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Abstract

The CM SAF Top of Atmosphere (TOA) Radiation MVIRI/SEVIRI Data Record provides a homogeneous satellite-based climatology of the TOA Reflected Solar (TRS) and Emitted Thermal (TET) radiation in all-sky conditions. The continuous monitoring of these two components of the Earth Radiation Budget is of prime importance to study climate variability and change. The Meteosat Visible and InfraRed Imager (MVIRI - from 1983 until 2004) and the Spinning Enhanced Visible and Infrared Imager (SEVIRI - from 2004 onward) on board the Meteosat First and Second Generation satellites are combined to generate a long Thematic Climate Data Record (TCDR). Combining MVIRI and SEVIRI allows an unprecedented temporal (30 minutes / 15 minutes) and spatial (2.5 km / 3 km) resolution compared to the Clouds and the Earth's Radiant Energy System (CERES) products. This is a step forward as it helps to increase the knowledge of the diurnal cycle and the small-scale spatial variations of radiation.

The MVIRI/SEVIRI Data Record covers a 32 years time period from 1 February 1983 to 30 April 2015. The TOA radiation products are provided as daily means, monthly means and monthly averages of the hourly integrated values (diurnal cycle). To ensure consistency with other CM SAF products, the data is provided on a regular grid at a spatial resolution of 0.05 degrees (i.e. about 5.5 km) and covers the region between $\pm 70^\circ$ longitude and $\pm 70^\circ$ latitude.

