The EUMETSAT Network of Satellite Application Facilities

CM SAF
Climate Monitoring

Satellite Product Validation Needs for Upper-Air Data

Marc Schröder
Deutscher Wetterdienst
on behalf of the CM-SAF consortium

www.cmsaf.eu

Outline

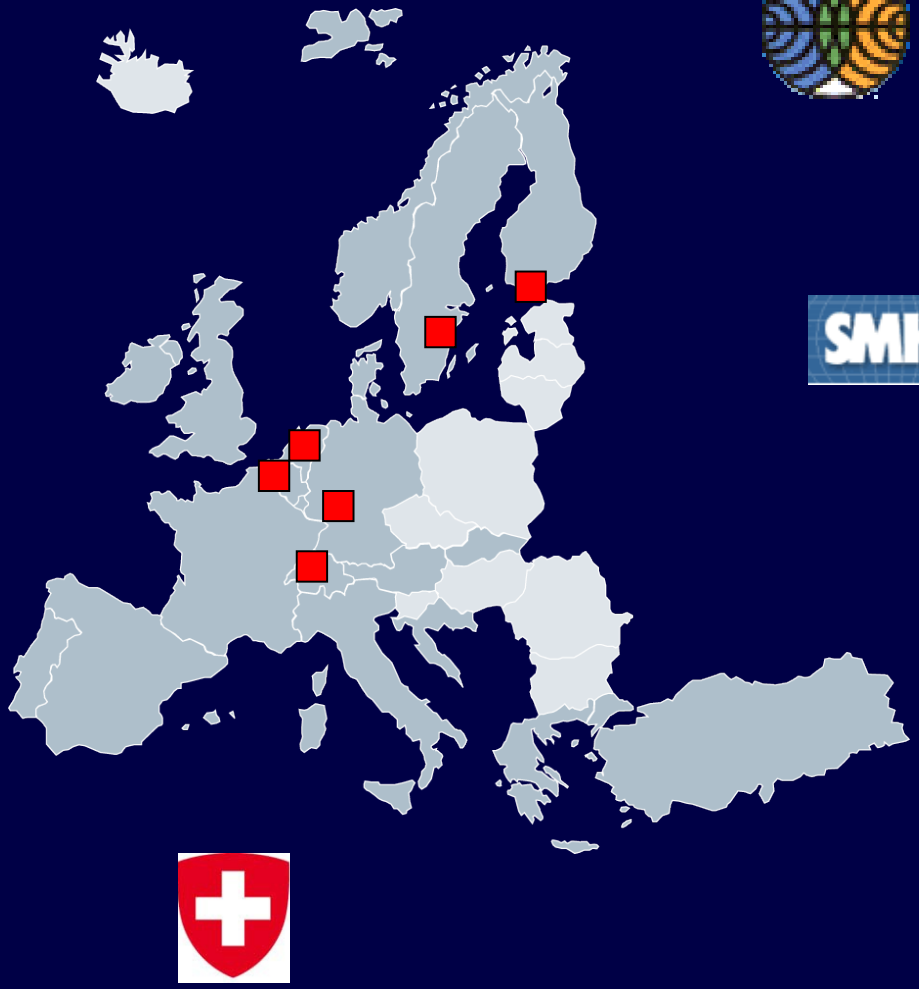
- Introduction to CM-SAF and
- SCOPE-CM.

- Climate monitoring using satellites
  - Approach: what we do,
  - Problems: what we need.

- Utilisation and recommendations.

CM-SAF

Satellite Application Facility on Climate Monitoring



Energy and Water Cycle

3 science groups: radiation, clouds, and water vapour.

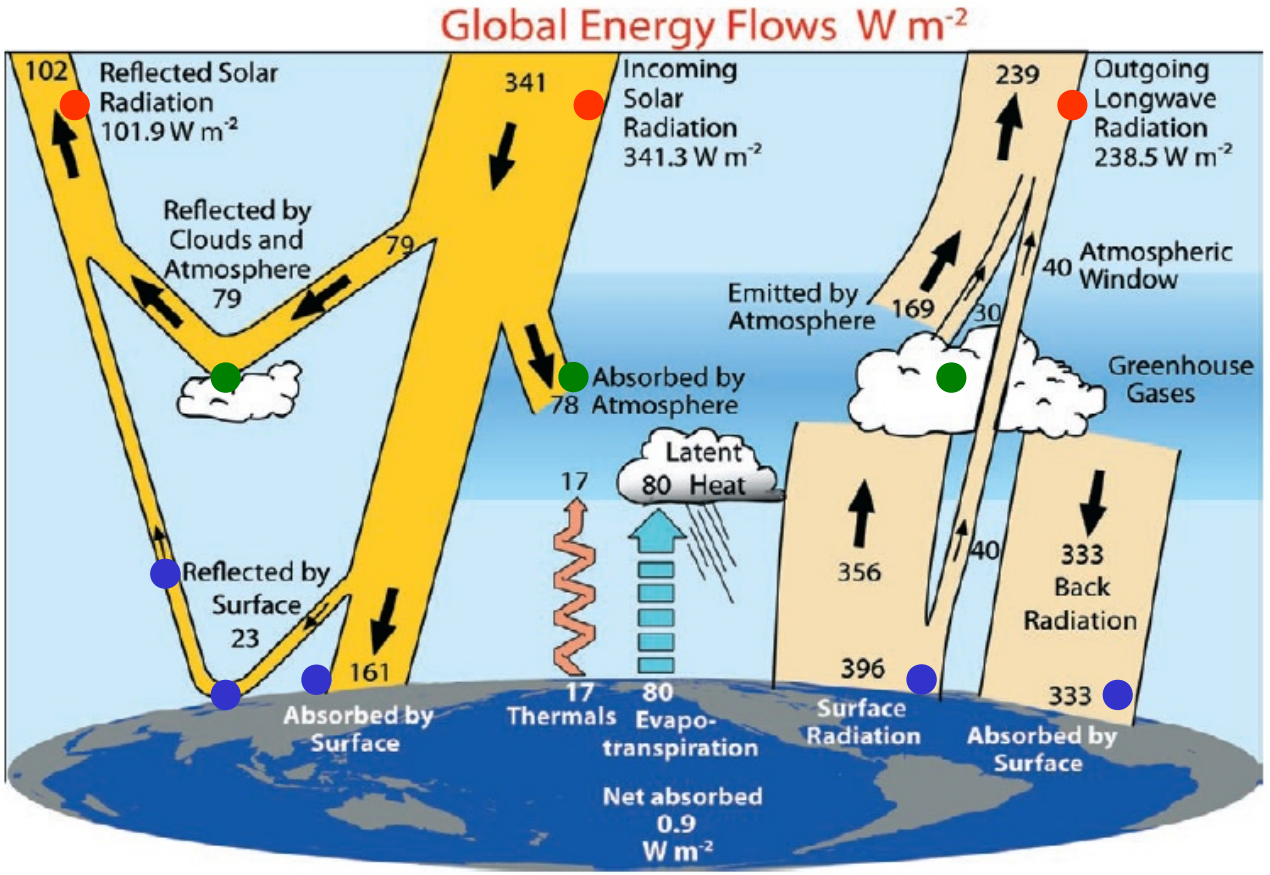
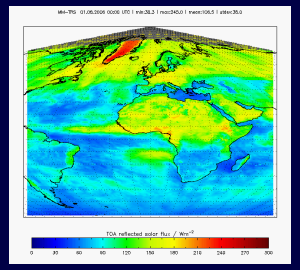
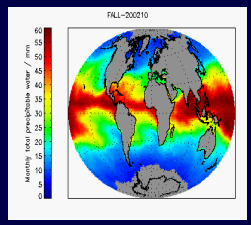
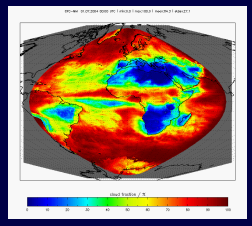


