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Spatiotemporal Representativeness of Surface-measured Variations in Downward Solar Radiation: Spatial Correlations, Biases and Errors

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Surface solar radiation (SSR) is most directly observed with ground-based pyranometer measurements. Besides measurement uncertainties, which arise from the instruments themselves, also errors attributable to the limited spatiotemporal representativeness of single observations for their immediate surroundings have to be taken into account when using such measurements in combination with gridded data products.

In our studies (Schwarz, et al. 2018, Schwarz, et al., in prep.), we examined monthly mean surface solar radiation time series from station data in Europe as well as satellite-derived SSR to achieve an integrated near-global assessment (altogether leading to a near-global coverage from 55°S to 55°N) for the spatial representativeness of monthly mean SSR time series from point observations.

We focus on three different aspects of representativeness: (1) We examine the spatial extent for which SSR point observation can be considered representative before (2) we quantify spatial sampling biases (β) and (3) spatial sampling errors (ϵ) which arise when using SSR point observations in combination with one-degree gridded data, specifically the one-degree grid from the Clouds and Earth's Radiant Energy System (CERES).

From a correlation analysis, we find that SSR point observations in most regions generally show large enough correlations with their surrounding to allow a valid combination with gridded data. For the one-degree target grid, we find a near-global average for β and ϵ of roughly 1W/m^2 and 8W/m^2, respectively.

Overall, our work shows that the combination of monthly mean SSR time series from point observations with gridded data is feasible and does not introduce prohibitively large errors in most regions between 55°S and 55°N.

References:

Schwarz, M., Folini, D., Hakuba, M. Z., and Wild, M. (2017). Spatial representativeness of surface-measured variations of downward solar radiation. Journal of Geophysical Research: Atmospheres, (p. 2017JD027261). DOI: 10.1002/2017JD027261

Schwarz, M., Folini, D., Hakuba, M. Z., and Wild, M. (in prep.)