Identifying statistical behaviors explaining the different performances of site-adaptation of global horizontal irradiation depending on the satellite database

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Objective & Background

The financing of new solar-related projects strongly depends on the characterization of the local meteorology. Most developers derive representative meteorological inputs at the location of a specific site through the construction of a Typical Meteorological Year (TMY) based on historical satellite-based estimation. In the case of global horizontal irradiation (GHI), the mean bias error (MBE) observed in the TMYs from the most efficient satellite databases are of the order of 3%, which distorts the value of both the P50 and P90 of any solar system and forces a greater gap between the two. In markets where profitability is strongly dependent on business model optimization, this uncertainty, even if remarkably low, can very quickly call into question the economic health of a project and its ability to raise financial debt. Calibration using a short-term measurement campaign drastically reduces these risks [1] and is becoming part of the good practices throughout the solar industry. It has been shown in a previous article [2] that the calibration performance (i.e., the uncertainty over post-calibration bias) partly depends on the database used. This goes against the theory of most of the calibration algorithms used, which have the concept of capturing the "way the satellite databases are wrong" in order to correct it, no matter what the so-called way.

Method and principal findings

The present article, as an extension of the previous works, highlights some statistical behaviors that allow to understand the origin of these differences in calibration performances and extends the investigation to a representative panel of databases: CAMS from Copernicus, HelioClim3 from MINES Paris PSL, Solargis as well as 3E Solar Data.

In particular, in the case of Quantile Mapping calibration, a strong link between post-calibration MBE uncertainty and non-representativeness of the short-term measurement campaign compared to the historical long-term is exposed. A pseudo-linear dependence between post-calibration bias and mean solar irradiance received at the site is also revealed, suggesting that sites with larger mean clear-sky index (Kc) are more likely to be better calibrated regardless of the database.

Conclusion

All these results together contribute to the understanding of the impact of the choice of the satellite data provider in the case of GHI site-adaptation, a problem that is of interest not only for developers, but also for the technical advisors who are in charge of validating, on behalf of investors and banks, the representativeness of the inputs used to generate the P50/P90s submitted by the latter.

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2. [2] Loïc Yezeguelian, Christophe Vernay, Thomas Carrière, Philippe Blanc. Characterizing The Convergence And Robustness Of The Kernel Density Mapping Method For Site-Adaptation Of Global Horizontal Irradiation In Western Europe. 38th European Photovoltaic Solar Energy - Conference and Exhibition (EU PVSEC 2021), Sep 2021, online, France. hal-03337523v3