Presentation “GERB team”

Observation department day 2013

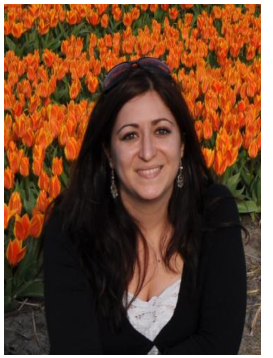
Content

- Weather satellites
  - Generalities
  - Implementation at RMIB

- Main scientific projects of the team:
  - GERB
  - Climate Monitoring SAF
  - Earth CARE

- Various activities




The team

Alessandro Ipe

Edward Baudrez

Ilse Decoster

Nicolas Clerbaux

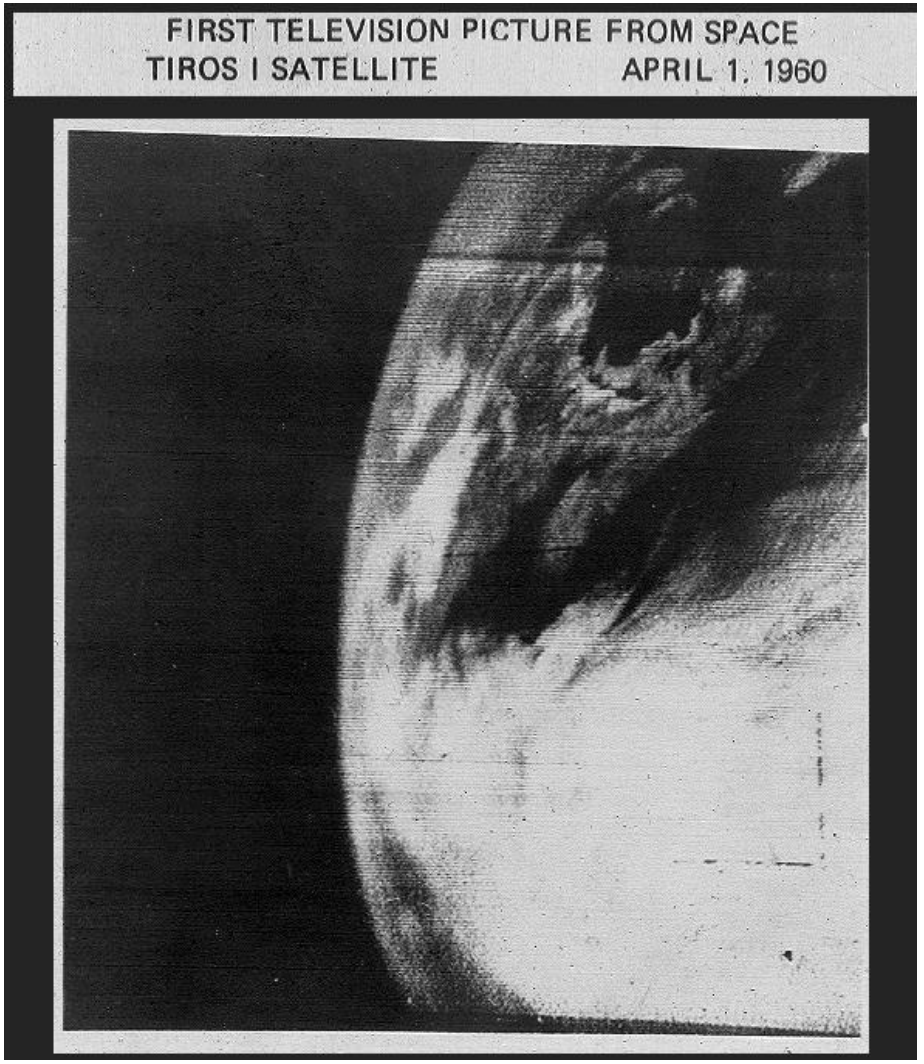
Almudena Velazquez Blazquez

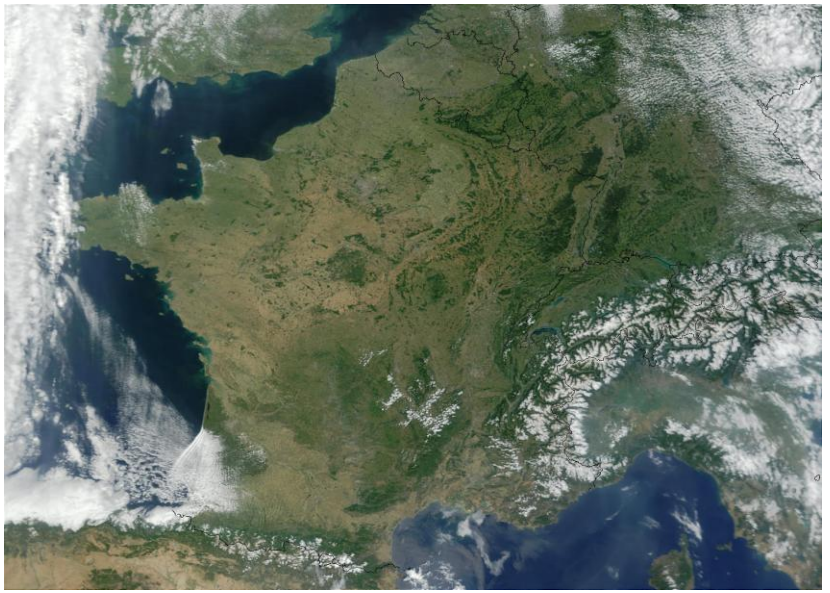
Stijn Nevens

Patrick Vandermeulen

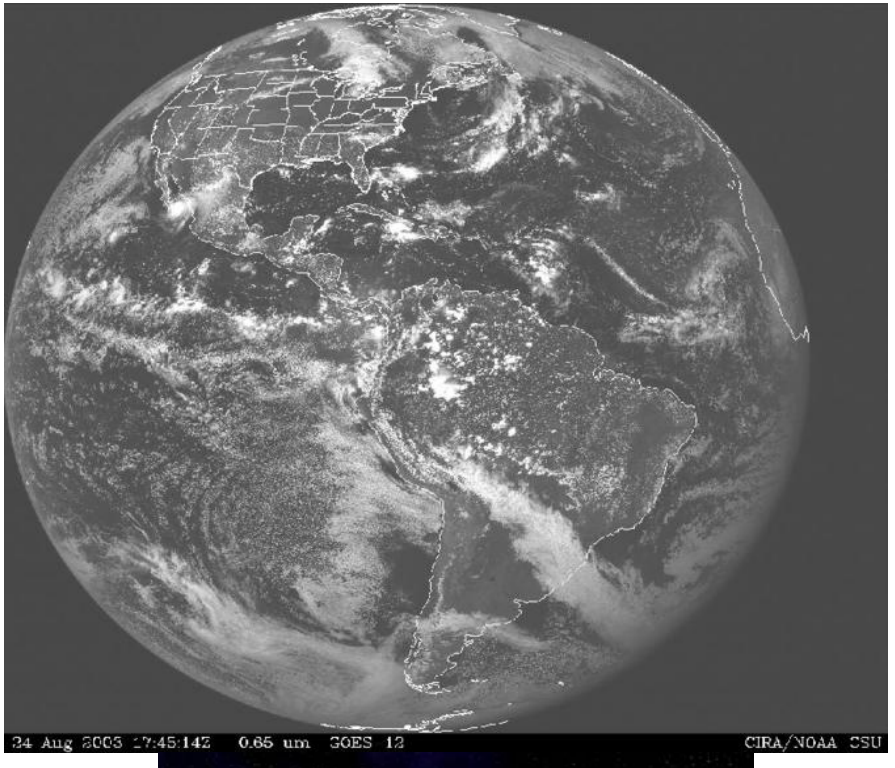
- Located in “building B” (first/second floor)
- team email “gerb@oma.be”

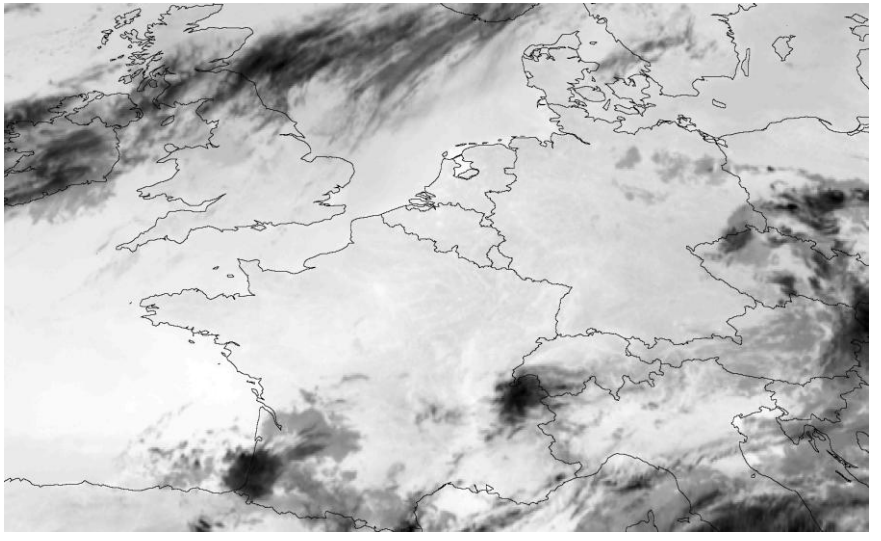
Weather satellites

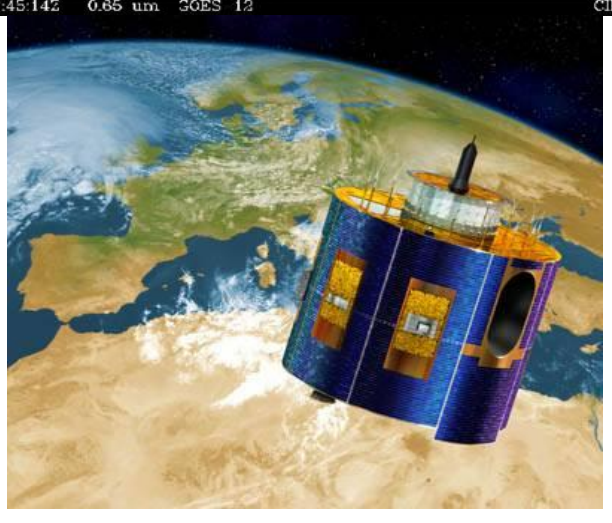


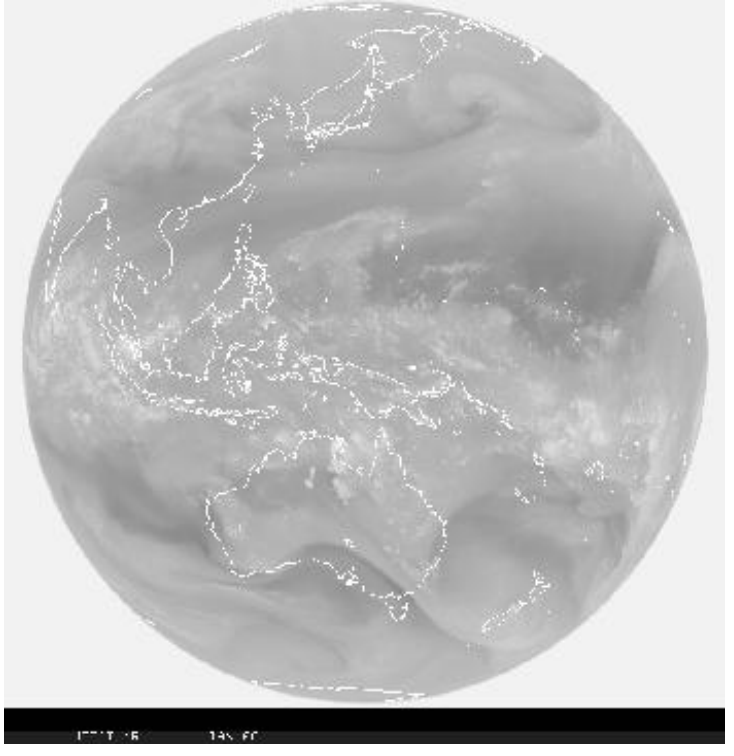


Geostationary weather satellites





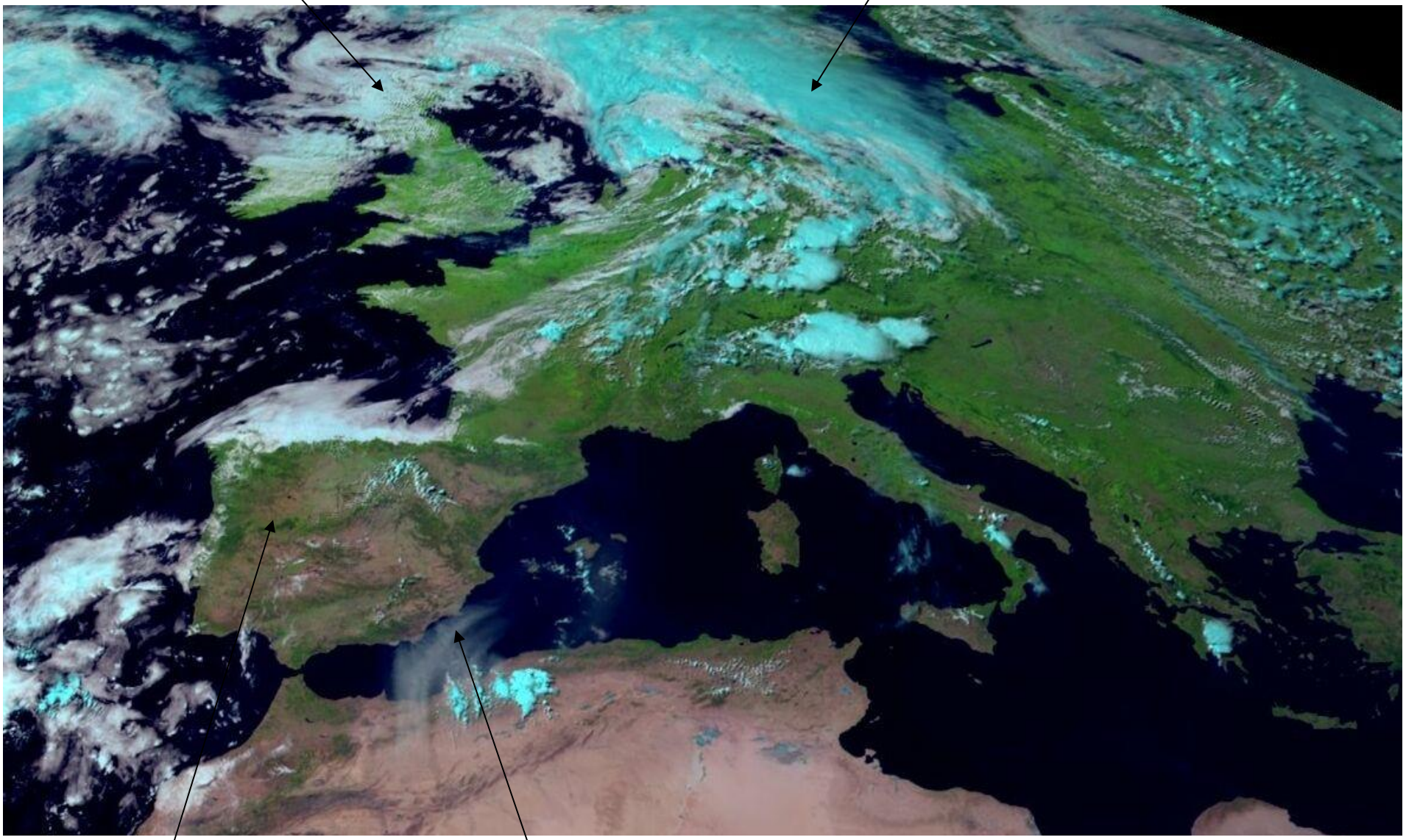




“natural color” RGB=(1.6, 0.8, 0.6)

