EUMETSAT

GOME-2 / Metop-A instrument, PPF and auxiliary-data change history

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Document Signature Table

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Distribution List

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Document Change Record

Issue / Revision	*Date*	*DCN. No*	*Changed Pages / Paragraphs*
v1	28/12/2008		Initial version up to processor version 4.1.3
v2	29/01/2009		Following instrument throughput test behaviour
v2a	18/02/2009		Following AR 10874
v3	01/04/2009		Prior to installation of PPF 4.2
v4	09/06/2009		After installation of PPF 4.2.2
v5	18/08/2009		After installation of PPF 4.3.0
v5A	30/09/2009		After second instrument throughput test
v5B	21/01/2010		After installation of PPF 4.4.0
v5C	09/09/2010		After installation of PPF 4.5.0; Product Format version change history added.
v5E	03/01/2011		After installation of PPF 5.0.0
v5F	02/03/2011		After installation of PPF 5.1.0
v5G	08/04/2011		Problem with band separation setting in channel 2 at 5th of April 2011.
v5H	02/05/2011		Failed commanding and collision avoidance manoeuvre.
v5I	06/09/2011		After installation of PPF 5.2.0
v5J	03/11/2011		After Metop-A PLSOL
v6	09/05/2012		Change document title to accommodate satellite platform Installation of PPF 5.3.0 Collision avoidance manoeuvre.
v6A	03/07/2012		Update of FM3 instrument key-data
v6B	17/07/2012		Update of instrument events table
v6C	27/03/2012		Update of instrument events table after tandem operations test
v6D	17/04/2013		Update after Metop-B commissioning phase and preparation for tandem operations

v6E	10/09/2013		Update of instrument events table after start of tandem operations
v7	10/12/2013		Added list of moon intrusion events (solar eclipse)
v7A	29/04/2014		Updated GOME-2 Stokes fraction correction auxiliary data.
v7C	02/10/2014		Installation of PPF version 6.
v7D	26/06/2015		Installation of PPF version 6.1.

Table of Contents

1 INTRODUCTION

1.1 Purpose and Scope

The document details all changes applied to the Metop-A GOME-2 level 0 to 1b data processor (PPF) with a potential impact on data quality, especially with respect to the quality of derived level 2 data. In addition to processor changes any substantial instrument or Metop-A satellite platform anomalies or events are listed here which have interrupted data-dissemination or may have affected level 1b and 2 data quality.

1.1.1 Document Structure

Section 2 provides a brief introduction on the provided tables and listings. Section 3 lists all events for instrument and PPF starting March 2007. Section 4 provides a detailed list with relevant changes applied to the PPF.

Note, that all times given in the document are UTC if not stated otherwise.

1.2 Documents

Routine monitoring results and additional documentation of Metop-A / GOME-2 processing is available at:

www.eumetsat.int > Service Status > Product Quality Monitoring > GOME-2 Instrument (http://oiswww.eumetsat.org/epsreports/html/index.php?instrument=GOME).

The GOME-2 instrument, processing and products newsletter is available under:

www.eumetsat.int > Service Status > Product Quality Monitoring > GOME-2 Newsletter (http://www.eumetsat.int/Home/Main/Satellites/Metop/Instruments/sp_2011011017745548)

The GOME-2 Product Users Guide is available online under:

http://oiswww.eumetsat.int/WEBOPS/eps-pg/GOME-2/GOME2-PG-index.htm .

EPS technical documentation including the documents listed in 1.2.1 can be found under:

www.eumetsat.int >Data & Products > Resources (http://www.eumetsat.int/Home/Main/DataProducts/Resources/index.htm?l=en).

GOME-2 FM3/Metop-A instrument key-data files are available under:

ftp://ftp.eumetsat.int/pub/EPS/out/GOME/Calibration-Data-Sets/Calibration-Key-Data/FM3-Metop-A

1.2.1 Applicable Documents

AD1	GOME-2 Products Guide	EUM/OPS-EPS/MAN/07/0445	Issue: v2C
AD2	GOME-2 L1 Product Generation Specification	EPS.SYS.SPE.990011	Version: 7
AD3	GOME-2 L1 Product Format Specification	EPS.MIS.SPE.97232	Version: 9
AD4	GOME-2 PMD band definitions 3.0 and PMD calibration	EUM/OPS-EPS/DOC/07/0601	Version 5
AD5	Generic Product Format Specification	EPS.GGS.SPE.96167	Version 7D

1.3 Abbreviations and Acronyms

CGS x	Core Ground Segment Number x
GOME	Global Ozone Monitoring Experiment
PDU	Product Dissemination Unit
GPFS	Generic Product Format Specification
PFS	Product Format Specification
PPF	Product Processing Facility
PGS	Product Generation Specification
PMD	Polarisation measurement devices
FPA	Focal Plane Assembly (Main instrument channels)
BU	Binary units

Auxiliary data tagging:

[Auxiliary data type]_[instrument model]_[version number]

STA:
GOME-2 Static auxiliary file, holding elevation model as well as Fresco transmission, reflectance and surface albedo database.

INS:
Initialisation file, holding GOME-2 level0 to 1b processor settings.

COR:
Correction file, holding GOME-2 instrument degradation correction parameters

CAL:
Calibration file, holding GOME-2 instrument keydata.

