

## Sentinel Non-Radiation MetData

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## 1. Dataset Description:

**1.1 Introduction:** The Sentinel Non-Radiation MetData provided in situ measurements of meteorological variables (such as 2-meter temperature, relative humidity, wind speed and direction, and precipitation).

**1.2 Data version: v1.0**

**1.3 Time period covered by the data:**

*Table 1: Time period covered*

Sites	Start	End
Gault	2021-11-01	2022-03-31
Arboretum	2021-11-01	2022-03-31
UQAM-PK	2022-01-26	2022-03-31
Trois-Rivières	2021-12-08	2022-03-31

**1.4 Location of stations:**

*Table 2: Location and elevation of each site*

Sites	Latitude	Longitude	Site elevation (MSL)
Gault	45.535021°N	73.149006°W	132 m
Arboretum	45.430065°N	73.942156°W	49 m
UQAM-PK	45.508594°N	73.568741°W	69 m*
Trois-Rivières	46.349835°N	72.581354°W	47 m

\*Instruments are on a rooftop platform that is 69 m above mean sea-level. The building ground floor is 39 m above mean sea-level.

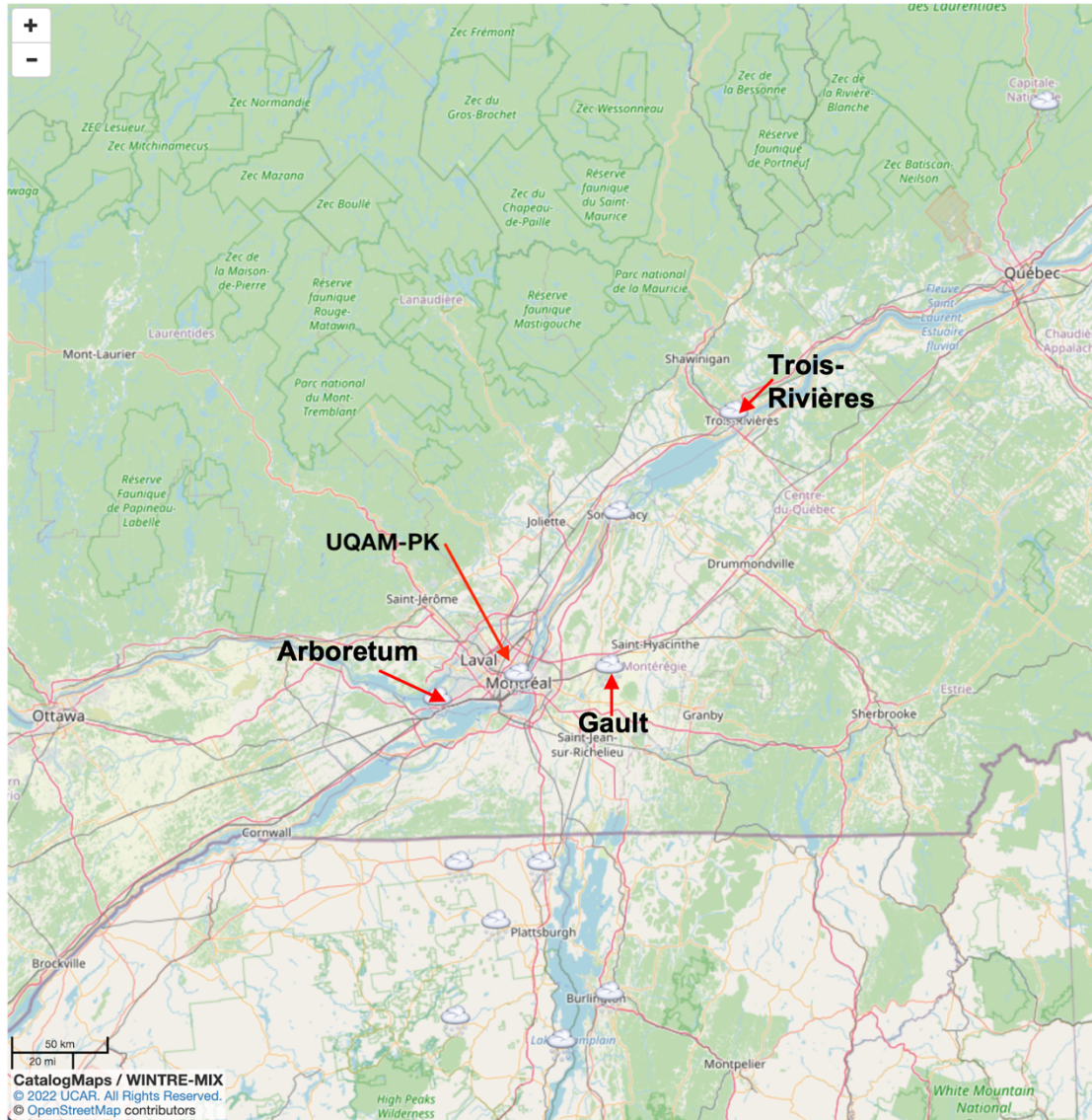


Figure 1: Map of site locations

1.5 Data frequency: Once per minute

1.6 Data source: Adaptable Earth Observation System

## 1.7 Web address references:

Gault: <https://eos.meteo.mcgill.ca/stations/1/live-data>

Arboretum: <https://eos.meteo.mcgill.ca/stations/2/live-data>

(None for Trois-Rivières and UQAM-PK)

**1.8 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:** The instruments used to conduct measurements are shown in the following tables and figures:

### 2.1 Gault:

*Table 3: Instruments used, height of instruments, and variables measured at Gault site*

