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ABB Bomem inc.

ENVISAT-1 GROUND SEGMENT

Michelson Interferometer for Passive Atmospheric Sounding

In-Flight Characterisation for Modified Operation

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	Function	Name	Signature	Date
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DOCUMENT CHANGE RECORD

Issue	Rev.	Date	Chapter/Paragraph Number, Change Description (and Reasons)
Draft		20 April 2004	First draft
1	-	12 July 2004	First release
1	A	17 Aug. 2004	Added IF16
1	B	17 Aug. 2004	Added the last sentence about the definition of the in-flight characterizations
1	C	19 Oct 2004	Clarified Section 3.1.1

1. INTRODUCTION

1.1 PURPOSE OF DOCUMENT

This document enumerates the in-flight validation and characterisation activities to be repeated if the baseline operational mode of MIPAS is modified. This document can be seen as an extension of the In-Flight Characterization and Calibration Definition Document (RD1).

1.2 SCOPE

The document is performed under ESRIN contract no 17124/03/I-OL.

1.3 DOCUMENT OVERVIEW

First the proposed modification options are enumerated and the associated impact on behaviour and performance are listed. Then, the validation activities (extracted from RD1) to be repeated are listed for each option.

1.4 REFERENCE DOCUMENTS

No	Reference	Issue	Title
RD1	PO-TN-BOM-GS-0013	1B	In-Flight Characterization and Calibration Definition, May 2001.
RD2	-		E-mail from Rob Koopman, 14 April 2004.

1.5 ACRONYMS

CBB	On-board Calibration Black Body
DS	Deep Space
ILS	Instrument Line Shape
MIPAS	Michelson Interferometer for Passive Atmospheric Sounding
MPD	Maximum Path Difference
OPD	Optical Path Difference
RD	Reference Document
SNR	Signal-to-Noise Ratio
TBC	To Be Confirmed
TBD	To Be Determined
ZPD	Zero Path Difference

2. MODIFICATION TO OPERATIONS

2.1 DEFINITION OF MODIFICATIONS

The following potential modifications to the baseline operation of MIPAS are defined as follows (RD2):

Table 1: Modified operation modes

Acronym	Full name	Description
Ba	Backup mode with Side A	Primary OPD system (side A) One slide fixed
Aa	Asymmetric mode with side A	Primary OPD system (side A) Both slides moving around a limited range around an off-centre position
Bb	Backup mode with Side B	Redundant OPD system (side B) One slide fixed
Ab	Asymmetric mode with Side B	Redundant OPD system (side B) Both slides moving around a limited range around an off-centre position
Ra	Reduced resolution with side A	Primary OPD system (side A) Both slides moving over a limited range
Rb	Reduced resolution with side B	Redundant OPD system (side B) Both slides moving over a limited range
Fb	Full resolution with side B	Redundant OPD system (side B) Baseline mode otherwise

2.2 EXPECTED IMPACTS ON PERFORMANCE

2.2.1 OPD System

Switching from the primary OPD system to the redundant OPD system may have the following impacts:

- Metrology laser wavelength may be different (due to different temperature, drive current or characteristics of the laser diode itself)
- Metrology laser wavelength stability may be different (due to different stability of temperature and drive current or different characteristics of the laser diode itself)
- The OPD sampling may be different (due to different zero-detection thresholds for instance)
- The velocity and velocity stability of the slide(s) may be different (different feedback and control)
- TBD

These technical impacts may affect the performance as follows:

- The spectral stability may change
- The spectral calibration may change
- The spectral linearity may change
- $NESR_0$ may change (if speed stability and sampling were non-negligible contributors)
- Aliasing impact on radiometric accuracy may change since the laser wavelength may be different
- TBD

2.2.2 Modification to the OPD

Switching to the backup mode, the asymmetric mode or the reduced resolution mode has an impact on the number of acquired samples. This, in turn, has an impact on the spectral interval of the resulting spectra. It will have the following performance impacts:

- Spectral calibration will change
- ILS may change
- $NESR_0$ and SNR will change.
- The radiometric calibration scenario will have to be updated; the required number of coadditions to maintain the radiometric accuracy will change.
- If the resolution of the calibration data is coarser than 0.25 cm^{-1}, it will be necessary to repeat test IF11 (high-resolution features in gain).
- The frequency of the pointing mirror will change to accommodate the different sampling time. The artefacts due to the jitters of the pointing mirror might be different.

3. REQUIRED CHARACTERISATION AND VALIDATION

The table below lists the tests from RD1 that are associated to the potential impacts identified in the previous section.

Table 2: Tests associated to identified impacts

Impacts	Related tests
$NESR_0$	IF10
Radiometric calibration scenario	IF6 IF8
Aliasing vs. radiometric accuracy	IF3
Spectral calibration, stability, etc.	IF2
High resolution features in gain	IF11
Raw data	IF16

Considering Table 1 and the identified impacts related to the proposed modification to the operational mode of MIPAS, the table below lists the required and suggested validation activities to be repeated for each option:

Table 3: Required tests for each proposed operation option

Mode	Required tests	Suggested tests
Ba	IF2 IF10 IF6 IF8 IF11* IF16	
Aa	IF2 IF10 IF6 IF8 IF11* IF16	
Bb	IF2 IF3 IF10 IF6 IF8 IF11* IF16	
Ab	IF2 IF3 IF10 IF6 IF8 IF11* IF16	
Ra	IF2 IF10 IF6 IF8 IF11* IF16	
Rb	IF2 IF3 IF10 IF6 IF8 IF11* IF16	
Fb	IF2 IF3	IF6 IF8 IF10

* IF11 must be repeated if the resolution of the calibration data is coarser than 0.25 cm^{-1}

3.1 IMPACT AT OTHER LEVELS

3.1.1 Onboard processing

Since the resolution is downgraded, the data rate of the instrument is not as high as it was initially. Decimation is done to reduce the data rate. Since the new data rate is lower, the decimation can be reduced and re-optimised until the initial data rate is achieved. Since the initial data rate was acceptable, this modification should also be acceptable. The advantage is that it might be possible to decimate in such a way as to remove the aliasing spikes from the useful spectral bands.

3.1.2 Level 1b processing and MICAL

If the OPD is fixed, the calibration data will be acquired at the same resolution as the science data. The ground segment will have to be updated so that the resolution of the calibration can be reduced in order to reduce the noise and improve the radiometric accuracy.

4. CONCLUSION

As of July 2004, it seems that the selected mode will be reduced OPD with primary OPD system (Ra). The following tests need to be repeated:

- IF2 (Spectral calibration)
- IF6 (Radiometric calibration scenario)
- IF8 (Radiometric calibration scenario)
- IF10 ($NESR_0$)
- IF11 (if the resolution of the gain calibration data is coarser than 0.25 cm^{-1})
- IF16 (to verify if the low frequency noise and the pointing jitters have changed significantly)

It is also suggested to recharacterize the ILS and to re-optimize the decimation factors.

The modified operation mode also has no impact on the definition of the in-flight characterizations mentioned above since they all require data in Nominal Mode only. The definition of Nominal Mode needs, however, to be modified; data in Nominal Mode is data acquired at a resolution of 0.061 cm^{-1}.