



Churchill Marine Observatory Weather Station Data Curation Cookbook

Dataset Metadata

Dataset Name: CMO Weather Station Data

Platform: Churchill Marine Observatory (CMO) Weather Tower

Instrument System: Campbell Scientific CR1000X-based meteorological station

Organization: Churchill Marine Observatory (CMO) in collaboration with the Centre for Earth observation Science (CEOS), University of Manitoba.

Document Control

Version History

Version	Author(s)	Type	Date Modified	Comments
1.0	Aluloska, T.	Working Copy	2026-03-25	Initial version.

Document Location

A digital copy of this document can be found on the [Churchill Marine Observatory](#) CanWIN page.

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1. Overview

This cookbook describes the workflow used to clean output files from the Churchill Marine Observatory weather tower. The workflow is applicable to six separate data tables (meta data, weather data, hourly, daily, monthly, and geo processing data) which are output as .DAT files from the data logger program.

2. Raw or Input Data

- Raw files are in .DAT file format
- Metadata row preceding the header
- Units row below the header row
- Additional row for defining statistics parameters such as Min, Avg etc.
- Measurements logged in different intervals depending on the table
- Wind speed recorded in meters per second and kilometers per hour.

Example of CR1000XSeries__churchill_weather.dat

CR1000XSeries_churchill_weather

TOA5	CR1000XSeries	CR1000X	33093	CR1000X.Std.08.01	CPU:cmo_weatherst_v4.3.CR1X	58972	churchill_weather					
TIMESTAMP	RECORD	BV_BP_Avg	FluxDens_W_Avg	PAR_umol_Avg	AirTC_Avg	RH	WS_kmh_S_WVT	WindDir_D1_WVT	WindDir_SD1_WVT	HI_C_Avg	WC_C_Avg	TdC_Avg
TS	RN	kPa	W/m^2	umol/m^2/s	Deg C	%	km/h	Deg	Deg	Deg C	Deg C	Deg C
		Avg	Avg	Avg	Avg	Smp	WVc	WVc	WVc	Avg	Avg	Avg
2024-10-18 19:30:00	0	100.2125	237.7	499.1	8.11	60.15	20.66	287	10.29	0	5.487	0.86
2024-10-18 19:45:00	1	100.2347	220.7	463.4	8.34	57.51	23.48	284.6	12.55	0	5.244	0.949
2024-10-18 20:00:00	2	100.2693	182.2	382.6	8.65	56.97	25.58	280.3	11.26	0	5.469	0.758
2024-10-18 20:15:00	3	100.308	150.2	315.4	8.75	59.07	32.32	286.9	8.85	0	5.101	0.941
2024-10-18 20:30:00	4	100.3487	101	212.1	8.48	60.98	35.57	285	9.27	0	4.527	1.201
2024-10-18 20:45:00	5	100.382	114.1	239.6	8.4	63.77	31.55	282.3	7.681	0	4.697	1.591
2024-10-18 21:00:00	6	100.4067	88.1	185	8.3	64.4	33.11	278.1	6.111	0	4.462	1.968
2024-10-18 21:15:00	7	100.4413	63.51	133.4	8.24	65.23	32.49	275	10.13	0	4.426	1.941
2024-10-18 21:30:00	8	100.472	20.94	43.97	7.957	66.86	30.77	273.2	9.29	0	4.176	1.965
2024-10-18 21:45:00	9	100.516	10.11	21.23	7.695	67.08	26.64	278.9	10.37	0	4.162	1.893
2024-10-18 22:00:00	10	100.5507	3.674	7.715	7.323	69.01	20.95	279.5	7.38	0	4.212	1.907
2024-10-18 22:15:00	11	100.5913	0.094	0.197	7.189	68.37	22.67	276.5	6.827	0	3.871	1.86
2024-10-18 22:30:00	12	100.622	0	0	7.144	69.31	24.01	274.8	10.68	0	3.688	1.937
2024-10-18 22:45:00	13	100.67	0	0	6.874	73.51	21.12	278.1	5.881	0	3.635	2.055
2024-10-18 23:00:00	14	100.714	0	0	6.764	74.04	21.08	275	10.36	0	3.497	2.393

3. Workflow Summary

3.1 Structural File Cleaning

- Remove metadata row above the header row
- Merge header row and row containing units so that they are a single header row.
- Remove row containing description of the statistics applied on the variables (the variable headers already contain this statistics term).

