GOMOS ESL

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GOMOS
Calibration - Algorithms Verification Plan

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Change Record

Issue	Date	Description		Approval
draft	24/04/99	draft		No
	• initial version			
Is1r0	19/05/99	Issue 1 Rev. 0		No
	• objectives, tasks and MDG consolidated and more detailed			
Is1r1	15/05/00	Issue 1 Rev. 1		No
	• previously named GOMOS commissioning Verification Scenario renamed in GOMOS Calibration-Validation Plan • team composition and organisation, review of tasks including ESA inputs			
Is2r0	15/09/00	Issue 2 Rev. 0		No
	• add executive summary • merging with PO-TN-ESA-GM-974 from R.Fraisse • SODAP and CAL activities description • change pages: all (no change bars)			
Is2r1	22/12/00	Issue 2 Rev. 1		No
	• introduces comments from reviewers			
Is2r2	27/07/01	Issue 2 Rev. 2		No
	• detailed task procedures added • observation sets consolidated • change pages: all (no change bars)			
Is2r3	31/08/01	Issue 2 Rev. 3		No
	• change the title of the plan to more appropriately reflect its terms of reference • include comments provided by the reviewers (Rob Koopman, Tobias Wehr, Erkki Kyrölä, and Torgeir Paulsen). • Section 5.2.3 to include a second level breakdown of the VAL activity together with a clarification of its scope			

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Action Items List

Related task ID	Task	Date	Actionee
V.3.3	Prepare draft commisioning validation observation plan	1/3/2001	T. Wehr
C.2.5	Prepare draft commisioning calibration observation plan	1/3/2001	T.Paulsen
C.2.6	Prepare draft commissioning observation plan for calibration	1/3/2001	R.Fraisse
-	Perform a end-to-end macro-command generation test starting from the observation plan	12/10/2001	ESA / ACRI

1. - Executive summary

1.1 - Organisation

1.1.1 - Overview

Within the overall ENVISAT CAL/VAL, coordinated by Guido Levrini, the GOMOS Calibration and Algorithms Verification team, later refered to as GOMOS CAL/VAL is organised as one group coordinated by Odile Hembise (ACRI-ST) and including two sub-groups:

1. the GOMOS calibration group, coordinated by Torgeir Paulsen (ESA), later referred to as GOMOS CAL.
2. the GOMOS ALgorithms Verification group, coordinated by Odile Hembise (ACRI-ST), later referred to as GOMOS VAL.

GOMOS CAL and GOMOS VAL have been set up, composed of engineers and scientists members of ESA, ESL, ACRI-ST, Matra, AO CAL/VAL project PI, SSF. There is one representative of the GOMOS VAL in the CAL team, and one representative of the GOMOS CAL in the VAL team.

With regards to the ALgorithms Verification activity, this plan does only involve itself with the GOMOS internal validation and to some degree the validation with external sources of data and the MIPAS and SCIAMACHY instruments on the assumption that verified geophysical data from these instruments are made available in time.

1.1.2 - Role of the GOMOS CAL team

The GOMOS CAL team is in charge of i) the full in-flight calibration and re-characterisation of GOMOS, ii) all the activities required to achieve the complete verification of the level 1b processing models, including: algorithms, auxiliary products, instrument performance, and validation of the atmosphere and geolocalisation. The GOMOS CAL team provides also the relevant inputs to the GOMOS mission planning monitoring, and to the future routine calibration operations.

1.1.3 - Role of the GOMOS VAL Team

Within the scope of the commissioning phase activity, the GOMOS VAL team is in charge of all the activities required to achieve the verification of the level 2 processing models, including: algorithms, auxiliary products. The GOMOS VAL team provides also the relevant inputs to the GOMOS mission planning monitoring, and to the future routine validation activities.

In addition to the GOMOS VAL core team, there will be the participation of the GOMOS ESL members and ESA representatives to two internal validation round tables (at L+3.5 months, and L+5 months), followed by the participation to one validation round table organised by the ACVT team (at L+7.5 months) and to the validation workshop (at L+9 months).

1.1.4 - GOMOS CAL/VAL Top level overview

This provides an overview of the ESL CAL/VAL work, the GOMOS CAL/CHAR team and the GOMOS Algorithms Verification team (VAL team) and their place in the context.

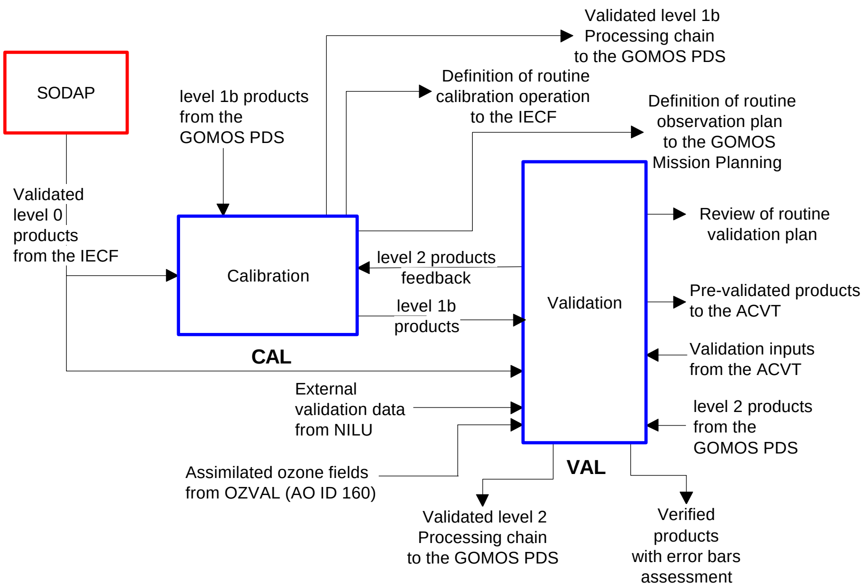


Figure 1.1.4 - 1: GOMOS CAL/VAL top-level organisation

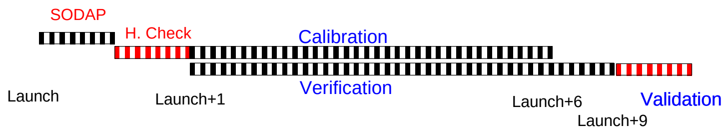


Figure 1.1.4 - 2: GOMOS CAL/VAL top-level timeline

To summarise, the list of all the external interfaces to the GOMOS CAL/VAL is provided below:

1. GOMOS IECF (Instrument Engineering Calibration Facility)
2. GOMOS Mission Planning
3. GOMOS PDS (Payload Data Segment)
4. ENVISAT CAL/VAL
5. Atmospheric Chemistry Validation Team (ACVT)
6. NILU ENVISAT database

1.1.5 - Proposals part of the GOMOS CAL/VAL

The following proposals are fully part of the GOMOS CAL/VAL activity:

- CATSPEC (AOID 233), P.I. Bertaux, is part of the GOMOS CAL activity. CATSPEC intends to monitor the spectro-radiometric sensitivity of GOMOS and proposes to generate a stellar catalogue from the GOMOS stellar spectra measurements.
- GRAZE (AOID 156), P.I. Dalaudier, is part of the GOMOS VAL activity. GRAZE aims to process long lasting occultations (>120 sec.), and to optimise the level 2 algorithms in order to

derive maximum information on the horizontal structures of the atmosphere and their vertical dependency.

- NORM (AOID 190), P.I. Tamminen, is part of the GOMOS VAL activity. NORM intends to validate the GOMOS UV-visible spectrometer data processing algorithms using novel and alternative inversion methods, and comparing the results obtained on both the constituent density estimates and the error estimates.
- LIMBVAL (AOID 648), P.I. Kyrölä, is part of the GOMOS VAL activity. LIMBVAL aims to validate the GOMOS background term measurements by comparing to Odin/OSIRIS and to ENVISAT SCIAMACHY measurements. The possibilities of GOMOS to contribute to studies of natural emissions, especially auroral emissions, will be also investigated, as well as the effect of emissions on the GOMOS data processing.

1.2 - GOMOS CAL activity

1.2.1 - Objectives

The objective of the GOMOS CAL is to achieve at end of the commissioning phase (6 months after launch) a complete GOMOS calibration, including:

- Full in-flight calibration and re-characterisation of GOMOS
- Complete verification of the level 1b processor (tuning of all parameters, regeneration of all L1b auxiliary products)
- Upgrade of the level 1b processor
- Definition of routine calibration operations (to start at the end of the commissioning phase for the whole duration of the mission)[1]
- Definition of routine observation plan

Prior to detail the tasks of the CAL activity, the pre-launch status is provided, together with a brief reminder of the GOMOS instrument measurement concept.

1.2.2 - Pre-launch status

1.2.2.1 - Brief reminder of the GOMOS instrument measurement concept

The GOMOS operating principle relies on the occultation method, which consists to acquire a star outside the atmosphere (thus providing a reference stellar spectrum) and track it as it sets through the atmosphere (thus providing spectra with absorption features). When these occulted spectra are divided by the reference spectrum, nearly calibration-free horizontal transmission spectra are obtained, assuming the instrument response function does not change during one occultation; lasting typically 30 to 40 seconds. These transmissions provide the basis for retrieval of atmospheric constituents density profiles, which benefits from the fact that observing the star light confines the measurement to a "thin" well-defined volume.

1.2.2.2 - Pre-launch activities

[1] The teams mentioned in this document will contribute to the routine observation plan, but technically this is not the objective of the GOMOS Cal activity. Formally, the routine-phase observation plan is the responsibility of the mission manager, who in practice will accept the relevant inputs from the SAGs, instrument teams etc.

On-ground calibration

The instrument was fully calibrated and characterised during the on-ground development and test phase. The measured data have already been exploited and converted into the relevant parameters of the two auxiliary products: the instrument physical characteristics and the calibration products. These products are used as input to the level 1b and level-2 on-ground processors and will serve as the reference performance for in-flight calibration. These products may be updated throughout the commissioning phase.

Calibration preparatory activities

The Calibration team has been settled and the team has started the preparatory activities since more than one year. In particular, the following tasks have been performed:

- the GOMOS Calibration-Validation Plan, ref. PO-AD-ACR-GS-0003, issue 1 rev.1, has been issued on May 15, 2000. Its purpose is to define the detailed plan of all the activities required to achieve the validation of the level 1b and level 2 processing models. In addition, it provides the relevant inputs to the GOMOS mission planning to be prepared in advance to the launch for the whole commissioning period. Detailed Procedures will be integrated before launch in a software tool allowing dynamic real-time management of resources and planning.
- a calibration processor, named CALEX, has been developed and installed at the IECF. CALEX will allow processing the complete in-flight calibration data of GOMOS.
- two calibration exercises involving the complete CAL team have already been carried out. Two more calibration exercises are planned before the launch.

1.2.3 - CAL Tasks

In order to achieve its objectives, the CAL activity has been split into four main tasks as depicted in the folowing figure.

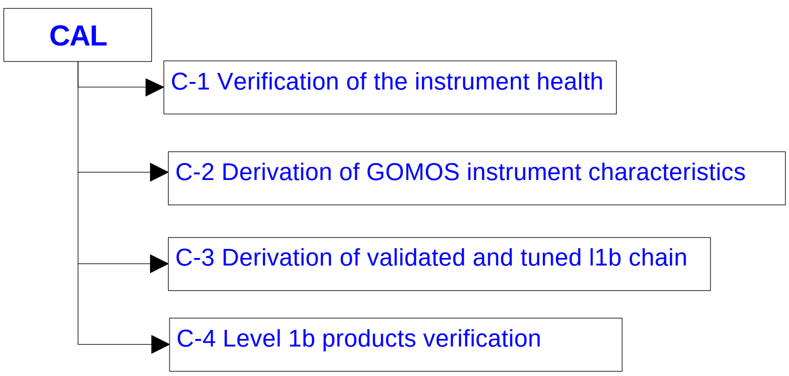


Figure 1.2.3 - 1 - Breakdown of the CAL activity

These tasks are further detailed below.

1.2.3.1 - Verification of the instrument health

The verification of the instrument health activities start just after the SODAP phase which has validated the correct behaviour of the Service Module, Payload Equipment Bay and payload instruments, checked the GOMOS level 0 products format, and verified that the instrument can be commanded as expected.

This first activity may lead to an update of the Instrument physical characteristics and calibration auxiliary products. It may also happen that very small problems (but with huge impact) will be detected during this task leading to an early change of the PDS operational level 1b processor.

Instrument signal level analysis and band setting confirmation

The first task will last two weeks and will be to analyse the instrument signal level (thermistor temperature, dark charge level, SFA angles, SATU data, star spectra shape, limb level) and re-assess the band setting (i.e. verify the location of the star spectra on the CCD in order to validate or redefine the definition of the spatial bands for the observations in occultation and linearity modes). During this task, a first evaluation of the stability of the dark charge versus time and spacecraft latitude will be provided. This first task will last two weeks.

GOMOS tracking capability

As soon as the spatial bands are correctly set, the second task will start and will verify if the GOMOS instrument is able to acquire and track stars outside and through the atmosphere. This task will allow to assess tracking limits (altitude range versus star magnitude) and to verify the dynamic component of the pointing errors that contribute to the dynamic spatial and spectral Line Spread Functions. This second task will also last two weeks.

Instrument performance evaluation

While the calibration activity is dedicated to the verification and possibly to the update of the instrument characteristics, the aim of the "Instrument Performance Evaluation task" is to assess the instrument behaviour during the observations from the engineering and scientific points of view. The verification of several assumptions made on the instrument will be also checked during this task.

The study of the internal straylight level, the dark charge variation along the orbit, the effect of band setting, the effect of SFA angles and of the polarisation on the recorded signal are directly related to the instrument and are more on the *engineering side* of the performance evaluation. The study of the Rayleigh scattering, the occurrence of Mesospheric clouds, the aerosol characterisation, the capability of the instrument to observe the Moon, the planets or double stars as well as the instrument performance in bright limb conditions are more related to the *scientific side* of the performance evaluation.

Preliminary analysis will be performed as far as possible with the time frame dedicated to this task (9 weeks) in order to detect features not included in the processing chains that may have a strong impact on the product quality. The conclusions of this task may have a direct impact on the processing chain algorithms through the modification of algorithms or through the choice of the operational processing options when several ones exist.

1.2.3.2 - Derivation of GOMOS Instrument characteristics

Due to the launch and in-orbit environments, several instrument characteristics may be modified like the instrument response function, thermal distortion and settling of the optical bench, ... and this calls for calibration and monitoring of GOMOS parameters: Electronic gain chain, read-out noise and offset, Non linearity, Dark charge, Pixel response non-uniformity, Radiometric sensitivity, Spectral line spread function, Wavelength assignment, Vignetting, and Straylight.

After having verified that the GOMOS Calibration Processor (CALEX) integrated in the IECF performs as expected using real measurements, the proper in-flight calibration activity will start. The primary objective of this task is to re-assess the instrument parameters and to validate (including possible updates) the two auxiliary products:

Auxiliary Product description	PDS name
Instrument physical characteristics	GOM_INS_AX
Instrument calibration	GOM_CAL_AX

A first in-flight calibration will start six weeks after launch and will last three weeks. During this task, a number of targets (stars, dark regions and limb) will be acquired using the three instrument monitoring modes (linearity mode, spatial spread monitoring mode and uniformity mode). These data sets will be processed using CALEX and analysed.

One month after the completion of the first in-flight calibration, a second in-flight calibration will be performed over two weeks. This 2nd calibration will allow identifying the deviations with respect to the first calibration phase, deriving the trends in order to set a calibration time frequency, updating the calibration auxiliary product if necessary.

Two other major outcomes are expected from this task:

1. *from the initial trends analysis, it is planned to define the routine calibration operations, ready for the end of the commissioning phase ;*
2. *from the analysis of the calibration activities performed during the commissioning, it is planned to specify the schedule and observation plan requirements for in-flight calibration*

1.2.3.3 - Derivation of validated and tuned level 1b processing chain

The main level-1b product of GOMOS is geolocated and spectrally calibrated transmission absorption spectra. Prior to calculating the transmission the individual spectra are corrected for saturation, cosmic rays, dark charge, detector response variation (PRNU), offsets and non-linearity. The spectra are furthermore spectrally shifted using the tracking unit pointing shift data. The precise geolocation of the transmission spectra is computed, using the satellite and star positions, and a ray tracing model through the atmosphere characterised using ECMWF data combined with a climatological model above the ECMWF upper pressure level.

The objective of this task is to verify each individual processing step with respect to each model assumptions taken, and to tune each model parameters.

Level 1b processing chain verification (step by step)

The first task of the level-1b processing check activity will be to ensure the internal correctness of the above processing steps, and to verify that the processor operates as expected according to the configuration options. This task will start five weeks after the launch and will last two weeks.

Tuning of level 1b processing parameters

As soon as the level 1b chain is verified at module level, the second task will start and will consist to tune the parameters of the level 1b processing chain in order to confirm or identify the new operational configuration. This task will last three weeks.

The auxiliary product which may be updated during this task is:

Auxiliary Product description	PDS name
Level-1b processing configuration product	GOM_PR1_AX

Upgrade of the level 1b processor and configuration parameters

The two previous tasks may have implied changes either in the processing chain or in the level 1b processing configuration product. The objective of this task is to ensure that the modifications are properly transmitted and implemented in the level 1b operational processor.

The outcome of this task is possibly a new version of the GOMOS level 1b processor, which will be updated twelve weeks after the launch.

1.2.3.4 - Level 1b products verification

A specific activity dedicated to the validation of the two level 1b products will start as soon as the level 1b chain is verified at module level, and will last 17 weeks.

The products that will be validated during this task are:

Product description	PDS name
Geolocated calibrated transmission spectra and photometer fluxes	GOM_TRA_1P
Geolocated calibrated background spectra	GOM_LIM_1P

The analysis of the products will also lead to provide recommendations for the routine observation plan.

Verification of data coherency (range ….)

This activity will focus on the level-1b products quality and consistency. It will check the range of each level 1b product MDS (Measurement Data Set) items. It will analyse the self coherency of GOMOS products (e.g. the instrument pointing direction and the deviation, the transmission at the same location observed by different stars, the photometer data and the spectrally integrated spectrometer data,....).

Validation of geolocation and atmosphere level 1b products

The objective of this task is to analyse and validate the level 1b geolocation and atmosphere products. This task will start after the upgrade of the level 1b processor and will last 13 weeks. It will require the comparison with external data at specific locations, the comparison between the level 1b NRT and analysis products, which relies either on forecast or analysis ECMWF products.

Validation of stellar derived products (CATSPEC - AO ID 233)

This task is fully covered by the AO proposal, ID 233, named CATSPEC. The objective of this task is to analyse the stellar spectra products, and create a stellar spectra database. This may also lead to update the star catalogue product (GOM_CAT__P).

The product that will be created during this task is:

Auxiliary Product description	PDS name
Stellar spectra product	GOM_STS_AX

This task will start as soon as the spatial bands are correctly set, and will last throughout the commissioning phase, and will be also pursued later.

Data flagging monitoring and statistics

As soon as the spatial bands are correctly set, the monitoring of the data flagging of the level 1b and limb products will start and will provide useful indications to all the other tasks of the GOMOS commissioning.

This task will last throughout the commissioning phase, and will be also maintained later, during the routine operations.

1.3 - GOMOS VAL activity

1.3.1 - Objectives

The objective of the GOMOS VAL is to achieve by the Validation Workshop (9 months after launch) a complete GOMOS algorithms verification and a preliminary GOMOS validation carried out on the basis of GOMOS data and preliminary results of some validation campaigns, including:

- Verification of the level 2 processor (tuning of all processing parameters, first regeneration of all L2 auxiliary products)
- Consistent geophysical products (at end of commissioning phase)
- Upgrade of the level 2 processor
- Assessment and quantification of errors (prior to the validation workshop).
- Definition of routine validation activities as far as progress with respect to validation activity will have been achieved within a limited time period (i.e. until the validation workshop).

1.3.2 - VAL Tasks

In order to achieve these objectives, VAL activity has been split into three main tasks as depicted in the following figure.

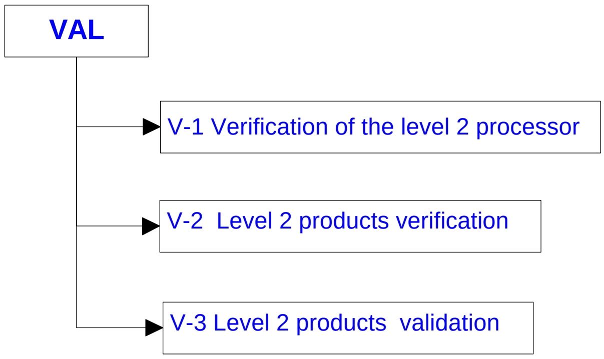


Figure 1.3.2 - 1 - Breakdown of the VAL activity

These tasks are further detailed below.

1.3.2.1 - Verification of the level 2 processor

The transmission spectra that come from the GOMOS level-1b product are first corrected for dilution and scintillation effects; the remaining transmission can then be connected to the atmospheric constituent densities (O_3, NO_2, NO_3, aerosols, Rayleigh, O_2, H_2O), whose retrieval is the main mission objective of the GOMOS instrument. The inversion is then performed in a sequential way: first a spectral inversion is performed and produces horizontal column densities of different constituents; then a vertical inversion is performed, assuming a local purely radial dependence of the atmosphere, and produces local density profiles of the constituents. Iterative loops over the spectral and vertical inversion may be performed. A high-resolution temperature profile is also retrieved from the exploitation of the time delay between the two photometers data.

Level 2 processing chain verification (step by step)

The first task of the level 2 processing chain verification activity will be to check that the level 2 processing chain can process level 1b products generated by the level 1b processing chain when using a predefined processing configuration auxiliary product. The main level 1b data are the transmission spectra at different tangent heights. Photometry data from the two fast photometers are used to correct the transmissions for the scintillation effects. But photometry data are also used to retrieve a high-resolution temperature profile of the atmosphere. The geolocation data and the *a priori* atmospheric data are necessary information in dealing with the refractive effects and in initialising the inversion.

The second task will be to ensure the internal correctness of the above processing steps, and to verify that the processor operates as expected according to the configuration options. This task will last three weeks and will start as soon as one level 1b product MDS is in the coherency range, assumed to happen seven weeks after the launch.

Tuning of level 2 processing parameters

As soon as the level 2 chain is verified at module level, the second task will start and will consist to tune the parameters of the level 2 processing chain in order to confirm or identify the new operational configuration. This task will last four weeks.

The auxiliary product that may be updated during this task is:

Auxiliary Product description	PDS name
Level 2 processing configuration product	GOM_PR2_AX

Upgrade of the level 2 processor and configuration parameters

The two previous tasks may have implied changes either in the processing chain or in the level 2 processing configuration product. The objective of this task is to ensure that the modifications are properly transmitted and implemented in the level 2 operational processor.

The outcome of this task is possibly a new version of the GOMOS level 2 processor that will be updated 16 weeks (3.5 months) after the launch.

1.3.2.2 - Level2 products verification

GOMOS products consistency verification

This activity will focus on the level 2 products quality and consistency. It will check the range of each level 2 product MDS (Measurement Data Set) items. It will analyse the self coherency of GOMOS products (e.g. self-consistency of dilution, Rayleigh, and O2, self-consistency of NO_2, NO_3 and O_3, consistency of the retrieved species at the same location observed by different stars,...). It will also check the consistency of GOMOS products with dynamics chemistry transport model prediction (the MSDOL model developed by the team in charge of the GOMOS validation will run continuously during the validation period) and climatology trends.

This activity will strongly rely on the residual extinction product that will be continuously monitored during the activity as it contains the transmission corrected for scintillation and dilution together with the transmission model, thus allowing the tracking of any unexpected spectral features.

This task will start as soon as the level 2 chain is verified at module level, and will last ten weeks.

Data flagging monitoring and statistics

As soon as the level 2 chain is verified at module level, the monitoring of the data flagging of the level 2 and residual extinction products will start and will provide useful indications to all the other tasks of the GOMOS commissioning.

This task will last throughout the commissioning phase, and will be also maintained later, during the routine operations.

1.3.2.3 - Level2 products preliminary validation

A specific activity dedicated to the validation of the level 2 products will start as soon as the level 2 chain is verified at module level, and will last 6 months (until the validation workshop). This activity may obviously have an impact on the final recommendations of processing parameters setting.

The products that will be validated during this task are:

Product description	PDS name
GOMOS temperature, atmospheric constituents profiles	GOM_NL__2P
Residual extinction	GOM_EXT_2P
Meteo user products; Extracted profiles at reduced spatial resolution for NRT dissemination to meteo users	GOM_RR__2P

Two other major outcomes are expected from this task:

1. it is planned to define the routine validation activities from the synthesis of all the validation activities;

2. from the analysis of the level 2 products produced during the commissioning, it is planned to specify the observation plan requirements for the routine observation plan.

GOMOS products preliminary validation with external data

Before scientific investigations of trends and of agreements with model predictions are carried out using GOMOS measurements, it is essential to conduct validation campaigns of the atmospheric parameters measured by GOMOS with measurements of the same parameters from other sensors. Different classes of observation techniques will be used for the validation. A common problem for all validation measurements will be to measure as simultaneously as possible in space and time with GOMOS. Furthermore, the vertical resolution and horizontal smearing of the measurement will be very different for most of the validating instruments. Two strategies will be applied to overcome this problem:

1. The GOMOS mission planning will try to plan GOMOS measurements as close as possible to the validating instruments (i.e. within 200 km). This will be easiest for ground-based instruments, which are observing 24 hours a day, but it will be rather difficult for balloon campaigns.
2. The GOMOS data will be assimilated in atmospheric chemistry-transport models, which can calculate via their atmospheric models the state of the atmosphere on the exact location and time of the validating instruments.

The activity will include an intercomparison with other ENVISAT products that will obviously not be complete as the external products from ENVISAT will not be fully validated at that time. For example, the instruments MIPAS and SCIAMACHY will each measure, amongst other parameters, O_3, NO_2, aerosol and temperature. MERIS and AATSR may also provide relevant information, for example measures of aerosol properties.

This task will start as soon as the level 2 chain is verified at module level, and will last until the end of the validation phase (validation workshop).

1.4 - Observation plan

The whole commissioning tasks rely so far on 5 observation sets, characterised each by a set of requirements defined to cover all the needs of the commissioning tasks. The main characteristics of these observation sets are provided in the table below.

Observation set	GOMOS CAL/VAL task	Schedule
OS0 - OS1	SODAP activity	first four weeks only
OS2	Verification of he instrument health	only once, within the first two weeks
OS3	Instrument calibration	every one or two weeks over the whole commissioning period
OS4	Instrument performance evaluation	2 weeks spread over about one month
OS5	Level 1b and level 2 verification & validation	continuously, from T0+2 weeks (*)

(*) T0 is the first day of availability of the GOMOS data.

The observation set OS5 is further detailed as:

Observation sub-set	GOMOS CAL/VAL task
OS5-1	Processing chain verification & tuning
OS5-2	Internal consistency verification
OS5-3	Validation with external data

OS5-4	GOMOS/MIPAS comparison
OS5-5	GOMOS/SCIAMACHY comparison
OS5-6	Occultation for GRAZE project
OS5-7	Occultation for specific user requests

The first week of observations will be fully dedicated to the SODAP activity (*OS0*), followed by the verification of the instrument health - signal level, band setting, tracking capability (*OS2*). Then, a background routine observation activity starts (including *OS5-2* and *OS5-3*), interrupted by planned observation campaigns for calibration (*OS3*), instrument performance evaluation (*OS4*), punctual rendez-vous with MIPAS (*OS5-4*) or SCIA (*OS5-5*), GRAZE project (*OS5-6*) and some specific user request (*OS5-7*).

The observation set *OS5-1* is actually made of the collection of three other observation sets: *OS1b*, *OS2c* and *OS2d*.

A calibration campaign is performed every week during the first 3 months and then every two weeks the last three months of the commissioning period. The first calibration observation campaign occurs at T0+2 weeks.

The observation campaign for instrument performance evaluation is split into 2 weeks of observations to be performed from T0+2 weeks to T0+7 weeks (one month). The astronomical constraints of these observations make them impossible to plan without knowing exactly the launch date. A coarse evaluation is that a maximum of 2 weeks (several observation sub-sets may perhaps be performed the same day) has to be reserved.

2. - Introduction

2.1 - Purpose and scope

This document is part of the ENVISAT commissioning plan, dedicated to the commissioning of the GOMOS G/S, including the full in-flight calibration and re-characterisation of GOMOS.

Its purpose is to define the detailed plan of all the activities required to achieve the verification of the level 1b and level 2 processing models, including: algorithms, auxiliary products, in-flight calibration, and instrument performance.

With regards to the validation activity, this plan does only involve itself with the GOMOS internal validation and to some degree the validation with external sources and with the MIPAS and SCIAMACHY instruments on the assumption that verified geophysical data from these instruments are made available in time.

In addition, this document provides the relevant inputs to the GOMOS mission planning to be prepared in advance to the launch for the whole commissioning period.

At high level, the plan provides the overall organisation and planning, the general rules for the validation procedures, the interface with all the external entities.

At detailed level, the plan specifies, down to the level of each unit task, the following items:

- objective
- schedule (duration, provisional start, prerequisites)
- procedure,
- task responsible,
- detailed involved team.

Procedures are integrated in a software tool allowing dynamic real-time management of resources and planning.

2.2 - Context

This plan is prepared in advance to the ENVISAT launch, assumed to be mid October 2001. It covers the period November 2001 until end of July 2002.

The verification scenario relies on a full simulation of the GOMOS mission during the commissioning period, based on our best knowledge derived from the following tools:

- GOSS: GOMOS system simulator able to generate representative GOMOS packets, taking into account the GOMOS instrument characteristics, the observation geometry, the environment (star, atmosphere, limb). GOSS includes also a Mission Scenario tool.
- GOPR: fully representative prototype of the GOMOS level 1b and level 2 PDS.
- CALEX: GOMOS in flight calibration tool.

2.3 - Intended Readership

This document is intended to the participators of the ENVISAT CAL/VAL, especially to the GOMOS CAL/VAL team in charge of implementing the plan during the commissioning.

It assumes familiarity of the reader with ENVISAT context, thorough expertise of the GOMOS mission, and the general and detailed principles of GOMOS data processing.

2.4 - Structure of the document

This document is structured as follows:

- the first chapter is the executive summary of the CAL/VAL plan giving to the reader a quick high level description of what will be performed during the GOMOS commissioning phase;
- the second chapter is the introduction, providing an overview of the objectives of each commissioning task, scope and context, the intended readership and the authors;
- the third chapter gives an overview of the organisation, team composition, individual roles of team members, plus an overview of the external interfaces;
- the fourth chapter gives a description of the methods, standards, rules, definitions, environment, database, tools that are applicable to the preparation of the plan, and later to its implementation;
- the fifth chapter gives an overview of the GOMOS CAL/VAL activity, including objectives, milestones, task breakdown, logic, and schedule;
- the sixth, seventh and eighth chapters and associated appendices provide the description of the CAL/VAL tasks down to the detail level;
- the ninth chapter gives the initial inputs to the mission planning in terms of observation requirements, and preliminary schedule;
- the chapter 10 provides the cross-reference between all the commissioning tasks and all the products/parameters intended to be checked and or validated during the commissioning;
- finally, the chapter 11 lists all the tools required to properly achieve the identified tasks of the commissioning.

2.5 - Authors

This document is the outcome of a joint activity performed by a scientific and engineering group involved since the beginning in the specification of the GOMOS processing algorithms. The team is led by ACRI. The following institutes participate to the scientific team that is referred to as "Expert Support Laboratory" (ESL):

- the Finnish Meteorological Institute (FMI), (Finland);
- the Service d'Aéronomie (S.A.), (France);
- the Institut d'Aéronomie Spatiale de Bruxelles (IASB.), (Belgium).

In addition, contributions are also provided by the other members of the GOMOS CAL/VAL team, especially from the ESA ESTEC and ESRIN representatives, and from the GOMOS instrument contractor.

