

Operations of the University of Oregon Solar Radiation Monitoring Lab

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Introduction

The University of Oregon Solar Radiation Monitoring Laboratory (SRML) operates one of the most comprehensive and longest-running solar monitoring networks in the United States. Established in the late 1970s, the SRML was initially created to study the solar energy potential of the Pacific Northwest—an area often characterized by high cloud cover and variable weather patterns. Over the decades, the network has expanded in both scope and sophistication, evolving into a cornerstone of solar resource research and atmospheric science.

Long-term ground-based solar radiation measurements are essential for evaluating solar energy feasibility and satellite models. Researchers use the data to model solar resource variability, climatologists integrate them into long-term trend analyses, and energy professionals apply them to design photovoltaic and solar thermal systems. The laboratory's overarching goal remains unchanged: to provide high-quality, traceable, and publicly accessible solar radiation and meteorological data.

This report provides a detailed account of the operations, methodologies, and data processing workflows that sustain the SRML network of stations. It describes each stage of the process—from instrument calibration and deployment to data validation and publication.

Network Configuration and Instrumentation

The current SRML network currently consists of eight monitoring stations distributed throughout Oregon and Washington. Each station is equipped with a standard suite of instruments designed to measure key components of solar radiation and supporting meteorological parameters. In recent years efforts have been undertaken to standardize each station as much as possible.

Figure 1 shows a map of the SRML network. Primary (First class) stations are equipped with a two-axis tracker and global horizontal (GHI), direct normal (DNI), and diffuse horizontal (DHI) sensors. Secondary stations are equipped with a CMP11 primary GHI sensor and a rotating shadowband radiometer (RSR) secondary sensor. The RSR instrument generates a DNI and DHI measurement. However it is not a first-class instrument.

Table 1 and Table 2 give details related to each station in the network, including instrument make and model, maintenance protocols, and key dates. Photographs of each station in the network are shown in Figures 2- 9. Calibrated sensors were installed at stations at the time of the SRML staff site visit.

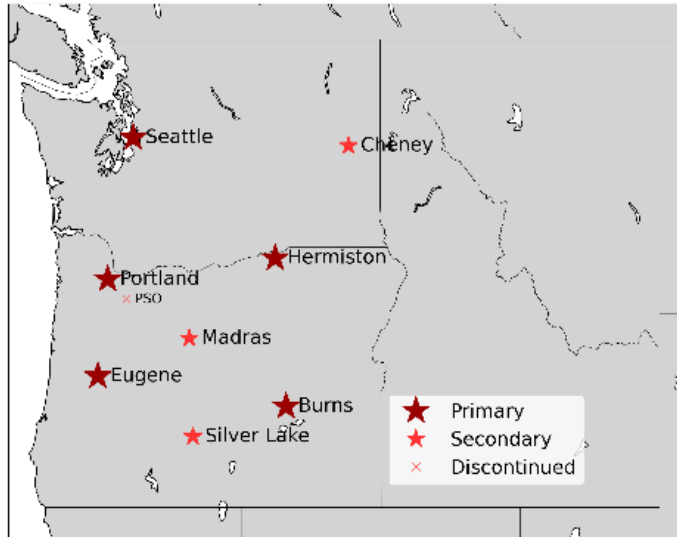


Figure 1. Map of the SRML network. The stations are located in states of Oregon and Washington in the United States.

Table 1. Station location and maintenance details

	BUO	CYW	EUO	HEO	MDO	PDO	SIO	STW
LOCATION	Burns OR	Cheney WA	Eugene OR	Hermiston OR	Madras OR	Portland OR	Silver Lake OR	Seattle WA
LATITUDE (N+)	43.519	47.490	44.047	45.818	44.623	45.5484	43.119	47.654
LONGITUDE (E+)	-119.022	-117.589	-123.074	-119.285	-121.143	-122.909	-121.059	-122.309
ALTITUDE (m)	1270	777	150	188	683	70	1324	70
TIMEZONE (E+)	-8	-8	-8	-8	-8	-8	-8	-8
START DATE	1978	2002	1975	1978	2023	2024	2002	2015
END DATE	Present	Present	Present	Present	Present	Present	Present	Present
LT MAINTENANCE	2 per week	1 per month	3 per week	2 per week	1 per week	3 per week	None	2 per week
LAST SRML STAFF SITE VISIT	2025-07	2025-08	2025-09	2025-08	2025-08	2025-09	2025-07	2025-09
HOST GROUP	OSU Ag research center	Eastern WA U	U of OR	OSU Ag research center	Deschutes water valley authority	Oregon Dept of Env Quality	National forest service	U of WA
STATION LOCATION	Roof of building	Roof of building	Roof of building	Ground	Ground	Roof of building	Ground	Roof of building
DATA COLLECTED BY NREL-MIDC	Yes	No	Yes	Yes	No	No	No	Yes

Table 2. Instrumentation for each station.