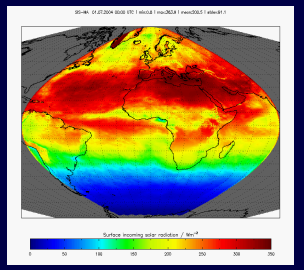
FIG. 1. The global annual mean Earth's energy budget for the Mar 2000 to May 2004 period (W m^{-2}). The broad arrows indicate the schematic flow of energy in proportion to their importance.

Trenberth et al. (2009)



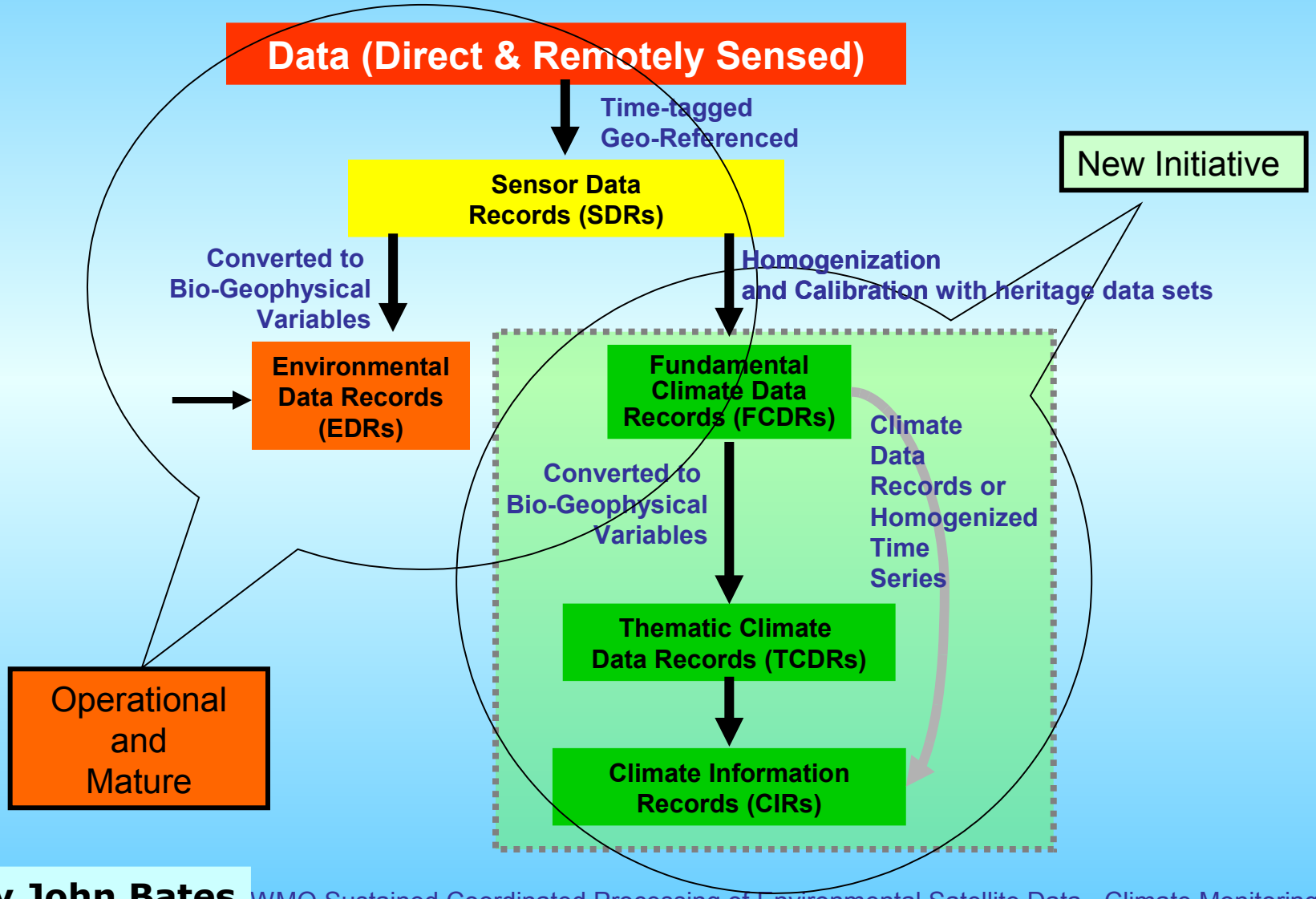






Weather vs. Climate Processing

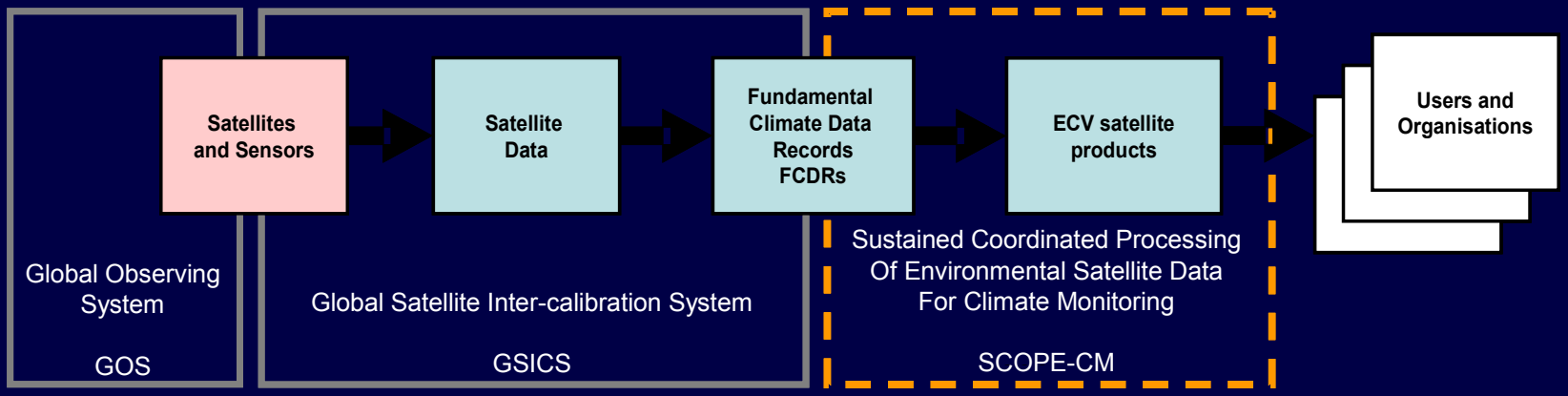
Distinct Paths, Technologies, and Timelines