3. - Organisation

3.1 - Overview

The GOMOS CAL/VAL is part of the general ENVISAT CAL/VAL coordinated by Guido Levrini.

Within the overall ENVISAT CAL/VAL, the GOMOS Calibration and Algorithms Verification team, later refered to as GOMOS CAL/VAL is organised as one group coordinated by Odile Hembise (ACRI-ST) and including two sub-groups:

1. the GOMOS calibration group, coordinated by Torgeir Paulsen (ESA), later referred to as GOMOS CAL.
2. the GOMOS ALgorithms Verification group, coordinated by Odile Hembise (ACRI-ST), later referred to as GOMOS VAL.

GOMOS CAL and GOMOS VAL have been set up, composed of engineers and scientists members of ESA, ESL, ACRI-ST, Matra, AO CAL/VAL project PI, SSF. There is one representative of the GOMOS VAL in the CAL team, and one representative of the GOMOS CAL in the VAL team.

3.2 - GOMOS CAL team

3.2.1 - Role of the team

The GOMOS CAL team is in charge of i) the full in-flight calibration and re-characterisation of GOMOS, ii) all the activities required to achieve the validation of the level 1b processing models, including: algorithms, auxiliary products, and instrument performance. The GOMOS CAL team provides also the relevant inputs to the GOMOS mission planning monitoring, and to the future routine calibration operations.

3.2.2 - Team members

The GOMOS CAL team consists of the following people:

- Torgeir Paulsen (ESA) *as coordinator*
- Gilbert Barrot (ACRI-ST) *as GOMOS level 1b processing and CALEX expert*
- Pascal Lecomte (ESRIN) *as ESA representative responsible for the routine operation plan*
- Jean-Loup Bertaux (SA) *as ESL member and CATSPEC PI (AO ID 233*)
- Alain Hauchecorne (SA) *as ESL member (expert on atmosphere)*
- Johanna Tamminen (FMI) *as ESL member*
- Renaud Fraisse (Matra) *as GOMOS Instrument contractor representative*
- Antoine Mangin (ACRI-ST) *as expert on geolocalisation*
- Olaf Frauenberger (SSF) *as GOMOS operational processor representative*
- Odile Hembise (ACRI-ST) *as GOMOS VAL representative and overall coordinator*

3.3 - GOMOS Val Team

3.3.1 - Role of the team

Within the scope of the commissioning phase activity, the GOMOS VAL team is in charge of all the activities required to achieve the verification and validation of the level 2 processing models, including:

algorithms, auxiliary products. The GOMOS VAL team provides also the relevant inputs to the GOMOS mission planning monitoring, and to the future routine validation activities.

3.3.2 - Team members

- Odile Hembise (ACRI-ST) *as coordinator*
- Alex Popescu (ESTEC) *as ESA representative coordinator*
- Pascal Lecomte (ESRIN) *as ESA representative responsible for the routine operation plan*
- Antoine Mangin (ACRI-ST) *as level 2 processing expert*
- Alain Hauchecorne (SA) *as ESL member and level 2 processing expert*
- Erkki Kyrölä (FMI) *as ESL member and LIMBVAL PI (AO ID* 648)
- Johanna Tamminen (FMI) *as ESL member and NORM PI (AO ID* 190)
- Francis Dalaudier (SA) *as ESL member and GRAZE PI (AO ID* 156)
- Olaf Frauenberger (SSF) *as GOMOS operational processor representative*
- Torgeir Paulsen (ESA) *as GOMOS CAL representative*

In addition to the GOMOS VAL core team, there will be the participation of GOMOS ESL members to two validation round tables (at L+3.5 months, and L+5 months). The participants to the validation round tables will be:

- Odile Hembise (ACRI-ST)
- Antoine Mangin (ACRI-ST)
- Erkki Kyrölä (FMI)
- Johanna Tamminen (FMI)
- Liisa Oikarinen (FMI)
- Didier Fussen (IASB)
- Jean-Loup Bertaux (SA)
- Francis Dalaudier (SA)
- Alain Hauchecorne (SA)
- Torgeir Paulsen (ESTEC)
- Pascal Lecomte (ESRIN)
- Tobias Wehr (ESTEC)

3.4 - Proposals part of the GOMOS CAL/VAL

The following proposals are fully part of the GOMOS CAL/VAL activity:

- CATSPEC (AOID 233), P.I. Bertaux, is part of the GOMOS CAL activity. CATSPEC intends to monitor the spectro-radiometric sensitivity of GOMOS and proposes to generate a stellar catalogue from the GOMOS stellar spectra measurements.
- GRAZE (AOID 156), P.I. Dalaudier, is part of the GOMOS VAL activity. GRAZE aims to process long lasting occultations (>120 sec.), and to optimise the level 2 algorithms in order to derive maximum information on the horizontal structures of the atmosphere and their vertical dependency.
- NORM (AOID 190), P.I. Tamminen, is part of the GOMOS VAL activity. NORM intends to validate the GOMOS UV-visible spectrometer data processing algorithms using novel and

alternative inversion methods, and comparing the results obtained on both the constituent density estimates and the error estimates.

- LIMBVAL (AOID 648), P.I. Kyrölä, is part of the GOMOS VAL activity. LIMBVAL aims to validate the GOMOS background term measurements by comparing to Odin/OSIRIS and to ENVISAT SCIAMACHY measurements. The possibilities of GOMOS to contribute to studies of natural emissions, especially auroral emissions, will be also investigated, as well as the effect of emissions on the GOMOS data processing.

3.5 - GOMOS CAL/VAL external interfaces

The list of all the external interfaces to the GOMOS CAL/VAL is provided below (see also the following figure):

1. GOMOS IECF
2. GOMOS Mission Planning (RGT - Reference Operation Plan Generation Tool)
3. GOMOS PDS
4. ENVISAT CAL/VAL
5. Atmospheric Chemistry Validation Team
6. NILU ENVISAT database

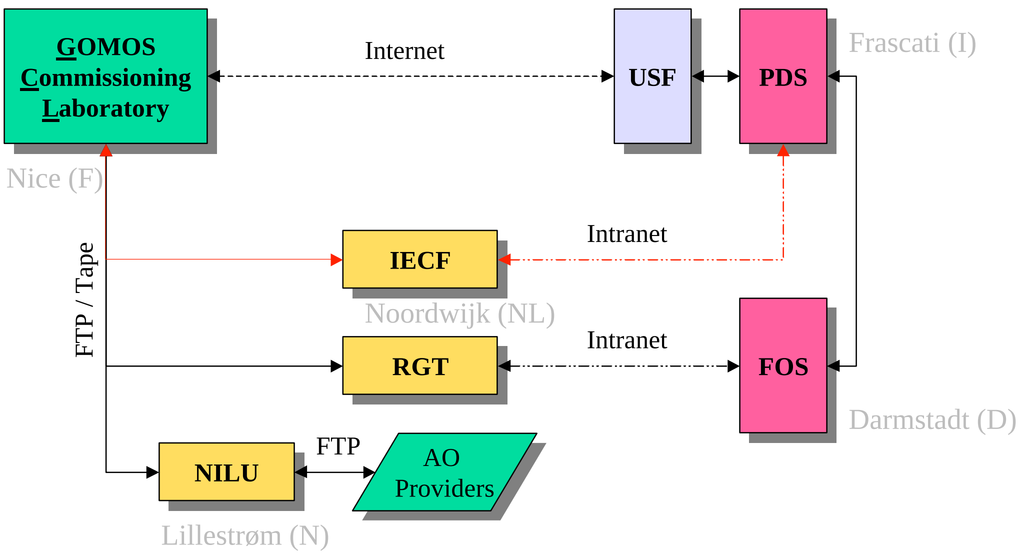


Figure 3.5 - 1*: GOMOS CAL/VAL interfaces*

The following chapters section briefly describe the contents of each interface in terms of input data, output data, events...

3.5.1 - Interface with the GOMOS IECF

Commissioning observation plan:

The GOMOS CAL/VAL team is responsible for defining the commission planning objectives. They are also responsible for defining appropriate targets and approximate time lines to meet the CAL/VAL objectives.

The ENVISAT ROP Team (Reference Operation Plan) is responsible for converting these requests, using the RGT (ROP Generation Tool), into mission planning files (basically time ordered macro-commands) as used by the mission operation center (ESOC) for commanding the instrument. In this sense, the CAL/VAL team interfaces with ESOC only via the ROP team.

Operational mission plan

The GOMOS CAL/VAL also covers the update of the operational mission plan after the commissioning: a validation round table will be responsible for proposing updates to the plan according to the commissioning activity outcome. The reviewed operational plan is proposed to the ENVISAT mission manager who will approve the plan on advice from the GOMOS SAG. This mission plan is in return named the “GOMOS Background Mission Plan” as is approved by the PB-EO. This plan is then becoming the default GOMOS mission plan, only interrupted by specific user requests. (See RD-8 for further details).

3.5.2 - Interface with the GOMOS mission planning

There are interaction in both senses between the GOMOS CAL/VAL and the GOMOS macro-command generation centre. The GOMOS CAL/VAL sends mission planning requests from the different CAL/VAL tasks, and checks that they are correctly understood and translated into macro-commands, that the macro-commands are sent to the instrument and that the corresponding observations are downloaded to the GOMOS CAL/VAL and locally archived.

The definition or the update of the observation plans during and after the commissioning is also an activity covered by the GOMOS CAL/VAL. The GOMOS CAL/VAL is responsible to transfer the observation plan definition or update into the observation plan document to be sent to the macro-command generation centre.

The interface is handled by the MOP (Management of the Observation Plan) team.

3.5.3 - Interface with the GOMOS PDS

The commissioning activity of the CAL/VAL is first performed in the Commissioning Working Environment with respect to the software modification, followed by an upgrade of the operational processing chain. The interface between the GOMOS CAL/VAL and the GOMOS PDS is through updated Detailed Processing Model documents and associated Test Data Sets in order to implement the modifications in the PDS operational processing chains.

The initial status of the PDS and CWE processing chains is called release V0 corresponding to a software version and initial auxiliary products. A first set of updates (level 1b release V1) will be provided at the end of the level 1b processing tuning and a second one will be provided at the end of the level 2 processing tuning (level 2 release V1). These updates include both processing modifications and auxiliary products update.

One must note that if only very small problems (but with huge impact) have been detected at a earlier stage, the PDS operational chain should be modified, reaching an intermediate update level V0a.

The following graphic presents the four chains used during the commissioning i.e. a *working chain* and an *operational* chain for the CWE and the *development* and *operational* PDS chains. There is also another processing chain in the background of the CWE, at the same update level as the current PDS chain. This background chain is not shown in the graphic.

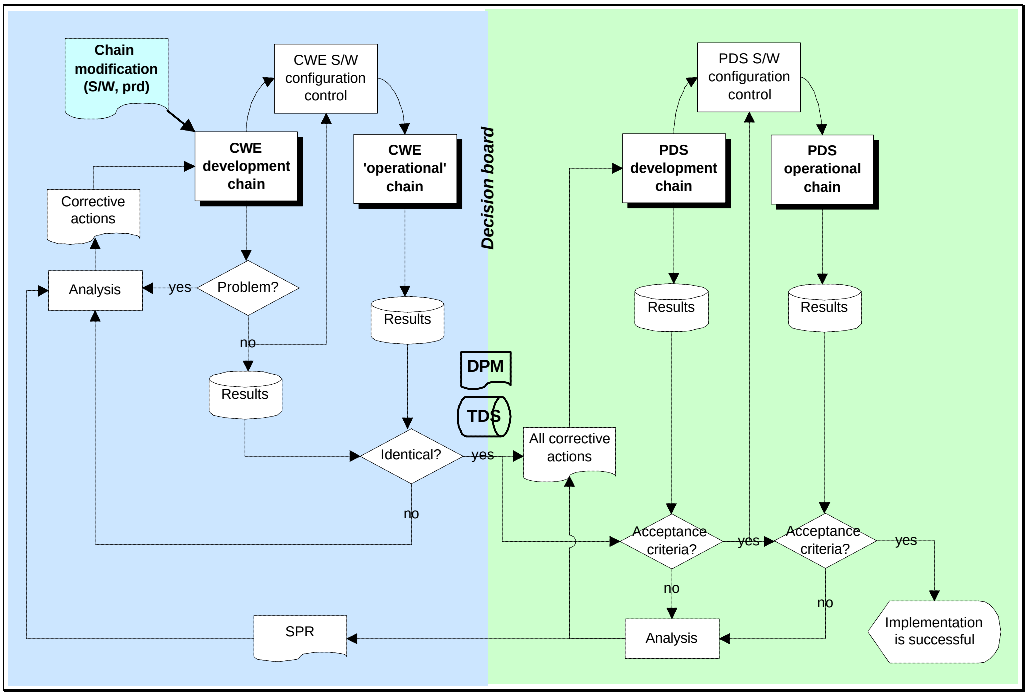


Figure 3.5.3 - 1: Commissioning working and operational processing chains

3.5.4 - Interface with the ENVISAT CAL/VAL

The interface with the ENVISAT CAL/VAL team is mainly taking place through internal meetings as arranged by the ESA ENVISAT CAL/VAL responsible (G. Levrini). Validation results will be communicated via the Subgroup leaders.

3.5.5 - Interface with the Atmospheric Chemistry Validation Team

The interface with the ACVT is taking place through meetings arranged by the ESA ACVT leader (E. Attema).

3.5.6 - Interface with NILU ENVISAT database

The interface with the NILU ENVISAT database is taking place via the server managed by NILU.

4. - Methods

4.1 - References

4.1.1 - Applicable documents

- AD1: PO-TN-MAT-GM-0223, Issue 2.2,
  Instrument measurement Data Definition
- AD2: PO-RS-DOR-SY-0029, Issue 1b,
  GOMOS Assumptions on the Ground Segment
- AD3: PO-ID-DOR-SY-0032, Issue 3,
  Measurement data definition and format description for GOMOS
- AD4: Ref. PO-PL-ESA-GS-1092, Issue 1,Rev. 0.2
  ENVISAT Calibration and Validation Plan
- AD5: PO-RS-ACR-GS-0003, Issue 5.0
  GOMOS Input / Output Data Document

4.1.2 - Reference documents

- RD1: PO-RS-MDA-GS—2009, Issue 3K
  ENVISAT Product Specification (Chapter 10: GOMOS)
- RD2: PO-RS-ACR-GS-0001, Issue 5.1
  Level 1b Detailed Processing Model
- RD3: PO-RS-ACR-GS-0002, Issue 5.1
  Level 2 Detailed Processing Model
- RD4: PO-AD-ACR-GS-0002, Issue 1.3
  CALEX IECF/CFI algorithms document
- RD6: PO-PL-DOR-GM--212, issue 1.0,

  GOMOS Switch-On and Acquisition Plan (SODAP)
- RD7: PO-TN-ESA-GM-974, Issue 1,
  Input to GOMOS commissioning verification scenario and observation plan
- RD8: EN-PL-ESA-GS-0334, Issue 1,
  Reference Operation Plan

4.2 - Standards

4.2.1 - List of abbreviations and acronyms

ADC	Analogue-to-Digital Converter
ADU	Analogue-to-Digital Units
CAL	Calibration auxiliary products
CAT	Star catalogue auxiliary products
CCD	Charge Coupled Device
CFI	Customer Furnished Item
CNT	Crossing Nodal Time
COM	Computation stage of the CALEX processor calibration functions
COR	Correction stage of the CALEX processor calibration functions
CRS	Cross-section auxiliary products
CWE	Commissioning Working Environment
DC	Dark Current
DM	Detection Module
DSNU	Dark Signal Non-Uniformity
ESL	Expert Support Laboratory
FM	Flight Model
FOS	Flight Operation Segment
FP	Fast Photometers
FPn	Fast Photometer number 'n'
GMT	Greenwich Mean Time
GOMOS	Global Ozone Monitoring by Occultation of Stars
GOMOS CAL	GOMOS calibration group
GOMOS VAL	GOMOS validation group
ICU	Instrument Control Unit
IECF	Instrument Engineering Calibration Facility
I/O	Input / Output
IPC	Instrument Physical Characteristics
IR	Infra-Red
JD	Julian Date LOS (Line Of Sight)
LSB	Least Significant Bit <=> ADU
LSW	Least Significant Word
LSF	Spectral Line Spread Function
LUT	Look Up Table
MDS	Measurement Data Set (ENVISAT products terminology)
MOP	Management of the Observation Plan
MPS	Mission Planning Support
MSW	Most Significant Word

NIR	Near Infra-Red
OBT	On Board Time
OMC	Opto-Mechanical Cover
PAN	Product Analysis module (part of the CALEX processor)
PDS	Payload Data Segment
PEB	Payload Equipment Bay
PMC	Polar Mesospheric Clouds
PPF	Polar Platform
PR1	Level 1b processing configuration auxiliary products
PR2	Level 2 processing configuration auxiliary products
PRNU	Pixel Response Non Uniformity
PSF	Spatial Line Spread Function
PUP	Product Update module (part of the CALEX processor)
ROP	Reference Operation Plan
RGT	ROP Generation Tool
SAA	Sun Aspect Angle
SATU	Star Acquisition and Tracking Unit
SDE	Science Data Electronic
SDP	Source Data Packets
SFA	Steering Front Assembly
SFM	Steering Front Mirror
SM	Service Module
SP	Spectrometer
SODAP	Switch-On and Data Acquisition Phase
SP	Spectrometers A and B
SPA	Spectrometer A
SPAn	Spectrometer A CCD number 'n' (n=1 or 2 for UV or VIS)
SPB	Spectrometer B
SPBn	Spectrometer B CCD number 'n' (n=1 or 2 for IR1 and IR2)
SPR	Software Problem Report
SSM	Spatial Spread Monitoring
TBC	To Be Confirmed
TBD	To Be Defined
TDS	Test Data Set
UTC	Universal Time Co-ordinates
UV	Ultra Violet
UVIS	Ultra violet - VISible

4.2.2 - Definitions

Calibration:	this is the process of quantitatively defining the system response to known, controlled signal inputs (CEOS definition).
Characterisation:	the act of determining the parameters defining the measurement system transfer characteristics.
Crash test	a crash test consists in running a computation module (level 1b, level 2 or calex) using real GOMOS measurements and under several processing configurations. One has to verify that the module does not crash. The analysis of the results is restricted to the status of the run with a log of any warning.
Measurement	time range or integration corresponding to one GOMOS packet (in Occultation or Linearity Monitoring mode) or to eleven packets (in Spatial Spread Monitoring or Uniformity Monitoring modes).
Observation	set of continuous measurements with no time interupt using the GOMOS instrument in the same mode, observing the same target. Example: a star occultation is one observation, observing the bright limb in uniformity mode is another observation.
Observation Sequences	series of observations, contiguous in time, made in the same GOMOS instrument mode. Exemple: several star occultations performed one after the other.
Observation set	set of individual observations or observation sequences used as an input to a commissioning task. A set of observations is generally used for a specific activity inside a task, anyway one observation set may be used by several tasks and one task may use several observation sets. Several observation sets of the same type may be necessary (e.g. the same observations performed each week).
Spectrometer sample	spectrometer measurement made by the binning of several CCD lines in Occultation or Linearity Monitoring mode or by one single CCD pixel in Spatial Spread Monitoring or Uniformity Monitoring modes. One sample is provided for each transmitted CCD column.
Spectrum	set of spectrometer samples measured by one CCD line or one spatial band during one measurement.
Synchronous Observation	a synchronous observation is an observation that is part of a sequence of observations, repeated over several orbits contrarily to an asynchronous observation that is an observation performed only one time.
Tuning	the tuning of the level 1b or level 2 processing chain consists in looking for values of the parameters of their configuration auxiliary products in order to obtain the best accuracy on the results. Modification of some parameters may also correspond to the execution of different options of processing (e.g. the central background estimation may be performed through three different algorithms).

Validation: the process of assessing by independent means the quality of the data products derived from the system outputs (CEOS definition).

Verification the act of checking the internal consistencies and validation of assumptions behind the system transfer model.

4.2.3 - Auxiliary products and software version number

In the following chapters, a version number is attached to the auxiliary products. This version number allows following the evolution of each product but also identifies without ambiguity which auxiliary product is used by a commissioning task. The pre-flight version of the auxiliary products is called V0. The next versions are numbered V1, V2 ... Vn.

The same kind of numbering is used for the issues of the level 1b processing chain, level 2 processing chain, CALEX software, and in general to all software tools used to perform the analysis. Some intermediate versions may be called V0a, V0b...

4.2.4 - Mnemonics

Each commissioning phase task is defined by a set of items such as: task objectives, task prerequisites, instrument input data, acquisition duration ... In order to simplify the identification of these items a set of mnemonics are used in this document, as described in the following table:

Mnemonic	Associated task item
TO	Task objectives
TL	Responsible, team and location
TS	Task schedule
PR	Task procedure (including all sub-items below)
TA	Task activities
TP	Task prerequisites
ID	Input instrument data
IA	Input auxiliary data
IR	Input reference data or document
SW	Tools and associated configurations
PD	Processing description
OD	Output data
AR	Archive
PF	Passed/failed criteria
AA	Anomaly action
TR	Task report

4.3 - General Rules

4.3.1 - Rules for execution

Each GOMOS calibration and validation task will be performed under the responsibility of a member of the corresponding group.

This responsibility covers:

- the management and monitoring of the activities performed during the task,
- the management of the human resources, of the computer resources and of the data availability,
- the organisation of the technical and scientific support required by the tasks,
- the interface with the CAL or VAL group coordinator,
- the generation of the planned output data and task report.

Each task procedure is defined according to the following items:

- task activities,
- input instrument data,
- input auxiliary data,
- input reference data or document,
- needed tools and associated configuration,
- processing description,
- output data,
- archive,
- passed/failed criteria,
- anomaly action,
- task report content.

4.4 - Project Database

The required products will be temporally stored in a specific disk in the ACRI system (***TEMP DISK***). These products may come from the DDS PC-RX (*ECMWF files, nominal level 0 products and level 1b products automatically moved from the PC-RX to the ACRI system*), from CD-ROM (*in case of specific orders to the USF*), from ftp (*automatic ftp for GOMOS monitoring level 0 products, level 2 and meteo products*) and from Exabyte tapes (*limb and residual extinction products*).

All GOMOS products will also be available on Exabyte tapes (1 tape every day).

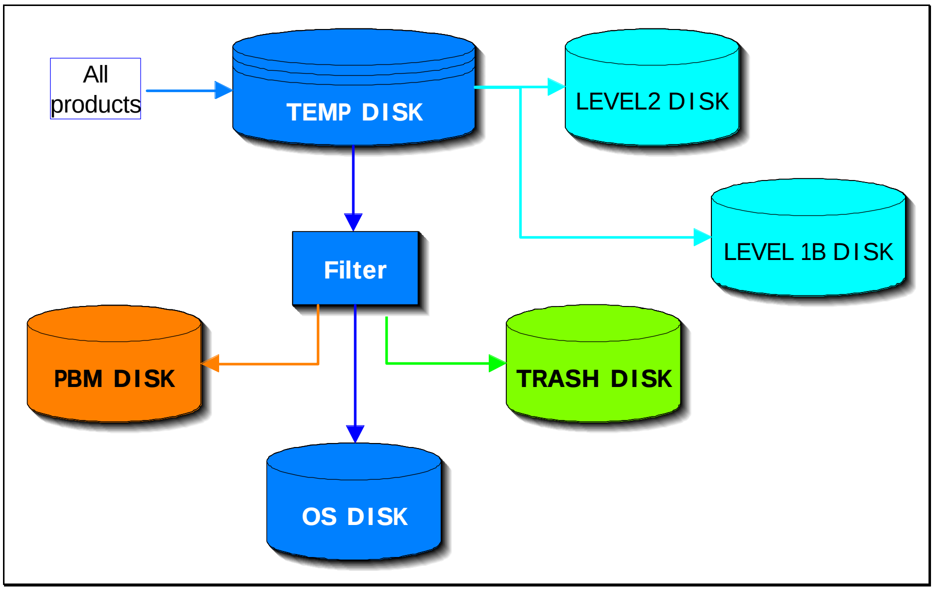
This temporary storage mass is used as a buffer. No process or analysis will be performed at this level. The first task of the OS management tools will be to sort all these files to send them in the appropriate working environment.

First action: a description tool is applied to the new products (level 0, level 1b and level 2) to inform us about their content qualitatively (which instrument mode, which star...) and quantitatively (PCDs, Earth coverage...). We will call these files 'summary reports'.

Second action: a filter is automatically applied to the existing products in order to redirect them and their associated summary reports to their correct storage device. When moved to another disk, the products are not deleted from the *TEMP DISK*. This will be a manual task performed once a week (TBC). The level 2 files are always copied to the *LEVEL 2 DISK*. The level 1b files are always copied to the *LEVEL 1B DISK*. When the occultation is part of a specific OS, the files are moved to the *OS DISK* (disk containing only the Observation Sets). This check will be made by the analysis of the level 2 products when it is available or by the verification in a list of predefined occultations (TBC).

When the analysis of the level 2 products PCD shows that some problem has occurred during the PDS processing, the files are copied to the *PBM DISK* (disk containing only occultation with problems). For these occultations, a request for all result files may be done after further analysis.

Note: if necessary, the files stored in the *LEVEL 2 DISK* and LEVEL 1B DISK will be compressed (using standard gzip). The gain in size is better than 50 percents. Only the summary reports will stay in ASCII format to be accessible at any time.



The filter should be able:

1. to detect the occultations which belong to each OS, using a description file.
2. to detect the occultations containing problems.
3. to detect the occultations which belong to OS5-2, OS5-3 and OS5-6.

The commissioning activities will take place in a specific working environment where the useful files (OS) will be copied or referenced by link (TBC). In any case, there will be a full visibility of the disk described above from the commissioning working environment.

4.5 - Tools

This section provides an overview of the tools needed during the commissioning phase. A detailed description is provided in a dedicated section ("Tools").

The main tools are:

- the GOMOS product viewers (*already included in the GOMOS product toolbox and also in the GOMOS IDL I/O toolbox*),
- an ECMWF file viewer (to be defined),
- the GOMOS auxiliary product viewers/editors (*GOMOS product toolbox and GOMOS IDL I/O toolbox*),
- the CALEX result file viewers (*IOMAP toolbox*),
- the CALEX input files viewers/editors (*also in IOMAP toolbox*),
- two compilers (C and Fortran),
- a text editor (*Xemacs*),
- a mission scenario tool (*Starsel*),
- two interactive analysis packages (*IDL*, *IGOR*),
- an atmospheric spectra simulator (*MODTRAN*),
- all tools needed to prepare the products (observation sets management, sorting tools, summary report tools) and to backup them.

Additional small tools will be used for specific use in the various tasks of the CAL/VAL. For most of them, they will be developed in real time to be perfectly well adapted to the tasks context. As for already developed tools, they will be based on the low-level data extraction utilities of the GOMOS product toolbox or of the IOMAP toolbox and to Unix filters (*awk/grep/expr/cut/paste*).

5. - Commissioning Description

5.1 - GOMOS CAL/VAL Objectives

The objective of the GOMOS CAL is to achieve at end of the commissioning phase (6 months after launch) a complete GOMOS calibration, including:

- *Full in-flight calibration and re-characterisation of GOMOS*
- *Complete verification of the level 1b processor (tuning of all parameters, regeneration of all level 1b auxiliary products)*
- *Upgrade of the level 1b processor*
- *Definition of routine calibration operations (to start at the end of the commissioning phase for the whole duration of the mission)*
- *Definition of routine observation plan*

The objective of the GOMOS VAL is to achieve by the Validation Workshop (9 months after launch) a preliminary GOMOS validation carried out on the basis of GOMOS data and preliminary results of some validation campaigns, including:

- *Verification of the level 2 processor (tuning of all processing parameters, first regeneration of all level 2 auxiliary products)*
- *Consistent geophysical products (at the end of commissioning phase)*
- *Upgrade of the level 2 processor*
- *Assessment and quantification of errors (prior to the validation workshop)*
- *Definition of routine validation activities*

5.2 - Task Breakdown

5.2.1 - Top Level

The GOMOS commissioning is split into three main activities, further detailed in sections 6, 7, and 8:

1. the SODAP activity
2. the CAL activity
3. the VAL activity

The SODAP (Switch-On and Data acquisition Phase) is nominally planned to last a maximum of 4 weeks for GOMOS. The CAL phase will start just after the SODAP, and last until T0+6 months. The VAL phase will start at about T0 + 1 month and last until L +9 months.

The following figures present the global breakdown of the GOMOS commissioning and the product data flow between these tasks.

Note : L is the launch date and T0 is the first day of availability of the GOMOS data.

