

## NGEE Tropics - ENSO leaf spectral collection: HR-1024i Protocol

*Use this protocol document as a guide for unpacking, using and packing up the BNL TEST SVC HR-1024i spectroradiometer*

**The instrument manuals can be found on the NGT Google Drive at:**

Instrument - [https://drive.google.com/open?id=0B\\_qFBZ6hyQLcMXZMTExyMWNJUkU](https://drive.google.com/open?id=0B_qFBZ6hyQLcMXZMTExyMWNJUkU)

Plant Probe - [https://drive.google.com/open?id=0B\\_qFBZ6hyQLcTW1uWkRHR3JCSIU](https://drive.google.com/open?id=0B_qFBZ6hyQLcTW1uWkRHR3JCSIU)

Software - [https://drive.google.com/open?id=0B\\_qFBZ6hyQLcWIZfcHZjb0FlcFU](https://drive.google.com/open?id=0B_qFBZ6hyQLcWIZfcHZjb0FlcFU)

### Using the SVC HR-1024i

1. Unpack the SVC HR-1024i from the larger pelican case (labeled Spec Body)



2. Set spectrometer body on solid surface, such as a table / folding table, concrete floor, etc. DO NOT SET ON THE GROUND OR THE SOIL!
3. Insert spectrometer battery.



- a. Or if possible you can use the spectrometer AC adapter. Insert this the same as you would a battery and then connect the power plug to the adapter and then to a wall socket or a power strip



4. Remove plant probe and plant probe battery from second pelican case (labeled "spec head") and set aside on work surface.



5. Remove standard 4degree lens from the front of the spectrometer body. **NOTE:** Rotation is clockwise as shown on the front of the body



6. Remove protective rubber caps from fiber optic and place into the small ziploc bag in the spectrometer body pelican case



7. Insert fiber optic (FIBER1) into the spec body as shown below and hand tighten - **do not overtighten or tool tighten**. **NOTE:** you need to align the metal notch with the receptacle on the spectrometer body and then turn the collar counterclockwise to secure the fiber optic to the instrument.



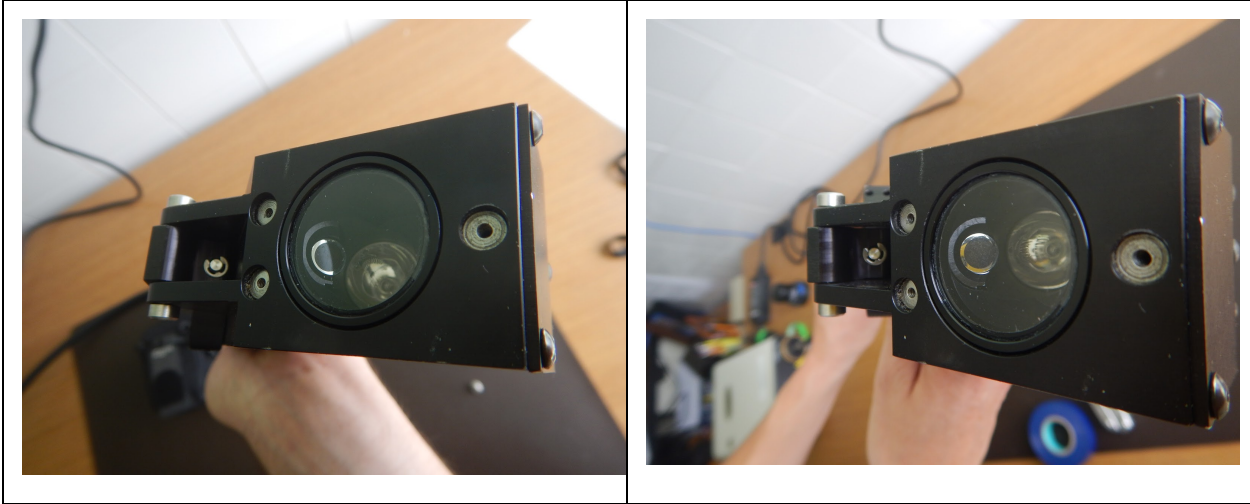
8. Once the end of the fiber optic is installed into the instrument, move to the other end and install into the plant probe. **WARNING: DO NOT COIL THE FIBER OPTIC TOO TIGHTLY OR BEND GREATER THAN 90DEG AS THIS COULD DAMAGE OR DESTROY THE INTERNAL FIBERS.**
- a. Remove protective cap and safely store, if not already done and remove silver thumb set screw from plant probe. **WARNING: Make sure you remove the thumb screw completely before inserting so that you do not damage the end of the fiber optic during insertion**



- b. Insert fiber optic into plant probe



9. Confirm fiber optic is fully installed into the plant probe. To do this look into the business end of the probe for the the end of the fiber optic which should be clearly visible behind the lens. See images below for proper fiber optic insertion. NOTE: blue tape on fiber also serves as a check for full fiber insertion



10. Once fiber is fully inserted screw in and hand tighten the silver thumb set screw on the plant probe. NOTE: Hand tighten as well as possible but DO NOT TOOL TIGHTEN as this could damage the end of the fiber optic.
- Regularly check that the fiber stays fully inserted during data collection. If the fiber slides back out of place, make sure to loosen the screw, reset and re-tighten. ***It is critical that the fiber optic stay fully inserted during data collection***



