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Global validation of satellite-based and reanalysis surface solar radiation data sets

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The solar radiation reaching the Earth's surface determines our climate and is therefore important to be monitored as consistent and complete as possible. Even though surface reference measurements of surface solar radiation are available (e.g. from the Baseline Surface Radiation Network (BSRN)), their density remains low and large areas, like the oceans, remain poorly covered. To fill the gaps in space and time, satellite-based data records (like CLARA-A2 and SARA-2.1 from the EUMETSAT Satellite Application Facility on Climate Monitoring (CM SAF)) or model-based reanalysis data records (like ERA-5) are used. They provide surface solar radiation data with regional and global coverage, which are needed to understand its distribution and variability from the regional to the global scale.

Here we present a validation and analysis of monthly mean surface solar irradiance from multiple satellite-based and reanalysis data sets on the regional and global scale with reference to a data base of hundreds of surface measurements over land and ocean, collected from different sources (incl. BSRN, GEBA, WRDC, and buoy networks). This study provides new insights about the quality and uncertainty of available state-of-the-art satellite-based and reanalysis data records for climate studies. Regions of agreement as well as areas where the gridded data records exhibit larger differences are identified, providing important information on our current knowledge of the surface solar radiation climatology and possible improvements for future developments.