CM–SAF high resolution radiation budget products

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Overview

- The SAF concept and the Climate Monitoring SAF
- RMIB tasks
- TOA fluxes generation
- Status and conclusions

RMI

- Network of elements known as Satellite Application Facilities (SAF), specialised distributed development and processing centres.

- Complement the production of standard meteorological products derived from satellite data at EUMETSAT's Central Facilities in Darmstadt and might also distribute user software packages.

- The scope of the SAF on Climate Monitoring is to generate and archive high quality data sets on a continuous basis for the following application purposes:

  * Monitoring of the climate state and its variability.

  * Analysis and diagnosis of climate parameters to identify and understand changes in the climate system.

  * Input for climate models to study processes in the climate system on a European and/or global scale and for climate prediction.

  * Validation of simulation models (climate and NWP).

The CM–SAF consortium

- Deutscher Wetterdienst (leading institute) with GKSS Research Centre
- Finnish Meteorological Institute
- Royal Meteorological Institute of Belgium with Free University Brussels
- Royal Netherlands Meteorological Institute
- Swedish Meteorological and Hydrological Institute

RMIB tasks

- Climate Monitoring SAF aims to provide consistent cloud and radiation parameters in high spatial resolution for an area covering at least and part of the North Atlantic Ocean

- RMIB is in charge with the Top Of the Atmosphere (TOA) radiative flux components:
  - TOA Incoming Solar radiation (TIS)
  - TOA Emitted Thermal radiation (TET)
  - TOA Reflected Solar radiation (TRS)

- Daily means, monthly means and monthly mean diurnal cycles will be provided

RMIB tasks (continued)

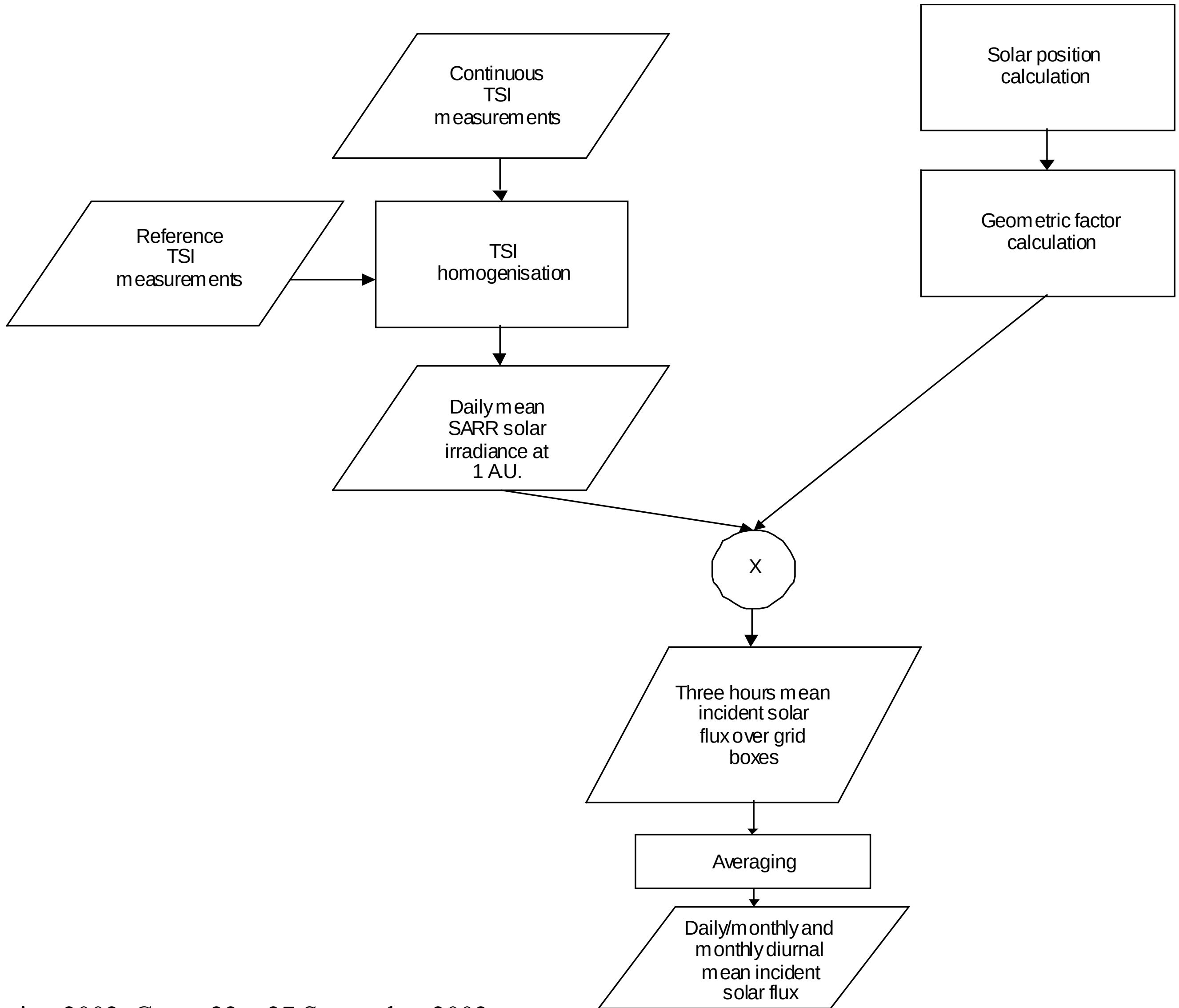
- Products derived over a nested 0.5º equal angle grid:

