The climate monitoring SAF TOA radiation products

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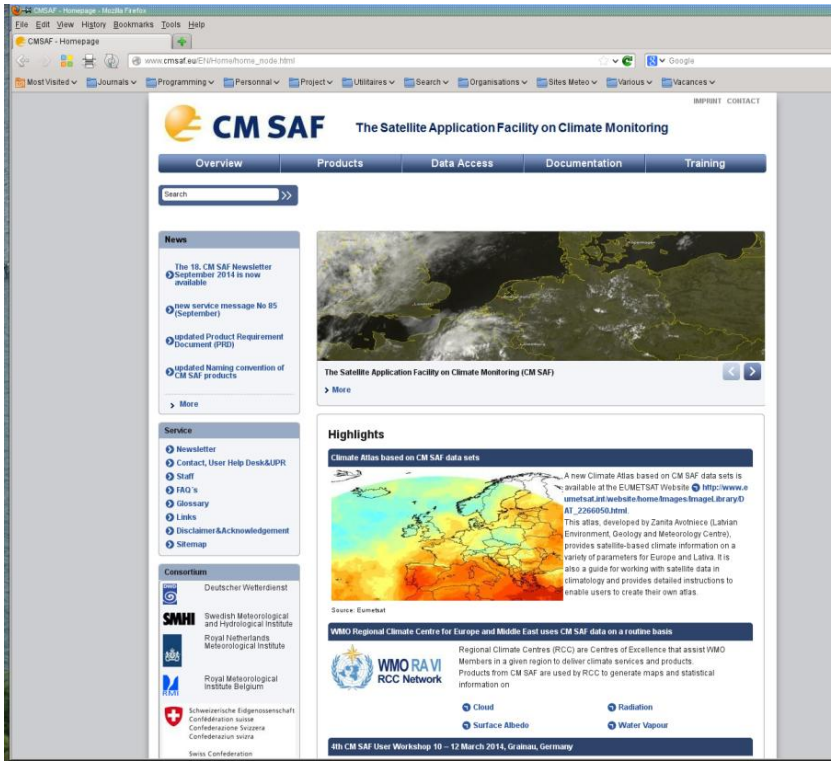
Content:

- Brief introduction to Climate Monitoring Satellite Application Facility (CM SAF) – illustrations of available products/datasets
- CM SAF GERB/SEVIRI TOA radiation dataset (edition 1)
- Developments toward an edition-2
- Summary

What is CM SAF?

- Climate products from (weather) satellites
- Part of EUM ground segment
- Products target the energy and water cycles
- 3 types of products:
  - EDR = Environmental Data Record
  - ICDR = Interim Climate Data Record
  - TCDR = Thematic Climate Data Record
- Global/regional products
- Polar and geo satellites
- User's oriented programme: help desk, web user interface, data ordering system, users training events, …
- Operational: annual quality ass. Review, operation reviews, …
- Guidance from a steering group, visiting scientist programme, …

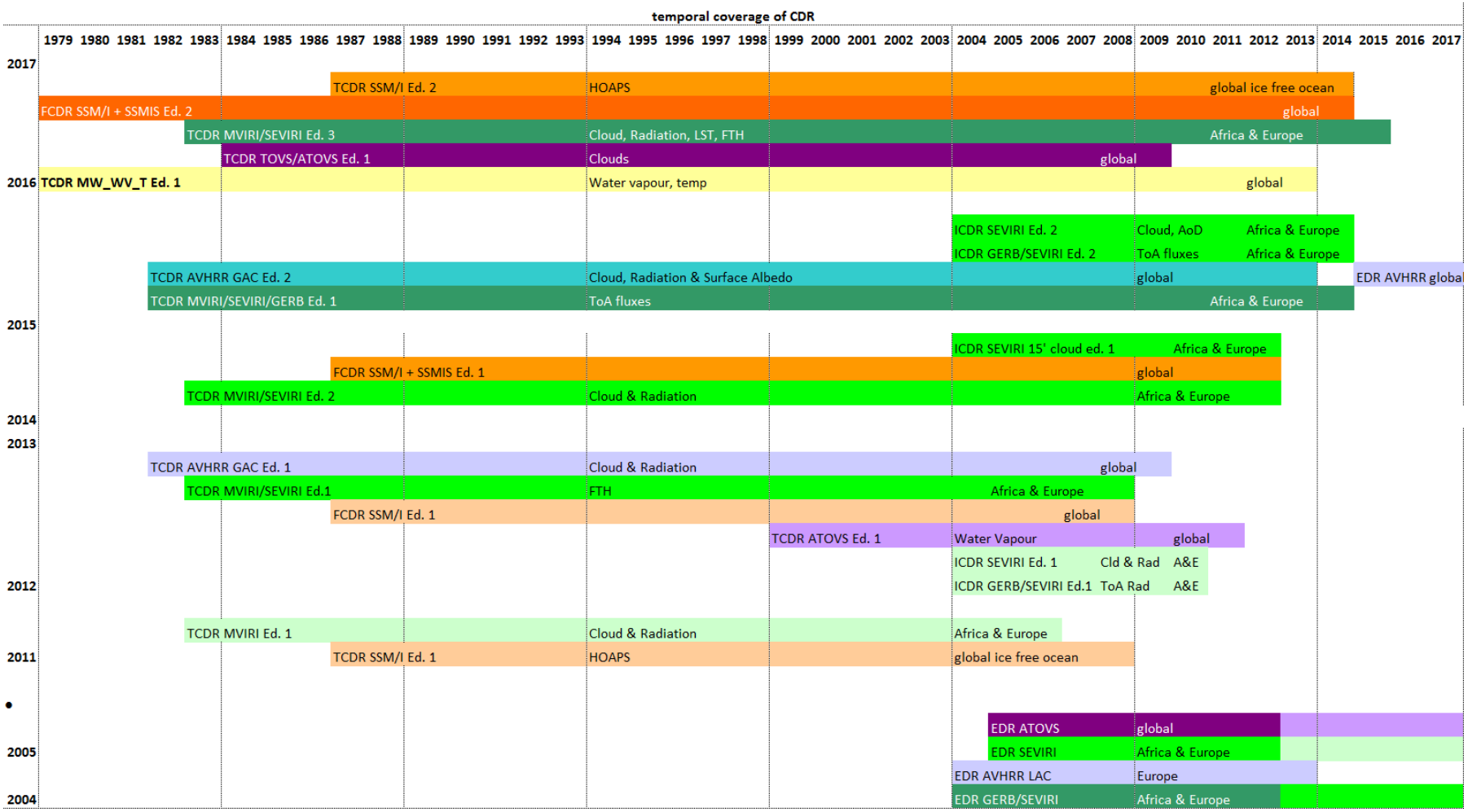


http://www.cmsaf.eu

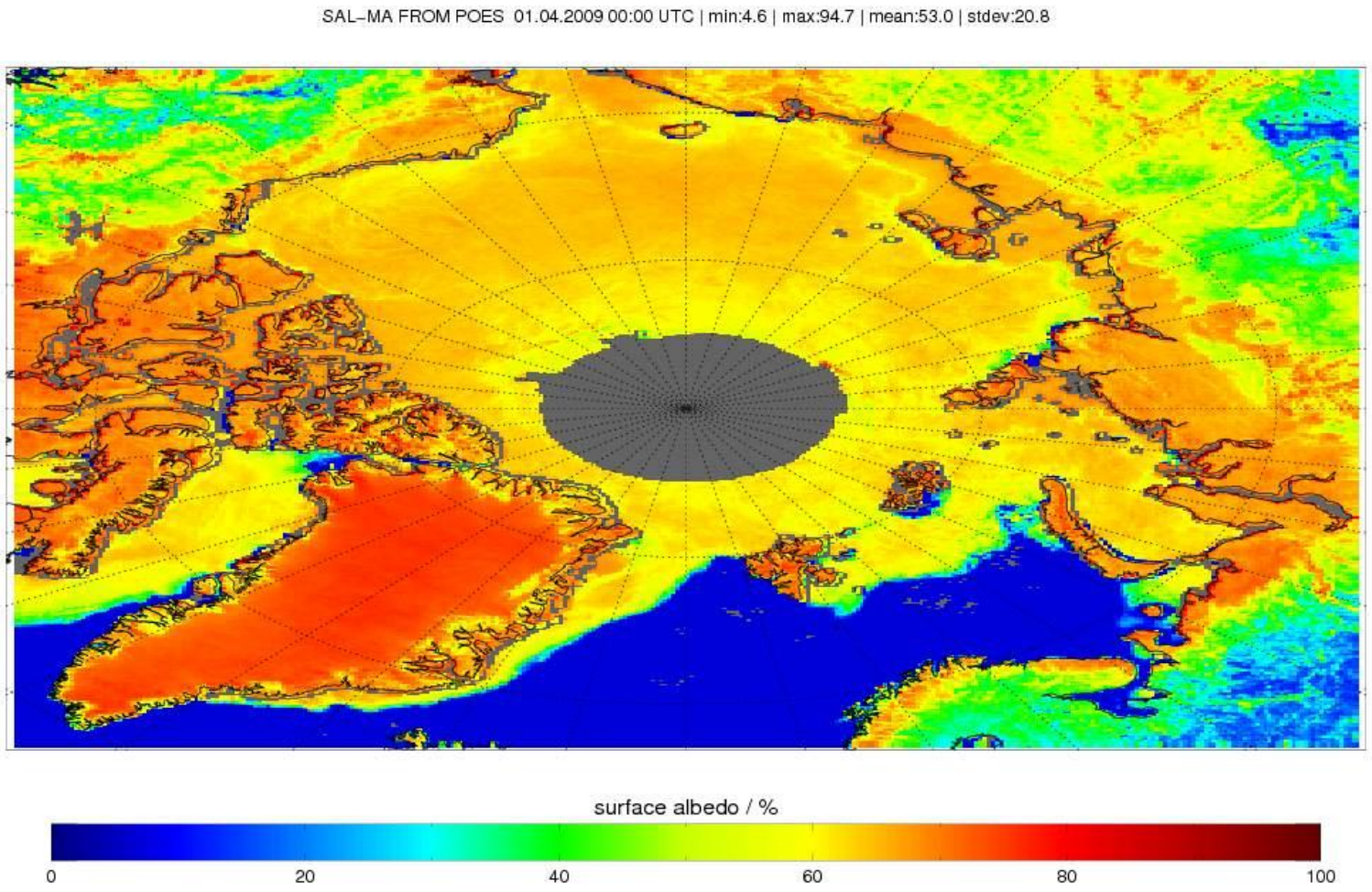
also

CM SAF will have a "booth" at the Climate Symposium next week.

CM SAF datasets delivery schedule



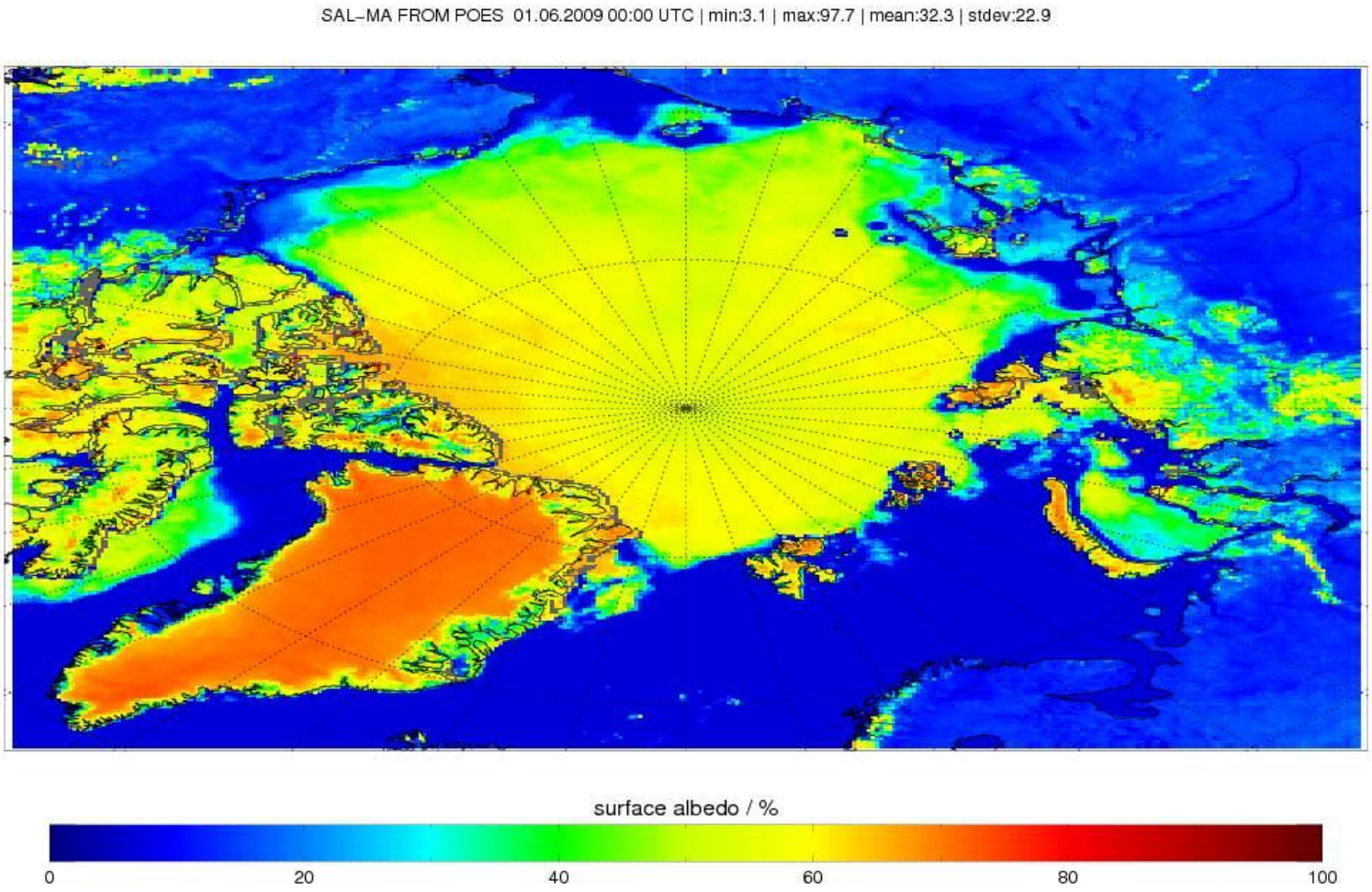
Surface albedo in the Arctic



Monthly mean, 15x15 km², 200904

SAL is based on the FMI retrieval algorithm, here applied to AVHRR.

