

## Protocol for collecting field reflectance spectra

*(This text is a modification of Pfitzner, K., Bartolo, R., Carr G, Esparon A., Bollhöfer, A. 2011. Standards for reflectance spectral measurement of temporal vegetation plots. Supervising Scientist Report 195, Supervising Scientist, Darwin NT)*

During this fieldwork we will take spectral data of several samples (bare soil, leaves, grass, wet vegetation, dry vegetation, sidewalks, asphalt, concrete, etc.) using the spectro-radiometer ASD FS4. The data are measured with the pistol grip, except for leaves measures that be taken with the plant probe and leaf clip accessory.

The main objective of this protocol is to take reflectance data using the same steps for different samples.

### 1 Plan the field work

For the success of the fieldwork it is essential to good planning: experimental design, ASD configuration, date, etc.

### 2 Turn on the spectrometer

Always turn the spectrometer on before the laptop to prevent irreparable damage to the spectrometer array.

Turn on the spectrometer (connected to the mains power) so that the spectrometer can warm up while the equipment is packed and loaded into the vehicle. Note that the spectrometer must be running longer than 30 minutes and ideally warmed up for **90 minutes** prior to the collection of spectra.

Note the time that the spectrometer was turned on so that the length of warm-up time can be documented in the spectral metadata.

### 3 Set up the ASD FS4 into the Backpack

Set up the instrument in the backpack following the FieldSpec 4 User Guide that recommends that:

“When arriving on site, unpack the instrument from the shipping case, and set up the instrument in the backpack before use.

You can use the instrument in the backpack with either hand. Determine which hand you want to use for collecting spectra with the fiber optic cable and which you need available to type on the keyboard and handle samples.

Aiming the fiber optic cable or accessory will probably require less dexterity than operating the instrument controller and typing. You may want to set up the instrument with the fiber optic cable on the side of your nondominant hand and keep your dominant hand free for other tasks, like one-handed typing.”

### 4 Attach the pistol grip or the plant probe

Screw the pistol grip that holds the fore optics.

Remove the fibre optic cap and store in a secure place so that the fibre optic can be recapped at the end of measurement collection.

Unscrew the crimp on the pistol grip and carefully feed the fibre optic cable through the crimp and gently through the pistol grip until the tip of the fibre optic can be seen protruding through. Tighten the crimp so that the cable is held in place but be careful not to over tighten as this will damage the fibre optic cable. Remember to be careful not to kink or step on the cable and keep the cable only loosely rolled.

Install the plant probe and leaf clip when you will take measurement in leaves.

## 5 Switch laptop on

The spectrometer is already switched on and running. Turn the controlling laptop computer on. Check that the date and time on the PC are correct. These fields will be recorded in the spectral header.

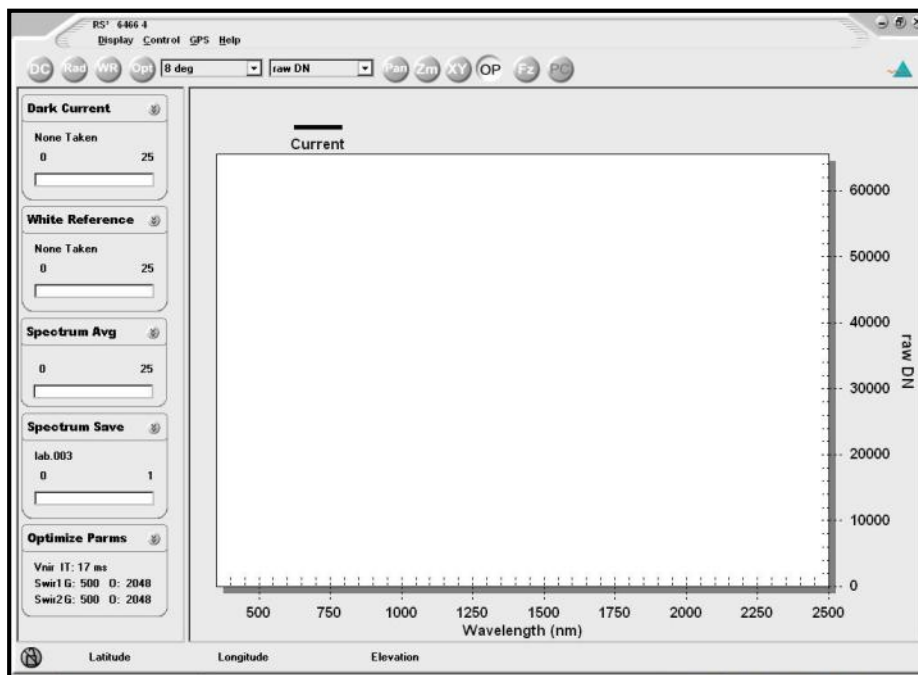
## 6 Create a path to store the spectral data

