# CFI Climate Sentinels Snow Depth Data

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## 1. Data Set Description

**1.1. Introduction:** This dataset includes snow depth and snow water equivalent data from 4 sites in the St. Lawrence River Valley. The snow depth data were obtained by the *SDMS40: Multipoint Scanning Snowfall Sensor* and the *SR50A Snow-Depth Sensor*. The *CS725 Snow-Water Equivalent Sensor* measured the snow water equivalent data. This dataset includes measurements done at 4 different sites: UQAM-PK (UQAM), Trois-Rivières, Gault and Arboretum.

**1.2. Data version:** v1.0, 11 July 2022

**1.3. Time period covered:**

*Table 1 : Time period covered*

| Sites | Instrument | Start | End |
|---|---|---|---|
| Gault | SDMS40 | 2021-11-01 | 2022-03-30 |
| Gault | SR50A | 2021-11-01 | 2022-03-30 |
| Gault | CS725 | 2021-11-01 | 2022-03-30 |
| Arboretum | SDMS40 | 2021-11-01 | 2022-03-30 |
| UQAM-PK | SDMS40 | 2022-02-12 | 2022-03-29 |
| Trois-Rivières | SR50A | 2021-12-08 | 2022-03-30 |

**1.4. Location:**

Table 2 summarizes the location and elevation of every instrument included in this dataset. UQAM-PK weather station is permanently installed on the rooftop of the President Kennedy building in downtown Montreal. Trois-Rivières weather station was temporarily deployed in the instrument yard of UQTR as part of the WINTRE-MIX field campaign. Arboretum and Gault weather stations are permanently installed in the instrument yard of Gault and Arboretum.

*Table 2 : Location and elevation of each instrument at every site*

| Sites | Instrument | Latitude | Longitude | Site elevation (MSL) | Instrument elevation (AGL) |
|---|---|---|---|---|---|
| Gault | SDMS40 | 45.535021 N | 73.149006 W | 132 m | 2.8 m |
| Gault | SR50A | " | " | " | 2.8 m |
| Gault | CS725 | " | " | " | 2.1 m |
| Arboretum | SDMS40 | 45.430065 N | 73.942156 W | 49 m | 2.6 m |
| UQAM-PK | SDMS40 | 45.508594 N | 73.568741 W | 69 m | 1.5 m |
| Trois-Rivières | SR50A | 46.349835 N | 72.581354 W | 47 m | 1.5 m |

**1.5. Data frequency:** 1 minute for the SDMS40 and SR50A and 6 hours for the CS725.

**1.6. 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) for more information regarding dataset restrictions and dissemination.

