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Title : IDEAS – ENVISAT 2010+ Mini-commissioning and Cal/Val Plan for GOMOS, MIPAS and SCIAMACHY

Abstract : The scope of this document is to provide an overview of all mini-commissioning phase and Calibration/Validation activities for GOMOS, MIPAS and SCIAMACHY during and after the ENVISAT mission extension maneuvers starting 22 October 2010. The aim is to summarise in a single document all activities and references executed by IDEAS as external groups (ESL, QWG, etc). The document refers to existing documents where applicable and is not repeating activities reported elsewhere in order to avoid duplication.

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AMENDMENT POLICY

This document shall be amended by releasing a new edition of the document in its entirety. The Amendment Record Sheet below records the history and issue status of this document.

AMENDMENT RECORD SHEET

ISSUE	DATE	DCI No	REASON
1.1	08 July 2010		First draft, containing SCIAMACHY inputs
1.2	06 Aug 2010		MIPAS version
1.3	08 Sep 2010		Update of SCIAMACHY part and integration of all instruments
2.0	20 Sep 2010		First complete version including GOMOS input, harmonized for contents and including chapter 2.2 on interface and responsibilities
3.0	4 Oct 2010		Document revised taking into account the comments provided by T. Fehr, mainly updates on the SCIAMACHY section.
3.1	15 Oct 2010		SCIAMACHY section updated following comments from SOST-DLR, minor modifications on MIPAS section.
3.2	... 2010		MIPAS section updated with the inputs collected during the QWG#24 Meeting concerning the instrument characterization plan. Switch-on dates updated taking into account the latest planning.



1. INTRODUCTION

Starting from 22 Oct 2010 the ENVISAT satellite will be placed in a new orbit, 17.4 km lower than the original one, and a new mission phase (E3) will be initiated allowing to save fuel and operate all payloads up to end of 2013 and to maintain orbit manoeuvre capabilities afterwards. The fuel saving will be realized via the termination of the inclination control manoeuvres at the price of a drifting Mean Local Solar Time (MLST).

The impact of the orbit lowering and of the drifting MLST was intensively analysed for all instruments on ENVISAT. In particular, for the Atmospheric-Chemistry sensors (GOMOS, MIPAS and SCIAMACHY) no showstoppers have been identified on the instrument operations and no or minor impact is expected on the data processing or products quality. However, a mini-commissioning of these three instruments will be carried out in order to prevent any unexpected performances degradation.

1.1 Purpose and scope

This document provides an overview of the calibration and validation activities planned for the Atmospheric Chemistry instruments during the ENVISAT 2010+ Mini-Commissioning Phase. These activities will be carried out by the IDEAS GOMOS, MIPAS and SCIAMACHY teams, the Expert Support Laboratories (ESLs), the QWGs and the Instrument provider in case of SCIAMACHY.

The present document is not providing a detailed time planning, but rather an overview for required activities and collecting this information in a unique document. Roles and responsibilities of interfaces will be described in this document, and in this way successful transition to the new mission phase shall be supported. Any activities related to the IPF and operational platform testing and validation before the orbit lowering are not reported in this document.

Main input for the definition of activities is the ESA's document "ENVISAT 2010+ Orbit Change Operations Plan" [RD1] and the dedicated IDEAS Work package description.

1.2 Structure of the Document

The document is divided into a number of major sections that are briefly described below:

Section 2: Overview E2010+ mission extension

Section 3: Description of GOMOS mini-commissioning plan and Cal/Val plan

Section 4: Description of MIPAS mini-commissioning and Cal/Val plan

Section 5: Description of SCIAMACHY mini-commissioning and Cal/Val plan

Section 6: Summary

1.3 Referenced Documents

The following is a list of documents with a direct bearing on the content of this report. Where referenced in the text, these are identified as RD.n, where 'n' is the number in the list below:

RD.1 ENVISAT 2010+ Orbit Change Operations Plan v 0.3, 20/05/2010

RD.2 IDEAS – Compliance Analysis for ENVISAT Mission Extension, IDEAS-VEG-MGT-TSP-0390, Issue 1, 12/03/2010

RD.3 IDEAS GOMOS QCPP, IDEAS-VEG-MGT-PLN-0266, Issue A

RD.4 MIPAS Mission Extension Analysis, ENV-TN-ASG-MP-045, Issue 4, 11/05/2009

RD.5 MIPAS Mission Plan, ENVI-SPPA-EOPG-TN-07-0073, Issue 4.3, 20/01/2008

RD.6 MIPAS LONG-TERM CALIBRATION AND CHARACTERISATION PLAN, ENVI-GSOP-EOPG-TN-03-0008, Issue 1, 03/04/2003

RD.7 ENVISAT MIPAS IN-ORBIT PERFORMANCE REVIEW #16 MINUTES OF MEETING, PE-MN-ESA-MIP-290, 11/06/2010

RD.8 MIPAS INSTRUMENT AND PRODUCTS MONITORING, Issue 1.1, 27/07/2004

RD.9 CONTAMINATION EFFECTS DURING THE 2010 ENVISAT MANOEUVRES, ESTEC/TEC-MPA A. Passaro & Neil Murray, with inputs from E. Krieg and R. Snel, Memo, 07/2010

1.4 Definitions of Terms

The following terms have been used in this report with the meanings shown.