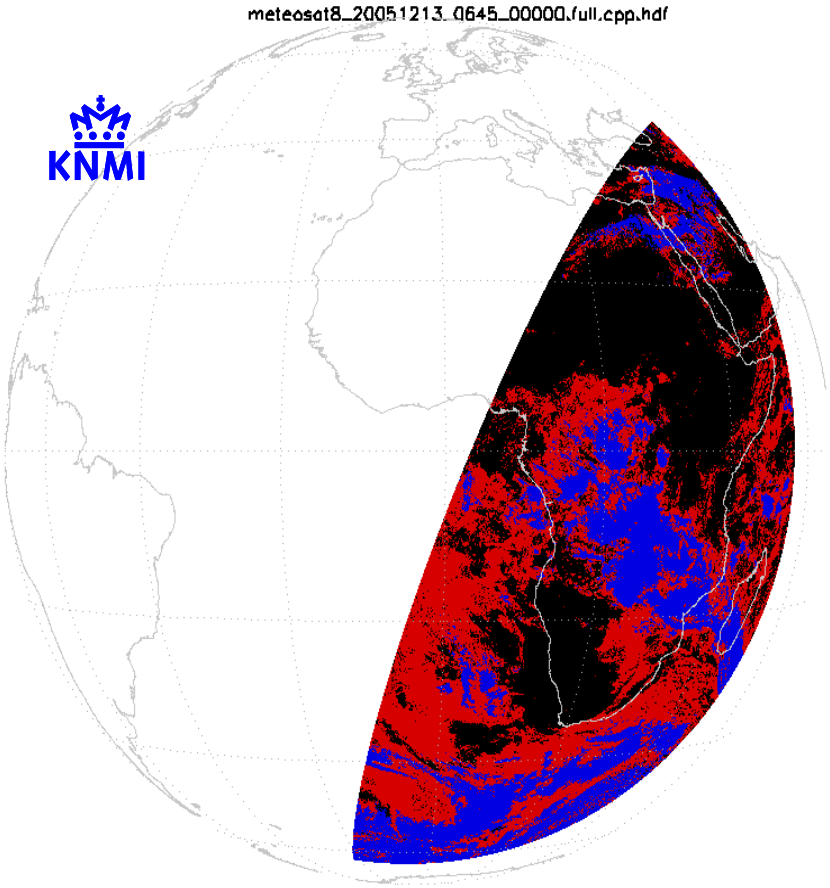
Surface albedo in the Arctic

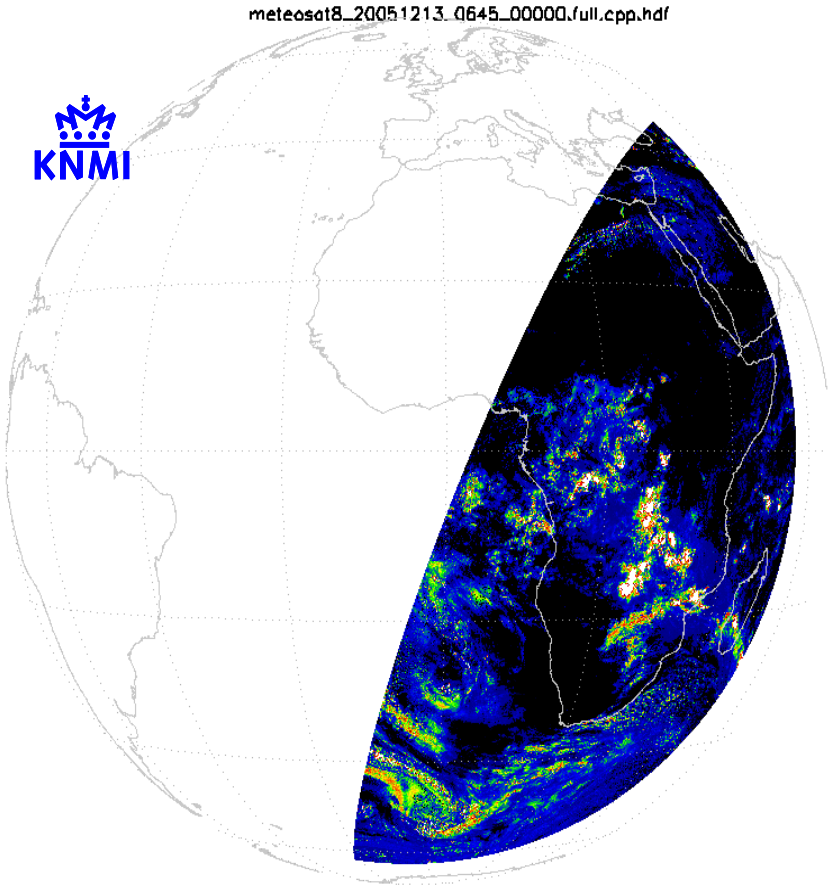


Monthly mean 200906

Enables the monitoring of the Arctic melting season.

Clouds diurnal cycle
Meteosat Seconde Generation





Cloud phase

water **ice** **cloud-free**

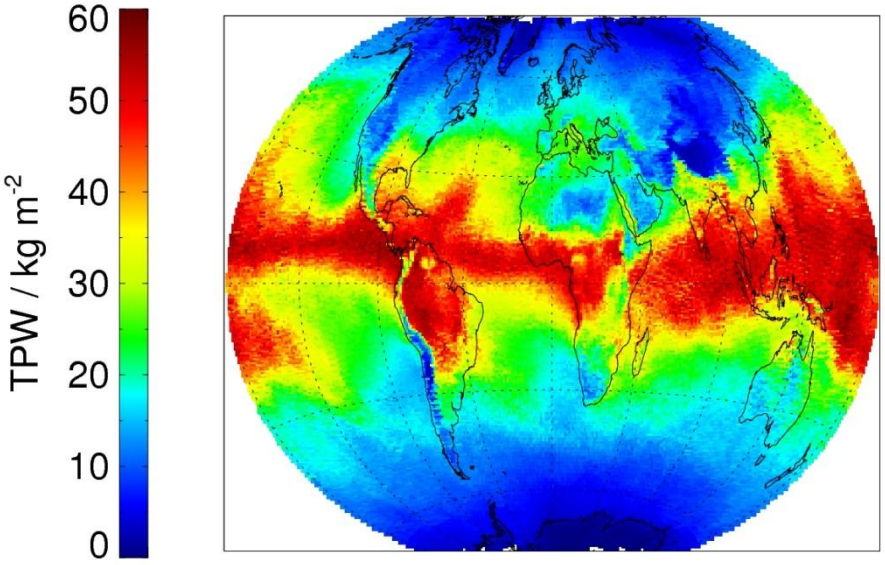
Cloud optical thickness

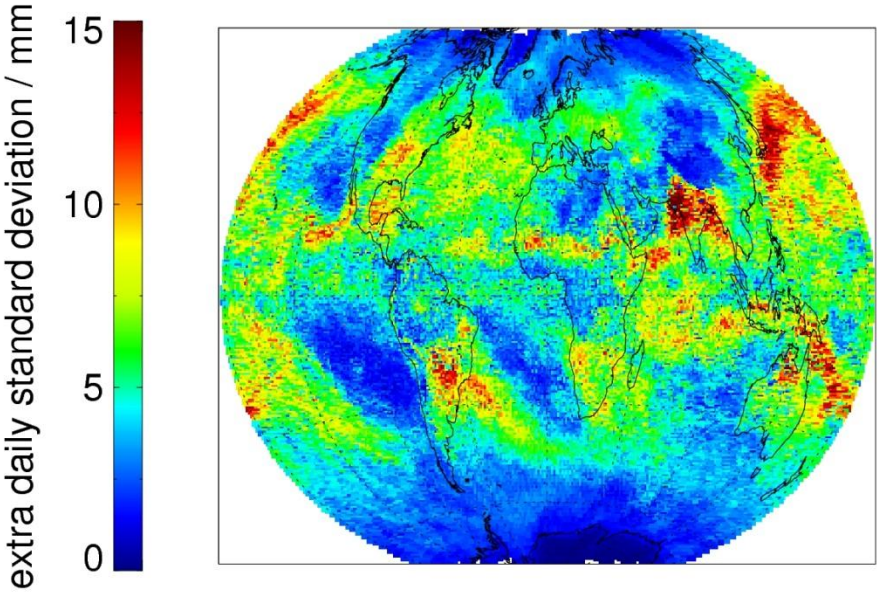
0 7 14 21 28 35 42 49 56 63 70

ATOVS

A**dvanced** T**IROS-N** O**perational** V**ertical** S**ounder**

- Utilises AAPP and IAPP to derive water vapour and temperature profiles from ATOVS observations from NOAA-15, -16, -18 and -19 and MetOp satellites.
- Swath-based output of IAPP is quality controlled, vertically integrated and averaged into 5 atm. layers.
- A Kriging routine (Lindau+Schulz, 2004) is applied to provide:
  - global products on equal area (90 km)^2 grid (left), standard deviations (right),
  - daily and monthly averages.





Example for October 2004

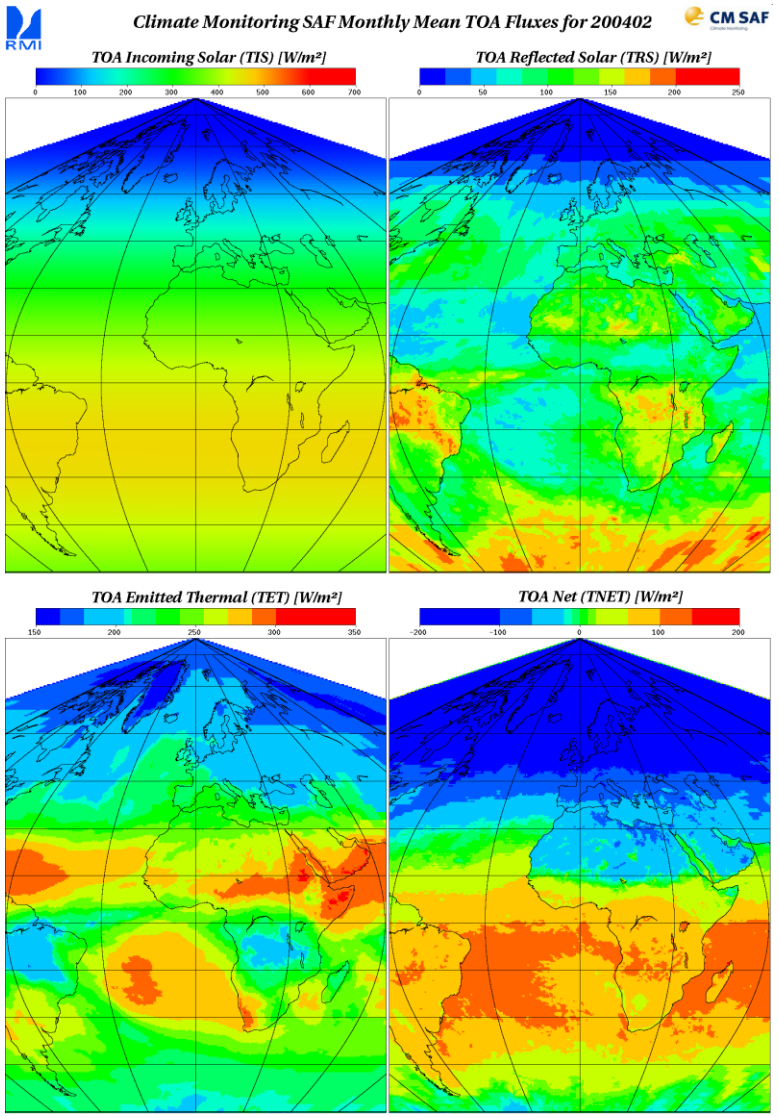
TOA radiation EDRs

- TIS : TOA Incoming Solar
- TRS : TOA Reflected Solar
- TET : TOA Emitted Thermal

- Monthly mean
- Daily mean
- Monthly mean diurnal cycle

- Not homogeneous time series

- Produced in NRT since 2004

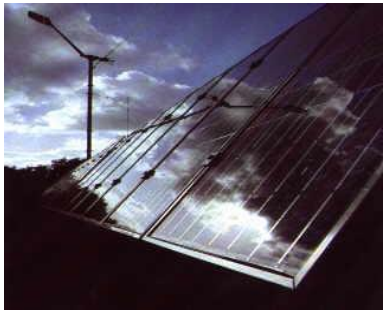


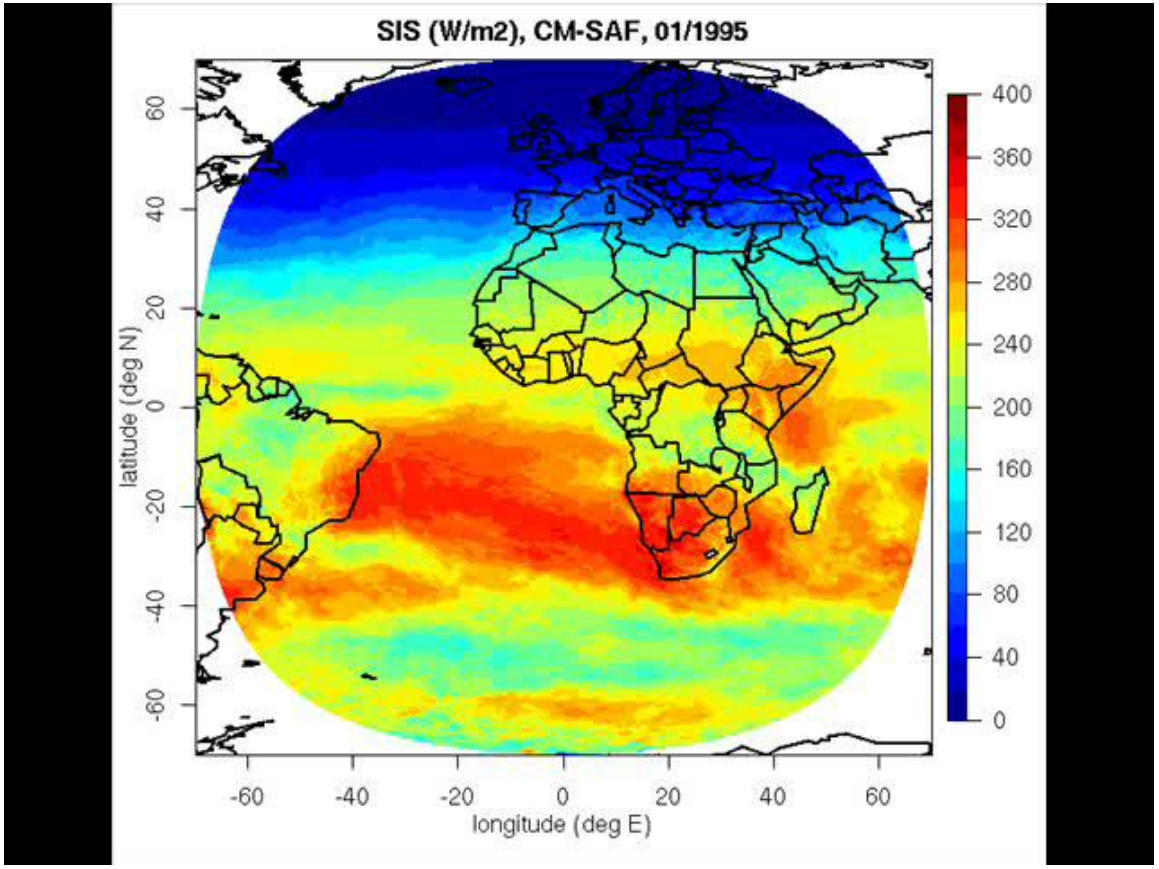
Example for February 2004

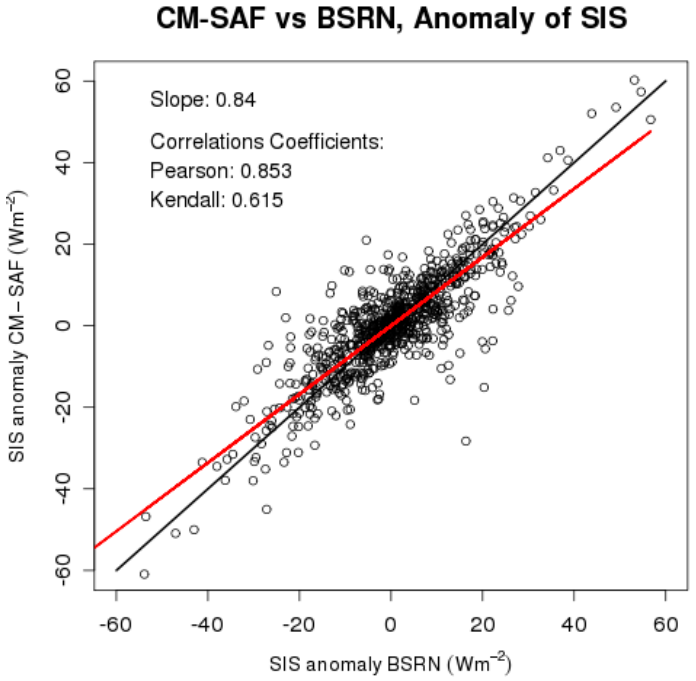
CDR of Surface Radiation products

Solar surface radiation (SIS) (1983-2010)

