Automatic Classification

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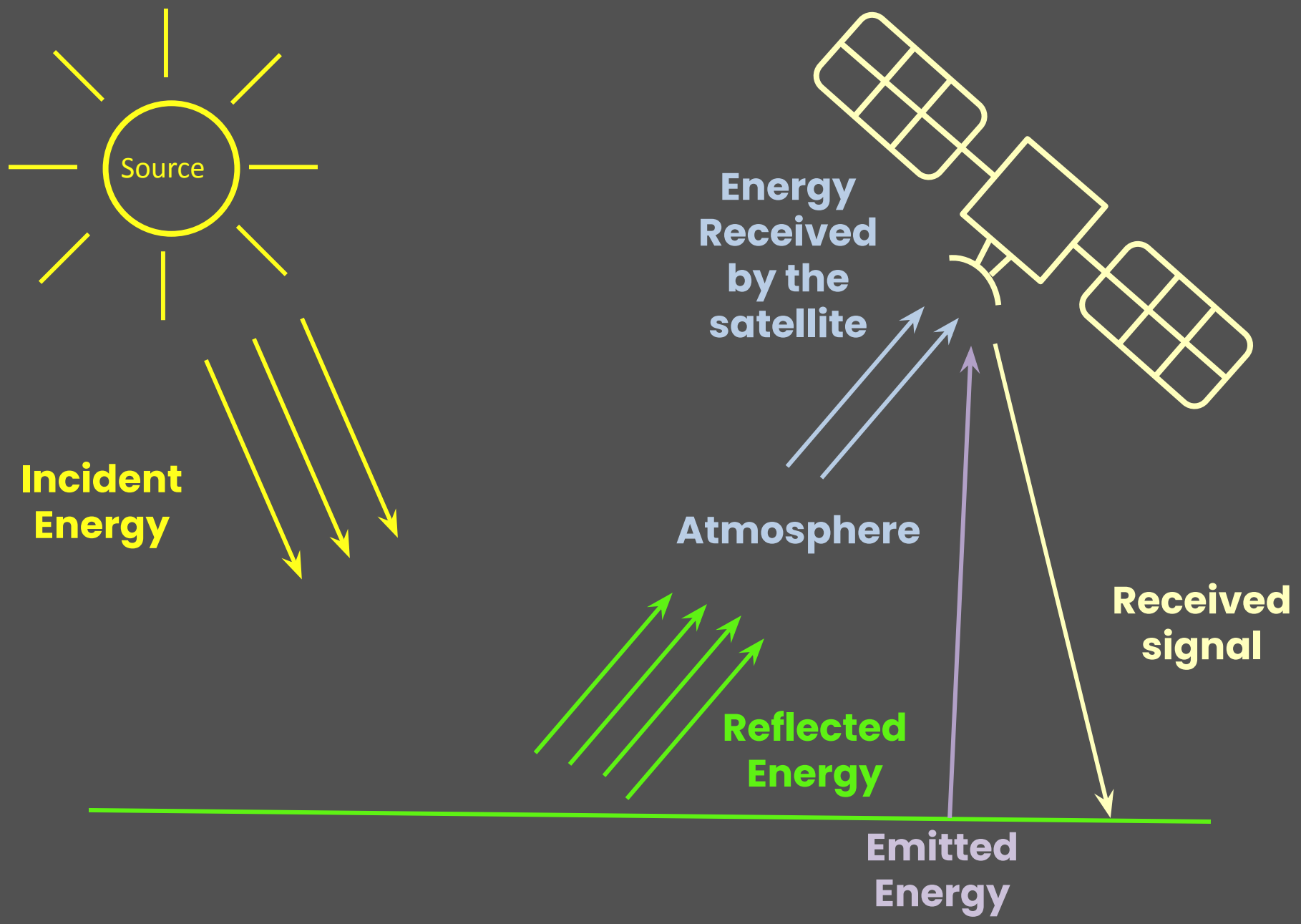
