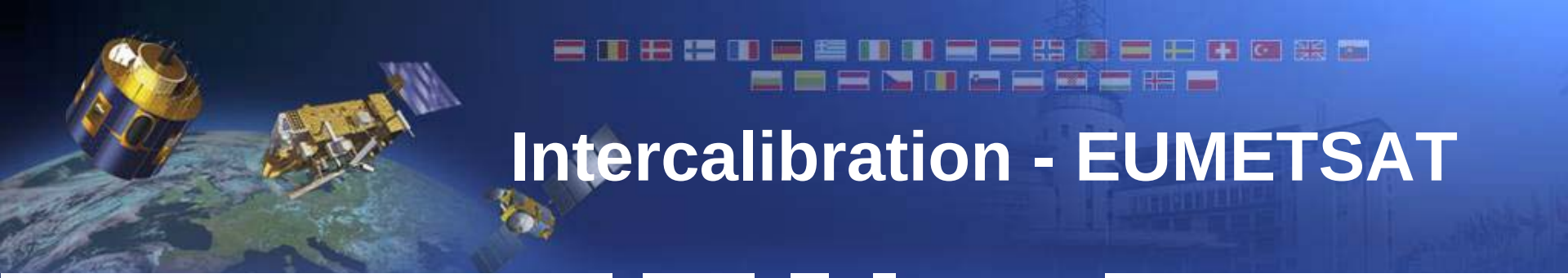

Intercalibration - EUMETSAT

Marianne König

GSICS, 22-23 January 2007

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Background

CGMS XXV (1997): CGMS members to collect datasets with overlap between polar orbiter sensors (HIRS/AVHRR) and geostationary imagery, process inter-calibration with own algorithm

Cross-calibration of Meteosat-5 and Meteosat-6 against Meteosat-7

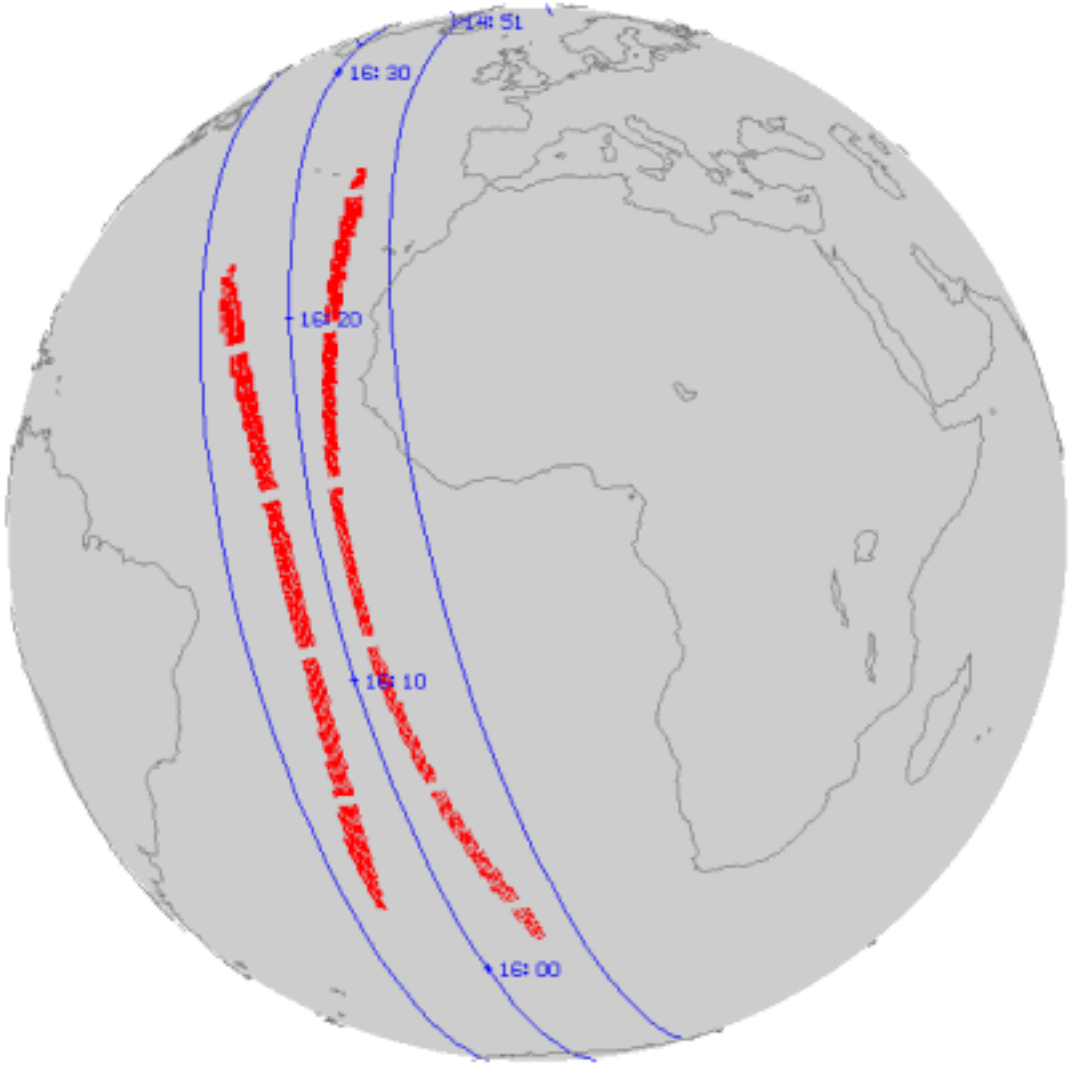
EUMETSAT Algorithm

- Time difference between satellite measurements less than 15 minutes ✓
- Spatial co-location: Agreement of viewing a… within 5 degrees, absolute viewing a… within 50 degrees
- Correction for differences in … function