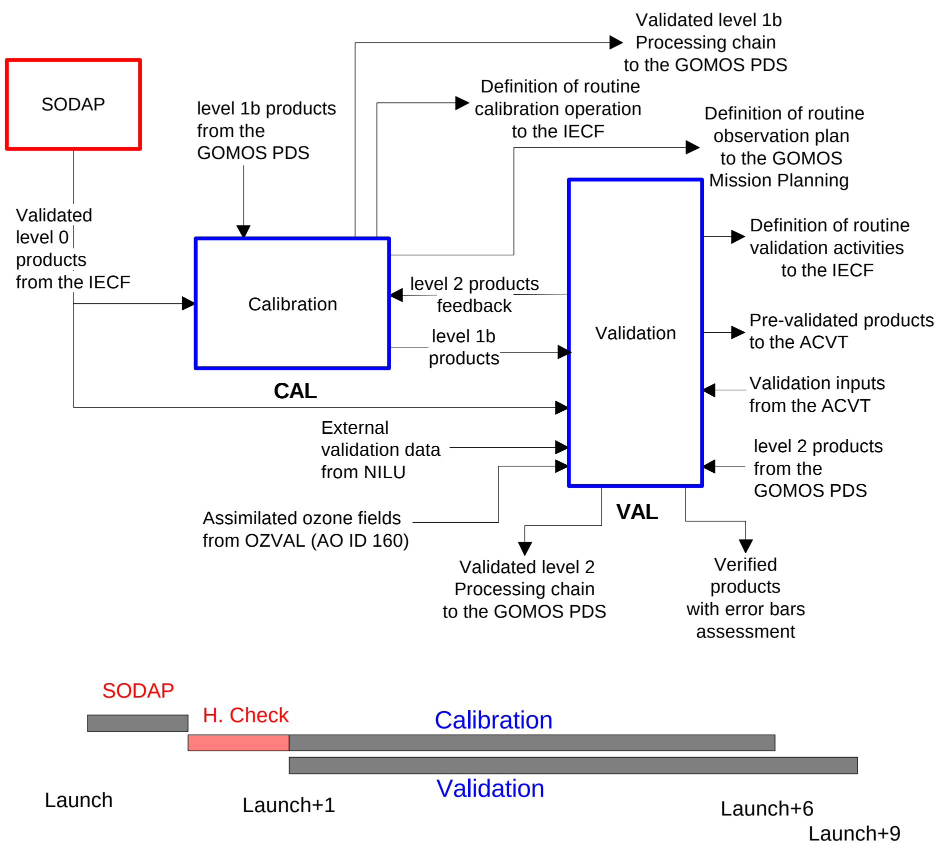


Figure 5.2.1 - 2: GOMOS CAL/VAL top-level organisation and timeline

5.2.2 - First level Breakdown

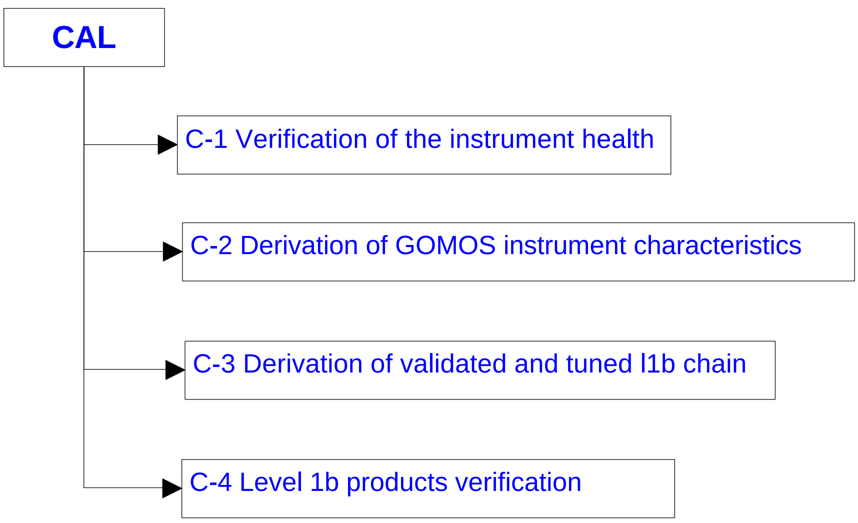


Figure 5.2.2 - 1: Breakdown of the CAL activity

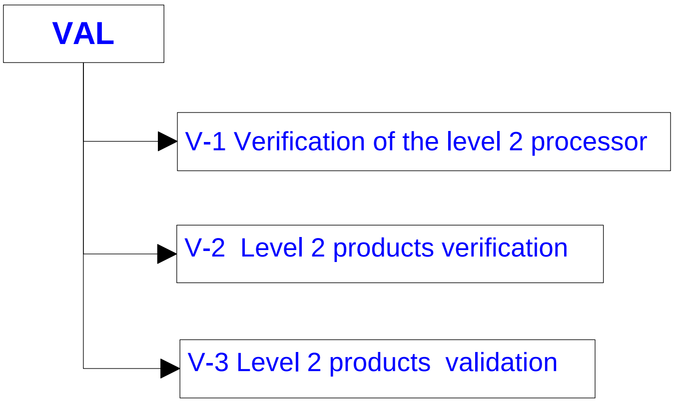


Figure 5.2.2 - 2: Breakdown of the VAL activity

5.2.3 - Second level Breakdown

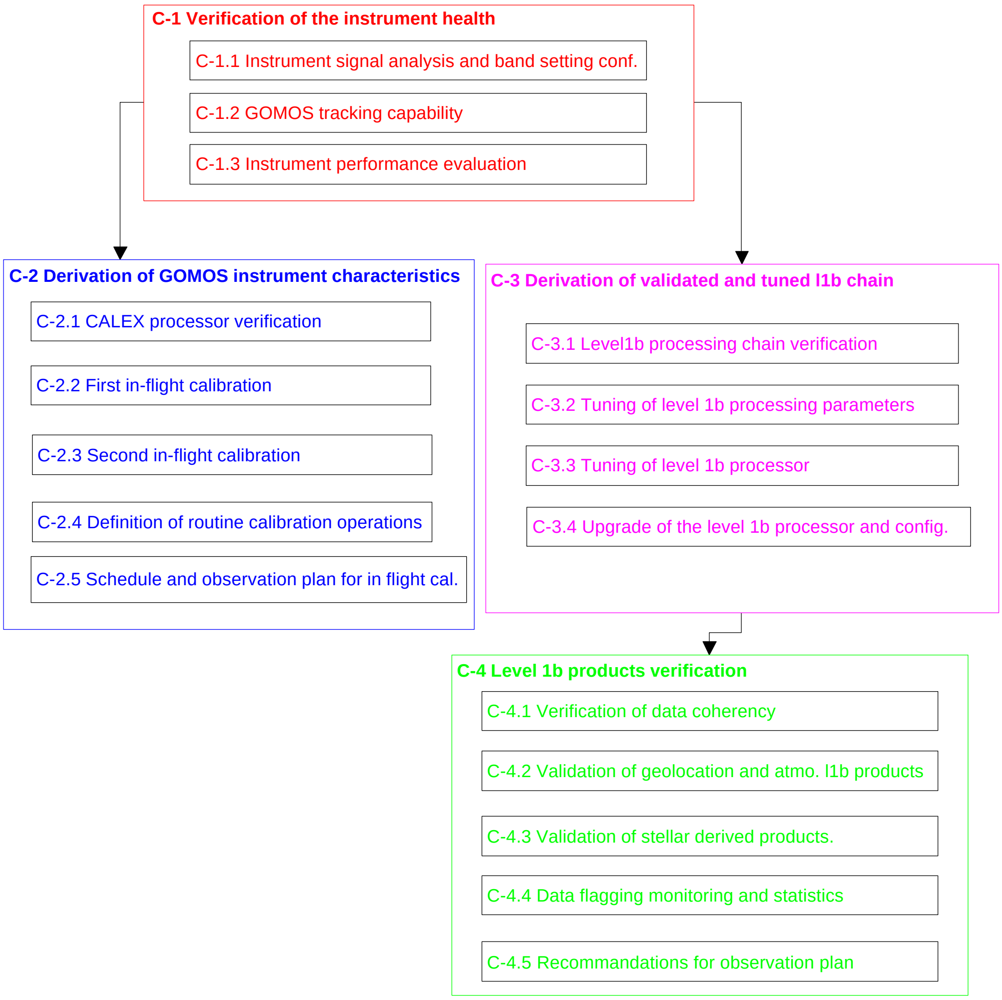


Figure 5.2.3 - 1: Second level breakdown of the CAL activity

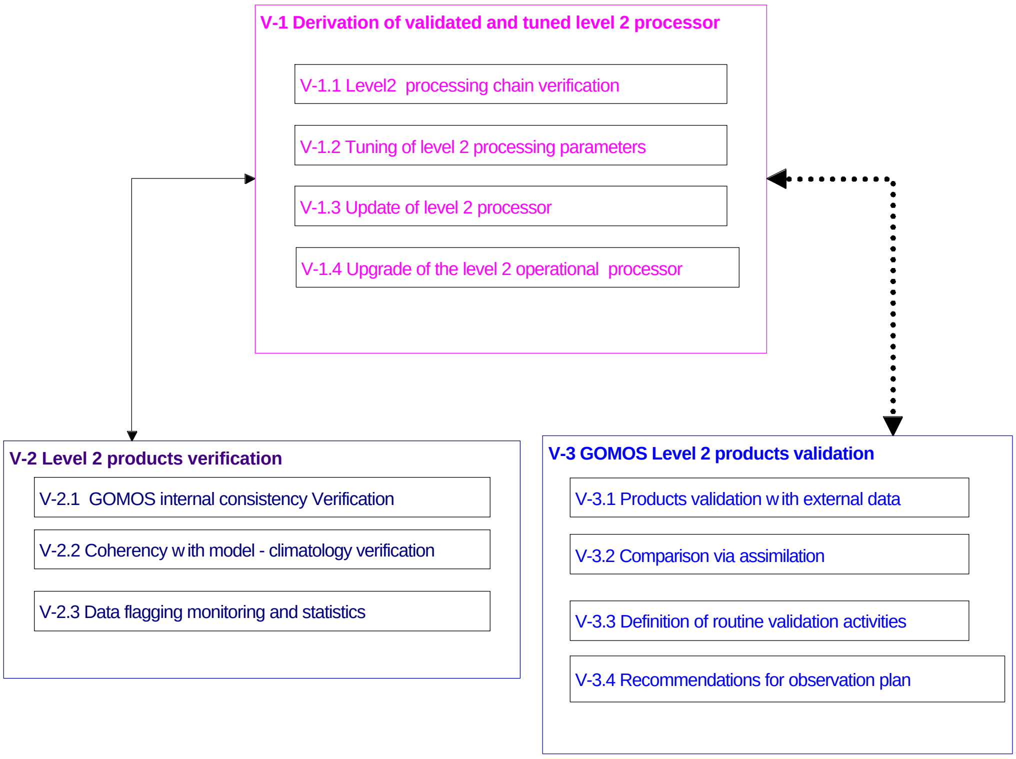


Figure 5.2.3 - 2: Second level breakdown of the VAL activity

V.1.3 is repeated all the time in parallel to V2 (but not until the end of V2) during 7 weeks.
Nominal assumption is V.1.4 is done only once after V.1.3 is completed, and as soon as possible, say mid-February 2002 assuming an ENVISAT launch early November 2001. However, two kind of contingencies are considered : an upgrade of the chain very early in the commissioning in case of a major trouble, an upgrade of the chain at the end of the commissioning if proven fully relevant by further V2 and V3 activities.

Note : the ESL team activity described in the plan is to be seen only as a contribution to the overall GOMOS validation. It does not include any AO part of the ACVT and dedicated to validation via comparison with external measurements. The assimilation task defined in V-3.2 will be one means, among others, to get early inputs on the validation of GOMOS products. The priority of this task is subject to external constraints, like e.g. the availability (through NILU) of a sufficient number of coincident measurements to perform direct validation. Furthermore, if MIPAS/SCIA data are available in due time, an attempt of comparison will be made. If they are not available, the resources of the team will be concentrated toward other tasks like comparison with external data.

5.2.4 - Task Summary

The main tasks of the SODAP activity are:

Task S.1: Ranges and measurement modes verification

Task S.2: Level 0 product format verification

Task S.3: Programming verification

The main tasks of the CAL activity are:

Task C.1: Verification of the instrument health

Task C.1.1: Instrument signal level analysis and band setting confirmation

Task C.1.2: GOMOS tracking capability

Task C.1.3: Instrument performance evaluation

Task C.2: Derivation of GOMOS Instrument characteristics

Task C.2.1: CALEX processor verification

Task C.2.2: Scientific performance evaluation

Task C.2.3: First in-flight calibration

Task C.2.4: Second in-flight calibration and trends analysis

Task C.2.5: Definition of routine calibration operations

Task C.2.6: Schedule and observation plan requirements for in flight calibration

Task C.3: Derivation of validated and tuned level 1b processing chain

Task C.3.1: Level 1b processing chain verification (step by step)

Task C.3.2: Tuning of level 1b processing parameters

Task C.3.3: Update of the level 1b processor

Task C.3.4: Upgrade of the level 1b processor and configuration parameters

Task C.4 Level1b products verification

Task C.4.1: Verification of data coherency (range)

Task C.4.2: Validation of geolocation and atmosphere level 1b products

Task C.4.3: Validation of stellar derived products (CATSPEC)

Task C.4.4: Data flagging monitoring and statistics

Task C.4.5: Recommendation for observation plan

The main tasks of the VAL activity are:

Task V.1: Verification of the level 2 processor

Task V.1.1: Level 2 processing chain verification (step by step)

Task V.1.2: Tuning of Level 2 processing parameters

Task V.1.3: Update of the level 2 processor

Task V.1.4 Upgrade of the level2 processor and configuration parameters

Task V.2: Level 2 products verification

Task V.2.1: GOMOS internal consistency verification

Task V.2.2: Coherency with model - climatology

Task V.2.3: Data flagging monitoring and statistics

Task V.3: Level 2 products validation

Task V.3.1: GOMOS products validation with external data

Task V.3.2: Comparison with other ENVISAT data via assimilation

Task V.3.3: Definition of routine validation activities

Task V.3.4: Recommendations for routine observation plan

5.3 - Observation plan

The whole commissioning tasks rely so far on 5 observation sets, characterised each by a set of requirements. The main characteristics of these observation sets are provided in the table below while the detailed requirements are provided in the chapter "Inputs to the mission planning".

Observ. set	Commissionning task	Schedule
OS0 - OS1	SODAP activity	first four weeks only
OS2	Verification of he instrument health	only once, within the first two weeks
OS3	Instrument calibration	every one or two weeks over the whole commissioning period
OS4	Instrument performance evaluation	2 weeks spread over about one month
OS5	Level 1b and level 2 verification & validation	continuously, from T0+2 weeks

Table 5.3 - 1: Observation sets during the GOMOS commissioning

5.4 - Logic

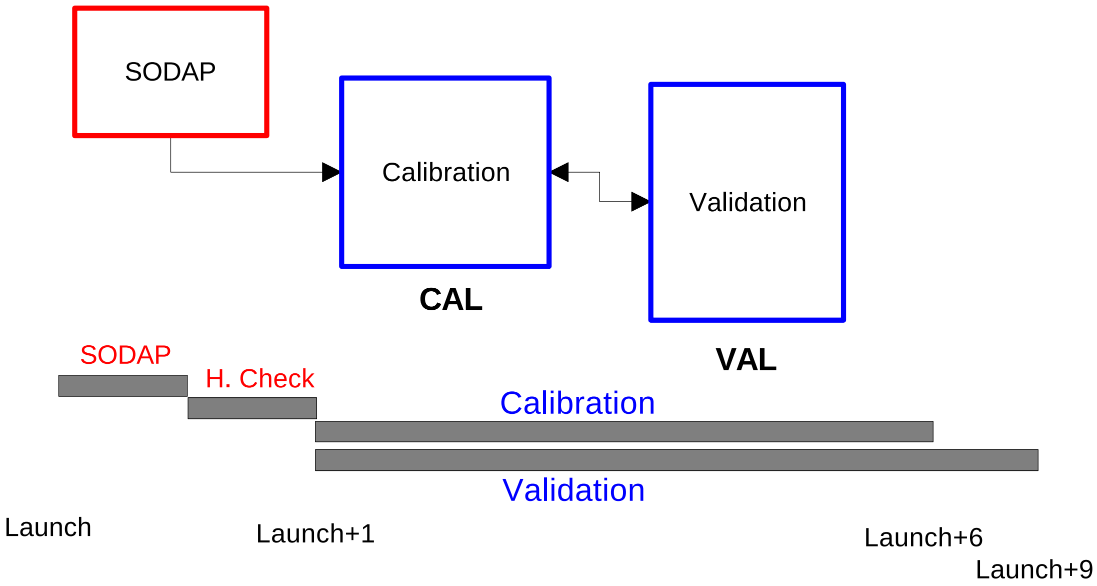


Figure 5.4 - 1: High level logic of tasks

5.5 - Schedule

The schedule is provided in a separate file.

6. - GOMOS SODAP activity detailed description

This chapter is here for information. It is extracted from the SODAP plan. It gives the contribution of the CAL team to the sub-phases III and IV.

6.1 - General

6.1.1 - SODAP objectives

TO-S-1: To validate the correct behaviour of the Service Module (SM), Payload Equipment Bay (PEB) and payload instruments.

6.1.2 - SODAP schedule

TS-S-1: maximum total duration is 6 weeks.

TS-S-2: pre-release is 2 weeks (availability of GOMOS packets)

TS-S-3: provisional start is: November 1, 2001.

TS-S-4: prerequisite is: successful ENVISAT launch.

6.1.3 - SODAP procedure

TP-S-1: Defined in the "ENVISAT Switch-on and Data Acquisition plan (SODAP)", RD6

6.1.4 - Responsible/Team/location

TL-S-1: Task responsible is K-D Mau (outside CALVAL responsibility)

TL-S-2: Task team is: ESTEC

TL-S-3: Processing location is ESOC.

6.2 - Task S.1: GOMOS ranges and measurement modes verification

6.2.1 - Task objectives

TO-S.1-1: To verify the availability of full angular range

TO-S.1-2: To verify the radiometric dynamic range

TO-S.1-3: Verification of the acquisition bias and first check of the tracking capability

TO-S.1-4: To verify the correct behaviour of the GOMOS monitoring modes

6.2.2 - Task schedule

This task represents most of the part of the sub-phase III

6.2.3 - Task procedure

TP-S.1-1: Defined in the "ENVISAT Switch-on and Data Acquisition plan (SODAP)", RD6

6.2.4 - Responsible/Team/location

From the CAL team side:

TL-S.1-1: Task responsible is R.Fraisse

TL-S.1-2: Task team is: G. Barrot, T. Paulsen

TL-S.1-3: Processing location is ACRI.

6.3 - Task S.2: Level 0 product format verification

6.3.1 - Task objectives

TO-S.2-1: to verify that the Level 0 products are formatted as expected.

TO-S.2-2: to verify that the GOMOS packets are formatted as expected.

6.3.2 - Task schedule

TS-S.2-1: duration is 1 week.

TS-S.2-2: provisional start is: November 8, 2001.

TS-S.2-3: prerequisite is: successful pre-release achievement of task S.1.

6.3.3 - Task procedure

TP-S.2-1: Defined in the Appendix: SODAP "detailed procedure", in this document

6.3.4 - Responsible/Team/location

TL-S.2-1: task responsible is: G. Barrot

TL-S.2-2: task team is: R. Fraisse, T. Paulsen

TL-S.2-3: processing location is ACRI.

6.4 - Task S.3: Programming verification

6.4.1 - Task objectives

TO-S.3-1: to verify that the instrument can be commanded as expected: *DM and SATU programming area*.

The integration time, the gain setting and the instrument configuration are verified during the modes verification (task S.1).

6.4.2 - Task schedule

This task consists in the sub-phase IV of SODAP plan.

6.4.3 - Task procedure

TP-S.3-1: Defined in the "ENVISAT Switch-on and Data Acquisition plan (SODAP)", RD6

6.4.4 - Responsible/Team/location

From the CAL team side:

TL-S.3-1: Task responsible is R. Fraisse

TL-S.3-2: Task team is: G. Barrot, T. Paulsen, J. L. Bertaux

TL-S.3-3: Processing location is ACRI.

7. - GOMOS CAL activity

7.1 - Task C.1: Verification of the instrument health

7.1.1 - Task C.1.1: Instrument signal level analysis and band setting confirmation

7.1.1.1 - Task objectives

TO-C.1.1-1: to verify the alignment of the SATU centre of tracking window and the middle of the slit in the spectral direction.

TO-C.1.1-2: to analyse the CCD map in spatial spread monitoring mode to verify the location of the star spectra on the CCD in order to validate or redefine the definition of the spatial bands for the observations in occultation and linearity modes.

TO-C.1.1-3: to analyse the content of the GOMOS packet in terms of auxiliary data and signal levels (thermistor temperature, dark charge level, star spectra shape, limb level).

7.1.1.2 - Task schedule

TS-C.1.1-1: duration is 2 weeks.

TS-C.1.1-2: provisional start is: November 15, 2001.

TS-C.1.1-3: successful achievement of band setting is: November 22, 2001.

TS-C.1.1-4: pre-requisite is successful achievement of SODAP phase.

7.1.1.3 - Task procedure

TP-C.1.1-1: Defined in the Appendix: CAL-1 "detailed procedure", in this document

7.1.1.4 - Responsible/Team/location

TL-C.1.1-1: Task responsible is R. Fraisse

TL-C.1.1-2: Task team is: G. Barrot, T. Paulsen, J. L. Bertaux

TL-C.1.1-3: Processing location is ACRI.

7.1.2 - Task C.1.2: GOMOS tracking capability

7.1.2.1 - Task objectives

TO-C.1.2-1: verify if the GOMOS instrument is able to acquire and track stars outside and through the atmosphere. Assess tracking limits (altitude range versus star magnitude) and refraction impact.

TO-C.1.2-2: verify the dynamic component of the pointing errors that contributes to the dynamic spatial and spectral Line Spread Functions.

7.1.2.2 - Task schedule

TS-C.1.2-1: duration is 2 weeks.

TS-C.1.2-2: provisional start is: November 22, 2001.

TS-C.1.2-3: task C.1.1 must have shown that the spatial bands are correctly set.

7.1.2.3 - Task procedure

TP-C.1.2-1: Defined in the Appendix: CAL-1 "detailed procedure", in this document

7.1.2.4 - Responsible/Team/location

TL-C.1.2-1: Task responsible is R. Fraisse

TL-C.1.2-2: Task team is: T. Paulsen, G. Barrot, J. L. Bertaux

TL-C.1.2-3: Processing location is ACRI.

7.1.3 - Task C.1.3: Instrument performance evaluation

7.1.3.1 - Rationale

During the commissioning phase, several aspects of the GOMOS instrument have to be studied in mode detail than during the activity covered by the instrument calibration, because the impact of these aspects is not well known up to now.

While the calibration activity is dedicated to the verification and possibly to the update of the instrument characteristics, the aim of the "Instrument Performance Evaluation task" is to assess the instrument behaviour during the observations from the engineering and scientific points of view. The verification of several assumptions made on the instrument will be also checked during this task.

The study of the internal straylight level, the dark charge variation along the orbit, the effect of band setting, the effect of SFA angles and of the polarisation on the recorded signal are directly related to the instrument and are more on the *engineering side* of the performance evaluation. The study of the Rayleigh scattering, the occurrence of Mesospheric clouds, the aerosol characterisation, the capability of the instrument to observe the Moon, the planets or double stars as well as the instrument performance in bright limb conditions are more related to the *scientific side* of the performance evaluation. These scientific objectives are put in the task "Scientific performance evaluation".

Several conclusions of this task will have a direct impact on the processing chain algorithms through the modification of algorithms or through the choice of the operational processing options when several ones exist.

All activities described here will not been completely finished due to the short time affected to this task. Anyway, all required observations will be performed and preliminary analysis will be performed in order to detect features not included in the processing chains that may have a strong impact on the product quality.

7.1.3.2 - Task objectives

TO-C.1.3-1: analysis of the SFM reflectivity factors

TO-C.1.3-2: analysis of the polarisation sensitivity.

TO-C.1.3-3: estimation of the band setting effect on the transmission computation.

TO-C.1.3-4: comparison of the two SATU (nominal and redundant).

7.1.3.3 - Task schedule

TS-C.1.3-1: duration is 9 weeks.

TS-C.1.3-2: provisional start is: November 29, 2001.

TS-C.1.3-3: task pre-requisite is: task C.1.1 must be in PASSED status.

7.1.3.4 - Task procedure

TP-C.1.3-1: Defined in the Appendix: CAL-1 "detailed procedure", in this document.

7.1.3.5 - Responsible/Team/location

TL-C.1.3-1: Task responsible is R. Fraisse

TL-C.1.3-2: Task team is: J.L. Bertaux, T. Paulsen, G. Barrot

TL-C.1.3-3: Processing location is ACRI.

7.2 - Task C.2: Derivation of GOMOS instrument characteristics

7.2.1 - Task C.2.1: CALEX processor verification

7.2.1.1 - Task objectives

TO-C.2.1-1: verify the CALEX processor functions using real measurements.

TO-C.2.1-2: update the CALEX monitoring configuration file.

TO-C.2.1-3: verify the functionality of the CALEX processor (modes, calibration function selection).

7.2.1.2 - Task schedule

TS-C.2.1-1: duration is 1 week.

TS-C.2.1-2: provisional start is: December 5, 2001.

TS-C.2.1-3: pre-requisite is successful achievement of task C.1.2 (PASSED status).

7.2.1.3 - Task procedure

TP-C.2.1-1: Defined in the Appendix: CAL-2 "detailed procedure", in this document

7.2.1.4 - Responsible/Team/location

TL-C.2.1-1: Task responsible is G. Barrot

TL-C.2.1-2: Task team is: R. Fraisse, T. Paulsen

TL-C.2.1-3: Processing location is ACRI.

7.2.2 - Task C.2.2: Scientific performance evaluation

7.2.2.1 - Rationale

Please refer to the rationale of chapter "Task C.1.3: Instrument performance evaluation".

7.2.2.2 - Task objectives

TO-C.2.2-1: estimation of the Rayleigh scattering at high altitude

TO-C.2.2-2: study of the Moon observation capability

TO-C.2.2-3: study of the planets observation capability

TO-C.2.2-4: observation of Polar Mesospheric Clouds

TO-C.2.2-5: observation of double stars

TO-C.2.2-6: instrument performance in bright limb conditions

7.2.2.3 - Task schedule

TS-C.2.2-1: duration is 9 weeks.

TS-C.2.2-2: provisional start is: November 29, 2001.

TS-C.2.2-3: task pre-requisite is: task C.1.1 must be in PASSED status.

7.2.2.4 - Task procedure

TP-C.2.2-1: Defined in the Appendix: CAL-2 "detailed procedure", in this document

7.2.2.5 - Responsible/Team/location

TL-C.2.2-1: Task responsible is J.L. Bertaux

TL-C.2.2-2: Task team is: R. Fraisse, T. Paulsen, A. Hauchecorne, F. Dalaudier, E. Kyrölä, J. Tamminen

TL-C.2.2-3: Processing location is ACRI.

7.2.3 - Task C.2.3: First in-flight calibration

7.2.3.1 - Task objectives

TO-C.2.3-1: first in-flight calibration: update the Calibration and Instrument Physical Characteristics auxiliary products.

7.2.3.2 - Task schedule

TS-C.2.3-1: duration is 3 weeks.

TS-C.2.3-2: provisional start is: December 12, 2001.

TS-C.2.3-3: pre-requisite is successful achievement of task C.2.1 (PASSED status).

7.2.3.3 - Task procedure

TP-C.2.3-1: Defined in the Appendix: CAL-2 "detailed procedure", in this document

7.2.3.4 - Responsible/Team/location

TL-C.2.3-1: Task responsible is R. Fraisse

TL-C.2.3-2: Task team is: T. Paulsen, G. Barrot, J.L. Bertaux

TL-C.2.3-3: Processing location is ACRI.

7.2.4 - Task C.2.4: Second in-flight calibration and trends analysis

The second in-flight calibration shall include the routine calibration, the trend parameters, and possibly the initial calibration functions that should possibly need to be repeated.
The initial trend analysis shall be performed at a minimum on the following parameters: spot position, wavelength assignment, DC, PRNU, radiometric sensitivity.

7.2.4.1 - Task objectives

TO-C.2.4-1: identify the deviations with respect to the first calibration phase.

TO-C.2.4-2: identify the trends in order to set a calibration time frequency.

TO-C.2.4-3: update the calibration auxiliary product if necessary.

7.2.4.2 - Task schedule

TS-C.2.4-1: duration is 2 weeks.

TS-C.2.4-2: provisional start is: January 30, 2002.

TS-C.2.4-3: pre-requisite is 4 weeks after successful achievement of task C.2.3 (PASSED status).

7.2.4.3 - Task procedure

TP-C.2.4-1: Defined in the Appendix: CAL-2 "detailed procedure", in this document

7.2.4.4 - Responsible/Team/location

TL-C.2.4-1: Task responsible is R. Fraisse

TL-C.2.4-2: Task team is: T. Paulsen, G. Barrot

TL-C.2.4-3: Processing location is ACRI.

7.2.5 - Task C.2.5: Definition of routine calibration operations

7.2.5.1 - Task objectives

TO-C.2.5-1: analyse the calibration activities performed during the GOMOS commissioning time.

TO-C.2.5-2: define a calibration plan for the following months.

7.2.5.2 - Task schedule

TS-C.2.5-1: duration is 4 weeks.

TS-C.2.5-2: provisional start is: February 15, 2002.

TP-C.2.5-3: pre-requisite is successful achievement of task C.2.4 (PASSED status).

TP-C.2.5-4: in any case, this task must start no later than six weeks before the end of the commissioning.

7.2.5.3 - Task procedure

TP-C.2.5-1: Defined in the Appendix: CAL-2 "detailed procedure", in this document

7.2.5.4 - Responsible/Team/location

TL-C.2.5-1: task responsible is: T. Paulsen

TL-C.2.5-2: task team is: P. Lecomte, R. Fraisse, G. Barrot, J. L. Berteaux

TL-C.2.5-3: task location is ACRI/ESRIN/ESTEC

7.2.6 - Task C.2.6: Schedule and observation plan requirements for in-flight calibration

7.2.6.1 - Task objectives

TO-C.2.6-1: define the observation plan requirements for in-flight calibration.

7.2.6.2 - Task schedule

TS-C.2.6-1: duration is 2 weeks.

TS-C.2.6-2: provisional start is: February 15, 2002.

TS-C.2.6-3: pre-requisite is completion of task C.2.5.

TS-C.2.6-4: in any case, this task must start no later than two weeks before the end of the commissioning.

7.2.6.3 - Task procedure

TP-C.2.6-1: Defined in the Appendix: CAL-2 "detailed procedure", in this document

7.2.6.4 - Responsible/Team/location

TL-C.2.6-1: task responsible is: P. Lecomte

TL-C.2.6-2: task team is: T. Paulsen, R. Fraisse, G. Barrot, J. L. Berteaux

TL-C.2.6-3: task location is ACRI/ESRIN/ESTEC

7.3 - Task C.3: Derivation of validated and tuned level 1b processor

7.3.1 - Task C.3.1: Level 1b processing chain verification (step by step)

7.3.1.1 - Task objectives

TO-C.3.1-1: check the functionality of the level 1b processing chain using real measurements.

TO-C.3.1-2: check the options of the level 1b processing chain read from the level 1b processing configuration auxiliary product.

7.3.1.2 - Task schedule

TS-C.3.1-1: duration is 2 weeks.

TS-C.3.1-2: provisional start is: December 5, 2001.

TS-C.3.1-3: pre-requisite is successful achievement of task C.1.2 (PASSED status).

7.3.1.3 - Task procedure

TP-C.3.1-1: Defined in the Appendix: CAL-3 "detailed procedure", in this document

7.3.1.4 - Responsible/Team/location

TL-C.3.1-1: Task responsible is G. Barrot

TL-C.3.1-2: Task team is: Antoine Mangin, Odile Hembise, Alain Hauchecorne

TL-C.3.1-3: Processing location is ACRI.

7.3.2 - Task C.3.2: Tuning of Level 1b processing parameters

7.3.2.1 - Task objectives

TO-3.2-1: tuning of the parameters of the level 1b processing chain to identify the new operational configuration.

7.3.2.2 - Task schedule

TS-C.3.2-1: duration is 3 weeks.

TS-C.3.2-2: provisional start is: December 19, 2001.

TS-C.3.2-3: pre-requisite is successful achievement of task C.3.1 (PASSED status).

7.3.2.3 - Task procedure

TP-C.3.2-1: Defined in the Appendix: CAL-3 "detailed procedure", in this document

7.3.2.4 - Responsible/Team/location

TL-C.3.2-1: Task responsible is G. Barrot

TL-C.3.2-2: Task team is: Antoine Mangin, Odile Hembise, J. L. Bertaux

TL-C.3.2-3: Processing location is ACRI.

7.3.3 - Task C.3.3: Update of the Level 1b processor

7.3.3.1 - Task objectives

TO-C.3.3-1: modify, adjust the algorithms of the level 1b processing chain as appropriate.

7.3.3.2 - Task schedule

TS-C.3.3-1: duration is 5 weeks.

TS-C.3.3-2: provisional start is: December 5, 2001.

TS-C.3.3-3: pre-requisite is successful achievement of task C.1.2 (PASSED status).

TS-C.3.3-4: the task is performed in parallel of task C.3.1 and C.3.2 (PASSED status).

7.3.3.3 - Task procedure

TP-C.3.3-1: Defined in the Appendix: CAL-3 "detailed procedure", in this document

7.3.3.4 - Responsible/Team/location

TL-C.3.3-1: Task responsible is G. Barrot

TL-C.3.3-2: Task team is: G. Barrot

TL-C.3.3-3: Processing location is ACRI.

7.3.4 - Task C.3.4: Upgrade of the level 1b processor and configuration parameters

7.3.4.1 - Task objectives

TO-C.3.4-1: correct implementation of the level 1b processing chain updates into the PDS operational chain.

7.3.4.2 - Task schedule

TS-C.3.4-1: duration is 2 weeks.

TS-C.3.4-2: provisional start is: January 9, 2002.

TP-C.3.4-3: nominal pre-requisite is successful achievement of task C.3.3 (PASSED status).

TP-C.3.4-4: the task may be triggered on an urgent requirement basis raised by task C.3.3.

7.3.4.3 - Task procedure

TP-C.3.4-1: Defined in the Appendix: CAL-3 "detailed procedure", in this document

7.3.4.4 - Responsible/Team/location

TL-C.3.4-1: Task responsible is O. Fanton d'Andon

TL-C.3.4-2: Task team is: O. Frauenberger, A. Mangin, G. Barrot, T. Paulsen

TL-C.3.4-3: Processing location is ACRI.

7.4 - Task C.4: Level 1b products verification

7.4.1 - Task C.4.1: Verification of data coherency (range)

7.4.1.1 - Task objectives

TO-C.4.1-1: Check the range of each level 1b product MDS items. Analyse the self-coherency of GOMOS products (e.g. the transmission at the same location observed by different stars...)

