ERA-CLIM2-WP3:
Satellite data reprocessing and inter-calibration

Rob Roebeling, Jörg Schulz, Marie Doutriaux-Boucher, Alessio Lattanzio, Viju John, and Andrey Bogdanov

Thanks to:
Christian Marquardt and Axel Von Engeln

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Content

- **EUMETSAT's Role in ERA-CLIM2**

- **EUMETSAT's Status and Plans**

- **Planning for next period**

ERA-CLIM2 – EUMETSAT

Introduction

ERA-CLIM2 – EUMETSATs Tasks in WP3

WP3   -> EARTH SYSTEM OBSERVATIONS
Task 3.2 -> Satellite data rescue, reprocessing, and inter-calibration.

– To inter-calibrate of radiance measurements from Meteosat First and Meteosat Second Generation, and for other geostationary satellites in collaboration with NOAA and JMA within SCOPE-CM (D3.12);

– To provide consolidated radio occultation data records for Metop A and Metop-B instruments, and third-party instruments (CHAMP, COSMIC, and GRACE) (D3.14);

– To create an FCDR of SSM/T2 and AMSU-B/MHS radiances in collaboration with CMSAF and UK MetOffice (D3.11);

– To extend the polar wind retrievals for AVHRR record back to 1982 (D3.10);

– To improve the AMV data records from Meteosat First Generation and Second Generation, and for other geostationary satellites in collaboration with JMA (and potentially NOAA) within SCOPE-CM (D3.13).

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ERA-CLIM2 – EUMETSATs Deliverables

WP3 -> **EARTH SYSTEM OBSERVATIONS**
Task 3.2 -> *Satellite data rescue, reprocessing, and inter-calibration.*

Deliverable	Deliverable Title	Delivery date *(months after kickoff)**
D3.10	AVHRR: polar winds (30+ years)	36
D3.11	SSM/T2 and AMSU-B/MHS: radiance data	24
D3.12	MFG* and MSG**: inter-calibrated radiances	36
D3.13	MFG* and MSG**: Atmospheric Motion Vectors (AMVs) *including All Sky Radiances (ASRs) and Clear Sky Radiances (CSRs)*	42
D3.14	Metop, CHAMP, COSMIC (GRACE): consolidated Radio Occultation (RO) data	36

* *MFG =   Meteosat First Generation*
** *MSG =   Meteosat Second Generation*

*ERA-CLIM2 Kickoff date: February 2014

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Status and Planning
December 2015

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D3.10 - TCDR AVHRR polar winds (1982-2011)