<u>Variable</u>	<u>Height above ground (m)</u>	<u>Instrument</u>	<u>Link to manual</u>
Air temperature	2	HMP 155	<a href="https://eos.meteo.mcgill.ca/media/documents/hmp155.pdf">https://eos.meteo.mcgill.ca/media/documents/hmp155.pdf</a>
Relative humidity	2	HMP 155	<a href="https://eos.meteo.mcgill.ca/media/documents/hmp155.pdf">https://eos.meteo.mcgill.ca/media/documents/hmp155.pdf</a>
Wind speed	10	Anemometer 05103	<a href="https://eos.meteo.mcgill.ca/media/documents/wind.pdf">https://eos.meteo.mcgill.ca/media/documents/wind.pdf</a>
Wind direction	10	Anemometer 05103	<a href="https://eos.meteo.mcgill.ca/media/documents/wind.pdf">https://eos.meteo.mcgill.ca/media/documents/wind.pdf</a>
Standard deviation of wind direction	10	Anemometer 05103	<a href="https://eos.meteo.mcgill.ca/media/documents/wind.pdf">https://eos.meteo.mcgill.ca/media/documents/wind.pdf</a>
Maximum wind speed	10	Anemometer 05103	<a href="https://eos.meteo.mcgill.ca/media/documents/wind.pdf">https://eos.meteo.mcgill.ca/media/documents/wind.pdf</a>
Direction of maximum wind speed	10	Anemometer 05103	<a href="https://eos.meteo.mcgill.ca/media/documents/wind.pdf">https://eos.meteo.mcgill.ca/media/documents/wind.pdf</a>
Station pressure	5	CS106 - IRGASON enhanced barometer	<a href="https://eos.meteo.mcgill.ca/media/documents/irgason.pdf">https://eos.meteo.mcgill.ca/media/documents/irgason.pdf</a>