Term	Definition
ADF	Auxiliary Data File
CFI	Customer Furnished Item
CTI	Configurable Transfer Item
ESL	Expert Support Laboratory
EO	Earth Observation
EOM	End Of Mission
EOP	Earth Observation Program department
EOP-GQ	EO Data Quality & Algorithms Management Office
ESA	European Space Agency
ESOC	European Space Operation Centre
ESRIN	European Space Research Institute
ESTEC	European Space Technology Centre
FOCC	Flight Operations Control Center
FOV	Field of View
FOS	Flight Operations Segment
IDEAS	Instrument Data quality Evaluation and Analysis Service
IOP	In-Orbit Performance
IPF	Instrument Processing Facility
ISP	Instrument Source Packet
GOMOS	Global Ozone Monitoring by Occultation of Stars
MIPAS	MIPAS Michelson Interferometer for Passive Atmospheric Sounding
MLST	Mean Local Solar Time
NRT	Near Real Time
OCM	Orbital Control Manoeuvre
OCR	Orbit Change Request



OSDF	Orbit Sequence Definition File
PDGS	Payload Data Ground Segment (excluding Product Quality control Service) Synonym of PDS
PDS	Payload Data Segment (excluding Product Quality control Service) Synonym of PDGS
PLSO	(ESTEC) Post Launch Support Office
QC	Quality Control
QWG	Quality Working Group
RGT	ROP Generator Tool
ROP	Reference Operation Plan
SCIAMACHY	Scanning Imaging Absorption Spectrometer for Atmospheric Chartography
SOST	SCIAMACHY Operations Support Team
TDS	Test Data Set

2. OVERVIEW

2.1 ENVISAT mission extension

The ENVISAT extension orbit will be implemented through an altitude decrease of 17.4 km and via the interruption of the inclination control manoeuvres in order to save fuel. The new orbit will be characterized by a different repeating cycle, going from the actual 35 days/501 orbits to 30/431, and by a drifting MLST that will vary in the +/- 10 min range, while now it is maintained in the +/-5 min range. This is depicted in the figure below.

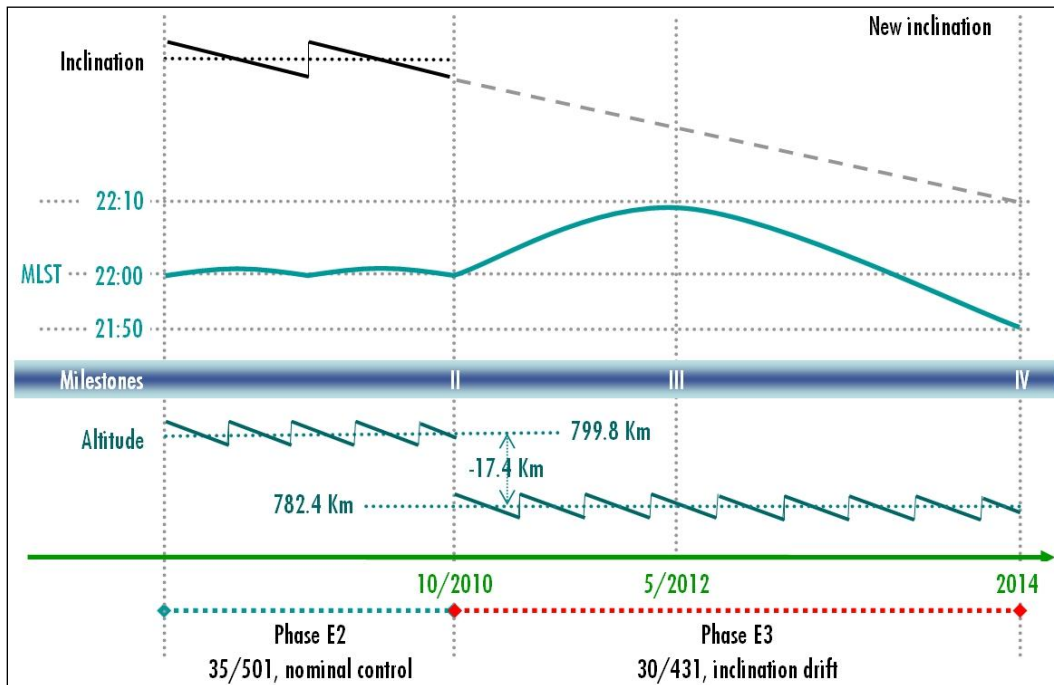


Figure 1: Envisat 2010+ selected Orbit Control Strategy; from RD.1.

The transition to the new phase will be performed according to the following milestones:

- | | |
|----------------------------|---|
| Until 22 Oct 2010 | Nominal ENVISAT Phase E2 mission |
| 22 – 26 Oct 2010 | Orbit Transition phase – Start of orbit manoeuvres to reduce orbit height. Interruption of data processing in PDGS. |
| 26 Oct – 2 Nov 2010 | Start-up Operations Phase – Data not distributed to users, but internally available to Quality Control teams (IDEAS with support from ESL and QWG) for a first check of data quality and for issuing a quality disclaimer. |
| 2 Nov – 31 Dec 2010 | Mini-commissioning Phase – Data distribution to external users resumed with quality disclaimer that will be progressively updated or removed by the Quality Control teams. |
| Jan 2010 – Dec 2013 | Nominal ENVISAT Phase E3 mission |

The new ENVISAT orbit scenario will represent the start of a “new” mission for all payload instruments with significantly changed orbit parameters. Therefore a re-characterization (mini-commissioning) of each system has to be performed. The impact of these changes on the various ENVISAT instruments is variable depending on the different measurement techniques, viewing geometries and processing assumptions.

2.2 ENVISAT 2010+ project interfaces and responsibilities

The overall project of the ENVISAT orbit lowering requires coordination and planning of all related activities in order to prevent any possible impacts and to ensure an adequate information flow to the data users. The project manager dedicated to this is Sergio Vazzana (ESA/ESRIN).

This chapter shall describe at high level the groups and teams involved their responsibilities and the interfaces between the groups. Fig. 1 shows a simplified diagram on the main interfaces.