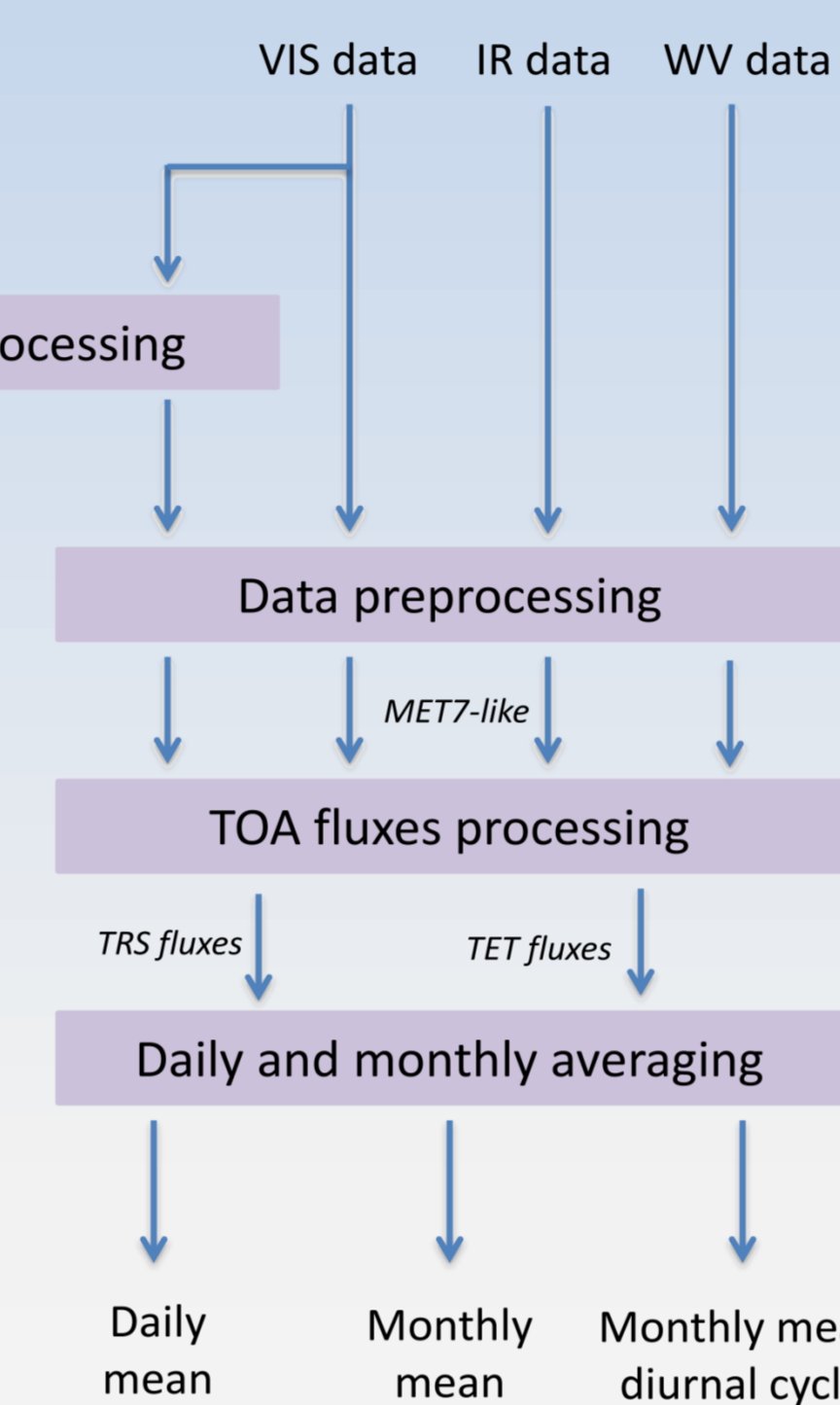
Processing overview

The **visible clear-sky processing** subsystem aims at generating the clear-sky visible data which are an important input for cloud detection and characterization. In those images, the cloud effect has been filtered by image processing techniques.

