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# 2008 Solar Annual Review Meeting

## Solar Resource Characterization

**Session: Modeling and Analysis**

**Company or Organization: National Renewable Energy  
Laboratory**

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Presented at the Solar Energy Technologies Program (SETP) Annual Program Review Meeting held  
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# Budget and Solar America Initiative Alignment



<b>Project Beginning Date</b>	<b>FY07 Budget</b>	<b>FY08 Budget</b>	<b>Total Budget</b>
PV: 10/1/06	\$420K	\$580K	\$1,000K
CSP: 10/1/07	\$75K	\$650K	\$725K

- This project supports the Solar America Initiative by:
  - Meeting increasing demands for expertise in and products on solar radiation data and models
    - Production and distribution of reliable, accurate domestic and international solar resource data
    - Benchmarking and cross-comparison of solar irradiance models
    - Coordination with the international community (IEA/SHC Task 36, WMO)
  - Reducing data uncertainties and increasing temporal and spatial data resolutions
  - Developing and testing short term solar resource forecasts
  - Evaluating methods for producing long term data sets from short term observations
  - Conducting measurement activities at selected sites

# Project Overview



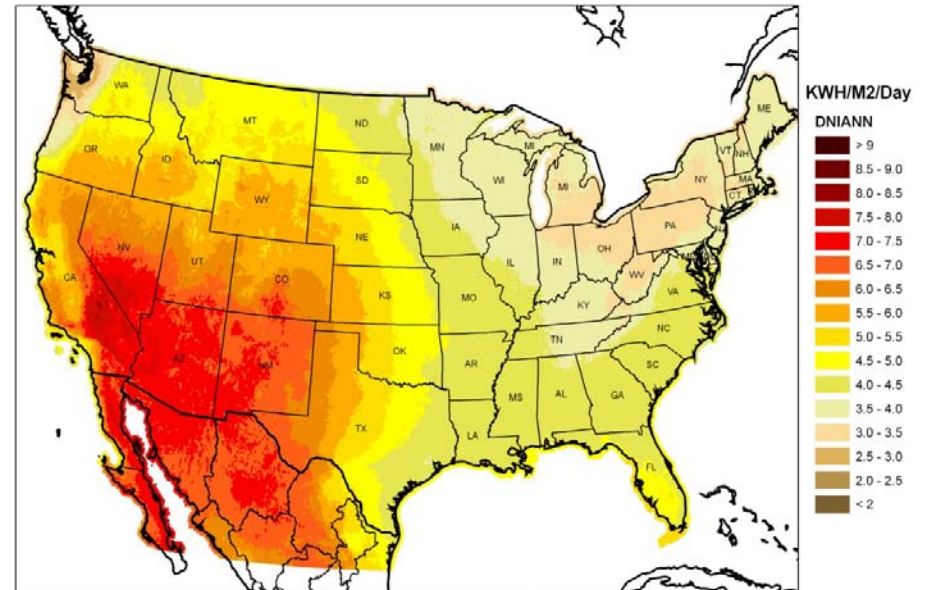
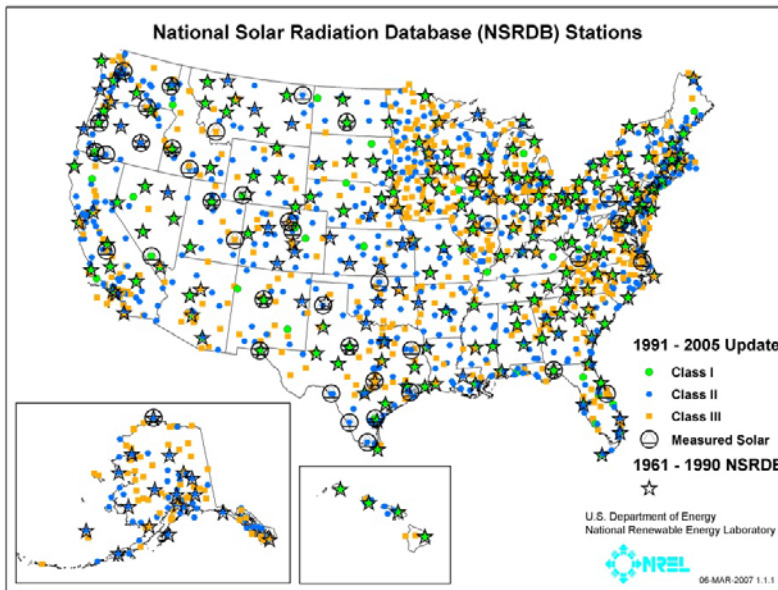
- Addresses several key requirements:
  - Demands for reliable, site-time specific solar resource and weather data
  - Short-term solar forecasts Tools to extrapolate short term data sets to long term records
  - Improved understanding of interannual solar resource variability
  - Measured data to support project deployments
  - Geospatial analysis of solar resource data, especially as inputs to analytical tools
  - Improved data accessibility
- In FY08 Solar Resource Assessment is co-funded by PV and by CSP, with additional plans for support from grid-integration studies
- Also in FY08, Solar Resource Characterization has been combined with Metrology

