Monitoring Insolation with Inexpensive Pyranometers

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Defining the Science: Objectives

- Build a network of sites for continuously monitoring insolation, using one-minute instantaneous samples.
- Use these data to supplement models of insolation, validate satellite-based measurements, generate cloud statistics to characterize cloud climatologies.

Defining the Science: Methods

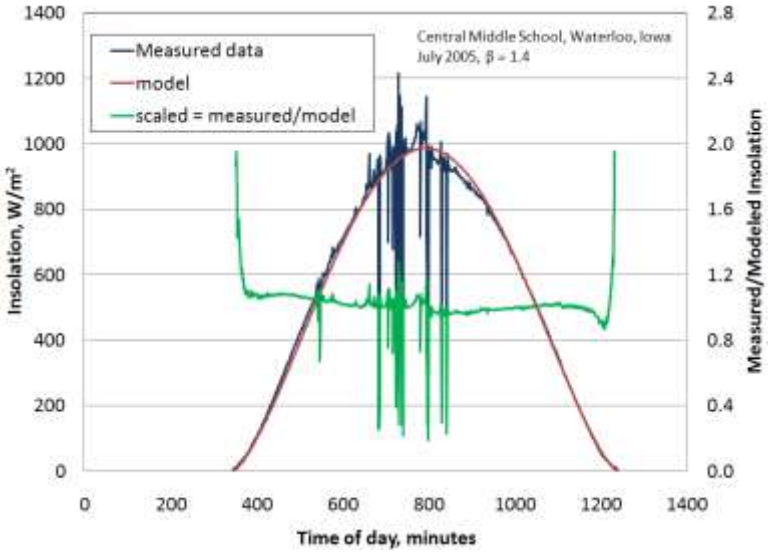
- Use inexpensive (~$10 in parts) silicon photodiode-based pyranometers and self-contained data loggers to measure insolation at sites selected in collaboration with teachers and students.
- Use high-quality pyranometers for calibration and data quality control.
- Establish a central data collection and dissemination site.
- Provide support for long-term continuous sampling (with personnel support to accommodate school schedules).

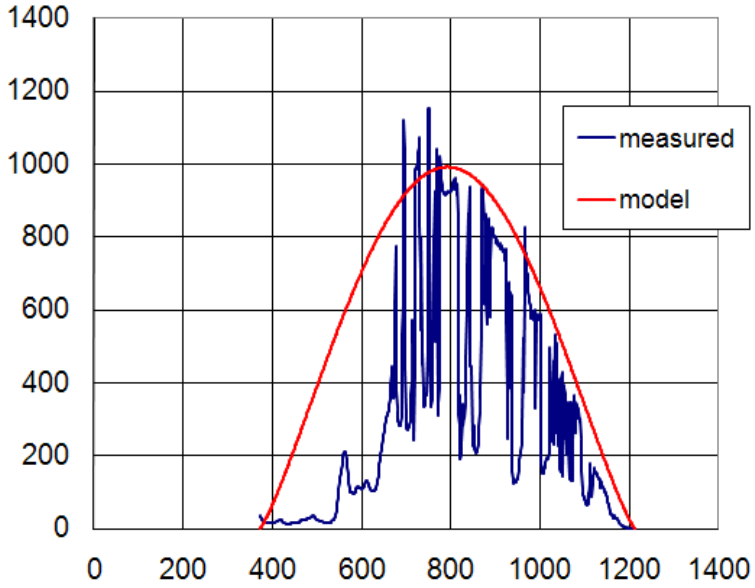
$95
U12-006
4 External Channels
- AC Current
- AC Voltage
- 4-20mA
- DC Voltage
- Temp
- CO_2

