

## CFI Climate Sentinels Arboretum Parsivel Disdrometer Data [ARBO]

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## 1 Data Set Description

**1.1 Introduction:** This dataset contains raw data collected from an OTT Parsivel<sup>2</sup> laser disdrometer installed at a climate sentinel (Arboretum) in the Saint Lawrence River Valley (see *Table 1*). The data is available from 1 Nov 2021 to 31 March 2022 (inclusive) to support the Winter Precipitation Type Research Multi-Scale Experiment (WINTRE-MIX). The instrument provides histograms of hydrometeor size and fallspeed. The Arboretum site is located on the southwestern tip of Montreal Island near the confluence of the Ottawa River and the St. Lawrence River. Several other sites also collected Parsivel data during WINTRE-MIX. Data from these other sites will also be made available in the WINTRE-MIX data archive ([https://data.eol.ucar.edu/master\\_lists/generated/wintre-mix/](https://data.eol.ucar.edu/master_lists/generated/wintre-mix/)).

**1.2 Data version:** v1.0, 09 September 2022

**1.3 Time period covered:** Given in *Table 1*. Note that times in this document are specified in the format 'HH:MM:SS dd.mm.yyyy'.

| <b><u>Station full name</u></b> | <b><u>Station abby</u></b> | <b><u>Start date/time (UTC)</u></b> | <b><u>End date/time (UTC)</u></b> |
|---------------------------------|----------------------------|-------------------------------------|-----------------------------------|
| Arboretum                       | ARBO                       | 00:00:00 01.11.2021                 | 23:58:00 31.03.2022               |

Table 1: Time period of availability for the disdrometer data.

**1.4 Location data:** The instrument is mounted next to other instruments at the site. The location information is given in Table 2. A map showing the sentinel location is given in Figure 1.

| <u>Station</u> | <u>Latitude</u><br><u>(degrees North)</u> | <u>Longitude</u><br><u>(degrees</u><br><u>East)</u> | <u>Elevation</u><br><u>above</u><br><u>mean sea-</u><br><u>level (m)</u> |
|----------------|-------------------------------------------|-----------------------------------------------------|--------------------------------------------------------------------------|
| ARBO           | 45.430065                                 | -73.942156                                          | 49                                                                       |

Table 2: Physical location data for stations containing disdrometer data.

**1.5 Data frequency:** minutely.

**1.6 Website address references:** Preliminary Parsivel data are visualized as “quick look” plots on the WINTRE-MIX field catalog (<https://catalog.eol.ucar.edu/wintre-mix/114/date/>).

**1.7 Dataset restrictions:** Please refer to the WINTRE-MIX data policy (<https://www.eol.ucar.edu/content/wintre-mixdata-policy>) as well as the WINTRE-MIX data management plan ([https://www.eol.ucar.edu/system/files/Data\\_Management\\_Plan-1Dec2021.pdf](https://www.eol.ucar.edu/system/files/Data_Management_Plan-1Dec2021.pdf)) for more information regarding dataset restrictions and dissemination.

## 2 Instrument Description

A Parsivel<sup>2</sup> laser disdrometers (Parsivel; <https://www.otthydromet.com/en/p-ott-parsivel-laser-present-weather-sensor/70.210.002.3.0>) was deployed at the Arboretum sentinel (see Figure 2 for instrument photo). The Parsivel uses measured extinction of a laser beam by falling hydrometeors to classify each hydrometeor by its size and fall speed. The data are recorded as counts in 32 size bins and 32 fall speed bins. The instrument height and manual is provided in Table 3. The attributes of the Parsivel are summarized in Table 4. More detailed technical information on the Parsivel is available in OTT (n.d.) and Tokay et al. (2014).

| <u>Station</u> | <u>Instrument name</u>                   | <u>Elevation of detector above ground-level (m)</u> | <u>Link to the manual</u>                                                                                                   |
|----------------|------------------------------------------|-----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| ARBO           | OTT Parsivel <sup>2</sup><br>Disdrometer | 3                                                   | <a href="https://www.fondriest.com/pdf/ott_parsivel2_manual.pdf">https://www.fondriest.com/pdf/ott_parsivel2_manual.pdf</a> |