# FY08 Major Activities and Milestones



AGREEMENT	ACTIVITY	FY08 FUNDING	MILESTONE	STATUS
Solar Resource Characterization (ID: 15153)	Solar Resource Forecasting	\$160K	36374: Complete a test and validation of a solar resource forecasting application (Level 5)	Sept-08
	Solar Resource Data Products and Product Development	\$390K	Status report on methodologies for improving solar resource spatial and temporal resolutions (Level 5)	Sept-08
	GIS Applications for Decision Support Systems	\$30K		
CSP Resource Assessment (ID: 16728)	Annual DNI and Resource Mapping and Data Outreach	\$50K	36440: Complete beta test version of an updated DNI resource web application providing access to time-series data, mapping of avg. DNI, and interannual variability of DNI for southwestern U.S. (Level 4)	Beta version completed March-08
	High Resolution Bankable Data	\$380K/\$155K = \$535K	36441: Deploy up to 12 weather and solar radiation meas. Stations at key locations designated by CSP (Level 5)	Sept-08
	Interannual Variability of the Solar Resource	\$90K/\$50K = \$140K	36442: Publish tech. report summarizing investigation of interannual variability of solar radiation (Level 5)	Sept-08

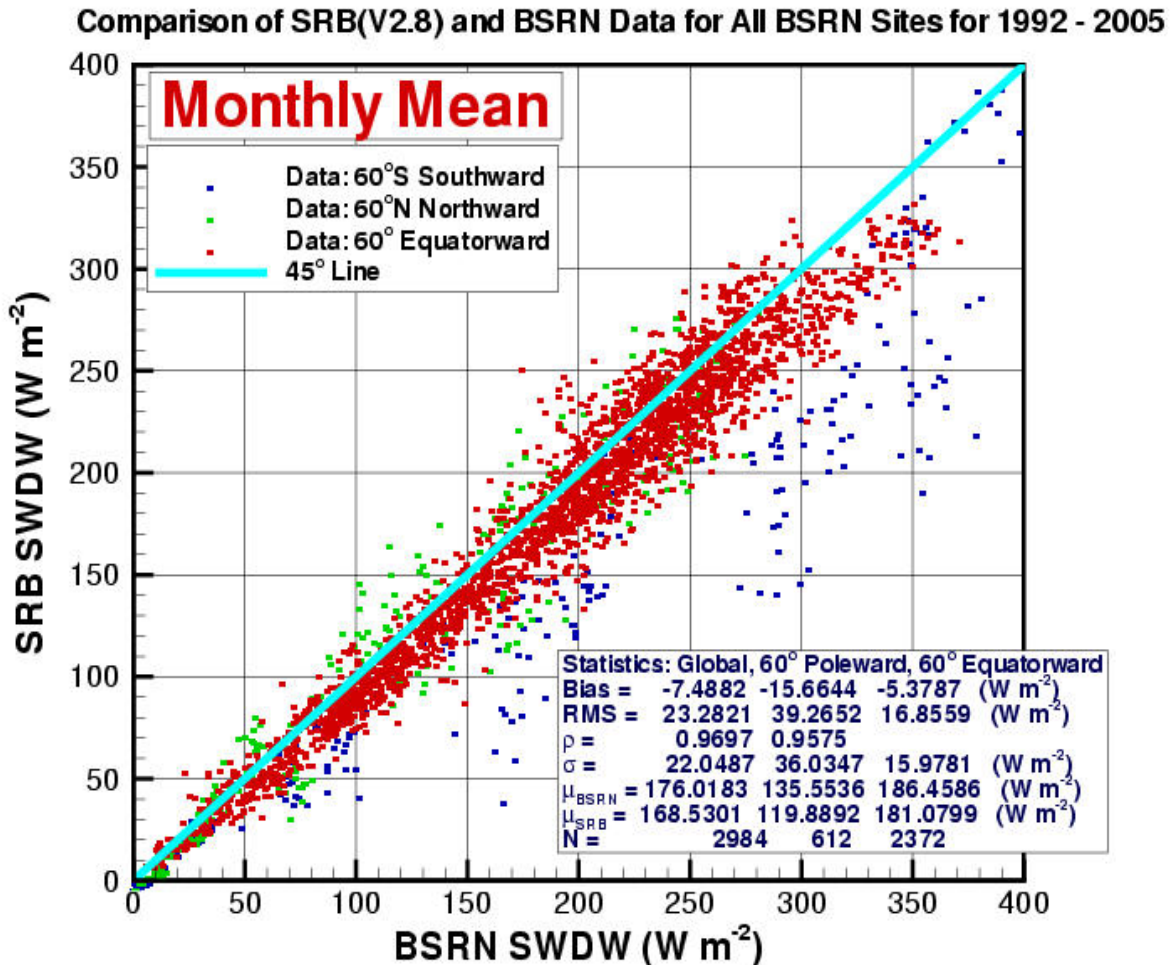
# NSRDB Update, 1991-2005: Released May 2007