[illegible]



Figure 2. Burns OR (BUO) station



Figure 3. Cheney WA (CYW) station

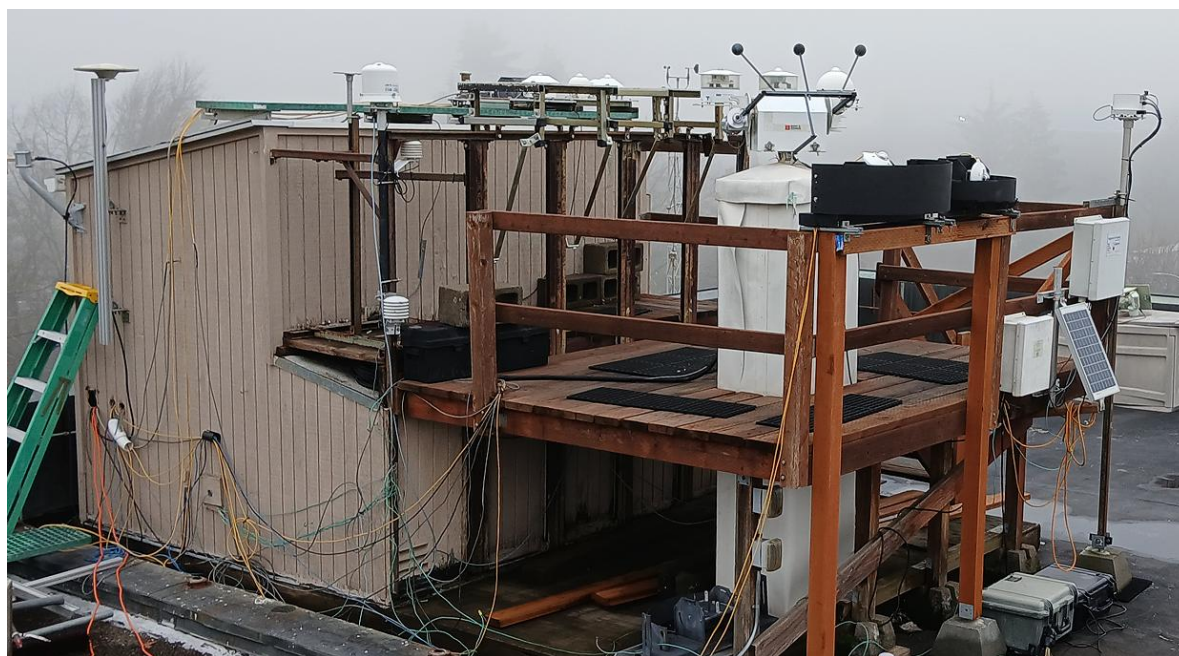


Figure 4. Eugene OR (EUO) station. Note the Eugene station is significantly larger than the other stations in the network. Two axis reference cell experiment not shown. Wind and albedo measurements not shown.



Figure 5. Hermiston OR (HEO) station



Figure 7. Portland OR (PDO) station



Figure 6. Madras OR (MDO) station



Figure 8. Silver lake OR (SIO) station



Figure 9. Seattle WA (STW) station

Calibration protocols

The sensor calibration is the cornerstone of a reliable solar radiation measurement. Without consistent and traceable calibration procedures, even the best-maintained instruments can produce data that are scientifically unreliable. The SRML follows a rigorous, multi-step calibration protocol to ensure that all field sensors conform to internationally recognized standards and that long-term data remain consistent across decades of operation.

Calibration procedures are governed by the principles of traceability and comparability. Traceability ensures that every measurement can be linked through an unbroken chain of comparisons to the World Radiometric Reference (WRR), maintained by the World Radiation Center in Davos, Switzerland. Comparability

ensures that measurements from different stations, instruments, or years can be directly compared with confidence. The SRML achieves both through a combination of controlled laboratory calibration, field intercomparison, and continuous performance monitoring.

The SRML performs outdoor calibrations in Eugene, Oregon. An Eppley AWX Absolute Cavity Radiometer (ACR), serves as the laboratory's primary reference instrument. The ACR is periodically verified through yearly international comparison campaigns (IPC, NPC) coordinated by the World Radiation Center, thereby maintaining its traceability to the WRR.

The SRML performs calibrations in several (3-4) measurement campaigns over the course of each summer. During each campaign, at least three days of data are collected for each instrument to account for short-term atmospheric fluctuations. This calibration protocol is used to calibrate both pyranometers and also pyrheliometers used in the network.

At the start of each summer, the primary reference diffuse pyranometer is mounted horizontally on a two-axis tracker. The shade / unshade calibration method is used to calibrate this sensor. An overview of the technique is given below. Table 3 gives detailed information on the shade / unshade technique.