Status

- Collected AVHRR GAC data (1982-2014) from the CM SAF (based on PATMOS-X) (**done**);
- Modified the Cooperative Institute for Meteorological Satellite Studies (CIMSS) processing chain for polar winds retrievals from AVHRR Global Area Coverage (GAC) data (**done**);
- Testing and verification of AVHRR-GAC based polar winds (**ongoing**).
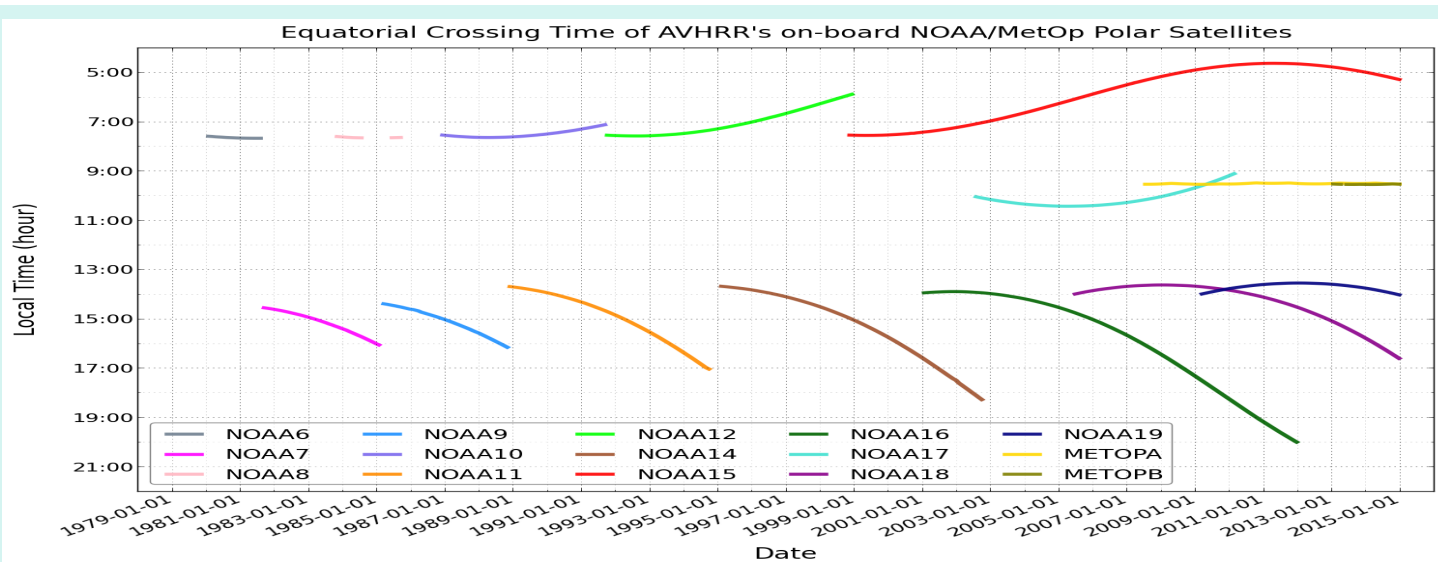
Planned

- To generate, validate, document, and release GAC based polar winds data record;
- To update the EUM algorithm for use with AVHRR GAC data (optional);

Note: Due to change of ERA-CLIM2 consultant, and limited availability of data storage the delivery of the polar AMVs from AVHRR-GAC slips into 2016

Nr.	Task Name	2014	2015	2016
1	Algorithm update to GAC version	④	❶❷❸	
2	Algorithm testing and verification		①❷❸❹	
3	Algorithm implementation and processing		❸❹	❶❷
4	Validation and documentation		①②③④	①②❸❹
5	Data Record Release Delivery (D3.10)			❹

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Time series of the equatorial crossing time of AVHRR level 1C GAC data used at EUMETSAT for the polar AMV reprocessing (*Courtesy of C. Schlundt*).
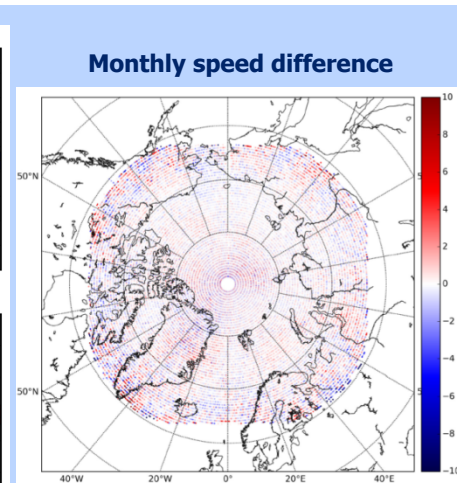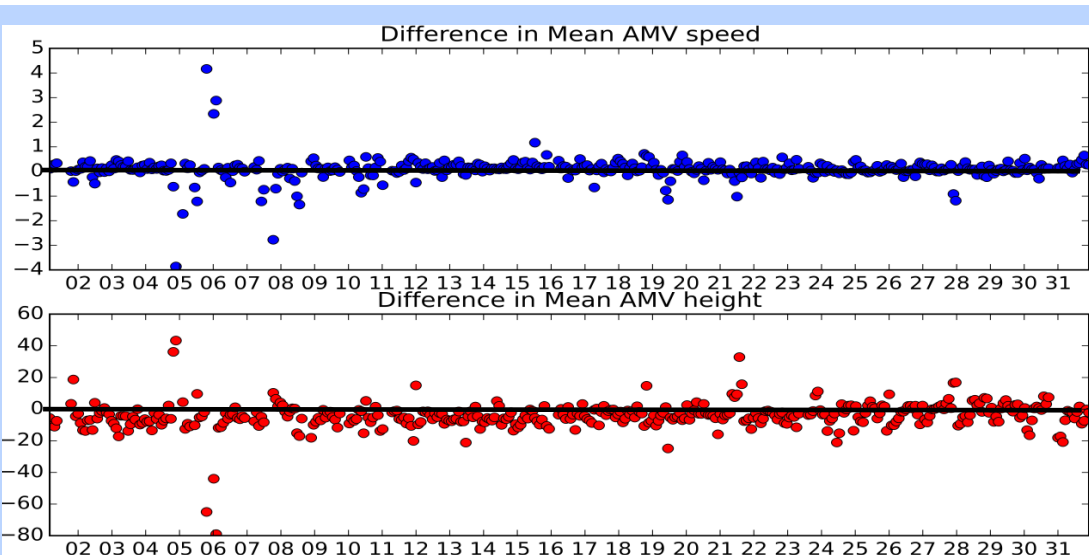
Example of AMVs retrieved over the North pole in October 2010 using original (LAC) resolution versus reduced resolution (GAC) data.

