

EUMETSAT AGENCY REPORT

2014/15 INSTRUMENT CAL/VAL ACTIVITIES



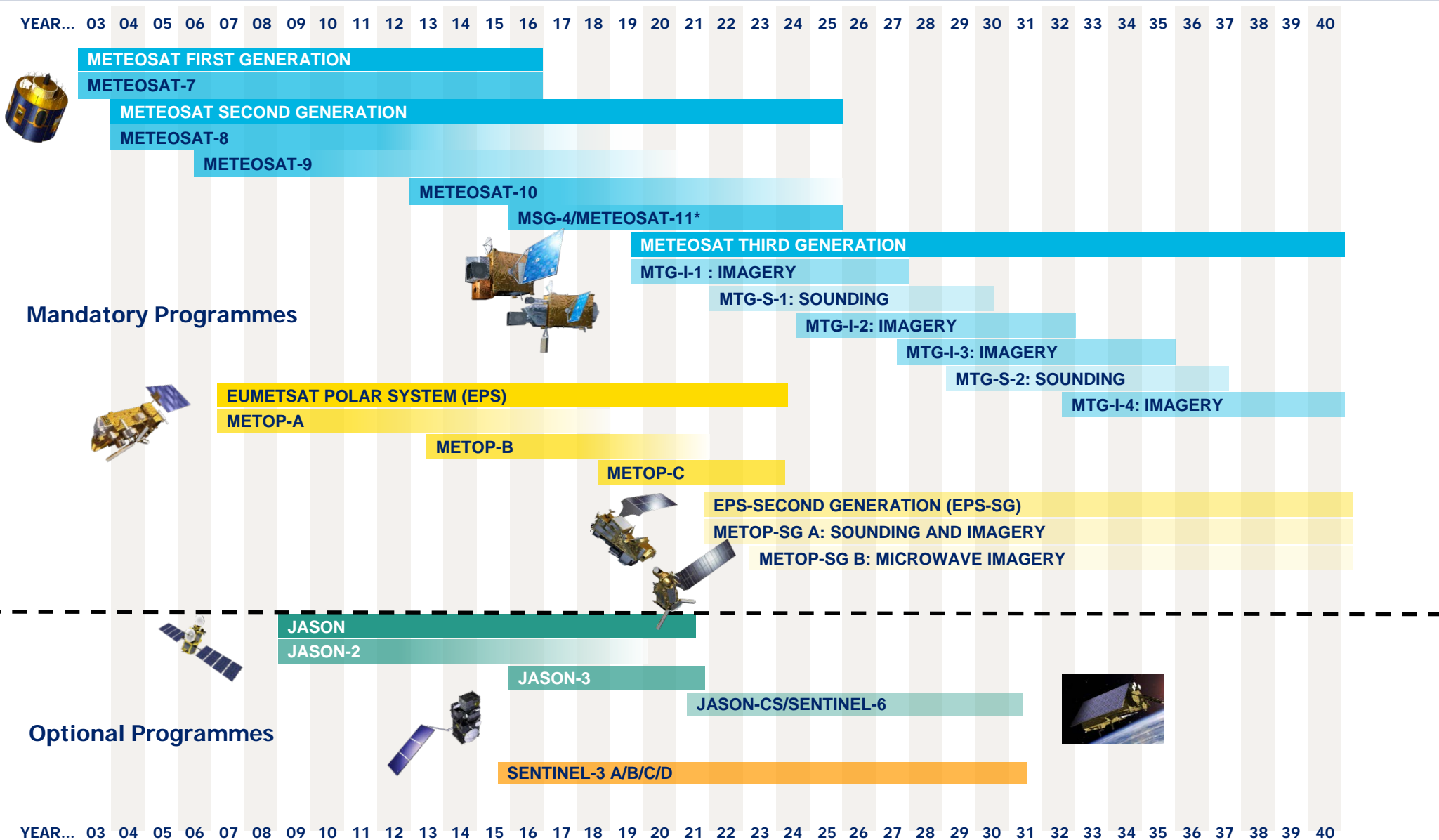
**J. Ackermann, S. Elliott, T. Hewison, K. Holmlund,
V. John, R. Munro, P. Miu, A. O'Carroll,
R. Roebeling, H. Rothfuss, B. Viticchiè, S. Wagner**



Overview

- Satellite Status
- Instrument Calibration Event Logs & Information
- Development of GSICS Products at EUMETSAT
 - GEO-LEO IR Products for current Meteosats using IASI
 - GEO Solar-band Channels for current Meteosat – DCC & Lunar
 - Re-calibration of Meteosat archive data

Operational services call for long term commitments..



