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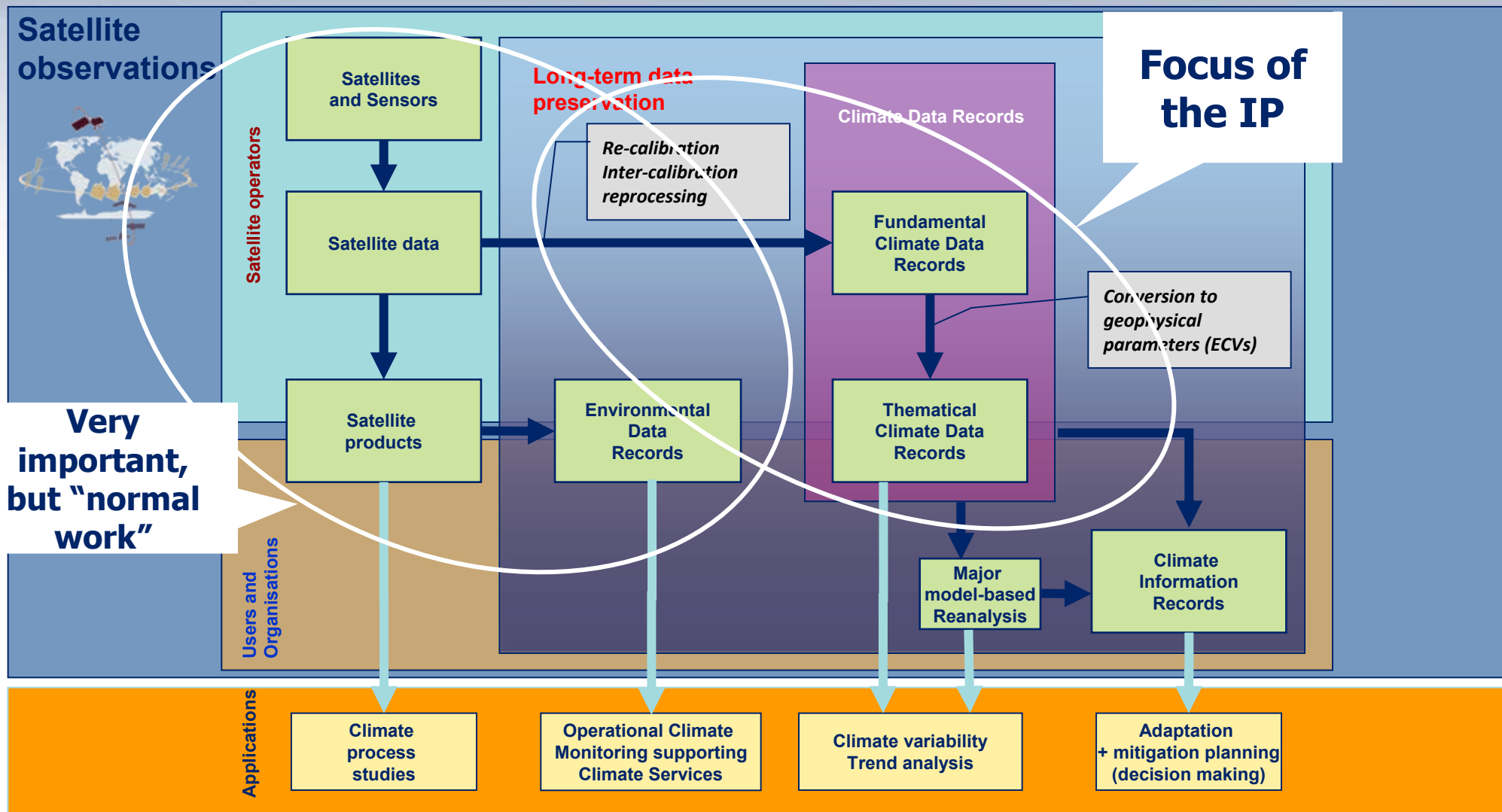
# EUMETSAT's commitment and activities

As stated in its **Convention**, EUMETSAT is committed to the contribution to the operational monitoring of the climate and the detection of global climate change.

This objective is addressed by EUMETSAT at different levels (recent Council Resolution, 2009 and associated Implementation Plan, 2010):

- Taking into account **climate-specific requirements** in the planning of new programmes;
- The **provision of observational data** with its satellites and embarked instruments;
- Generation of **Fundamental Climate Data Records (FCDRs)** through re-calibration and re-processing is the main focus;
- Generation of **Thematic Climate Data Records (TCDRs)**, making best use of Satellite Application Facility Network expertise, is a second focus;
- Contributions and coordination with international partners, organisations and initiatives.

# Implementation Plan Focus





# EUMETSAT CDR Overview

- Aim for combined FCDR for Meteosat series (MVIRI, SEVIRI homogenised radiance record);
- Aim for FCDRs for all Metop instruments (first records using latest operational algorithm version are called initial FCDR);
- Aim for FCDRs for all NOAA heritage instruments on Metop (AVHRR, HIRS, MSU, SSU, AMSU-A/B (MHS));
- Produces FCDRs in joint activities with NOAA NESDIS/NCDC;
- TCDR production aims at ECVs plus typical data for assimilation in atm. Reanalysis as AMVs;
- Supports specific international activities as WCRP (GEWEX Radiation Panel Reprocessing and Assessment), WMO (GSICS, SCOPE-CM), ECMWF Reanalysis, ESA-CCI.





