

NASA Satellite Measurements and Modeling Contributions to Decision Support in the Energy Sector

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NASA Energy Management

Prediction Of Worldwide Energy Resource Project

NASA POWER Project

Objective: Improve the Nation's public and private capability for integrating environmental data into sound management of energy production and energy efficiency systems.

Goals:

- 1. Establish partnerships to facilitate the integration and adaptation of NASA satellite analysis and modeling data into electric power industry Decision Support System's (DSS) and databases.**
- 2. Target such datasets for Electric Power, Renewable Energy, Energy-Efficient Building Design and Biomass Crop Development Industries**
- 3. Transition operational capabilities to government and/or private sector entities.**



NASA Energy Management

Process Flow Plan

Energy Management Process Flow

Identification of need for NASA data

What missions or ground systems will provide these measurements?

What models or computational technologies are available?

What information systems are necessary?

If not available, assess need & priority.

Evaluation
Research

Make contact and build partnerships with prospective DSS developers and data users in government and industry

Partnership
Development

Develop specifications that can improve socioeconomic benefits.

Translate specs into results

Cultivate new users.

Upgrade capabilities and parameters as new analysis and modeling techniques are developed and improved

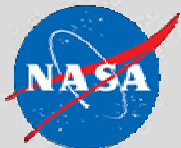
Prototype
Datasets

Decision Support Systems

Assessments

V&V/Benchmarking
Transfer Outputs to
Operations

Process flow



NASA POWER Project: Integrated System Solution

EARTH SYSTEM MODELS

- Earth System & Climate Change: *GMAO Analysis, NCEP Analysis*
- Seasonal Prediction Models: *NSIPP Analysis, NCEP Analysis*
- Aerosol Transport Models: *RAQMS, GMAO fvCAM, NCAR WRF, GFDL FMS Atmosphere*
- Climate Models: *GISS Model II, GFDL FMS B-Grid Atmosphere*
- Atmospheric Analysis Projects: *ISCCP, SRB, CERES-SARB, GVAP, GPCP*
*Supported Non-NASA Model



- 20+ years
- Past 90 days
- 1 – 15 day forecasts
- 12 – 18 month seasonal forecasts
- 10 – 20 year forecasts

- Temperature & humidity profiles
- Cloud systems
- Land cover albedo
- Land surface temperature
- Soil Moisture
- Ocean Surface Winds
- Global Precipitation
- Total Aerosol Amount
- Land Surface Topography
- Trace gas profiles



Data

EARTH OBSERVATIONS

- **Atmosphere:** *GOES, POES, TRMM, Terra, Aqua, TOMS, Aeronet, AIRNow, INTEX, Aura, CALIPSO, APS, CloudSat, GPM, NPP, GIFTS, HYDROS*
- **Land :** *Terra, Aqua, Landsat, Terrestrial Networks, BSRN, ARM, SURFRAD,*

*Future Mission

DECISION SUPPORT TOOLS

RETScreen

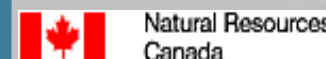
- Provides common platform for evaluating project proposals while significantly reducing the costs and uncertainties of preliminary studies
- Reduces the time and errors of a preliminary study

NREL

- HOMER
- National Solar Radiation Database (NSRDB)
- Provides data sets for numerous energy management decisions

EPRI

- Neural Net Load Forecast Tools
- Forecasting tool for Energy industry
- Integration of renewable sources to traditional power grids



VALUE & BENEFITS

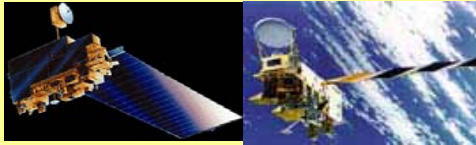
- Optimize renewable energy systems for power production
- Optimal integration of traditional and renewable energy supply systems into electric power grid
- Improved prediction of electric power need and supply – mitigate power shortages, prevent price increase
- Reduction in greenhouse emissions from energy production

