13.7 ENERGY DESIGN SOFTWARE USING NASA METEOROLOGY AND SOLAR ENERGY DATA

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1. INTRODUCTION

NASA's Prediction of Worldwide Energy Resource (POWER) Project is developing data sets from Earth Science Enterprise research to support design software from Energy sector industries. One such data set is the Surface meteorology and Solar Energy (SSE) data set (Whitlock et al, 2000). The SSE data set is a 10-year global climatology (1983-1993) of satellite-derived insolation and meteorology data on a one-degree latitude by one-degree longitude grid. It contains solar parameters principally derived from satellite observations and meteorology parameters from an atmospheric model constrained to satellite and sounding observations. There are parameters for sizing and pointing solar panels, solar thermal applications, and energy-storage systems. Information is also provided for clouds, temperature, humidity, and wind (Figure 1) parameters.

Local climatological data from ground measurement stations are a useful asset for renewable energy projects. The global coverage of the SSE data set fills the gap for remote locations lacking ground measurement data. Most ground measurement stations are located near populated regions that may have natural or urban influence on the local climate. The SSE data set, averaged over a one-degree latitude by one-degree longitude grid, can augment ground measurement data affected by microclimates. The SSE data are considered accurate for preliminary feasibility studies of renewable energy projects. This paper will discuss collaboration with renewable energy industry partners that resulted in co-developed applications for easy insertion of the SSE data into renewable energy design software.

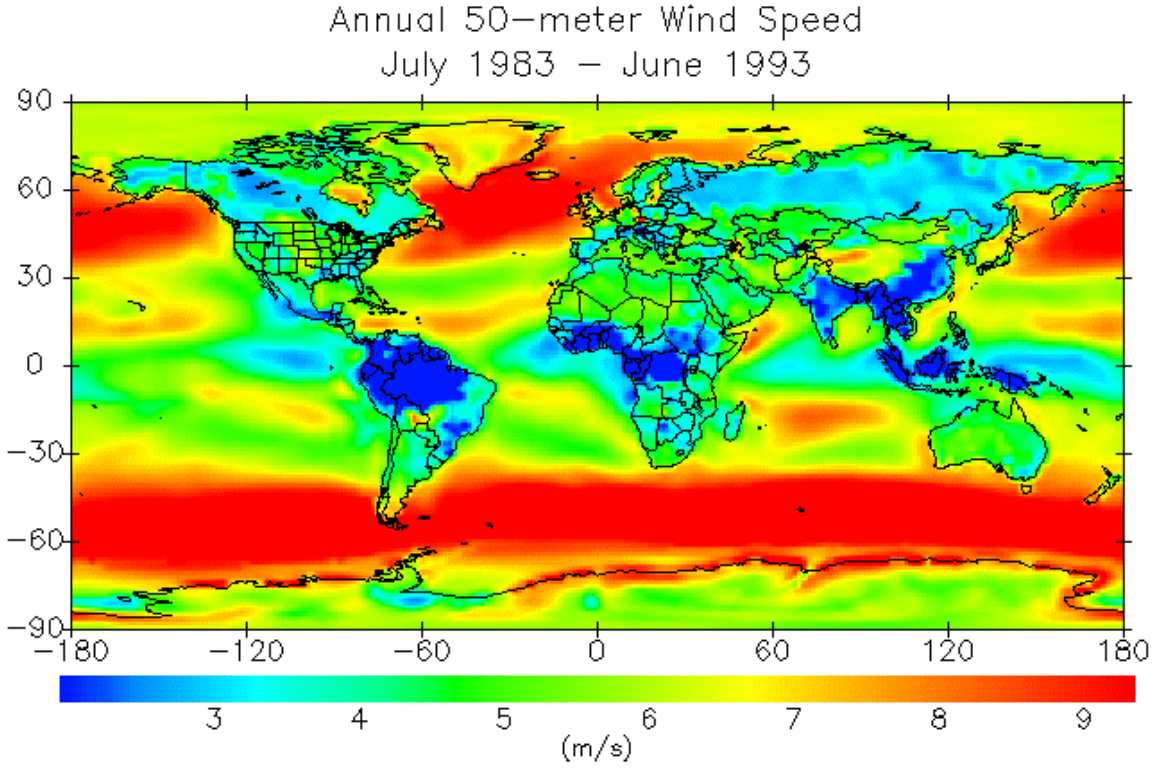

Fig. 1. Annual 50-meter Wind Speed.