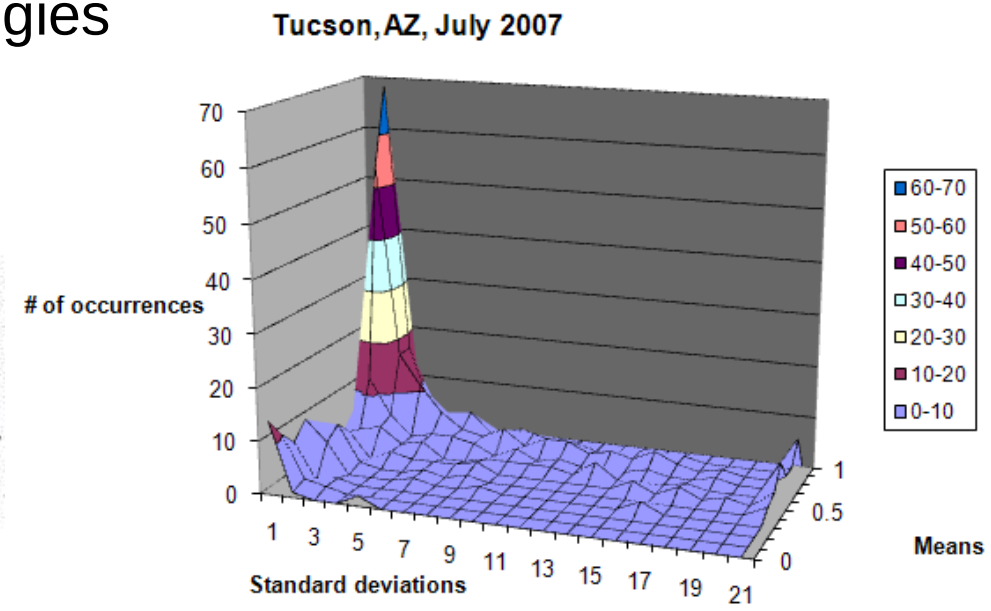
Defining the Science: Outcomes

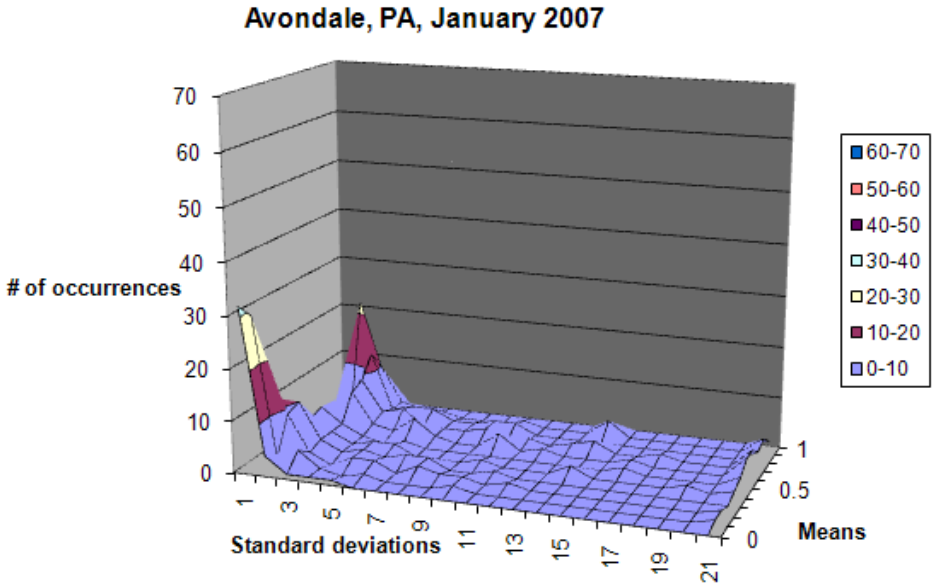
- Characterize insolation patterns, especially as related to cloud patterns and major aerosol and air quality events.
- Sufficient data to construct seasonal cloud climatologies.
- Provide reliable local data for implementing solar technologies.
- Use two as reflectometer for surface albedo, VIS/near-IR version for NDVI (still very inexpensive)

Constructing Cloud Climatologies with Pyranometer Data









Defining the Collaboration: Project Structure

- Centralized and ongoing science oversight to ensure data quality.
- Permanent data repository.
- Project personnel are required to ensure ongoing data collection at school sites (e.g., when schools are not in session).

Defining the Collaboration: Cost

- Cost to establish a site is not large, depending on physical characteristics (<$100?).
- Basic instrumentation costs for pyranometer, data logger, temperature sensor (optional) <$150. Redundant instrumentation is desirable to ensure a continuous data record.

Defining Education: Audience

- Middle/secondary school, possibly upper elementary (see typical Earth science texts and curriculum)
- Insolation is a fundamental part of understanding “Earth’s radiative balance.”
- Requires basic computer skills with spreadsheet software.

Defining Education: Implementation

- A site that is accessible to students, with a good view of the horizon.
- The project takes no more than half an hour per week for basic sustained implementation.
- Data are submitted to a central repository and also saved onsite (in text format) for use by students.

Defining Education: Meeting Student Needs

- Provides a window into understanding Earth's radiative balance, and provides a sense of data ownership.
- Helps students understand seasons and the effects of clouds. (Correct widely held misconceptions?)

Defining Education: Meeting Teacher Needs

- Provides professional development opportunities to reinforce concepts about the sun's role in weather, climate, and a sustainable energy future. (Sometimes teacher misconceptions will need to be addressed, too!)
- A simple protocol minimizes the need for "hands on" training.
- Science support is required to help teachers interpret data.

Defining Education: Standards

- Meets process and content standards for STEM curriculum.
- Directly relates to an Earth science curriculum.
- Learning about the role of solar energy in a post-fossil fuel energy future.
- Provides opportunities for inquiry-based learning linked directly to interesting science results.

Defining Education: Outcomes

- Teachers and their students have a sense of data ownership that leads to an accurate fact-based understanding of the sun's role in Earth's weather, climate, and a post-fossil fuel energy economy.
- Opportunities for building and calibrating instruments provide unique opportunities for STEM education that will inform students about what Earth/climate scientists do and about the career choices that are available.