



TO PRESERVE THE MAGNIFICENT DARK SKIES
OF OREGON AND DIMINISH LIGHT POLLUTION
FOR THE HEALTH, SAFETY AND WELL-BEING
OF ALL LIFE

IDA Oregon Technical Memo SQM-LU-DL Data Retrieval Procedure 1 January 2023

Summary

This document describes the procedure for downloading stored data from a Unihedron SQM-LU-DL to a laptop or desktop computer and submitting the data file to IDA Oregon. The procedure, performed at 3-month intervals, includes replacing batteries, and updating real time clock synchronization.

Preparations

1. Remove the SQM from its weatherproof housing.
2. Connect the SQM via USB cable to the computer (desktop or laptop):
 - a. Disconnect the battery pack from the SQM.
 - b. Connect the USB cable to the SQM.
 - c. Connect the USB cable to the computer. (Red light on SQM will light briefly upon connection).
3. Create a folder on the computer hard drive to receive data if one does not already exist.

Data Download

1. Launch the Unihedron Device Manager (UDM) application.
 - a. The current version of UDM (Windows, Mac OS, or Linux version) can be downloaded from the Unihedron website at: <http://unihedron.com/projects/darksky/cd/>.
2. The UDM main window will display (*Figure 1*) and UDM will recognize and connect to the SQM automatically. Press the Find button (1) if UDM fails to connect with the SQM automatically. If UDM still fails to find the SQM, reboot the computer, relaunch UDM, execute Find again if necessary.
 - a. The Information tab (2) is selected by default upon launch.
 - b. USB connection is selected by default upon launch, with USB port details listed below the connection type selection bar (3).
 - c. The current measurement is displayed in the Measurement box (4).
 - d. SQM device details are displayed in the Version box (5).
 - e. The last reading details are displayed in the Reading box (6).
3. Click Header button under Logging (7) to open the Datalogging Header window (*Figure 2*)

- a. Verify header entries are correct (see SQM-LU-DL Setup & Installation Procedure document for details).
- b. Correct any erroneous or missing entries discovered.
- c. Click Close (1) to close the Datalogging Header window (Figure 2) and return to the UDM main window (Figure 1).

Note 1: It is essential that correct values for *Position (lat, long, elev)*, *Local timezone region*, and *Local timezone name* are correctly entered in the header, or the downloaded data will be corrupted and not usable. The download can be performed successfully once correct header values have been entered.

Note 2: The header information is stored in a config file on the computer used to set up the SQM originally. The config file is a text file. It is in a folder specified under “View/Directories/Configfile Path”. If a different computer is used to download data, then the header fields need to be re-entered before performing the download. The next time the same computer is used to perform a download, the header fields will be repopulated automatically from the information stored on that computer for that SQM. The SQM will be identified by serial number and the correct header data for that SQM will be loaded. The first time a different computer is used to perform the download, the header data will have to be manually entered before performing the download. Alternatively, if you are computer savvy, copy the config file from the old computer to the config file path on the new computer.

4. In the UDM main menu, select View | Directories (in the application main menu bar at the top of the screen on Mac OS) to open the Directories window (Figure 3).
 - a. In Logs Directory Path, click the folder icon (1) to open the operating system’s file browser (Figure 4).
 - b. Verify that the desired data directory is selected, if not, browse to and select, or create the desired data directory to be used during data download.
 - c. Click Close (2) to close the Directories window (Figure 3).
5. In the UDM main window (Figure 1), select the Data Logging tab (8) to display the data logging controls (Figure 5).
 - a. Under Storage, click Retrieve (1) to open the DL Retrieve window (Figure 6).
 - b. Note the path displayed under File directory (1). Verify that the path displayed points to the desired data output folder. If incorrect, click the folder icon (2) to open the file browser and browse to and select the desired folder.
 - c. Select, Retrieve Range (5) to retrieve new data collected since the previous data download. First, enter the record number of the last record from the previous download into the start record box (6) (after each download, write the last record number on a post-it note, or piece of tape attached to the body of the SQM). A -1 in the end record box (7) will result in all records stored, from the start record onward being downloaded.
 - d. The last record number is displayed just to the right of the last record box (7) such as “13568 max”. Note and save the last record number. It will be the first record for the next data download.
 - e. Click the Retrieve Range button (5) to start the download.
 - f. Retrieved record count (1) will be displayed during the process (Figure 7).

- g. When data retrieval is complete, the number of records retrieved, the path to the data file, and the time elapsed during the process will be displayed (*Figure 8*).
- h. Keep previous data on the SQM as a backup. The SQM-LU-DL has sufficient memory to store years of data. Download and submit only new data acquired since the previous download.

Data Inspection

1. Inspect a graph of the retrieved data to verify successful retrieval.
 - a. Click the Plotter button (1) in the DL Retrieve window (*Figure 8*) to open the Plotter window (*Figure 9*).
 - b. In the Plotter files selection panel (*Figure 10*) click the file folder icon (1) to open the file browser and browse to the file folder in which the retrieved data was saved if the correct folder is not already selected.
 - c. Scroll down the file list and select the data file just created by the data retrieval process (2).
 - d. Under File Selection Mode, Single should be selected (3).
 - e. Under Position (4), the coordinates, region and time zone are displayed (read from the data file header).

Note: If the Position fields are blank, the corresponding fields in the data file header are empty, a consequence of failure to enter location data correctly when the SQM was set up or using a different computer for data retrieval and not repopulating essential header fields (Data Download Step 3). No data will be displayed in the plot. The data is present, just crammed into the top end of the plot. Return to Data Download Step 3, enter essential location and time zone information into the header and repeat the download.

- f. Under Settings (*Figure 11*), select Plot number (1), select Continuous line (2), select Grid, Darkness, Sun and Moon under Display (3), select the twilight marker lines for sunset, civil, nautical, and astronomical twilight under Twilight lines (4), and set time to Local (5). Click Replot (6) to update the plot.
- g. Zoom in on a selected portion of the plot by clicking and dragging a selection box. Click and drag from upper left to lower right for zoom to work correctly (*Figure 12*).
- h. When done inspecting downloaded data, close Plotter.

SQM Real Time Clock Synchronization

Before closing UDM and disconnecting the SQM from your computer perform the following procedure to synchronize the internal real time clock of the SQM with the clock in your computer, which in turn is automatically kept in synch with an internet time standard.

1. Upon returning to the Data Logging window, select the Data Logging tab (1). Under Device Clock press the Settings button (2), this will open the Device Real Time Clock setting window (*Figure 13*)

2. Initially there may be a difference (1) between the SQM unit clock and the computer clock (*Figure 14*).
3. Press the Set button (2) to synchronize the SQM internal real time clock with the connected computer's clock. Your computer's clock is in synch with an Internet time standard service if your computer is currently or was recently connected to the Internet.
4. After synchronization the difference between your computer' clock and the SQM's real time clock should be 0 to 1 second (*Figure 15*).
5. Press Close (1) to return to the Data Logging window (*Figure 16*).

