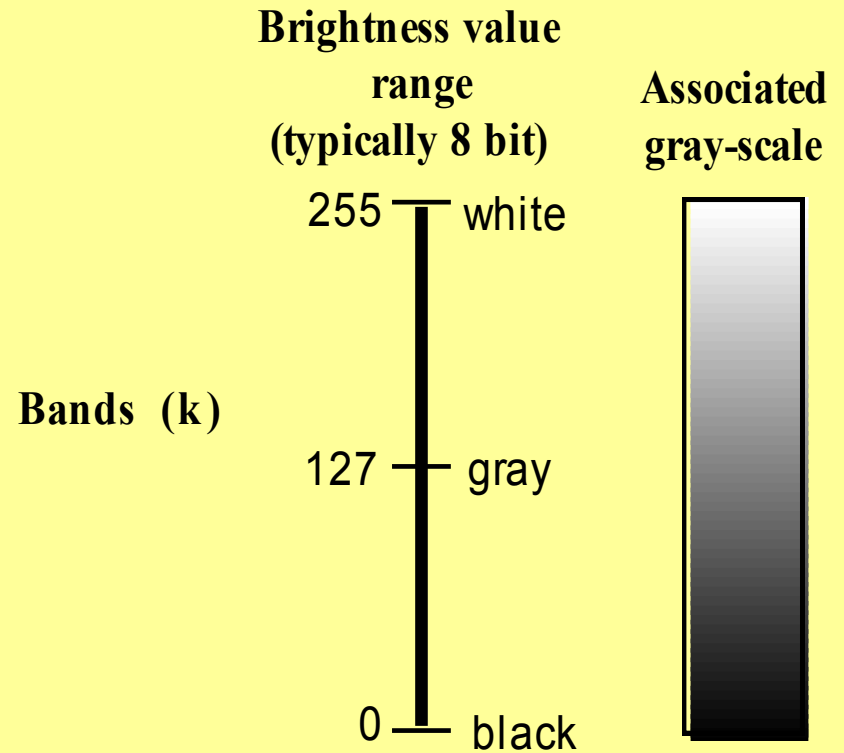
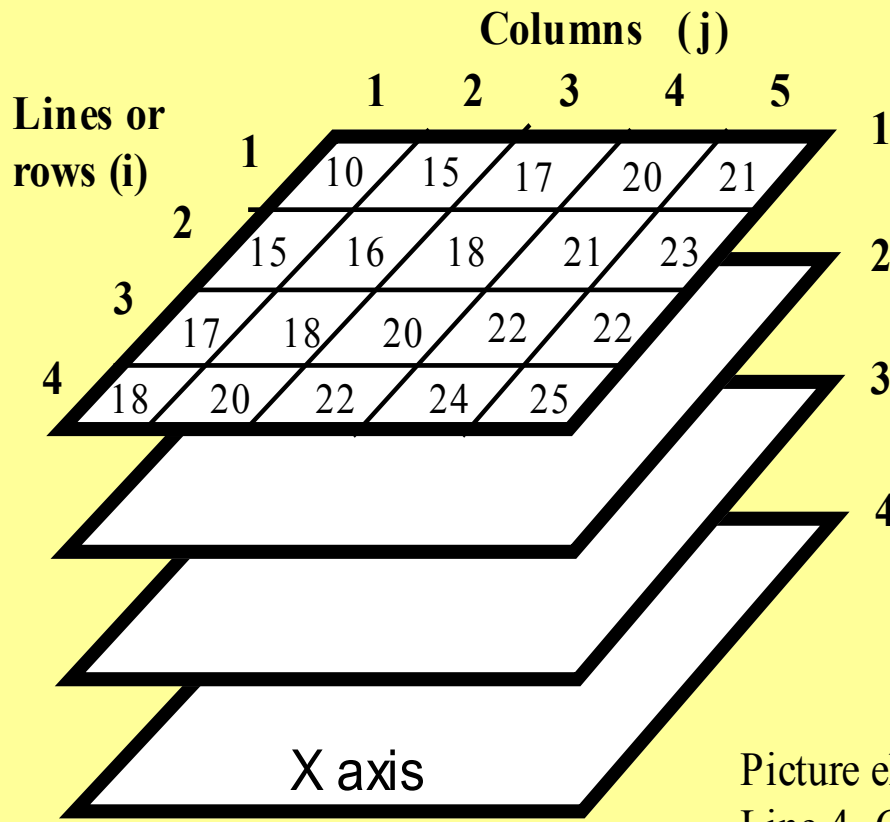
Characteristics of Sentinel 2 – MSI camera