7.4.1.2 - Task schedule

TS-C.4.1-1: duration is 17 weeks.

TS-C.4.1-2: provisional start is: December 19, 2001.

TS-C.4.1-3: pre-requisite is completion of task C.3.1.

7.4.1.3 - Task procedure

TP-C.4.1-1: Defined in the Appendix: CAL-4 "detailed procedure", in this document

7.4.1.4 - Responsible/Team/location

TL-C.4.1-1: task responsible is: G. Barrot

TL-C.4.1-2: task team is: J. Tamminen, J.L. Bertaux, O. Fanton d'Andon, A. Mangin

TL-C.4.1-3: task location is ACRI

7.4.2 - Task C.4.2: Validation of geolocation and atmosphere products

7.4.2.1 - Task objectives

TO-C.4.2-1: analyse and validate the level 1b geolocation and atmosphere products using all the relevant information either from level 1b (e.g. instrument pointing direction and deviation), or from level 2

7.4.2.2 - Task schedule

TS-C.4.2-1: duration is 17 weeks.

TS-C.4.2-2: provisional start is: December 19, 2001.

TS-C.4.2-3: pre-requisite is completion of task C.3.1.

7.4.2.3 - Task procedure

TP-C.4.2-1: Defined in the Appendix: CAL-4 "detailed procedure", in this document

7.4.2.4 - Responsible/Team/location

TL-C.4.2-1: task responsible is: A. Mangin

TL-C.4.2-2: task team is: A. Hauchecorne, O. Hembise

TL-C.4.2-3: task location is ACRI

7.4.3 - Task C.4.3: Validation of stellar derived products (CATSPEC)

7.4.3.1 - Task objectives

TO-C.4.3-1: to provide the means for monitoring the sensitivity drift of GOMOS and to retrieve the actual sensitivity history over the commissioning period.

TO-C.4.3-2: to build an absolute calibrated stellar spectra database, corrected for instrument sensitivity drift to be used for updating the GOMOS auxiliary file GOM_STS_AX.

TO-C.4.3-3: to provide a mean for performing an independent estimate of the calibration of stellar spectra using Rayleigh scattering of solar light on the day side above 35 km tangent altitude, where aerosol contribution is negligible.

Note: the absolute calibration of GOMOS is performed:

- for a point source, by the comparison of observations of standard stars to their known spectra, assumed to represent the true absolute spectra.
- for an extended source, by comparison of a model calculation of Rayleigh scattered solar light to observations of the bright limb at high altitude.

The two curves as a function of wavelength are related by a geometrical factor which should be independent of wavelength.

7.4.3.2 - Task schedule

TS-C.4.3-1: duration is 8 months.

TS-C.4.3-2: provisional start is: December 5, 2001.

TS-C.4.3-3: pre-requisite is successful achievement of task C.1.2 (PASSED status).

7.4.3.3 - Task procedure

TP-C.4.3-1: Defined in the Appendix: CAL-4 "detailed procedure", in this document

7.4.3.4 - Responsible/Team/location

TL-C.4.3-1: task responsible is: J.L. Bertaux

TL-C.4.3-2: task team is: CATSPEC team

TL-C.4.3-3: task location is SA

7.4.4 - Task C.4.4: Data flagging monitoring and statistics

7.4.4.1 - Task objectives

TO-C.4.4-1: monitor the data flagging of the level 1b and limb products

7.4.4.2 - Task schedule

TS-C.4.4-1: duration is 8 months.

TS-C.4.4-2: provisional start is: December 5, 2001.

TS-C.4.4-3: pre-requisite is successful achievement of task C.1.2 (PASSED status).

7.4.4.3 - Task procedure

TP-C.4.4-1: Defined in the Appendix: CAL-4 "detailed procedure", in this document

7.4.4.4 - Responsible/Team/location

TL-C.4.4-1: task responsible is: G. Barrot

TL-C.4.4-2: task team is: T. Paulsen

TL-C.4.4-3: task location is ACRI

7.4.5 - Task C.4.5: Recommendation for routine observation plan

7.4.5.1 - Task objectives

TO-C.4.5-1: provide inputs to the observation plan derived from level 1b products analysis

7.4.5.2 - Task schedule

TS-C.4.5-1: duration is 2 weeks.

TS-C.4.5-2: provisional start is: February 15, 2002.

TS-C.4.5-3: pre-requisite is completion of task C.3.4.

TP-C.4.5-4: in any case, this task must start no later than two weeks before the end of the commissioning.

7.4.5.3 - Task procedure

TP-C.4.5-1: Defined in the Appendix: CAL-4 "detailed procedure", in this document

7.4.5.4 - Responsible/Team/location

TL-C.4.5-1: task responsible is: P. Lecomte

TL-C.4.5-2: task team is: G. Barrot, J.L. Berteaux, A. Hauchecorne, A. Mangin

TL-C.4.5-3: task location is ESRIN/ACRI

8. - Task V: GOMOS VAL activity

8.1 - Task V.1: Derivation of validated and tuned level 2 processor

8.1.1 - Task V.1.1: Level 2 processing chain verification (step by step)

8.1.1.1 - Task objectives

TO-V.1.1-1: check that the level 2 processing chain can process level 1b products generated by the level 1b processing chain when using a predefined processing configuration auxiliary product.

TO-V.1.1-2: check the functionality of the level 2 processing chain using real measurements.

TO-V.1.1-3: check the options of the level 2 processing chain read from the level 2 processing configuration auxiliary product.

8.1.1.2 - Task schedule

TS-V.1.1-1: duration is 3 weeks.

TS-V.1.1-2: provisional start is: December 5, 2001.

TS-V.1.1-3: pre-requisite is successful achievement of task C.1.2 (PASSED status).

TS-V.1.1-4: pre-requisite is: at least one level 1b product MDS is in the coherency range.

8.1.1.3 - Task procedure

TP-V.1.1-1: Defined in the Appendix: VAL-1 "detailed procedure", in this document

8.1.1.4 - Responsible/Team/location

TL-V.1.1-1: Task responsible is Antoine Mangin

TL-V.1.1-2: Task team is: O. Hembise, Alain Hauchecorne, J. Tamminen

TL-V.1.1-3: Processing location is ACRI.

8.1.2 - Task V.1.2: Tuning of Level 2 processing parameters

8.1.2.1 - Task objectives

TO-V.1.2-1: starting from each item of the level 2 products MDS, tuning of the parameters of the level 2 processing chain to identify the new initial operational configuration.

8.1.2.2 - Task schedule

TS-V.1.2-1: duration is 4 weeks.

TS-V.1.2-2: provisional start is: December 26, 2001.

TS-V.1.2-3: pre-requisite is successful achievement of task V.1.1 (PASSED status).

8.1.2.3 - Task procedure

TP-V.1.2-1: Defined in the Appendix: VAL-1 "detailed procedure", in this document

8.1.2.4 - Responsible/Team/location

TL-V.1.2-1: Task responsible is Antoine Mangin

TL-V.1.2-2: Task team is: Odile Hembise, Alain Hauchecorne, J. Tamminen

TL-V.1.2-3: Processing location is ACRI.

8.1.3 - Task V.1.3: Update of the Level 2 processor

8.1.3.1 - Task objectives

TO-V.1.3-1: modify, adjust the algorithms of the level 2 processing chain as appropriate.

8.1.3.2 - Task schedule

TS-V.1.3-1: duration is 7 weeks.

TS-V.1.3-2: provisional start is: December 5, 2001.

TS-V.1.3-3: pre-requisite is: at least one level 1b product MDS is in the coherency range.

TS-V.1.3-4: the task is performed in parallel of task V.1.1 and V.1.2.

8.1.3.3 - Task procedure

TP-V.1.3-1: Defined in the Appendix: VAL-1 "detailed procedure", in this document

8.1.3.4 - Responsible/Team/location

TL-V.1.3-1: Task responsible is O. Hembise

TL-V.1.3-2: Task team is: Antoine Mangin, Alain Hauchecorne, J. Tamminen

TL-V.1.3-3: Processing location is ACRI.

8.1.4 - Task V.1.4: Upgrade of the level 2 operational processor

8.1.4.1 - Task objectives

TO-V.1.4-1: implementation of the level 2 processing chain updates into the PDS operational chain.

8.1.4.2 - Task schedule

TS-V.1.4-1: duration is 2 weeks.

TS-V.1.4-2: provisional start is: February 1, 2002.

TS-V.1.4-3: nominal pre-requisite is successful achievement of task V.1.3 (PASSED status).

TS-V.1.4-4: the task may be triggered on an urgent requirement basis raised by task V.1.3.

8.1.4.3 - Task procedure

TP-V.1.4-1: Defined in the Appendix: VAL-1 "detailed procedure", in this document

8.1.4.4 - Responsible/Team/location

TL-V.1.4-1: Task responsible is O. Fanton d'Andon

TL-V.1.4-2: Task team is: O. Frauenberger, A. Mangin

TL-V.1.4-3: Processing location is ACRI.

8.2 - Task V.2: Level 2 products verification

8.2.1 - Task V.2.1: GOMOS internal consistency verification

8.2.1.1 - Task objectives

TO-V.2.1-1: analyse the self-coherency of GOMOS products (e.g. dilution, Rayleigh, and O2, the retrieved species at the same location observed by different stars...)

8.2.1.2 - Task schedule

TS-V.2.1-1: duration is 10 weeks.

TS-V.2.1-2: provisional start is: December 26, 2001.

TS-V.2.1-3: nominal pre-requisite is successful achievement of task V.1.1 (PASSED status).

8.2.1.3 - Task procedure

TP-V.2.1-1: Defined in the Appendix: VAL-2 "detailed procedure", in this document

8.2.1.4 - Responsible/Team/location

TL-V.2.1-1: Task responsible is A. Mangin

TL-V.2.1-2: Task team is: Odile Hembise, A. Hauchecorne

TL-V.2.1-3: Processing location is ACRI.

8.2.2 - Task V.2.2: Coherency with model - climatology verification

8.2.2.1 - Task objectives

TO-V.2.2-1: verification of the coherency of the GOMOS level 2 products using model - climatology information.

8.2.2.2 - Task schedule

TS-V.2.2-1: duration is 10 weeks.

TS-V.2.2-2: provisional start is: December 26, 2001.

TS-V.2.2-3: nominal pre-requisite is successful achievement of task V.1.1 (PASSED status).

8.2.2.3 - Task procedure

TP-V.2.2-1: Defined in the Appendix: VAL-2 "detailed procedure", in this document

8.2.2.4 - Responsible/Team/location

TL-V.2.2-1: Task responsible is E. Kyrölä

TL-V.2.2-2: Task team is: J. Tamminen, A. Hauchecorne

TL-V.2.2-3: Processing location is ACRI.

8.2.3 - Task V.2.3: Data flagging monitoring and statistics

8.2.3.1 - Task objectives

TO-V.2.3-1: monitor the data flagging of the level 2 product

8.2.3.2 - Task schedule

TS-V.2.3-1: duration is 6 months.

TS-V.2.3-2: provisional start is: December 26, 2001.

TS-V.2.3-3: pre-requisite is successful achievement of task V.1.1 (PASSED status).

8.2.3.3 - Task procedure

TP-V.2.3-1: Defined in the Appendix: VAL-2 "detailed procedure", in this document

8.2.3.4 - Responsible/Team/location

TL-V.2.3-1: task responsible is: G. Barrot

TL-V.2.3-2: task team is: O. Hembise, A. Mangin

TL-V.2.3-3: task location is ACRI

8.3 - Task V.3: Level 2 products validation

8.3.1 - Task V.3.1: GOMOS products validation with external data

8.3.1.1 - Task objectives

TO-V.3.1-1: preliminary validation of the GOMOS products by comparison with external data.

8.3.1.2 - Task schedule

TS-V.3.1-1: duration is 6 months.

TS-V.3.1-2: provisional start is: January 9, 2002.

TS-V.3.1-3: nominal pre-requisite is successful achievement of task V.1.1 (PASSED status).

8.3.1.3 - Task procedure

TP-V.3.1-1: Defined in the Appendix: VAL-3 "detailed procedure", in this document

8.3.1.4 - Responsible/Team/location

TL-V.3.1-1: Task responsible is A. Hauchecorne

TL-V.3.1-2: Task team is: J. Tamminen, E. Kyrölä, A. Mangin, O. Hembise

TL-V.3.1-3: Processing location is ACRI.

8.3.2 - Task V.3.2: Comparison with other ENVISAT data via assimilation

8.3.2.1 - Task objectives

TO-V.3.2-1: preliminary validation of the GOMOS products by comparison with other ENVISAT data via assimilation[2]

8.3.2.2 - Task schedule

TS-V.3.2-1: duration is 6 months.

TS-V.3.2-2: provisional start is: January 9, 2002.

TS-V.3.2-3: nominal pre-requisite is successful achievement of task V.1.1 (PASSED status).

8.3.2.3 - Task procedure

TP-V.3.2-1: Defined in the Appendix: VAL-3 "detailed procedure", in this document

8.3.2.4 - Responsible/Team/location

TL-V.3.2-1: Task responsible is O. Hembise

TL-V.3.2-2: Task team is: A. Hauchecorne, J. Tamminen, E. Kyrölä, A. Mangin

TL-V.3.2-3: Processing location is ACRI

8.3.3 - Task V.3.3: Definition of routine validation activities

8.3.3.1 - Task objectives

TO-V.3.3-1: Define of routine validation requirements derived from task V.2 synthesis

8.3.3.2 - Task schedule

TS-V.3.3-1: duration is 4 weeks.

TS-V.3.3-2: provisional start is: May 30, 2002.

TP-V.3.3-3: pre-requisite is completion of task V.1.

TP-V.3.3-4: in any case, this task must start no later than four weeks before the validation workshop.

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[2] This covers the part of the ESL work involved in the comparison tasks of the ACVT

8.3.3.3 - Task procedure

TP-V.3.3-1: Defined in the Appendix: VAL-3 "detailed procedure", in this document

8.3.3.4 - Responsible/Team/location

TL-V.3.3-1: task responsible is: P. Lecomte

TL-V.3.3-2: task team is: O. Hembise, A. Hauchecorne, E. Kyrölä, J. Tamminen, A. Mangin

TL-V.3.3-3: location is ESRIN/ACRI

8.3.4 - Task V.3.4: Recommendations for observation plan

8.3.4.1 - Task objectives

TO-V.3.4-1: provide inputs to the observation plan derived from 2 products analysis

8.3.4.2 - Task schedule

TS-V.3.4-1: duration is 2 weeks.

TS-V.3.4-2: provisional start is: June 21, 2002.

TP-V.3.4-3: pre-requisite is completion of task V.1.

TP-V.3.4-4: in any case, this task must start no later than two weeks before the validation workshop.

8.3.4.3 - Task procedure

TP-V.3.4-1: Defined in the Appendix: VAL-3 "detailed procedure", in this document

8.3.4.4 - Responsible/Team/location

TL-V.3.4-1: task responsible is: P. Lecomte

TL-V.3.4-2: task team is: O. Hembise, A. Hauchecorne, E. Kyrölä, J. Tamminen, A. Mangin

TL-V.3.4-3: task location is ESRIN/ACRI

9. - Inputs to the mission planning

9.1 - Introduction

The precise timing of some campaigns is independent of the launch date and time, while others are strongly dependent of astronomical constraints (mostly the star availability in requested limb illumination condition), and therefore are dependent of launch date and time.

Still it is possible to define the set of requirements to cover all the needs of the commissioning tasks. They are split into several categories of observations requirements, namely:

- Observation requirements for the SODAP activity
- Observation requirements for the verification of the instrument health
- Observation requirements for the instrument and scientific performance evaluation
- Observation requirements for the instrument calibration
- Routine commissioning observation requirements, including:
  - *Observation requirements for processing chains verification and tuning*
  - *Observation requirements for internal coherency verification*
  - *Observation requirements for external consistency verification*
  - *Observation requirements for GOMOS/MIPAS comparison*
  - *Observation requirements for GOMOS/SCIAMACHY comparison*
  - *Observation requirements for the GRAZE project*
  - *Observation requirements for specifc user requests*

These requirements are expressed in this section in order to provide the early inputs required to build the initial commissioning observation plan.

The observation requirements will be defined within an overall plan schedule and through the following information:

- Star ID or star characteristics (magnitude, temperature)
- Location on the orbit
- Minimum duration
- Dark/bright limb condition
- Instrument mode
- Integration time
- Observation mode (synchronous/asynchronous). Except when explicitely stated, all measurements are done in asynchronous mode.
- Number of orbits in synchronous mode
- Band setting

The observation requirements are then to be merged together, according to a specified hierarchy, in order to build the complete observation set.

In addition, it is planned to monitor the commissioning observation plan throughout the commissioning lifetime. The relevant activities associated with this monitoring task are also described in this section.

9.2 - Preliminary observation plan schedule

The following table lists the specific observation sets attached to each commissioning task.

Commissioning task	Observation set list
S: SODAP activity	OS0 - OS1
C.1: Verification of he instrument health	OS2
C.2: Instrument calibration	OS3
C.1.3, C.2.2: Instrument and scientific performance evaluation	OS4
C.3, C.4, V: Level 1b and level 2 verification & validation	OS5
Processing chain verification & tuning	OS5-1
Internal consistency verification	OS5-2
Validation with external data	OS5-3
GOMOS/MIPAS comparison	OS5-4
GOMOS/SCIAMACHY comparison	OS5-5
Occultations for GRAZE project	OS5-6
Occultations for specific user requests	OS5-7

Table 9.2 - 1: Commissioning tasks

The first week of observations will be fully dedicated to the SODAP activity (*OS0*), followed by the verification of the instrument health - signal level, band setting, tracking capability (*OS2*). Then, a background routine observation activity starts (including *OS5-2* and *OS5-3*), interrupted by planned observation campaigns for calibration (*OS3*), instrument performance evaluation (*OS4*), and punctual rendez-vous with MIPAS (*OS5-4*), SCIA (*OS5-5*), the occultation specific for the GRAZE project and the occultations covering some specific user requests.

The following table presents the planned duration of each observation set, the number of occurrence during the commissioning phase and the expected relative date.

Observation set	Duration (in days)	Number of occurrences	Starting date (in days)
OS0	7	1	T0
OS1	1	1	T0+7
OS2	2	1	T0+8
OS3	2	12 + 7 (1)	T0+10
OS4	1	10 (2)	T0+14
OS5	continuous	- (3)	T0+12

Table 9.2 - 2: Planned duration of the Observation Sets

(1): A calibration campaign is performed every week during the first 3 months and then every two weeks the last three months of the commissioning period. The first calibration observation campaign occurs at T0+10 days.

(2): the observation campaign for instrument performance evaluation is split into 10 days of observations to be performed from T0+14 to T0+45 (one month).

Note : T0 is the first day of availability of the GOMOS data

The astronomical constraints of these observations make them impossible to plan without knowing exactly the launch date. A coarse evaluation is that a maximum of 10 days (several observation sub-sets may perhaps be performed the same day) has to be reserved.

(3): the commissioning background observation starts at T0+12 and is continuous, with between 25 and 40 occulted stars per orbit, 14 orbits a day, interrupted by the others planned observation campaigns. This background observation covers the internal consistency verification (OS5-2), validation with external data (ground-based and planned balloon measurements) (OS5-3), the GOMOS/MIPAS comparison (OS5-4), the GOMOS/SCIAMACHY comparison (OS5-5), the observations for the GRAZE project (OS5-6) and for some specific user requests.

9.3 - Definitions, abbreviations, and conventions

In this chapter, if not detailed, the classification "*bright star*" indicates a star with a magnitude lower than 1.25; "*medium star*" is used for star with a magnitude in the range [1.25; 3.00] (TBC) and "*faint star*" is used for a star with a magnitude greater than 2.5 (TBC). There are 19 bright stars in the Star catalogue, 151 medium stars and 729 faint stars.

For each series of observation requirements attached to a dedicated commissioning task, there is a summary table that lists more explicitly the observations to be planned. Several abbreviations are used in order to reduce the size of the table as defined below:

- *The first column is the identifier of the Observation Set.*
- *The second column is the identifier of the observation in the observation set.*
- *For the observation type: A represents the asynchronous mode while S represents the synchronous mode.*
- *For the instrument mode: OCC represents the occultation mode, LIN the linearity monitoring mode, SSM the spatial spread monitoring mode and UNI the uniformity monitoring mode.*
- *For the star: B is used for the bright stars, M for the medium, F for the faint stars and Fict for a fictitious star.*
- *The dark/bright limb flag may be set to D for dark and B for bright limb conditions.*
- *For the instrument configuration, E represents the extended mode while Nx represents the nominal mode number x [2-7] (nominal mode description is detailed in the table below).*

Mode	Extended	Nominal					
Index	1	2	3	4	5	6	7
Useful data	all FPs and SPs	all except SPB1	all except SPB2	FP1 SPA1 SPA2	FP1 SPA1 SPB1	FP2 SPA2 SPA1	FP2 SPA2 SPB2
SDE1	ON	ON	ON	ON	ON	OFF	OFF
SDE2	ON	ON	ON	OFF	OFF	ON	ON
DMSA UV channel	SDE1	SDE1	SDE2	SDE1	SDE1	SDE2	SDE1
DMSA VIS channel	SDE2	SDE1	SDE2	SDE1	SDE2	SDE2	SDE2

Table 9.3 - 1: GOMOS instrument configurations

In the observation set tables, the acronyms are the following:

A	Asynchronous
S	Synchronous
OCC	Occultation mode
UNI	Uniformity mode
SSM	Spatial Spread Monitoring mode
LIN	Linearity mode
B, M, F	Bright (Mv < 1.25), Medium (1.25 < Mv < 3), Faint star (Mv > 3)
D, B	Dark, Bright Limb
E	Extended configuration
X_0	First line read
S_0	First column read
L_p	Number of column of the spectrum
H_i	Number of lines of background (H_1), separation (H_2) and target (H_3) areas
Nom	Nominal prog. of the recorded area (X_0, S_0, L_p, H_1, H_2, H_3), output from task C.1.1.

9.4 - Observation requirements for the SODAP activity

9.4.1 - Observation set identifiers

The 4 observation sets described in this chapter are the following:

OS1a for the SFM health check (task S.1-1).

OS1b for the occultation mode verification (task S.1-2 & 3)

OS1c for the monitoring modes verification (task S.1-4).

OS1d for the SATU programming verification (task S.3).

9.4.2 - SFM health check

9.4.2.1 - Instrument mode

Measurements are made in occultation/fictive star mode.

9.4.2.2 - Star ID or star characteristics

All measurements shall be done during a visibility window of the ground station by immediate commanding.

The fictive star coordinates whall correspond to edges and centre of the Total Clear Field of View (Azimuth at –11°, 40°, 91°) at the end of the occultation.

Moreover, the speed characteristics shall allow for covering the whole traking range (azimuth and elevation in 8° x 7.2°) during the occultation.

9.4.2.3 - Summary table

OS	#	Ins. mode	Star	Δt	Duration	$FLAG_{DB}$	Az	El	dAz	dEl
1a	1	OCC/F	Fict1	0.5	0	D	-8°	65°	0	0
1a	2	OCC/F	Fict2	0.5	0	D	40°	65°	0	0
1a	3	OCC/F	Fict3	0.5	0	D	88°	65°	0	0
1a	4	OCC/F	Fict4	0.5	250	D	40°	68°	+0.03°	-0.024°
1a	5	OCC/F	Fict5	0.5	113	D	-10°	68.8°	-0.0071°	-0.06°
1a	6	OCC/F	Fict6	0.5	100	D	40°	68.8°	-0.06°	-0.06°
1a	7	OCC/F	Fict7	0.5	93	D	88°	66°	+0.03°	-0.03°

9.4.3 - Occultation mode verification

9.4.3.1 - Instrument mode

Measurements are made in Occultation mode.

9.4.3.2 - Star ID or star characteristics

The first occultation shall be done just before a visibility window of the ground station.
Different star magnitude and color are used.

9.4.3.3 - Summary table

OS	#	S/A	Ins. mode	Star	Mv	Temp	Δt	Duration	$FLAG_{DB}$
1b	1	A	OCC	B1	0	10 000	0.5	28	D
1b	2	A	OCC	B1	0	10 000	0.5	until loss	D
1b	3	A	OCC	B2	1	< 5 000	0.5	until loss	D
1b	4	A	OCC	B3	1	> 20 000	0.5	until loss	D
1b	5	A	OCC	M1	2	10 000	0.5	until loss	D
1b	6	A	OCC	M2	3	10 000	0.5	until loss	D
1b	7	A	OCC	B4	0	10 000	0.5	until loss	B
1b	8	A	OCC	M3	3	10 000	0.5	until loss	B
1b	9	S	OCC	B1	0	10 000	0.5	until loss	D
1b	10	S	OCC	B4	0	10 000	0.5	until loss	B

9.4.4 - Monitoring modes verification

9.4.4.1 - Instrument mode

Measurements are made in monitoring modes: linearity, spatial spread, and uniformity.

9.4.4.2 - Star ID or star characteristics

The brightest star available shall be used.

9.4.4.3 - Summary table

OS	#	Ins. mode	Star	Δt	Duration	$FLAG_{DB}$	H_1, H_2, H_3
1c	1	SSM	B1	0.5	30	B	n.a.
1c	2	SSM	B1	2	30	B	n.a.
1c	3	LIN	B1	0.5	30	D	9,3,9
1c	4	LIN	B1	2	30	D	9,3,9
1c	5	UNI	dark sky	0.5	30	D	n.a.
1c	6	UNI	dark sky	2	30	D	n.a.

9.4.5 - SATU programming verification

9.4.5.1 - Star ID or star characteristics

A bright star shall be used.

9.4.5.2 - Programming parameters

The nominal set of parameter comes from the ground characterisation.

9.4.5.3 - Summary table

OS	#	Ins. mode	Star	Δt	Duration	$FLAG_{DB}$	SATU shift
1d	1	OCC	B	0.5	30	D	201
1d	2	OCC	B	0.5	30	B	196

9.5 - Observation requirements for the verification of the instrument health

9.5.1 - Observation set identifier

The 4 observation sets described in this chapter are the following:

OS2a for the SATU/Slit alignment observations (task C.1.1-1).

OS2b for the band setting observations (task C.1.1-2).

OS2c for the signal analysis occultations (task C.1.1-3).

OS2d for the tracking capability occultations (task C.1.2).

9.5.2 - SATU/Slit alignment

The objective of this task is to verify the alignment of the SATU centre of tracking window and the middle of the slit in the spectral direction (orthogonal to the spatial direction).

The output of this task is the nominal value of the tracking window shift (ground value: 201).

9.5.2.1 - Instrument mode

Only Occultation mode is used. The instrument is set in extended configuration. The same star is observed for each SATU shift.

9.5.2.2 - Star ID or star characteristics (magnitude, temperature)

The selected star is a bright star that shall illuminate the whole spectrum: temperature is in the range [6000 ; 10000].

9.5.2.3 - Minimum duration

The occultation shall last at least 30 seconds.

9.5.2.4 - Integration time

Occultations: 0.50 second in dark limb condition

9.5.2.5 - Dark/bright limb condition

Observations shall be done in dark limb outside the atmosphere.

9.5.2.6 - Band setting

The band setting is the nominal one. This is the on-ground setting since the task C.1.1-2 is not performed yet. A rough verification of the ground setting shall have been done during the SODAP phase.

9.5.2.7 - Location on the orbit

N/A

9.5.2.8 - Summary table

OS	#	S/A	Ins mode	Target	Δt	duration	$FLAG_{DB}$	Conf	X_0	SATU shift	H_1, H_2, H_3
2a	1	A	OCC	B1	0.5	30	D	E	Nom	196	9, 2, 9
2a	2	A	OCC	B1	0.5	30	D	E	Nom	197	9, 2, 9
2a	3	A	OCC	B1	0.5	30	D	E	Nom	198	9, 2, 9
2a	4	A	OCC	B1	0.5	30	D	E	Nom	199	9, 2, 9
2a	5	A	OCC	B1	0.5	30	D	E	Nom	200	9, 2, 9
2a	6	A	OCC	B1	0.5	30	D	E	Nom	201	9, 2, 9
2a	7	A	OCC	B1	0.5	30	D	E	Nom	202	9, 2, 9
2a	8	A	OCC	B1	0.5	30	D	E	Nom	203	9, 2, 9
2a	9	A	OCC	B1	0.5	30	D	E	Nom	204	9, 2, 9
2a	10	A	OCC	B1	0.5	30	D	E	Nom	205	9, 2, 9
2a	11	A	OCC	B1	0.5	30	D	E	Nom	206	9, 2, 9

9.5.3 - Band setting

The objective of this task is to locate the position of the spectra in spatial direction for the spectrometers and the position of the spot for the photometers.

9.5.3.1 - Instrument mode

Only Spatial spread monitoring mode is used. The instrument is set in extended conf. mode.

9.5.3.2 - Star ID or star characteristics (magnitude, temperature)

The selected star is a bright star that shall illuminate the whole spectrum: temperature in [6000; 10000]. The maximum signal in each column shall be greater than 200 LSB (TBC) after background correction.

9.5.3.3 - Minimum duration

The occultation shall be outside atmosphere (altitude higher than 60 km). The measurement shall last longer than 50 s.

9.5.3.4 - Integration time

The integration time shall be such that the star signal is higher than 200 LSB at each CCD edge. Two measurements at different integration time may be necessary for the UV spectrum.

9.5.3.5 - Dark/bright limb condition

Occultations shall be done in dark limb.

9.5.3.6 - Band setting

The band setting (X_0) shall be the ground values.

9.5.3.7 - Summary table

OS	#	S/A	Ins. mode	Star	Δt	Duration	$FLAG_{DB}$	Conf.	X_0	H_1, H_2, H_3
2b	1	A	SSM	B1	1	> 50	D	E	Nom	N/A
2b	2	A	SSM	B2	1	> 50	D	E	Nom	N/A
2b	3	A	SSM	B3	1	> 50	D	E	Nom	N/A
2b	4	A	SSM	B4	1	> 50	D	E	Nom	N/A
2b	5	A	SSM	B5	1	> 50	D	E	Nom	N/A
2b	6	A	SSM	B6	1	> 50	D	E	Nom	N/A

9.5.4 - Signal analysis

The objective of this task is to analyse the signal received by the instrument: the spectra of different stars and of the limb, the dependence of the limb vs altitude (flux, spectrum, uniformity), and the different spectral lines of the stars.

9.5.4.1 - Instrument mode

Only Occultation mode is used. The instrument is set in extended configuration.

9.5.4.2 - Star ID or star characteristics (magnitude, temperature)

The selected stars must cover the full range of magnitude [-1.4; +4.5] and temperature [2800; 39000].

The observations of limb shall be done for different brightness of the limb (different latitudes).

9.5.4.3 - Minimum duration

The star occultations shall last longer than 50 s. The limb occultations shall last longer than 200 s.

9.5.4.4 - Dark/bright limb condition

Star occultations shall be done in dark limb. Limb measurements shall be done for different brightness of the limb (different latitudes).

9.5.4.5 - Band setting

The band setting (X_0, H_i) shall be the nominal ones (from task C.1.1-2).

9.5.4.6 - Summary table

OS	#	S/A	Ins mode	Target	Star mag	Δt	duration	$FLAG_{DB}$	Conf	X_0	H_1, H_2, H_3
2c	1	A	OCC	B1	TBC	0.5	50	D	E	Nom	nominal
2c	2	A	OCC	B2	TBC	0.5	50	D	E	Nom	nominal
2c	3	A	OCC	B3	TBC	0.5	50	D	E	Nom	nominal
2c	4	A	OCC	M1	TBC	0.5	50	D	E	Nom	nominal
2c	5	A	OCC	F1	TBC	0.5	50	D	E	Nom	nominal
2c	6	A	OCC/F	Limb	-2	0.5	200	B	E	Nom	nominal
2c	7	A	OCC/F	Limb	-2	0.5	200	B	E	Nom	nominal
2c	8	A	OCC/F	Limb	-2	0.5	200	B	E	Nom	nominal
2c	9	A	OCC/F	Limb	-2	0.5	200	B	E	Nom	nominal
2c	10	A	OCC/F	Limb	-2	0.5	200	B	E	Nom	nominal

9.5.5 - Tracking capability

- The first objective of this task is to evaluate the minimal altitude reachable by the tracking for various conditions.