Latitude	Grid Size
0°-45°	0.5°x0.5°
45°-70°	1°x0.5°
70°-80°	2°x0.5°
80°-89°	4°x0.5°
89°-90°	180°x0.5°

- TIS based on data from Total Solar Irradiance instruments

- TRS and TET based on data from polar orbiting satellites (CERES instruments) for northern latitudes and on data from METEOSAT Second Generation (MSG) for mid latitudes (GERB and SEVIRI).

Flowchart for the generation of the mean TIS fluxes



TIS calculation

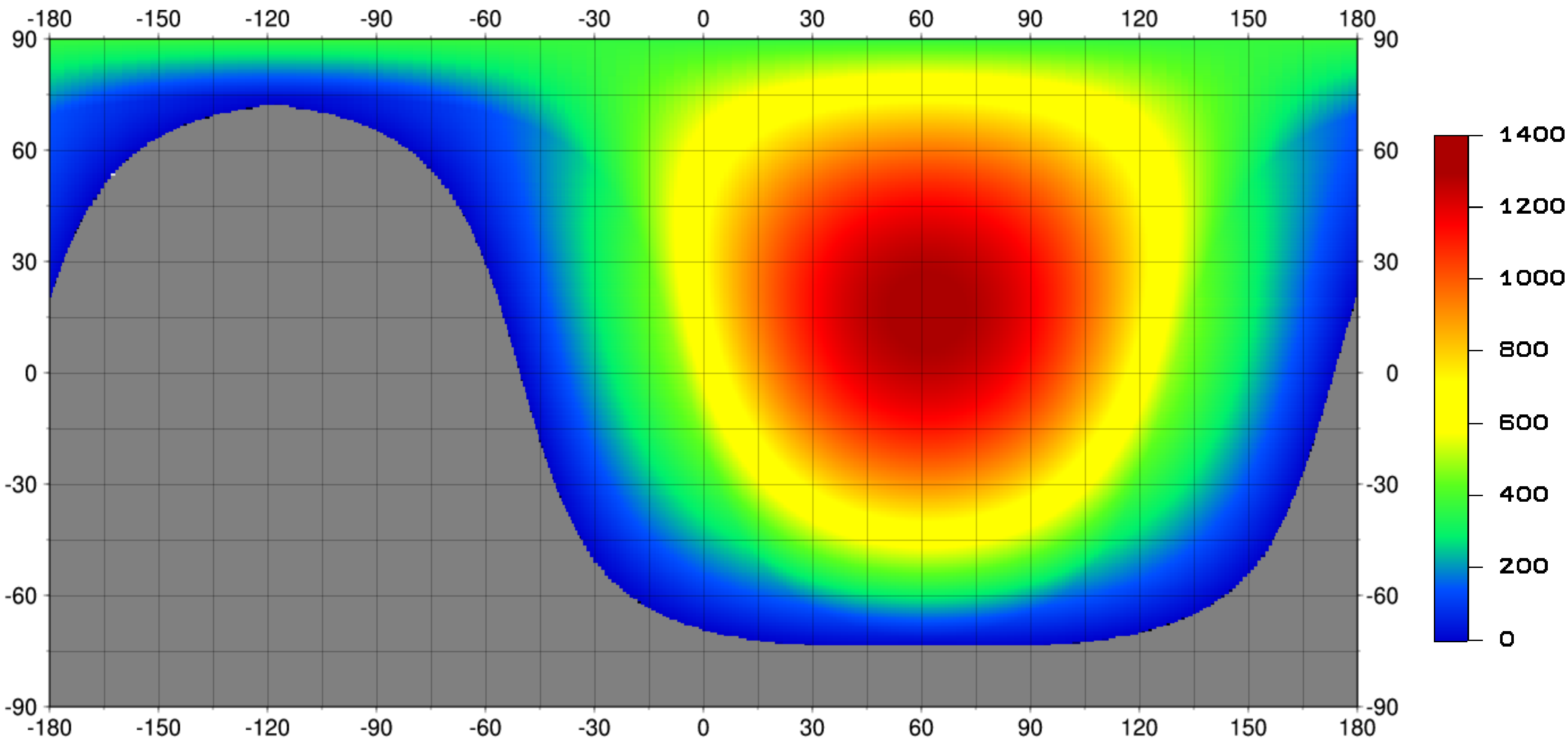
– the incoming solar flux is determined by the Total Solar Irradiance (TSI) at 1 A.U., the distance to the sun and the solar-zenith angle.