Through Windows explorer, create a path to store the spectral data. The correct working folder is based on: C:\Data\GEO4D\Location (Ponferrada)\_yyyymmdd

eg C:\Data\GEO4D\PONF\_2018sep

## 7 Start 'High Contrast RS3' instrument software

Start RS3 to obtain an interface like that illustrated below.

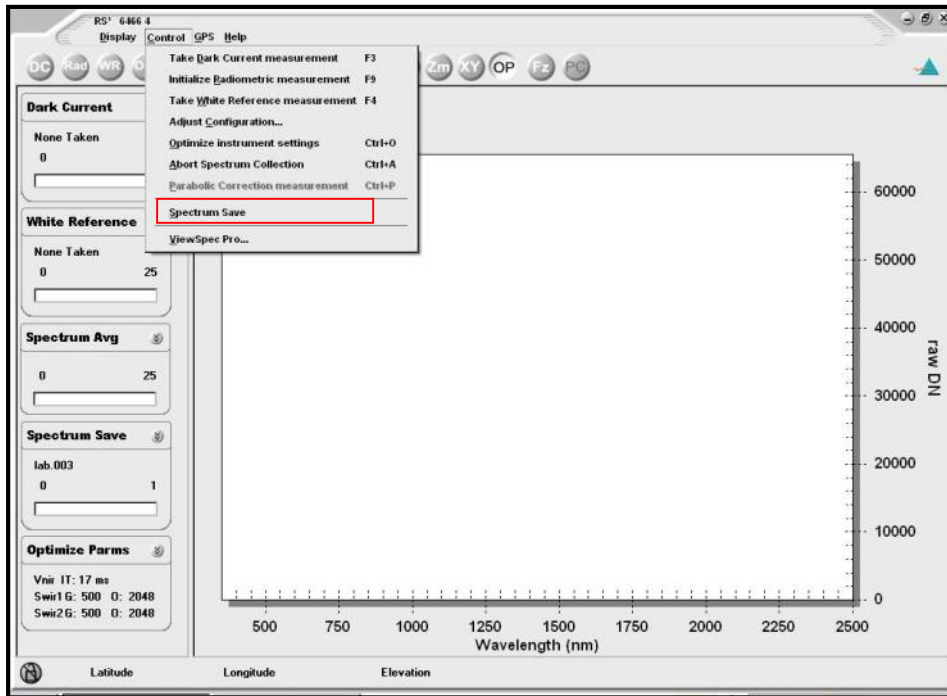


## 8 Connect GPS (via Bluetooth) to the laptop

The GPS should be set up with NMEA output. Connect the GPS via Bluetooth to the laptop. This must be done once the laptop is running. Under RS3s GPS menu, enable the GPS. The coordinates will be recorded in the spectral header file and coordinates can be seen displayed in the lower left corner of the screen.