2 INTRODUCTION

Metop-A / GOME-2 level 1B data is disseminated since 1st of March 2007 via EUMETCast. Level 1A and 1B data is also available from UMARF since that time. Since 11th of Match 2008 the data is labelled "operational". The following PPF change history applies to all changes introduced since 1st of March 2007 to processor and auxiliary data affecting the data content and/or quality of level 1A and 1B (more changes might have been applied to the processor, which however did not affect the science data). **Note that starting with operational dissemination of GOME-2/Metop-B level-1 data at the 7th of May 2013 level 1 processor changes usually apply to both Metop-A and B processing change whereas auxiliary file changes may apply to only one chain.** The data is disseminated from our Core Ground Segment number 1 (CGS1) and tagged with O at the end of the file name. Note that all data tagged with C or T stems either from CGS2 or CGS3 and might therefore be of different quality than listed here! Note also that changes to the processor applied during the Metop-A Satellite In-orbit Verification phase (SIOV) are not listed here! Data prior to 1st of March 2007 has therefore to be treated with special caution! In doubt, please contact EUMETSAT GOME CalVal staff for details or help (ops@eumetsat.int).

Events affecting the instrument, like satellite-platform or instrument anomaly switch-off phases, as well as non-nominal instrument operations are listed in a separate table. Updates to the product format are detailed in a table along with the version of applicable documents, products and processors.

3 EVENT HISTORY

3.1 Tabular PPF change history

Table of Metop-A / GOME-2 Processor and Auxiliary data version update for CGS1/EUMETCast/UMARF. Changes are indicated in blue.

Date	Processor Version	AUX data version	PFS version	PGS version
01/03/2007	**3.2.11**	**STA_FM3_102** **INS_FM3_112** **COR_FM3_100** **CAL_FM3_100**	**7.2**	**6.1**
03/04/2007	**3.3.0**	STA_FM3_102 **INS_FM3_113** COR_FM3_100 **CAL_FM3_101**	7.2	6.1
12/04/2007	**3.3.1**	STA_FM3_102 INS_FM3_113 COR_FM3_100 CAL_FM3_101	7.2	6.1
04/05/2007	**3.3.2**	STA_FM3_102 INS_FM3_113 COR_FM3_100 CAL_FM3_101	7.2	6.1
04/05/2007	3.3.2	**STA_FM3_103** **INS_FM3_114** COR_FM3_100 CAL_FM3_101	7.2	6.1
05/06/2007	**3.3.3**	STA_FM3_103 INS_FM3_114 COR_FM3_100 CAL_FM3_101	7.2	6.1
12/07/2007	**3.3.4**	STA_FM3_103 INS_FM3_114 COR_FM3_100 CAL_FM3_101	7.2	6.1
03/09/2007	**3.4.0**	STA_FM3_103 **INS_FM3_115** COR_FM3_100 CAL_FM3_101	7.2	6.1
04/10/2007	**3.5.0**	STA_FM3_103 INS_FM3_115 COR_FM3_100 CAL_FM3_101	7.2	6.1
14/11/2007	**3.7.0**	STA_FM3_103 **INS_FM3_116** COR_FM3_100 CAL_FM3_101	7.2	6.1
31/01/2008	**3.8.0**	STA_FM3_103 **INS_FM3_119** COR_FM3_100	**7.3**	6.1

		CAL_FM3_102		
10/03/2008	**3.9.0**	STA_FM3_103 INS_FM3_119 COR_FM3_100 **CAL_FM3_103**	7.3	6.1
26/06/2008	**4.0.0**	STA_FM3_103 **INS_FM3_120** COR_FM3_100 **CAL_FM3_104**	**7.4/8A**	6.1
07/01/2009	**4.1.3**	STA_FM3_103 **INS_FM3_121** COR_FM3_100 **CAL_FM3_106**	7.4/8A	6.1
07/04/2009	**4.2.1**	STA_FM3_103 **INS_FM3_122** COR_FM3_100 CAL_FM3_106	7.4/8A	6.1
09/06/2009	**4.2.2**	STA_FM3_103 INS_FM3_122 COR_FM3_100 CAL_FM3_106	7.4/8A	6.1
18/08/2009	**4.3.0**	STA_FM3_103 **INS_FM3_123** **COR_FM3_101** **CAL_FM3_107**	7.4/8A	6.1
21/01/2010	**4.4.0**	STA_FM3_103 INS_FM3_123 COR_FM3_101 **CAL_FM3_108**	7.4/8A	6.1
09/09/2010	**4.5.0**	STA_FM3_103 **INS_FM3_124** COR_FM3_101 CAL_FM3_108	7.4/8A	6.1
05/01/2011	**5.0.0**	**STA_FM3_104** **INS_FM3_125** COR_FM3_101 CAL_FM3_108	**9**	**7**
02/03/2011	**5.1.0**	STA_FM3_104 **INS_FM3_126** COR_FM3_101 CAL_FM3_108	9	7
06/09/2011	**5.2.0**	STA_FM3_104 **INS_FM3_127** COR_FM3_101 **CAL_FM3_109**	9	7
20/09/2011	**5.2.1**	STA_FM3_104 INS_FM3_127 COR_FM3_101 CAL_FM3_109	9	7
03/11/2011	**5.2.2**	STA_FM3_104 **INS_FM3_128** COR_FM3_101 CAL_FM3_109	9	7

24/01/2012	**5.3.0**	STA_FM3_104 **INS_FM3_129** COR_FM3_101 **CAL_FM3_110**	9	7
03/07/2012	5.3.0	STA_FM3_104 **INS_FM3_200** COR_FM3_101 **CAL_FM3_201**	9	7
04/02/2013	5.3.0	STA_FM3_104 **INS_FM3_201** COR_FM3_101 CAL_FM3_201	9	7
13/06/2013	5.3.0	STA_FM3_104 **INS_FM3_202** COR_FM3_101 **CAL_FM3_202**	9	7
15/04/2014	5.3.0	STA_FM3_104 INS_FM3_202 **COR_FM3_102** CAL_FM3_202	9	7
17/06/2014	6.0.0	STA_FM3_104 **INS_FM3_203** COR_FM3_102 CAL_FM3_202	9	7
26/06/2015	6.1.0	STA_FM3_104 **INS_FM3_204** COR_FM3_102 **CAL_FM3_203**	9	7

3.2 Tabular instrument event history

Table of Metop-A / GOME-2 FM3 instrument events and operations. Note that the events start/stop times do not necessarily coincide with NRT data dissemination start/stop times! All events are expected to impact product quality except where explicitly noted (No impact!). Note that the impact on quality may last longer than the duration of the event.