Examples will follow

- All pixels that fulfil these conditions are processed, irrespective of scene type

Examples HIRS - Meteosat



HIRS track within the Meteosat-7 FOV:

Valid calibration targets are shown in red

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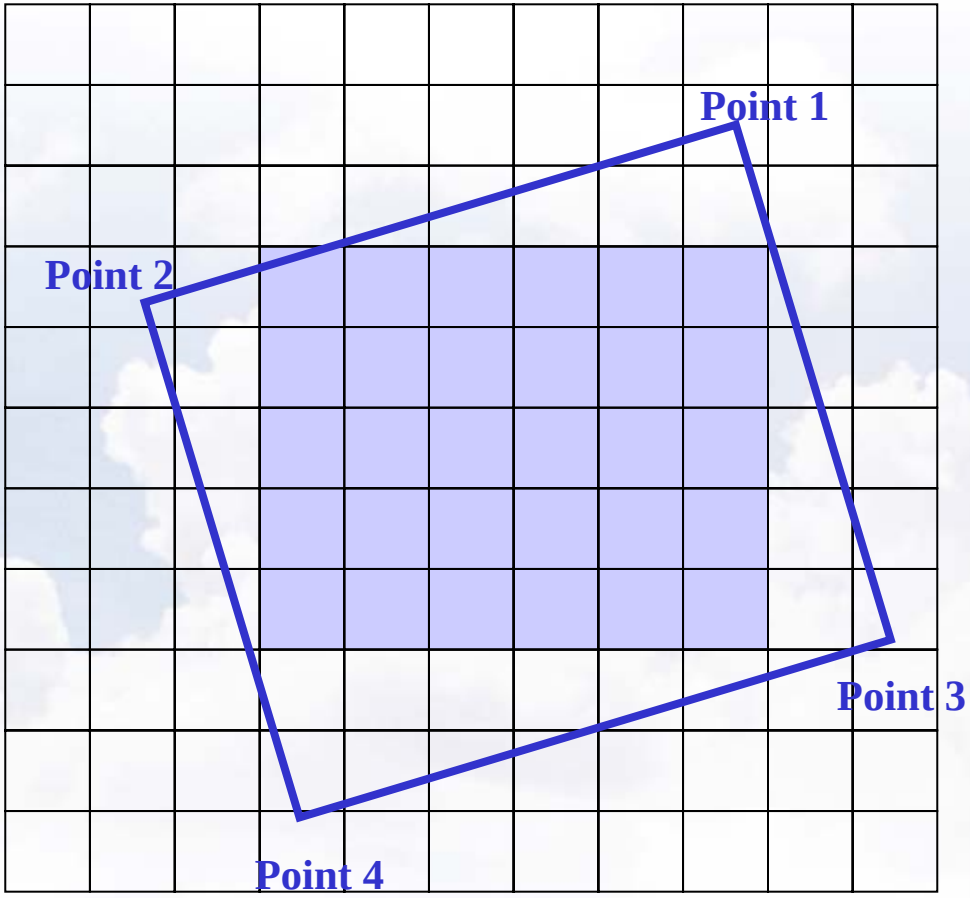
HIRS – Meteosat Pixel Comparison



Black: Meteosat Pixels

Blue: HIRS Pixel

4 corner points of HIRS pixel within Meteosat grid

Innermost area defined by these 4 corner coordinates is averaged for comparison

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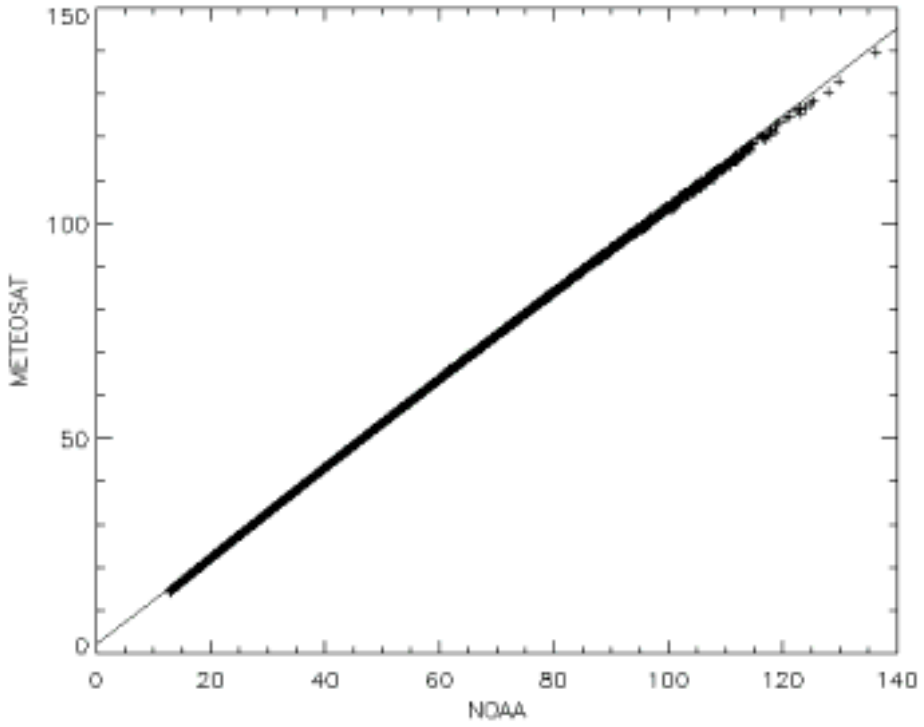
Correction for Filter Function

Radiation model simulations on TIGR database of atmospheric profiles, with inclusion of clouds at various levels:

Gives set of Meteosat / MSG / HIRS radiances

Radiation model: RTTOV-8.5

Correction for Filter Function



Linear relationship is found between radiances of similar channels – independent of viewing angle!