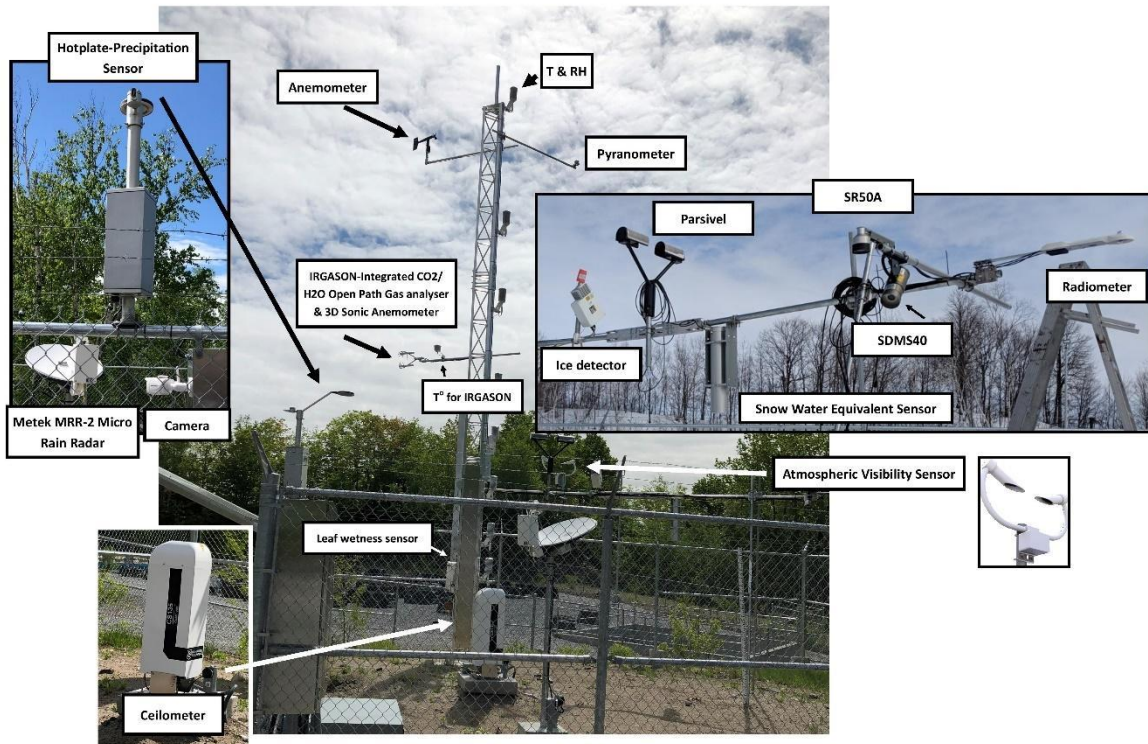


Figure 2: Photo of the Gault site

## 2.2 Arboretum:

Table 4: Instruments used, height of instruments, and variables measured at Arboretum site

<u>Variable</u>	<u>Height above ground (m)</u>	<u>Instrument</u>	<u>Link to manual</u>
Air temperature	2.2	HMP 155	<a href="https://eos.meteo.mcgill.ca/media/documents/hmp155.pdf">https://eos.meteo.mcgill.ca/media/documents/hmp155.pdf</a>
Relative humidity	2.2	HMP 155	<a href="https://eos.meteo.mcgill.ca/media/documents/hmp155.pdf">https://eos.meteo.mcgill.ca/media/documents/hmp155.pdf</a>
Wind speed	10.5	Anemometer 05103	<a href="https://eos.meteo.mcgill.ca/media/documents/wind.pdf">https://eos.meteo.mcgill.ca/media/documents/wind.pdf</a>
Wind direction	10.5	Anemometer 05103	<a href="https://eos.meteo.mcgill.ca/media/documents/wind.pdf">https://eos.meteo.mcgill.ca/media/documents/wind.pdf</a>

Standard deviation of wind direction	10.5	Anemometer 05103	<a href="https://eos.meteo.mcgill.ca/media/documents/wind.pdf">https://eos.meteo.mcgill.ca/media/documents/wind.pdf</a>
Direction of maximum wind speed	10.5	Anemometer 05103	<a href="https://eos.meteo.mcgill.ca/media/documents/wind.pdf">https://eos.meteo.mcgill.ca/media/documents/wind.pdf</a>
Station pressure	7	CS106 - IRGASON	<a href="https://eos.meteo.mcgill.ca/media/documents/irgason.pdf">https://eos.meteo.mcgill.ca/media/documents/irgason.pdf</a>



