SOLAR SPECTRUM

Newsletter of the Resource Assessment Division

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United Nations Environment Programme's Solar and Wind Energy Resource Assessment (SWERA) Project Launched

by Dave Renné and Richard Perez

During this past summer the SWERA project became fully implemented. The objective of this project is to develop versatile solar and wind resource data for selected developing countries.

Funds began to flow from the UNEP Headquarters in Nairobi to a number of international organizations. In the U.S. the technical organizations involved in SWERA are the National Renewable Energy Laboratory, the Atmospheric Sciences Research Center at the State University of New York (SUNY)-Albany, and the UNEP/U.S. Geological Survey Global Resource Information Database (GRID) Center in Sioux Falls, South Dakota. In addition, a number of U.S. subcontractors will be engaged to support the activities of these technical organizations.

Other agencies from around the world that also have major technical roles in SWERA are the Riso National Laboratory in Roskilde, Denmark, the German Aerospace Center (DLR) in German, the TATA Energy Research Institute in New Delhi, India, and the Brazilian Space Agency (INPE) in Sao Jose dos Campos, Brazil.

SWERA will provide high quality and reliable solar and wind energy resource data sets and maps to 13 developing countries that were chosen by UNEP during the project planning process. These countries are Guatemala, Honduras, Nicaragua, El Salvador, Cuba, Brazil, Ghana, Ethiopia, Kenya, China, Nepal, Bangladesh, and Sri Lanka. The data sets will be output into Geographic Information Systems (GIS) format and then incorporated into UNEP's GRID archive in Sioux Falls. Simple tools will be created so that users can access, manipulate and customize the data outputs for specific applications.

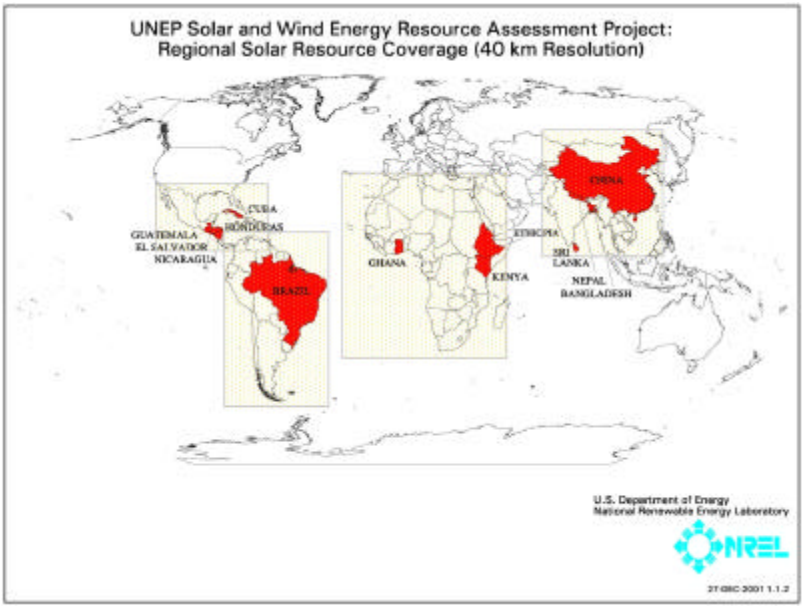

Fig. 1. *Map of countries participating in the UNEP's program*

NREL is playing a lead role in this activity in several key areas by developing: 1) regional climatological (monthly and annual) solar resource data and maps using the 40-km resolution cloud cover data (Real-Time Nephanalysis) provided by the National Climatic Data Center, 2) solar resource time series and Typical Meteorological Year data for a number of select ground stations within each of the countries; 3) high-resolution (1-km)

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Inside This Issue

Solar Spectrum is the newsletter from the Resource Assessment Division of the American Solar Energy Society and is published on a semi-annual basis. The purpose of this newsletter is to inform division members of events in the resource assessment field and activities of the division and its members.

Success of the newsletter depends on your contributions.

You are encouraged to send comments, letters, or short articles to the Editor:

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I would like to thank Dave Renné, Joe Michalsky, Richard Perez, and Tom Stoffel for their contributions to this newsletter.