Low level clouds

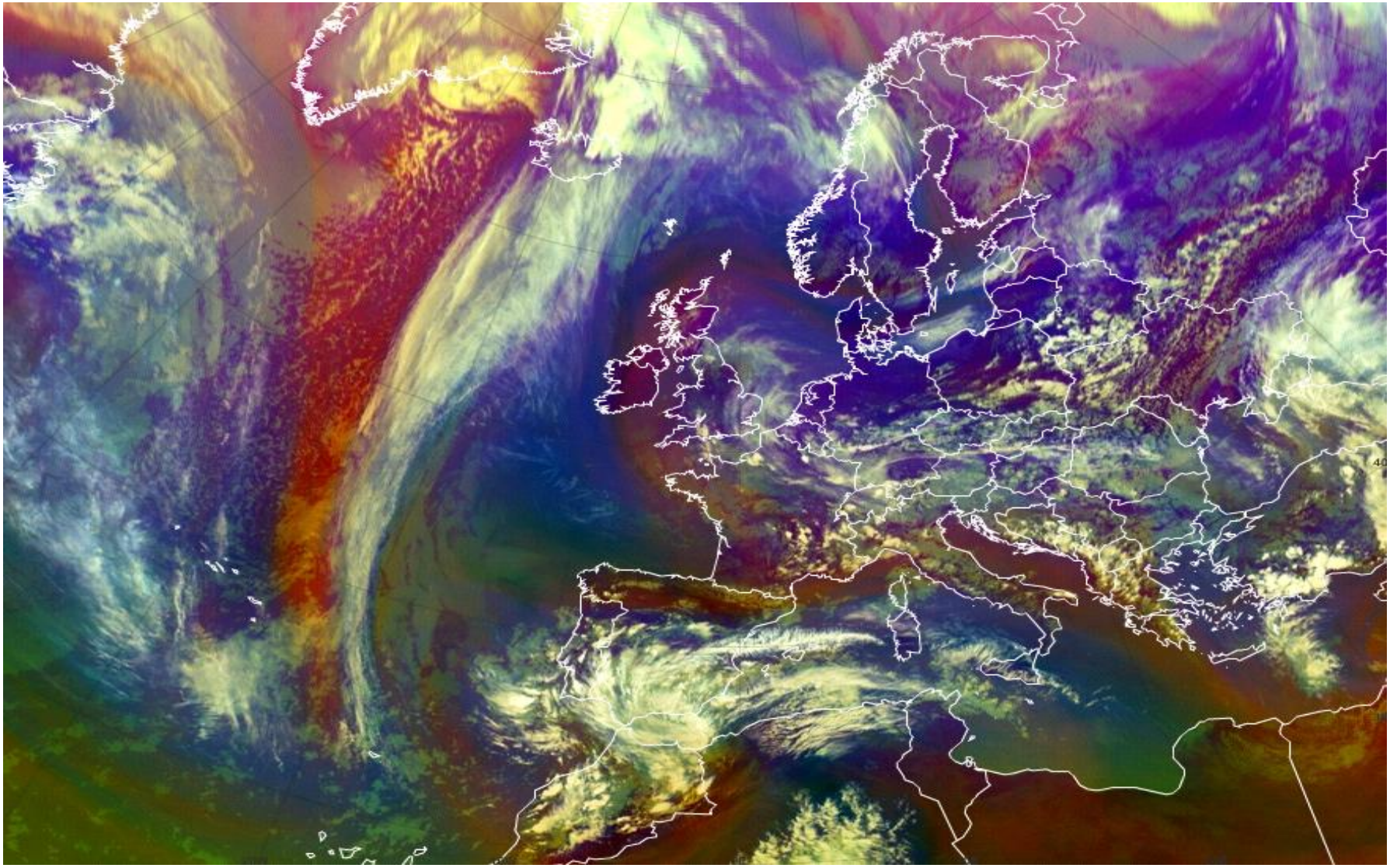
High level clouds (ice)



vegetation

dust and aerosol

Air masses...

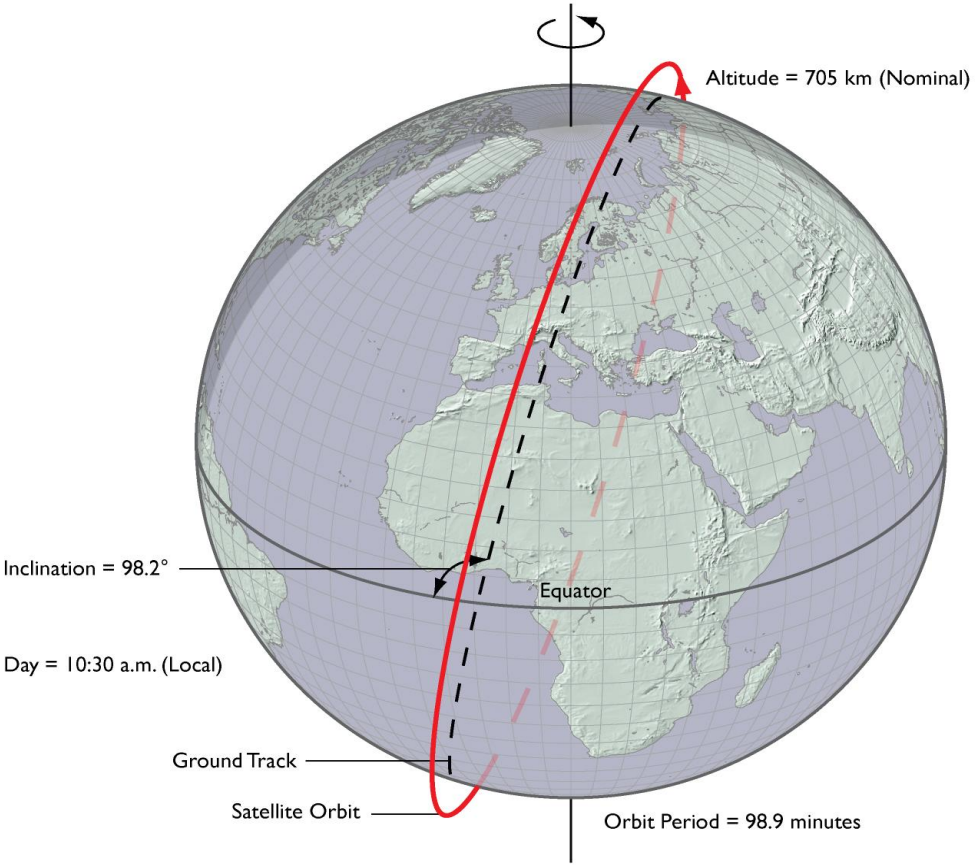


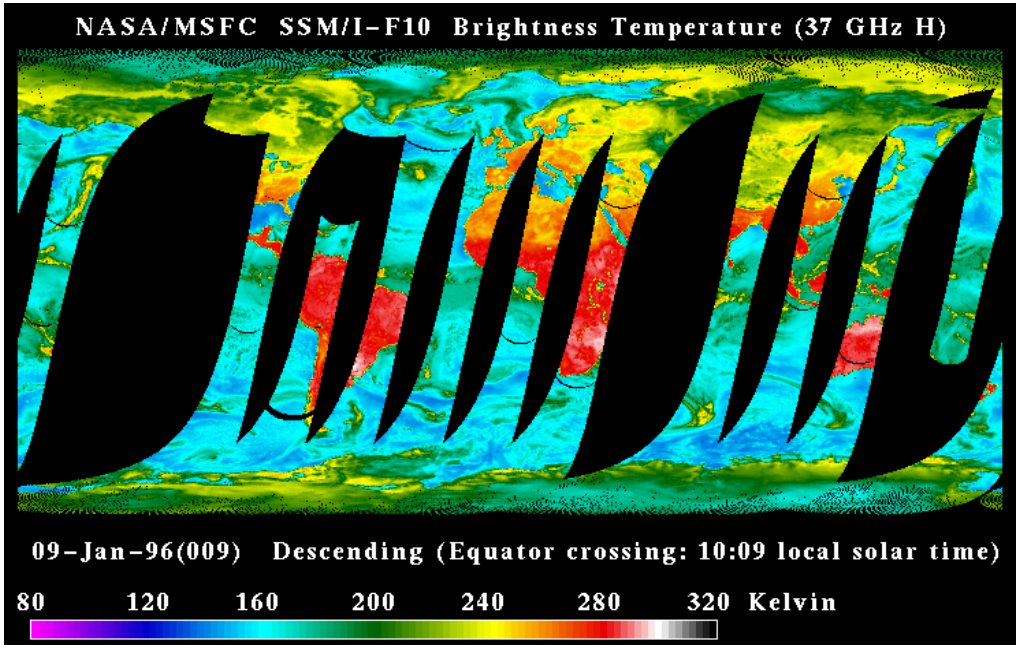
Rapid scan (5') imagery

(Insert animation)

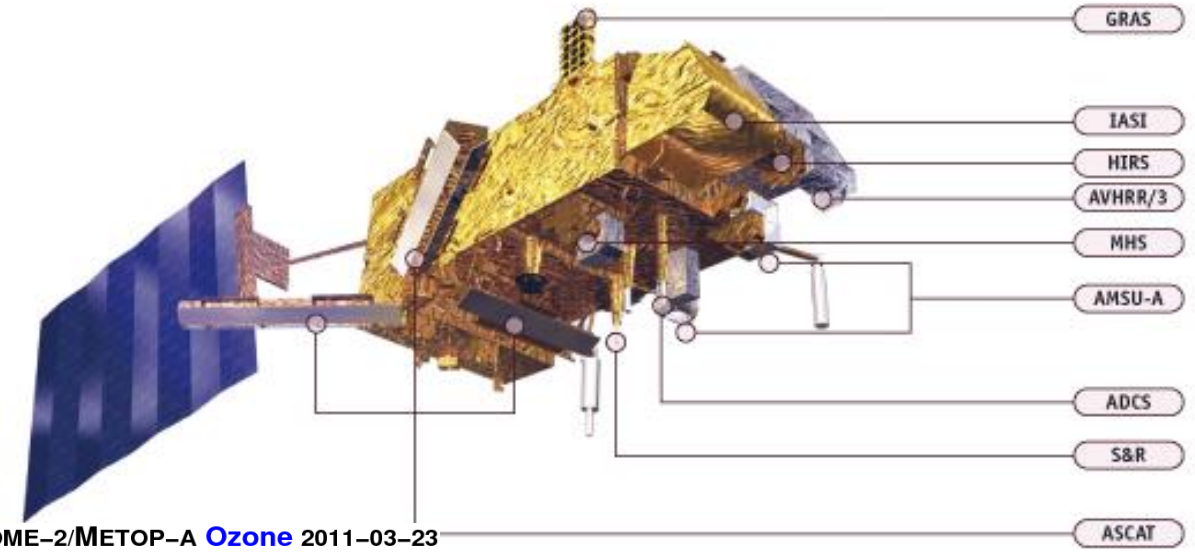
Meteosat second generation is widely used at the weather office

Polar satellites...



