2010 HIGHLIGHTS

SHC Task 36
Solar Resource Knowledge Management

THE ISSUE

Knowledge of solar energy resources is critical when designing, building and operating successful solar water heating systems, concentrating solar power systems, and photovoltaic systems. The ability to forecast solar resources reliably for up to 72 hours ahead is one important way to assist solar system operators how to best manage the output of their systems, especially in those cases where these systems are connected to the utility grid. One way to develop these forecasts is to adapt existing forecasting methods to address specific solar resource forecast estimates. However, little information is currently available on how well these solar resource forecasts actually compare with what actually occurred in specific locations.

OUR WORK

The participants in *Task 36: Solar Resource Knowledge Management*, who represent research institutions and private consultancies from around the world, are engaged in producing information products on solar energy resources that will greatly assist policymakers as well as project developers in advancing renewable energy programs worldwide.

One of the objectives of their work is to provide the solar energy industry, the electricity sector, and system operators, particularly those operating large-scale grid-tied PV systems, with information on how reliably solar radiation resources can be forecast at specific locations, ideally on an hourly basis, for up to 72 hours ahead. The scope of this particular task is to "benchmark" various solar resource forecasting schemes developed by research institutions and private companies with ground-based solar measurement data, and even with actual PV system output.

PARTICIPATING COUNTRIES

Austria
Canada
European Commission
France
Germany
Spain
Switzerland
United States

Task 36, originally a five-year collaborative project with IEA's SolarPACES and Photovoltaic Power Systems Programmes, has been extended by one year. The work will now be completed in June 2011.

Task Date	**2005-2011**
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KEY RESULTS OF 2010

Last year's highlights focused on an assessment of solar resource forecasting capabilities in the European region. This continues to be a major area of emphasis within the task, and the work has been extended to the U.S. and Canada. Therefore a major highlight of 2010 is the gaining of further understanding of a variety of solar resource forecasting methods, with a particular emphasis on results in Canada. Solar resource forecasting is becoming of growing importance towards the cost-effective and successful operation of large-scale, grid-tied solar energy systems, both PV and CSP (Concentrated Solar Power). Utilities and system operators can use the forecasts to predict the approximate amount of energy they can rely upon over the next several hours to the next two to three days. If the operators know with sufficient certainty that the solar energy technologies operating within their system will be on or off, this information can be important to them for determining what other types of back-up systems they may need to plan for to meet forecasted loads.

In addition to the European studies reported in our 2009 Highlights, SUNY/Albany, New York (U.S.) and CANMET Energy (Canada) are continuously evaluating forecasts at high quality ground solar measurement stations in the U.S. and Canada. For example, using the metric of the Root Mean Square Error (RMSE) for forecast accuracy, the U.S. is evaluating satellite-derived cloud motion vectors for short-term (0-6 hour) forecasts, and the National Digital Forecast Database (NDFD) for 1-3-day ahead forecasts at seven Surface Radiation (SURFRAD) solar monitoring stations in the U.S. Figure 1 shows some preliminary results of these studies, indicating that the satellite-derived vectors generally provide more accurate forecasts than either persistence of the NDFD in the 0-6-hour time frame, and the NDFD forecasts are greatly superior to persistence in the 1-3-day time frame.

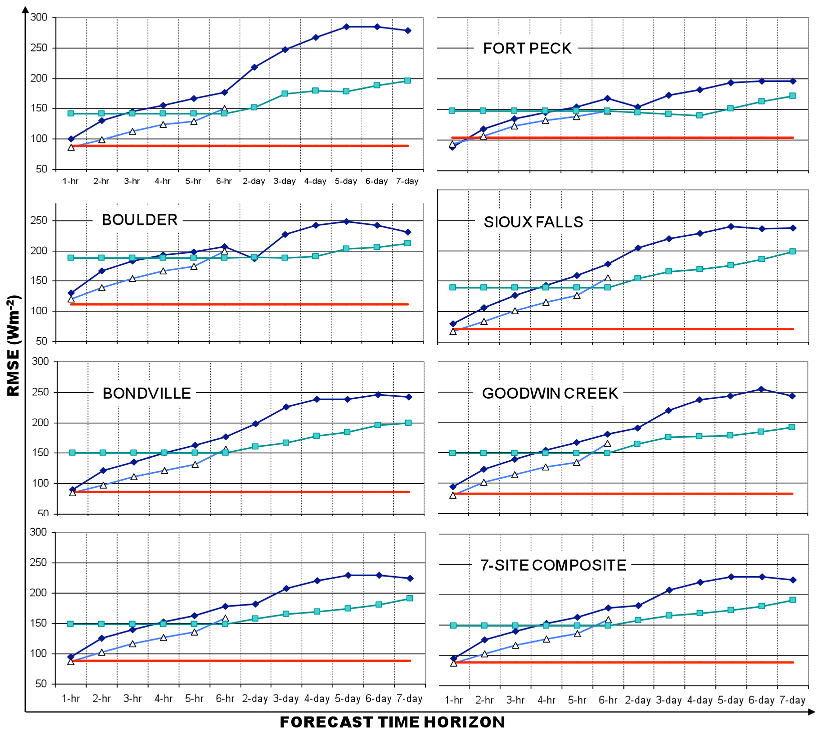

Figure 1. Preliminary test comparing the NDFD Numerical Weather Prediction forecast to measured persistence and cloud-motion forecasts at the seven SURFRAD sites in the U.S. *(Source: Richard Perez, SUNY/Albany New York)*