Figure 3: Photo of the Arboretum site

### 2.3 Trois-Rivières:

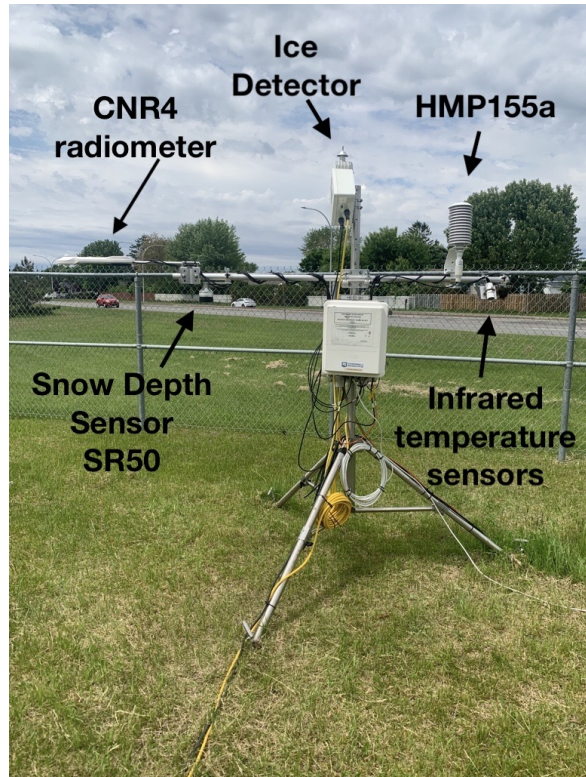
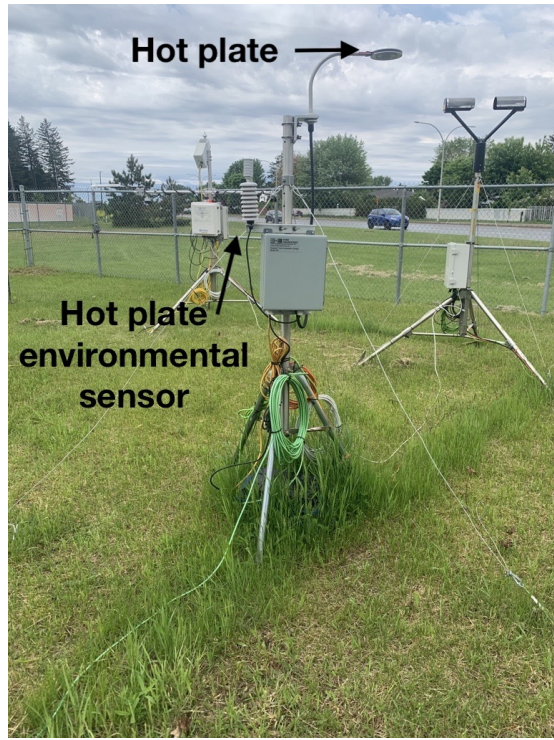
Table 5: Instruments used, height of instruments, and variables measured at Trois-Rivières site for the first part of the dataset.

<u>Variable</u>	<u>Height above ground (m)</u>	<u>Instrument</u>	<u>Link to manual</u>
Air temperature	2	HMP 155	<a href="https://eos.meteo.mcgill.ca/media/documents/hmp155.pdf">https://eos.meteo.mcgill.ca/media/documents/hmp155.pdf</a>
Relative humidity	2	HMP 155	<a href="https://eos.meteo.mcgill.ca/media/documents/hmp155.pdf">https://eos.meteo.mcgill.ca/media/documents/hmp155.pdf</a>

Wind speed	1.51	K63 Hotplate Precipitation Gauge	<a href="http://www.pondengineer.com/k63">http://www.pondengineer.com/k63</a>
Station pressure	1.51	K63 Hotplate Precipitation Gauge	<a href="http://www.pondengineer.com/k63">http://www.pondengineer.com/k63</a>

*Table 6: Instruments used, height of instruments, and variables measured at Trois-Rivières site for the second part of the dataset.*

<u>Variable</u>	<u>Height above ground (m)</u>	<u>Instrument</u>	<u>Link to manual</u>
Air temperature	n/a	n/a	n/a
Relative humidity	n/a	n/a	n/a
Station pressure	n/a	n/a	n/a