Courtesy John Bates

WMO's SCOPE-CM initiative: goals and structure

- **Objective:** Continuous and sustained provision of high-quality Essential Climate Variables satellite products (Climate Data Records) on a global scale
- **Structure**: The SCOPE-CM Network will be:
  - » Based on activities of existing initiatives (GOS, GCOS and GSICS)
  - » Build upon existing operational infrastructures
  - » Serve users and other organisations (e.g. WMO Regional Climate Centres RCC, National Weather Services)



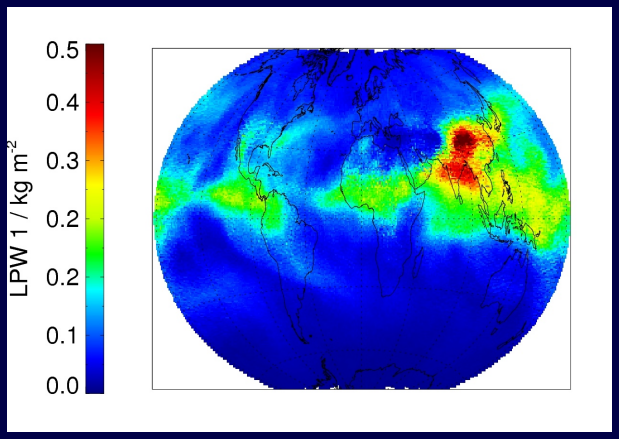
SCOPE-CM Pilot Projects

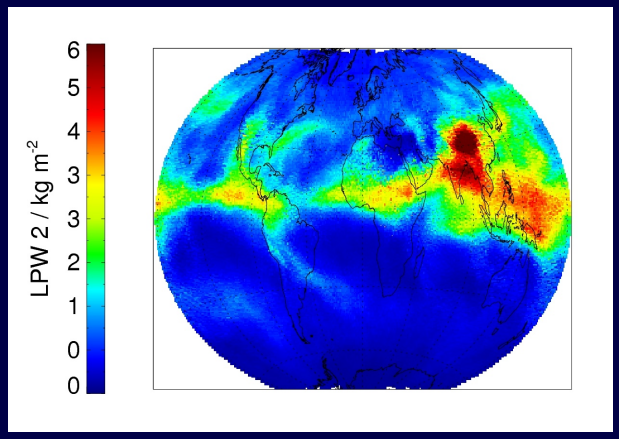
	Sensors	*Parameters and topics*	*Lead*	*Contributors*
1	AVHRR	Clouds and Aerosols	NOAA	CM SAF
2	SSM/I	Water vapour, clouds, precipitation	CM SAF	NOAA
3	GEO	Surface albedo, clouds and aerosols	EUMETSAT	EUMETSAT, NOAA
4	GEO	Winds and clear sky radiances	EUMETSAT	EUMETSAT
5	GEO	Upper tropospheric humidity	NOAA	EUMETSAT, CM SAF