### 9 Spectral measurement setup – saving data

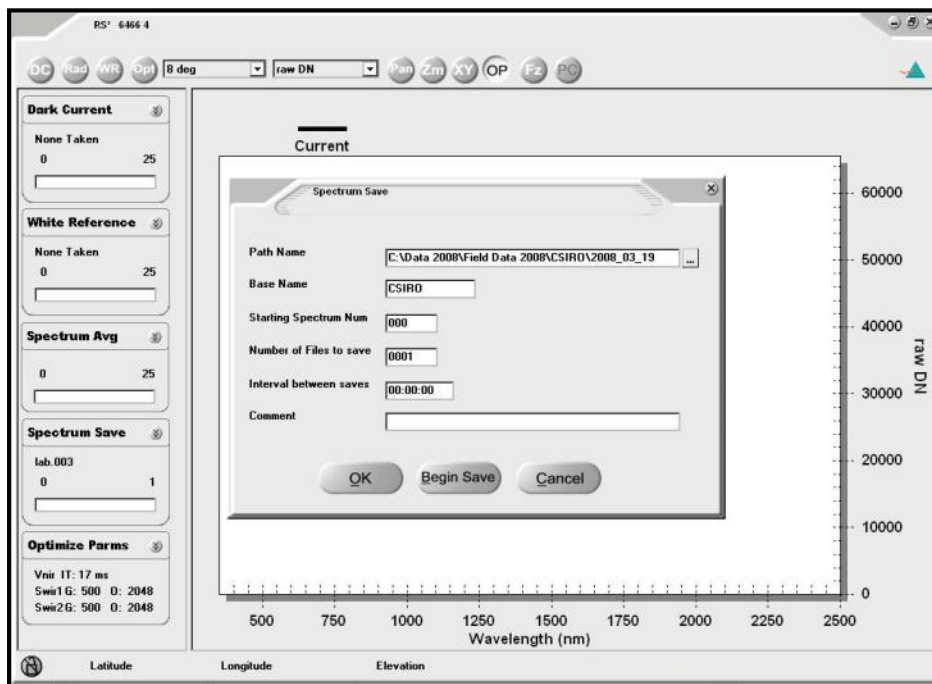
Go to Menu – Control\Spectrum Save or press Alt+S



Tab down to 'Path Name' (C:\...) and ensure the correct working folder is marked as the target folder for all data. If not, click on the box with the three dots at the end of the 'Path Name' box, and navigate to desired folder.

Tab to the Base Name and put in the correct format for data. The correct format for data is site (CS, BF or CP) plot number (eg 01) and begins at .000. (eg CS01.000). Note that the software will only allow a maximum of eight alphanumeric characters in a file name.

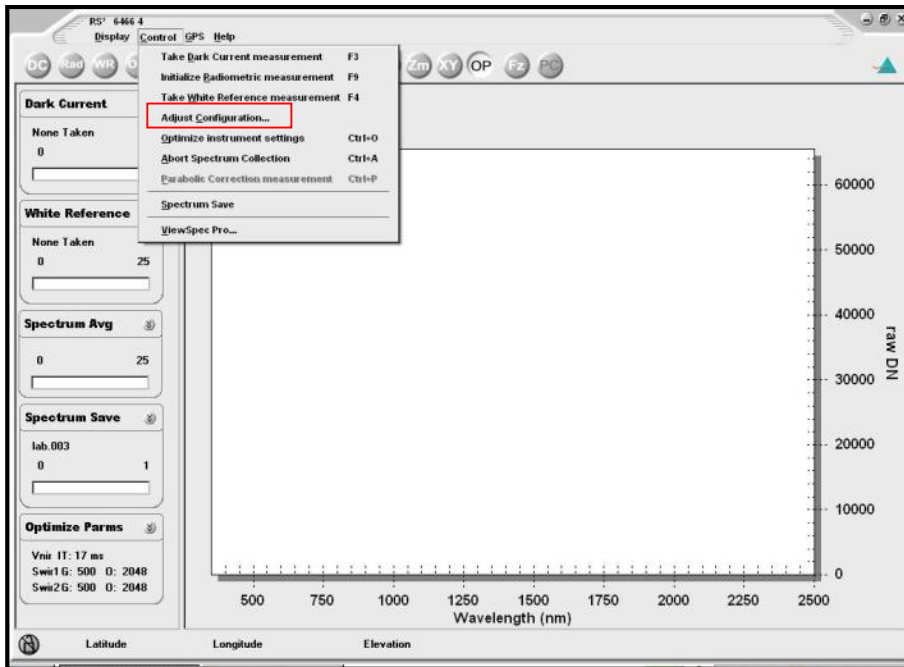
The interface should look similar to the one below:



Click OK or press ALT+O (letter 'o')

### 10 Adjusting the measurement configuration – fore optics and spectral averaging

Open the Control\Adjust configuration (Alt C + C)

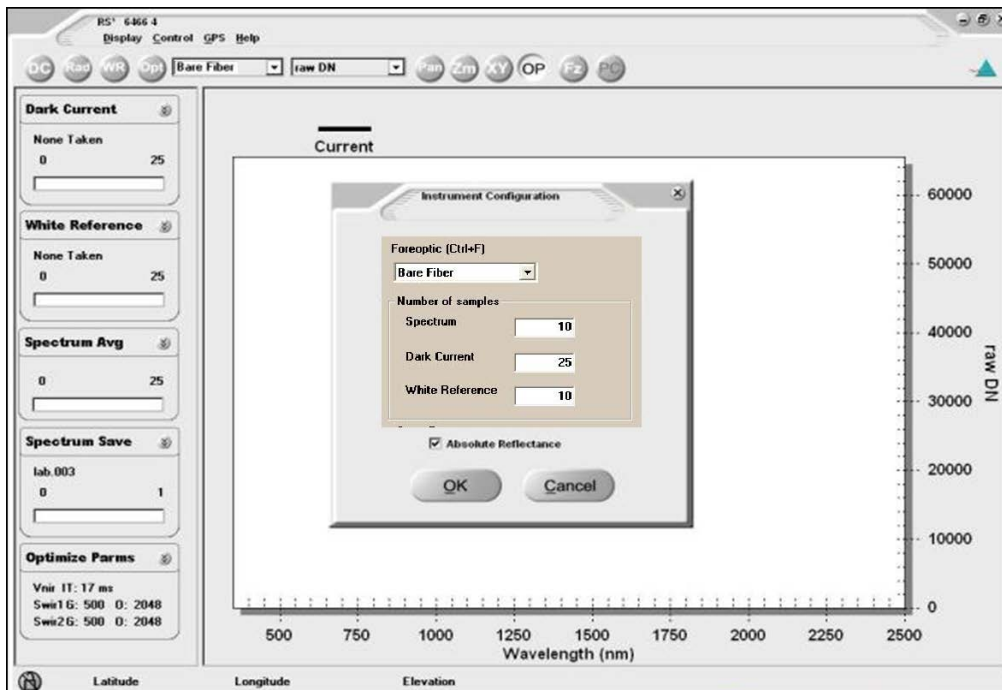


*Fore optic selection:* in the pull down menu box next to the integration time, set the fore optic to Bare Fiber

*Spectral averaging selection:* Spectrum averaging is the number of samples taken per observation. Check the software to see the configuration for the number of samples is correct. For field measurements,

Spectrum = 10, Dark current = 25 and White reference = 10

The interface should appear similar to the following one.



IMPORTANT: remember that ASD Technical Support must create an Absolute Reflectance file specific to your Spectralon® calibration panel in order to view Absolute Reflectance.

Select OK to accept the details and close the window.

## 11 Taking measurements – optimisation

Check the viewing geometry, before taking data

- Orientate the white panel box to ensure that the open lid will not cast a shadow on the panel.
- Ensuring the probe is pointing to the centre of the white panel box.
- Once the FOV is centred in the middle of the WR panel and the probe in the nadir, the WR panel ready for spectral measurements.

Given suitable sampling conditions, ensure the fore optic is pointed at the centre of the WR panel. **Open the white panel lid to expose the white panel.**

### Press the Opt-button (or CTRL-O)

You will see the profile changing while the instrument is adjusting. The different regions of the three detector arrays will be visible, with obvious separation around the 1000 and 1800 nm region. You may notice a clicking sound when the optimisation process is complete.