Deadline for contributions to the next newsletter is February 1, 2003.

Frank Vignola

Resource Assessment Division Officers & Board Members

Frank Vignola, Chair
Gary Vliet, Vice Chair
Gary Vliet, Secretary

Ray Bahm	June 2001
Mark Beaubien	June 2002
Doug Balcomb	June 2002
John Dunlop	June 2002
Dan Greenberg	June 2001
Bill Marion	June 2001
Rob Nelson	June 2001
Richard Perez	June 2002

Upcoming Events

America's Secure Energy
June 21-26, 2003
Austin, Texas
Information: ASES
2400 Central, G-1
Boulder, CO 80301
Tel 303-443-3130
Fax 303-443-3212
Email: ases@ases.org
http://www.ases.org

ISES World Congress
June 14-19, 2003
Göteborg, Sweden
Dr. Jan-Olof Dalenbäck
Information: ISES 2003 World Congress, c/o Building Services Engineering, Chalmers University of Technology
Se-4129 Göteborg, Sweden
Fax: +46 31 772 1152
Email: jod@vsect.cchalmers.se
http://www.congrex.com/ises2003

RAD Division Officers and Board—In transition

The division of ASES are undergoing reorganization. See note on the RAD division meeting at ASES 2002.

Thanks should be given to Roberta DiPasquale of NASA Langley/SAIC Surface Solar Energy Project for her efforts with the Solar Spectrum and serving as Vice Chair. In addition, thanks should be given to David Rennè of NREL who has severed as Secretary for several terms.

At the 2002 Annual meeting, Frank Vignola was appointed Chair of the Division to fill the term vacated by Roberta DiPasquali. Gary Vliet then was appoint Vice Chair and also volunteered to be Secretary.

Discussions were held on the status of board members and whether it was appropriate to nominate or appoint interim board members until the bylaws of the reformed Resource Assessment Division are approved.

Attend the 2003 RAD division meeting to learn about the status.

Email Addresses for Resource Assessment Division Members

In order to open communications between RAD division members, the following members circulated their Email address at the RAD division annual meeting. If you are not on this list and would like to add your name to the list, contact Solar Spectrum's editor and your Email address will be added to the list and published in the next newsletter.

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John Dunlop	JRDunlop@IGC.org
Eppley Laboratory Inc.	eplab@mail.bbsnet.com
Tracy Gardner	tgardner@nrel.nrel.gov
Jack Garrison	jgarriso@sciences.sdsu.edu
Chris Gueymard	chris@fsec.ucf.edu
Bill Marion	bill_marion@nrel.gov
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Cecile Warner	cecile@nrel.nrel.gov

Resource Assessment Division (RAD) Meeting Minutes

June 17, 2002

Reno/Sparks, Nevada

by Dave Renné, Secretary

In attendance: Robert Cable, Daryl Myers, Donald Brown, Richard Perez, Dave Renné, Frank Vignola, Gary Vliet.

The meeting was called to order by the Division Chair, Bob Cable. We started with introductions and general discussions. Gary Vliet discussed the annual conference to be held in Austin next year. Donald Brown works for SAIC, a contractor to NASA, and is involved in the Surface Solar Energy database program.

We discussed the purpose of having a Board for the Division. It was noted that Board members can write letters to reflect the interests of the Division. However, it was also pointed out that the Division needs new members, not just Board members.

Joint Division meetings, such as the one held last year in DC, would be useful to promote the Society's cross-cutting activities.

Because Roberta DiPasquale has left the Division, there was a need to re-appoint the Chair-elect. A motion was made and passed to appoint Frank Vignola to the position of Chair, and to appoint Gary Vliet to be the Chair-elect. Gary will also serve as Secretary for the next year.

As Chair-elect, Gary will solicit articles for the Solar Spectrum. The deadline for articles is September 15. The minutes of the RAD meeting shall be published in the next issue of the Solar Spectrum. We agreed that Dave and Richard will submit an article on the UNEP/SWERA project, and that Joe Michalsky will be asked to submit an article on the Ogden, UT atmospheric radiation meeting.