11. Install the plant probe battery to the plant probe. Again only hand tighten this connection.

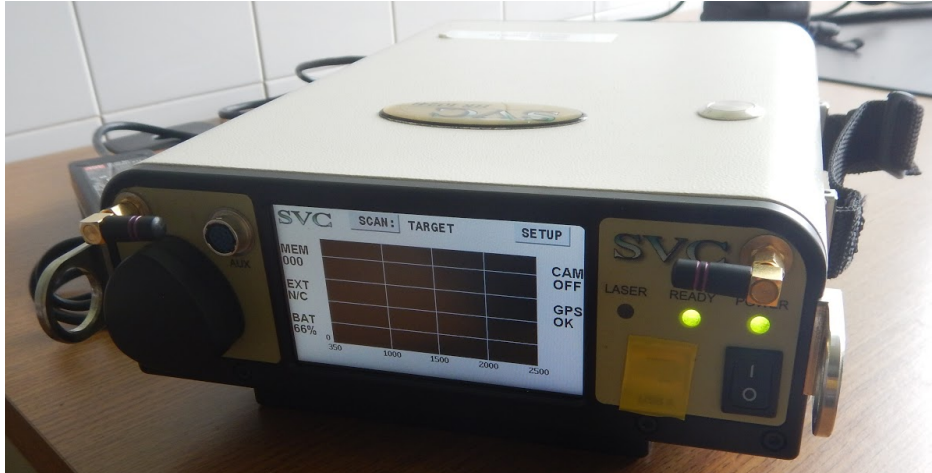


12. At this stage the plant probe should be setup similar to the image below. NOTE: Make sure the probe lamp intensity setting is set to "low"



13. Turn on the plant probe lamp using the green power switch on the back. NOTE: Allow lamp to warm up for 10-15 minutes before use, however it is advised to turn this off during long periods of down time (i.e. longer than 20 minutes) to conserve battery and the life of the bulb

14. Turn on the SVC HR-1024i spectrometer using the black power switch on the back of the spectrometer body. Once fully booted up the screen should look like below. NOTE: Allow spectrometer to warm up for 10-15 minutes before use, however it is advised to turn it off during long periods of down time (i.e. longer than 20 minutes) when running on battery to conserve battery and the life.



- a. Note if using spectrometer on a particularly hot day or if the spectrometer is sitting in direct sunlight (not advised) turn on fan by using switch on the underside of the spectrometer body
- b. It is advisable to use fan when on AC power
15. Install bluetooth adapter into the Algiz 10x tablet and boot up computer. NOTE: It is best to first setup spectrometer and begin warm up before starting computer. Then reverse the order when stopping for the day



- a. NOTE: You need to hold down the power button for about 30 seconds in order to boot the computer from a completely powered down state

16. When the tablet gets to the ctrl+alt+delete screen simultaneously press the UP and DOWN arrows to get to the BNL security notification screen and then hit OK, either with your stylus or finger (*capacitive screen*)





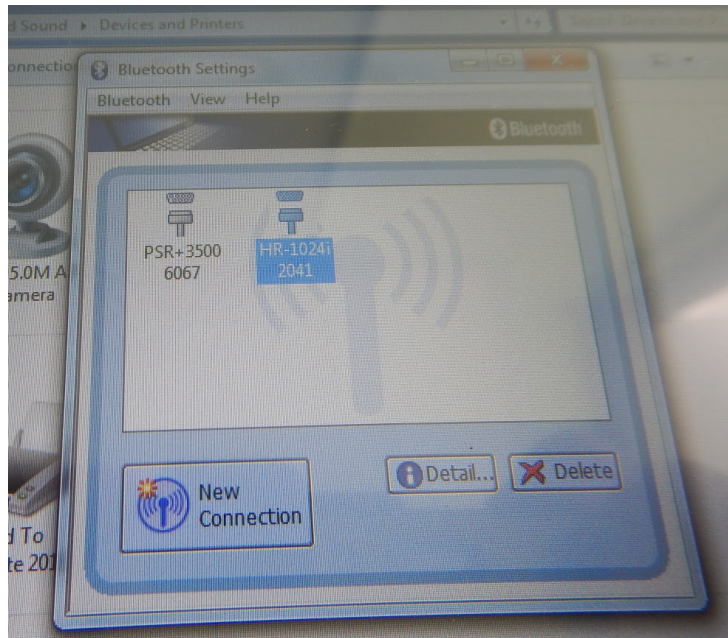
17. Once at the login screen enter in the username and password. NOTE: Until you are used to using the screen it can be bit tricky to “press” the correct buttons on the keyboard



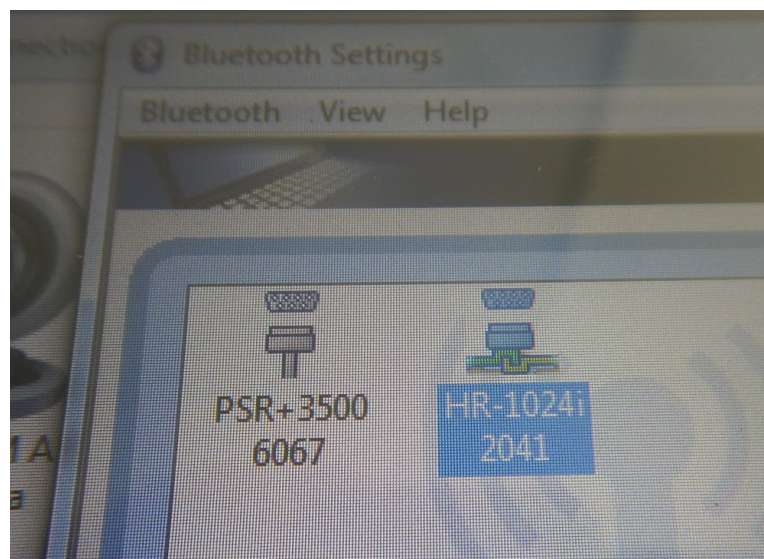
18. Once logged onto the tablet, open up “Devices and Printers” and select the “Bluetooth Adapter” tool