# GCOS ECVs at EUMETSAT Ground Segment (inclusive SAFs)

## Atmospheric (over land/sea/ice):

**Surface:** Air Pressure, Air Temperature, Precipitation, Surface Radiation Budget (*including Solar Radiation*), Water Vapour, Wind Speed and Direction.

**Upper-Air:** Cloud properties, Earth Radiation Budget, Upper-Air Temperature, Water Vapour, Wind Speed and Direction.

**Composition:** Aerosol Properties, Carbon Dioxide, Methane, Other Long-Lived Green House Gases: (*Nitrous Oxide (N<sub>2</sub>O)*, *Chlorofluorocarbons (CFCs)*, *Hydrochlorofluorocarbons (HCFCs)*, *Hydrofluorocarbons (HFCs)*, *Sulphur Hexafluoride (SF<sub>6</sub>)*, and *Perfluorocarbons (PFCs)*), Ozone.

**Oceanic: Surface:** Carbon Dioxide Partial Pressure, Current, Ocean Color (*for Biological Activity*), Sea Ice, Sea Level, Sea State, Sea Surface Salinity (SSS), Sea Surface Temperature.

**Sub-surface:** Temperature, Salinity, Current, Nutrients, Carbon, Ocean Tracers, Phytoplankton.

**Terrestrial:** River Discharge, Water Use, Ground Water, Lake Levels, Snow Cover, Glaciers and Ice Caps, Permafrost and Seasonally-Frozen Ground, Albedo, Land Cover (*including Vegetation Type*), Fraction of Absorbed Photosynthetically Active Radiation, Leaf Area Index, Biomass, Fire disturbance, Soil moisture (*recognized as an emerging ECV (not part of the 44)*).

