READ ME document for JSU mobile datasets

Dataset Title: Mobile Surface Meteorology: Automobile

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Dataset Overview:
Surface meteorology parameters were measured by sensors mounted to an automobile which was driven on roads within SWEX domain and surrounding region.

Time Period: 2022/04/01 00:00:00 to 2022/05/14 00:00:00

Area Bounding Box: 34.00 to 35.00 latitude; -121.00 to -119.00 longitude

Data Frequency: All data are logged at 2-s intervals. Primary time reference is UTC from GPS (not from datalogger).

Data Spatial Type: Consecutive point data

Dataset Description:
Data are primarily collected while mobile, but stationary data may also be included for short periods.

Times in descriptive data report document are rounded to the nearest minute, with stops longer than 2 minutes noted.

Preliminary dataset release:
The supplemental 'Elevation 2' variable is not yet included for most files.

Procedures:
The .dat files from CR23X logger are manipulated in Excel to separate to legs and to calculate derived parameters. Each leg is saved as a separate .csv file compatible with QGIS, as well as a full day csv file. Stops longer than 10 minutes will generally break to a new leg with the stationary data excluded.

File Naming Convention:
xOPx car MMDDYYYY Legx
where the second x denotes the IOP/EOP number (1-10) and the third x counts the data collection legs on the day (beginning at 1).

Instrument Description:

- Campbell Scientific HygroClip HC2S (2)
- Campbell Scientific T109 fast temperature probe
- LiCor LI-200 pyranometer
- Campbell Scientific PTB101-B barometer with external pressure port
- Campbell Scientific PTB101-B barometer without external pressure port
- Campbell Scientific IRTS-P Infrared Temperature Sensor
- Garmin GPS16X-HVS
- CR23-X datalogger
- 10-plate Gill radiation shield
- NSSL U-tube shield

Description of parameters directly measured on mobile system

- Datalogger time: HHMM SS.S
- GPS time in UTC: HH MM SS
- GPS latitude: DDMM .MMMM
- GPS longitude: DDMM .MMMM
- GPS elevation (m)
- Number of GPS satellites
- GPS reception quality
- Datalogger panel temperature (C)
- Incoming solar radiation (kW/m^2)
- Temperature in Gill shield (C)
- Relative humidity in Gill shield
- Temperature in U-tube shield (preferred in rain) (C)
- Relative humidity in U-tube shield (preferred in rain)
- Fast response temperature from T109 probe in U-tube shield (C)
- Station pressure (hPa - 1000) (with port)
- Station pressure (hPa - 1000) (without port)
- Upward looking infrared temperature (IRTS) (C): Indication of cloud base, overhanging canopy, etc.

Description of derived/calculated quantities

- Decimal GPS latitude
- Decimal GPS longitude

- *Elevation 2: Estimated elevation above MSL from combination of USGS DEM, GPS, and barometer, including height above ground. This normally corresponds to DEM + height above ground except when crossing bridges or overpasses.*
- Dewpoint calculated from Gill shield temperature and humidity (C)
- Potential temperature calculated from Gill shield temperature and station pressure (K)
- Dewpoint calculated from U-tube shield temperature and humidity (C)
- Potential temperature calculated from U-tube shield temperature and station pressure (K)
- Potential temperature calculated from T109 fast response probe in U-Tube shield (K)
- Vapor pressure calculated from Gill shield dewpoint (hPa)
- Mixing ratio calculated from Gill shield vapor pressure and station pressure (g/kg)
- Vapor pressure calculated from U-tube shield dewpoint (hPa)
- Mixing ratio calculated from U-tube shield vapor pressure and station pressure (g/kg)
- IRTS minus Gill shield temperature (C): Used for identification of overhanging vegetation/structures and low cloud bases.
- Gill shield temperature minus U-tube temperature (C): Used to identify wetbulb effect cooling of Gill shield sensor in rain. (No rain observed during SWEX transects.)
- Equivalent potential temperature from Gill shield temperature and dewpoint (K)
- Virtual temperature from Gill shield temperature and dewpoint (K)
- Virtual potential temperature from Gill shield temperature and dewpoint (K)
- Speed (m/s): Measure of motion relative to ground from difference of GPS positions. Determined from 2-s Euclidean distances using longitudinal and latitudinal distances on a spherical earth with radius of *a* = 6371 km.
- Cumulative distance: Accumulation of Euclidean distances since beginning of transect leg (km)
- Road ID: SR = state route; US = U.S. federal route; SR = state route; CR = county route; FR = forest road
- gps flag: “1” indicates that some data (time, position, or elevation) were changed to correct errors; “0” indicates no correction was made. *This column is only used for files of transect segments that had observations known to be impacted by GPS problems.*

Formulas used for calculations:

Dewpoint: $T_d = (RH * 0.01)^{0.125} * (112 + 0.9 * T) + (0.1 * T) - 112$

(from Wanielista et al. 1997)

Potential temperature: $\theta = (T + 273.15) * \left(\frac{1000}{p}\right)^{(287/1004)}$

Vapor pressure: $q_p = 6.112 * e^{\left(\frac{17.67 * T_d}{T_d + 243.5}\right)}$

Mixing ratio: $q_r = \frac{q_p * 621.97}{p - q_p}$

Virtual temperature:

$$T_v = \frac{T_k}{1 - \frac{q_p}{p}(1 - 0.622)}$$

Equivalent potential temperature:

$$\theta_e = T_K \left(\frac{1000}{p}\right)^{0.2854(1-0.00028q_r)} \exp\left[\left(\frac{3.376}{T_L} - 0.00254\right) q_r(1 + 0.00081q_r * 0.001)\right]$$

With lifting temperature $T_L = \frac{1}{\frac{1}{T_{dK}-56} + \frac{1}{800}\ln\left(\frac{T_K}{T_{dK}}\right)} + 56$

(T_K and T_{dK} are temperature and dewpoint in Kelvin.)

Ground-relative speed (m/s):

$$d = \frac{\sqrt{(\Delta x)^2 + (\Delta y)^2}}{2\ \mathrm{s}}$$

where

$$\Delta x = a(\lambda_2 - \lambda_1)\cos\left[\left(\frac{\varphi_1 + \varphi_2}{2}\right)\right]$$

$$\Delta y = a\ (\varphi_2 - \varphi_1)$$

with longitude λ and latitude φ in radians.

Other notes:

The pressure used in calculation of potential temperature and mixing ratio is from the pressure with external port and is uncorrected for dynamic pressure effects of vehicle motion. Refer to White (2021) for justification why this has negligible impact on the resulting values.

References:

Wanielista, Martin P., Robert. Kersten, and Ron. Eaglin, 1997: *Hydrology : Water Quantity and Quality Control.* Second edition. New York: John Wiley & Sons.

White, Loren, 2021: Approaches to mesoscale pressure patterns from mobile data platforms. *Environ. Sci. Proc.,* **8**, 46, https://doi.org/10.3390/ecas2021-10689.