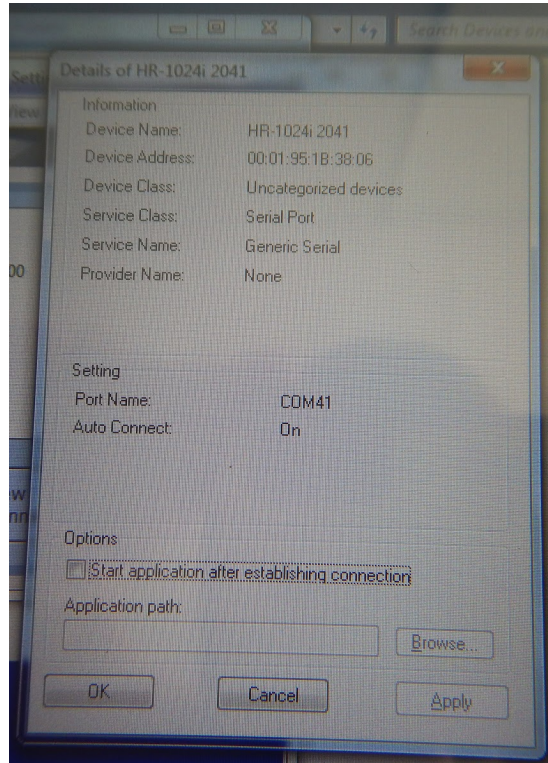
19. Once open, select the “HR-1024i 2041” option and “double click” it or double tap the screen to connect to the instrument. NOTE: This assumes that the instrument has already been powered on and warming up, if this isn’t the case then you need to go back to step 14, wait for the spectrometer to turn on, then come back to this step and try again to connect



- a. Once the tablet connects to the instrument you should see a new graphic below “HR-1024i 2041” which indicates a connection

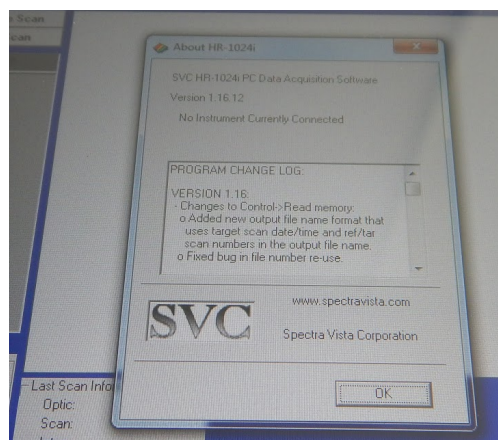


20. Once connected within Windows, you can check which “port” the bluetooth is connection on. You will need this for connecting and using the instrument with the instrument software. To check the comm port click the “Detail” button. By default, the comm port is 41. This should not change but if it does you can use this to find the new port number.

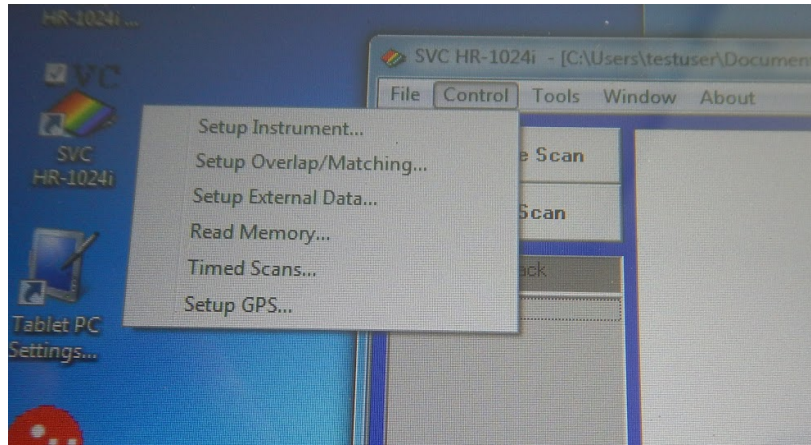


21. Once connected within Windows, launch the SVC software “SVC HR-2014i” found on the desktop

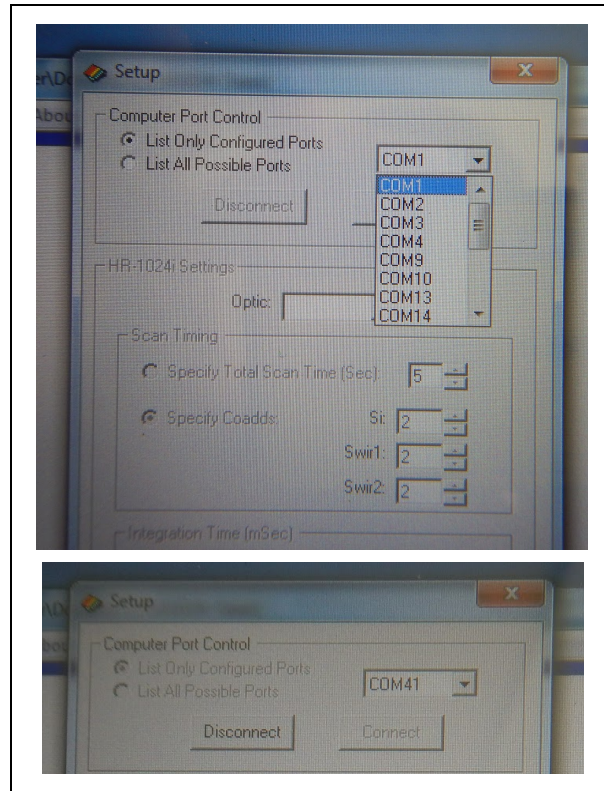
22. Once launched you should see the software splash screen and an information window. Just hit “OK”