Example: Metosat-7 IR channels, HIRS channel 8 onboard NOAA-17

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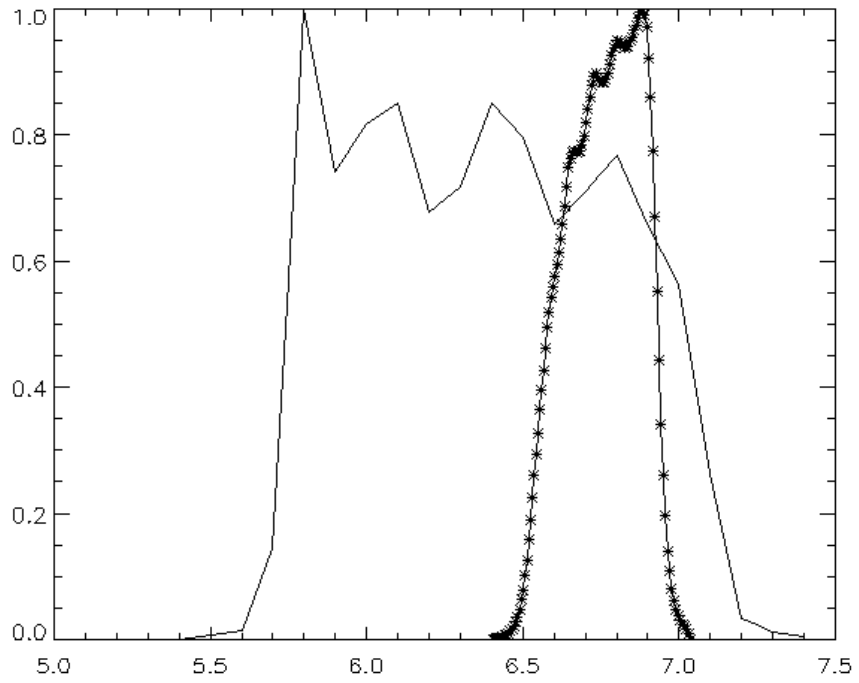
Correction for Filter Function



The correction for filter function has its limitations on channels with less similar filters …

Example: Metosat-7 WV channels, HIRS channel 12 onboard NOAA-17

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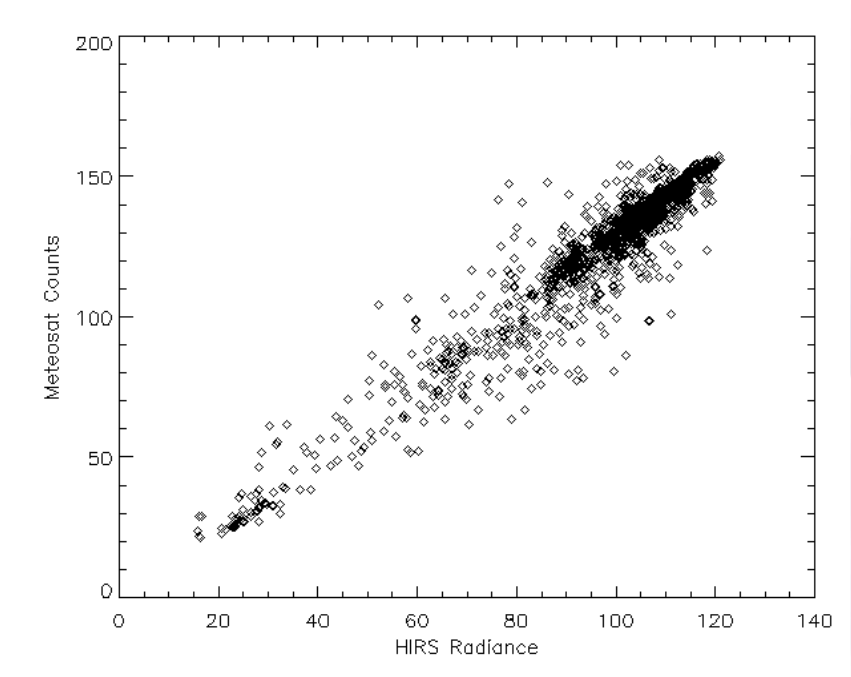
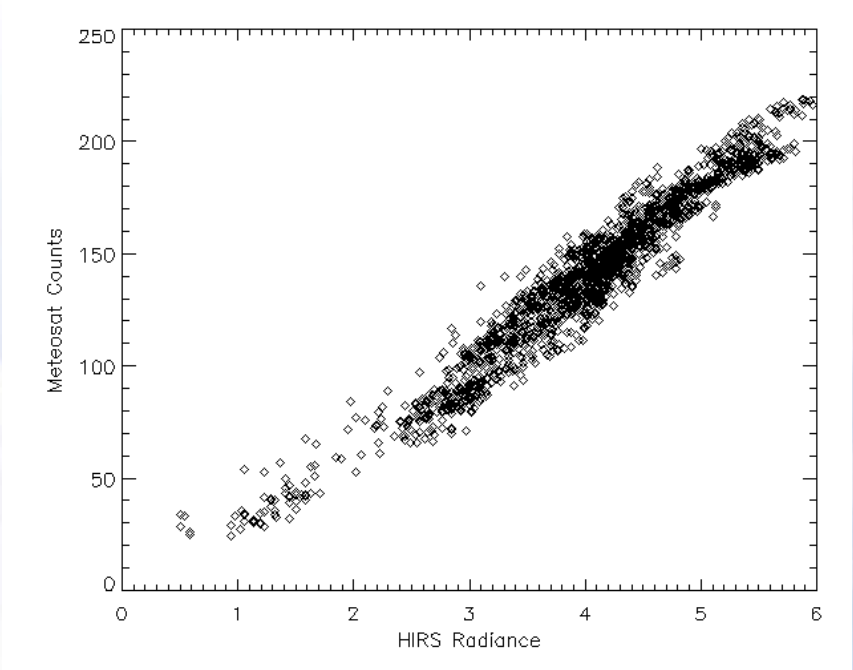
Example of one Intercalibration Instant



