Surface meteorology and Solar Energy (SSE) Applications Project

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**CERES Science Team Meeting
January 23-26, 2001**
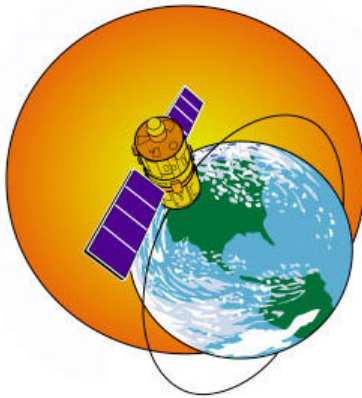
APPLICATION

USE OF NASA DATA FOR THE
PRELIMINARY DESIGN OF
RENEWABLE-ENERGY POWER
PLANTS (Solar, Wind, Small
Hydro, Biomass Burning and
Ground- Source Heat Pumps).

WHY?

LETTERS FROM DR. CREEDON AND MR. GOLDIN
EMPHASIZING COMMERCIAL APPLICATIONS.

(LETTERS TO "ALL HANDS" ABOUT 1996)

DATA DELIVERY METHOD

http://eosweb.larc.nasa.gov/sse/
(DATA TABLES & MAPS)

Surface meteorology and Solar Energy Data Set

A renewable energy resource web site
sponsored by
NASA's Earth Science Enterprise Program

- over 100 satellite–derived meteorology and solar energy parameters
- monthly averaged from 10 years of data
- data tables for a particular location
- color plots on both global and regional scales
- global solar energy data for 1195 ground sites
- data for the RETScreen® Renewable Energy Project Analysis Software

HIGHLIGHTS

Data Retrieval:

- Meteorology and Solar Energy
- Ground Site
- RETScreen Users

Supporting Documentation:

- Geometry
- Accuracy
- Methodology
- Parameters (Units & Definition)
- Related Web Sites
- Join SSE mailing list / Submit Questions
- Release Notes

Pictures courtesy of the DOE/NREL
Photographic Information eXchange.

Responsible NASA Official: Richard McGinnis
Site Administration: NASA Langley ASDC User Services
Site URL: http://eosweb.larc.nasa.gov/sse/
Last Updated January 8, 2001

SSE SUCCESS TO DATE

DATA CUSTOMERS

- U.S.: 551 FROM 46 STATES.
- INTERNATIONAL: 1388 FROM 94 COUNTRIES.
- REPEAT TO NEW RATIO = 25% TO 45% OVER PAST 6 MONTHS.

LARGER-SIZE CUSTOMERS

Duke Solar Power, DuPont, BP Amoco, Shell, Siemans Solar Industries, International Finance Corporation, the World Bank, UNESCO, UNEP, Winrock International, the Jet Propulsion Laboratory, the U.S. Department of Energy, the USDA Forest Service, and 79 educational institutions in the U.S.

WHY?

1. RENEWABLE'S TO PROVIDE 5 TO 10% OF WORLD ENERGY BY 2025 AND 50% BY 2050[1].
2. PHOTOVOLTAIC MARKET GROWING AT 25% PER YR.
3. WIND TURBINE SALES GROWING AT 40% PER YR.
4. SOLAR-THERMAL AND BIOMASS PLANTS TO BE ECONOMICAL BY 2010.
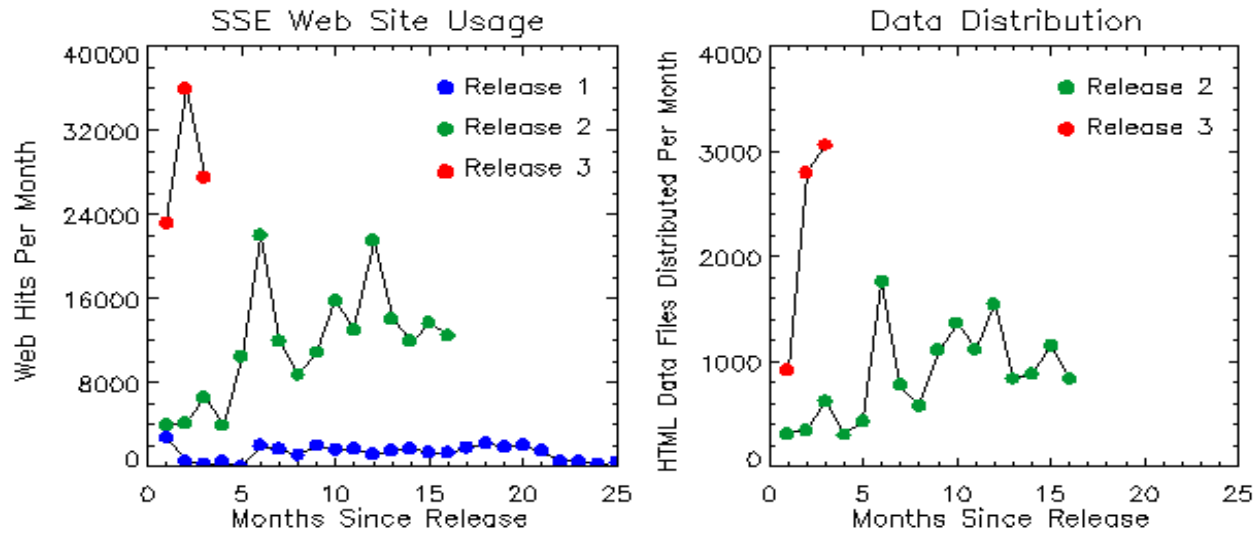5. HYBRID-SYSTEM DESIGN PROCEDURES[2] BECOMING MORE ACCURATE.