2. SSE WEB SITE HISTORY

The first release of the SSE data set became available via the Internet in 1997. The SSE data was presented in a scientific style using static documents and graphics.

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Release 2 of the SSE web site (1999) was revised to speak the language of the renewable energy industry. We enlisted the help of several industry partners to advise about additional useful parameters and to simplify the presentation of the data. Upon their recommendations, the SSE web site was redesigned. Users could select just the parameter data tables and definitions of interest to them. Other revisions to the web site were the addition of new data types calculated on the fly from parameters in the database, an application to plot the average daily global radiation for 1195 ground sites from the 30-year World Radiation Data Centre data set, and the first application designed to provide data directly to a renewable energy assessment tool called RETScreen® International (RETScreen, see section 4).

3. SSE WEB SITE TODAY <http://eosweb.larc.nasa.gov/sse/>

Release 4 of the SSE data set and web site (2002) has grown to provide more than 150 monthly averaged solar energy and meteorology parameters. A user-friendly interface delivers all web documents on the fly. Users can access data by entering a particular latitude and longitude location, or panning on an image of the globe and zooming into the area of interest. Data selection is grouped by their most probable application. Users can select just the parameter data tables of interest to them. Parameter definitions can be displayed below their respective data tables. Four new applications have been included (Figure 2).

