UNIVERSITY OF TWENTE.

REMOTE SENSING FOR NATURAL HAZARDS

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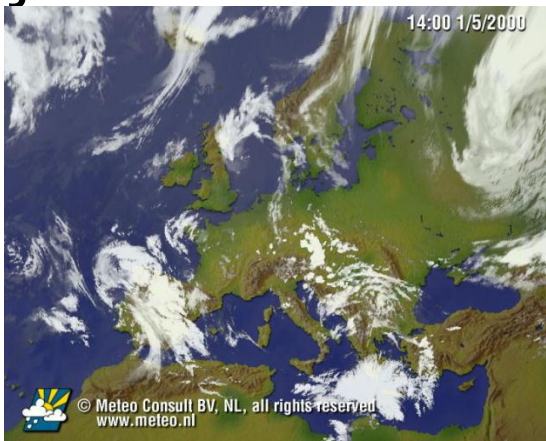
DEFINITION

Remote Sensing is the science or the technique of deriving information about objects at the Earth surface from images using (parts of) the electromagnetic spectrum

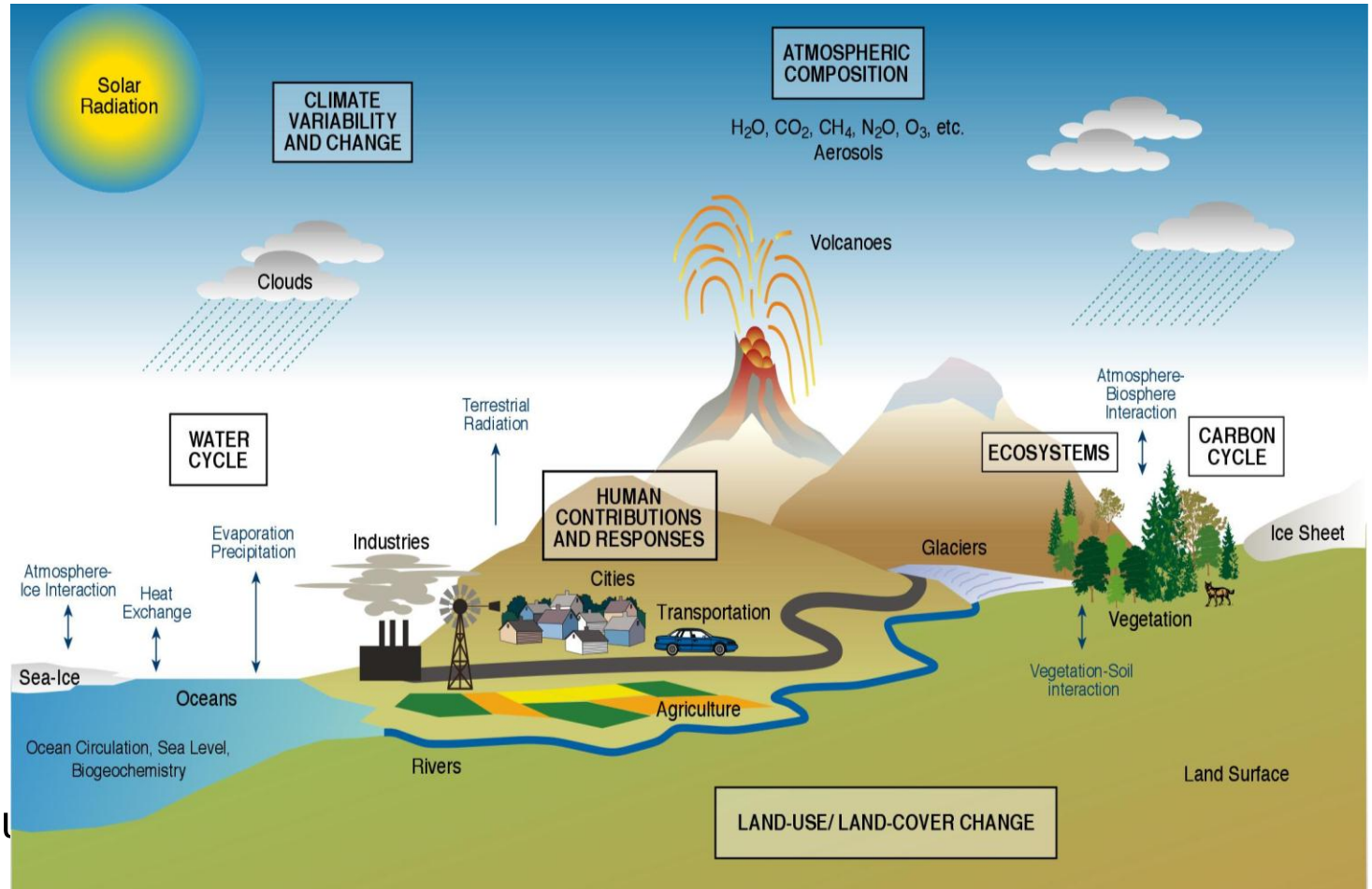
- Measuring electromagnetic energy (light), reflected or emitted
- Non-destructive method, no physical contact

- Surveying the spatial distribution of objects
- Determining properties of objects
- Monitoring the dynamics of features