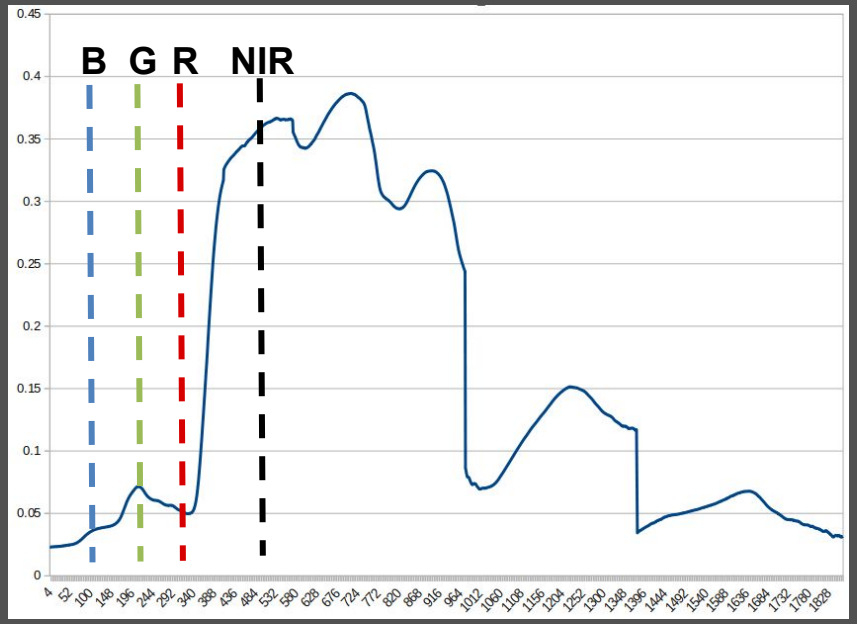
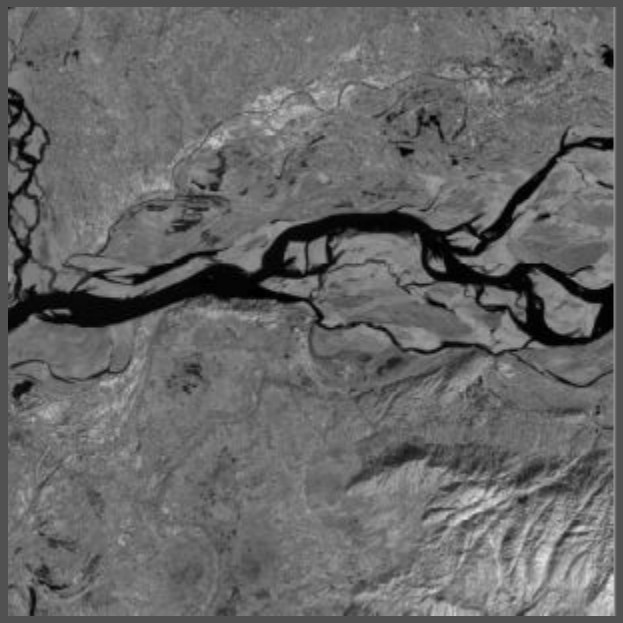