IR Window Channel



WV Channel

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Meteosat Calibration Background

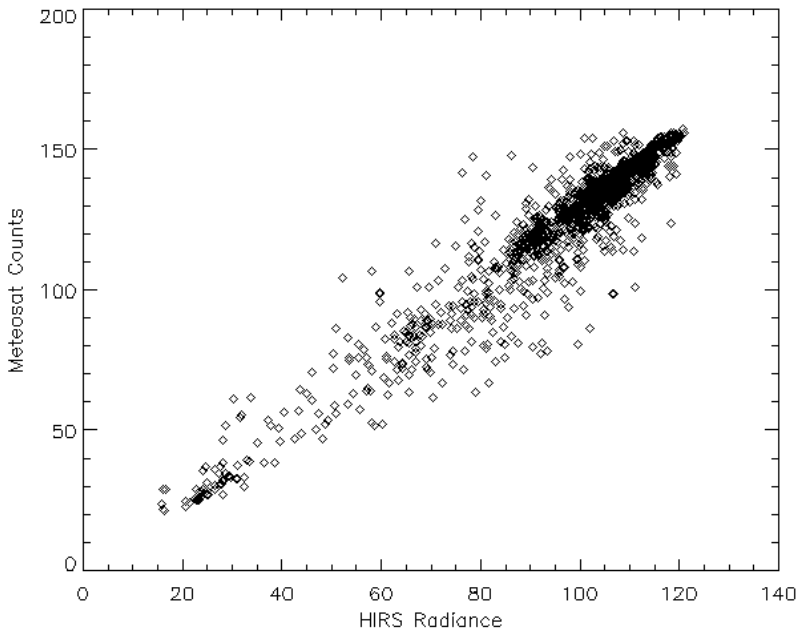
The Meteosat satellites measure the radiance in terms of engineering units which are usually called "counts".

The relation between counts and radiances in physical units is linear (both first and second generation):

$$R = a(C - SC)$$

R: radiance
A: calibration coefficient
C: measured count (“raw” value)
SC: radiometric offset (referred to as "space count")

Application to our Data



The calibration coefficient is the slope of the linear regression curve – the uncertainty of this regression results in an uncertainty of the calibration coefficient.

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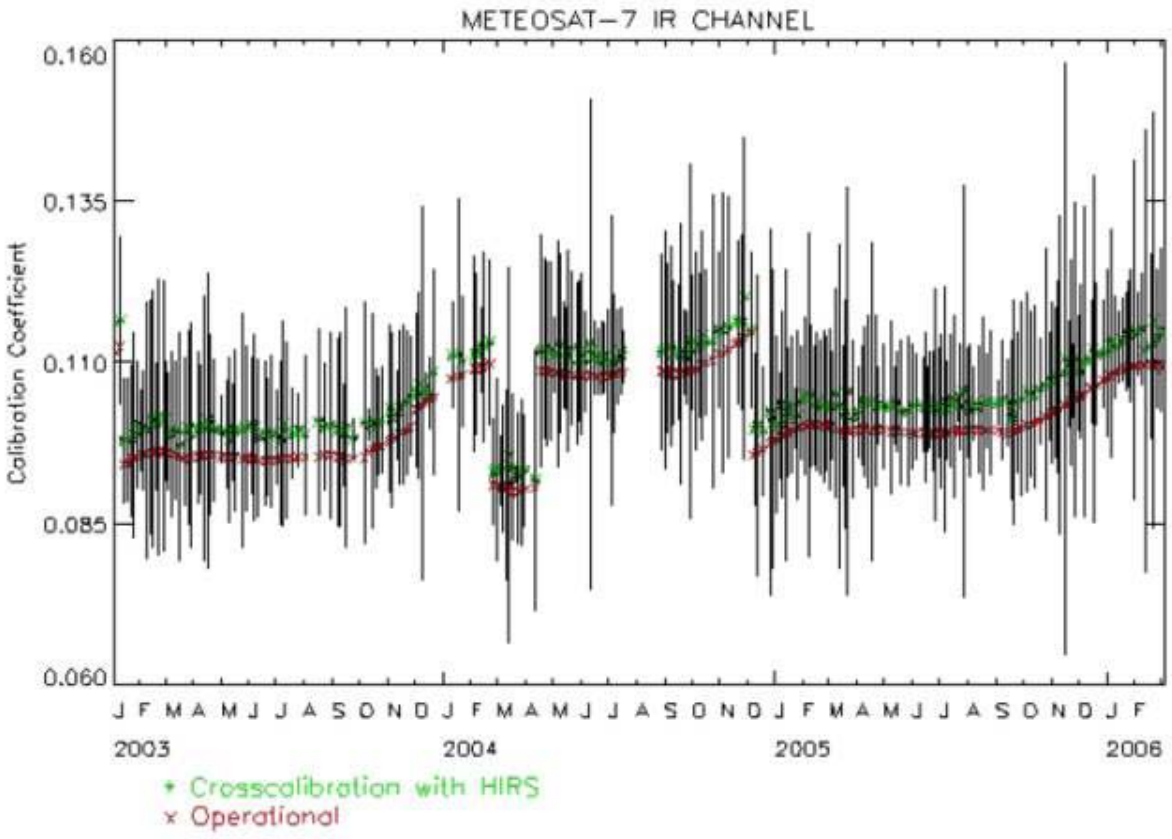
Time Series of a, Including Error Bars