Table 3: Instrument information

| <u>Parameter</u>                                     | <u>Values</u> |
|------------------------------------------------------|---------------|
| Measuring surface                                    | 180 x 30 mm   |
| Measuring range – liquid precipitation particle size | 0.2 – 8 mm    |
| Measuring range – solid precipitation particle size  | 0.2 – 25 mm   |
| Measuring range – particle speed                     | 0.2 – 20 m/s  |
| Optical sensor laser diode – wavelength              | 650 nm        |
| Optical sensor laser diode – output power            | 0.2 mW        |
| Data collection frequency                            | 60 s          |

Table 4: Attributes

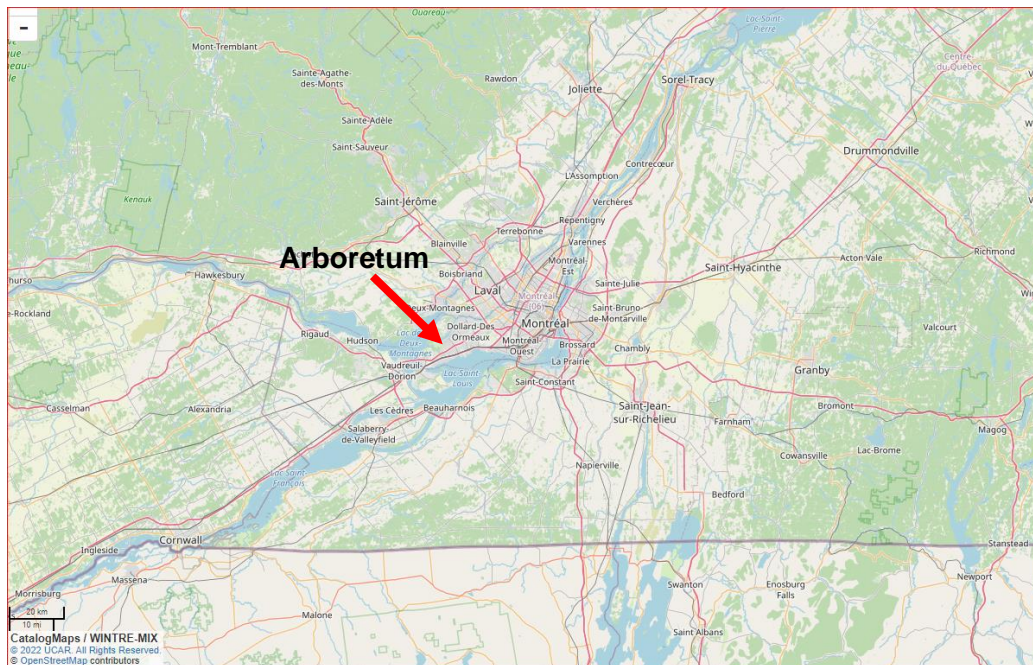


Figure 1: Physical location of the Arboretum sentinel

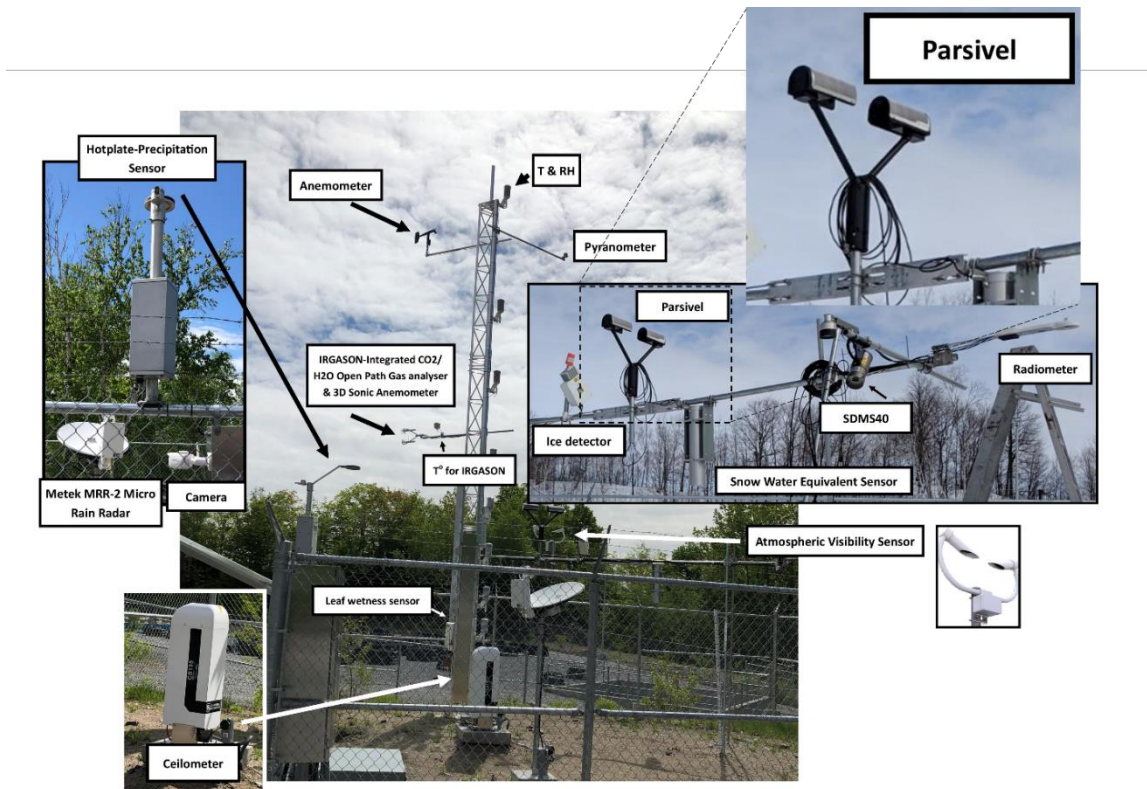


Figure 1: Illustration of the Parsivel at the neighbouring Gault sentinel (same instrument installed at the Arboretum).

### 3 Data Collection and Processing

**3.1 Data collection:** The Parsivel was configured to collect data every 60 seconds (Table 4). Heating was supplied to the sensor heads to prevent accumulation of snow and ice, using the default temperature threshold of 10°C. Data was logged onto a Windows PC using the OTT ASDO Software (ASDO Basic Version 1.15.0) as daily text files. These were converted into netCDF files with additional metadata added. No quality control checks were applied beyond those used in the routine OTT processing.

## 4 Data Format

**4.1 Data structure and naming conventions:** The data format is netCDF-4 (.nc). One file is produced, called 'CFI\_Arboretum\_Parsivel\_Disdrometer\_data\_WINTRE-MIX.nc'. This file contains disdrometer data collected by the detector at the sentinel. The variables provided in the file is summarized in *Table 6*. Additional metadata is provided in the netCDF file.

**4.2 Data format and layout:** The dimensions of the variables are shown in *Table 5*.

| <u>Dimension</u> | <u>Size</u> | <u>Description</u>                                                   |