Complete Data Download Session

1. Close UDM.
2. Complete installing new batteries in battery holder (see notes below on battery replacement).
3. Disconnect SQM from USB cable to computer.
4. Connect battery holder to SQM USB port.
5. Insert SQM in weatherproof housing with cap window positioned over SQM lens.

Note: Power is maintained to the SQM internal real time clock (RTC) by the charge on a capacitor when the SQM is not connected to the battery pack or computer USB port. If the SQM is disconnected from either the battery pack or USB port for too long, the RTC will stop and when power is restored no longer have the correct time. To prevent this from happening do not leave the SQM disconnected from power for more than a few minutes.

Data Submission

Send the retrieved data file as an email attachment to IDA Oregon at michael.mckeag@darksky.org. Include in the subject line something like "SQM data from..." and include the name of your location.

Battery Replacement

While the battery pack is disconnected from the SQM during data retrieval, and the SQM is connected to the computer USB port, remove the old batteries and replace with six new AA alkaline batteries, taking care to insert the batteries in the correct polarity. We have found Duracell AA "Coppertop" batteries to reliably power an SQM-LU-DL for more than three months. To be on the safe side and minimize the risk of data loss resulting from battery failure, we recommend battery replacement after three months during each quarterly data retrieval.

After completing data download and installing new batteries in the battery pack:

1. Close Unihedron Device Manager application.
2. Disconnect the SQM from the USB cable that connected the SQM to your computer.
3. Connect the battery pack to the SQM.

4. Attach a post-it note, piece of tape, or adhesive label to the SQM body, with the last record number noted, onto the SQM body. The last record number plus 1 will be the starting record number for the next download. That number, attached to the SQM body, will be readily available during the next download.
5. Return the SQM to its weatherproof housing and clean the housing cap window inside and out.
6. Make sure the window is centered over the SQM lens.
7. If the housing cap fits loosely, one layer of electrical tape applied to the outside of the housing body will result in a tighter fit and better seal. If a full turn of tape is too much, try just a partial turn to produce a snug fit.

Figures:

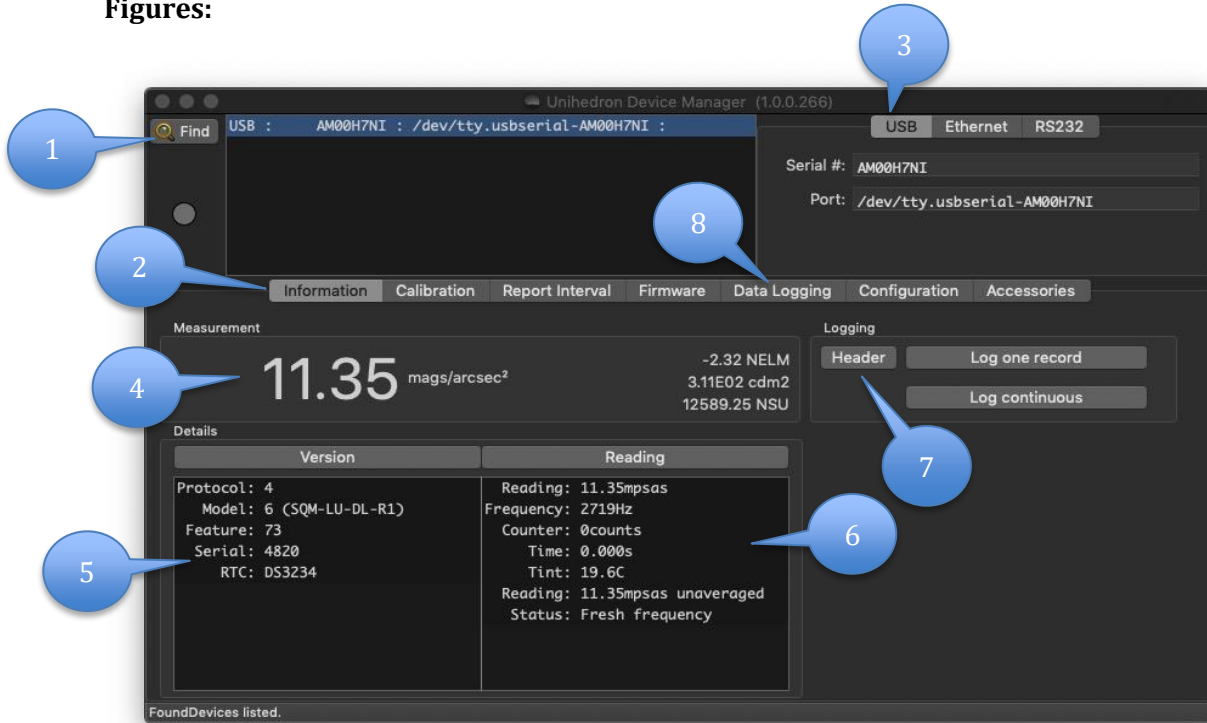


Figure 1: Unihedron Device Manager (UDM) main window. If SQM connection is successful, USB/serial connection details will be displayed at the top of the screen, the current brightness reading will be displayed in bold in the Measurement box. SQM firmware version and current measurement details will be displayed in the Version and Reading boxes respectively.

