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ENVISAT PHASE E CAL/VAL ACQUISITION PLAN

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1 INTRODUCTION

1.1 Purpose

The document is based on both the High Level Operation Plan [AD – 1] and the Reference Operation Plan [AD – 2], which specify high level and operational rules for the ENVISAT-1 mission. This document keeps track of the instruments' calibration planning during the routine operations of Phase E.

1.2 Scope

The present document is structured in the following sections:

- chapter 2 describes mission principles and characteristics
- chapter 3 covers routine calibrations and user requirements
- appendices.

1.3 Applicability

The present document is applicable since 1 June 2003.

1.4 References

1.4.1 APPLICABLE DOCUMENTS

[AD – 1] ENVISAT-1 High Level Operation Plan, *ESA/PB-EO/DOSTAG (97) 14*

[AD – 2] ENVISAT-1 Reference Operation Plan (ROP) – Routine Operation Phase, *EN-PL-ESA-GS-00334*

1.4.2 REFERENCE DOCUMENTS

[RD – 1] ENVISAT-1 ROP File Rules, *PO-TN-ESA-GS-00876, version 2.1*

[RD – 2] Rules applicable to the ENVISAT Payload Instruments Configuration Table Interface files for configuration, distribution and utilization, *PO-RS-ESA-SY-1339*

[RD – 3] STARSEL: Mission Planning Tool for GOMOS, *EWP-2133*

[RD – 4] GOMOS Procedure for Planning of Calibration, *GOCOM-TN*

[RD – 5] RA-2 Operations Description, *PO-TN-ESA-GS-0835*

[RD – 6] Mission Planning Tools for MIPAS Nominal and Special Event Measurements, *PO-RS-ESA-GS-0760*

[RD – 7] MIPAS CAL/VAL Phase Procedure Inputs, *PO-TN-DOR-MP-0464*

[RD – 8] Implementation of MIPAS Post-Lunch Calibration and Validation Tasks, *PO-PL-ESA-GS-1124*

[RD – 9] MIPAS Calibration Report, *PO-TN-BOM-GS-0033*

[RD – 10] MIPAS RGT Procedures draft, communication from Manolo Sanchez Gestido

[RD – 11] MIPAS RGT Planning e-mails collection, communication from Manolo Sanchez Gestido

[RD – 12] MIPAS Mission Plan v.4.2, 15 July 2005

1.5 Acronyms and abbreviations

ABS	Absolute	
ADC	Analogue Digital Converter	SCIAMACHY
AGV	Analogue Gain Verification	MIPAS
ANX	Ascending Node Crossing	
AOIP	Announced of Opportunity Instrument Provider	
AOS	Acquisition of Signal	
AP	Alternating Polarization Mode	ASAR
ASAIT	Azimuth Scan Angle Increment Table	MIPAS
ASAT	Azimuth Start Angle Table	MIPAS
BB	Black Body	MIPAS
BBC	Black Body Calibration	MIPAS
CAL	Calibration	
CFI	Customer Furnished Item	
CM	Calibration Mechanism	MERIS
CTI	Configuration Table Interface	
DAC	Dark Current Calibration	MERIS
DMOP	Detailed Mission Operations Plan	
DRS	Data Relay Satellite	
DS	Deep Space	MIPAS
DSA	Dark Sky Area	GOMOS
DSC	Deep Space Calibration	MIPAS

DSS	Data Subsystem	ASAR
EC	External Characterization	ASAR
EMM	ENVISAT Mission Management	
ESAC	Elevation Start Angle Correction	MIPAS
ESAIT	Elevation Scan Angle Increment Table	MIPAS
ESL	Engineering Support Laboratories	
ESM	Elevation Scan Mirror	SCIAMACHY
FCM	Fine Control Mode/Manoeuvres	
FOCC	Flight Operations Control Centre	
FOS	Flight Operation Segment	
FOV	Field of View	
FR	Full Resolution	MERIS
GMM	Global Monitoring Mode	ASAR
GND	Ground	
H	Horizontal (Polarization)	ASAR
HLOP	High Level Operation Plan	
HR	High Rate	
Id	Identity	
IDU	Interferometer Drive Unit	MIPAS
IE	Individual Echo	RA-2
IECF	Instrument Engineering Calibration Facility	
IF	In Flight	MIPAS
IF	Intermediate Frequency	RA-2
IFOV	Instrument Field of View	
IM	Image Mode	ASAR
IS	Instrument Swath	ASAR
LIN	Linearity Monitoring	GOMOS
LOS	Line Of Sight	MIPAS
LR	Low Rate	
LRCS	Low Rate Communication Scenarios	
MCMD	Macro Command	
MCF	Monitoring and Control Facility	
MLST	Mean Local Solar Time	
MPL	Mission Planning	
MPS	Mission Planning System	
MS	Module Stepping	ASAR
NDFM	Neutral Density Filter Mechanism	SCIAMACHY
NOM	Nominal Measurement	MIPAS
NUM	Number	
OCC	Occultation Mode	GOMOS
OCM	Orbit Control Mode/Manouvres	
ORB	Orbit	
OSD	Orbit Sequence Definition	SCIAMACHY
PAW	Pre-Amplifier/Warm	MIPAS
PD	Passive Decontamination	MIPAS

PDCC	Payload Data Control Centre	
PDS	Payload Data Segment	
PLO	Preset Loop Output	RA-2
PRF	Pulse Repetition Frequency	ASAR
PT	Preset Tracking	RA-2
QWG	Quality Working Group	
RC1	Radiometric Calibration Diffuser 1	MERIS
RC2	Radiometric Calibration Diffuser 2	MERIS
RCS	Radar Cross Section	ASAR
REL	Relative	
RF	Radio Frequency	RA-2
RFOV	Reduced Field Of View	MERIS
RGC	Radiometric Gain Calibration	MERIS
RGT	ROP Generation Tool	
ROEF	Reference Orbit Event File	
ROP	Reference Operation Plan	
RR	Reduced Resolution	MERIS
SAG	Science Advisory Group	
SAIT	Scan Angle Increment Table	MIPAS
SDS	Strategic Data Set	ASAR / MERIS
SEM	Special Event Measurement	MIPAS
SLS	Spectral Line Source	SCIAMACHY
SOST	SCIAMACHY Operations Support	SCIAMACHY
SOT	Star Opportunity Table	GOMOS
SPC	Spectral Calibration	MERIS
SPE	Signal Processing Electronics	MIPAS
SSC	Sub Solar Calibration	SCIAMACHY
SSM	Spatial Spread Monitoring	GOMOS
SSR	Solid State Recorder	
S/W	Software	
SWST	Sample Window Start Time	ASAR
Sx	Special Observation Mode x	MIPAS
SZA	Sun Zenith Angle	
T/R	Transmit/Receive	ASAR
TC	Time Compensation	MIPAS
TSS	Tile Subsystem	ASAR
UAx	Upper Atmosphere Observational Scenario x	MIPAS
UNI	Uniformity Monitoring	GOMOS
USF	User Earth Terminal	
V	Vertical (Polarization)	ASAR
VAL	Validation	
VCCS	Voice Coil Command Saturation	GOMOS
WCC	Wear Control Cycle	MIPAS
WLS	White Light Source	SCIAMACHY
WV1	Wavelength Type 1 Calibration	MERIS

WV2	Wavelength Type 2 Calibration	MERIS
WS	Wide Swath Mode	ASAR

2 MISSION PRINCIPLES

During the entire mission, the ENVISAT-1 repeat cycle and the reference orbit definition should remain constant.

2.1 *Orbit scenario definition*

2.1.1 REFERENCE ORBIT DEFINITION

1. The characteristics of the reference orbit are:
   - 35 days repeat cycle
   - 501 orbits per repeat cycle
   - 14 and 11/35 orbits per day
   - 6035.928 seconds per orbit
   - 10:00 a.m. mean local solar time at ANX
   - 320.612542 degrees longitude at ANX for phase 2 start.

2.1.2 ORBIT AND CYCLE NUMBERING

1. The absolute orbit numbering follows the rules:
   - ABS_ORBIT = 0 launch orbit until the first ANX crossing
   - ABS_ORBIT = 1 orbit starting at the first ANX crossing after launch
   - ABS_ORBIT = 2 orbit starting at the second ANX crossing after launch
   - …

2. The relative orbit numbering in every repeat cycle follows the rules:
   - REL_ORBIT = 1 first orbit in which ANX is east of Greenwich meridian
   - REL_ORBIT = 2 second orbit in which ANX is east of Greenwich meridian
   - …

3. The mapping of the mission phase, repeat cycle, relative orbit number and absolute orbit number is defined in the Reference Orbit Event File [RD – 1] (see Appendix 4.1). That file contains also the ascending node time and longitude, Mean Local Solar Time, earth-fixed equator, mean Kepler and Cartesian state vector, satellite eclipse exit and entry time, sun eclipse by moon time and finally the time when the Nadir Sun Zenith Angle is equal to 90° and 80°.

4. The following relations are applicable in Phase E [RD – 1]:
   - ABS_ORBIT = 486 + (REL_ORBIT – 432) + [(CYCLE – 4) * 501]
   - REL_ORBIT = 432 + (ABS_ORBIT – 486) – [(CYCLE – 4) * 501]
   - CYCLE = 4 + {[(ABS_ORBIT – 486) – (REL_ORBIT – 432)] / 501}

where the numbers 486, 432 and 4 are respectively the reference values for absolute orbit, relative orbit and cycle number at the beginning of phase 2 (see Appendix 4.1).

2.1.3 ORBIT AND CYCLE TIMES

1. The ENVISAT-1 cycle boundaries are listed in the Table 4.2.1 (see Appendix 4.2).

2. The ANX time of the 501 cycle orbits is given in Table 4.2.2 (see Appendix 4.2). The day shift column represents the number of elapsed days since the UTC time of the beginning of the cycle.