Note that there should be no movement of the fore optic during spectral measurement, which is obtainable with the fore optic mounted in the standard set-up. The operator must ensure he/she is on the side of the computer, panel and target away from the sun and that their presence is not interfering with the spectral measurement in terms of contributing shadowing or scattering components.

## 12 Taking measurements – radiance

After optimising and collecting a dark current the graph will display measurements in radiance (raw digital numbers) and plot them against wavelength in nm. **This is the incoming solar spectrum.**

**Press the space bar to save the averaged spectrum.**

It will have the file suffix **\_000**

## 13 Taking measurements – white reference

**Continue pointing the fore optic at the white panel and press the WR-button (or F4).**

A reflectance curve with a near horizontal line at a value of 1 should appear if the illumination and viewing geometry set-up is correct.

Allow two screen refreshes (you can wait longer and observe the reflectance line, confirming that illumination conditions are not changing because the line is quite stable) and if the white reference reading is stable, press the spacebar to record the WR.

It will have the file suffix **\_001**

## 15 Taking measurements – target

**Swing the pointer of the fibre optic cable by 90° over the sample plot.**

Wait for two screen refreshes.

Press the spacebar to save. **File suffix\_.002**

**Repeat this step checking that the measurement is representative of the sample.**

Save the target spectra. **File suffix\_.003-004.**

## **16 Taking measurements – repeat white reference**

**Swing the probe back over the centre of the white reference panel.**

Wait for two screen refreshes.

**Take another WR reading (press the WR-button or F4).**

A reflectance curve with a near horizontal line at a value of 1 should appear if the illumination and viewing geometry set up is correct.

**Save the WR as a target by pressing the spacebar.**

**File suffix\_.005**

**Close white panel box to prevent airborne contaminants settling on white panel surface.**

If during the measurements saturation occurs, then optimise again and repeat the measurements with the steps as described above.

## **17 Recording metadata**

When the spectral data have been obtained, record the metadata on the data sheets: Date, Reference Panel, Location, Foreoptics (FOV), Instrument, Mode, Operator, Accessory, Light source...

Other possible metadata are:

- An estimation of the cloud cover is recorded. If the operator is confident with cloud descriptions, the cloud types can be defined.
- Provide a qualitative estimate of smoke and haze cover, described by visibility in km.
- The sky will also be documented by photographs.
- Record the site code and species name.
- Record the pattern of distribution (where, even distribution describes a uniform cover of vegetation over the ground and clumped describes vegetation that presents as distinct clumps across plot).
- Estimate and record the amount of layering within the vegetation plot (where, single describes a layer of vegetation where all plant components are at the same level and little scattering would occur and multiple describes those vegetation that grow in layers as either different components of the plants or as different growth heights of individual plants. Nearly all vegetation types will have multiple layering).
- Estimate and record the cover homogeneity as % cover of the target vegetation. Ideally all plots will have a 100% cover of the target species. At times, cover may include a % component of exposed soil interspace, leaf litter or an alien species.
- Measure and record the maximum plant height mean density (or the height at which most biomass occurs)
- Describe the phenology of the sample with terms such as green growth, flowering, seeding, senescing or drying.
- Record any disturbances that are visualised, such as trampling.

## 18 Take reference photos

First photographed one pace from site (no zoom on camera). Captures site and surrounds.

Then take from nadir with the camera held at a 1 meter height, or as the vegetation height will allow with camera without zoom.

