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Quality check of ground-based hourly measurements of downwelling surface solar irradiance in China

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Ground-based measurements of downwelling surface solar irradiance (DSSI) play an important role in many topics, such as the design and operation of solar energy systems, the study of the Earth radiation budget, and the validation of gridded DSSI products such as those derived from satellite imagery and reanalyses. For our purpose of validating satellite-based estimates of DSSI over China, we use ground-based hourly measurements at 99 stations operated by China Meteorological Administration (CMA). The measurements might not be perfect, including outliers, biases, sudden shifts or slow instrumental drifts that an extended quality check (QC) can detect. Physical threshold methods like the one proposed by Long and Dutton (2002) are frequently used to detect some of the physically impossible data records on an hourly or sub-hourly basis. However, in our case, we observed many inconsistent measurements that can pass such threshold-based QC. This is especially because diffuse and/or direct components of DSSI are not measured for most CMA stations and only global irradiance-based check for DSSI can be realized.

To detect drifts or jumps that might last for weeks or months in the time series of measured DSSI, we carried out the QC by comparing the clearness indices (i.e., the ratio between DSSI and horizontal irradiance at the top of atmosphere) from measurements with those from the ERA-5 reanalysis, in a similar approach to Urraca et al. (2017). Consistency of ERA-5's clearness indices was checked at first by comparison with high quality measurements from Baseline Surface Radiation Network. The same quality check was then applied to the hourly datasets at CMA stations. Over the years 2017-2018, our QC method led us to keep 52 stations fully and 19 stations partly.

Reference:

Long C.N. and Dutton E.G. BSRN Global Network recommended QC tests, V2.0, BSRN Technical Report, pp 3, 2002.

Urraca R., Gracia-Amillo A., Huld T., et al. Quality control of global solar radiation data with satellite-based products, Solar Energy 158, pp 49-62, 2017. https://doi.org/10.1016/j.solener.2017.09.032.