EUMETSAT Satellite Data Records for Reanalysis

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EUMETSAT

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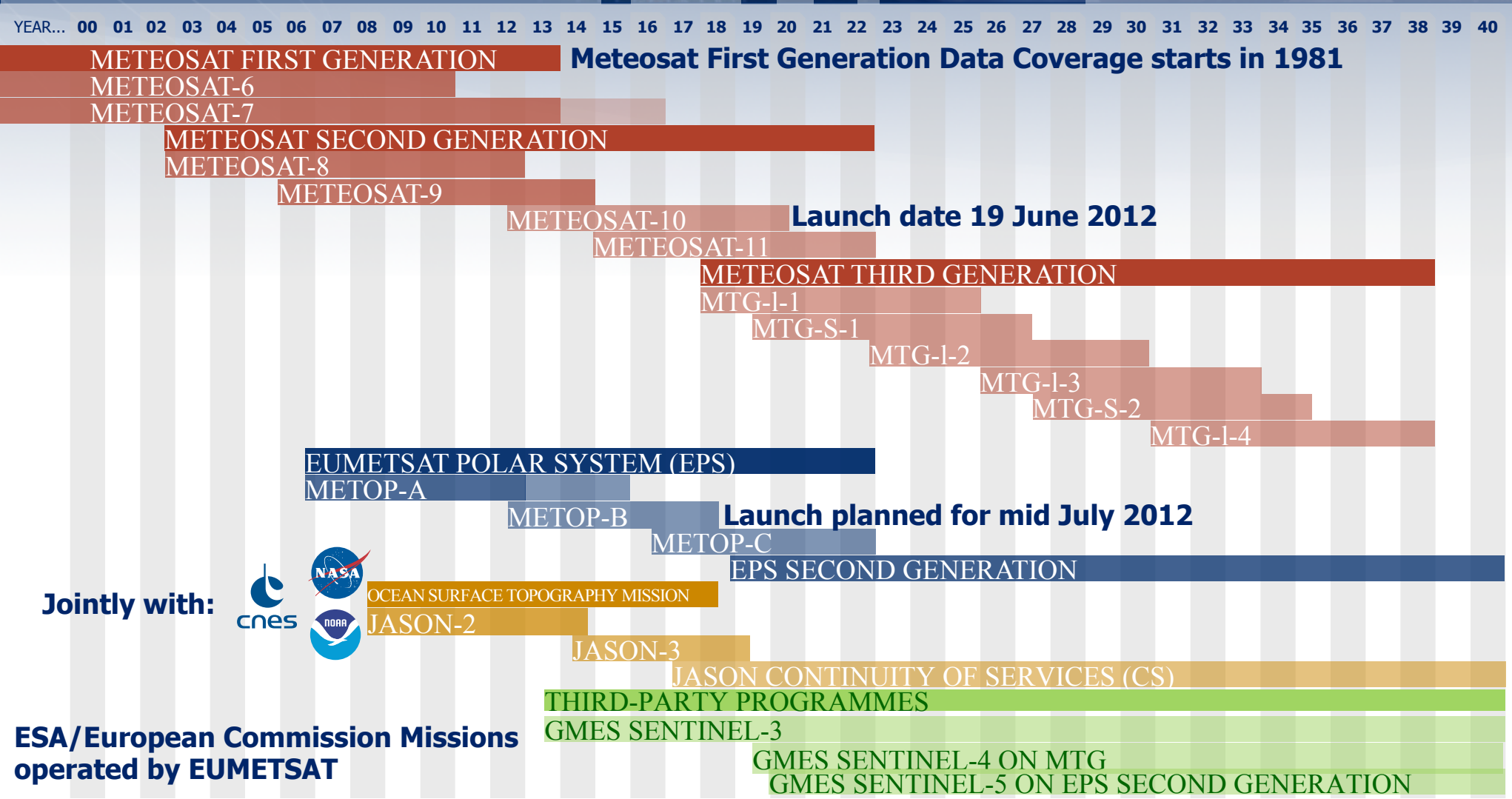
- EUMETSAT Space Segment and Mandate
- Data Record Generation Plan
- ERA-CLIM Records from EUMETSAT EPS System
- Towards a Geostationary Fundamental Climate Data Record
- Conclusions

EUMETSAT Space Segment



Historical Context – Products and Customers

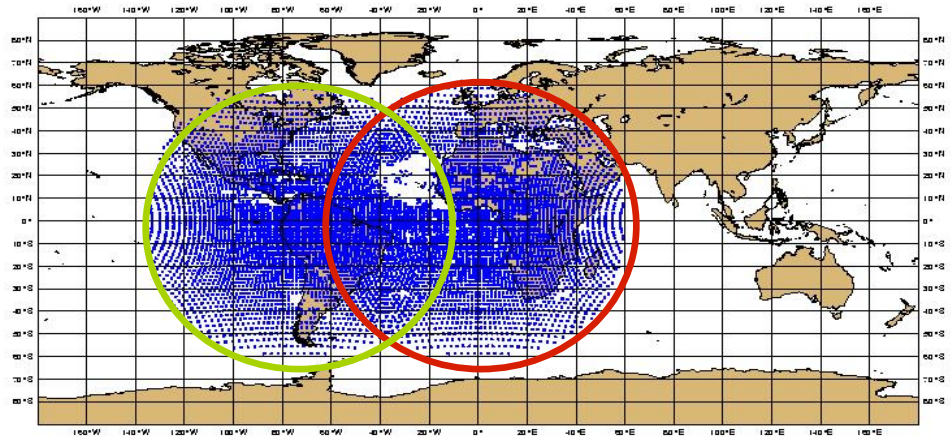
Reprocessing of long-term data of Meteosat Atmospheric Motion Vectors was an important contribution to Re-analyses at NWP Centers in particular ECMWF:

=> Substantially improved coverage and impact of re-processed winds from Meteosat satellites (C. Desol, ECMWF, 2008)

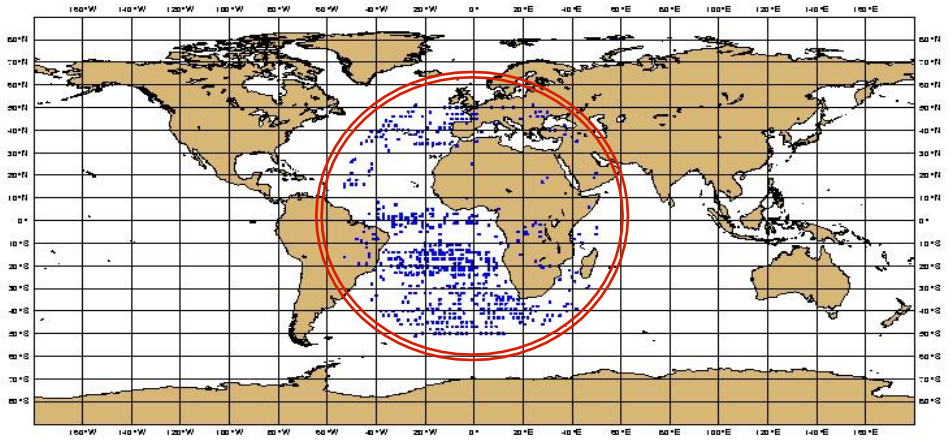
Period corresponds to time when Meteosat-5 was operational at 0º and Meteosat-3 supported NOAA because there was only one GOES satellite.