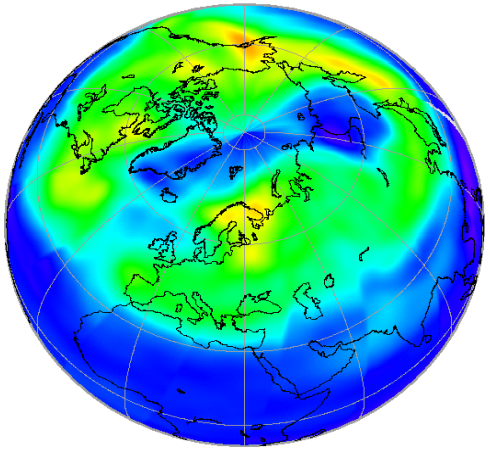


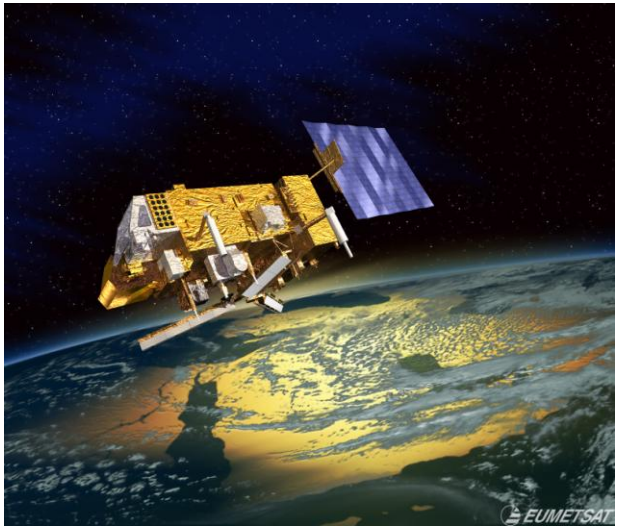
Exemple of polar satellite: Metop

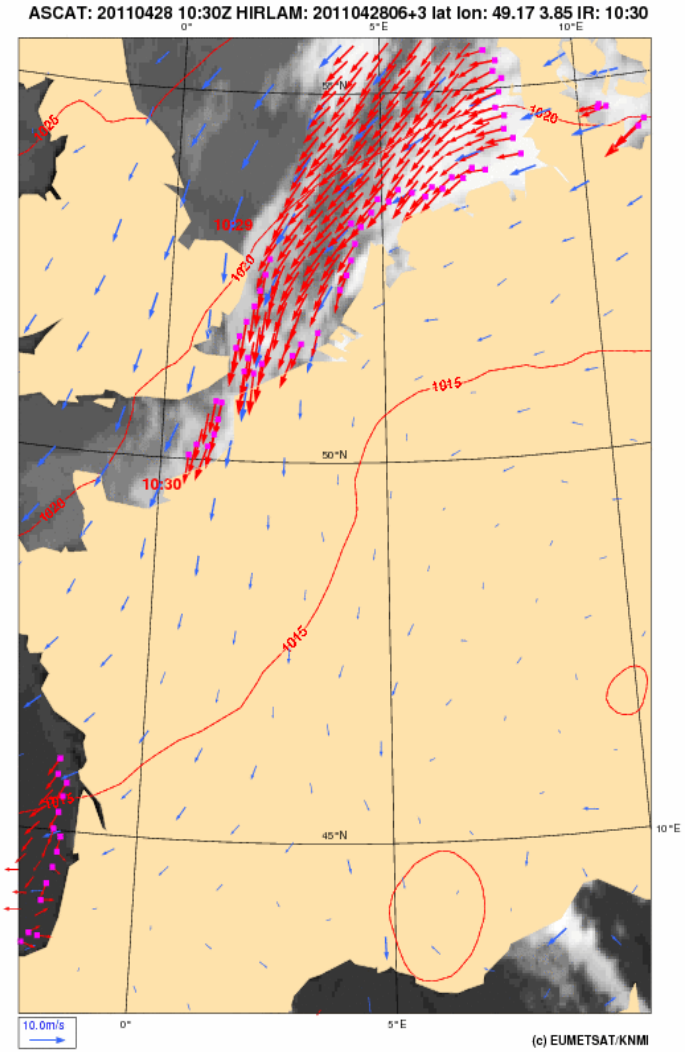


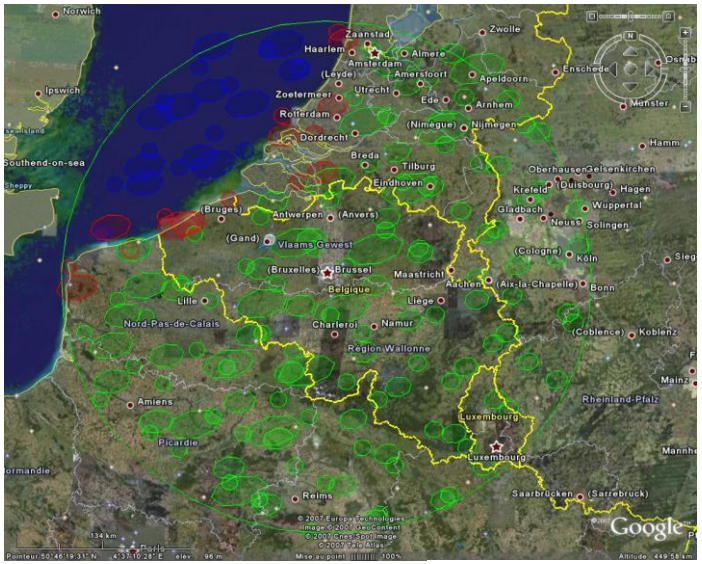
GOME-2/METOP-A Ozone 2011-03-23

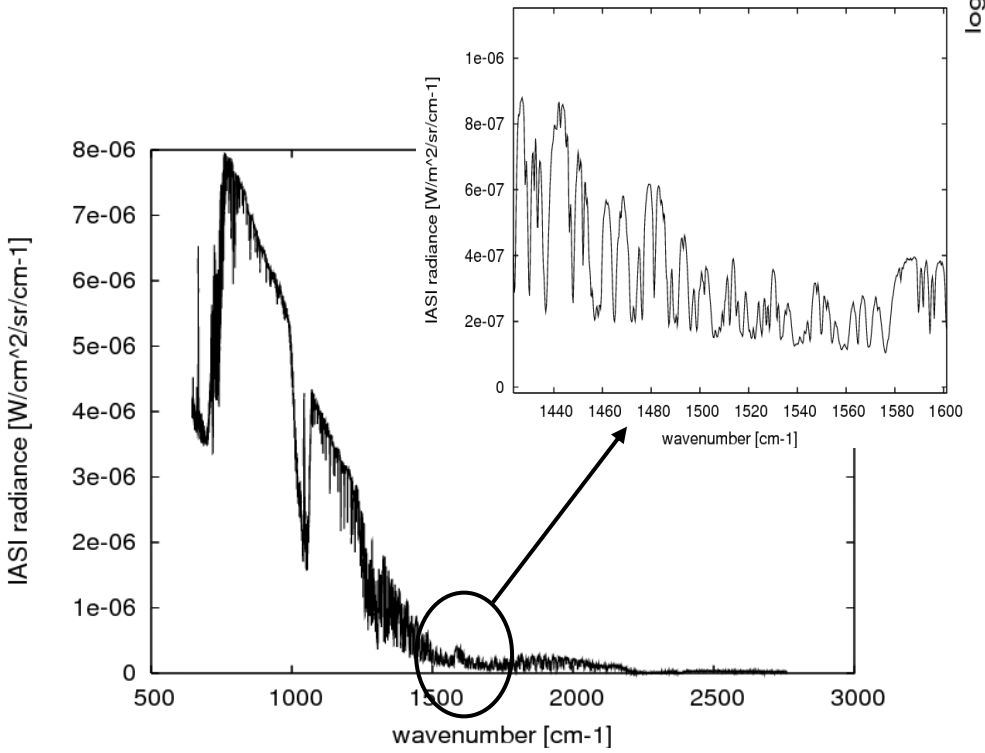
http://atmos.caf.dlr.de/gome2

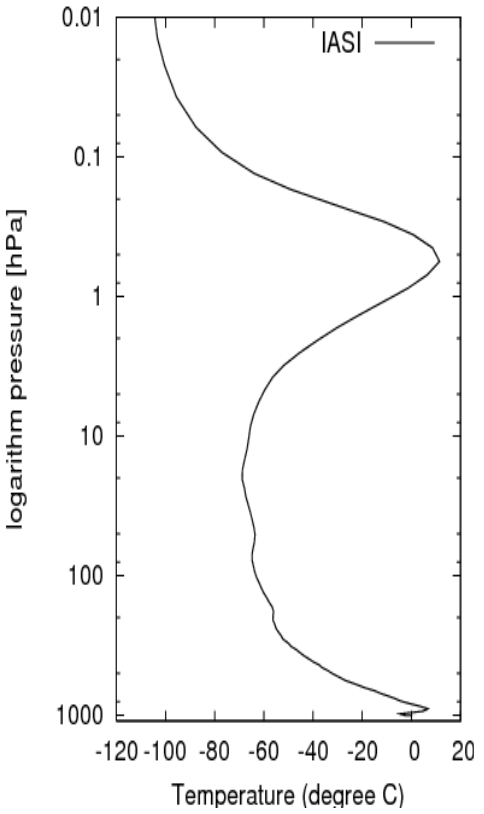




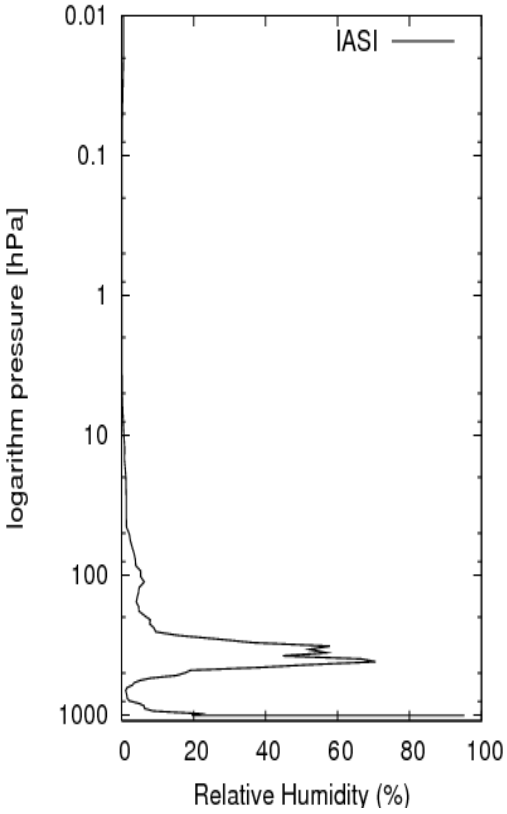








Temperature profile



Humidity profile

Organized at european level

EUMETSAT:

26 members states

Created in 1985

Members states contributions 2006:

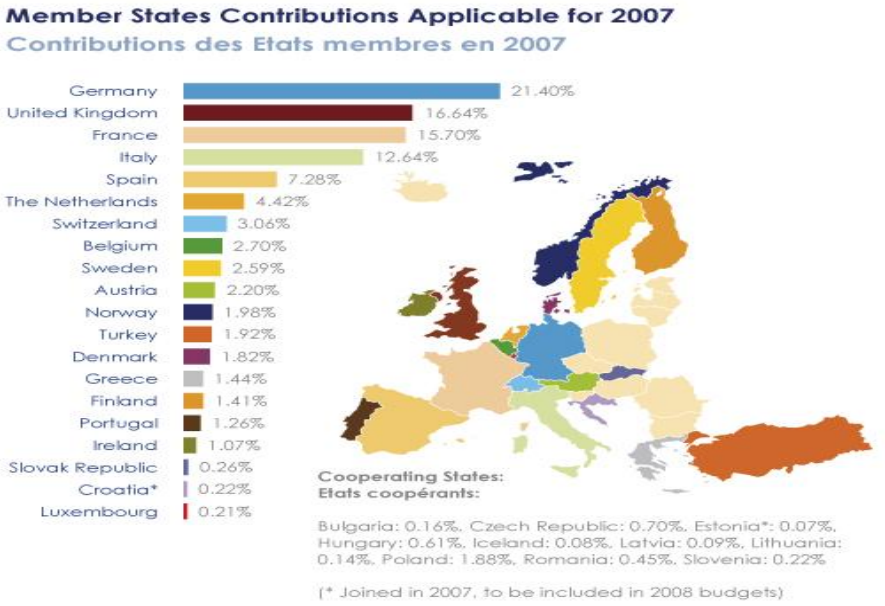
Total : 227 millions euros

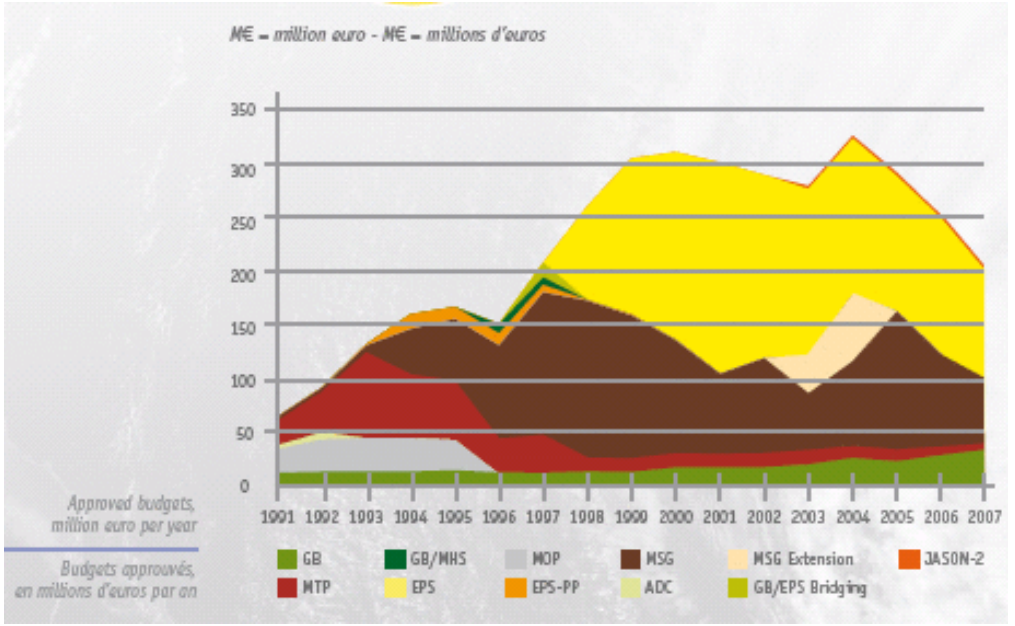
Belgium = 6.1 millions euros

Note: ECMWF contributions 2006

Total : +/- 45 millions euros

Belgium : +/- 1.3 millions euros





Satellite data reception/dissemination at RMIB

Euro Bird 9a, Ku band

DVB1

DVB2

antenna's

stratus (everest/illuin) HP server

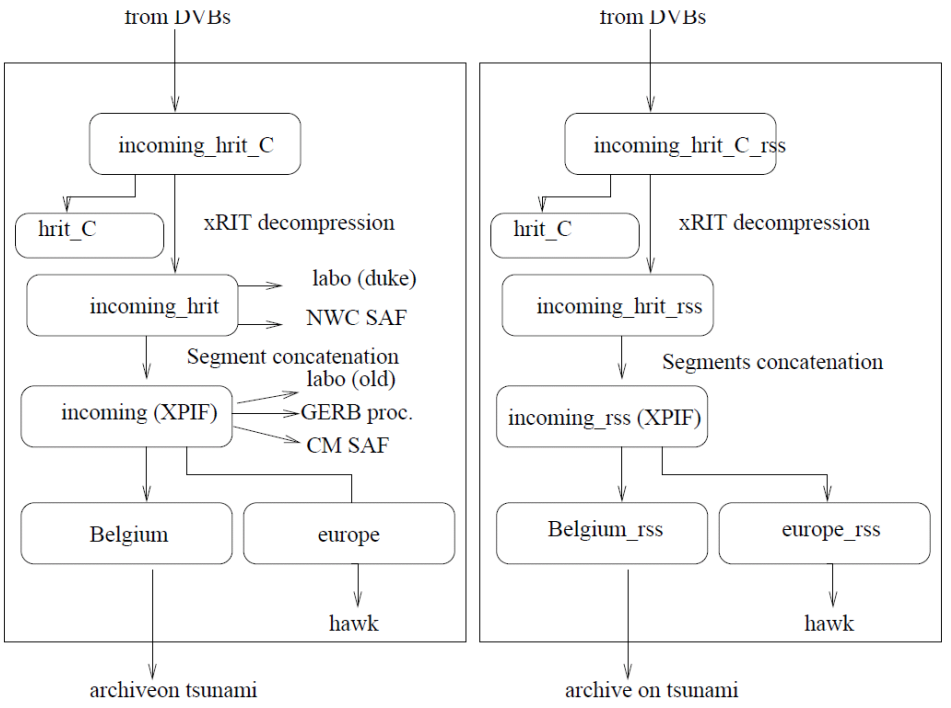
tsunami file server

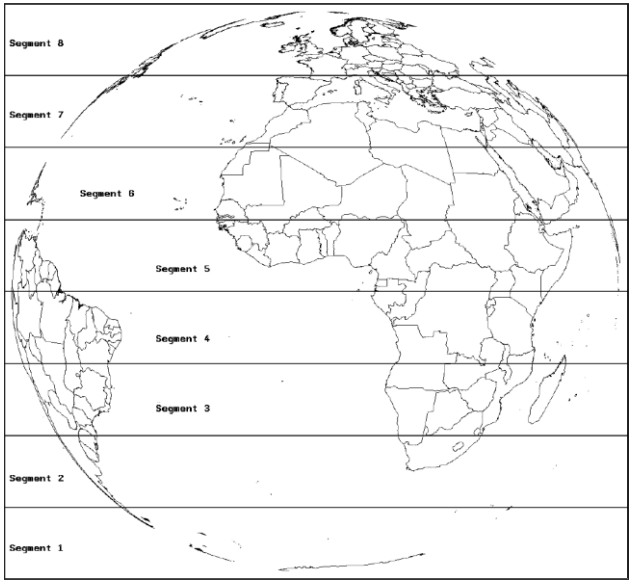
LTO tapes

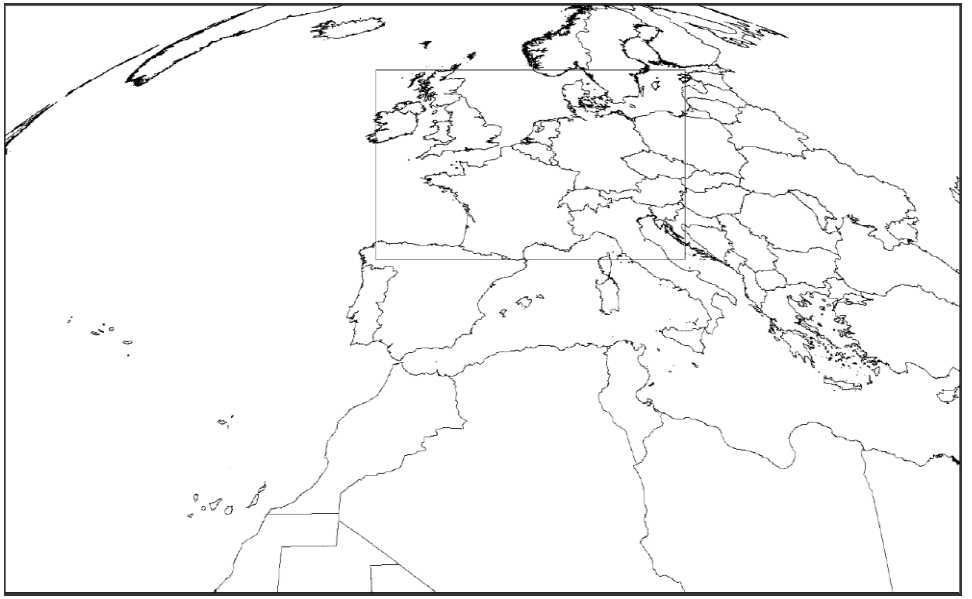
real time users (forecasters, TV, NWP, GERB, CM SAF, SAF nowcsating …)

"archive" users (research centers, universities, CM SAF, …)

Processing on “stratus” (at the CC)







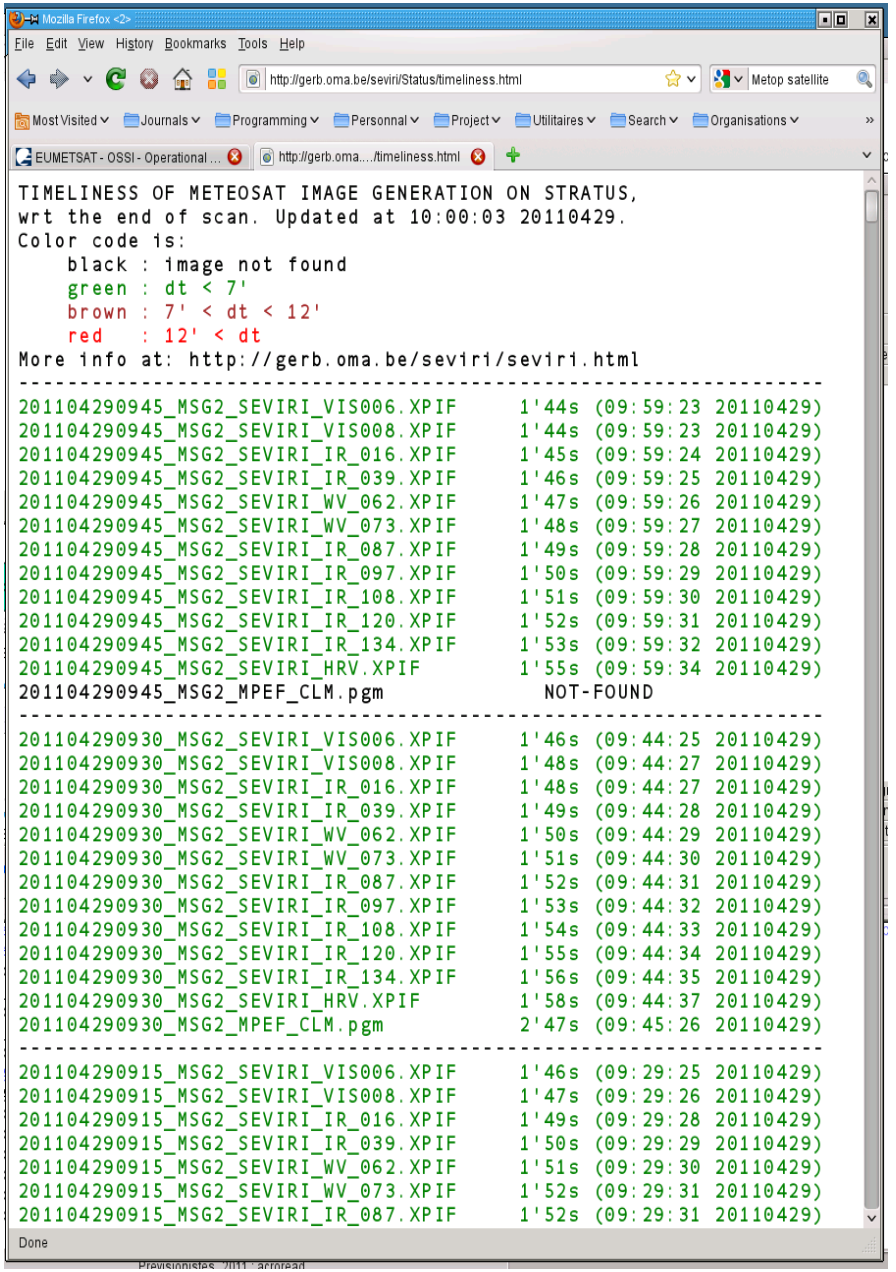
System Status

http://www.eumetsat.int

0° Service	MET-10
9.5° RSS	MET-9
57.5° IODC	MET-7
GDS-Metop	Metop-A
GDS-NOAA	NOAA-19
OSTM	Jason-2