## 19 Moving to the next plot

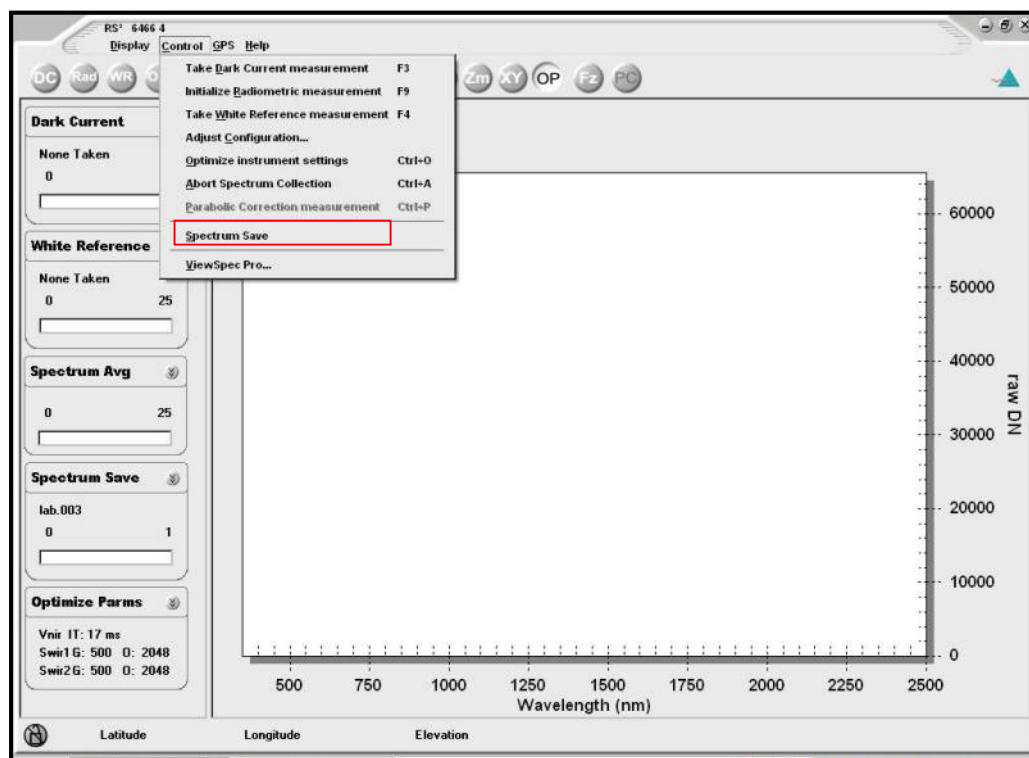
Move the ASD FS4 ensuring that the fibre optic cable is not bent, kinked or pinched. Fold up stabilizing mechanism and rest onto wooden panel, and move on to next plot.

## 20 Setup for the next plot

Once the equipment is setup on the side of the target point opposite the sun, and the viewing geometry has been checked, the controlling software needs to be told where to save data for the next site. Adjust the working folder.

## 21 Spectral measurement setup – saving data

Go to Menu – Control\Spectrum Save or press Alt+S



Tab down to the 'Path Name' (C:\...) and ensure that the correct working folder is marked as the target folder for this plot by clicking on the box with three dots at the end of the 'Path Name' box and navigate to desired folder. Assuming you are measuring more than one plot at each site, the change will only be to the plot number. For example, CS02.000.

Click OK or press ALT+O (letter 'o')

You are now ready to repeat the spectral measurements at the next site, including optimisation, incoming solar radiation, WR, target spectra, repeat WR spectra and metadata recording including photographic records.

## **22 Taking spectral measurements – additional plots**

For every additional plot, the following steps need to be repeated:

- Adjusting the path to where the spectral files will be saved.
- Optimisation
- Saving incoming solar radiation
- Saving WR spectra
- Saving the target spectra
- Saving an additional WR spectrum
- Recording metadata and photographs.

## **23 Returning from spectral sampling**

On returning from field trip it is important to back up data immediately to avoid loss or damage to data.

The field data should be copied from the laptop to the server.

The metadata should be added to the spectral metadatabase as soon as possible. Field data is entered and saved onto the server and then stored in a folder by date in the laboratory.

