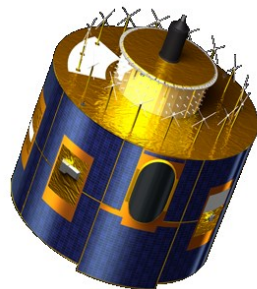


Potential use of feedback and blacklist for reprocessing at EUMETSAT



Climate Team



Climate Services Development Plan (CSDP)

- The Climate Service Development Plan is a rolling four year plan structured into work packages with associated time line that allow cost estimates per activity/data record;
- It covers climate related activities of the EUMETSAT Secretariat;
- The activities are currently funded by several programmes and European Union (EU FP 7 and H2020) projects;

CSDP Work Packages

WP	WP Name	Major Deliverable	Priority
100	Preparation for New Programs		
110	Development of CDRs for MTG	Scientific results for creating multi-program FCDRs and TCDRs including MFG, MSG and MTG	N/A
120	Development of CDRs for EPS-SG	Scientific results for creating multi-program FCDRs and TCDRs including EPS and EPS-SG	N/A
200	Fundamental Climate Data Records		
210	Meteosat Document Archaeology/Event Data Base	Calibration event data base interoperable with NOAA	Medium
220	IASI Level 1c FCDR from Metop-A /B	Release (R)1 of best calibrated IASI L1c including PC Scores (Release: 2017)	High
230	Radio Occultation FCDRs	R1/2 of homogenously produced bending angle data records for GRAS, COSMIC, CHAMP and GRACE (Release: R1 GRAS 2014, other 2015; R2 2016)	High
240	ASCAT FCDR from Metop-A and B	R3 of ASCAT L1b data record with updated calibration (Release: R3 2016)	High
250	AMSU-B, MHS and SSM/T2 FCDRs	R1 of homogenously produced L1 data records (Release: 2017)	High
260	HIRS channels 8 (IR) and 12 (WV) FCDR	R1 of inter-calibrated HIRS channels (Release: 2015)	High
270	GOME-2 Metop A/B FCDRs	R3/1 of Metop-A/B GOME-2 L1b records with updated instrument key data (Release 2017)	High
280	Meteosat First Generation Image Reprocessing	R1 of Meteosat First Generation L1.5 with identified/corrected image anomalies and improved correction of geometric and radiometric distortion (Release: 2018)	High
290	Meteosat First and Second Generation FCDR	R1 of inter-calibrated complete Meteosat IR, WV and VIS data records (Release: IR 2015, VIS 2017)	High

- Highest priority to FCDRs and medium/low priority for TCDRs;

Table 2: Dependency of work packages on other WPs and external inputs.

CSDP Work Packages

WP	WP Name	Major Deliverable	Priority
300	Thematic Climate Data Records (TCDR)		
310	Polar AMV TCDR	R1 of polar AMV from AVHRR (NOAA-7-19, Metop A/B) (Release: 2015)	Medium
320	Total Ozone TCDR from Metop A/B	R1 of total ozone data record from combined GOME-1, IASI and AVHRR (Release: 2018)	Low
330	IASI Trace Gas, Temperature and Humidity TCDR	R1 of trace gas, temperature and humidity profiles from IASI (Release: 2018, eventually moved forward to 2017)	Low
340	AMV, CSR and ASR TCDR from Meteosat	R2 of Meteosat First and Second Generation AMV, CSR and ASR based on WP290 (Release: 2016)	Medium
350	Surface albedo TCDR from Meteosat	R1a and 2 of Meteosat First and Second Generation surface albedo TCDR (Release: R1a 2015; R2 2017)	Medium
360	Optimal Cloud Analysis (OCA) TCDR	R1 of OCA for Meteosat Second Generation (Release: 2016, eventually postponed to 2017)	Medium
400	Engineering Development		
410	CDR Project 1	Updated requirements, designs and cost estimates for CDR generation systems	High
420	CDR Project 2	Implementation of CDR Project 1 designs	High
430	CM SAF Offline Product Implementation	Processing System for a subset of CM SAF offline products	High
500	Coordination Activities		
510	International Coordination	Coordination with CGMS, CEOS, WCRP, NOAA, ECMWF, ESA, etc.	N/A
520	Coordination within EUMETSAT and with Member States	Coordination inside Secretariat, with SAF network, User Feedback, etc.	N/A