Courtesy Shinya Kobayashi, Paul Poli and Viju John

Status:

- UKMO (CM SAF) evaluated the following issues:
  scan & time dependent biases; diurnal cycle aliasing (orbit drift); assessment of inter-calibration methods;
- UKMO (CM SAF) prepared ATBD.

Planned:

- generate, validate, and release FCDR (Q1 2016);
- archive and distribute the release (Q2 2016).

Departures of the upper tropospheric channel over tropical ocean (30N-30S) before correction
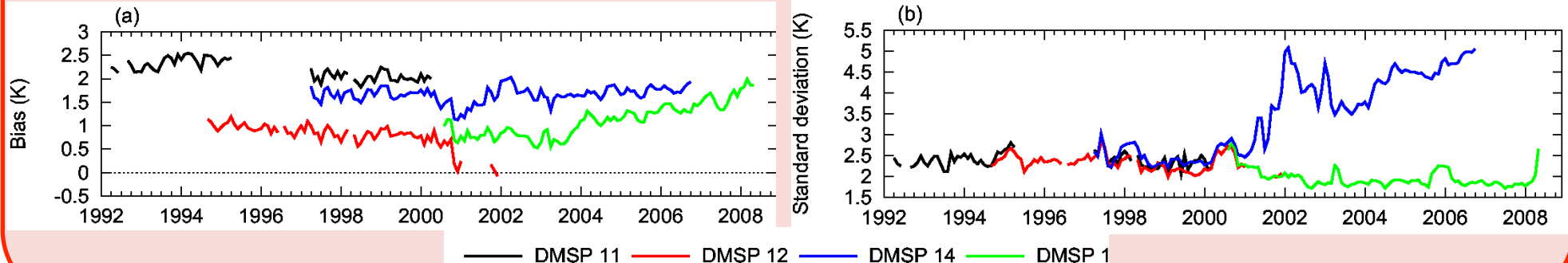
D3.12 - FCDR MFG and MSG radiances (1982- 2014)
Coordinated with SCOPE-CM

Status:

- Developed infra-red (IR) and water vapour (WV) re-calibration method;
- Generated IR and WV re-calibration coefficients for the MFG time-series;
- Verified impact of re-calibrated IR/WV data for land surface temperature retrieval (CM SAF)
- Defined standard NetCDF format of the FCDR of MFG and MSG radiances;

Planned:

- to recalibrate MSG radiances for the IR/WV channels;
- to generate an FCDR of MFG and MSG radiances in standard NetCDF format;

Note: SCOPE-CM and GSICS initiated a coordinated activity to inter-compare recalibrated IR and WV radiances from the METEOSAT, GOES, Himawari, Feng-Yun, and Kalpana satellites.