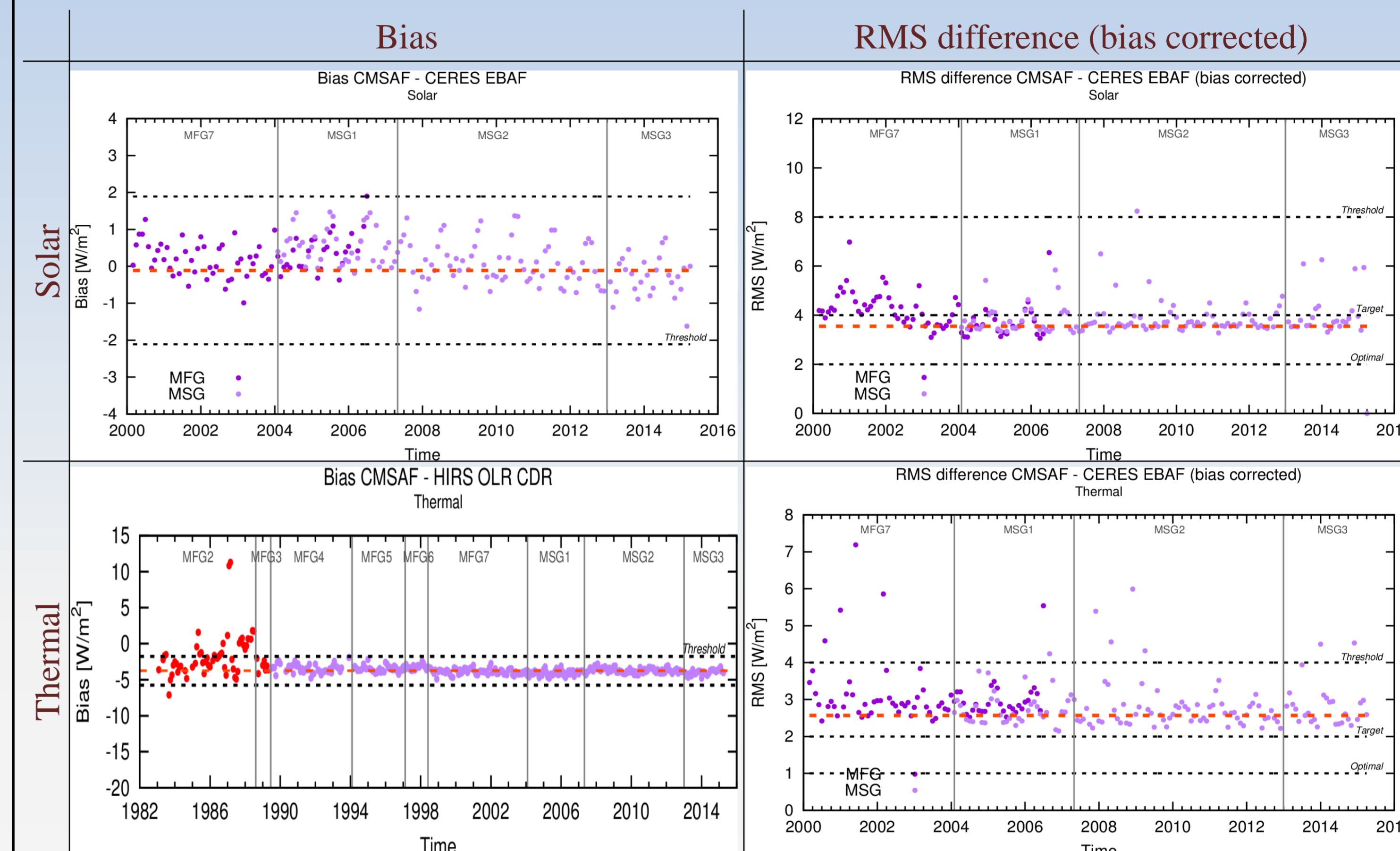
The **data preprocessing** subsystem performs several corrections of the input clear-sky visible, visible (VIS), water vapour (WV) and infrared (IR) data, such as calibration, ageing correction and conversion to equivalent Meteosat-7 (MET7-like) observations.