EDR's or operational products

Exemplary results and validation

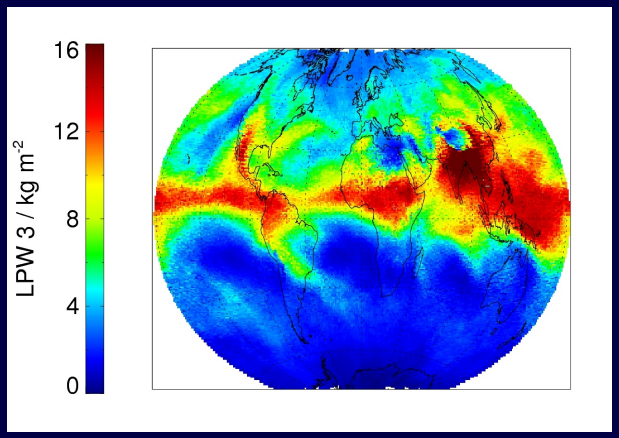
Water vapour from ATOVS

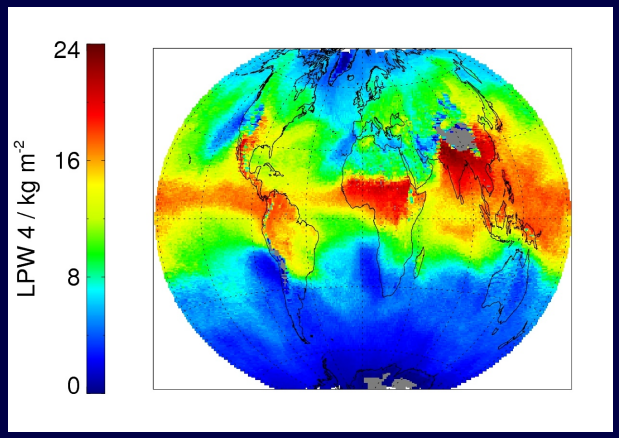


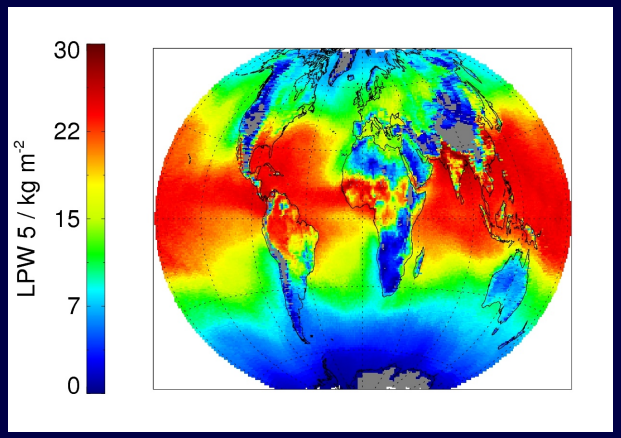


Layered precipitable water

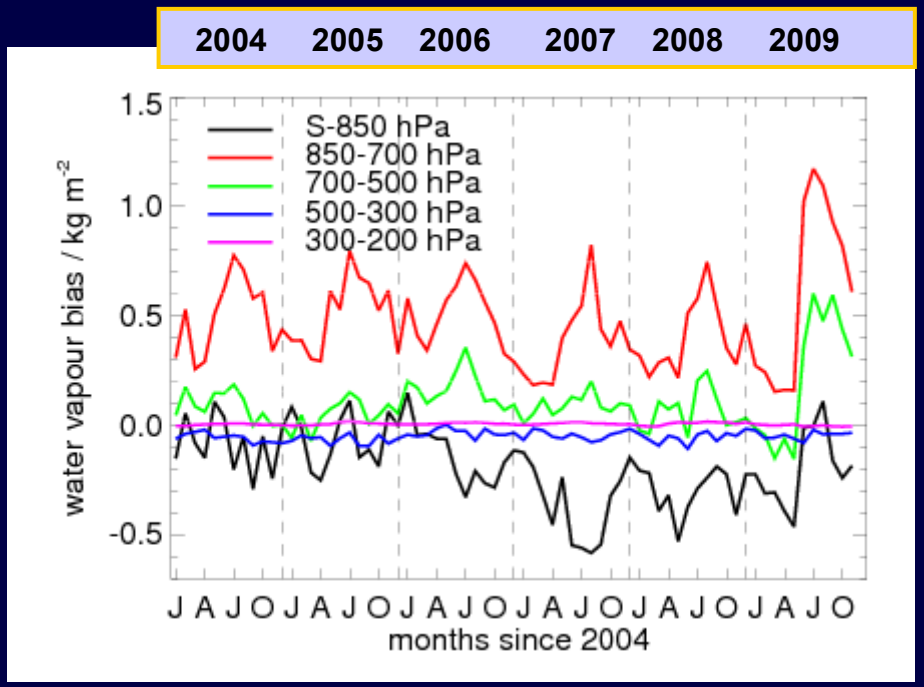
July 2009
NOAA19 + MetOp

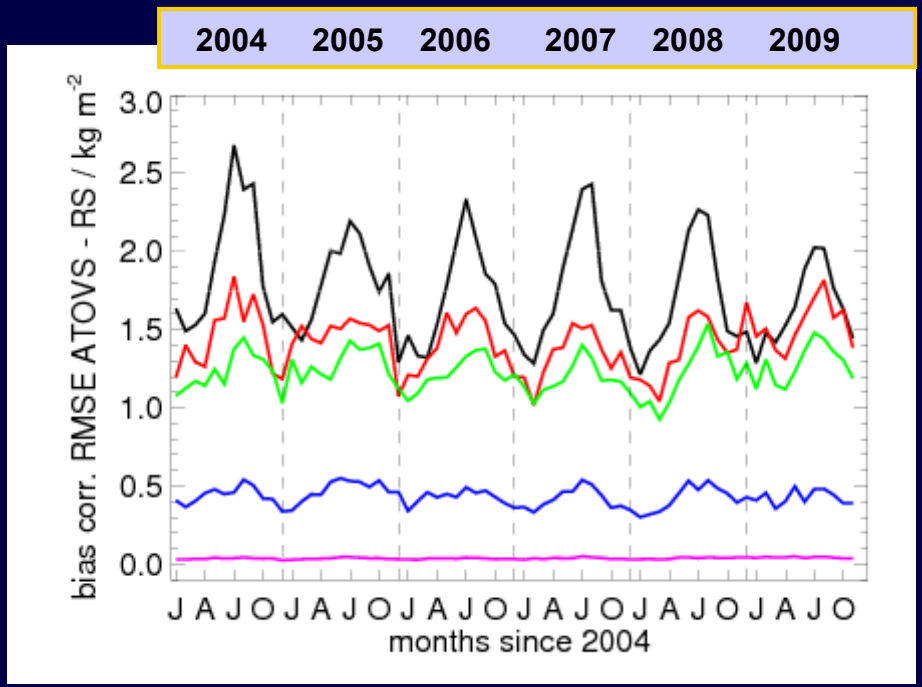






Validation using GUAN data





Operational validation on annual basis.

Interim conclusions

- Cover as much atmospheric ECVs as possible.
- Full error information (well calibrated, retrieval error, sampling error).
- High temporal resolution to reduce collocation problems.

- Installation on “homogeneous” terrain to reduce sub-pixel variability.
- Distribute stations such that atmospheric variability is covered.

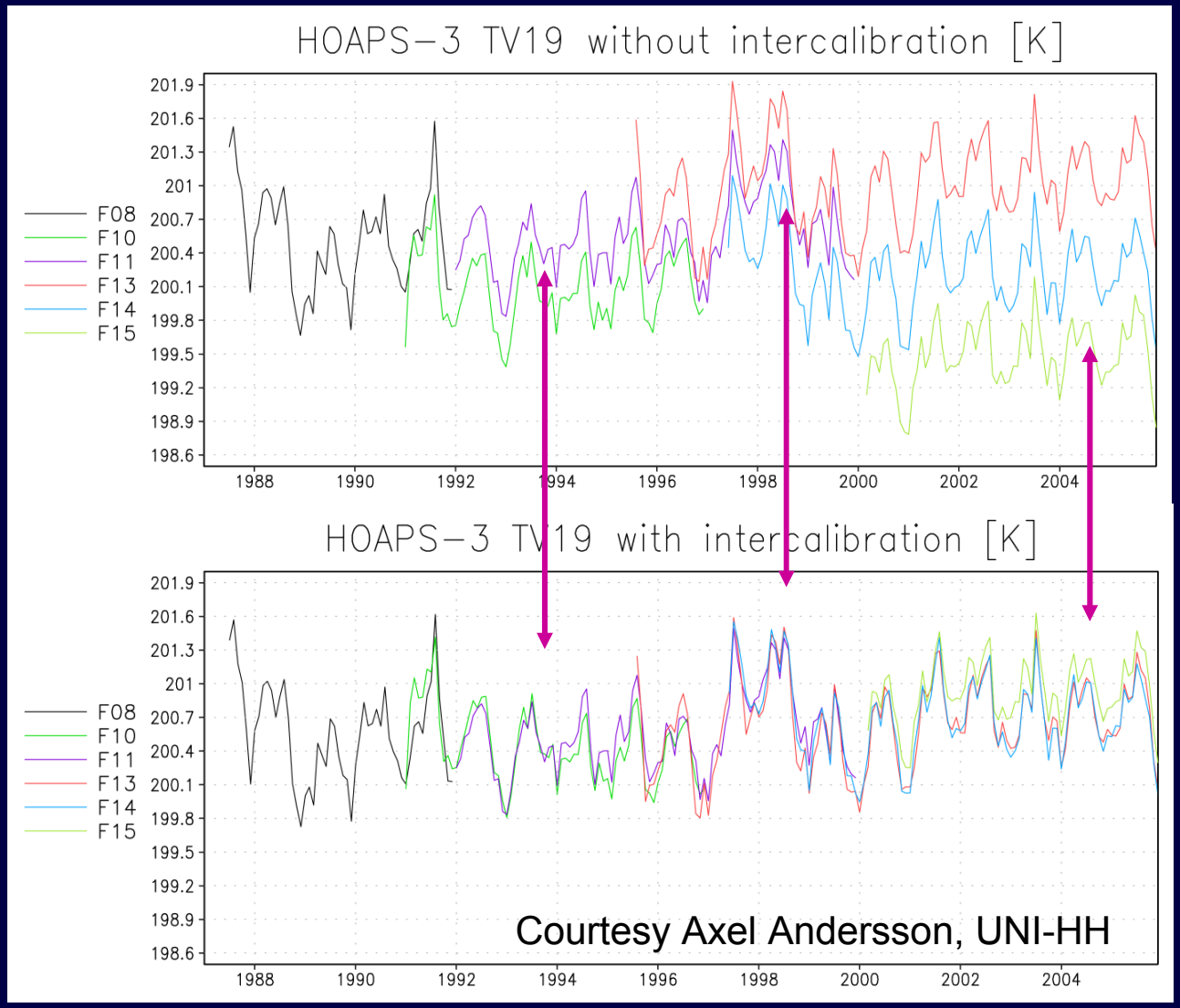
- High vertical resolution
  (IASI: 10 independent layers, RO: 0.1-0.5 km).