Start date	End date	Start orbit	End orbit	Instrument event/operation	Type
02/03/2007 19:50:55	06/03/2007 12:32:54	1905	1958	Instrument switch of due to single-event set-up	Instrument anomaly
08/04/2007 23:05:56	10/04/2007 15:29:59	2433	2457	Instrument switch of due to single-event set-up	Instrument anomaly
20/04/2007 08:38:55	26/04/2007 09:24:30	2594	2681	Satellite platform switch-of due to single-event set-up	Platform anomaly
17/09/2007 05:11:57	20/09/2007 14:17:55	4723	4772	Satellite platform switch-of due to single-event set-up	Platform anomaly
08/10/2007 08:02:59	09/10/2007 09:23:59	5024	5039	Test upload of PMD band definitions version 2.1 [AD4]	Instrument operations
16/01/2008 13:32:59	19/01/2007 10:50:59	6447	6488	Satellite platform switch-of due to single-event set-up	Platform anomaly
29/01/2008 11:53:48	31/01/2008 12:53:11	6632	6661	Degraded spectral calibration for FPA channel 2 and PMDs between 300 and 400 nm.	Instrument anomaly
05/02/2008 09:26:55	06/02/2008 15:51:22	6730	6747	Test upload of PMD band definitions version 3.0 [AD4]	Instrument operations
11/03/2008 10:43:20	n/a	7227	n/a	Final upload of PMD band definitions version 3.1 [AD4]	Instrument operations
19/03/2008 21:50:54	22/03/2008 12:26:56	7347	7385	Satellite platform switch-of due to single-event set-up	Platform anomaly
02/09/2008 07:17:56	03/09/2008 15:35:54	9712	9730	On-board software co-adding patch I	Instrument operations **(no impact)**
10/09/2008 07:53:57	11/09/2008 14:29:59	9826	9843	On-board software co-adding patch II	Instrument operations **(no impact)**
10/12/2008 07:53:59	n/a	11119	n/a	Shift of FPA band 1a/b separation to pixel detector pixel 658 at 283 nm.	Instrument operations
27/01/2008 06:40:00	29/01/2008 16:06:00	11800	11833	Test of instrument throughput behaviour	Instrument operations
16/02/2009 21:38:55	18/02/2009 12:40:00	12092	12117	Instrument macro-command error - EQSOL	Instrument anomaly
03/03/2009 08:00:00	04/03/2009 17:45:00	12998	12318	On-board software co-adding patch III	Instrument operations **(no impact)**
26/08/2009	26/08/2009	14798	14798	On-board QTH lamp test	Instrument operations

07:26:58	09:08:58				**(no impact)**
27/08/2009 08:47:57	27/08/2009 10:26:57	14813	14813	On-board QTH lamp test	Instrument operations **(no impact)**
28/08/2009 08:26:57	28/08/2009 10:05:57	14827	14827	On-board QTH lamp test	Instrument operations **(no impact)**
07/09/2009 06:16:00	12/09/2009 09:50:00	14968	15041	Second test of instrument throughput behaviour and instrument out-gassing	Instrument operations
04/01/2011 09:45:00	04/01/2011 10:20:00	21846	21846	Old spectral calibration applied due to sudden drop in on-board temperatures because of ASCAT anomaly (switched to calibration mode)	Instrument (ASCAT) anomaly
05/04/2011 09:20:30	05/04/2011 n/a	23138	23138	Upload of updated instrument timelines.	Instrument operations
05/04/2011 10:44:00	05/04/2011 16:41:00	23139	23143	Wrong channel 2 band separation settings due to erroneous commanding of the instrument.	Instrument operations
19/04/2011 23:20:00	20/04/2011 00:20:00	23346	23346	Timeline failed executing. Orbit contains only dark measurements	Instrument operations
01/05/2011 02:20:00	01/05/2011 03:59:00	23504	23505	In-Plane collision avoidance manoeuvre.	Instrument operations
22/10/2011 21:54:00	25/10/2011 13:15:00	25987	26024	Metop-A Payload switch-off	Platform anomaly
02/03/2012 12:14:58	02/03/2012 13:53:58	27857	27857	In-Plane collision avoidance manoeuvre.	Instrument operations
14/04/2012 17:26:58	14/04/2012 19:05:58	28471	28471	In-Plane collision avoidance manoeuvre.	Instrument operations
29/01/2013 06:30:00	27/02/2013 08:30:00	32584	32997	PPG from previous month (31st of December 2012) used due to data loss of monthly on-board calibration	Reception station anomaly
07/03/2013 14:38:57	14/03/2013 15:32:54	33115	33215	FM3 on 960 km swath as part of the “tandem-operation test” for both instruments.	Instrument operations
15/07/2013 14:48:00	n/a	34962		Start of GOME-2 Metop-A/B tandem operations phase. FM3 nominal swath width is set to 960 km (half swath at 40 by 40 km spatial resolution)	Instrument operations
2014-01-21 22:41:57	**2014-01-24 19:56:59**	**37667**	**37707**	GOME-2 switch-off due to single event	**Instrument anomaly**
15/07/2013 14:48:00	**n/a**	**34962**		Start of GOME-2 Metop-A/B tandem operations phase. FM3 nominal swath width is set to 960 km (half swath at 40 by 40 km spatial resolution)	**Instrument operations**

3.3 Moon intrusion (solar eclipse) event history

Table of moon intrusion events which significantly reduce signal levels for the Metop-A / GOME-2 FM3 instrument.

