Solar Resource Assessment for the CSP Industry

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CONCENTRATING SOLAR POWER
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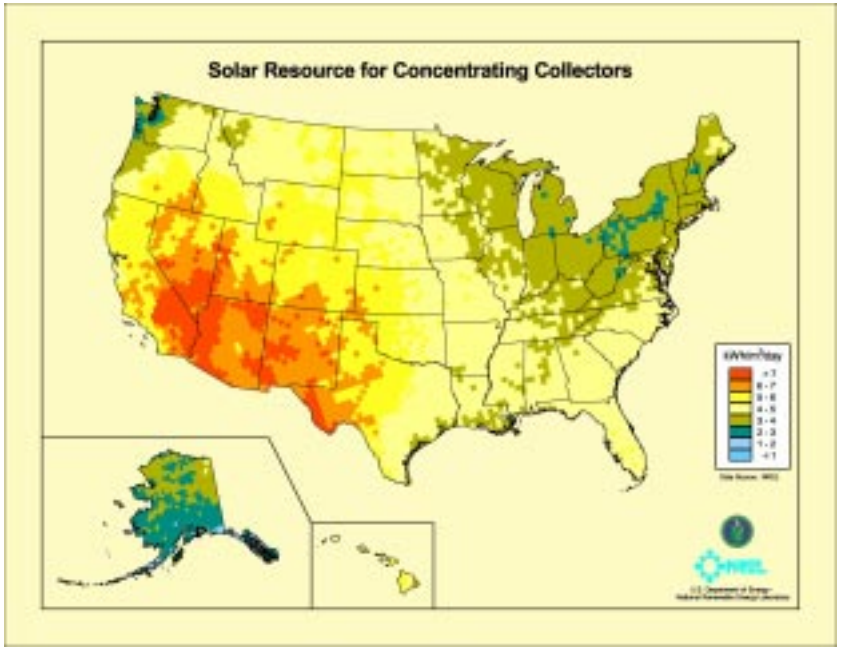
Background

- Objectives
  - Assist SunLab and U.S. industry with high quality direct normal insolation (DNI) data, regionally and at specific sites
  - Optimize resource evaluation and CSP facility siting processes through GIS
- Importance
  - DNI data of critical importance to industry for proper siting, performance assessment; however, measurements are limited and costly, and developing climatology through measurement activities requires many years
  - Many requests for DNI data (maps and station-specific data) are received from industry, government, public
  - Typical Meteorological Year (TMY) site-specific hourly time series DNI and weather data necessary for detailed CSP plant design
  - Improved spatial resolution, time series data, and model accuracy will enhance project viability and reduce costs

Approach

- Satellite-derived approaches for regional DNI mapping
  - NREL's Climatological Solar Radiation model
  - SUNY/Albany method (U.S.); Satel-Light (Europe)
  - Aerosol Optical Depth from climate research results using ground-based and satellite measurements
- Worldwide surface weather database used as input to model for site-specific hourly DNI
- Software for developing site-specific TMYs of DNI, temperature, and humidity
- Improved DNI measurement strategies (Augustyn+Co.)
- GIS analyses and data sets