Valid for: 2013/04/18 12:56:59 UTC

http://gerb.oma.be/seviri/Status/timeliness.html

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TIMELINESS OF METEOSAT IMAGE GENERATION ON STRATUS,
wrt the end of scan. Updated at 10:00:03 20110429.
Color code is:
    black : image not found
    green : dt < 7'
    brown : 7' < dt < 12'
    red   : 12' < dt
More info at: http://gerb.oma.be/seviri/seviri.html
-----------------------------------------------------------------
201104290945_MSG2_SEVIRI_VIS006.XPIF     1'44s (09:59:23 20110429)
201104290945_MSG2_SEVIRI_VIS008.XPIF     1'44s (09:59:23 20110429)
201104290945_MSG2_SEVIRI_IR_016.XPIF     1'45s (09:59:24 20110429)
201104290945_MSG2_SEVIRI_IR_039.XPIF     1'46s (09:59:25 20110429)
201104290945_MSG2_SEVIRI_WV_062.XPIF     1'47s (09:59:26 20110429)
201104290945_MSG2_SEVIRI_WV_073.XPIF     1'48s (09:59:27 20110429)
201104290945_MSG2_SEVIRI_IR_087.XPIF     1'49s (09:59:28 20110429)
201104290945_MSG2_SEVIRI_IR_097.XPIF     1'50s (09:59:29 20110429)
201104290945_MSG2_SEVIRI_IR_108.XPIF     1'51s (09:59:30 20110429)
201104290945_MSG2_SEVIRI_IR_120.XPIF     1'52s (09:59:31 20110429)
201104290945_MSG2_SEVIRI_IR_134.XPIF     1'53s (09:59:32 20110429)
201104290945_MSG2_SEVIRI_HRV.XPIF        1'55s (09:59:34 20110429)
201104290945_MSG2_MPEF_CLM.pgm             NOT-FOUND
-----------------------------------------------------------------
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201104290930_MSG2_SEVIRI_IR_039.XPIF     1'49s (09:44:28 20110429)
201104290930_MSG2_SEVIRI_WV_062.XPIF     1'50s (09:44:29 20110429)
201104290930_MSG2_SEVIRI_WV_073.XPIF     1'51s (09:44:30 20110429)
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201104290915_MSG2_SEVIRI_WV_062.XPIF     1'51s (09:29:30 20110429)
201104290915_MSG2_SEVIRI_WV_073.XPIF     1'52s (09:29:31 20110429)
201104290915_MSG2_SEVIRI_IR_087.XPIF     1'52s (09:29:31 20110429)
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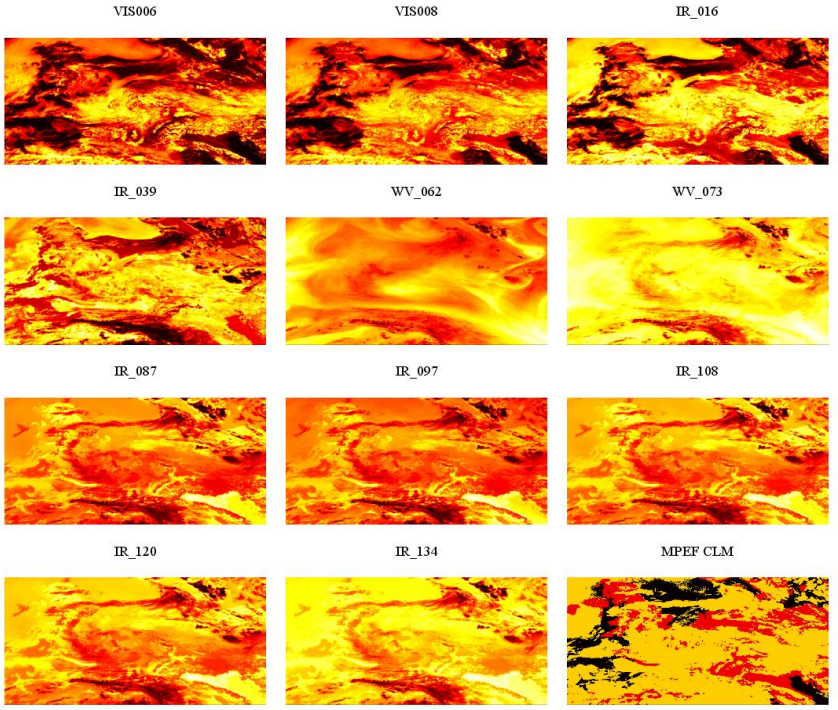
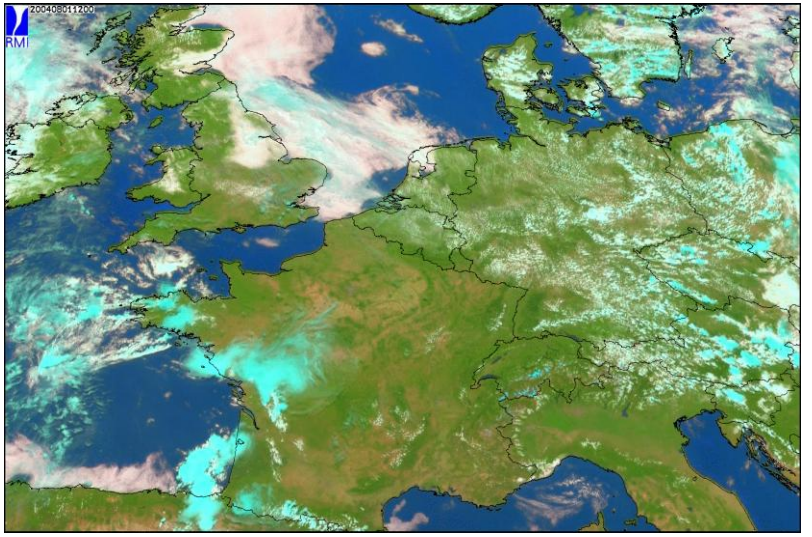
SEVIRI BEL archive

- from July 2003 onward
- “on-line” on the fileserver
- for product development, reasearch, climate





See : http://gerb.oma.be/seviri/Seviri_BEL/seviri_bel.html

Our scientific projects

GERB

- started 1998 should last during MSG era (2020?)
- Funding : UK+bel project, then EU project, now EUM (+/- 260 kEUR/year)
- Alessando, Edward, Patrick + Almu, Nicolas

Climate Monitoring SAF

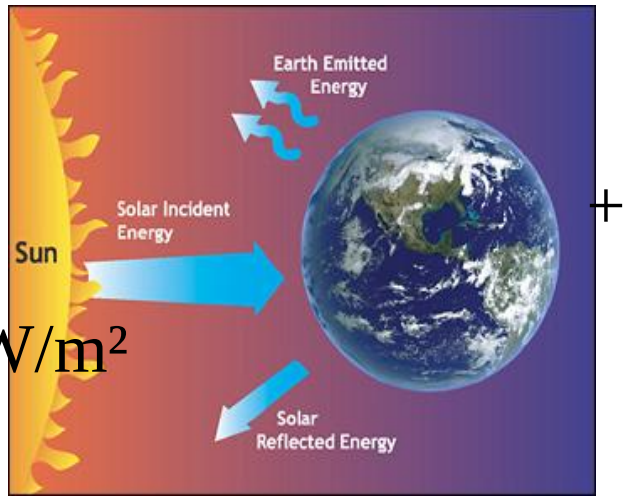
- started 1999 , now in CDOP-2 phase (2012-2017), proposal for CDOP-3 (2017-2022) in preparation.
- Funding : EUM at 50% (about 130 kEUR) → institute/Belspo provide the solde
- Stijn, Ilse, Patrick and Nicolas

Earth CARE

- Funding ESA
- Scientist : Almudena

GERB : the Geostationary Earth Radiation Budget

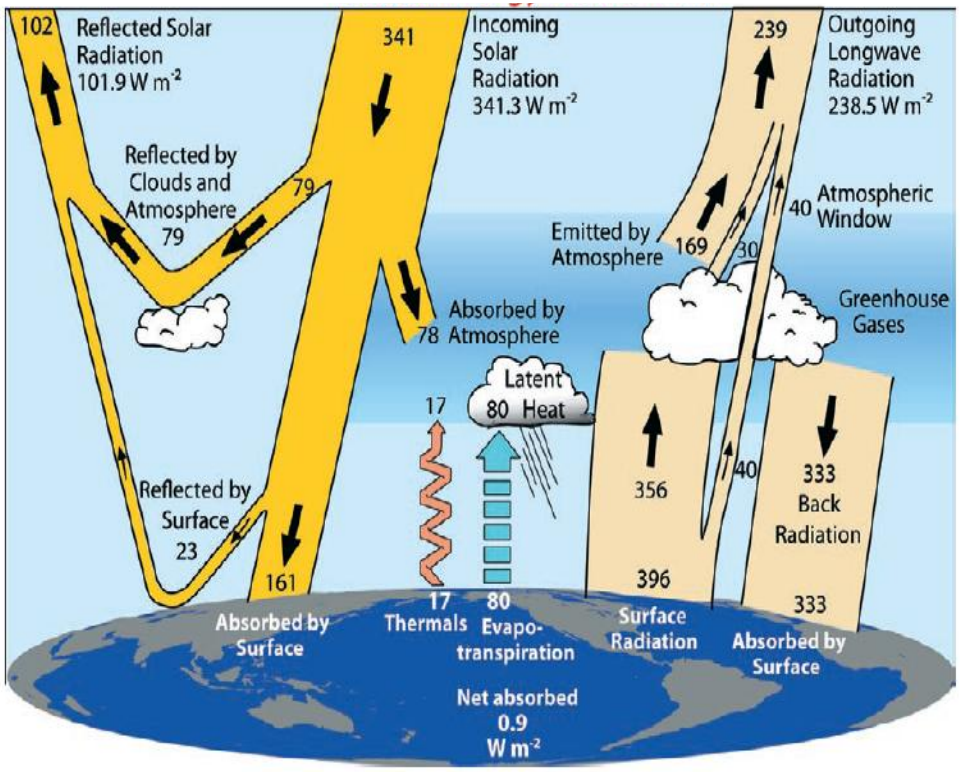
- 238.65 W/m²



+0.85 W/m²

+341 W/m²

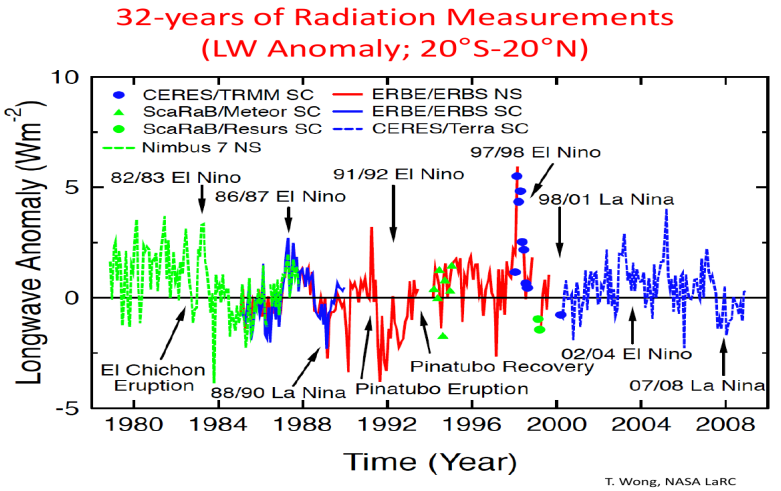
- 101.5 W/m²



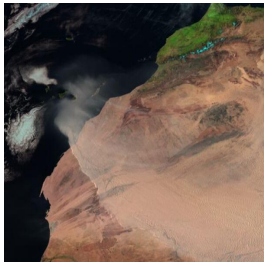
Trenberth at al., BAMS, 2009

Why do we measure ERB?

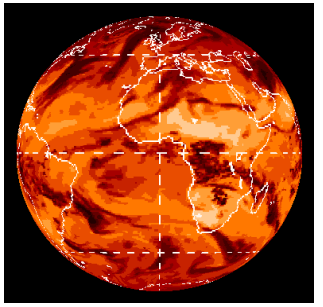
1. Climate monitoring
   - Long term climate variations and trends
   - El Nino/La Nina
   - Effect of natural events (volcanic eruptions, …)
   - Land cover change, snow and sea ice
   - …

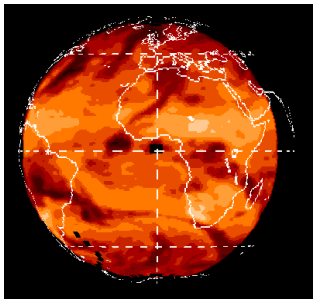


2. Processes study
   - Cloud forcing
   - Aerosol forcing
   - Convection
   - Surface albedo
   - …



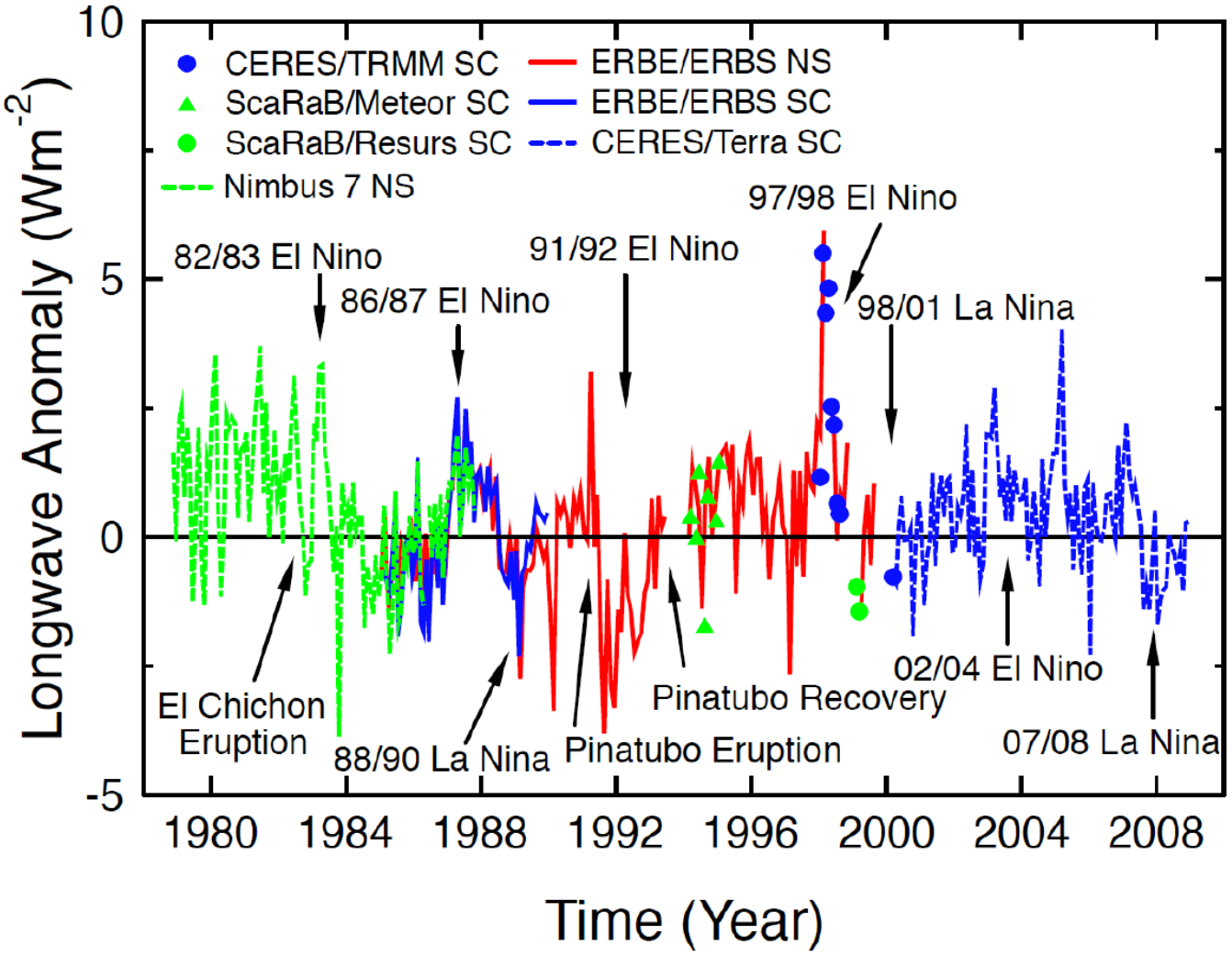
3. Climate/weather modelling
   - Validation/ improvement of radiation scheme in climate/ NWP models