Start	End / Duration (s)
17/02/2007 15:55	17/02/2007 16:01
19/03/2007 01:25	19/03/2007 01:30
19/03/2007 02:49	19/03/2007 03:05
19/03/2007 04:22	19/03/2007 04:31
11/09/2007 11:05	11/09/2007 11:12
11/09/2007 12:49	11/09/2007 13:13
07/02/2008 03:06	07/02/2008 03:30
01/08/2008 08:37	01/08/2008 08:38
01/08/2008 09:56	01/08/2008 10:19
01/08/2008 11:34	01/08/2008 11:38
26/01/2009 05:55	26/01/2009 06:10
22/07/2009 01:09	22/07/2009 01:22
15/01/2010 05:20	15/01/2010 05:34
15/01/2010 06:58	15/01/2010 07:04
15/01/2010 08:17	15/01/2010 08:20
11/07/2010 17:48	11/07/2010 18:00
11/07/2010 19:50	11/07/2010 19:57
04/01/2011 08:01	04/01/2011 08:19
04/01/2011 09:33	04/01/2011 09:46
01/06/2011 20:27	01/06/2011 20:32
01/06/2011 21:49	01/06/2011 22:08
01/07/2011 08:57	01/07/2011 09:03
25/11/2011 06:32	25/11/2011 06:55
24/12/2011 17:45	24/12/2011 17:47
20/05/2012 21:57	20/05/2012 22:03
20/05/2012 23:26	20/05/2012 23:42
21/05/2012 00:47	21/05/2012 01:01
13/11/2012 21:04	13/11/2012 21:21
13/11/2012 23:24	13/11/2012 23:24
09/05/2013 23:16	09/05/2013 23:33
23/10/2014 21:03	23/10/2014 21:24
23/10/2014 22:44	23/10/2014 22:08
23-Oct-2014 21:03:17	1291.199
23-Oct-2014 22:44:40	229.828
20-Mar-2015 08:26:18	412.072

20-Mar-2015 09:49:59	1087.679
20-Mar-2015 11:21:53	673.895

3.4 Tabular level 1 product format change history

Table of product format and product generation specification change history including the product format version number, and as indicated in the products Main Product Header Record (MPHR). The MPHR record per orbit file is also displayed in the detailed orbit monitoring listing on gome.eumetsat.int under "Details".

Start date	Start orbit	PFS version	GPFS version	Product format version[1]	Changes with respect to previous verison	Applicable PPF versions
18/10/2006 (Metop-A launch)	1	7.1	6.5/6.6	10.0	n/a	3.2.1 to 3.2.10
26.02.2007	1843	7.2	6.5/6.6	10.0	Fields GOOD_FIT and FINAL_CHI_SQUARE from the compound variable CLOUD, both previously u-integer2 have been combined so that GOOD_FIT is no longer written to the product and FINAL_CHI_SQUARE becomes u-integer4. The size and structure of the product does not change, only the use of these specific 4 bytes. Additionally the scaling factor for FINAL_CHI_SQUARE has been reduced from 6 to 5. These changes were necessary to accommodate the dynamic range of FINAL_CHI_SQUARE which was not possible using u-integer2 The scaling factors for E_FIT_1 and E_FIT_2 have been changed to be 1 and 4 respectively to accommodate the range of values experienced with in-flight data. The flag F_HOT no longer causes DEGRADED_PROC_MDR to be raised as hot pixels occur regularly in the SAA due to particle bombardment and are filtered out by on-ground processing where	3.2.11 to 3.7

[1] **as indicated in the MPHR of the product**

					necessary. The instrument is not degraded as such.	
31.01.2008-	6661	7.3	6.5/6.6	11.0	VIADR-1a-SPEC updated to replace the polynomial coefficients describing the FPA and PMD spectral calibration with the complete spectral grid in both cases. Field PCD_SPEC: N_ITERATIONS changed to be SHIFT_PER_WINDOW with size unchanged. Record GIADR-1b-PMDBandDef added.	3.8.0 to 4.5.0
26.06.2008-	n/a	7.4/8A	6.6/7D	11.0	n/a*)	n/a*)
05.01.2011	21863	9	6.6/7D	12.0	Changes to PCD_BASIC in Compounds: increased read-out numbers predominantly by changing variable type to bitstring. GEO_EARTH_ACTUAL: compound field added for scan-direction index. Added field to BAND_P compound: UNCORR_RAD provides PMD-P and PMD_S read-outs which are not corrected for the instrument sensitivity to polarisation. UNCORR_ERR_RAD provides the corresponding error. MDR-1b-Earthshine: Introduction of new GEO_EARTH_ACTUAL_[#] fields where # is from 1 to 10 and corresponds to the unique integration time index. Their field dimension is given by N_UNIQUE_INT and GEO_REC_LENGTH. CHANNEL_READOUT_SEQ field added in GIADR-Channel for detector pixel read-out sequence direction. Two cloud parameter fields CLOUD_PMD_1 and CLOUD_PMD_2 added in CLOUD compound for PMD derived cloud parameters. MDR level 0 GHR start and stop time have been added as additional fields to the ISP and ISP_HEAD compounds.	5.0.0 to ...

*) **Note, PFS 8A (7.4) introduced at 26/06/2008 did not change the product format.**

4 DETAILED PPF EVOLUTION HISTORY

1st of March 2007 14:00 UTC

Start of dissemination with processor 3.2.11. Changes of 3.2.11 with respect to earlier versions.