Nr.	Task Name	2014	2015	2016
1	IR/WV: Algorithm development, testing, and verification	❶❷❸❹	❶ ②③④	
2	IR/WV: Algorithm implementation and processing		①❷❸④	❶❷❸④
3	Validation and documentation		❸❹	❸❹
4	Data Record Release Delivery (D3.12)			①②③❹

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Comparison of operational and re-calibrated radiances

- **Substantial Reduction of the biases to 1.2 K for IR and 2.2 K for WV**
- **The effect will likely be bigger for earlier Meteosat satellites**
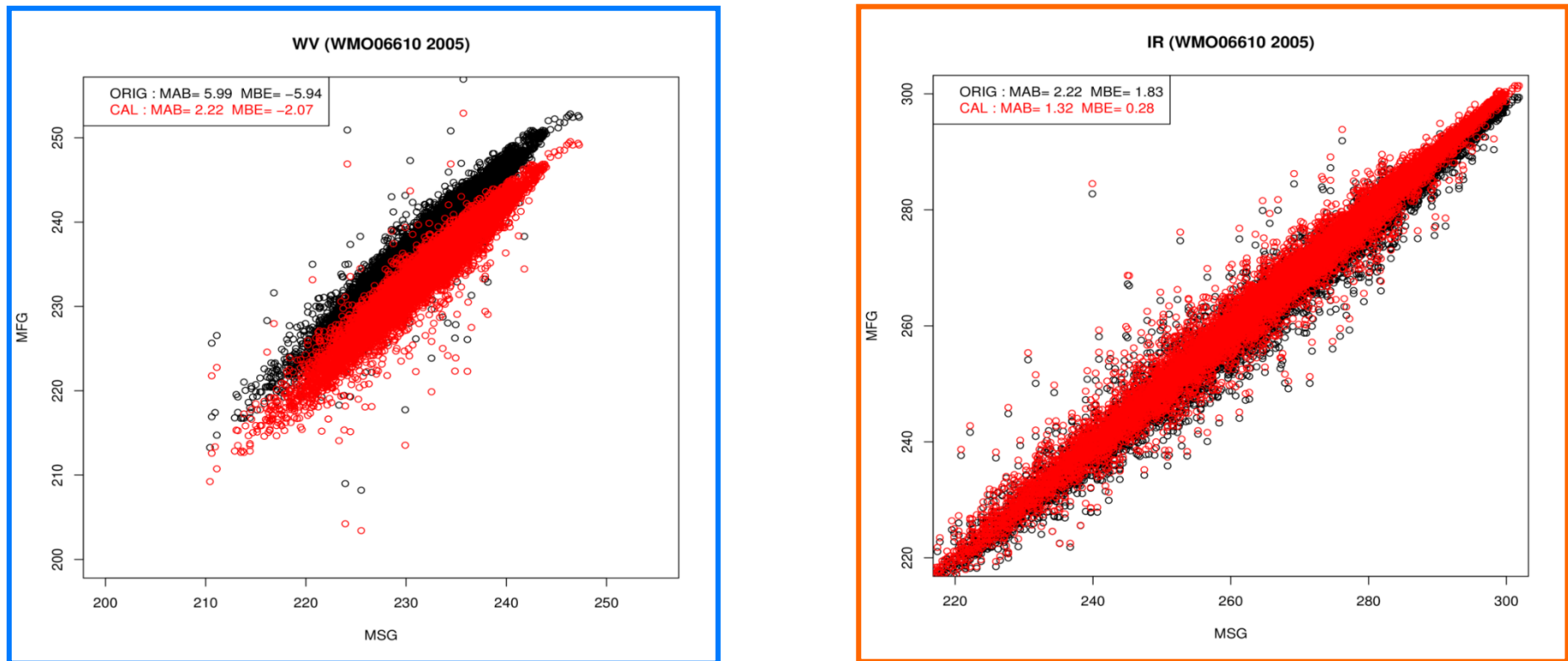- **Note: *the comparison does not account for differences in Spectral Response***

