Exam GEO4-4408 Master Remote Sensing
20 April 2011

Question 1:
Top soil moisture is an important variable in many studies on hydrology, crop growth and erosion. Spatial patterns of top soil moisture can, for selected areas, be derived from combined thermal (8 to 14μm) and optical (400 to 1100nm) remote sensing imagery. Thermal and optical spectral bands are then combined in a so-called TVX (temperature-vegetation index) plot.

a) Describe the concept behind the combined use of optical and thermal remote sensing to map top soil moisture patterns.

b) Sketch a TVX plot: 1) Indicate what is given by the X- and Y-axes and add units; 2) Draw pixel locations in the plot with different land cover types including pixels with full vegetation cover, pixels with intermediate vegetation cover and pixels with bare soil and water pixels; 3) Indicate in your sketch where in the graph you expect low top soil moisture values and high top soil moisture values; 4) Explain why.

Question 2:
In lecture 6 we discussed the scientific paper of Woodcock and Strahler "On the Nature of Models in Remote Sensing". The paper aims at improving our understanding of image information in relation to objects at the earth surface. The paper introduces the scene model and the image model.

a) What is a scene model? What is an image model?

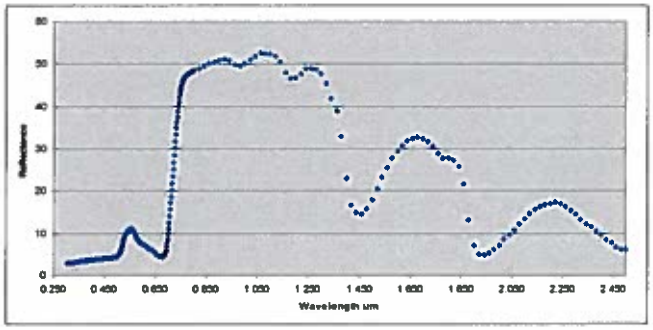
b) Explain the difference between H and L resolution images.

c) Indicate for the following classes whether one should use an IKONOS or a Landsat TM image to get an H resolution:
   - Tree
   - Forest
   - House
   - City

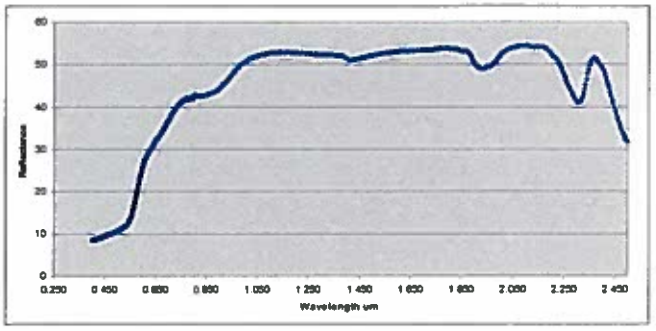
Motivate your answer.

Question 3:
Convex Hull transformation is an often used image processing method for hyperspectral imagery. What is convex hull transformation of a spectrum? What are the advantages of a convex hull transformation for further analysis of spectra? Use a sketch to illustrate your answer.

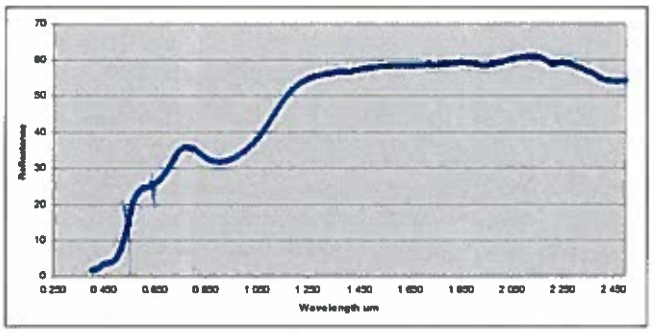
Question 4:
The following 6 graphs show spectral signatures of a selection of the following 10 objects: ~~water~~, cloud, ~~deciduous vegetation, senescent vegetation~~, ~~snow~~, asphalt, ~~peat soil~~, dolomite, goethite, quartz, ~~red building brick~~. Please assign the appropriate object to the corresponding spectrum. Motivate your answer!! Note the difference ranges of the y-axes.