- A couple of parameters from the cloud-detection algorithm of the GOME-PPF 3.2.10 have been written in-correctly or not adequately to the product. PPF 3.2.11 will only write absolute chi-squares numbers using integer-4 variable, replacing both u-integer2 parameters GOF and delta_chi-square. The scaling factors for e_fit1 and e_fit2 parameters from the cloud fitting parts are changed to 1 and 4 respectively in order to cover the adequate ranges. All of the latter required a change to the PFS reflected in PFS 7.2.
- First introduction of new IFC writing and application concept. In case the endofMODE switch is set, an IFC and MON-1a file containing the latest calibration measurements of the just ended calibration MODE is written out. The same type of relevant VIADR-sub-classes are also updated. In this way the calibrations are available already for the next PDU. The results are greatly reduced numbers of unusable calibrations because of orbit to orbit changes, and, in effect, an increased likelihood of fully valid level 1B calibrations. All level 1A and B product will therefore contain a larger number of VEADR (IFC) and VIADRs than specified in PFS 7.2. An update of the latter is therefore required.
- GOME-PPF 3.2.10 fails to write sun-stokes fractions from sun measurements in case endofMODE for sun occurs just at the beginning of PDU (1st MDR). In this case, when there is no scan data but endofMODE triggered, writing of the fractions is suppressed. Bug fixed with 3.2.11.
- Introduction of relaxation time for dark measurement mode at MODE transitions and for integration time changes. It appears that for changes from long integration to short integration times (implies mode transitions) noise levels can be still quite high at mode/IT-change borders. The relaxation time for dark is now configurable via the INS file. Three parameters define the dedicated settings: tStabDark=60sec for stabilisation time after MODE changes, tStabDarkIt=10sec for stabilisation time after integration time changes, and minDarkCalDuration=30sec for minimum duration of dark measurements to be flagged as useable. The latter is important to prevent any situation for which, due to the former settings, the valid dark measurement time becomes too short.
- The calculation of PMD band averaged values for sun-measurements in raw transfer mode, have been introduced with 3.2.11 calling the generic apply irradiance for PMD function in readout ‘band’ and transfer ‘sun’ mode. Output is written to the first part of the 1024 PMD level 1B read-out vectors using the first 15 unused pixels (since PMD raw mode values occupy only the last 279 entries where the rest is flagged undefined). Only average dark measurements are subtracted no further calibration are applied like in the earthshine case.
- A minimum solar elevation angle for SMR calculation has been changed from 5 to 6, to avoid F_MODE_GEOLOCATION. Introduced 23rd February.

3.4.2007, 12:30 UTC

Changes of 3.3.0 with respect to 3.2.11
The key-data and initialisation auxiliary file (CAL 1.01 and INS 1.13) have been updated

- PPF 3.3 is a wrap-up of all previous patches applied to version 3.2 (1 to 11). It also includes an updated configuration file with which the terminator can be triggered after the end of each measurement mode.
- The calibration file holding all key-data values is updated along with installation of PPF 3.3. The latter resolves AR 7050 (Channel overlap issue) by modifications of the radiance response tables only for the mentioned overlap regions. The files WL_OVERLAP, VALID_RANGES_MAIN for FPA channels have been edited at EUM to introduce a shift of -0.48 nm for channel 1 to 2 transitions and -1.37 nm for channel 2 to 3 transitions improving the impact of the RA_ABS_RAD_MAIN.203 and RA_ABS_IRR_MAIN.203 key-data corrections delivered by SSST
- PMD band value nr 15 (1 to 15) has always been set to undefined because the range of lambda MME in INS file has been set to 810nm (as defined as default in PGS 6.2). Since band 15 is around 823 and 849 nm for PMD S and P results were undefined. To prevent this VALID_RANGES_PMD_P and VALID_RANGES_PMD_S in key-data has been extended to 870 nm by EUM and lambda MME in INS file has been extended to the same value.

12.4.2007 15:00UTC

Changes of 3.3.1 with respect to 3.3.0

- Negative radiances occur for Band1A in regions of the SAA. This is due to the additional subtraction of the kth intensity sorted pixel read-out from the beginning of Band 1A for dark-measurement correction (as specified for SAA cases in the PGS 6.2 Eq. 337) effectively 2*1500 BU are subtracted in this case. So the additional SAA induced subtraction of this correction needs to be done on the dark measurement corrected read-out. Fixed in 3.3.1.
- The VIADR-SMR record is not written to the level 1B PDU in some cases because of a rounding error in the validity time of the subclass. This has been fixed with 3.3.1 by allowing a margin on the validity time and by raising a warning only but writing the VIADR-SMR in any case.

4.5.2007; 15:00UTC

Changes of 3.3.2 with respect to 3.3.1

- There were inconsistencies detected between the number of VIADRs recorded in the MPHR and the actual number of VIADRs in the product identified from 3.3.1. This bug in the code has been a result of the changed output rate of the new concept of

handling the in-flight calibration. The related VIADR counting has not been updated correctly in the new processor version. This has been fixed with 3.3.2.

- The FRESCO code has been cleaned up for this version. Two bugs have been found: I) Solar zenith angle (SZA) was set to SZA at satellite and not at h0: fixed. II) In case of our-of-limits of the fitting parameters during iteration, the latter are set to hard coded, fixed values during the iteration loop. This re-initialisation has only been carried out for the first of the 15 detector pixels used. As a result a lot of out-of-limit flags have been triggered.
- For all previous versions of 3.1 to 3.3 FRESCO has converged only for about 50% of the cases. It has been found that the sigma weights used for the fitting introduce this instability because they were calculated incorrectly (ErrSim has been used as relative error on RSim and the square values of ErrMeas and ErrSim have been added for sigma, instead of the non-square value). The latter has been fixed in 3.3.2 and resolved the issue of non-convergence.