Resource assessment integrates measurements and models using GIS analysis



GIS

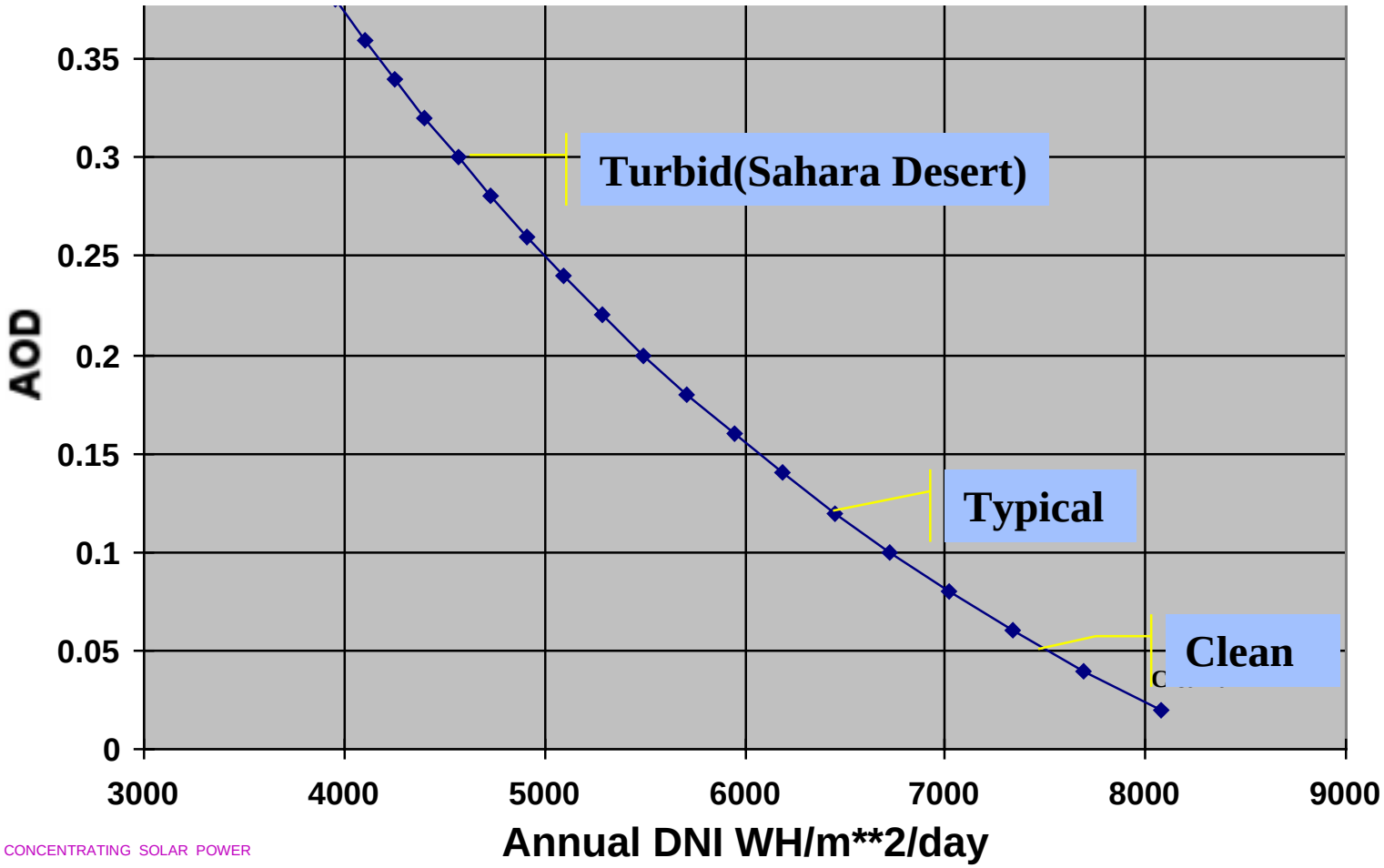
Measurements

Model Results

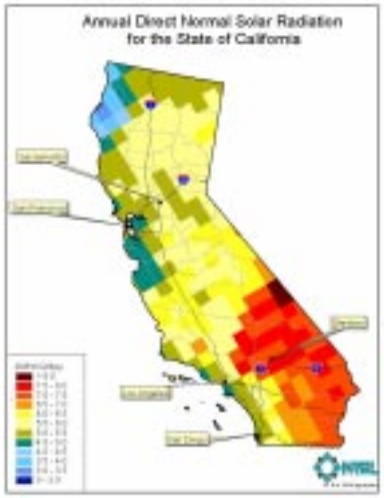
Status and Accomplishments

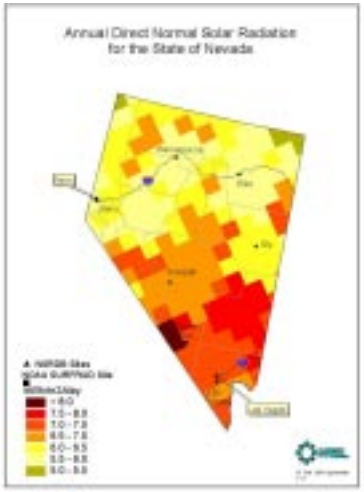
- Industry Assistance (FY01)
  - Resource mapping and data analysis for southern Spain
  - Nevada, California, Utah, Idaho, New Mexico resource maps
- R&D
  - Testing of U.S. high-resolution solar mapping techniques and Typical Meteorological Year (TMY) development using geostationary weather satellites over western hemisphere (SUNY/Albany)
  - Identification of new aerosol optical depth data sources
  - Improved measurement strategies (Augustyn+Co.)