– TSI - mean SARR adjusted measurements from different instruments (VIRGO/SOHO, ACRIM III and future SOVIM/ISS, PICARD, TIM/SORCE)

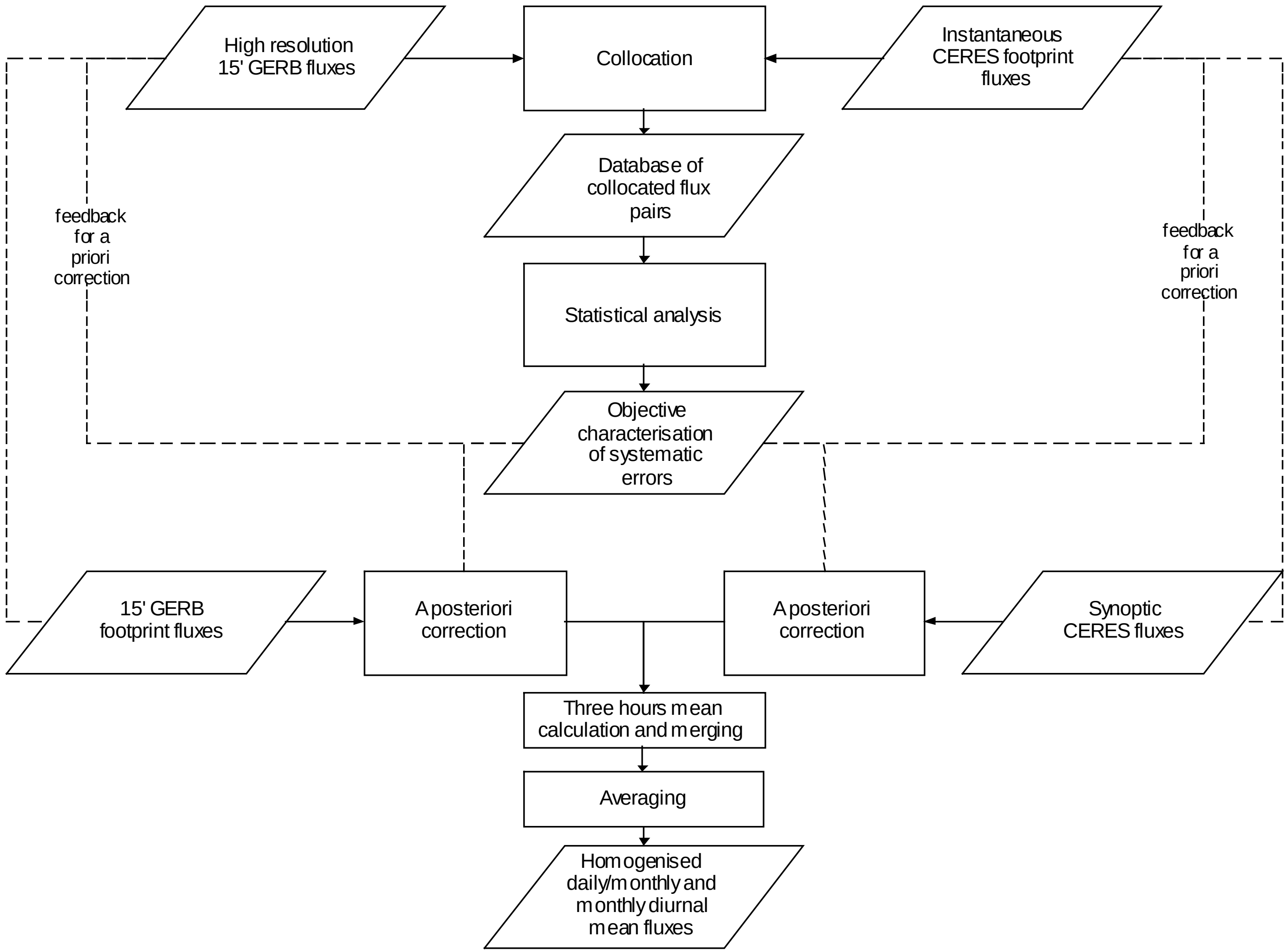
– TIS = (TSI / sun distance^2) * cos(solar zenith angle)

– Only TSI measured, the others are calculated geometrically

Mean TIS on 8th August 1998 06:30–09:30 UTC (W/m^{-2})



Flowchart for the generation of the mean merged TRS and TET fluxes



Merging of the fluxes

- At higher latitudes, where CERES provides the best coverage, CERES fluxes will be used. At mid latitudes, where GERB provides the best coverage, GERB fluxes will be used.
- In between, the homogenised flux will be a weighted mean:

$$F = w * F_{GERB} + (1 - w) * F_{CERES}$$

- The weight changes linearly with MSG viewing zenith angle (VZA) to avoid discontinuites:

$$w = 1 \qquad \text{for VZA} < 70^{\circ}$$

$$w = 1 - (\text{VZA} - 70^{\circ}) \qquad \text{for } 70^{\circ} < \text{VZA} < 80^{\circ}$$

$$w = 0 \qquad \text{for VZA} > 80^{\circ}$$

- Merging consists in collocation of the two instruments, building of a database of the systematic dependencies of the flux estimates on the scene type and viewing angles, removal of those dependencies and regridding on the common grid.