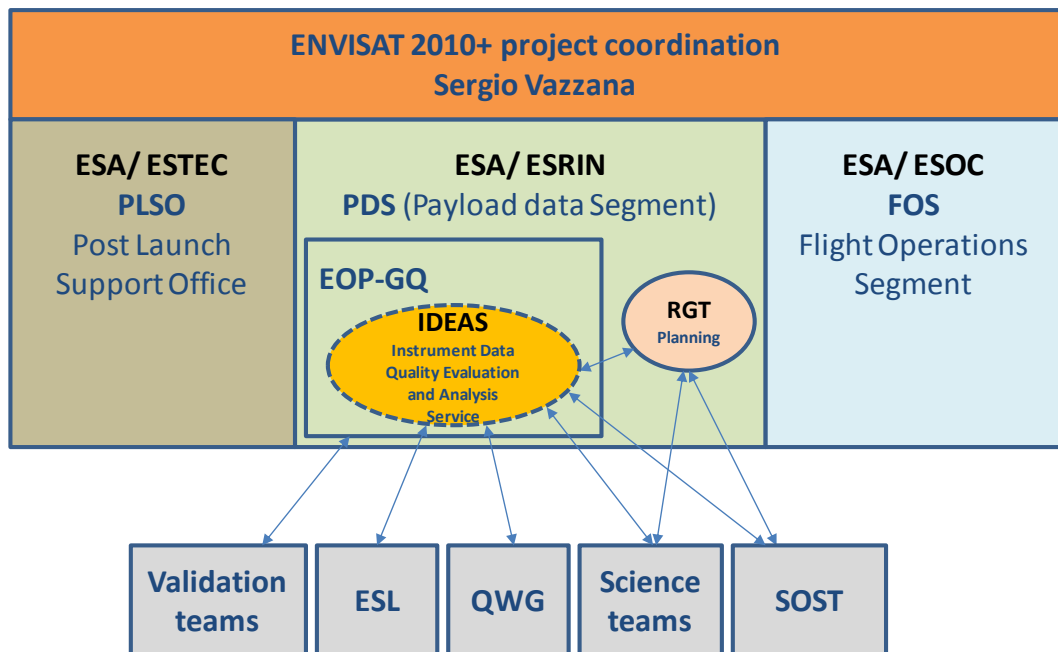


Figure 2: ENVISAT 2010+ interfaces

Regular progress meetings are held on the project, where representatives from ESA (PLSO, PDGS, FOS) teams discuss the status of the single elements in preparation of the change of the operations. A detailed work plan has been established that describes all single Work Packages of the various teams. In support of the main ESA domains PLSO, PDS, FOS several sub teams exist that have dedicated tasks and responsibilities.

To give a better insight view on the different responsibilities, selected relevant Work Packages assigned to the different teams are presented in the following.



2.2.1 ESA/ESTEC – Post Launch Support Office (PLSO)

- Monitoring the performance of ESA satellites in strict collaboration with ESOC/FOS, ESRIN/EOP-GQ, Mission Management
- On board anomaly investigation and coordination of assessments
- Scope to preserve the spacecraft in orbit performance as long as possible
- Definition of new Orbit scenarios
- Aerothermodynamics Section (analysis on thrusters impact)

2.2.2 ESA/ESRIN

- Mission Planning
- RGT Reference Files generation and distribution
- Data product catalogue configuration
- User Services (messages to the customers on WEB Pages and via Newsletters)
- IPF Upgrade and Validation against current orbit scenario (*EOP-GQ/IDEAS*)
- IPF New Orbit Scenario testing (*EOP-GQ/IDEAS*)
- Mini-commissioning Preparation (*EOP-GQ/IDEAS*)
- Quality Control Tools upgrade (*EOP-GQ/IDEAS*)

2.2.3 ESA/ESOC (Flight Operations Segment)

- AOCS Command Checker Verification
- Orbit Manoeuvre Preparation and Verification
- FOS Time Update Function
- FOCC CTI File Verification
- Instrument Switching Operations
- Instrument Commissioning Plan
- Spacecraft Operations Timeline
- Transition Phase Simulation Campaign
- New Reference Ground Track



2.2.4 IDEAS

We focus in this document on the role of IDEAS (Instrument Data Quality Evaluation and Analysis Service), that has a major coordination role entrusted by EOP-GQ in particular to the external groups, like the QWG, ESL etc.

The IDEAS instrument teams for GOMOS, MIPAS and SCIAMACHY are responsible for the operational Instrument Processor Facility (IPF) validation (from an engineering point of view) prior to the transfer to operation. They also perform routine data monitoring in order to assess the data product quality and are responsible for the in-orbit calibration and ADF dissemination. The particular role per instrument linked to the orbit lowering is described as well later on in this document.

Being a part of the PDS team in ESRIN, IDEAS has also direct interfaces with the teams in the PDGS, like for example the Mission Planning team (RGT) or provides support to User queries and prepare user messages (EOHelp).

With IDEAS interfacing as well the ESA elements as the external groups like QWG, it has a privileged role acting as coordinator on behalf of the EOP-GQ technical officer between the above groups.

For SCIAMACHY as an Announcement of Opportunity Instrument, responsibilities on monitoring of data quality aspects are distributed between ESA (IDEAS) and the instrument provider. The SOST team (at DLR and IFE Bremen) carry out dedicated monitoring aspects over level 0 data and DLR is also responsible for the SCIAMACHY instrument planning. Therefore SOST has also direct interfaces with mission planning teams and RGT.



3. GOMOS

3.1 Impact of mission extension on GOMOS

The impact of the new orbit scenario on GOMOS is analysed in [RD.2]. The orbit change is expected to have no impact on the instrument itself. The star acquisition planning tools, in particular STARSSEL, were adjusted. Moreover the orbit change will have no detrimental impact on the quality of Level 1b and Level 2 data, being this dependent upon the instrument degradation.

It is anticipated that no changes of the algorithms are required for either the prototype processor or the IPF. The only modification required for handling the new orbit scenario is the implementation of the new ESA CFI v5.8.1.

However, in order to verify that the instrument and the Ground Segment chain is working as expected a mini-commissioning phase has been planned.