Generation of FCDR/TCDR

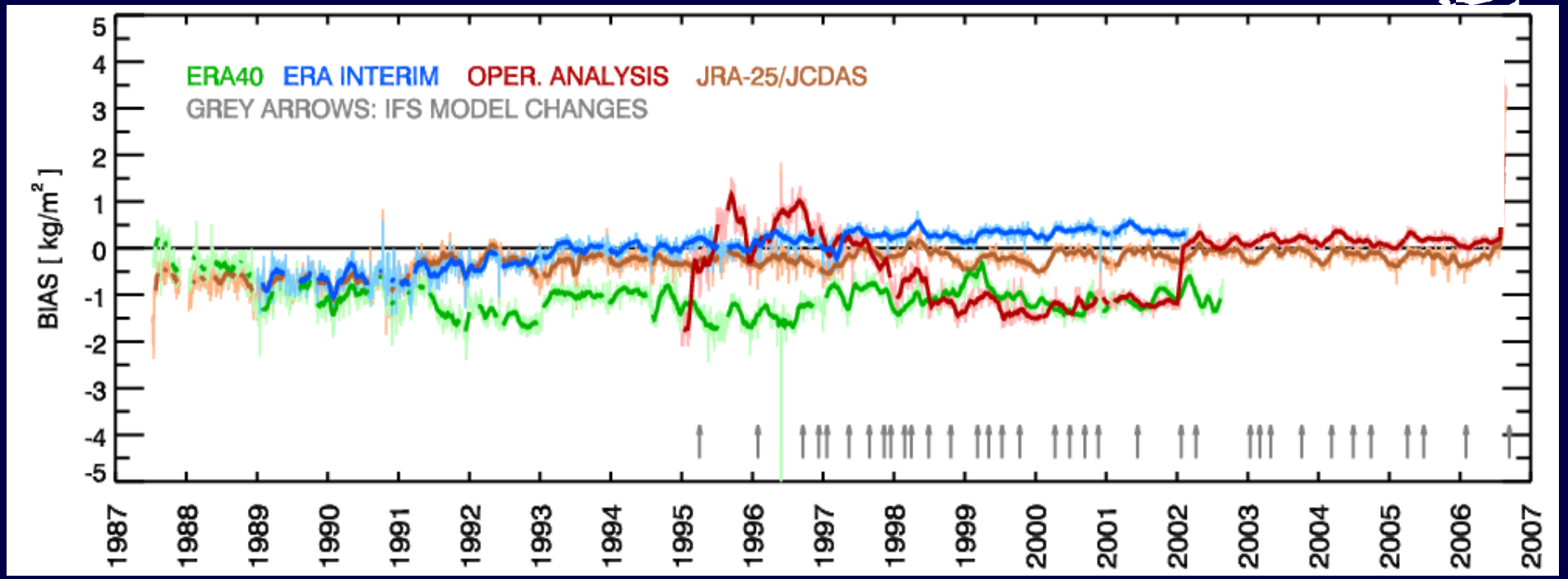
FCDR – fundamental climate data record
(based on inter-calibration / homogenisation)

TCDR – thematic climate data record
(based on FCDRs)

CM-SAF Intersatellite Homogenisation Example, SSM/I



Daily CMSAF-HOAPS SSM/I IWV vs. Reanalyses



Stability/redundancy.

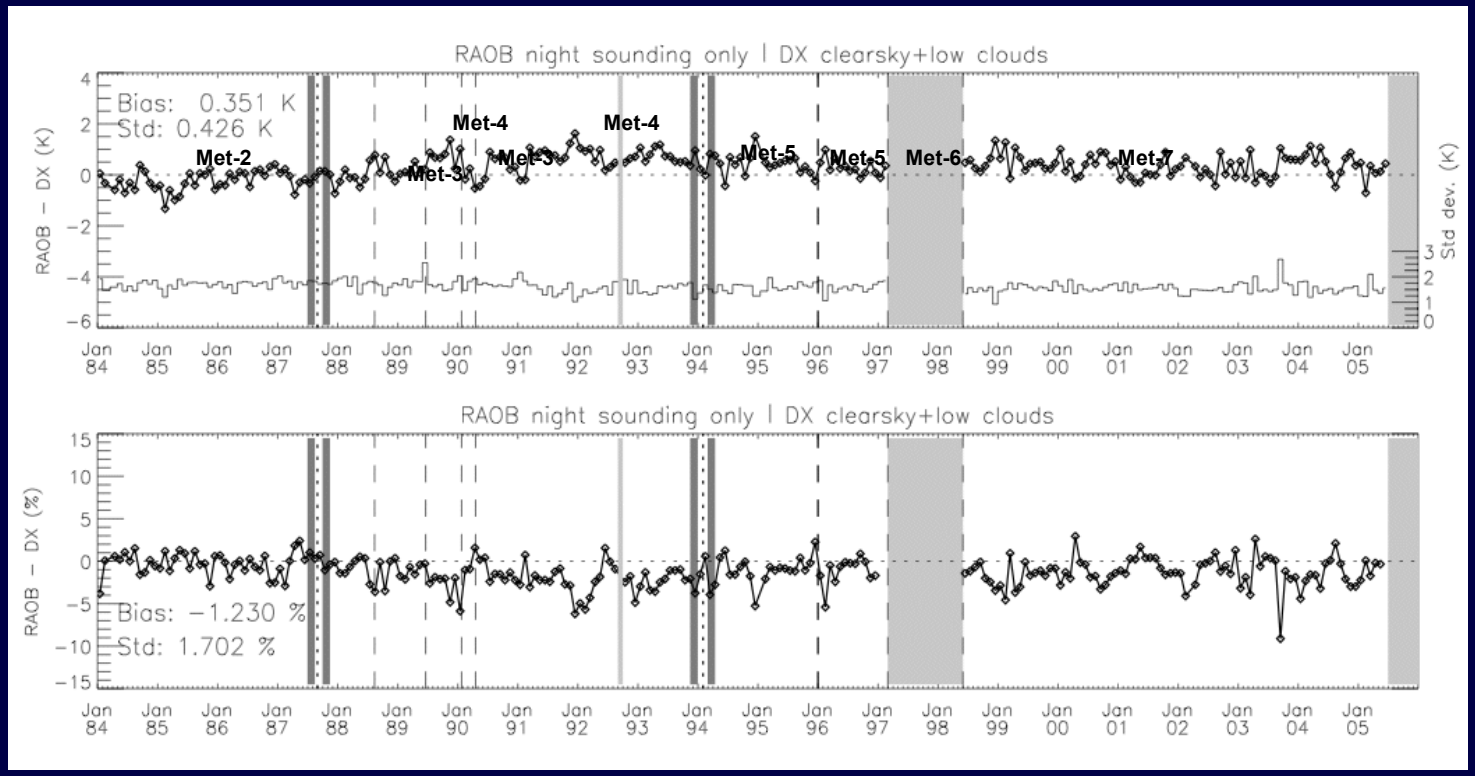
Two datasets with high quality superior to one dataset with potentially better but not perfect quality - confidence.