# Surface Albedo from GEO Orbit

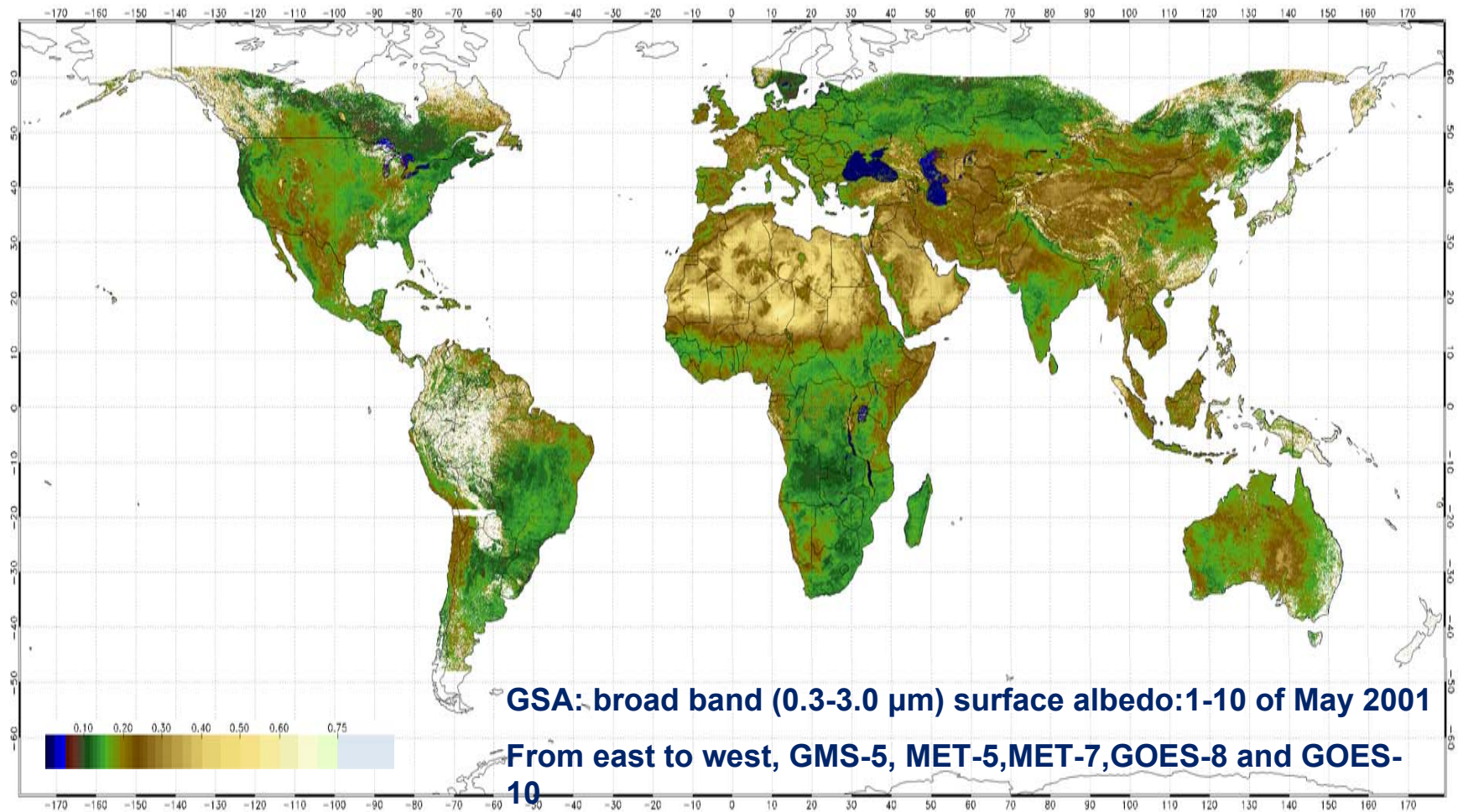
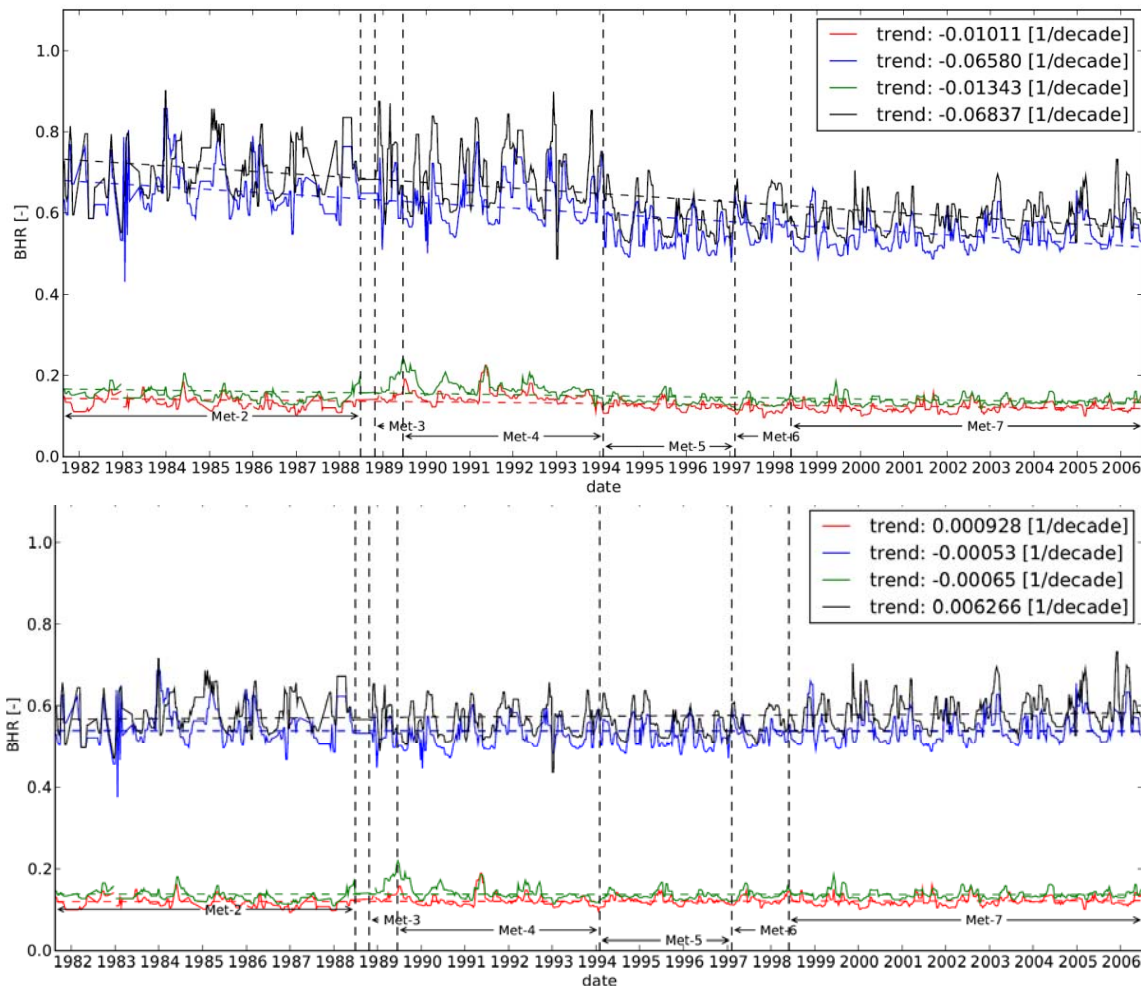


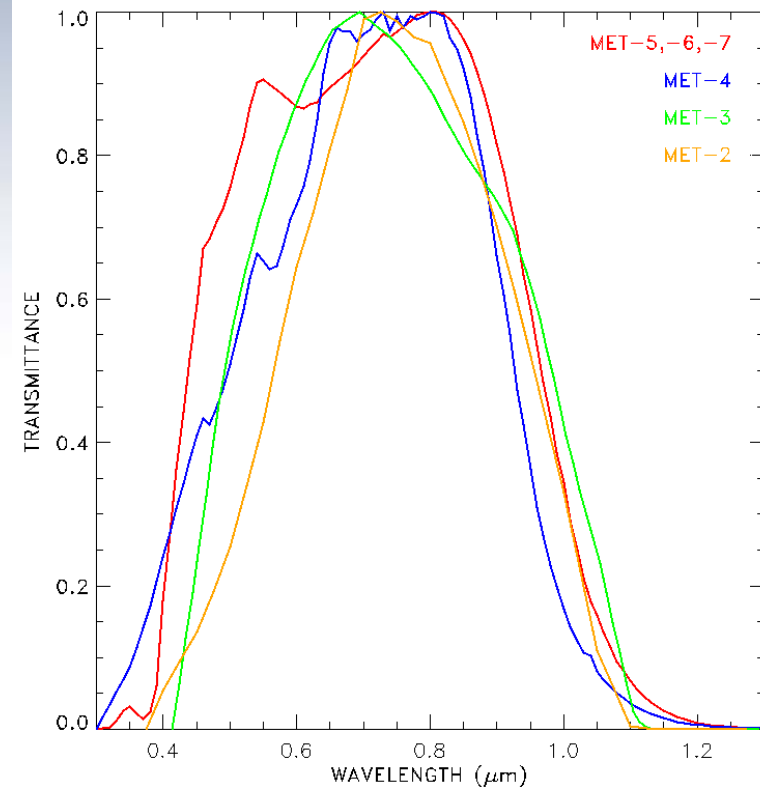
Figure Yves Govaerts, EUMETSAT

# User Support is Key: Problems identified in early version of the Meteosat albedo data



**Broadband surface albedo time series for dark and bright desert targets with standard (top) and corrected (bottom) conversion coefficients.**