Development data sources

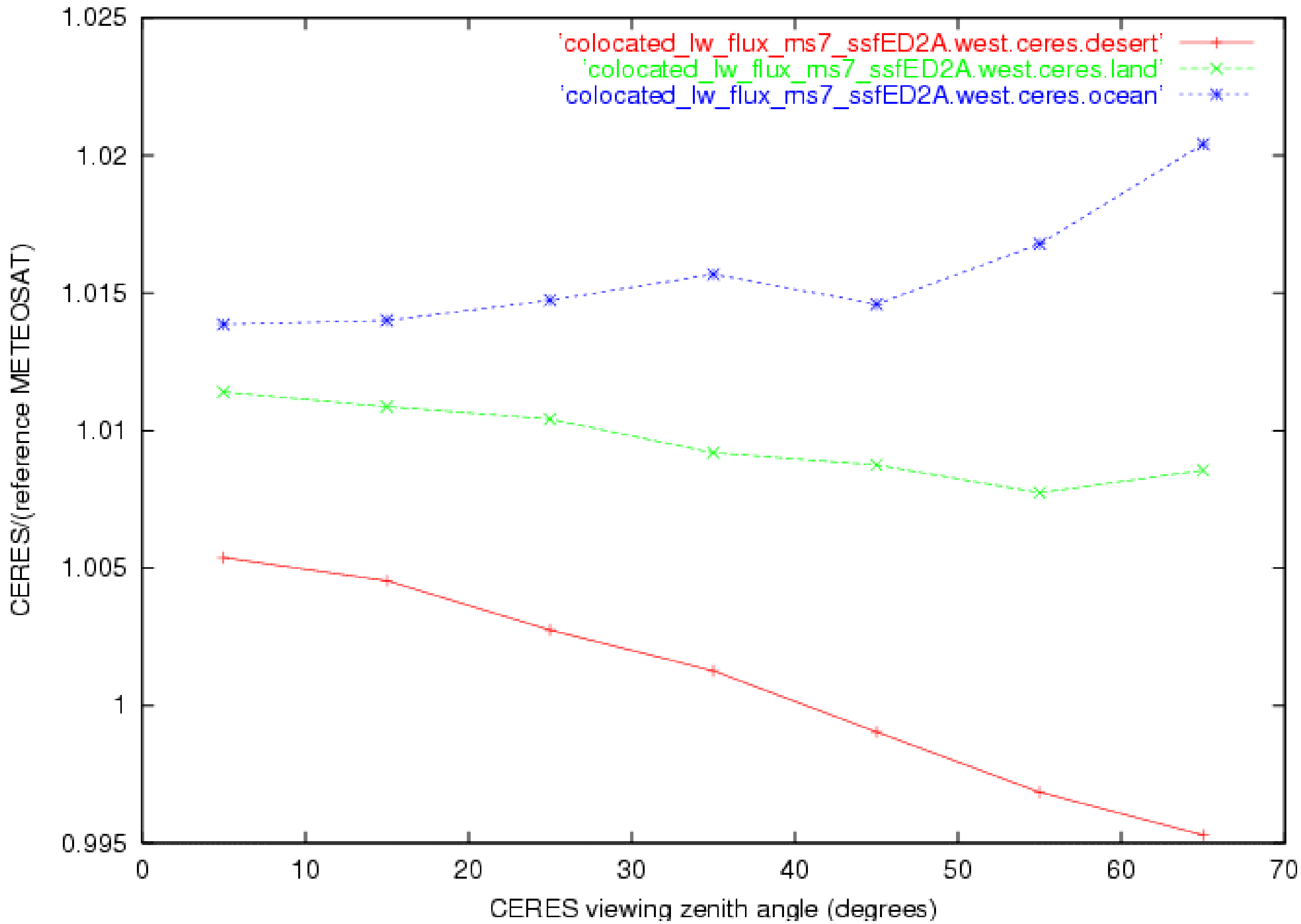
- Since MSG data is not available, GERB–*like* data derived at RMIB from METEOSAT 7 data was used.

- CERES data from the instrument flying on Tropical Rainfall Measuring Mission (TRMM) when scanning in rotating azimuth plane mode, for good random sampling of all viewing zenith and relative azimuth angles.

TET homogenisation

- For a certain scene type and METEOSAT viewing zenith angle select all CERES footprints in a certain CERES viewing zenith angle bin
- Average CERES TET values and then divide by reference METEOSAT TET
- Those are the factors used for scaling CERES TET to obtain the homogenised CERES TET
- The homogenised METEOSAT TET is obtained similarly using as reference the homogenised CERES TET