3.2 GOMOS mini-commissioning plan

3.2.1 Overview

In the table below the planning of the GOMOS mini-commissioning and its status is summarized.

Table 1: Overview plan for GOMOS/ENVISAT 2010+ mini-commissioning

Activity	Schedule	Responsible	Comments
Instrument planning	Until 22 Oct 2010	Science Team, QWG	No special requirements
Ground Segment upgrades - Processing	Until 22 Oct 2010	IDEAS	Operational IPF 5.01 ready and verified with non-regression test. IPF test with simulated L0 done No need of updates of the calibration chain, ADF and CTI
Ground Segment upgrades - Planning	Until 22 Oct 2010	RGT	Upgrade of the STARSEL software module done
Preliminary data quality assessment	26 Oct - 1 Nov 2010	IDEAS with support from QWG	Standard daily QC tools ready Nominal monitoring activities will be intensified during these days. Product disclaimers will be issued at the end of this phase as a result of the QC.
Instrument characterization	2 Nov – 31 Dec 2010	IDEAS with support from QWG, PLSO	Daily and long-term monitoring tools and procedures ready Calibration baseline may need to be reviewed in case of unexpected behaviour. If this is the case support from QWG is possibly needed. Product disclaimers will be progressively updated or removed.

3.2.2 Instrument planning

No specific requirements for GOMOS mini-commissioning phase have been put forward by the QWG.

A provisional high level planning is reported below.

Table 2: Provisional GOMOS Mini-Commissioning Phase Planning

Time	Phase	Instrument planning
22 – 26 Oct 2010	Orbit transition phase	As from the latest IOP meeting if contamination were a threat during ENVISAT orbit descent manoeuvres, then the most exposed surface would be the SFM. Heating it up to the Payload Module ambient temperature (20 to 30 degrees, TBC) would be recommended.
26 Oct – 2 Nov 2010	Start-up Operations phase	No special requirements
2 Nov – 31 Dec 2010	Mini-commissioning phase	Nominal measurements and calibration planning baseline should be continued according to [RD.3]

3.2.3 Ground Segment upgrades

In order to handle the new mission scenario the only change needed in the GOMOS processor is the inclusion of the new CFI 5.8.1. The GOMOS processor IPF V5.01 implements this CFI. A non-regression test has been successfully performed to check the correct implementation of the new CFI in the IPF 5.01. Also, a test of the IPF V5.01 with Level 0 NRT input data partly simulating the new orbit scenario has been successfully performed. In the case of the GOMOS prototype only a non-regression test has been necessary and was successfully performed.

No specific changes are needed in the GOMOS calibration chain, in GOMOS ADF and in the CTI.

Table 3: Status of Ground Segment upgrades for GOMOS.

PDGS item	Status	Comment
IPF	Ready	IPF 5.01 includes the CFI 5.8.1 which is compliant with E2010+ scenario. Non-regression test successfully passed. Test with simulated L0 successfully passed.
IPP (prototype)	Ready	Implementation of CFI 5.8.1 and non- regression test successfully passed
Calibration tools	Ready	No need of changes for GOMOS
ADF	Ready	No need of changes for GOMOS
CTI	Ready	No need of changes for GOMOS
QC tools	Ready	Although none of the tools requires any major development, some configuration files need to be modified.

3.2.4 Preliminary data quality assessment

At the moment it is expected that no specific investigation needs to be carried out during these days apart from the nominal daily monitoring baseline [RD.3]. Nevertheless the nominal monitoring activities will be intensified during these days.

Output of this verification phase will be product disclaimers to be issued at the time of data distribution resumption (2 Nov 2010). The disclaimers will contain any quality degradation issue detected during the verification phase.

Table 4: Main parameters to be checked during the initial verification phase

Data	Parameter	Comment
Telemetry	MIP	The Most Illuminated Pixel should be monitored carefully. If it is very far from the current value this could cause star loss during centering phase
Level 1b products	SATU "Y"	A current anomaly affecting the elevation angle and visible on the SATU Y data should be checked.
Telemetry	Starts lost in "DETECTION" or in "CENTERING" sub-modes	It should be checked if the current rate of stars lost in detection and centering phases remains the same.
Level 1b products	Last tangent altitude	The last tangent altitude should be as in the current scenario, any undesired trend could put at risk the main objective of GOMOS mission: ozone profiles
Level 1b products	Quality flags	Non nominal values indicate problems to the instrument or to the processor
Level 2 products	Species profiles	The output of the Level 2 processor should be nominal

3.2.5 Instrument characterization

The standard long term monitoring baseline [RD.3] should be applied during this mission period.

As a result of the daily and long term monitoring, the product quality disclaimers will be progressively updated or removed if no more quality issues are present in the operational products. The nominal ENVISAT Phase E3 mission will start on 1st January 2011, at that time all quality issues are expected to be understood and fixed.

Table 5: Main parameters to be checked during the mini-commissioning.

Data	Parameter	Comment
Telemetry	MIP	The Most Illuminated Pixel should be monitored carefully. If it is very far from the current value this could cause star loss during centering phase
Level 1b products	SATU "Y"	A current anomaly affecting the elevation angle and visible on the SATU Y data should be checked.
Level 1b products	Last tangent altitude	The last tangent altitude should be as in the current scenario, any undesired trend could put at risk the main objective of GOMOS mission: ozone profiles
Level 1b products	Quality flags	Non nominal values indicate problems to the instrument or to the processor



3.3 GOMOS Cal/Val Plan

No dedicated validation measurement campaigns will be performed in the case of GOMOS instrument.

4. MIPAS

4.1 Impact of mission extension on MIPAS

The impact of the new orbit scenario on the MIPAS instrument was extensively analyzed in the reference RD.4. According to this document there are no major constraints or limitations on the extension of the MIPAS mission until the end of 2013. The only initial concern was on a potential sun illumination on the ASU mirror. However, the latest analysis presented in RD.4 has shown that the risk likelihood is very limited and no direct sun illumination should be expected on the inner mirrors.