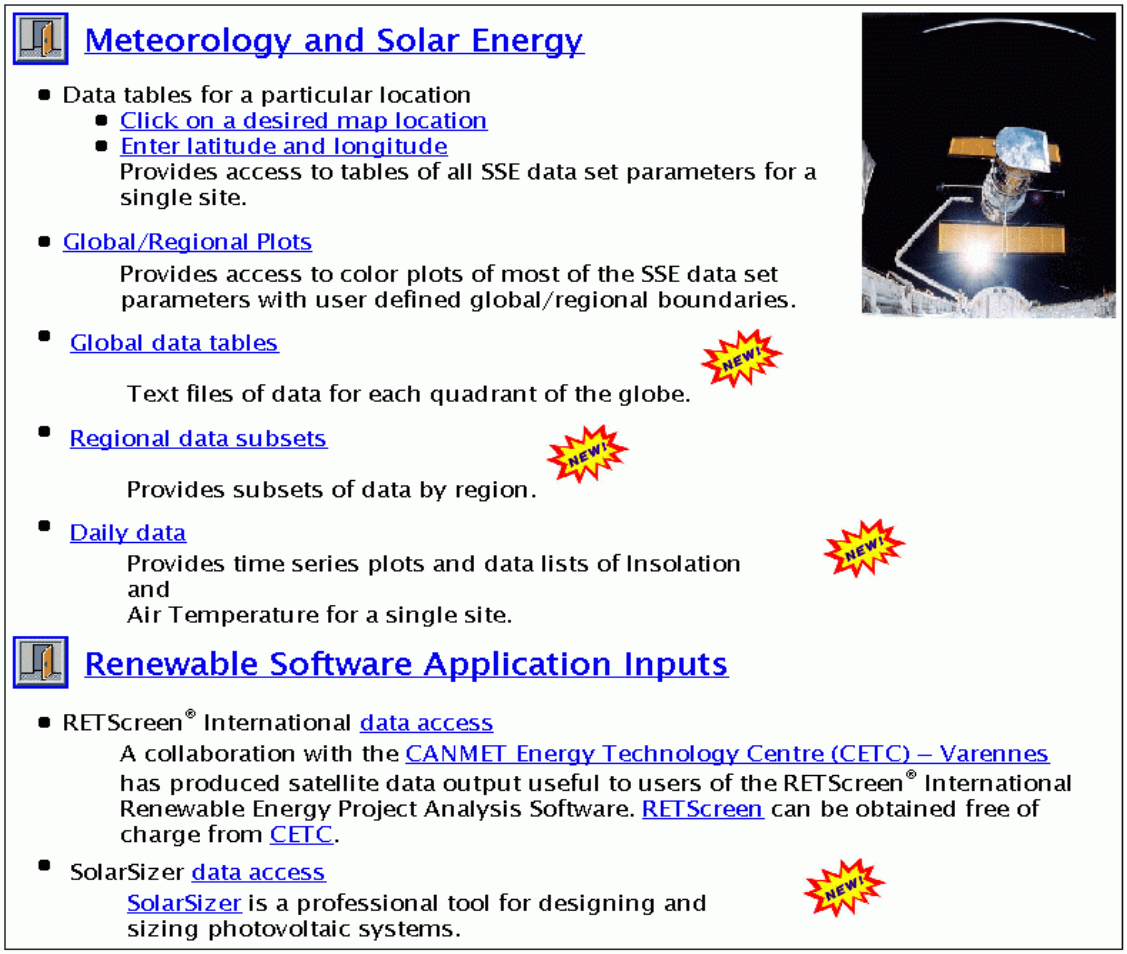

Fig. 2. Web site snapshot showing new applications.

Dynamic data mapping and graphical location selection were introduced in Release 3 of the SSE web site (2000). The underlying database was redesigned to store data for global maps and expanded to include over 100 parameters. This redesign allowed users the freedom of displaying global maps of monthly averaged parameters or zooming in on any region as small as six by six degrees of latitude and longitude.

SolarSizer (see section 5) is the first photovoltaic system design software that queries an SSE application and receives data without the user actively using a web browser.

The specialized applications for RETScreen and SolarSizer allow quick insertion of SSE data. They rely on the standard SSE database and provide navigation to the full suite of information on the SSE web site.

Additional resources on the SSE web site include accuracy, methodology, related web resources, usage statistics and a form for submitting questions.

4. RENEWABLE ENERGY PROJECT ANALYSIS

Within a year following the implementation of web based access to the SSE data set we were approached by the developers of RETScreen, a renewable energy project analysis software tool developed by Natural Resources Canada's CANMET Energy Technology Centre (CETC) - Varennes (Leng et al, 2002). Collaboration ensued, resulting in an SSE web application designed to meet the specific needs of RETScreen. Cooling and heating design temperatures, heating degree days and average summer daily temperature range are a few of the new parameters calculated and presented in a format that may easily be inserted into RETScreen (Table 1). Each model requires one to six of these parameters.

RETScreen offers two options for inserting insolation and weather data into the RETScreen models. Data from the RETScreen weather database may be pasted into the RETScreen models with the press of a button. Drop down menus provide a selection of more than 1,000 locations of ground monitoring stations worldwide. This is useful if the project is located near one of those stations.

The second option is to use NASA satellite-derived data. This is useful if the project is located away from any ground monitoring stations. RETScreen menus (Figure 3) and worksheets offer multiple paths to the SSE data.