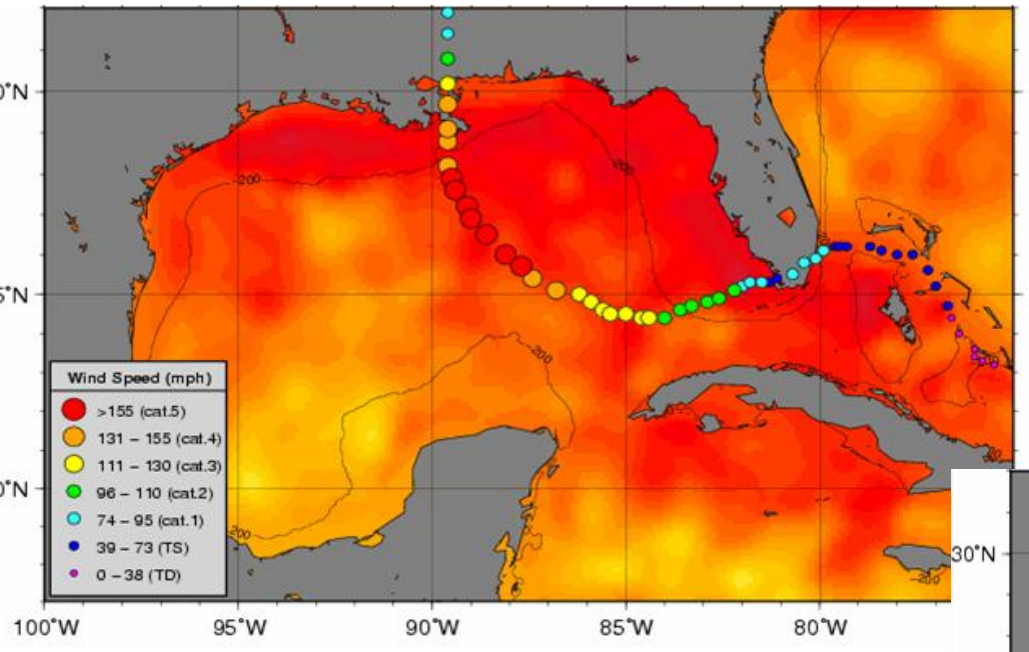


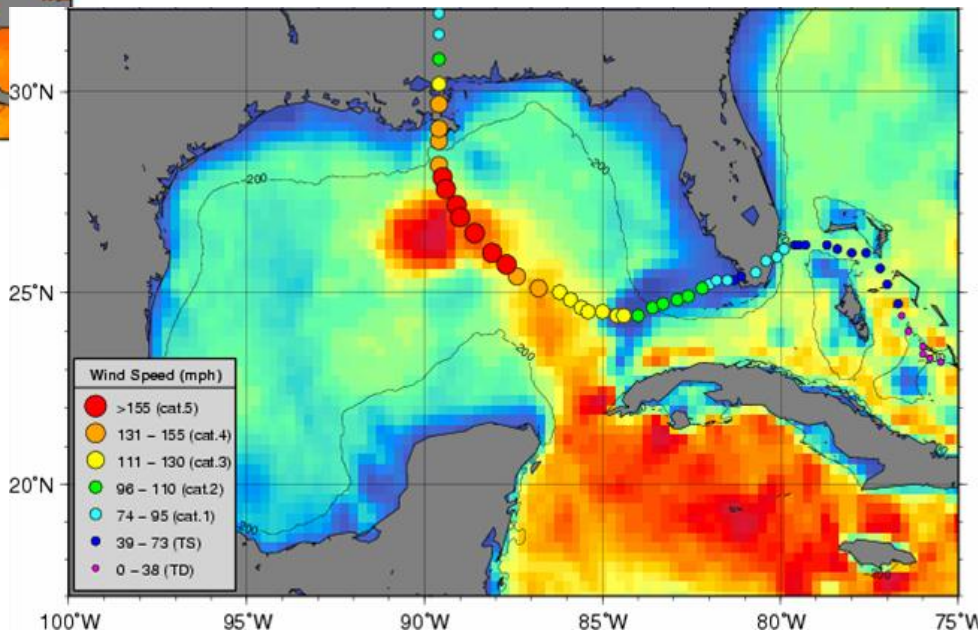
RS AND YOUR PROBLEMS

- Any Single Problem Requires Many Data Sets
- A Single Data Set Will Serve Many Communities