Band number	Spatial Sample Distance (m)	Central wavelength (nm)	Bandwidth (nm)
1	60	443	20
2	10	490	65
3	10	560	35
4	10	665	30
5	20	705	15
6	20	740	15
7	20	783	20
8	10	842	115
8a	20	865	20
9	60	945	20
10	60	1 375	30
11	20	1 610	90
12	20	2 190	180





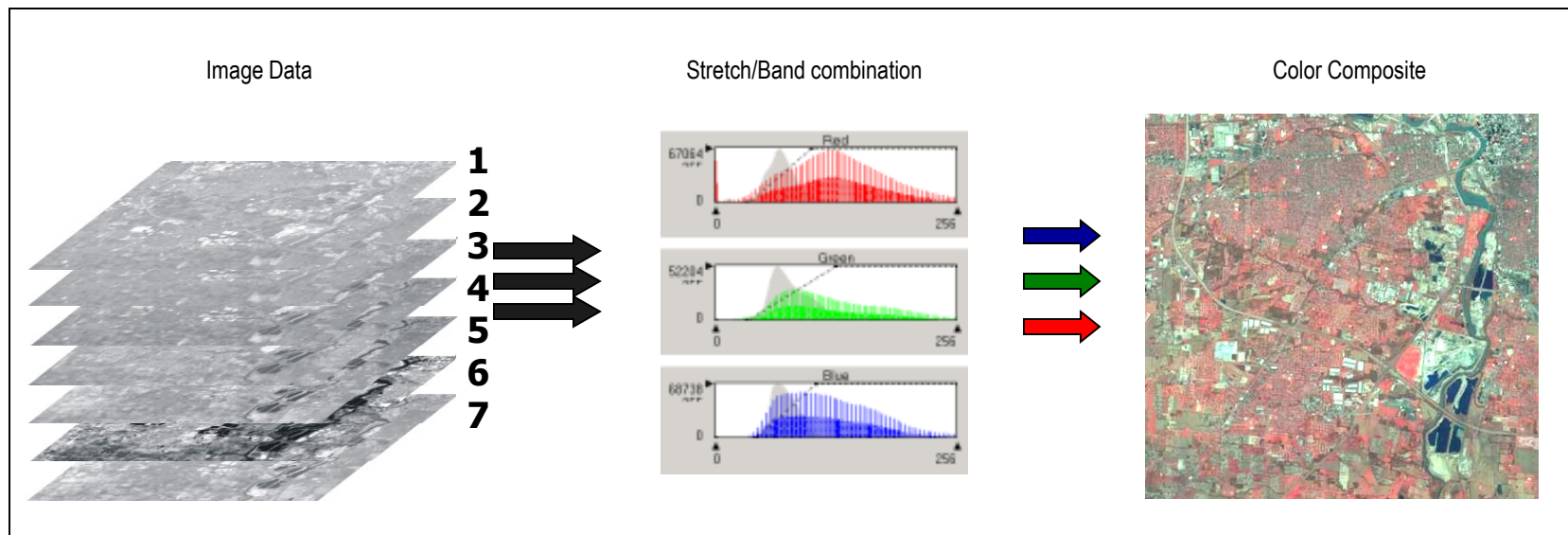
<http://fiesta.bren.ucsb.edu/~dozier/Class/ESM266/Slides/04-Multispectral.ppt>

