RP1023

EVALUATION AND IMPROVEMENT OF AUSTRALIAN BUREAU OF METEOROLOGY'S SOLAR IRRADIANCE FORECASTS

Research Question

What are the solar irradiance forecasting skills of operational Numerical Weather Prediction models perform in Australia?

Numerical Weather Predictions (NWP) are used for forecasting solar irradiance, and subsequently, PV generation for day-ahead time frames. Therefore, improving the accuracy of NWP forecasts will directly improve the accuracy of PV generation forecasts.

Methodology

The solar irradiance forecasting skills of the Bureau of Meteorology's (BOM) operational NWP, ACCESS-C version APS2, was assessed against the ground based observations at six different locations in Australia. Further, the forecasts were corrected for bias by modelling the Mean Bias Errors (MBE) as a fourth order polynomial function of solar zenith angle (SZA) and forecast clearness index, as shown in Figure 1 and Equation 1.

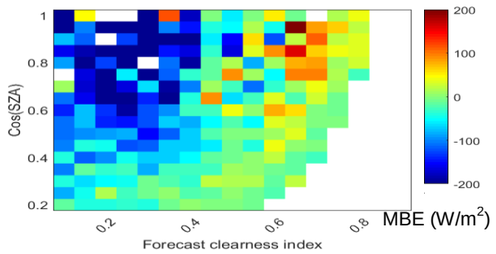

Figure 1 MBE as a function of solar zenith angle (SZA) and forecast clearness index at Adelaide airport

$$MBE = p0 * (\cos(SZA))^4 + p1 * (kt)^4 + \cdots \quad (1)$$

Where, forecast clearness index (kt) is the ratio of global horizontal irradiance to extraterrestrial irradiance.

Results

ACCESS-C tends to under predict solar irradiance or over predict cloud cover at all sites. The bias correction function successfully minimized bias and reduced RMSE at all locations as shown in Table 1.

Table 1 MBE and RMSE for NWP forecasts before and after correction at different sites

Site	RMSE (W/m^2)	$RMSE_c$ (W/m^2)	MBE (W/m^2)	MBE_c (W/m^2)
Adelaide	135	118	-22	-2
Cape Grim	141	122	-31	-3
Darwin	179	151	-3	-1
Melbourne	142	128	-17	2
Rockhampton	138	118	-33	-1
Wagga Wagga	114	105	-16	1

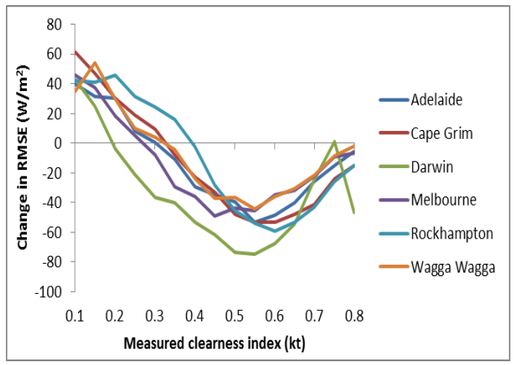

Figure 2: Change in RMSE for different measured sky conditions due to bias correction

The reduction in RMSE varies significantly with observed sky conditions (shown in Figure 2) because of the bias correction's inability to distinguish between cloud model errors and radiative transfer model errors in NWP.

Conclusions

ACCESS-C has tendency to under predict solar irradiance which can be reduced to achieve improved forecast skills using bias correction. However, basic bias correction methods are limited by their inability to identify the sources of errors. Further research will investigate the relationship between forecast errors and other prognostic variables, particularly related to cloud modelling.

Future works

This study is a part of the project where the value of distributed PV generation forecasts for residential PV systems will be studied. In the future works, a residential electricity system with PV and battery storage will be simulated and the influence of varying forecast accuracy, battery size, tariff structures and load profiles on electricity bill savings will be studied. This study will provide insights into the value of PV generation forecasts for residential PV system owners.

Finally, based on the value assessment of PV generation forecasts, appropriate forecast models will be developed for different climate conditions in Australia.

Anticipated impacts

Accurate distributed PV generation forecasts will assist grid operators to better schedule the conventional generators and allocate reserves economically with reduced risks of supply uncertainty, which is crucial for mass integration of distributed PV systems. Further, these forecasts are valuable for energy management solutions that can bring benefits to residential and commercial PV system owners.

Further information

The project is a collaboration between UNSW and Solar Analytics.

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