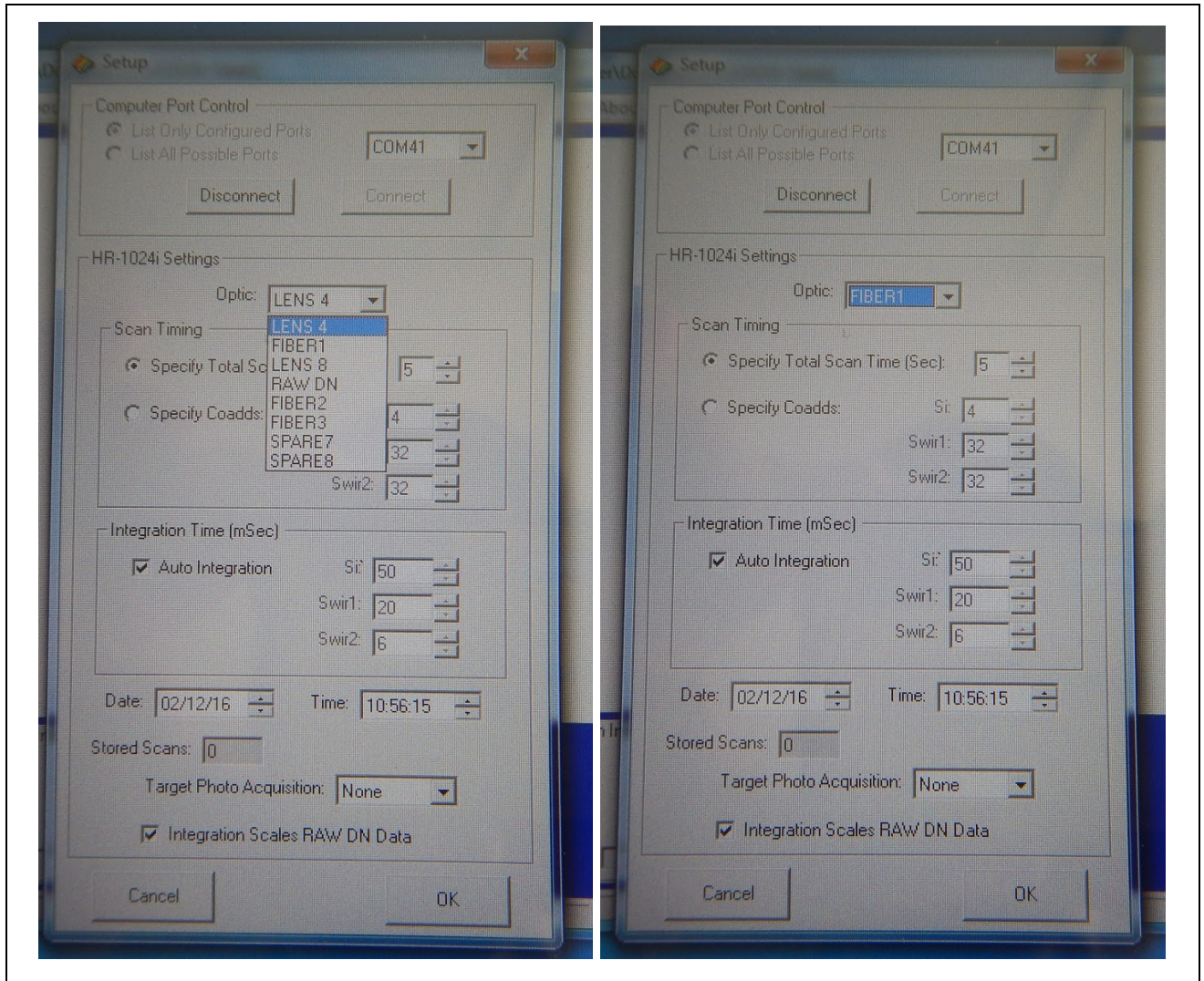
23. The next step is to connect to the instrument within the SVC software. To do this go to the “Control” menu and select “Setup Instrument”



24. If this is the first time you are connecting to the instrument from a computer, you will need to set the correct comm port in the instrument setup. To do this go to the comm selection menu and scroll to the port number shown in step 20 (Default is 41)

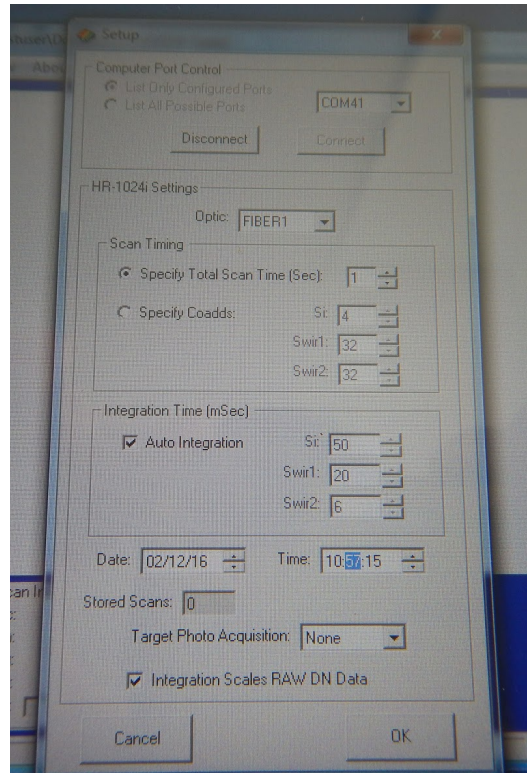


25. Next select the appropriate option in the “Optic” menu. Select “FIBER1” (like the cereal) for use with the plant probe