Source
Incident Energy
Energy Received by the satellite
Atmosphere
Reflected Energy
Received signal
Emitted Energy

Color Composites

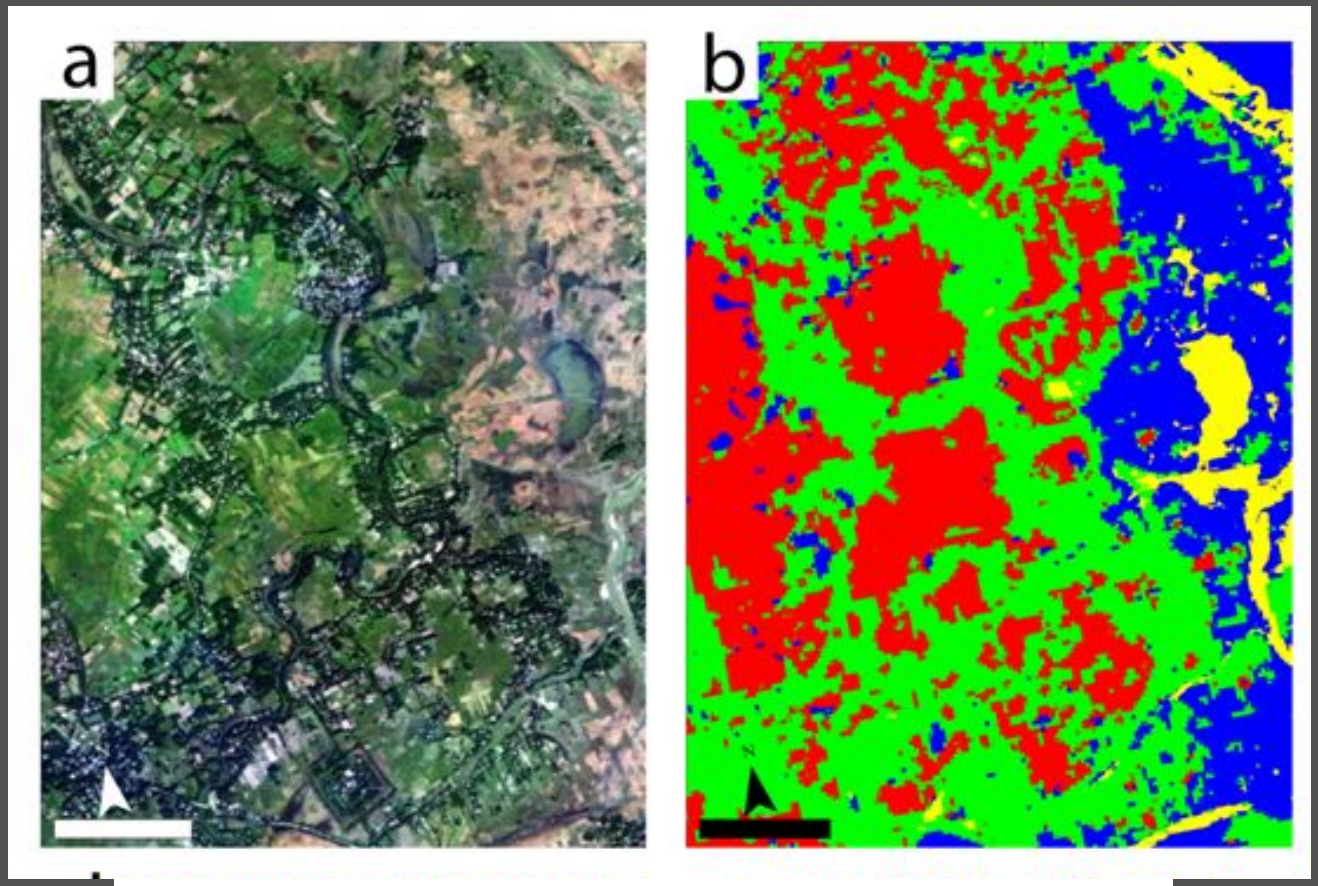
Software Visualization Channel	Satellite Band True Color	Satellite Band Standard False Color
Red	Red	900nm
Green	Green	660nm
Blue	Blue	550nm





Why Classification?

- A user / decision maker is not interested in brightness values, but the information relayed