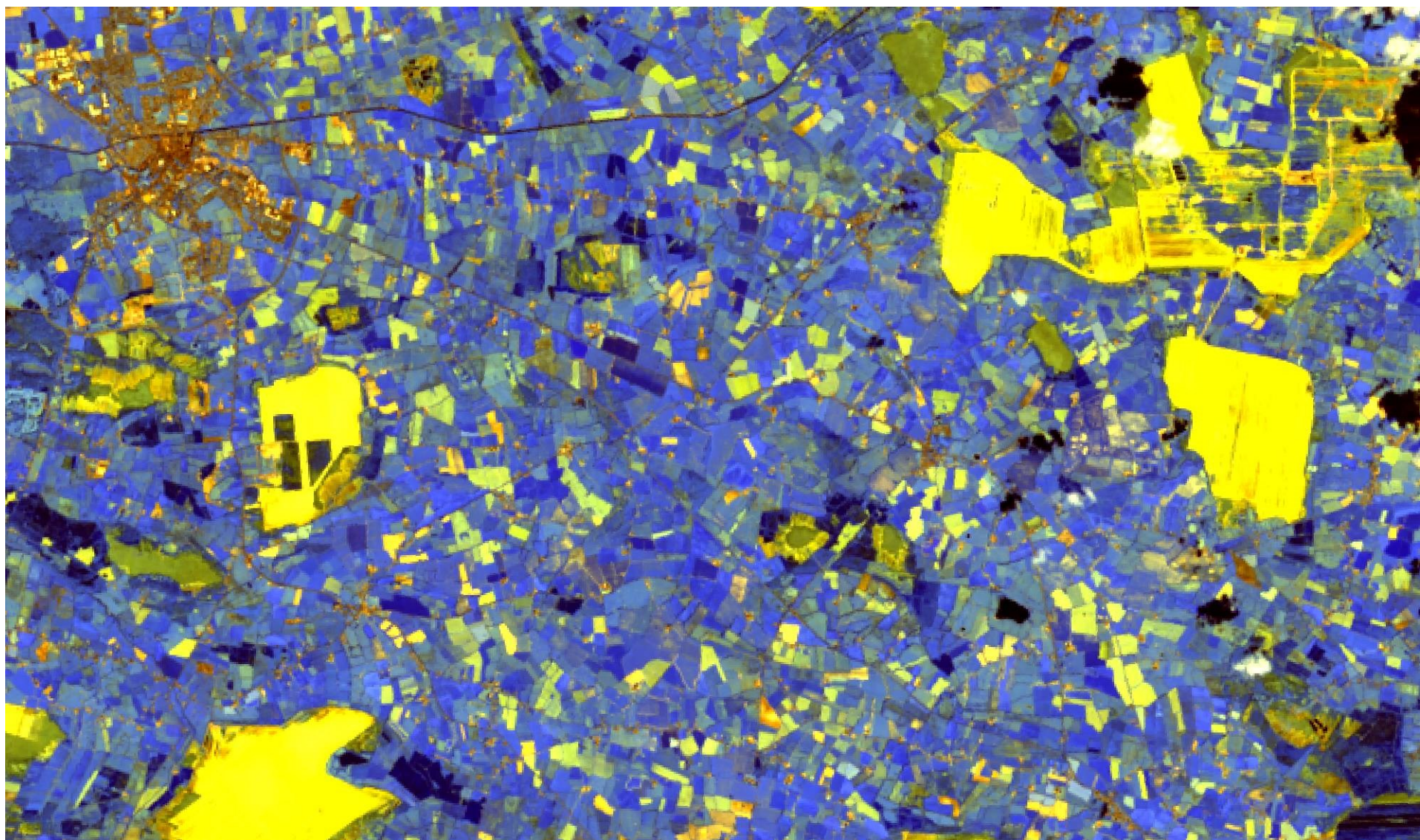


Picture element (pixel) at location Line 4, Column 4, in Band 1 has a Brightness Value of 24, i.e., $BV_{4,4,1} = 24$.

Image display

Selected bands are remapped (stretched) to fit the display device. The output image color space is called a look-up table.