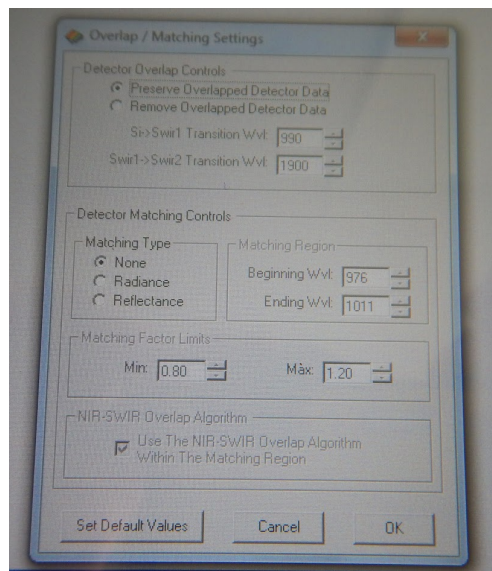


26. Now select the correct setting in the “Specify Total Scan Time (Sec):” and set to 1 second

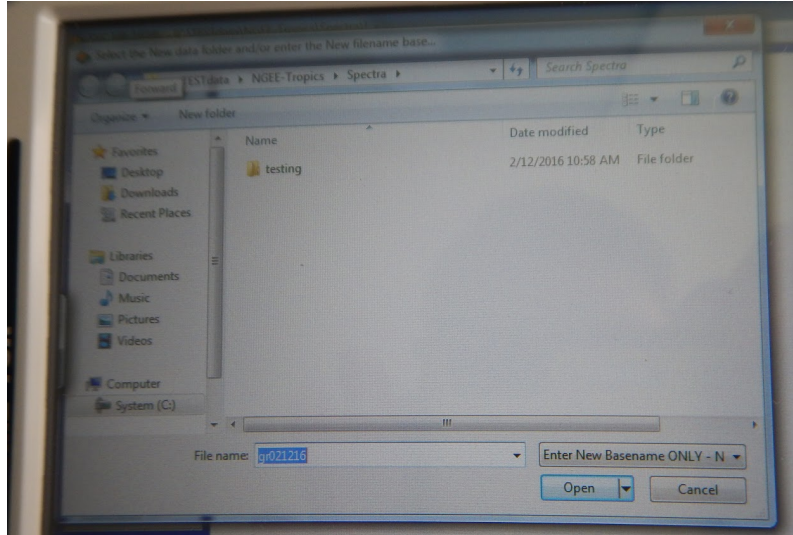
27. Next check the instrument clock and adjust as necessary



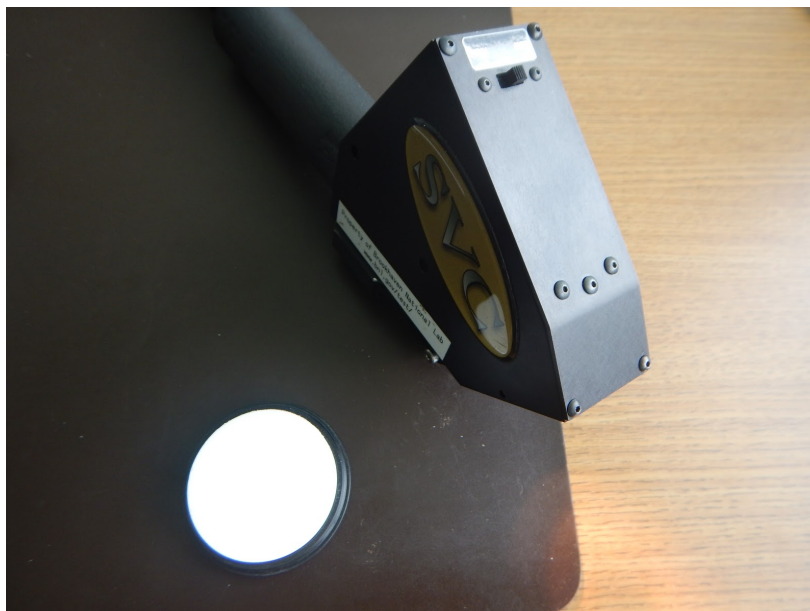
28. The detector overlap and matching settings should be set to the appropriate setting, but you can confirm this by going to the “Control” menu on the main screen and selecting “Setup Overlap/Matching...” The correct options are “Preserve Overlapped Detector Data” in the “Detector Overlap Controls” options and “Matching Type None” in the “Detector Matching Controls” as shown below



29. To begin collecting data you should first setup your directory structure and file naming. To do this go to the file menu and select “New”. Use this to store spectra files in your directory of choice.