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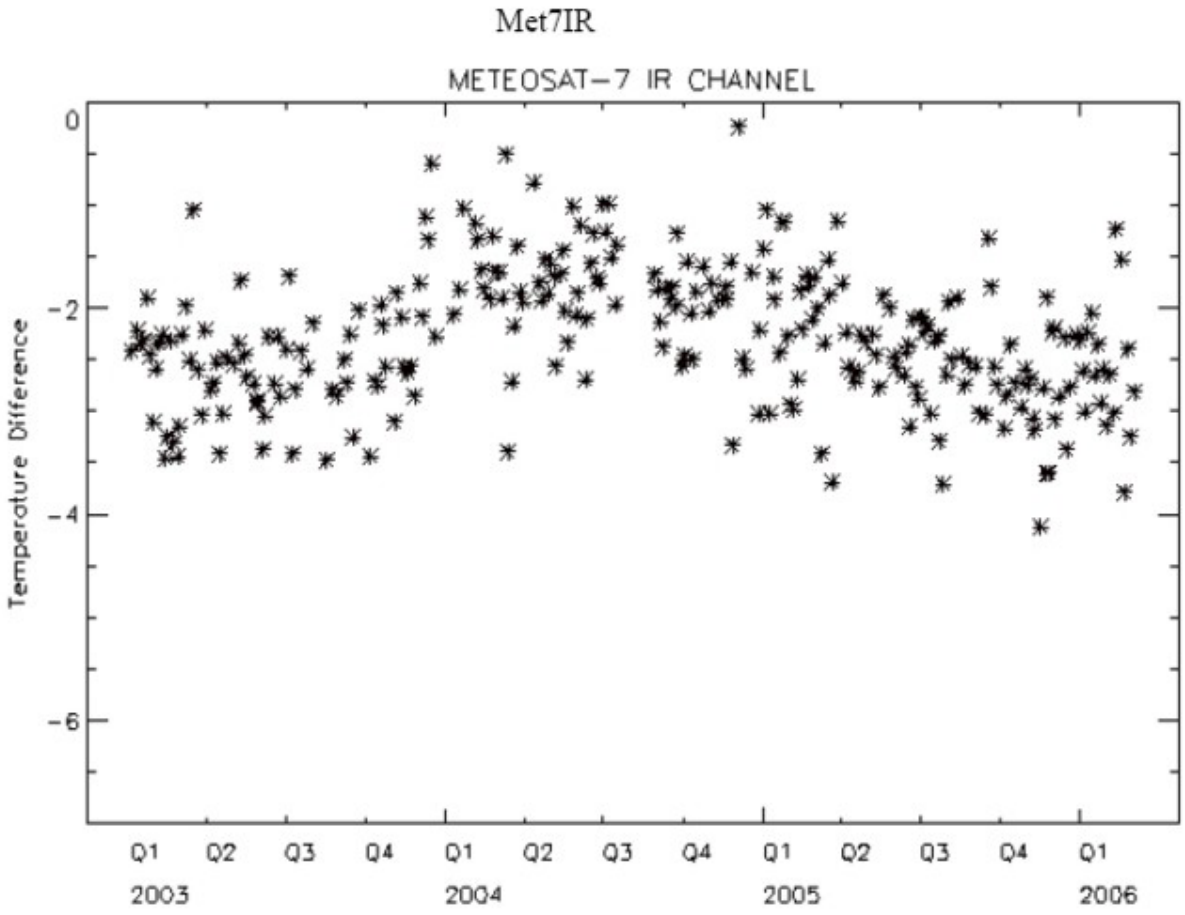
Translation into a Temperature Difference



IR:

Differences refer to temperature of 280K

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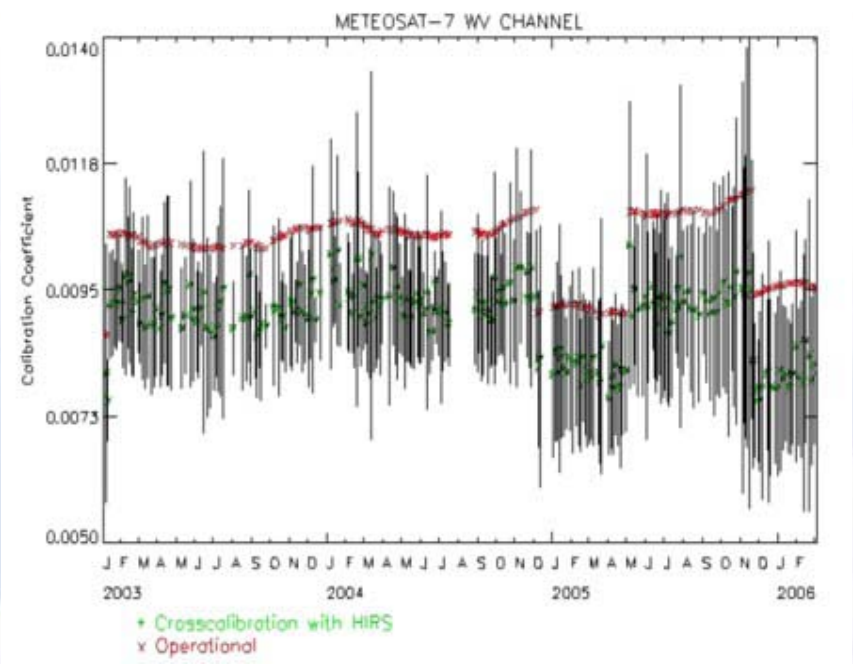
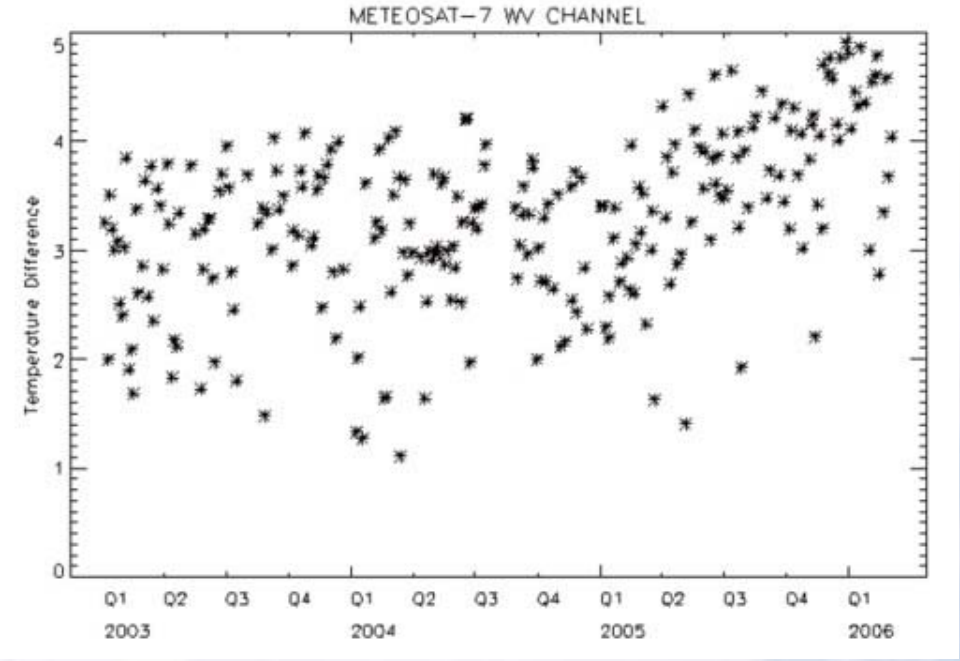
And for the WV Channel …





Calibration coefficient with error bars

Associated temperature difference at 240K

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Operational Activities

The described process is operationally applied at EUMETSAT for Meteosat-5 and Meteosat-7 (against HIRS/NOAA-16 and NOAA-17), since 2001. Results can be found on the EUMETSAT web site. Cross-calibration runs are done 1-2 times per week.

And MSG?

A similar algorithm is applicable to MSG – except for Channel IR8.7 (no similar channel on HIRS)

Filter correction functions are available for both MSG-1 and MSG-2, against NOAA-17.

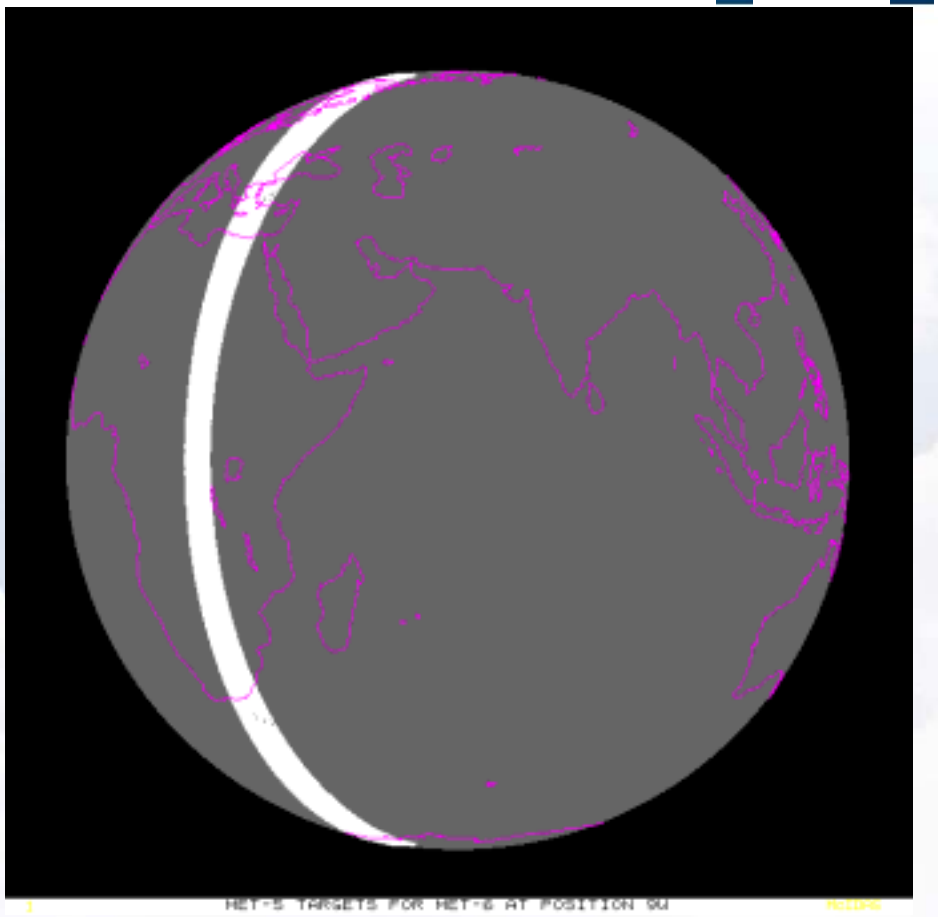
No operational results yet in terms of time series.