- The second objective of this task is to measure the pointing stability in the flight environment.

The SATU noise equivalent angle will be monitored for different stars and limb configurations, along the orbit and for different PLM operations.

The SFM angles will also be monitored.

The fictive star pointing accuracy will also be monitored through the SFM angles data.

- The third objective of this task is to evaluate the amplitude of the refraction effect.

9.5.5.1 - Instrument mode

Only Occultation mode is used. The instrument is set in extended configuration.

9.5.5.2 - Star ID or star characteristics (magnitude, temperature)

The observations 1 to 9 are done with the brightest stars available. They will allow monitoring the pointing perturbations along the orbit (and thus for different PLM operations). This will be done over 5 consecutive orbits to allow for comparison.

The observations 10 to 14 will be done for medium and faint stars.

The observation 15 will be a fictive star observation to measure the fictive star pointing accuracy.

9.5.5.3 - Minimum duration

All occultations are done until the loss of the tracking. The measurement duration shall correspond to an altitude of 0 km.

9.5.5.4 - Integration time

The integration time shall be 0.5 s.

9.5.5.5 - Dark/bright limb condition

Star occultations shall be done in dark limb except for the measurements 1 and 10. The star magnitude (instrument value in MCMD) for observations 1 and 10 is 0 since Sirius is never in the FOV in bright limb condition.

9.5.5.6 - Band setting

The band setting (X_0, H_i) shall be the nominal ones (from task C.1.1-2).

9.5.5.7 - Summary table

OS	#	S/A	Ins mode	Target	Star mag	Δt	duration	$FLAG_{DB}$	Conf	X_0	H_1, H_2, H_3
2d	1	A (5)	OCC	B	0	0.5	until loss	B	E	Nom	nominal
2d	2	A (5)	OCC	B	-2	0.5	until loss	D	E	Nom	nominal
2d	3	A (5)	OCC	B	0	0.5	until loss	D	E	Nom	nominal
2d	4	A (5)	OCC	B	0	0.5	until loss	D	E	Nom	nominal
2d	5	A (5)	OCC	B	0	0.5	until loss	D	E	Nom	nominal
2d	6	A (5)	OCC	B	0	0.5	until loss	D	E	Nom	nominal
2d	7	A (5)	OCC	B	1	0.5	until loss	D	E	Nom	nominal
2d	8	A (5)	OCC	B	1	0.5	until loss	D	E	Nom	nominal
2d	9	A (5)	OCC	B	1	0.5	until loss	D	E	Nom	nominal
2d	10	A	OCC	M	2	0.5	until loss	B	E	Nom	nominal
2d	11	A	OCC	M	3	0.5	until loss	D	E	Nom	nominal
2d	12	A	OCC	M	4	0.5	until loss	D	E	Nom	nominal
2d	13	A	OCC	F	5	0.5	until loss	D	E	Nom	nominal
2d	14	A	OCC	F	6	0.5	until loss	D	E	Nom	nominal
2d	15	A	OCC/F	Fict	6	0.5	50 s	D	E	Nom	nominal

Several of these observations will be done at the same time than the task 3a.

9.6 - Observation requirements for the instrument calibration

9.6.1 - Rationale

The observation campaign for the instrument calibration must be performed repetitively during the commissioning period.

During the first three months, the whole set of observation must be performed each week. The frequency for the following months will be an outcome of the CAL team activity.

Due to the astronomical constraints (stars observed one day will perhaps be not available one month later), the observation plan has to be defined for each calibration sequence.

The band definition in the spectral direction is set to the operational configuration for all the calibration functions.

9.6.2 - Observation set identifier

The observation sets described in this chapter are the following:

OS3a for the electronic chain gain and offset calibration function.

OS3b for the non-linearity calibration function.

OS3c for the dark charge at pixel level calibration function.

OS3d for the dark charge at band level calibration function.

OS3e for the PRNU at pixel level calibration function.

OS3f for the PRNU at band level calibration function.

OS3g for the radiometric sensitivity calibration function.

OS3h for the spectral point spread function calibration function.

OS3i for the wavelength assignment calibration function.

OS3j for the vignetting calibration function.

OS3k for the external earth straylight calibration function.

OS3l for the external sun straylight calibration function.

OS3m for the internal straylight calibration function.

9.6.3 - Electronic chain gain, read-out noise and offset

9.6.3.1 - Objective

The objective of this task is to measure the gains for the spectrometers and the read-out noise and offset for the spectrometers.

9.6.3.2 - Observation set description

The following table describes the observation set needed for the task.

OS	#	S/A	Inst mode	Target	Star mag	Δt	duration	$FLAG_{DB}$	Conf	X_0	extended spectrum	H_1, H_2, H_3
3a	1	A (5)	OCC	B	0	0.5	50	B	E	Nom	no	nominal
3a	2	A (5)	OCC	B	-2	0.5	50	D	E	Nom	no	nominal
3a	3	A (5)	OCC	M	2	0.5	50	D	E	Nom	no	nominal
3a	4	A (5)	OCC	F	6	0.5	50	D	E	Nom	no	nominal
3a	5	A	OCC/F	dark sky	-2	0.5	50	B	E	Nom	first 500 col	3, 1, 6
3a	6	A	OCC/F	dark sky	-2	0.5	50	B	E	Nom	first 500 col	5, 1, 8
3a	7	A	OCC/F	dark sky	-2	0.5	50	B	E	Nom	first 500 col	7, 1, 14
3a	8	A	OCC/F	dark sky	-2	0.5	50	B	E	Nom	first 500 col	10, 1, 2
3a	9	A	OCC/F	dark sky	-2	0.5	50	B	E	Nom	first 500 col	19, 1, 4
3a	10	A	OCC/F	dark sky	-2	0.5	50	D	E	Nom	first 500 col	3, 1, 6

3a	11	A	OCC/F	dark sky	-2	0.5	50	D	E	Nom	first 500 col	5, 1, 8
3a	12	A	OCC/F	dark sky	-2	0.5	50	D	E	Nom	first 500 col	7, 1, 14
3a	13	A	OCC/F	dark sky	-2	0.5	50	D	E	Nom	first 500 col	10, 1, 2
3a	14	A	OCC/F	dark sky	-2	0.5	50	D	E	Nom	first 500 col	19, 1, 4
3a	15	A	OCC/F	dark sky	6	0.5	50	D	E	Nom	first 500 col	3, 1, 6
3a	16	A	OCC/F	dark sky	6	0.5	50	D	E	Nom	first 500 col	5, 1, 8
3a	17	A	OCC/F	dark sky	6	0.5	50	D	E	Nom	first 500 col	7, 1, 14
3a	18	A	OCC/F	dark sky	6	0.5	50	D	E	Nom	first 500 col	10, 1, 2
3a	19	A	OCC/F	dark sky	6	0.5	50	D	E	Nom	first 500 col	19, 1, 4

Several of these observations will be done at the same time than the task 2d.

The first 4 measurements are repeated over 5 orbits. They are used for the gain and read-out noise.

The next occultations are used for the offset measurement. The observed scene is the dark sky.

All occultations shall occur in dark limb, although in the case of the occultations 1 and 5 to 9, the limb flag shall be set to Bright, in order to force the gain setting to its lowest value for DMSA (gain = 1). For the occultations 10 to 15, the observed scene is the dark sky but the star magnitude is set to -2 to command the gain 4 for DMSA. The last five occultations are done with a star magnitude of 6 to set the DMSA gain to 8.

9.6.4 - Non linearity

9.6.4.1 - Objective

The objective of this task is to record the non-linearity curve of the spectrometers.

9.6.4.2 - Observation set description

The following table describes the observation set needed for the task.

The stars shall be very stable in time (< 0.1%). Each orbit is dedicated to one integration time.

Depending on the gain, different star magnitudes are used. The 3 operational gains of DMSA (1, 4 and 8) and one gain for DMSB (1) have to be measured.

The different values of the integration time are : 0.25 s, 0.5 s, 1 s, 2 s, 5 s, 10 s.

The occultation shall be only outside the atmosphere (altitude above 60 km).

OS	#	S/A	Ins mode	Target	Δt	duration	$FLAG_{DB}$	Conf	X_0	H_1, H_2, H_3
3b	1	A	LIN	B	0.25	50	B	E	Nom	9, 3, 9
3b	2	A	LIN	B	0.25	50	D	E	Nom	9, 3, 9
3b	3	A	LIN	F	0.25	50	D	E	Nom	9, 3, 9
3b	4	A	LIN	B	0.5	50	B	E	Nom	9, 3, 9
3b	5	A	LIN	B	0.5	50	D	E	Nom	9, 3, 9
3b	6	A	LIN	F	0.5	50	D	E	Nom	9, 3, 9
3b	4	A	LIN	B	1.0	50	B	E	Nom	9, 3, 9
3b	5	A	LIN	B	1.0	50	D	E	Nom	9, 3, 9
3b	6	A	LIN	F	1.0	50	D	E	Nom	9, 3, 9
3b	4	A	LIN	B	2.0	50	B	E	Nom	9, 3, 9
3b	5	A	LIN	B	2.0	50	D	E	Nom	9, 3, 9

3b	6	A	LIN	F	2.0	50	D	E	Nom	9, 3, 9
3b	4	A	LIN	B	5.0	50	B	E	Nom	9, 3, 9
3b	5	A	LIN	B	5.0	50	D	E	Nom	9, 3, 9
3b	6	A	LIN	F	5.0	50	D	E	Nom	9, 3, 9
3b	4	A	LIN	B	10.0	50	B	E	Nom	9, 3, 9
3b	5	A	LIN	B	10.0	50	D	E	Nom	9, 3, 9
3b	6	A	LIN	F	10.0	50	D	E	Nom	9, 3, 9

9.6.5 - Dark charge maps

9.6.5.1 - Objective

The objective of this task is to record the Dark Charge maps (pixels values) of the spectrometers and photometers. These DC maps are used only for their information about the non-uniformity of the dark current (DSNU).

9.6.5.2 - Observation set description

The following table describes the observation set needed for the task.

OS	#	S/A	Ins mode	Target	Δt	duration	$FLAG_{DB}$	Conf	X_0	H_1, H_2, H_3
3c	1	A	UNI	dark sky	5.0	120	D	E	Nom	N/A
3c	2	A	UNI	dark sky	5.0	120	D	E	Nom	N/A
3c	3	A	UNI	dark sky	5.0	120	D	E	Nom	N/A
…	…	…	…	…	…	…	…	…	…	…
3c	10	A	UNI	dark sky	5.0	120	D	E	Nom	N/A
3c	11	A	UNI	dark sky	5.0	120	D	E	Nom	N/A

These observations will be done at the same time as the task 3k and 3l.

Dark sky areas have to be analysed to verify that no star inside the field of view is able to send a flux higher than 0.4 LSB. If the sky is not dark enough, observing the ocean at night without moon may be used. The radiance of the sea and of the boats has to be evaluated.

The following table gives the characteristics of the star that correspond to 0.4 LSB/pixel on each CCD. The gain is maximal (Low target/No limb) and integration time is 0.5 s for spectrometers.

Mv of star giving 0.4 LSB on:	star temp = 3 000 K	star temp = 30 000 K
SPA1	5	9
SPA2	8.5 to 7	9 to 7.5
SPB1	8.5	6
SPB2	8	5
FP1	6	6.5
FP2	8	6.5

Table 9.6.5.2 - 1: Stars producing 0.4 LSB/pixel

NB: one visual magnitude corresponds to a change in logarithm of the brightness equal to 2.5 (the given values minus one give the correspondence for 1 LSB).

It has to be recalled that the Uniformity mode does not allow for orbital motion compensation. This means that the sky is scanned during one occultation. During 120 s, the angular movement on sky is between 3° and 8° depending on the azimuth position.

This means that a single star will be integrated on one pixel during only 30 ms. This condition corresponds to a difference of 3 magnitude w.r.t. a 0.5 s integration time.

But, even if each star does not stay a long time on each pixel, the scan will make that a lot of stars will be integrated on each pixel. Thus, it is the average brightness of the sky that has to be considered.

9.6.6 - Dark charge at band level

9.6.6.1 - Objective

This task consists to record the Dark Charge at band level (average level) of the spectrometers and the DC average level of the photometers.

The first objective of this task is to record the level of the dark current for a given position in the orbit (20 positions). For this, we use the masked edges of each CCD (extended spectrum).

The second objective is to record the non-uniformity of the dark current between the 3 spatial bands (U, C and L). This will be compared to the non-uniformity at pixel level of the dark current that is recorded in the parameter "DC map".

9.6.6.2 - Observation set description

The following table describes the observation set needed for the task.

OS	#	S/A	Ins mode	Target	Star mv	Δt	duration	$FLAG_{DB}$	Conf	X_0	ext. spectrum	H_1, H_2, H_3
3d	1	S (3)	OCC/F	DSA	6	0.5	150	D	E	Nom	UV	nominal
3d	2	S (3)	OCC/F	DSA	6	0.5	150	D	E	Nom	UV	nominal
…	…	…	…	…	…	…	…	…	…	…	…	…
3d	20	S (3)	OCC/F	DSA	6	0.5	150	D	E	Nom	UV	nominal
3d	21	S (3)	OCC/F	DSA	6	0.5	150	D	E	Nom	VIS	nominal
…	…	…	…	…	…	…	…	…	…	…	…	…
3d	40	S (3)	OCC/F	DSA	6	0.5	150	D	E	Nom	VIS	nominal
3d	41	S (3)	OCC/F	DSA	6	0.5	150	D	E	Nom	IR1	nominal
…	…	…	…	…	…	…	…	…	…	…	…	…
3d	60	S (3)	OCC/F	DSA	6	0.5	150	D	E	Nom	IR1	nominal
3d	61	S (3)	OCC/F	DSA	6	0.5	150	D	E	Nom	IR2	nominal
…	…	…	…	…	…	…	…	…	…	…	…	…
3d	80	S (3)	OCC/F	DSA	6	0.5	150	D	E	Nom	IR2	nominal
3d	81	A	OCC/F	DSA	6	0.5	150	D	E	Nom	no	nominal
3d	82	A	OCC/F	DSA	6	0.5	150	D	E	Nom	no	nominal
3d	83	A	OCC/F	DSA	6	0.5	150	D	E	Nom	no	nominal
3d	84	A	OCC/F	DSA	6	0.5	150	D	E	Nom	no	nominal
3d	85	A	OCC/F	DSA	6	0.5	150	D	E	Nom	no	nominal

Dark sky areas have to be analysed to verify that no star inside is able to send a flux higher than 0.4 LSB.

The following table gives the characteristics of the star that correspond to 0.4 LSB/pixel on each CCD. The gain is maximal (Low target/No limb) and integration time is 0.5 s for spectrometers.

Mv of star giving 0.4 LSB on:	Star temp = 3 000 K	Star temp = 30 000 K
SPA1	5	9
SPA2	8.5 to 7	9 to 7.5

SPB1	8.5	6
SPB2	8	5
FP1	6	6.5
FP2	8	6.5

Table 9.6.6.2 - 1: Stars producing 0.4 LSB/pixel

NB: one visual magnitude corresponds to a factor of 2.5 (subtract one will give the correspondence for 1 LSB).

The possibility of observing the sea at night without moon shall be analysed. The radiance of the sea and the flux of the boats have to be evaluated.

The dark current is very sensitive to the CCD temperature. And the temperature varies during the orbit. It is then necessary to characterise this variation during commissioning. This can be done by looking to the non-illuminated part of the CCD. Measurement at band level is sufficient and allows for more accurate measurement (more integrations).

The following table gives the column number to be recorded and the level of residual flux in these columns.

	Area for DC recording	Residual flux in these columns	
SA1	col 15 - 200	< 0.1%	
	col 1000 - 1360	< 0.1%	
SA2	col 15-25	< 0.3%	col 25 – 50: < 0.5%
	col 1290 - 1360	< 0.1%	
SB1	col 15 - 100	0.1%	
	col 1250 - 1360	0.1%	
SB2	col 15 – 100	0.5%	
	col 1260 – 1360	0.4%	

Table 9.6.6.2 - 2: Column numbers to be recorded

These areas are large enough and the residual flux is low enough to allow a good recording of the Dark Current.

Four sets of occultations are programmed for each different CCD:

#	SPA1	SPA2	SPB1	SPB2
1	15-1360	600-929	600-929	600-929
2	600-929	15-1360	600-929	600-929
3	600-929	600-929	15-1360	600-929
4	600-929	600-929	600-929	15-1360

Each set consists in 20 occultations in synchronous mode over 3 orbits with the nominal band programmation. They will give the evolution of the DC along the orbit.

9.6.7 - PRNU maps

9.6.7.1 - Objective

The objective of this task is to record the PRNU maps of the spectrometers and photometers. These maps are used for the flat field correction.

9.6.7.2 - Observation set description

The following table describes the observation set needed for the task.

OS	#	S/A	Ins mode	Target	Δt	duration	$FLAG_{DB}$	Conf	X_0	H_1, H_2, H_3
3e	1	A	UNI	Limb	1-5	80	B	E	Nom	N/A
3e	2	A	UNI	Limb	1-5	80	B	E	Nom	N/A
3e	3	A	UNI	Limb	1-5	80	B	E	Nom	N/A
…	…	…	…	…	…	…	…	…	…	…
3e	18	A	UNI	Limb	1-5	80	B	E	Nom	N/A

The target is the bright limb, as uniform as possible. Saturation shall be avoided. Since there is no orbital compensation in Uniformity mode, the altitude will be roughly constant during one occultation (no scan of the limb). This altitude and the integration times (adjusted for each CCD) shall be chosen so that the level on each CCD is between 1000 and 3500 LSB. For UV and VIS bands for which the flux is varying spectrally, 2 different integration times will be needed.

9.6.8 - PRNU at band level

9.6.8.1 - Objective

The objective of this task is to record the non-uniformity of the response between the 3 spatial bands of the spectrometers. This will be compared to the non-uniformity at pixel level of the response that is recorded in the parameter "PRNU map".

9.6.8.2 - Observation set description

The following table describes the observation set needed for the task.

OS	#	S/A	Ins mode	Target	Star mag	Δt	duration	$FLAG_{DB}$	Conf	X_0	H_1, H_2, H_3
3f	1	A	OCC/F	Limb	6	0.5	100	D / B	E	Nom	nominal
3f	2	A	OCC/F	Limb	6	0.5	100	D / B	E	Nom	nominal
3f	3	A	OCC/F	Limb	6	0.5	100	D / B	E	Nom	nominal
…	…	…	…	…	…	…	…	…	…	…	…
3f	10	A	OCC/F	Limb	6	0.5	100	D / B	E	Nom	nominal

If the nominal Hi are equal to 7, 2 and 7, then, the their separation corresponds to 0.74 km.

The target is the bright limb, as uniform as possible. Saturation shall be avoided. The observation shall be made in the orbital plane so that the limb is nearly the same along the occultation.

The velocity of the fictive star shall be set so that the altitude decreases slowly: 1.48 km per second that means exactly 1 samples of 0.5 s for 0.74 km. The beginning of acquisition shall be around 150 km altitude and the end of acquisition around 0 km. This corresponds to an elevation speed of 0.027°/s and no speed in azimuth. If the Hi are different, the fictive star velocity shall be adjusted to take it into account.

The limb flag is put to dark and the star magnitude to 6 in order to set the DMSA gain to 4 and to be able to measure something in UV. This means that the DMSA2 will saturate early. Maybe, a different set of occultations will be needed for UV.

9.6.9 - Radiometric sensitivity

9.6.9.1 - Objective

The objective of this task is to measure the radiometric sensitivity of each chain in electrons per ph/s.cm².nm.

9.6.9.2 - Observation set description

The following table describes the observation set needed for the task.

OS	#	S/A	Ins mode	Target	Star mag	Δt	duration	$FLAG_{DB}$	Conf	X_0	H_1, H_2, H_3
3g	1	S (5)	OCC	B1	< 2	0.5	50	D	E	Nom	9, 3, 9
3g	2	S (5)	OCC	B2	< 2	0.5	50	D	E	Nom	9, 3, 9
3g	3	S (5)	OCC	B3	< 2	0.5	50	D	E	Nom	9, 3, 9
…	…	…	…	…	…	…	…	…	…	…	…
3g	6	S (5)	OCC	B6	< 2	0.5	50	D	E	Nom	9, 3, 9

This task is done with the task 2c.

The targets have to be well known stars brighter than magnitude 2. Their absolute flux has to be known for each useful wavelength with accuracy as good as possible. The wavelength list shall be the same as the one used for the on-ground characterisation.

For the spectrometers the wavelengths are: 250, 270, 300, 350, 405, 500, 600, 675, 756, 766, 773, 926, 940, 952 nm; around these wavelengths, the spectral bands over which is computed the sensitivity are ± 3 nm (10 columns) in UVIS and ± 0.5 nm (10 columns) in IR.

For the photometers, the bands are 470-520 and 650-700 nm.

The occultation shall be only outside the atmosphere.

9.6.10 - Spectral Line Spread Function

9.6.10.1 - Objective

The objective of this task is to measure the width of the spectral Line Spread Function (LSF) of the spectrometers.

9.6.10.2 - Observation set description

The following table describes the observation set needed for the task.

OS	#	S/A	Ins mode	Target	Star mag	Δt	duration	$FLAG_{DB}$	Conf	X_0	H_1, H_2, H_3
3h	1	S (5)	OCC	B1	< 2	0.5	50	D	E	Nom	9, 3, 9
3h	2	S (5)	OCC	B2	< 2	0.5	50	D	E	Nom	9, 3, 9
3h	3	S (5)	OCC	B3	< 2	0.5	50	D	E	Nom	9, 3, 9
…	…	…	…	…	…	…	…	…	…	…	…
3h	6	S (5)	OCC	B6	< 2	0.5	50	D	E	Nom	9, 3, 9

The targets have to be stars brighter than magnitude 2 with well-known narrow lines. This means lines of width less than 1 nm in UVIS and less than 0.1 nm in IR. This implies a sampling even better than this.

The occultation shall be only outside the atmosphere.

9.6.11 - Wavelength assignment

9.6.11.1 - Objective

The objective of this task is to assign a wavelength for each column of the spectrometers.

9.6.11.2 - Observation set description

The following table describes the observation set needed for the task.

OS	#	S/A	Ins mode	Target	Δt	duration	$FLAG_{DB}$	Conf	X_0	H_1, H_2, H_3
3i	1	S (5)	OCC	B1	0.5	50	D (/B)	E	Nom	9, 3, 9
3i	2	S (5)	OCC	B2	0.5	50	D (/B)	E	Nom	9, 3, 9
3i	3	S (5)	OCC	B3	0.5	50	D (/B)	E	Nom	9, 3, 9
3i	4	S (5)	OCC	B4	0.5	50	D (/B)	E	Nom	9, 3, 9

This task is done with the task 3h.

The targets have to be chosen to contain known spectral lines in each spectrometer band.

The reference spectra have to be convoluted with the GOMOS LSF to allow a valid comparison.

9.6.12 - Vignetting

9.6.12.1 - Objective

The objective of this task is to check the vignetting due to OMC baffle on the IR pupil.

9.6.12.2 - Observation set description

The following table describes the observation set needed for the task.

OS	#	S/A	Ins mode	Target	Δt	duration	$FLAG_{DB}$	Conf	X_0	H_1, H_2, H_3
3j	1	A	OCC	B1	0.5	60	D	E	Nom	9, 3, 9
3j	2	A	OCC	B1	0.5	60	D	E	Nom	9, 3, 9
3j	3	A	OCC	B1	0.5	60	D	E	Nom	9, 3, 9
3j	4	A	OCC	B1	0.5	60	D	E	Nom	9, 3, 9
…	…	…	…	…	…	…	…	…	…	…
3j	9	A	OCC	B1	0.5	60	D	E	Nom	9, 3, 9
3j	10	A	OCC	B1	0.5	60	D	E	Nom	9, 3, 9

The target has to be chosen to cross the azimuth angular range [-10°, -5°] during the different occultations. The azimuth coordinates will increase slowly with the orbit number (about 1° per day for the heliosynchronous orbit). It will be nearly constant during one occultation.

The 10 different occultations will be done over a period of time long enough so that the azimuth varies from –5° to –10° (this means roughly one occultation per day).

The star has to be stable in flux and the flux shall be bright in IR.

The occultation shall last 60 s between the altitudes of 250 and 50 km.

9.6.13 - Earth straylight

9.6.13.1 - Objective

The objective of this task is to record the straylight maps when the earth is illuminating GOMOS but not in the Line Of Sight.

9.6.13.2 - Observation set description

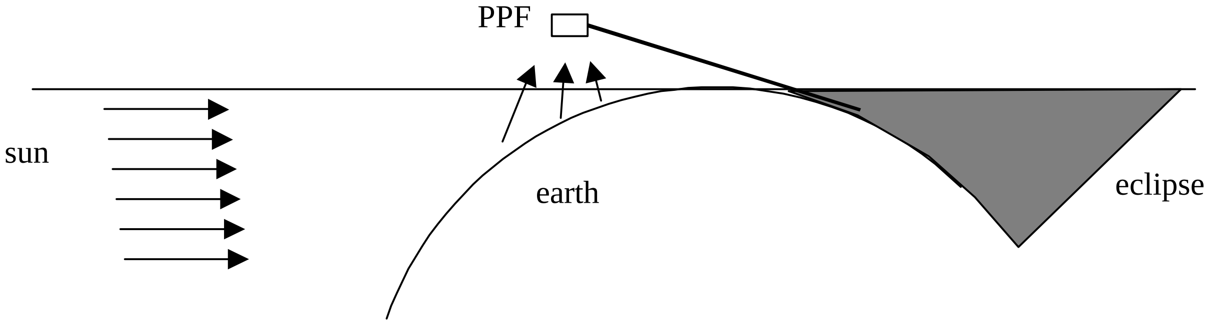
The following table describes the observation set needed for the task.

OS	#	S/A	Ins mode	Target	position on orbit	Δt	duration	$FLAG_{DB}$	Conf	X_0	H_1, H_2, H_3
3k	1	A	UNI	Dark sky	day side	1-5	50	D	E	Nom	N/A
3k	2	A	UNI	Dark sky	day side	1-5	50	D	E	Nom	N/A
3k	3	A	UNI	Dark sky	night side	1-5	50	D	E	Nom	N/A
3k	4	A	UNI	Dark sky	night side	1-5	50	D	E	Nom	N/A

This task is done with the task 3c.

The target is the dark sky. Two measurements on dayside with the earth as bright as possible but no limb in the LOS will be compared to 2 measurements on night side with the CCD at the same temperature. To know the positions on orbit corresponding to the same temperature, the output from task 2.4 is used (DC level as function of position on orbit).

The two measurements on dayside have to be done near the North Pole just after the eclipse. The earth below Envisat shall be as bright as possible (in worst configuration) but the instrument shall still look to the dark side of the earth.



9.6.14 - Sun straylight

9.6.14.1 - Objective

The objective of this task is to record the straylight maps when the sun is illuminating GOMOS.

9.6.14.2 - Observation set description

The following table describes the observation set needed for the task.

OS	#	S/A	Ins mode	Target	position on orbit	Δt	duration	$FLAG_{DB}$	Conf	X_0	H_1, H_2, H_3
3l	1	A	UNI	Dark sky	day side	1-5	50	D	E	Nom	N/A
3l	2	A	UNI	Dark sky	day side	1-5	50	D	E	Nom	N/A
3l	3	A	UNI	Dark sky	night side	1-5	50	D	E	Nom	N/A
3l	4	A	UNI	Dark sky	night side	1-5	50	D	E	Nom	N/A

This task is done with the task 3c.

The target is the dark sky. Two measurements on dayside with the sun as close as possible from the LOS will be compared to 2 measurements on night side with the CCD at the same temperature. To know the positions on orbit corresponding to the same temperature, the output from task 2.4 is used (DC level as function of position on orbit).

The two measurements on dayside have to be done near the South Pole and for the azimuth where the sun aspect angle (SAA) is minimal (near 0°). The period of the year with the minimal SAA is the summer solstice.

9.6.15 - Internal straylight

9.6.15.1 - Objective

The objective of this task is to record the internal straylight maps.

9.6.15.2 - Observation set description

The following table describes the observation set needed for the task.

OS	#	S/A	Ins. mode	Star	Δt	Duration	$FLAG_{DB}$	Conf.	X_0	H_1, H_2, H_3
3m	1	A	SSM	B1	5.00	100	D	E	Nom	N/A
3m	2	A	SSM	B2	5.00	100	D	E	Nom	N/A
3m	3	A	SSM	B3	5.00	100	D	E	Nom	N/A

3m	4	A	SSM	B4	5.00	100	D	E	Nom	N/A
3m	5	A	SSM	B5	5.00	100	D	E	Nom	N/A
3m	6	A	SSM	B5	5.00	100	D	E	Nom	N/A
3m	7	A	SSM	B5	5.00	100	D	E	Nom	N/A

The occultations must be performed with the same gain setting.

The observation must be performed outside the atmosphere.

Different bright stars must be observed corresponding to different spectral types anyway hot stars should be prefered (more UV signal).

9.7 - Observation requirements for the instrument and scientific performance evaluation

9.7.1 - Rationale

The observation campaign for the additional instrument and scientific performance evaluation is performed only one time during the commissioning.

Anyway, several observations must be done during several days.

The band definition in the spectral direction is set to the operational configuration for all the calibration functions.

There is no specific measurement for the analysis of the instrument performance in bright limb conditions. Occultations of OS5 will be used for this activity.

9.7.2 - Observation set identifier

Task C.1.3:

OS4a for the analysis of the SFM reflectivity factors
OS4b for the analysis of the polarisation sensitivity
OS4c for the estimation of the band setting effect on the transmission computation
OS4d for the comparison of the two SATU (nominal and redundant)

Task C.2.2:

OS4e for the Rayleigh scattering at high altitude
OS4f for the aerosol characterisation
OS4g for the Moon observation
OS4h for the planets observation
OS4i for the Polar Mesospheric Clouds observation
OS4j for the double stars observation

9.7.3 - SFM reflectivity factors

9.7.3.1 - Objective

The objective of this task is to verify the SFM reflectivity variation versus incidence angle. The reflectivity will be compared between occultations of the same star but for different incidence angles.

9.7.3.2 - Observation set description

The following table describes the observation set needed for this task.

OS	#	S/A	Ins. mode	Star	Δt	Duration	$FLAG_{DB}$	Conf.	X_0	H_1, H_2, H_3
4a	1-5	A (5)	OCC	B1	0.50	50	D	E	Nom	7, 2, 7
4a	6-10	A (5)	OCC	B2	0.50	50	D	E	Nom	7, 2, 7
4a	11-15	A (5)	OCC	B3	0.50	50	D	E	Nom	7, 2, 7
4a	16-20	A (5)	OCC	B4	0.50	50	D	E	Nom	7, 2, 7

The observations must be performed with different SFA angles (this will need observations made at several days or weeks interval).

The occultations shall be done outside the atmosphere.

The targets shall be very stable bright stars. If possible, different bright stars will allow measuring this reflectivity factor for the whole GOMOS spectrum. It will also give a validity criterion.

9.7.4 - Polarisation sensitivity

9.7.4.1 - Objective

The objective of this task is to verify the sensitivity of GOMOS to the polarisation. The limb is measured for different sun zenith angles.

9.7.4.2 - Observation set description

The following table describes the observation set needed for this task.

OS	#	S/A	Ins. mode	Star	Δt	Duration	$FLAG_{DB}$	Conf.	X_0	H_1, H_2, H_3
4c	1-10	A (10)	OCC	Fict (10)	0.50	until loss	B	E	Nom	7, 2, 7

This task will be done with the task 2c.

Occultations of fictitious stars with different Sun zenith angles at the tangent point are needed.