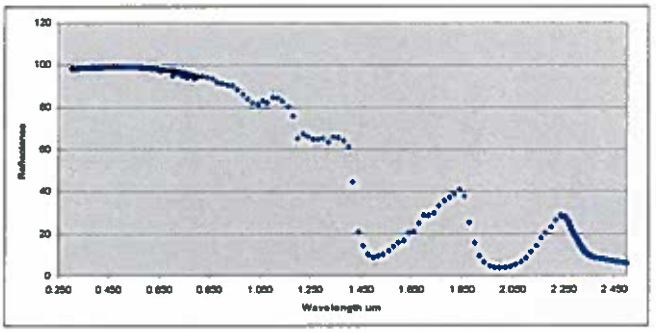
1. deciduous



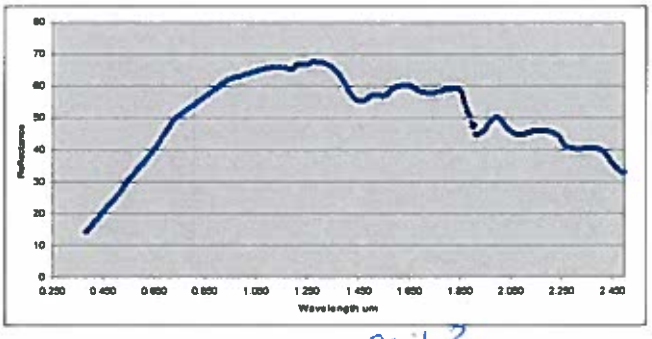
2.



3. ~~senescent~~

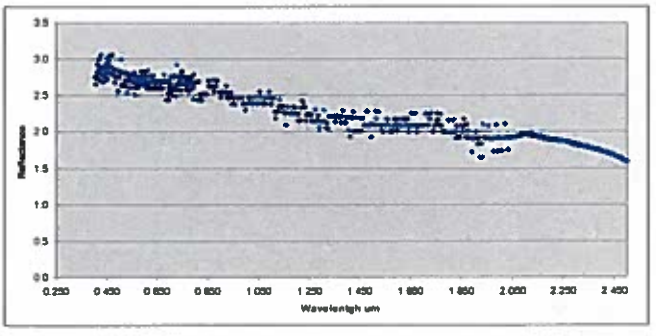


4. snow



peat soil ?

5.



6. ~~asphalt~~ / water ?

Question 5:
Electrical Resistivity Tomography (ERT) is a sub-surface remote sensing technique used during field campaigns to gain insight in soil moisture patterns.

a) Describe the concept of ERT. Use a sketch to illustrate your ERT description.

b) In what kind of conditions is ERT superior over other methods to determine soil moisture conditions?

c) The figure shows ERT profiles for an identical transect of a soil developed upon Flysch under forest in the Peyne study area in France. Figure A for June, figure B for September and figure C a difference image of A and B. Explain how a researcher should interpret the figures A, B and C with respect to soil moisture patterns in this soil.