Cross-Calibration of the Meteosats

- The same procedure is also applied to inter-calibration the Meteosat First Generation satellites.
- The reasoning behind this is that only Meteosat-7 has a working on-board blackbody calibration, so that the calibration of Meteosat-7 is then transferred to Meteosat-5 and Meteosat-6*

*Meteosat-6 in addition has a radiometric anomaly which causes radiance jumps in entire image blocks – so here cross-calibration is used as an image correction tool and is absolutely necessary

Meteosat Overlap Area (Within 5 Deg)



Meteosat-5 and Meteosat-7
(63 E and 0)

Meteosat-6 and Meteosat-7
10 E and 0)

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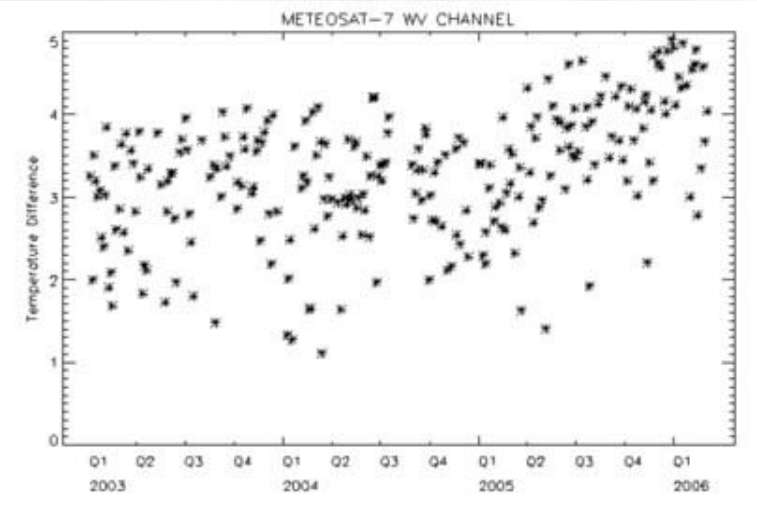
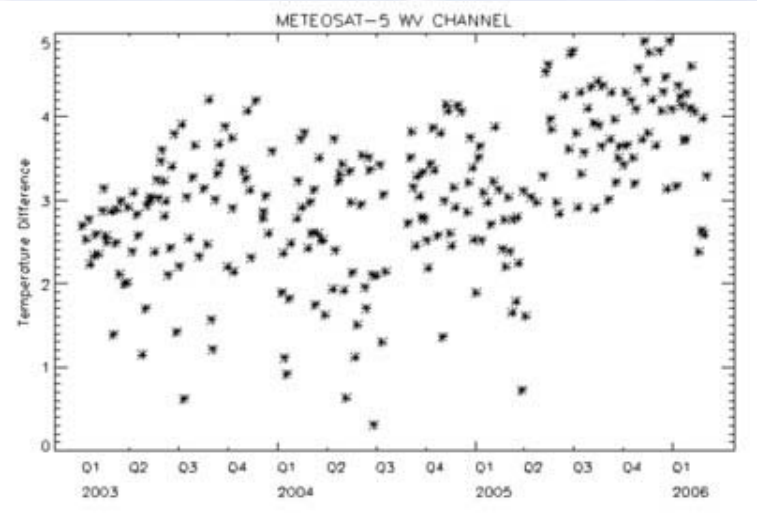
Meteosat-5 and Meteosat-7 Against HIRS …

This inter-calibration of the Meteosats in turn implies that the Meteosats have very similar behaviour when compared to HIRS:





Temperature Differences for WV: Meteosat-7 (left) and Meteosat-5 (right)

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Areas of Improvement

Co-location Procedure:

Effects of geo-location errors

Effects of pixel remapping

Effects of viewing angle

Effects of parallax

Radiometric correction (filter):

Effect of scene type

Filter uncertainties

(could also be studied with IASI)