POWER Historical Data for Renewable Energy

Earth-Sun System Science

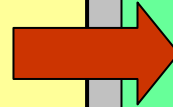
Applied Science Outcome

NASA Satellite Measurements, Analysis and Modeling



Terra

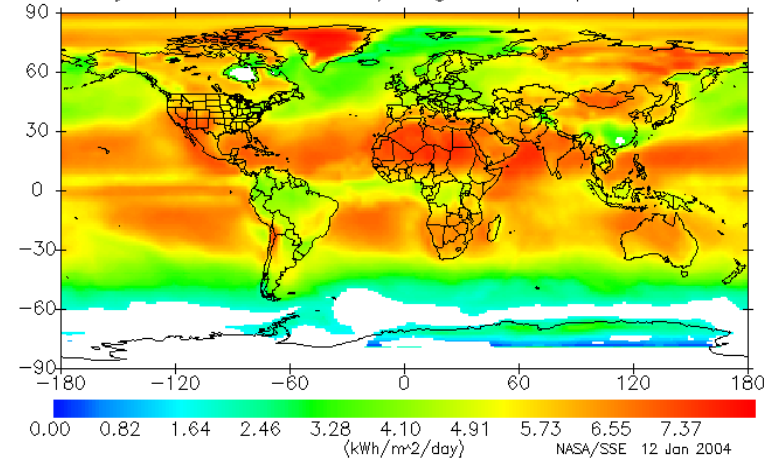
Aqua



Surface Meteorology and Solar Energy (SSE) Datasets And Web interface



April Radiation on Equator-pointed tilted surfaces (Perez/Erbs et al.)
July 1983 - June 1993 / Angle of tilt equals latitude



SSE Web Site

<http://eosweb.larc.nasa.gov/sse/>

Over 200 solar energy and meteorology parameters averaged from 10 years of data



Growing over the last 5 years to nearly 14,000 users, nearly 3.6 million hits and 700,000 data downloads

NASA POWER Project:

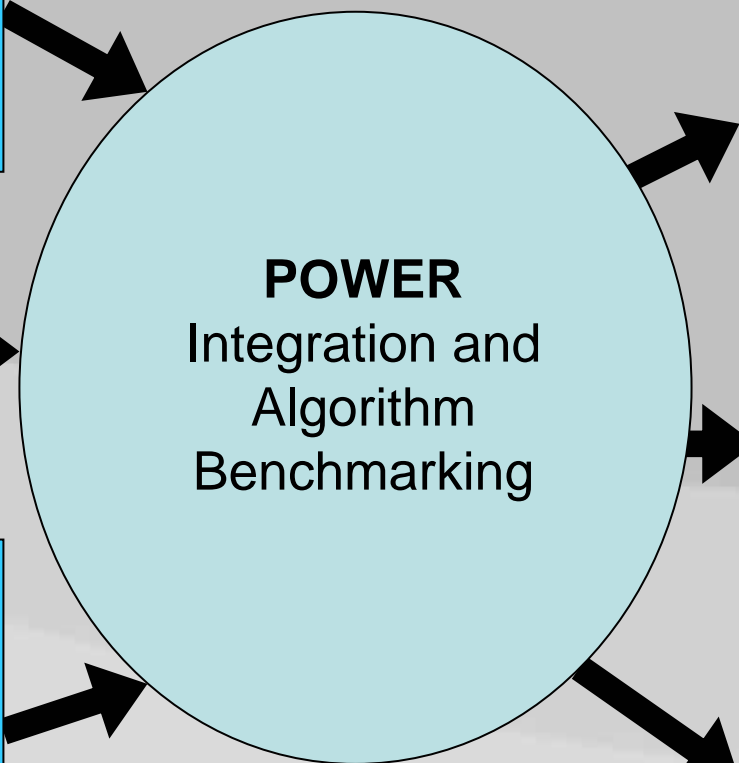
Logistical Approach

NASA Input Sources

Satellite-Based Retrievals and Analysis
(ISCCP, SRB, CERES)

Data Assimilation
(GMAO, NOAA NCEP)

Forecast Models (Days to Decadal):
(NASA GMAO, NSIPP, GISS; NOAA Wx, SFM, GFDL)



DSS Needs

Historic Records:
Renewables (RETScreen, NREL), Buildings (ASHRAE), Biomass, Utilities (EPRI)