Fig2: *Scatterplots of relationship between MFG and MSG brightness temperatures **Before** and **After** re-calibration corrections for the* **Water Vapor channel** *(left panel) and the* **Infrared channel** *(right panel)*

Status:

- Selected algorithm for retrieving *cloud properties and AMVs* from MFG and MSG data;
- Started adopting and testing the selected algorithm;

Planned:

- to reprocess MFG and MSG AMVs (and ASR and CSR);
- to validate and document TCDR;
- to archive and deliver the released TCDR.

Nr.	Task Name	2014	2015	2016	2017
1	Algorithm assessment	❸❹	❶❷		
2	Algorithm updating, testing, and verification		❷❸❹	❶❷❸④	
3	Algorithm implementation and processing			❸❹	❶❷
4	Validation and documentation			❹	❶❷❸
5	Data Record Release Delivery (D3.13)				❸❹

D3.13 - TCDR MFG and MSG AMVs (1982 - 2014)
MFG/MSG Reprocessing status

Item	Development	Testing	Integration
Framework	Modified MPEF framework (reuse of EUMETSAT method)	On going	Under testing
Cloud Mask	On going for MFG/MSG (CMSAF algorithm)	Done in for small regions for both MFG/MSG.	Under testing
Cloud Top Height	On going for MFG (based on EUMETSAT method)	On going	None
ASR	Done (reuse of EUMETSAT method)	On going	Tested for both MFG/MSG as standalone. Under testing within Framework
CSR	None (reuse of EUMETSAT method)	None	None
AMV	Standalone version MPEF method (based on EUMETSAT method)	On going	None

To limit porting issues the testing environment has been created identical to the target processing one: Intel 64 bits with similar CPU (Intel Xeon)

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D3.14 – FCDR Radio Occultation (2001-2014)
(GRAS/CHAMP/COSMIC/GRACE)

Status

- Completed the update to **WaveO**ptics based processor for GRAS on Metop;
- Processed GRAS data (Metop-B and Metop-A) with the **WaveO**ptics processor;
- Validated GRAS bending angles (Metop-B and Metop-A) from **WaveO**ptics;
- Preparations for processing CHAMP/COSMIC data with the **WaveO**ptics are ongoing;

Planned

- Processing of CHAMP and COSMIC with the **WaveO**ptics based processor;
- Validation of CHAMP/COSMIC bending angles from **WaveO**ptics;