2.1.4 EVENT TIME

1. The long-term mission planning is based on the reference orbit using the event time specified as follows:
   - EVENT_TIME = {ABS_ORBIT, ANX}

where the ANX is the elapsed time in seconds since ascending node crossing, with a precision of microseconds.

3 INSTRUMENTS' CALIBRATION

3.1 AATSR

1. The AATSR calibration activity is on the repeat cycle basis.

2. AATSR Level 1b products acquired over the sites shown in Figure 3.1.1 (see Appendix 4.3.1) are used to support core validation activities, i.e. validation of visible channel data over desert sites and clouds, algorithm verification and Level 2 anomaly investigations.

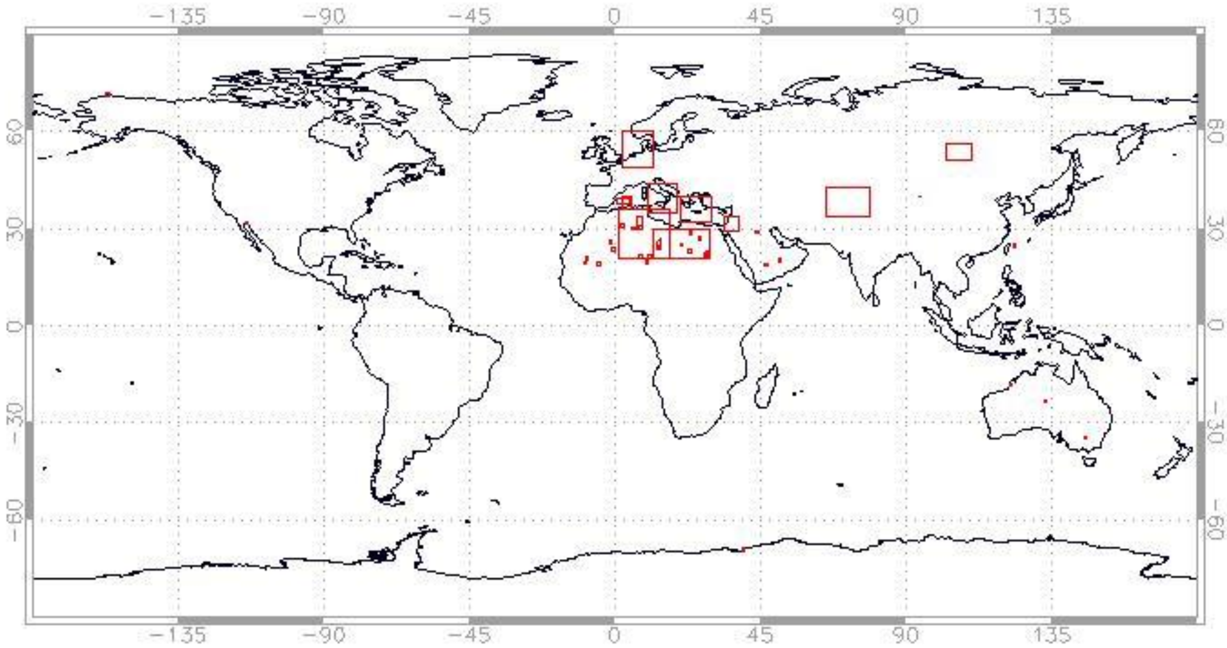

Figure 3.1.1: AATSR acquisition sites for validation activities.

3. Level 1b scenes are also required over a number of fixed sites (see Appendix 4.3.2) for the validation of the prototype for Land Surface Temperature products; Figure 3.1.2.

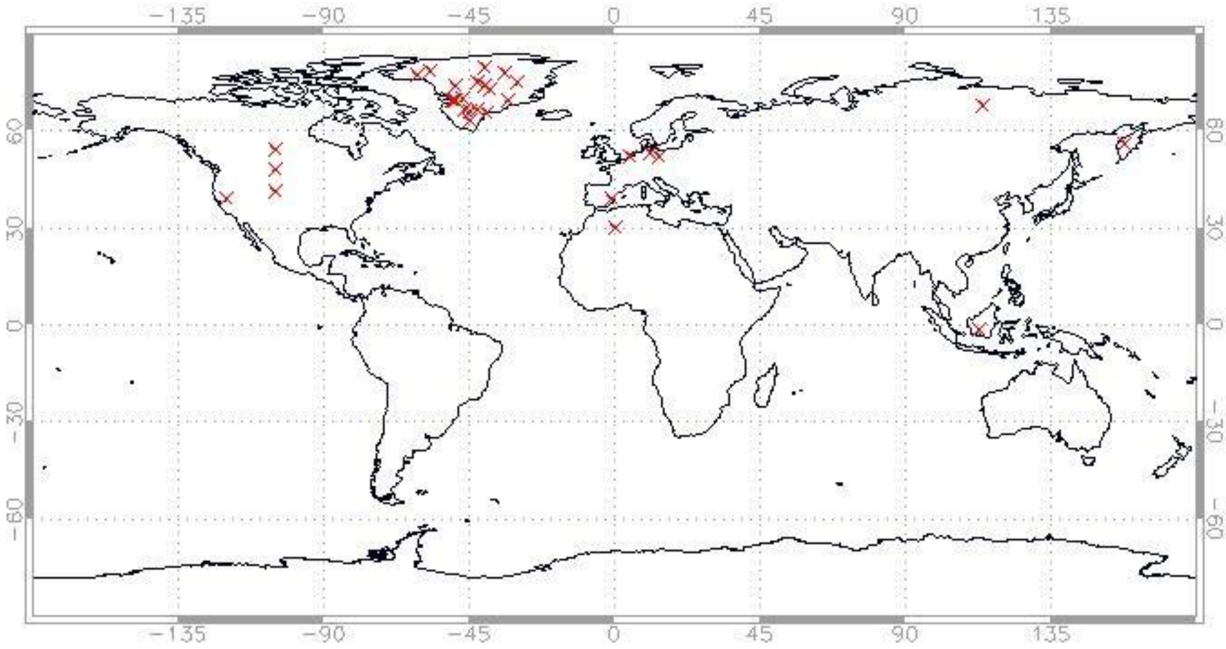

Figure 3.1.2: AATSR acquisition sites for the validation of Land Surface Temperature products.

4. Other additional cruises and deployment opportunities for the autonomous and precision radiometers are continually being sought. Areas of particular interest include the Southern Ocean, Arabian Sea and West Africa.

3.2 ASAR

1. The ASAR calibration activity is on the repeat cycle basis.

2. There are four sites systematically used for calibration but they are not planned with the same priority.

3. The main sites are the four ASAR transponders located in Netherlands, which are entirely dedicated to ASAR acquisitions, and the Amazon rain forest. They are planned for calibration purposes with the highest priority, while the other two sites are planned with lower priority (the four Radarsat transponders located in Canada and the two receiving ground stations).

3.2.1 ASAR TRANSPONDERS

1. Data acquired over the ASAR transponders located in Netherlands are used primarily for radiometric calibration of Level 1 products and secondary for geometric calibrations.

2. The geolocation and other parameters of the four transponders are shown in the table below (see Table 3.2.1.1).

TARGET	LAT (dec deg)	LONG (dec deg)	HEIGHT (m)	DELAY (μs)	RCS (dBm^2)			
					HH	HV	VH	VV
Edam	52.524552	5.049332	42.46	1.52	62.19	62.05	62.78	62.49
Zwolle	52.5506	6.0045	40	1.54	61.84	62.40	62.37	62.52
Swifterbant	52.555019	5.668965	40	1.51	62.29	63.05	62.58	62.96
Aalsmeer	52.199801	4.818415	42.30989	1.57	62.76	62.84	61.82	61.93

Table 3.2.1.1: ASAR transponders location.

3. Currently the acquisitions take part during all the ascending and descending passes over the targets but those opportunities are shared between different modes and polarizations (see below Table 3.2.1.2).

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)	MODE	BEAM	POL
22	2100	2190	90	IM	IS6	H/H
29	833	923	90	AP	IS2	H/HV
65	2098	2188	90	WS	N/A	H/H
72	816	936	120	IM	IS3	H/H
108	2077	2197	120	IM	IS3	V/V
115	827	917	90	WS	N/A	H/H
151	2092	2182	90	WS	N/A	V/V
158	824	914	90	WS	N/A	H/H
194	2089	2179	90	IM	IS1	H/H
201	821	911	90	IM	IS7	H/H
215	839	929	90	IM	IS1	V/V
251	2100	2190	90	AP	IS7	H/HV
258	835	925	90	WS	N/A	V/V
294	2099	2189	90	AP	IS5	V/VH
301	831	921	90	AP	IS3	H/HV

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)	MODE	BEAM	POL
337	2096	2186	90	IM	IS4	V/V
344	826	916	90	AP	IS4	V/VH
380	2093	2183	90	WS	N/A	V/V
387	828	918	90	AP	IS5	H/HV
423	2090	2180	90	IM	IS2	V/V
430	823	913	90	AP	IS6	V/VH
466	2087	2177	90	AP	IS1	V/VH
480	2099	2189	90	AP	IS7	H/HV
487	837	927	90	AP	IS1	H/HV

Table 3.2.1.2: Acquisition segments over ASAR transponders.

4. Only few changes between modes and polarizations are introduced for different cycles to ensure an equivalent number of measurements for all ASAR modes. Sometimes one of the changes introduced is the replacement of one IM IS3 acquisition (or eventually another IM swath available in WS ScanSAR) by a WS mode acquisition; the aim of this exchange is to build generate IM-WS InSAR opportunities.