CM-SAF / SCOPE-CM
(redo calibration for transparency)

FTH from METEOSAT

Comparison with radiosondes using radiative transfer simulations

BT (K)



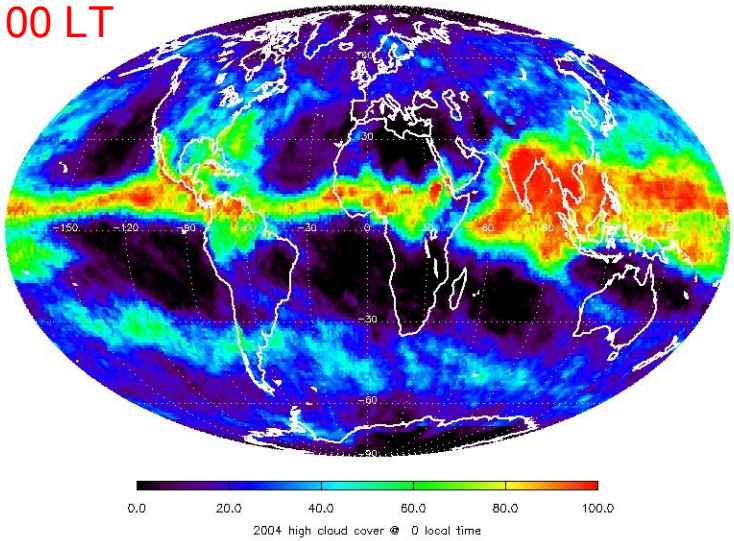
FTH (%)

Quality?
Stability?

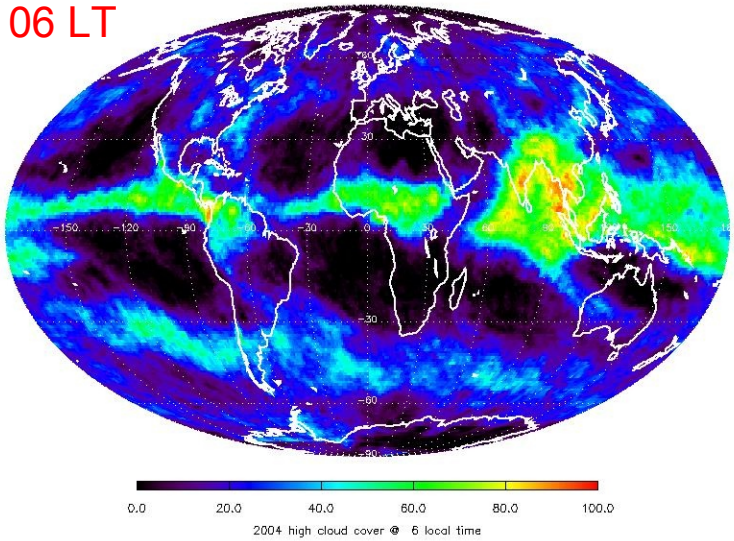
SCOPE-CM
β-User of GSICS

Processing of NOAA GAC data 1982 – 2010 (here: 2004)