|------------------|-------------|----------------------------------------------------------------------|
| time             | 217440      | The number of minutely observations between the start and end dates. |
| bin_diameters    | 32          | The number of diameter classes.                                      |
| bin_velocities   | 32          | The number of velocity classes.                                      |

*Table 5: Dimensions of disdrometer variables and their meanings.*

**4.3 Variables:** List of dataset variables and their properties, as given in *Table 6*.

| <u>Parameter</u> | <u>Value</u>                                  | <u>Unit</u>        |
|------------------|-----------------------------------------------|--------------------|
| bin_velocities   | Middle of velocity bin                        | m s <sup>-1</sup>  |
| bin_diameters    | Middle of diameter bins                       | mm                 |
| time             | Measurement time in UTC                       | Timestamp          |
| Prcp_Intensity   | Intensity of precipitation                    | mm h <sup>-1</sup> |
| Prcp_Start       | Precipitation since start of period           | mm                 |
| Wx_Code_Synop    | Synoptic Present Weather code                 | -                  |
| Wx_Code_METAR    | METAR Special Weather code                    | -                  |
| Wx_Code_NWS      | NWS Weather code                              | -                  |
| Reflectivity     | Radar reflectivity                            | dBZ                |
| Visibility       | Meteorological Optical Range (MOR) visibility | m                  |
| Signal_Ampl      | Signal amplitude of laserband                 | -                  |
| Num_Particles    | Number of detected particles                  | -                  |
| Sensor_Temp      | Temperature in sensor                         | °C                 |