In the shade / unshade technique, a pyranometer is alternately exposed to full sunlight and then shaded from the direct solar beam using a shadeball. When unshaded, the pyranometer measures the total global irradiance. When shaded, the direct beam is blocked, and the instrument measures only the diffuse component. The diffuse (shaded) measurement is interpolated during the times when the sensor is unshaded. By taking the difference between the two measurements (GHI and DHI) the direct

normal irradiance is determined. This DNI value can then be compared to the ACR reference and the sensor's responsivity can be determined.

The shade–unshade method is performed under stable, clear-sky conditions, over the full range of solar zenith angles throughout the day. Immediately after the shadeball is moved, irradiance values are omitted to remove times when the sensor is not in thermal equilibrium. The shadeball is moved manually. The millivolt signal from the pyranometer is recorded.

The data for the shade / unshade technique is analyzed using the SRML calibration analysis program. The program automatically detects non-stable

sky conditions and also outlier data points. The outlier data points correspond to times when the sensors were being adjusted or cleaned. The details of this program are beyond the scope of this document, but can be obtained from SRML staff.

From the resulting 2 second responsivity values, the median value across all zenith angles is computed. This responsivity value is used as the responsivity for the sensor. Figure 10 shows the automated calibration data for the CMP22 shade / unshade calibration.

Table 3. Shade / unshade calibration details

Time of day	All day (Elv > 10°)
Scan rate	2 second
Number of days	3 clear days (minimum)
Time of year	May – June
DHI reference instrument	CMP22 (SN 110265)
Repeats every	20 minute cycles
ACR measuring (minutes into hour)	(0 – 17), (20 – 37), (40 – 57)
ACR calibration (minutes into hour)	(17 – 20), (37 – 40), (57 – 60)
Shaded (DHI) (minutes into hour)	(0 – 2), (4 – 22), (24 – 42), (44 – 62)
Unshaded (GHI) (minutes into hour)	(2 – 4), (22 – 24), (42 – 44)
Times removed due to non-thermal equilibrium (40 seconds)	(4 – 4.67), (24 – 24.67), (44 – 44.67), (2 – 2.67), (22 – 22.67), (42. 42.67)
Times used to interpolate DHI (1.3 minutes on either side)	(0.67 – 2 and 4.67 – 6), (20.67 – 22 and 24.67 – 26), (40.67 – 42 and 44.67 – 46),
Minutes when DNI is computed	(2.67 – 4), (22.67 – 24), (42.67 – 44)

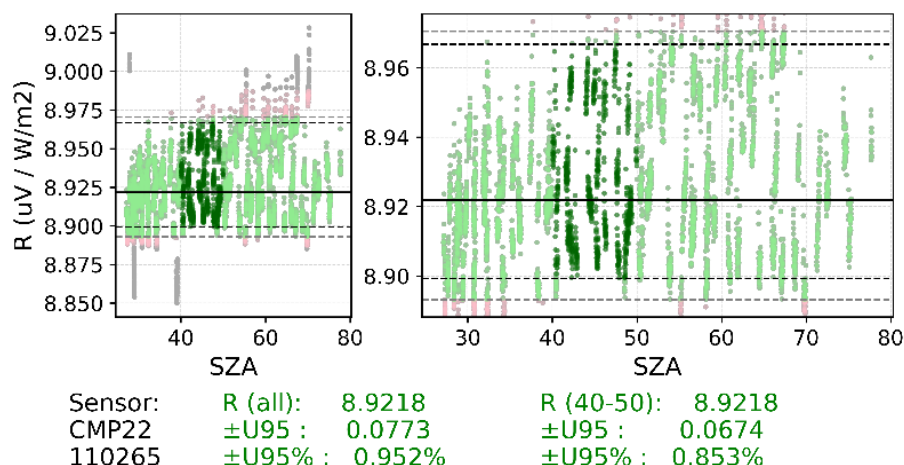


Figure 10. Responsivity vs solar zenith angle (SZA) for CMP22 110265. The shade / unshade method was used to generate these results. The figure on the left shows the responsivity before the outliers are removed. The figure on the right shows the data with the outliers removed. The dark green band corresponds to data in the 40-50 degree range.

Once the reference DHI sensor is obtained, batch component sum comparison calibrations can be performed on the rest of the pyranometers in the fleet. Up to 14 sensors can be mounted on a fixed plate. Figure 11 shows a photograph of the batch pyranometer calibration platform. Pyrheliometers can also be calibrated during this same time by mounting them to the two-axis tracker.



Figure 11. Pyranometers mounted for calibration. Note the mounting platforms used to easily level the sensors.