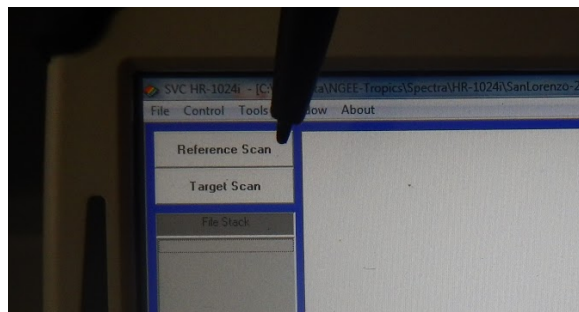
30. To begin collecting data with the plant probe, you need to first calibrate the spectrometer to a Spectralon reference reflectance standard. Two of these standards are located in the spectrometer case labeled “0826” and “0827”. Always make note of which standard you use during collection so that we can apply the correct standard correction factors during later data processing. NOTE: It is advised not to mix standards during a single day's collection, unless necessary. If it is, make a new folder and note the change.



31. To collect a good reference, first align the business end of the probe on the Spectralon disc as shown below



32. Once on the probe is in position, hit the "Reference" button

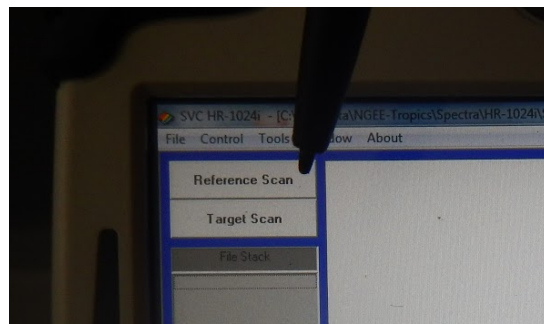




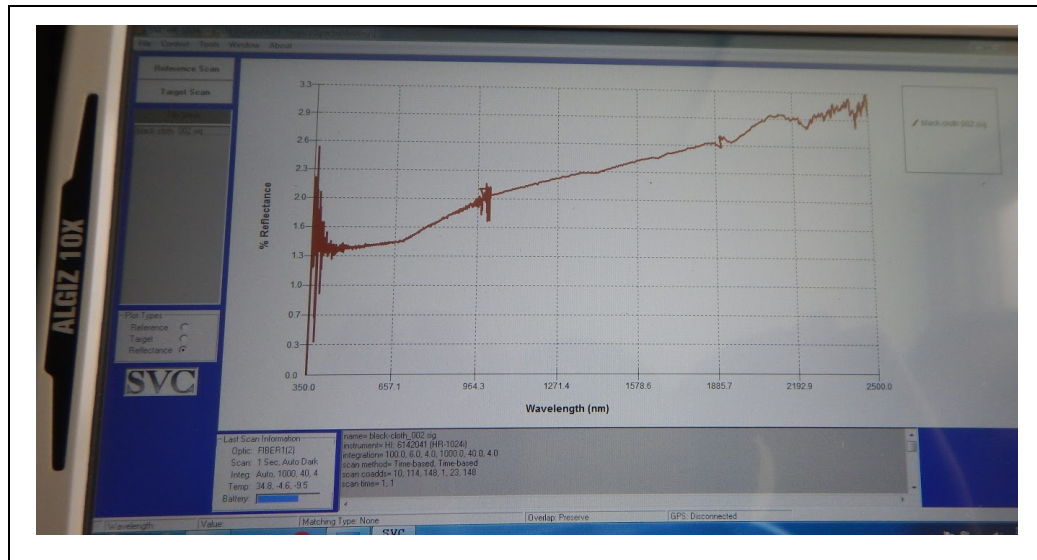
- a. Make sure you leave the probe on the Spectralon until the reference collection is complete. Once complete you will see a curve on the screen similar to the image below. Note the the reference does not get saved into a separate file, but instead gets stored in the “Target” spectra file (see 33 and 34)



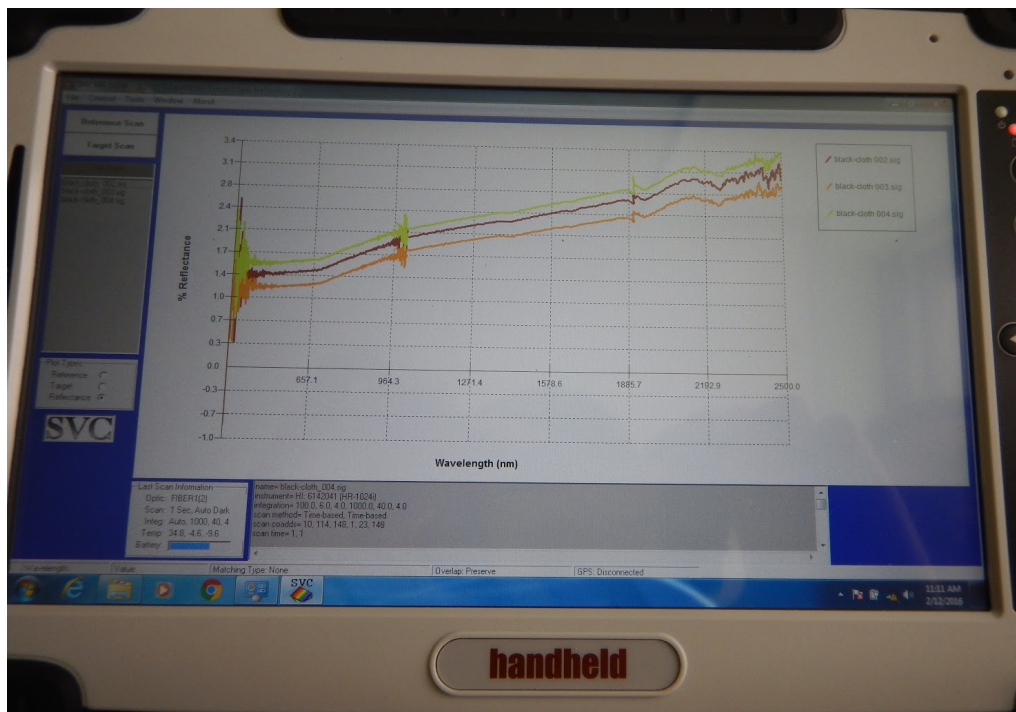
33. Now that you have completed the reference scan, place your sample (leaf) on the black cloth. The black cloth serves as an optically dark surface to minimize reflectance from the background when collecting the leaf spectra. The black cloth is provided in the spectrometer pelican case.
34. Start collecting spectra of your “target,” which will generally be your sample leaves, by pressing the “Target” button to collect the spectral data.