Meteosat Radiances Re- and Inter-calibration

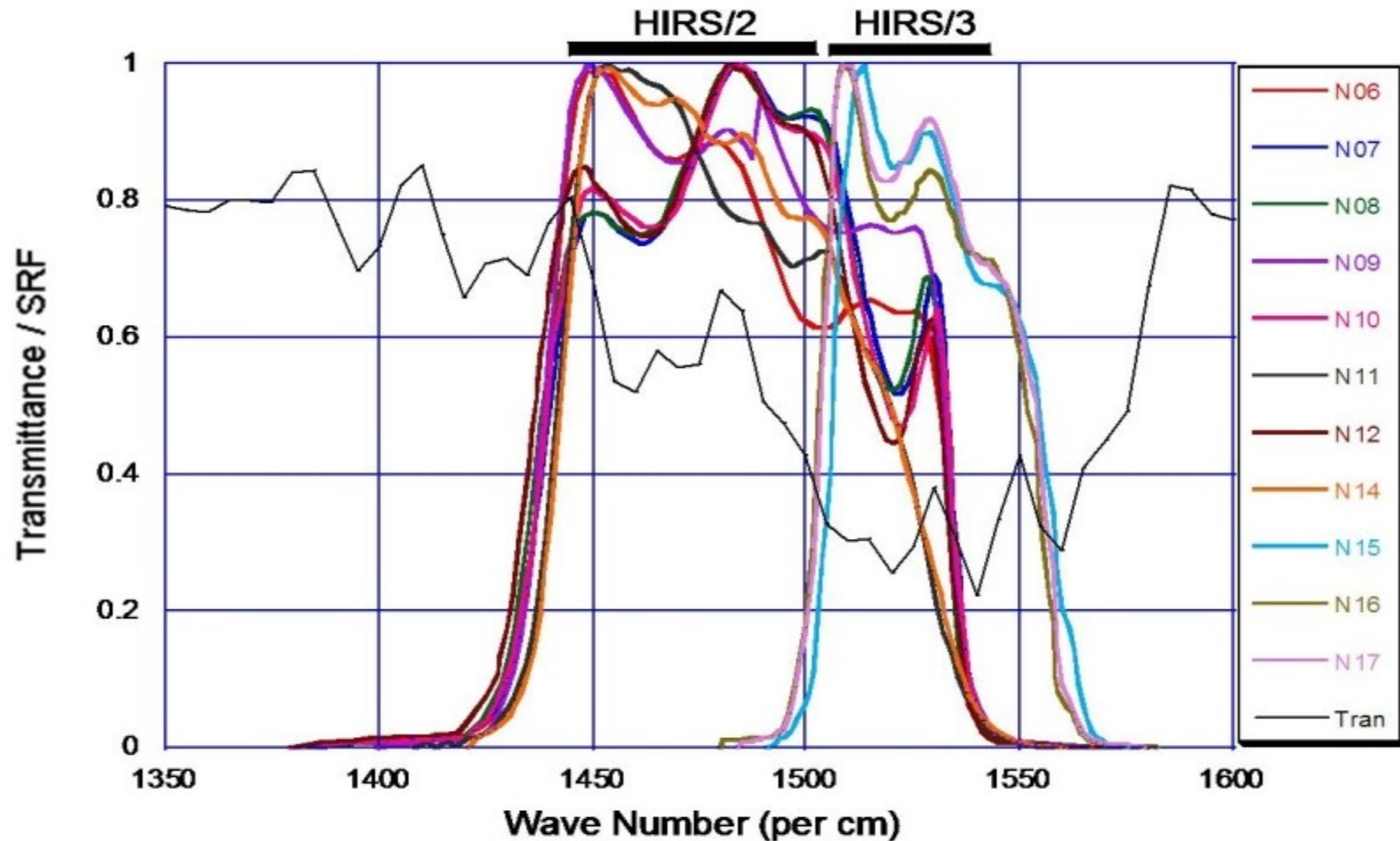
Objective:

- Re-calibrate and Inter-calibrate Meteosat First Generation (MFG) and Meteosat Second Generation (MSG) IR and WV radiances from 1982 till date against reference data.

