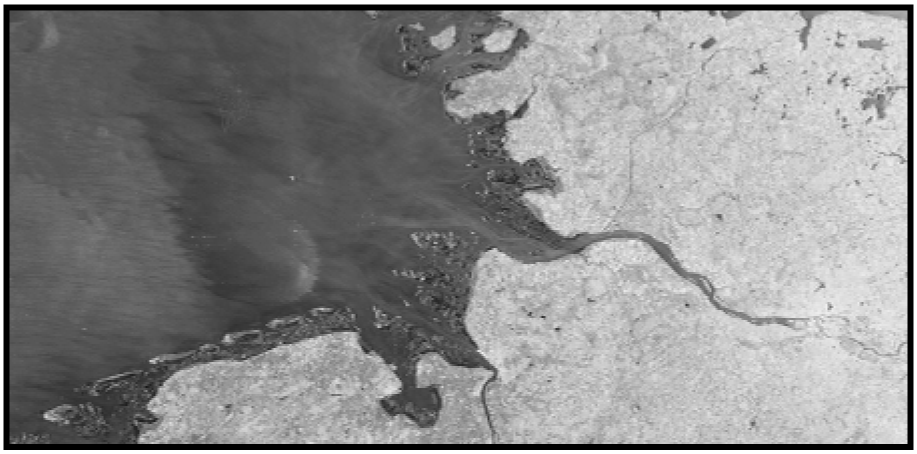
ASSIGNMENT 1

1. SIGNATURES OF REMOTE SENSING



Introduction- What are signatures; why are they needed?

Identity is what makes an entity or object recognizable. Signatures is what gives an object or entity an identity. What could be these identities? *Characteristics* is what makes a feature identifiable. Spectral, spatial temporal and polarization variations facilitate discrimination of the features of a remotely sensed data.

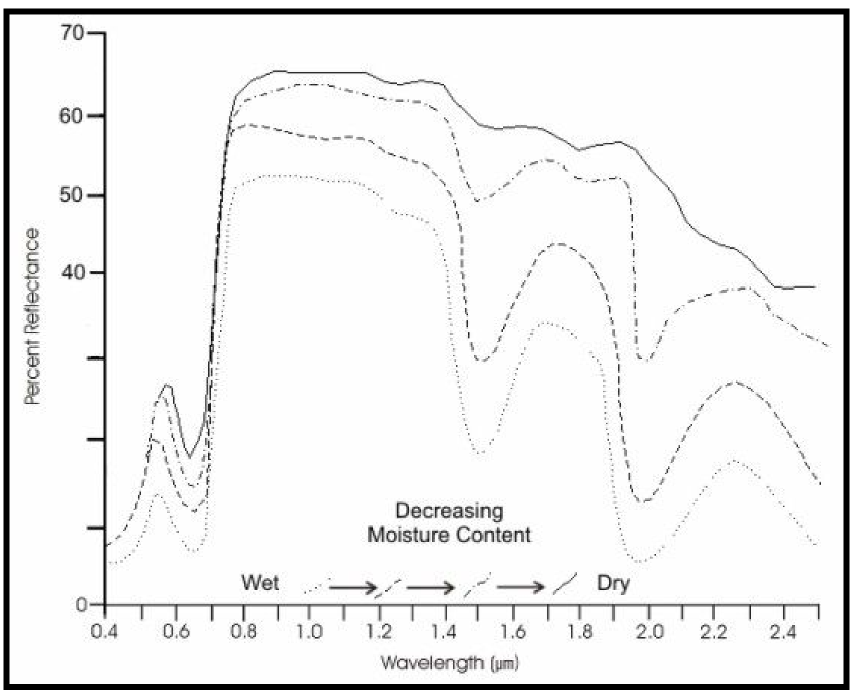
Which are these signatures in remote sensing?

The observed variations in the characteristics of features to target physical properties are defined as signatures. The commonly used signatures are:

1. Spectral Reflectance
2. Spectral Emittance
3. Radiance, Brightness temperature of a body, spectral wavelength
4. Temporal and spatial effects on spectral response patterns