CEOS Atmospheric Composition Constellation Meeting, Oxford UK, 9-10 September 2010

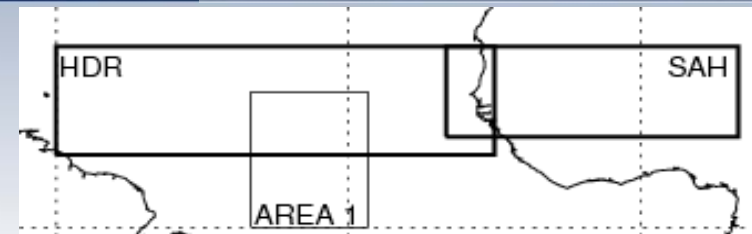
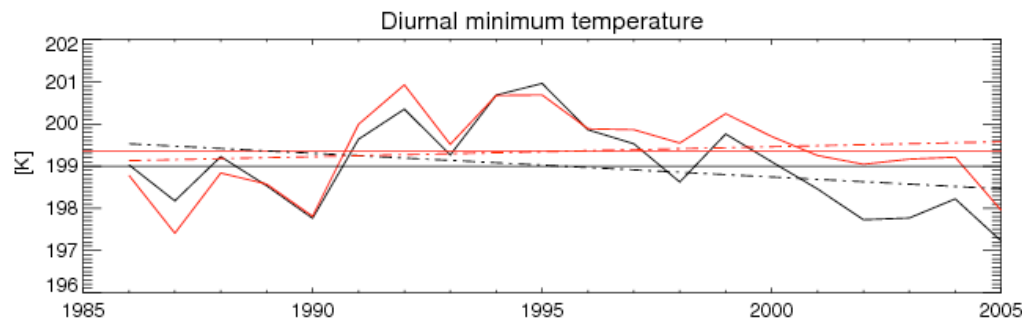
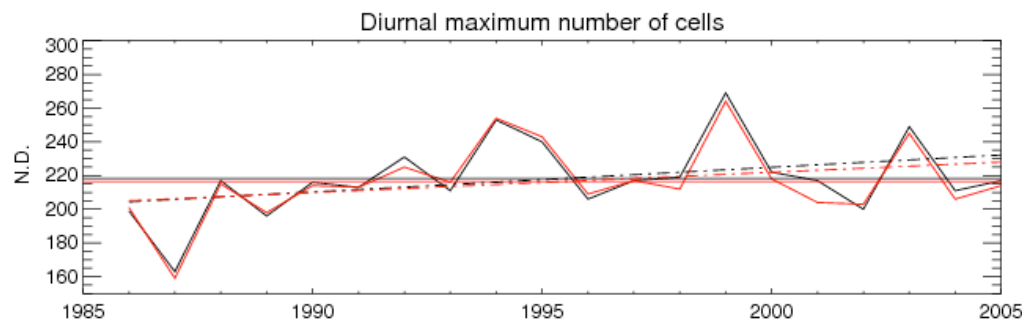
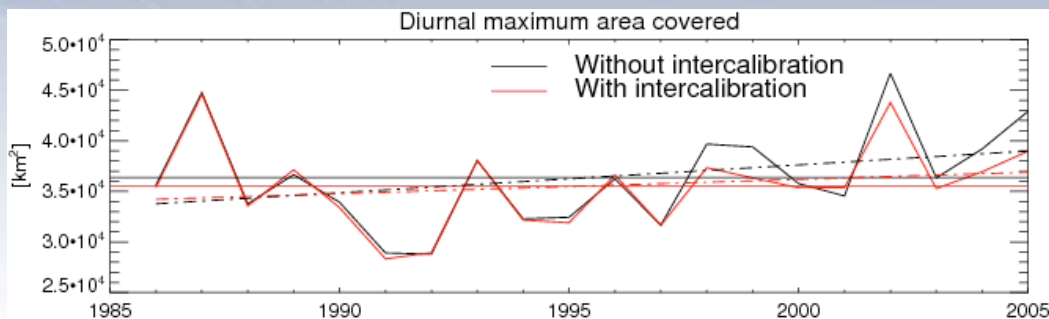


**Meteosat Sensor Spectral Response**

Figures from Loew and Govaerts, 2010



# Are there trends in convection features over the Sahel?



	SAH	
	Mean	Slope
Max. Area	3.6E4 km <sup>2</sup>	+3.9 % / decade (61%)
No. Cells	216	<b>+5.6 %/ decade (85%)</b>
Coldest Temp.	199 K	+0.1 % / decade (46%)

- Slight increase in diurnal maximum area
- Increase in number of cells
- None are significant
- If radiances are not intercalibrated different/stronger trends appear: +8% (at 86%) for max area and -0.3% (at 84%) for coldest temperature.