The Band Combinations of S2 images for different applications

<http://step.esa.int/main/toolboxes/snap/>

- Natural Colors: 4 3 2
- False color Infrared: 8 4 3
- False color Urban: 12 11 4
- Agriculture: 11 8 2
- Atmospheric penetration: 12 11 8a
- Healthy vegetation: 8 11 2
- Land/Water: 8 11 4
- Natural Colors with Atmospheric Removal: 12 8 3
- Shortwave Infrared: 12 8 4
- Vegetation Analysis: 11 8 4



Image Interpretation Keys

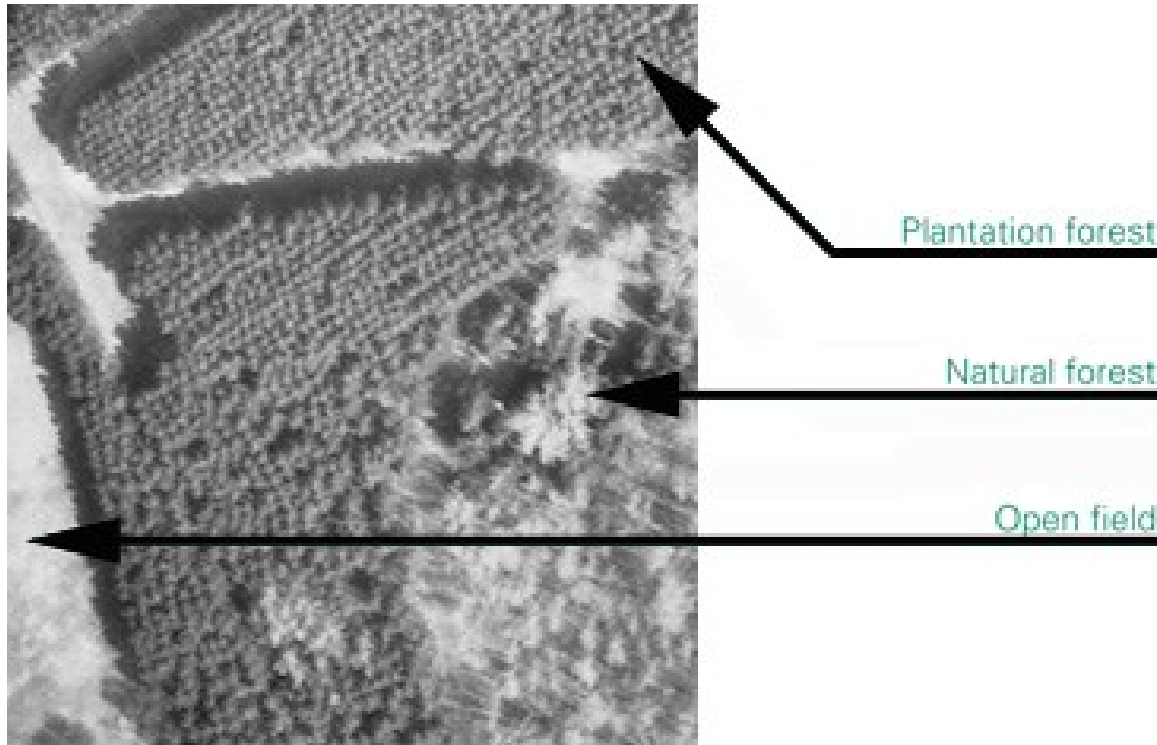
- The key is a means of organising the essential characteristics of a topic in an orderly manner. It should be noted that scientific keys of all forms require a basic familiarity with the subject matter.
- Keys designed solely for use by experts are referred to as **technical keys**.
- **Nontechnical keys** are those designed for use by those at a lower level of expertise.
- OR
- **Essay keys** consist of extensive written descriptions, usually with annotated images as illustrations.
- **A file key** is essentially a personal image file with notes; its completeness reflects the interests and knowledge of the compiler. Its content and organisation suit the needs of the compiler, so it may not be organised in a manner suitable for use by others.

Table 7.5.1 Interpretation keys for forestry

species	crown shape	edge of crown	tone	pattern	texture
ceder	conical with sharp spear	circular and sharp	dark	spotted grain	hard and coarse
cypress	conical with round crown	circular but not sharp	dark but lighter than ceder	spotted	lard and fine
pine	cylindrical with shapeless crown	circular but unclear	light and unclear	irregularly spotted	soft but coarse
larch	conical with unclear crown	circular with unclear edge	lighter than cypress	spotted	soft and fine
fir/spruce	conical with wider crown	circular with zigzag edge	dark and clear	irregular	coarse
deciduous	irregular shapes	unclear	lighter	irregular	coarse

(by country of Japan Association of Forestry)