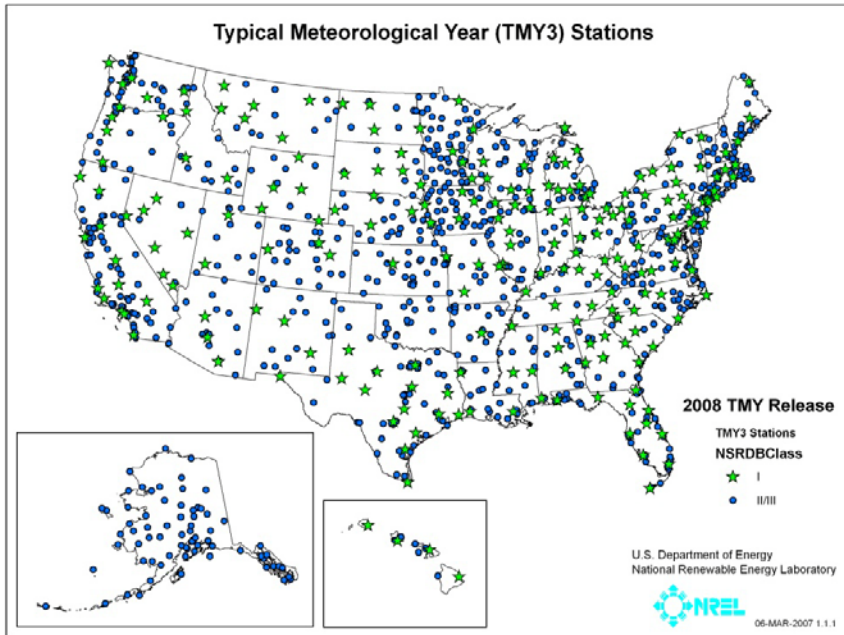
- 1454 Ground Stations
- 1991-2005
- Distributed by NCDC

- Gridded Satellite-Derived
- 10-km Resolution
- 1998-2005
- Provided by SUNY/Albany

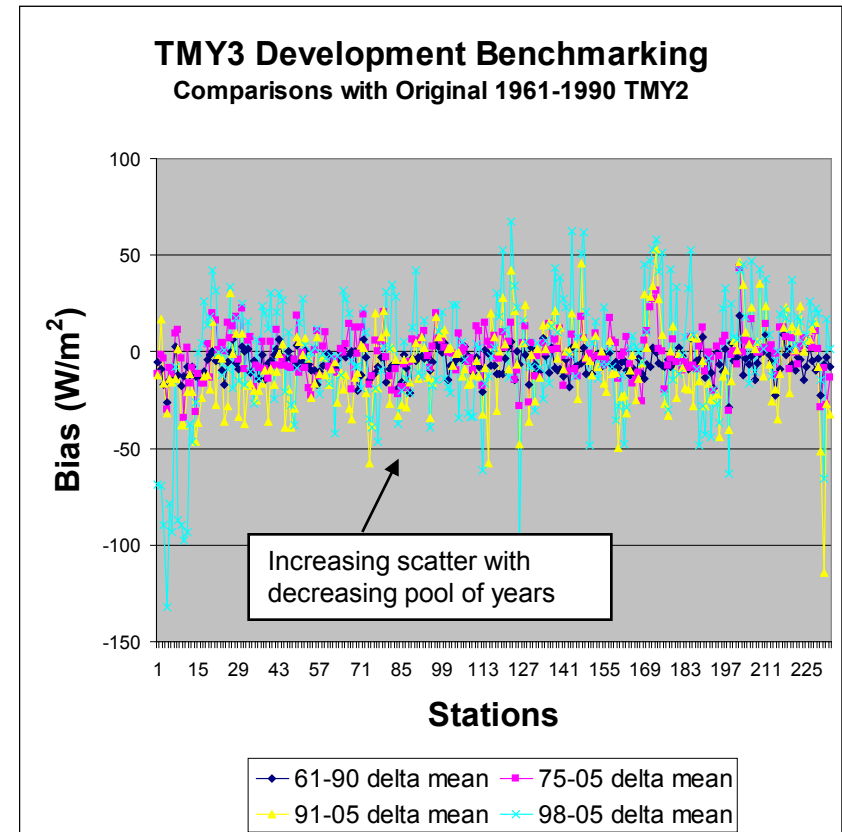
# Satellite-Derived Solar Data Benchmarking Activities under IEA/SHC Task 36: NASA Example