5. Starting from cycle 45 (6 February 2006), the ASAR transponders have been moved to the following locations (see Table 3.2.1.3):

TARGET	LAT (dec deg)	LONG (dec deg)	HEIGHT (m)	DELAY (μs)	RCS (dBm^2)			
					HH	HV	VH	VV
Edam	52.524552	5.049332	42.46	1.52	62.19	62.05	62.78	62.49
Estec	52.215860	4.419250	42.00	tbc	tbc	tbc	tbc	tbc
Resolute	74.746398	-95.00137	68.03	1.86	53.07	53.07	53.07	53.07
Ottawa	45.294665	-75.75755	92.88	1.87	55.24	55.24	55.24	55.24

Table 3.2.1.3: ASAR transponders location starting from cycle 45.

3.2.2 AMAZON RAIN FOREST

1. Because of its radar backscattering homogeneity and stability, data acquired over the Amazon rain forest are used primarily for radiometric calibration of Level 1 products by the monitoring of the elevation antenna pattern shape.

2. In the Table 3.2.2.1 and Figure 3.2.2.1 it is shown the large calibration area over the Amazon rain forest.

TARGET	LAT (dec deg)	LONG (dec deg)
Area extension	from -11 to -4	from -71 to -65

Table 3.2.2.1: Location of the Amazon rain forest area.

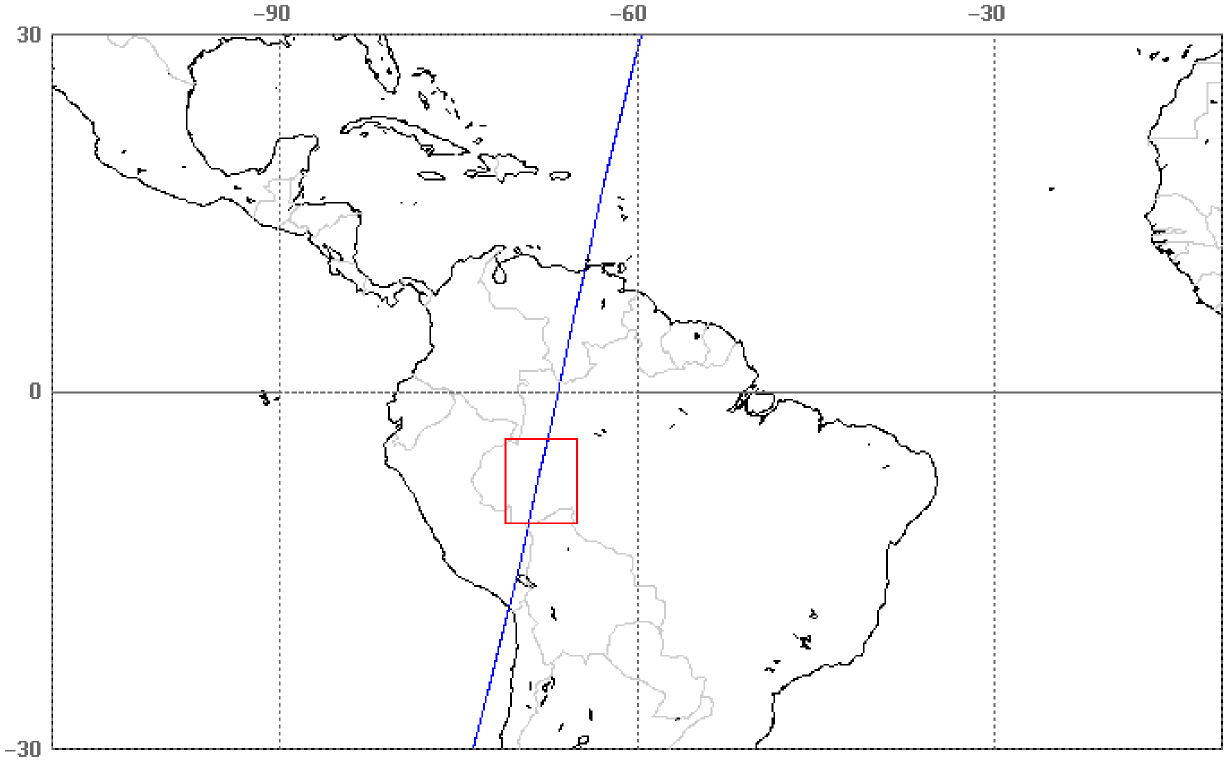

Figure 3.2.2.1: Example of ASAR descending passes over Amazon. The red perimeter defines the "Amazon rain forest area" used for calibration.

3. The available opportunities are shared between different modes, beams and polarizations. The typical plan over this area is shown in Table 3.2.2.2 (below) but few changes could be introduced from cycle to cycle.

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)	MODE	BEAM	POL
3	5855	5935	80	WS	N/A	H/H

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)	MODE	BEAM	POL
10	3115	3195	80	IM	IS6	H/H
46	5895	5975	80	AP	IS6	H/HV
53	3115	3195	80	WS	N/A	H/H
60	5855	5935	80	IM	IS1	V/V
89	5855	5935	80	IM	IS6	V/V
96	3115	3195	80	AP	IS4	H/HV
103	5855	5935	80	IM	IS3	V/V
139	3115	3195	80	WS	N/A	V/V
146	5855	5935	80	AP	IS4	V/VH
182	3115	3195	80	WS	N/A	V/V
189	5855	5935	80	AP	IS5	V/VH
225	3115	3195	80	IM	IS2	V/V
232	5855	5935	80	AP	IS1	V/VH
239	3115	3195	80	AP	IS6	V/VH
268	3115	3195	80	IM	IS1	H/H
275	5855	5935	80	IM	IS2	H/H
282	3115	3195	80	AP	IS3	H/HV
318	5895	5975	80	AP	IS7	V/VH
325	3155	3235	80	AP	IS1	H/HV
332	5855	5935	80	AP	IS2	H/HV
361	5855	5935	80	AP	IS7	H/HV
368	3115	3195	80	AP	IS3	V/VH
375	5855	5935	80	IM	IS4	H/H
411	3115	3195	80	AP	IS5	H/HV
418	5855	5935	80	AP	IS6	H/HV
454	3115	3195	80	IM	IS4	V/V
461	5855	5935	80	IM	IS5	H/H
468	3115	3195	80	IM	IS7	H/H
497	3115	3195	80	AP	IS2	V/VH

Table 3.2.2.2: ASAR acquisition segments over Amazon rain forest area.

3.2.3 RADARSAT TRANSPONDERS

1. Data acquired over the Radarsat transponders located in Canada are used primarily for radiometric calibration of Level 1 products and secondary for geometric calibrations.

2. An agreement reached between ESA and the Canadian Space Agency made possible the use of the Radarsat transponders for ASAR calibration during the ENVISAT Commissioning Phase. A less intensive use is foreseen in the future, when a more accurate calibration will be achieved for all modes.

3. The geolocation and other information of the four transponders are provided in the table below (see Table 3.2.3.1).

TARGET	LAT (dec deg)	LONG (dec deg)	HEIGHT (m)	DELAY (µs)	RCS (dBm^2)			
					HH	HV	VH	VV
Ottawa	45.29	-75.76	92.88	1.87	55.24	55.24	55.24	55.24
Resolute	74.75	-95.00	68.03	1.86	53.07	53.07	53.07	53.07
Fredericton	45.87	-66.54	19.73	1.86	53.68	53.68	53.68	53.68
Saskatchewan	53.22	-105.68	429.93	1.86	52.54	52.54	52.54	52.54

Table 3.2.3.1: Radarsat transponders location.

4. Not all the opportunities over the Radarsat transponders are planned. The Table 3.2.3.2 shows the acquisition segments and its modes and polarizations.

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)	MODE	BEAM	POL
4	1236	1276	40	IM	IS5	H/H
12	1744	1784	40	IM	IS7	H/H
18	736	776	40	IM	IS2	H/H
18	1248	1288	40	IM	IS2	H/H
18	1262	1302	40	IM	IS2	H/H
25	2225	2265	40	IM	IS1	V/V
55	1742	1782	40	IM	IS6	H/H
84	1730	1770	40	AP	IS3	H/HV
98	1741	1781	40	AP	IS6	H/HV
98	2112	2152	40	IM	IS6	V/V
104	1243	1283	40	IM	IS3	V/V
111	2249	2289	40	AP	IS7	H/HV

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)	MODE	BEAM	POL
133	1231	1271	40	AP	IS6	H/HV
141	2109	2149	40	IM	IS4	V/V
147	726	766	40	IM	IS6	V/V
168	2234	2274	40	IM	IS4	V/V
176	1229	1269	40	AP	IS7	H/HV
184	1737	1777	40	AP	IS4	H/HV
190	1239	1279	40	IM	IS4	H/H
191	864	904	40	IM	IS5	V/V
204	1252	1292	40	IM	IS1	H/H
211	2230	2270	40	AP	IS3	H/HV
227	1735	1775	40	AP	IS4	H/HV
247	738	778	40	AP	IS1	H/HV
247	1250	1290	40	AP	IS1	H/HV
254	2227	2267	40	AP	IS1	V/VH
256	1719	1759	40	AP	IS1	V/VH
276	1235	1275	40	AP	IS5	V/VH
284	1743	1783	40	IM	IS7	V/V
290	734	774	40	AP	IS2	V/VH
290	1247	1287	40	AP	IS2	V/VH
291	874	914	40	IM	IS1	V/V
313	1731	1771	40	IM	IS3	V/V
319	1233	1273	40	AP	IS6	V/VH
356	1729	1769	40	IM	IS2	V/V
370	1740	1780	40	AP	IS5	H/HV
370	2110	2150	40	AP	IS5	H/HV
376	1242	1282	40	AP	IS3	V/VH
377	868	908	40	IM	IS3	H/H
405	1230	1270	40	AP	IS7	V/VH
413	1738	1778	40	IM	IS5	V/V
419	725	765	40	IM	IS7	H/H
426	2244	2284	40	AP	IS5	V/VH
442	1723	1763	40	AP	IS2	H/HV
456	2105	2145	40	AP	IS3	V/VH
462	1238	1278	40	AP	IS4	V/VH

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)	MODE	BEAM	POL
463	862	902	40	AP	IS6	V/VH
483	2229	2269	40	IM	IS2	V/V
485	1721	1761	40	IM	IS1	H/H
499	2102	2142	40	AP	IS2	H/HV

Table 3.2.3.2: ASAR acquisition segments over Radarsat transponders.