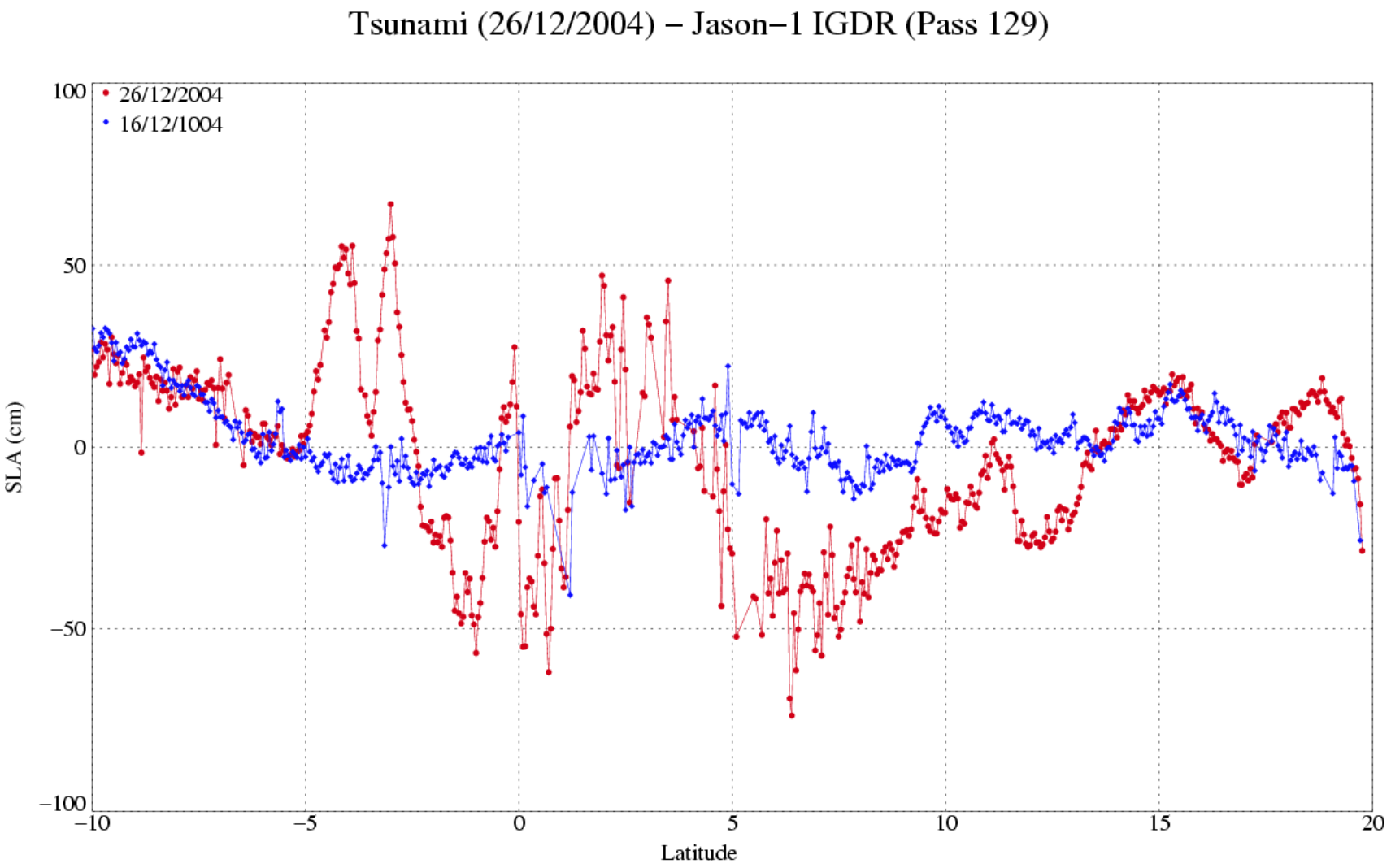


EXPERT INFO AND ADVANCED PROCESSING

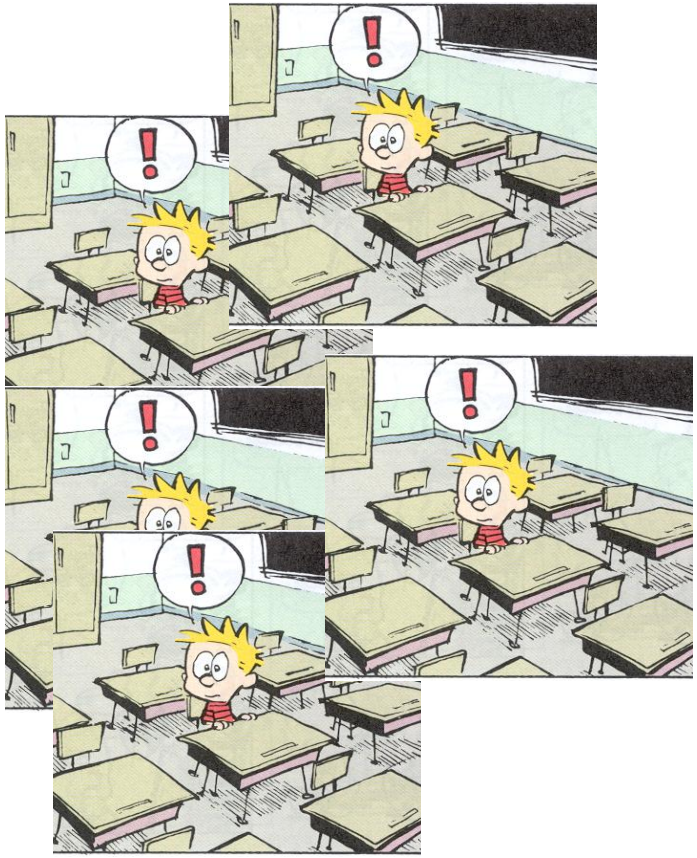


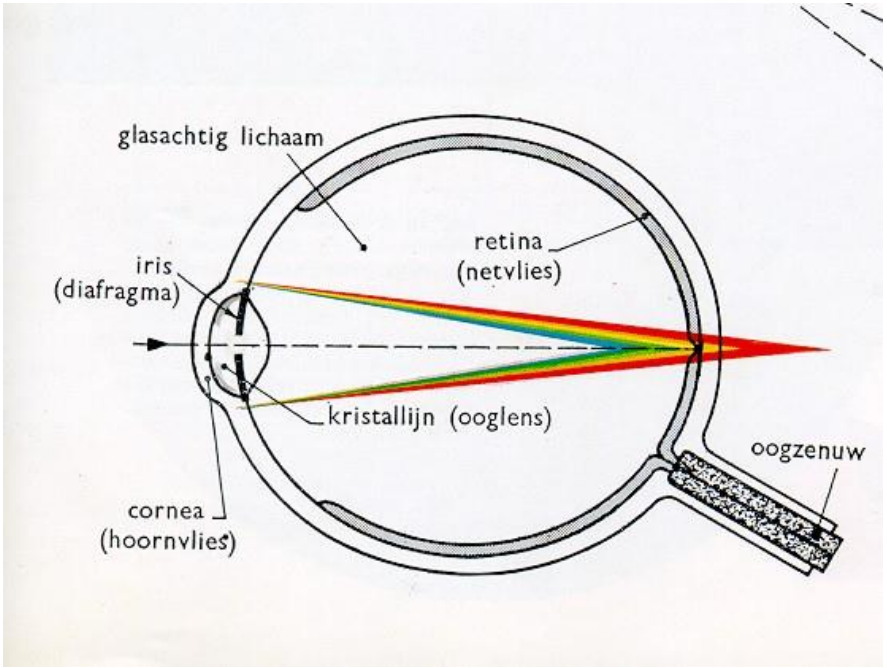


TSUNAMI UNDERSTANDING



FOLLOWING THIS LECTURE, YOU APPLY REMOTE SENSING





However, all your experiences will vary! Why are we not seeing and hearing the same? And do we when we work with RS data?

EXERCISE

- How do we actually extract (geological) information from images?
- **What are the criteria?**
- Which methods can be employed?
- How can it support mapping?
- What are the success factors?

RS DATA PROCESSING FLOW

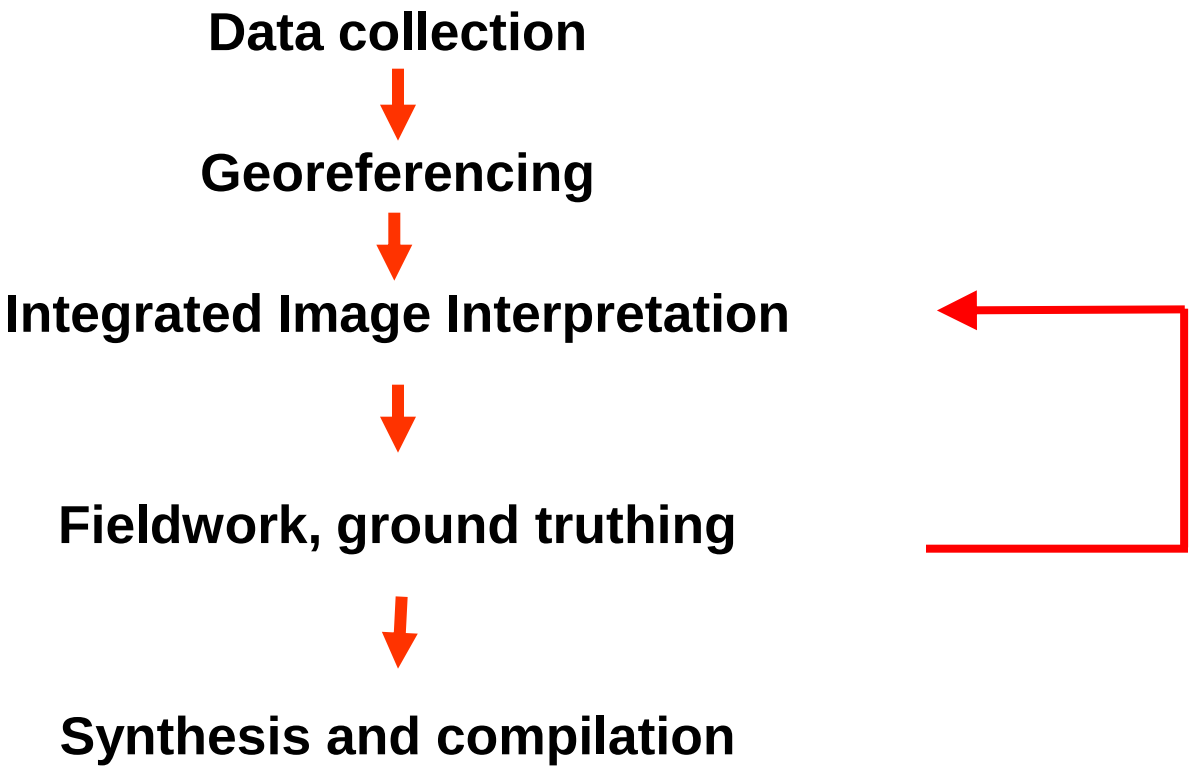


IMAGE INTERPRETATION – DEFINITION

Image interpretation can be defined as:

- The **study of the imaged objects** using the image/photo interpretation criterias,
- The **extraction** of those features relevant to the object of study,
- The **analysis** of the selected features with the objective to come to a deduction of their significance for the specific field of study.