Concerning the instrument operations, no impact is expected in the data processing and quality. However in order to verify that the instrument and the complete Ground Segment chain is working as expected a mini-commissioning phase should be prepared and properly planned.

4.2 MIPAS mini-commissioning plan

4.2.1 Overview

In the table below the planning of the MIPAS mini-commissioning is summarized with the relevant schedule and the name of the groups which are responsible for each activity. Details on each activity are provided in the following paragraphs.

Table 6: Overview plan for MIPAS/ENVISAT 2010+ mini-commissioning

Activity	Schedule	Responsible	Comments
Instrument planning	Until 22 Oct 2010	Science Team, QWG	No special requirements, a template planning was agreed during QWG#23 meeting. Additional requirements for the instrument characterization period were highlighted during QWG#24 meeting.
Ground Segment upgrades	Until 22 Oct 2010	IDEAS, ESL	Operational IPF 5.05 ready and verified with non-regression test and with simulated L0 data. Level 1 prototype is also ready and was verified with simulated L0 data No need of updates of the calibration chain, ADF and CTI
Preliminary data quality assessment	28 Oct – 1 Nov 2010	IDEAS with support from QWG and ESL	Standard daily QC tools (QUADAS, Beat) are ready, nominal monitoring activities will be intensified during these days. Main parameters to be checked defined in this document. Product disclaimers will be issued at the end of this phase as a result of the QC.
Instrument characterization	2 Nov – 31 Dec 2010	IDEAS with support from QWG, ESL and PLSO	Daily and long-term monitoring tools and procedures are ready. Main parameters to be checked defined in this document. Calibration baseline may need to be reviewed in case of unexpected behaviour. Support will be needed from QWG in order to analyze special in-flight measurements. Product disclaimers will be progressively updated or removed.

4.2.2 Instrument planning

The MIPAS Science Team is responsible for the definition of the instrument planning. The baseline planning (see RD.5) is a general schema that covers all mission events (seasonal-dependent) and it is changed only in case of specific scientific requirements or in case of significant changes in the instrument operations. Similarly, the Calibration and Characterization Plan (see RD.6) was redacted by the MIPAS QWG and was not changed since launch. It provides the basic template to be adopted for instrument calibration and characterization.

In preparation to the new ENVISAT orbit scenario, the question on how to adapt both the instrument planning and the Calibration and Characterization baseline was posed during the last QWG Meetings. So far no specific requirements were defined by the QWG for a MIPAS mini-commissioning phase. A provisional high level planning is reported below.

Table 7: Provisional MIPAS Mini-Commissioning Phase Planning

Time	Phase	Instrument planning
22 – 26 Oct 2010	Orbit transition phase	MIPAS to be put in Heater Mode, as agreed during IOP#16 [RD.7]
28 Oct – 2 Nov 2010	Start-up Operations phase	Nominal planning consisting of: <ul style="list-style-type: none"> • Nominal mode operations. • Daily gain calibration should be planned. • One LOS calibration (if possible)
2 Nov – 31 Dec 2010	Mini-commissioning phase	The following planning for the mini-commissioning phase is envisaged: <ul style="list-style-type: none"> • Nominal measurements and calibration planning baseline to be continued according to RD.5 • Sideways LOS to be planned once during the period (sideways measurements in AE mode are already part of the nominal planning for the winter period) • Special in-flight characterization measurements (see RD.6) to be planned once during this period, in particular: <ul style="list-style-type: none"> ○ IF9 for offset tangent height determination ○ IF10 for NESR₀ verification ○ IF14 for IFOV characterization ○ IF16 raw mode observations

4.2.3 Ground Segment upgrades

The IDEAS team is responsible for the processor upgrades and maintenance in the Ground Segment. The baseline and prototype upgrades are performed by the ESLs: BOMEM for Level 1 and Astrium for Level 2 in the case of MIPAS. The prototype upgrades are coordinated by IDEAS on behalf of ESA. IDEAS team is also responsible for the validation and dissemination of the related ADF and CTI files. The activities to be performed by IDEAS in this frame are detailed in the main ESA's document [RD.1] and we provide here only an overview with the associated status, a summary is also provided in Table 8.

The MIPAS processor modifications needed to handle the new mission scenario are minor and are limited to the inclusion of the new CFI 5.8.1 in the Level 1 processor. No changes are foreseen in the Level 2 processor (ML2PP), which should be able to process all data acquired in the new orbit configuration with an adjusted pointing information file and activated altitude correction.

The MIPAS processor IPF V5.05 implements already the new CFI 5.81, therefore it is in principle ready to handle the new mission scenario. A first non-regression test was successfully performed, verifying the correct implementation of the new CFI in the IPF 5.05. A test with simulated Level 0 products and a simulated orbit state vector in line with the E2010+ scenario has shown that the IPF 5.05 is ready for the operations in the new orbit scenario. The same test was performed with the Level 1 prototype (Migsp) showing that also the prototype processor is ready with the implementation of the new CFI 5.8.1 and for handling the new Level 0 products and state vector file.

For MIPAS there are no specific changes to be implemented either in the calibration chain, in the ADF or in the CTI in order to be aligned with the mission extension.

Table 8: Status of Ground Segment upgrades for MIPAS.

PDGS item	Status	Comment
IPF	Ready	IPF 5.05 implements already the CFI 5.8.1 that are compliant with E2010+ scenario. Non-regression test was successfully passed. Test with simulated L0 products was successfully passed.
IPP (prototype)	Ready	Implementation of CFI 5.8.1 in the Level 1 processor and generation of TDS with L0 simulated products is done. The Level 1 prototype is ready for the new scenario. The Level 2 prototype processor should be able to process all data acquired in the new orbit configuration with an adjusted pointing information-file and activated altitude correction.
Calibration tools	Ready	No need of changes for MIPAS
ADF	Ready	No need of changes for MIPAS
CTI	Ready	No need of changes for MIPAS
QC tools	Ready	No need of changes for MIPAS

4.2.4 Preliminary data quality assessment

The IDEAS team is responsible for the first quality check to be performed during the Start-up Operations phase in the period from 26 Oct to 1 Nov 2010. Support may be requested to ESL or QWG in case of specific anomalies.