The irradiance from the reference DNI (ACR) and the reference DHI (CMP22 110265) are combined using the component sum method. This generates a reference GHI measurement. The millivolt signal from the device under test (DUT) is compared to the reference GHI to generate a responsivity for each sensor. Pyrheliometers are compared to the ACR directly.

For the component sum calibrations, two-second data are collected. Data is collected over the course of three clear sky days, typically in June – July. The data is processed using the same automated calibration program that was used in the shade / unshade method. Non-stable sky conditions and outlier data points are removed.

Figure 12 shows the results from a calibration. The plot on the left shows the reference irradiance (left axis) and DUT millivolt signal (right axis) vs zenith angle. Note that the two measurements lie on top of one another. The plot on the right shows the responsivity of the device under test vs zenith angle. Non-clear skies and outliers have been removed in both plots. This plot is generated by the automated calibration program.

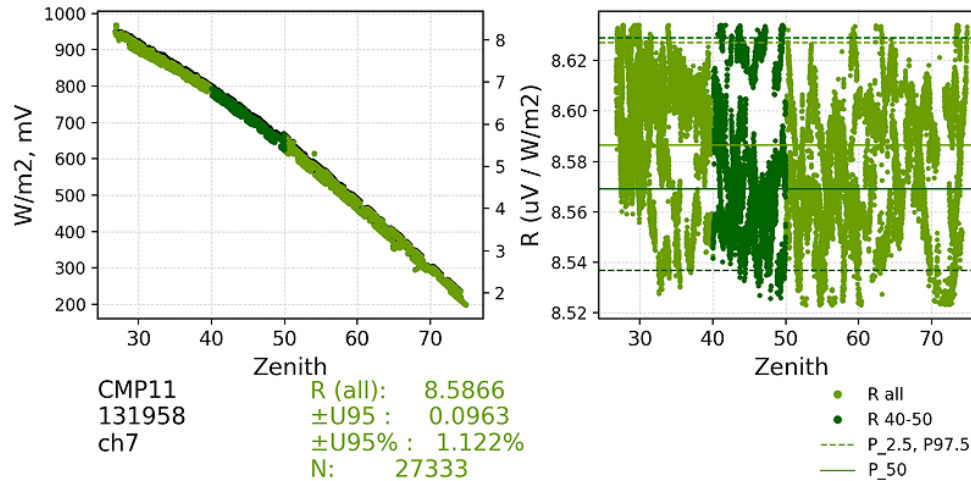


Figure 12. Sample component sum calibration results of a pyranometer.

Once the pyranometers are calibrated, the results are recorded in an ongoing calibration record for each sensor. The results from each calibration are compared to the previous results. This validates that the calibration is accurate from one year to the next. If a sensor has a calibration that does not match previous years, it is cross checked and if need be, recalibrated again. Only sensors that have a consistent calibration record are used in field deployment.

The final step in the calibration process involves computing the responsivity of each sensor as a running average of the previous three years of data. This long-term averaging approach minimizes year-to-year fluctuations in responsivity values, thereby enhancing the overall stability and consistency of the measurements.

The calibration and quality control procedures described above are applied to both thermopile and photodiode (LICOR 200) pyranometers. The photodiode pyranometers are utilized in the Rotating Shadowband Radiometer (RSR) systems. Several adjustments are applied to the

photodiode pyranometers to correct for known systematic errors inherent to this sensor type.

Modern thermopile pyranometers exhibit significantly reduced thermal offsets compared to older models. As a result, the small millivolt-level thermal offset signal can generally be neglected during calibration. The measured millivolt output is used directly in the calibration process—that is, the minor negative nighttime signal is not subtracted from the daytime measurements.

Prior to the 2024 season, the SRML conducted sensor calibrations on site. This practice was discontinued due to the high frequency of site visits coinciding with marginal weather conditions, which often prevented reliable calibration. Additionally, performing both calibration and station maintenance during a single visit proved operationally challenging. Beginning in 2024, all sensor calibrations have been conducted at the Eugene station under controlled conditions, resulting in a more consistent and efficient calibration process with excellent outcomes.

Yearly SRML staff site visits.

Each summer, a member of the SRML staff visits every monitoring site. The objectives of these visits are to (1) perform routine station maintenance, (2) install freshly calibrated sensors, and (3) implement network-wide improvements across all stations.

During the site visits, routine annual maintenance tasks are completed. These activities include servicing the two-axis solar trackers, maintaining the ventilation systems, assessing battery health, inspecting and reinforcing support structures, repainting equipment, and performing other general upkeep as needed.

In addition to maintenance, newly calibrated sensors are installed during each visit. From the calibration batch conducted at the Eugene facility, the best-performing sensors are selected for field deployment. Serial numbers of the installed sensors are recorded, and updates are made to the corresponding data logger programs. This is a coordinated operation: one SRML staff member performs the physical installation on site, while another remotely connects to the control computer to upload the updated data logger program.