Climate monitoring

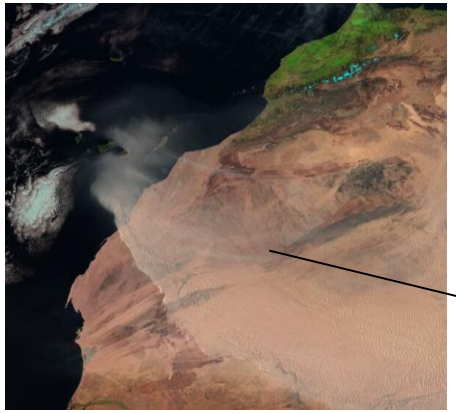
32-years of Radiation Measurements (LW Anomaly; 20°S-20°N)



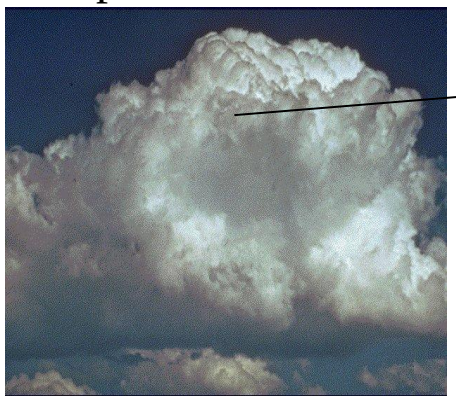
T. Wong, NASA LaRC

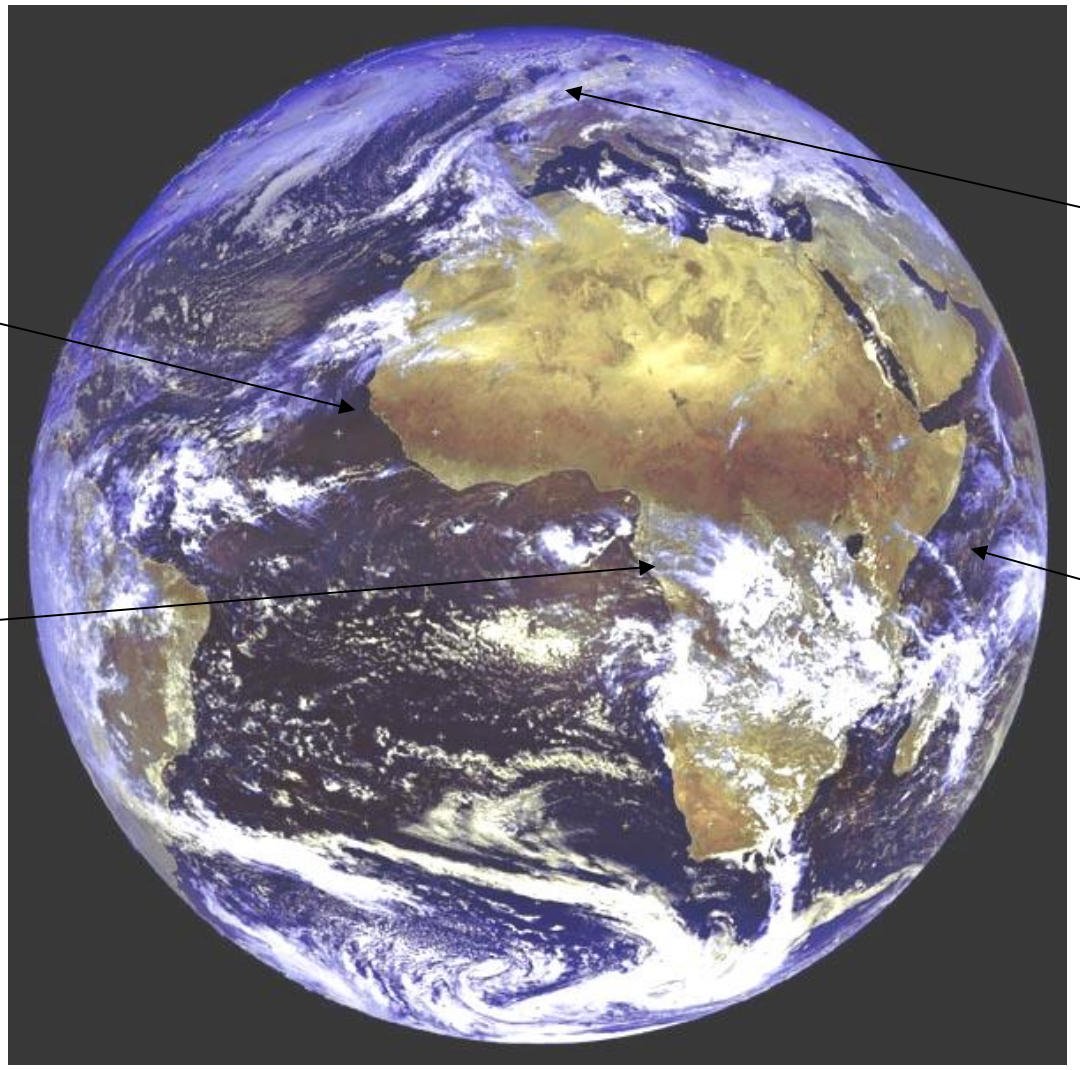
Processes Study

Aerosols

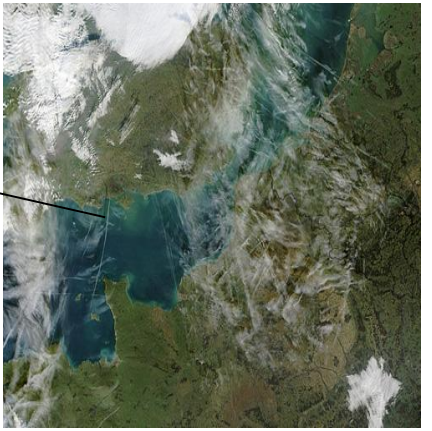


Tropical Convection





Contrails



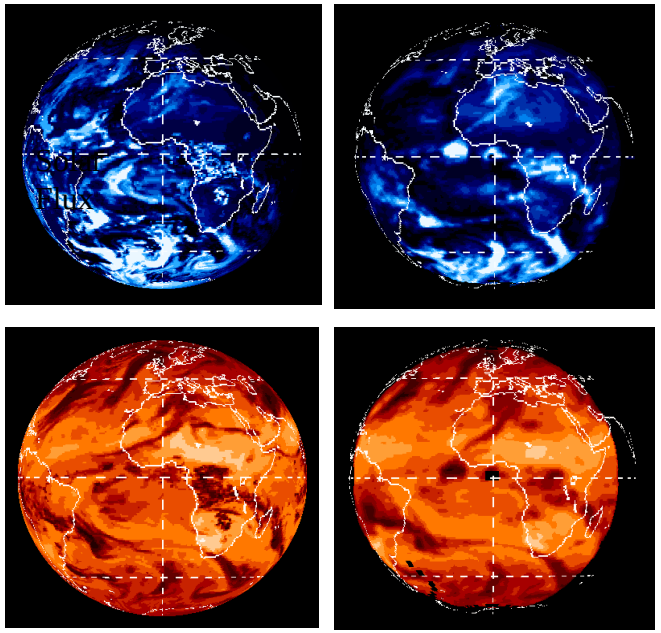
Cirrus

Also: desertification, African monsoon, marine stratocumulus, volcaneos, biomass burning, …

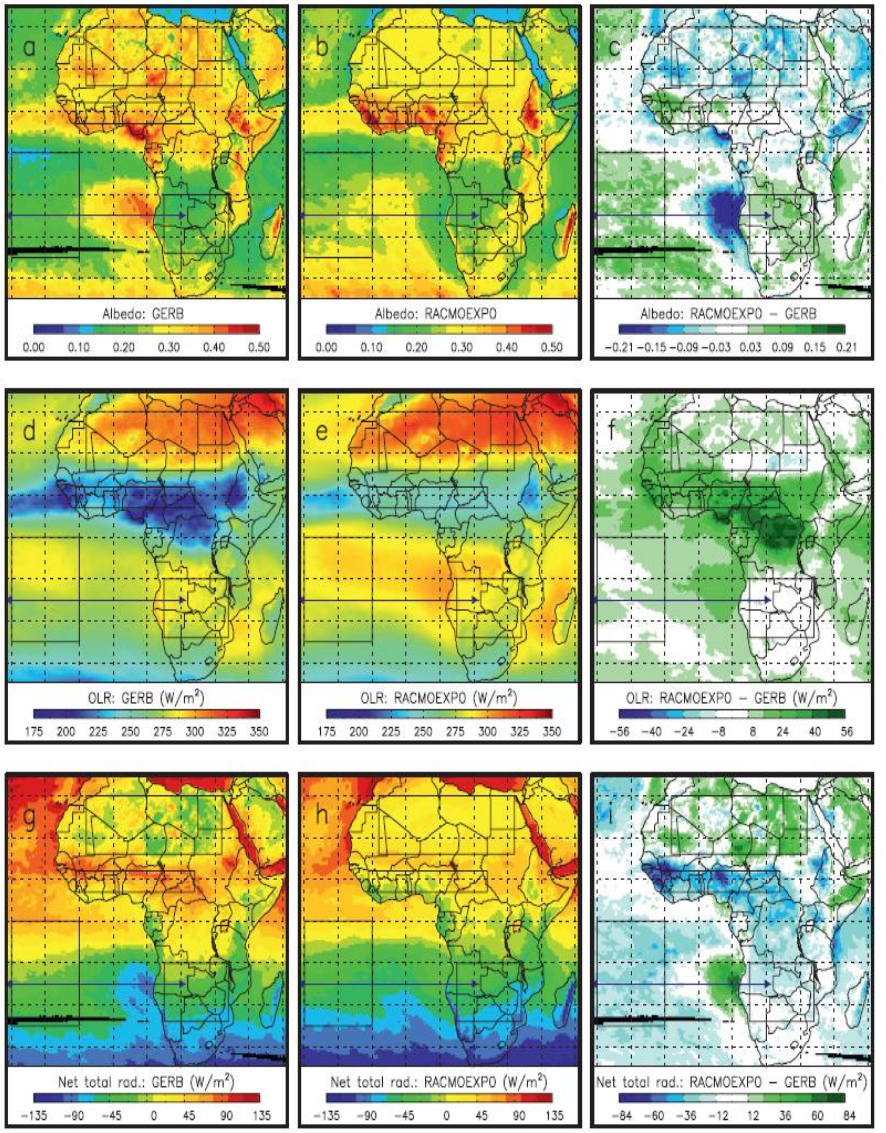
Climate models evalution/improvement

UK-MO Unified Model GERB

Thermal Flux



(Courtesy UK Met Office)



Greuell et al identified 3 main climate regimes where RACMO – GERB differences are higher than observational accuracy and proposed and tested model improvements:

- Underestimation of model desert albedo. Improvements were then obtained using MODIS instead of ECOCLIMAP albedo.
- Underestimation of stratocumulus cloud field albedo: improvements were obtained by prescribing the cloud effective radius.
- the ITCZ over land (ITCZ over ocean is ok). The error is due to inaccurate diurnal cycle of CWP in the deep convection zone (cloud fraction was okay).

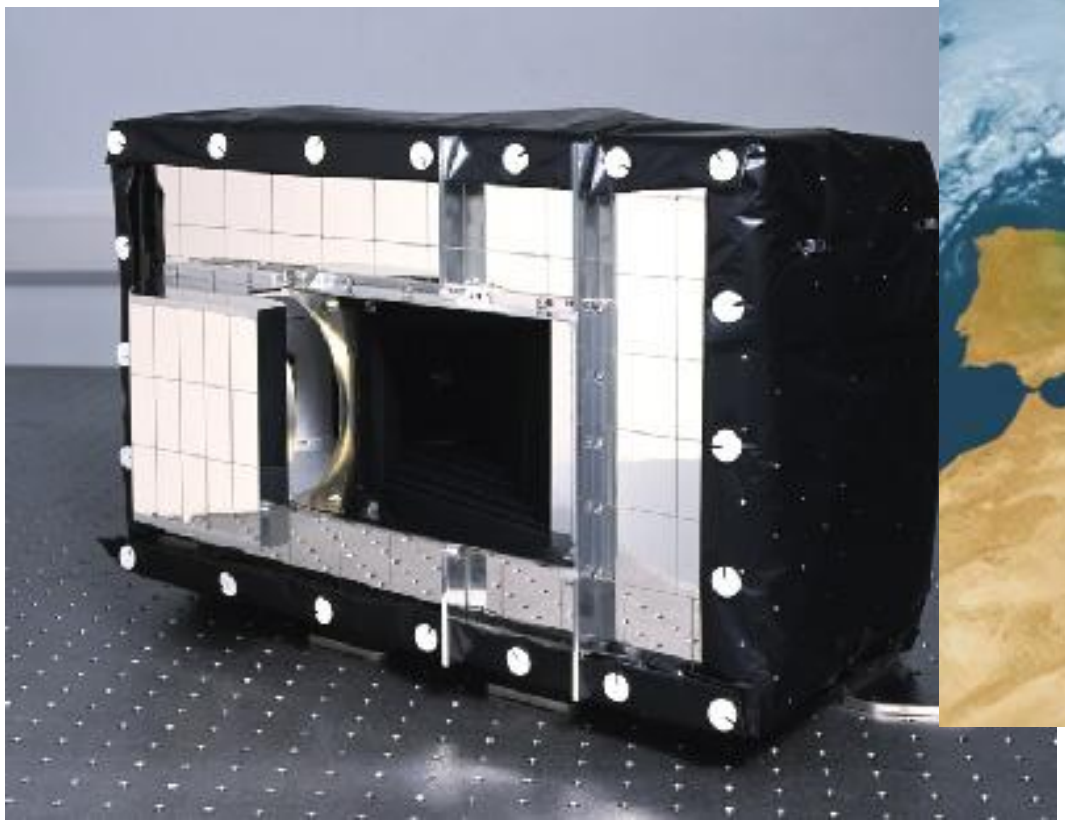
They also provided 2 recommendations for GERB project:

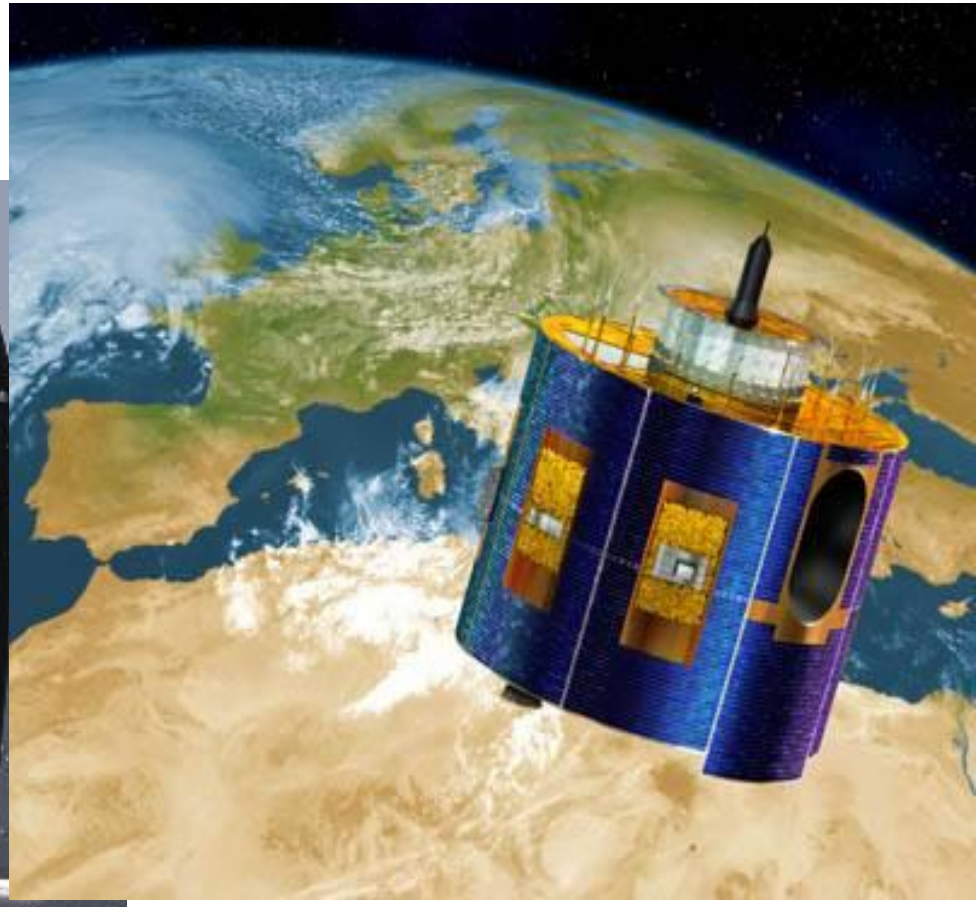
- To ease the comparison with climate models, GERB clear sky fluxes should be provided,
- Improve the angular model for SW radiation in clear sky conditions.