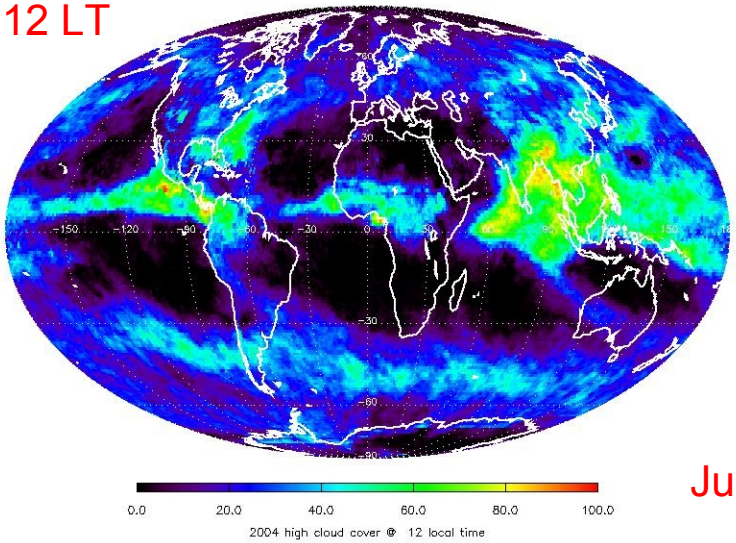
00 LT



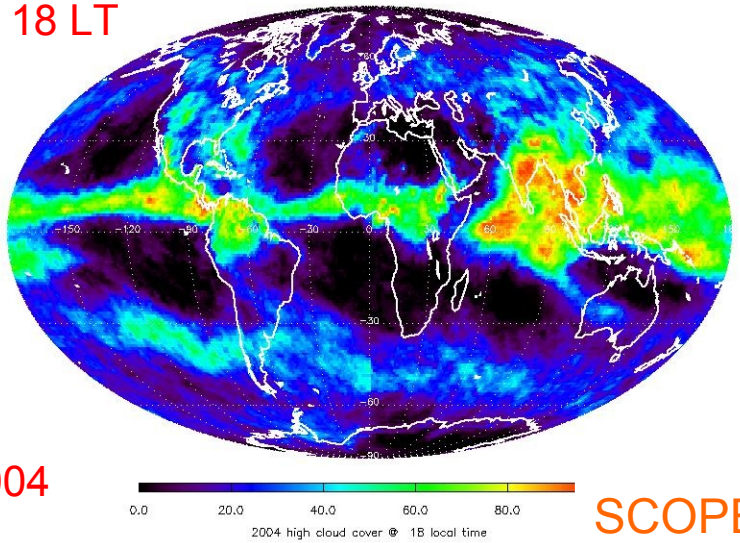
06 LT



12 LT



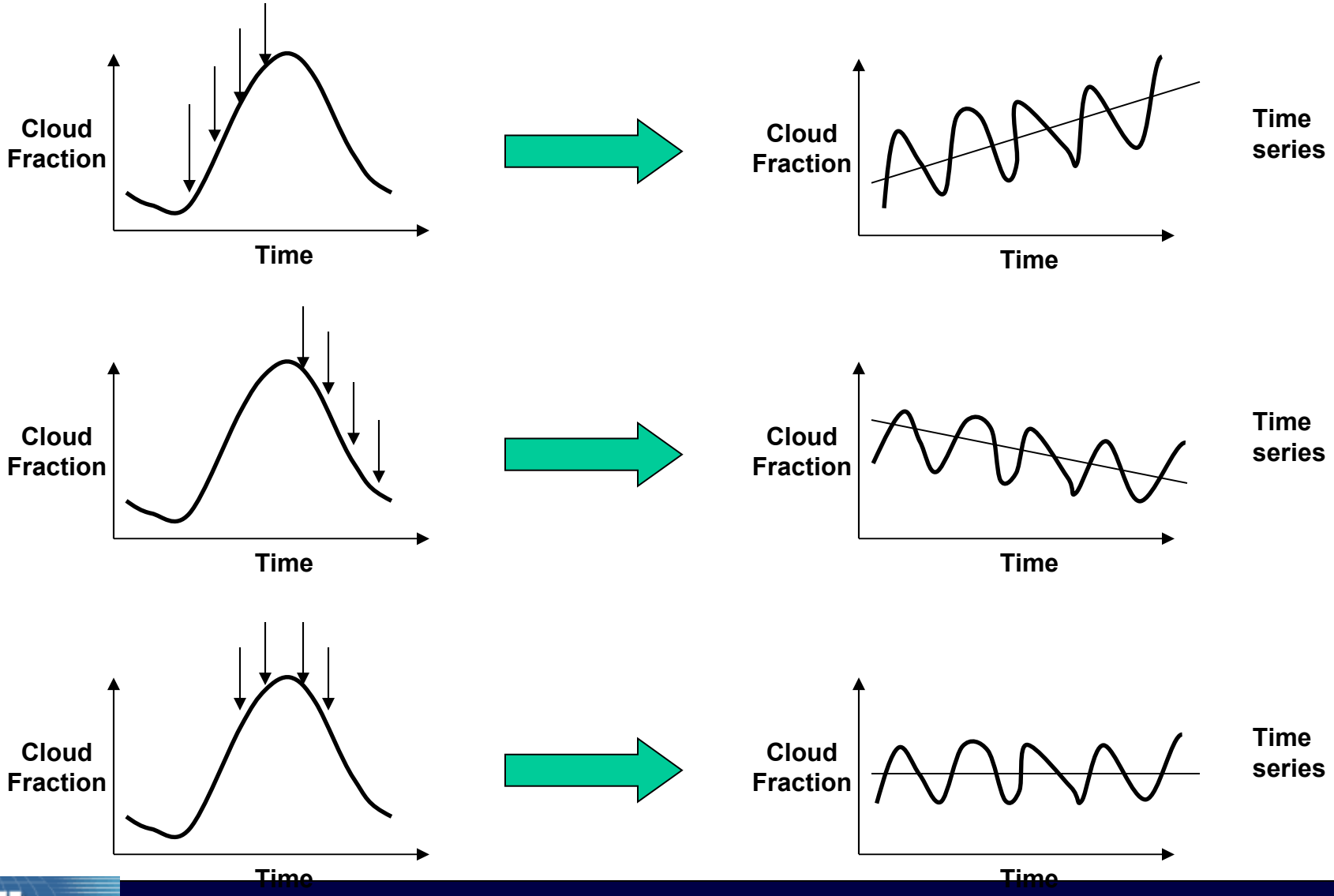
18 LT



July 2004

SCOPE-CM

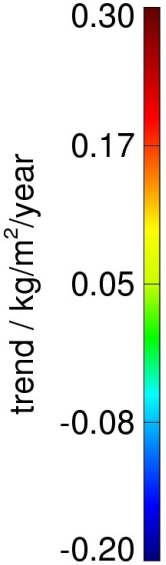
Relevance for cloud climatology – its all about diurnal cycle !!!

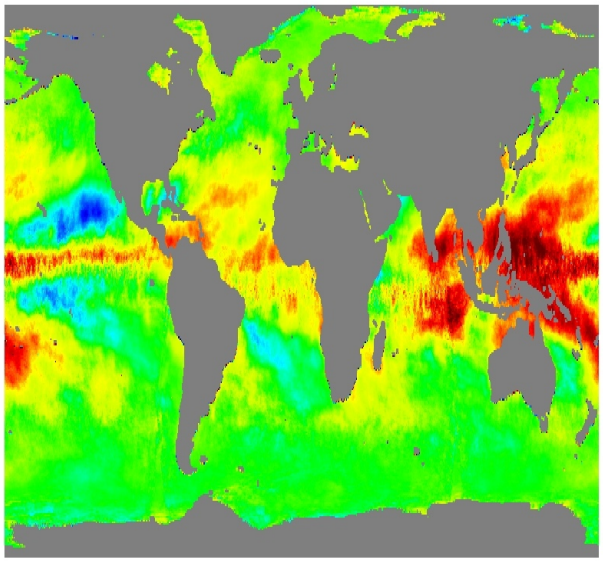


HOAPS trend analysis

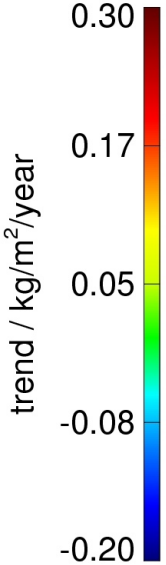
1987-2006, 4 frequencies and El Nino fitted