The End

Thank you

Merci

Dankeschön

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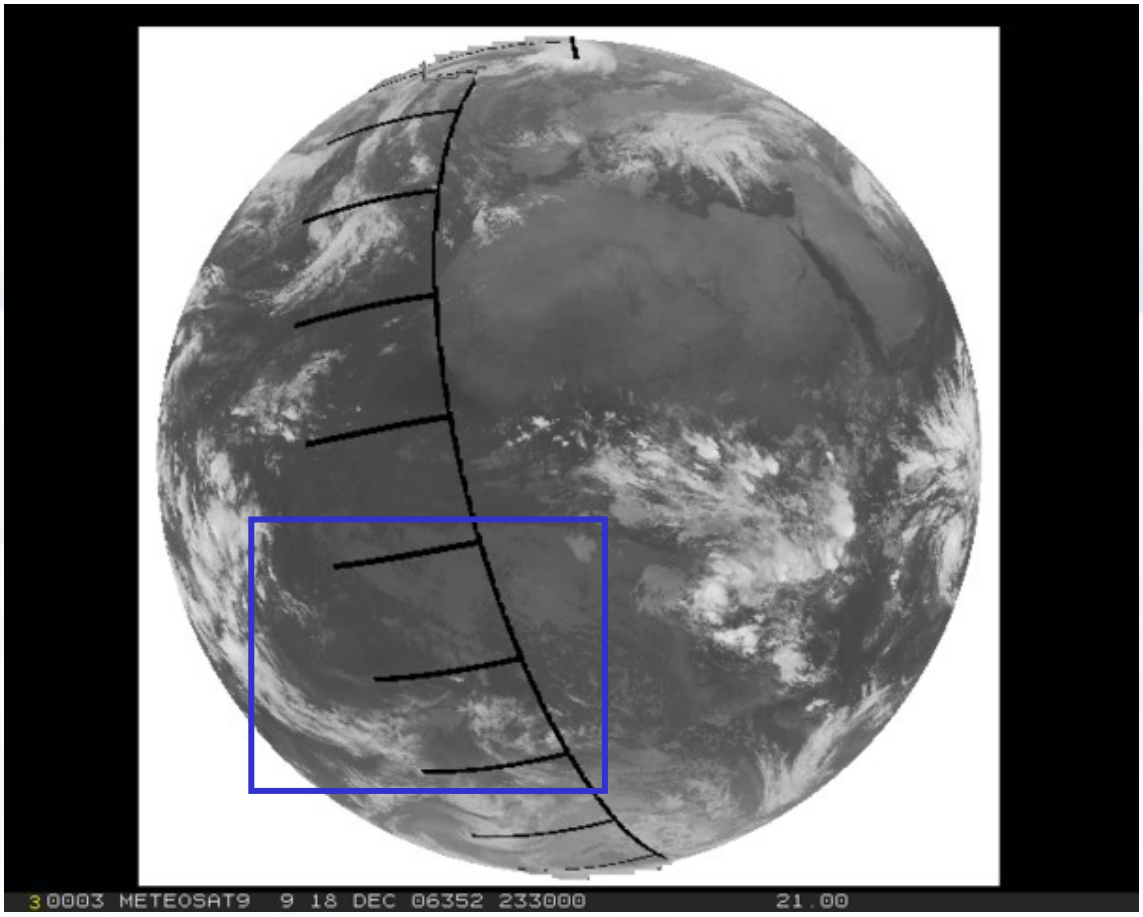
Example: HIRS Data and MSG



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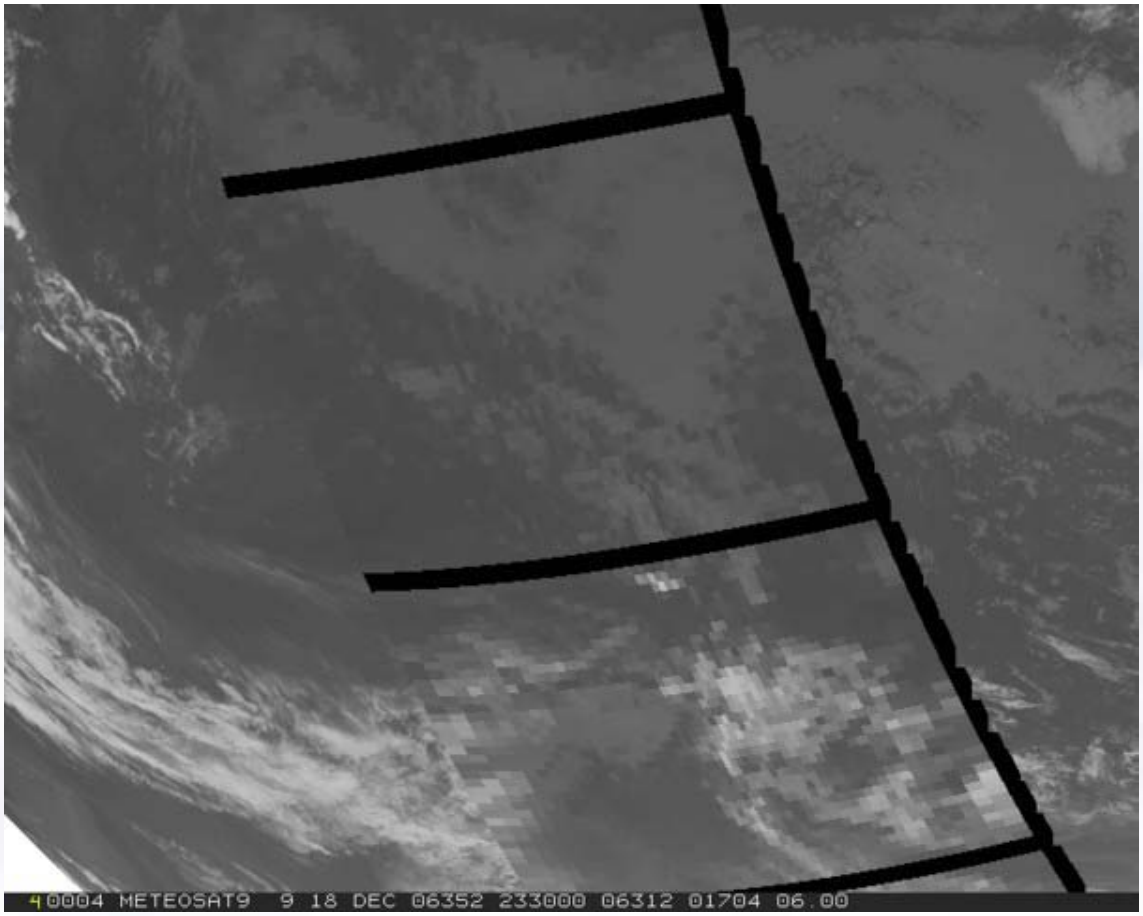
Example: HIRS Data and MSG



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