Because irradiance data are computed directly on the data logger, it is essential that the correct sensor responsivity values are entered into the program. During the transition period from the old sensors to the newly installed ones, approximately one hour of data is typically lost.

Along with the maintenance and sensor installation, the SRML has been systematically making improvements to each station in the network. These improvements are applied at the network level in an effort to standardize the network of stations as much as possible. Major improvements that were undertaken during the summer of 2025 include:

Leveling platforms have been installed for each Global Horizontal Irradiance (GHI) and Diffuse Horizontal Irradiance (DHI) sensor. These platforms are modeled after the leveling mechanisms used at the Eugene calibration facility. Their purpose is to simplify the leveling process for local technicians (LTs), ensuring that sensors are accurately aligned. Each platform consists of a spring-loaded bolt and nut assembly mounted in a triangular configuration on the support structure. Tightening a nut lowers that side of the platform, while the spring mechanism allows for smooth adjustment without requiring a secondary tie-down bolt to be loosened. Prior to the installation of these platforms, sensors were leveled using the pyranometer's built-in leveling screws, a process that proved difficult for inexperienced users.

Maintenance buttons were also installed at each site. These mechanical switches allow local technicians to indicate when maintenance is being performed. When pressed, the button sends a signal to the data logger, which records the event in the station's output file. The number of days since the last button press is also tracked. This feature allows SRML staff to correlate site visits and sensor cleaning events directly with recorded data.

In addition, an online maintenance form was developed for each station. The form is accessible via mobile phone, allowing technicians to log site visits in real time. During a visit, the LT records the date, time, and general status of the station. Upon submission, the information is transmitted to SRML's data processing system and automatically uploaded to the SRML website. This digital system replaced the previous paper-based

method, which was cumbersome and inefficient to manage in a modern data environment.

Together, the maintenance buttons and online forms provide a more reliable and transparent record of site maintenance activities. Effective communication and training with local technicians were critical to the successful implementation of this new system.

Local technician maintenance

Each SRML monitoring site is maintained by a local technician (LT) several times per week, as outlined in Table 1. Local technicians receive an annual stipend and are responsible for routine maintenance tasks, including cleaning sensors, verifying sensor leveling, and ensuring proper operation of the two-axis tracking systems.

Recruiting, training, and retaining qualified local technicians is an ongoing challenge. The Burns and Portland sites benefit from long-term, stable LT support. The Hermiston, Madras, and Seattle sites currently have technicians in place for the upcoming year; however, these positions are often filled by students or temporary workers and therefore subject to higher turnover. The Cheney site is serviced monthly by custodial staff from Eastern Washington University (EWU). The Silver Lake site currently does not have a designated LT, but due to its remote location in an undisturbed sagebrush region, the sensors tend to remain clean throughout the year. The Eugene site is maintained directly by SRML staff.

Even with strong local technician support, stations may occasionally experience early morning dew or frost. LTs are not expected to visit sites at specific times of day or during poor weather conditions, as such requirements would make technician retention even more difficult. While ventilators help mitigate dew and frost

accumulation, they are not always sufficient under certain environmental conditions. At present, SRML does not have an effective solution to completely eliminate this issue.

Data Acquisition and Transmission

Each SRML monitoring site is equipped with a data logger programmed to scan sensor outputs at intervals of 1, 2, or 3 seconds, depending on the specific station configuration. The data loggers collect raw voltage signals from the sensors and convert them into engineering units using stored calibration coefficients. From these second-level measurements, one-minute data tables are generated for export. The resulting output files contain timestamped measurements that represent either instantaneous or averaged irradiance and meteorological values. Both irradiance (in engineering units) and the corresponding raw millivolt measurements are included in the output files.

The file format and structure were developed in consultation with NREL staff to ensure compatibility with the MIDC database. As part of this collaboration, efforts were made to standardize the output tables across the entire SRML network.

Data from each station are transmitted every five minutes (at 0, 5, 10, 15 ... minute marks) to SRML's central servers at the University of Oregon. Depending on site location and connectivity, transmissions occur via either cellular modem or direct internet connection. Data are collected and managed using Campbell Scientific's LoggerNet software.

A variety of Campbell Scientific data loggers are employed throughout the SRML network, as summarized in Table 1.

During the past year, several systematic improvements were implemented across the SRML data logger programs.

A comparison between two Global Horizontal Irradiance (GHI) measurements was incorporated directly into the logger code. For first-class sites, this comparison involves evaluating the primary GHI sensor against a component sum measurement derived from Direct Normal Irradiance (DNI) and Diffuse Horizontal Irradiance (DHI). For second-class sites, the comparison is made between the primary and secondary GHI sensors. This real-time evaluation enables the early detection of discrepancies between sensors, particularly during new sensor installations. Calibration errors, if present, become immediately apparent through these direct comparisons.