All activities were performed on best effort basis.

Example of coverage: 19950102



Reprocessed Met3 and Met5



Original Met5

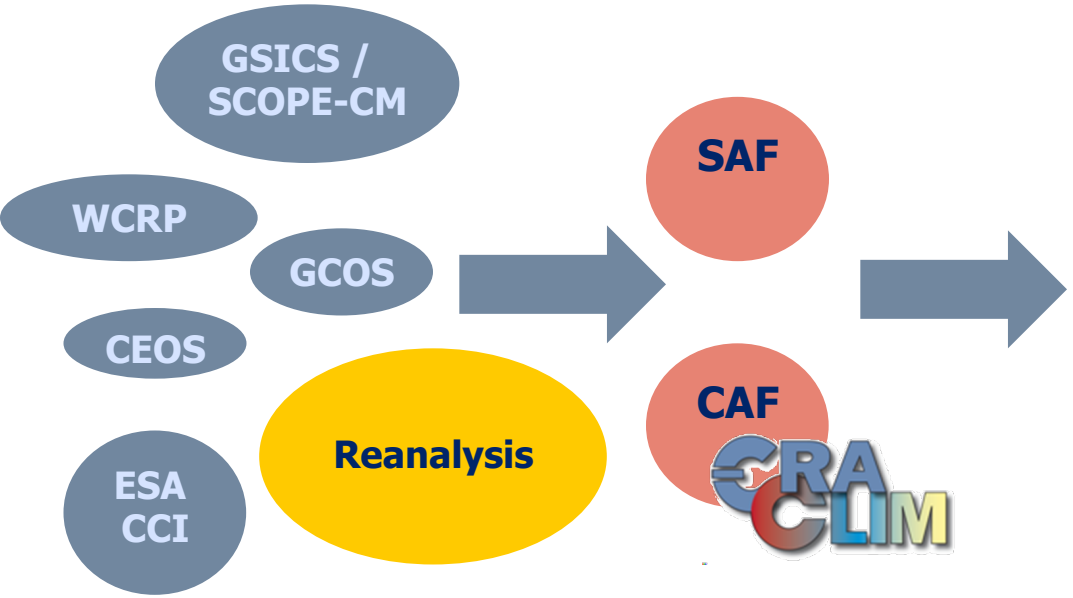
EUMETSAT's Climate Monitoring Implementation Plan

EUMETSAT Convention (November 2000):

Commitment to support Climate Monitoring and Climate Change Detection

Council Resolution (July 2009):

- Consideration of Climate requirements in programme preparation
- Generation of Climate Data Records (CDR) Fundamental and Thematic (FCDR+TCDR)
- Internal and external coordination and communication



Climate Monitoring Implementation Plan (July 2010)

- Description of tasks implementing the Council Resolution
- Instrument to coordinate and document related activities, and to monitor its progress (towards Delegate Bodies)
- Links to frameworks in which related (sub) tasks are implemented

Data Record Release Overview I

Identifier	Satellites/Instrument	Data Record	Coverage	Delivery
CAF-014	Met-8 and Met-9 / SEVIRI	Level 1.5	Meteosat 0° 2004 - 2008	Available
CAF-004	Metop-A / GOME-2	Level 1a and 1b	Global 2007 - 2011	Q2/2012
CAF-007	Met-7 / MVIRI	Surface Albedo	IODC 2006 - 2011	Q2/2012
CAF-008	Met-3 / MVIRI	Surface Albedo	ADC 1991 - 1993	Q2/2012
CAF-009	Met-3 / MVIRI	Surface Albedo	XADC 1993 - 1995	Q2/2012
CAF-012	Met-8 to Met-9 / SEVIRI	AMV, CSR and ASR	Meteosat 0° 2004 -2012	Q4/2012
CAF-005	Metop-A/ AVHRR	Polar AMV (Two algorithms)	Arctic and Antarctic	Q4/2012

