



Gridded sunshine duration climate data record for Germany based on combined satellite and in situ observations

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The purpose of this study is to create a 1 km² gridded daily sunshine duration data record for Germany covering the period from 1983 to 2015 (33 years) based on satellite estimates of direct normalised surface solar radiation and *in situ* sunshine duration observations using a geostatistical approach.

The CM SAF SARA direct normalized irradiance (DNI) satellite climate data record and *in situ* observations of sunshine duration from 121 weather stations operated by DWD are used as input datasets. The selected period of 33 years is associated with the availability of satellite data. The number of ground stations is limited to 121 as there are only time series with less than 10% of missing observations over the selected period included to keep the long-term consistency of the output sunshine duration data record.

In the first step, DNI data record is used to derive sunshine hours by applying WMO threshold of 120 W/m² (SDU = $\text{DNI} \geq 120 \text{ W/m}^2$) and weighting of sunny slots to correct the sunshine length between two instantaneous image data due to cloud movement. In the second step, linear regression between SDU and *in situ* sunshine duration is calculated to adjust the satellite product to the ground observations and the output regression coefficients are applied to create a regression grid. In the last step regression residuals are interpolated with ordinary kriging and added to the regression grid. A comprehensive accuracy assessment of the gridded sunshine duration data record is performed by calculating prediction errors (cross-validation routine). "R" is used for data processing. A short analysis of the spatial distribution and temporal variability of sunshine duration over Germany based on the created dataset will be presented.

The gridded sunshine duration data are useful for applications in various climate-related studies, agriculture and solar energy potential calculations.