Interpretation Keys Often provide examples

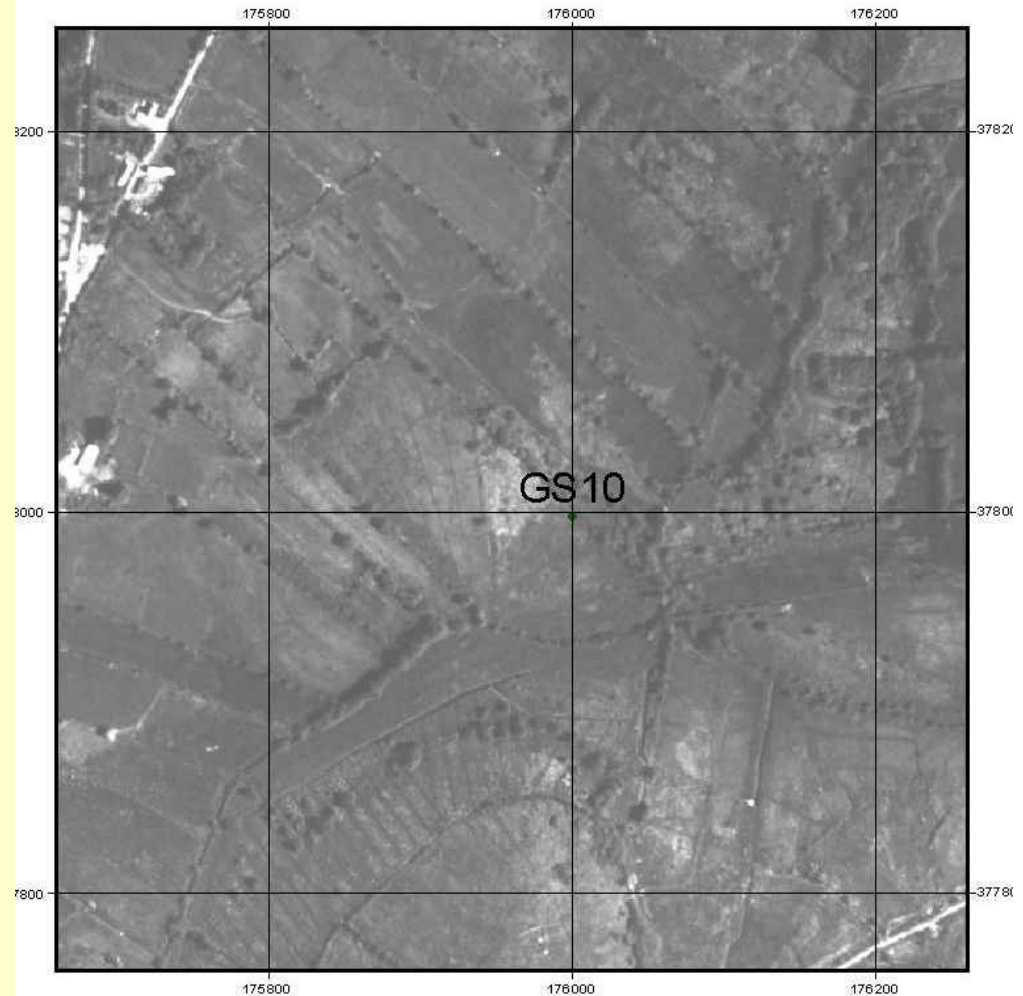


Land Cover

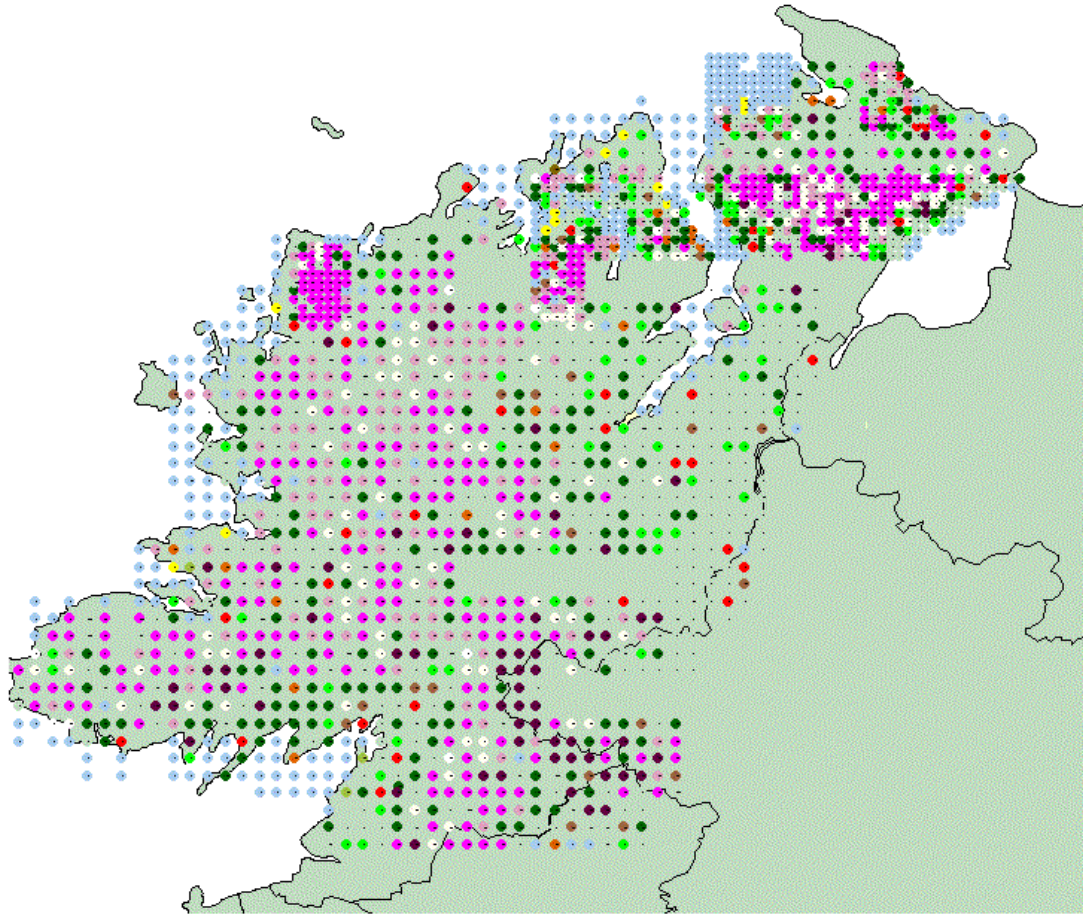


Sample Point Classification

- Stereo photography.
(B&W, 1995)
- Interpretation using soft copy photogrammetric station.
- Intersection of northings and eastings at 2km intervals.
- Labelled according to a classification aligned to “*A Guide to Habitats in Ireland*”, Heritage Council.