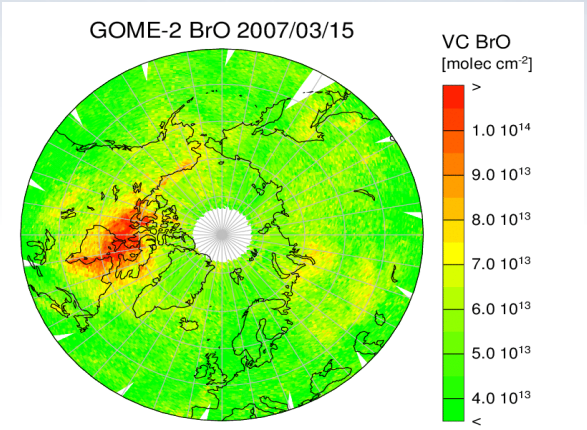
Poster: OB-7

Data Record Release Overview II

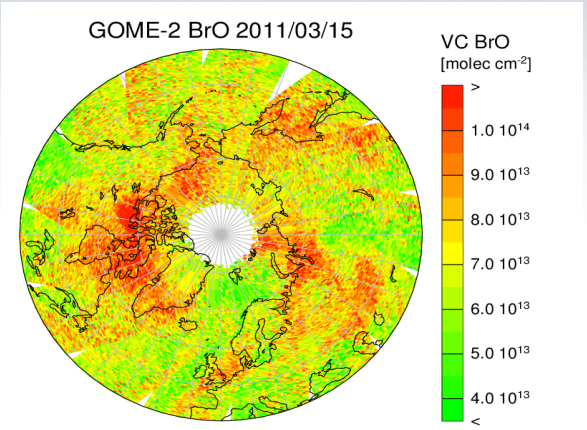
Identifier	Satellites/Instrument	Data Record	Coverage	Delivery
CAF-002	Metop-A / GRAS	Level 1B (Bending Angle)	Global 2007 - 2012	Q4/2012
CAF-016	COSMIC / IGOR	Level 1B (Bending Angle)	Global 2006 – 2012	Q4/2012
CAF-017	CHAMP / BLACKJACK	Level 1B (Bending Angle)	Global 2001 - 2008	Q2/2013
CAF-018	GRACE / BLACKJACK	Level 1B (Bending Angle)	Global 2005 - 2012	Q2/2013
CAF-010	Met-2 to Met-9 / MVIRI and SEVIRI	IR and WV Radiances (referenced to IASI and HIRS)	Meteosat 0° IODC	Q3/2013 (will be released piecewise)
CAF-015	Met-2 to Met-7 / MVIRI	AMV, CSR and ASR	Meteosat 0°, IODC 1982 -2011	Q4/2013
CAF-019	Metop-A / GOME-2, IASI, AVHRR	Ozone (total and profile)	Global 2007 -2012	Q4/2013
CAF-003	Metop-A / ASCAT	ASCAT Level 1b Soil moisture Level 2	Global 2007 - 2012	Q4/2013
CAF-001	Metop-A / IASI	Level 1c	Global 2007 - 2012	Q4 2013

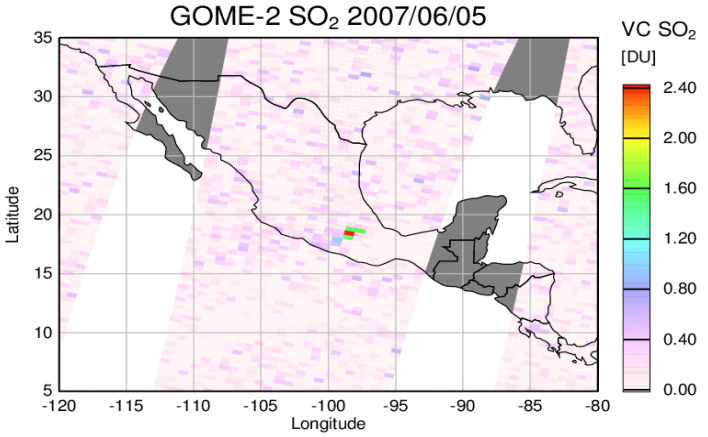
Motivation of GOME-2 Reprocessing

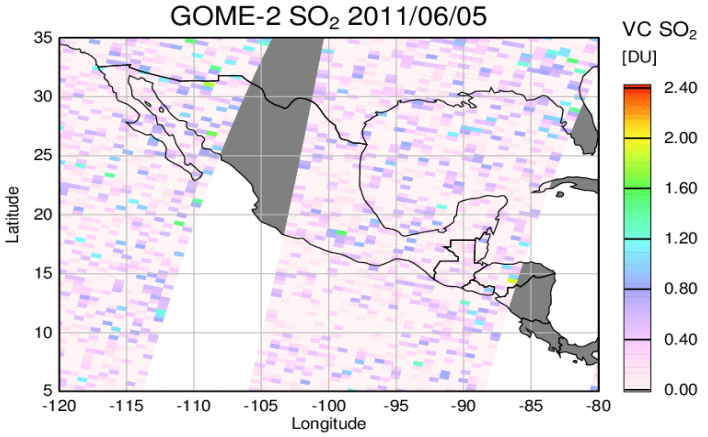
At beginning of mission



After 4 years of operation





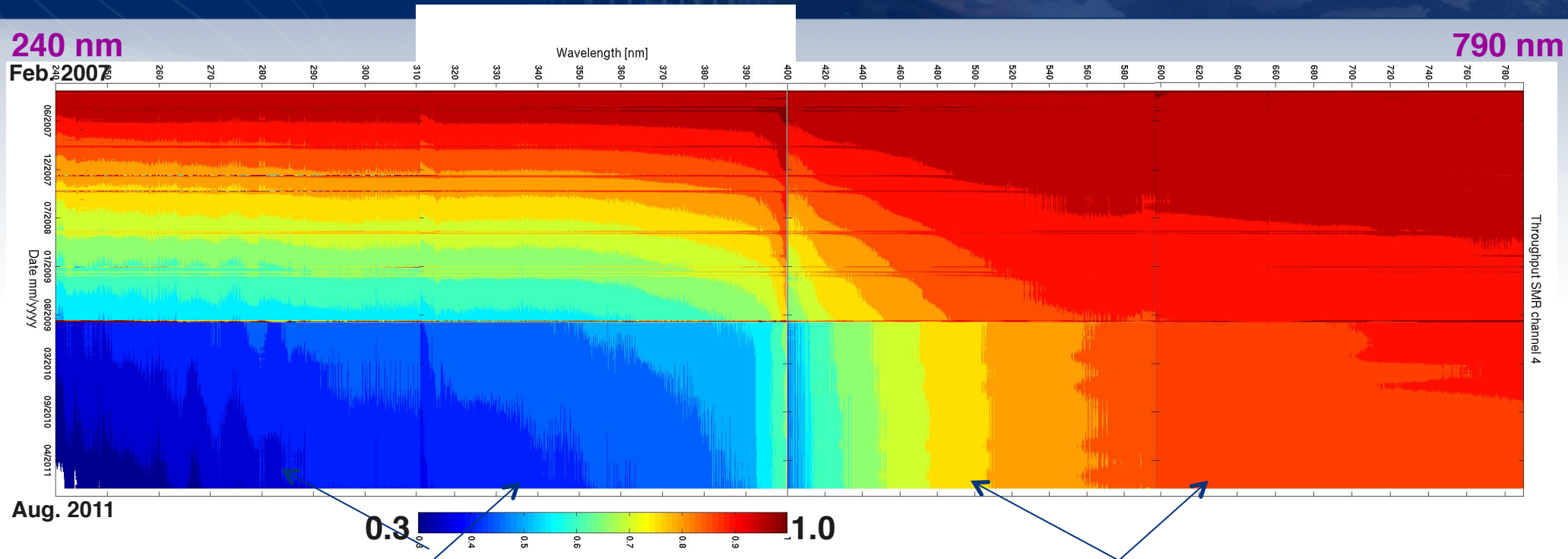


GOME-2 Long-term throughput changes

Solar Mean Reference (SMR) spectrum

240 nm

790 nm



Slow onset of degradation observed after 2nd throughput test in channel 1 and 2.