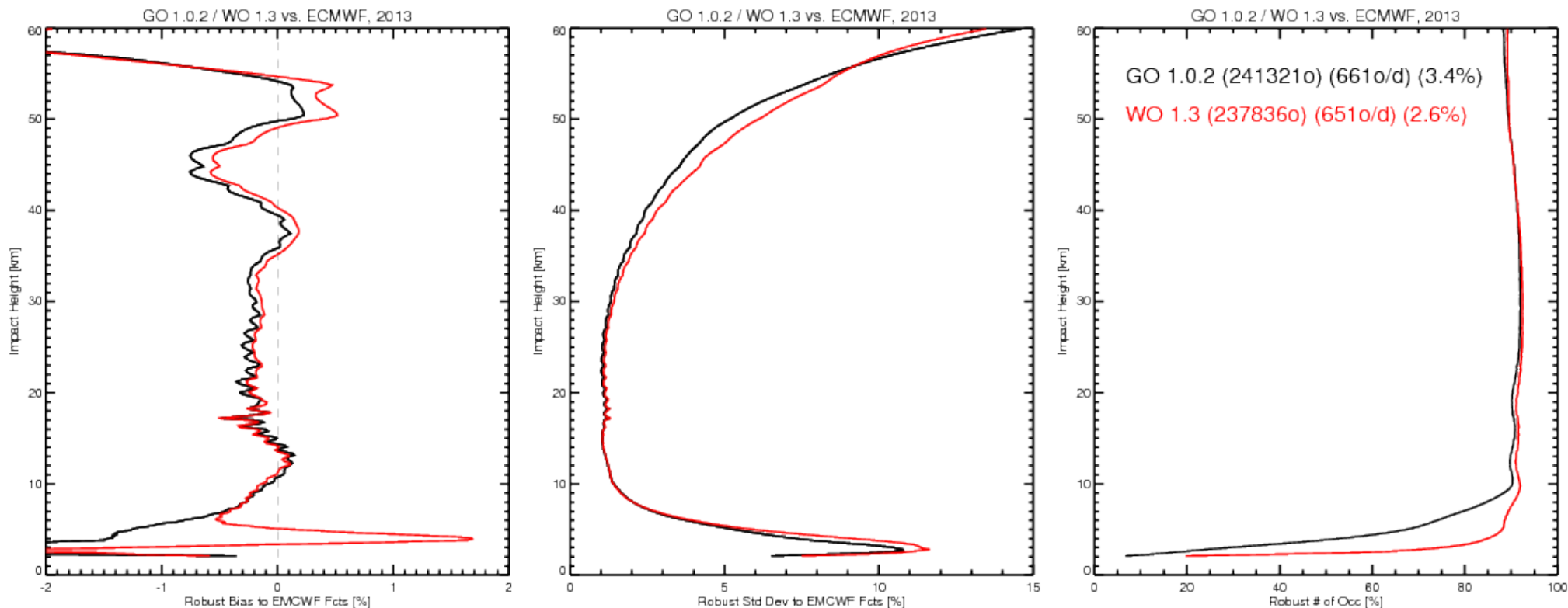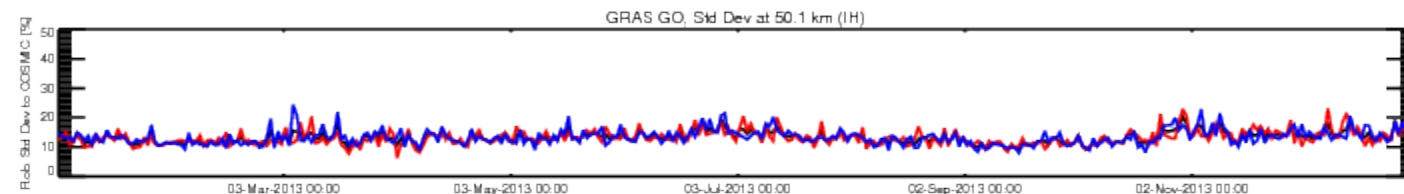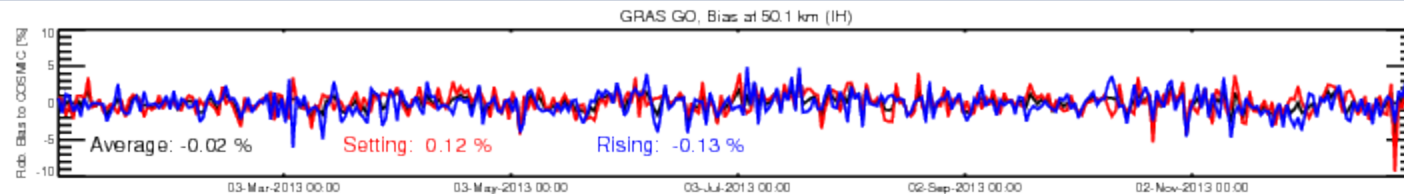| Nr.	Task Name	2014	2015	2016
1	Algorithm update to WaveOptics	❸❹	❶	
2	Algorithm testing and verification	❹	❶❷	
3	Algorithm implementation and processing GRAS		❷❸❹	
4	Algorithm update for CHAMP, COSMIC, and GRACE I/O		❸❹	❶❷
5	Algorithm implementation and processing CHAMP, COSMIC, and GRACE			❶❷❸
6	Validation and documentation		❸❹	❸❹
7	Data Record Release Delivery (D3.14)			❹