Current EUMETSAT satellites

METOP A-B

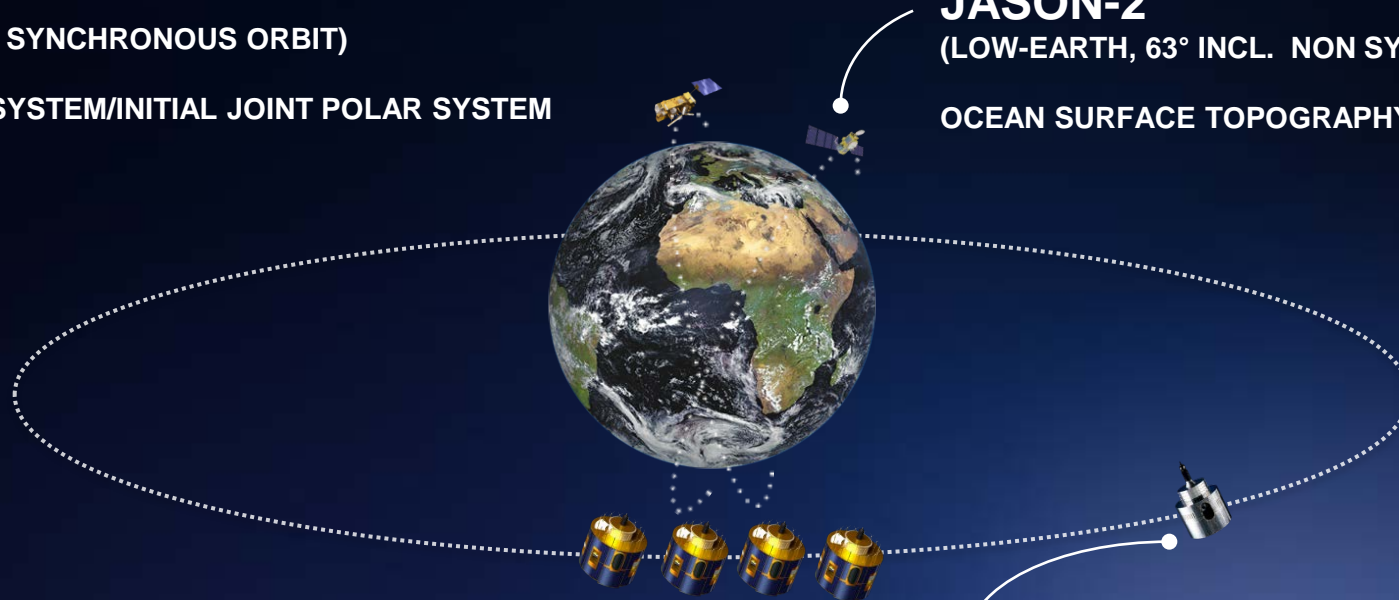
(LOW-EARTH, SUN – SYNCHRONOUS ORBIT)

EUMETSAT POLAR SYSTEM/INITIAL JOINT POLAR SYSTEM

JASON-2

(LOW-EARTH, 63° INCL. NON SYNCHRONOUS ORBIT)

OCEAN SURFACE TOPOGRAPHY MISSION



METEOSAT 8-9-10-11 (2nd GENERATION)

(GEOSTATIONARY ORBIT)

TWO-SATELLITE SYSTEM:

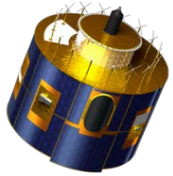
- METEOSAT - 10: FULL DISK IMAGERY MISSION AT 0° (15 MN)
- METEOSAT - 9: RAPID SCAN SERVICE OVER EUROPE AT 9.5°E (5 MN)
- METEOSAT - 8: BACK UP AT 3.5°E
- METEOSAT - 11: Launch Planned 2015-07-02 => STORAGE