3.2.4 RECEIVING GROUND STATIONS

1. The receiving antennas located in Kiruna and Neustrelitz ground stations are used as passive corner reflectors when they track ASAR overpasses.

2. The geolocation of both sites is shown in the table below (see Table 3.2.4.1).

TARGET	LAT (dec deg)	LONG (dec deg)	HEIGHT (m)
Kiruna	67.854752	20.963405	290
Neustrelitz	53.328787	13.069388	40

Table 3.2.4.1: ASAR receiving antennas location.

3.2.5 WAVE MODE OVER ASAR TRANSPONDERS

1. WAVE mode acquisitions support the calibration of Level 1 data ASA_WVI_1P.

2. They are planned over one of the ASAR transponders (see paragraph 3.2.1). Usually Aalsmeer transponder is used for this purpose but any of the other transponders could be used or even the Amazon rain forest.

3. These acquisitions should be planned every 3 ÷ 4 months. They are currently performed on IS2 swath and on vertical polarization (see Table 3.2.5.1) but other swaths and polarizations might be calibrated in the future. Any acquisitions on IS2 swath used from image modes calibration could also be used for WAVE mode.

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)	BEAM	POL
301	576	1176	600	IS2	V or H

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)	BEAM	POL
423	1835	2435	600	IS2	V or H

Table 3.2.5.1: WAVE mode acquisition segments over ASAR transponders.

3.2.6 WAVE MODE OVER A COMPLETE ORBIT

1. WAVE mode products acquired on different swaths (usually IS1-IS7) are used to estimate the in-flight ASAR antenna mispointing, using the Doppler Centroid frequency at near range and its variation across range (from IS1 to IS7).

2. For this purpose WAVE mode products are acquired over a complete orbit.

3. During the Commissioning Phase few acquisitions were performed and a preliminary measurement was derived; this result shall be verified using few more acquisitions. The activity should be repeated afterwards every 6 months ÷ 1 year, depending on the antenna status.

3.2.7 MODULE STEPPING MODE

1. The Module Stepping mode provides an internal health checking facility on an individual T/R module basis. This calibration mode can identify malfunctioning modules and those for which calibration offsets are to be applied. Furthermore MS results can be used to synthesize the shape of the antenna pattern.

2. Because of the internal checks this calibration can be planned at any time, independently on the satellite location. It has been decided to plan MS acquisitions close to the Amazon rain forest site (see paragraph 3.2.2) in order to have simultaneous MS measurements and image data, as both can be used to derive the antenna patterns.

3. In a MS acquisition each of the 320 modules is cycled in a pseudo-random sequence. That is planned every 5 ÷ 6 days on both vertical and horizontal polarizations (see below Table 3.2.7.1).

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)	POL
89	5500	5540	40	H
89	5600	5640	40	V
139	2800	2840	40	H
139	2900	2940	40	V

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)	POL
210	1500	1540	40	H
210	1600	1640	40	V
275	5500	5540	40	H
275	5600	5640	40	V
360	5500	5540	40	H
360	5600	5640	40	V
418	5500	5540	40	H
418	5600	5640	40	V
497	2800	2840	40	H
497	2900	2940	40	V

Table 3.2.7.1: ASAR Module Stepping mode acquisition segments.

4. During cycle 17 to 20 (June – October 2003) the MSM planning has been updated to one acquisition per day on both vertical and horizontal polarizations (see below Table 3.2.7.2).

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)	POL
13	4800	4840	40	H
13	4880	4920	40	V
27	4800	4840	40	H
27	4880	4920	40	V
42	4800	4840	40	H
42	4880	4920	40	V
56	4800	4840	40	H
56	4880	4920	40	V
70	4800	4840	40	H
70	4880	4920	40	V
85	4800	4840	40	H
85	4880	4920	40	V
99	4800	4840	40	H
99	4880	4920	40	V
114	4800	4840	40	H
114	4880	4920	40	V
128	4800	4840	40	H

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)	POL
128	4880	4920	40	V
142	4800	4840	40	H
142	4880	4920	40	V
156	4800	4840	40	H
156	4880	4920	40	V
171	4800	4840	40	H
171	4880	4920	40	V
185	4800	4840	40	H
185	4880	4920	40	V
199	4800	4840	40	H
199	4880	4920	40	V
214	4800	4840	40	H
214	4880	4920	40	V
228	4800	4840	40	H
228	4880	4920	40	V
242	4800	4840	40	H
242	4880	4920	40	V
256	4800	4840	40	H
256	4880	4920	40	V
270	4800	4840	40	H
270	4880	4920	40	V
285	4800	4840	40	H
285	4880	4920	40	V
299	4800	4840	40	H
299	4880	4920	40	V
314	4800	4840	40	H
314	4880	4920	40	V
328	4800	4840	40	H
328	4880	4920	40	V
342	4800	4840	40	H
342	4880	4920	40	V
357	4800	4840	40	H
357	4880	4920	40	V
371	4800	4840	40	H

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)	POL
371	4880	4920	40	V
385	4800	4840	40	H
385	4880	4920	40	V
400	4800	4840	40	H
400	4880	4920	40	V
414	4800	4840	40	H
414	4880	4920	40	V
429	4800	4840	40	H
429	4880	4920	40	V
443	4800	4840	40	H
443	4880	4920	40	V
457	4800	4840	40	H
457	4880	4920	40	V
471	4800	4840	40	H
471	4880	4920	40	V
485	4800	4840	40	H
485	4880	4920	40	V
500	4800	4840	40	H
500	4880	4920	40	V

Table 3.2.7.2: ASAR Module Stepping mode acquisition segments from cycle 17 to 20.

5. From cycle 21 to 28 (October 2003 – July 2004) the MSM planning has been updated to one acquisition per day; H polarization one day at ANX=5160 sec and V polarization the following day at ANX=5100 sec.

6. Starting from cycle 29 (July 2004) the MSM planning is scheduled one acquisition per day; H polarization and V polarization the following day, always at ANX=4045 sec (Table 3.2.7.3).

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)	POL
12	4045	4085	40	H
26	4045	4085	40	V
34	4045	4085	40	H
48	4045	4085	40	V

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)	POL
64	4045	4085	40	H
79	4045	4085	40	V
93	4045	4085	40	H
107	4045	4085	40	V
121	4045	4085	40	H
135	4045	4085	40	V
149	4045	4085	40	H
163	4045	4085	40	V
177	4045	4085	40	H
191	4045	4085	40	V
205	4045	4085	40	H
219	4045	4085	40	V
233	4045	4085	40	H
247	4045	4085	40	V
261	4045	4085	40	H
275	4045	4085	40	V
289	4045	4085	40	H
293	4045	4085	40	V
307	4045	4085	40	H
321	4045	4085	40	V
335	4045	4085	40	H
349	4045	4085	40	V
363	4045	4085	40	H
377	4045	4085	40	V
391	4045	4085	40	H
405	4045	4085	40	V
421	4045	4085	40	H
437	4045	4085	40	V
454	4045	4085	40	H
472	4045	4085	40	V
485	4045	4085	40	H
499	4045	4085	40	V

Table 3.2.7.3: ASAR Module Stepping mode acquisition segments from cycle 29 on.

3.2.8 EXTERNAL CHARACTERIZATION MODE

1. The External Characterization mode provides absolute calibration measurements during the over-flight of a ground receiver.

2. EC acquisitions are always planned over the ASAR transponders (see paragraph 3.2.1).

3. They should be planned every 6 months. The Table 3.2.8.1 shows the usual planning configuration.

REL ORB (#)	ANX (sec)	DURATION (sec)	POL
108	2136.5	160	H or V

Table 3.2.8.1: ASAR External Characterization mode acquisition segment.

4. However due to instrument instability problems detected systematically after EC no acquisitions have been planned since the end of 2002. The problem is currently under investigation. The EC planning shall be resumed when a corrective measure will be identified and implemented.

3.3 GOMOS

1. The GOMOS calibration plan bases on two different levels, weekly and monthly.

2. There is one DSA-only calibration orbit per week and one full monitoring sequence per month.

3.3.1 DSA-ONLY OCCULTATION ORBITS

1. The DSA-only asynchronous orbit is usually planned in the middle of the planning week (e.g. on Saturday) during Kiruna visibility.

2. It includes all available DSAs in the altitude range between 5 and 130 km.

3. Starting from orbit 13380 (20 September 2004) the planning of the DSA-only calibration orbit has been interrupted.

3.3.2 MONITORING MODE SEQUENCES

1. The full calibration sequence is usually planned at the beginning of the month during eight Kiruna orbits.

2. It includes the monitoring modes (Spatial Spread, Uniformity and Linearity Monitoring mode) and two DSA-only asynchronous orbits [RD – 4].