Canada is evaluating the Canadian Meteorological Center's Global Environmental Multiscale (GEM) forecasting model, as well as the European Centre for Mid-Range Weather Forecasting (ECMWF) model for three Canadian ground stations covering the period 1 June 2009 to 31 May 2010. Their results are shown in Figure 2. As with the earlier studies reported for the European stations, the Canadian study shows that global NWP's perform best, with RMSE's of the order of 30% to 40%

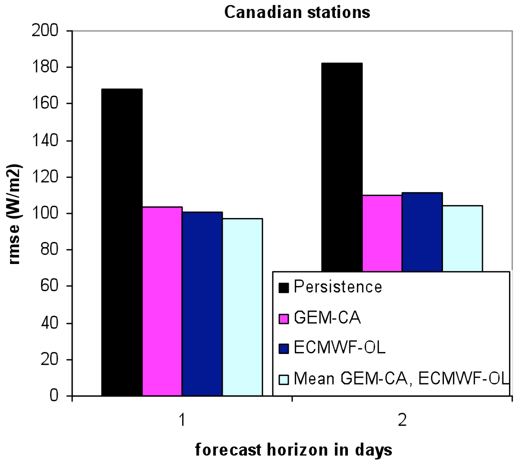

Figure 2. Average root mean squared error (rmse) for three Canadian ground stations for 1- and 2-day ahead forecasts, from Sophie Pelland, CanmetENERGY. *(Source: Canada)*

The contribution of power production to the electricity supply from PV systems is constantly increasing throughout the countries represented by Task 36, but in particular with countries like Germany and Spain. Thus, the University of Oldenburg, in partnership with Meteocontrol GmbH, has focused on the application of solar irradiance forecasts for regional power prediction. Their regional power prediction system for up to 2 days ahead with hourly resolution is based on ECMWF forecasts, with a post-processing procedure to derive optimized site-specific irradiance forecasts and explicit physical modeling steps to convert the predicted irradiances to PV power. Finally, regional power forecasts are derived by up scaling from a representative set of PV systems. A modified up scaling approach, modeling the spatial distribution of the nominal power with a resolution of 1^0 x 1^0 has also been introduced.

Figure 3 shows a scatter plot of the operational forecasts versus measured PV power feed-in (left) and the RMSE values of the operational forecasts in comparison to a modified up scaling approach (right). For the operational forecasts RMSE values are in the range of 4% to 5% with respect to the nominal power for intra-day and day-ahead forecasts. Further improvement is achieved with the modified up scaling approach.

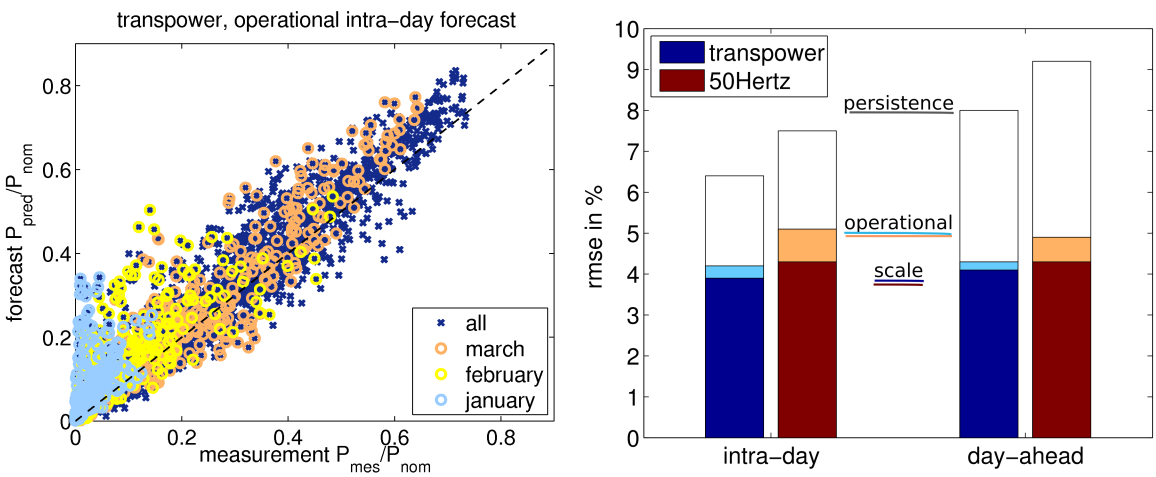

Figure 3. Left: Scatter plot of predicted over measured PV power. The months January (light blue), February (yellow), and March (orange) are highlighted in different colors. Right: RMSE of different forecasting approaches in based on forecast horizon in for a test area in Germany. *(Source: Elke Lorenz, University of Oldenburg, Germany)*

UPCOMING WORK

The solar resource forecasting work underway in Task 36 is just one of several examples of how the results from the Task will benefit utilities, system operators, project planners and developers, financial institutions, and many other stakeholders in the solar heating and cooling and solar electricity business. Task 36 will be completed by 30 June 2011 and produce a Best Practices Guide to capture the key findings. Following this, the Task participants will initiate *Task 46: Solar Resource Assessment and Forecasting* to further develop solar resource assessment products and methodologies to support all aspects of the solar energy industry.