Note : RACMO = Regional Atmospheric Climate Model version 2

Greuell, Wouter, Erik van Meijgaard, Nicolas Clerbaux, Jan Fokke Meirink, 2011: Evaluation of Model-Predicted Top-of-Atmosphere Radiation and Cloud Parameters over Africa with Observations from GERB and SEVIRI. J. Climate, 24, 4015–4036.

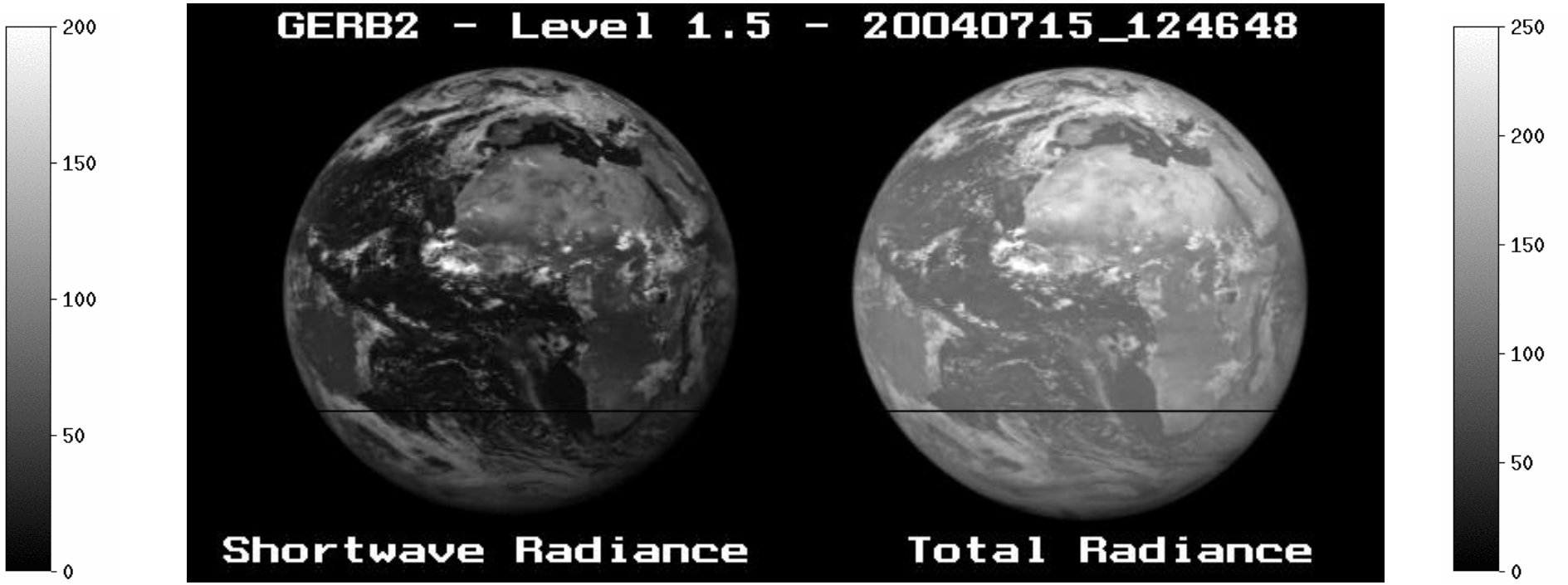
GERB on Meteosat Second Generation





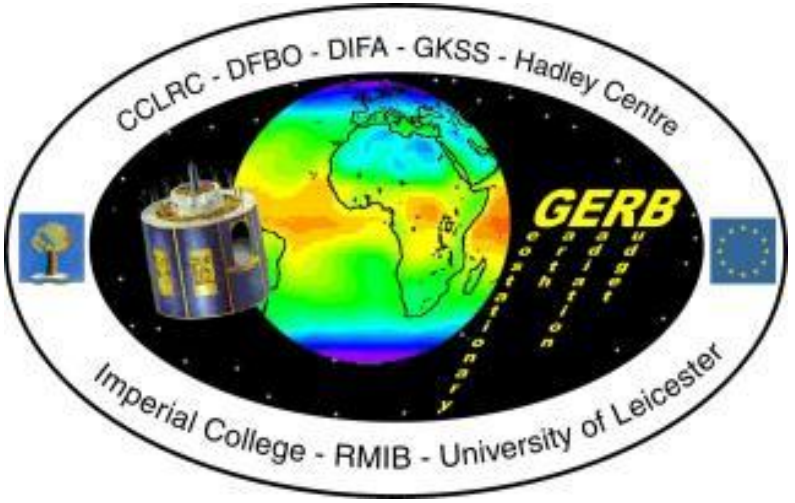
The GERB instruments

First BB instrument on geo orbit
On the 4 MSG satellites (Meteosat-8, -9, 10 and -11)
Repeat cycle : 5’ (!)



GERB data processing

Level 1 -> 1.5 (GERB team @ RAL & ICL)
Calibration
Geolocation



Level 1.5 -> level 2 (GERB team @RMIB)
Unfiltering
Angular modelling
Spatial modelling (including resolution enhancement)
Temporal modelling

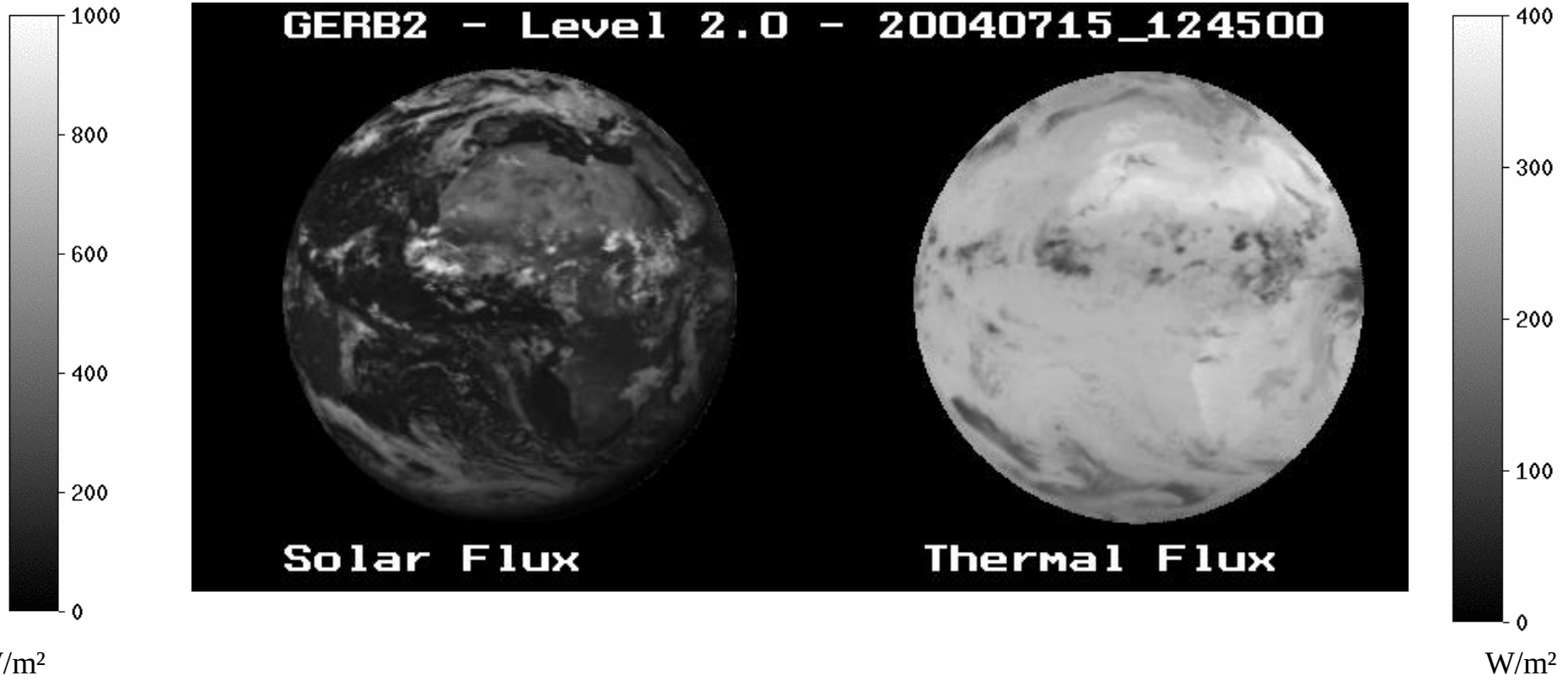
Level 2 -> level 3 (CM SAF)
Monthly averaging
Gap filling

The EUMETSAT Network of Satellite Application Facilities

CM SAF
Climate Monitoring

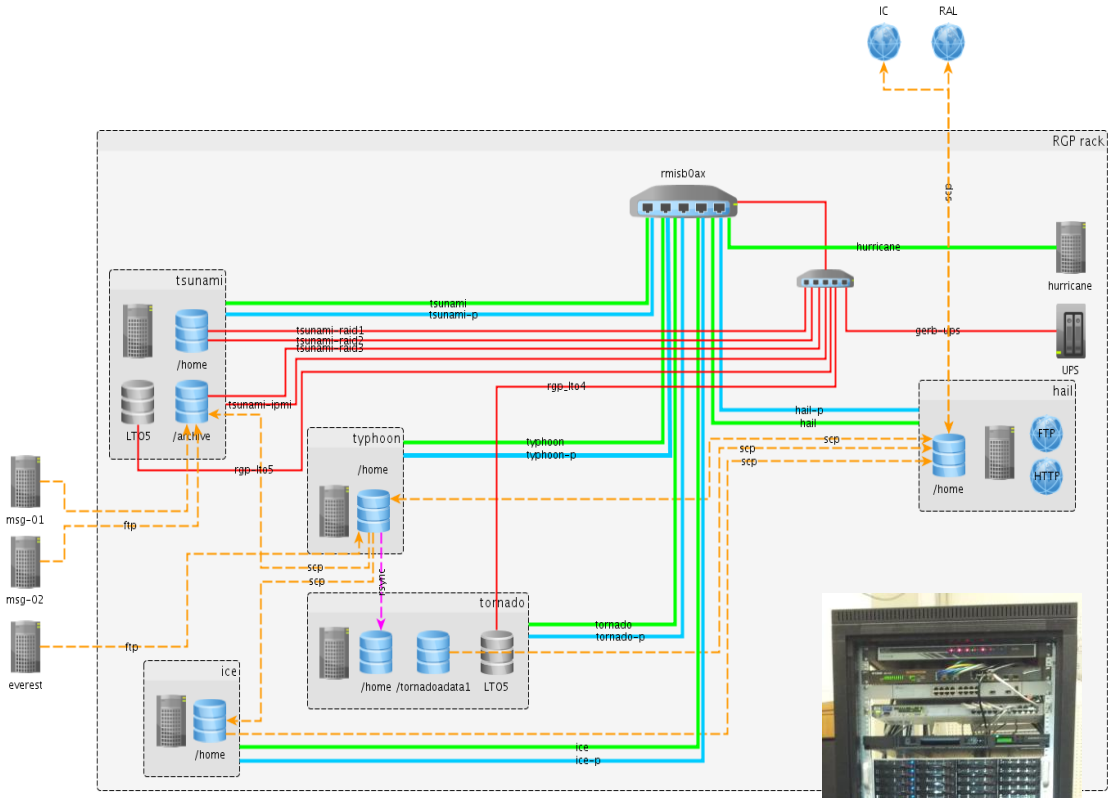
Illustration GERB level 2

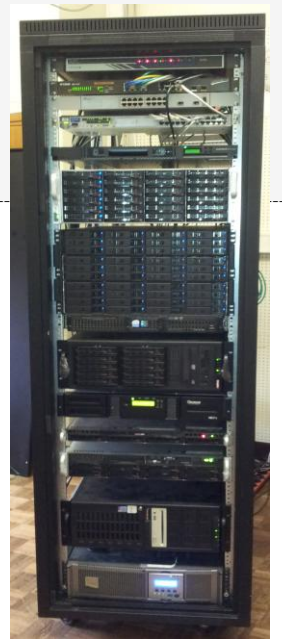
Each 15’
Instantaneous TOA fluxes
3 formats : ARG, BARG, HR



GERB in practice

- Operate the RMIB GERB Processing (RGP) system for NRT data generation
- Reprocess the data record
- Maintain operational system, including our own file server and ftp/http server
- Archive on LTO-X tapes
- Validate and improve the RGP





The EUMETSAT‘s Climate Monitoring Satellite Application Facility (CM SAF)

http://www.cmsaf.eu

CM SAF International Board visiting KNMI/Cabauw, NL.

The EUMETSAT Network of Satellite Application Facilities

CM SAF
Climate Monitoring

EUMETSAT

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

DWD

KNMI

RMI

SMHI

Met Office

GCOS Essential Climate Variables (ECVs)

Red : ECVs targeted by CM SAF.

Domain	GCOS Essential Climate Variables
Atmospheric (over land, sea and ice)	Surface:[1] Air temperature, **Wind speed and direction**, Water vapour, Pressure, **Precipitation**, **Surface radiation budget**. Upper-air:[2] **Temperature**, **Wind speed and direction**, **Water vapour**, **Cloud properties**, **Earth radiation budget (including solar irradiance)**. Composition: **Carbon dioxide**, **Methane**, and other long-lived greenhouse gases[3], **Ozone** and **Aerosol**, supported by their precursors[4].
Oceanic	Surface:[5] **Sea-surface temperature**, **Sea-surface salinity**, **Sea level**, **Sea state**, **Sea ice**, Surface current, **Ocean colour**, Carbon dioxide partial pressure, Ocean acidity, Phytoplankton. Sub-surface: Temperature, Salinity, Current, Nutrients, Carbon dioxide partial pressure, Ocean acidity, Oxygen, Tracers.
Terrestrial	River discharge, Water use, Groundwater, **Lakes**, **Snow cover**, **Glaciers and ice caps**, Ice sheets, Permafrost, **Albedo**, **Land cover (including vegetation type)**, **Fraction of absorbed photosynthetically active radiation (FAPAR)**, **Leaf area index (LAI)**, **Above-ground biomass**, Soil carbon, **Fire disturbance**, **Soil moisture**.