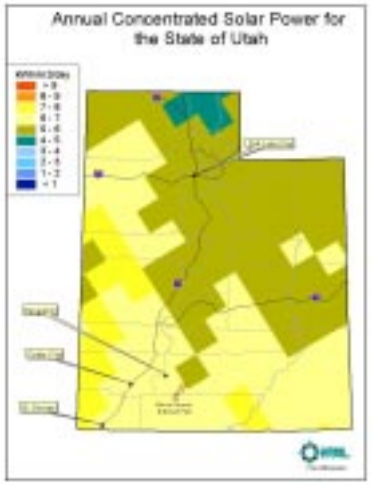
DNI Very Sensitive to Aerosol Optical Depth (AOD)

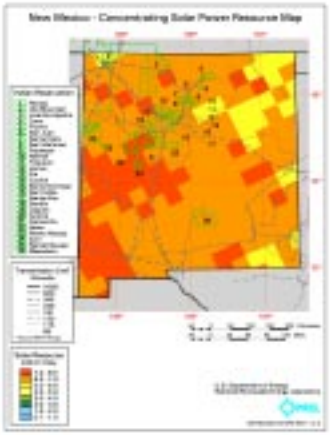


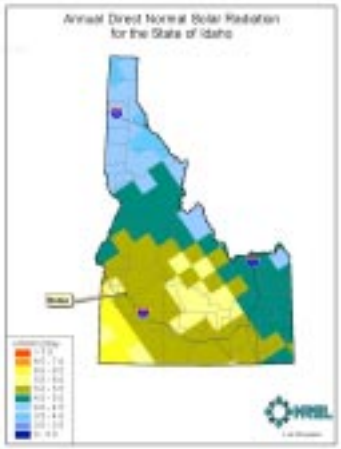
State-Specific Maps Produced on Request





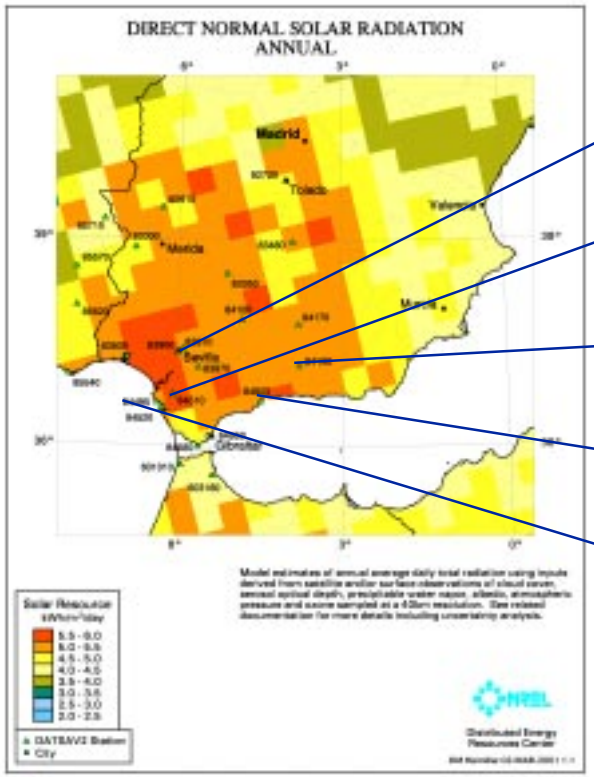






Resources Available to CSP Projects in Spain

Satellite Data



Sevilla: 5.3 kw-hr/m^2-day

Jerez: 5.2 kw-hr/m^2-day

Granada: 5.1 kw-hr/m^2-day

Malaga: 5.1 kw-hr/m^2-day

Cadiz Bay: 5.5 kw-hr/m^2-day

Improved Measurement Strategies*

Estimated Accuracy Improvements

(Clear sky DNI Uncertainties:)

	New	Old
Mid-day	**±5%**	**±10%**
High Zenith	**±60%**	**±300%**

Estimated Cost Improvements

New RSP: $8K

Traditional 3-component Thermopile: $30K

***Correcting for:**

- **-Angular characteristics**
- **-Spectral characteristics**
- **-Temperature**

