DATA SET DESCRIPTION

Daily means of hourly grids of direct radiation for Germany (project TRY Advancement)

Version V001

Cite data set as: Krähenmann, S., Walter, A., Brienen, S., Imbery, F., Matzarakis, A.: Daily means of hourly grids of direct radiation for Germany (project TRY Advancement), Version V001, DWD Climate Data Center (CDC), DOI:10.5676/DWD_CDC/TRY_Basis_v001, 2016.

INTENT OF THE DATASET

This document describes freely available data of the DWD Climate Data Centre which are the raw data set used for input to generate the German Test Reference Years (2017). The commissioned research project "TRY Advancement" was supported with funding from the Research Initiative Future Building through BBSR.

POINT OF CONTACT

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DATA DESCRIPTION

Spatial coverage	Germany
Temporal coverage	01.01.1995 - 31.12.2012
Spatial resolution	1 km x 1 km
Temporal resolution	monthly
Projection	ETRS89 / ETRS-LCC, ellipsoid GRS80, EPSG: 3034, see http://spatialreference.org/ref/epsg/3034/.
Format(s)	NetCDF
Parameters	mean direct radiation [Wh/m²] in the data SID_*daymean.nc
Uncertainties	Uncertainties result from the interpolation procedure and from erroneous or missing observations. When comparing grids of different years, changes of the station network over the time have to be taken into account.

DATA ORIGIN

Input data for the gridding are synoptic station data from the DWD database, supplemented by satellite observations (Müller et al., 2015). Gridding is done using the interpolation method described below. Daily means are derived by averaging the hourly grids. A comparison between satellite- and ground-based data revealed specific errors depending on location, season and presence

of snow. It is particularly difficult to distinguish snow from clouds as both are good reflectors of shortwave radiation. Radiances obtained at 32 ground-based Pyranometer stations are used to correct for the bias of the satellite-derived shortwave radiances. Surface stations provide point-wise observations, satellites by design spatial mean values (~25 km²). This can lead to substantial differences between the two datasets, particularly when cloud cover is variable and averaging periods are short. Hence, the two datasets cannot be directly merged, yet resolution dependent differences average out over longer time periods (e.g. days). The ratio between direct and global radiation depends on several factors including cloud cover, atmospheric moisture, time of the day and season. This is already accounted for in the satellite-based direct radiation data (Müller et al., 2015). However, the corrections applied to the global radiation dataset (https://opendata.dwd.de/climate_environment/CDC/grids_germany/hourly/Project/r radiation_global/ DESCRIPTION_gridsgermany_monthly_Project_TRY_radiation_global_en.pdf) require an update of the satellite-based direct radiation dataset. This is done in a two-step process; the current (weather condition dependent) ratio is calculated from the original satellite-derived datasets and applied to the corrected global radiation dataset, followed by a residual interpolation. Since the ratio strongly depends on atmospheric moisture and solar elevation, it is individually determined for every hour and in eight overlapping regions over Germany and also individually applied to the hourly global radiation sums. Subsequently, the normalized residuals (e.g. to remove the geographical effect) of daily direct radiation sums are interpolated using multiple linear regression is used for interpolation. Summing the updated hourly direct radiation sum (yields the updated daily direct radiation sum) and the residual field provides the corrected daily direct radiation dataset. Correction of the hourly direct radiation fields is achieved multiplying the updated hourly direct radiation fields with the ratio of the corrected daily direct radiation sum to the updated daily direct radiation sum.

VALIDATION AND UNCERTAINTY ESTIMATE

The 1 km² grid resolution matches the resolution of the digital elevation model. Residual interpolation is error prone. The true information density depends on the station network, particularly in regions of complex terrain. The station density is particularly low, with only about 30 Pyranometer stations contributing to the gridding. To ensure an improvement of the satellite-derived dataset, the correction is only carried out on days for which cross-validation indicates an improvement in terms of both BIAS and MAE.

CONSIDERATIONS FOR APPLICATIONS

The interpolation of hourly values focuses on temporal consistency over a day and consistency between parameters. Due to changes in the station network (openings and closings of stations and relocation), climatological analysis (e.g. identification of long-term trends) are not possible. Satellite-derived radiations are used assuming that its spatial distribution is overall correct. In addition, the assumption is made that any bias inherent to the satellite date is spatially well correlated. These are often made assumptions for monthly data which yield satisfactory results. However, for daily grids these assumptions do not always hold. Thus, daily grids should be used with caution, and they should be validated before any application. The dataset has proven to be excellently suited for its original application (test reference years).

REFERENCES

Krähenmann S, Walter A, Imbery F, Brienen S, Matzarakis A (2016): High-resolution grids of hourly meteorological variables for Germany. TAAC. DOI:10.1007/s00704-016-2003-7

Müller R, Pfeifroth U, Träger-Chatterjee C, Trentmann J, Cremer R (2015) Digging the METEOSAT Treasure – 3 Decades of Solar Surface Radiation. Remote Sens 7:8067-8101. DOI:10.3390/rs70608067

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REVISION HISTORY

The data are output of a project and not subject to change. This document is maintained by the Climate and Environmental Consultancy Department (KU11), DWD, last edited 19.12.2018.