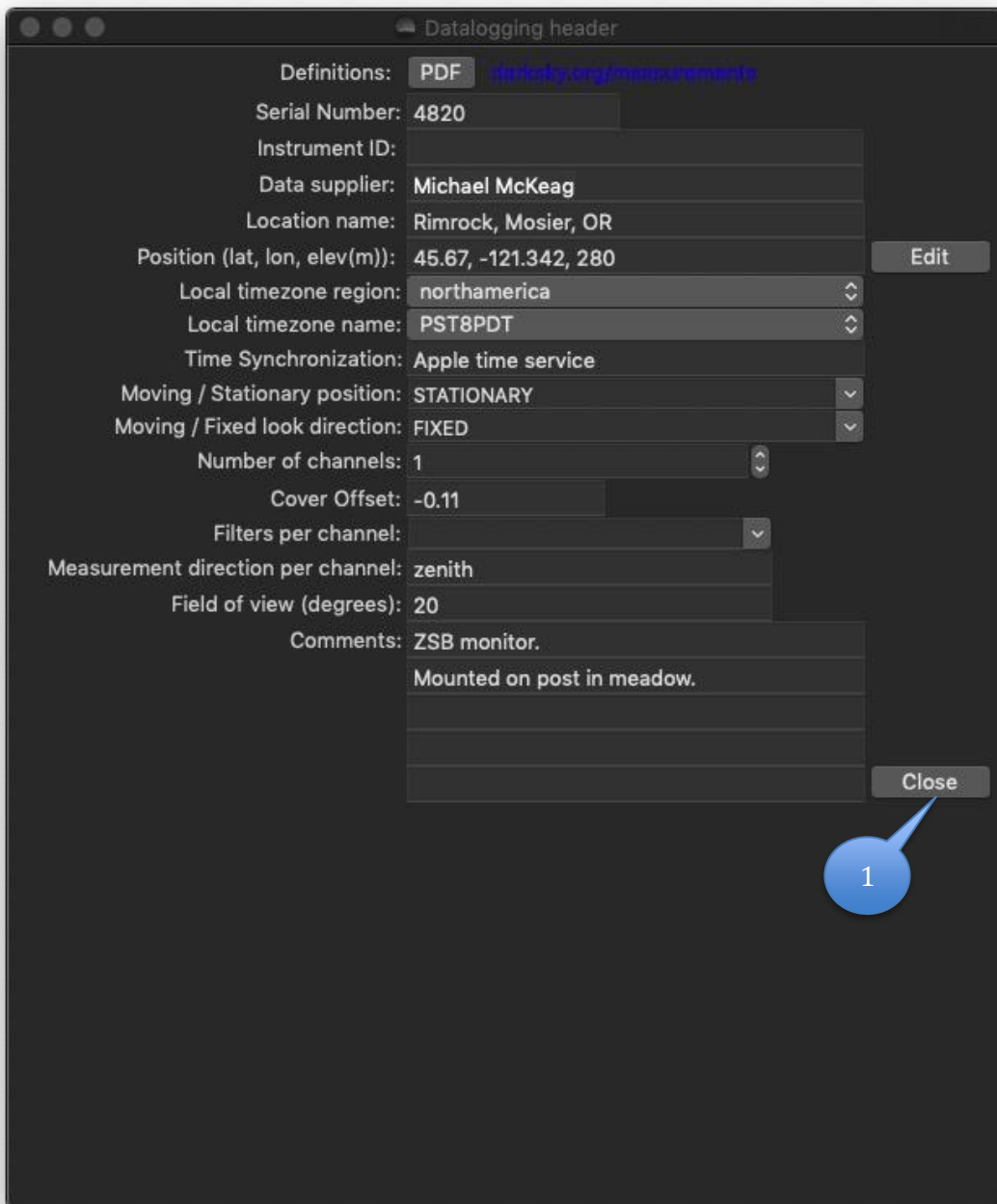


Figure 2: UDM Datalogging Header window. Verify, and update or correct if necessary, header information.

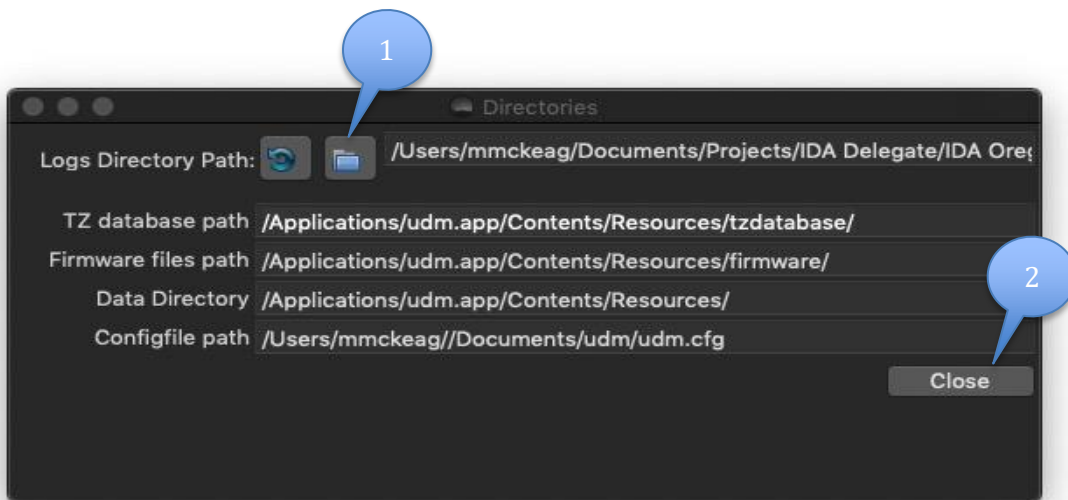


Figure 3 UDM Directories window. Under Logs Directory Path, verify the desired destination folder for retrieved data file is correct. Click the folder icon to open the operating system's file browser and select the desired folder if necessary.

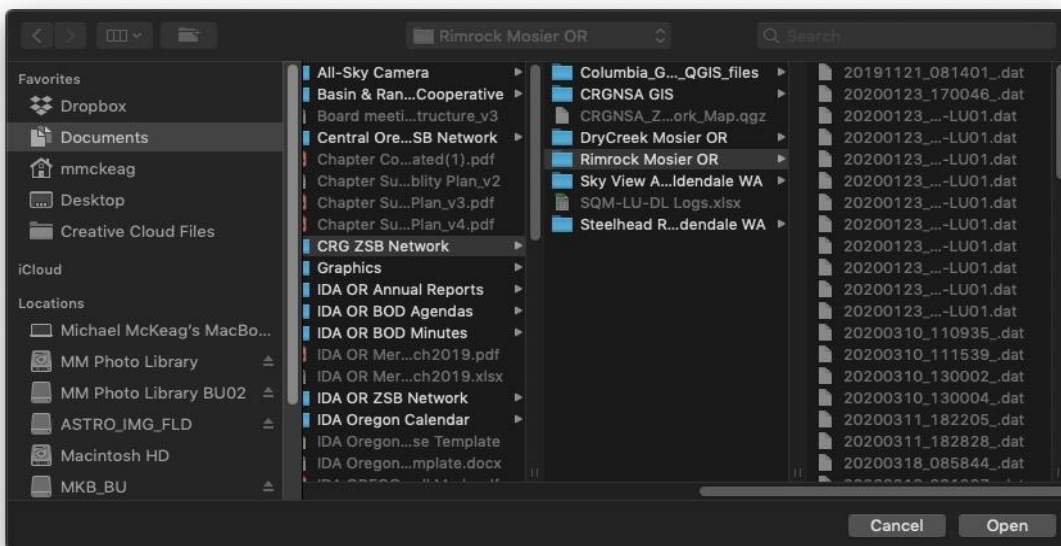


Figure 4: Operating system's file browser window (in this example, Mac OSX Finder). Select desired folder in which retrieved data will be saved.