MANUAL VS DIGITAL ANALYSIS

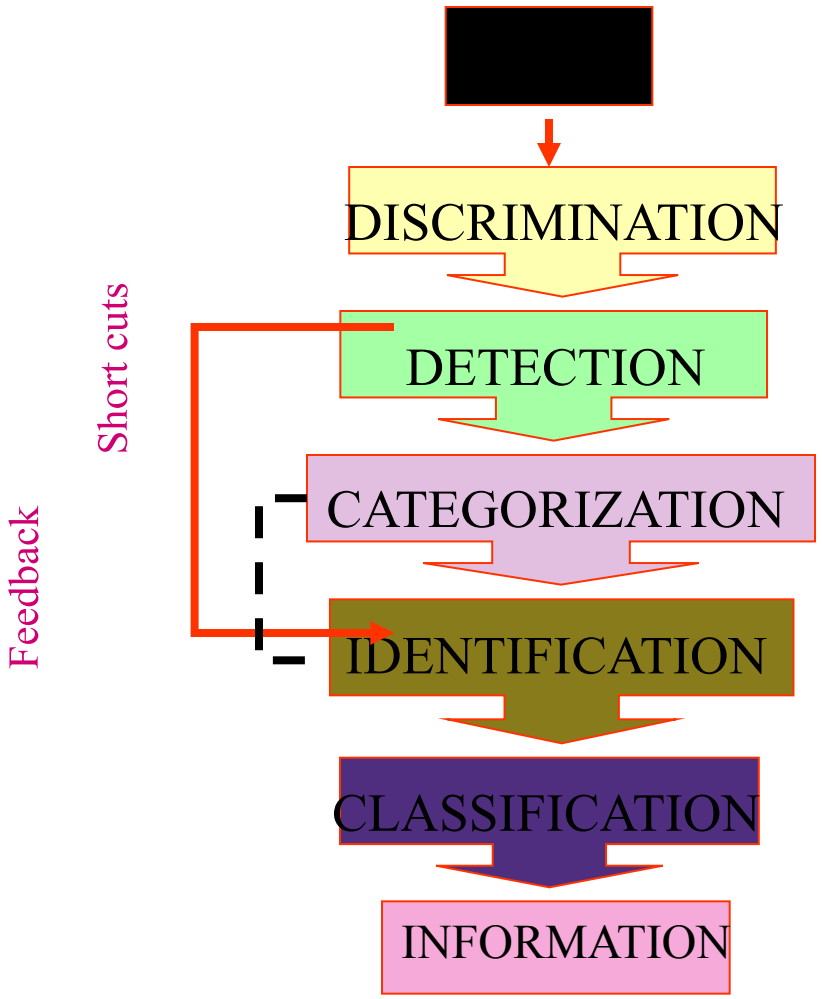
MANUAL INTERPRETATION

- Traditional: intuitive.
- Simple, inexpensive equipment.
- Uses brightness and Spatial content of the image.
- Usually single channel data or three channels at most.
- Subjective, concrete, qualitative.

DIGITAL INTERPRETATION

- Recent: requires specialized training
- Complex, expensive equip.
- Relies chiefly upon brightness and spectral content, limited spatial.
- Frequent use of data from several channels.
- Objective, abstract, quantitative.

DIFFERENT STEPS IN IMAGE ANALYSIS



Remotely sensed datasets

Is targets distinguishable from background? ("separability')

Selective picking out things of informational value

Partitioning and coding

"Recognition"

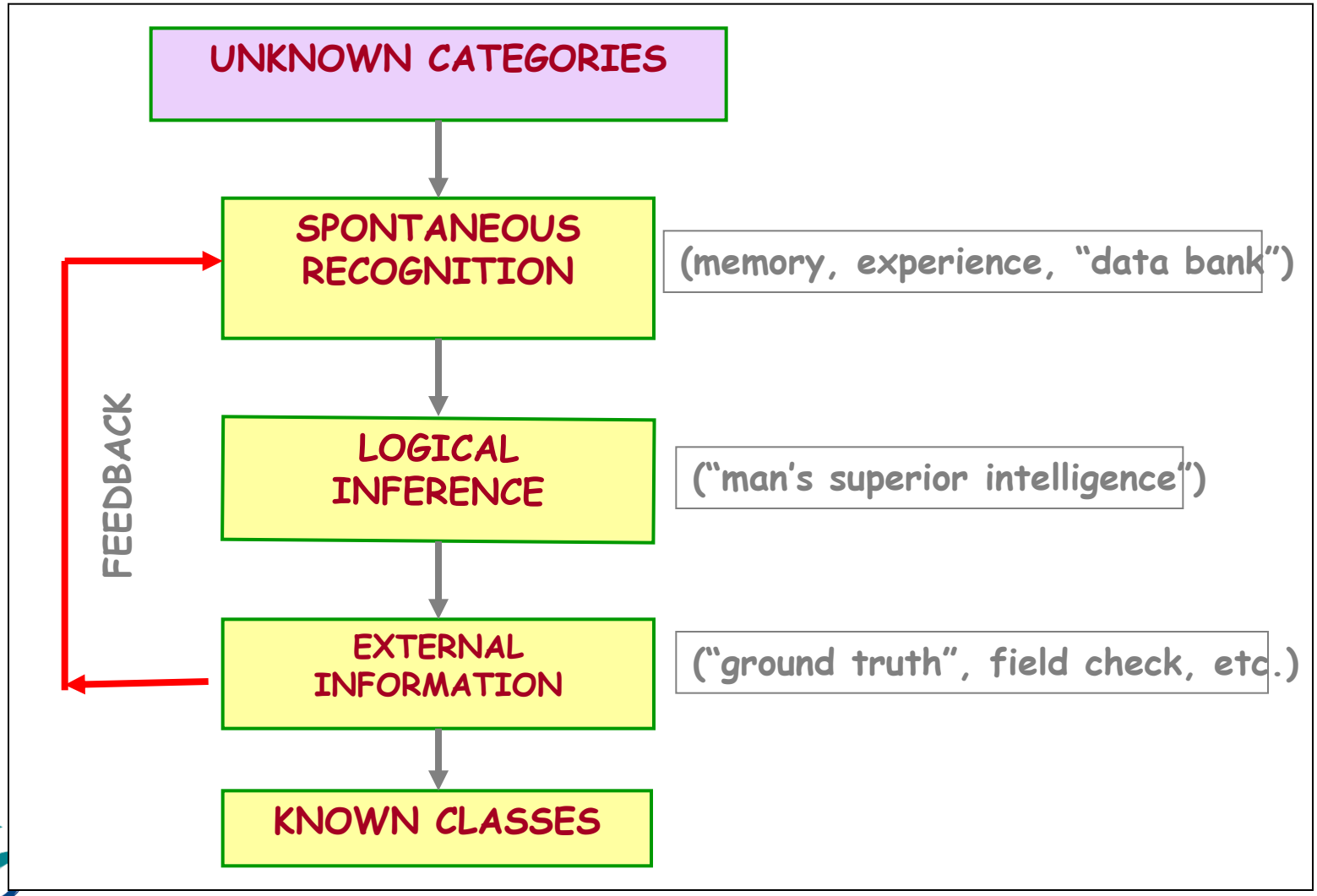
Is a "discipline-oriented" kind of classification