METEOSAT – 7 (1st GENERATION)

(GEOSTATIONARY ORBIT)

INDIAN OCEAN DATA COVERAGE MISSION AT 57°E
(UNTIL END 2016)

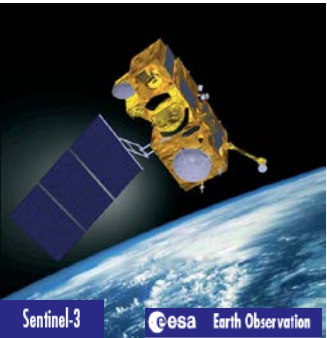
NEAR FUTURE - GEO AND LEO SATELLITES



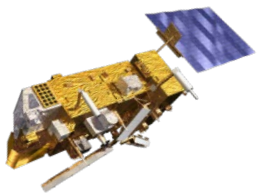
- **MSG-4 launch 2 July 2015 (for in orbit storage)**



- **Jason-3 launch (with NOAA, CNES, NASA) on 22 July 2015**



- **EUMETSAT will operate Copernicus Sentinel-3 (Marine Mission) after commissioning by ESA, in 2016**



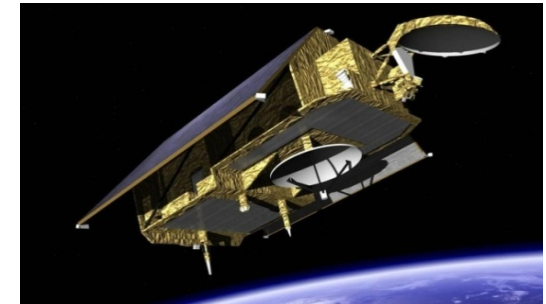
- **Metop-C launch planned in October 2018**

Future satellites & programmes: Observations in 2019 – 2040



MTG: Approved, under development

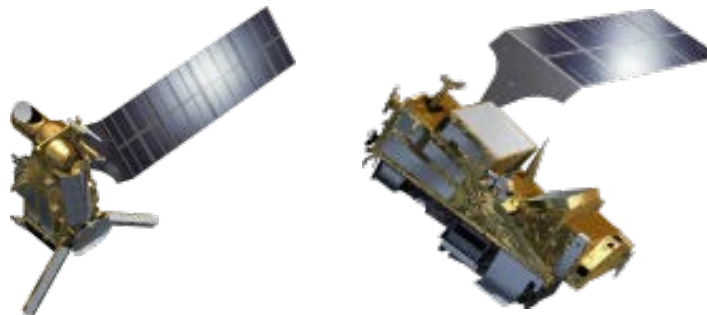
Sentinel-4 onboard MTG-I satellite



Jason-CS/*Sentinel-6*:

Proposed, *for approval in 2015*

Phase B2 approved at ESA CMIN12
Recurrent satellite co-funded by EU/Copernicus



EPS-SG: *Approval process started in July 2014*

Metop-SG programme approved at ESA CMIN12
Sentinel-5 development approved at CMIN14
Recurrent Sentinel-5 instruments funded by EU/Copernicus

WMO OSCAR

- The database (<http://www.wmo-sat.info/oscar/>) -

The screenshot shows the WMO OSCAR website interface. At the top, there is a navigation bar with the OSCAR logo and the text "Observing Systems Capability Analysis and Review Tool". Below this is a menu with categories like "Home", "Observation Requirements", "Space-based Capabilities", and "Surface-based Capabilities". A search bar is also present. The main content area is titled "Instrument: SEVIRI" and contains several sections: "Instrument details", "Satellites this instrument is flying on", "Contribution to Space Capabilities", and "Tentative Evaluation of Measurements".