We discussed the possibility of submitting a Forum proposal for next year's conference. The deadline for proposals is December 2. One suggestion is to conduct a forum on high-quality instrumentation, addressing the needs of data users and data formats. This could also be put onto the NREL web site. Another suggestion is to visit an actual PV site, such as a TEAM-UP site.

Mail-in reviewers for the next conference will be Gary, Daryl, and Donald.

Dave, Frank and Jim will serve on a by-laws committee to review and recommend changes to the Divisions by-laws.

A Committee to develop a new name for the Division was established, and Dave, Richard and Frank will serve on it. This committee will propose changes to the Division's name by the Austin conference; the proposed change may be published in the Solar Spectrum prior to the meeting.

From the Chair

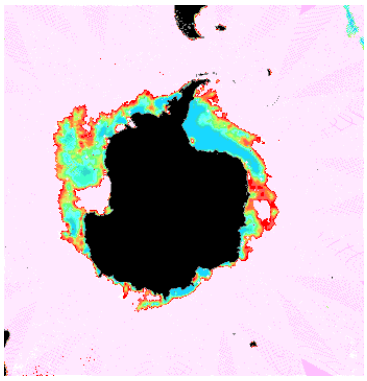
by Frank Vignola

If solar technologies are ever to contribute a significant portion to our nation's energy mix it is necessary to have sound resource information. As with most meteorological measures, it takes about 30 years to obtain statistically significant norms and variabilities. In other words, resource assessment require adequate sustained funding.

Resource assessment has diverse benefits to many users but no one user has a large enough direct interest to support the efforts necessary to maintain an adequate program. Therefore it is an appropriate activity for government support. If resource assessment activities are ever to get adequate funding, a champion is needed to spearhead the effort.

Almost 10 years ago there was a successful to adequately fund resource assessment. This effort just got underway when it ran into opposition. Situations have changed and it is again time to seek adequate funding. What is needed is for RAD division members to work as a group to persuade decision makers about the value of resource assessment.

As chair of the RAD division, I would like to coordinate this effort and am seeking information on decision makers who would be receptive to our concerns. Also, any RAD members who would like to participate in this activity, contact me at fev@uoregon.edu.

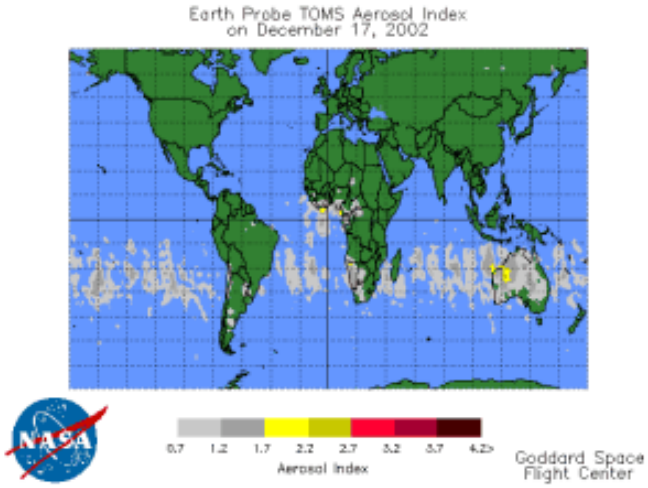


NOAA's Antarctic Sea Ice monitoring — January 2002
From: http://polar.wwb.noaa.gov/seaice/Historical.html#animate

Overview of American Meteorological Society's 11th Conference on Atmospheric Radiation June 3-7, Ogden, Utah