At the moment no specific investigation are expected to be carried out during these days apart from the nominal daily monitoring baseline defined by the QWG [RD.8] and implemented operationally using the Quadas tool. Nevertheless, the nominal monitoring activities will be significantly intensified during these days and we will focus on the verification of some specific parameters that are reported in Table 9. These parameters are the ones that are expected to be (potentially) more impacted by the change in the orbit scenario.

The output of this verification phase will be the products disclaimers to be issued at the time of resuming the data distribution to external users (2 Nov 2010). The disclaimer will contain any quality degradation issue that was detected during the verification phase.

Table 9: Main parameters to be checked during the initial verification phase

Data	Parameters	Comment
Gain calibration	Calibration measurements	It should be carefully verified the level of gain with respect to a measurement before the orbit lowering
LOS calibration	Star signal and pointing	The pointing is the crucial parameter of the new orbit scenario, we should carefully verify the pointing stability before and after the orbit lowering
Level 0 products	Cooler acceleration ADC counts	Special attention should be paid to verify the cooler acceleration level and the detector signal (ADC counts), in order to check that the gain tables are the correct ones and there are no contamination effects caused by the manoeuvre (e.g.: particles injected from thrusters)
Level 1 products	Product quality flag NESR level Engineering altitude	We should verify that the Level 1 processing chain works as expected and that the calibrated spectra have a nominal noise level (NESR). Special attention should be paid to the engineering altitude which is the parameter that could be likely affected by the altitude lowering and by the change in the CFI
Level 2 products	Product quality flag Retrieved species Corrected altitude	We should check that the Level 2 processing chain works as expected generating good output data. Special attention should be paid to the corrected altitude computation

4.2.5 Instrument characterization

The IDEAS team is responsible for the instrument characterization to be carried out during the mini-commissioning phase from 02 Nov to 31 Dec 2010. Support may be required from ESL and QWG.

The standard long term monitoring baseline [RD.8] should be applied during this mission period with main parameters to be checked listed in Table 10. Some specific in-flight calibrations were suggested by instrument expert that may be useful for the instrument characterization. In particular, the IF9 sequence for offset tangent height determination and the IF14 for IFOV characterization. The analysis of these special measurements will be made with the support of QWG (BOMEM and DLR).

As a result of the daily and long term monitoring, the products quality disclaimers will be progressively updated or removed if no more quality issues are present in the operational products.

The nominal ENVISAT Phase E3 mission will start on 1st January 2011, at that time all eventual quality issues are expected to be understood and fixed.

Table 10: Main parameters to be checked during the mini-commissioning.

Data	Parameter	Comment
Gain calibration	Gain long term evolution	It is extremely important to verify the level of detector contamination to avoid products quality degradation
LOS calibration	Mispointing long term evolution	It is essential to check the stability of the instrument pointing in the new orbit scenario
Level 0 products	Instrument temperatures	The evolution of the instrument temperature should be investigated to check instrument thermal condition in the new orbit scenario
Level 1 products	NESR level Engineering altitude	The evolution of NESR should be verified to check instrument contamination. The stability of the pointing should be also checked
Level 2 products	Profiles of geo-physical parameters	The zonal mean long term trend of the different target parameters should be checked carefully to highlight any potential drift or systematic error after the orbit change
In-flight calibration	Calibration measurements	The verification of the instrument characterization already performed after launch will be possible using some special in-flight calibration measurements. The measurements analysis will be carried out by DLR and BOMEM.



4.3 MIPAS Cal/Val Plan

Validation activities for MIPAS need to be agreed with the validation teams, requested via Thorsten Fehr (EOP-GQ), in order to get feedback on what commitment will be provided and on plan for validation scenes. Feedback on validation planning shall be collected by IDEAS, in order to act as book captain of the overall planned activities.

No dedicated validation measurement campaigns will be performed for MIPAS. Any geophysical validation with data sets resulting from regularly executed ground based measurement should be coordinated via EOP-GQ with the dedicated validation teams (e.g. EQUAL, VALID, MMVALRO).

The validation teams are responsible for the analysis and geo-physical validation of the data. IDEAS team will act as support to Validation activities.

5. SCIAMACHY

5.1 Impact of mission extension on SCIAMACHY

Extending the SCIAMACHY mission until at least end 2013 has a twofold impact on the instrument's in-orbit performance. The first concerns control of the line-of-sight (LoS) due to the modified orbit and the second how degradation evolves in a mission lifetime which exceeds the originally planned time span considerably.

- Orbit modification: SCIAMACHY as an instrument with multi-viewing capabilities is strongly dependent on the status of the LoS during measurements. Besides the impact of degrading instrument and platform components controlling the LoS, the selected orbital parameters determine how terrestrial and celestial targets can be observed along the orbit. By modifying certain on-board engineering and measurement parameters lowering the orbit is compensated such that the nominal LoS performance can be maintained.
- Continuing degradation: With evolving time the subsystems of the instrument continue to degrade. Thus instrument properties further deviate from both the *Begin of Life (BOL)* and the predicted nominal *End of Life (EOL)* status. Close monitoring of affected subsystems is a means to characterize the changing instrument performance and to establish appropriate countermeasures in data processing.

