

Typical Radiometric Noise, Calibration Bias and Stability for Meteosat-8, -9, -10 and -11 SEVIRI

This Document is Public

Doc.No. : EUM/OPS/TEN/07/0314
Issue : v2D e-signed
Date : 3 June 2019
WBS/DBS :

EUMETSAT
Eumetsat-Allee 1, D-64295 Darmstadt, Germany
Tel: +49 6151 807-7
Fax: +49 6151 807 555
<http://www.eumetsat.int>

***Typical Radiometric Noise, Calibration Bias and Stability for
Meteosat-8, -9, -10 and -11 SEVIRI***

This Document is Public

Page left intentionally blank

**Typical Radiometric Noise, Calibration Bias and Stability for
Meteosat-8, -9, -10 and -11 SEVIRI**

*This Document is Public***Document Change Record**

<i>Issue / Revision</i>	<i>Date</i>	<i>DCN. No</i>	<i>Changed Pages / Paragraphs</i>
1	27 February 2007		First Issue
2 & 2A	12 December 2012		New template Change of author MSG3 updates: - Change of title to avoid "accuracy" and to include MSG3 - Update of noise figures based on August 2012 results and addition of MSG3 - Update of accuracy figures now based on IASI – MSG comparison including MSG3 - changed satellite names to conventional Meteosat 8, 9 and 10
2B	19 January 2015		Updates to §1 and Table 2
2C	2 May 2016		Update for Meteosat 11: noise based on commissioning report
2D	3 June 2019		Issue for publishing on the web.

This Document is Public

Table of Contents

1	INTRODUCTION.....	5
2	NOISE	6
3	BIAS	7
3.1	Solar Channels.....	7
3.2	Thermal Infrared Channels.....	7
4	REFERENCES	9

Table of Figures

Table of Tables

Table 1	Specified noise budget compared to observed performance in-flight at operating temperature of 95 K (measured 2015-09-23 T12:30:00).....	6
Table 2	Estimated Uncertainty of SEVIRI Solar Channels Vicarious Calibration, for Meteosat 8, 9, 10 and 11.....	7
Table 3	Mean bias for SEVIRI IR channels evaluated by inter-comparison with Metop-A/IASI on 2015-09-23 at reference radiance scenes (k=1 uncertainty ~0.01K).....	7
Table 4	– Mean rate of IR channels’ calibration drift for standard radiance scenes evaluated by inter-comparison with Metop-A/IASI over 1 year from 2014-12-05 to 2015-12-05 (3 months 2015-09-04/12-06 for Meteosat-11).....	8
Table 5	– Mean rate of VIS/NIR channels’ calibration drift from Lunar Calibration System over operational lifetime.....	8

This Document is Public

1 INTRODUCTION

This document provides sample figures for the noise and radiometric accuracy estimated for SEVIRI level 1.5 image products for Meteosat-8, -9, -10 and -11. These figures represent snapshots of the basic instrument monitoring, as reported by Pili *et al.* [2016]. They are provided as indicators and should be referenced as such.

**Typical Radiometric Noise, Calibration Bias and Stability for
Meteosat-8, -9, -10 and -11 SEVIRI**

This Document is Public

2 NOISE

	Specified (SY2) noise budget	Measured noise			
		Met-8	Met-9	Met-10	Met-11
VNIR (SNR)					
HRV	1.2	2.95	3.47	2.68	3.19
VIS 0.6	10.1	427.04	650.94	48.80	222.64
VIS 0.8	7.28	29.08	52.94	29.72	39.97
NIR 1.6	3	9.31	10.64	11.04	10.90
IR (NEdT) [K]					
IR 3.9	0.35	0.07	0.09	0.10	0.09
IR 6.2	0.75	0.04	0.04	0.04	0.05
IR 7.3	0.75	0.05	0.05	0.06	0.05
IR 8.7	0.28	0.06	0.07	0.06	0.07
IR 9.7	1.5	0.10	0.11	0.09	0.09
IR 10.8	0.25	0.06	0.06	0.06	0.06
IR 12.0	0.37	0.16	0.11	0.11	0.10
IR 13.4	1.8	0.24	0.23	0.22	0.22

**Table 1 Specified noise budget compared to observed performance in-flight at operating temperature of 95 K
(measured 2015-09-23 T12:30:00)**

This Document is Public

3 BIAS

3.1 Solar Channels

Channel	Calibration System Estimated Uncertainty
HRV	4%
VIS 0.6	4%
VIS 0.8	4%
NIR 1.6	5%

Table 2 Estimated Uncertainty of SEVIRI Solar Channels Vicarious Calibration, for Meteosat 8, 9, 10 and 11.

The operational calibration system is believed to generate calibration biases larger than these expected values in the higher part of the dynamic range. This is currently under investigation.