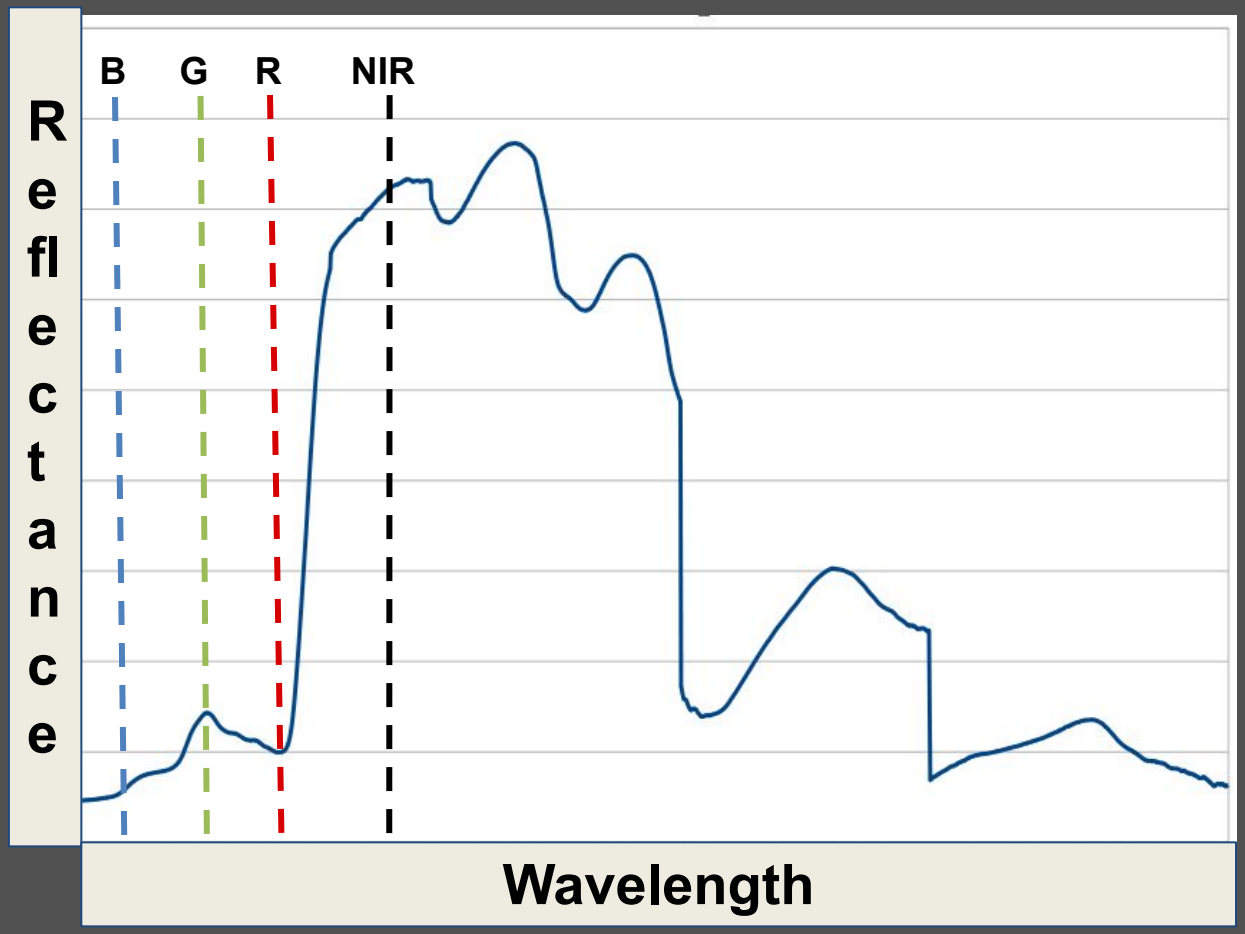


a: True Color Image

b: Classified Image

Source: Anilkumar et al 2018

Thresholding Spectral Indices



NDVI=(NIR - Red) / (NIR + Red)

For veg: High NIR, low Red. So values will be high and close to 1

Urban: close to 0 as both NIR and Red is high

Water: Negative as NIR is lower than Red

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( "ndvi@1" >= 0 ) AND ( "ndvi@1" < 0.28 )
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Types of Classification

- Based on Technique:
  - Unsupervised: Uses patterns in data. Eg K-means, ISODATA
  - Supervised: Uses inputs from expect (supervision)
- Based on target object:
  - Pixel based classification
  - Object based classification

Unsupervised Classification

- Also called Clustering as it groups the data based on similarity between the pixels (or objects!)
- It requires only a minimum amount of initial input from the user
- Once the groupings are known, we try to understand what they represent using visual interpretation.
- Some algorithms: K-Means, ISODATA