The orbit manoeuvre required to lower the altitude of the ENVISAT platform was suspected to add contaminants to the optical surfaces of the ASM and ESM mirrors. This was the result of an initial study performed by a specialist team (TEC-MPA) at ESTEC on request of ESA/ESTEC Post Launch Support Team (PLSO). Based on these findings exhaust emission from hydrazine combustion of the thrusters, located in close vicinity of SCIAMACHY, was identified to be a potential risk. The nominal decontamination was not considered to be a suitable mechanism to avoid such a risk because it would not generate sufficiently elevated temperatures on the mirror surfaces. In addition, changing the thermal status of all channels just at the time of the orbit manoeuvre would have hampered identifying performance glitches due to the reduced orbit altitude. Since SCIAMACHY had sustained OCMs using the same thruster over several years without showing signs of exhaust induced contamination it was finally decided to consider the risk of contamination negligible and leave SCIAMACHY in MEASUREMENT TIMELINE mode without having the decontamination heaters on during the manoeuvre period. Detailed optical throughput monitoring is part of the routine monitoring tasks such that any impact of the manoeuvre would be immediately obvious. Details of the contamination study can be found in Memo [RD.9].

5.2 SCIAMACHY mini-commissioning plan

No dedicated mini-commissioning phase is foreseen for SCIAMACHY, as confirmed during the IOP meeting in June 2010 and also during the previous SCIAMACHY QWG progress meeting as well in June 2010.

5.2.1 Overview

In the table below the planning of the SCIAMACHY mini-commissioning and its status is summarized.

Table 11: Overview plan for SCIAMACHY/ENVISAT 2010+ mini-commissioning

Activity	Schedule	Responsible	Comments
Instrument planning	Until 22 Oct 2010	SOST-DLR	Exact planning provided by SOST-DLR to RGT on 28/09. .
Ground Segment upgrade	Until 22 Oct 2010	IDEAS, SOST-DLR	CTI tables provided by SOST-DLR to FOCC on 06/10. SOR for update of engineering parameters provided by SOST-DLR to FOCC on 01/10. Static ADF do not require any update as confirmed by DLR. Dynamic ADFs do not require any change. Generation with SciCal 2.2 and dissemination are under IDEAS responsibility.
Preliminary data quality assessment	26 Oct - 2 Nov 2010	IDEAS with support from QWG	Standard daily QC tools (QUADAS, CODA) are ready, nominal monitoring activities will be intensified during these days. Product disclaimers will be issued at the end of this phase as a result of the QC. Routine HK telemetry and measurement data monitoring by SOST
Instrument characterization	2 Nov – 31 Dec 2010	IDEAS with support from SOST-DLR, SOST-IFE and QWG	Daily and long-term monitoring tools and procedures are ready. Main parameters to be checked defined in this document. Support will be needed from QWG in order to analyze special in-flight parameters. Product disclaimers will be progressively updated or removed.

5.2.2 Instrument planning

SOST-DLR, who is responsible for instrument planning, foresees to operate SCIAMACHY nominally until the first Orbit manoeuvre on 22 October 2010. Three monthly calibration (with moon) measurements before the orbit change 22 October 2010 on three consecutive days (19-21/10/2010) will provide a final characterization in the nominal orbit. These measurements are planned via the OSDF..

Between 22 and 26 October SCIAMACHY will be in MEASUREMENT IDLE mode.

Afterwards operations will be in modified orbit from October 27 onwards based on OSDF. Three monthly calibrations (without moon) at the beginning of routine measurements after the orbit change (planned for 27-30/10/2010) will show the initial instrument status in the modified orbit.

The exact planning was provided from SOST to the Mission Planning team (RGT) at ESRIN; two OSDFs were delivered: OSDF_3601 from October 27 to 31 (orbit 45261-45332) and OSDF_3602 from November 01 to December 31 (orbit 45333-46209). All the measurements are scheduled as nominal except for OSDF_3601 where a monthly calibration sequence is run on three consecutive days to calibration & monitoring purposes after the orbit manoeuvre. These new OSDFs use a new timeline set (set 36) already delivered to FOS.

Table 12: Provisional SCIAMACHY Mini-Commissioning Phase Planning

Time	Phase	Responsible	Instrument planning
22 – 26 Oct 2010	Orbit transition phase	SOST	SCIAMACHY will be in MEASUREMENT IDLE mode
27 Oct – 2 Nov 2010	Start-up Operations phase	SOST	Operations will be in modified orbit from October 27 onwards based on OSDF with monthly calibrations (without moon). Exact planning provided by SOST.
2 Nov – 31 Dec 2010	Mini-commissioning phase	SOST with QWG's recommendations	Nominal measurements as during phase E2 are foreseen.

5.2.3 Ground Segment upgrades

SCIAMACHY CTI table updates are under SOST-DLR responsibility. CTI parameter tables and timelines for operations in the modified orbit are submitted to FOCC via the CTI interface based on an approved OCR with the validity time start parameter compatible with ESA's manoeuvre planning. Engineering parameters for operations in the modified orbit are submitted to FOCC via a SCIAMACHY Operations Request (SOR).

An assessment of ADF header format for all SCIAMACHY dynamic ADFs has been performed. ADFs have an ENVISAT common MPH ASCII header. Generally for ENVISAT data products a new mission phase flag will be used; from E2 to E3.. For SCIAMACHY ADFs (SCI_LK1_AX, SCI_SU1_AX, SCI_SP1_AX, SCI_PE1_AX) this value is always set to "X" and therefore no change will be required from mission phase E3, as the flag is not used for processing constraints.

The static ADFs delivered from the SCIAMACHY ESL, SCI_LI1_AX (initialisation file) and SCI_KD1_AX (key data file) will not require updates in their contents, this has been assessed by DLR.

The update of ADFs resulting from calibration measurements is under IDEAS responsibility.

Table 13: Status of Ground Segment upgrades for SCIAMACHY.