|                             |                                                           |                                            |
|-----------------------------|-----------------------------------------------------------|--------------------------------------------|
| Heating_Current             | Heating current                                           | A                                          |
| Sensor_Voltage              | Sensor voltage                                            | V                                          |
| Kinetic_Energy              | Kinetic Energy                                            | $\text{J m}^{-2} \text{h}^{-1}$            |
| Snow_Intensity              | Snow Intensity                                            | $\text{mm h}^{-1}$                         |
| Nd_Spectra                  | Particle number concentration in each diameter bin        | $\log_{10} (\text{m}^{-3} \text{mm}^{-1})$ |
| Vd_Spectra                  | Average particle speed in each diameter bin               | $\text{m s}^{-1}$                          |
| Raw_Data                    | Number of counts in each combined velocity, diameter bins | -                                          |
| latitude                    | Latitude of Parsivel                                      | $^{\circ}\text{N}$                         |
| longitude                   | Longitude of Parsivel                                     | $^{\circ}\text{W}$                         |
| height_above_mean_sea_level | Elevation of Parsivel                                     | m above mean sea level                     |
| bin_diameters_width         | Width of diameter bins                                    | mm                                         |
| bin_velocities_width        | Width of velocity bins                                    | $\text{m s}^{-1}$                          |

*Table 6: List of disdrometer variables and their properties.*

Description of selected variables and constants in the dataset:

“time”: The time of an observation expressed in the following format: minutes since 13:40:00 01.11.2021.

“Raw\_Data”: Precipitation particles are partitioned into one of 32 diameter and one of 32 velocity classes, for a total of 1024 possible classifications. Class tables are provided in the .nc file, and are given in the manual and reproduced in **Appendix A** for convenience

**Meaning of NaN elements:** NaN values indicate when data is unavailable.

## 5 Data Remarks

**Note 1:** The two smallest size bins are outside the measurement range of the instrument and are not used. The Parsivel appears to systematically undercount drops in the third smallest size bin. Thus, drops with diameters < 0.37 mm are likely poorly characterized by this instrument.

**Note 2:** The variable “Sensor\_Temp” represents the temperature in the disdrometer sensor. The sensor contains a heater that is designed to activate when the outside temperature drops below a specified value to prevent ice buildup. The default value for the disdrometer is 10°C. The sensor temperature at the Arboretum sentinel is found to differ from the outside temperature (as determined by the 2-m air temperature, available in the file ‘Arboretum\_Non-Rad\_Met\_Data.nc’) by over 15°C at times. The sensor temperature is occasionally more than 5°C colder than the outside temperature. Caution should be exercised when analysing this temperature sensor data.

**5.1 Missing data periods:** See *Table 7*. Only major gaps, defined as at least one consecutive hour of missing data, are shown. Yellow shading indicates that the gap occurred during the WINTRE-MIX campaign.

| <u>Station</u> | <u>Length of data gap</u> | <u>Start of gap</u> | <u>End of gap</u>   |
|----------------|---------------------------|---------------------|---------------------|
| ARBO           | 5h05m                     | 07:10:00 01.11.2021 | 12:15:00 01.11.2021 |
|                | 17h21m                    | 22:46:00 11.11.2021 | 16:07:00 12.11.2021 |
|                | 5h43m                     | 12:26:00 30.11.2021 | 18:09:00 30.11.2021 |
|                | 1h23m                     | 04:21:00 12.12.2021 | 05:44:00 12.12.2021 |
|                | 3h09m                     | 20:26:00 18.02.2022 | 23:35:00 18.02.2022 |
|                | 4h53m                     | 19:07:00 02.03.2022 | 00:00:00 03.03.2022 |
|                | 4h02m                     | 23:02:00 04.03.2022 | 03:04:00 05.03.2022 |

*Table 7: Occurrences of significant data gaps in the disdrometer variables.*

In addition, *only* spectrum data was missing for the periods outlined in *Table 8*. The corresponding ‘Raw\_Data’ variable is set to ‘NaNs’. Please be aware of this when analysing data from other variables during this time. Yellow shading indicates that the gap occurred during the WINTRE-MIX campaign.



| <u>Station</u> | <u>Length of missing data</u> | <u>Start time</u>      | <u>End time</u>        |
|----------------|-------------------------------|------------------------|------------------------|
| ARBO           | 115h26m                       | 15:30:00<br>10.03.2022 | 10:56:00<br>15.03.2022 |

*Table 8: Periods with missing spectrum data only.*

## 6 Acknowledgment

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## 7 References

Minder, J., N. Bain, W. Bartolini, Jr., K., and S. McKim, 2022: NYSM Chazy, NY Parsivel Disdrometer Data. Version 1.0. <https://doi.org/10.26023/KRFX-TMZW-JJ0W> .