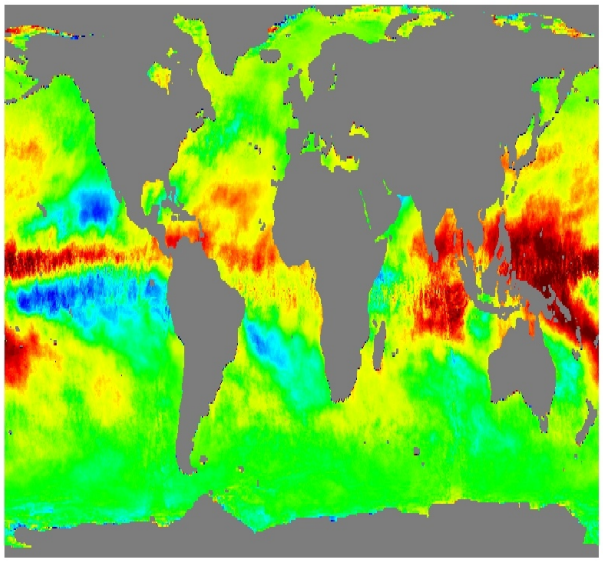
Data as is





1997/1998 removed





1988-2005

trend ≠ climate trend/change

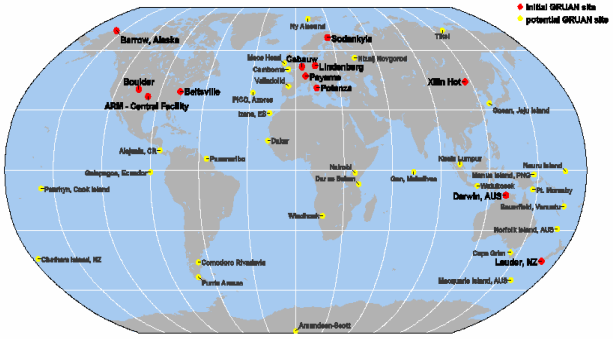
El Nino is part of part of climate signal.

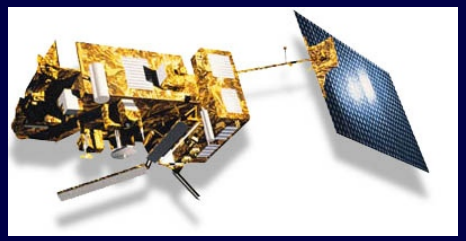
A strong need for long-time series!

Bias Monitoring at CM-SAF

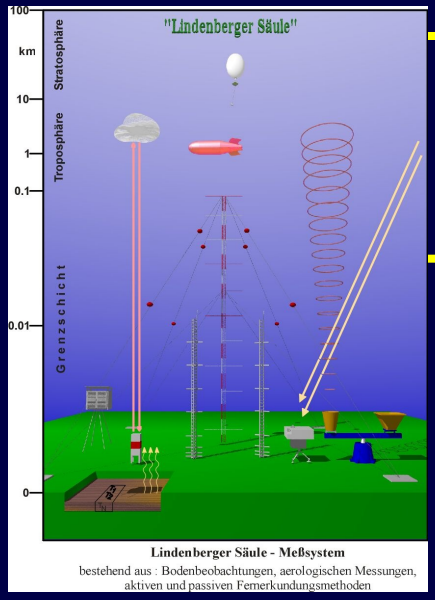
support of GSICS

GRUAN





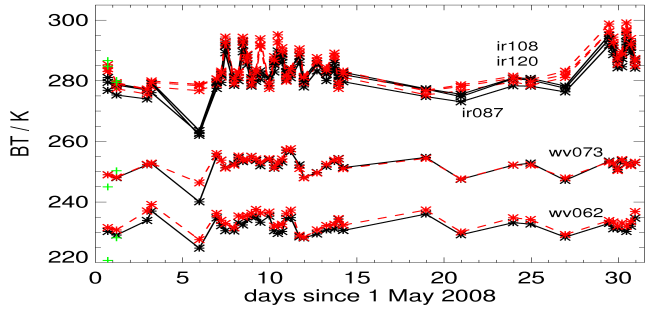
Aiming at global coverage



Satellite instruments
- Collocation
- Cloud filtering

RT-models
- RTTOV
- RT-IASI
- line-by-line

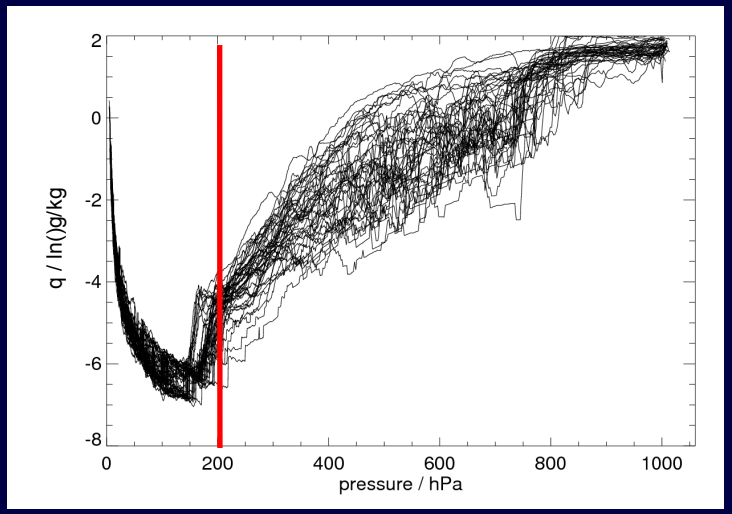
Comparison statistics



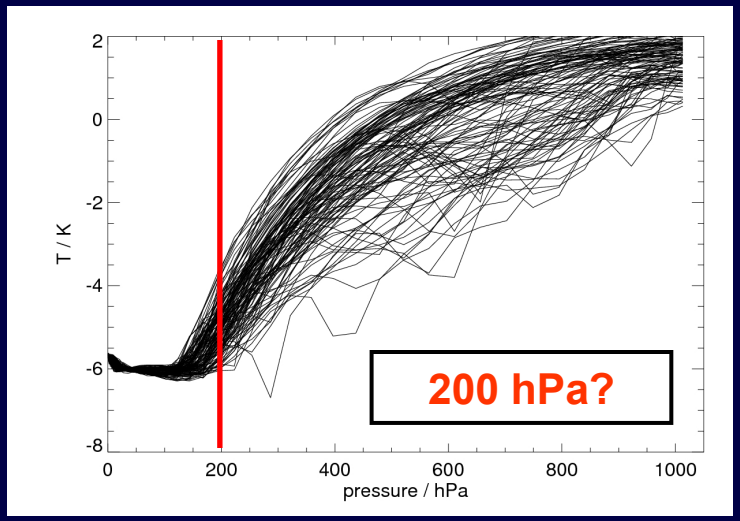
Aiming at redundancy

Bias Monitoring

Guidance needed – max. reliable RS height, MWR/lidar near surface?



Radiosonde



Chevallier

Anchor – Level 1 space

Summary

- No reference available to demonstrate (climate) quality on a global scale. Heritage satellites product start in late 1970s.
- Guidance and training.
- Change management (consistency and stability).
  Homogenisation/Inter-calibration preferably done in Level 1 space, not in product space.
- Reprocessing.
- Carry out redundant observations (RS,MWR,Lidar-confidence).
- Keep raw data “forever” – avoid data thinning (outliers, “large” errors, inconsistency).
- Easy and free access to data and documents.
- Computation of e.g. monthly averages helps to identify problems and clearly define averaging process (details!).