PDGS item	Status	Comment
IPF	Ready	The IPF 7.04 is ready and was successfully certified with non-regression test and validation on simulated Level 0 products.
IPP (prototype)	Ready	The TDS generated with the prototype was delivered by DLR,
Calibration tools	Ready	No need of update for SciCal.
ADF	Ready	The static ADFs delivered from the SCIAMACHY ESL, SCI_LI1_AX (initialisation file) and SCI_KD1_AX (key data file) will not require updates in their contents, this has been assessed by DLR. The update of ADFs resulting from calibration measurements is under IDEAS responsibility.
CTI	Ready	CTI was provided by SOST (measurement parameters and timelines).
Engineering parameters	Ready	SOR was provided by SOST (engineering parameters)
QC tools	Ready	Although none of the tools requires any major development, some configuration files need to be modified.

5.2.4 Preliminary data quality assessment

The commissioning programme will consist of a thorough analysis of calibration and monitoring measurement data and certain HK telemetry. Particular attention has to be given to the derived geolocation (limb/nadir matching and limb profile altitudes).

The IDEAS team will perform close monitoring of the instrument products and ADFs throughout the complete period of the orbit lowering, in particular data between 26 October and 01 November 2010 will be analysed in order to prepare dedicated product disclaimers.

Data products between 26 October and 01 November 2010 will also be made available to the QWG, in order to support the analysis of data quality after the orbit lowering.

At the moment no specific investigations are expected to be carried out during these days apart from the nominal daily monitoring baseline implemented operationally using the Quadas tool. Nevertheless, the nominal monitoring activities will be significantly intensified during these days and we will focus on the verification of some specific parameters that are reported in Table 9.

The output of this verification phase will be the products disclaimers to be issued at the time of resuming the data distribution to external users (02 Nov 2010). The disclaimer will contain any quality degradation issue that was detected during the verification phase with also additional inputs from QWG and SOST on the quality results. The results will be made available either via EOHep or on a dedicated web page, with IDEAS access.

Table 14: Main parameters to be checked during the initial verification phase

Data	Parameters	Responsibility	Comment
LK1 ADF	Calibration measurements	IDEAS	Since the dark signal depends on instrument temperature, and therefore on the position in the orbit, leakage current variation will be carefully verified with respect to measurements before the orbit lowering.
SU1 ADF	Calibration measurements	IDEAS	It will be carefully verified the SMR spectra derived from calibrated SMR/ESM (D0) with respect to measurements before the orbit lowering.
SP1 ADF	Calibration measurements	IDEAS	
PE1 ADF	Calibration measurements	IDEAS	Changes in PPG and Etalon are expected as a consequence of the instrument IDLE.
Dead and bad pixels mask	Calibration measurements	IDEAS, SRON	The dead and pixel mask will be monitored to verify any potential impact from particles injected from thrusters.
MF1 ADF	Calibration measurements	SOST-IFE	Any light path related degradation resulting from the new scenario will be monitored by SOST-IFE with the consolidated long term analysis.

Data	Parameters	Responsibility	Comment
Level 0 products HK telemetry	Operational products	IDEAS, SOST	Special attention should be paid to verify the detectors and optical benches temperatures. Pointing information from scanner readings is analyzed to verify the LoS performance.
Level 1 products	Leakage current variations SMR spectra Source packets Pointing	IDEAS, SOST	We will verify that the Level 1 processing chain works as expected and that the awaited calibrations are correctly applied. Special attention should be paid to the leakage current variations and the sun mean reference spectrum adopted for the spectral calibrations. Special attention should be paid to the pointing of the new orbit scenario. Geolocation information is used to verify performance of limb/nadir matching and limb profile altitudes.
Level 2 products	Product quality flag All retrieved species m-factor results	IDEAS	We will check that the Level 2 processing chain works as expected generating good output data.



5.2.5 Instrument characterization

SOST-DLR and SOST-IFE will continue close monitoring of the instrument status, including quality of the level 0 data during this period.

IDEAS team will be continue the data monitoring as in nominal cases and if necessary, disclaimers will be updated progressively.

If required PRs against the IPF will be opened.

Also QWG will continue close monitoring of data quality after the orbit lowering period.

5.3 SCIAMACHY Cal/Val Plan

In this chapter Geophysical cal/val activities are listed that should be considered for the period after the orbit lowering from 02 November 2010. However some overlap to the previous chapter related to calibration activities may occur.

No dedicated validation measurement campaigns will be performed. Any geophysical validation with data sets resulting from regularly executed ground based measurement should be coordinated via EOP-GQ with the dedicated validation teams (e.g. SCIAVALIG).

5.3.1 Cal/val plan proposal

For SCIAMACHY the planned calibration scene is already described in chapter 5.2.3.

Validation activities have been agreed with the validation teams during the last SCIAVALIG meeting (06/07 September 2010). Validation results will be provided to Thorsten Fehr, EOP-GQ.

5.3.2 In-orbit Calibration

As described in chapter 5.2.3, basically SCIAMACHY monthly calibration measurements before and after the orbit lowering will be executed.

Within the nominal IDEAS QC activities, measurements will be processed to SCI_LK1_AX, SCI_PE1_AX, SCI_SP1_AX and SCI_SU1_AX files with SciCal and disseminated through the IECF to the MMFI system for further processing to Level 1b products.

5.3.3 Geophysical validation of planned scenarios

This activity will be executed by the validations team, as agreed with SCIAVALIG.



6. SUMMARY

The ENVISAT orbit model will be changed starting from 22 Oct 2010 in order to extend the mission up to end of 2013. The new orbit scenario will represent a significant change in the boundary conditions for all payload systems. Therefore a mini-commissioning plan should be defined for each ENVISAT subsystem.

A mini-commissioning plan for Atmospheric Chemistry instruments was presented in this document, describing all the activities to be performed before, during and after the ENVISAT orbit lowering.

The impact of the new orbit model for GOMOS, MIPAS and SCIAMACHY is minor and the Ground Segment modules and QC tools are ready for the new scenario. The instrument planning and the activities to be performed in order to certify the quality of the products in the new mission phase were defined in this document and will be the basis in order to safely operate the instrument until the ENVISAT end of life (end 2013).