Unsupervised Classification: K-Means

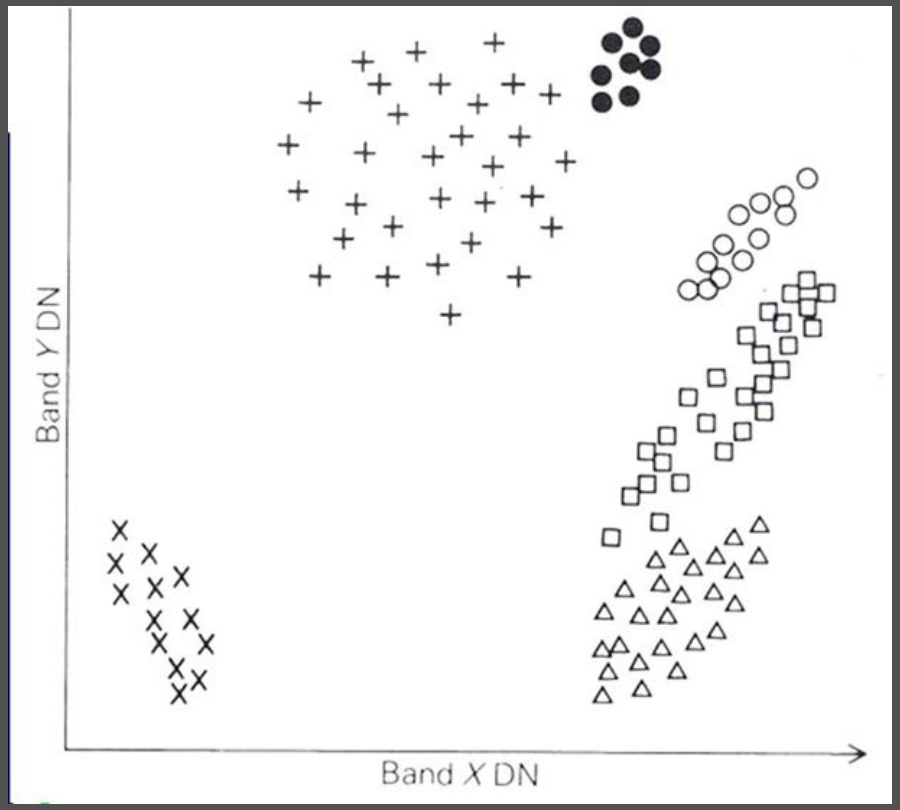
- Select randomly 'k' number of pixels from the image. These are the initial centroids or "group leaders"
- Group all other pixels in the image into one of the k groups
- Group is assigned based on how similar the pixels are to the centroid
- Calculate new centroid by taking mean of all group members
- Repeat until no change or a fixed number of iterations
- ISODATA: Same process. Sets limits on the groups formed.
  - If the variance of the group formed is high, split that group into 2 groups
  - If number of pixels in a group is too less, merge with closest group

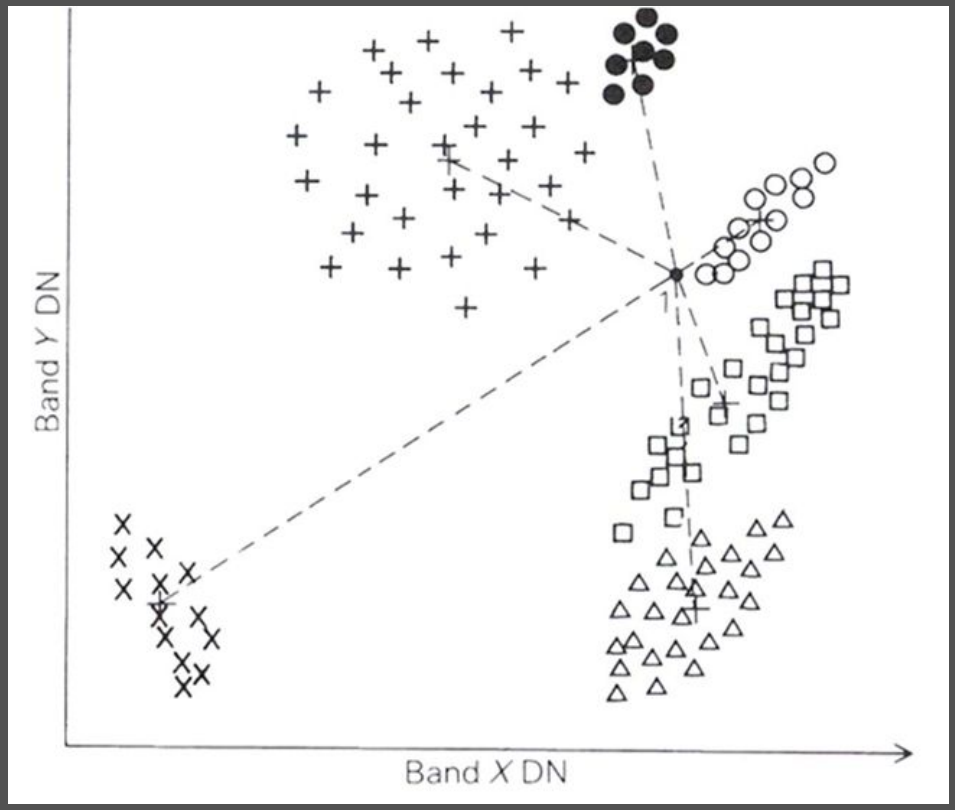
Supervised Classification

- Supervisor provides the computer some examples
- The computer learns from these examples and predicts other pixels (or objects).
- Learning is using similarity metrics in the FEATURE SPACE: distance or probability
- Eg: Minimum distance to mean, maximum likelihood, decision tree, random forest, support vector machine, neural networks
- Examples provided are called TRAINING SAMPLES:
  - Should be pure
  - Should represent all the classes of interest
  - Can be selected using: spectral signatures, user defined ROI or sampling from known images