- e.g. application for Photovoltaic systems
- Accuracy: 10 W/m², high spatial-temporal resolution







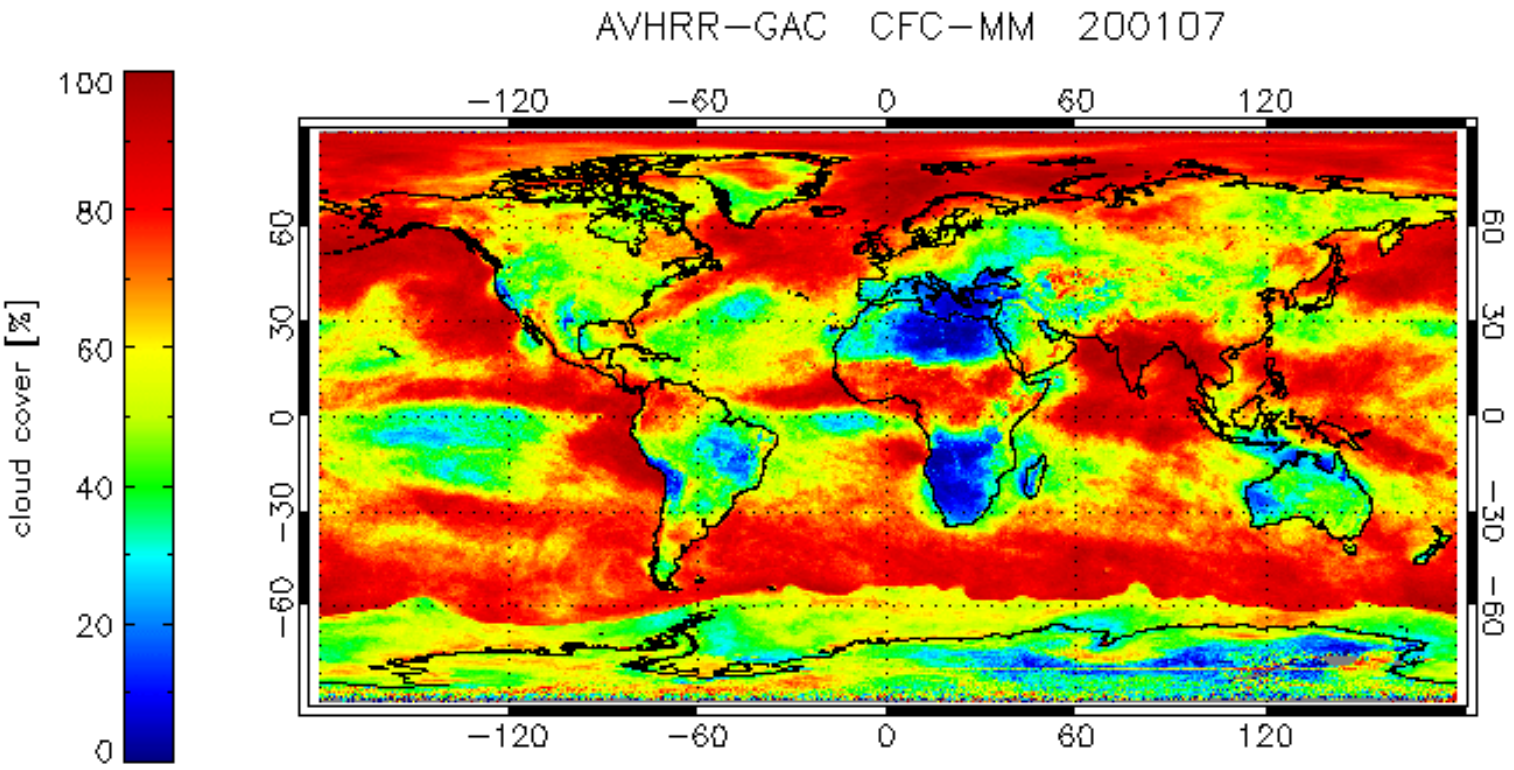
Comparison vs. *Baseline Surface Radiation Network* (BSRN)

Global CDR AVHRR GAC cloud properties

Cloud Fractional Coverage (CFC)

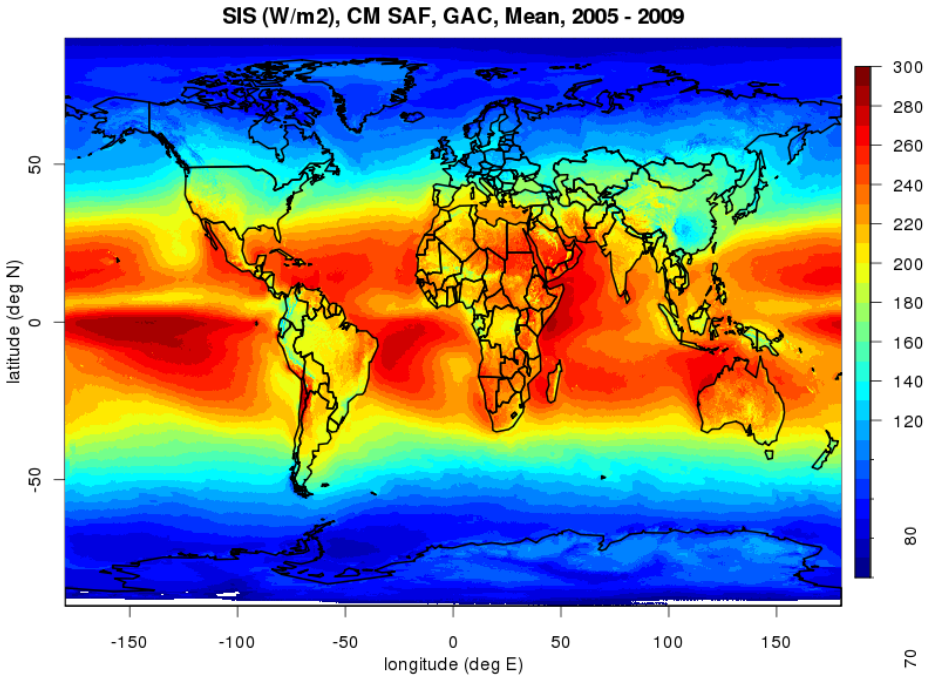
- First global CM SAF AVHRR GAC cloud data sets
- temporal coverage 1982 to 2009

Released

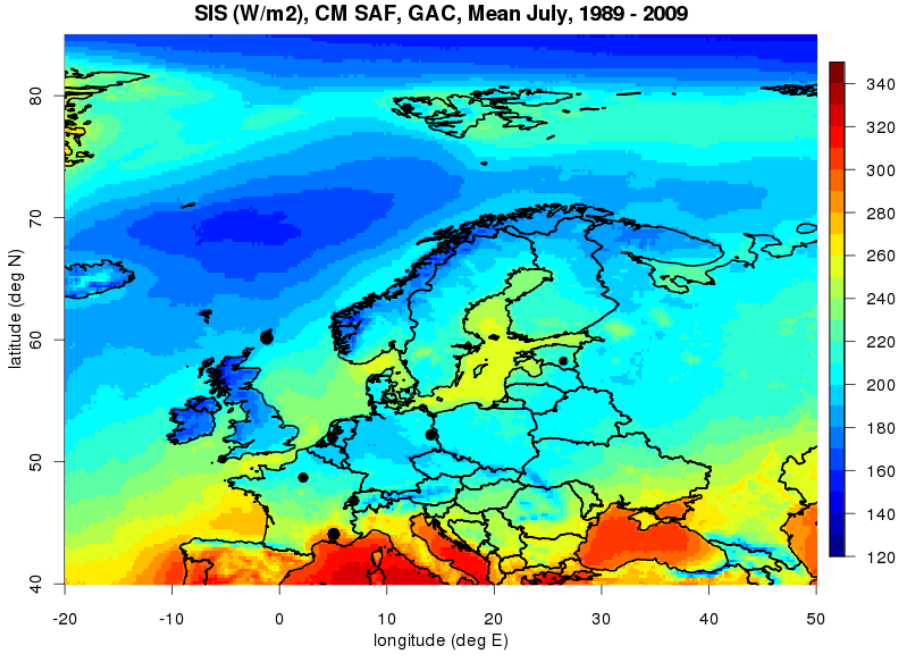


Animation of monthly mean cloud fraction for July (2001 - 2009)

Global CDR AVHRR GAC Surface Solar Radiation



Released

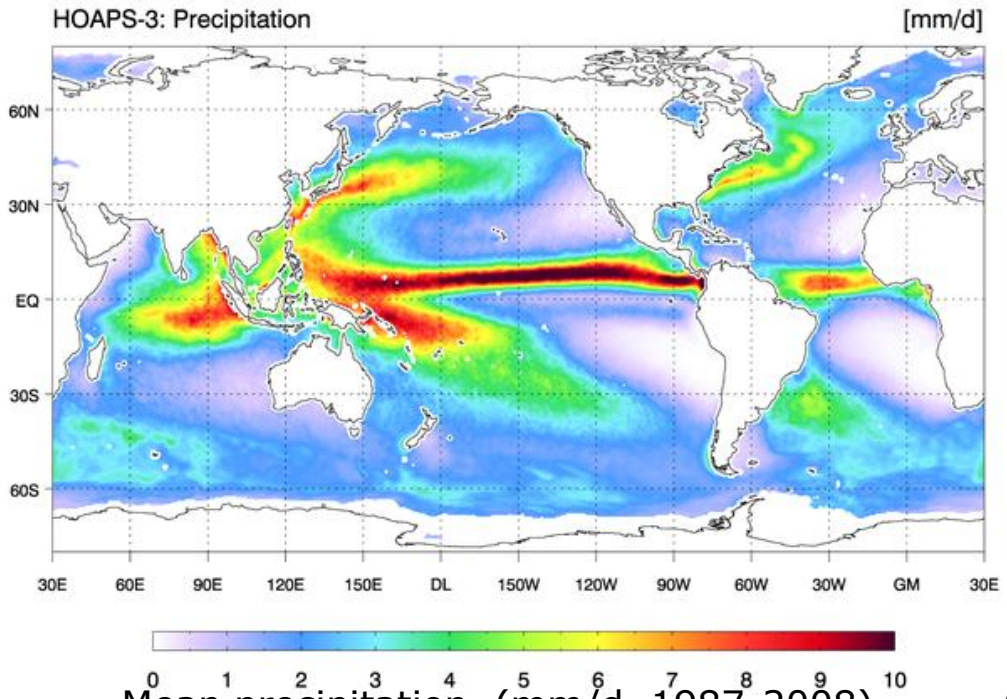


Global Surface solar radiation 5-year mean (top)

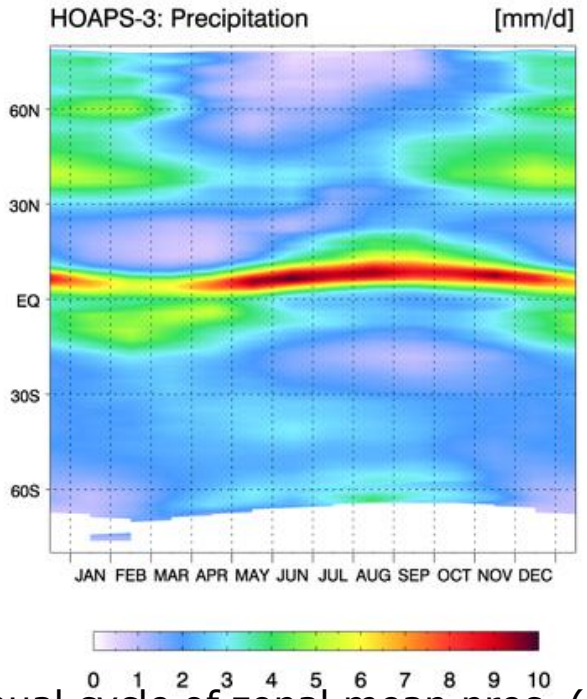
20 year monthly mean of July in Europe (right)

Hamburg Ocean-Atmosphere Parameters and fluxes from Satellite data (HOAPS) TCDR

- Thematic Climate Data Records from HOAPS released as HOAPS v3.2. Covered time period from 1987 until 2008 using observations from F08, F10, F11, F13, F14 and F15
- Parameters are: near surface wind speed, near surface humidity, precipitation, latent heat flux, evaporation, freshwater flux, …
- Products available as monthly means and 6-hourly composites on a regular lat-lon grid at 0.5 degree resolution, products also available on native SSM/I resolution on request



Mean precipitation (mm/d, 1987-2008)



Annual cycle of zonal mean prec. (mm/d)

CM SAF GERB/SEVIRI TOA radiation dataset : edition-1

- Released in 2013
- Feb. 2004- Jan. 2011
- All sky TRS and TET
- SEA grid 45km
- In NetCDF CF conv.
- Monthly Mean (MM), Daily Mean (DM) and Monthly Mean Diurnal Cycle (MMDC = M1hour)