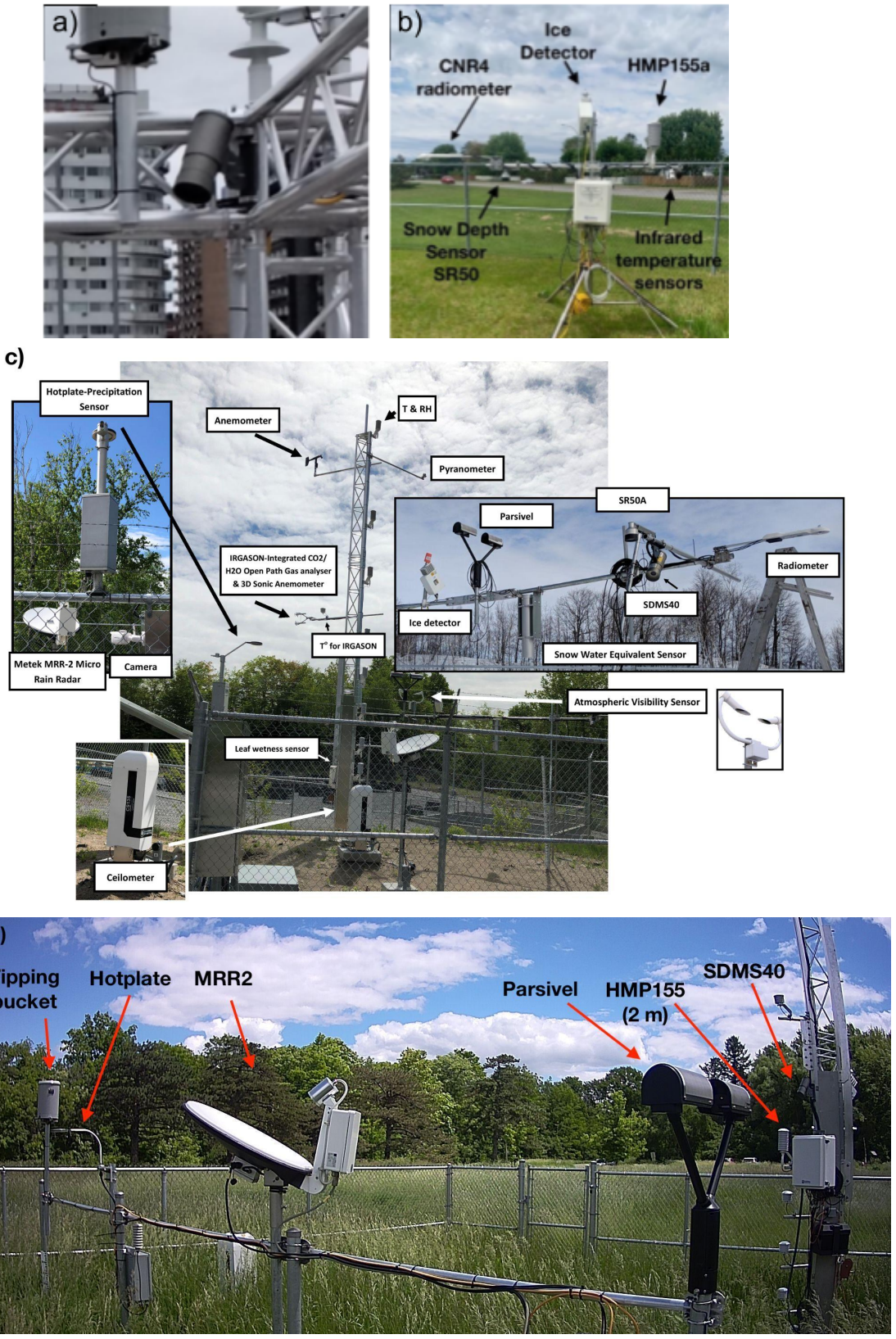


*Fig 1. a) SDMS40 snow depth sensor on the rooftop of President-Kennedy pavilion at UQAM, downtown Montreal (UQAM-PK station), b) SR50A snow depth sensor mounted on a met-tripod, in the instrument yard of UQTR, Trois-Rivières, c) Gault*

*instrumentation including SDMS40 and SR50A sensors and, d) Arboretum site including SDMS40 sensor.*

