

# High Resolution Solar Radiation Datasets

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## Introduction

High-resolution solar radiation time series data enabling representative power system simulations of the impact of short-term (< 5 minutes) resources fluctuation on a power plant or neighbourhood ( $\approx 25$  ha) have been developed.

Actual measurements of the solar radiation was performed at a high frequency (30-100 Hz or up to once every 10 ms) to allow high ramp-rate events to be recorded. The datasets were retrieved from a network composed of 17 units that measure the solar irradiance located in [Varennes](#) (Québec). This system allows measuring the ground-level solar variability on a network of sensors distributed over a given surface.

## Instrumentation and Sampling

The irradiance sensors are LI-COR LI-200S photodiode-type pyranometers installed on wirelessly communicating and autonomously powered remote units. Each unit has two irradiance sensors: the first for global horizontal irradiance, and the second for global tilted irradiance on an inclined plane. At Varennes, the inclined plane has a slope of  $45^\circ$  from the horizontal and faces south.

Each unit takes measurements every millisecond (1 ms), averages them over a period of 10 ms, and saves the data when it changes by more than  $5 \text{ W/m}^2$  since the last saved value. In addition, data is saved at 1 min intervals. The units are synchronised using a GPS system and ensures the unit to unit skew is limited to 1 ms.

## Data File Description

Data files are saved in CSV format (comma separated values) and correspond to each unit of the network. The system located in Varennes has 17 units.

Files are named by date and unit identifier where the data is taken from. The location of each unit is saved in a KML file as described below. Data was taken on the date corresponding to the folder name containing the file (using the format *yyyymmdd*), from sunrise to sunset (civil twilight when the geometric center of the sun is  $6^\circ$  below horizon), for each unit of the corresponding site.

Table 1 shows the content of each column in the files.

**Table 1 – Data files content and format**

Column	Content	Format
1	Day	yyyy-mm-dd yyyy : Year mm : Month of the year (1-12) dd : Day of the month (1-31)
2	Hour of the day, Eastern Standard Time (GMT-5:00).	HH:mm:ss.nnn HH : Hours (0-23) mm : Minutes (0-59) ss : Seconds (0-59) nnn : Milliseconds (0-999)
3	Global horizontal irradiance, in W/m <sup>2</sup>	Integer
4	Global tilted irradiance, in W/m <sup>2</sup>	Integer

The available data corresponds to four categories of day observed in Varennes. Table 2 categorises the available data.

**Table 2 – Available data categories**

Day type	Varennes
Clear-sky	2014-12-30
Overcast	2014-10-21
Variable	2015-02-26
Very variable	2014-07-17

## KML Location File Description

A KML file describes the location of each of the 17 units located in Varennes. The file can be opened using [Google Earth](#) or the online tool [Google Maps](#). The map in Figure 1 shows the location of each unit on the site. Their coordinates are located in annex of this document.

Because of the high sampling rate, the sensors are capable of capturing shadows caused by birds or insects passing over them. These events may cause a sudden drop in the measured irradiance on a unit. Some units are relatively close to obstructions (trees, power lines, etc.) which can also shade the sensors during certain times of the day and year. The identifier for the Varennes units begins with the letters VAR.

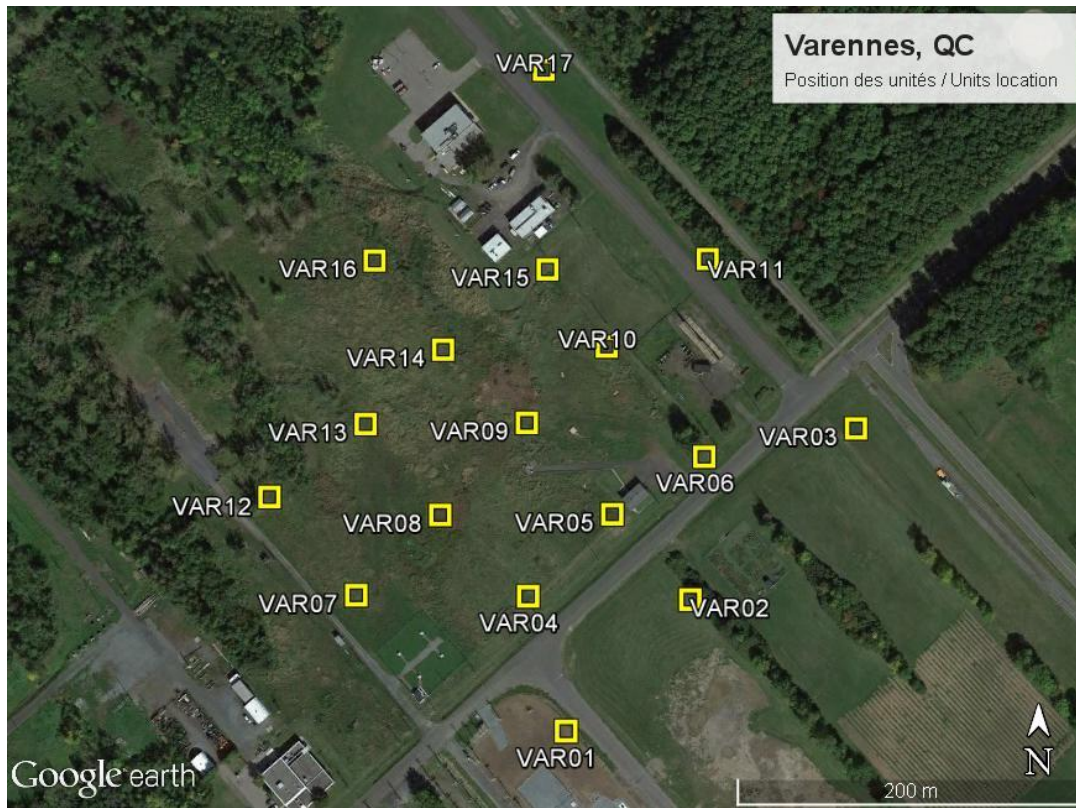


Figure 1 – Map showing the unit location in Varennes

## Acknowledgments

The data has been collected by the CanmetENERGY laboratory in Varennes as part of the *High Resolution Solar Radiation Time Series Generation* (RENI-506) project. Location for the installation of the system in Varennes has been provided by the Hydro-Québec Research Institute (IREQ). Funding for this project has been provided by the Government of Canada through the ecoENERGY Innovation Initiative (ecoEII).

## Annex: Unit Coordinates

The following table lists the coordinates (latitude and longitude) of each unit.

Unit identifier	Latitude (°)	Longitude (°)
VAR01	45.616084	-73.386362
VAR02	45.616760	-73.385428
VAR03	45.617659	-73.384157
VAR04	45.616777	-73.386646
VAR05	45.617206	-73.386011
VAR06	45.617509	-73.385312
VAR07	45.616783	-73.387937
VAR08	45.617202	-73.387311
VAR09	45.617689	-73.386657
VAR10	45.618096	-73.386048
VAR11	45.618569	-73.385269
VAR12	45.617297	-73.388603
VAR13	45.617682	-73.387882
VAR14	45.618080	-73.387298
VAR15	45.618513	-73.386500
VAR16	45.618561	-73.387829
VAR17	45.619610	-73.386530