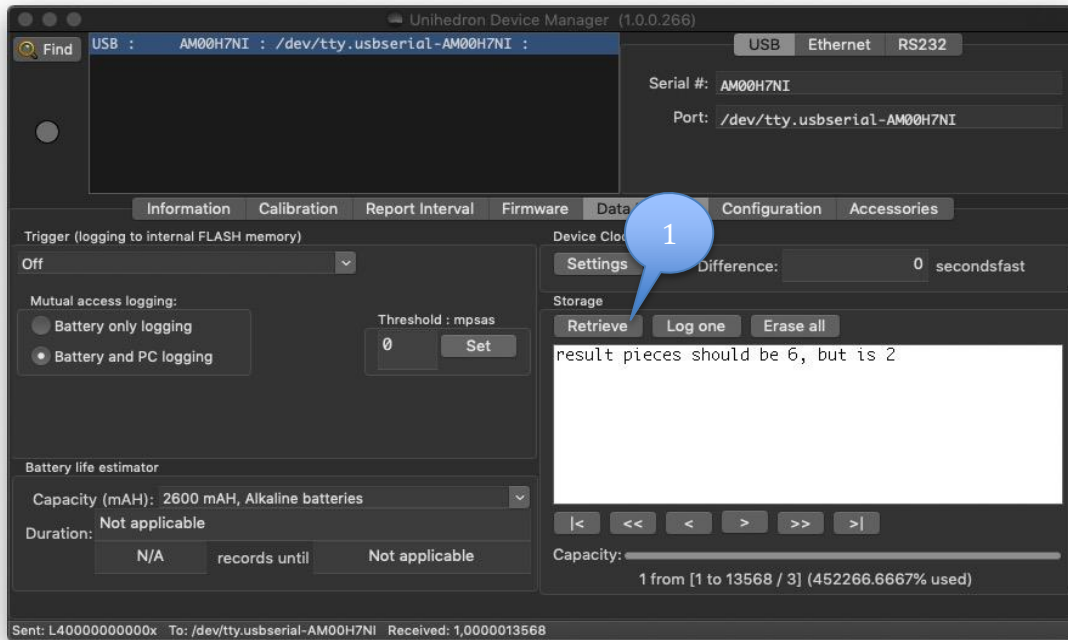


Figure 5: UDM main window with the Data Logging tab selected. Under Storage, click the Retrieve button to open the DL Retrieve window.

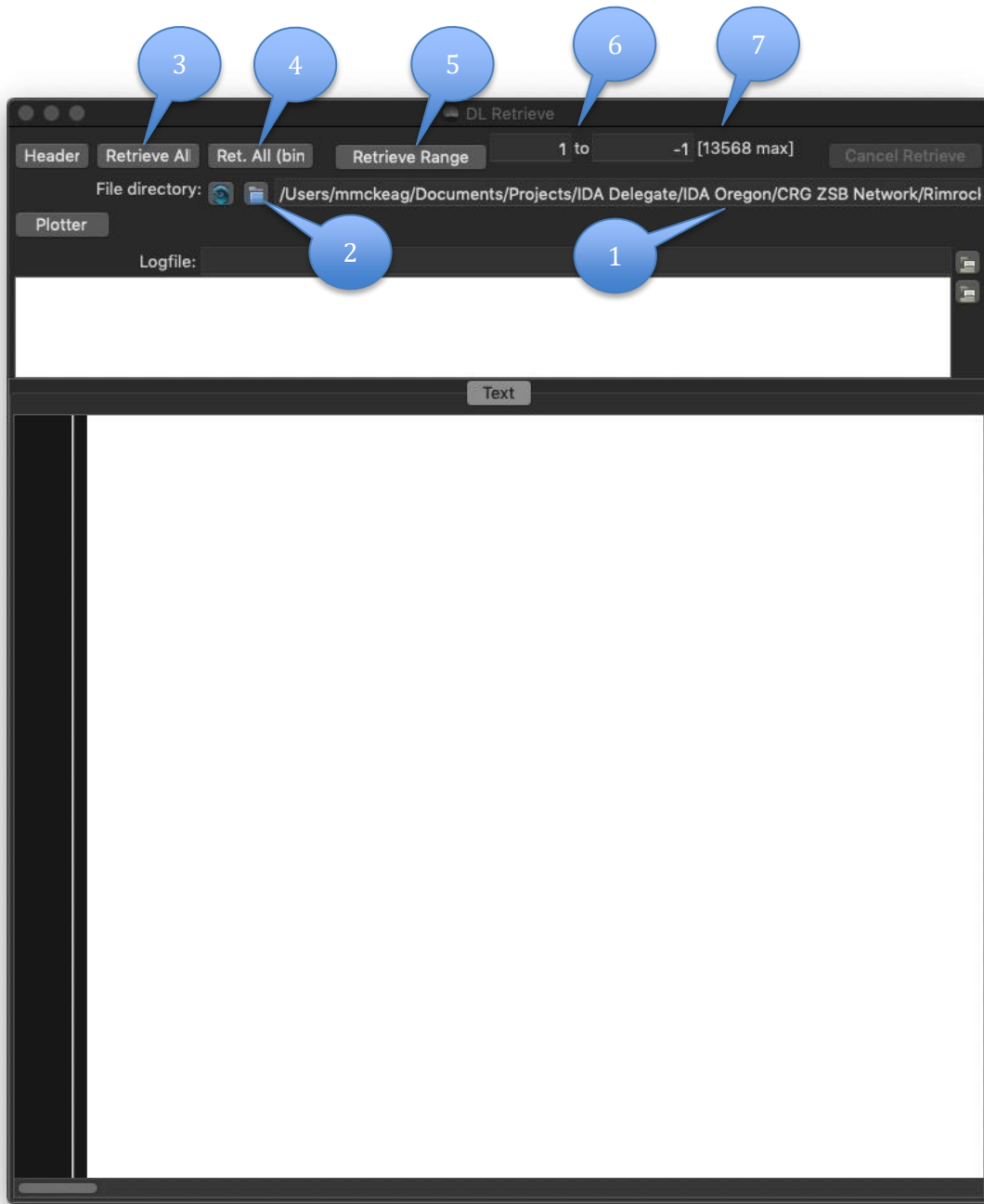


Figure 6: UDM DL Retrieve window. Verify that the desired output file directory is selected. Clicking Header displays the data file header. Clicking Retrieve All retrieves all data stored on the device and saves the data file to the selected folder in ASCII format (recommended). Clicking Ret. All (bin) retrieves a binary file version (not recommended).