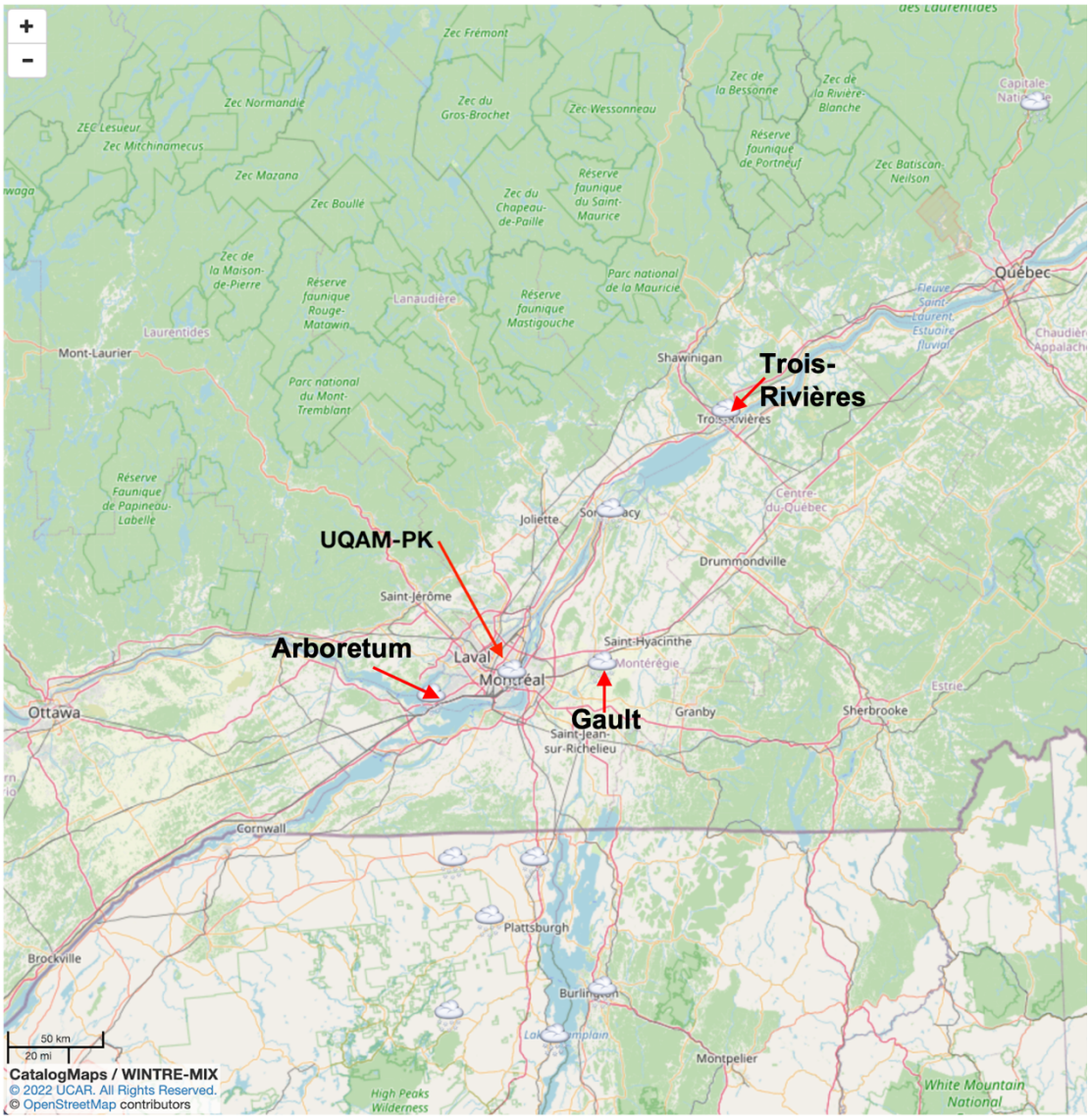


*Figure 2 : Approximate location of each site*

## 2. Instrument Description

The SDMS40 is a 2D multipoint laser-based snowfall sensor. The instrument scans a laser beam on a circular path and calculates the average snow depth at 36 points along this path (https://www.campbellsci.ca/sdms40). The attributes of the SDMS40 are summarized in Table 3.

*Table 3: Technical specification and configuration settings for the SDMS40 Multipoint Scanning Snowfall Sensor*

| Parameter | Value |
|---|---|
| Half Angle | 6° |
| Number of Scanning Points | 36 |
| Accuracy | ±3 mm |
| Resolution | 1 mm |
| Laser Classification | 2 |

The SR50A Sonic Distance Sensor emits an ultrasonic pulse and measures the time elapsed between the emission and the return of the pulse to calculate the snow depth (https://www.campbellsci.ca/sr50a). The attributes of the SR50A are summarized in Table 4.

*Table 4 : Technical specification and configuration settings for the SR50A Snow-Depth Sensor*

| Parameter | Value |
|---|---|
| Measurement Time | < 1.0 s |
| Baud Rates | 1200 to 38400 bps (RS-232, RS-485 modes) |
| Beam Acceptance | ~30° |
| Resolution | 0.25 mm |
| Accuracy | ±1 cm or 0.4% of distance to target |
| Laser Classification | 2 |

The CS725 measures snow-water equivalent (SWE) by measuring how the snowpack attenuates the electromagnetic energy emitted by the ground (https://www.campbellsci.ca/cs725). The attributes of the CS725 are summarized in Table 5.

*Table 5 : Technical specification and configuration settings for the CS725 Snow-Water Equivalent Sensor*

| Parameter | Value |
|---|---|
| Measurement Range | 600 mm maximum water equivalent |
| Accuracy | • ±15 mm (from 0 to 300 mm)<br>• ±15% (from 300 to 600 mm) |
| Coverage Angle | 60° |

More detailed technical information about the SDMS40, the SR50A, and the CS725 are available in their instruction manual (Campbell Scientific, 2022; Campbell Scientific, 2021).