*Figure 4: Photos of the Trois-Rivières site*

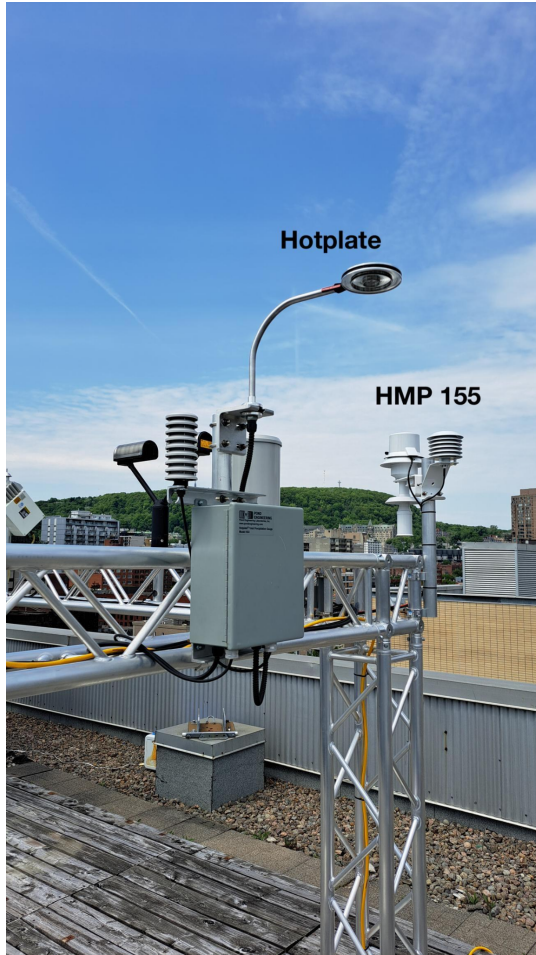
#### **2.4 UQAM-PK:**

*Table 7: Instruments used, height of instruments, and variables measured at UQAM-PK site*

<u>Variable</u>	<u>Height above rooftop platform</u>	<u>Instrument</u>	<u>Link to manual</u>
Air temperature	2.2	HMP 155	<a href="https://eos.meteo.mcgill.ca/media/documents/hmp155.pdf">https://eos.meteo.mcgill.ca/media/documents/hmp155.pdf</a>
Relative humidity	2.2	HMP 155	<a href="https://eos.meteo.mcgill.ca/media/documents/hmp155.pdf">https://eos.meteo.mcgill.ca/media/documents/hmp155.pdf</a>

Wind speed	8.74	Anemometer 05103	<a href="https://eos.meteo.mcgill.ca/media/documents/wind.pdf">https://eos.meteo.mcgill.ca/media/documents/wind.pdf</a>
Wind direction	8.74	Anemometer 05103	<a href="https://eos.meteo.mcgill.ca/media/documents/wind.pdf">https://eos.meteo.mcgill.ca/media/documents/wind.pdf</a>
Standard deviation of wind direction	8.74	Anemometer 05103	<a href="https://eos.meteo.mcgill.ca/media/documents/wind.pdf">https://eos.meteo.mcgill.ca/media/documents/wind.pdf</a>
Maximum wind speed	8.74	Anemometer 05103	<a href="https://eos.meteo.mcgill.ca/media/documents/wind.pdf">https://eos.meteo.mcgill.ca/media/documents/wind.pdf</a>
Direction of maximum wind speed	8.74	Anemometer 05103	<a href="https://eos.meteo.mcgill.ca/media/documents/wind.pdf">https://eos.meteo.mcgill.ca/media/documents/wind.pdf</a>
Station pressure	1	CS106	<a href="https://s.campbellsci.com/documents/us/manuals/cs106.pdf">https://s.campbellsci.com/documents/us/manuals/cs106.pdf</a>
Accumulated precipitation	2	CS700 tipping bucket rain gauge	<a href="https://s.campbellsci.com/documents/ca/manuals/cs700_man.pdf">https://s.campbellsci.com/documents/ca/manuals/cs700_man.pdf</a>





*Figure 5: Photos of the UQAM-PK weather station*

### **3. Data collection and processing:**

The data was collected in real-time via a CR6-Wifi datalogger. This dataset contains the raw data, without any processing or derived parameters.

