High Resolution Solar Radiation Datasets

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 (≈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 24 units that measure the solar irradiance in Alderville (Ontario). The system is co-located within a 1 MW sub-array of the 5 MW Alderville First Nations Solar Farm. 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 Alderville, the inclined plane has a slope of 30° from the horizontal (south-facing), which corresponds to the plane of irradiance for this array.

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 W/m² 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 Alderville has 24 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° 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/m²	Integer
4	Global tilted irradiance, in W/m²	Integer

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

Table 2 – Available data categories

Day type	Alderville
Clear-sky	2015-03-24
Overcast	2015-02-08
Variable	2015-10-08
Very variable	2015-08-12

KML Location File Description

A KML file describes the location of each of the 24 units located in Alderville. 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. The identifier for the Alderville units begins with the letters AFN.
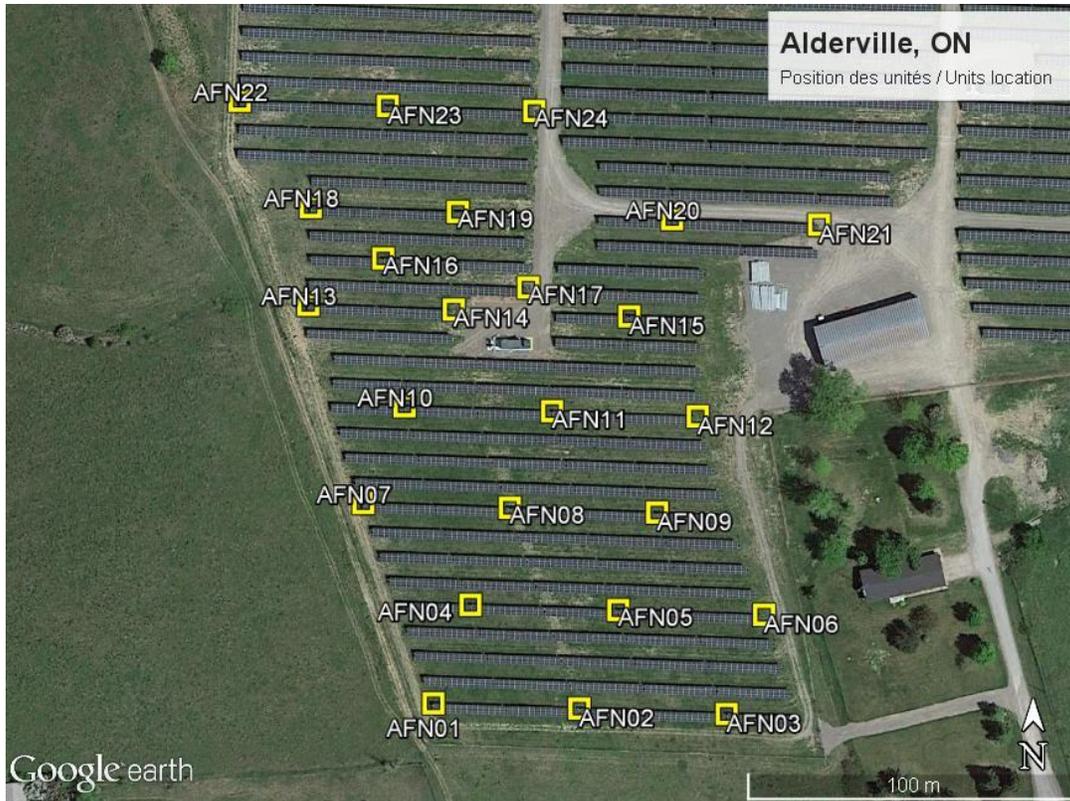
Figure 1 – Map showing the unit location in Alderville

Acknowledgments

Annex: Unit Coordinates

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

Unit identifier	Latitude (°)	Longitude (°)
AFN01	44.190159	-78.096701
AFN02	44.190145	-78.096148
AFN03	44.190130	-78.095589
AFN04	44.190427	-78.096561
AFN05	44.190412	-78.096000
AFN06	44.190400	-78.095447
AFN07	44.190703	-78.096967
AFN08	44.190691	-78.096411
AFN09	44.190678	-78.095852
AFN10	44.190967	-78.096811
AFN11	44.190953	-78.096251
AFN12	44.190939	-78.095698
AFN13	44.191243	-78.097176
AFN14	44.191230	-78.096624
AFN15	44.191211	-78.095958
AFN16	44.191369	-78.096892
AFN17	44.191290	-78.096341
AFN18	44.191509	-78.097167
AFN19	44.191495	-78.096609
AFN20	44.191476	-78.095796
AFN21	44.191460	-78.095238
AFN22	44.191798	-78.097437
AFN23	44.191783	-78.096875
AFN24	44.191770	-78.096319