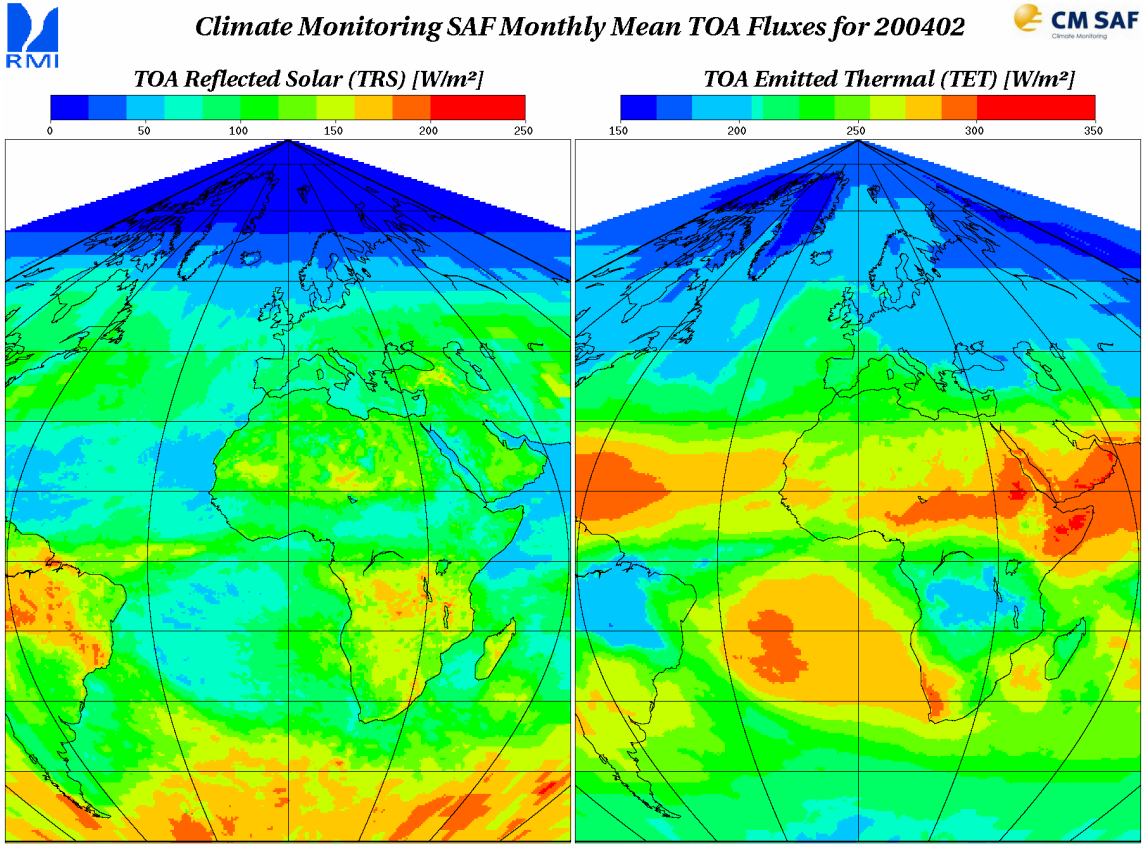


Illustration of Monthly Mean (MM)

Illustration : TOA radiation daily means

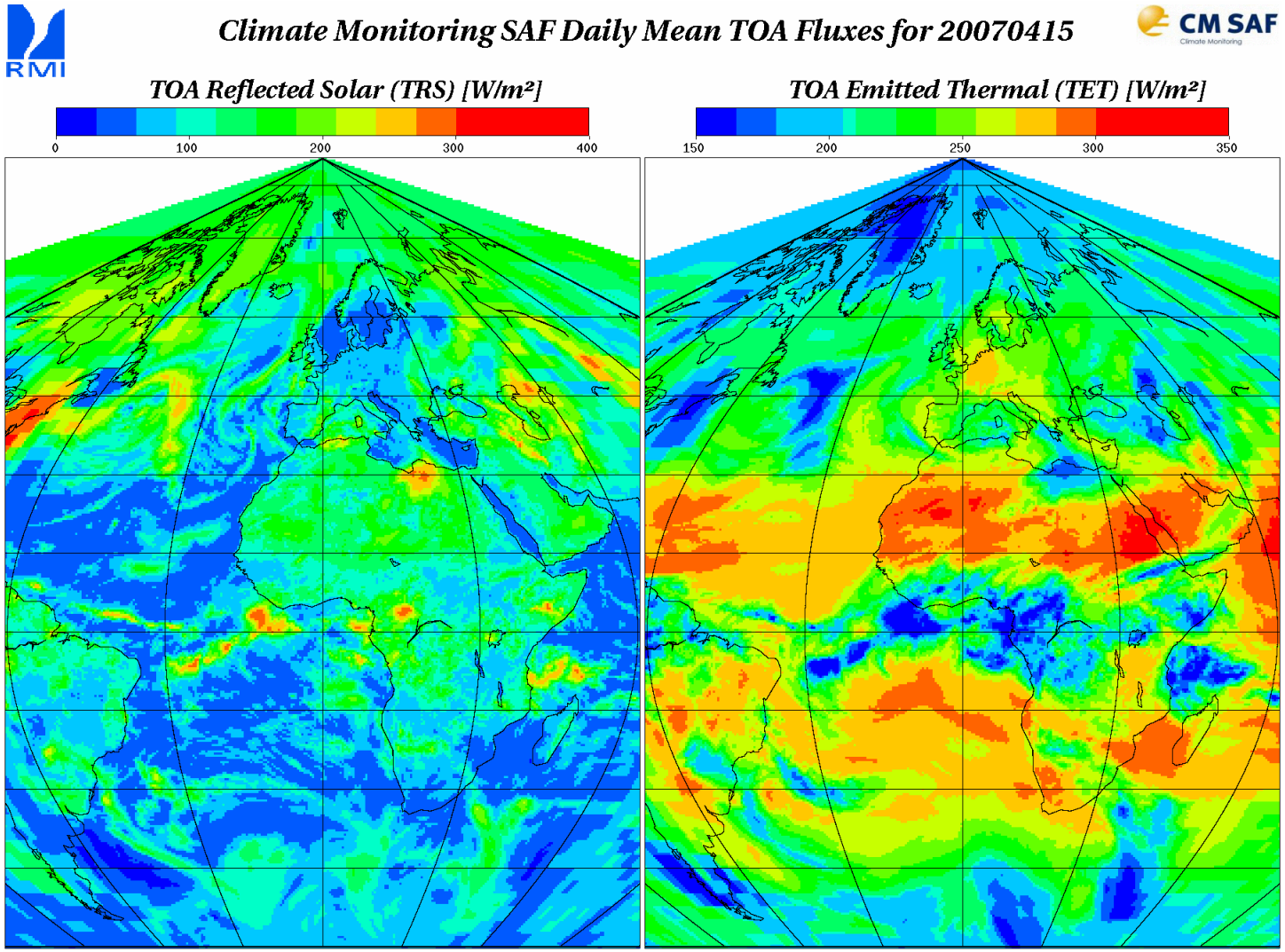
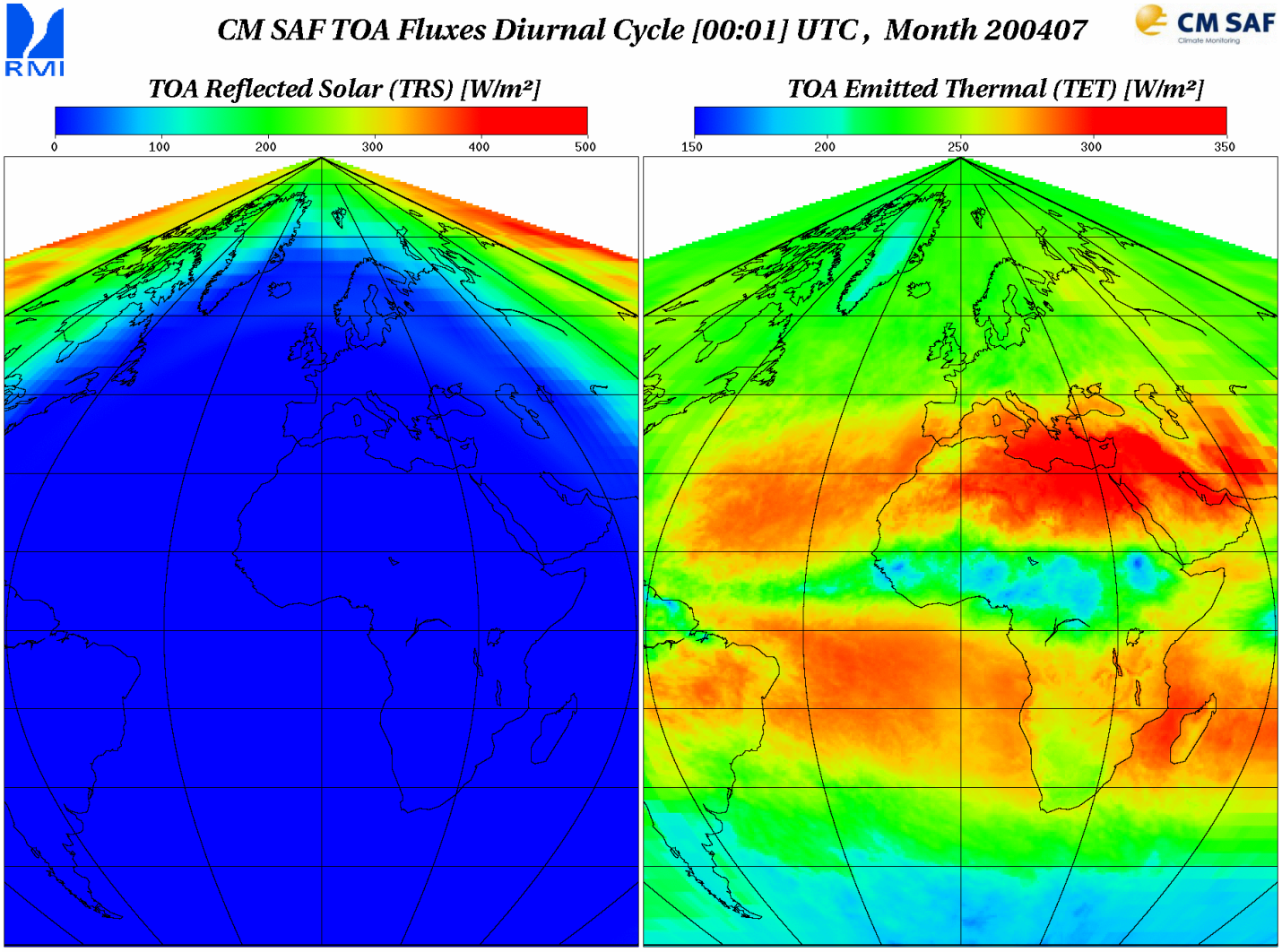
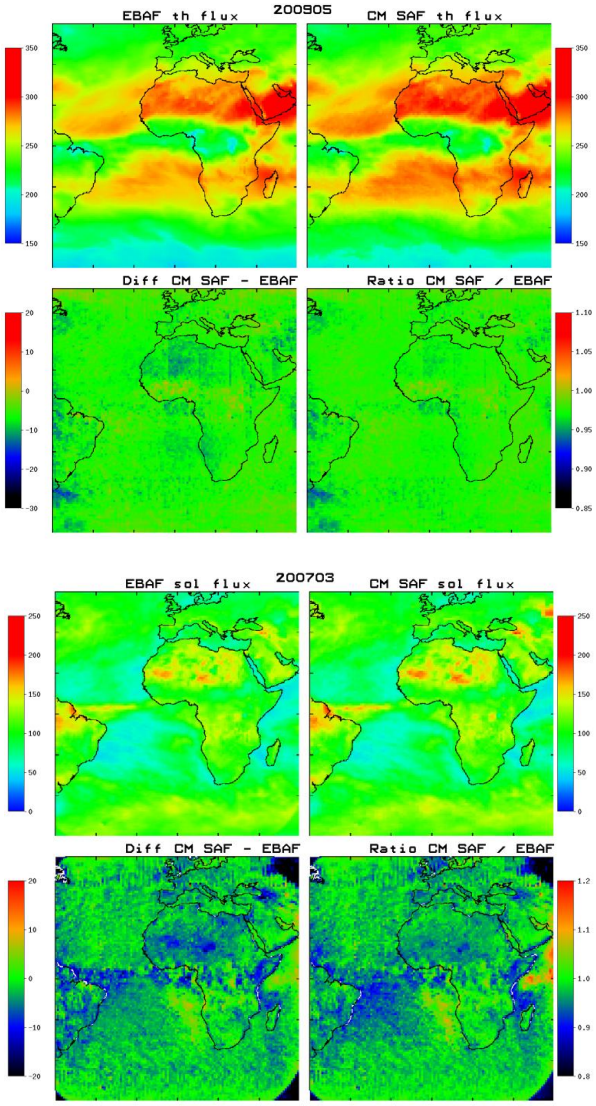


Illustration : TOA radiation monthly mean diurnal cycle



CM SAF GERB/SEVIRI TOA rad. dataset validation

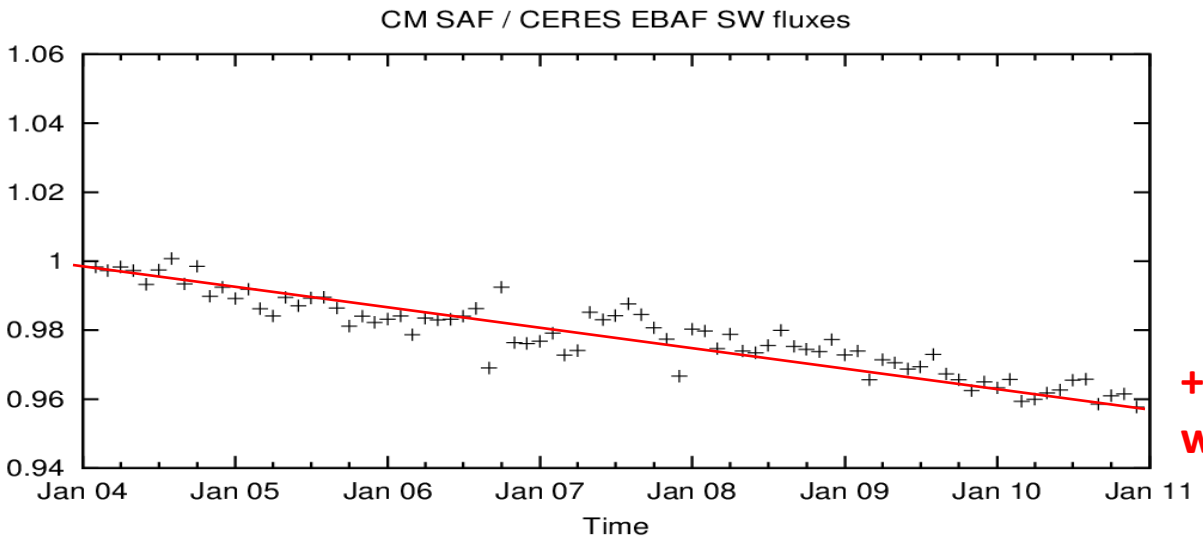


Estimated uncertainty at 1-sigma :

