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To cite this version:

Mireille Lefèvre, Christelle Rigollier, Sylvain Cros, Michel Albuisson, Lucien Wald. A shortwave radiation database to support GODAE-related activities. International Symposium "En route to GODAE", Jun 2002, Biarritz, France. pp.157-158. hal-00466451

HAL Id: hal-00466451

https://hal-mines-paristech.archives-ouvertes.fr/hal-00466451

Submitted on 23 Mar 2010

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Proceedings of the International Symposium "En route to GODAE", 13-15 June 2002, Biarritz, France. Published by CNES, Toulouse, France, 2002, pp. 157-158.

A SHORTWAVE RADIATION DATABASE TO SUPPORT GODAE-RELATED ACTIVITIES

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Abstract – A new method Heliosat-II was designed for the conversion of spaceborne observations made in the visible range by geostationnary satellites into SW radiation available at ocean level. It offers several improvements in operation and accuracy with respect to previous methods. Typical bias for irradiance for a month is 3 W m^{-2}. A database is being produced, covering the Eastern Atlantic Ocean, Europe and Africa from 1985 onwards and for each day. This database is accessible through the SoDa service on a free basis (http://soda.jrc.it).

1 – Introduction - The method Heliosat-II

Shortwave (SW) radiation is an element of the radiation budget, an essential component in climate studies that will be supported by the GODAE experiment. The network of stations measuring radiation is very scarce in the ocean and coastal areas.[1] and [2] demonstrate that a proper processing of satellite data provides better results than interpolation techniques. Several methods are available for the conversion of spaceborne observations made in the visible range by geostationnary satellites into SW radiation available at ocean level. Our concern is the series of Meteosat satellites that observe the Eastern Atlantic Ocean and the Mediterranean Sea for several years. When operated on a routine basis, many of these methods exhibit several drawbacks, one of them being the poor accuracy in irradiance [3].
We designed a new method that is capable of processing long time-series of images acquired by the series of sensors aboard the Meteosat satellites. The method is using the same principle than several methods of proven quality: [4] [5] [6] [7] [8] [9] [10] [11]. With respect to these methods, the new one, called Heliosat-II, offers several improvements in operation and accuracy. These improvements are due to several causes:

- the Meteosat data are calibrated and converted into radiances [12];
- we use a new database of monthly values of the atmospheric optical turbidity for clear skies available on cells of 5' of arc angle in size (SoDa Web site: http://soda.jrc.it);
- we use terrain elevation TerrainBase database using the same cell size (useful for land / ocean separation);
- a better modelling of the irradiation under clear-skies and overcast skies was performed [13];
- more physical description of the optical processes was made possible by the calibration step; known proven models are implemented in the method;
- observations of [14] were used to model the spatial distribution of radiances of the very thick clouds;
- changes in ocean albedo due to sun glitter are taken into account.

2 – Results – Constructing a database

We made comparisons between satellite-derived assessments and measurements performed in the world radiation network in Europe and Africa. The results depend upon several parameters; the type of data (high-resolution or B2 format) and the number of pixels whose values are averaged for the comparison with the irradiation measurements.
As for the high-resolution data, assessments were compared to observations made by 60 stations in Europe for one year. The bias and root mean square error (RMSE) for the assessment of the irradiance for a month are equal

to respectively 2 and 11 W m^{-2} on cells of 5' of arc angle in size (approx. 10 km at mid-latitude). The RMSE may decrease down to 4 W m^{-2} if assessments are averaged over cells of 0.5° of arc angle (see Table).
The performances are worse for the data in B2 format. This format results from a sub-sampling of the high-resolution data. Briefly written, one pixel out of six original pixels is kept. Estimates at the geographical locations of the stations are therefore produced by spatial interpolation [15]. Comparisons were performed using 60 stations in Europe and 30 stations in Africa for the same year. The bias and RMSE are better than respectively 3 and 17 W m^{-2} for one month and a cell of 5'. The RMSE decreases to 9 W m^{-2} for cells of 0.5° in size.
Data in B2 format were collected from Eumetsat. They were quality-controlled and calibrated. The method Heliosat-II is being operated to produce a database of SW downward radiation for the Eastern Atlantic Ocean, Europe and Africa from 1985 onwards and for each day. This database is accessible through the SoDa service on a free basis [16]. Further, tools are available through this service to estimate longwave downward irradiance and net irradiance from the SW downward irradiance. The Heliosat-II method can be operated in real-time. When applied to Meteosat data (MOP and MSG), it produces maps of downward SW irradiance within the hour following the acquisition.

Errors (W m^{-2}) in assessing SW downward irradiance for a month

	Hi-Res images		B2 format	
	5' cell	0.5° cell	5' cell	0.5° cell
Bias	2	2	3	3
RMSE	11	4	17	9

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