Near-Term Records (last 90 days):
Utilities (EPRI), Biomass

Forecasts (day – yrs):
Utilities (EPRI), Renewables (NREL), Buildings (ASHRAE), Biomass



NASA POWER Partnership Example: *RETScreen from NRCAN/CANMET*

Natural Resources Canada RETScreen

The screenshot shows the RETScreen International website. At the top, it features the Canadian flag and the text 'Natural Resources Canada' and 'Ressources naturelles Canada'. A navigation menu includes 'Français', 'Home', 'Contact Us', 'Download Free', 'Help', 'Calendar', 'Search', 'Marketplace', 'Canada Site', and 'NRCan Site'. The main content area is titled 'RETScreen® International Clean Energy Decision Support Centre' and lists various energy technologies: WIND ENERGY, SMALL HYDRO, PHOTOVOLTAICS, COMBINED HEAT & POWER, BIOMASS HEATING, SOLAR AIR HEATING, SOLAR WATER HEATING, PASSIVE SOLAR HEATING, GROUND-SOURCE HEAT PUMPS, and REFRIGERATION. The website is managed by the CANMET Energy Technology Centre - Varennes (GETC-Varennes) and includes logos for NASA, UNEP, and GEF. A language dropdown is set to 'English - Anglais'. Below the dropdown, it states: 'RETScreen now has 68482 users in 210 countries around the world. More than 12,000 RETScreen products downloaded every week. New Ground-Source Heat Pump Project Model (Version 3) available to [download](#).'

**RETScreen Design System
(>68,000 Global Users)**

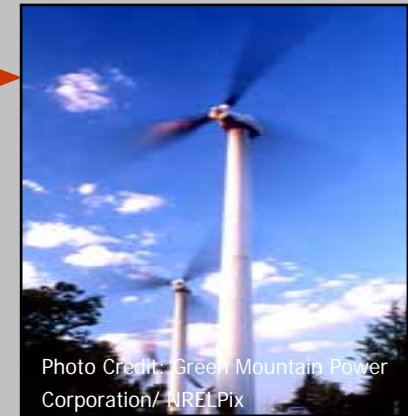
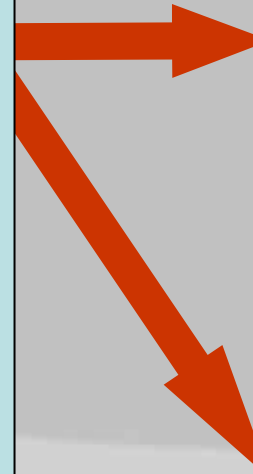


Photo Credit: Green Mountain Power Corporation/ NREL Pix



Solar Water Heating



POWER Plans

Additional Web-based Data and Prototypes

- **Historic global datasets and industry prototypes:**
 - SSE Release 5 (spanning July '83 – Oct '95): complete
 - *20+ Year SSE Rel. 6: spring 2006 (Joint Release with RETScreen 4)*
 - Sustainable Buildings Prototype: Release 1, complete
 - Agroclimatology/Biomass Prototype: Release 1, Dec. 2005
- **Near-term global prototype datasets (FLASHFlux/CERES):**
 - Prototype operational system (archived up to 6 months from real-time): Limited operations Oct. 1; full operations Dec 1.
- **Forecasted datasets:**
 - Preliminary discussions w/modeling partners underway; new partners being sought in climate prediction
 - *Now supporting PNNL's MINICAM*
 - Short-term regional prototype - Summer 2006
 - Seasonal prototypes 2006 - 2007



The slide features a background image of Earth from space, with a bright light source on the left creating a lens flare effect. The title is prominently displayed at the top in white text against a dark, starry space background.

NASA Energy Management Conclusions and Future Plans

- NASA's Energy Management Program is aimed at transitioning improved satellite analysis and modeling information to Decision Support Systems (DSS) in the Energy sector
- Energy Management's POWER project has already demonstrated the value of external partnerships with DSS owners
 - *POWER/RETScreen plans for continued collaboration and a joint release of respective SSE and RETScreen Software versions*
- Other opportunities for collaboration are possible and being actively sought