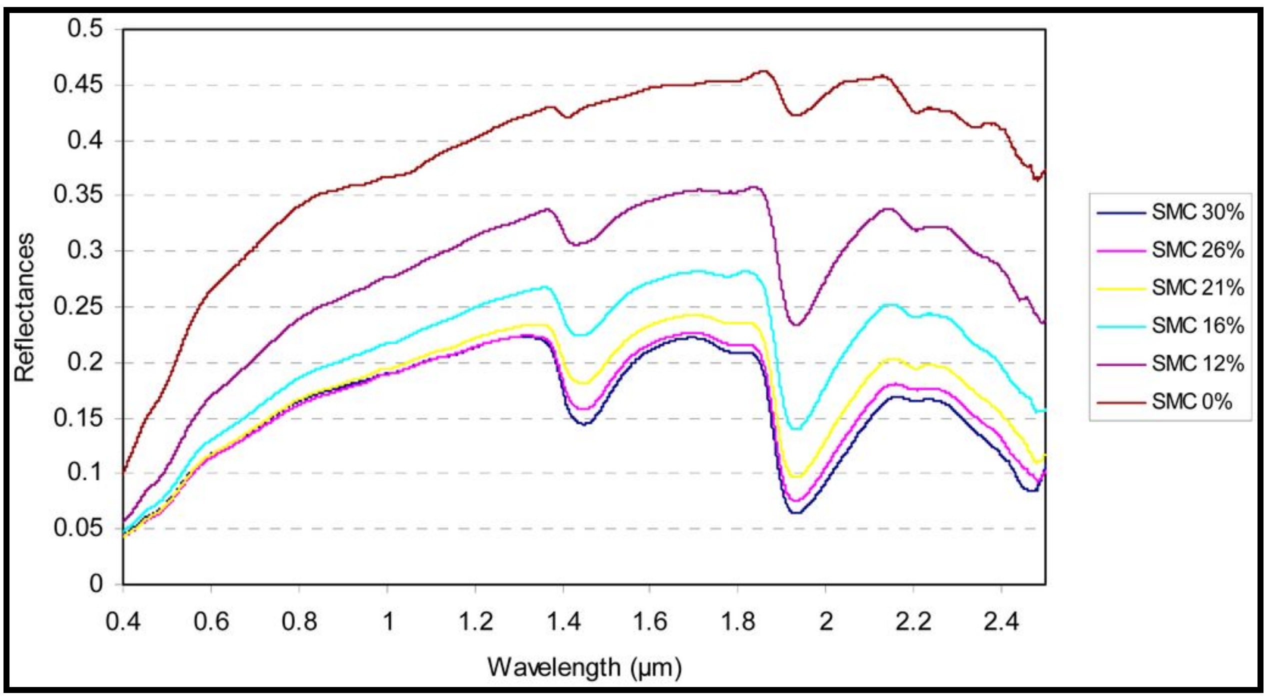
Vegetation

A chemical compound in leaves called chlorophyll strongly absorbs radiation in the red and blue wavelengths but reflects green wavelengths. Leaves appear "greenest" to us in the summer, when chlorophyll content is at its maximum. In autumn, there is less chlorophyll in the leaves, so there is less absorption and proportionately more reflection of the red wavelengths, making the leaves appear red or yellow (yellow is a combination of red and green wavelengths). The internal structure of healthy leaves act as excellent diffuse reflectors of near-infrared wavelengths. If our eyes were sensitive to near-infrared, trees would appear extremely bright to us at these wavelengths. In fact, measuring and monitoring the near-IR reflectance is one way that scientists can determine how healthy (or unhealthy) vegetation may be. The reflectance increases to more than 50% because of the cell structure of the plants in the near infrared region; while in the middle infrared region a steep trough is noticed around 1.9 micrometre because of the water content of the plant. The typical spectral reflectance curve for healthy vegetation is as shown below:



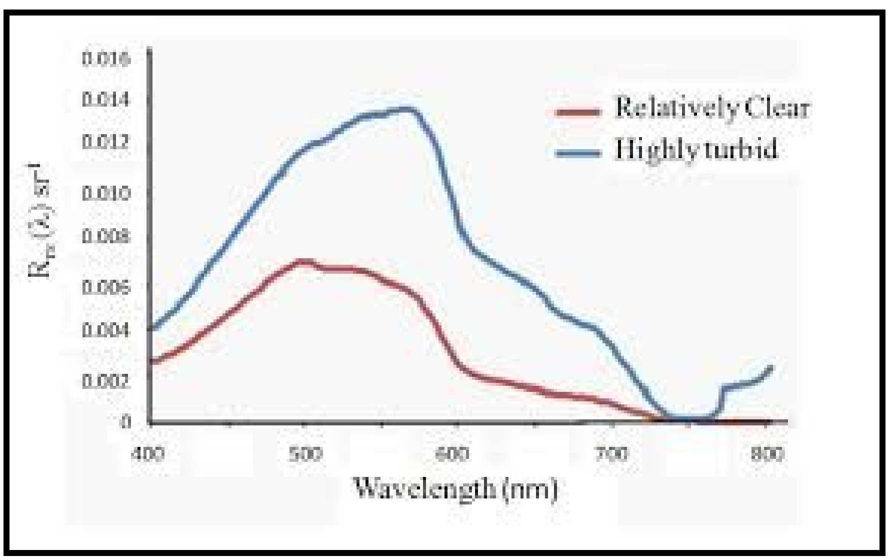
Soil

Soils tend to have reflection properties that increase approximately monotonically with wavelength. They tend to have high reflectance in all bands. This of course is dependant on factors such as the colour, constituents and especially the moisture content. As described above, water is a relatively strong absorber of all wavelengths, particularly those longer than the red part of the visible spectrum. Therefore, as soil moisture content increases, the overall reflectance of that soil tends to decrease. Soils rich in iron oxide reflect proportionally more of the red than other visible wavelengths and therefore appear red (rust colour) to the human eye. A sandy soil on the other hand tends to appear bright white in imagery because visible wavelengths are more or less equally reflected, when slightly less blue wavelengths are reflected this results in a yellow colour. The spectral reflectance curve of soil moisture content is as shown below:



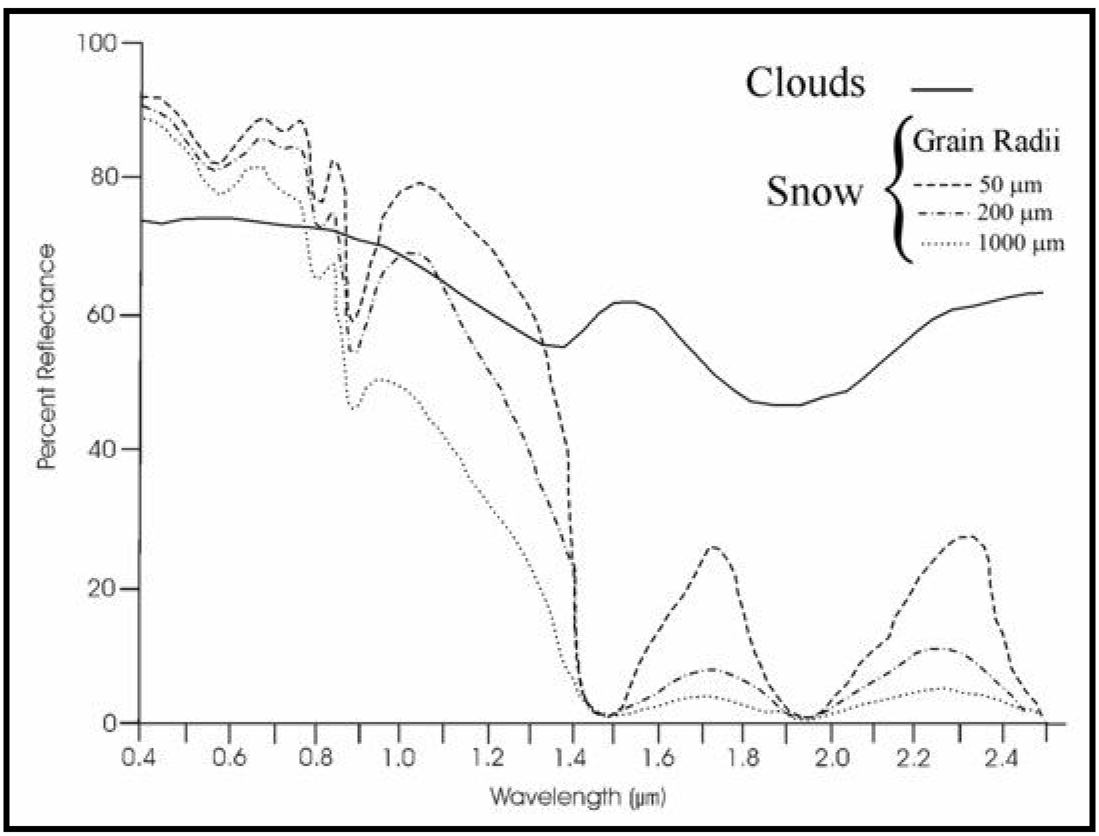
Water

Longer wavelength visible and near infrared radiation is absorbed more by water than shorter visible wavelengths. Thus water typically looks blue or blue-green due to stronger reflectance at these shorter wavelengths, and darker if viewed at red or near infrared wavelengths. If there is suspended sediment present in the upper layers of the water body, then this will allow better reflectivity and a brighter appearance of the water. The apparent colour of the water will show a slight shift to longer wavelengths. Suspended sediment (S) can be easily confused with shallow (but clear) water, since these two phenomena appear very similar. Chlorophyll in algae absorbs more of the blue wavelengths and reflects the green, making the water appear more green in colour when algae is present. The topography of the water surface (rough, smooth, floating materials, etc.) can also lead to complications for water-related interpretation due to potential problems of specular reflection and other influences on colour and brightness. The reflectance curve for a clear water and a highly turbid water are shown in graphic below:



Snow

Ice and snow have a similar number of absorption bands as water but their absorption maxima varied from those of water. River float-ice and glacial ice have diagnostic absorption features at 1.02 and 1.25 μm and negligible reflectance in the > 1.33 μm region. New powder snow, new wet snow, and older deep snow packs have similar shaped reflectance spectra. Thin snow accumulations readily masked the underlying surfaces. These snowpack surfaces have a small asymmetric absorption features at 0.90 μm and strong asymmetric absorption features at 1.02, 1.25, and 1.50 μm. These snow packs have measurable SWIR reflectance. An avalanche snowpack had low SWIR reflectance, which was similar to ice spectra. Water, ice and snow and ice surfaces have spectrally distinct features, which differentiates them and the background surfaces.



CRUX

By measuring the energy that is reflected by targets on earth's surface over a variety of different wavelengths we can build up a spectral signature for the object. And by comparing the response pattern of different features we may be able to distinguish between them, which we may not be able to do if we only compare them at one wavelength. For example water and vegetation behave similarly in the visible wavelength but on in infrared.