Execution timers were added to the logger programs to monitor how long specific portions of the code take to execute. This feature is particularly important at sites operating with fast scan rates, where the volume of measurements and calculations could potentially interfere with overall system performance.

In 2024, the clocks of the 2AP two-axis trackers were configured to synchronize automatically with the data logger's internal clock. Automating this process eliminated a source of human error, as tracker clock settings were previously adjusted manually by local technicians using unfamiliar software.

Finally, output tables were standardized across all SRML stations. The column order and table structure for each station were clearly defined and uniformly

deployed. The resulting standardization greatly simplifies data management, analysis, and integration across the SRML network.

Data Processing Workflow

Data collected from the data loggers must be processed into a format suitable for public dissemination. This is accomplished through a series of post-processing Python scripts. The primary objectives of these scripts are to (1) format the raw data files into the standardized SRML structure and (2) remove any extraneous or non-public information from the output files.

SRML data are stored as monthly text (*.txt*) files. The associated Python scripts transcribe the incoming *.dat* files from each site into their corresponding monthly output files. Data processing occurs every five minutes and must be completed before the next collection cycle begins. Consequently, the scripts are designed to operate reliably and efficiently to prevent data loss or delays. At present, SRML has not transitioned to a database system for data storage, though a migration to such a system is planned when time permits.

A detailed description of the SRML data file format is available on the website <https://solardata.uoregon.edu/ArchivalFiles.html>. Each data file includes a single header row identifying the measurement types. Further details regarding data element numbers can be found at this page. <https://solardata.uoregon.edu/DataElementNumbers.html>. Every measurement is accompanied by a corresponding quality control (QC) flag. The QC flag structure is described in detail at <https://solardata.uoregon.edu/QualityControlFlags.html>.

In 2025, several significant changes were implemented in SRML's data processing

workflow to improve efficiency, reliability, and transparency. The key updates are summarized below:

The Python-based processing code is now executed from a single PowerShell script, replacing the previous system that relied on multiple batch (*.bat*) files. The batch file approach was cumbersome and difficult to troubleshoot when errors occurred. Under the new system, all stations are processed through PowerShell, which is automatically triggered via Microsoft Task Scheduler. This change has streamlined error handling and improved automation reliability.

A new convention has been adopted for the flagging of unverified data. When data are initially processed—but before undergoing manual verification by SRML staff—their validity is unknown. To reflect this uncertainty, unverified data are now assigned a flag value of 1. Once the data have passed through the formal quality control (QC) process, the flag is updated from 1 to 11. The QC process is conducted at the conclusion of each month.

SRML no longer manually adjusts or “corrects” erroneous irradiance data. In previous years, bad data points were sometimes adjusted to approximate more realistic irradiance values—an informal form of gap-filling intended to improve dataset completeness. Due to time constraints and the inherent uncertainty of such adjustments, this practice has been discontinued. Data are now either flagged as *good* or *bad*, with no manual editing applied to the output values.

Thermopile irradiance data are no longer adjusted for non-zero thermal offsets.

Older thermopile sensors (e.g., PSPs) consistently exhibited negative nighttime values due to thermal offset effects. However, with the transition to modern sensors such as the CMP11 and SR20, these offsets have been greatly reduced. To simplify the processing workflow and improve transparency, nighttime offset values are no longer subtracted from daytime irradiance measurements.

Irradiance values computed directly by the data loggers are now used in the final output files. With the removal of the thermal offset correction, the logger-generated irradiance values can be assimilated directly, eliminating the previous post-processing step that combined millivolt sensor signals with responsivity coefficients.

A plotting routine is now executed every five minutes as part of the PowerShell processing script. The generated plots—displaying irradiance and meteorological data for each station—are automatically uploaded and made accessible via the SRML website. These visualizations provide real-time monitoring capabilities and are an integral part of SRML’s daily data review process. The plots can be viewed on the following page: <https://solardata.uoregon.edu/DataDisplay1.html>. The page automatically cycles through plots for all stations, providing an efficient tool for ongoing network performance assessment.

Quality control measures

The Solar Radiation Monitoring Laboratory upholds the highest standards of data quality through a comprehensive quality control (QC) process that integrates both automated and manual review protocols.

The automated QC procedures are implemented using Python-based software developed in accordance with the Baseline Surface Radiation Network (BSRN) QC guidelines. This system efficiently identifies clear and obvious data errors.

Where the automated process can identify obvious problems, subtle or context-dependent errors are often more difficult to flag correctly automatically. The automated QC process relies heavily on intercomparisons between paired measurements (e.g., *GHI* vs. *GHI_calc* or *GHI_primary* vs. *GHI_secondary*). When discrepancies arise between these measurements, the automated system cannot determine which sensor is accurate. In such cases, the most reliable automated approach is to flag both measurements as potentially invalid.