3.2 Thermal Infrared Channels

IR channels	Radiance [K] Standard Scene	Bias [K]			
		Met-8 – IASI	Met-9 – IASI	Met-10 – IASI	Met-11 – IASI
IR 3.9	300	+0.66	+0.56	+0.66	+0.02
IR 6.2	250	-0.19	-0.11	-0.13	-0.08
IR 7.3	250	+0.81	+0.20	+0.07	+0.25
IR 8.7	300	-0.06	-0.05	-0.04	+0.09
IR 9.7	255	+0.01	+0.22	+0.08	+0.10
IR 10.8	300	-0.05	-0.05	+0.03	+0.14
IR 12.0	300	-0.03	-0.08	+0.04	-0.03
IR 13.4	270	-1.48	-1.09	-1.16	-0.23

Table 3 Mean bias for SEVIRI IR channels evaluated by inter-comparison with Metop-A/IASI on 2015-09-23 at reference radiance scenes ($k=1$ uncertainty $\sim 0.01K$)

The accuracy of the operational calibration for the IR channels is routinely validated by inter-comparison against collocated observations from Metop/IASI, following GSICS methodology [Hewison *et al.*, 2013]. The resulting biases and their rate of drift with respect to IASI are shown in Tables 3 and 4, respectively.

The rate of change of calibration coefficients of the VIS/NIR channels is assessed in Table 5 over the instruments' operational lifetime using the Lunar Calibration System [Viticchiè *et al.*, 2013]. These changes are nominally accounted for by irregular updates to the official calibration coefficients provided by the SEVIRI Solar Channel Calibration System [Govaerts *et al.*, 2001]. For example, a typical rate of change of +0.5%/year in the calibration coefficient will cause a bias the radiances to be an extra $\sim 1\%$ too dark before updates are issued after 2 years. Meteosat-11, which was relatively young at this time, still experiencing a significant rate of contamination and only operated for a short period, leading to larger uncertainties on the calibration drift (shaded grey).

**Typical Radiometric Noise, Calibration Bias and Stability for
Meteosat-8, -9, -10 and -11 SEVIRI**

This Document is Public

IR channels	Calibration Bias Drift [K/yr]			
	Met-8	Met-9	Met-10	Met-11
IR 3.9	-0.01	+0.15	-0.10	+0.16
IR 6.2	+0.01	+0.06	+0.00	+0.35
IR 7.3	+0.16	+0.05	-0.16	+0.79
IR 8.7	+0.01	+0.04	-0.05	-0.04
IR 9.7	+0.03	0.12	-0.06	+0.12
IR 10.8	-0.01	+0.03	-0.11	+0.08
IR 12.0	+0.01	+0.04	-0.08	+0.04
IR 13.4	-0.31	-0.17	-0.61	-4.24

Table 4 – Mean rate of IR channels’ calibration bias drift for standard radiance scenes evaluated by inter-comparison with Metop-A/IASI over 1 year from 2014-12-05 to 2015-12-05 (3 months 2015-09-04/12-06 for Meteosat-11)

VIS/NIR channels	Rate of Change of Calibration Coefficient [%/yr]		
	Met-8	Met-9	Met-10
HRV	+0.53	+0.49	+1.24
VIS 0.6	+0.52	+0.57	+1.08
VIS 0.8	+0.49	+0.52	+0.83
NIR 1.6	+0.03	+0.10	+0.15

Table 5 – Mean rate of change of VIS/NIR channels’ calibration coefficient estimated from Lunar Calibration System over operational lifetime

This Document is Public

4 REFERENCES

Hewison, T. J., X. Wu, F. Yu, Y. Tahara, X. Hu, D. Kim and M. Koenig [2013]: *GSICS Inter-Calibration of Infrared Channels of Geostationary Imagers using Metop/IASI*, IEEE Trans. Geosci. Remote Sens., vol. 51, no. 3, Mar. 2013, [doi:10.1109/TGRS.2013.2238544](https://doi.org/10.1109/TGRS.2013.2238544)

Y. Govaerts, A. Arriaga and J. Schmetz [2001]: *Operational Vicarious Calibration of the MSG/SEVIRI Solar Channels*, Adv. Space Res., Vol. 28, No.1, pp.21-30.

P. Pili, L. Matheson, C. Tranquilli, J. Müller, T. Hewison, S. Carlier, S. Bianchi, P. Coste [2016]: *The In-orbit Performance of the Meteosat Second Generation SEVIRI Instruments*, EUMETSAT Meteorological Satellite Conference, Darmstadt, Germany, Sept 2016

Bartolomeo Viticchiè, Sébastien Wagner, Tim J. Hewison, Thomas C. Stone, Jagjeet Nain, Rebeca Gutierrez, Johannes Müller, and Christopher Hanson [2013]: *Lunar Calibration of MSG/SEVIRI Solar Channels*, Proceedings of EUMETSAT/AMS Satellite Conference, Vienna, 16-20 September 2013. (Available [Online](#)).