Minimum Distance to Means

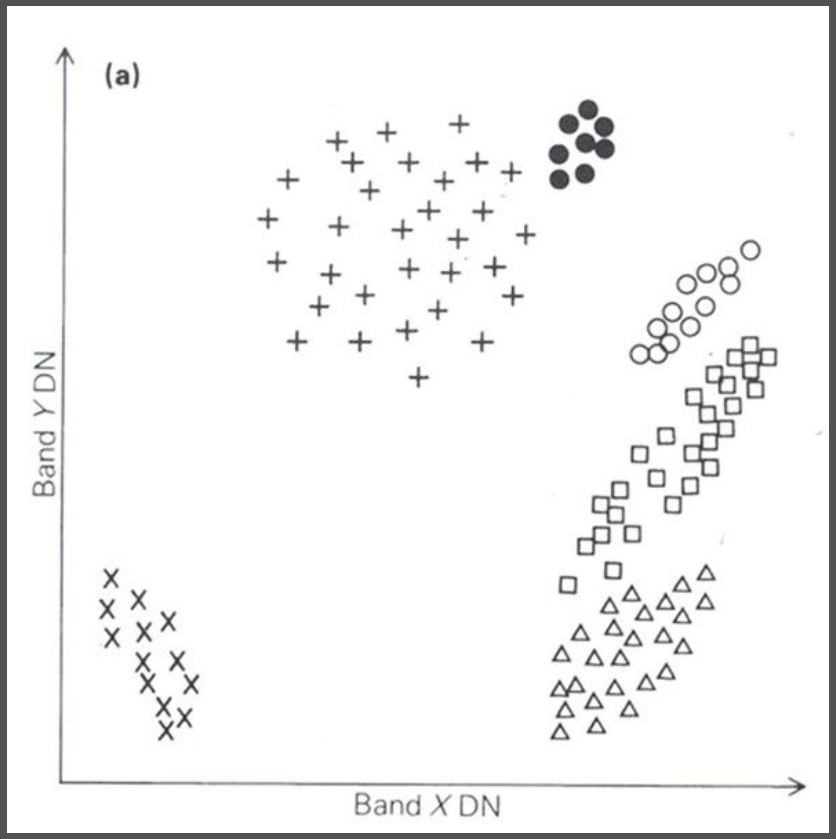
- Compute mean of each cluster
- For a new pixel, check distance to each mean and select class corresponding to lowest distance
- Distance can be Euclidean, Mahalanobis etc.