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Fig: *Validation of GRAS Metop-A data vs. ECMWF forecasts for 2013: Bias (left), std. dev. (middle), number of occultations . Notes:*
*(1) Statistics are calculated as (o-b)/b , where o = EUM **GeoO**ptics or EUM **WaveO**ptics and b = ECMWF*
*(2) Below 8km the EUM **GeoO**ptics and EUM **WaveO**ptics biases differ up to 2%*
*(3) Between 2 and 8 km up to 50% more Occultations from EUM **WaveO**ptics than from EUM **GeoO**ptics*
(4) Bias, std dev ripples at higher altitude due to ECMWF model resolution
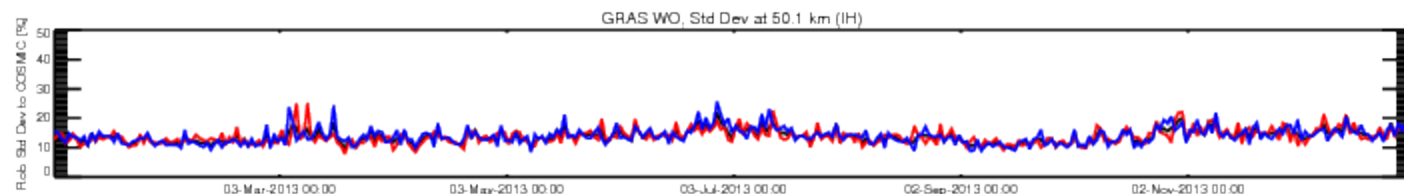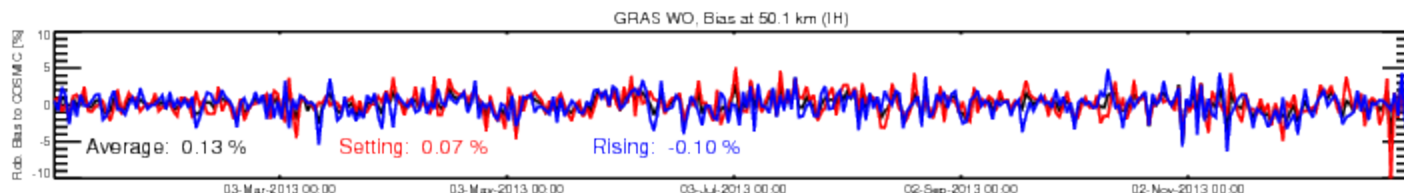
GeoOptics

WaveOptics

Fig: *Time-series of GRAS Geometrical Optics (**GeoOptics**) and GRAS **WaveOptics** biases and standard deviations at an impact height of about 50km vs. COSMIC reprocessed 2013 collocated data (300km/3h). The time-series are separated into setting and rising (year 2013, 300km/3h) witrh respect to their mean bias.*

Summary

Summary

- **Computer infrastructure has been procured, and will be expanded in 2016;**

- **Development or modification of several retrieval methods has been completed;**
  (MFG/MSG IR & WV re-calibration, WaveOptics for GRAS on Metop, SSM/T2)

- **Prototyping of several retrieval methods is ongoing;**
  (WaveOptics for CHAMP/COSMIC, Polar Winds, MFG/MSG winds)

- **Several reprocessing activities have been completed;**
  (ASCAT Level1, GRAS Radio Occultation using WaveOptics)

- **Reprocessing activities have started for some instruments;**
  (MFG/MSG re-calibration IR/WV, COSMIC/CHAMP RO using WaveOptics)

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Thank You