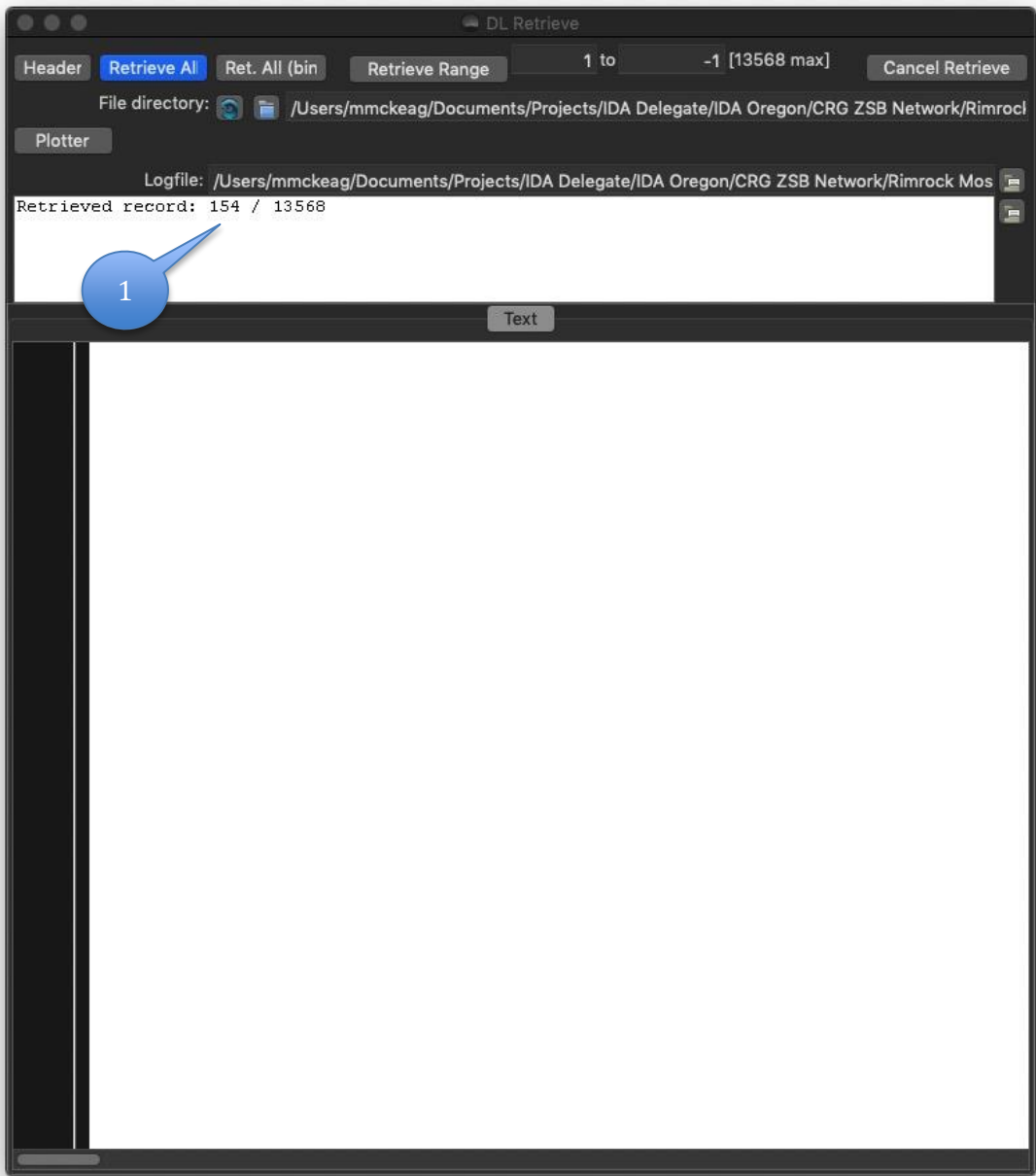


Figure 7: DL Retrieve window during data retrieval displays the current record being retrieved and the total number of records to be retrieved.