Tokay, A., Wolff, D. B., & Petersen, W. A. (2014). Evaluation of the New Version of the Laser-Optical Disdrometer, OTT Parsivel2. *Journal of Atmospheric and Oceanic Technology*, 31, 1276-1288. <https://doi.org/10.1175/JTECH-D-13-00174.1>

\*OTT, n.d: Operating instructions – Present Weather Sensor Parsivel 2 . OTT Hydromet GmbH, document number: 70.210.001.BE.

*\* OTT Parsivel manual is provided as an attachment.*

## 8 Appendix

Suggested GCMD keywords to accompany this dataset are provided below in no particular order:

- Solid precipitation
- Frozen precipitation

- Rain
- Freezing rain
- Drizzle
- Freezing drizzle
- Ice pellets
- Snow
- Droplet size
- Ice storms
- Snow storms
- Extratropical cyclones

## Appendix A – Disdrometer Size Classes

| Particle diameter and velocity classes |               |            |                |             |
|----------------------------------------|---------------|------------|----------------|-------------|
| Class                                  | Diameter (mm) | Width (mm) | Velocity (m/s) | Width (m/s) |
| 1                                      | 0.062         | 0.125      | 0.05           | 0.1         |
| 2                                      | 0.187         | 0.125      | 0.15           | 0.1         |
| 3                                      | 0.312         | 0.125      | 0.25           | 0.1         |
| 4                                      | 0.437         | 0.125      | 0.35           | 0.1         |
| 5                                      | 0.562         | 0.125      | 0.45           | 0.1         |
| 6                                      | 0.687         | 0.125      | 0.55           | 0.1         |
| 7                                      | 0.812         | 0.125      | 0.65           | 0.1         |
| 8                                      | 0.937         | 0.125      | 0.75           | 0.1         |
| 9                                      | 1.062         | 0.125      | 0.85           | 0.1         |
| 10                                     | 1.187         | 0.125      | 0.95           | 0.1         |
| 11                                     | 1.375         | 0.25       | 1.1            | 0.2         |
| 12                                     | 1.625         | 0.25       | 1.3            | 0.2         |
| 13                                     | 1.875         | 0.25       | 1.5            | 0.2         |
| 14                                     | 2.125         | 0.25       | 1.7            | 0.2         |
| 15                                     | 2.375         | 0.25       | 1.9            | 0.2         |
| 16                                     | 2.75          | 0.5        | 2.2            | 0.4         |
| 17                                     | 3.25          | 0.5        | 2.6            | 0.4         |
| 18                                     | 3.75          | 0.5        | 3.0            | 0.4         |
| 19                                     | 4.25          | 0.5        | 3.4            | 0.4         |
| 20                                     | 4.75          | 0.5        | 3.8            | 0.4         |
| 21                                     | 5.5           | 1.0        | 4.4            | 0.8         |
| 22                                     | 6.5           | 1.0        | 5.2            | 0.8         |
| 23                                     | 7.5           | 1.0        | 6.0            | 0.8         |
| 24                                     | 8.5           | 1.0        | 6.8            | 0.8         |
| 25                                     | 9.5           | 1.0        | 7.6            | 0.8         |
| 26                                     | 11.0          | 2.0        | 8.8            | 1.6         |
| 27                                     | 13.0          | 2.0        | 10.4           | 1.6         |
| 28                                     | 15.0          | 2.0        | 12.0           | 1.6         |

|    |      |     |      |     |
|----|------|-----|------|-----|
| 29 | 17.0 | 2.0 | 13.6 | 1.6 |
| 30 | 19.0 | 2.0 | 15.2 | 1.6 |
| 31 | 21.5 | 3.0 | 17.6 | 3.2 |
| 32 | 24.5 | 3.0 | 20.8 | 3.2 |