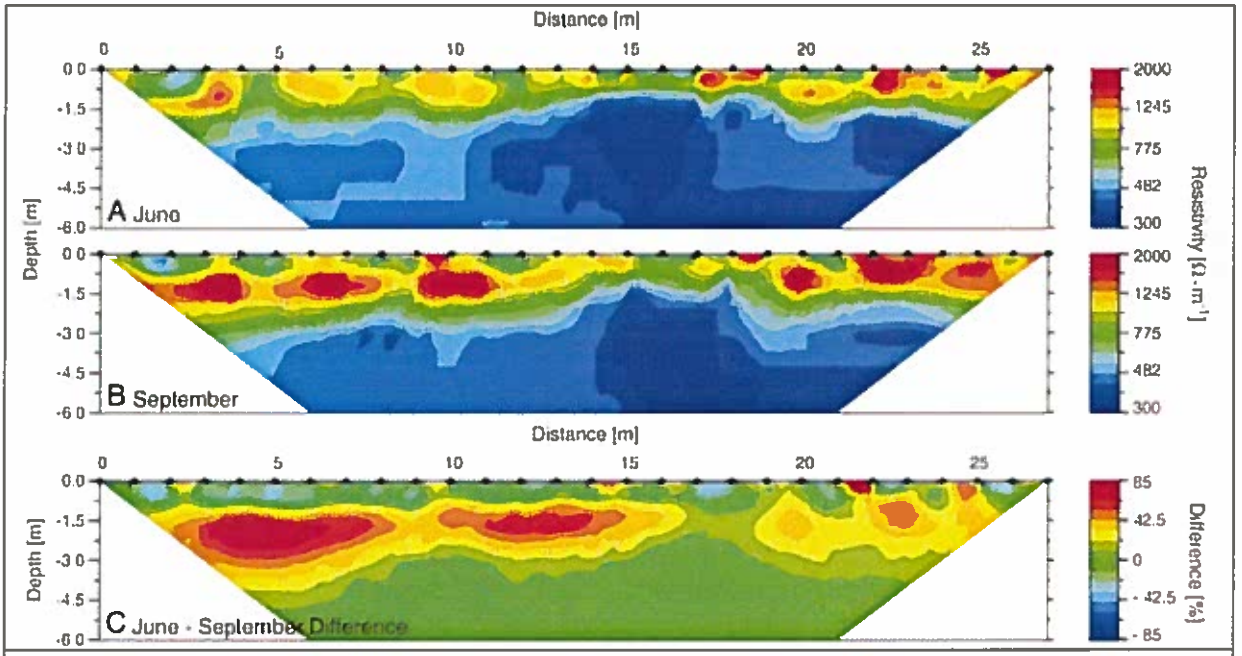


Figure 5.1: ERT profiles of soil on Flysch under forest collecte din the Peyne area in France.

Question 6:
The Minimum-distance-to-mean (MDM) algorithm and the Spectral Angle Mapper (SAM) are common image classification methods in remote sensing image analysis.

a) Describe in your own words how these two image classification methods work, use sketches to clarify your answers and list the advantages and disadvantages of both classifiers.

b) Figure 6.1 shows a feature space of an image with two spectral bands n and m. Which classifier will be superior in separating class a, b and c? Motivate your answer.

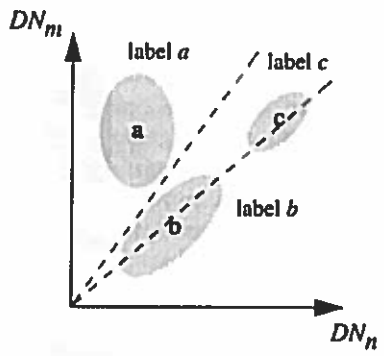


Figure 6.1 Feature space of an image with two spectral bands n and m.

c) Figure 6.2 shows a result of an AVIRIS image analysis using the SAM algorithm and as reference a spectrum of the clay mineral kaolinite. Where do you expect to find the highest concentration for kaolinite in the area, just above letter A or just above letter B. Motivate your answer.

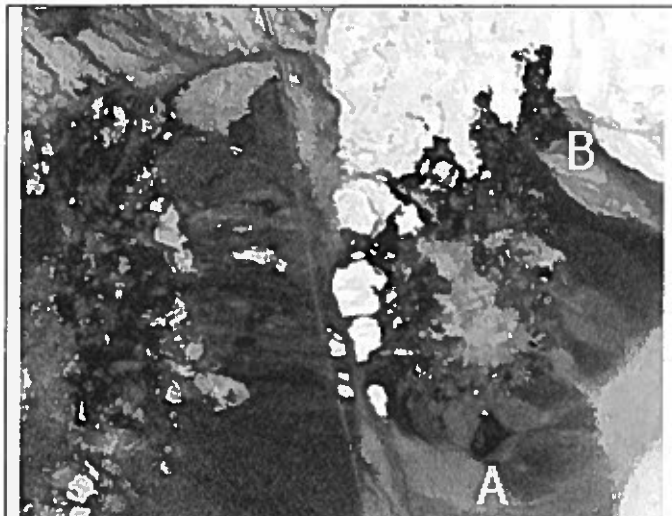


Figure 6.2: SAM result for Kaolinite in Cuprite, Nevada desert in the USA derived on an AVIRIS image.