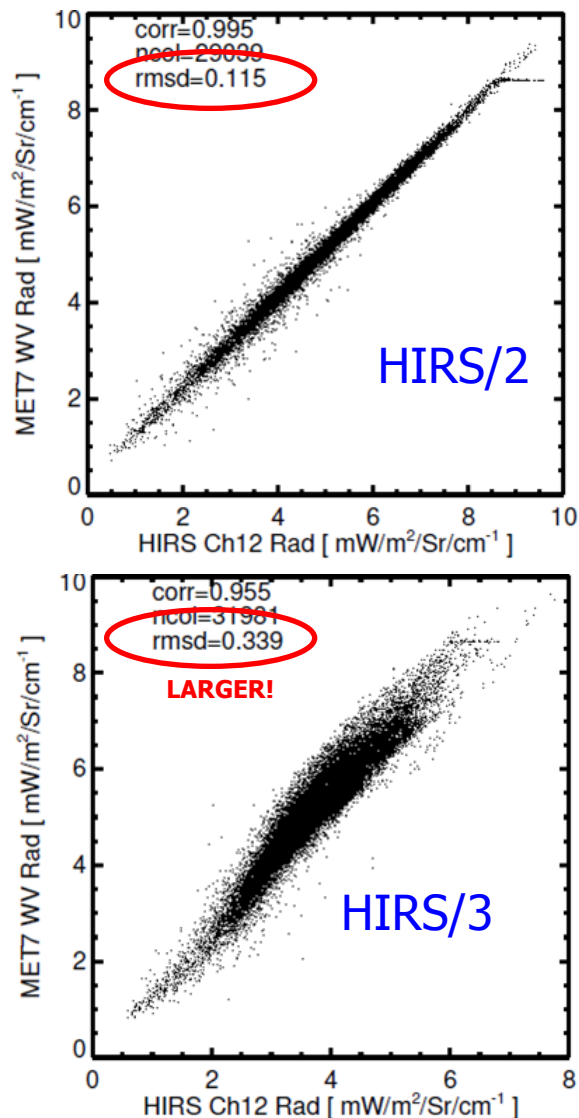
Status and Progress:

- Extended, redesigned the match-up procedure (**STAMP** – **S**pace **T**ime **A**ngle **M**atchup **P**rocedure) which can now handle all MFG, MSG and all reference data (IASI, AIRS, HIRS);
- Quantified uncertainty associated with use of HIRS/2, HIRS/3 and HIRS/4 as inter-calibration references for WV and IR channels of MFG/MSG;
- Identified AIRS as a suitable instrument to transfer calibration of HIRS/2 to MetopA/IASI;
- Extended inter-calibration approach from GSICS to include day time data to study first order correction of diurnal effects on calibration due to MFG orbit instability (IODC);
- Long-term orbital drift still needs to be analysed for all involved satellites - It determines the validity of assumptions on relative temporal stability of individual sensors against each other enabling choice of satellite pairs for inter-calibration;
- Processing of data and new calibration coefficients expected towards end of 2014.