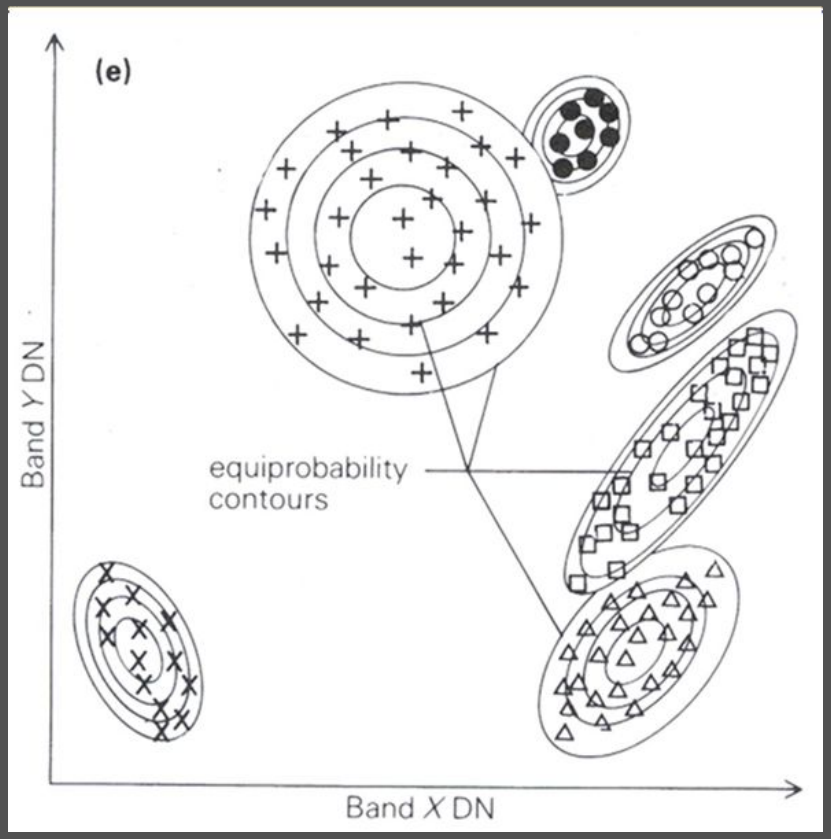




Maximum Likelihood

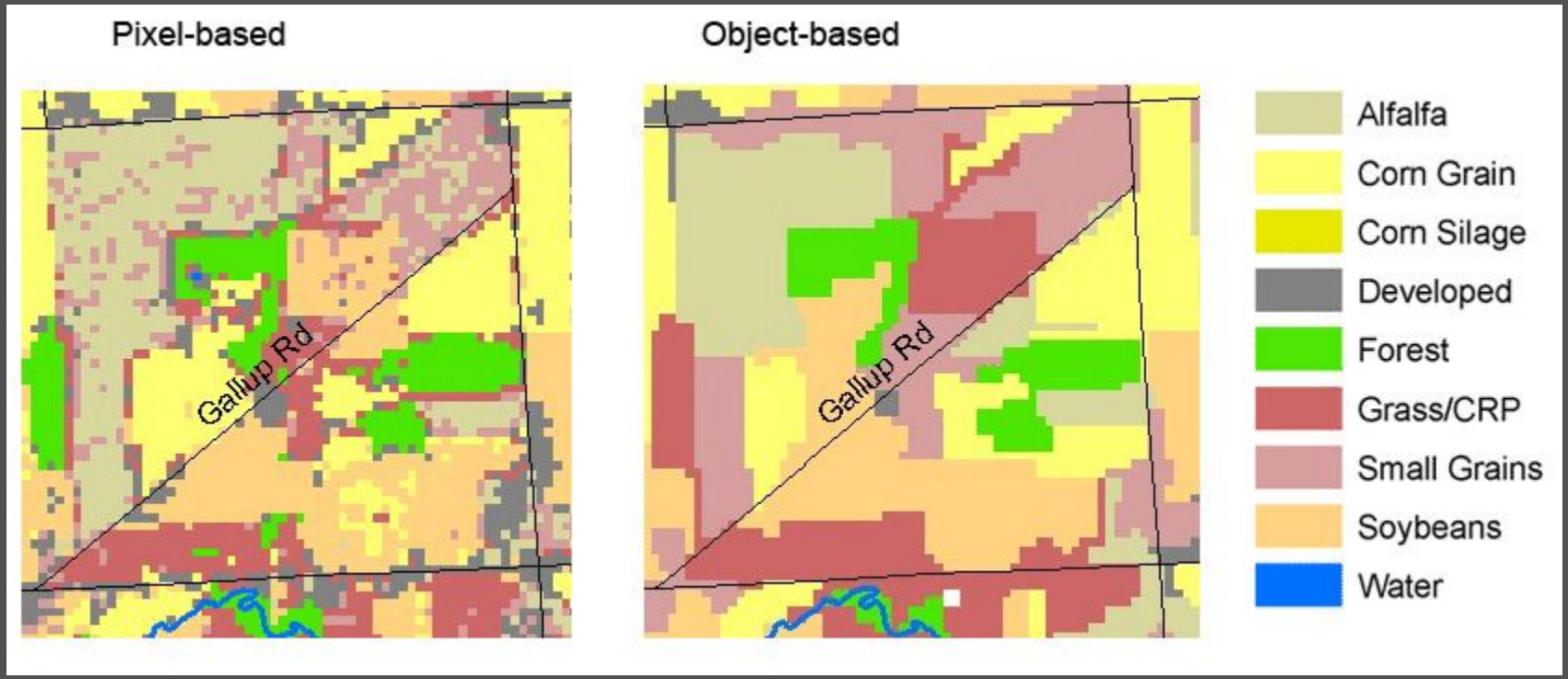
- Equal probability contours are plotted based on the spread of the data in the feature space
- For a new point, we assign to class with highest probability