IDENTIFICATION

IDENTIFICATION IS A RECOGNITION PROCESS

YOU CAN ONLY IDENTIFY SOMETHING BY COMPARING IT WITH SOMETHING ELSE WHICH YOU ALREADY HAVE GIVEN A NAME

RECOGNITION PROCESS IN VISUAL ANALYSIS



THE RESULT OF AN IMAGE INTERPRETATION

The result of an image interpretation
is a function of the
reference level of the image interpreter

determined by:

- professional knowledge
- experience in image interpretation
- local knowledge

7 INTERPRETATION CRITERIA - YOUR EYES ONLY

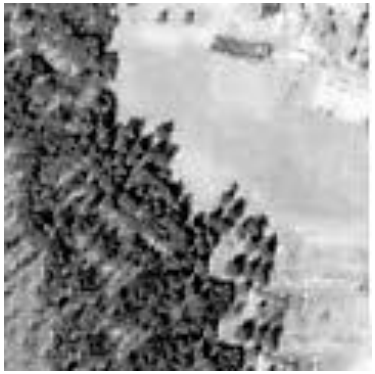
Association

Pattern

Shadow

Shape

Size



Texture

Tone

colour

TONE

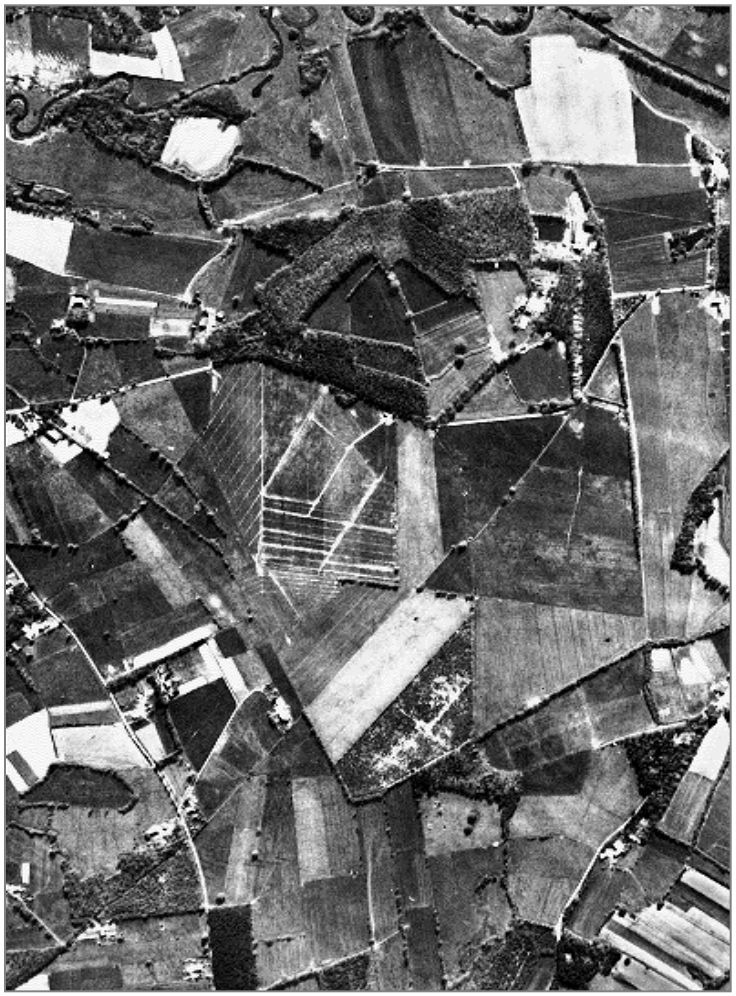
Tone = Density value

Variations in greytone are the main interpretation element used in differentiating landuse in this image.

The dark greytones correspond to forested areas.

The lighter greytones correspond to agriculture fields with different types of crops.

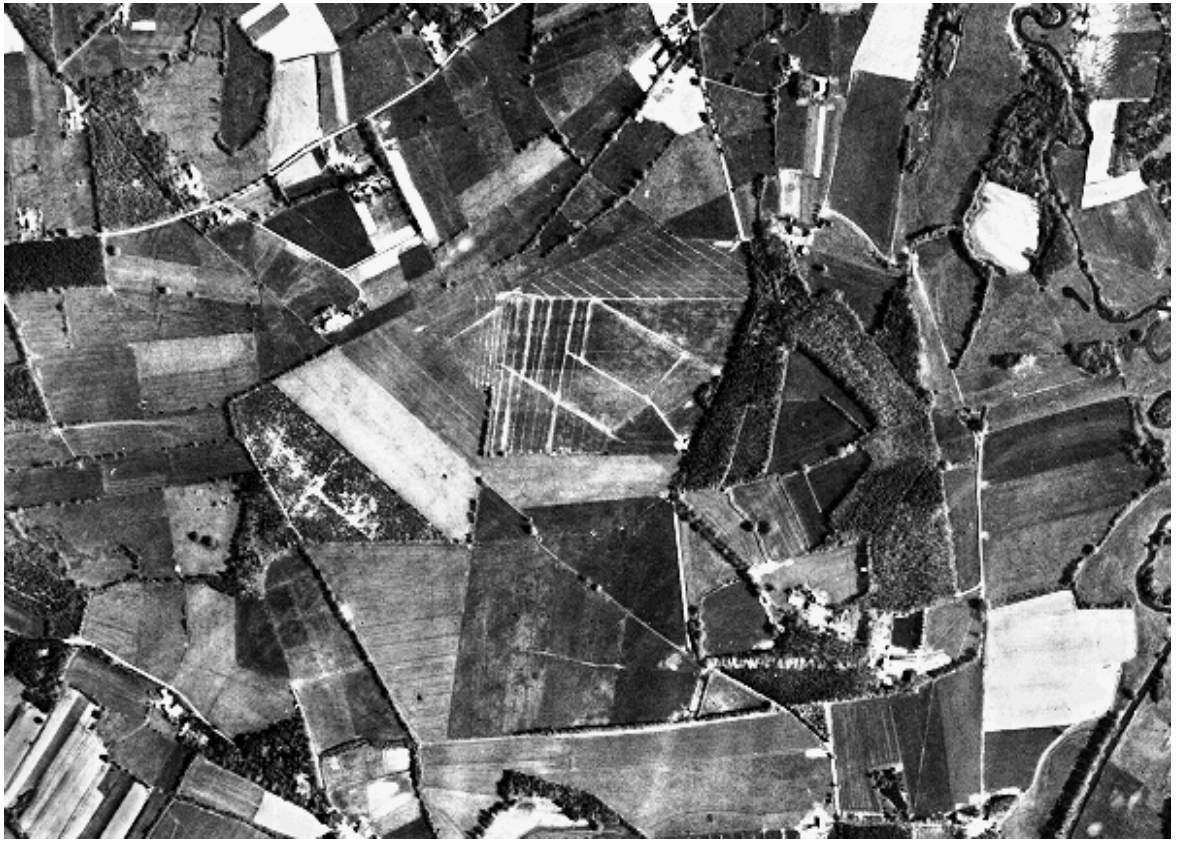
The mottled greytones visible in the lighter part are related to variations in moisture content of the soils



SIZE – DOES IT MATTER?