NOTE:
[1] Oil industry estimates.
[2] Three international design programs are already using NASA SSE data for input.

SSE METRICS

- RELEASE 1 = ENERGY INDUSTRY RESEARCH PARTNERS.
- RELEASE 2 = ENERGY INDUSTRY SMALL BUSINESS PARTNERS.
- RELEASE 3 = ENERGY INDUSTRY DESIGN/ECONOMICS PARTNERS.

WEB SITE PERFORMANCE

MONTHLY AVERAGES	RELEASE 1	RELEASE 2	RELEASE 3
WEB SITE HITS	1,278	12,533	29,000
DATA DOCUMENTS DOWNLOADED	59	873	2267

RELEASE (2 + 3) SUMMARY: (20 MONTHS)

HITS = 279,000
DATA DOCUMENTS DOWNLOADED ~ 20,000

SCIENCE AND COMMERCIAL PARAMETERS

SCIENCE   **- SYNTHESIZED TO ->**   **COMMERCIAL**

(5+ Yr Time Histories)   (Mult-Yr Avg, Max, Min, Mid-Day, Accum-Day, Etc.)

RADIATION & CLOUDS:	RAD & CLD:	TEMPERATURE:	OTHER:
TOA & Surf SW Down	Tot/Diff/DirN SW	10-m Air T	10-m Rel H
Cloud Fraction	Daily Accum SW Deficits & Surplus	Earth T Avg, Max, Min, Amp	Air Press
Surf Albedo		Number Frost Days	10-m Sp H
Surf Vegetation	Equivalent SW Black Days	Heating Deg Days	Surf & Col Prec H2O
Surf Altitude	Solar Geo. & SW @ 8 Times/Day	Cooling Deg Days	10-m Wind Vel
	Clr-Sky SW	Dew Pt	10-m Wind Dir
METEOROLOGY:	All- & Clr-Sky Clearness Index		10-m Wind Freq (6 Vel Ranges)
Surf Press	Cld Fraction & Number Clr Days		10-m Wind Dir (6 Vel Ranges)
Skin and 10-m Temp	Mid-Day SW		
10-m Wind U & V & Sp H			
Surf Roughness/vegetation Model Assumptions & Map			

RELEASE 3 SSE ACCURACY ESTIMATES

Parameter	Global sites WRDC	Global sites RETScreen	Renewable sites RETScreen
Solar Insolation (kWh/m^2/day)	14.2%	13.0%	
Near-Surface Air Temperature (K) (10-meter altitude)		< 243 K = 3.2% > 263 K = 1.1% linear variation between 243 K and 263 K	1.2%
Heating Design Temperature (K)			1.3%
Cooling Design Temperature (K)			1.4%
Summer mean daily design range (K)			0.9%
Heating degree-days below 18°C (degree-days)			14.6%
Relative Humidity (%)		15.3%	9.7%
Surface Air Pressure (kPa)		3.6%	2.4%
10-meter altitude Wind Speed (m/s)		1.9 m/s	1.4 m/s

SOLAR INSOLATION BIAS -2.0% $\leq$ +3.3% DEPENDING ON YEAR.

ON-THE-FLY SSE WEB SITE STRATEGY
(AFTER FORTRAN SYNTHESIS OF SCIENCE DATA)

SERVER INPUTS:

- **1,550 Meg for 114 SSE Parameters. (66,062 FILES)**

- **33 Meg of NREL/WRDC Ground Site Data.**

SERVER OPERATION:

- **PERL Software Calculation of 56 Additional SSE Parameters.**

- **ION Software Calculation of USER-DEFINED Data Plots and Regional Maps.**
  (SAVES CONSTRUCTION OF MILLIONS OF GRAPHICS IMAGES ON DATA UPGRADES)

- **PERL Software Calculation of USER-DEFINED HTML File Windows.**
  (SAVES CONSTRUCTION OF MILLIONS OF HTML FILES ON DATA UPGRADES)

WEB SITE OUTPUT: (Each 1-deg cell)

- **Digital Values for 149 SSE Parameters.**

- **Monthly Plots of Daily Data for 1195 WRDC Sites Over 30+ Years.**

- **Monthly Regional Maps for 61 SSE Parameters.**

- **108 SSE Parameters for RETScreen^{TM} Design/Financial Analysis Software.**

SSE LESSONS LEARNED

1. CONSTRUCT A COMMERCIAL PROTOTYPE PRODUCT.

2. GET OUTSIDE YOUR BOX.

3. WORK WITH END CUSTOMERS.

4. MAKE EASY-TO-USE DATA DELIVERY SYSTEM.

5. CONTINUALLY UPGRADE TO INCREASE DEMAND.