Instrument: SEVIRI

Instrument details

Acronym	SEVIRI
Full name	Spinning Enhanced Visible Infra-Red Imager
Type of Instrument	01. Moderate-resolution optical imager
Purpose	Multi-purpose imagery and wind derivation by tracking clouds and water vapour features
Short description	12 channels (11 narrow-bandwidth, 1 high-resolution broad-bandwidth VIS) [see detailed characteristics below]
Background	New development
Scanning Technique	Mechanical, spinning satellite, E-W continuous, S-N stepping
Resolution	4.8 km IFOV, 3 km sampling for narrow channels; 1.6 km IFOV, 1 km sampling for broad VIS channel
Coverage / Cycle	Full disk every 15 min. Limited areas in correspondingly shorter time intervals
Mass	260 kg
Power	150 W
Data Rate	3.26 Mbps

Providing Agency	EUMETSAT
Instrument Maturity	Flown on operational programme
Utilization Period:	2002-08-28 to ≥2022
Last update:	2012-09-13

Satellites this instrument is flying on

Note: a red tag indicates satellites no longer operational, a green tag indicates operational satellites, a blue tag indicates future satellites

- [Meteosat Second Generation \(MSG\) \(EUMETSAT\)](#)
 - [Meteosat-8 \(2002 - 2016\)](#)
 - [Meteosat-9 \(2005 - 2019\)](#)
 - [Meteosat-10 \(2012 - 2019\)](#)
 - [Meteosat-11 \(2015 - 2022\)](#)

Contribution to Space Capabilities

The instrument contributes to the following Capabilities, as identified in the "Vision for the GOS in 2025" and the Implementation Plan for the Evolution of Global Observing Systems:

- [Multi-purpose VIS/IR imagery from GEO](#)

Tentative Evaluation of Measurements

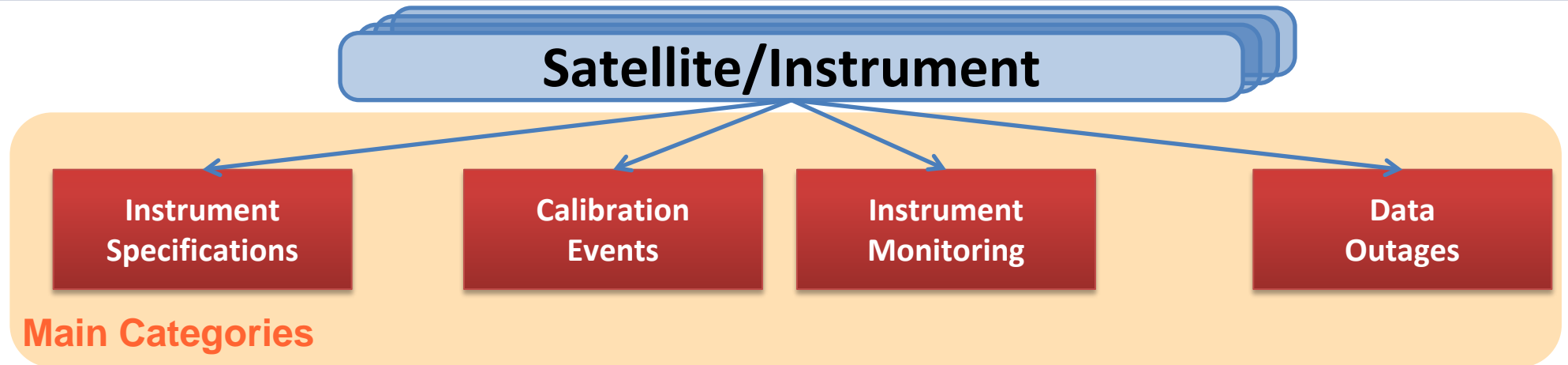
The following list indicates which measurements can **typically** be retrieved from this category of instrument. To see a full Gap Analysis by Variable, click on the respective variable.

Note: table can be sorted by clicking on the column headers.

Variable	Relevance for measuring this Variable	Operational Limitations	Processing maturity
Cloud top height	2-High	No specific	Consolidated methodology

WMO OSCAR

- Proposed structure stable landing pages –



Instrument Specifications

General information on the platform, instruments, and sensors operated in the mission that is relevant to all users of the satellite data (see OSCAR website).

Calibration Events

Database (and graphical interface) of events at satellite and processing level that are not occurring systematically and that impact the radiometric or geometric quality of the observations due to instruments calibrations, manoeuvres or miscellaneous.