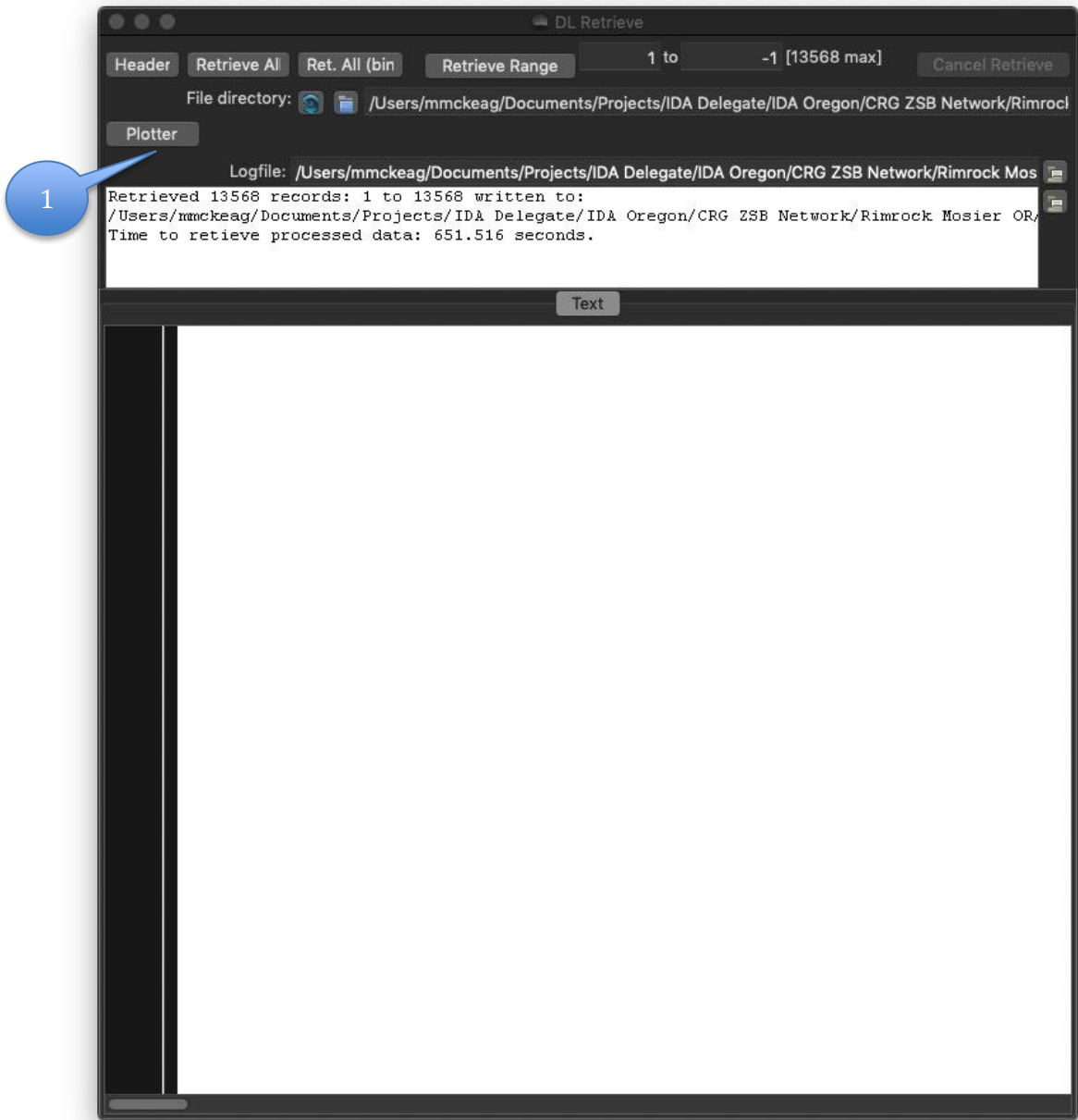


Figure 8: DL Retrieve window after data retrieval is complete displays the number of records retrieved, the data file path, and the time elapsed during data file retrieval.

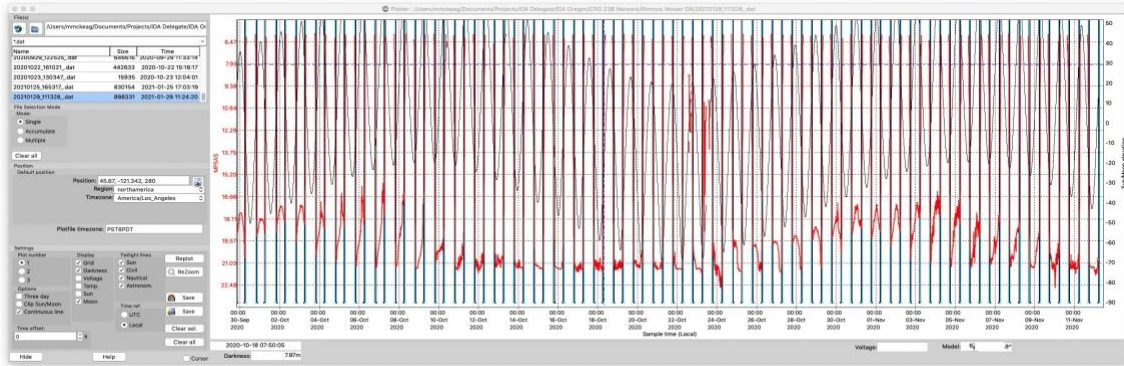


Figure 9: Plotter window displaying a graph of retrieved data. Select the desired folder and specific data file in the file selection pane in the upper left corner of the window.

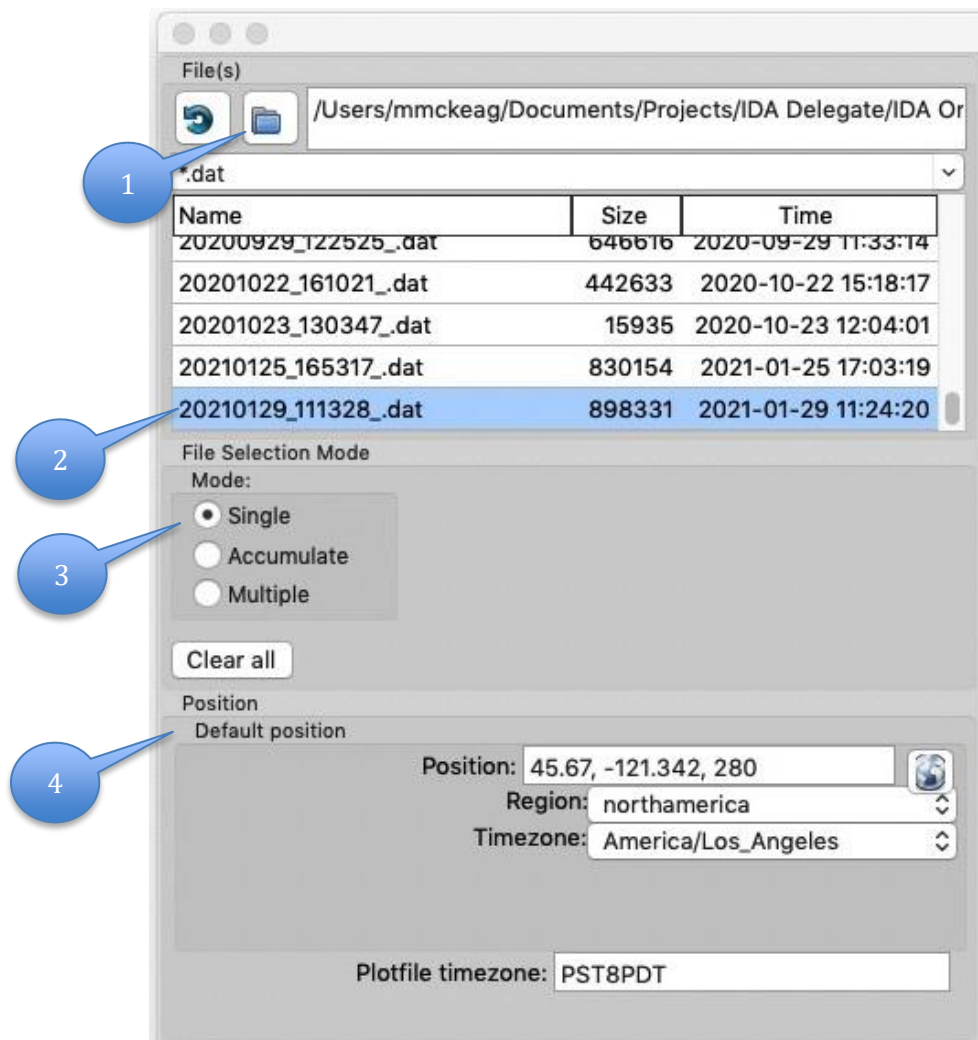


Figure 10: Plotter files selection panel.