Sample homogenisation factors for CERES TET



TRS homogenisation

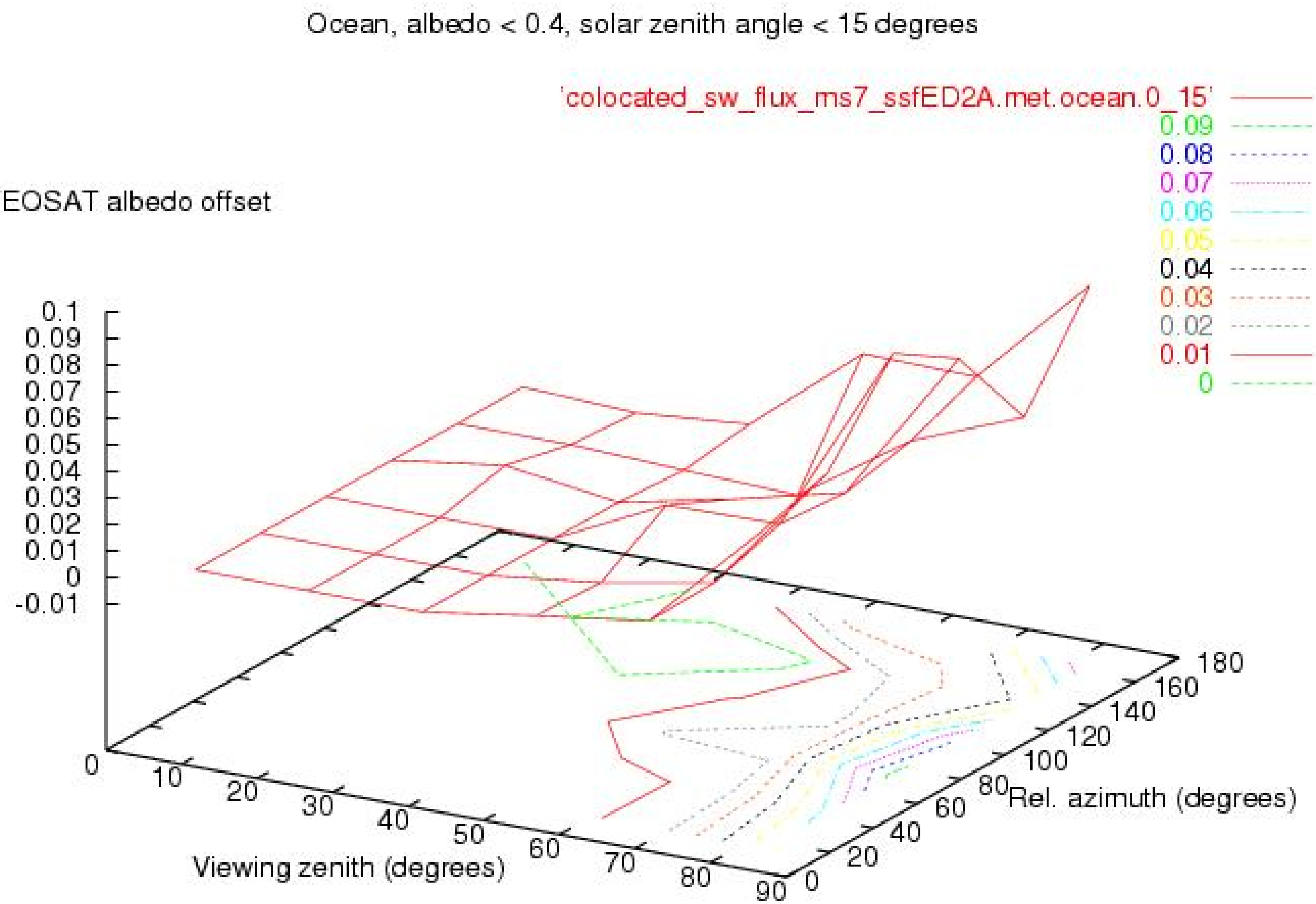
- Bin METEOSAT TRS by scene type, cloudiness class (albedo < 0.4 and albedo ≥ 0.4) and solar zenith angle