Instrument is stable now in channel 3 and 4.

Reprocessed signals R2 PPF 5.2 until August 2011 relative to February 2007

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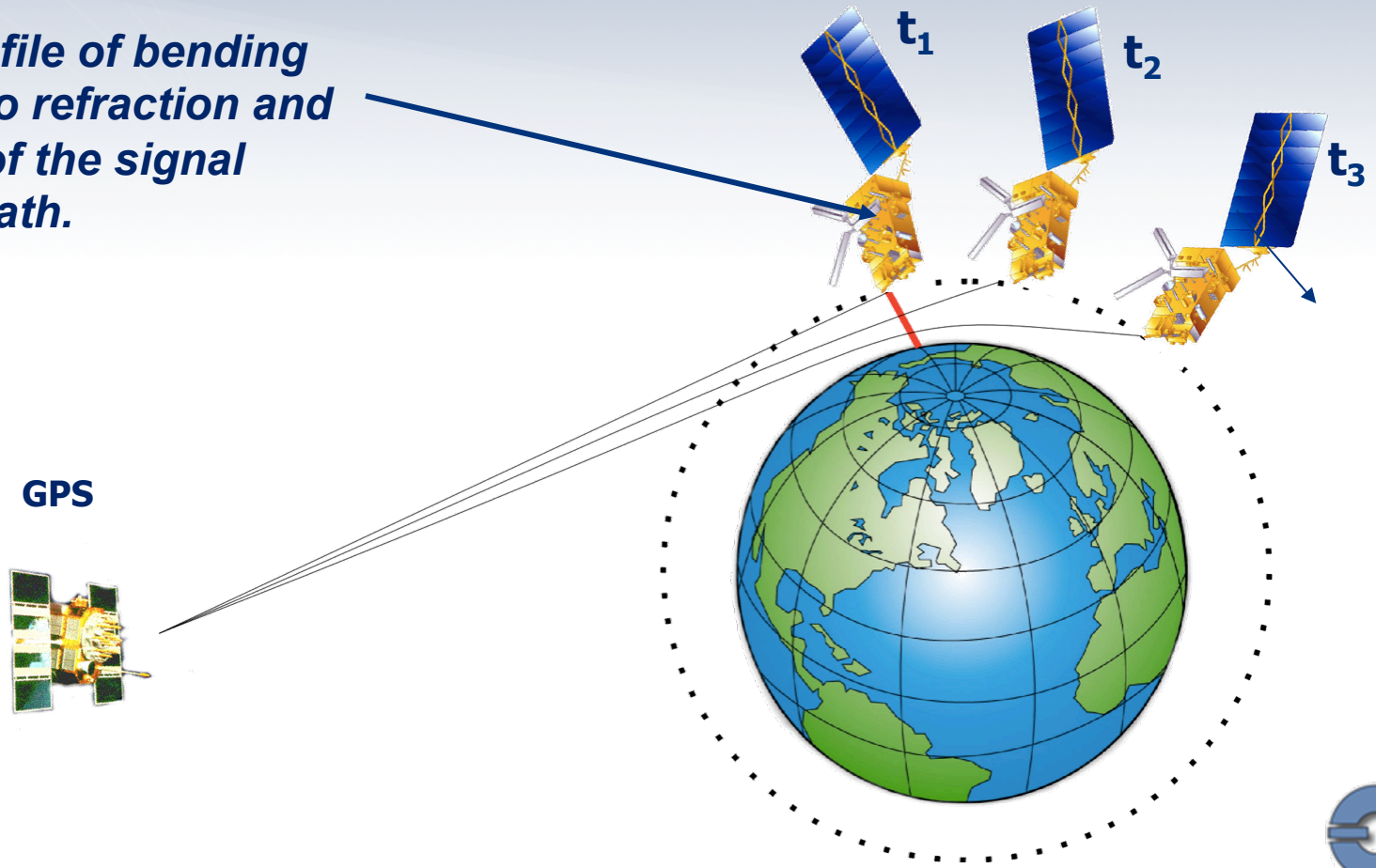
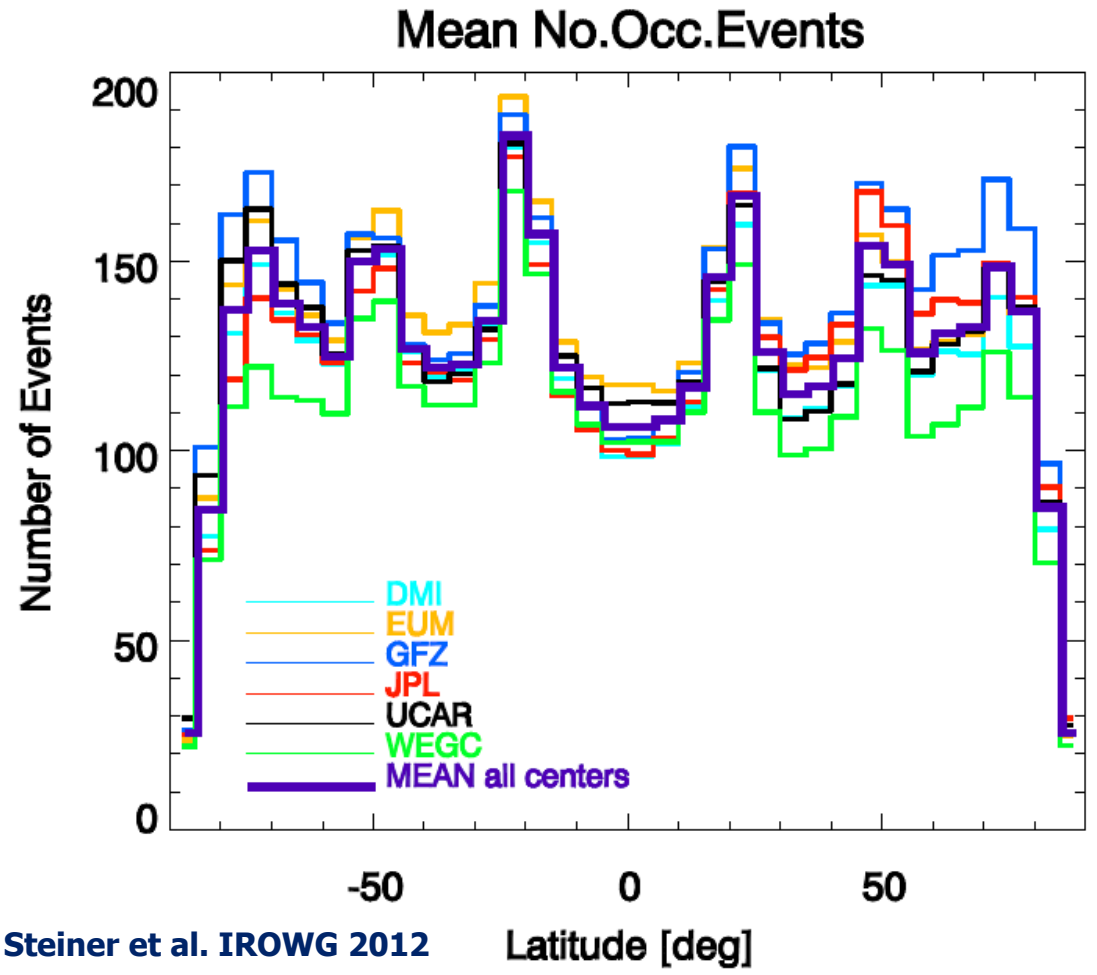
Atmospheric Profiling by Radio Occultation (RO)