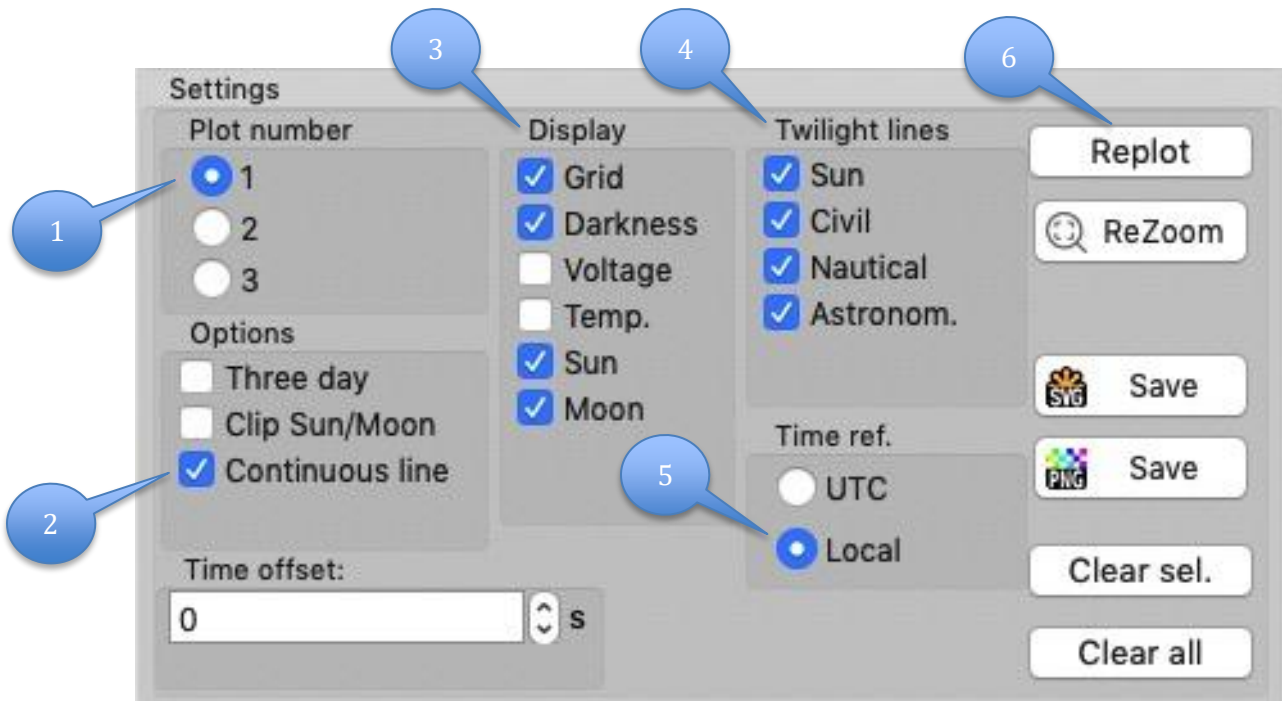


Figure 11: Plot settings are selected in the Settings pane in the lower left corner of the Plotter window. The selections illustrated are suggested as a starting point. Darkness is the red plot of zenith sky brightness measurements, with values in magnitudes per square arc-second (MPSAS) shown on the left-hand scale. Sun and Moon elevation plots can also be displayed, with values in degrees shown on the right-hand scale. Date and time values are shown on the bottom horizontal scale. Vertical reference lines mark the times of sunrise/sunset, and end of civil dusk/dawn, nautical dusk/dawn, and astronomical dusk/dawn each day.

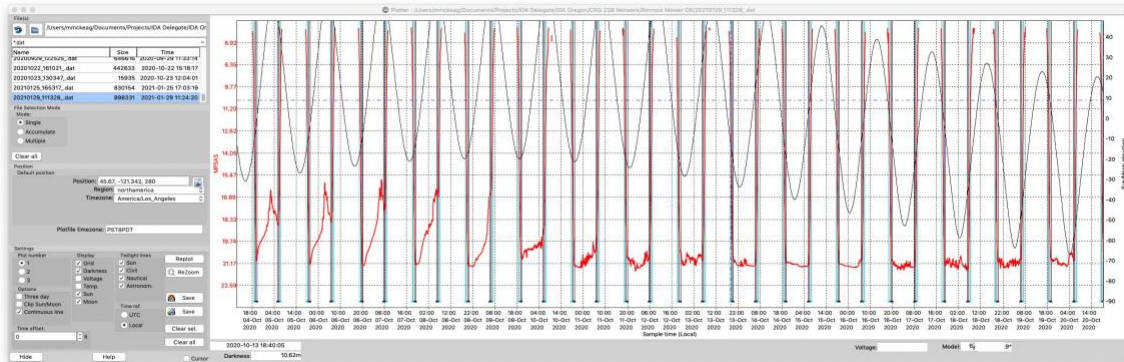


Figure 12: Zoom in on a portion of the plot by clicking and dragging a rectangle, from upper left corner to lower right corner to select the desired region. Each day, sky brightness decreases rapidly through the three stages of dusk (civil, nautical, and astronomical), and rises rapidly through the three stages of dawn (astronomical, nautical, and civil) until sunrise. On clear, moonless nights sky brightness will remain fairly constant from the end of astronomical dusk through the start of astronomical dawn. On cloudy nights sky brightness will vary with the passage of clouds overhead. Depending on the phase of the moon and timing of moonrise and moonset, sky brightness will vary considerably with moon phase and changing moon elevation angle.

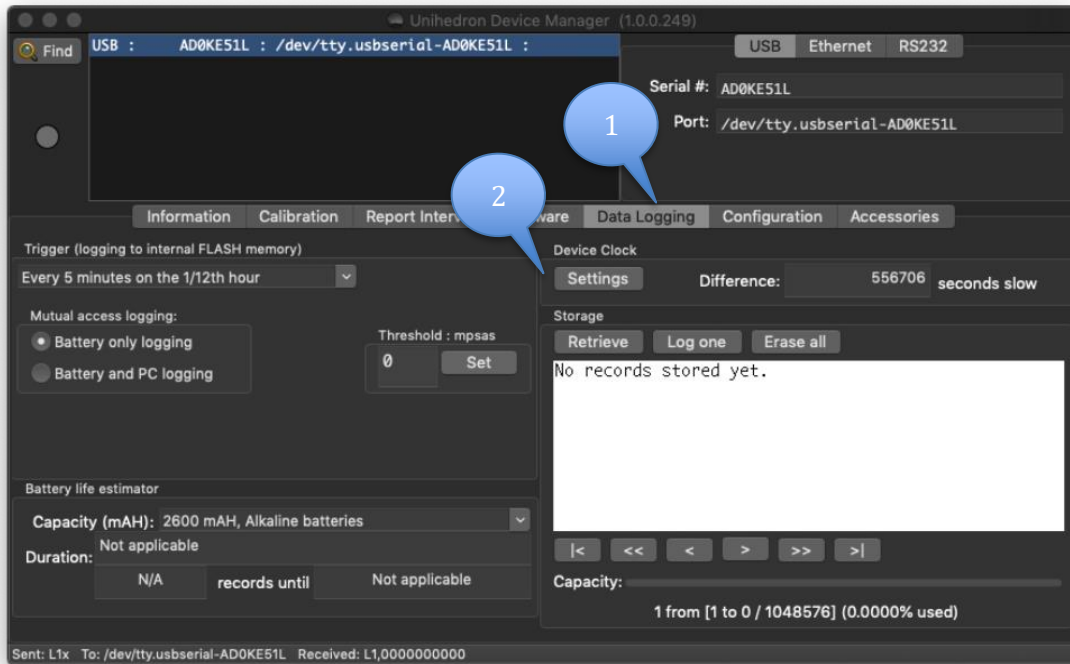


Figure 13: Data Logging window after selecting the Data Logging tab (1). Under Settings (2) the difference in seconds between your computer's internal clock and the SQM real time clock is displayed. This value should be 0 to 1 seconds.