Data Outages

Events that triggered the temporary or definitive end of the data collection.

Instrument Monitoring

Database (and graphical interface) of quasi continuous information on the present state of the instruments and sensors operated on the platform;

Stable Landing Page – Example EUMETSAT

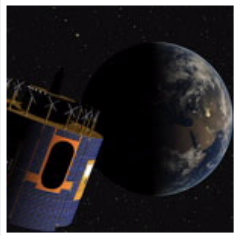
(<http://www.eumetsat.int/website/home/Data/Products/Calibration/MSGCalibrationNEW/index.html>)

MSG CALIBRATION (NEW)

- DATA
- DATA DELIVERY
- PRODUCTS
- LEVEL 1 DATA
- ATMOSPHERE
- OCEAN
- LAND
- CLIMATE
- FORMATS
- CALIBRATION
- MFG CALIBRATION
- MSG CALIBRATION
- INTER-CALIBRATION
- MSG CALIBRATION (NEW)**
- SOFTWARE PRODUCTS
- REGIONAL DATA SERVICE / EARS
- GLOBAL DATA SERVICE
- CLIMATE SERVICE
- METEOSAT DATA COLLECTION SERVICES
- THIRD PARTY
- TRAINING
- SERVICE STATUS
- TECHNICAL DOCUMENTS

MSG Calibration landing page

► [Meteosat-8](#), ► [Meteosat-9](#), ► [Meteosat-10](#)



METEOSAT-8

INSTRUMENT SPECIFICATIONS

- [WMO OSCAR \(Satellite Instrument Specifications\)](#)
- Spectral Response Function
 - Spectral responses are derived for all 12 channels of the SEVIRI instrument.
 - [Spectral responses for Meteosat Second Generation \(MSG\) \(ZIP, 226 KB\)](#). *Note: SEVIRI PFM is onboard Meteosat-8.*

CALIBRATION EVENTS

- [Meteosat-8 SEVIRI \(User Notification Service\)](#)
- [Meteosat-8 GERB \(User Notification Service\)](#)
- Monthly Operations Report

DATA OUTAGES

- Described in the Monthly Operations Report

INSTRUMENT MONITORING

- Navigation Monitoring
- [GSICS Calibration Monitoring](#)

RELEVANT DOCUMENTS

- [MSG Ground Segment LRIT/HRIT Mission Specific Implementation](#)
- [CGMS LRIT/HRIT Global Specification](#)
- [MSG Level 1.5 Image Data Format Description](#)
- [MSG Level 1.5 Image Product - Quality Indicators](#)

EUMETSAT achievements – GSICS IR subgroup

- Status of Current products
 - Meteosat/SEVIRI-Metop/IASI Pre-Op
 - Expected to promote to Operational in 2015
 - Meteosat-7/MVIRI-Metop/IASI Demo
 - Algorithm implemented for Reprocessing
- Development of New products
 - Prime GSICS Corrections
 - Combines results from IASI/Metop-A & -B
 - Ready to submit as Demo GSICS product
 - AVHRR-IASI to prepare for Sentinel-3/SLSTR
 - Support for EU Horizon2020 FIDUCEO project
 - Maybe future GSICS product?
- For past instruments:
 - Recalibration of MFG archive for IR/WV channels (FCDR available by end 2015)
 - Generation of FCDRs with HIRS and AVHRR to serve as references (FIDUCEO project)

EUMETSAT achievements – GSICS VIS/NIR subgroup

- Deep Convective Clouds
 - Accounting for seasonal variations
 - Support to visiting scientists from JMA and CMA with MTSAT2 & FY2E
 - EUMETSAT's ATBD ready
 - Preparing the demo product (expected in 2015)
- Lunar Calibration Workshop
 - Development of GSICS Implementation of ROLO
 - First iteration on the GSICS Lunar Observation Dataset
 - Support to visiting scientists from JMA and CMA with MTSAT2, Himawari-8/AHI & FY2E
- Implementing GIRO in Operations to monitor Meteosat-7, -8, -9, -10, -11 (soon)
- Incrementation of our monitoring capabilities (integrated multi-mission approach)

EUMETSAT achievements – GSICS MW subgroup

Planned activity for past instruments:

- FCDR of microwave humidity sounders L1 data (SSM/T2, AMSU-B, MHS) (FIDUCEO project)

EUMETSAT achievements – GSICS UV subgroup

- Formation of UV Sub-Group
 - ➔ New Chair: Rosemary Munro

Within the framework of Atmospheric Composition Group activities:

- CEOS WGCV: Support to the preparation of a workshop on sensor on-ground and in-orbit (no-vicarious) calibration. Proposal for joint meeting presented to WGCV in May
- Contribution to the inter-comparison between the OMPS and GOME-2 Sensor Data Record/L1b by Wu et al. (presented at the 2014 EUM User Conference)
- Prototyping inter-calibration procedure GOME-2/MSG (VIS06) and GOME-2/AVHRR channel 1.
- Preparing for routine AVHRR-GOME-2 and IASI sensor inter-calibration within operational PMAp EPS multi-mission sensor collocation and co-registration framework
 - ➔ Potential for producing time series of AVHRR Ch1(2)/GOME-2 and AVHRR T4/5/IASI inter-calibration coefficients.

EUMETSAT achievements – Data Working Group

- Improvement of the GSICS plotting tool performances.
- Support to NOAA to ensure compatibility of their pre-operational GSICS RAC products with the GSICS plotting tool.
- CMA technical expert hosted for 3 months at EUMETSAT HQ. Main activities:
 - Configuration of CMA GSICS collaboration server
 - Support to the validation of a GSICS product development framework developed by EUMETSAT
 - Familiarisation with on-going GSICS tasks
 - Event logging
 - Product notification and distribution
 - Data product contents wrt guidelines + conventions + standards
 - Familiarisation with Data Centre operational environment + archiving of data

GSICS Products Development – Lunar calibration

- **ACHIEVEMENTS**

- ✓ **Flexible and robust** extraction tool in place for the GEOs imagers
- ✓ **Unique archive** of lunar observations from GEOs available
- ✓ Applications: instrument **monitoring + characterization**
- ✓ **To secure operations**, implemented independent version of the ROLO model
- ✓ Extremely accurate drift estimate (uncertainty: $\sim 0.02\%$ yr⁻¹ for LRES, $\sim 0.05\%$ yr⁻¹ for HRVIS)
- ✓ All SEVIRI well within specification for long-term drift
- ✓ Lunar calibration can be used to **monitor the vicarious calibration**

- **OPEN ISSUES:**

- ✓ **Phase-angle dependence of the ROLO model**
- ✓ **Original ROLO spectral sampling**

- **FUTURE:**

- ✓ Keep consolidating in-house expertise and provide support to present and future programs and to climate activities.
- ✓ More GSICS related → Initiate a project for transferring MODIS calibration to the GEOs using the Moon as transfer target