15.5.2007 15:00 UTC

The static and initialisation file (STA 1.03 and INS 1.14) have been updated

- FRESCO transmission and LER database has not been updated during the previous STA update in January, because of a bug in the conversion data base. Version 2 of the latter has now been put into a new STA file.
- PMD Fourier filter frequencies for ETALON correction of PMD have been updated in order to improve the correction on the IR part of the spectrum.

5.6.2007; 12:00UTC

Changes of 3.3.3 with respect to 3.3.2

- FRESCO: fitting values set to 0 during Levenberg Marquardt fitting in FRESCO lead to singular matrices and raising of a lot of mathematical error flags during fitting. The reset value for negative fit results during iteration has been set to 1e-5 to avoid this.
- A couple of FRESCO quality parameters have not been initialised per read-out but per scan. As a result, the out of range flag for simulated reflectivities has been set without occurrence of the problem for many read-outs. Out of range flagging for the latter has been performed for every iteration step. This flagging is now performed only once after the last iteration.

12.7.2007; 9:00UTC

Changes of 3.3.4 with respect to 3.3.3

- Improved radiative calibration of PMD raw transfer-mode Earthshine read-outs applicable for the monthly PMDRAW timeline.

3.9.2007; 13:23 UTC

Changes of 3.4.0 with respect to 3.3.4

- Reading of kappa and chi from key-data files with respect to viewing angle Psi followed the wrong order in ascii key-data reader. Psi is increasing in order as in the PSI grid used by the PPF, however, the columns of kappa and chi have been read in reversed order. Fixed with 3.4.0.
- FRESCO pressure grid interpolation has been fixed by carrying out the interpolation linear in pressure and not in altitude. This removed the remaining small differences with offline KNMI-FRESCO in CTP.
- FRESCO Interpolation on static data in longitude at -180 to 180 boundary introduced large jumps. Fixed with 3.4.0.
- For conditions of CFR lower than 0.05 the derived values at last iteration step are now set to 0 and CTP is set to surface pressure. This significantly reduces the remaining number of non-convergence cases especially for clear-sky scenes.

4.10.2007; 12:00 UTC

Changes of 3.5.0 with respect to 3.4.0

- Fix an incorrect calculation of the sun stokes-fractions provided in GOM_MON file for monitoring purposes.
- “Apply radiance response for PMDs” (PGS 6.1, Eq. 256) is now calculated on the common MME grid (and not on PMD-P only) with an appropriate interpolation of PMD-P and S. Afterwards the result is interpolated back on the individual PMD-P and S grid and written into the product.
- A problem with spline interpolation of surface reflectivity values in the FRESCO algorithm leading to negative values at sharp transitions (ocean / snow) has been fixed by setting all negative values to 0.01.
- The code has been prepared for changes in PMD band-data definitions and of length B of the short-wave PMD pixels (PGS 6.1, Appendix B).

14.11.2007; 13:30 UTC

Changes of 3.7.0 with respect to 3.5.0 and update of initialisation file 1.15 to 1.16.

- Interpolation of PMD band data on a common spectral grid has been introduced for all processes involving PMD radiances.

31.01.2008; 14:10 UTC

Changes of 3.8.0 with respect to 37.0, update of initialisation file 1.16 to 1.19, and update of calibration key-data file 1.01 to 1.02.

The new PPF version 3.8.0 uses full (instead of polynomial) representations of the FPA and PMD spectral grids throughout the processing. This significantly increases the stability and accuracy of the spectral calibration for PMD and improves the in-flight co-registration of the two PMD detectors. For a detailed analysis of the problem and detailed changes implemented

we refer to EUM.OPS-EPS.DOC.07.0601, available on the GOME-2 CalVal pages in the document section (see also GOME CalVal newsletter #15). In parallel to these changes a couple of modifications had to be added to the GOME_INS auxiliary file and to the key-data auxiliary file GOME_CAL.

PPF 3.8.0 and higher versions now provide the full information on the active PMD band definitions in a dedicated sub-class of the GIADR records of the level 1B products.

PPF 3.8.0 changes the following level 1A and 1B file formats (PFS updated from 7.2 to 7.3 available in the document section on GOME-2 CalVal pages):

- Level 1A: VIADR-1a-SPEC updated to replace the polynomial coefficients describing the FPA and PMD spectral calibration with the complete spectral grid in both cases.
- Level 1A: Field PCD_SPEC: N_ITERATIONS changed to be SHIFT_PER_WINDOW with size unchanged.
- Level 1B: Record GIADR-1b-PMDBandDef added on user request.

10.03.2008; 13:15 UTC

Changes of 3.9 with respect to 3.8, update of calibration key-data file 1.02 to 1.03.

- The PPF 3.9 uses the angular dependence χ_ζ for 45° polarised light applied in calculation of Stokes fractions and polarisation correction.
- The new key-data file CAL version 1.03 applied by PPF 3.9 holds a changed version of the angular dependence of $\mu 2$ and M_P/M_S MMEs describing the (relative) polarisation sensitivity to linear polarised light. The new χ has been modelled from 12 orbits of PMD-RAW data for Stokes fractions of special geometry (q=0) (see also EUM.OPS-EPS.DOC.07.0601). All modifications have been carried out at EUM using the original IDL code for processing of raw calibration data provided by TNO-TPD/Galileo.

26.06.2008; 12:40 UTC

Changes of 4.0 with respect to 3.9, update of calibration key-data file 1.03 to 1.04, update of initialisation file 1.19 to 1.20.

- The calculation of single scattering Stokes fractions u and q has been revised completely following the derivations of Tilstra et al. for SCIAMACHY. - Tilstra, Schutgens and Stammes - ISBN 90-369-2237-2. The changes leave q(ss) unchanged but u(ss) changes sign.
- The signal minimum level for PMD P and S have been lowered to 35 BU from 50 BU, because signals for the first PMD band fall below the original threshold around mid-latitudes and for the extreme eastern part of the swath.
- Corrected table PCD_BASIC in PFS 7.3 listing flags which contribute to F_OLD_CAL_DATA being set. This has no impact on level 1 readers.