3. The first one is an asynchronous orbit in Spatial Spread mode, in which the brightest stars have to be chosen. It needs at least 3 stars in dark limb, 3 stars in eclipse and 3 stars in bright limb; other parameters are:
   - Altitude range: 250 – 0 km
   - Integration time: 0.5 sec
   - DMSA gains: 00 for bright stars, 10 for Sirius, 11 for dark stars
   - DMSB gains: always 00

4. Then two asynchronous orbits in Uniformity mode, the first one at 10 km and the second one at 30 km of altitude:
   - Azimuth: 30 deg
   - Integration time: 0.5 sec (except for last acquisition, which has i.t. = 5 sec)
   - DMSA gains: always 11
   - DMSB gains: always 00
   - Start time, stop time and duration: see Table 3.3.2.1 (below)
   - SATU windows position: see Table 3.3.2.2 (below)

START ANX (sec)	STOP ANX (sec)	DURATION (sec)
100	220	120
300	420	120
500	620	120
700	820	120
900	1020	120
1100	1220	120
1300	1420	120
1600	1720	120
1800	1920	120
2000	2120	120

START ANX (sec)	STOP ANX (sec)	DURATION (sec)
2200	2320	120
2400	2520	120
2600	2700	100
2780	2860	80
2940	3020	80
3100	3220	120
3300	3380	80
3460	3540	80
3620	3700	80
3780	3860	80
3940	4020	80
4100	4220	120
4300	4380	80
4460	4540	80
4620	4700	80
4820	4920	100
5000	5120	120
5200	5320	120
5400	5520	120
5600	5840	240

Table 3.3.2.1: GOMOS Uniformity monitoring mode segments.

#	X	Y
1	92	39
2	192	39
3	292	39
4	92	139
5	182	139
6	192	139
7	202	139
8	292	139

#	X	Y
9	92	239
10	192	239
11	292	239

Table 3.3.2.2: GOMOS SATU windows position.

5. There are three asynchronous orbits in Linearity mode, with integration time of 0.25 sec, 0.5 sec and 0.25 sec respectively. The brightest stars have to be chosen, at least 3 stars in dark limb, 3 stars in eclipse and 3 stars in bright limb:
   - Altitude range: 300 – 100 km
   - DMSA gains: 00 for bright stars, 10 for Sirius, 11 for dark stars
   - DMSB gains: always 00

6. And finally two asynchronous DSA-only orbits, the first one between 0 and 300 km and the second one between 200 and 300 km of altitude range. All available DSAs have to be observed.

7. Starting from cycle 41 (September 2005) the azimuth position used in the Uniformity mode orbits has to be adapted to the center of the current IFOV window.

3.3.3 REDUCED FIELD OF VIEW

1. After a long period of continuous instrument failures due to the VCCS anomaly and the related tests (end March – end August 2005), the operational mission re-started in orbit 18280 (29 August 2005).

2. The investigation resulted in the reduction of the azimuth FOV to a maximum of 25 degrees; this azimuth window can be moved in order to achieve the scientific needs (Table 3.3.3.1 below).

START ORB (#)	STOP ORB (#)	AZIMUTH (deg)
18280	18679	[-10; +10]
18680	18779	[-5; +20]
18780	18879	[-5; +15]
18880	21079	[-5; +20]
21080	…	[+10; +35]

Table 3.3.3.1: GOMOS historical azimuth changes.

3. Other settings included in the mission planning after resuming of nominal operations:
   - all stars of the catalogue taken into account (star_ID from 1 to 180)
   - all limbs considered (bright and dark)
   - 2 orbits per synchronous sequence
   - minimum occultation duration: set to 25 sec
   - nominal altitude range: from 130 to 5 km
   - reduced azimuth range: see Table 3.3.3.1.

3.4 MERIS

3.4.1 ROUTINE CALIBRATIONS

1. Starting from the absolute orbit 4858 (3 February 2003) the MERIS calibration planning is driven by an orbit frequency.

2. The basis frequency for the routine calibrations is equal to 200 orbits and the bandwidth in which to perform these calibrations is 10 orbits.

3. The calibration frequency is related to the calibration type as from the table below (see Table 3.4.1.1).

CALIBRATION	**REPETITION (#)**	**FREQUENCY (# of orbits)**
Dark Current	0	0
Radiometric	1	200
Diffuser Aging	6	1200
Wavelength type 1	6	1200
Wavelength type 2	12	2400

Table 3.4.1.1: Frequency of MERIS routine calibrations.

4. In the Table 3.4.1.2 are listed the MERIS routine calibrations planned until March 2006.

CAL	START ABS ORB (#)	STOP ABS ORB (#)	DATE
DAC	4858	4859	03 Feb 2003
WV2	4860	4863	03 Feb 2003
RC	5060	5060	17 Feb 2003
RC	5260	5260	03 Mar 2003
RC	5489	5489	19 Mar 2003
RC	5660	5660	31 Mar 2003
RC	5860	5860	14 Apr 2003
DAC	6058	6059	28 Apr 2003
WV1	6060	6061	28 Apr 2003
RC	6260	6260	12 May 2003
RC	6460	6460	26 May 2003
RC	6660	6660	09 Jun 2003
RC	6860	6860	23 Jun 2003
RC	7060	7060	07 Jul 2003
DAC	7258	7259	21 Jul 2003
WV2	7260	7263	21 Jul 2003
RC	7460	7460	04 Aug 2003
RC	7660	7660	18 Aug 2003
RC	7860	7860	01 Sep 2003
RC	8060	8060	15 Sep 2003
RC	8260	8260	29 Sep 2003
DAC	8458	8459	12 Oct 2003
WV1	8460	8461	13 Oct 2003
RC	8660	8660	27 Oct 2003
RC	8860	8860	10 Nov 2003
RC	9060	9060	24 Nov 2003
RC	9260	9260	07 Dec 2003
RC	9460	9460	21 Dec 2003
DAC	9658	9659	04 Jan 2004
WV2	9660	9663	04 Jan 2004
RC	9860	9860	18 Jan 2004
RC	10060	10060	01 Feb 2004
RC	10260	10260	15 Feb 2004
RC	10460	10460	29 Feb 2004

CAL	START ABS ORB (#)	STOP ABS ORB (#)	DATE
RC	10660	10660	14 Mar 2004
DAC	10858	10859	28 Mar 2004
WV1	10860	10861	28 Mar 2004
RC	11060	11060	11 Apr 2004
RC	11260	11260	25 Apr 2004
RC	11460	11460	09 May 2004
RC	11660	11660	23 May 2004
RC	11860	11860	06 Jun 2004
DAC	12058	12059	20 Jun 2004
WV2	12060	12063	20 Jun 2004
RC	12260	12260	04 Jul 2004
RC	12460	12460	18 Jul 2004
RC	12660	12660	01 Aug 2004
RC	12860	12860	15 Aug 2004
RC	13060	13060	29 Aug 2004
DAC	13258	13259	12 Sep 2004
WV1	13260	13261	12 Sep 2004
RC	13460	13460	26 Sep 2004
RC	13660	13660	10 Oct 2004
RC	13860	13860	24 Oct 2004
RC	14060	14060	07 Nov 2004
RC	14260	14260	21 Nov 2004
DAC	14458	14459	05 Dec 2004
WV2	14460	14463	05 Dec 2004
RC	14660	14660	19 Dec 2004
RC	14860	14860	02 Jan 2005
RC	15060	15060	16 Jan 2005
RC	15260	15260	30 Jan 2005
RC	15460	15460	13 Feb 2005
DAC	15658	15659	26 Feb 2005
WV1	15660	15661	27 Feb 2005
RC	15860	15860	13 Mar 2005
RC	16060	16060	27 Mar 2005
RC	16260	16260	10 Apr 2005

CAL	START ABS ORB (#)	STOP ABS ORB (#)	DATE
RC	16460	16460	23 Apr 2005
RC	16660	16660	07 May 2005
DAC	16858	16859	21 May 2005
WV2	16860	16863	21 May 2005
RC	17060	17060	04 Jun 2005
RC	17260	17260	18 Jun 2005
RC	17460	17460	02 Jul 2005
RC	17660	17660	16 Jul 2005
RC	17860	17860	30 Jul 2005
DAC	18058	18059	13 Aug 2005
WV1	18060	18061	13 Aug 2005
RC	18260	18260	27 Aug 2005
RC	18460	18460	10 Sep 2005
RC	18660	18660	24 Sep 2005
RC	18860	18860	08 Oct 2005
RC	19060	19060	22 Oct 2005
DAC	19258	19259	05 Nov 2005
WV2	19260	19263	05 Nov 2005
RC	19460	19460	19 Nov 2005
RC	19660	19660	03 Dec 2005
RC	19860	19860	17 Dec 2005
RC	20060	20060	31 Dec 2005
RC	20260	20260	14 Jan 2006
DAC	20458	20459	28 Jan 2006
WV1	20460	20461	28 Jan 2006
RC	20660	20660	11 Feb 2006
RC	20860	20860	25 Feb 2006
RC	21060	21060	11 Mar 2006

Table 3.4.1.2: MERIS routine calibrations.

5. Both Wavelength type 1 and type 2 calibrations require MERIS in Stabilization Mode during Region 1; therefore no scientific data are acquired during these orbits.

3.4.2 VICARIOUS CALIBRATIONS

1. For MERIS absolute calibration by vicarious methods it has to perform data extraction and spatial compression from Level 1b products acquired over specified sites (see Appendix 4.4.1), following radiometric and geographic criteria specific for each site type: Rayleight, Glitter, Desert, Snow and Buoy. They are shown in Figure 3.4.2.1.