- Calculate the offset of the METEOSAT TRS to the mean CERES TRS

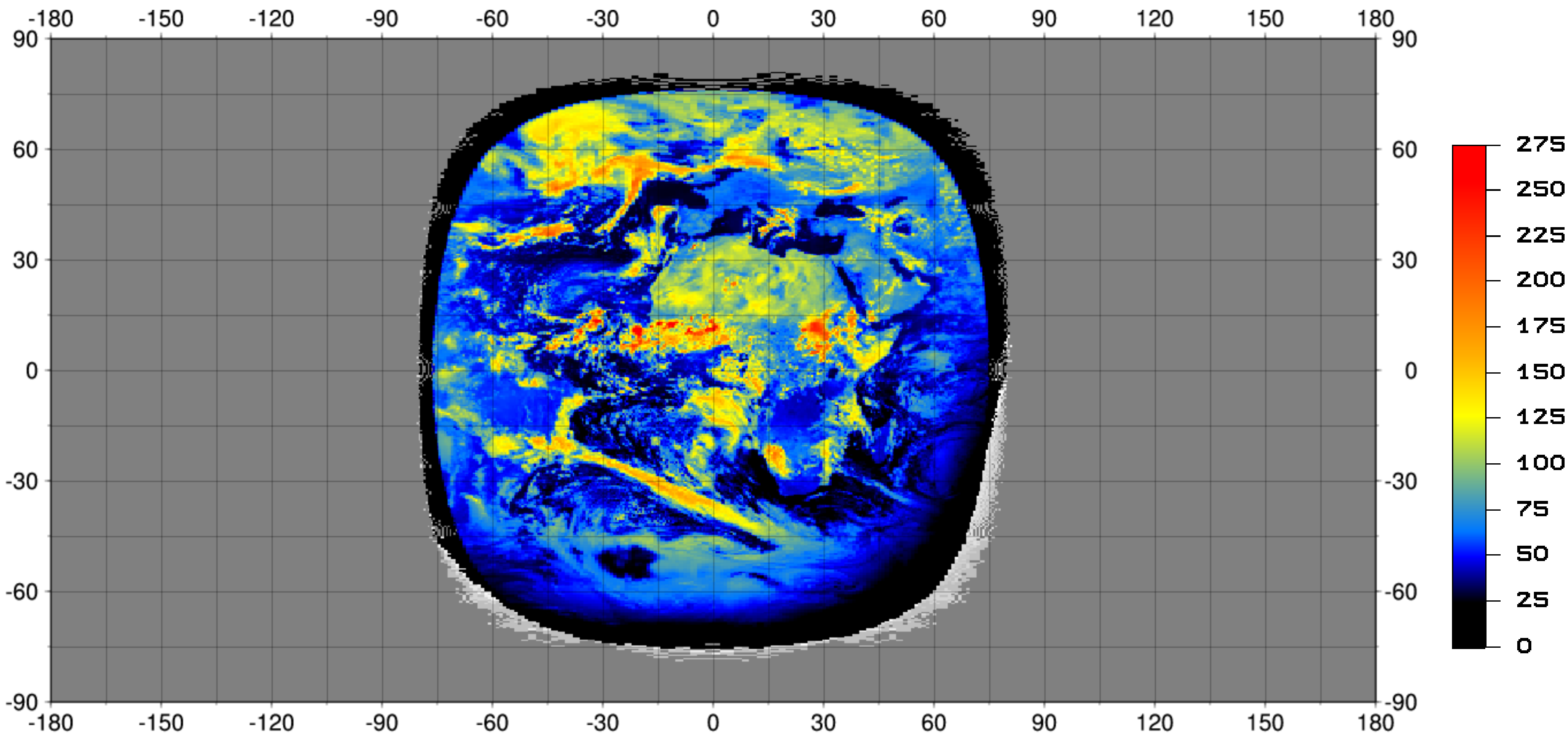
- The homogenised METEOSAT TRS is obtained by substracting the mean offset

- The homogenised CERES TRS is obtained similarly using as reference the homogenised METEOSAT TRS

Sample offset of METEOSAT relative to mean CERES (expressed in albedo)



Merged solar radiances on 8th August 1998 12:30–13:30 UTC (W/m^{-2}/sr)



Status and conclusions

- The system is currently integrated for the Integration Readiness Review.

- We hope that the products derived at RMIB for the CM–SAF will prove useful for the climate studies community.