By Joe Michalsky

Monday's oral session dealt with aerosol radiative forcing mostly as measured during large field campaigns including ACE-Asia (India to Japan south to equator), SAFARI-2000 (southern Africa), and CLAMS (east coast of US). This is calculated by measuring difference in net solar (shortwave) flux (downwelling minus upwelling) at the surface and above most of the aerosol layer (there was very little in the stratosphere during these campaigns) and comparing to the cleanest conditions you can find for that site. Typical values were around -40 to -50 W/m-sq per unit optical depth, that is, the solar radiation that enters the atmosphere is reduced by that amount because of the presence of aerosols in the atmosphere. The other concern in these experiments was the measurement of the absorptive properties of the aerosols. Single scattering albedo (**ssa**) is the probability of a photon being scattered (rather than absorbed) upon collision with an aerosol particle. One can infer a **ssa** from measured radiation values or use an *in situ* measurement where aerosol is collected on a filter and then absorption is measured based on the change is transmission through the aerosol-coated filter. For moderate to heavy aerosol cases the agreement between the two methods is within the typical uncertainty of 0.05 in **ssa**. For low aerosol cases the *in situ* technique gives a higher **ssa** than is inferred from radiation measurements. On Monday afternoon the emphasis was mostly on the retrieval of cloud properties including optical depth, effective cloud particle radius, liquid and ice water content. Mainly, the talks were on retrievals using radiance measurements made by satellites, but there was some discussion of using radar and lidar from the surface. There were papers on how one validates these retrievals using cloud particle probes on aircraft.



Sample of TOMS aerosol on December 17, 2002.
From: http://toms.gsfc.nasa.gov/aerosols/aerosols.html

Tuesday's discussions were mostly concerned with results from the Clouds and the Earth's Radiant Energy System (CERES). This instrumentation is on three satellites including TRRM, Terra, and Aqua. These are improved broadband measurements of total shortwave and longwave radiation. The spatial resolution is better than the earlier Earth Radiation Budget Experiment (ERBE) and the calibration is done onboard. There are better means for screening clouds. Since the measurements are radiance measurements, fluxes are estimated using models of the radiance angular distribution. Geo-stationary satellites are used to interpolate between the flyovers of the CERES satellites. Validation is based on ground-based and aircraft-based measurements under the spacecraft.

On Wednesday the results of the ARM Enhanced Shortwave Experiments (ARESE I and ARESE II) were discussed by a number of authors. The purpose of these experiments was to measure the absorbed radiation in a layer at the aircraft ceiling and at the surface; the difference in net radiation at the two levels is the absorbed radiation. There should be differences between clear layers and cloudy layers. The results from ARESE I suggested that the cloudy skies absorbed much more radiation than models suggested. The bottom line is that there is a little more absorption in measurements than models show, but the difference is within the combined errors of measurements and models including the errors associated with the inputs to those models. Pope and co-authors contend that the models of late are showing more absorption than the earlier models did when there was great controversy about the differences between models and measurements for cloudy skies. In the first Wednesday afternoon session the discussion was mostly about retrievals of liquid and ice cloud particle properties using various satellite instrumentation including MISR and MODIS on the Terra and Aqua satellites. In the last session of the day there were six papers on using satellite instruments to retrieve aerosols including AVHRR, VIRS on TRMM, TOMS,

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Overview of American Meteorological Society's 11th Conference

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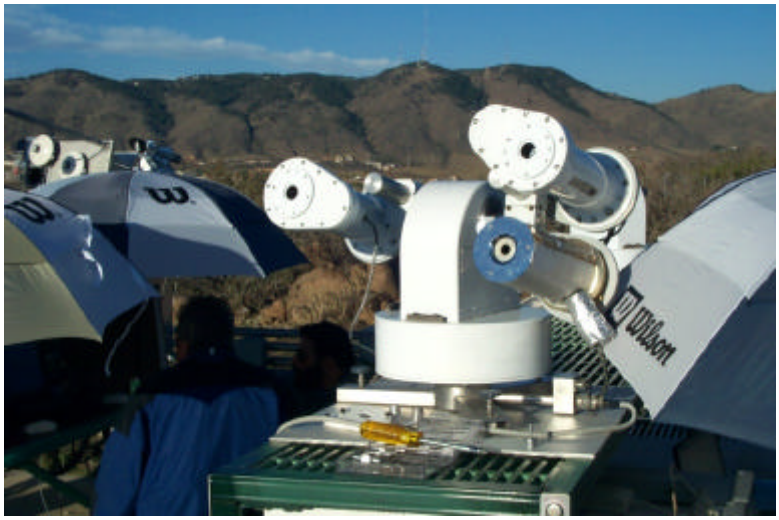
MODIS, GOES, and SEAWIFS. Much of this work is in support of NASA's Global Aerosol Climatology project.