Vertical profile of bending angle due to refraction and extinction of the signal along the path.



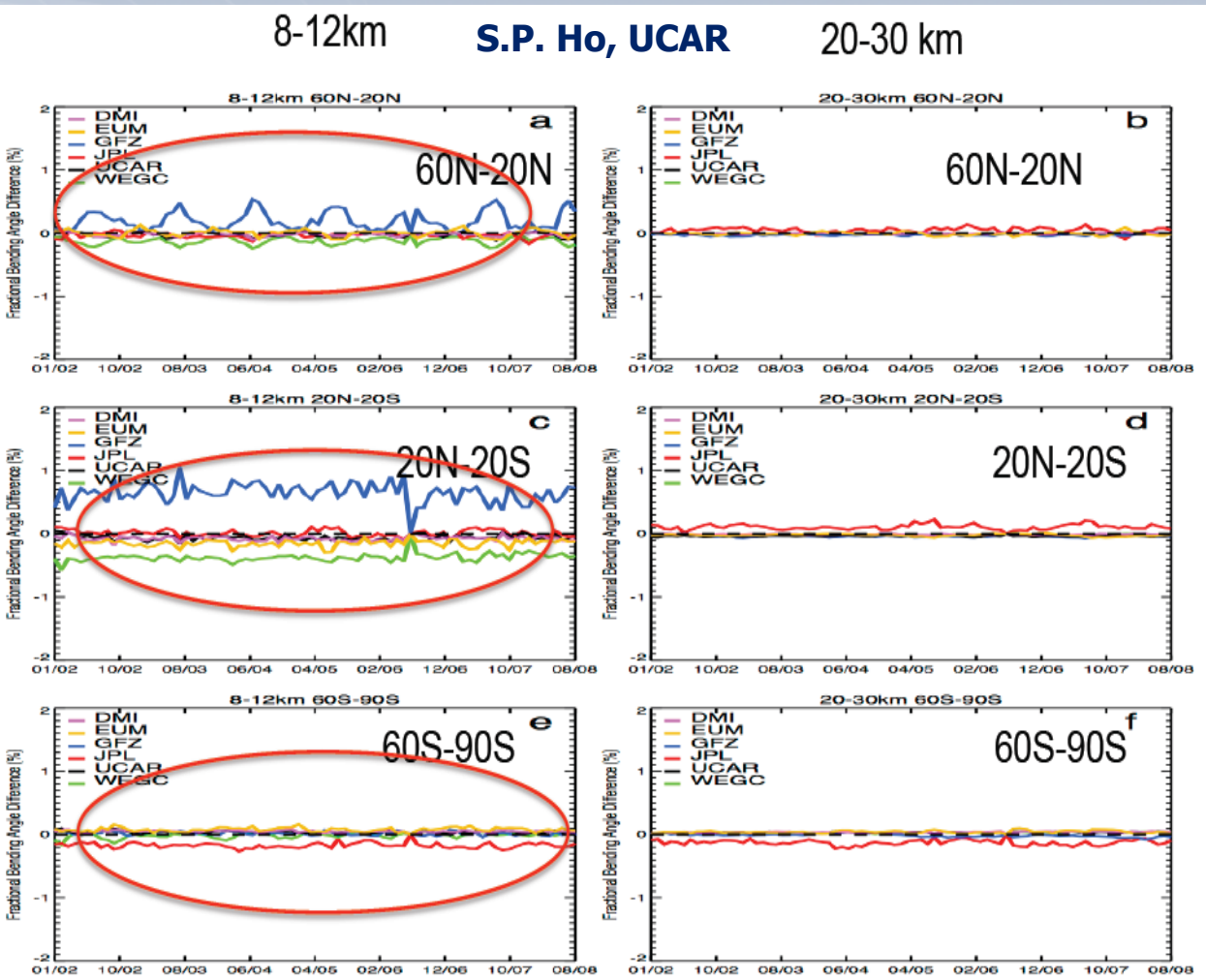
Successfully Processed Occultations



A.K. Steiner et al. IROWG 2012

- Number of occultations per 5 deg latitude bin in 8 year CHAMP reprocessing comparison (09/2001 – 09/2008); “ROTrends”);
- All retrievals based on identical Level 0 data;
- Numbers depend on QC, but also on processing glitches at various centres.
- Stricter QC / less profiles does not necessarily mean better quality data.