SRF changes from satellite to satellite



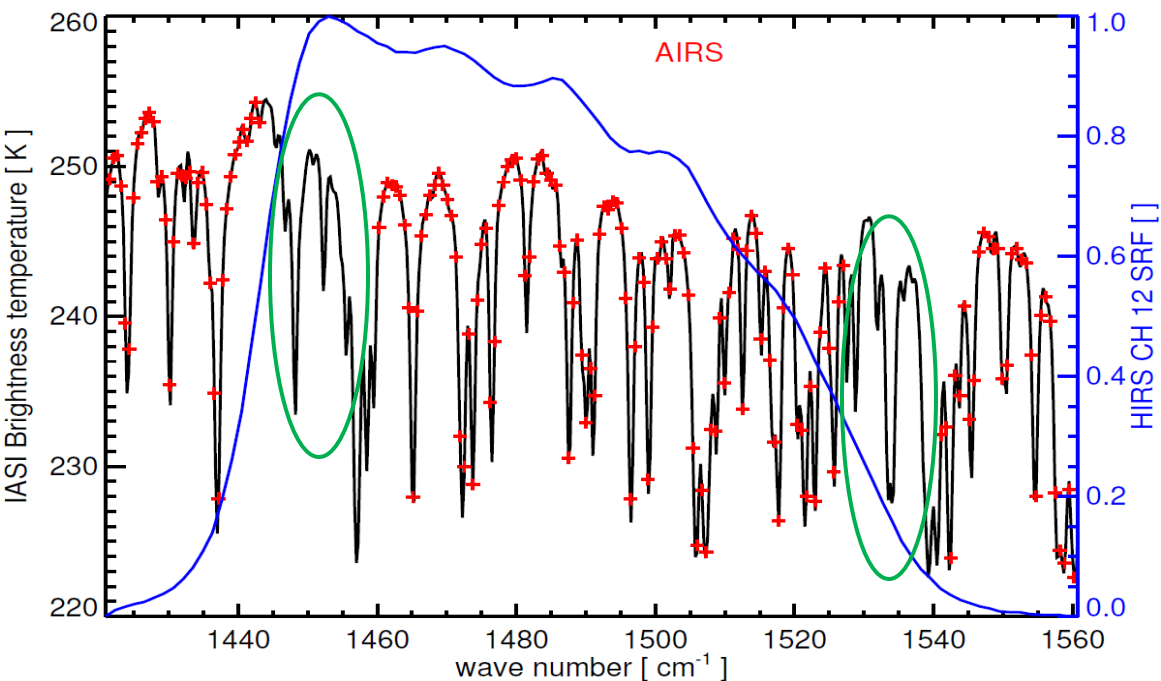
Choosing an Inter-Calibration Reference



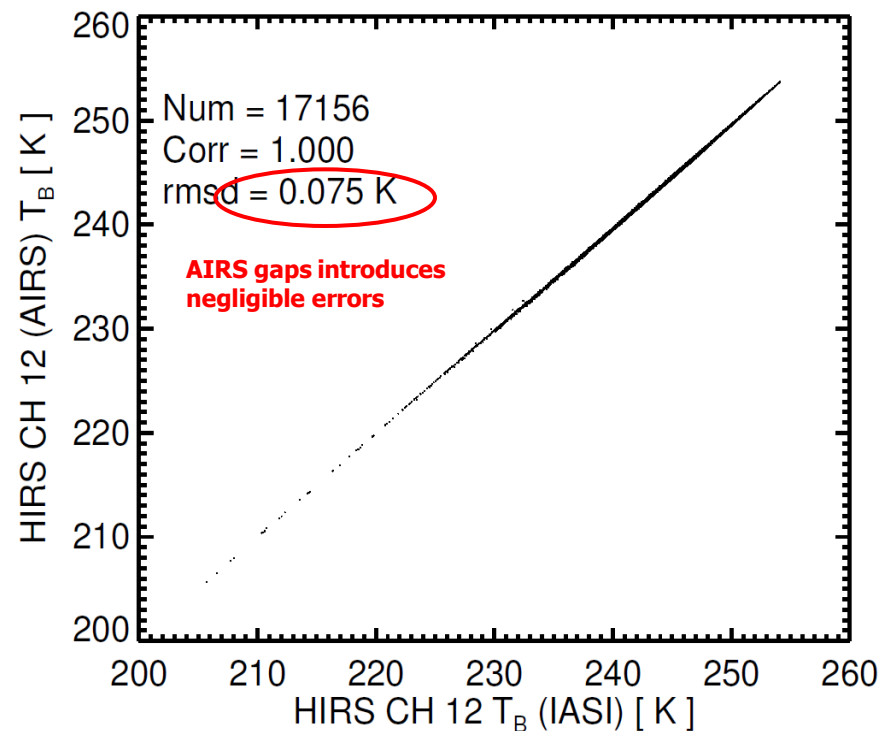
- We originally planned to use HIRS/2, HIRS/3, HIRS/4 and IASI to inter-calibrate the MFG and MSG heritage channels (WV and IR);
- We found that HIRS/3 and HIRS/4 are not suited as reference. Due to shift and narrowing of spectral response function from HIRS/2 to HIRS/3 and HIRS/4 the Spectral Band Adjustment Factor (SBAF) uncertainty of the WV channel increased from ~0.2 K to ~0.7 K;
- To replace HIRS/3 and HIRS/4 we will use observations from the NASA hyper spectral instrument AIRS in addition to IASI;
- We have also tested combinations of HIRS channels as reference, but found that this introduces more uncertainty.

The figure shows match-up data for Metosat-7 WV channel with HIRS-2 and HIRS-3 over 0° coverage for January 2003.

