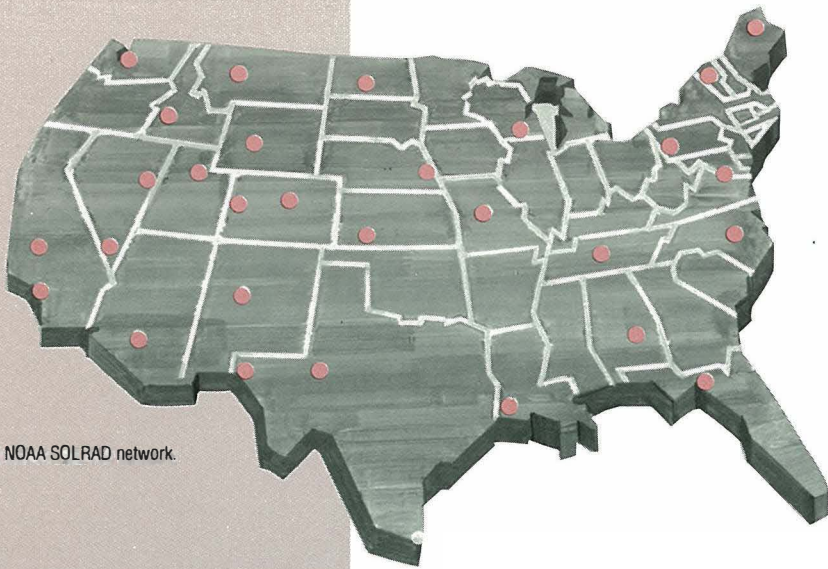


1961-1990 **Solar Radiation Data Base**

*A new 1961-1990
Solar Radiation Data
Base for the United States is
being compiled at the Solar Energy
Research Institute. Using solar radia-
tion and climate data collected by the
National Weather Service (NWS) from
1977 to 1990 and improved computer
models to fill in missing data, this update
will significantly upgrade the current
national SOLMET/ERSATZ data base.*

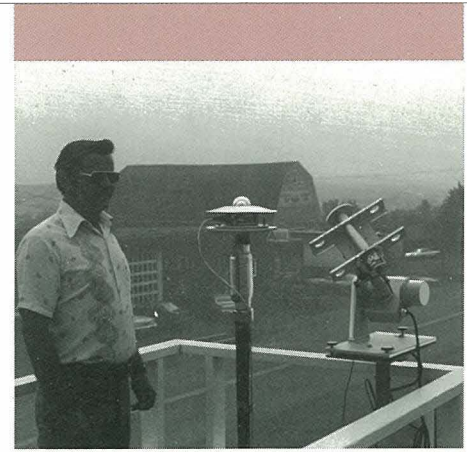


Current NOAA SOLRAD network.

Background

From the early 1950s through 1975, the NWS, which is now part of the National Oceanographic and Atmospheric Administration (NOAA), measured solar radiation at a network of locations across the United States. When interest in these data increased during the energy crisis of the early 1970s, the Department of Energy (DOE) and NOAA decided to form a national solar radiation resource data base. This became a major rehabilitation project when missing calibration records and other problems made it difficult to verify the data's accuracy.

Rehabilitation employed engineering corrections and the best models available, and resulted in the SOLMET (SOLar METeorological) data base, covering the period from 1952 through 1975. Of the 248 stations included in this data base, only 26 (the SOLMET stations) contained measured data from the original NWS network. The data for the other 222 ERSATZ (synthetic) stations were derived from regression models. All of the direct-beam (radiation from the solar disc) data were derived from models. This SOLMET/ERSATZ data base was ultimately