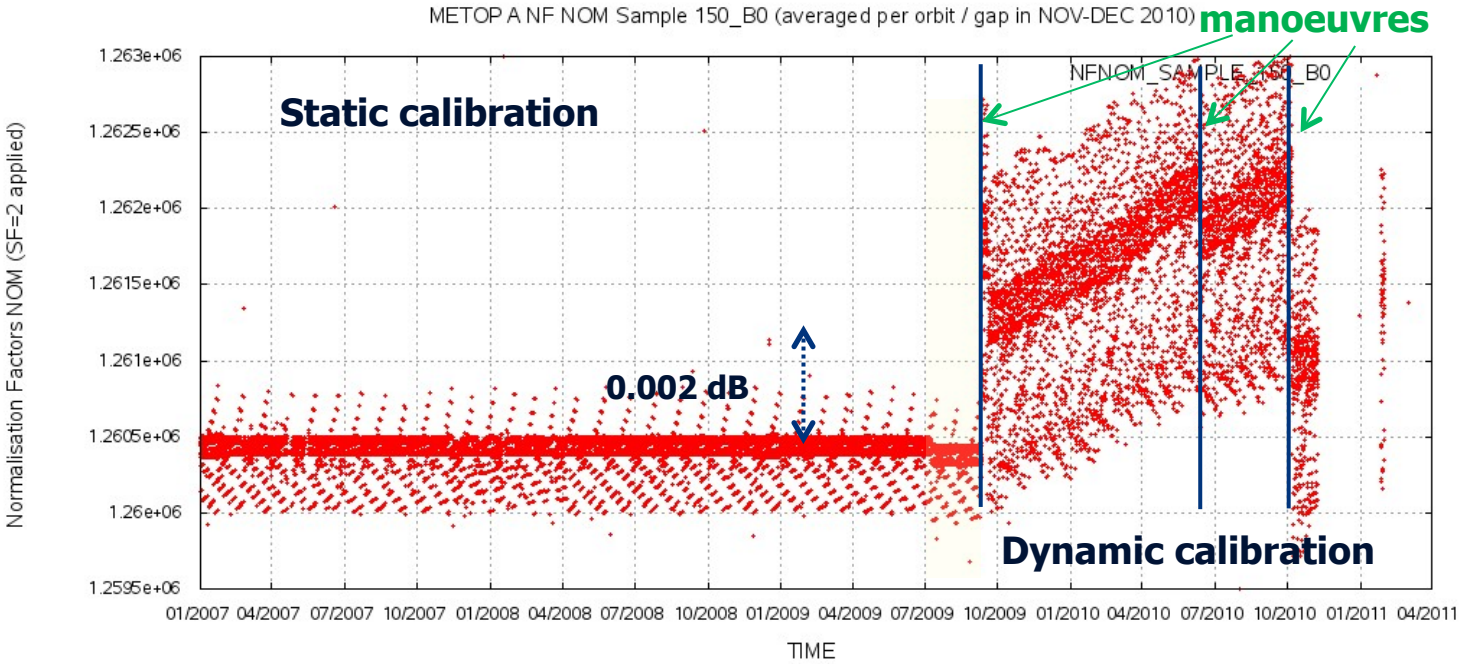
Bending Angle Consistency



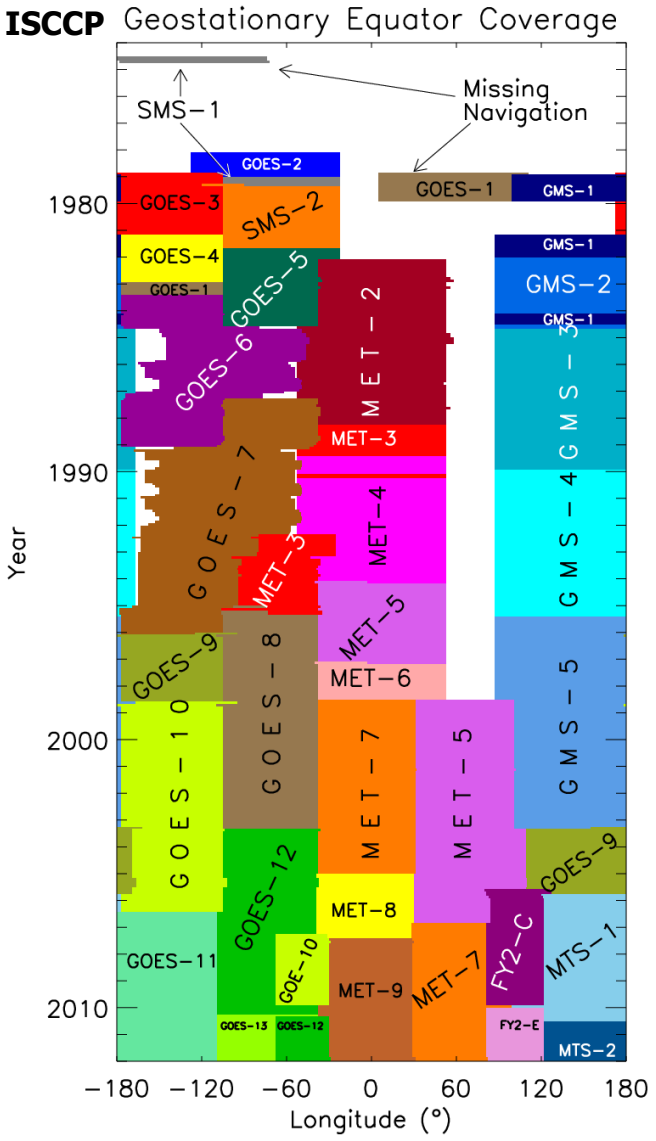
- Time series of relative bending angle anomalies from global inter-centre mean in 8 year CHAMP reprocessing comparison (09/2001 – 09/2008); "ROTrends");
- All retrievals based on identical Level 0 data;
- Excellent agreement in lower stratosphere (20 – 30km), but larger deviations below and above (due to differences in processing; upper level deviations not shown).

ASCAT L1b Data Record to Date

- Reprocessed Sigma 0 data 2007 – 2008, EC_2007 (*); objective of assessing instrument performance stability
- Operational Sigma 0 data 2009 Jan – Sept, EC_2007
- After September 2009, major changes in processing configuration and instrument calibration:
  - Operational data 2009 Sept – Aug 2011, EC_2007, dynamic calibration, non-frozen eccentricity orbit, Mid Left Beam calibration change;
  - August 2011 – today, EC_2010.



FCDR Creation - Scale of the Challenge



- International community has embarked on the creation of FCDRs for archived data (EUMETSAT, NOAA-CDR program and similar programs);
- Inter-calibration of the sensors to allow seamless products is a weakness in existing data records, e.g., GEWEX data projects and CSR products for reanalysis;
- We started to inter-calibrate the Meteosat IR and WV and quantifying the uncertainties using IASI as reference;
- Space agencies work in GSICS and SCOPE-CM frameworks to achieve the inter-calibration for the whole tapestry.