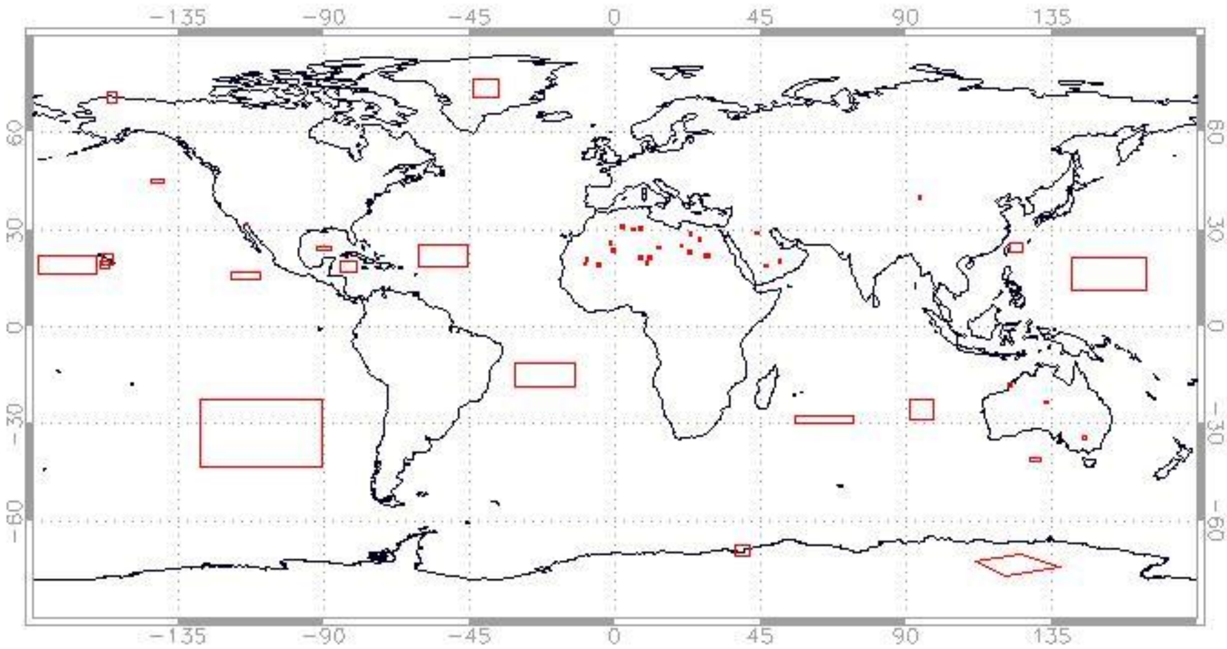

Figure 3.4.2.1: MERIS acquisition sites for absolute calibration by vicarious methods.

2. Other Level 1b products are also acquired over calibration sites (see Appendix 4.4.2) for general validation purpose by QWG and MERIS/AATSR Validation Team. See Figure 3.4.2.2.

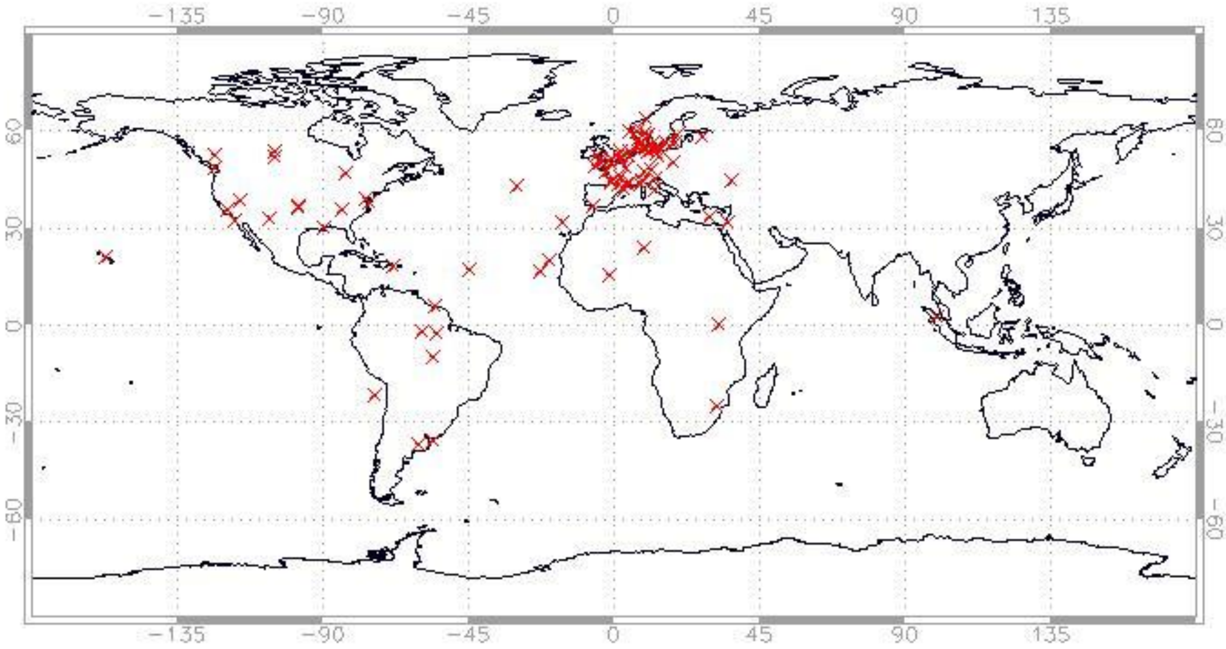

Figure 3.4.2.2: MERIS acquisition sites for validation activities.

3. Other vicarious calibrations can take place during the whole mission in order to support dedicated scientific campaigns. In the table below there is the list of calibrations already performed (see Table 3.4.2.1).

CAMPAIGN	START ABS ORB (#)	STOP ABS ORB (#)	DATE
Romilly	3525	3526	02 Nov 2002
O_2 Spectral	3568	3581	05 Nov 2002
SeaWiFS	3581	3582	06 Nov 2002
O_2 Spectral	3582	3583	06 Nov 2002
SciHi O_2	3583	3587	06 Nov 2002
SeaWiFS	3587	3597	06 Nov 2002
Fraunhofer 1	3597	3604	07 Nov 2002
Fraunhofer 2	3604	3611	07 Nov 2002
Romilly	3611	3612	08 Nov 2002
Chris_proba	3624	3625	09 Nov 2002
Chris_proba	3630	3631	09 Nov 2002
Vignetting Check	3747	3747	17 Nov 2002

CAMPAIGN	START ABS ORB (#)	STOP ABS ORB (#)	DATE
SciLo	4270	4270	24 Dec 2002
SciHiO_2	4297	4297	24 Dec 2002
Vignetting Check	4878	4878	04 Feb 2003
VGT	5658	5660	31 Mar 2003
Vignetting Check	6638	6638	07 Jun 2003
O_2 Spectral	7765	7768	25 Aug 2003
Fraunhofer 1	7769	7771	25 Aug 2003
Fraunhofer 2	7772	7774	26 Aug 2003
Fraunhofer 3	7775	7777	26 Aug 2003
O_2 Spectral	10796	10798	24 Mar 2004
O_2 Spectral A	13025	13030	27 Aug 2004
Fraunhofer	13031	13033	27 Aug 2004
O_2 Spectral B	13068	13073	30 Aug 2004
OCL Settings	13918	13919	28 Oct 2004

Table 3.4.2.1: MERIS vicarious calibrations.

3.5 MIPAS

3.5.1 THE “ORIGINAL” MISSION

1. The MIPAS calibration plan is constituted by different activities [RD – 10, RD – 11].

2. A short SEM activity was added to the nominal background mission at every orbit such that the automatic return to NOM mode occurred always at the same ANX time (ANX = 541.9 sec). This means that the scans geolocation in latitude was the same for all orbits (phasing in latitude).

3. The “orbital SEM” parameters were:
    - Frequency: every orbit, except for LOS orbits (see paragraph 3.5.2)
    - Number of sweeps: 2
    - DS calibration: yes
    - High resolution: 4 sec
    - Start time: ANX = 527.1 sec
    - Stop time: ANX = 556.15 sec
    - Duration: 29.05 sec.

3.5.1.1 Routine calibrations

1. The routine calibration activities are the Wear Control Cycle and the Radiometric Gain calibrations.

2. The WCC calibration was performed twice or three times per day, at all orbits multiple of 5:
    - Frequency: every 5 orbits
    - Number of sweeps: 12
    - Medium resolution: 2 sec
    - Start time: ANX = 4000 sec
    - Stop time: ANX = 4039.15 sec
    - Duration: 39.15 sec.

3. The RGC calibration was performed once per day, starting at the end of one orbit and ending at the following orbit:
    - Frequency: every 14 orbits. Starting from orbit 9700 (7 January 2004) it has been updated to 50 orbits. This has been updated again to 28 orbits starting from orbit 10300 (18 February 2004)
    - Number of sweeps: 600
    - Low resolution: 0.4 sec
    - Duration: 1040.4 sec
    - Start time: ANX = 5500 sec
    - Stop time: ANX = 504.47 sec, in the following orbit.

4. The RGC orbits numbering had to be restarted periodically (e.g. every 15 days) in order to meet the condition of the calibration being performed during Kiruna visibility. As long as the frequency was set to 14 orbits and the satellite completes 14 and ⅓ orbits every day, there was a drift of the orbit within the day where this RGC was performed (i.e. it went one orbit earlier approximately every 3 days). If a new calibration file was needed to restart the RGC, it was always advisable to set the absolute start orbit to an orbit number ending in 0 or 5, where the WCC should have been performed.

3.5.1.2 Line of sight calibrations

1. The LOS calibration is performed once per week.

2. It consists of a sequence of two consecutive orbits defined as PRIME sequence and, in case that the FOCC can’t schedule the LOS during those orbits, a BACKUP sequence is also defined.

3. The current plan foresees the PRIME sequence on Saturday, during the first two orbits of Kiruna visibility, and the BACKUP sequence during the same orbits of Sunday. Observations were planned in both rearward and sideways directions.

