**Light Sensor Setup**

1. User Manual Reference: <http://www.unihedron.com/projects/darksky/cd/SQM-LU-DL/SQM-LU-DL_Users_manual.pdf>
2. Website reference:<http://www.unihedron.com/projects/sqm-lu-dl/>
3. Plug in Sky Quality Meter (SQM) to computer
4. Open Unihedron Device Manager (UDM)
   1. Find
   2. Edit Header
      1. Location Name
      2. Time Zone North America, CST
      3. Position
         1. Drop pin in google maps and label with location name, insert coordinates into excel sheet for safe keeping and copy paste into lat long
         2. Use compass and record elevation
   3. Data Logging
      1. 1 1/12th default interval for reading every 5 minutes
      2. Seconds slow click settings
      3. Click set and difference should be 0
      4. Device timer needs to say running not charging.
5. Recommended to leave SQM plugged into computer for at least 10 minutes to charge the capacitor that keeps the time
6. Note the time that you unplug the SQM from the computer in the excel sheet in case device clock becomes slow
7. Plug into solar panel
8. Wait for flashing light. Light will hold when first plug in then one beeb each minute after. Additional flashes indicate batteries or capacitor is not charged sufficiently.

**Light Sensor Data Download**

1. Note time unplugging device in excel sheet
2. Plug into computer
3. Open UDM and click find
4. Data logging, select proper file location, retrieve all bin fast
5. View, plotter, double check records once finished
6. Rename .dat file with unique location name/ID in front ex. City\_20230420\_133238.dat
7. Erase all
8. Repeat steps for set up to plug back in

**Data Upload into R workspace**

1. Convert each of the .dat files to .csv with the same name
   1. UDM Tools .dat to Moon.csv
   2. WAIT until lower left hand corner says processing complete otherwise will truncate data set.
   3. Error: location in header not found
      1. View in plotter to see if data exists
      2. Open .dat in a Text editor
      3. Add the lat long coordinates as they appear in the plotter/from your google point
2. On sensor processor log folder
   1. Both .dat and .csv files need to be present in the folder.
   2. Right click in folder SensorDataProcessor open new terminal > pipenv shell > python main.py .
      1. Updates existing database
   3. Script creates a column in the database titled ‘location’ containing the unique name of the file
      1. Ex. City\_20230420\_133238.dat in the database will have location ‘City’ tied to each observation
      2. This becomes extremely convenient when working with a network of SQMs that have the exact same time/date stamps
   4. If you prefer to skip setting up a database with the python script, the serial number column in the .dat/.csv files may suffice to separate locations as long as same SQM remains at the same location over time. The R script provided are based off the SQL queries ran through the database so if skipping, the script will have to be adjusted to your specific use case

**Download Cloud and Weather variables**

Cloud cover:

<https://psl.noaa.gov/data/gridded/data.narr.html>

Total cloud cover (file name should be tcdc.yyyy.nc)

Particulate matter:

<https://www.epa.gov/outdoor-air-quality-data/download-daily-data>

PM2.5

Weather:

<https://www.texmesonet.org/>

<https://www.texmesonet.org/DataProducts/CustomDownloads>

**Cloud Python Script**

Insure tcdc.2022.nc and tcdc.2023.nc are downloaded from NARR website and in SenosrDataProcessor file

Open extract\_NaRR\_cloud-NEW.py in visual studio code to edit if needed

Right click on file > terminal > new terminal

Can check current directory using cwd

Run:

Pip install netCDF4

Pip install pandas

python3 extract\_NARR\_cloud-NEW.py

**A few things to keep in mind….**

Seasonality

* As the seasons change, the elevation of the moon above the Earth is much greater in the Winter than the Summer. If you are drawing comparisons about light pollution across time, consider that the contribution of natural light will change greatly depending not only on illumination percent/phase but also elevation angle.

Moonless cloudless nights

* In most astronomical research, only moonless and cloudless nights (new moon or negative angle (below horizon)) are considered.
* There is a conversion tool under tools in the UDM to convert the .dat excluding these conditions called Filter-Sun-Moon-MW-Clouds.csv but I have not used it personally.

MSAS units

* Magnitudes per square arcsecond are complicated unit. They are on a log scale but cannot be easily converted to lumens/candelas with additional information about the wavelength of the light source. If you are subtracting msas values across space or time to measure a difference in night sky brightness, log transforming the data will be necessary and consider changing atmospheric conditions (moon/clouds).