Figure: Courtesy of Ken Knapp, NOAA-NCDC

Scale of the Challenge

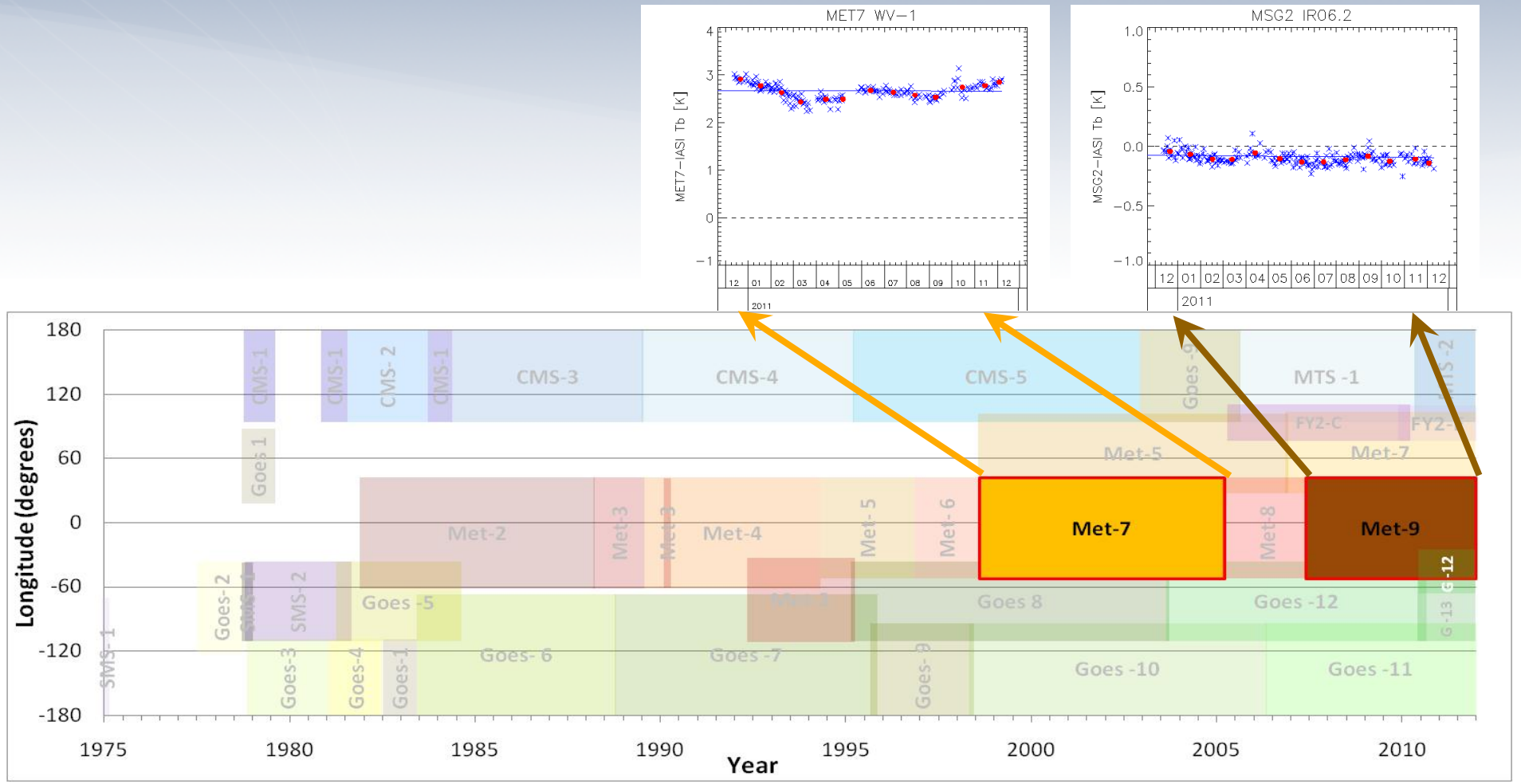
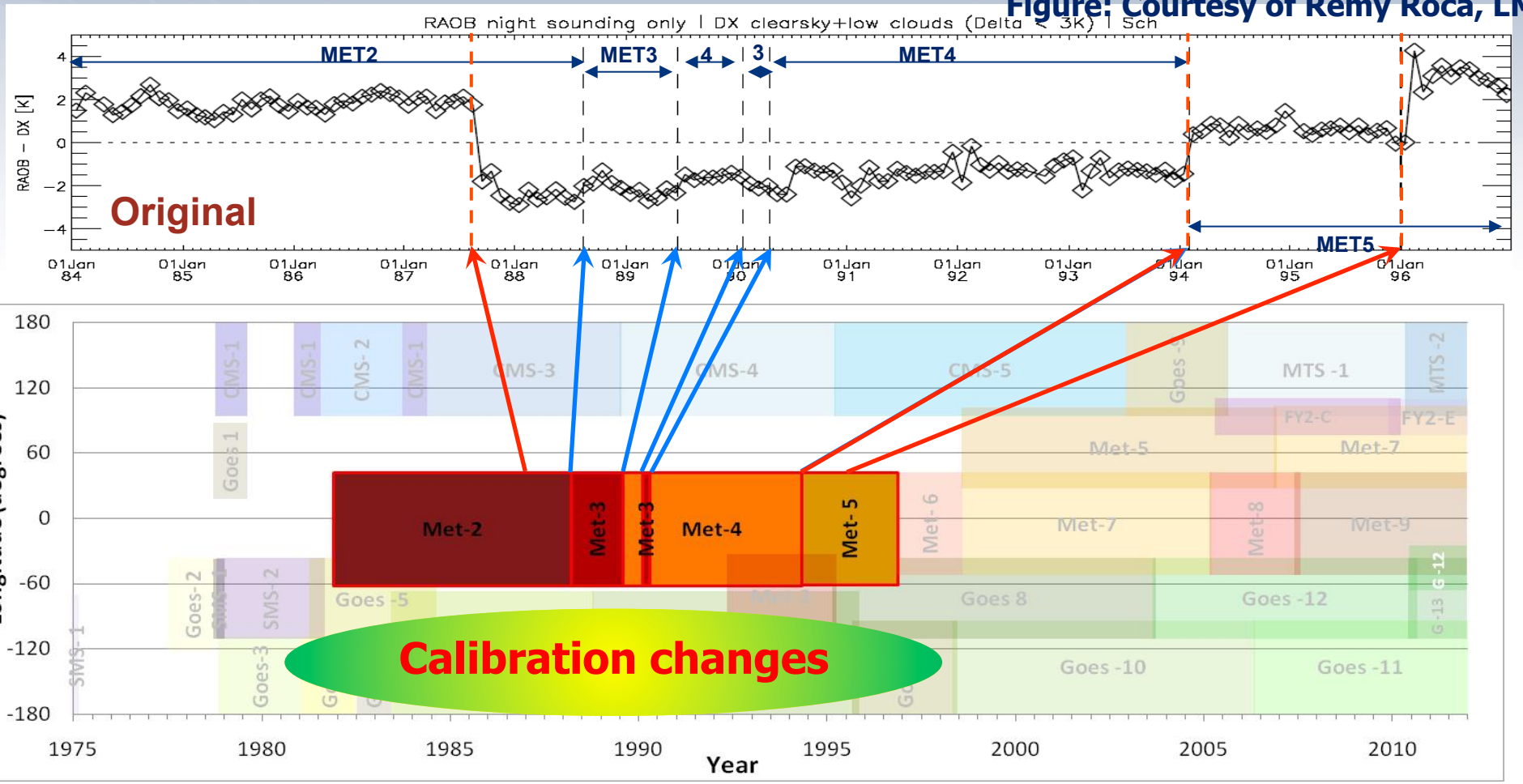