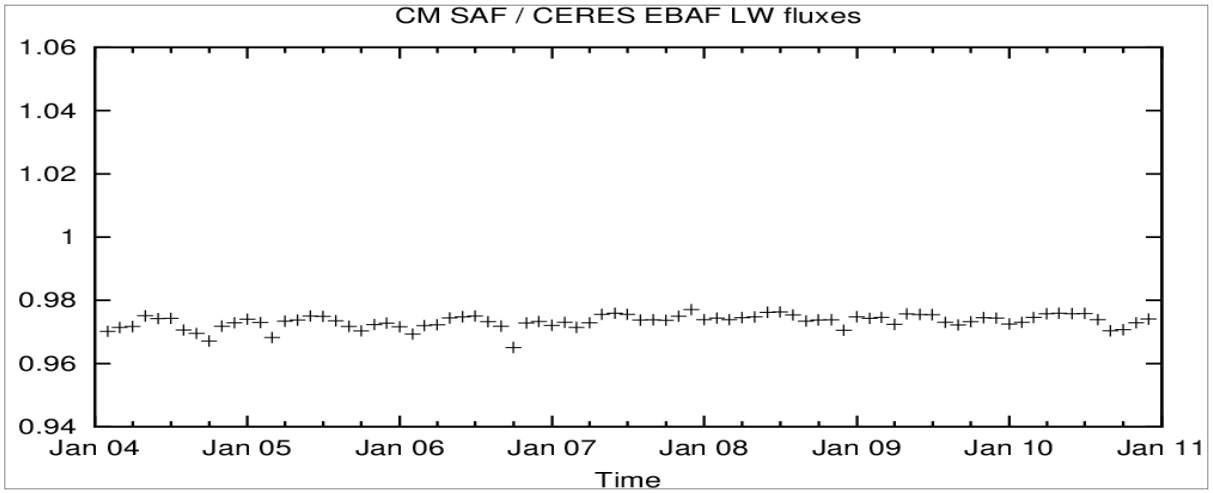
	TRS	TET
Monthly mean	4.0 W/m²	3.4 W/m²
Daily mean	6.2 W/m²	4.6 W/m²
MM diurnal cycle	14.5 W/m²	4.3 W/m²

(See Validation Report)

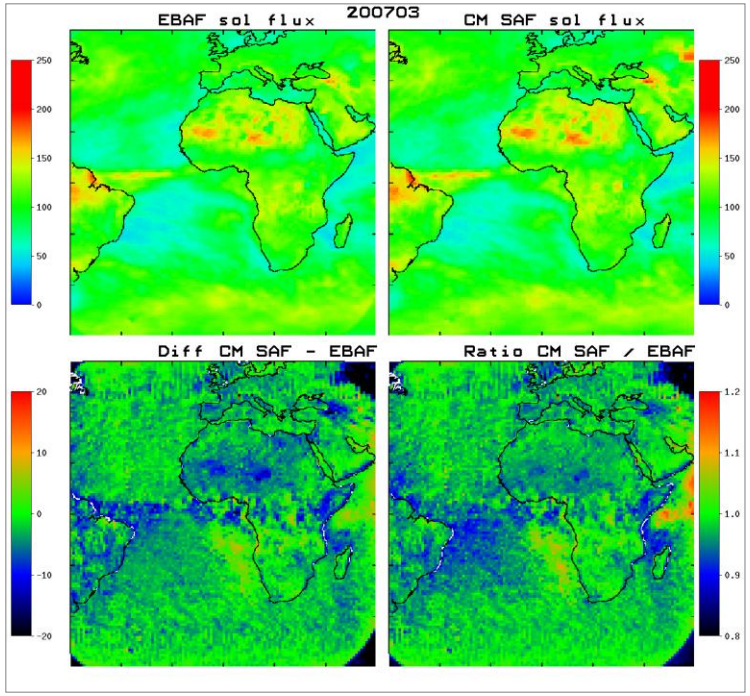
Validation: stability of the MM products

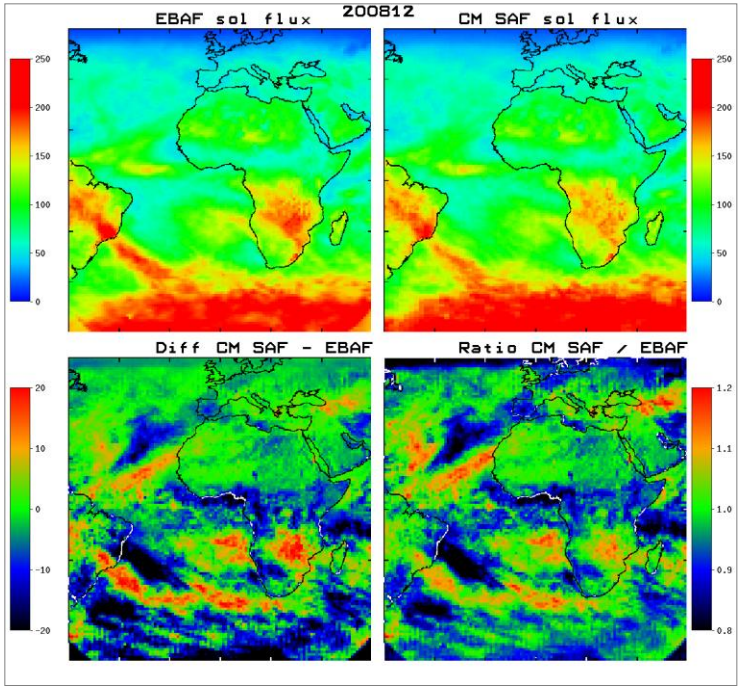


+/-0.6 %/ years wrt EBAF

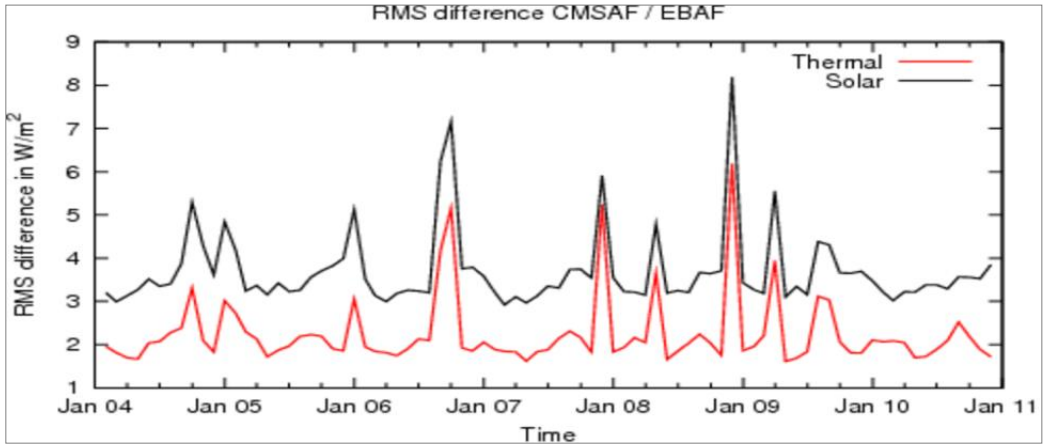


TRS MM validation : intercomparison with CERES

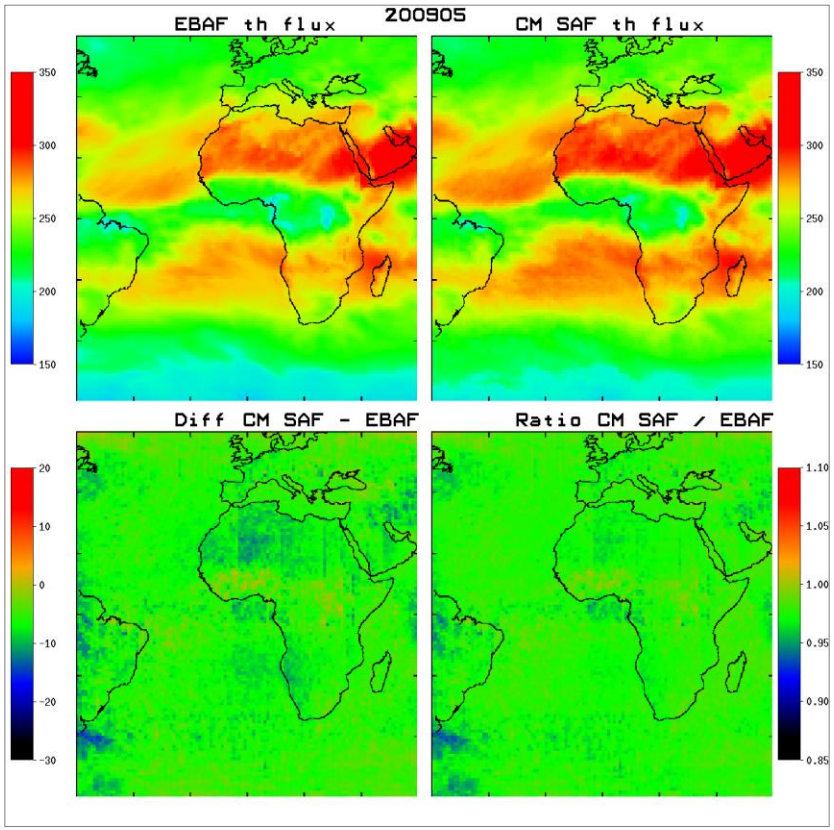


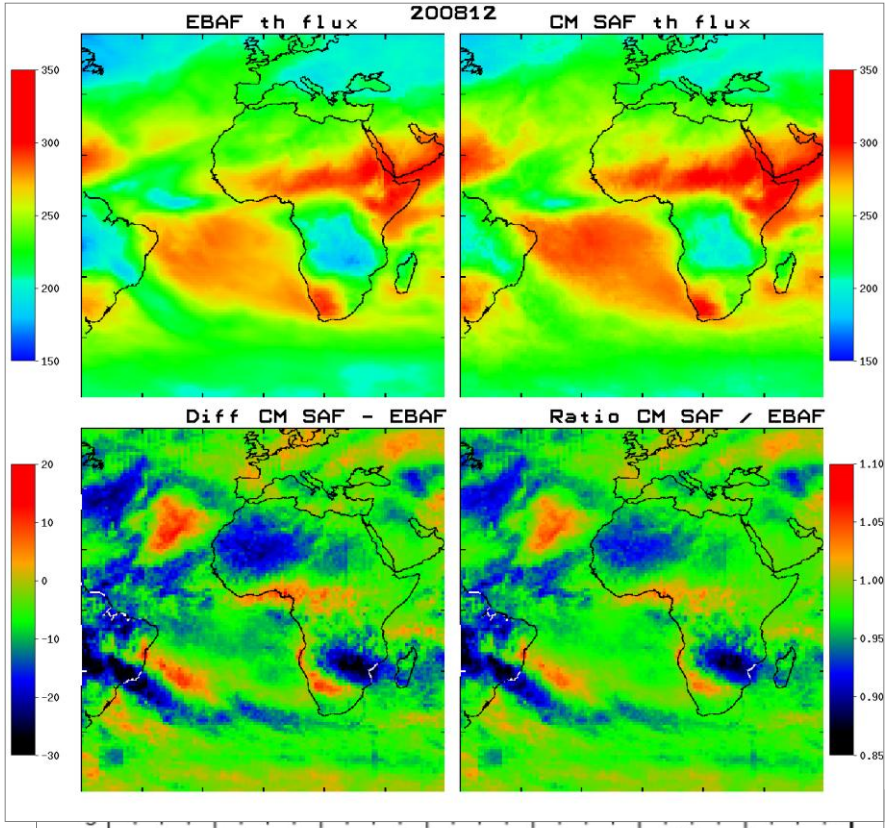


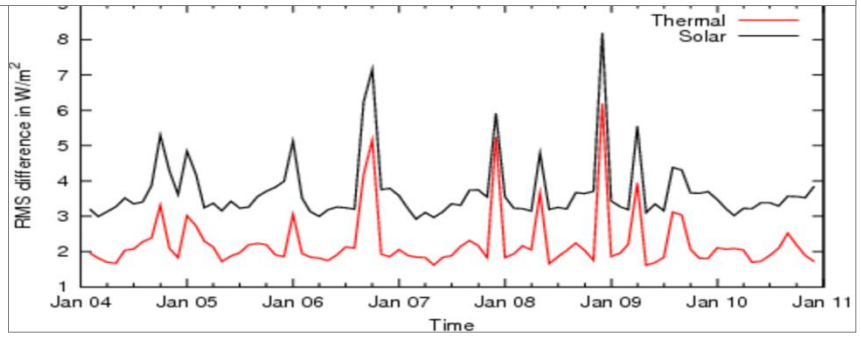
RMS difference with CERES EBAF ~ 3 W/m²



TET MM validation : intercomparison with CERES







RMS difference with
CERES EBAF ~ 2 W/m²

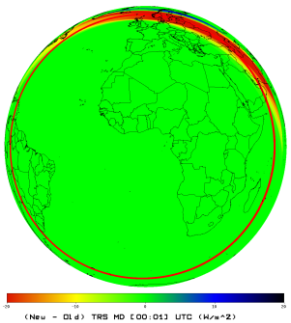
Toward CM SAF GERB/SEVIRI dataset ed02
Improvements wrt ed01

Edition-1

(released in 2013)

- GERB with masked sun-glint and terminator
- Feb. 2004 – Jan. 2011
- SEA (45km)² grid
- Allsky TRS and TET
- No aging correction
- Recalibration to GERB-1 level

- Only operational satellite

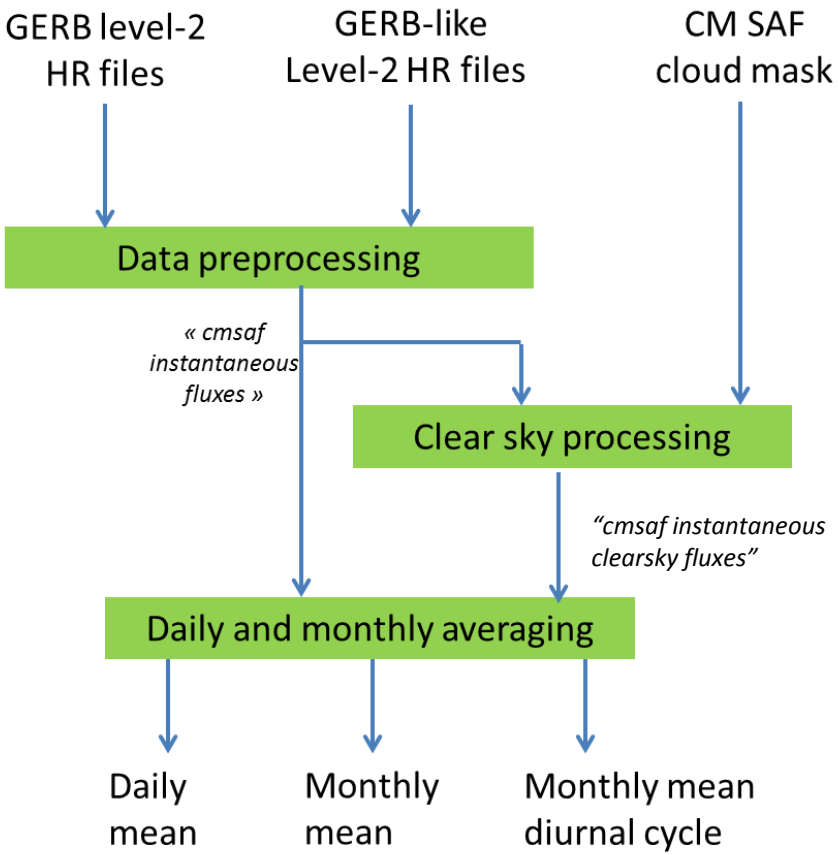


Edition-2

(to be released mid-2015)