9.7.5 - Band setting effect on the transmission computation

OS	#	S/A	Ins. mode	Star	Δt	Duration	$FLAG_{DB}$	Conf.	X_0	H_1, H_2, H_3
4b	1-13	A	OCC	B & F	0.50	until loss	B & D	E	Nom	7, 2, 7
4b	14-26	A	OCC	B & F	0.50	until loss	B & D	E	Nom	7, 2, 15
4b	27-39	A	OCC	B & F	0.50	until loss	B & D	E	Nom	5, 3, 7
4b	40-52	A	OCC	B & F	0.50	until loss	B & D	E	Nom	10, 2, 7
4b	53-65	A	OCC	B & F	0.50	until loss	B & D	E	Nom	7, 2, 5

Thirteen different stars will be used over 5 consecutive orbits (one for each H_i setting). The level 2 performance will be compared.

9.7.6 - Comparison of the two SATU

9.7.6.1 - Objective

The objective of this task is to verify that the SATU2 is really the best one (as measured on ground).

The differences between the two SATU are the following:

Performance	Best SATU
imaging quality	SATU2
pupil size	SATU2
telescope coating	SATU2
sun straylight	SATU2
earth straylight	SATU1
thermal sensitivity	SATU2
PRNU	SATU2
radiometric sensitivity	SATU2
dark current	no difference

Even if the difference is small for each parameter, the SATU2 is clearly the best. Therefore, it is chosen as the nominal one and the whole commissioning (SODAP, CAL and VAL phases) is done with the SATU2.

Nevertheless, it is worth to verify that the straylight on SATU is as expected. The dark current will also be verified in the same way.

A part of the SATU pixel map will be monitored for different straylight configurations.

9.7.6.2 - Observation set description

The following table describes the observation set needed for this task. This measurement set shall be performed for each SATU.

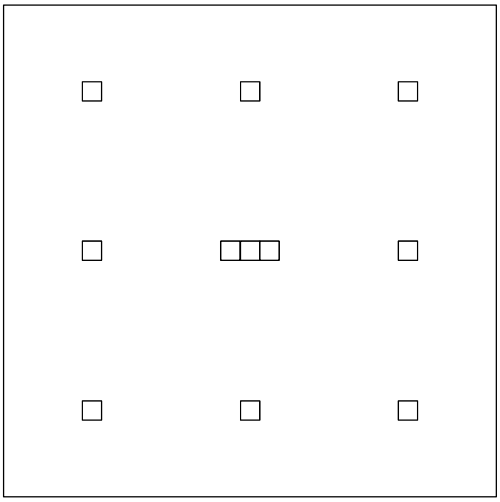
OS	#	S/A	Ins. mode	Target	Δt	Duration	$FLAG_{DB}$	Conf.	X_0	H_1, H_2, H_3
4d	1	A	UNI	alt = 150 km	0.50	60	D	E	Nom	7, 2, 7
4d	2	A	UNI	alt = 100 km	0.50	60	D	E	Nom	7, 2, 7
4d	3	A	UNI	alt = 50 km	0.50	60	D	E	Nom	7, 2, 7
4d	4	A	UNI	alt = 30 km	0.50	60	D	E	Nom	7, 2, 7
4d	5	A	UNI	alt = 20 km	0.50	60	D	E	Nom	7, 2, 7
4d	6	A	UNI	alt = 150 km	0.50	60	D	E	Nom	7, 2, 7
4d	7	A	UNI	alt = 100 km	0.50	60	D	E	Nom	7, 2, 7
4d	8	A	UNI	alt = 50 km	0.50	60	D	E	Nom	7, 2, 7
4d	9	A	UNI	alt = 30 km	0.50	60	D	E	Nom	7, 2, 7
4d	10	A	UNI	alt = 20 km	0.50	60	D	E	Nom	7, 2, 7
4d	11	A	UNI	alt = 150 km	0.50	60	B	E	Nom	7, 2, 7
4d	12	A	UNI	alt = 100 km	0.50	60	B	E	Nom	7, 2, 7
4d	13	A	UNI	alt = 50 km	0.50	60	B	E	Nom	7, 2, 7
4d	14	A	UNI	alt = 30 km	0.50	60	B	E	Nom	7, 2, 7

4d	15	A	UNI	alt = 20 km	0.50	60	B	E	Nom	7, 2, 7
4d	16	A	UNI	alt = 150 km	0.50	60	B	E	Nom	7, 2, 7
4d	17	A	UNI	alt = 100 km	0.50	60	B	E	Nom	7, 2, 7
4d	18	A	UNI	alt = 50 km	0.50	60	B	E	Nom	7, 2, 7
4d	19	A	UNI	alt = 30 km	0.50	60	B	E	Nom	7, 2, 7
4d	20	A	UNI	alt = 20 km	0.50	60	B	E	Nom	7, 2, 7
4d	21	A	UNI	alt = 200 km	0.50	60	D	E	Nom	7, 2, 7
4d	22	A	UNI	alt = 200 km	0.50	60	B	E	Nom	7, 2, 7

The first 5 measurements are done in the night side and without sun. The measurements 6 to 10 are done in the night side but with the sun as close as possible from the line of sight. The last five measurements are done in the day side .The first measurement will give the dark current.

The programmation of the SATU windows shall allow measuring the straylight inside the whole SATU FOV. The following figure shows the position of these 11 windows available in the auxiliary data.

Their position allows having an idea of the straylight inside the acquisition FOV and around the tracking window.



9.7.7 - Rayleigh scattering at high altitude

OS	#	S/A	Ins. mode	Star	Δt	Duration	$FLAG_{DB}$	Conf.	X_0	H_1, H_2, H_3
4f	1-5	S (5)	OCC	Fict (5)	0.50	100	B	E	Nom	7, 2, 7

Note 1: 5 different fictitious stars must be used for long lasting or tangential occultations. Only the samples for the upper part of the atmosphere (35 to 90 km) are analysed where there is no aerosol contribution and only Rayleigh scattering.

Note 2: the minimum duration of 100 second is specified as an indication for the long lasting occultations. Any tangential occultation may be used for the analysis.

9.7.8 - Aerosol characterisation

OS	#	S/A	Ins. mode	Star	Δt	Duration	$FLAG_{DB}$	Conf.	X_0	H_1, H_2, H_3
4e	1	S (5)	OCC	B/M	0.50	until loss	D	E	Nom	7, 2, 7
4e	2	S (5)	OCC	Fict	0.50	until loss	B	E	Nom	7, 2, 7

Note 1: look at the same geographical location in dark and bright limb conditions using several stars (real and fictitious) during one or several orbits.

Note 2: observations with different Sun zenith angles at the tangent point are needed.

9.7.9 - Moon observation

OS	#	S/A	Ins. mode	Star	Δt	Duration	$FLAG_{DB}$	Conf.	X_0	H_1, H_2, H_3

4g	1-7	A	OCC	Fict	0.50	250	B	E	Nom	7, 2, 7

Note 1: the Moon is used as a target for a fictive occultation.

Note 2: several Moon illuminations must be observed (7 times during the lunar cycle - 1 time every 4 day). Observations during 4 cycles must be performed.

Note 3: the bright limb flag is set to force the DMSA gain to 1. Even with this, most of the spectrum may saturate.

Note 4: the velocity shall be chosen so that the moon is scanned during the 250 s occultation

9.7.10 - Planets observation

OS	#	S/A	Ins. mode	Star	Δt	Duration	$FLAG_{DB}$	Conf.	X_0	H_1, H_2, H_3
4h	1	A	OCC	Venus	0.50	until loss	B	E	Nom	7, 2, 7
4h	2	A	OCC	Mars	0.50	until loss	B	E	Nom	7, 2, 7
4h	3	A	OCC	Saturn	0.50	until loss	B	E	Nom	7, 2, 7
4h	4	A	OCC	Jupiter	0.50	until loss	B	E	Nom	7, 2, 7

Note 1: each specified planet is used as a target for occultation.

Note 2: 10 observations per planet must be performed (one per week).

Note 3: the bright limb flag is set to limit the saturation on DMSA

9.7.11 - Polar Mesospheric Clouds observation

OS	#	S/A	Ins. mode	Star	Δt	Duration	$FLAG_{DB}$	Conf.	X_0	H_1, H_2, H_3
4i	1-50	S (5)	OCC	B/M	0.50	until loss	N/A	E	Nom	7, 2, 7

Note 1: perform occultation in polar region during the polar summer.
Note 2: there is only a constraint on the geographical location of the tangent point (polar region).
Note 3: the observation date and the selected stars will determine the dark/bright limb condition. There is no constraint on it.
Note 4: 50 different occultations must be performed in such condition to have a high probability to observe PMC.

9.7.12 - Double stars observation

OS	#	S/A	Ins. mode	Star	Δt	Duration	$FLAG_{DB}$	Conf.	X_0	H_1, H_2, H_3
4j	1-10	S (5)	OCC	M (10)	0.50	until loss	N/A	E	Nom	7, 2, 7

Double stars are defined as:

- for acquisition: a useful star of magnitude M is flagged as "double" if there exists a star brighter than magnitude M + 1 at less than 0.6° from the useful star

- for tracking: more than one star brighter than magnitude 7 (TBC) in the slit field of view (0.011° by 0.11°)

Note 1: 10 different double stars must be occulted.

Note 2: the dark/bright limb condition will be determined by the observation date and selected star. There is no constraint on it.

9.8 - Level 1b & level 2 verification and validation

9.8.1 - Rationale

- The routine observations during the commissioning are all dedicated to the Level 1b & level 2 verification and validation. They are to be performed when there is no other planned calibration or instrument performance evaluation campaign during the commissioning period. All observations are in occultation mode. This routine observation plan is also called "commissioning background observation plan".

9.8.2 - Observation set identifier

The general OS5 observation set is built by merging the requirements of the following sub-sets:

OS5-1 for the processing chain verification & tuning

OS5-2 for the internal consistency verification

OS5-3 for the validation with external data

In addition, the two following sub-sets are to be considered at several periods during the commissioning:

OS5-4 for the GOMOS/MIPAS comparison

OS5-5 for the GOMOS/SCIAMACHY comparison

OS5-6 for the GRAZE project (AOID 156)

OS5-7 for some specific user requests

9.8.3 - General observation requirements for OS5

The requirements expressed below are superseded by the specific requirements of OS5-2, OS5-3, and, when appropriate, by those of OS5-4, OS5-5 and OS5-6.

9.8.3.1 - Instrument mode

Occultation mode only. The instrument is set in extended configuration mode.

9.8.3.2 - Star ID or star characteristics (magnitude, temperature)

The choice of the stars will be driven by the choice of the sequences of objectives for the commissioning background plan. The next table recalls the 4 objectives.

#	Name
L1	Stratospheric Ozone monitoring
L2	Mesospheric Ozone monitoring
L3	Stratospheric chemistry (upper atmosphere)
L4	Stratospheric chemistry lower/middle atmosphere)

One star (Sirius) will be forced during the background observations.

Assuming:

L4S = Stratospheric chemistry lower/middle atmosphere, South latitude)

L4N = Stratospheric chemistry lower/middle atmosphere, North latitude)

L4NS = Stratospheric chemistry lower/middle atmosphere, North and South latitude)

The observation priority are set to:

L4S has priority during week 47 to 12 (inclusive) in latitude 60 - 90 degrees South.

L4N has priority during week 24 to 48 (inclusive) in latitude 60 - 90 degrees North.

L4NS has priority during week 47 to 48 (inclusive) in latitude 60 - 90 degrees North/South.

The timeline definition:

44 orbits are defined as one Mission Planning Unit (MPU), equal to a duration of about 3 days.

The timeline distribution rule is as follows (with respect to the above objectives):

The first 9 MPUs (i.e. 27 days):

During week 1 to 52:
If 60S < latitude < 60N then [L1] [L1] [L2] [L1] [L1] [L3] [L1] [L1] [L4]
During week 47 to week 12 (following year):
If latitude = 90S – 60S: [L4] [L4] [L4] [L4] [L4] [L4] [L4] [L4] = L4S
During week 24 to week 48 (following year):
If latitude = 60N – 90N: [L4] [L4] [L4] [L4] [L4] [L4] [L4] [L4] = L4N

Note: this includes two weeks overlap during week 47 and 48

Each bracket pair constitutes one MPU (2 x 22 orbits = 3 days)

9.8.3.3 - Observation mode (synchronous/asynchronous)

Observations are in synchronous mode.

9.8.3.4 - Number of orbits in synchronous mode

As described above, the commissioning background observation plan will be defined by MPUs of 44 orbits (more or less 3 days). The number of orbits in synchronous mode will be set in order to cover these periods.

9.8.3.5 - Minimum duration

There is no constraint on the occultation duration. The occultation must start outside the atmosphere (at least at 120 km) and stop when the setting of the star occurs or when the star tracker loses the star.

9.8.3.6 - Integration time

Occultations: 0.50 second in dark limb condition and 0.25 second in bright limb condition (with a sampling time of 0.50 second anyway by the averaging of two measurements).

9.8.3.7 - Dark/bright limb condition

The limb illumination condition is a function of the observed star. There is no constraint on it.

9.8.3.8 - Band setting

Only one band setting (the one fixed at the end of the task C.1.1).

9.8.3.9 - Location on the orbit

There is no constraint on the location on the orbit.

9.8.3.10 - Summary table

OS	#	S/A	Ins. mode	Star	Δt	Duration	$FLAG_{DB}$	Conf.	X_0	H_1, H_2, H_3
OS5	1-40	S(14)	OCC	B/M	0.50	until loss	D/B	E	Op	nominal

9.8.4 - Observation requirements for processing chains verification and tuning

9.8.4.1 - Observation set identifier

OS5-1 for the processing chains verification and tuning.

9.8.4.2 - Star ID or star characteristics (magnitude, temperature)

The observation set OS5-1 is actually made of the collection of the three observation sets: OS1b, OS2c and OS2d. That is to say about 53 occultations with 12 occultations in bright limb conditions and 41 in dark limb (31 bright stars).

9.8.4.3 - Dark/bright limb condition

See comment above ("Star ID or star characteristics")

9.8.4.4 - Summary table

See comment above ("Star ID or star characteristics")

9.8.5 - Observation requirements for internal coherency verification

9.8.5.1 - Observation set identifier

OS5-2 for internal consistency verification.

During the commissioning, a list of stars will be forced in the background observation plan.

Several couples of stars have to be selected with respect to their property to be occulted at the same geographical location (stars S1 and S2, S3 and S4, ... S5 and S6). A dedicated tool has been developed by ACRI to analyse the output file of the GOSS mission scenario utility (miscen) and look for couples of such stars.

The collocation criterion has been set to a rectangular lon-lat window of ±1.25°. If the difference between the mean TGP location of two occultations is lower than 2.50°, then the couple of stars must be observed. As it is a huge amount of work to specify these stars for each occultation during the commissioning, we have chosen to specify them only once a week, assuming that the collocation will occur at least during several orbits of this week.

A first analysis has been performed from November 2001 to April 2002, one orbit per week. The results have shown that there are between 1 and 7 couples of stars available per orbit, with a mean number of couples of 3.

9.8.5.2 - Dark/bright limb condition

Observations in dark limb conditions. Bright limb occultations should be also taken; anyway there are not a lot of them (16 over 197 occultations).

9.8.5.3 - Location on the orbit

Selected stars will be occulted at very close geographical locations (within 200 km) during the same orbit. The exercise described above provides star occultations in the latitude range [-60°, +68°]. A large percentage of the occultations (68%) are in the latitude range [-30°, +30°].

9.8.5.4 - Summary table

These observations have to be forced for each orbit of the specified week:

OS	Date	#	S/A	Star ID	Mv	Duration	DB	Azim	Lat
os5-2	2001 11 01	1	(*)	91	2.49	36	D	17	-18
os5-2	2001 11 01	2	(*)	71	2.25	36	D	14	-15
os5-2	2001 11 01	3	(*)	322	3.6	50	D	44	4
os5-2	2001 11 01	4	(*)	216	3.21	46	D	39	6
os5-2	2001 11 01	5	(*)	316	3.59	87	D	66	62
os5-2	2001 11 01	6	(*)	206	3.18	67	D	59	65
os5-2	2001 11 08	7	(*)	191	3.11	34	D	-1	-24
os5-2	2001 11 08	8	(*)	48	1.98	71	D	58	-24
os5-2	2001 11 08	9	(*)	91	2.49	37	D	20	-13
os5-2	2001 11 08	10	(*)	71	2.25	36	D	16	-12
os5-2	2001 11 08	11	(*)	161	2.93	41	D	31	15
os5-2	2001 11 08	12	(*)	2	-0.74	40	D	28	17
os5-2	2001 11 15	13	(*)	191	3.11	34	D	2	-22
os5-2	2001 11 15	14	(*)	334	3.63	34	D	-1	-20
os5-2	2001 11 15	15	(*)	334	3.63	34	D	-1	-20
os5-2	2001 11 15	16	(*)	470	3.9	109	D	68	-18
os5-2	2001 11 15	17	(*)	199	3.14	37	D	19	-10
os5-2	2001 11 15	18	(*)	71	2.25	37	D	18	-8
os5-2	2001 11 15	19	(*)	46	1.95	39	D	25	-2
os5-2	2001 11 15	20	(*)	41	1.86	37	D	20	0
os5-2	2001 11 15	21	(*)	161	2.93	41	D	31	19
os5-2	2001 11 15	22	(*)	2	-0.74	39	D	27	21
os5-2	2001 11 15	23	(*)	193	3.12	47	D	42	44
os5-2	2001 11 15	24	(*)	440	3.86	45	D	40	46
os5-2	2001 11 22	25	(*)	12	0.78	34	D	0	-23

os5-2	2001 11 22	26	(*)	411	3.82	59	D	51	-23
os5-2	*2001 11 22*	*27*	*(*)*	*329*	*3.61*	*34*	*D*	*-7*	*-18*
os5-2	2001 11 22	28	(*)	328	3.61	74	D	59	-16
os5-2	2001 11 22	29	(*)	199	3.14	37	D	21	-6
os5-2	2001 11 22	30	(*)	71	2.25	37	D	20	-4
os5-2	2001 11 22	31	(*)	46	1.95	39	D	26	2
os5-2	2001 11 22	32	(*)	41	1.86	37	D	21	4
os5-2	2001 11 22	33	(*)	361	3.71	50	D	44	22
os5-2	2001 11 22	34	(*)	216	3.21	46	D	40	24
os5-2	2001 11 22	35	(*)	316	3.59	52	D	49	66
os5-2	2001 11 22	36	(*)	139	2.83	50	D	47	68
os5-2	*2001 11 22*	*37*	*(*)*	*35*	*1.79*	*36*	*B*	*25*	*38*
os5-2	*2001 11 22*	*38*	*(*)*	*160*	*2.93*	*36*	*B*	*21*	*35*
os5-2	*2001 11 22*	*39*	*(*)*	*107*	*2.65*	*63*	*B*	*61*	*15*
os5-2	*2001 11 22*	*40*	*(*)*	*42*	*1.9*	*54*	*B*	*55*	*13*
os5-2	2001 11 29	41	(*)	316	3.59	47	D	43	66
os5-2	2001 11 29	42	(*)	139	2.83	44	D	40	68
os5-2	2001 12 06	43	(*)	88	2.45	56	D	51	53
os5-2	2001 12 06	44	(*)	23	1.5	51	D	47	55
os5-2	2001 12 06	45	(*)	193	3.12	39	D	29	50
os5-2	2001 12 06	46	(*)	108	2.65	39	D	28	52
os5-2	2001 12 06	47	(*)	316	3.59	42	D	36	66
os5-2	2001 12 06	48	(*)	139	2.83	41	D	34	68
os5-2	2001 12 13	49	(*)	26	1.62	35	D	12	-20
os5-2	2001 12 13	50	(*)	238	3.33	255	D	83	-20
os5-2	2001 12 13	51	(*)	20	1.25	35	D	9	-21
os5-2	2001 12 13	52	(*)	238	3.33	255	D	83	-20
os5-2	2001 12 13	53	(*)	321	3.6	50	D	44	19
os5-2	2001 12 13	54	(*)	65	2.2	47	D	40	21
os5-2	2001 12 13	55	(*)	193	3.12	37	D	24	51
os5-2	2001 12 13	56	(*)	108	2.65	37	D	22	53
os5-2	*2001 12 20*	*57*	*(*)*	*212*	*3.19*	*34*	*D*	*-4*	*-23*
os5-2	2001 12 20	58	(*)	100	2.58	58	D	51	-22
os5-2	*2001 12 20*	*59*	*(*)*	*145*	*2.87*	*34*	*D*	*-9*	*-21*
os5-2	2001 12 20	60	(*)	100	2.58	58	D	51	-22
os5-2	2001 12 20	61	(*)	171	3	55	D	48	-19
os5-2	2001 12 20	62	(*)	26	1.62	36	D	15	-16
os5-2	2001 12 20	63	(*)	314	3.59	35	D	13	-14
os5-2	2001 12 20	64	(*)	329	3.61	34	D	1	-13
os5-2	2001 12 20	65	(*)	317	3.59	155	D	74	-12
os5-2	2001 12 20	66	(*)	243	3.36	37	D	19	3
os5-2	2001 12 20	67	(*)	159	2.92	36	D	15	5
os5-2	2001 12 20	68	(*)	193	3.12	36	D	18	51
os5-2	2001 12 20	69	(*)	108	2.65	36	D	17	54
os5-2	*2001 12 20*	*70*	*(*)*	*32*	*1.76*	*42*	*B*	*38*	*-32*
os5-2	*2001 12 20*	*71*	*(*)*	*55*	*2.06*	*40*	*B*	*34*	*-34*
os5-2	2001 12 27	72	(*)	26	1.62	36	D	18	-12
os5-2	2001 12 27	73	(*)	314	3.59	36	D	16	-10
os5-2	2001 12 27	74	(*)	243	3.36	37	D	19	6
os5-2	2001 12 27	75	(*)	159	2.92	36	D	15	8

os5-2	2001 12 27	76	(*)	193	3.12	35	D	12	52
os5-2	2001 12 27	77	(*)	108	2.65	35	D	11	54
os5-2	*2001 12 27*	*78*	*(*)*	*32*	*1.76*	*44*	*B*	*41*	*-31*
os5-2	*2001 12 27*	*79*	*(*)*	*55*	*2.06*	*42*	*B*	*38*	*-33*
os5-2	2002 01 03	80	(*)	21	1.35	34	D	5	-23
os5-2	2002 01 03	81	(*)	251	3.38	115	D	70	-23
os5-2	2002 01 03	82	(*)	4	-0.01	34	D	5	-23
os5-2	2002 01 03	83	(*)	251	3.38	115	D	70	-23
os5-2	2002 01 10	84	(*)	21	1.35	35	D	8	-20
os5-2	2002 01 10	85	(*)	212	3.19	34	D	5	-18
os5-2	2002 01 10	86	(*)	4	-0.01	35	D	8	-20
os5-2	2002 01 10	87	(*)	212	3.19	34	D	5	-18
os5-2	2002 01 10	88	(*)	145	2.87	34	D	-1	-18
os5-2	2002 01 10	89	(*)	15	0.98	75	D	60	-17
os5-2	*2002 01 10*	*90*	*(*)*	*17*	*1.16*	*45*	*B*	*44*	*49*
os5-2	*2002 01 10*	*91*	*(*)*	*24*	*1.58*	*42*	*B*	*41*	*48*
os5-2	*2002 01 17*	*92*	*(*)*	*43*	*1.91*	*34*	*D*	*-7*	*-20*
os5-2	2002 01 17	93	(*)	223	3.27	50	D	44	-20
os5-2	2002 01 17	94	(*)	21	1.35	35	D	11	-17
os5-2	2002 01 17	95	(*)	212	3.19	35	D	7	-15
os5-2	2002 01 17	96	(*)	4	-0.01	35	D	11	-17
os5-2	2002 01 17	97	(*)	212	3.19	35	D	7	-15
os5-2	2002 01 17	98	(*)	20	1.25	37	D	20	-2
os5-2	2002 01 17	99	(*)	12	0.78	36	D	16	0
os5-2	2002 01 17	100	(*)	388	3.77	37	D	21	13
os5-2	2002 01 17	101	(*)	243	3.36	36	D	17	15
os5-2	*2002 01 17*	*102*	*(*)*	*17*	*1.16*	*41*	*B*	*37*	*55*
os5-2	*2002 01 17*	*103*	*(*)*	*24*	*1.58*	*39*	*B*	*34*	*52*
os5-2	2002 01 24	104	(*)	20	1.25	37	D	20	1
os5-2	2002 01 24	105	(*)	12	0.78	36	D	17	3
os5-2	2002 01 24	106	(*)	388	3.77	37	D	20	16
os5-2	2002 01 24	107	(*)	243	3.36	36	D	15	18
os5-2	*2002 01 24*	*108*	*(*)*	*22*	*1.36*	*106*	*B*	*75*	*33*
os5-2	*2002 01 24*	*109*	*(*)*	*166*	*2.98*	*67*	*B*	*64*	*33*
os5-2	2002 01 31	110	(*)	43	1.91	34	D	-2	-18
os5-2	2002 01 31	111	(*)	122	2.75	65	D	55	-18
os5-2	2002 01 31	112	(*)	23	1.5	34	D	-1	60
os5-2	2002 01 31	113	(*)	37	1.83	34	D	2	62
os5-2	2002 01 31	114	(*)	213	3.2	34	D	3	-49
os5-2	2002 01 31	115	(*)	85	2.41	34	D	3	-47
os5-2	2002 02 07	116	(*)	43	1.91	34	D	0	-16
os5-2	2002 02 07	117	(*)	104	2.61	77	D	60	-18
os5-2	2002 02 07	118	(*)	199	3.14	35	D	9	28
os5-2	2002 02 07	119	(*)	91	2.49	35	D	10	31
os5-2	*2002 02 07*	*120*	*(*)*	*23*	*1.5*	*34*	*D*	*-8*	*60*
os5-2	*2002 02 07*	*121*	*(*)*	*37*	*1.83*	*34*	*D*	*-5*	*62*
os5-2	2002 02 14	122	(*)	20	1.25	37	D	20	12
os5-2	2002 02 14	123	(*)	314	3.59	37	D	19	14
os5-2	2002 02 14	124	(*)	199	3.14	34	D	6	30
os5-2	2002 02 14	125	(*)	91	2.49	34	D	6	32

os5-2	2002 02 14	126	(*)	235	3.32	34	D	0	-60
os5-2	2002 02 14	127	(*)	103	2.6	34	D	1	-57
os5-2	2002 02 21	128	(*)	194	3.12	36	D	14	-19
os5-2	2002 02 21	129	(*)	377	3.75	35	D	13	-17
os5-2	2002 02 21	130	(*)	20	1.25	37	D	19	15
os5-2	2002 02 21	131	(*)	314	3.59	36	D	17	17
os5-2	2002 02 21	132	(*)	64	2.2	41	D	31	25
os5-2	2002 02 21	133	(*)	99	2.58	39	D	26	27
os5-2	2002 02 21	134	(*)	199	3.14	34	D	2	31
os5-2	2002 02 21	135	(*)	91	2.49	34	D	2	33
os5-2	2002 02 21	136	(*)	235	3.32	34	D	7	-57
os5-2	2002 02 21	137	(*)	103	2.6	34	D	7	-54
os5-2	2002 02 21	138	(*)	213	3.2	37	D	19	-38
os5-2	2002 02 21	139	(*)	178	3.02	36	D	18	-36
os5-2	2002 02 28	140	(*)	194	3.12	36	D	17	-15
os5-2	2002 02 28	141	(*)	377	3.75	36	D	15	-13
os5-2	2002 02 28	142	(*)	199	3.14	34	D	-2	32
os5-2	2002 02 28	143	(*)	91	2.49	34	D	-2	34
os5-2	2002 02 28	144	(*)	235	3.32	35	D	13	-53
os5-2	2002 02 28	145	(*)	103	2.6	35	D	13	-51
os5-2	2002 02 28	146	(*)	213	3.2	38	D	25	-32
os5-2	2002 02 28	147	(*)	178	3.02	38	D	23	-30
os5-2	2002 03 07	148	(*)	429	3.85	36	D	15	-5
os5-2	2002 03 07	149	(*)	134	2.81	36	D	16	-2
os5-2	*2002 03 07*	*150*	*(*)*	*199*	*3.14*	*34*	*D*	*-6*	*32*
os5-2	*2002 03 07*	*151*	*(*)*	*91*	*2.49*	*34*	*D*	*-6*	*34*
os5-2	2002 03 07	152	(*)	235	3.32	37	D	20	-48
os5-2	2002 03 07	153	(*)	103	2.6	37	D	20	-46
os5-2	2002 03 07	154	(*)	213	3.2	41	D	30	-26
os5-2	2002 03 07	155	(*)	85	2.41	40	D	29	-24
os5-2	202 03 14	156	(*)	429	3.85	36	D	16	-1
os5-2	202 03 14	157	(*)	134	2.81	36	D	16	1
os5-2	*202 03 14*	*158*	*(*)*	*130*	*2.8*	*49*	*B*	*48*	*-34*
os5-2	*202 03 14*	*159*	*(*)*	*69*	*2.23*	*46*	*B*	*45*	*-36*
os5-2	202 03 14	160	(*)	235	3.32	39	D	26	-42
os5-2	202 03 14	161	(*)	103	2.6	39	D	26	-40
os5-2	2002 03 21	162	(*)	178	3.02	44	D	36	-11
os5-2	2002 03 21	163	(*)	40	1.86	43	D	34	-8
os5-2	2002 03 21	164	(*)	429	3.85	36	D	16	2
os5-2	2002 03 21	165	(*)	134	2.81	36	D	17	4
os5-2	2002 03 21	166	(*)	235	3.32	41	D	32	-36
os5-2	2002 03 21	167	(*)	103	2.6	41	D	31	-34
os5-2	2002 03 28	168	(*)	263	3.42	34	D	-2	-21
os5-2	2002 03 28	169	(*)	434	3.85	75	D	60	-22
os5-2	2002 03 28	170	(*)	213	3.2	49	D	42	-3
os5-2	2002 03 28	171	(*)	40	1.86	45	D	37	-1
os5-2	2002 03 28	172	(*)	429	3.85	36	D	16	5
os5-2	2002 03 28	173	(*)	134	2.81	36	D	17	7
os5-2	2002 04 04	174	(*)	167	2.98	59	D	51	4
os5-2	2002 04 04	175	(*)	213	3.2	51	D	45	6

os5-2	2002 04 04	176	(*)	25	1.62	53	D	46	11
os5-2	2002 04 04	177	(*)	236	3.32	47	D	40	12
os5-2	2002 04 04	178	(*)	429	3.85	36	D	16	8
os5-2	2002 04 04	179	(*)	134	2.81	36	D	16	10
os5-2	2002 04 11	180	(*)	263	3.42	34	D	3	-17
os5-2	2002 04 11	181	(*)	168	2.99	255	D	82	-19
os5-2	2002 04 11	182	(*)	429	3.85	36	D	15	11
os5-2	2002 04 11	183	(*)	134	2.81	36	D	15	13
os5-2	2002 04 18	184	(*)	204	3.17	70	D	57	13
os5-2	2002 04 18	185	(*)	38	1.84	57	D	50	14
os5-2	2002 04 18	186	(*)	85	2.41	52	D	46	22
os5-2	2002 04 18	187	(*)	236	3.32	46	D	40	23
os5-2	2002 04 18	188	(*)	4	-0.01	35	D	10	23
os5-2	2002 04 18	189	(*)	10	0.61	34	D	7	25
os5-2	2002 04 18	190	(*)	21	1.35	35	D	10	23
os5-2	2002 04 18	191	(*)	10	0.61	34	D	7	25
os5-2	2002 04 25	192	(*)	263	3.42	35	D	8	-13
os5-2	2002 04 25	193	(*)	220	3.24	120	D	70	-15
os5-2	2002 04 25	194	(*)	4	-0.01	35	D	7	25
os5-2	2002 04 25	195	(*)	10	0.61	34	D	4	27
os5-2	2002 04 25	196	(*)	21	1.35	35	D	7	25
os5-2	2002 04 25	197	(*)	10	0.61	34	D	4	27

Instrument configuration will be: occultation mode, extended configuration, operational band settings, integration time of 0.5 second.

