Australian Government
Australian Renewable Energy Agency

ARENA

Lessons Learnt

Lessons Learnt Report: *Satellite versus ground mounted climate prospecting for PV applications*

Project Name: *Photovoltaic Modules for the Australian Environment (PV-MATE)*

Knowledge Category:	Technical
Knowledge Type:	Technology
Technology Type:	Solar PV
State/Territory:	Canberra ACT, Adelaide ACT

Key learning

We have investigated the impact of two fundamentally different irradiance data sources on the calculation of the yearly yield and performance ratio for five locations in different climatic regions of Australia. We find an overestimation of the yield calculation of up to 9.3% for satellite-based climate irradiance data compared against one-minute ground-based irradiance data. There is a general correlation between satellite data overestimation and the number of cloudy days.

Implications for future projects

We have proposed a linear correction of the yield calculation which allows us to improve the prediction accuracy based on more broadly available satellite-based irradiance data. It can be directly employed to mitigate satellite data bias in a computationally efficient manner.

Knowledge gap

High accuracy of yield prediction is of utmost importance for commercial scale photovoltaic systems. One key parameter crucial to the prediction accuracy is the choice and availability of reliable solar radiation data. Ground mounted weather stations provide the best measurements of historical weather data, but their relevance is confined to a close geographical proximity. Satellite measurements of irradiance are performed efficiently for the entire country. However, the satellite measurements of the direct and global irradiance introduce bias, particularly in regions where there is significant yearly cloud coverage. This work, determines the magnitude of the bias, and suggests a method for correcting for satellite bias.

Background

Objectives or project requirements

We are looking at designing PV modules specifically for the Australian environment; hence a good climatological model is essential for making predictions of array performance.

Process undertaken

The calculations in this work were based on two different sources of solar irradiance data. The ASEIS dataset is based on geostationary satellite data and contains monthly average hourly irradiance values. The BoM dataset contains ground-based measured one-minute solar irradiance data which are traceable to the World Radiometric Reference for solar components. Both datasets provide direct normal irradiance (DNI) and global horizontal irradiance (GHI) values. The BoM dataset additionally provides diffuse horizontal irradiance values. Using both data sets we predict the performance of PV modules in the 5 regions depicted in Figure 1 making corrections for the effect of module operating temperature on performance. The yield for the different locations based on the two data sets is presented in Figure 2 a), for 3 different module varieties. The correlation of the impact of number of cloudy days is presented in Figure 2 b).

Supporting information

This work can be found in full online, in Energy Procedia, entitled: "Comparison of ground-based and satellite-based irradiance data for photovoltaic yield estimation", Marco Ernst, Andrew Thomson, Ingrid Haedrich, Andrew Blakers.

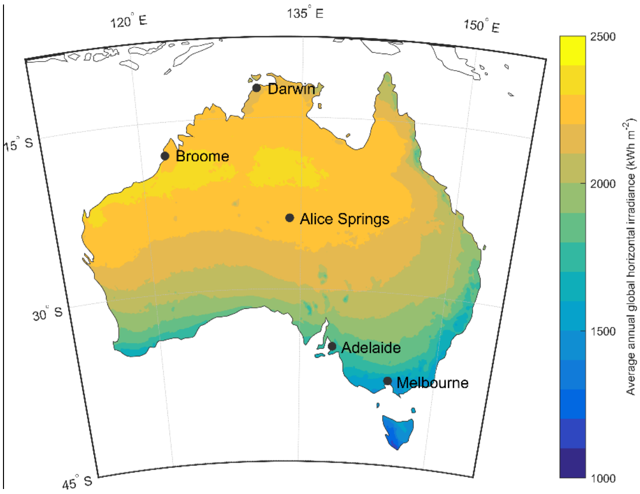

Fig. 1. Average yearly global horizontal irradiance over Australia for the period 1990 to 2011. Data reproduced from BoM. The five locations investigated in this work are marked on the map.

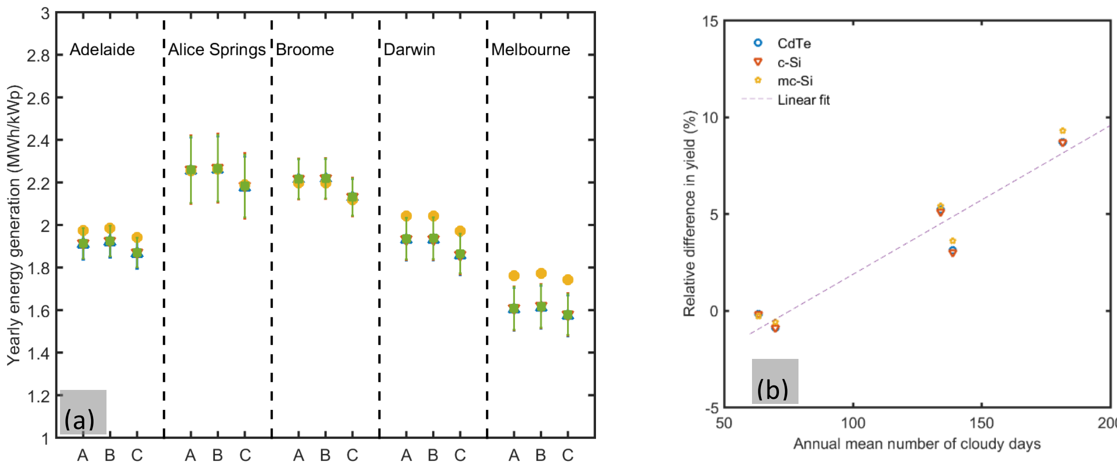

Fig. 2. (a) Yearly energy generation and 95% confidence intervals calculated for four combinations of irradiance and temperature datasets and for the three module technologies (A, B, C). (b) Relative difference of ASEIS yield (●) to BoM one-minute yield (▲) as a function of the annual mean number of cloudy days.