# International Partnership

- EUMETSAT is contributing to International Initiatives related to climate monitoring:
  - ISCCP and GPCP (Major GEWEX Cloud and Precipitation Climatology)
  - WMO-GSICS (Global Space-based Intercalibration System)
  - WMO-SCOPE-CM (Sustained COordinated Processing of Environmental satellite data – Climate Monitoring)
  - Major model-based reanalysis activities (EU ERA-CLIM project at ECMWF)
  - ESA Climate Change Initiative
  - CGMS, CEOS and GEO



# WMO SCOPE-CM

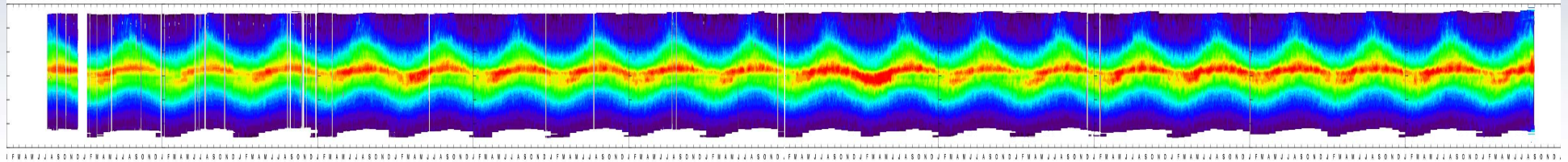
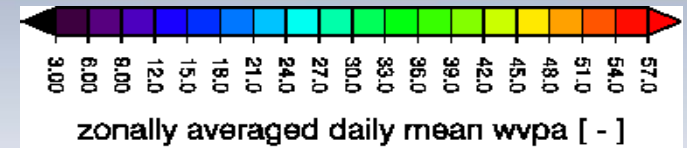
- SCOPE-CM = Sustained Coordinated Processing of Environmental Satellite data for Climate Monitoring. EUMETSAT acts as the SCOPE-CM Secretariat.
- Network of operational satellite operators: currently CMA, EUMETSAT, JMA and NOAA initiated by WMO Space Programme with links to GCOS, CEOS, CGMS, WCRP/GEWEX and GSICS.
- Aiming at the sustained generation of global climate data records from satellites addressing observational needs for climate variability and trend analysis.
- Current EUMETSAT contributions through Central Application Facility and the Climate Monitoring SAF.
- SCOPE-CM has a high potential to serve the sustainable generation of satellite-derived CDRs in close collaboration between scientific and operational institutions.
- SCOPE-CM may also play a role in supporting CDR assessments initiated by GEWEX-Radiation Panel.



# Total Column Water Vapour from SSM/I



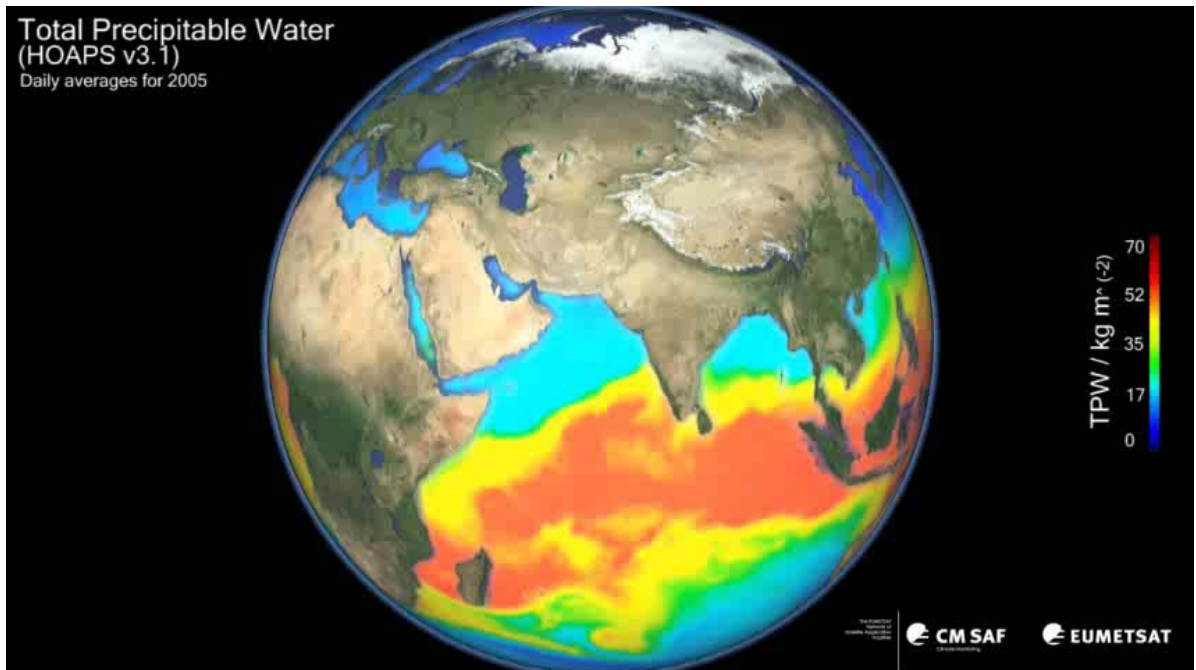
SSM/I 20 years data set water vapour over ocean  
Frame: SCOPE-CM activity 2