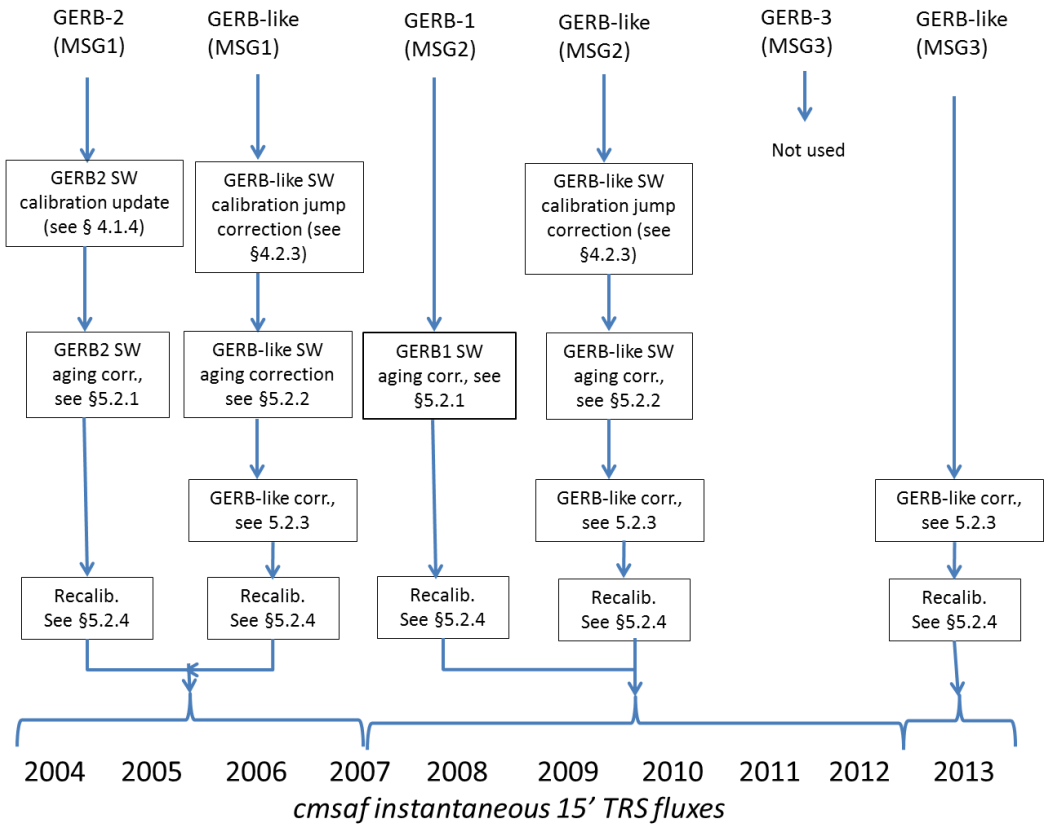
- Improved GERB data at input (filled HR files)
- Feb. 2004 – Jan. 2014
- GERB HR geo grid (9km² sub-sat)
- Allsky and clearsky TRS and TET
- GERB and SEVIRI SW aging corrections
- Recalibration to average of GERB-1 and GERB-2 level (TBC with GERB instrument principal scientist)
- Also use data from the backup MSG satellites in case of decontamination/failure

Edition-2 processing overview

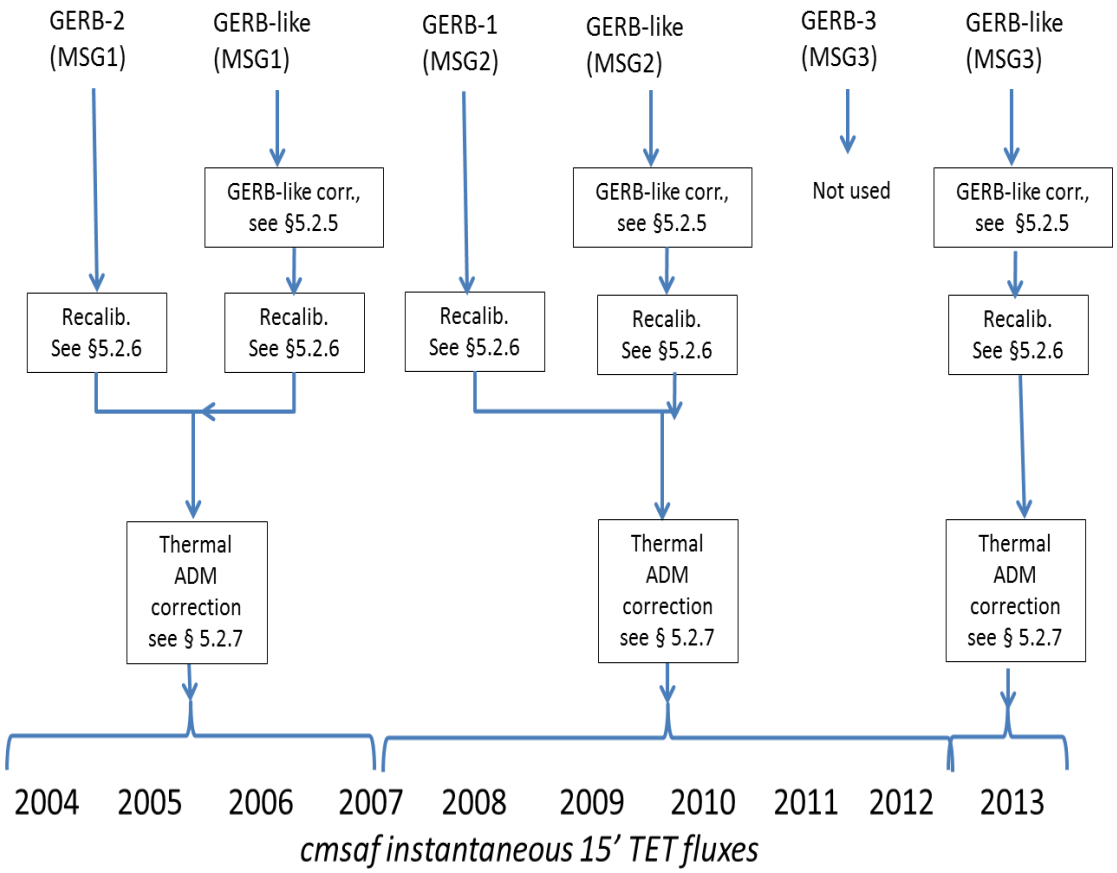


GERB / GERB-like data preprocessing - SW

Aging correction → (see after)



GERB / GERB-like data preprocessing - LW



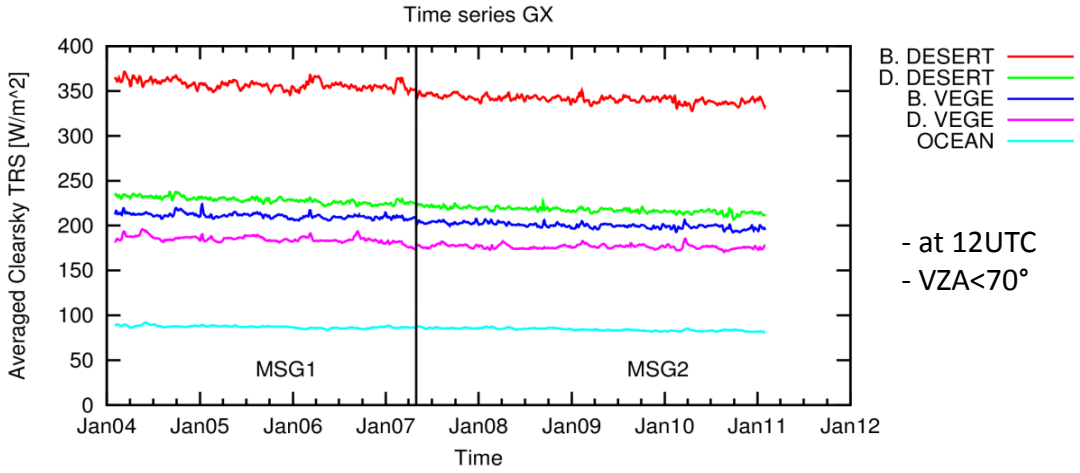
SW aging correction

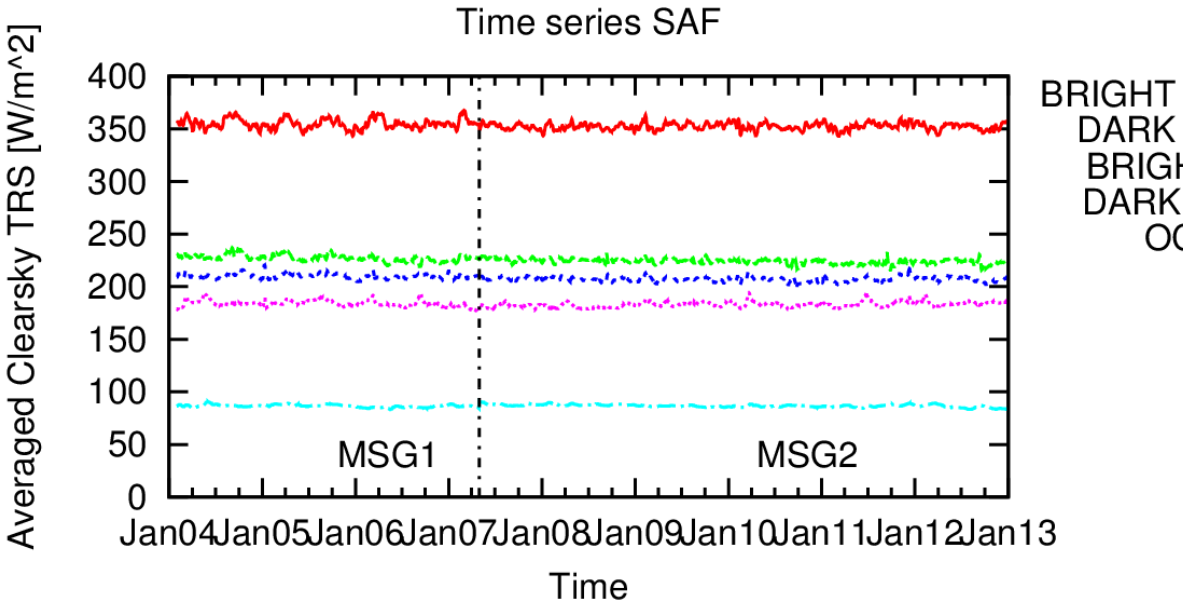
- Based on clear desert region or DCC (TBC)
- Linear temp. drift (desert):

	GERB	GERB-like
MSG1 (GERB2)	- 0.696 % /year	-0.51 % /year
MSG2 (GERB1)	-0.643% /year	-0.46% /year

- Overall level correction:

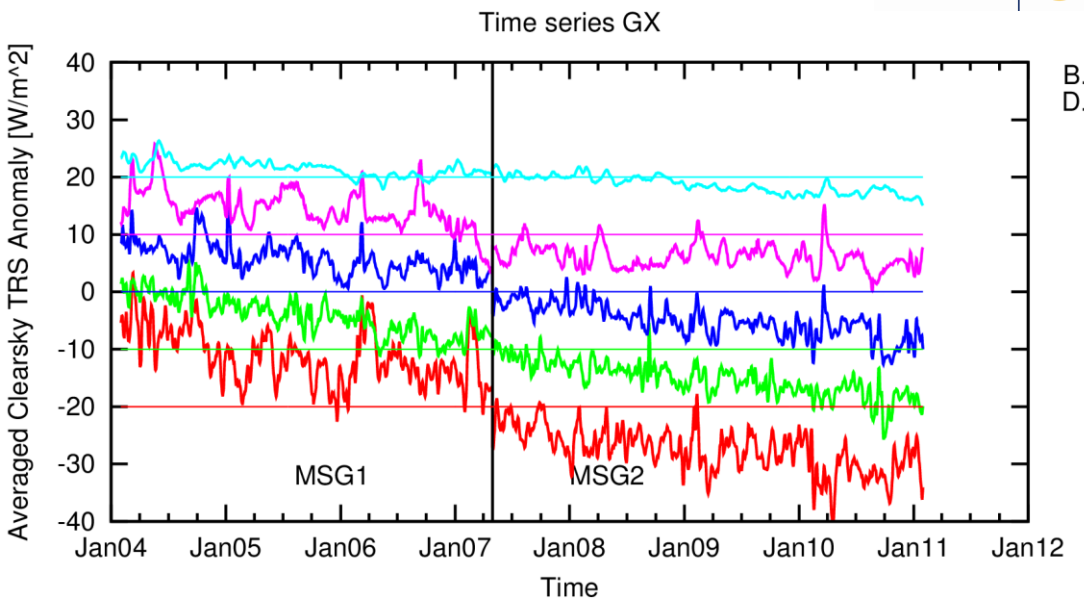
	GERB	GERB-like
MSG1	0.9776	1.0379
MSG2	1.0235	1.0309



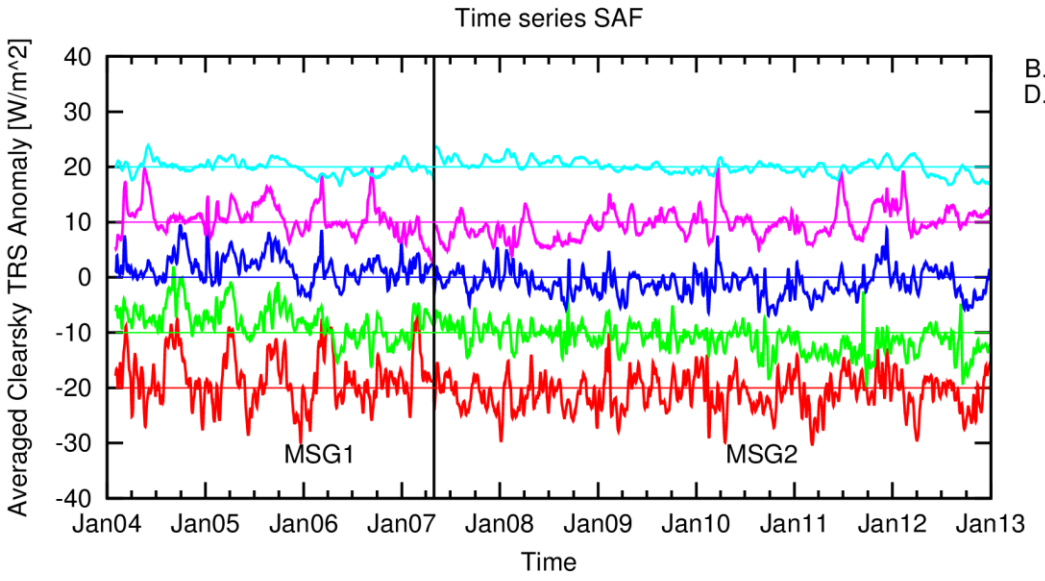


Residual drift / anomalies

ed01	full	MSG1	MSG2
ocean	-0.76 % / year	-0.81 % / year	-0.91 % / year
dark vege.	-0.81 % / year	-0.82 % / year	-0.26 % / year
bright vege.	-0.90 % / yea	-0.64 % / year	-0.71 % / year
dark desert	-0.90 % / year	-0.91 % / year	-0.74 % / year
bright desert	-0.81 % / year	-0.56 % / year	-0.52 % / year