Date is the start date of the star observation. Star ID is the star identifier in the GOMOS star catalogue. Mv is the star visual magnitude. Duration is the estimated value provided by the GOSS simulator. Azim is the mean instrument azimuth angle during the occultation and Lat is the mean tangent point latitude.

(*): the occultations must be performed at each orbit during one week (synchronous mode).

The occultations shown in *italic* characters are in bright limb conditions or are in or close to the vignetting azimuth range. Anyway, they should also be considered in the observation plan.

9.8.6 - Observation requirements for the validation with external data

9.8.6.1 - Observation set identifier

OS5-3 for the validation with external data.

9.8.6.2 - Location on the orbit

First requirement: *The occultations that will occur at very close geographical locations of the stations listed in the following table shall be systematically selected in the commissioning background observation plan. The "black" stations are prioritary stations (top priority is marked with ***) for which data are strongly expected. The "grey" stations are secondary stations.*

Lat	Lon	Station	L	SAOZ	D	B	GUV	MV	Sonde
80 N	86 W	EUREKA	X						X
79 N	12 E	Ny Alesund		X	X		X	X	

77 N	69 W	Thule		X	X				X
70 N	22 W	Scoresbysund		X					
69 N	16 E	Andoya	X						
68 N	21 E	Kiruna	X	X				X	
67 N	51 W	SondreStromfjord				X			
67 N	27 E	Sodankyla ***		X					X
67 N	67 E	Salekhard	X						X
67 N	123 E	Zhigansk	X						
60 N	10 E	Harestua		X					
60 N	11 E	Oslo			X	X	X		X
52 N	4 W	Aberystwyth		X					X
48 N	11 E	Hohenpeissenberg	X		X	X			X
47 N	7 E	Bern						X	
47 N	8 E	Junfraujoch		X				X	
46 N	9 E	Arosa			X	X			
45 N	1 W	Bordeaux			X			X	
44 N	6 E	OHP ***	X	X	X				X
44 N	86 W	Toronto	X						
34 N	118 W	Table Mountain	X						
20 N	156 W	MaunaLoa	X	X					
1 N	173 E	Tarawa		X					
21 S	55 E	Saint Denis	X	X					X
22 S	49 W	Bauru		X					
45 S	170 E	Lauder ***	X	X	X				X
49 S	70 E	Kerguelen		X					
55 S	159 E	Macquarie		X					
67 S	140 E	Dumont d'Urville	X	X					X
68 S	68 W	Rothera		X					
76 S	26 W	Halley		X	X				
78 S	167 E	Arrival Heights		X					
90 S	0 E	South Pole station			X	X			

Table 9.8.6.2 - 1: Location, station and type of instrument measuring ozone routinely (L = lidar, D= Dobson, B = Brewer, GUV = UV Radiometer, MV = Microwave sounder)

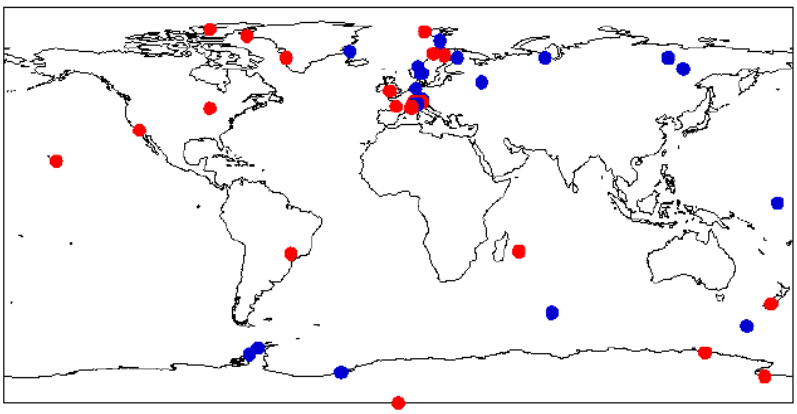


Figure 9.8.6.2 - 1: Location of the ground-stations

Note: ozone profiles may be derived from regular soundings at several ground stations (e.g. Sodankyla). This kind of information is currently used, for example, in the OSIRIS level 2 verification and validation work performed at FMI .

Second requirement: *There will be a plan for balloon collocations only if it can be done on very short notice (after knowing both exact balloon launch time and predicted trajectory starting from locations listed in next table) (TBC).*

Latitude	Longitude	Station
68 N	21 E	Kiruna (Finland)
44 N	6 E	Gap (France)
45 N	0 E	Aire sur Adour (Fr.)
22 S	49 W	Bauru (Brazil)
		Milo (Italy)

Table 9.8.6.2 - 2: Locations of stations of launch for balloon validation

9.8.7 - Observation requirements for GOMOS/MIPAS comparison

9.8.7.1 - Observation set identifier

OS5-4 for GOMOS/MIPAS comparison.

9.8.7.2 - Star ID or star characteristics (magnitude, temperature)

Stars to be used for this comparison will be extracted from the commissioning background plan. Colocation dates will be defined with the MIPAS team.

9.8.7.3 - Number of orbits in synchronous mode

The occultations will be selected from the commissioning background observations.

9.8.7.4 - Dark/bright limb condition

Occultations in both illumination conditions must be performed.

9.8.7.5 - Location on the orbit

There is a constraint not on the location on the orbit but on the pointing direction. GOMOS must look in or near the orbital plane to be in an observation condition similar to MIPAS. This configuration should occur several times per orbit in the commissioning background observation plan.

9.8.7.6 - Summary table

N/A

9.8.8 - Observation requirements for GOMOS/SCIAMACHY comparison

9.8.8.1 - Observation set identifier

OS5-5 for GOMOS/SCIAMACHY comparison.

9.8.8.2 - Instrument mode

Occultation mode is used using real and fictive stars. The instrument is set in extended configuration mode.

9.8.8.3 - Star ID or star characteristics (magnitude, temperature)

Stars to be used for this comparison will be extracted from the commissioning background plan. Colocation dates will be defined with the SCIAMACHY team.

9.8.8.4 - Number of orbits in synchronous mode

The occultations will be selected from the commissioning background observations.

9.8.8.5 - Dark/bright limb condition

Occultations in bright limb condition.

9.8.8.6 - Location on the orbit

There is a constraint not on the location on the orbit but on the pointing direction. GOMOS must look in or near the orbital plane to be in an observation condition similar to SCIAMACHY. A computation of the time delay between the two instrument observations must also be done to have a correct coincidence of the observations. This configuration should occur several times per orbit in the commissioning background observation plan.

9.8.8.7 - Summary table

N/A

9.8.9 - Observation requirements for the GRAZE project

9.8.9.1 - Observation set identifier

OS5-6 for the GRAZE project occultations.

The GRAZE project needs tangential and long duration occultations.

A preliminary analysis has been performed: only star brighter than magnitude 2.0 (49 stars), one orbit per day, one year simulation, starting in November 2001. The results have shown that there are only 35 series of occultations of this kind during the year (19 series in dark limb conditions).

The duration of these occultations is always greater than 150 seconds.

One can see that most of these occultations occur between September and November. Two short series occur in December (stars 8 and 17 both in bright limb conditions). Four occur in January (stars 3, 15, 22 and 48 with 3 and 15 in dark limb conditions). Then, only two in March (stars 3 and 15 both in bright limb conditions), one in April (star 11 in dark limb conditions) and one in June (star 11 in bright limb conditions).

9.8.9.2 - Dark/bright limb condition

Both observations in dark and bright limb conditions.

9.8.9.3 - Location on the orbit

There is no constraint on the observation latitude.

9.8.9.4 - Summary table

These observations have to be forced for each orbit of the specified periods:

OS	Start date	Stop date	#	Star ID	Mv	DB
os5-6	15/10/01	07/11/01	1	47	1.98	D
os5-6	17/10/01	21/10/01	*2*	8	0.40	D
os5-6	*30/10/01*	*02/11/01*	*3*	*7*	*0.10*	*B*
os5-6	*31/10/01*	*04/11/01*	4	*28*	*1.65*	*B*
os5-6	08/11/01	15/11/01	*5*	1	-1.44	D
os5-6	*08/11/01*	*10/11/01*	*6*	*27*	*1.64*	*B*
os5-6	*09/11/01*	*11/11/01*	*7*	*30*	*1.69*	*B*
os5-6	*10/11/01*	*12/11/01*	*8*	*33*	*1.77*	*B*
os5-6	*16/11/01*	*18/11/01*	*9*	*14*	*0.87*	*B*
os5-6	**19/11/01**	**24/11/01**	**10**	**48**	**1.98**	**D**
os5-6	**23/11/01**	**27/11/01**	**11**	**22**	**1.36**	**D**
os5-6	*26/11/01*	*28/11/01*	*12*	*44*	*1.93*	*B*
os5-6	*28/11/01*	*02/12/01*	*13*	*24*	*1.58*	*B*
os5-6	*06/12/01*	*09/12/01*	*14*	*17*	*1.16*	*B*
os5-6	*12/12/01*	*14/12/01*	*15*	*8*	*0.40*	*B*
os5-6	*02/01/02*	*05/01/02*	*16*	*48*	*1.98*	*B*
os5-6	*19/01/02*	*21/01/02*	*17*	*22*	*1.36*	*B*
os5-6	**20/01/02**	**25/01/02**	**18**	**15**	**0.98**	**D**
os5-6	**26/01/02**	**31/01/02**	**19**	**3**	**-0.05**	**D**
os5-6	*01/03/02*	*04/03/02*	*20*	*15*	*0.98*	*B*
os5-6	*21/03/02*	*24/03/02*	*21*	*3*	*-0.05*	*B*
os5-6	**20/04/02**	**24/04/02**	**22**	**11**	**0.77**	**D**
os5-6	*16/06/02*	*18/06/02*	*23*	*11*	*0.77*	*B*
os5-6	31/08/02	05/09/02	24	13	0.87	D
os5-6	12/09/02	17/09/02	25	27	1.64	D
os5-6	15/09/02	20/09/02	26	7	0.10	D
os5-6	19/09/02	22/09/02	27	30	1.69	D
os5-6	20/09/02	25/09/02	28	28	1.65	D
os5-6	20/09/02	23/09/02	29	33	1.77	D
os5-6	20/09/02	24/09/02	30	14	0.87	D

os5-6	01/10/02	06/10/02	31	44	1.93	D
os5-6	18/10/02	27/10/02	32	1	-1.44	D
os5-6	24/10/02	30/10/02	33	17	1.16	D
os5-6	26/10/02	02/11/02	34	24	1.58	D
os5-6	*26/10/02*	*29/10/02*	*35*	*13*	*0.87*	*B*

9.8.10 - Observation requirements from user requests

9.8.10.1 - Observation set identifier

OS5-7 for the occultations covering some specific user requests.

One user asked for the occultation of the South Cross stars in the vicinity of New-Zeland. Unfortunately, the lowest latitudes are obtained in beginning of November (-32°). Beginning of December, the three brightest stars of the South Cross are visible from GOMOS. We propose to observe these three stars as soon as possible. In the summary table is listed the characteristics of the occultations for the 01 and 08 December 2001.

9.8.10.2 - Dark/bright limb condition

Both observations in dark and bright limb conditions.

9.8.10.3 - Location on the orbit

Low latitudes for the occultation of the four brightest stars of the South Cross.

9.8.10.4 - Summary table

Occultations of South Cross stars:

OS	Date	#	S/A	Star ID	Mv	Duration	DB	Azim	Lat
os5-7	2001 12 01	1	S (14)	12	0.775	34	D	3.7	-20.8
os5-7	2001 12 01	2	S (14)	20	1.253	34 (*)	D	3.3	-25.2
os5-7	2001 12 01	3	S (14)	26	1.624	32	D	6.8	-25.4

or

OS	Date	#	S/A	Star ID	Mv	Duration	DB	Azim	Lat
os5-7	2001 12 08	1	S (14)	12	0.775	34	D	6.4	-18.4
os5-7	2001 12 08	2	S (14)	20	1.253	34	D	6.5	-22.6
os5-7	2001 12 08	3	S (14)	26	1.624	35	D	10.2	-22.4

(*): the occultation of BetCru (star #20) occurs between two orbits at this date.

9.9 - Monitoring of the observation plan during the commissioning phase

This task is active all along the commissioning.

9.9.1 - Task objectives

TO-MOP-1: management of the observation sets.

TO-MOP-1: update of the routine observation for commissioning.

TO-MOP-2: observation plan definition for geophysical validation.

TO-MOP-3: definition of the routine observation after commissioning.

9.9.2 - Task activities

TA-MOP-1: archive of the level 0 products coming from the distribution centre.

TA-MOP-2: distribution of the level 0 products to the different tasks.

TA-MOP-3: creation/update of the observation plan documents in collaboration with the team of the commissioning tasks.

TA-MOP-4: distribution of the observation plan documents to the GOMOS macro-command generation centre. Verification of the macro-commands to be uploaded to the instrument.

9.9.3 - Prerequisites

TP-MOP-1: the initial commissioning observation plan must be defined.

TP-MOP-2: the request document format for observation plan definition/update must be defined.

9.9.4 - Processing description

PD-MOP-1: verify that the creation of the macro-commands from the observation plans is performed.

PD-MOP-2: verify that the sending of the macro-commands to the instrument is performed.

PD-MOP-3: verify that the conversion of the GOMOS packets into level 0 products is performed.

PD-MOP-4: receive the tapes coming from the level 0 products distribution centre and store them into the local archiving system.

PD-MOP-5: notify the different task teams that the level 0 products are available.

PD-MOP-6: provide the level 0 products to the different task teams when they required them.

PD-MOP-7: receive the document containing the observation plan definition/update form the different teams.

PD-MOP-8: receive the document containing the observation plan definition/update from the different teams and verify that the team in charge of the macro-command generation correctly handles these modifications.

9.9.5 - Output data

OD-MOP-1: level 0 in the Commissioning Working Environment archiving system.

9.9.6 - Passed/failed criteria

PF-MOP-1: this task is passed if all planned observations are performed as expected in the predicted timeline and if the level 0 products are distributed to the different commissioning tasks in time.

9.9.7 - Task report

TR-MOP-1: the task report consists in a checklist of planned observations, performed observations and archived level 0 products. This report contains also the requests for observation plan updates.

9.9.8 - Team/location

TL-MOP-1: task responsible is: P. Lecomte

TL-MOP-2: task team is: T. Paulsen, J.L. Bertaux, G. Barrot, O. Hembise

TL-MOP-3: processing location is ESRIN/ESTEC

10. - Cross-reference tables

10.1 - Introduction

The aim of this chapter is to link the commissioning tasks with the several updates of the auxiliary products, processing chains and associated TDS but also with the fields of the GOMOS packets to be checked during task 1.2 and the parameters of the auxiliary products and the modules of the CALEX, level 1b and level 2 processing chains that will be modified during the processing chains verification and tuning.

10.2 - Version number of the updated items

The following table lists the update version number of the auxiliary products, processing chains and Test Data Sets versus the different tasks of the commissioning.

	Instrument check and level 0 products validation	GOMOS tracking capability	CALEX processor verification	First in-flight calibration	Initial trend analysis	Additional instrument performance evaluation	Second in-flight calibration	Level 1b processing chain verification
Level 1b processing chain	V0							V0a
Level 2 processing chain	V0							V0a
Level 1b and level 2 TDS	V0							V1
Calibration aux. product	V0			V1	V2		V3	
IPC aux. Product	V0			V1	V2		V3	
Level1b processing configuration aux. product	V0							V1
Star catalogue aux. product	V0	V1						
Stellar spectra aux. product	V0							
Level 2 processing configuration aux. product	V0							V0a
Cross-section aux. product	V0							
CALEX processing chain	V0		V1					
Monitoring configuration file	V0		V1	V2	V3	V4		
CALEX TDS	V0		V1	V2	V3	V4		

	Level 1b processing chain tuning	Level 2 processing chain verification	Level 2 processing chain tuning	GOMOS algorithms internal consistency verification	GOMOS validation with external data	First update of the PDS operational chains	Second update of the PDS operational chains	
Level 1b processing chain	V1							
Level 2 processing chain		V0b	V1					
Level 1b and level 2 TDS	V2	V3	V4					
Calibration aux. product								
IPC aux. product								
Level1b processing configuration aux. product	V2			V3				
Star catalogue aux. product								
Stellar spectra aux. product								
Level 2 processing configuration aux. product		V1	V2	V3				
Cross-section aux. product								
CALEX processing chain								
Monitoring configuration file								
CALEX TDS								

10.3 - GOMOS packet header fields

The following table lists the fields of the packet header to be checked during task 1.2.

#	Description	Task IDs
1	Application process identifier	C.1
2	Segmentation flag	C.1
3	Packet counter (*)	C.1
4	Packet length	C.1

(*): only the counter sequence will be checked and not the absolute value of the counter.

10.4 - GOMOS data field header fields

The following table lists the fields of the data field header to be checked during task C.1.

#	Description	Task IDs
1	Instrument mode	C.1
2	ICU time code (*)	C.1
3	Redundancy definition vector	C.1
4	Instrument configuration	C.1
5	Star identifier	C.1
6	Dark/bight limb flag	C.1
7	Data valid flag	C.1
8	DM gain	C.1
9	DM integration duration	C.1
10	Integration number	C.1
11	Bands setting (1st packet of an observation)	C.1
12	SATU tracking window shift (1st measurement of an observation) (**)	C.1
13	CCD thermistor temperatures (1st measurement of an observation) (**)	C.1
14	SFA angles codes (***)	C.1
15	SATU data codes (****) (except for the 1st measurement of an observation)	C.1

(*): only the ICU time code sequence will be checked and not the absolute value of the code. Difference between two ICU times should be close to the measurement sampling (0.5 second in occultation and programmable integration time in monitoring modes).

(**): the value provided in the packets is compared with admissible ranges.

(***): the SFA angles codes are converted into azimuth and elevation angles. The variation of these angles is coarsely analysed.

(****): the SATU data are converted into pointing error angles. The mean pointing error and the standard deviation are computed and plotted versus time for analysis.

10.5 - GOMOS source data fields

The following table lists the fields of the source data field to be checked during task C.1.

#	Description	Task IDs
1	Spectrometer identifiers (SPA1, SPA2, SPB1, SPB2) (*)	C.1
2	Photometer identifiers (FP1, FP2) (*)	C.1
3	Occultation mode: upper, central and lower spectra (**)	C.1
4	Monitoring modes: CCD maps (**)	C.1

(*): the verification of the identifiers will confirm the correct storage of the spectra as a function of the bands setting and of the instrument configuration (nominal or extended mode).

(**): the coarse verification of the spectra in occultation and monitoring modes consists in plotting several spectra or maps at the beginning and at the end of the observation and see if something strange is visible. At least two spectra for upper, central and lower bands must be analysed in occultation or in linearity monitoring mode. At least two CCD maps must be analysed for an observation in uniformity or in spatial spread monitoring mode.

10.6 - Instrument signal level analysis

The following table lists the items analysed during task C.2.

#	Description	Task IDs
1	Thermistor temperature	C.2
2	Dark charge level	C.2
3	SFA angles	C.2
4	SATU data	C.2
5	Star spectra shape and signal level	C.2
6	Limb spectra shape and signal level	C.2

10.7 - Level 1b processing chain algorithms

The following table lists the modules of the level 1b processing chain that will be verified during the commissioning phase.

#	Description	Task IDs
1	Read the level 0 product and source data packet extraction	C.3 (1) (3)
2	Read the auxiliary products (CAL, IPC, CAT, PR1)	C.3 (1)
3	Datation	C.3 (1)
4	Wavelength assignment	C.3 (4)
5	Atmosphere parameters retrieval	C.3 (2)
6	Geolocation (ray tracing, orbit propagator, star direction)	C.3 (2)
7	Spectrometer saturated samples processing	C.3 (4)
8	Spectrometer bad pixels processing	C.3 (4)
9	Spectrometer cosmic rays processing	C.3 (4)
10	Spectrometer ADU to electrons conversion	C.3 (4)
11	Spectrometer dark charge correction	C.3 (4)
12	Spectrometer internal straylight correction (*)	C.3 (4)
13	Spectrometer external straylight correction (*)	C.3 (4)
14	Spectrometer vignetting correction	C.3 (4)
15	Spectrometer central background estimation	C.3 (4)
16	Star signal computation	C.3 (4)

17	Reference star spectrum computation	C.3 (4)
18	Full transmission and covariance computations	C.3 (4)
19	Photometer saturated samples processing	C.3 (5)
20	Photometer ADU to electrons conversion	C.3 (5)
21	Photometer dark charge correction	C.3 (5)
22	Photometer internal straylight correction (*)	C.3 (5)
23	Photometer external straylight correction (*)	C.3 (5)
24	Photometers vignetting correction	C.3 (5)
25	Photometer background subtraction	C.3 (5)
26	Photometer flat-field correction	C.3 (5)
27	Creation of the level 1b and limb products	C.3 (1)

(*): in the initial Calibration auxiliary product, the straylight LUTs are empty. The verification of the straylight correction will be performed only when the LUTs will be determined in-flight.

Note: the verification process will be mainly based on five tasks:

(1) verification of the I/O operations including the reading of the level 0 products, of the auxiliary products and the creation of the level 1b and limb products,

(2) verification of the geolocation including atmosphere parameters retrieval and datation,

(3) verification of the SATU and SFA angles processing,

(4) verification of the spectrometer samples processing including the spectra wavelength assignment,

(5) verification of the photometer samples processing.

Different people involved in the task C.3 may perform these verifications in parallel.

10.8 - Level 2 processing chain algorithms

The following table lists the modules of the level 2 processing chain that will be verified during the commissioning phase.

#	Description	Task IDs
1	Read the level 1b product	V.1.1
2	Read the auxiliary products (IPC, CRS, PR2)	V.1.1
3	Preparation of the inversion process (SDC)	V.1.1
4	Scintillation dilution correction (SDC.1)	V.1.1
5	Chromatic refraction correction (SDC.2)	V.1.1
6	Inversion initialisation (INI)	V.1.1
7	Initial computation for the transmission model (INI-1)	V.1.1
8	Levenberg Marquard Minimisation (INI-2.1)	V.1.1
9	DOAS inversion (INI-2.2)	V.1.1
10	Initialisation for spectro B data inversion (INI-3)	V.1.1
11	Vertical inversion initialisation (INI-4)	V.1.1

12	Spectral inversion (SPI)	V.1.1
13	Spectral inversion for spectro A (SPI-1)	V.1.1
14	Spectral inversion for spectro B (SPI-2)	V.1.1
15	Smoothing process (SMO)	V.1.1
16	Vertical inversion (VAL)	V.1.1
17	Exceptions handling (VAL-1)	V.1.1
18	Computations of local densities and associated covariances (VAL-2)	V.1.1
19	Unit conversion (VAL-3)	V.1.1
20	Products confidence factor computation (PCO-1)	V.1.1
21	Exit test for the whole inversion process (WHO)	V.1.1
22	(New) Cross section computation (CSC.1)	V.1.1
23	Global exit test (GET-1)	V.1.1
24	GOMOS Atmospheric Profile determination (GAP-1)	V.1.1
25	GOMOS Atmospheric Profile product creation (GAP-2)	V.1.1
26	Rapid fluctuations processing (TS)	V.1.1
27	Transmission due to scintillation only (TS-1)	V.1.1
28	Turbulence computation (TS-2)	V.1.1
29	Use of the Ray Tracing module (URT-1)	V.1.1
30	Ray tracing computation for level 2 (RTL-2)	V.1.1
31	Retrieval of Atmospheric parameters (Level 2) (RAP-2)	V.1.1
32	GOMOS products creation (PRO)	V.1.1

10.9 - Instrument Physical Characteristics auxiliary product

The following cross-reference table lists the parameters of the IPC auxiliary product that may be potentially modified during the commissioning phase.

#	Description	Task IDs
1	SATU reference wavelength	C.2
2	Lower wavelength of the invalid spectral range	C.2
3	Higher wavelength of the invalid spectral range	C.2
4	Number of reference wavelengths for the static spectral PSF (SPA/SPB)	C.2
5	Reference wavelengths of the static spectral PSF (SPA/SPB)	C.2
6	Number of points for the static spectral PSF (SPA/SPB)	C.2
7	Discretisation step of the static spectral PSF (SPA/SPB)	C.2
8	Static spectral PSF values (SPA/SPB)	C.2
9	Number of reference wavelengths for the static spatial PSF (SPA/SPB)	C.2
10	Reference wavelengths of the static spatial PSF (SPA/SPB)	C.2
11	Number of points for the static spatial PSF (SPA/SPB)	C.2
12	Discretisation step of the static spatial PSF (SPA/SPB)	C.2
13	Static spatial PSF values (SPA/SPB)	C.2

10.10 - Calibration auxiliary product

The exhaustive list of the parameters of the Calibration auxiliary product that will be potentially modified during the commissioning phase is detailled in the following table.

#	Description	Task IDs
1	First used column on the CCD array for SPA and SPB	C.2
2	Number of used columns for the CCD arrays of SPA and SPB	C.2
3	First used lines of the CCD arrays	C.2
4	Number of lines of the background bands (*)	C.2
5	Number of lines of the isolation bands (*)	C.2
6	Number of lines of the target bands (*)	C.2
7	First used column of the FP1/FP2 CCD array	C.2
8	Last used column of the FP1/FP2 CCD array	C.2
9	IR-vignetting correction LUT	C.2
10	Star spot half axis lengths on the FP CCD array	C.2
11	Nominal CCD line index of the star spectrum projection (SP) (*)	C.2
12	Nominal location of the star spot centre (FP)	C.2
13	Spectrometer wavelength assignment (*)	C.2
14	Spectral dispersion LUT (*)	C.2
15	Photometer spectral ranges	C.2
16	Transformation between electrons received by spectrometers and electrons received by photometers	C.2
17	Calibration gain curve for the conversion of the limb radiance into physical unit	C.2
18	Calibration gain curve for the conversion of the star spectra into physical unit	C.2
19	CCD spectral orientation	C.2
20	CCD/SATU relative orientation	C.2
21	Spectrometer bad pixel list	C.2
22	Photometer bad pixel list	C.2
23	Spectrometer electronic chain gain (*)	C.2
24	Photometers electronic chain gain (*)	C.2
25	ADC offsets for the spectrometers (*)	C.2
26	ADC offset for photometers	C.2
27	Non-linearity look-up table for SP (*)	C.2
28	Non-linearity look-up table for FP (*)	C.2
29	Detection chain offset for the spectrometers	C.2
30	Detection chain offset for the fast photometers	C.2
31	Thermistor reference temperature for the spectrometers dark charge maps (*)	C.2
32	Spectrometer dark charge map at the thermistor reference temperature (*)	C.2
33	Temperature variation that doubles the dark charge (SP)	C.2
34	Thermistor reference temperature for the photometers dark charge maps	C.2
35	Photometer dark charge map at the thermistor reference temperature (*)	C.2
36	Temperature variation that doubles the dark charge for FP	C.2

37	Spectrometer pixel relative response non-uniformity maps (*)	C.2
38	Photometer relative pixel response non-uniformity maps (*)	C.2
39	Spectrometers electronic chain noise (n0) (*)	C.2
40	Photometers electronic chain noise (n0)	C.2
41	Spectrometers noise LUT	C.2
42	Photometers noise LUT	C.2
43	Internal straylight maps	C.2
44	Sun straylight maps	C.2
45	Earth straylight maps	C.2

(*): these parameters must be calibrated in higher priority.

10.11 - Level 1b processing configuration auxiliary product

The next table provides the list of the parameters of the Level 1b processing configuration auxiliary product that will be potentially modified during the verification and tuning tasks of the commissioning phase.

#	Description	Task IDs
1	Cosmic rays processing activation switch	C.3.2
2	Dark charge correction processing activation switch	C.3.2
3	Internal straylight correction activation switch	C.3.2
4	External earth straylight correction activation switch	C.3.2
5	External sun straylight correction activation switch	C.3.2
6	Central background estimation mode	C.3.2
7	SATU data use activation switch	C.3.2
8	Vignetting activation switch	C.3.2
9	Flat-field correction mode	C.3.2
10	Interpolation mode for spectra resampling	C.3.2
11	Spectral grid selection for transmission computation	C.3.2
12	Covariance computation mode	C.3.2
13	Atmosphere thickness	C.3.2
14	Ray tracing parameters	C.3.2
15	Time shift for ray tracing computation	C.3.2
16	Minimum wavelength value for ray-tracing	C.3.2
17	Maximum wavelength value for ray-tracing	C.3.2
18	Reference wavelength for the ray tracing	C.3.2
19	Half-number of measurements for CR detection	C.3.2
20	Half-number of CCD columns for CR detection	C.3.2
21	Threshold for relative variation of the signal for cosmic rays detection	C.3.2
22	Threshold for absolute variation of the signal for cosmic rays detection	C.3.2
23	Threshold for cosmic rays detection activation	C.3.2
24	Number of frames for dark charge estimation	C.3.2

25	Threshold for background correction (dark limb)	C.3.2
26	Threshold for background correction (bright limb)	C.3.2
27	Altitude range used in the estimated central background computation (general method)	C.3.2
28	Order of the polynomial used in the central background computation (general method)	C.3.2
29	Photometer index for the scintillation correction in the flat-field correction processing	C.3.2
30	Number of measurements to be used for the reference star spectrum computation	C.3.2
31	Number of altitude grid points for upper part of the atmosphere	C.3.2
32	Minimum altitude for lower part of the atmosphere	C.3.2
33	Minimum altitude for upper part of the atmosphere	C.3.2
34	Altitude step for lower part of the atmosphere	C.3.2
35	Altitude step for upper part of the atmosphere	C.3.2
36	Number of pressure levels for upper part of the atmosphere	C.3.2
37	Index of the reference level for the iterative verification of hydrostaticity	C.3.2
38	Threshold for the convergence of the iterative process	C.3.2
39	Maximum iteration number for the iterative process	C.3.2
40	Delta angle for the atmosphere zone in the occultation area	C.3.2
41	Transition height expressed in number of atmospheric scale heights	C.3.2
42	Size of the reference atmospheric profile	C.3.2
43	First altitude of the profile	C.3.2
44	Altitude discretisation	C.3.2

Note: task C.3.1 is dedicated to the algorithm verification and task C.3.2 is dedicated to the tuning of the parameters.

10.12 - Level 2 processing configuration auxiliary product

The next table provides the list of the parameters of the Level 2 processing configuration auxiliary product that that will be potentially modified during the verification and tuning tasks of the commissioning phase.