Research  
To  
Operations



Total Precipitable Water  
(HOAPS v3.1)  
Daily averages for 2005







# EUMETSAT contribution to model-based reanalysis: EU-FP7 ERA-CLIM

- ERA-CLIM is a new EU-FP7 reanalysis project led by ECMWF that prepares for the next major reanalysis.
- The project will run from 01/2011 - 12/2013
- EUMETSAT tasks are:
  - Generation of consistent AMV and CSR products for Meteosat 2 – 9 (covering 1982 – 2010) available in 09/2012;
  - Generation of consistent radio-occultation data (bending angles) back to 2001 from GRAS, CHAMP, GRACE and COSMIC sensors – available 12/2012;
  - Consistent total ozone from combined GOME-2 and IASI observations – available 12/2013;
  - First reprocessing of all Metop data including ASCAT (soil moisture, surface ocean wind) and AVHRR (polar AMV and SST) – AVHRR available 12/2012, ASCAT 12/2013.



# Global Space-based Inter-Calibration System

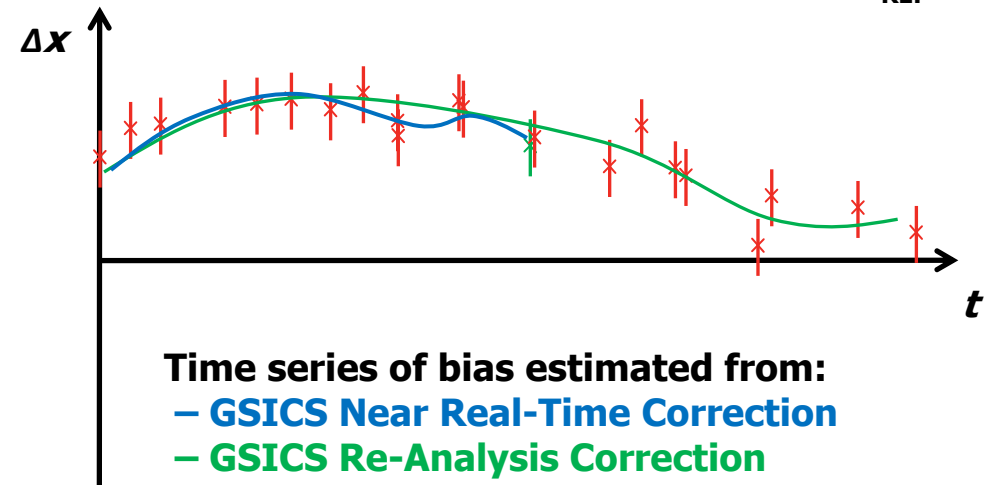
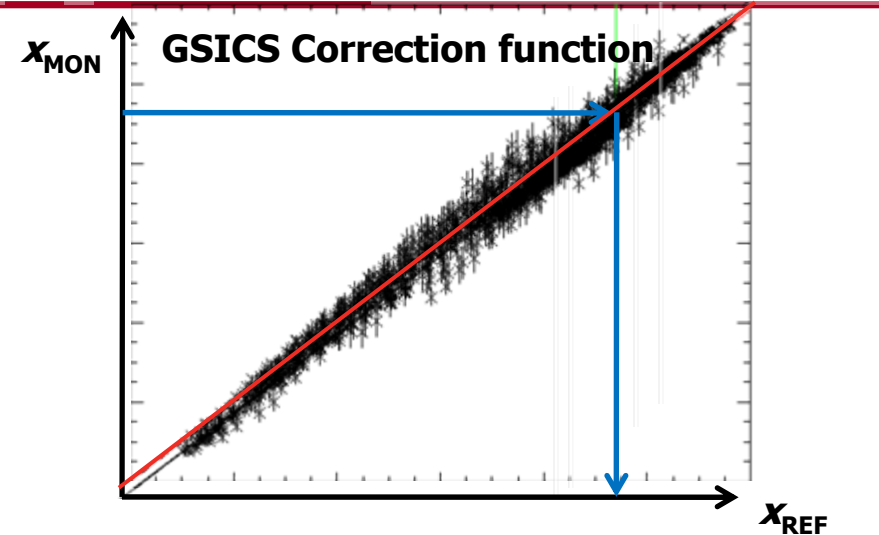
- What is GSICS?
  - Global Space-based Inter-Calibration System
  - Initiative of CGMS and WMO
  - An effort to produce consistent, well-calibrated data from the international constellation of operational meteorological satellites
- What are the basic strategies of GSICS?
  - Best practices/requirements for prelaunch characterisation (with CEOS WGCV)
  - Improve on-orbit calibration by developing an integrated inter-calibration system
    - Initially by LEO-GEO Inter-satellite/  
inter-sensor calibration
- This will allow us to:
  - Improve consistency between instruments
  - Produce less bias in Level 1 and 2 products
  - Retrospectively re-calibrate archive data
  - Better specify future instruments





# GSICS Products for GEO IR

- GSICS Monitoring
- GSICS Corrections
  - Near Real-Time & Re-Analysis
- for Monitored instrument
  - IR channels of GEO imagers
- against reference instrument
  - IASI and AIRS (hyperspectral)
- by direct comparison
  - of collocated radiances
- Typical Corrections  $\sim 1K$ 
  - For GEO IR channels

