EMS Annual Meeting Abstracts
Vol. 9, EMS2012-102, 2012
12th EMS / 9th ECAC

Extension of the CM SAF surface radiation climatology beyond Meteosat first generation satellites

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A 23 year (1983-2005) long continuous surface radiation climate data record (MAGICSOL-V1/RAD_MVIRI CDR, [1]) from METEOSAT's first generation satellites is MeteoSwiss' contribution to the Satellite Application Facility for Climate Monitoring (CM SAF). CM SAF is a joint activity of several national Meteorological Services within EUMETSAT's satellite data processing (SAF – Satellite Application Facilities). CM SAF generates, archives and distributes widely recognized high-quality satellite-derived products relevant for climate monitoring in operational mode with a special emphasis on climate variables such as cloud parameters, radiation budget and water vapour.

The MAGICSOL-V1 CDR by MeteoSwiss and DWD is generated using MAGICSOL. This method includes an extended climate version of the Heliosat algorithm, which exploits the attenuation of radiation by clouds from the broadband METEOSAT visible channel (0.45-1 μm), and the MAGIC (Mesoscale Atmospheric Global Irradiance Code) radiative transfer model that accounts for water vapour, ozone and aerosol absorption on clear sky radiation. The MAGICSOL-V1 CDR was processed and consistently validated for the Meteosat satellites of the first generation ([2],[3]). However, an extension of the data set towards the present has often been requested by users. However, a successful extension of the dataset has to overcome the substantial differences in the spectral response functions of the visible channel(s) between MVIRI (Meteosat Visible and InfraRed Imager) on-board the Meteosat first generation satellites (until 2005) and SEVIRI (Spinning-Enhanced Visible and InfraRed Imager) on-board Meteosat's second generation satellites (since 2004). Applying the Heliosat algorithm to the narrowband visible channels (0.6 and 0.8 μm) of the second generation satellites separately lead to large inhomogeneities in comparison to the MAGICSOL-V1 CDR[2]. Especially, over vegetated areas the reflectance exhibits a high spectral dependency resulting in large differences in the retrieved solar surface radiation.

As a first step to reduce the differences in retrieved surface radiation between MVIRI and SEVIRI, a simulated visible broadband channel is used that is generated by a linear combination of the two narrowband visible channels [4]. First studies of the overlap period 2004-2005 of the two Meteosat generations show good agreement over the whole disc and an especially improved agreement over the vegetated areas. Thus, the MAGICSOL-V1 CDR has been extended using this methodology until 2011. Updates of the dataset will continue on a non-regular basis.

Here we will present the extended dataset and a statistical analysis of the surface radiation climatology. Monthly means of surface radiation but also TOA cloud albedo are analysed for trends, changes in patterns and also for homogeneity between the different satellite generations. Furthermore, the dataset is compared to reference surface radiation products from ISCCP, GEWEX and ERA interim. Ground based measurements of the BSRN (Baseline surface radiation network) network are used to estimate the uncertainty of the satellite surface radiation climatology.

The MAGICSOL-V1 CDR is freely available to the research community through the CM SAF website (www.cmsaf.eu). The extension will be provided through MeteoSwiss upon request.

[1] R. Posselt, R. Müller, R. Stöckli und J. Trentmann, «CM SAF Surface Radiation MVIRI Data Set 1.0 – Monthly Means / Daily Means / Hourly Means,» Satellite Application Facility on Climate Monitoring, DOI:10.5676/EUM_SAF_CM/MAGICSOL-V1/V001, 2011.

[2] R. Posselt, R. Mueller, R. Stöckli und J. Trentmann, «Spatial and Temporal Homogeneity of Solar Surface Irradiance across Satellite Generations,» Remote Sens., Bd. 3, Nr. 5, pp. 1029-1046, 2011.

[3] R. Posselt, R. Mueller, R. Stöckli und J. Trentmann, «Remote sensing of solar surface radiation for climate monitoring - The CM SAF retrieval in international comparison,» Remote Sensing of the Environment, Bd. 118, pp. 186-198, 2012.

[4] S. Cros, M. Albuisson und L. Wald, «Simulating Meteosat-7 broadband radiances using two visible channels of Meteosat-8,» Sol. Energy, Bd. 80, Nr. 3, pp. 361-367, 2006.