Table 1. RETScreen Models and SSE Parameters

RETScreen Models	SSE daily, monthly and/or annual average values
Wind Energy Small Hydro Photovoltaics Solar Air Heating Biomass Heating Solar Water Heating Passive Solar Heating Ground-Source Heat Pumps	Horizontal solar radiation Wind speed Atmospheric pressure Relative humidity Ambient temperature Heating degree-days Heating design temperature Cooling design temperature Summer daily temperature range Frost days Earth (skin) temperature Annual earth (skin) temperature amplitude

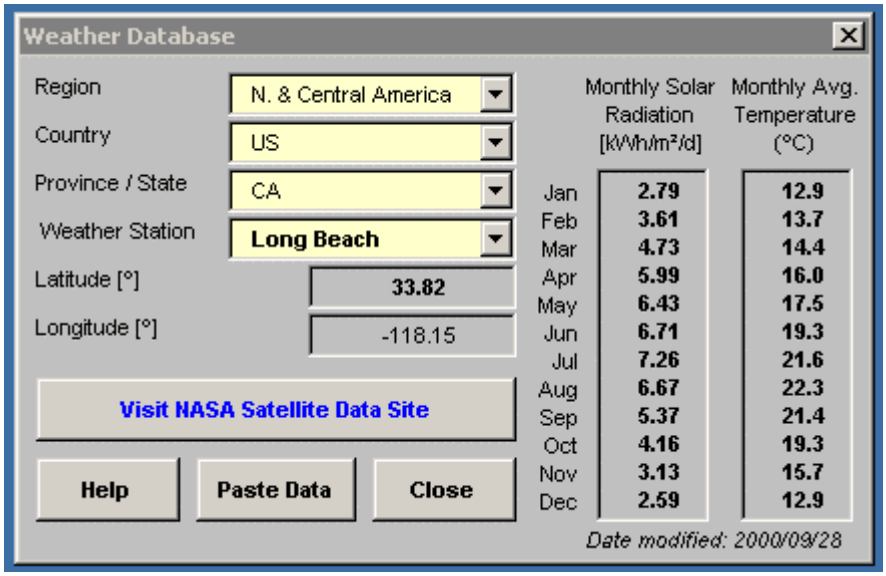

Fig. 3. One of several options for inserting data into RETScreen Models.

RETScreen is a series of Microsoft® Excel workbooks and worksheets. A user must have an Internet connection and browser to find the appropriate data on the SSE web site. Although the data tables are presented in horizontal rows by parameter type (Figure 4), simple clipboard cut and paste methods allow replacement of the RETScreen worksheet entries.

group wishes to partner with more smart building, wind power and solar energy software developers that would benefit from NASA global climatological resources. Support for other design tools that are in use or under development today would be welcome additions to the SSE suite of web applications.

NASA Surface meteorology and Solar Energy

RETScreen Data

Latitude 33.79 / Longitude −118.16 was chosen.

RETScreen Model(s) chosen:
Solar Air Heating

Average Daily Radiation on Horizontal Surface (kWh/m²/day)

Lat 33.79 Lon −118.16	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
10 Year Average	3.13	4.16	5.00	6.35	6.89	7.04	6.97	6.50	5.79	4.30	3.49	2.78

Average Temperature (°C)

Lat 33.79 Lon −118.16	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
10 Year Average	10.0	11.0	12.0	14.0	15.9	18.4	21.0	21.4	20.1	17.4	13.0	10.0	15.4

Average Wind Speed at 10m (m/s)

Lat 33.79 Lon −118.16	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
10 Year Average	4.86	4.86	4.87	4.83	5.05	4.80	4.30	3.97	3.98	3.88	4.69	4.80	4.57

Fig. 4. SSE web site data for a RETScreen Model.

5. PHOTOVOLTAIC SYSTEM DESIGN

Concurrently, several potential users suggested additional useful parameters and web site content. Among them were Solar Energy International and the Center for Renewable Energy and Sustainable Technology (CREST). The developers of SolarSizer, CREST's professional tool for designing and sizing photovoltaic systems, wished to design new modules that could directly use the SSE data set (Olson and Woods, 2001). We co-developed applications on the SSE web site and in SolarSizer. The latest version of SolarSizer ingests time series and monthly averaged insolation data from the SSE web site when those data types are required.

6. FUTURE

RETScreen and SolarSizer have become integral SSE web site applications. The POWER project

7. REFERENCES

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