#	Description	Task IDs
1	Pressure at the top of the atmosphere	V.1.2
2	Limit value for the relative variation of density	V.1.2
3	Maximum number of iteration for the iterative process	V.1.2
4	Number of GOMOS sources data (used in GAP)	V.1.2
5	Activation flag for GOMOS sources data (GAP)	V.1.2
6	Weight factor on O2 data (used in GAP)	V.1.2
7	Chromatic refraction mode for the measured transmission	V.1.2
8	Chromatic refraction mode for transmission model	V.1.2
9	Instrument function mode for the transmission model	V.1.2
10	Vertical inversion mode	V.1.2
11	Atmosphere thickness	V.1.2
12	Maximum number of iterations for the deviation computation	V.1.2
13	Threshold value for the ray deviation computation	V.1.2
14	First altitude step for the ray tracing	V.1.2
15	Altitude step for the ray tracing	V.1.2
16	Altitude sampling for density second derivative calculation	V.1.2

17	Maximum number of iterations for impact parameter computation	V.1.2
18	Precision for impact parameter computation	V.1.2
19	Minimum and maximum wavelength values for ray-tracing	V.1.2
20	Altitude range for turbulence fluctuations processing	V.1.2
21	Length of the cross-correlation window	V.1.2
22	Number of altitudes for reference line density	V.1.2
23	Choice of atmospheric model for SPA (reference line density)	V.1.2
24	Air reference line density computation model	V.1.2
25	Total number of species for spectrometer A	V.1.2
26	Number of species groups (initialisation phase)	V.1.2
27	Number of species groups (spectral inversion phase)	V.1.2
28	Number of altitudes for spectral windows	V.1.2
29	Hanning filter cut-off frequency (half extent)	V.1.2
30	Aerosol model selection	V.1.2
31	Order of the polynomial aerosol model	V.1.2
32	Aerosol model coefficients	V.1.2
33	DOAS sliding window size in pixels	V.1.2
34	Maximum value of chi2 before a warning flag is raised	V.1.2
35	Flag for negative densities in LMA (0=no 1=yes)	V.1.2
36	Photometer flag (0=blue 1=red) - scintillation processing	V.1.2
37	Minimum and maximum values for transmission terms	V.1.2
38	Minimum and maximum values for optical thickness	V.1.2
39	Minimum and maximum values for column densities	V.1.2
40	Minimum and maximum values for local densities	V.1.2
41	Maximum altitude for H2O retrieval	V.1.2
42	Number of altitudes for all convergence criteria	V.1.2
43	Maximum number of iterations for the main loop	V.1.2
44	Maximum number of iterations for the inversion process	V.1.2
45	Maximum number of iterations for the spectral inversion of SPA	V.1.2
46	Maximum number of iterations for the spectral inversion of LMA	V.1.2
47	Maximum for relative standard deviation evolution	V.1.2
48	Convergence criteria for Air in the main loop (local density)	V.1.2
49	Convergence criteria for each species (local density)	V.1.2
50	Chi2 criteria value (for LMA)	V.1.2
51	Inversion method choice (LMA=0, DOAS=1) from the group of species (initialisation phase) MDG	V.1.2
52	Number of species from the group of species (initialisation phase) MDG	V.1.2
53	Species list from the group of species (initialisation phase) MDG	V.1.2
54	Inversion method choice (LMA=0, DOAS=1) from the group of species MDG	V.1.2
55	Number of species from the group of species MDG	V.1.2
56	Species list from the group of species MDG	V.1.2
57	Spectral window for each species from the spectral windows (initialisation phase) MDG	V.1.2
58	Spectral window for each species from the spectral windows MDG	V.1.2

10.13 - Star catalogue auxiliary product

During the commissioning, there is a potential possibility to update the quality fields attached to each star (fields 80 and 81 of the MDG layout). This will be performed during the GOMOS tracking verification task.

#	Description	Task IDs
1	Quality codes 1 (Star catalogue MDG field #80)	C.1.2
2	Quality codes 2 (Star catalogue MDG field #81)	C.1.2

10.14 - Stellar spectra databank auxiliary product

CATSPEC (task C.4.3) is dedicated to the update of the stellar spectra databank auxiliary product.

10.15 - Cross-section auxiliary product

During the validation tasks, the comparison between GOMOS data and other instrument data will perhaps lead to an update of the cross-section auxiliary product. Anyway, there is currently no identified task specificly dedicated to this modification. It will be mainly part of an *anomaly action procedure* if such modification seems necessary.

11. - Tools

11.1 - Introduction

The following chapters provide the list of functionalities that will be needed to perform the commissioning tasks. Some of them are covered by already existing tools. Others may need some specific developments. The functionalities include the visualisation in text and graphical mode of the content of the GOMOS products, of the intermediate files of the GOMOS processing and of the intermediate files of the calibration processing. The tools also cover the modification of the input files and of the auxiliary products. Non-specific tools such as compilers, editors, word processors, and mathematical packages will be also needed.

The following table provides a short description of each needed function and associated tool:

#	Mnemonic	Mode	Description	Tool
P1	lv0_view	T/G	visualisation of the level 0 products	GOMOS product toolbox
P2	lv1_view	T/G	visualisation of the level 1b products	GOMOS product toolbox, IDL GOMOS I/O toolbox
P3	lim_view	T/G	visualisation of the limb products	GOMOS product toolbox, IDL GOMOS I/O toolbox
P4	lv2_view	T/G	visualisation of the level 2 products	GOMOS product toolbox, IDL GOMOS I/O toolbox
P5	ext_view	T/G	visualisation of the residual extinction products	GOMOS product toolbox, IDL GOMOS I/O toolbox
P6	ecmwf_view	T/G	visualisation of the ECMWF files	
P7	Enviview	T/G	visualisation of all GOMOS products, conversion to HDF format	Enviview

Table 7.1-1: GOMOS product viewers

#	Mnemonic	Mode	Description	GOMOS I/O toolbox
A1	cal_edit	T/G	visualisation and edition of the calibration auxiliary products	GOMOS product toolbox, IDL GOMOS I/O toolbox
A2	ipc_edit	T/G	visualisation and edition of the instrument physical characteristics auxiliary products	GOMOS product toolbox, IDL GOMOS I/O toolbox
A3	pr1_edit	T	visualisation and edition of the level 1b processing configuration auxiliary products	GOMOS product toolbox, IDL GOMOS I/O toolbox
A4	pr2_edit	T	visualisation and edition of the level 2 processing configuration auxiliary products	GOMOS product toolbox, IDL GOMOS I/O toolbox
A5	cat_edit	T/G	visualisation and edition of the star catalogue auxiliary products	GOMOS product toolbox, IDL GOMOS I/O toolbox
A6	sts_edit	T/G	visualisation and edition of the stellar spectra databank auxiliary products	GOMOS product toolbox, IDL GOMOS I/O toolbox
A7	crs_edit	T/G	visualisation and edition of the cross-section auxiliary products	GOMOS product toolbox, IDL GOMOS I/O toolbox

Table 7.1-2: GOMOS auxiliary product viewers

#	Mnemonic	Mode	Description	Tool
I1	iomedit	T/G	visualisation and edition of the IOMAP and IOMAP2 files (intermediate result files of GOPR and CALEX)	IOMAP toolbox

Table 7.1-3: GOMOS intermediate file viewers

#	Mnemonic	Mode	Description	Tool
M1	cc	T	ANSI C compiler	Sun Solaris C compiler
M2	f77	T	Fortran 77 compiler	Sun Solaris Fortran 77 compiler
M3	xemacs	T	text editor	Xemacs 19.15 for Sun Solaris
M4	IDL	G	interactive analysis and visualisation package	IDL 5.4
M5	IGOR	G	interactive analysis and visualisation package	IGOR Pro 4
M6	StarSel	T	mission scenario preparation tool	Starsel issue 2.0
M7	MODTRAN	T	software to simulate limb spectra	MODTRAN issue x.x

Table 7.1-4: Miscellaneous tools

Note: the mode column indicates if the tool works in text mode (T) or graphic mode (G) or both (T/G).

11.2 - Description of the tools

11.2.1 - GOMOS product toolbox

During the development of the GOPR prototype, several specific functionalities to edit/browse/plot GOMOS products content have been created. Unfortunately, these tools were strongly linked to the GUI environment of GOPR and could not be used as external tools. Some code rewriting has been necessary to extract the functions. Now, they are available in the GOMOS product toolbox, together with new functions defined from the expected needs of the commissioning phase.

The GOMOS products toolbox is a set of several programs dedicated to simple tasks: extracting data from a product in order to plot it, modifying a field in a product. It covers most of the functionality required to browse/edit the GOMOS products. These programs are:

- **gomtab**: extraction of data from a GOMOS level 0 product.
- **display_pr**: extraction of data from a GOMOS product (excluding a level 0 product).
- **info_pr**: returns the number of elements of a specified field of the product.
- **export_pr**: similar to display_pr except that the output format is compatible with the input format of modify_pr.
- **modify_pr**: allows to modify a product. Read an ASCII file generated by export_pr and store the data in a product. Note that the input data must be fully compatible with the product (same size of the field).
- **diff_pr**: comparison of two products.
- **header_pr**: write the header of a product on the standard output.
- **extract_pr**: extract the values of a variable written in a file generated by display_pr or export_pr.

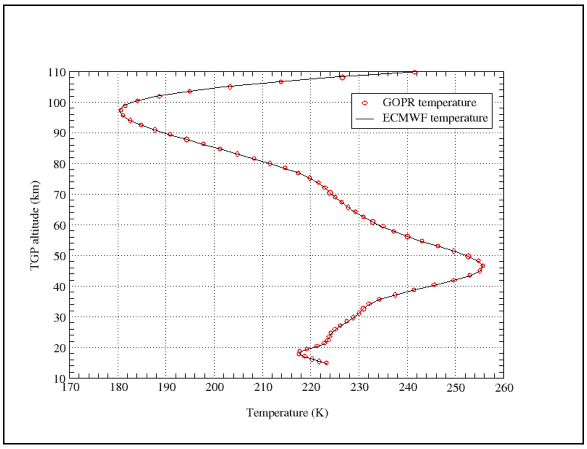
- **gopr_pan**: analysis of the content of a level 0 product (occultations characteristics)

In order to extract data from the GOMOS products, a specific data dictionary must be available in the working environment of the toolbox user. This data dictionary is specific to ACRI tools and is not compatible with the Envisat GOMOS DDT used by Enviview for example.

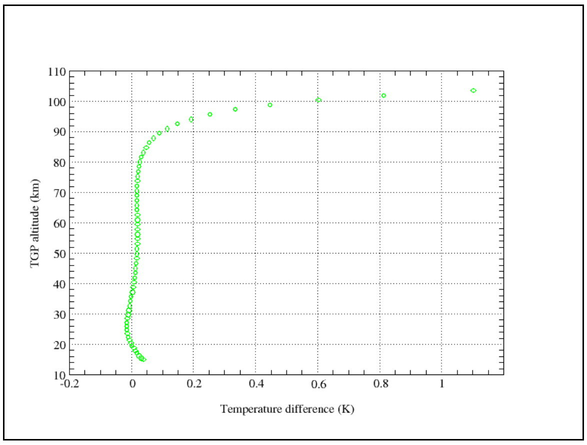
The GOMOS products toolbox has been developed for Sun Unix platforms, system Solaris 2.6.

Examples: see next page.

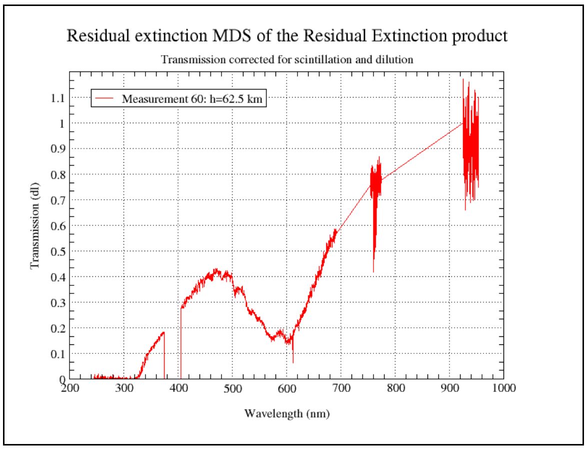
Comparison between the temperature profiles from the ECMWF external model and computed by the level 1b processing chain (data extracted from the level 1b product using the GOMOS product toolbox and Unix filters - awk, paste, cut and plot created by the xmgrace freeware)



Difference between the two previous curves

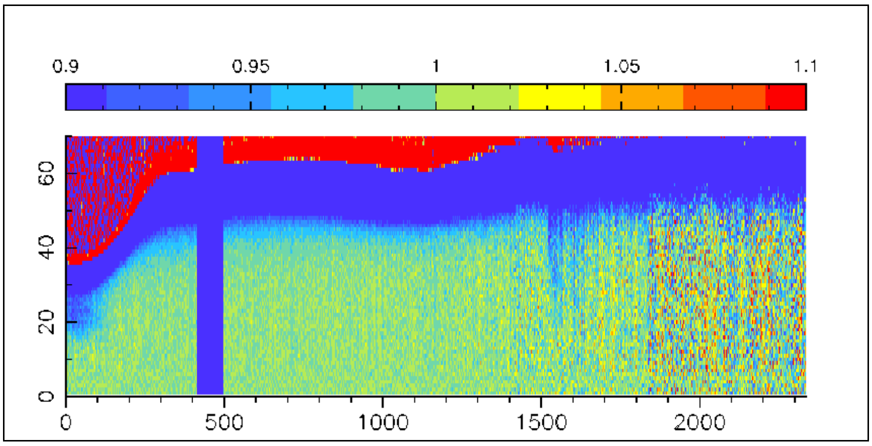


Transmission spectrum corrected for scintillation and dilution effects (data extracted fron the Residual Extinction product)



Note: to visualise a map extracted from a GOMOS product, the following logic can be applied:

1. write a line like: **`R4 M2336,70 "var_name  "`** at the beginning of a text file (assuming a map of 70 lines of 2336 floating point numbers)
2. use display_pr/extract_pr to export the map and add it in the text file
3. use atob to convert the text file into an IOMAP file (don't forget to use the -v switch!)
4. use iomedit to display the map in 2D or profiles

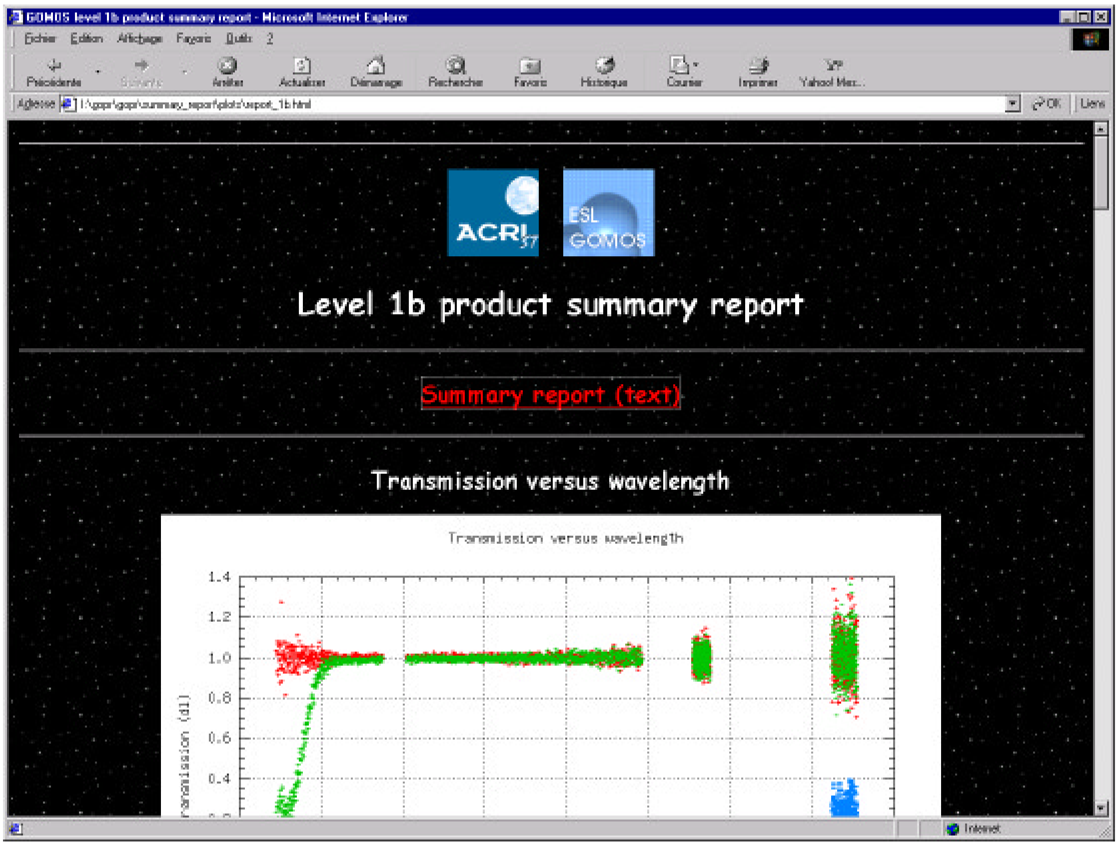


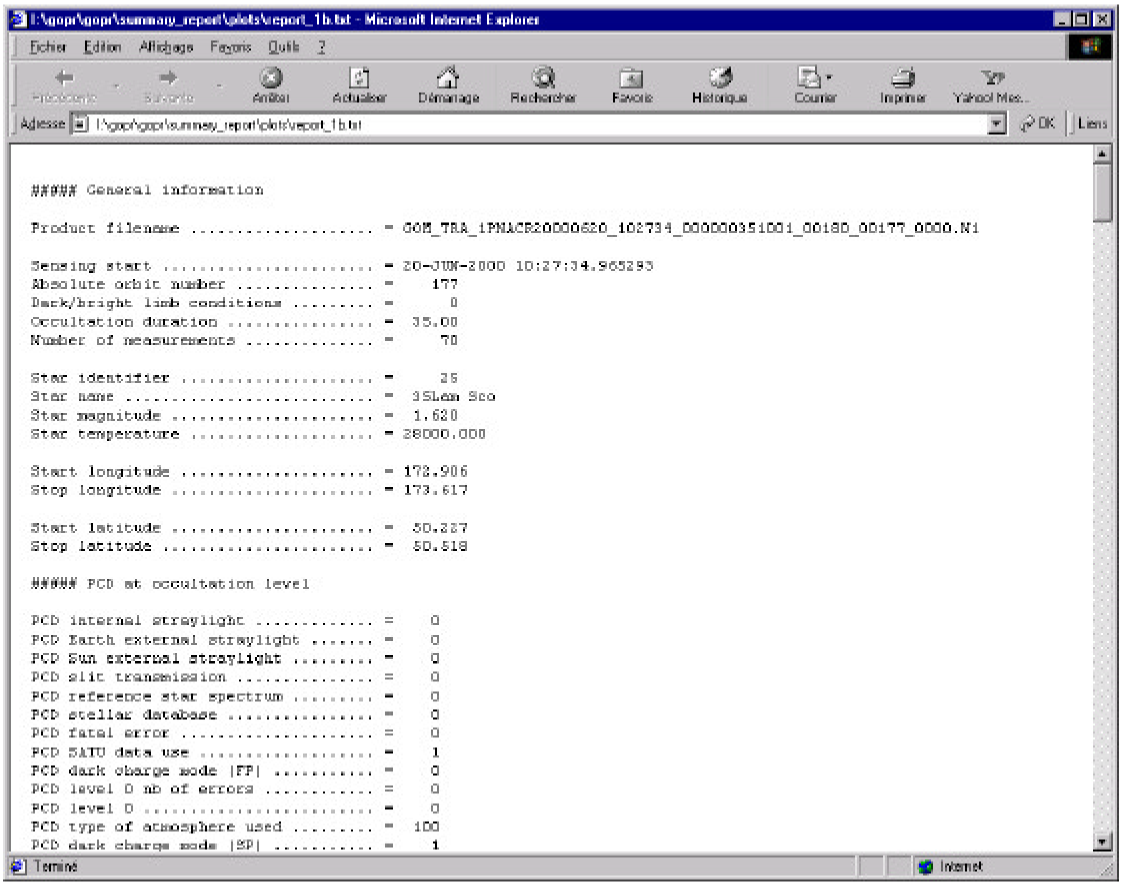
The GOMOS product toolbox is used by shell scripts to automatically generate summary reports of the GOMOS products (level 1b, level 2).

The following figures present an example of HTML pages automatically created from a level 1b product.

The first one is the main page, containing predefined plots of transmission and covariance spectra versus wavelength, photometer flux versus time, SSP and TGP geolocation versus time... and a hyperlink to a text document containing general information about the occultation and an analysis of the PCD at occultation, measurement and pixel level (for several predefined pixels). During the commisioning, these summary reports are generated for each occultation of the identified observation sets to help people to quickly visualise the content of the products. There will be also summary reports attached to the simulated occultations (GOSS/GOPR). This will allow making quick comparisons between similar products.

The second one is a text display of the content of one occultation of a level 0 product.





```
##### General information

Product filename ..................... = GOM_TRA_1PNACR20000620_102734_000000351001_00180_00177_0000.N1

Sensing start ........................ = 20-JUN-2000 10:27:34.965293
Absolute orbit number ................ =    177
Dark/bright limb conditions .......... =      0
Occultation duration ................. =  35.00
Number of measurements ............... =     70

Star identifier ...................... =     25
Star name ............................ =  35Lam Sco
Star magnitude ....................... =  1.620
Star temperature ..................... = 28000.000

Start longitude ...................... = 172.906
Stop longitude ....................... = 173.617

Start latitude ....................... =  50.227
Stop latitude ........................ =  50.518

##### PCD at occultation level

PCD internal straylight .............. =    0
PCD Earth external straylight ........ =    0
PCD Sun external straylight .......... =    0
PCD slit transmission ................ =    0
PCD reference star spectrum .......... =    0
PCD stellar database ................. =    0
PCD fatal error ...................... =    0
PCD SATU data use .................... =    1
PCD dark charge mode (FP) ............ =    0
PCD level 0 nb of errors ............. =    0
PCD level 0 .......................... =    0
PCD type of atmosphere used .......... =  100
PCD dark charge mode (SP) ............ =    1
```

11.2.2 - IOMAP toolbox

The IOMAP toolbox is a set a several programs dedicated to simple tasks: extracting data from an IOMAP file in order to plot it or use it in some further processing, modifying a field in a file. These programs are:

- **btoa**: display the content of an IOMAP file.
- **atob**: build an IOMAP file from an ASCII file (btoa -R format)
- **iomview**: extraction of data from an IOMAP file.
- **iomview_2d**: extraction of a 2D matrix from an IOMAP file.
- **iomview_all**: extraction of all the occurrences of a variable from an IOMAP file.
- **iomlist**: list the variables contained in an IOMAP file.
- **iomprop**: return the characteristics of a variable stored in an IOMAP file.
- **iomprof**: extract a profile from a multi-occurrence of a variable in an IOMAP file (i.e. one element of each occurrence of a variable in the file).
- **iomoccmax**: return the total number of occurrence of a variable in an IOMAP file.
- **iomdiff**: compare two IOMAP files having the same binary structure.
- **iomstore**: update a record in an IOMAP file.

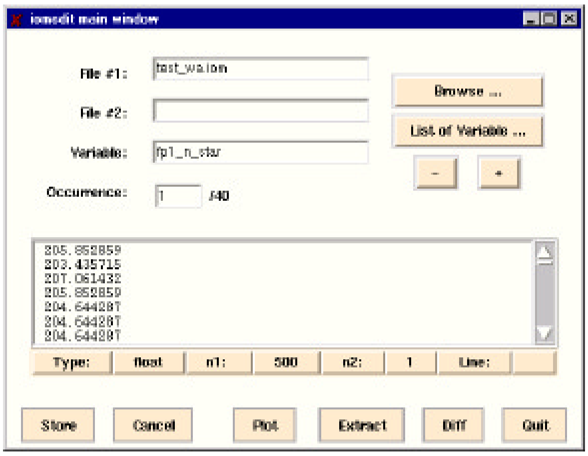
The IOMAP toolbox has been developed for Sun Unix platforms, system Solaris 2.6.

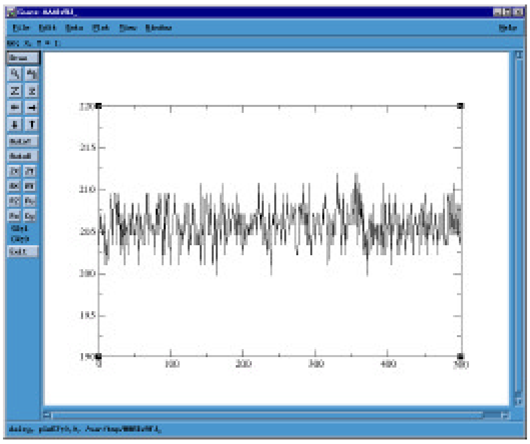
The IOMAP toolbox also includes a GUI giving access to most of the IOMAP toolbox utilities in a friendly way. It allows displaying, modifying, plotting (XY and 2D plots), extracting data from any IOMAP V2.0 file, and comparing the content of two IOMAP files.

Note: two functions are compatible with IOMAP V1.0 files (atob, btoa). This allows visualising the data from the intermediate files of the GOMOS level 1b processing.

Examples:

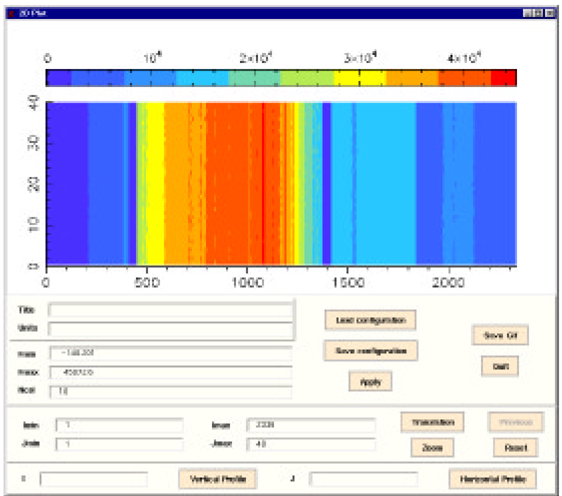
iomedit GUI main window with one file loaded and one variable selected





xmgrace plotting utility is called by clicking on the Plot button

2D plot from iomedit interface



11.2.3 - IDL GOMOS product I/O toolbox

Two specific functions have been adapted from MERISVIEW (ACRI software for the visualisation and post-processing of the MERIS products) in order to read/write data in any GOMOS product. These functions are available under IDL: rd_prod, wr_prod. These functions allow the user to store in an IDL structure one or several variables of any GOMOS Envisat product. The variable name(s) can be specified in the command line or interactively through a scrolling list. Once read, this structure can be used as any other IDL variable.

11.2.4 - Interactive analysis and visualisation packages (IDL, Igor)

Needed functions:

idl-R1: a package allowing the interactive analysis and visualisation of any data during any task of the commissioning shall be available.

idl-R2: the package shall be programmable to allow writing routines.

idl-R3: the package shall be able to be executed on all computer systems used for the data analysis during the commissioning phase (Sun under Solaris, PC under Windows 95/98/NT and Macintosh system 7).

The IDL and Igor packages seem to fulfil all predicted needs.

Here is the IDL description in its web site:

"*IDL is a complete computing environment for the interactive analysis and visualisation of data. IDL integrates a powerful, array-oriented language with numerous mathematical analysis and graphical display techniques. Programming in IDL is a timesaving alternative to programming in FORTRAN or C. Using IDL, tasks that require days or weeks of programming with traditional languages can be accomplished in hours. Users can explore data interactively using IDL commands and then create complete applications by writing IDL programs*"

"IDL is a complete, structured language that can be used both interactively and to create sophisticated functions, procedures, and applications. Operators and functions work on entire arrays (without using loops), simplifying interactive analysis and reducing programming time. Immediate compilation and execution of IDL commands provides instant feedback and "hands-on" interaction."

"Rapid 2D plotting, multi-dimensional plotting, volume visualisation, image display, and animation allow you to observe the results of your computations immediately. Many numerical and statistical analysis routines, including Numerical Recipes routines, are provided for analysis and simulation of data. IDL's flexible input/output facilities allow you to read any type of custom data format."

"IDL widgets can be used to quickly create multi-platform graphical user interfaces to your IDL programs. IDL programs run the same across all supported platforms (Unix, VMS, Microsoft Windows, and Macintosh systems) with little or no modification. This application portability allows you to easily support a variety of computers. Existing FORTRAN and C routines can be dynamically linked into IDL to add specialised functionality. Alternatively, C and FORTRAN programs can call IDL routines as a subroutine library or display "engine"."

Description of the Igor package:

"IGOR Pro is an interactive environment for experimentation with scientific and engineering data and for the production of publication-quality graphs and page layouts. IGOR Pro produces publication-quality graphics:

IGOR prints at high resolution and exports high-resolution graphics formats such as Encapulated PostScript (EPS). IGOR Pro can display multiple data sets of any length in any number of graphs and tables".

"IGOR Pro can import data from a wide variety of formats, including text, general binary, Excel, JCAMP, and MatLab data files. IGOR supports import and export of many graphics file formats via QuickTime. IGOR's Data Browser lets you organize you data efficiently in much the same way that you organize files in a hierarchy of folders on your hard drive. With the browser you can navigate through the different levels of data folders, examine values of variables, strings and waves, and load data objects from other Igor experiments".

"Analysis capabilities include: Fourier, wavelet, and Hough transforms; linear and non-linear curve fitting to built-in or user-defined functions with unlimited independent variables; differentiation, integration, and ordinary differential equations; convolution; correlation; histograms; smoothing; mathematical expression evaluation; matrix operations featuring many LAPACK routines; signal measurement; contouring of sparse or matrix data; and false-color displays."

"IGOR Pro includes a powerful and full-featured structured programming language that you can use for automation of data import, file I/O, analysis, data acquisition, graphing, drawing, printing, and just about anything you can think of. You can add menus to the program and create control panels containing buttons, checkboxes, popup menus, and other controls to set parameters or display results."

11.2.5 - StarSel

The StarSel tool is used to define observation plans. The PVwave library shall be available on the computer system where Starsel is run.

11.2.6 - MODTRAN

The MODTRAN software is used to simulate atmospheric limb spectra.

11.3 - Availability of the tools

GOMOS product toolbox is available.

IDL GOMOS product I/O toolbox is available.

IOMAP toolbox is available.

Enviview is available.

Compilers and IDL are available (commercial software).

xemacs, MODTRAN, xmgrace, gnuplot are available (freeware).

Starsel is available (ESA software).

11.4 - Missing or incomplete tools

11.4.1 - Level 0 product viewer (lv0_view)

The GOMOS level 0 products will contain measurements at orbit level, that is to say several occultations. The level 0 product viewer available in the GOMOS product toolbox only allows to visualise the content of a level 0 product containing only one occultation. Some code rewriting has to be performed to adapt this tool to the actual content of the product.

The following chapter lists the requirements for such a tool.

lv0_view-R1: level 0 product viewer containing a GOMOS packet viewer which shall be able to allow the visualisation of any field of the packet header, of the data field header and of the source data fields.

lv0_view-R2: the level 0 product viewer shall be able to export any or all fields of a level 0 product in an ASCII file. An option shall exist to allow the user to ask only for the first and last values of all the vector and matrix fields.

lv0_view-R3: the level 0 product viewer shall be able to select any occultation of the level 0 product (which is at orbit level) by its relative location in the product or by some other pertinent information.

lv0_view-R4: the level 0 product viewer shall be able to list the content of the packet header and data field header in an understandable form each time it is possible (i.e. replace any code by an equivalent text message - e.g. instrument mode 25 shall be replaced by "occultation mode").

lv0_view-R5: the level 0 product viewer shall be able to plot/superpose any spectrum found in the source data fields (occultation and linearity modes).

lv0_view-R6: the level 0 product viewer shall be able to plot any CCD image map found in the source data fields (spatial spread and uniformity modes). This implies the reading of 11 packets to build the CCD image map.

lv0_view-R7: the level 0 product viewer shall allow the comparison of the fields of two occultations. This function is needed for example during the comparison of real and simulated occultations.

lv0_view-R8: the level 0 product viewer shall allow the generation of sub-products made of one or several selected occultations.

lv0_view-R9: the level 0 product viewer shall be able to read any level 0 product containing GOMOS packets (occultation and monitoring modes).

11.4.2 - ECMWF file viewer (ecmwf_view)

The ECMWF files are written in GRIB format. A C library is distributed by ECMWF to allow reading the GRIB files. Anyway, this library has not been included in a visualisation tool. Some coding is necessary.

The following chapter lists the requirements for such a tool.

ecmwf_view-R1: the ECMWF file viewer shall be able to visualise any field under a graphical representation (temperature profile, density profile, temperature maps and density map) for a specified geometrical or geopotential altitude.

ecmwf_view-R2: the ECMWF file viewer shall be able to export any or all fields of an ECMWF file in an ASCII file. An option shall exist to allow the user to ask only for the first and last values of all the vector and matrix fields.

ecmwf_view-R3: the viewer shall be able to plot/superpose any profile coming from one or several ECMWF files.