The Size of objects must be considered in the context of the scale of a photograph or an image.

The scale will help one to determine if an object is a stock pond or a lake.



SIZE

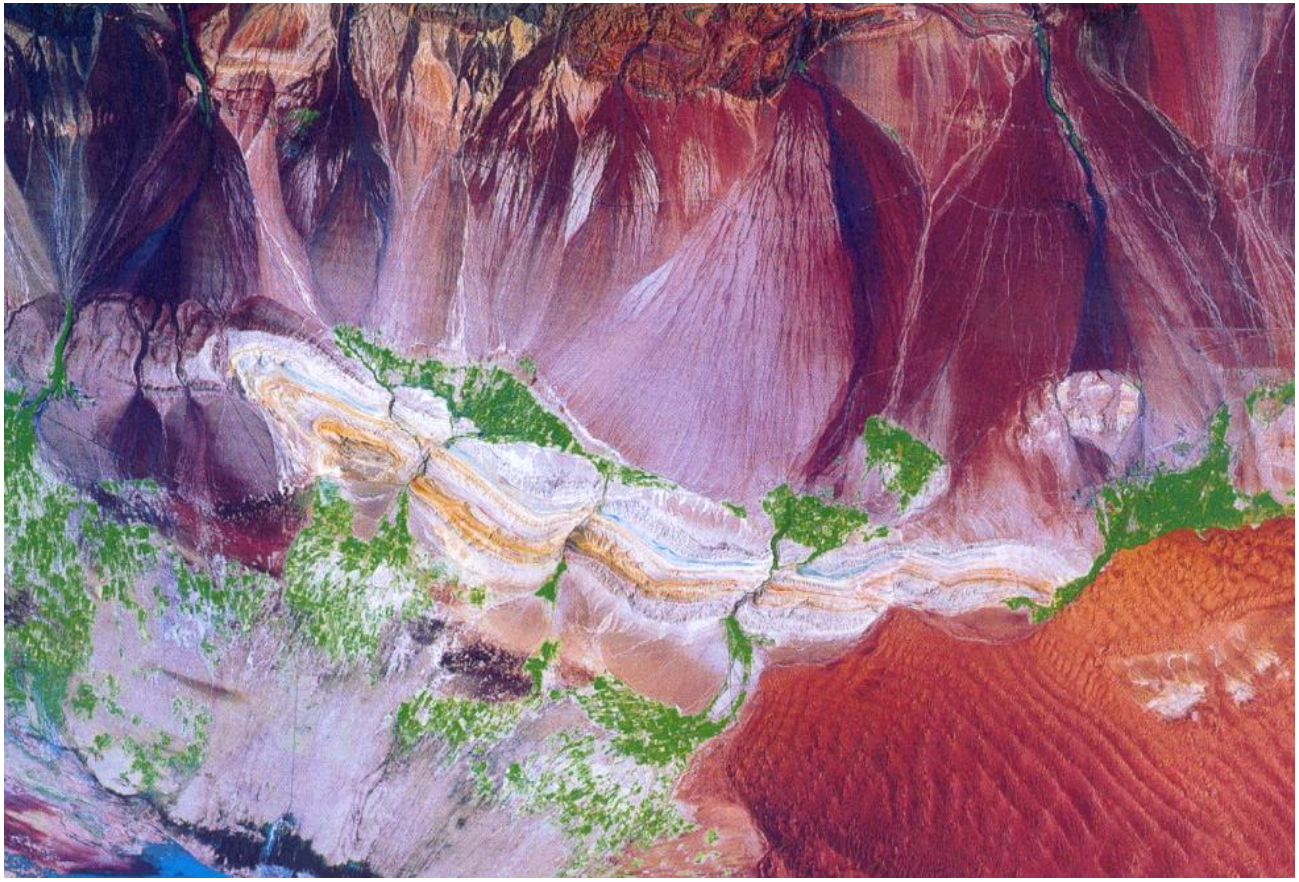
SHAPE

Shape refers to the general outline of objects

Many geomorphological shapes are diagnostic, like alluvial fans, sand dunes, ox-bow-lakes, volcanic cones, etc.

Regular geometric shapes are usually indicators of human presence and use. Some objects can be identified almost solely on the basis of their shapes (famous buildings).

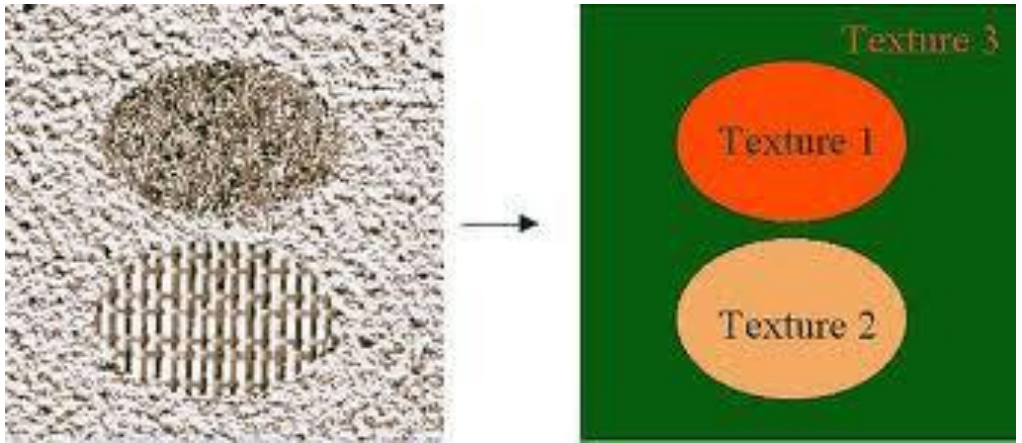
SHAPE



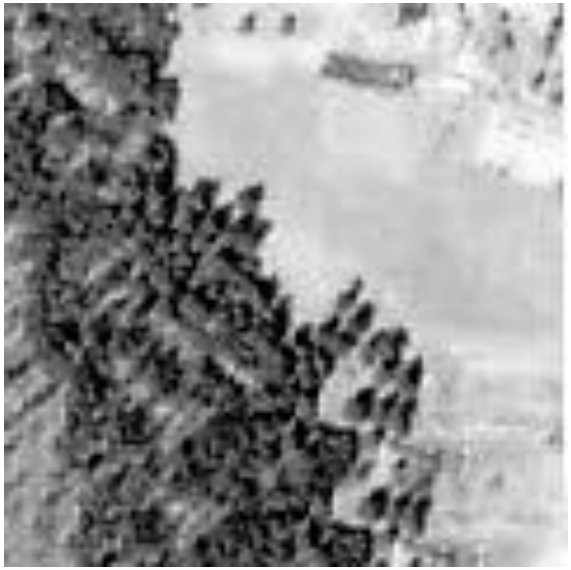
TEXTURE

Texture is visible in micro changes in density distribution:

- The impression of “smoothness” or “roughness” of image features is caused by the frequency change of tone in photographs. Texture is dependent on scale.
- It is produced by a set of features too small to identify individually. Grass, cement and water generally appear “smooth”, while a forest canopy may appear “rough”.
- Various terms can be used to describe a texture, e.g. fine, medium, coarse, speckled, granular, mottled, banded, linear, blocky, rippled, smooth or even etc



TEXTURE

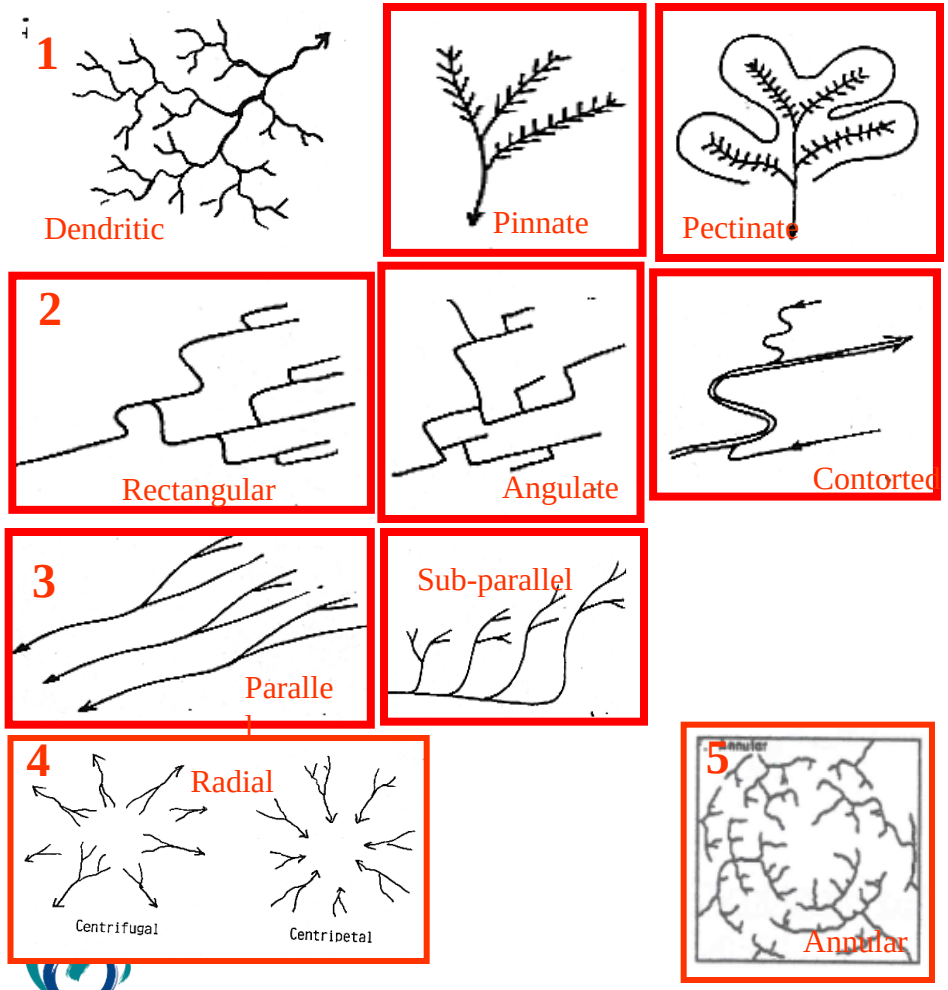


PATTERN

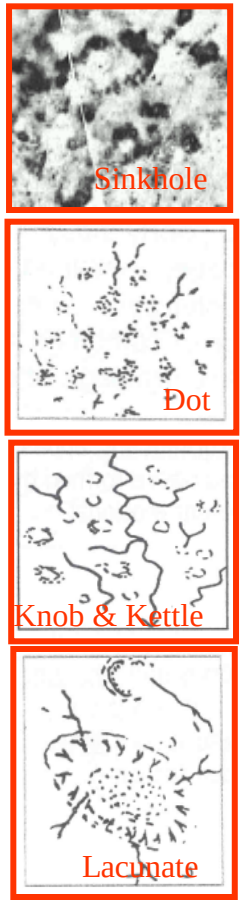
Macro changes in density, resulting in a geometric configuration that repeats itself in space → spatial arrangement

- Pattern refers to the spatial arrangement of visibly discernible objects.
- The patterns formed by objects in a photo can be diagnostic.
- Patterns can be formed by different object-elements, such as rock outcrops, drainage, streets, fields, soil type, etc.