### **4. Data format:**

The `sentinels_metdata.nc` NetCDF file contains the data for all the sites. The time is in UTC time. The dataset contains the 2 following dimensions :

- time (length 217441: 0 to 217440 representing the number of minutes since 2021-11-01 00:00, or the time period 2021-11-01 00:00 to 2022-04-01 00:00)
- station (length 4: 'ARBO', 'GAUL', 'TROI', 'UQAM', representing Arboretum, Gault, Trois-Rivières, and UQAM-PK respectively)

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

- latitude (station)

- longitude (station)
- height\_above\_mean\_sea\_level (station)
- temp\_2m (station, time)
- relative\_humidity (station, time)
- wind\_speed (station, time)
- wind\_direction (station, time)
- wnd\_direction\_stddev (station, time)
- max\_wind\_speed (station, time)
- max\_wind\_direction (station, time)
- accumulated\_precipitation (station, time)
- station\_pressure (station, time)

Table 8: Parameters of variables included for Gault site

<u>Variable</u>	<u>Description</u>	<u>Units</u>	<u>Accuracy</u>	<u>Time interval between data points</u>	<u>Averaging or reporting interval</u>	<u>Start time (UTC)</u>	<u>End time (UTC)</u>
temp_2m	Air temperature at 2 meters above ground	°C	$\pm(0.226 - 0.0028 \times \text{reading})$ °C (-80° to +20°C)	1 min	Instantaneous	2021-11-01 00:00	2022-04-01 00:00
relative_humidity	Relative humidity at 2 meters above ground	%	$\pm(1.0 + 0.008 \times \text{reading})$ % RH (at -20° to +40°C)	1 min	1 min average	2021-11-01 00:00	2022-04-01 00:00
wind_speed	Mean wind speed	m/s	$\pm 0.3$ m s <sup>-1</sup> ( $\pm 0.6$ mph) or 1% of reading	1 min	1 min average	2021-11-01 00:00	2022-04-01 00:00
wind_direction	Mean wind direction	degrees from north	$\pm 3^\circ$	1 min	1 min average	2021-11-01 00:00	2022-04-01 00:00
wind_direction_stddev	Wind direction standard deviation	degrees from north	N/A	1 min	1 min standard deviation	2021-11-01 00:00	2022-04-01 00:00

max_wind_speed	Maximum wind gust	m/s	N/A	1 min	1 min maximum	2021-11-01 00:00	2022-04-01 00:00
max_wind_direction	Wind direction of maximum wind gust	degrees from north	N/A	1 min	1 min maximum	2021-11-01 00:00	2022-04-01 00:00
station_pressure	Station pressure	hPa	±1.5 hPa	1 min	Instantaneous	2021-11-01 00:00	2022-04-01 00:00

Table 9: Parameters of variables included for Arboretum site

<u>Variable</u>	<u>Description</u>	<u>Units</u>	<u>Accuracy</u>	<u>Time interval between data points</u>	<u>Averaging or reporting interval</u>	<u>Start time (UTC)</u>	<u>End time (UTC)</u>
temp_2m	Air temperature at 2 meters above ground	°C	±(0.226 - 0.0028 × reading) °C (-80° to +20°C)	1 min	Instantaneous	2021-11-01 00:00	2022-04-01 00:00
relative_humidity	Relative humidity at 2 meters above ground	%	±(1.0 + 0.008 × reading) % RH (at -20° to +40°C)	1 min	1 min average	2021-11-01 00:00	2022-04-01 00:00
wind_speed	Mean wind speed	m/s	±0.3 m s <sup>-1</sup> (±0.6 mph) or 1% of reading	1 min	1 min average	2021-11-01 00:00	2022-04-01 00:00
wind_direction	Mean wind direction	degrees from north	±3°	1 min	1 min average	2021-11-01 00:00	2022-04-01 00:00
wind_direction_stddev	Wind direction standard deviation	degrees from north	N/A	1 min	1 min standard deviation	2021-11-01 00:00	2022-04-01 00:00
max_wind_direction	Wind direction of maximum wind gust	degrees	N/A	1 min	1 min maximum	2021-11-01 00:00	2022-04-01 00:00

	maximum wind gust	from north					
station_pressure	Station pressure	hPa	±1.5 hPa	1 min	Instantaneous	2021-11-01 00:00	2022-04-01 00:00

Table 10: Parameters of variables included for Trois-Rivières site for first part of dataset.

<u>Variable</u>	<u>Description</u>	<u>Units</u>	<u>Accuracy</u>	<u>Time interval between data points</u>	<u>Averaging or reporting interval</u>	<u>Start time (UTC)</u>	<u>End time (UTC)</u>
temp_2m	Air temperature at 2 meters above ground	°C		30 min		2021-11-01 00:00	2022-02-17 23:30
relative_humidity	Relative humidity at 2 meters above ground	%		30 min		2021-11-01 00:00	2021-12-08 20:30
station_pressure	Station pressure	kPa		30 min		2021-11-01 00:00	2022-02-02 22:00

Table 11: Parameters of variables included for Trois-Rivières site for second part of dataset.

