

# A comparison of data sources for creating a long-term time series of daily gridded solar radiation for Europe\*

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## Scope and objectives

The present study was largely motivated in order to provide **daily surface solar radiation** as input to the European Commission's MARS Crop Yield Forecasting System (MCYFS, <http://marswiki.jrc.ec.europa.eu/agri4castwiki/>).

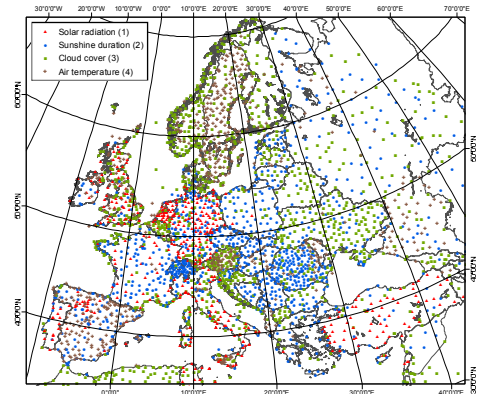
The specific objective was to compare existing solar radiation data sources with the aim to create a long-term (> 15 years) seamless gridded time series for Europe, which can be operationally prolonged in near real-time (max. delay of 3 days). Solar radiation derived from the satellite observations (SIS and DSSF), ERA-Interim reanalysis and interpolated JRC-MARS weather data were evaluated and inter-compared.

## Compared data sets

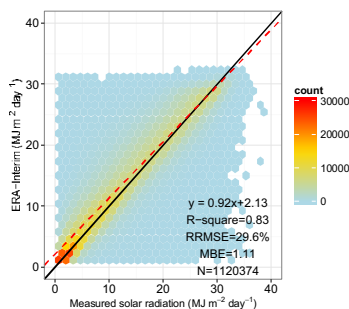
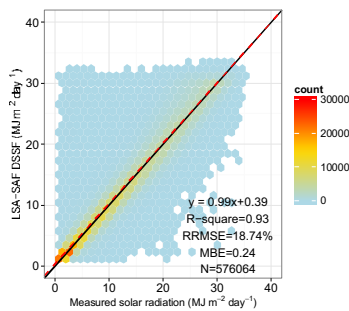
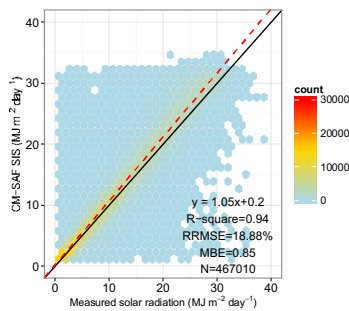
	Provider	Source	Period	Spatial resolution
SIS	CM-SAF	Meteosat First Generation	1983–2005	0.03° (3.34 km)
DSSF	LSA-SAF	Meteosat Second Generation	2005–2011	5 km
ERA-Interim	ECMWF	Reanalysis	1983–2011	0.75° (83.5 km)
JRC-MARS	JRC-MARS	Interpolated weather station data	1983–2011	25 km

JRC-MARS solar radiation was interpolated from 3,549 weather stations, where it was derived from solar radiation measurements, or alternatively modelled from sunshine duration (Ångström, 1924), cloud cover and air temperature range (Supit and Van Kappel, 1998) and air temperature range (Hargreaves *et al.*, 1985). Model empirical coefficients were derived from MSG data as proposed in Bojanowski *et al.* (AgrForMet 2013).

Solar radiation measured at 373 weather stations was used for evaluation of SIS, DSSF and ERA-Interim data sets.



## Evaluation



## Intercomparison

	RMSE (MJ m <sup>-2</sup> )		RRMSE (%)		MBE (MJ m <sup>-2</sup> )		RMBE (%)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
SIS – DSSF	2.00	0.48	16.28	5.62	0.37	0.46	2.97	3.73
SIS – ERA-Interim	3.19	0.61	25.77	5.12	-0.34	0.60	-2.40	4.63
SIS – JRC-MARS	3.62	0.52	29.94	5.77	0.33	0.83	1.69	5.76
DSSF – ERA-Interim	3.36	0.47	28.22	5.71	-0.40	0.71	-2.80	5.93
DSSF – JRC-MARS	2.56	0.51	21.57	4.24	0.13	0.70	0.23	5.39
ERA – JRC-MARS	3.08	0.42	26.41	6.70	0.49	1.07	2.60	8.30

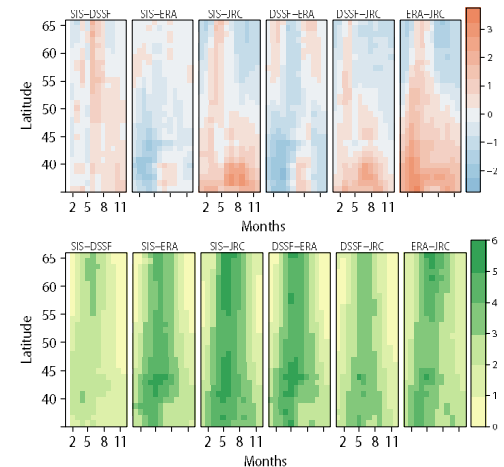
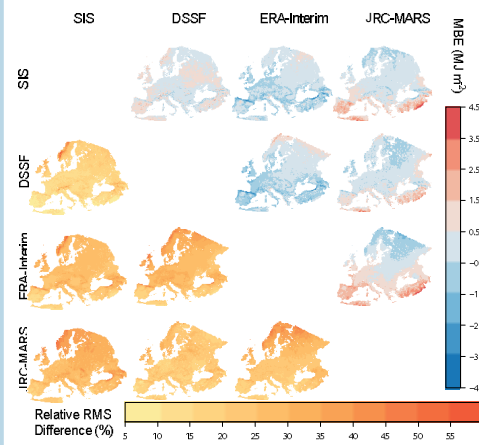


Fig. left: Positive mean bias indicates that the estimate represented by a row has a higher value than estimate represented by a column.

Spatio-temporal distribution of: (above) MBE (MJ m<sup>-2</sup>), (below) RMSE (MJ m<sup>-2</sup>). Each pixel corresponds to the statistic aggregated for one month for 1 degree of latitude across Europe.

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## Conclusions

The comparison with measured solar radiation data showed a similarly good agreement of satellite-based SIS and DSSF solar radiation estimates. A grid-based comparison showed an average RMSE of 2 MJ m<sup>-2</sup> and a mean bias of 0.37 MJ m<sup>-2</sup> (SIS > DSSF). However, the differences are not evenly distributed in time and space. Merging both datasets should provide an accurate source for a long-term solar radiation dataset for Europe.

## Forthcoming

In the CM-SAF's CDOP II a solar radiation dataset spanning Meteosat First and Second Generations (1983–present) is under development. A single solar radiation retrieval algorithm is applied to homogenized radiance data from both satellites: the two narrow-band visible channels of the MSG satellites are combined to simulate a broadband channel similar to the MFG visible channel (see Posselt *et al.*, Rem. Sens. Env., 2014 for details).