Rotating Shadowband Pyranometers
At NREL's Solar Radiation Research Lab

Left: Original RSP (circa 1990)
Right: 2nd Generation RSP

High Resolution Solar Modeling Using GOES Satellites

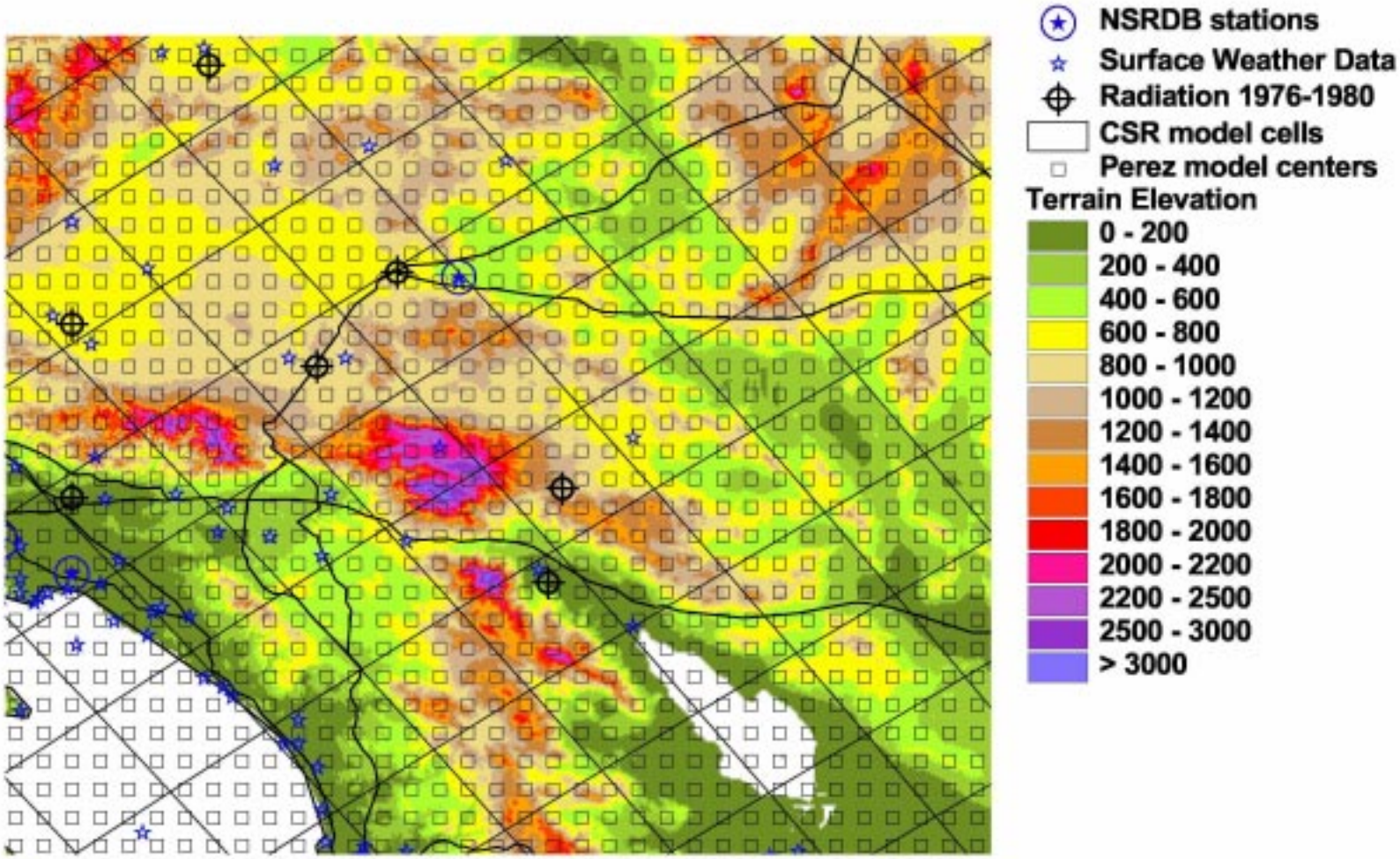
Trough USA Subcontract to SUNY/Albany (Perez)

- Improve DNI modeling capabilities of SUNY model.
- Model validation using measured DNI for U. S. climates.
- Will produce model outputs of DNI and GHI on 10km grid for select region of SW U.S. and NW Mexico.

Further SunLab work on Perez models

- Advanced Aerosol/Linke turbidity estimates
- Validation of time series of DNI from models, using ground measurements
- Creation of adjusted TMYs at each 10-km grid location

Multiple Data Sources for DNI Analysis



Issues and Opportunities

- Need stable funding source to allow R&D in improved time and space solar resource products
- Need to deploy high-quality DNI measurement hardware to assess critical gaps in our knowledge.
- Opportunities to leverage activities:
  - NCPV (ongoing)
  - United Nations Environment Programme's Solar and Wind Energy Resource Assessment Project (expected in FY2002)
- Opportunities to acquire improved aerosol data from current programs (e.g. NASA/ESE activities)
- Improvements in methodology are possible through stronger coordination with other program activities (e.g. RDI)