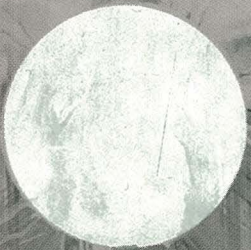


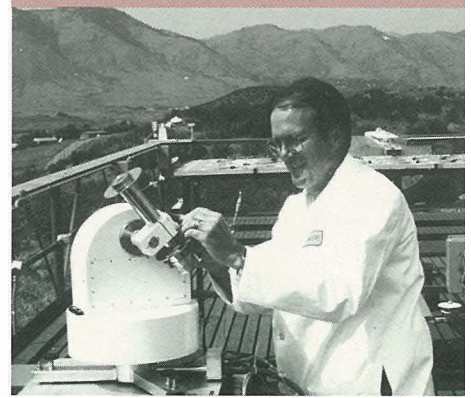
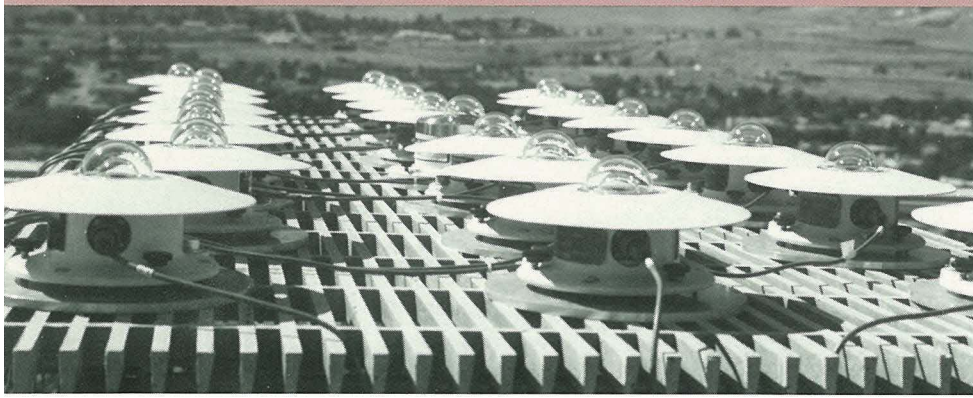
“We will use the data base to find to aid in the design of the plants.”

used to create other products such as the Typical Meteorological Year (TMY) data sets and the **Solar Radiation Energy Resource Atlas of the United States**. These products remain the primary source of solar radiation data for the United States.

As the historical data were being rehabilitated, NOAA and DOE were launching an upgrade of the solar radiation (SOLRAD) network. The new, 38-station SOLRAD network, which began collecting data in 1977, was equipped with improved instruments, called pyranometers, to measure the global-horizontal radiation and included tracking instruments, or pyrhemometers, to measure the direct-beam from the solar disc. Nine of the stations also measured diffuse radiation from the sky. A radiometer calibration facility, set up by NOAA in Boulder, Colorado, ensured the accuracy of data.

From 1977 through 1980, data were collected, quality controlled, and archived at the National Climatic Data Center (NCDC), a NOAA facility in Asheville, North Carolina. Beginning in 1981, budget cuts reduced data processing to copying field cassettes to computer magnetic tapes, which were shipped to SERI for storage. Budget cuts also prevented the repair and replacement of equipment. The network





The Science of Sunlight

NOAA National Weather Service meteorological station, Caribou, ME (left photo). NOAA solar radiation calibration facility, Boulder, CO (center photo). SERI solar outdoor radiation research lab with Eppley SMT-3 solar tracker. Golden, CO (right photo).

potentially good sites for solar power plants, and Christina Jennings, PG&E

gradually decayed and was shut down in October 1985. Fortunately, the calibration facility in Boulder continued to perform its vital function through these difficult years.

At the same time that the network was being shut down, NOAA was undertaking a second upgrade. A new solar tracker (Eppley Model SMT-3) was developed and a new data acquisition system was installed to correct problems that had caused the shutdown. A 31-station SOLRAD network was reactivated in January 1988, but funding limitations prevent its full operation.