<u>Variable</u>	<u>Description</u>	<u>Units</u>	<u>Accuracy</u>	<u>Time interval between data points</u>	<u>Averaging or reporting interval</u>	<u>Start time (UTC)</u>	<u>End time (UTC)</u>
temp_2m	Air temperature at 2 meters above ground	°C	±(0.226 - 0.0028 × reading) °C (-80° to +20°C)	1 min	1 min average	2022-02-18 00:00	2022-04-01 00:00
relative_humidity	Relative humidity at 2 meters above ground	%	±(1.0 + 0.008 × reading) % RH (at -20° to +40°C)	1 min	Instantaneous	2021-12-08 20:46	2022-04-01 00:00

wind_speed	Mean wind speed	m/s	±1 m/s	1 min	1 min average	2022-02-02 22:10	2022-04-01 00:00
station_pressure	Station pressure	kPa	±1 hPa	1 min	1 min average	2022-02-02 22:10	2022-04-01 00:00

Table 12: Parameters of variables included for UQAM-PK site

<u>Variable</u>	<u>Description</u>	<u>Units</u>	<u>Accuracy</u>	<u>Time interval between data points</u>	<u>Averaging or reporting interval</u>	<u>Start time (UTC)</u>	<u>End time (UTC)</u>
temp_2m	Air temperature at 2 meters above ground	°C	±(0.226 - 0.0028 × reading) °C (-80° to +20°C)	1 min	1 min average	2022-01-26 05:20	2022-04-01 00:00
relative_humidity	Relative humidity at 2 meters above ground	%	±(1.0 + 0.008 × reading) % RH (at -20° to +40°C)	1 min	Instantaneous	2022-01-26 05:20	2022-04-01 00:00
wind_speed	Mean wind speed	m/s	±0.3 m s <sup>-1</sup> (±0.6 mph) or 1% of reading	1 min	1 min average	2022-01-26 05:20	2022-04-01 00:00
wind_direction	Mean wind direction	degrees from north	±3°	1 min	1 min average	2022-01-26 05:20	2022-04-01 00:00
wind_direction_std_dev	Wind direction standard deviation	degrees from north	N/A	1 min	1 min standard deviation	2022-01-26 05:20	2022-04-01 00:00
max_wind_speed	Maximum wind gust	m/s	N/A	1 min	1 min maximum	2022-01-26 05:20	2022-04-01 00:00
max_wind_direction	Wind direction of maximum wind gust	degrees from north	N/A	1 min	1 min maximum	2022-01-26 05:20	2022-04-01 00:00



station_pressure	Station pressure	kPa	±0.3 hPa at 20°C ±0.6 hPa at 0 to 40°C ±1 hPa at -20 to 45°C	1 min	Instantaneous	2022-01-26 05:20	2022-04-01 00:00
accumulated_precipitation	Accumulated precipitation since 00 UTC of particular day	mm	±2%	1 min	Accumulation since 00 UTC of the particular day	2022-01-26 05:20	2022-04-01 00:00

\*This data was obtained from the UQTR temperature sensor.