07.01.2009; 14:00 UTC

Changes of 4.1 with respect to 4.0, update of calibration key-data file 1.04 to 1.06, update of initialisation file 1.20 to 1.21.

- Introduction of "Method B" for calculation of u-Stokes fraction within C-shape area. For the latter the minimum single-scattering q-fraction outside the "C-shape" area has been increased from 0.05 to 0.08.
- Lowering of the PMD signal acceptance threshold from 35 to 5 BU.
- Improved modelling results of the polarisation sensitivity of main channel and PMD signals (key-data POL_CHI file) have been added based on modelling of CHI from 18 raw orbits of reprocessed data in-flight data and using a revised POL_ALPHA key-data file. The latter has been modelled from in-flight data using the same set of PMD raw orbits. The new POL_CHI file ends with valid data at 800 nm (as for previous versions since PPF 3.9). PMD band 15 data is derived by extrapolation (as for previous versions since PPF 3.9).
- A bug in 4.0 caused VIADR start/stop times to be incorrect in some cases. In such cases start/stop times were set to start_time=product_stop_time-6s, stop_time=product_stop_time. The effect is that for re-constructed orbits from PDUs multiple VIADRs measured at different times have been associated to the same start/stop time. As a consequence one of the wrongly assigned "duplicates" has previously been removed by the reconstruction. This has been fixed in 4.1.

07.04.2009; 9:30 UTC

Changes of 4.2 with respect to 4.1, update of initialisation file 1.21 to 1.22.

- PPF 4.2.1 introduces revised dark signal correction for channel 1 in SAA by introduction of additional threshold derived from extreme UV pixel readout signals.
- Change flagging of MDR degraded instrument flags for saturation events by setting the flag only if all valid readouts in one scan/mdr (32 minus number of gaps/invalid) are flagged.
- PPF 4,2,1 solves an anomaly detected in processing after on-board co-adding in channel 3 (saturation patch) has been turned on (starting 4th of March 2009). In the transition to and from detector pixel co-adding, the readout normalisation has been turned on and off at a scan-to-scan level. As a result individual readouts within one scan (MDR) and for channel 3 only are normalised incorrectly, resulting, under rare circumstances, in an error of factor 2 in radiance levels.

09.06.2009; 15:45 UTC

Changes of 4.2.2 with respect to 4.2.

- Dark measurement reported signal-errors within parts of the SAA appeared to be wrong inside the SAA flagged region and outside the new correction scheme affected region introduced with PPF version 4.2.1 (see before). As a consequence also the reported errors on the earthshine radiances in the level 1b product and for band 1a only (!) within the SAA box (outside the detected SAA) are wrong. Fixed with 4.2.2.

18.08.2009; 13:30 UTC

Changes of 4.3.0 with respect to 4.2.2

- New Stokes fraction correction scheme introduced. This results in a regular online update and correction of the Stokes fraction offsets by the PPF. The occurrence rate of the latter is about 1 to 5 times per month depending on the number of acquired correction measurements.
- New interpolation of single-scattering values on PMD read-out (angle) grid. For this all single-scattering values of u_{ss}, q_{ss}, $\cos(2\chi)$, and $\sin(2\chi)$ and P_{ss} are separately calculated and prepared on the scanner angle grid. Following this the interpolation scheme, as defined for the scanner angle, to PMD grid (Eq. 225 to 227; PGS6.1) is applied to all the single scattering parameters used in the determination of stokes fractions. This is essential for an improved accuracy of processing the "C-shape" area and for the newly introduced online correction of Stokes fraction offsets.

21.01.2010; 14:30 UTC

Changes of 4.4.0 with respect to 4.3.0

- Key-data has been updated which has not been corrected for stray-light in the original derivation from raw calibration measurements The following key-data files are affected and have been updated:
  - POL_ALPHA.203
  - POL_BETA.203
  - POL_GAMMA.203
  - POL_ETA.203
  - POL_ZETA.203
- The scan angle dependence of polarization sensitivity (-45/45) PMD should be charachterised by specific new key-data:
  - POL_CHI_ZETA_PMD_P.203
  - POL_CHI_ZETA_PMD_S.203.

The original key-data for GOME-2 FM3 (Metop-A) is available on the GOME-2 CalVal Extranet pages under "Calibration Data Set". Access to the Extranet is available via the link specified in Section 1.2. Updated versions of key-data files are available on request by sending an e-mail to ops@eumetsat.int.

09.09.2010; 13:20 UTC

Changes of 4.5.0 with respect to 4.4.0

- All latitude/longitude geo-location parameters are shifted by 1 to 2 km along the orbit, i.e. by 2.5 to 5% of the along-track pixel size at nadir position. The across-track values are not affected! This fixes an issue with an incorrect scanner position read-out time offset in the processor settings.

05.01.2011; 15:15 UTC
Changes of 5.0.0 with respect to 4.5.0

- The product format has been updated to version 12.0 (PFS 9). Changes from PFS7.4/8A to PFS 9 are detailed in (EUM/OPS-EPS/TEN/09/0549 available on http://www.eumetsat.int/Home/Main/DataProducts/Resources/index.htm?l=en > Product Format Specifications). One main aspect of the changes are the provision of polarisation uncorrected PMD read-outs and geo-location information for PMD readouts. See also GOME-2 newsletter #23 and 25 available under http://www.eumetsat.int > service status > Product Quality Monitoring.

- FRESCO has been updated to FRESCO+. For a detailed description of the changes we refer to the new PGS 7 and to the FRESCO project report.