4. Few changes to this orbit selection could have been introduced in order to avoid conflicts between LOS sequences and routine calibrations. In fact in case of planning conflict the WCC was shifted either to the orbit before or after the LOS sequence (in the way to minimize the shift in time with respect to the original planning) and the RGC was canceled from the planning.

3.5.1.3 In flight calibrations

1. Other special in-flight activities are periodically needed in order to better calibrate the instrument during the entire mission.

2. The frequency of the IF calibrations in the original mission is listed in the table below (see Table 3.5.1.3.1) [RD – 7, RD – 8, RD – 9].

ID	DESCRIPTION	FREQUENCY
IF16	Several limb scanning sequences (raw mode)	2 months
IF9	Offset tangent height determination	3 months
IF11	Absence of high resolution features	3 months
PD-IF16-IF4-IF16	Passive Decontamination – IF16 – IF4 – IF16	6 months
IF4	Generation of the non-linearity coefficients	6 months
IF10	$NESR_0$ verification	6 months
IF6	CBB and DS SNR characterization	1 year
IF14	Field of View In-Flight Check	1 year

Table 3.5.1.3.1: Description and frequency of MIPAS In-Flight calibrations.

3. In Table 3.5.1.3.2 there is the list of the MIPAS In-Flight calibrations performed during the first part of the MIPAS mission (“the original mission”).

CAL	START ABS ORB (#)	STOP ABS ORB (#)	DATE
IF6	5201	5201	27 Feb 2003
IF11	5202	5202	27 Feb 2003
IF16	5203	5204	27 Feb 2003
IF10	5205	5205	27 Feb 2003
IF9	5206	5209	27 Feb 2003
PD	5680	5738	01-05 Apr 2003

CAL	START ABS ORB (#)	STOP ABS ORB (#)	DATE
IF16	5764	5765	07 Apr 2003
IF4	5766	5809	07-10 Apr 2003
IF16	5821	5822	11 Apr 2003
IF14	6312	6312	16 May 2003
IF14	6985	6985	02 Jul 2003
IF11	6989	6989	02 Jul 2003
IF16	6990	6991	02 Jul 2003
IF9	6992	6995	02 Jul 2003
IF10	7907	7907	04 Sep 2003
IF16	7908	7909	04 Sep 2003
IF11	8609	8609	23 Oct 2003
IF9	8611	8614	23 Oct 2003
IF16	8808	8809	06 Nov 2003
IF14	9817	9817	15 Jan 2004
IF14	9903	9903	21 Jan 2004
IF6	10067	10067	02 Feb 2004
IF10	10068	10068	02 Feb 2004
IF11	10069	10069	02 Feb 2004
IF9	10070	10073	02 Feb 2004
Dec + IF4	10074	10231	02-3 Feb 2004
IF16	10173	10174	09 Feb 2004
IF16	10230	10231	13 Feb 2004

Table 3.5.1.3.2: MIPAS In-Flight calibrations performed.

3.5.1.4 Special mode and upper atmosphere scenarios

1. Special observation modes and Upper Atmosphere observational scenarios were foreseen during the original mission for scientific purposes in response to SAG requests.

2. The MIPAS special modes and scenarios are listed in the table below (see Table 3.5.1.4.1).

ID	DESCRIPTION
S1	Polar chemistry and dynamics

ID	DESCRIPTION
S2	Tropospheric / stratospheric exchange processes – Tropospheric chemistry
S3	Impact of aircraft emissions
S4	Stratospheric dynamics – Transport processes
S5	Diurnal changes
S6	Upper troposphere / lower stratosphere
UA1	Validation (confirmation of predicted non-LTE effects on the retrieval of p-T and target species)
UA2	Upper polar vortex dynamics – Stratosphere-mesosphere exchange and dynamics
UA3	Radiative energy budget of the mesosphere and lower thermosphere – Hydrogen, nitrogen and carbon budgets in the upper atmosphere – mesospheric dynamic – Non-LTE studies
UA4	Non-LTE studies of NO – Radiative cooling of the thermosphere

Table 3.5.1.4.1: Description of MIPAS Sx modes and UAx scenarios.

3. In the Table 3.5.1.4.2 there is the list of the Sx modes and UAx scenarios performed during the first part of the mission (“the original mission”).

MODE	START ABS ORB (#)	STOP ABS ORB (3)	DATE
S6 (test)	6590	6601	04-05 Jun 2003
S1 (test)	6675	6680	10 Jun 2003
S2 (test)	6681	6689	10-11 Jun 2003
UA1 (test)	6690	6695	11 Jun 2003
UA2 (test)	6718	6723	13 Jun 2003
UA3 (test)	6724	6732	13-14 Jun 2003
UA4 (test)	6733	6738	14 Jun 2003
S6	7020	7035	04-05 Jul 2003
S5 (test)	9300	9300	10 Dec 2003
S3 (test)	9318	9324	12 Dec 2003
S4 (test)	9325	9325	12 Dec 2003
Volcanoes SEM (test)	9411	9411	18 Dec 2003

MODE	START ABS ORB (#)	STOP ABS ORB (3)	DATE
S1	9776	9790	13 Jan 2004
S1	10263	10276	16 Feb 2004

Table 3.5.1.4.2: MIPAS Sx modes and UAx scenarios performed.

3.5.2 THE “NEW” MISSION

1. After a long period of instrument unavailability and investigations related to the IDU anomaly (end March – December 2004), the operational mission re-started in orbit 14978 (10 January 2005). The new “experimental mission” has been resumed with different setting.

2. “2RR” instrument configuration:
   - Double slides operations
   - 41% reduced resolution, 1.64 sec sweeps, 62400 fc
   - Asymmetric transitory sweeps
   - Compensation and transition times adapted to that configuration

3. Event oriented scenario:
   - Continuous operations no more feasible
   - Measurement segments broken off by switch-off segments
   - Duty cycle characterization always underway, currently fixed at 35% to 45%
   - Availability/unavailability segments defined by ESRIN through the AVI_UAV_TL files

4. Automatic recovery procedure
   - IDU slide initialization every orbit
   - Controlled stop/restart of nominal measurements even if the instrument is working
   - Frequency and stop/restart timing defined by ESRIN through the ILS record in the MPL_CAL_MP file
   - 4 minutes data gap due to that procedure.

3.5.2.1 Routine calibrations

1. DS offset during nominal operations in both rearward and sideways:
   - Frequency: every 800 sec
   - Number of sweeps: 1 scan of 12 sweeps
   - Duration: 29.26 sec
   - Elevation start angle: 113.0 deg
   - Azimuth start angle: 90.0 deg.

2. The WCC calibration is now automatically scheduled by ESOC after every transition to Heater, with the following setting:
   - Number of sweeps: 1 scan of 12 sweeps
   - Duration: 32.23 sec
   - Elevation start angle: 119.8 deg.

3. The RGC calibration is performed once per measurement day:
   - Number of sweeps: 1 scan of 200 DS + 200 BB sweeps
   - Duration: 850.30 sec
   - Elevation start angle: 113.0 deg
   - Azimuth start angle: 90.0 deg (DS sweeps only)
   - They are planned during Kiruna orbits but out from the data dump window.

3.5.2.2 Line of sight calibrations

1. The LOS calibration is still performed once per week.

2. It consists of a sequence of two consecutive orbits defined as PRIME sequence and, in case that the FOCC cannot schedule the LOS during those orbits; a BACKUP sequence is also defined.

3. The current plan foresees the PRIME sequence on Saturday, during the first two orbits of Kiruna visibility, and the BACKUP sequence during the same orbits of Sunday.

4. As for an ESOC requirement, the LOS observations have to be apart from the nominal measurements segments.

5. Starting from orbit 14250 (20 November 2004) new settings have been applied to LOS observations:
   - Rearward observations only
   - Elevation angle offset: 0.1 deg; maximum scans per star: 15
   - Pitch bias: -0.030 deg; no harmonics.

3.5.2.3 In flight calibrations

1. In-flight calibrations are still needed in the new mission but types and frequencies are changed with respect to the original ones. They are listed below in Table 3.5.2.3.1.

ID	DESCRIPTION	FREQUENCY
IF8	Radiometric calibration characterization	daily

ID	DESCRIPTION	FREQUENCY
IF16	Several limb scanning sequences (raw mode)	2 months
IF9	Offset tangent height determination	3 months
IF11	Absence of high resolution features verification	3 months
IF10	$NESR_0$ verification	6 months
IF6	CBB and DS SNR characterization	1 year

Table 3.5.2.3.1: Description and frequency of MIPAS In-Flight calibrations in the new mission.

2. In Table 3.5.2.3.2 there is the list of the In-Flight calibrations already commanded during the new MIPAS mission.

CAL	START ABS ORB (#)	STOP ABS ORB (#)	DATE
IF2	15364	15372	06 Feb 2005
IF16	15377	15378	06 Feb 2005
IF6	15379	15379	06 Feb 2005
IF11	15380	15380	06 Feb 2005
IF10	15381	15381	06 Feb 2005
IF9	16480	16483	25 Apr 2005
IF11	16485	16485	25 Apr 2005
IF16	16486	16487	25 Apr 2005
IF9	19139	19143	28 Oct 2005
IF10	19144	19144	28 Oct 2005
IF11	19145	19145	28 Oct 2005
IF16	19146	19147	28 Oct 2005
IF9	21048	21051	10 Mar 2006
IF16	21052	21053	10 Mar 2006
IF6	21054	21054	10 Mar 2006
IF10	21055	21055	10 Mar 2006
IF11	21056	21056	10 Mar 2006

Table 3.5.2.3.2: MIPAS In-Flight calibrations commanded in the new mission.

3.5.2.4 Measurement modes

1. Also the Nominal and the Special observation modes have been adapted to the new instrument configuration; those have been defined during the 1st and the 2nd Science Team meeting, held in ESRIN in 6 October 2004 and 3-4 March 2005.