Manual review by a trained QC operator is therefore a critical component of the process. Experienced operators can often identify cases in which only one sensor is malfunctioning. For example, under clear-sky conditions, one GHI sensor may produce a smooth, physically consistent irradiance curve, while another exhibits irregular or implausible behavior. In such instances, manual inspection ensures that valid data are preserved while only erroneous measurements are appropriately flagged.

To support the QC process, a Python-based plotting and editing tool was developed. Figure 13 illustrates a sample view of this program. The tool allows users to visualize data from multiple sensors over user-defined timeframes, select data ranges, and modify associated quality control flags as needed.

To enhance data interpretation, the program offers several x-axis options, including time, solar zenith angle, solar azimuth angle, global irradiance, and temperature. Plotting data as a function of zenith angle facilitates comparisons between morning and afternoon measurements, while plotting versus azimuth angle enables full-day or multi-day comparisons.

The lower portion of the visualization displays the ratio between the two GHI measurements. As shown in Figure 13, deviations in this ratio often correspond to data points that have been automatically flagged as invalid.

The standard QC protocol involves systematically reviewing each day's dataset, comparing both GHI measurements alongside the corresponding DNI and DHI data. The QC operator identifies discrepancies and evaluates the physical plausibility of the measurements. When one sensor is determined to be operating correctly and another is not, the good data are retained and flagged as valid, while erroneous data are flagged as invalid. This manual verification process ensures that SRML datasets consistently meet the laboratory's rigorous standards for accuracy and reliability.

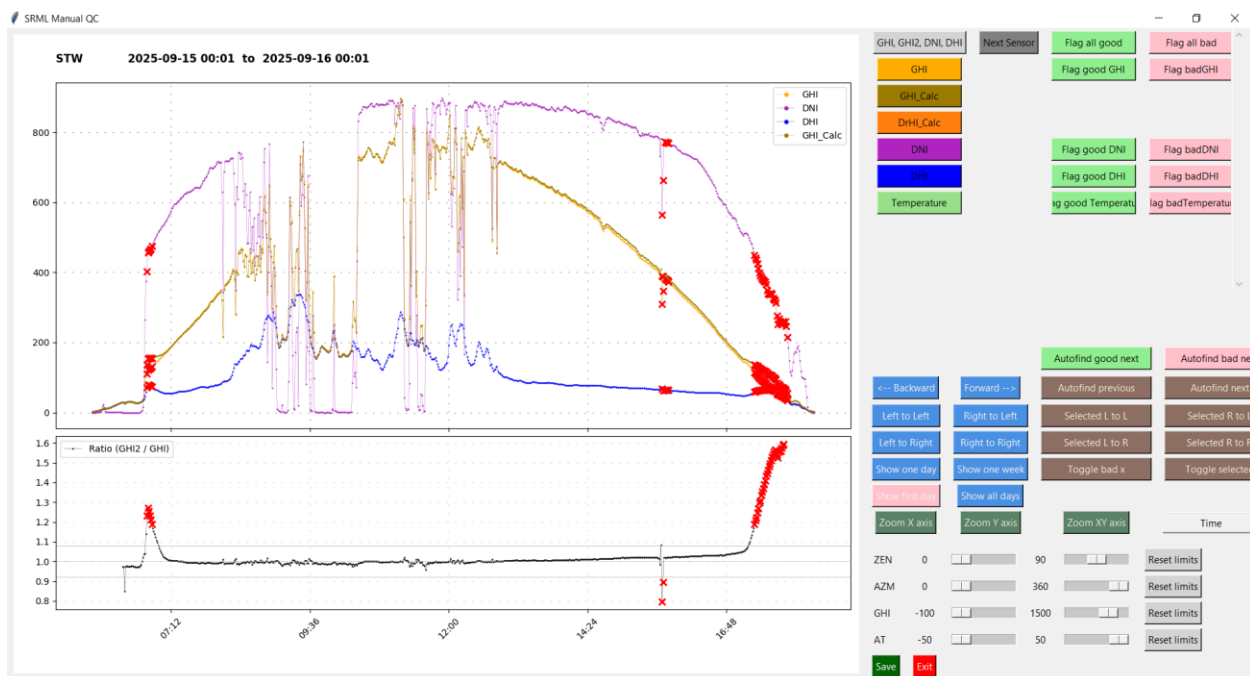


Figure 13. Manual QC operator screen. The left portion displays a plot of the data. The right portion displays the editing buttons, that allow the user to change the view, and edit the data flags.

Quality control (QC) operations are conducted at the completion of each month. A typical QC inspection requires approximately 30 minutes per station for a one-month dataset. Common issues identified during this process include dew and frost accumulation during winter months, insect interference and sensor soiling during summer, and occasional tracker or sensor leveling problems. Conducting QC on a monthly basis allows for the timely detection and correction of such issues, ensuring the continued accuracy and reliability of data collection.