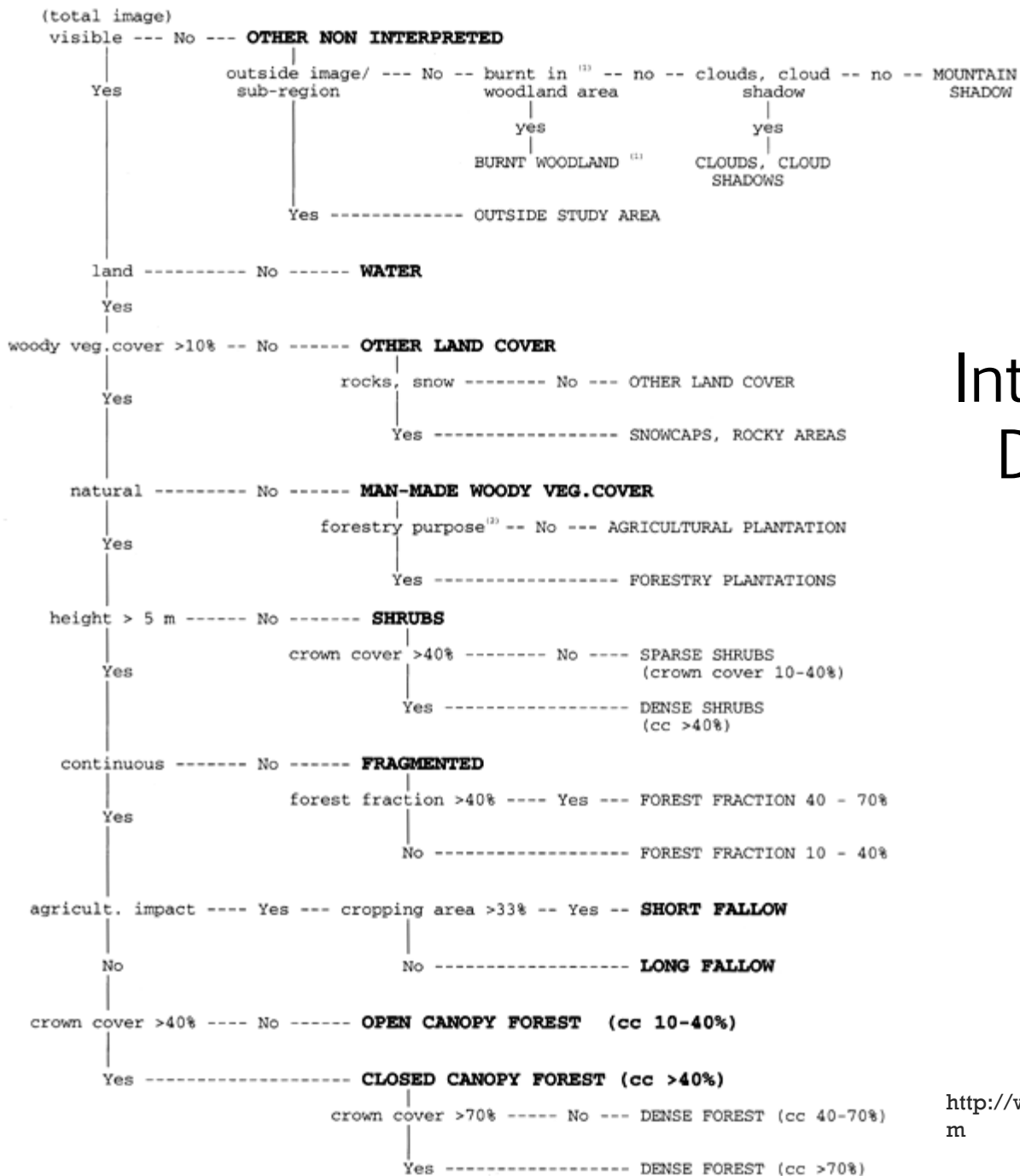


Sample Point Classification

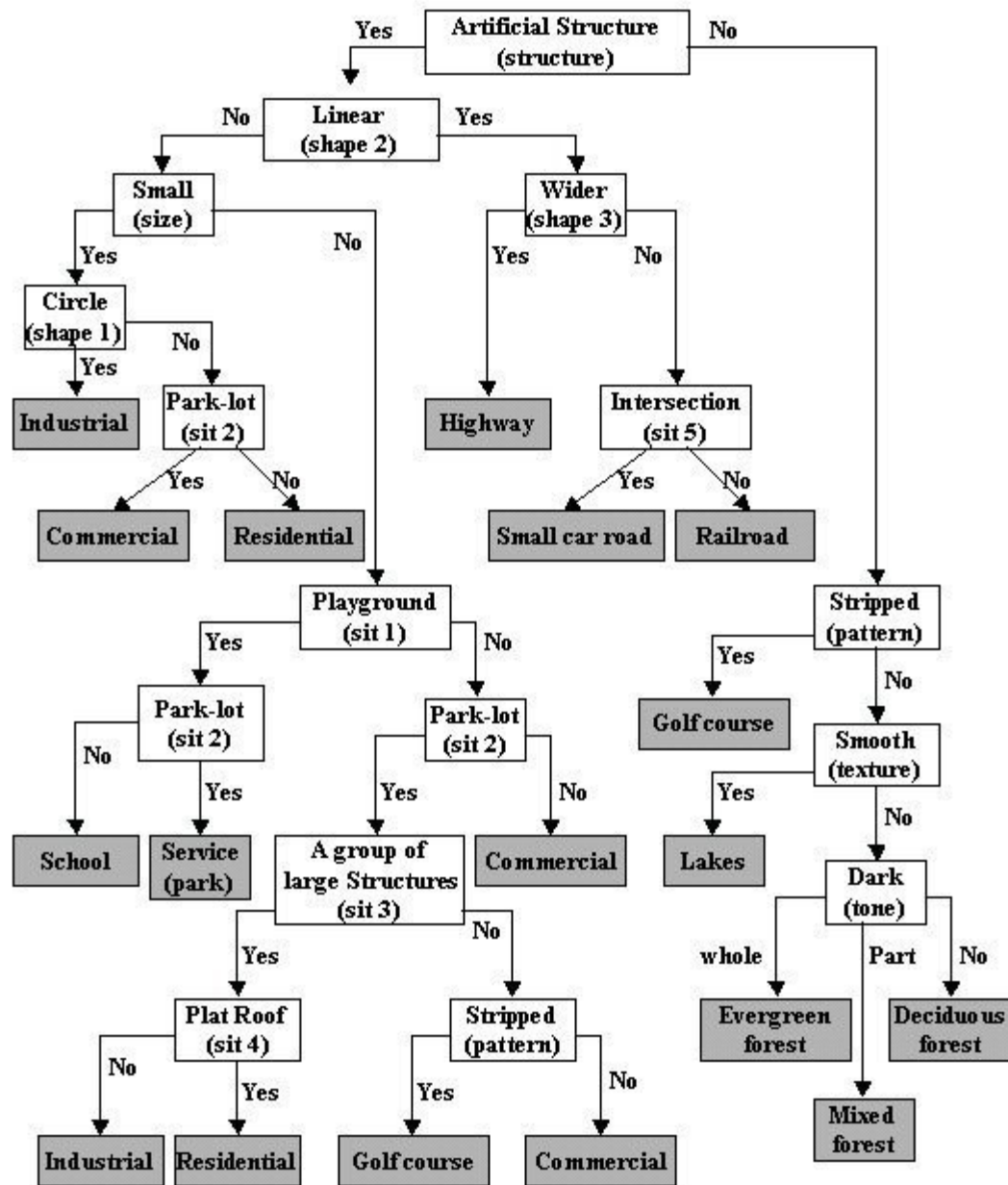


LAND COVER CLASS

- | | | |
|----------------------|----------------------|--------------------|
| ● Recently Felled | ● Improved Grassland | ● Up. Blanket Bog |
| ● Recently Planted | ● Low. Dry Grassland | ● Low. Blanket Bog |
| ● Conifer Plantation | ● Machair | ● Cutover Bog |
| ● Native Scrub | ● Up. Dry Grassland | ● Raised Bog |
| ● Native Woodland | ● Low. Wet Grassland | ● Wet Heath |
| ● Mixed Woodland | ● Up. Wet Grassland | ● Dry Heath |
| ● Dune | ● Flush | ● Unclassified |
| | ● Freshwater Marsh | ● Built Land |
| | ● Mosaic G R H | ● Bare Ground |





Interpretation as Decision Tree



What to map?

- Deciding what to map can be tricky.
- You need meaningful classes that work for the user but are distinguishable on the image.
- You need to try and avoid confusing classes but some ambiguity is inevitable

Level 0	Level 1	L2	L3	L4	FOSSITT		
Grassland	Improved Grassland [GA]	DRY [GAd]					
		Reclaimed [GAr]					
	Semi- Improved Grassland [GS]	Wet [GSw]					
		Dry [GSd]	Humic [GSdh]				
			Calcareous [GSdc]				
Forest land Settlement Water Peatland Cropland	Not Grassland [NA]						

HELM - Harmonised European Land Monitoring

- Introduced by the increase of national land monitoring activities in Europe
- Funded by Seventh Framework Programme of the European Commission (2011-2013)

Overall goal of HELM

“A move initiated that will make European land monitoring more productive by increasing the alignment of national and sub-national level land monitoring endeavours and by enabling their integration to a coherent European Land Use and Land Cover (LULC) data system”

- As part of this, the EAGLE –group (European Action Group on Land monitoring in Europe) contributed to the dialog

→ **EAGLE data model**

http://www.umweltbundesamt.at/fileadmin/site/en/pdf/HELM_Book_2nd_Edition.pdf