## 3. Data Collection and Processing

The SDMS40 outputs snow depth averages from its 36 sensors per minute. The CS725 outputs SWE data every 6 hours and the SR50A also outputs snow depth data every minute. A different file (suffix .dat) exists for every instrument. They are daily and contain 24 hours of data. These files were read using Python and merged within a single NetCDF file.

## 4. Data Format

A NetCDF file contains the data for all sites. The time is in UTC time and the dataset contains the 2 following dimensions:

- time (length 216001: 1 November 2021-1 April 2022)
- station (length 4 : 'ARBO' 'GAUL' 'TROI' 'UQAM')

The dataset includes the 6 following data variables (the dimensions are listed between the parenthesis):

- latitude (station)
- longitude (station)
- height_above_mean_sea_level (station)
- snow_depth_avg_sdms40 (station, time): Snow depth average measured by SDMS40 at ARBO, GAUL and UQAM [mm]. Minute data.
- snow_depth_sr50a (station, time) : Snow depth measured by SR50A at GAUL and TROI [mm]. Minute data.
- swe_cs725 (station, time) : Snow water equivalent of the snowpack measured by CS725 at GAUL [mm]. 6 hours data.

## 5. Data Remarks

The SR50A, in Gault, was miscalibrated during the field campaign. The data provided by this instrument had an offset of -2500 mm, compared with the average snow depth measured by the SDMS40. This offset corresponds to the height of the instrument. The data were corrected by adding the height of the instrument from the measurements.

Table 6 summarizes the interruptions > 1 h for the SR50A and the SDMS40 data and > 6 h for the CS725 data. Only 3 long interruptions occurred during the field campaign (1 Feb 2022 – 15 March 2022) and are highlighted in yellow. UQAM SDMS40 and Trois-Rivières SR50A had no interruption during the time period covered (Table 1).

*Table 6: Summary of missing data*

| Site | Instrument | Interruption Lenght [hour] | Start | End |
|---|---|---|---|---|
| Gault | CS725 | 12 | 2021-12-13 12:30 | 2021-12-14 00:30 |
| | | 12 | 2022-01-03 12:30 | 2022-01-04 00:30 |
| | | 12 | 2022-01-14 18:30 | 2022-01-15 06:30 |
| | | 12 | 2022-01-24 12:30 | 2022-01-25 00:30 |
| | | 12 | 2022-01-26 12:30 | 2022-01-27 00:30 |
| | | 12 | 2022-01-30 12:30 | 2022-01-31 00:30 |
| | | 12 | 2022-02-05 12:30 | 2022-02-06 00:30 |
| | | 12 | 2022-02-18 12:30 | 2022-02-19 00:30 |
| | | 12 | 2022-02-28 12:30 | 2022-03-01 00:30 |
| Gault | SR50A | 334 | 2021-11-26 17:52 | 2021-12-10 15:30 |
| | | 3 | 2021-12-18 23:58 | 2021-12-19 03:13 |
| | | 14 | 2021-12-21 23:58 | 2021-12-22 14:08 |
| | | 1 | 2022-01-14 23:58 | 2022-01-15 01:10 |
| Gault | SDMS40 | 14 | 2021-12-17 00:51 | 2021-12-17 15:07 |
| | | 6 | 2021-12-18 23:57 | 2021-12-19 05:55 |
| | | 14 | 2021-12-21 23:57 | 2021-12-22 14:08 |
| | | 1 | 2022-01-14 23:57 | 2022-01-15 01:10 |
| Arboretum | SDMS40 | 4 | 2021-11-05 07:39 | 2021-11-05 11:42 |
| | | 5 | 2021-11-30 12:26 | 2021-11-30 18:08 |
| | | 1 | 2021-12-12 04:21 | 2021-12-12 05:39 |

## 6. Acknowledgement

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## 7. References

Campbell Scientific, 2022: SDMS40 Multipoint Scanning Snowfall Sensor Product Manual. *Campbell Scientific, Inc.*

Campbell Scientific, 2021: SR50A-Series Sonic Ranging Sensors Product Manual. *Campbell Scientific, Inc.*

Campbell Scientific, 2021: CS725 Snow Water Equivalent Sensor Product Manual. *Campbell Scientific, Inc.*

**The 3 manuals are provided as attachments.*