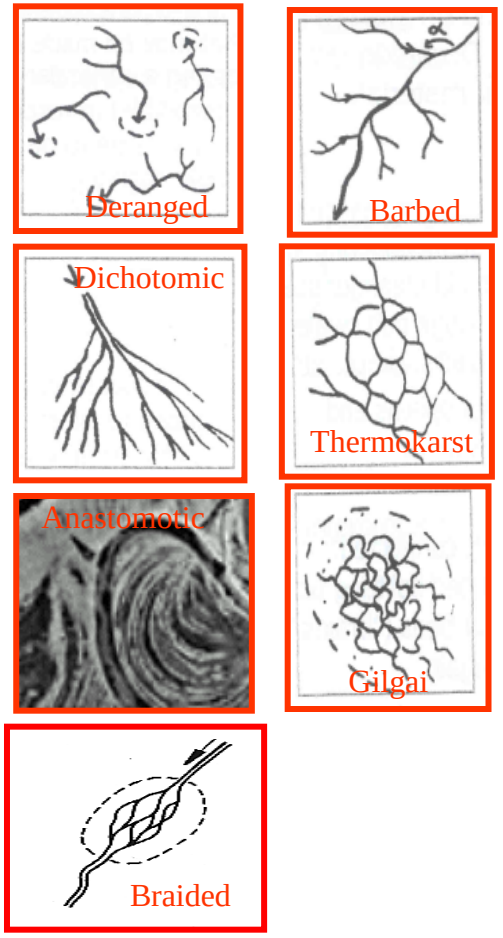
PATTERN - DRAINAGE



Internal Draiange



Special Patterns

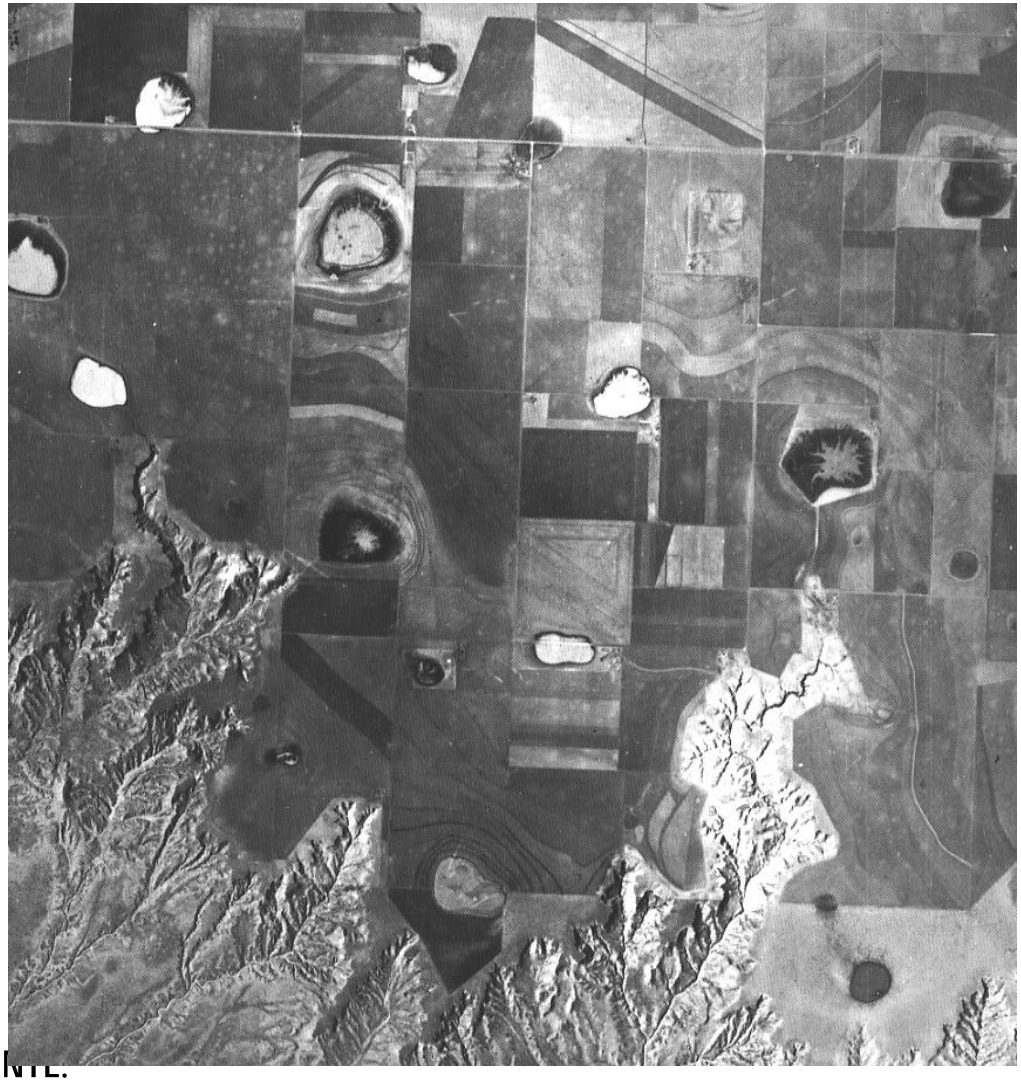


SITE

Site -- refers to topographic or geographic location.

- This characteristic of photographs is especially important in identifying vegetation types and landforms.
- For example, large circular depressions in the ground are readily identified as sinkholes in central countries, where the bedrock consists of limestone.
- This identification would make little sense, however, if the site were underlain by granite.

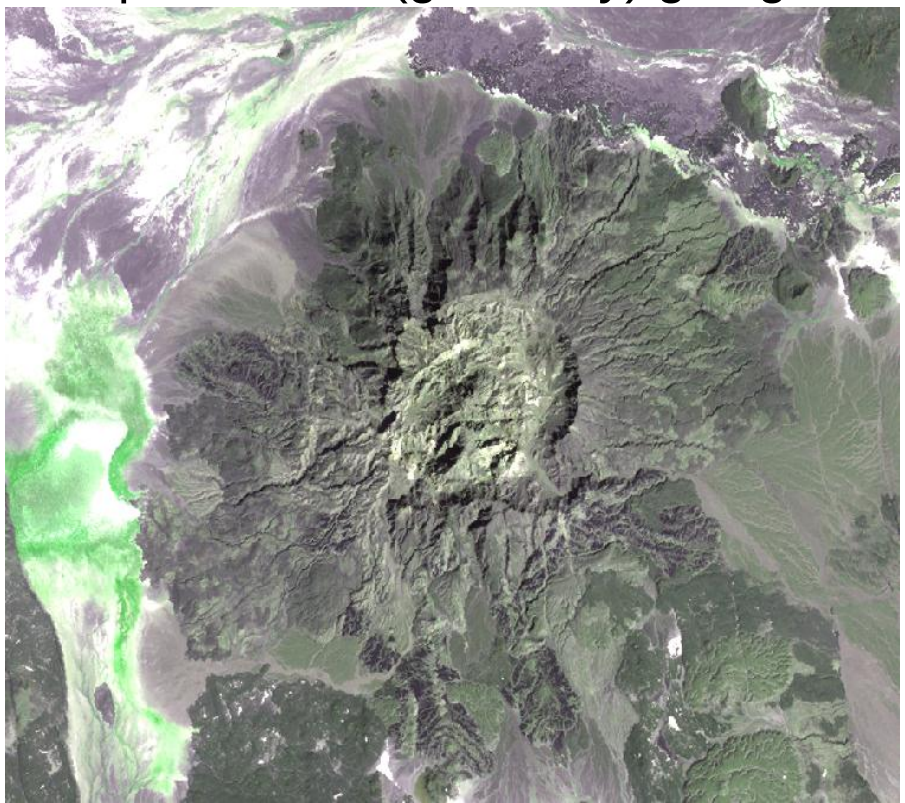
SITE



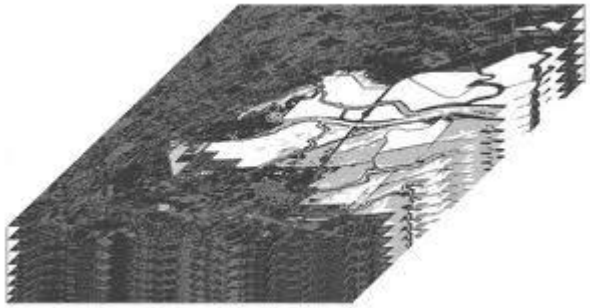
ASSOCIATION

Some objects are always found in association with other objects.

- The context of an object can provide insight into what it is.
- For instance, a nuclear power plant is not (generally) going to be found in the midst of single-family housing.
- Extrusive rocks are associated with volcanic landforms like cones, calderas, lava flows, etc.



USE OF MULTIPLE IMAGES



- Multi-band concepts and Images
  - VNIR, SWIR, TIR
- Multi date concept and imagery
  - Change detection (flood assessment, disaster evaluation, monitoring changes in coastal morphology
- Multi-stage Concept and data
  - From generality to detail analysis
- Multi-disciplinary Analysis
  - The idea that 1 image can be looked by a variety of users.

GROUP EXERCISE

We will now do an exercise in identifying landslides:

- Use of pre- and post Kashmir earthquake imagery
- Different imagery datasets with different resolutions:
  - ASTER (15m) and Quickbird (2m)

Make teams of 3-4 people

- Do not work with a participant from the same country
- Create a mix of multi-disciplinary and expert groups

Compare results of teams

- Are they the same?
- What is causing difference? data?, interpreter?