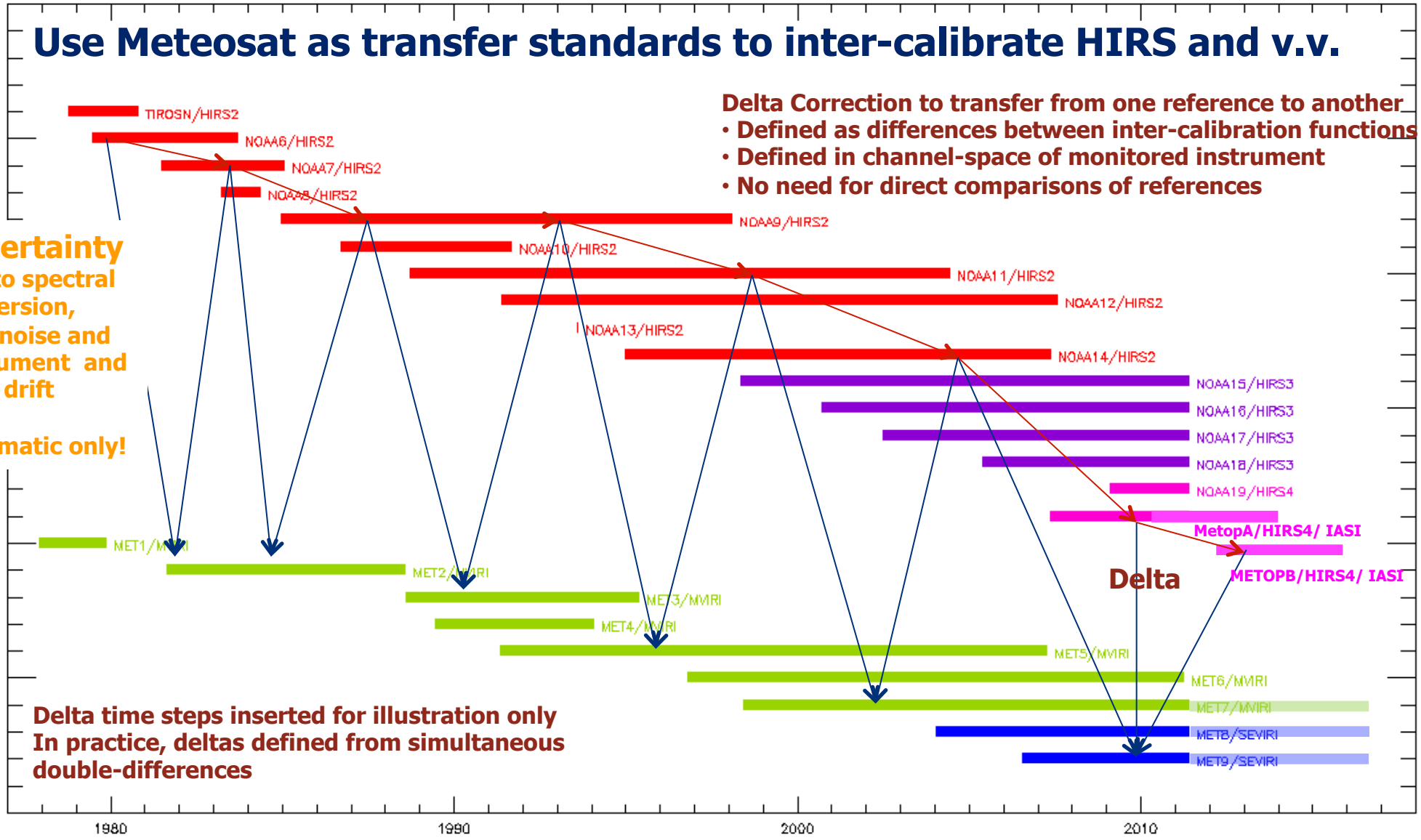
Fig: *Satellites used for the ISCCP climate data record. (Courtesy of Ken Knapp, NOAA-NCDC)*

Scale of the Challenge

Figure: Courtesy of Rémy Roca, LMD



The Zipper Model of Transferring References



Uncertainties due to Spectral Conversion for Each Class of Instrument: WV

Monitored→ Reference ↓	HIRS/2 NOAA6-14	HIRS/3 NOAA15-17	HIRS/4 NOAA18-MetopB	MVIRI Meteosat 2-3	MVIRI Meteosat 4-7	SEVIRI Meteosat 8-11
HIRS/2 NOAA6-14	0.04	1.03	1.07	0.07	0.16	0.41
HIRS/3 NOAA15-17	0.78	0.05	0.06	X	0.67	0.51
HIRS/4 NOAA18-MetopB	0.84	0.06	0.03	X	0.74	0.57

Mean RMSD Tb [K] of Spectral Conversion Functions for each class of instrument: WV

Also need to:

- Estimate Calibration Transfer Uncertainty (e.g. by SNO)
- Estimate drift in reference transfer standards

Conclusion

- EUMETSAT provides long term continuity of space observations – A key for the generation of Climate Data Records and Reanalysis input.
- EUMETSAT generates data records from own and third party missions utilising its Central and Satellite Application Facilities that shall benefit reanalysis activities;
- The ERA-CLIM project has helped to speed up activities at EUMETSAT;
- Activities towards referencing Meteosat IR and WV channels to IASI/HIRS are underway using a traceable chain of inter-calibrations. Further analysis of uncertainties is needed – The ERA-CLIM feedback archive will play a major role in this as well.
- The EUMETSAT SAF network has committed more work on CDRs in their CDOP-2 project phase (2012-2017), e.g., microwave humidity (183 GHz) FCDR, new versions of sea ice concentration and other atmospheric, oceanic and land data records.