35. Once you hit the “Target” button, you will see your new sample spectra curve on the screen (actual file is stored in the previously selected directory with the selected filename) - NOTE: the spectra below are not from a leaf, see appendix A for example leaf spectra



36. You can continue to collect spectra on your sample and the spectral curves will show on the screen together (seen below for the black cloth used behind the leaf samples)



37. If you have a delay in your sampling, you can put the tablet to sleep and power down the spectrometer and plant probe to save battery or to cool down the instruments. To do this, first disconnect the instrument using the “Control” screen, “Setup Instrument” and select “Disconnect” Hit “OK” at the bottom but DO NOT close the SVC software. Instead put the tablet to “Sleep” and then power down the spec and the probe.
- To reconnect when you have new samples, repeat in reverse order. That is, turn on the spec and the probe. Wait 30 seconds, and then open “Control/Setup Instrument” and hit “Connect” Then select “OK” and start collecting data.

**38. Important: Remember to collect a Spectralon reference between each sample to keep the instrument calibrated**

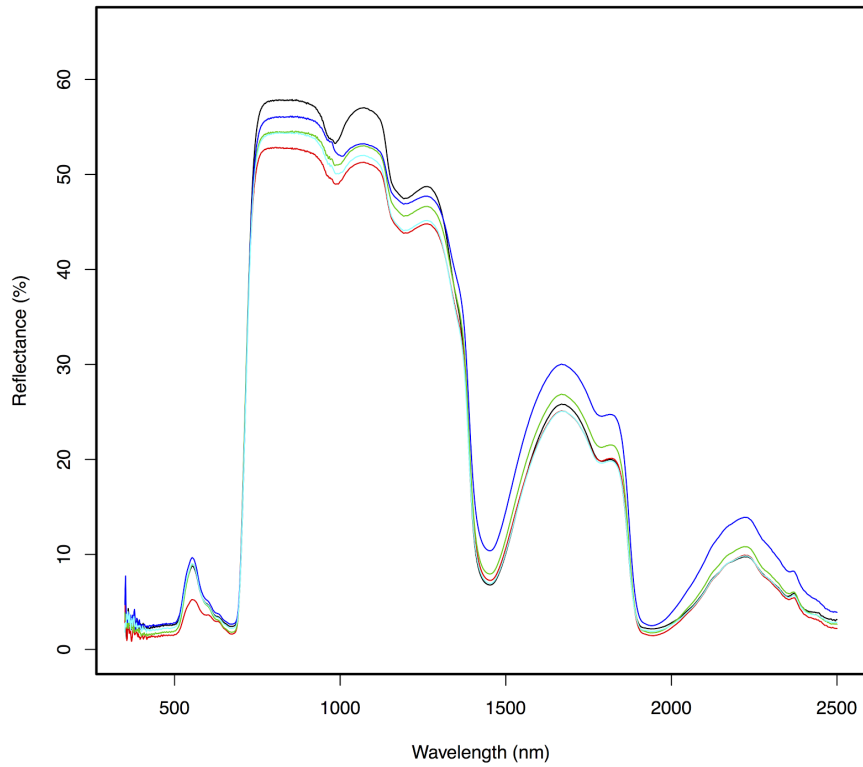
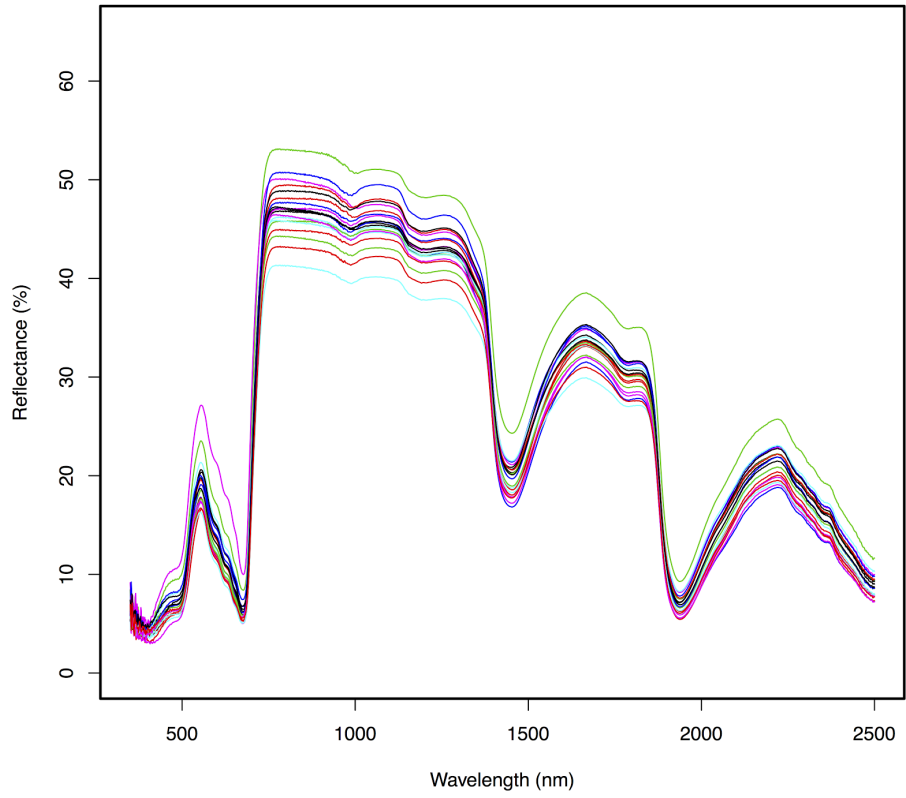
39. At the end of the day, first disconnect the instrument in the SVC software and close. Then shutdown the tablet, followed by the plant probe and instrument.