3.3 Quality Control

- Standardizing column names to ensure consistency and machine compatibility. Follows the Climate Forecast (CF) vocabulary.
- Convert timestamps to datetime
- Ensure timestamps are formatted in ISO (YYYY-MM_DDTHH:MM:SS)

3.4 Quick Template for Scripting

- Read file
- Drop metadata row
- Merge header + units
- Drop statistics row
- Rename columns
- Convert timestamp
- Validate ranges (if available)
- Export CSV

4. Variable Transformations

This section documents how variables change from raw to processed form.

Table 4.1. Variable Transformations

Original Name	Name used in final files	Measurement Type/ Statistic	Units
TIMESTAMP	date_and_time		UTC
RECORD	record		index
BV_BP_Avg	barometric_pressure_avg_kPa	Avg	kPa
FluxDens_W_Avg	flux_density_avg_w_m2	Avg	W/m2
PAR_umol_Avg	photosynthetically_active_radiation_avg_umol_m2_s	Avg	umol/m ² /s
AirTC_Avg	air_temperature_avg_deg_c	Avg	°C
RH	relative_humidity_percent		%
WS_kmh_S_WVT	wind_speed_kmh	Mean wind speed (WVc - wind vector calculation)	km/h
WindDir_D1_WVT	wind_direction_deg	Unit vector mean wind direction (WVc - wind vector calculation)	deg
WindDir_SD1_WVT	wind_direction_std_deg	Standard deviation of wind direction (WVc - wind vector calculation)	deg
HI_C_Avg	heat_index_deg_c	Avg	°C
WC_C_Avg	wind_chill_deg_c	Avg	°C
TdC_Avg	dew_point_temperature_deg_c	Avg	°C

Note

WVT variables are produced by the Campbell Scientific WindVector instruction, which calculates vector-averaged wind speed, vector-averaged wind direction, and the standard deviation of wind direction.

5. Output Files

5.1 Processed File Structure

A single raw DAT file that follows this workflow produces one clean CSV file containing:

- Structurally cleaned file that is analysis ready
- Standardized variable names

CR1000XSeries_churchill_weather

date_and_time	record	barometric_pressure_avg_kPa	flux_density_avg_w_m2	photosynthetically_active_radiation	air-temperature_deg_c	relative_humidity	wind_speed_kn_h	wind_direction_deg	wind_direction_std_i	heat_index	wind_chill_deg_c	dew_point_temperature
2024-10-18 19:30:00	0	100.2125	237.7	499.1	8.11	60.15	20.66	287	10.29	0	5.487	0.86
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2024-10-18 23:00:00	14	100.714	0	0	6.764	74.04	21.08	275	10.36	0	3.497	2.393
2024-10-18 23:15:00	15	100.742	0	0	6.634	75	22.51	280.6	5.323	0	3.186	2.427
2024-10-18 23:30:00	16	100.78	0	0	6.053	77.79	18.39	270.6	9.96	0	2.921	2.291
2024-10-18 23:45:00	17	100.8127	0	0	5.751	78.81	18.71	287.1	6.393	0	2.502	2.252
2024-10-19 00:00:00	18	100.8467	0	0	5.44	80.3	14.6	281.9	6.916	0	2.682	2.196
2024-10-19 00:15:00	19	100.8713	0	0	5.241	79.89	12.65	277.8	8.23	0	2.751	2.104
2024-10-19 00:30:00	20	100.89	0	0	4.968	82.7	14.32	270.2	6.607	0	2.142	2.043

5.2 File Location

Cleaned output files can be found on the [CMO Weather Station CanWIN page](#).