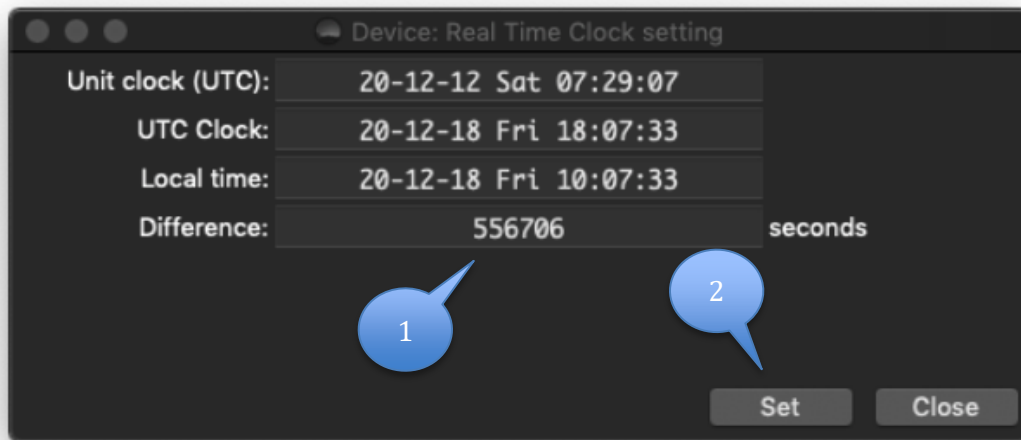


Figure 14: Device Real Time Clock setting window. The top row displays the current SQM real time clock date/time value (UTC). The second row displays your computer's current internal clock date/time value (UTC), the third line the corresponding date/time, the fourth line (1) the difference between the SQM real time clock and your computer's clock in seconds. Clicking the Set button (2) synchronizes the SQM clock with your computer's clock, which in turn is automatically synchronized with an internet time standard.

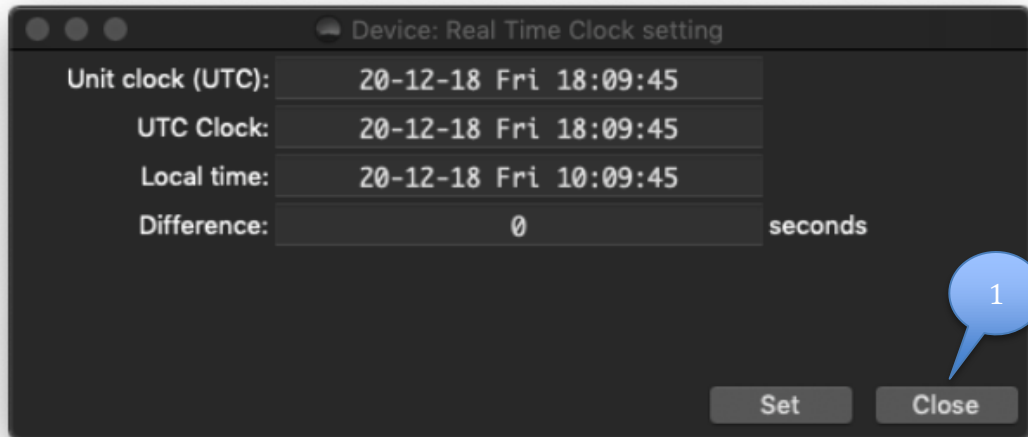


Figure 15: Device Real Time Clock setting window after synchronization. The difference is now 0 seconds (a difference of 1 second is satisfactory). Click Close (1) to close the window.

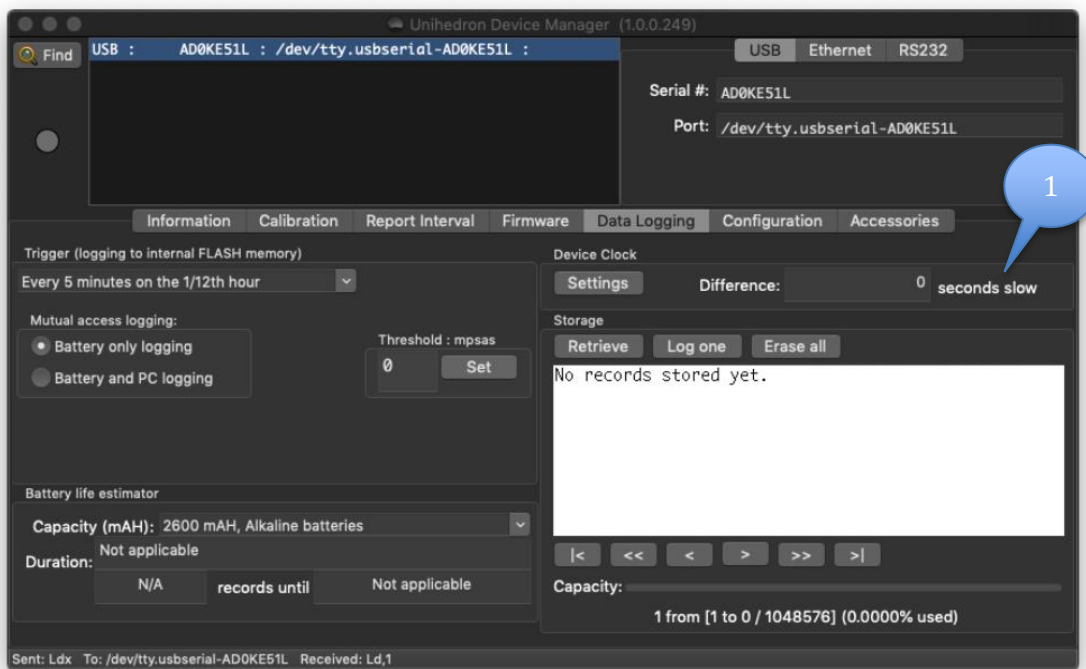


Figure 16: Data Logging window after synchronizing the SQMs real time clock. Note that Difference in the Device Clock box (1) is shown as “0 seconds slow.”