1961-1990 Data Base

The data collected by the NOAA SOLRAD network from 1977-1980 have already served two important functions. First, these data were used to evaluate the quality of the SOLMET/ERSATZ data base. Significant shortcomings were discovered, particularly in the modeled data. The modelers did their job well, but they were severely handicapped by the limited data available for model development. Second, the good data, along with the meteorological data collected at each station, are being used to develop

new, improved models that will be instrumental in creating the 1961-1990 data base.

Improved data and improved models will significantly increase the accuracy of our assessment of the nation's solar radiation resources. The models will improve the accuracy of the data base through the use of estimated solar radiation for times and locations where measured data are not available. In addition to improving the quality of the data, the new data base will also account for any climate changes that might have occurred since 1975.

The new data base will be valuable to utilities, architects, builders, engineers, energy specialists and homeowners. Christina Jennings of Pacific Gas and Electric says, "We will use the data base to find potentially good sites for solar power plants, and to aid in the design of the plants. The use of outdated or inaccurate data could be disastrous." Architectural Energy Corporation (AEC) of Boulder, Colorado will make use of the new data base to assist architects with passive and active solar designs. AEC's president Michael Holtz shows his enthusiasm: "The new data base will benefit clients and individual homeowners through improved daylighting design and energy consumption planning."

Into the Future

The 1961-1990 Solar Radiation Data Base will be completed in late 1991 or early 1992. Once it is in place, SERI scientists will concentrate their efforts on enhancing the application of the data to the needs of the entire solar community. During the 1990s, SERI expects to produce

- CD-ROM products that will make the data base accessible to a wider range of users.
- Climate-based models that will allow a user to estimate solar radiation resources for any location in the United States.
- Monthly mean hourly data for a uniform grid covering the United States, along with PC-based software to interpolate between grid points. Grid points spaced 50 to 100 km apart will be the objective. These would become the source data for a new solar radiation atlas.
- Criteria and software for creating design-year and typical-year data sets for major applications of solar radiation resources.

The 1961-1990 Solar Radiation Data Base is being developed in three phases. Interim products will be sent to the National Climatic Data Center (NCDC) for general dissemination before the entire data base is completed.



A Three-Year Project

Phase I (1989)

- 1. Improve the quality control of the data.**
SERI has developed an improved method of quality control that adds a two-digit flag to the solar radiation data. The flag indicates the magnitude and nature of any departures from expected values.
- 2. Form an interim product from NOAA data collected between 1977 and 1985.**
The 1981-1985 data, which had been collected at one-minute intervals, have been reduced to hourly values and combined with hourly data collected from 1977 to 1980. All of these data have been subjected to SERI's new quality control software and will soon be available from NCDC.
- 3. Assist network operators in collecting high-quality solar radiation data.**
SERI is providing limited support to NOAA and other network operators, including help in calibrating radiometers. Good quality data collected during 1988-1990 is key to anchoring the 1961-1990 data base to a solid foundation of measurements.

Phase II (1990)