On Thursday there were a few papers that tested whether 3D models correctly predicted the behavior of observed radiances from aircraft and satellites flying above clouds; they did not do well. Two papers tried to deal with scattering from clouds of ice crystals in a realistic manner. Some of the ice was modeled as droxtals, which I'm still trying to define, but I think are sphere-like, but not smooth. The final session of the day dealt with trying to incorporate the inhomogeneous nature of clouds into models in a realistic way to get top-of-atmosphere, surface flux, heating rate profiles, and cloud layering correct in a statistical or long-term average sense.

On Friday surface measurements and models of radiation were discussed. Michalsky gave a talk on defining a diffuse irradiance standard based on a comparison of 14 simultaneous measurements over a two-week period. Five of the measurements agreed to within 2 W/m^2 for clear and totally overcast conditions. Flynn described results from models of these and other measurements showing that there is still disagreement in the diffuse with models higher by 5-7 W/m^2 even with a moderately absorbing aerosol. Philipona discussed the offset problem in pyranometers used to measure diffuse and total irradiance. Trishchenko gave a talk about combing multi-platform satellite measurements of surface reflectivity to get albedo inputs to models correct. Chowdhary gave a talk on the effect of ocean color on the polarization and radiance leaving the ocean surface, and Brandt talked about the albedo of ice in the Antarctic.

In the afternoon several infrared talks were given. Mlynczak gave a talk on far infrared spectroscopy of the troposphere (beyond 15.4 micrometers). He is trying to understand the seldom sampled 10-100 micron region with 1.4 sec and 0.6 wavenumber resolution. Ackerman described cloud retrievals of cloud and fire properties using High-resolution Infrared Sounder (HIS) radiance data. Newman described the Airborne Infrared Interferometer Evaluation System (AIRES), much the same as HIS, used in the UK Met Office for validation of models. He suggested a modification of the current continuum formulation. Glew used same instrument to look at surface temperature and emissivity. Turner review the ARM/FIRE Water Vapor Experiment (AFWEX) which attempted to measure high troposphere water vapor from several platforms including HIS measurements with mixed results.

In the last session of the conference there were several interesting talks about retrievals using unconventional techniques. DeHaan described using the weak collision-induced O_2-O_2 absorption band at 477 nm to retrieve cloud top pressure. Min described using the strong O_2 band at 760 nm to get photon pathlengths in clouds. Davis described using lidar returns off beam to probe for optical thickness and cloud absorption properties. Mahesh described the problem that blowing snow presents for getting surface altitude correct from satellites. Suspended snow also has a radiative forcing effect much as a cloud would.



Cavity radiometers at the 2002 NREL Pyrheliometer Intercomparison

NREL Pyrheliometer Comparisons 2002

23 September – 4 October

Solar Radiation Research Laboratory (SRRL)

Purpose

Transfer the World Radiometric Reference (WRR) for radiometer calibrations to participating instruments by outdoor comparisons with NREL reference absolute cavity radiometers under clear sky conditions.

Participants

16 people operating 23 absolute cavity radiometers

DOE/NREL/National Center for Photovoltaics
DOE/Atmospheric Radiation Measurement Program
NOAA/Climate Monitoring & Diagnostics Laboratory
NOAA/Surface Radiation Research Branch
State University of New York at Albany
NASA/Analytical Services & Materials
Desert Sunshine Exposure Test (DSET) Laboratories
Lockheed Martin Technical Operations
European Commission Directorate General JRC

IPC-IX Results Summary for the NPC2002 TSG

Serial Number	WRR Factors from IPC-IX	%Standard Deviation	Number of Readings
AHF28968	0.99866	0.06	113
AHF29220	0.99846	0.06	113
AHF30713	0.99861	0.06	113
TMI68018	0.99848	0.05	113
Mean WRR for the TSG	0.99855	%Pooled Std. Deviation for the TSG	0.06