40. Charge the spectrometer (when used) and plant probe batteries before packing back into the pelican cases
- The chargers are located in the plant probe pelican case and can also be used with the spectrometer batteries as shown below

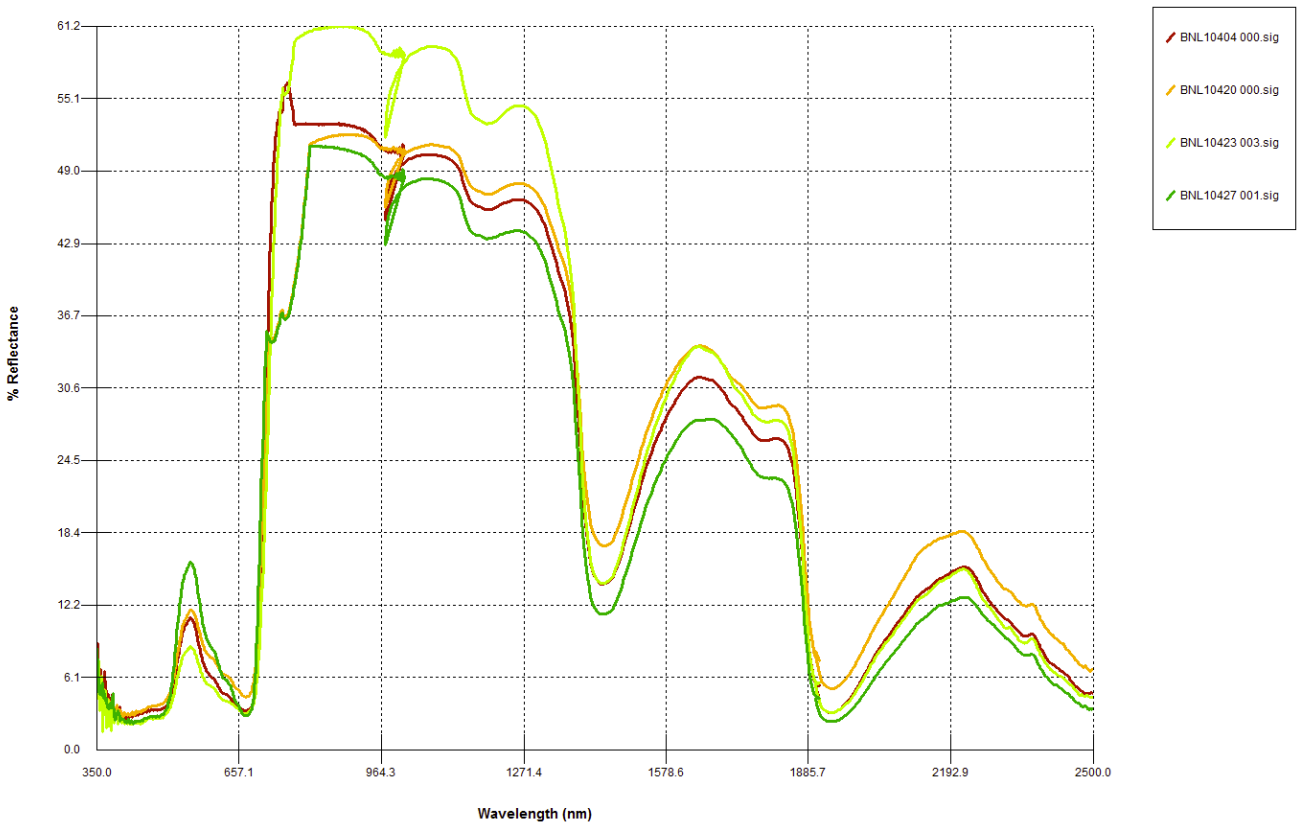


41. Replace instrument, fiber optic, and plant probe to their respective cases and store for transport. **Reminder: Do not coil fiber optic too tightly or bend beyond 90 degrees when handling.**

### A. Supplementary - Example SVC HR-1024i spectral output



## B. Supplementary - Examples of bad spectral measurements from Feb2016 Panama Trip



**Notes:** Ignore the detector overlap in the ~964 nm spectral region as this is something that I handle during data processing (i.e. this is normal). You are looking for strange artifacts, generally in the VNIR, that show up do to improper placement of the sample in relation to the plant probe, bad white reference, issues related to measuring certain leaf morphologies, etc, that manifest similarly to above. When issues like above happen, just collect additional spectra; we will remove all of the bad data during post-processing.