Choosing Inter-Calibration References

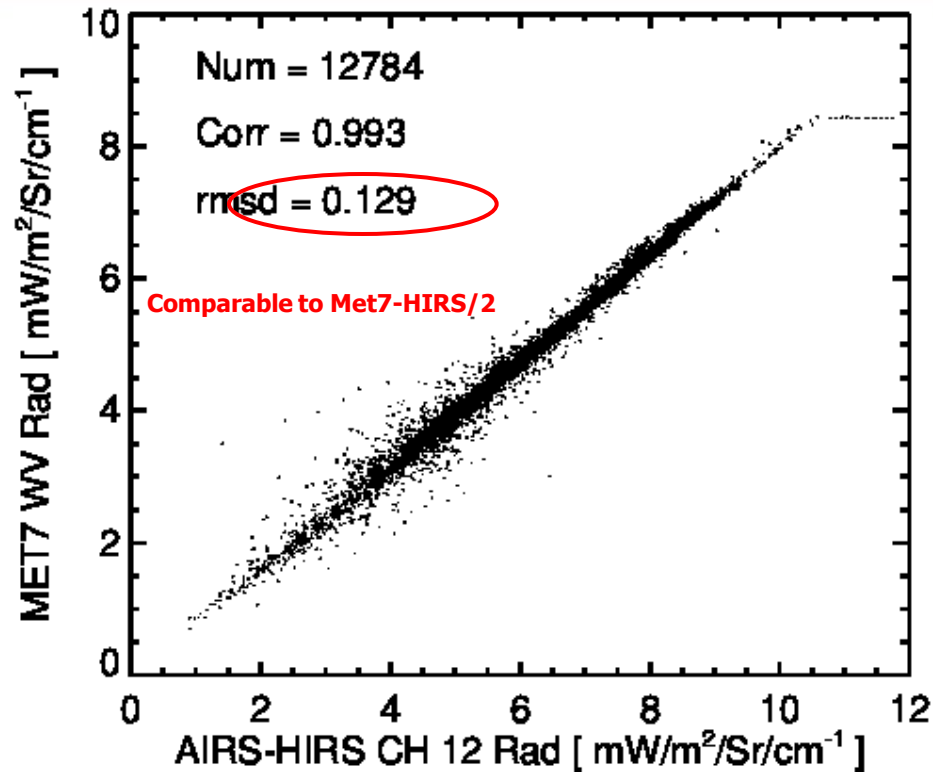


AIRS and IASI spectra with HIRS Channel 12 SRF in blue.



Relationship of HIRS/2 like radiances from IASI and AIRS.

Testing HIRS-2 Radiances Simulated from AIRS



- We collocated AIRS with MET-7 for January 2003 and converted AIRS spectra to HIRS12 radiances;
- RMSD for this is similar to match-up data for HIRS 12 on NOAA14;
- This confirms the use of AIRS as a reference instruments for MFG/MSG despite gaps in HIRS12 band;

The figure shows match-up data for Metosat-7 WV channel with HIRS-2 radiances simulated from AIRS over 0° coverage for January 2003.

Availability of reference instruments



Re- and Inter-Calibration: Detailed Status

Table 1: List of input datasets

Data Name	Period	Uncompressed Volume (TB)	Compressed Volume (TB)	Activity	Status	In %	Comment
MVIRI (level 1.5)	1983-2013	25.0	6.0	A2,A3	✓	100	Data are staged from the archive
SEVIRI (level 1.5)	2004-2013	90.0	60.0	A2,A3	✓	100	Reuses data from SEVIRI reprocessing but data must be relocated
HIRS	1979-2013	4.0	3.0	A1,A2	✓	100	Import from NOAA NCDC
MHS	2007-2013	0.6	0.4	A1,A4	✗	0	Data will be staged from the archive
SSM/T-2	1992-2008	0.2	0.2	A1,A4	✗	0	Import from UKMO, data are at EUM but need to be staged
AMSU-B	1998-2013	0.5	0.3	A1,A4	✗	0	Import from NOAA CLASS
ERA-Interim	1982-2013	11.0	8.0	A1,A4	✓	30	Reuses data from SEVIRI reprocessing but data must be relocated
Total		131.3	77.9				

Table 2: List of temporary input datasets

Data Name	Period	Uncompressed Volume (TB)	Compressed Volume (TB)	Activity	Status	In %	Comment
AIRS L1b	2002-2013	30.0	20.0	A2	✓	100	All data have been imported from NASA and staged
IASI L1c	2007-2013	6.0	4.0	A2	✓	40	GISCS is only using night-time overpasses
Total		36	24				