Current and future CM SAF datasets

Remark: heavy review process (requirements, ATBD, delivery)

Illustration : TOA radiation monthly means

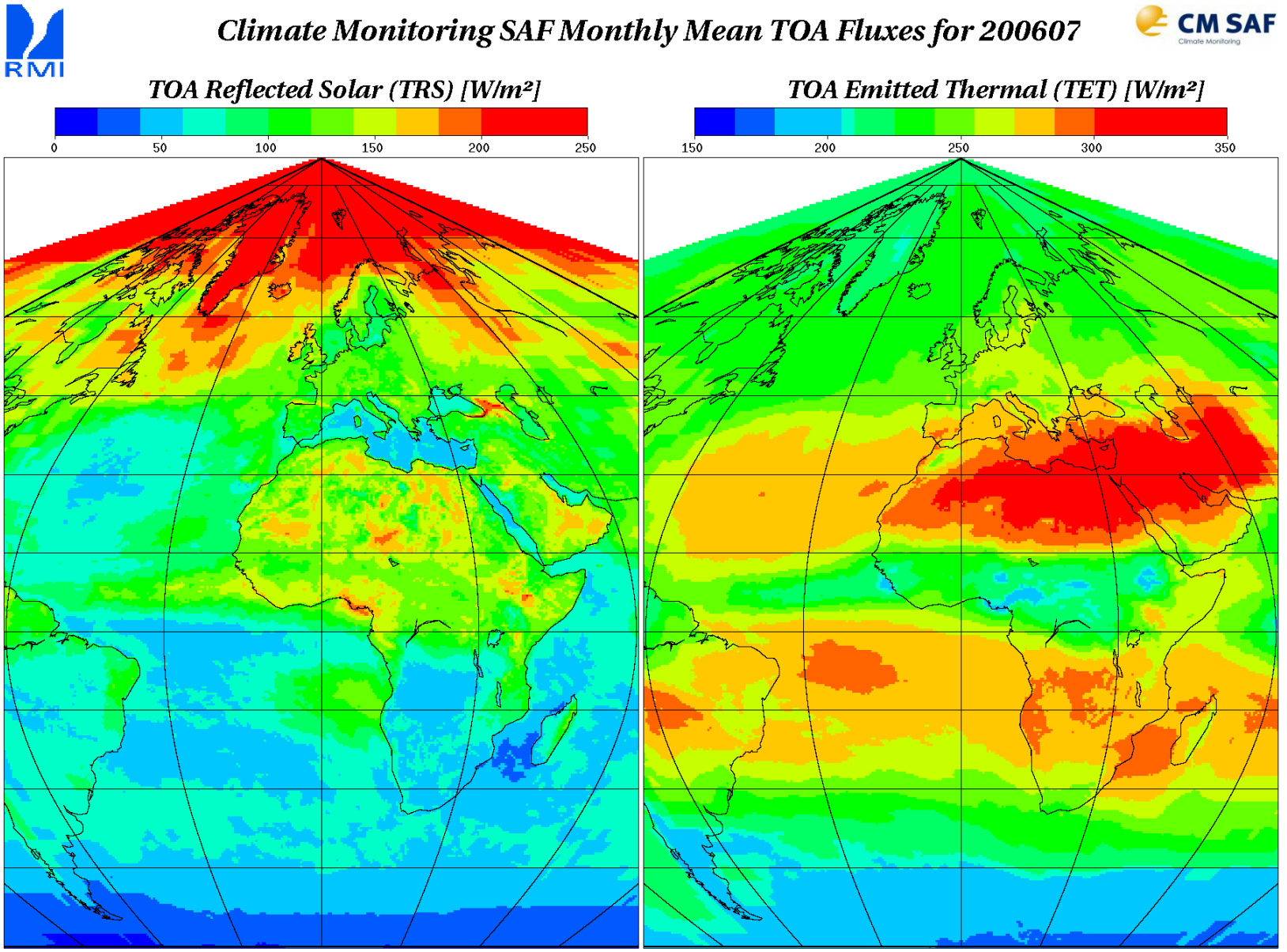


Illustration : TOA radiation daily means

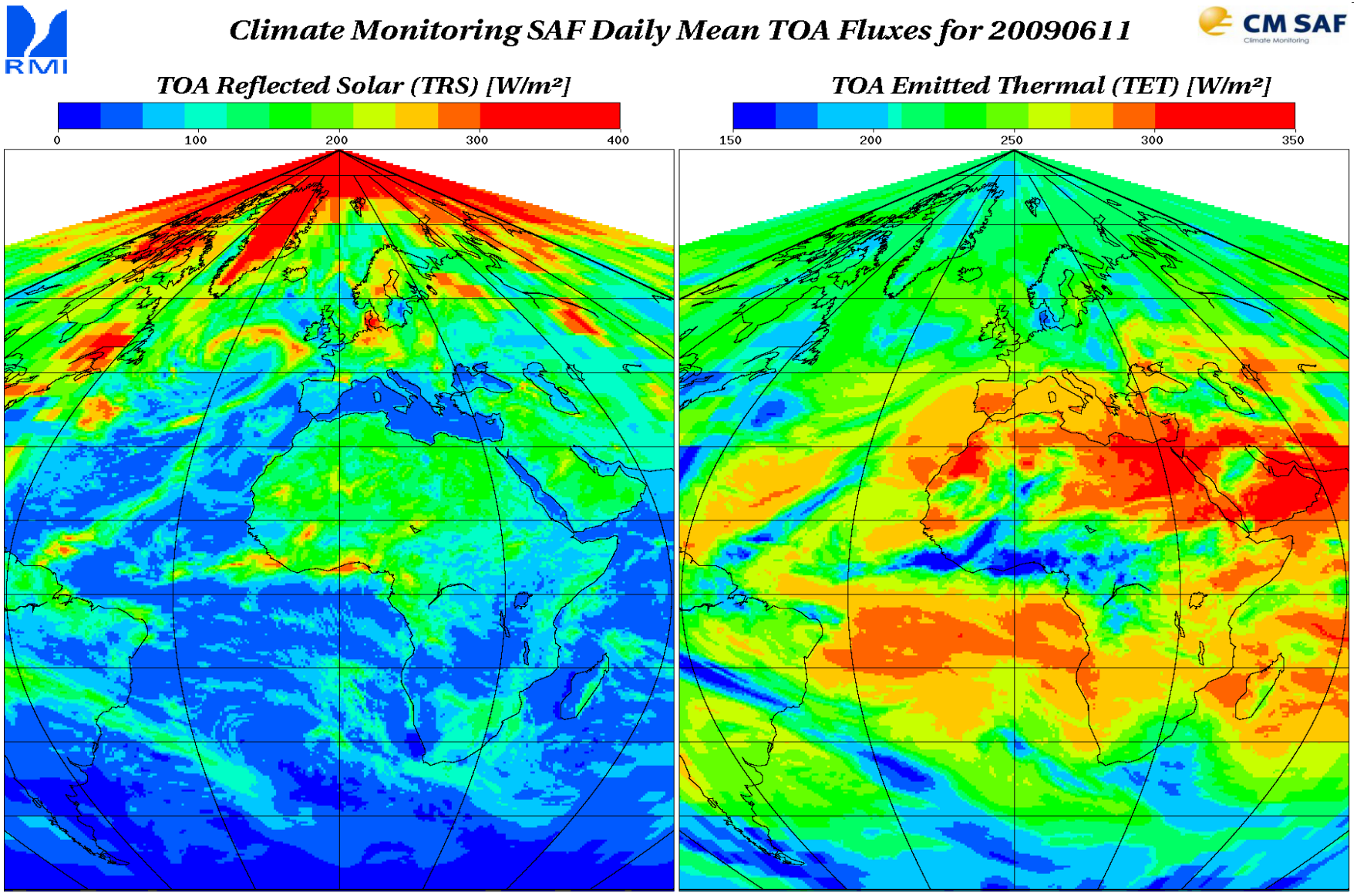


Illustration : TOA radiation monthly mean diurnal cycle

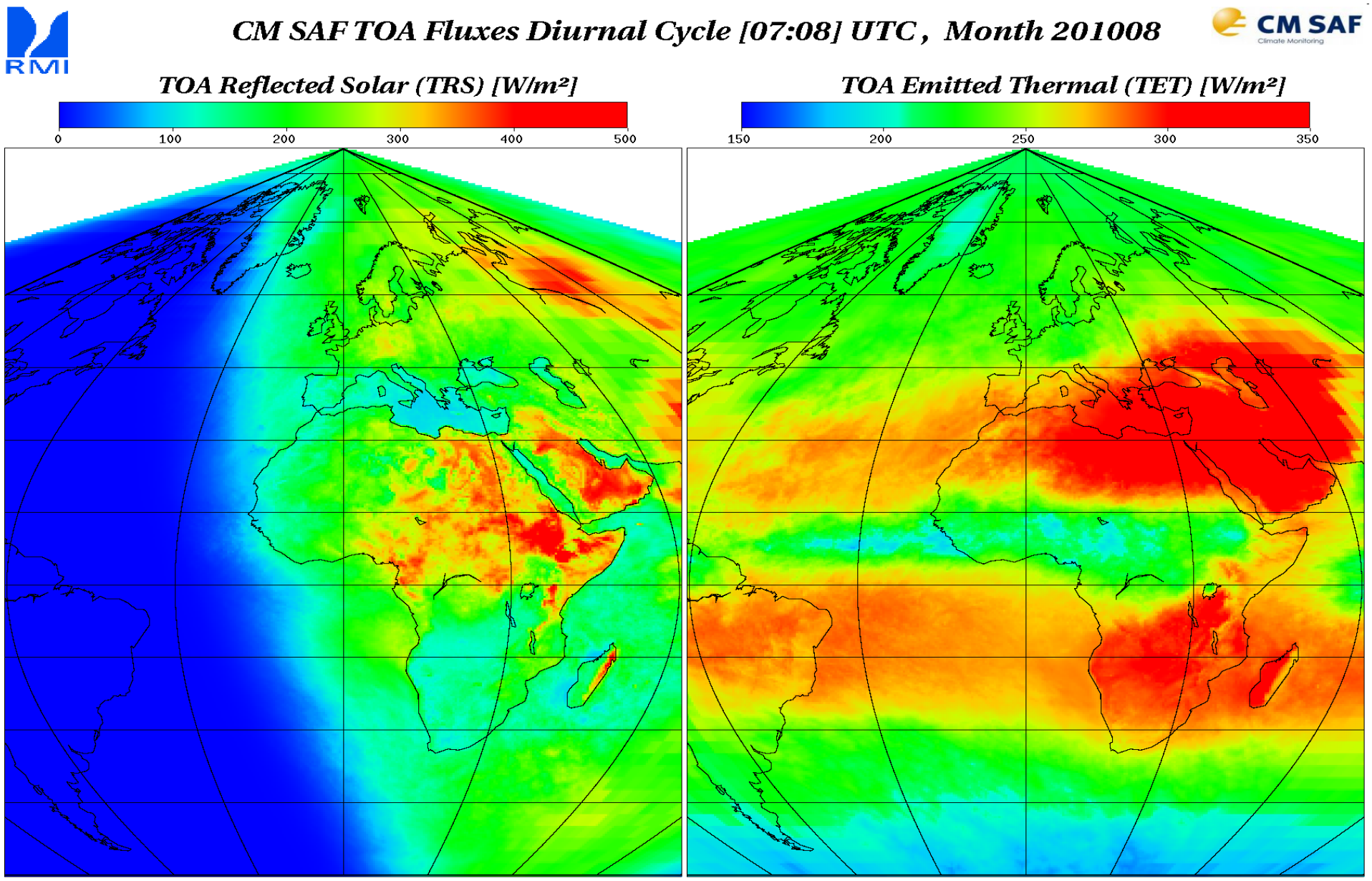
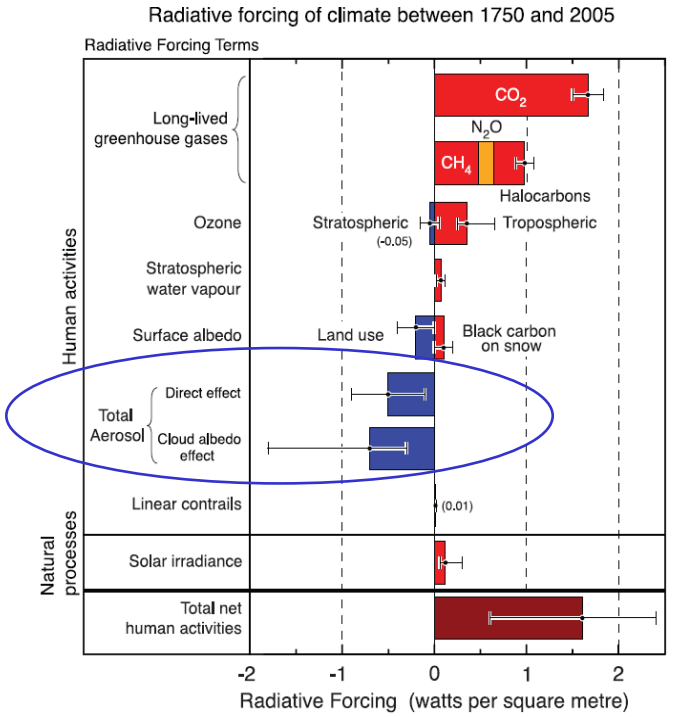
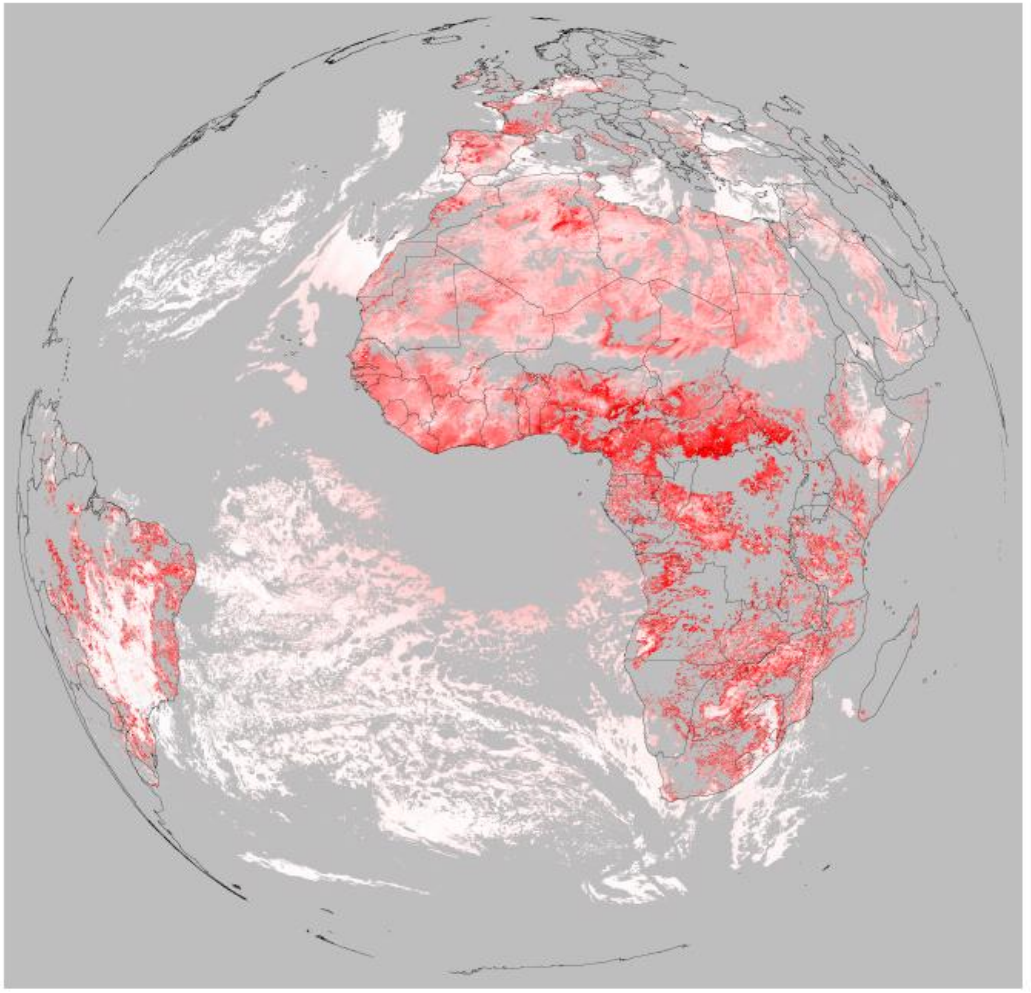
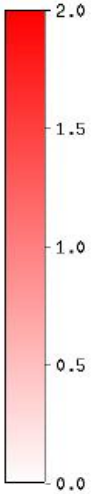