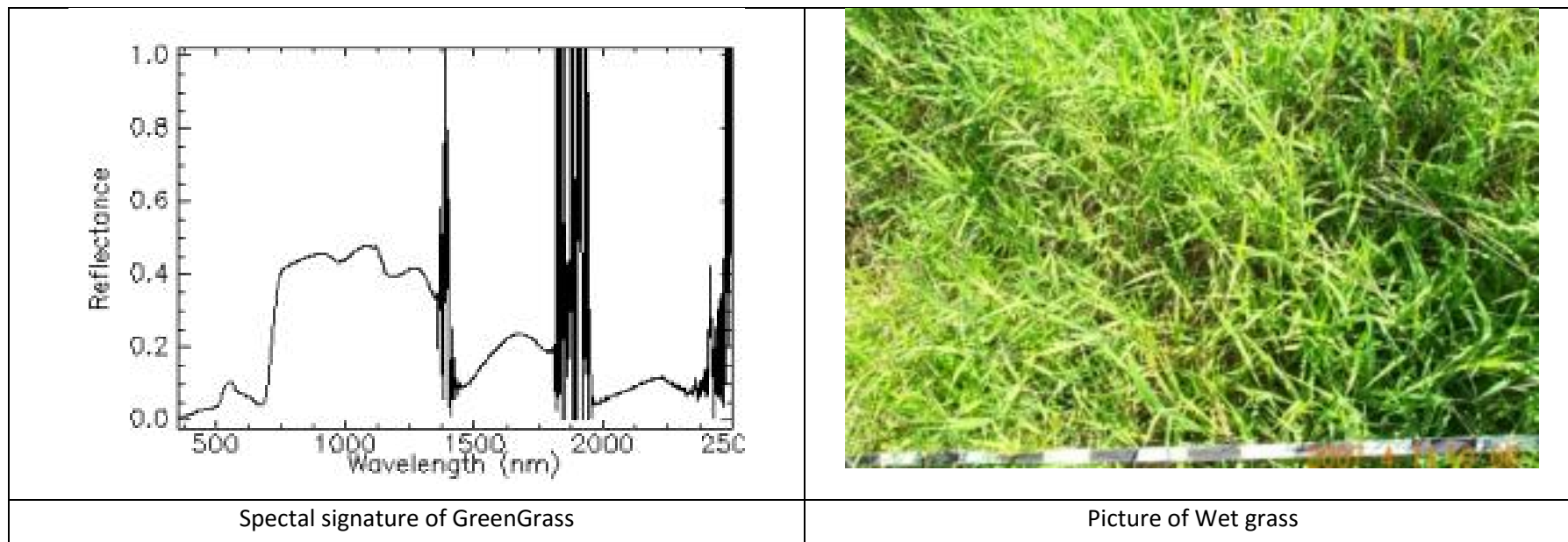
Images that are stored on the camera need to be copied to the server and given the appropriate filename.



**Final Report**

After taking field data, these will be processed to get a card for each sample on display representative spectral signature and metadata (including a picture).

The final spectral reflectances will be performed using the software View Spect and SAMS. An Example:



Spectral signature of GreenGrass

Picture of Wet grass

|                               |                    |                          |   |                         |                      |
|-------------------------------|--------------------|--------------------------|---|-------------------------|----------------------|
| <b>Description</b>            | Wet grass          | <b>Time</b>              | 13:15 h                                     | <b>Reference Panel</b>  | Spectralon 99%       |
| <b>Filename</b>               | GreenGrass         | <b>Date</b>              | 2015_07_25                                  | <b>Foreoptics (FOV)</b> | 25°                  |
| <b>Specie (if vegetation)</b> | Lolium multiflorum | <b>Location (ETRS89)</b> | 42° 33' 04,032336" N<br>6° 34' 54,393479" W | <b>Mode</b>             | Absolute reflectance |
| <b>Comments</b>               |                    | <b>Instrument</b>        | ASD FS4                                     | <b>Accessory</b>        | Pistol grip          |
| <b>Sky</b>                    | Clear              | <b>Operator</b>          | José Ramón                                  | <b>Light source</b>     | Sun                  |

