Microclimate Data

Updated 2024-04-09

**Brief explanation:**

This document is about using and interpreting the microclimate app ([http://rshiny.hpc.ar53.wfu.edu/TMCF\_Microclimate](https://nam04.safelinks.protection.outlook.com/?url=http%3A%2F%2Frshiny.hpc.ar53.wfu.edu%2FTMCF_Microclimate&data=05%7C01%7CDamon.Vaughan%40uky.edu%7C9136622a022f482b7a5208dbf72cb45e%7C2b30530b69b64457b818481cb53d42ae%7C0%7C0%7C638375543622890847%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=wLJtCZro6sQ5HV0eYmo79Jbk2Q%2Fobj0OTvV3b3TH4b4%3D&reserved=0)). Included are:

1. Some notes on using the app
2. A description of variables and units
3. A table with tree metadata
4. Some extra notes and references

These data (“Level 2”) have been appended and lightly processed to have more friendly column names, and some basic errors are corrected (such as RH > 1 and VPD of NA). Note that this dataset has not had a thorough quality control check and may have some occasional periods of untrustworthy data from sensor malfunctions (I think those are rare). Also included are data from the ground-level sensors in the pastures. These have a “P” in the title (e.g. “TVP” or “ETP1”). Precipitation data from pasture stations are meant to apply to the closest trees (see tree metadata chart).

**Description of stations**

* S0 (“P”): Ground station in pasture. LWS, ATM41, and fog station. For fog data, select the Precipitation variable of interest that is preceded by “ECRN-100”.
* S1-S3: Mid-canopy stations in every tree. Each has LWS, ATM14, and PYR. One has ATM22
* S4: Inner-canopy station in every tree. LWS, ATM14, ATM22, and PYR
* S5: Station on a long pole above forest trees. LWS, ATM14
* CS: Canopy soil stations in select trees. Soil moisture and soil temperature
* Stemflow: Only in FB5 and FB6, starting March 2024. Pluviometer. Not currently in the app.

**Using the app:**

1. Pick a tree. Trees with odd numbers are experimental trees, even numbers are control trees. The last 5 options (with “P” in title) are not actually trees but are pasture ground stations.
2. Pick a station. Each tree has up to 5 stations. S1-S3 are mid-canopy stations, S4 is the central station, and S5 is the one on the long pole in forest trees. S0 applies only to the pasture ground stations, so you have to click this box if you want to see that data. Otherwise you get an error. CS represents canopy soil sensors which only appear in a few trees (ET8, FB2, FB4, FB6, FB8, and TV4).
3. Select variable. Not all variables are available at all stations; you get an error message in those cases
4. Select time resolution. Data are recorded at 15 minute intervals, but to see different averages you can push the different buttons.
5. Download time format. By default, the timestamp is in the ISO format (timezone indicated by a T and a Z inserted into the timestamp), but that is not very compatible with Excel. Select the “Excel ready” option if you will be doing analysis in Excel.

**Variable names, units, and name of instrument:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable name** | **Units** | **Instrument** | **Explanation** |
| **Tree** | NA | NA | TreeID, following naming conventions from this project. Ground stations also use the column name “Tree”, but that’s a bit misleading |
| **Timestamp** | “y-m-d h-m-s” | NA | Data recorded every 15 minutes. If an aggregated time interval is selected, the values are averaged together. |
| **Solar** | Watts per meter squared | PYR | Solar radiation |
| **Temp** | Degrees Celsius | ATM14 | Temperature |
| **RH** | Proportion (0-1) | ATM14 | Relative humidity |
| **Atmos\_pressure** | Kilopascals | ATM14 | Atmospheric pressure |
| **VPD** | Kilopascals | ATM14 | Vapor pressure deficit |
| **LW\_minutes\_H** | Minutes | LWS | Number of minutes that the “leaf” has been wet in the previous 15-minute interval. The “H” indicates this is using a higher count threshold for wetness, which is more appropriate for dirty sensors. |
| **Wetness** | Grams per meter squared | LWS | Quantity of water on the leaf surface. Calculated from the “Counts” output of LWS using the formula1 y = 1.54 \* e ^ 0.0058x |
| **Wind\_direction** | Compass direction (0-360) | ATM22 | Direction from which the sensor is receiving wind |
| **Wind\_speed** | Meters per second | ATM22 | Typical wind speed |
| **Gust\_speed** | Meters per second | ATM22 | Speed of wind gusts |
| **EpiMoisture** | NA- raw output | EC5 | Moisture content of epi mat- needs to be standardized |
| **EpiTemp** | Degrees Celsius | RT1 | Temperature of epi mat |

**Additional variables from Pasture stations**

|  |  |  |  |
| --- | --- | --- | --- |
| **Column name** | **Units** | **Instrument** | **Explanation** |
| **Precipitation** | Millimeters | ATM41 or ECRN-100 | Base time: Total precipitation over the last 15 minutes. If you selected hourly, daily, or weekly, the average of those periods is taken. |
| **Precip\_max** | Millimeters per hour | ATM41 or ECRN-100 | Base time: The maximum precipitation recorded over the last 15 minutes, in terms of mm/h. Higher time aggregates produces an average of these values. |

**Tree metadata**

|  |  |  |  |
| --- | --- | --- | --- |
| **TreeID** | **Design** | **Land use** | **Pasture station** |
| FB1 | Experimental | Pasture | FBP1 |
| FB2 | Control | Pasture | FBP1 |
| FB3 | Experimental | Pasture | FBP2 |
| FB4 | Control | Pasture | FBP2 |
| FB5 | Experimental | Forest | FBP2 |
| FB6 | Control | Forest | FBP2 |
| FB7 | Experimental | Forest | FBP2 |
| FB8 | Control | Forest | FBP2 |
| ET1 | Experimental | Pasture | ETP2 |
| ET2 | Control | Pasture | ETP2 |
| ET3 | Experimental | Forest | ETP2 |
| ET4 | Control | Forest | ETP2 |
| ET5 | Experimental | Pasture | ETP1 |
| ET6 | Control | Pasture | ETP1 |
| ET7 | Experimental | Forest | ETP2 |
| ET8 | Control | Forest | ETP2 |
| TV1 | Experimental | Forest | TVP |
| TV2 | Control | Forest | TVP |
| TV3 | Experimental | Pasture | TVP |
| TV4 | Control | Pasture | TVP |

**Other notes**

* In cases where RH was >1, it was changed to 1
* In cases where RH was >= 1, VPD was changed to 0. This follows from the definition of VPD, but was necessary because VPD was often recorded as NA in cases where “calculation exceeded limits”, which was typically due to a very high RH
* The minimum value for wetness is 19.96, not 0. If we want, we could easily adjust this to zero. For reference, the maximum is over 3300.
* Some variables have been removed from this dataset because they do not seem relevant. I can add back in if needed. From the tree stations, this includes: X and Y axis of ATM22, sensor temperatures, and LW\_minutes using the low threshold. From the Pasture stations, this includes the same variables plus lightning strike and distance information. From the dataloggers, I have removed battery level and voltage, as well as reference atmospheric pressure and temperatures.

**References**

1Converting Leaf Wetness Sensor output to quantity of water:

<https://publications.metergroup.com/Sales%20and%20Support/METER%20Environment/Website%20Articles/predicting-amount-water-surface-lws-leaf-wetness-sensor.pdf>