In the **TOA fluxes processing**, the TRS and TET instantaneous radiative fluxes are generated at time of the imager acquisition from the MET7-like observations through various stages: a scene identification, narrowband-to-broadband relations and a radiance to flux conversion (ADMs).

Finally, the **daily and monthly averaging** subsystem performs the averaging of the TRS and TET fluxes in hourly boxes, from which the DM, MM and MMDC are estimated. The data are then re-gridded from the geostationary grid onto a common regular grid with a spatial resolution of $(0.05^\circ)^2$.



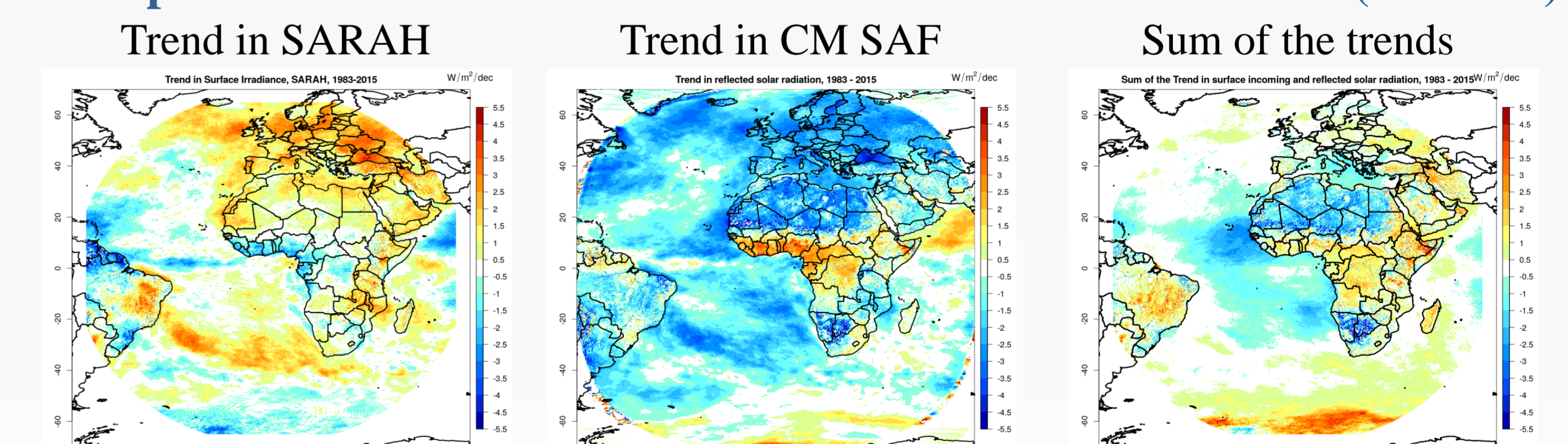
Evaluation



Summary of the errors

Error sources	MM		DM		MMDC	
	TRS	TET	TRS	TET	TRS (midday)	TET
Stability error	Stability of all the products better than 4 W/m ² (max-min)					
Processing error	3.6 W/m ²	2.6 W/m ²	6.5 W/m ²	4.2 W/m ²	11.0 W/m ²	3.5 W/m ²
Additional error due to missing input data	0.3 W/m ² /day	0.2 W/m ² /day	0.5 W/m ²	0.3 W/m ²	0.7 W/m ² /day	0.3 W/m ² /day

Comparison with Surface Solar Radiation Dataset – Heliosat (SARAH)



Further information

The TOA Radiation MVIRI/SEVIRI Data Record has been implemented as part of the CM SAF of EUMETSAT and has been published under the DOI:10.5676/EUM_SAF_CM/TOA_MET/V001.

Urbain, M.; Clerbaux, N.; Ipe, A.; Tornow, F. Product User Manual for the Top of Atmosphere Radiation MVIRI/SEVIRI Data Record. CM SAF- RMIB, 1.1 ed., 2016. DOI:10.5676/EUM_SAF_CM/TOA_MET/V001.

Urbain, M.; Clerbaux, N.; Ipe, A.; Tornow, F. Scientific Validation Report for the Top of Atmosphere Radiation MVIRI/SEVIRI Data Record. CM SAF- RMIB, 1.1 ed., 2016. DOI:10.5676/EUM_SAF_CM/TOA_MET/V001.

Urbain, M.; Clerbaux, N.; Ipe, A.; Tornow, F. Algorithm Theoretical Basis Document for the Top of Atmosphere Radiation MVIRI/SEVIRI Data Record. CMSAF - RMIB, 1.3 ed., 2016. DOI:10.5676/EUM_SAF_CM/TOA_MET/V001.

Input data

MVIRI Level 1.5 data

- MFG/MVIRI instrument characteristics :
 - > 2.5 km (Shortwave) & 5 km (Longwave) (sampling distance at sub-satellite point)
 - > 30 min (acquisition frequency)
 - > 1977-2006 (archived data since 1982)

SEVIRI Level 1.5 data

- MSG/SEVIRI instrument characteristics :
 - > 3 km (sampling distance at sub-satellite point)
 - > 15 min (acquisition frequency)
 - > 2002-TBC

SAF = Satellite Application Facility

Climate Monitoring SAF

- Objectives :** exploit the European meteorological satellites data to develop, generate, archive and distribute high-quality products of the energy & water cycle in support to monitor, understand and adapt to climate variability and climate change
- Website:** <http://www.cmsaf.eu>

Products features

Product name	TRS - Top of atmosphere Reflected Solar radiative flux TET - Top of atmosphere Emitted Thermal radiative flux
Temporal coverage	1983.02.01 – 2015.04.30 (32 years)
Temporal resolution	Daily Mean (DM), Monthly Mean (MM), Monthly Mean Diurnal Cycle (MMDC)
Spatial coverage	METEOSAT disk (geostationary orbit at 0° longitude)
Spatial resolution	$(0.05^\circ)^2$ i.e. $\sim (5.5 \text{ km})^2$ (regular grid)
File format	NetCDF (following the CF convention)

Products Examples

