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High resolution climatology
- towards climate change services

A satellite-derived climate data record of global radiation

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A 25 year long continuous and consistently validated surface incoming shortwave (SIS) radiation climate data record (CDR) from METEOSAT satellites is MeteoSwiss' contribution to CM SAF (Satellite Application Facility for Climate Monitoring). 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 and services relevant for climate monitoring in operational mode with a special emphasis on the retrieval of climate variables such as cloud parameters, radiation budget and water vapor.

The SIS CDR by MeteoSwiss and DWD is generated using an extended Heliosat algorithm which exploits the attenuation of radiation by clouds from the METEOSAT visible channel, and using the MAGIC (Mesoscale Atmospheric Global Irradiance Code) radiative transfer model that accounts for water vapor, ozone and aerosol absorption on clear sky radiation fluxes.

Besides the dataset itself, a statistical analysis of the surface radiation climatology will be presented. Monthly means of surface radiation but also TOA cloud albedo are analyzed for trends, changes in patterns and also for homogeneity between the different satellites. 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) and ASRB (Alpine surface radiation budget) network are used to estimate the uncertainty of the satellite surface radiation climatology.

In order to satisfy the dataset accuracy required for climate variability and change studies, discontinuities due to changes in satellite instrumentation must be avoided. Therefore, a selfcalibration technique within the Heliosat algorithm is applied. It uses the 95% percentile of the measured radiance distribution obtained in a selected (nearly) always cloudy region in the southern Atlantic. The overlap period between two satellites/instruments (Meteosat7 and Meteosat8 in 2005) is used to examine and validate the performance of the selfcalibration. First validation results show a good agreement for both satellite generations (within +/- 4Wm-2). Larger differences are mainly apparent in highly vegetated regions (Tropics, summer Europe) which are due to different spectral characteristics of the satellite instruments.

Special attention is also drawn to the radiative influence of snow. A time-series approach is applied which employs only a visible channel (available for all used satellites) and is based on the very low temporal variability of snow compared to clouds. In case of snow the Heliosat algorithm is slightly altered in order to account for reflected solar radiation. It is however found that this algorithm is not able to decide whether a bright pixel is due to snow (on a clear day) or clouds which results in an underestimation of the surface solar radiation in those regions. Future improvements of the algorithm should, therefore, use additional information from the IR channel to distinguish between snow and clouds.

The SIS CDR will be made available to the research community through the CM SAF website (www.cmsaf.eu) in Fall 2010.