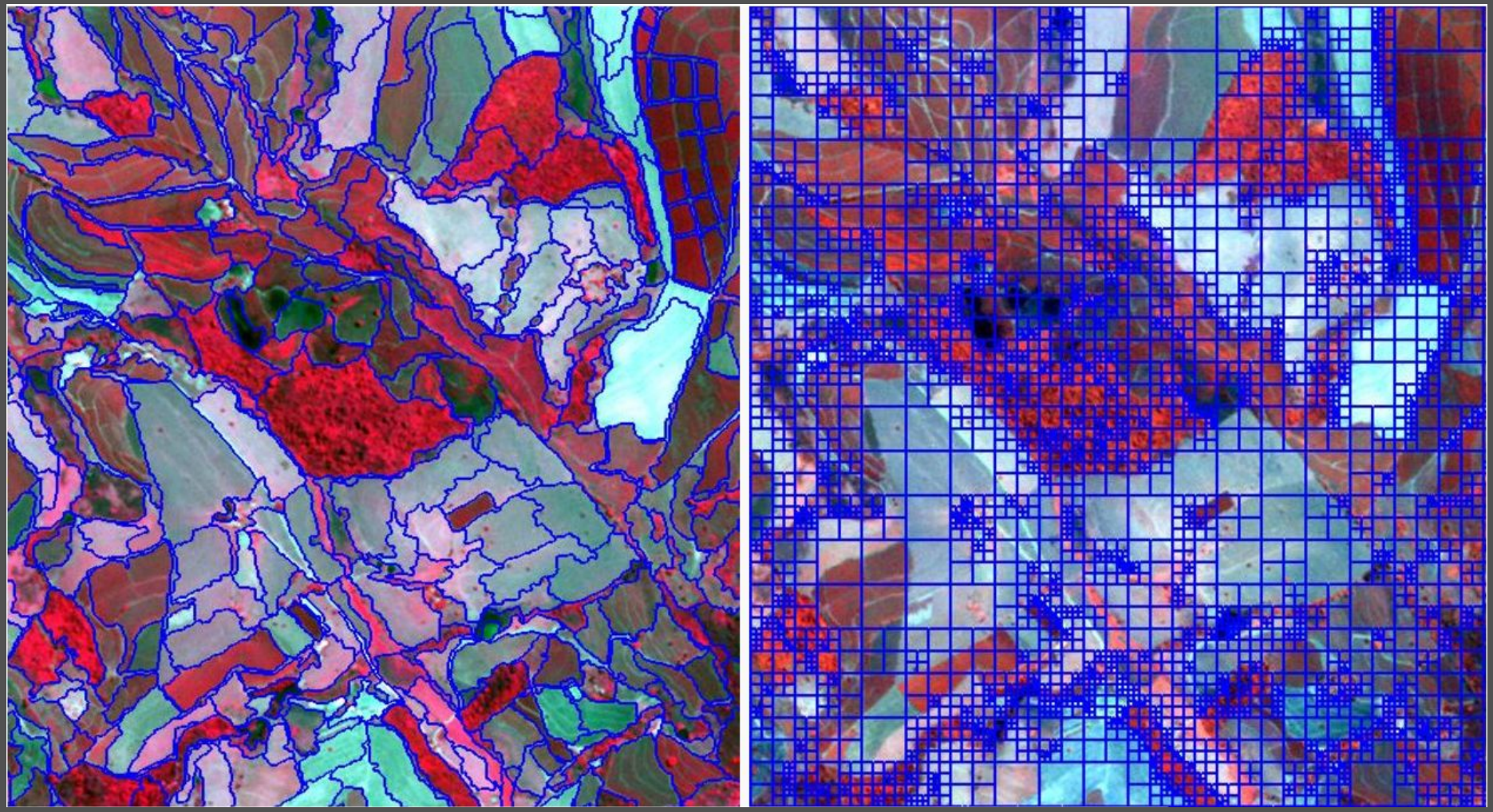
Object Based Image Classification

- More features apart from spectral reflectance. Texture, size, shape
- Use object level features by (i) creating objects (ii) Applying classification as usual.



Source: Powell and Brooks 2008

Creation of Image Objects



Source: Freitas et al 2015

Accuracy Assessment

- Each reference location is checked with the map
- Omission errors or commission errors may occur
- CONFUSION MATRIX can give us accuracy estimates

THANK YOU!

In case of queries, drop me an email at
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