%u95 of npc2002 = 0.32

NPC2002 Results for the Refrence Cavities

Serial Number	WRR-IPCIX	WRR-NPC2002	St. Dev.	Number of Readings
AHF28968	0.99866	0.99870	0.00	837
AHF29220	0.99846	0.99868	0.03	837
AHF30713	0.99861	0.99850	0.04	837
TMI68018	0.99848	0.99833	0.08	837
Mean WRR	0.99855	0.99855		

Those participating in the pyrheliometer intercomparison from left to right: Tom Stoffel, Wim Zaaiman, Duncan MacIver, Craig Webb, Bob Heiskell, Jim Goza, Fred Denn, Jim Treadwell, Ibrahim Reda
[not pictured: Chris Cornwall, Robert Dolce, Gary Hodges, Joe Michalsky, Bill Miller, Daryl Myers, and Don Nelson]

NPC2002 Results for the Test Cavities

Serial Number	WRR-TF NPC2002	%sd	Number of Readings	%U95	
				w.r.t. WRR	w.r.t. SI
17142	0.99865	0.08	749	0.19	0.36
23734	0.99892	0.05	833	0.15	0.34
28552	0.99816	0.09	661	0.22	0.37
28553	0.99724	0.05	606	0.15	0.34
28964	0.99862	0.06	740	0.17	0.35
29222	1.00060	0.05	796	0.16	0.34
30495	0.99787	0.05	796	0.16	0.34
30710	1.00002	0.06	798	0.17	0.34
31041	0.99785	0.06	810	0.17	0.34
31104	1.00040	0.04	831	0.15	0.33
31105	1.00357	0.07	816	0.18	0.35
32452	0.99908	0.06	837	0.18	0.35
67502	1.00053	0.08	611	0.20	0.36
68017	1.00020	0.07	731	0.18	0.35
68020	0.99721	0.12	720	0.27	0.40
69036	1.00250	0.15	99	0.33	0.45
PMO6 81109	0.99938	0.07	220	0.19	0.36
PMO6 911204	1.00034	0.09	221	0.21	0.37

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In This Issue... | **United Nations Environment Programme's SWERA Project Launched**

United Nations Environment Programme's Solar and Wind Energy Resource Assessment (SWERA) Project Launched

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wind resource maps using the empirical techniques developed at NREL and PNNL over the past two decades; and 4) providing GIS expertise and developing GIS tools to organize and disseminate the data through the GRID Center in Sioux Falls. Dave Renné, Dennis Elliott, and Liz Brady Sabeff are the NREL leads in these activities.

The SUNY/Albany effort, led by Richard Perez, will provide satellite-derived high-resolution (10-km) site-time specific solar resource data for the Central America and Caribbean region. This technique makes use of visible channel data from the Geostationary Operational Environmental Satellites (GOES) that are positioned over the equator in two western-hemispheric locations. Because the data from these satellites covers only a few years, Richard will also develop tools that allow the user to generate longer-term time series data at any location based on adjusting nearby climatological ground stations to that specific point. The SUNY activity also involves collaboration with DLR on high-resolution mapping techniques, since DLR will be developing similar solar data sets for the eastern-hemispheric regions covered by the Meteosat and INSAT geostationary satellites. NREL, SUNY, DLR and INPE will all be engaged in a model cross-calibration study over northeastern Brazil – this region is unique because it is seen equally by GOES and METEOSAT satellites -- to establish the relative uncertainties of the various approaches.

The participating countries will be actively engaged in this work. This includes assistance in the model validation studies by providing data from within their own organizations.

Although SWERA is a three-year program targeted to 13 specific countries, it is anticipated that many additional countries will seek some form of bilateral support or use internal funds to have similar data developed for their territory. Because SWERA is funded by the Global Environment Facility (and managed by UNEP's Division of Technology, Industry and Economics Energy in Paris), there will also be a number of studies to indicate how these new, more refined data sets are being used to stimulate renewable energy development that otherwise may not be occurring in the targeted countries.

More information about SWERA can be found on the SWERA web site at http://swera.unep.net.