Table 3: List of output datasets

Data Name	Period	Uncompressed Volume (TB)	Compressed Volume (TB)	Activity	Status
FCDR MVIRI/SEVIRI	1983-2013	30.0	20.0	A4	✗
SNO Matchups	1983-2013	1.0	0.6	A3	40
Total		31	20.6		

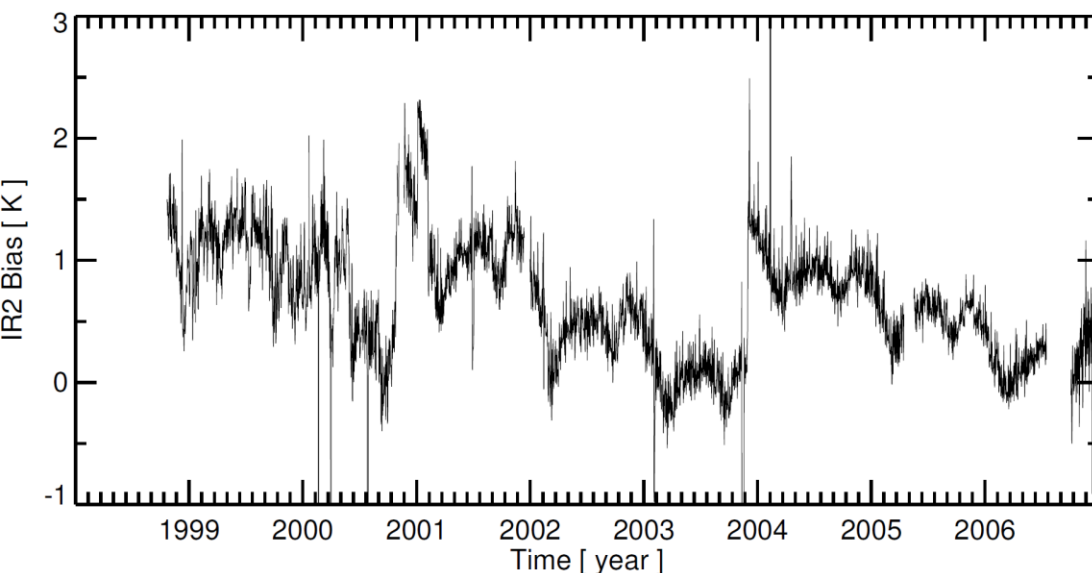
- Symbols:
 - ✓ - finished
 - ✓ - partly finished see percentage below
 - ✗ - not started

Table 4: List of software required

Software Name	Activity	Status	Remarks
STAMP	A2	✓	Finalised and tested for all instruments.
RICalS	A3	✓	Development of a C++ software from the RSP IDL prototype is ongoing using test data. Can only be verified when all data are online.