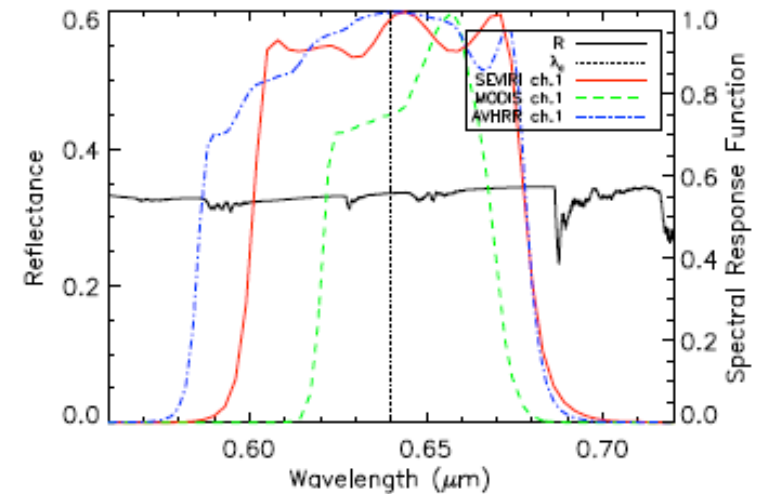


Time series of bias estimated from:  
– **GSICS Near Real-Time Correction**  
– **GSICS Re-Analysis Correction**

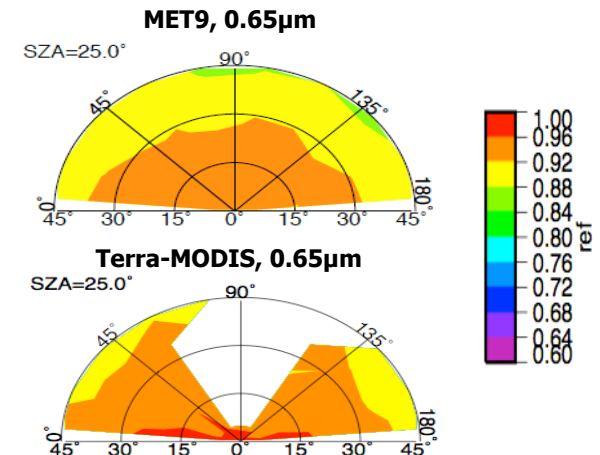


# Extension to Solar-band Channels

- Choice of Reference
  - No suitable hyperspectral instrument until CLARREO/TRUTHS
  - Use MODIS as inter-cal reference
    - Need spectral corrections
  - Use GOME2 to research anomalies
- Direct comparisons possible
  - Limited by solar & viewing geometry
  - Need to account for different SRFs
- Supplement with invariant targets
  - Build up BRDF of scene
  - Compare observed BRDF with reference BRDF



**Spectral Response Functions (SRFs) of three 0.6 $\mu$ m channels, compared to modelled reflectance of mean scene**



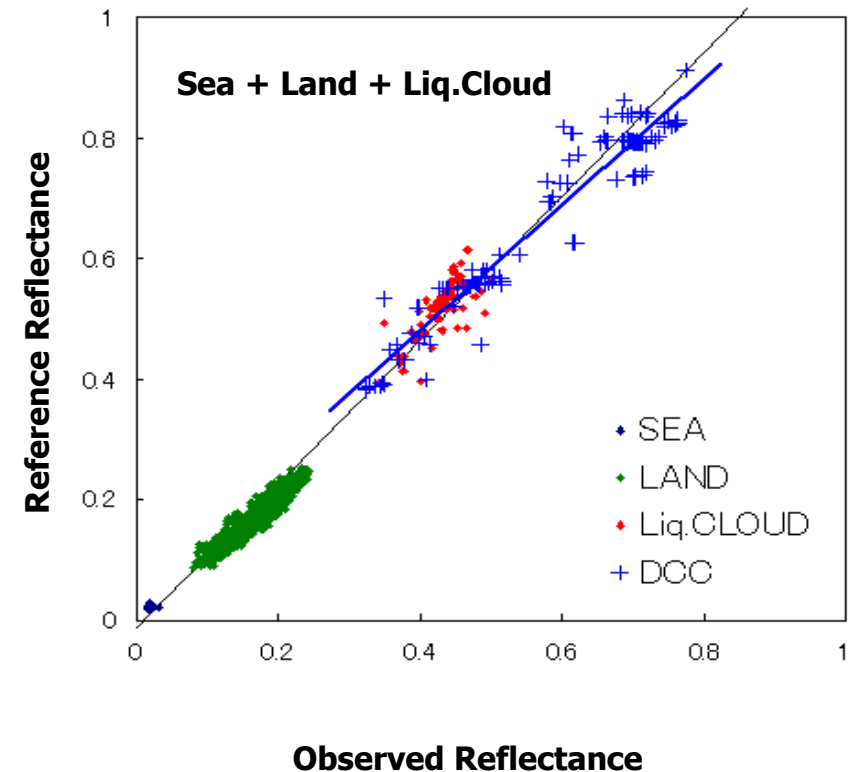
**Bi-Directional Reflectance Functions (BRDFs) derived from Meteosat & MODIS observations of Deep Convective Clouds**





# Combination of Methods (Solar)

- Combining results from
  - Direct Ray-matched Comparison
  - Different Invariant Targets
- Spans observational range
  - of Reflectance/Radiance
- Combine in linear regression
  - Weighted by methods' uncertainty
  - Similar concept used to MSG VIS
- Automatic, routine processing
  - Provide daily/monthly cal updates
- Error budget for each method
  - Also assess: Independence, Stability, Availability, Latency and Cost