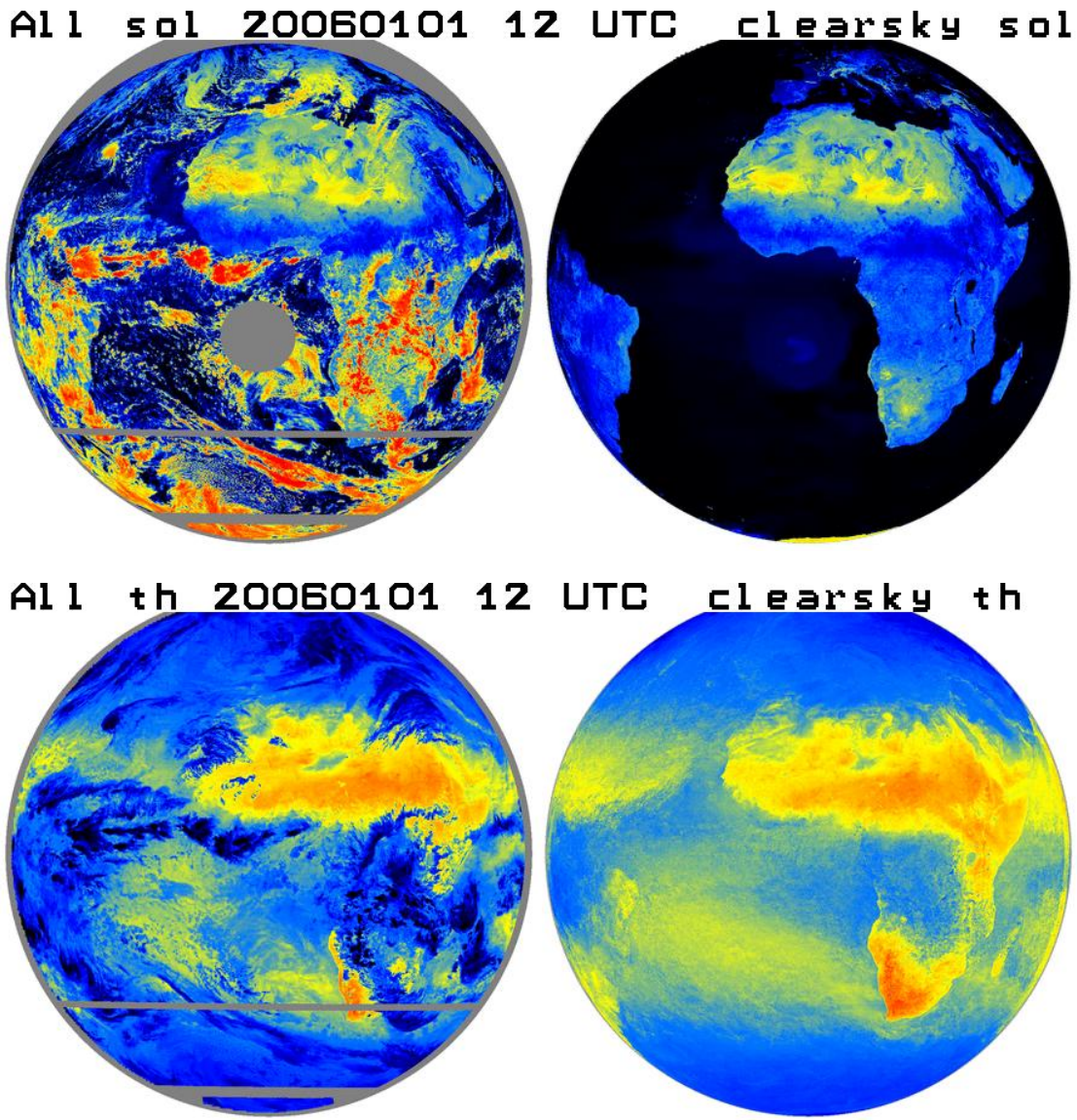


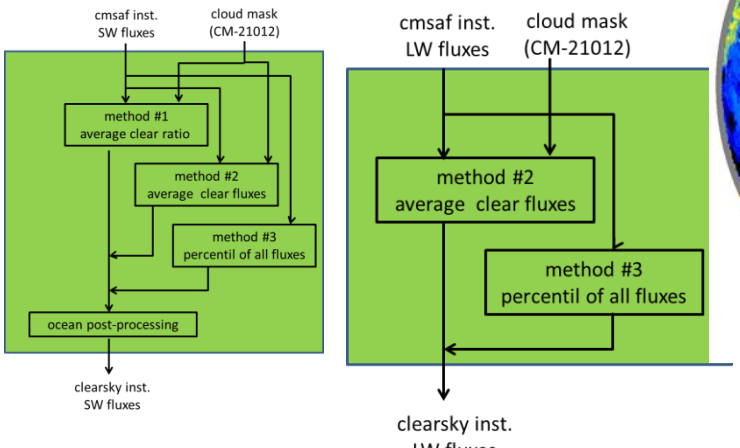
ed02	full	MSG1	MSG2
ocean	-0.12 % / year	-0.47 % / year	-0.41 % / year
dark vege.	-0.02 % / year	-0.46 % / year	0.41 % / year
bright vege.	-0.23 % / year	-0.21 % / year	-0.05 % / year
dark desert	-0.31 % / year	-0.55 % / year	-0.28 % / year
bright desert	-0.11 % / year	-0.04 % / year	0.02 % / year



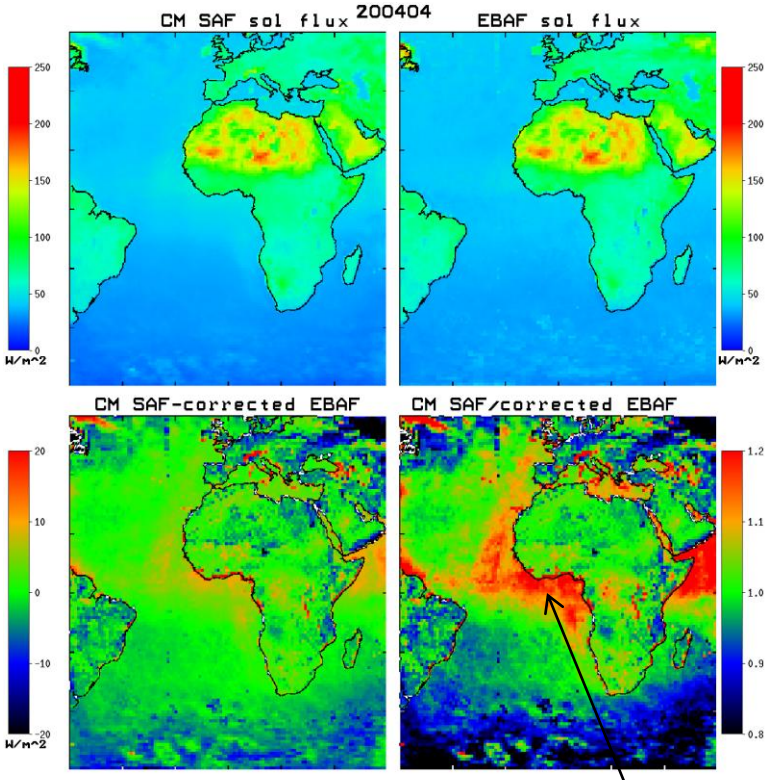
Clearsky processing

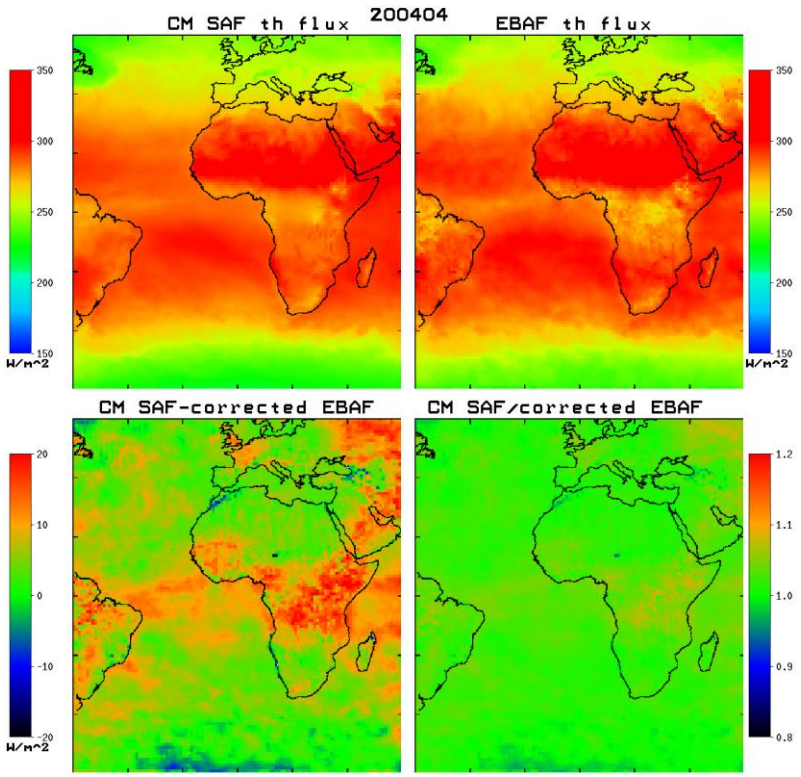
- General method : average the closest in time N (=5) clear sky observations for the same repeat cycle of the day
- Based on CM SAF cloud mask (CM-21012)
- Reject “dust events” (IR flagging) i.e. AOD ~> 0.4
- Fresh snow processing (N=1)
- Post-processing for ocean





Example of comparison with CERES EBAF 2.7r





No aerosol ADM for GERB? Or different aerosol processing in the clearsky products ?

Summary

- Several datasets/products available in CM SAF (http://www.cmsaf.eu)
- A first edition of the GERB/SEVIRI TOA radiation dataset is available
- The 2nd edition is expected to reduce most of the known problems with the dataset (e.g. aging) and also extend the validations and documentation.
- This 2nd edition will also provide clear sky fluxes e.g. for cloud forcing studies
- Preliminary (pre-released) data can be made available for beta-testing

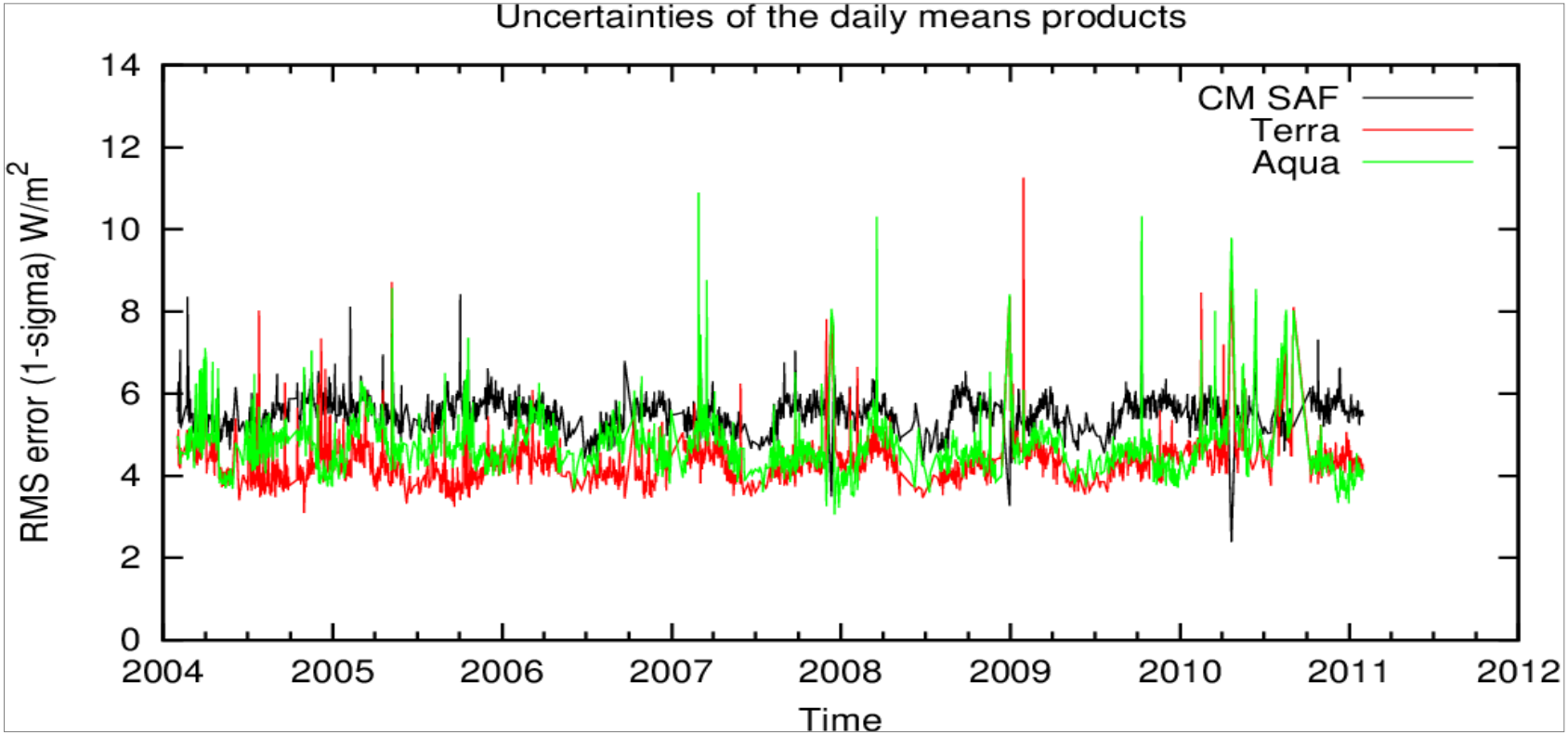
RMI

The EUMETSAT Network of Satellite Application Facilities

CM SAF
Climate Monitoring

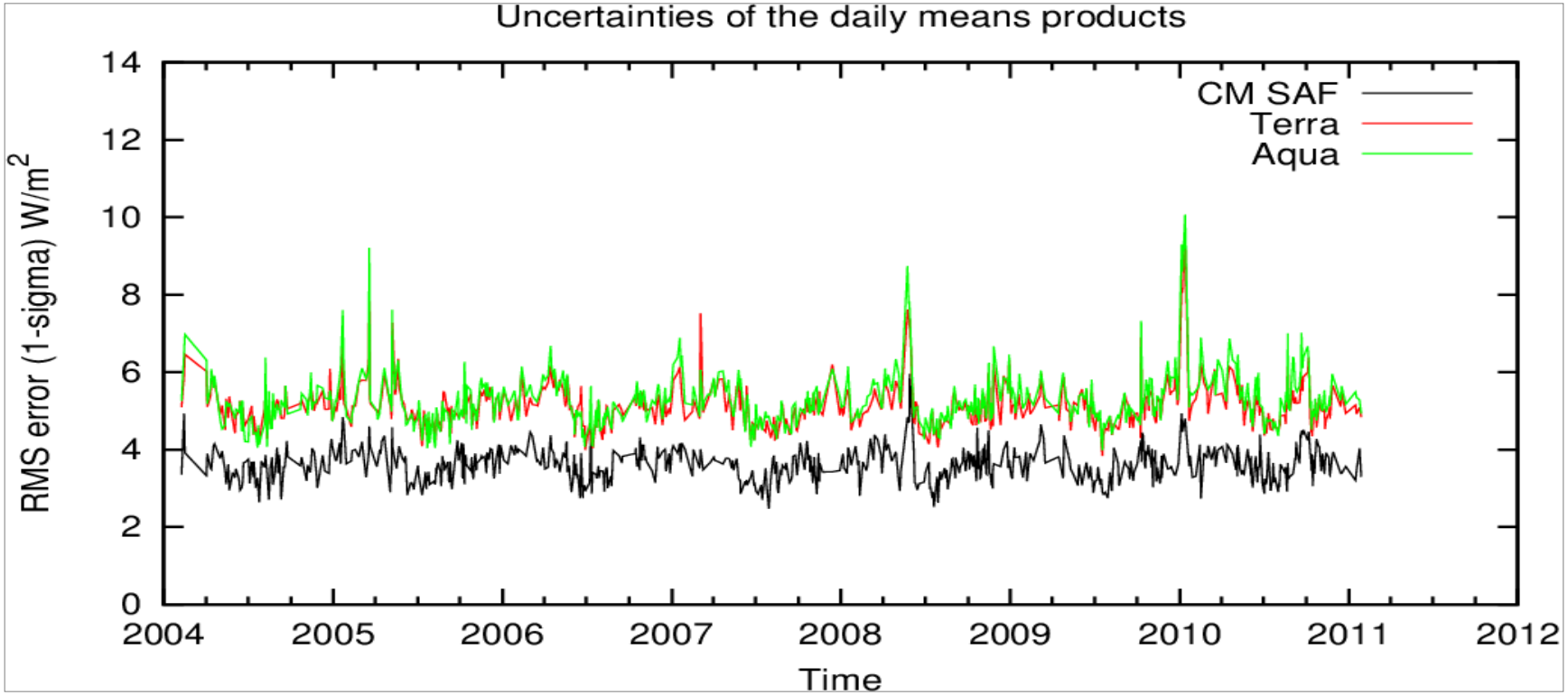
Thank you !