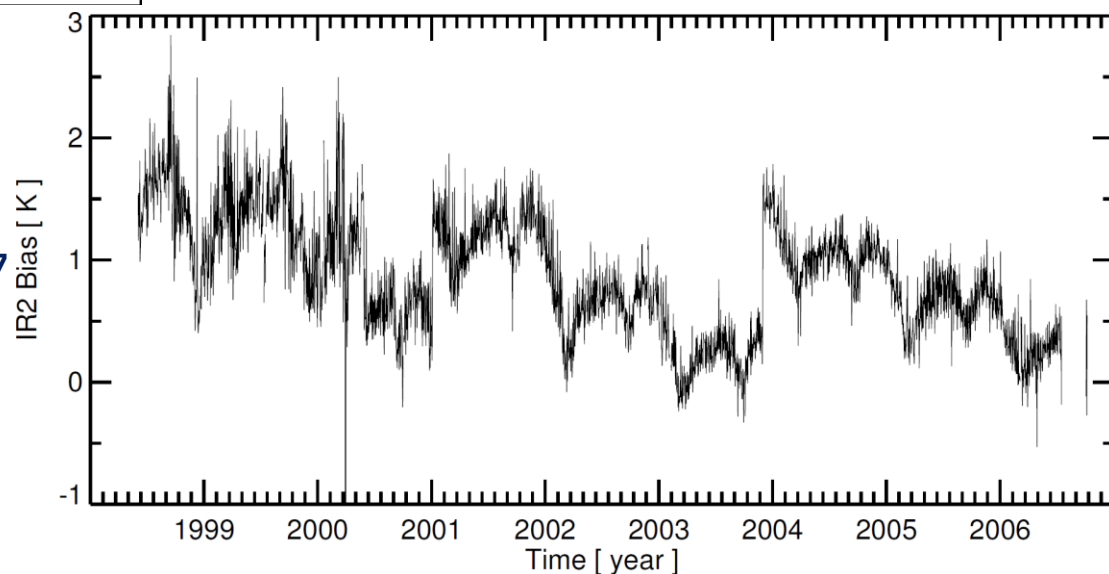
Meteosat-7 vs. NOAA-14/15 HIRS 10.8 μm

Met-7 NOAA-15 IR Window



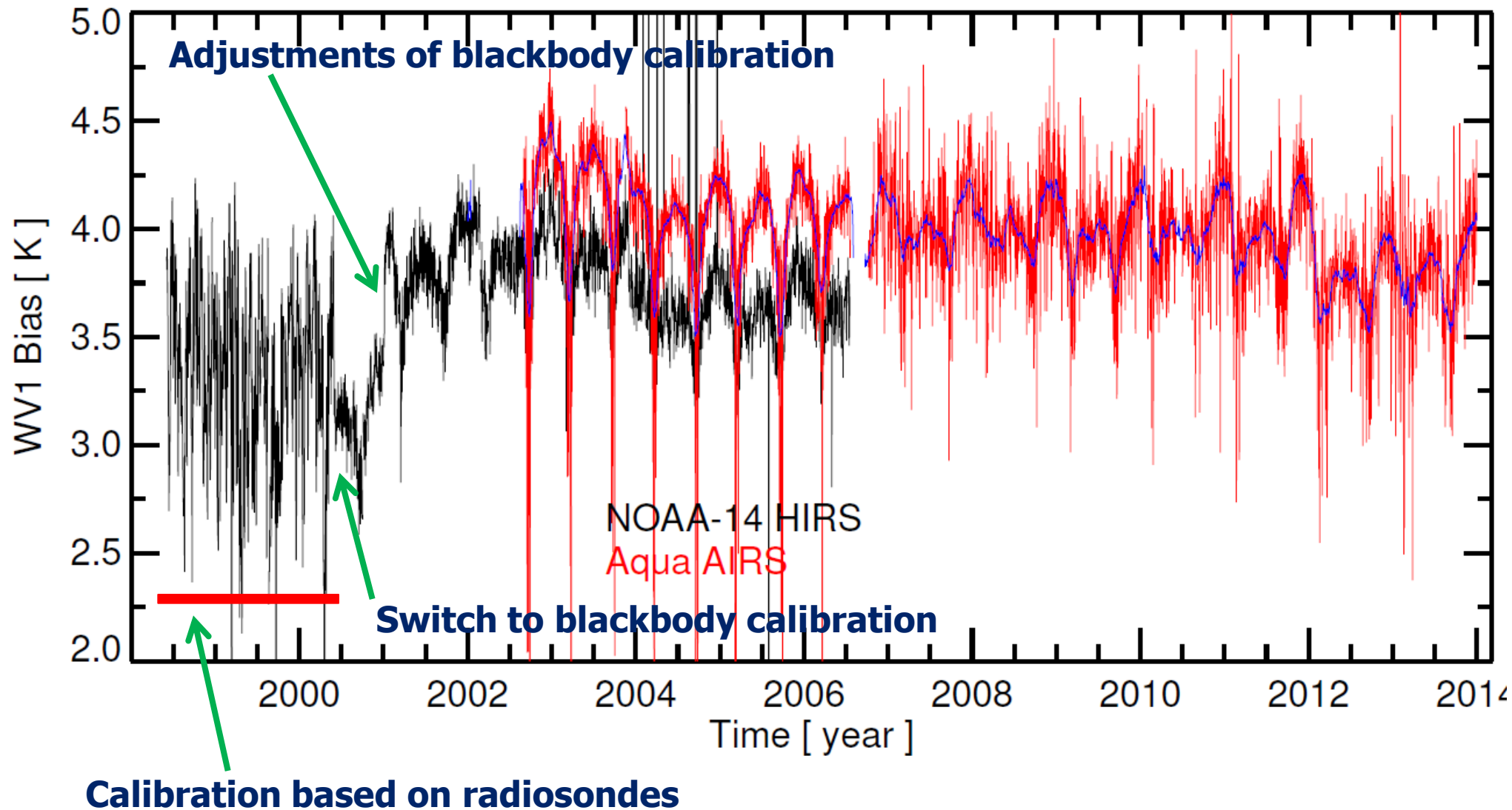
- Vicarious calibration (since beginning):
 - IR - Sea surface temperatures from NCEP data were converted to radiances and matched against observed counts;
 - WV – Operational radiosonde profiles were used to simulate radiances and matched against observed counts.