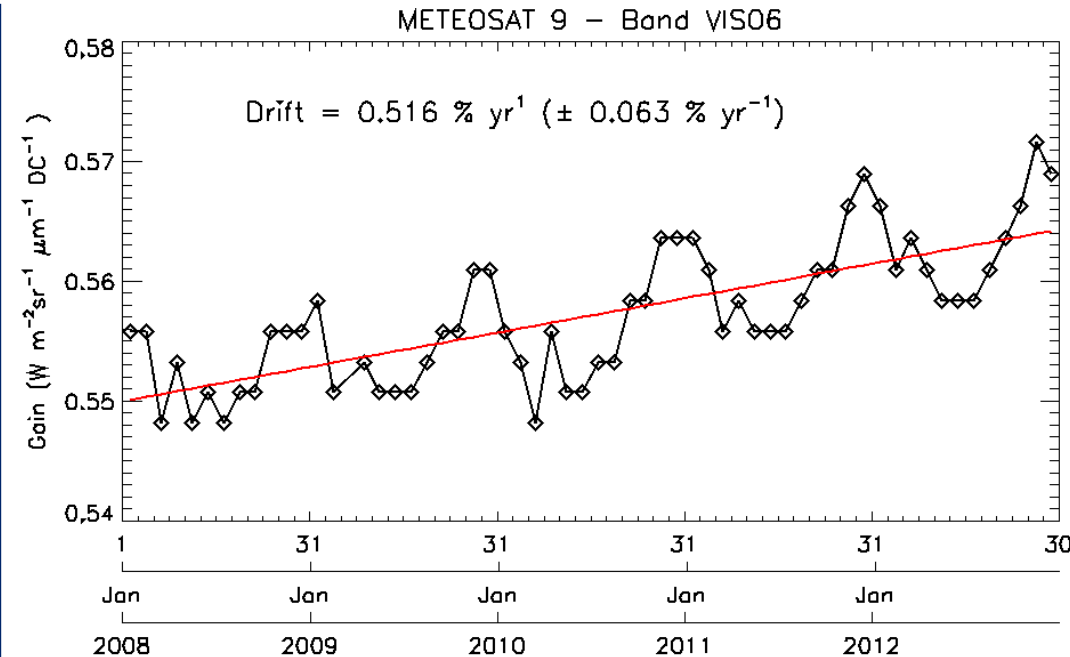
GSICS Products Development – DCC

ACHIEVEMENTS

- Implementation **COMPLETED**
- Decoupled processing of MODIS and SEVIRI to derive gains **COMPLETED**
- Uncertainty analysis to associate an uncertainty estimate to the derived gain **ON-GOING**
- Definition of a GSICS product content+ Formatting to GSICS standards in NetCDF **ON-GOING**
- Implementation of the DCC algorithm for Met-07 **ON-GOING**

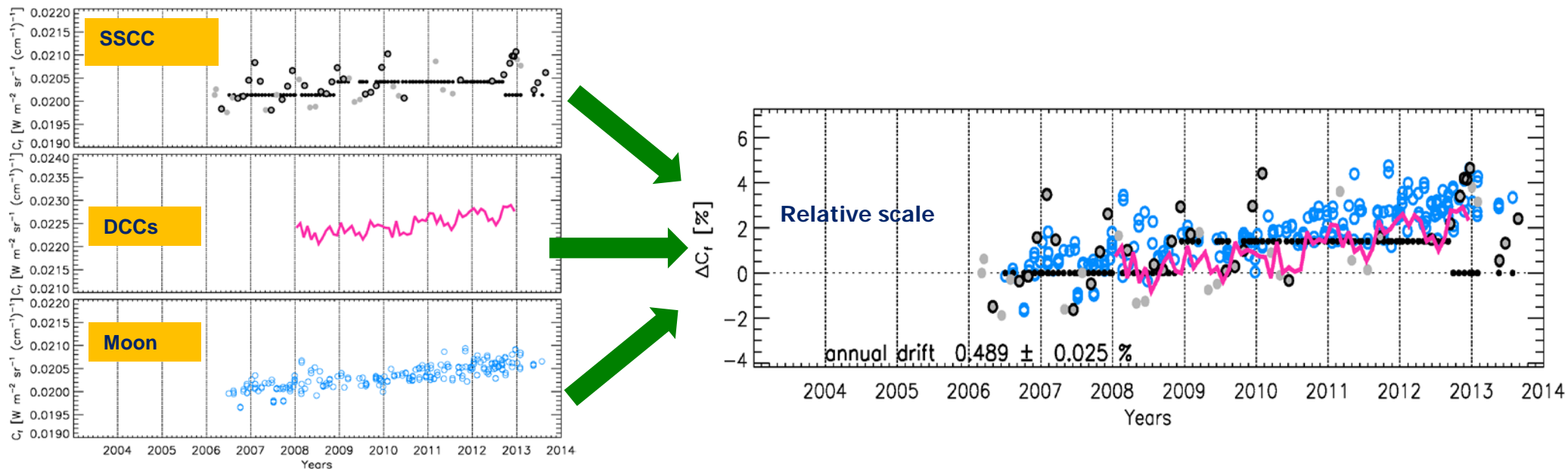
PLANNED WORK FOR 2015

- Establish a reference value for MODIS radiance
- Uncertainty analysis to be continued
- Operational implementation of the DCC extraction for MSGs
- Generation of a GSICS product (demo) for Met-9
- Support to SCOPE-CM → corrections for Met-7,8,9 and 10)
- Integration of the DCC results in a VIS/NIR calibration monitoring tool (→ towards consolidated GSICS corrections)



Enhancing monitoring capabilities

Towards consolidated GSICS corrections?