Data Products and Applications

Once processed and validated, SRML data are made available to the public through the laboratory's online portal. Datasets include the one-minute data files, accompanied by detailed metadata and quality flags. The data serve a broad community of users, including government agencies, utilities, academic researchers, and private companies. Due to the varied nature of

users keeping the data processing straightforward is essential so that all users know what has been done to the data.

Other research activities

The activities described thus far pertain primarily to the operation and maintenance of the SRML monitoring network. In addition to these core responsibilities, the SRML actively participates in a variety of research projects that advance the understanding and measurement of solar radiation. Several notable research efforts undertaken in recent years include:

Pyranometer tilt study. Pyranometers require precise leveling during calibration and operation. to ensure accurate responsivity and irradiance measurements. When leveling is compromised—due to improper installation, environmental factors, or gradual mechanical shifts—systematic

errors in irradiance readings can occur. This study investigates how tilt deviations affect pyranometer responsivity at various solar angles. Sensors were intentionally tilted by known amounts, and bubble level displacements are recorded alongside the corresponding electrical outputs. The relationship between bubble misalignment and measured responsivity is analyzed to quantify the sensitivity of the instruments to tilt.

Calibration round robin. A collaborative calibration round robin was conducted to compare and improve pyranometer calibration methodologies among different organizations. Each participating group calibrated three sensors and determined their responsivity values independently. A novel cross-evaluation approach was employed, where each group analyzed the data produced by others. This mutual assessment process led to significant improvements in calibration consistency and methodology across all participants. The project was a partnership between the University of Oregon, and subcontractors at NASA, and Sandia National Laboratories.

Pyranometer vs reference cell. This ongoing study evaluates the performance differences between thermopile-based pyranometers and reference photovoltaic (PV) cells. The SRML hosts a dedicated experimental setup for this project, which includes multiple reference cells, thermopile and photodiode pyranometers, and a spectroradiometer (MS-700). The experimental setup includes both horizontal and two-axis tracking configurations. The goal is to better understand the response

characteristics of different sensor types under varying sky conditions and spectral distributions, contributing to improved cross-calibration between thermopile and PV-based irradiance measurements.

Rotating sky brightness study. In collaboration with Sandia National Laboratories, the SRML hosted a prototype of a novel rotating sensor designed to detect the brightest region of the sky. The project aims to correlate sky imagery with direct sky brightness measurements. This technology has significant implications for solar energy applications, particularly for photovoltaic (PV) systems employing single-axis tracking. By enabling trackers to orient toward the brightest sky region rather than the solar disk alone, such systems can optimize energy capture under both clear and partly cloudy conditions.

Collaboration and Outreach

The SRML maintains strong collaborative relationships with a variety of national and regional partners, including the National Renewable Energy Laboratory (NREL), the Bonneville Power Administration (BPA), the Energy Trust of Oregon (ETO), Sandia National Laboratories, NASA, the National Oceanic and Atmospheric Administration (NOAA), and the Oregon Department of Environmental Quality (DEQ). These partnerships facilitate joint research projects, data sharing, and sensor calibration initiatives.

The laboratory also actively engages with students and teachers through internships and educational programs, including initiatives that promote diversity, equity, and inclusion. In the

upcoming winter, the SRML will host a student intern through the University of Oregon's DEI program to provide hands-on experience in solar radiation monitoring and data analysis. Additionally, SRML hosts local high school teachers as summer researchers, supported by the Partners in Science program. The program aims to give teachers direct research experience.

SRML participates in international collaborations such as IEA PVPS Task 16, contributing to global efforts in photovoltaic system performance monitoring and data standardization. The laboratory is also active in professional conferences, including the Photovoltaic Performance Modeling Collaborative (PVPMC), the IEEE Photovoltaic Specialists Conference (PVSC), and the International Pyrheliometer Comparison (IPC), where staff present research findings and exchange expertise with the broader solar measurement community.

Conclusion

The University of Oregon Solar Radiation Network exemplifies the meticulous work required to maintain a high-quality environmental monitoring program. Through systematic calibration, rigorous data processing, and open dissemination, the SRML provides one of the most trusted solar radiation datasets available.

As global reliance on renewable energy continues to grow, the importance of accurate solar resource information cannot be overstated. Networks like the SRML provide the empirical foundation upon which solar energy models, forecasts, and investment decisions are built. Their continued operation not only supports energy research but also enhances our broader understanding of the Earth's climate and atmospheric systems.

The SRML's success rests on the integration of sound scientific principles, precise instrumentation, and committed human expertise. It stands as a model for how academic institutions can sustain long-term observation networks that serve both science and society.