# Comparison of TMY3's for Various Yearly Spans with Original 1961-1990 TMY2



Source: Steve Wilcox and Ray George, NREL



Final TMY3's (about 1000 stations) to be released by end of April 2008.

# Beta Test Version of Solar Power Prospector: 1) Selection of grid cell



The screenshot shows the Solar Power Prospector (CSP) web application running in Mozilla Firefox. The browser title is "Solar Power Prospector (CSP) -- BETA - Mozilla Firefox" and the address bar shows "http://mercator.nrel.gov/csp/".

The application interface includes:

- Layers Panel:** A tree view on the left showing various data layers. Under "Solar Resources", "Average DNI (1998 - 2000)" is checked. Under "Slope Filters", "Less than 5% Slope" is checked. Other categories include Infrastructure, Hydrology, Land Ownership, Boundaries, and Base Data.
- Map:** A central map area displaying a grid of cells over a satellite-style terrain. A zoom box and navigation controls are visible on the left side of the map.
- Layer Information Panel:** A panel on the right showing "Active Layer: Solar DNI", a legend, an opacity slider set to 0.5, and a "Layer Description: Empty".
- Map Controls:** A "Zoom Box" with "Pan", "Query", "Download", and "Clear" options. A "Display Month: ANNUAL" dropdown is located at the bottom center of the map.
- Coordinates:** A "Permalink" box at the bottom right of the map displays the coordinates "115.61588, 35.64917".

The Windows taskbar at the bottom shows the Start button, several open applications (Inbox - Microsoft Out..., RE: CSP Site Testing..., Solar Power Prospect...), a search bar, and the system tray with the time "6:02 PM".



# Beta Test Version of Solar Power Prospector: 2) Download Tool, Appears Once Cell is Selected (5 years of data have been selected)



The screenshot displays the Solar Power Prospector (CSP) web application in Mozilla Firefox. The browser window title is "Solar Power Prospector (CSP) -- BETA - Mozilla Firefox". The address bar shows the URL "http://mercator.nrel.gov/csp/". A notification bar indicates "Firefox prevented this site from opening a popup window." The application interface includes a "Layers" panel on the left, a "Map" area in the center, and a "Layer Information" panel on the right. The "Download Window" dialog box is open, showing options to select formats (TMY Format, CSV Format) and years (1998-2005). The "Layer Information" panel shows the active layer as "Solar DNI" and a legend. The bottom of the browser window shows the Windows taskbar with various open applications and the system clock at 6:08 PM.

**Layers Panel:**

- Solar Resources
  - Average DNI (1998 - 200)
- Resource Classes
  - Slope Filters
    - Less than 1% Slope
    - Less than 2% Slope
    - Less than 3% Slope
    - Less than 4% Slope
    - Less than 5% Slope
- Infrastructure
  - Transportation
    - Interstates
    - US Highways
    - Rails
  - Hydrology
  - Land Ownership
  - Boundaries
    - States
    - Counties
    - Urban Areas
    - Cities
    - BLM Field Offices
  - Base Data
    - Shaded Relief
    - Satellite Imagery
  - Download
    - Download Grid

**Download Window:**

1. Select Formats:

- TMY Format
- CSV Format

2. Select Years

Available	Selected
1998	2001
1999	2002
2000	2003
	2004
	2005

Buttons: Submit, Close

**Layer Information Panel:**

Active Layer: Solar DNI

Legend:

Set Opacity: 0.5

Current Level: 0.5

Layer Description: Empty

# Beta Test Version of Solar Power Prospector: 3) Data Files Selected in Download Tool are Unzipped



The screenshot displays the Solar Power Prospector (CSP) application running in Mozilla Firefox. The browser window title is "Solar Power Prospector (CSP) -- BETA - Mozilla Firefox". The address bar shows the URL "http://mercator.nrel.gov/csp/". The application interface includes a "Layers" panel on the left, a central "Map" area, and a "Layer Information" panel on the right. The "Layers" panel shows a tree view with categories like "Solar Resources", "Infrastructure", "Hydrology", "Land Ownership", "Boundaries", "Base Data", and "Download". The "Map" area shows a satellite-style map with a red overlay representing solar resources. The "Layer Information" panel shows the "Active Layer: Solar DNI" and a legend. A "Download" button is visible in the map area. A "Filzip" file explorer window is open in the foreground, showing the contents of a zip file named "NREL\_SUNY\_data\_115053575.zip". The file explorer window title is "Filzip - NREL\_SUNY\_data\_115053575.zip". The file explorer window shows a list of files with columns for "Filename", "Type", "Size", "Packed", and "Ratio". The files listed are:

Filename	Type	Size	Packed	Ratio
radwx_115053575_2001.tn2.zip	Compress...	150,152	150,152	0%
radwx_115053575_2002.tn2.zip	Compress...	149,929	149,929	0%
radwx_115053575_2003.tn2.zip	Compress...	150,206	150,206	0%
radwx_115053575_2004.tn2.zip	Compress...	149,812	149,812	0%
radwx_115053575_2005.tn2.zip	Compress...	148,942	148,942	0%

The taskbar at the bottom shows the Windows Start button and several open applications: "Inbox - Microsoft Out...", "RE: CSP Site Testing ...", "Solar Power Prospect...", "Microsoft PowerPoint ...", and "Filzip". The system tray shows the search bar and the time "6:07 PM".

# Proposed Solar Monitoring Stations to Support Industry Deployments (CSP Program)



Industry participants fund equipment and station operations

NREL funds design, deployment, and data processing/archiving

Numerous requests for participation

## Tier 1 Station- Thermopile Radiometers

- 3 component measurements
- Lower uncertainty (1% to 3%)
- Optimal data QA

## Tier 2 Station- Rotating Shadowband Radiometer

- 2 component measurements (calculates DNI)
- Higher uncertainty (5% to 10%)
- Single pyranometer



Tier 1



Tier 2

# Project Update



<b>Planned work since last Program Review</b>		<b>Status</b>
↑	Release of 1991-2005 National Solar Radiation Database	May-07
↑	Complete 2007 IEA/SHC Task 36 Annual Report	Feb-08
↓	Initiate Solar Resource Forecasting Studies and provide preliminary validation results for western U.S.	Ongoing (PV, CSP)
↓	Release TMY3 data sets from new NSRDB	April 08
↓	IEA/SCH Annual Report on preliminary model benchmarking and solar resource forecasting results	Sep-08
↓	Develop enhancements to solar models, including an-house modeling capability	Ongoing (PV, CSP)
↓	Continue development of GIS and analytical tools for displaying and interpreting resource data	Ongoing (PV, CSP)
↓	Develop tools for extrapolating short term data sets to long-term and interannual data sets (CSP)	Sep-08
↓	Install up to 12 solar monitoring stations to support CSP industry deployments	Sep-08

Past

Future

# Out-Year Plans



- FY09:
  - Solar resource forecasting feasibility study
  - NSRDB updates (through CY 2008)
  - Production of 1983-1998 10-km satellite data using NASA's 100-km resolution data
  - IEA/SHC Task 36 reports on benchmarking of satellite-based solar resource techniques; solar forecasting methods
  - Improved customer interface to web-based data portals
- FY10:
  - Validation of high time/space resolution solar forecast methodology
  - Report on operational forecast tool(s)
  - Upgraded satellite-based solar resource methodology with improved AOD and terrain inputs
  - Completion of IEA/SHC Task 36 final reports
  - Web-accessible measurement data for new monitoring stations



- **Satellite-Derived Data are Now Being Developed by and for the Private Sector**
  - Commercialization activities limit availability of recent data for public distribution (i.e. 2006 and 2007 – probably 2008)
  - Affects ability to accomplish mission related to updating and distributing NSRDBs
- **Indicates dramatic increase in demand for solar resource data**
- **Solution**
  - Developing capability in-house
  - Exploring collaborations with NASA for global coverage