## 5. Data remarks:

*Table 11: Missing data periods (only >1-hr periods, times in UTC)*

<u>Gault surface pressure</u>	<u>Gault other variables</u>	<u>Arboretum pressure</u>	<u>Arboretum other variables</u>	<u>Trois to Rivières pressure</u>	<u>Trois to Rivières wind speed</u>
2021-11-25 20:23 to 2021-11-26 00:00	2021-12-09 23:58 to 2021-12-10 15:20	2021-11-11 22:47 to 2021-11-12 00:00	2021-11-07 23:57 to 2021-11-08 19:42	2021-12-08 20:46 to 2022-02-02 22:11*	2021-12-08 20:46 to 2022-02-02 22:09*
2021-12-11 08:48 to 2021-12-12 00:00	2021-12-18 23:58 to 2021-12-19 06:00	2021-11-30 12:22 to 2021-11-30 18:07	2021-11-30 12:27 to 2021-11-30 18:07	2022-02-02 22:23 to 2022-02-03 00:10	
2021-12-12 05:15 to 2021-12-13 00:00	2021-12-21 23:58 to 2021-12-22 14:07	2021-11-30 22:52 to 2021-11-30 23:56	2021-12-09 23:57 to 2021-12-10 15:31	2022-02-03 15:11 to 2022-02-07 20:47	
2021-12-13 05:14 to 2021-12-14 00:00	2022-01-13 23:58 to 2022-01-15 01:09	2021-12-12 04:17 to 2021-12-12 23:56	2021-12-12 04:21 to 2021-12-12 05:38	2022-02-08 3:40 to 2022-02-08 7:45	
2021-12-14 05:27 to 2021-12-15 00:00		2022-03-04 23:01 to 2022-03-05 00:00	2022-01-13 00:02 to 2022-01-13 18:07	2022-02-09 10:30 to 2022-02-09 11:30	

2021-12-15 22:56 to 2021-12-17 00:00				2022-02-09 14:40 to 2022-02-09 15:40	
2021-12-17 21:18 to 2021-12-22 14:07				2022-02-09 16:10 to 2022-02-10 5:16	
2022-01-14 07:44 to 2022-01-15 01:09				2022-02-10 14:00 to 2022-02-10 15:46	
2022-01-29 12:53 to 2022-02-01 00:00				2022-02-11 2:46 to 2022-02-11 4:42	
2022-02-24 09:10 to 2022-02-25 00:00				2022-02-11 14:32 to 2022-02-12 1:20	
2022-02-25 06:46 to 2022-02-26 00:00				2022-02-12 2:59 to 2022-02-12 4:08	
2022-02-26 06:48 to 2022-02-27 00:00				2022-02-12 21:34 to 2022-02-17 16:51	
2022-02-27 06:38 to 2022-02-28 00:00				2022-02-18 2:05 to 2022-02-23 0:21	
				2022-02-23 17:22 to 2022-02-25 16:40	
				2022-02-26 19:25 to 2022-03-01 20:40	
				2022-03-02 10:08 to 2022-03-02 12:23	
				2022-03-02 14:40 to	

				2022-03-03 3:55	
				2022-03-03 9:10 to 2022-03-05 7:33	
				2022-03-05 12:27 to 2022-03-06 6:00	
				2022-03-07 14:47 to 2022-03-07 18:47	
				2022-03-08 8:23 to 2022-03-09 5:18	
				2022-03-09 9:26 to 2022-03-11 20:35	
				2022-03-12 20:32 to 2022-03-14 11:12	
				2022-03-14 12:42 to 2022-03-15 2:46	
				2022-03-15 9:31 to 2022-03-17 5:51	
				2022-03-17 12:56 to 2022-03-18 0:19	
				2022-03-18 14:45 to 2022-03-19 11:03	
				2022-03-21 7:14 to 2022-03-24 9:49	

				2022-03-26 19:14 to 2022-03-27 0:53	
				2022-03-27 10:49 to 2022-03-27 12:10	
				2022-03-27 13:47 to 2022-03-31 3:13	
				2022-03-31 14:09 to 2022-03-31 16:28	

\*Effectively, the Trois-Rivières surface pressure and wind speed data start on 2022-02-02 22:12 UTC and 2022-02-02 22:10 UTC respectively.

- There are no >1 hr periods of missing data for the UQAM-PK variables.
- At Gault and Arboretum, the station pressure is measured every 0.1 seconds, but one timestep was only included every 1 min to match the rest of the data.
- At UQAM-PK, the pressure has a resolution of 1 hPa. At the other stations, the pressure has a resolution of 0.1 hPa.
- At all stations except at UQAM-PK, rainfall data is not included because the tipping buckets were not operational.
- The Trois-Rivières surface pressure data are sporadic.
- Icing appears to have prevented the anemometers at Gault, Arboretum, and UQAM-PK from working during the periods 2022-02-23 3:07-5:53 UTC, 2022-02-23 3:22-10:51 UTC, and 2022-02-23 2:36-7:14 UTC respectively, which is during IOP 5. It is unclear if the temperature data is affected during this time. There is no evidence of this icing issues during other IOPs. Periods outside IOPs were not checked.
- Data from additional instruments are available upon request.

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