Validation of the daily mean products : TRS accuracy



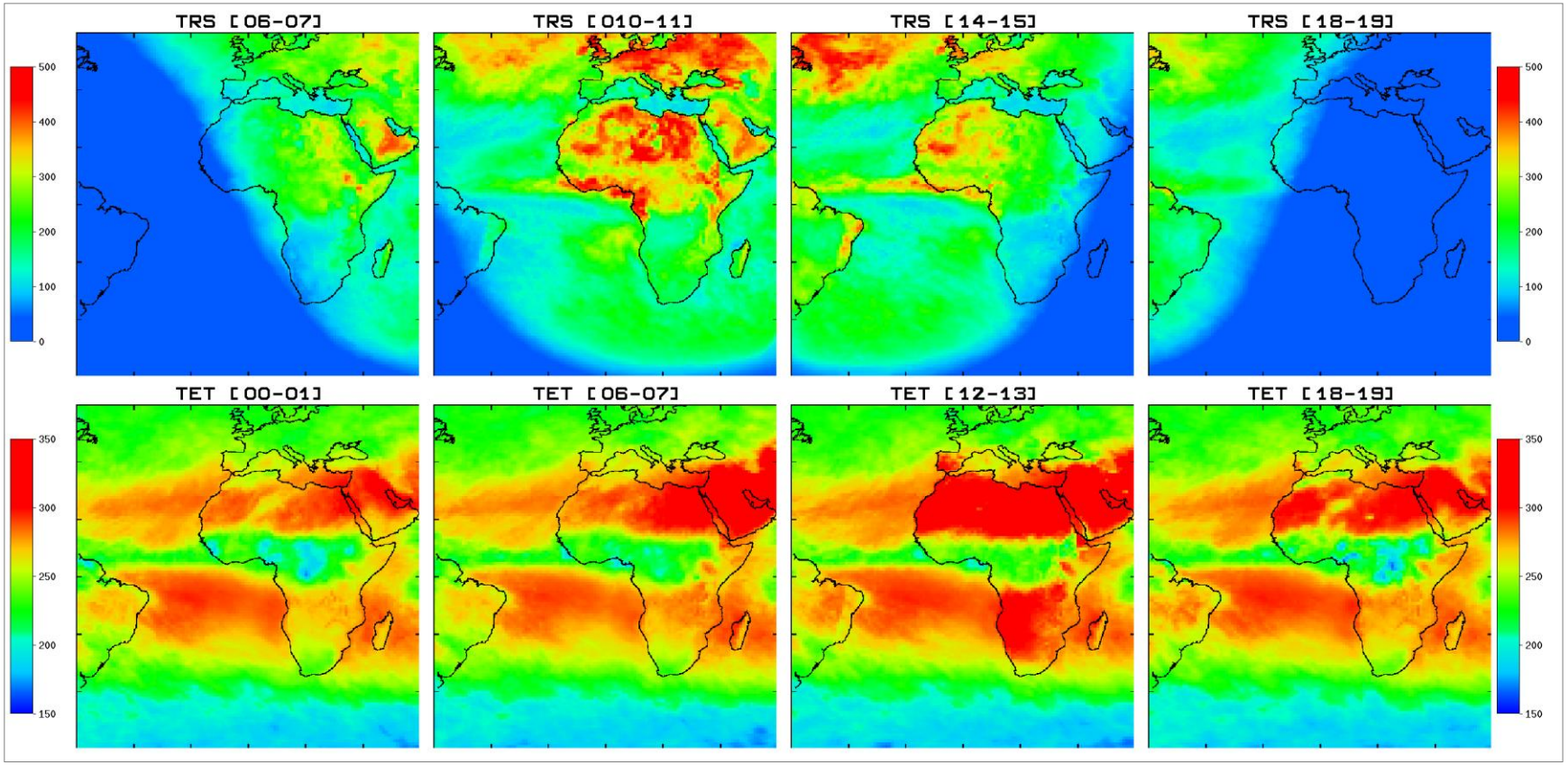
Accuracy ~ 5 W/m² (~ 5%)

Validation of the daily mean products: TET accuracy

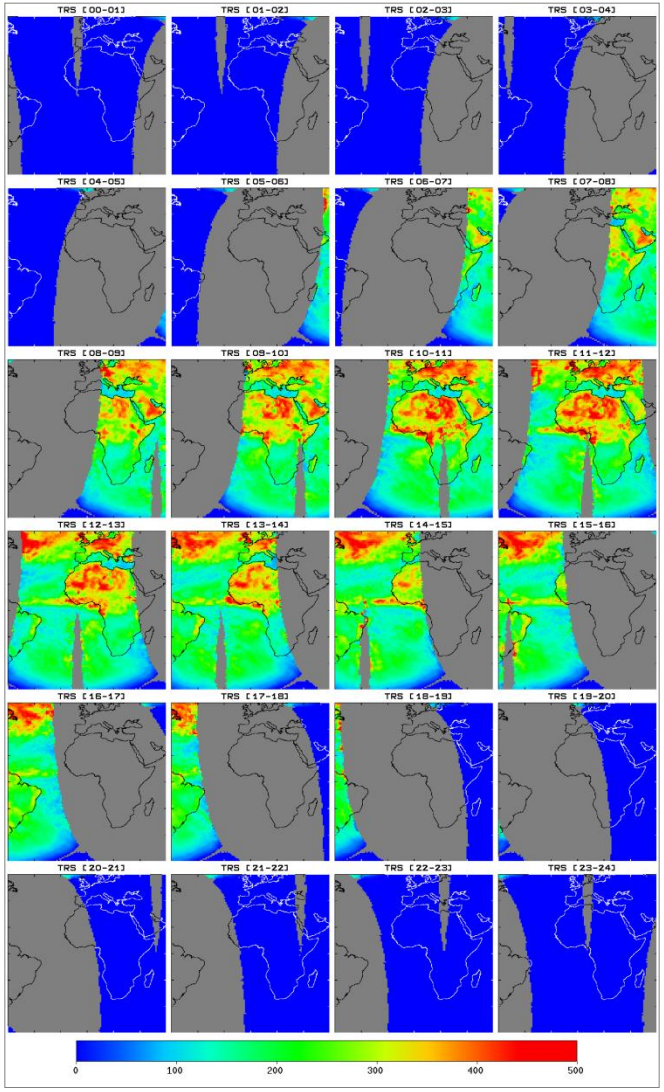


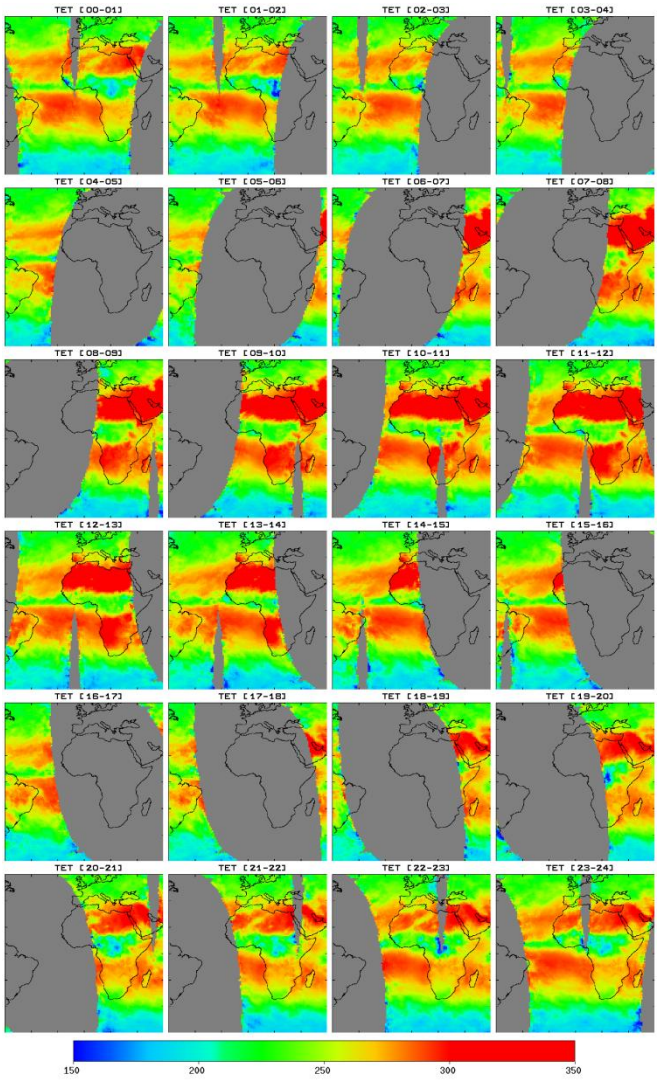
Accuracy ~ 4 W/m² (~ 2 %)

Validation of the monthly mean diurnal cycle



“Diurnal cycle” from CERES

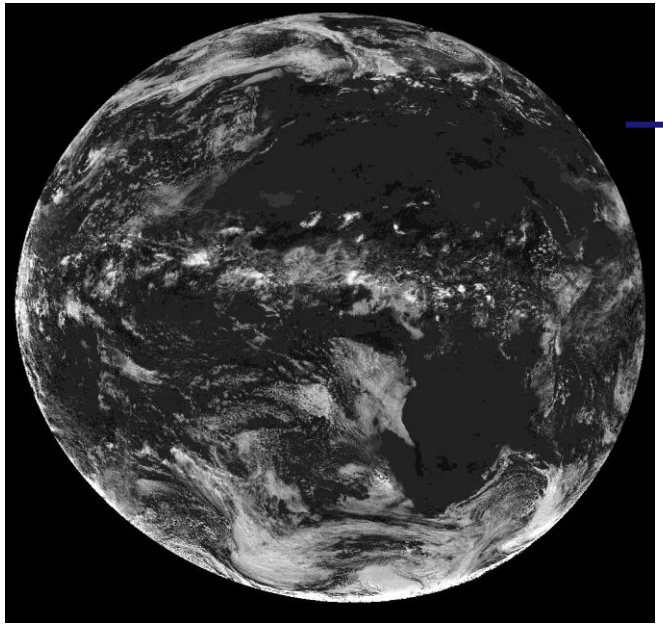




Summary of the validation
(1 σ uncertainty)

	TRS	TET
Monthly mean	4.0 W/m²	3.4 W/m²
Daily mean	6.2 W/m²	4.6 W/m²
MM diurnal cycle	14.5 W/m²	4.3 W/m²

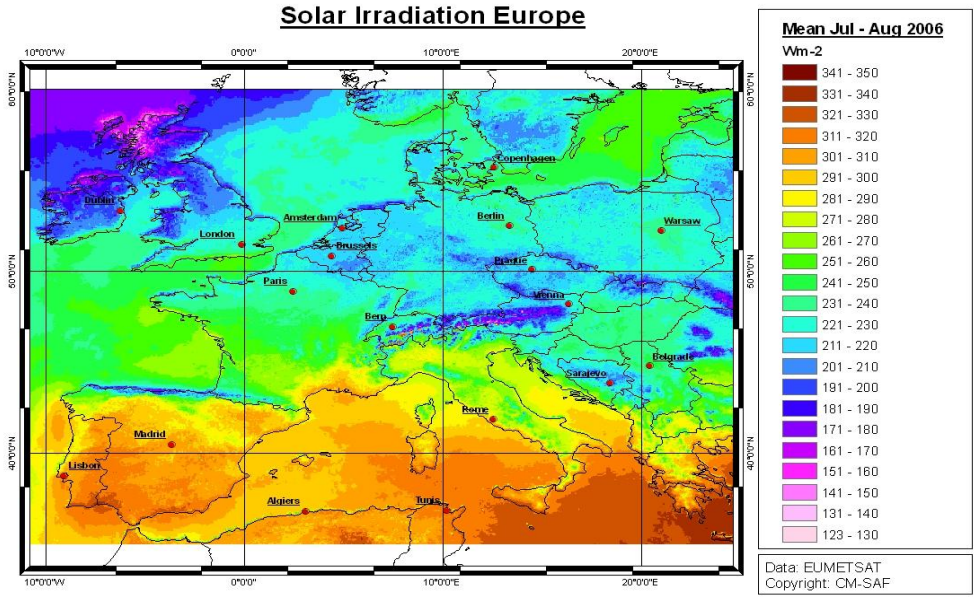
Solar Irradiation at Surface (SIS)



Cloud Index 1.7.2005, 11 h UTC

$$SIS = (n\text{-}1)\ SIS_{clear}$$

Clear sky model
gnu-MAGIC



TOA radiation dataset : edition-2

- **GERB/SEVIRI ed01 dataset**
  - Released in 2013
  - 2004-2010
  - All sky TRS and TET
  - MM , DM, MMDC
  - SEA grid 45km
- **GERB/SEVIRI ed02 dataset**
  - In development, release foreseen 2015
  - 2004-2012
  - Allsky and clearsky TRS and TET
  - MM , DM, MMDC
  - GEO grid 9km
- **MVIRI/GERB/SEVIRI ed02 dataset**
  - In development, release foreseen 2015
  - 1982-2014
  - Allsky TRS and TET
  - MM , DM, MMDC
  - Lat-lon grid 0.05°

- All datasets in NetCDF CF convention
- Synergy between products

Illustration : TOA radiation monthly means