IPID4all Doctorate Research Exchange with University of Victoria
Feedback report

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Short-term irradiance variability

Introduction
The installed capacity of photovoltaic (PV) power has drastically increased in many regions of the world during the last decade, and it is expected to continue its recent fast-paced growth. As a consequence, the challenges associated with the inherent volatility of PV power production will considerably increase as well. As PV power variability is primarily determined by weather-induced heterogeneity in solar irradiance fields, a comprehensive data-driven characterization of irradiance variability is key to the planning and reliable operation of future power grids and their corresponding subsystems. Gerald and Adam have been collaborating since 2014 to contribute to a better understanding of the biases in representation of temporal variability resulting from temporally coarse-resolution observations, as well as how spatial averaging (as would come from having distributed PV over a region) mitigates variability.

Research Undertaken
During the days of Gerald staying in Victoria, a number of analyses were carried out that focussed on temporal irradiance variability on short time scales between 0.01 s and about 1000 s. The results have since been included in a research article submitted to Atmospheric Measurement Techniques (AMT) and are also part of Gerald's recently submitted PhD thesis.

Personal Experience
As always, staying at the Canadian West Coast was a formidable experience. Reconnecting with the members of Adam's work group allowed Gerald to see beyond his own nose and to catch glimpses of a number of interesting research projects. The IPID4all administration was hassle-free and enabled Adam and Gerald to make the most of the relatively short stay.

Conclusions
The analysis of temporal averaging effects partly undertaken during the research stay resulted in the identification of an averaging time of around T = 1 s to mark a universal transition (i.e., independent of season and location) in representing single-point irradiance variability under mixed-sky conditions. Larger values of T tend to considerably underestimate variability, while smaller values of T increase the complexity of data management and quality control without appreciably improving the representation of variability. One specific consequence of these findings relates to the Baseline Surface Radiation Network (BSRN), which currently records solar irradiance in minute averages. The above-mentioned results strongly indicate the value of modifying this strategy towards much higher temporal resolutions.

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Outlook
A research article “Effects of temporal averaging on short-term irradiance variability under mixed sky conditions” was submitted to Atmospheric Measurement Techniques. A co-supervision of the thesis has been effectively realized since 2014 and Adam will attend Gerald's PhD defense as an examiner. Further collaboration between Adam and Gerald, as well as their respective research groups, is planned for the future.

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