02.03.2011; 11:40 UTC
Changes of 5.1.0 with respect to 5.0.0

- If no geo-location can be computed for a 6 seconds integration time (e.g. for the 1st scan of the orbit in band 1a) a single "undefined" record is saved (in 5.0.0 no record is saved).

06.09.2011; 11:51 UTC
Changes of 5.2.0 with respect to 5.1.0

- Fixed problem with reported number of read-outs instead of scans in the Second Product Header Record for N_SAA.
- New Equation for Apply Radiance response for PMD (affecting BAND_PP and BAND_PS fields in the product). Individual PMD-S and P signals are now polarisation corrected using ***c*** and normalised by the radiometric response functions (Mueller Matrix element 1) M_{1s} and M_{1p} separately.
- New key-data for kappa for PMDs, i.e. PMD_KAPPA_P and PMD_KAPPA_S as applied in the calculation of M_{1s} and M_{1p}.

24.01.2012; 10:13 UTC
Changes of 5.3.0 with respect to 5.2.0

- Improved radiometric key-data for solar PMD measurements.
- The random noise contributions of errors have been added to the product (ERR_RAD field in BAND compounds) replacing absolute error estimates. For details we refer to the GOME-2 Newsletter #28: http://www.eumetsat.int/groups/ops/documents/document/pdf_gome_newsletter_archive.pdf

03.07.2012; 8:54 UTC
Changes of instrument key-data for FM3

- Complete rework of the FM3 instrument key-data based on the reanalysis by TNO delivery issue 6 (ftp://ftp.eumetsat.int/pub/EPS/out/GOME/Calibration-Data-Sets/Calibration-Key-Data/FM3-Metop-A). The key-data auxiliary original file version is 2.00 and the version for which all post-launch adjusted key-data files (radiometric response in overlap region, and overlap wavelength region adjustment) have been carried over from the previous version 1.10.

13.06.2013; 10:00 UTC
Changes of instrument key-data

- Instrument radiometric key-data have been optimised in the channel overlap regions because of the continuous shift of the overlap point since 2006 (last update of the overlap region in the radiometric key-data during SIOV 2006). In addition the etalon correction from 1st of April 2013 has been applied on top to facilitate a smooth transition to the overlap point. As a consequence the level 1 radiances can now be used closer to the overlap point. The valid regions per channel are as follows:

After key-data update (situation before in brackets):

FM3 Channel Transition	First channel 50% point [pixel]	Second channel 50% point [pixel]	Wave-length 50% signal point [nm]
1/2	920.96 (921.06)	167.99 (167.37)	311.50 (311.46)
2/3	908.72 (904.90)	34.09 (32.62)	399.07 (398.54)
3/4	980.23 (980.40)	59.52 (60.16)	597.97 (598.03)

Table 1: GOME-2 Metop-A / FM3 Channel overlap point (50/50 signal) after 13th June 2013, 10:00 UTC (before)

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FM3	Channel 1	Channel 2	Channel 3	Channel 4	PMD-P	PMD-S
Start	310 (310)	168 (210)	34 (120)	60 (85)	750 (750)	750 (750)
Stop	921 (935)	909 (850)	980 (1009)	989 (989)	997 (997)	998 (750)

Table 2: GOME-2 Metop-A / FM3 validity of etalon correction [detector pixel start/stop] after 13th June 2013, 10:00 UTC (before)

Table 1 lists the specifications for the 50/50% signal overlap point to be used as a channel separation guideline. Table 2 lists the validity range of the applied etalon correction per channel. From Table 2, we can see that the valid etalon correction extends over the 50% overlap point.
As a result the whole spectral region can be exploited per channel after the change, with the 50% overlap point used as a channel separation guideline.

15.04.2014; 14:00 UTC
Changes of instrument key-data

- An improved online correction of the Stokes fractions has been introduced by implementing a new auxiliary file into the system (GOME_COR aux file). This improved auxiliary file version will address issues for M02 (FM3) concerning the Stokes fraction correction quality for the operational Metop-A narrow swath setting.

The effect of the change on level-1b quality is small so potentially non-negligible depending on spectral region. The effect to better stokes fraction quality is gradually introduced during a couple of hours after the installation and only fully in effect by the end of the 16th of April.

17.06.2014; 12:00 UTC

Changes of 6.0.0 with respect to 5.3.0

- Provision of additional cloud information from the AVHRR cloud mask on PMD read-out level in the MDR-1b Earthshine:CLOUD:CLOUD compound. The existing fields from PFS version 9 ***CLOUD_PMD_1*** and ***CLOUD_PMD_2*** are now filled with physical values for scene homogeneity and geometric cloud fraction.
  For details see GOME-2 newsletter # 35 at
  http://www.eumetsat.int/website/home/TechnicalBulletins/GOME2/index.html

  For details on how to correctly apply PMD data information to main channel data please also consult the GOME-2 factsheet on spatial aliasing at
  http://www.eumetsat.int/website/wcm/idc/idcplg?IdcService=GET_FILE&dDocName=PDF_GOME_FACTSHEET&RevisionSelectionMethod=LatestReleased&Rendition=Web

26.06.2015; 12:00 UTC

Changes of 6.1.0 with respect to 6.0.0

- Removal of instrument key-data addressing the contamination with Xe-line structures since those structures where negligible for FM3 on Metop-A. The change however is reducing key-data residuals in viewing angle direction.
- Introduction of the in-flight derived BSDF for solar radiometric calibration affecting the solar irradiance data. This may result in changes of the irradionmetric accuracy in all channels to various extend. It will improve reduce variability in the irradiometric accuracy over the year.
  For details see GOME-2 newsletter # 36 at
  http://www.eumetsat.int/website/home/TechnicalBulletins/GOME2/index.html