Example of the VIS06 band on MSG2/SEVIRI.

Development of Multi-Mission Integrated Calibration Monitoring System

Re-calibration of Meteosat archive data

- Aim is to re-calibrate the IR and WV channels on MFG and MSG and produce a 30+ years (1982 – present) FCDR;
- We have identified reference instruments (HIRS-2, AIRS, and IASI);
- We collected METEOSAT images and reference datasets;
- We generated collocations between MFG (and MSG) and reference measurements;
- We analysed Meteosat-5 and -7 time-series and confirmed need for recalibration;
- We plan to apply DCC-based algorithm to visible channel

e.g. Infrared channel ($10.8 \mu\text{m}$)

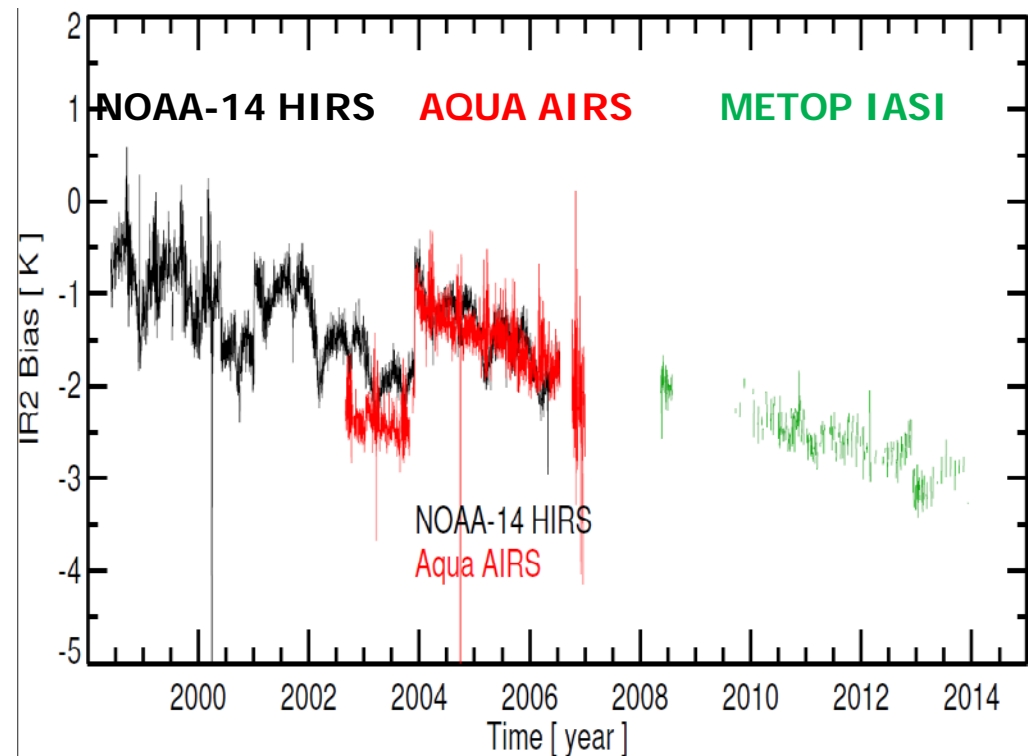


Fig: Time-series of infra-red biases of the MET-7 IR channel relative to HIRS/2/AIRS/IASI radiances adjusted for spectral band differences.

- **Calibration is key to ensuring EUMETSAT achieves its objectives:**
 1. To establish, maintain and exploit European systems of operational meteorological satellites
 2. To contribute to the operational monitoring of the climate & the detection of global climatic changes
 3. Furthermore, other environment monitoring issues are considered when interactions with the atmosphere or the ocean are involved
- **EUMETSAT continues to develop new calibration capabilities**
 1. For real-time operations
 2. Support of climate reanalysis
 3. Support to future programs (MTG + EPS/SG) + third party programs (S3)
 4. In international cooperation, including:
 - Global Space-based Inter-Calibration System
 - CEOS WGCV

Thank you