Met-7 NOAA-14 IR Window



- Black body calibration (since 29 May 2000): Started with MET-7 and was slightly updated on 4 January 2001;
- A cross calibration for MET- 5 using MET-7 became operational on 31 May 2001;
- There have been many updates in these calibrations in between.

Meteosat-7 vs. NOAA-14 HIRS Ch12 and AIRS (6 μm)



SCM-06: Inter-calibration of passive imager observations from time-series of geostationary satellites

Objective:

to generate a Fundamental Climate Data Record (FCDR) of calibrated and quality-controlled geostationary sensor data, including the visible, infra-red window and water vapour absorption channels of geostationary satellites.

Composition Project Team

- **EUMETSAT:** European Organisation for the Exploitation of Meteorological Satellites (Rob Roebeling, Tim Hewison)
- **JMA:** Japanese Meteorological Agency (Masaya Takahashi)
- **NOAA:** National Oceanic and Atmospheric Administration (Kenneth Knapp, Anand Inamdar)
- **DWD:** Deutscher Wetterdienst (Marc Schroeder)
- **CMA:** China Meteorological Administration (Peng Zhang, Xiuqing Hu)
- **IMD:** TBC (A.K, Sharma and Ashim Mitra)
- **NASA:** TBC (Dave Doeling)

Status of Produced Climate Data Records

Data Record	Period	Satellites	Status	Comment
R2 FCDR GOME-2 L1	2007 - 2011	Metop-A	Archived and accessible	
R2 FCDR ASCAT L1	2007 - 2014	Metop-A	Produced, validated, documented, available on request	Archival expected in 2014
R1 FCDR GRAS L1b (geometric optics)	2007 - 2014	Metop-A	Produced, validated, available on request	Archival expected in 2015
R1 TCDR polar AVHRR AMV	2007 - 2012	Metop-A	Produced, validated, documented, available on request	No official release, will be processed again following validation results
R1 TCDR surface albedo	1982 – 2010	Meteosat 2-7	Archived and accessible	Includes IODC, ADC and XADC
R1 TCDR AMV, CSR and ASR	2004 – 2012	Meteosat 8, 9	Produced, validated, available on request	Archival expected in 2015

Planned Activities for 2015

- Finalise Phase 2 of Climate Data Record infrastructure project by deciding on designs and implementing soft-and hardware solutions for development, processing, evaluation, archiving and distribution of Climate Data Records;
- Assess feasibility of full reprocessing of Meteosat First Generation image products and decide on the way forward supported by scientific studies to scientifically ascertain the feasibility of identification and flagging/correction of image anomalies in Level 1 and/or Level 1.5 Meteosat First Generation data;
- Perform extended validation of the first release of IR and WV channel inter-satellite calibration coefficients with update of user documentation and deliver them to the SCOPE-CM IGEO project. In addition, select inter-calibration approach for visible channels and start implementation;
- Deliver Release 2 of polar AVHRR AMV TCDR containing data back to 1982 to the FP7 ERA-CLIM-2 reanalysis project;
- Finalise FP7 CORE-CLIMAX project deliverables and close out project;
- Deliver Release 1a (with improved cloud clearing) of surface albedo products for Meteosat First Generation to SCOPE-CM phase 2 project;
- Assess implications of the outcome of the Climate Symposium for the Architecture for Climate Monitoring from space.

Highlights 2016 - 2018

- A first release of the VIS inter-calibrated Meteosat FCDR inclusive validation employing beta users;
- Meteosat First Generation Image Reprocessing establishing a new L1.5 data record;
- A first IASI L1c FCDR encompassing Metop-A and B data;
- Further releases of ASCAT and GOME-2 L1b data records using Metop-A and B data;
- A second release of Meteosat meteorological products based on inter-satellite calibrated Meteosat radiances to the FP7 ERA-CLIM2 project;
- A second release of Meteosat surface albedo encompassing First and Second Generation to the QA4ECV and SCOPE-CM projects;
- Release 1 of a IASI/GOME-2/AVHRR total ozone TCDR and Release 1 of IASI L2 Trace Gas as well as temperature and humidity profiles.