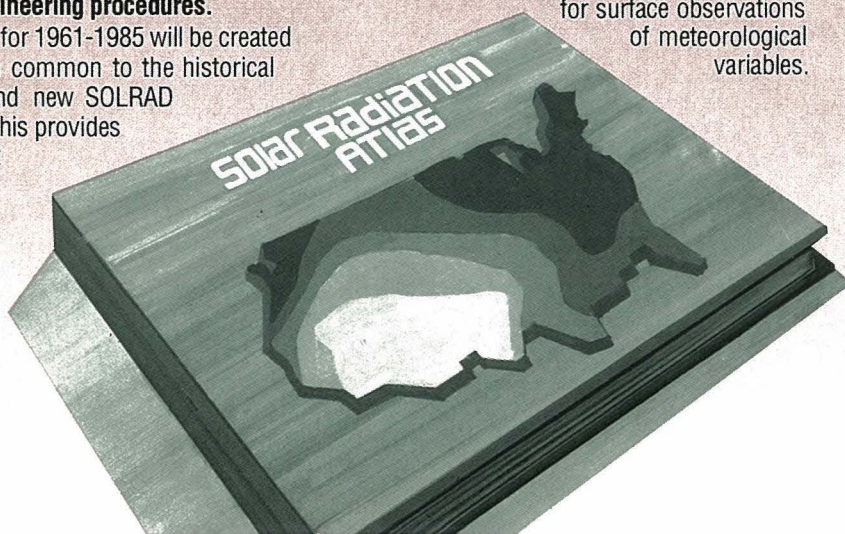
- 1. Evaluate, upgrade, and develop mathematical models to fill in missing data and to estimate values for locations where solar radiation was not measured.**
Because the number of stations in the solar radiation network is small, and their operation is not constant, computer models will be important in creating the 1961-1990 data base. The high-quality, 1977-1980 data are being used to develop and evaluate these models. These improved models will create more reliable data for the new data base. In addition, the engineering procedures that were used to rehabilitate the historical data (1952-1975) will be examined and upgraded as necessary.
- 2. Validate and test the mathematical models and engineering procedures.**
A data base for 1961-1985 will be created for stations common to the historical SOLMET and new SOLRAD networks. This provides an excellent way to

validate the performance of the models and procedures that will be used to create the complete 1961-1990 data base, and will further increase the quality and quantity of the data available to users. Values for all missing components and missing times will be filled in to produce a complete 25-year data base for 20 stations. The components included are global—horizontal, direct-normal and diffuse—horizontal solar irradiance. These data will be available through NCDC.

- 3. Continue support for network operators collecting high-quality solar radiation data.**

Phase III (1991)

- 1. Produce data for all network stations for 1961-1990.**
This will provide the final check for the models and procedures being used.
 - 2. Use models and procedures to create solar radiation data for 200-250 stations where no actual solar radiation data have been or are being collected.**
 - 3. Combine the measured and modelled data and transmit them to NCDC for general distribution to the public.**
These data will contain flags from the SERI quality control procedures.
 - 4. Transfer the entire data base to compact optical disks.**
Four or five compact disks would contain the entire 30-year, 250-station data base for the three fundamental solar radiation components (global-horizontal, direct-normal, and diffuse-horizontal). Compact optical disks make the data base easier to distribute, and users could more easily access data for specific stations and times.
- Note:** The 1961-1990 solar radiation data will be available from NCDC in the TD-3280 format (not SOLMET) used for surface observations of meteorological variables.



A Collaborative Project

The 1961-1990 Solar Radiation Data Base project utilizes the experience and facilities of two organizations: the Solar Energy Research Institute and the National Oceanic and Atmospheric Administration. SERI has provided NOAA with assistance in solar tracker development, software development, and calibration of the radiometers used to collect data. NOAA personnel have served in key positions on SERI review committees. NOAA and SERI scientists also work together on national and international intercomparisons of reference instruments that provide traceability to the World Radiation Reference, which is maintained by the World Meteorological Organization at Davos, Switzerland.

Operated for the Department of Energy by the Midwest Research Institute, SERI conducts research and development activities focusing on renewable energy technologies, including photovoltaics, solar fuels and chemicals, wind energy, ocean energy, and solar thermal energy. Getting the most from an energy source requires in-depth knowledge and understanding of the resource. SERI's Solar Radiation Research and Metrology Branch performs solar radiation research, assessment, and characterization in support of all solar technologies. SERI scientists also design, develop, and calibrate advanced instrumentation for solar radiation research. An outdoor radiation research facility monitors atmospheric conditions and solar radiation.

Contacts

For more information on the development of the 1961-1990 Solar Radiation Data Base, call or write the Task Leader, Dr. Eugene L. Maxwell (303) 231-7088. General technical information is available from the National Solar Technical Inquiry Service at SERI (303) 231-7303. We would also welcome comments regarding future user products that would be of greatest value to you. To acquire data from NCDC, call (704) 259-0682.



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