GEOS 654 – VIS and IR Remote Sensing

Lab 3: Analyzing Collected Field Spectroscopy Reflectance Data

Instructor: F.J. Meyer; J. Cristóbal; M. Buchhorn

This is an assessed lab. Please turn in your lab work by: Feb 17, 2016

1. Introduction:

A few days ago, you collected field reflectance measurements of a set of surface materials including vegetation samples (black or white spruce), snow types, soil, coal and water. Measurements were taken with the PSR+ 3500 High Resolution Portable Field Spectroradiometer and the acquired spectra were provided to you in the form of Excel Spreadsheets.

In this lab you will be analyzing these collected data. The lab will contain sample pre-processing, a qualitative description and comparison of samples, and a comparison of acquired data to published spectral libraries.

This document serves both as a guidance document for your lab exercise and as an instruction sheet for the work that you should turn in to me by Feb 17, 2016.

2. Perform Pre-Processing of Acquired Spectral Data

You have collected several repeated measurements for each material type (e.g. you may have repeated measurement of a "fine grain snow" material). In a pre-processing step, I want you to use these repeated measurements to reduce sampling bias and minimize measurement noise. Please complete the following pre-processing steps for every analyzed surface type:

a) For every sampled spectral wavelength, calculate the arithmetic mean observed reflectances $\overline{R_\mu}$ as well as their respective standard deviation σ. Store both $\overline{R_\mu}$ and σ in separate Excel columns for further use.

b) For every material, provide a plot that shows the average reflectance spectrum with the related uncertainties (similar to the example in Figure 1).

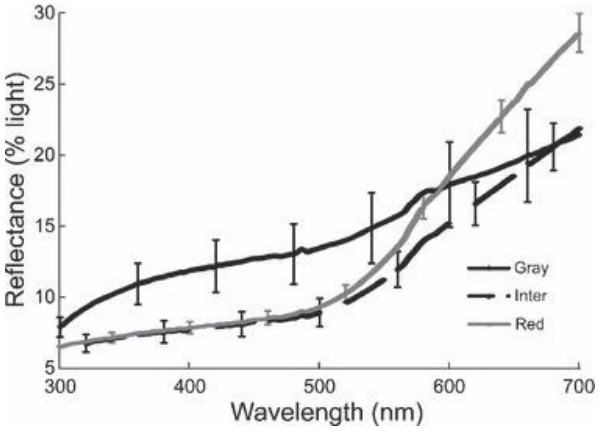

Figure 1: Sample of averaged reflectance spectrum showing both mean value and standard deviation.

c) Once averaged reflectance graphs for all analyzed materials were completed, provide a short discussion of the error bars you have derived. Are the uncertainties significantly different for the different observed materials (e.g., is the measurement noise in your vegetation samples significantly higher than in snow samples)? What might be the main sources for the calculated uncertainties be?

3. Describe the (Averaged) Spectra for Different Materials

First, provide a qualitative description of the averaged reflectance spectrum for (one of your) analyzed vegetation materials:

a) Compare your measured vegetation spectrum to the vegetation spectra that you saw in lecture 3. Does your sample show the typical features of vegetation materials? Describe the features you see. Which absorption bands can you identify and what might be the source of the observed absorption bands?

b) How would you (qualitatively) describe the materials moisture content?

c) Would you classify your material as "healthy" or "stressed" vegetation? Provide a justification for your conclusion?

Now, please look at your snow samples. You collected snow samples that may potentially have different grain sizes and moisture contents. Compare the averaged snow spectra by answering the following questions:

d) Which of your snow samples may have the largest average grain size and which one may have the smallest? Provide a justification for your choices. How do your findings compare to your field notes?

e) Which snow sample may have the lowest water content and which one may have the highest? Again, justify your answers. How do your findings compare to your field notes?

4. Identify Vegetation and Landcover Types:

In this last step, you will identify the measured spectra by comparing them to the ASTER Spectral Libraries, which are published at http://speclib.jpl.nasa.gov/. Version 2.0 of the ASTER Spectral Library is a compilation of over 2400 spectra of natural and manmade materials and was released in 2008. To utilize this resource, please use the following procedure and answer associated questions:

Start with your vegetation sample(s):

a) From your field notes you have a good initial idea of the vegetation type that you sampled from. Go to the "Search" page of the ASTER Spectral Library (http://speclib.jpl.nasa.gov/search-1) and search for this vegetation type (select "vegetation" from the lists of available materials --- only four vegetation types are available. Pick the one closest to your vegetation sample).

b) Download the reference spectrum (first click on "view graph" then then right-click on "View Data File" and save the spectrum as a text file).

c) Import your reference spectrum into Excel and compare it to your measured spectrum. Do they look similar in shape? If not, how are they different? What may be the causes for the observed differences?

d) With your written description, provide a side-by-side figure with measured and reference spectrum

Soil samples:

e)-h) Repeat the analysis (Steps a) – d)) for one of your soil samples

Finally, please look at the snow sample that you identified as "fine grain" in Section 3:

i) For the snow sample that you identified as "fine grain" in Section 3, find the respective reference spectrum by searching for "Fine Snow" in the "Water/Snow/Ice" section of the library.

j) Download the data.

k) Compare the library reference spectrum to your measured spectrum and describe differences by answering the same questions as above.

l) Provide a side-by-side plot of reference and measured spectrum.

m) Now also search and download the reference spectra for "Coarse Granular Snow" and "Medium Granular Snow".

n) Compare your "fine grain" sample to all three reference spectra (fine, medium granular, and coarse granular). Which of the three reference spectra resembles your observed data the most? Based on these findings, how would you describe the granularity of your snow sample?