Comparison of Reflectance from Monitored and Reference Instruments for 4 different invariant targets

Regression provides inter-calibration function

Blue line: Regression for Deep Convective Cloud (DCC) only  
Black line : Regression line for the other three targets



# EUMETSAT support and contribution to ESA's CCI

- There is a need of FCDRs from EUMETSAT sensors for CCI activities, e.g.:
  - GOME-2 to extend the observation series of ESA's GOME sensor
  - AVHRR as precursors for MERIS and Sentinel 3 satellites
  - ASCAT for validation and comparative studies of SAR sea-ice analysis
  - IASI for trace constituents, temperature, humidity, surface emission and cloud parameters
  - SEVIRI and MVIRI for cloud diurnal cycle analysis
- EUMETSAT will reprocess and document its data that enter the CCI according to the needs of the CCI.
- EUMETSAT would welcome feedback on the quality and usability of FCDRs.
- EUMETSAT will coordinate its activities in support to climate monitoring with ESA and the ESA CCI in particular.
- Activities under CCI and the corresponding 'lessons-learnt' could be of great benefit to SCOPE-CM.



The End



# Satellite Application Facilities (SAFs) in Europe

## Member State

## Cooperating State

- ① Support to Nowcasting and Very Short Range Forecasting
- ② Ocean and Sea Ice
- ③ Climate Monitoring
- ④ Numerical Weather Prediction
- ⑤ Land Surface Analysis
- ⑥ Ozone and Atmospheric Chemistry Monitoring
- ⑦ GRAS Meteorology
- ⑧ Support to Operational Hydrology and Water Management
- SAF Consortium Member
- Additional Met Service Users

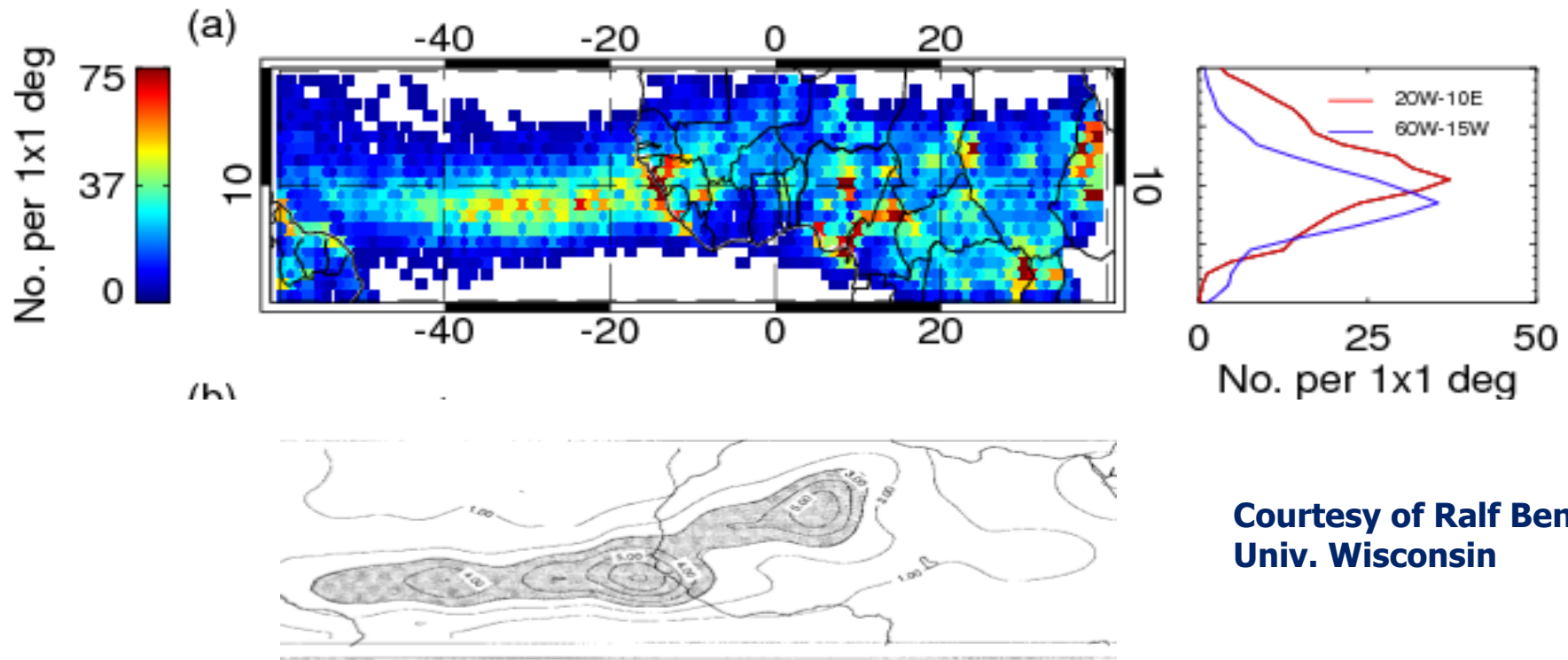


EUMETSAT's **Application Ground Segment** continuously generates on an operational basis products of climate relevant parameters and produces FCDRs and TCDRs in dedicated actions.



# User support is key: What does the user need ?

## Example: Where does convection get initiated?



Courtesy of Ralf Bennartz  
Univ. Wisconsin

Frequency of generation of African Easterly Waves (850 hPa)  
(Thorncraft and Hodges, 2001, J Climate)