Illustration : aerosol datasets

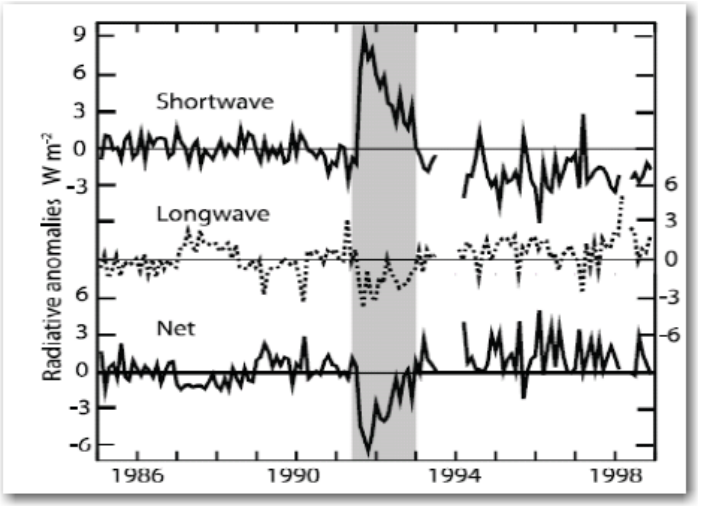


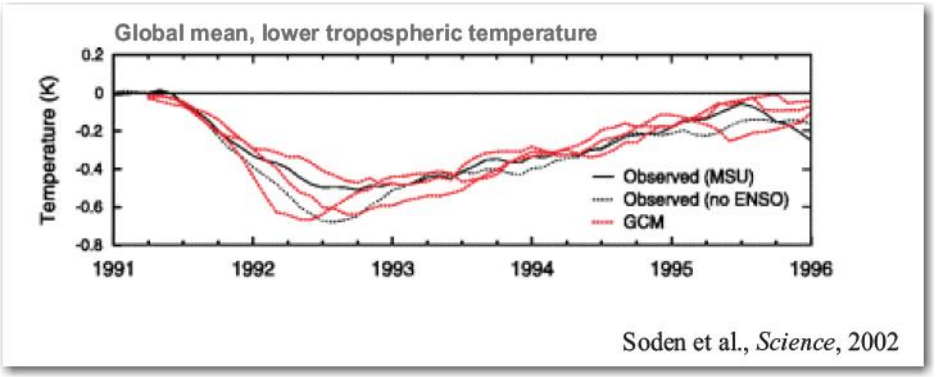




Notes :
- AOD is also important to improve the other CM SAF products.
- Combine with GERB → direct effect

Pinatubo example





Meteosat First Generation (1982-2006) FCDR

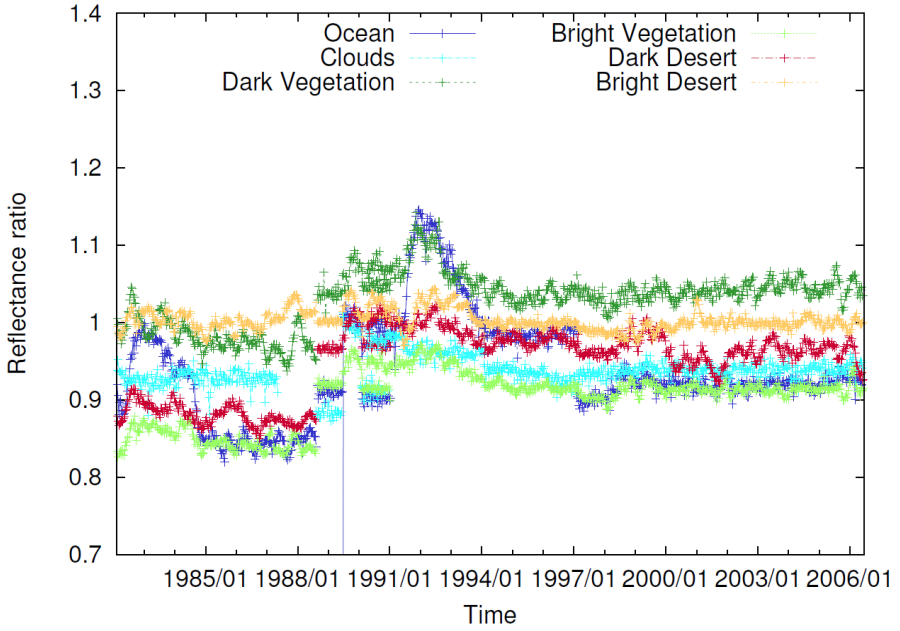
Goal:

- to have homogeneous and consistent radiance record as input of the retrieval algorithm

Work

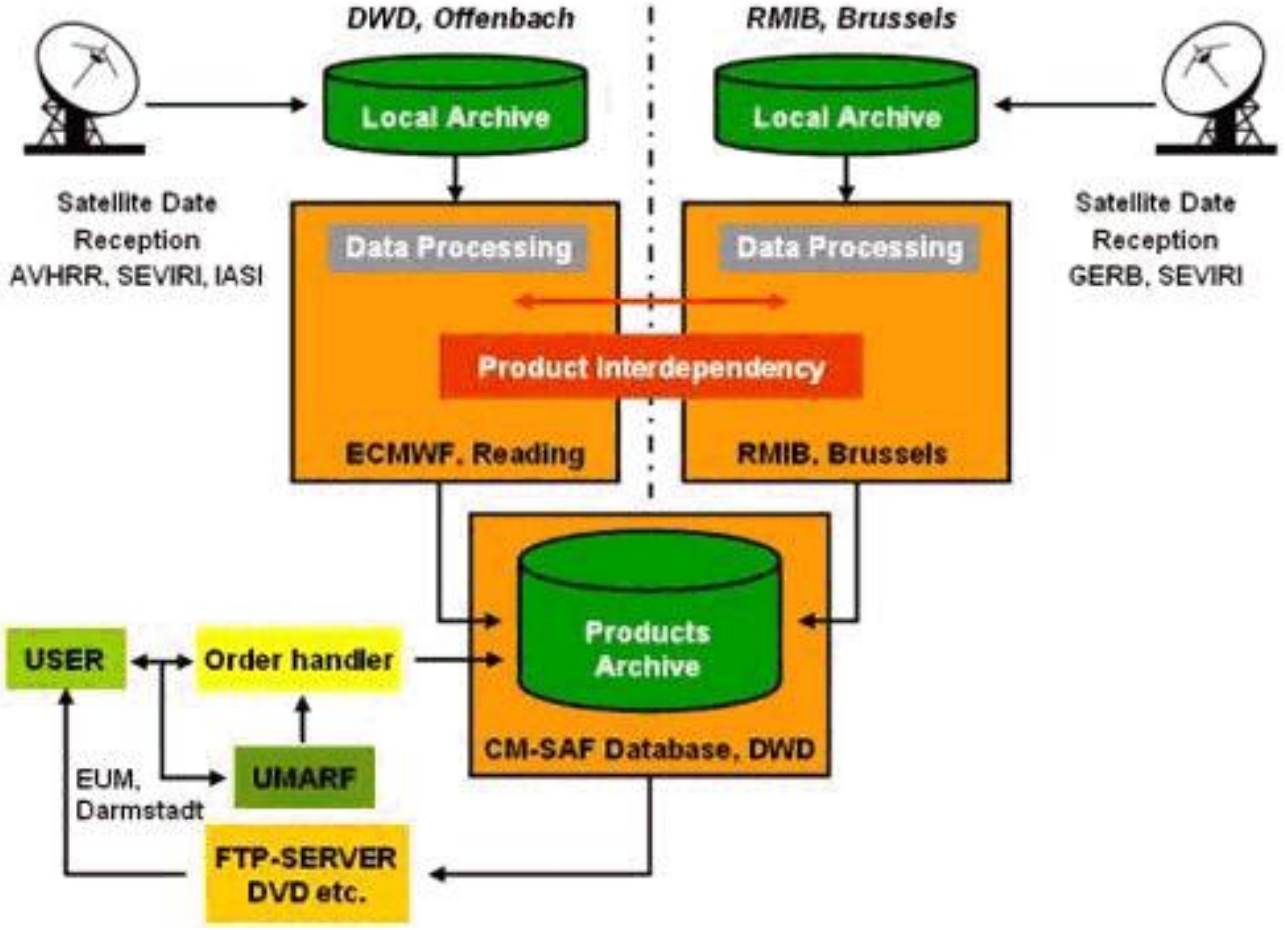
- develop an aging model of the Meteosat VIS channel

- revisit of the pre-launch pre-launch characterization.

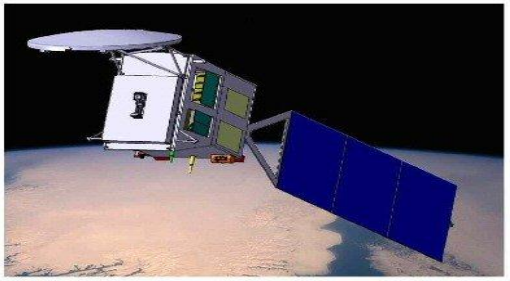


More info at RMIB conference: "*An aging model of the Meteosat visible channel for use in the Climate Monitoring SAF*" by Ilse Decoster on 9 October 2013.

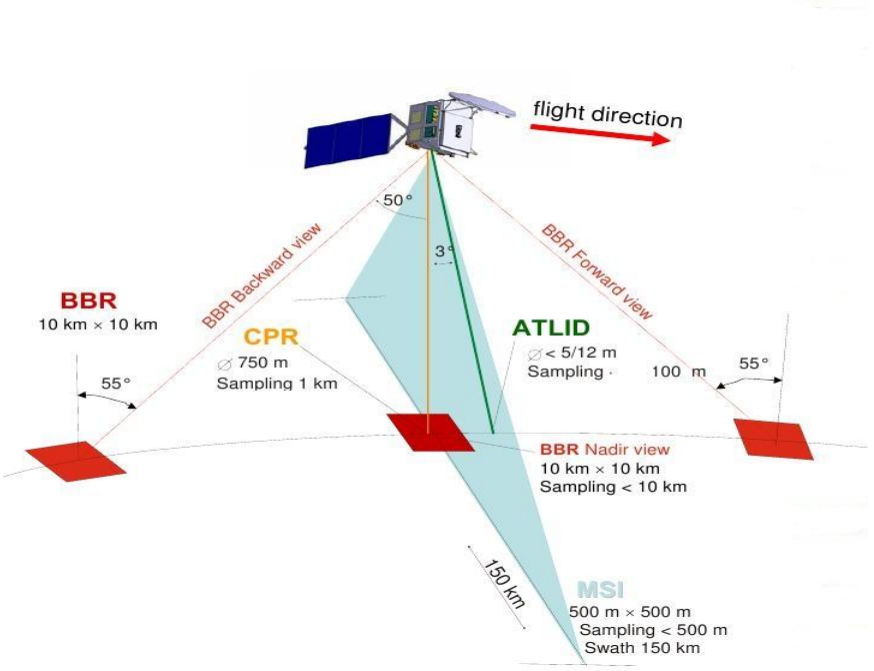
CM SAF in practice

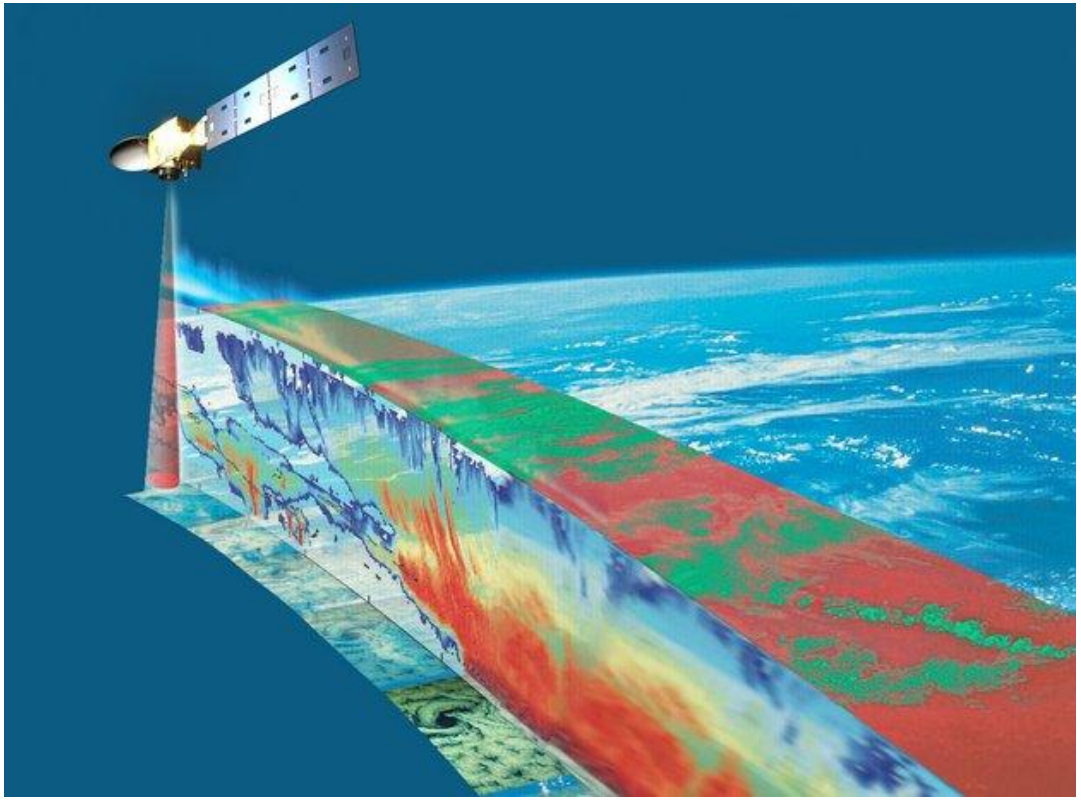


Earth Cloud Aerosol Radiation Explorer (Earth CARE)



- Satellite to be launch 2016
- Payload : lidar, radar, imager and BBR

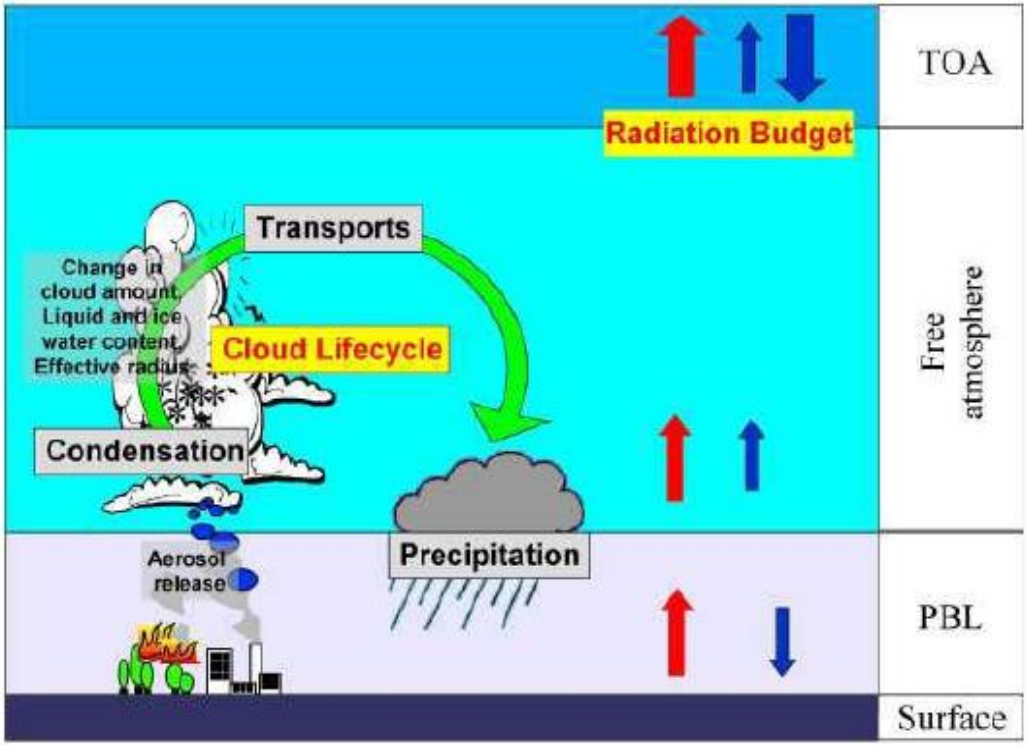




Earth CARE in practice

- Previous study done in 2000
- 2009-2010: SITS study of the BBR unfiltering
- FLURB : study of the BBR radiances to flux conversion.

  2 years study with 36 deliverables!



More info at RMIB conference: "*An aging model of the Meteosat visible channel for use in the Climate Monitoring SAF*" by Ilse Decoster on 9 October 2013.

Other activities/collaboration of the team

- Earth imbalance study for the STCE (EB)
- Run the SAF NWC software for weather office and other users in the institute
- Participate to the working groups:
    - Cloud Retrieval Evaluation (CREW)
    - EUMETSAT Science and Operation
- Give lessons: on satellite climatology at Ulg, Thermodynamics at UGhent
- PhD thesis:
    - “Validation of Satellite data using ground measurements” at Universitat Valencia
    - “Generation of GERB-like data from meteosat First generation” at V.U.B.
- Chairwoman in COSPAR conferences
- Participation to the RMIB “User's Committee”
- Master thesis e.g. Julien Beaumet “Retrieval of precipitation from SEVIRI”
- Simulation ozone sounding
- Collaboration with BIRA/IASB for GOME and IASI reception
- Collaboration with MUMM for Ocean Color retrieval from SEVIRI