2. The new measurement scenarios are listed below (see Table 3.5.2.4.1) [RD – 12].

ID	DESCRIPTION
NOM	Nominal mode using floating altitudes
UTLS-1	Upper Troposphere Lower Stratosphere
UTLS-2	Upper Troposphere Lower Stratosphere (for 2-D retrievals)
MA	Middle Atmosphere
NLC	Middle/Upper Atmosphere – Noctilucent Clouds
UA	Upper Atmosphere
AE	Aircraft Emissions

Table 3.5.2.4.1: Description of the new MIPAS observation modes.

3. Besides nominal operations, the scientists requested the support of MIPAS measurements for validation and scientific field campaigns, when they take place in specific geolocations. The list of campaigns already supported through MIPAS ad-hoc planning is in Table 3.5.2.4.2.

MODE	ABS ORB (#)	DATE
ESABC campaign (Teresina)	15435-15683	11 – 28 Feb 2005
ESABC campaign (Teresina)	17039-17661	3 Jun – 16 Jul 2005
ESABC campaign (Southern France)	18580-18987	19 Sep – 17 Oct 2005
SCOUT-03 campaign (Darwin)	19380-19711	13 Nov – 7 Dec 2005
ESABC campaign (Kiruna)	20316-20476	18 – 29 Jan 2006
CR-AVE campaign (San Jose)	20484-20650	30 Jan – 10 Feb 2006
ESABC campaign (Kiruna)	20658-20982	11 Feb – 5 Mar 2006
SAUNA campaign (Sodankyla)	21288-21527	27 Mar – 12 Apr 2006

Table 3.5.2.4.2: Validation campaigns supported by MIPAS ad-hoc operations.

3.6 MWR

1. The radiometer is a passive instrument, which operates continuously in nominal mode.

2. The instrument monitoring can be done by comparison against the European Center for Medium-Range Weather Forecast model (ECMWF model), radio-soundings and other on-flight radiometers (e.g. ERS-2, TMR).

3.7 RA-2

1. The RA-2 calibration activities are on the repeat cycle basis.

3.7.1 INTERMEDIATE FREQUENCY CALIBRATIONS

1. The baseline scenario is applicable to the Intermediate Frequency calibration activity.

2. It consists of switching the instrument to IF mode over the Himalayan area (see below Table 3.7.1.1 and Figure 3.7.1.1).

TARGET	**LAT (dec deg)**	**LONG (dec deg)**
Area extension	37.50	75.00
	35.00	82.00
	38.50	90.00
	36.00	97.00
	30.00	99.00
	27.50	90.00
	27.50	81.00
	30.00	74.00
	35.00	72.80

Table 3.7.1.1: Extension of the Himalayan zone.

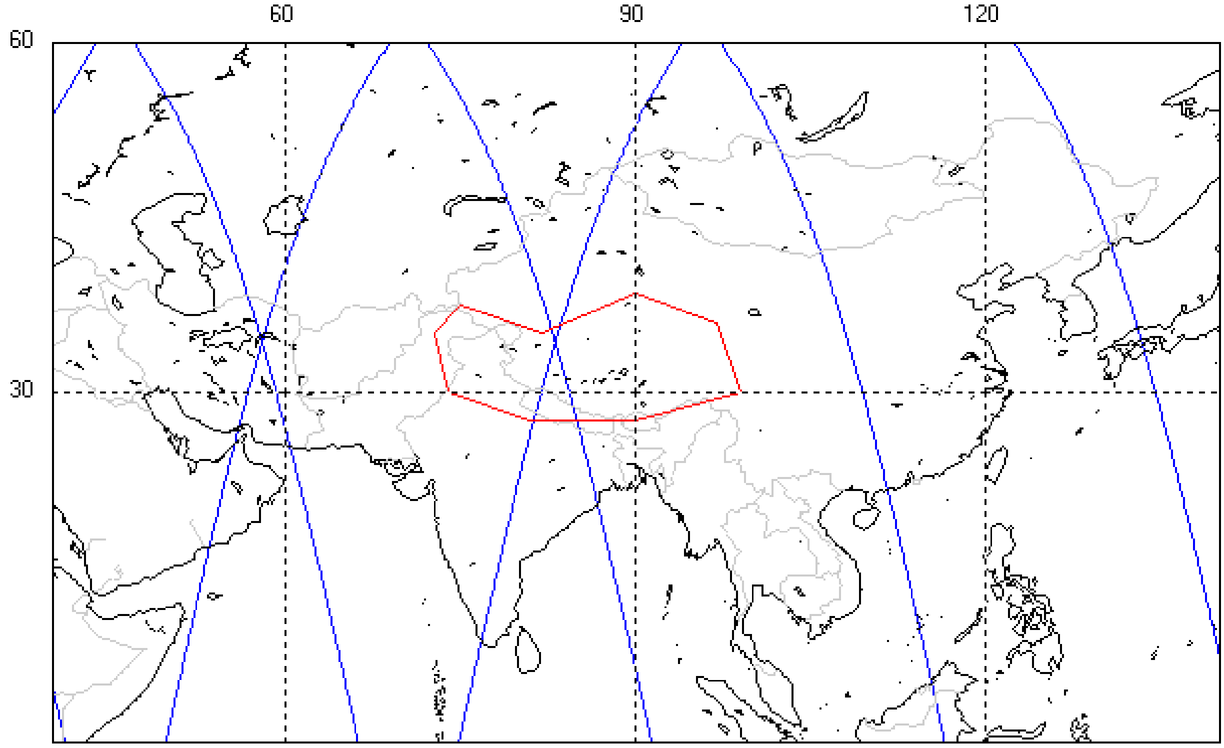

Figure 3.7.1.1: An example of RA-2 ascending and descending passes over Himalayas. The red perimeter defines the "Himalayan zone" used for calibration.

3. Until cycle 30 (September 2004) the acquisitions took place once per day during all the ascending passes over that location, with a minimum duration of 50 seconds. The table below (see Table 3.7.1.2) shows all the segments planned during the complete repeat cycle.

REL ORB (#)	**START ANX (sec)**	**STOP ANX (sec)**	**DURATION (sec)**
12	490.105677	623.045241	132.94
26	463.990642	597.207151	133.217
40	476.690357	649.07818	172.388
55	499.721155	602.377596	102.656
69	463.990642	594.692398	130.702
83	470.39161	639.668566	169.277
97	505.018328	608.222907	103.205
112	463.990642	604.452763	140.462
126	464.091678	630.249035	166.157
140	498.725648	618.006652	119.281

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)
155	466.113037	614.229716	148.117
169	463.990642	620.819917	156.829
183	492.431551	627.807923	135.376
198	475.70243	624.023961	148.322
212	463.990642	611.381501	147.391
226	486.136012	637.627422	151.491
241	485.301977	633.335638	148.034
255	463.990642	601.934122	137.943
269	479.839212	647.46592	167.627
284	494.912055	612.725592	117.814
298	463.990642	592.478039	128.487
312	473.541174	644.374628	170.833
327	504.533029	592.002065	87.469
341	463.990642	599.570545	135.58
355	467.241847	634.96002	167.718
369	501.872169	613.112625	111.24
384	463.990642	609.339118	145.348
398	463.990642	625.535659	161.545
412	495.578709	622.905058	127.326
427	470.90648	619.124641	148.218
441	463.990642	616.101847	152.111
455	489.283931	632.715342	143.431
470	480.500914	628.92776	148.427
484	463.990642	606.658916	142.668
498	482.987859	642.544246	159.556

Table 3.7.1.2: RA-2 acquisition segments in ascending pass over Himalayan zone.

4. Starting from cycle 31 (October 2004) the acquisitions take place during both ascending and descending passes over the location, with a minimum duration of 50 seconds (see above Figure 3.7.1.1). The table below (see Table 3.7.1.3) shows all the segments planned during the complete repeat cycle.

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)
5	2386.426794	2507.385710	120.959
12	490.105677	623.045241	132.940
19	2410.737032	2549.501392	138.764
26	463.990642	597.207151	133.217
33	2375.528956	2549.501392	173.972
40	476.690357	649.078180	172.388
48	2386.651758	2461.336467	74.685
55	499.721155	602.377596	102.656
62	2421.879749	2543.107045	121.227
69	463.990642	594.692398	130.702
76	2367.671626	2549.501392	181.830
83	470.391610	639.668566	169.277
90	2433.009962	2520.809411	87.799
97	505.018328	608.222907	103.205
105	2413.992798	2535.163497	121.171
112	463.990642	604.452763	140.462
119	2367.504568	2549.501392	181.997
126	464.091678	630.249035	166.157
133	2403.070861	2528.112047	125.041
140	498.725648	618.006652	119.281
148	2406.110819	2527.223192	121.112
155	466.113037	614.229716	148.117
162	2379.900663	2549.501392	169.601
169	463.990642	620.819917	156.829
176	2395.195373	2535.410066	140.215
183	492.431551	627.807923	135.376
191	2398.233418	2519.285740	121.052
198	475.702430	624.023961	148.322
205	2392.260285	2549.501392	157.241
212	463.990642	611.381501	147.391
219	2387.325000	2542.702823	155.378
226	486.136012	637.627422	151.491
234	2390.361017	2511.351576	120.991

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)
241	485.301977	633.335638	148.034
248	2404.586706	2549.501392	144.915
255	463.990642	601.934122	137.943
262	2379.459487	2549.501392	170.042
269	479.839212	647.465920	167.627
277	2382.493758	2484.793215	102.299
284	494.912055	612.725592	117.814
291	2416.879744	2547.079840	130.200
298	463.990642	592.478039	128.487
305	2371.599664	2549.501392	177.902
312	473.541174	644.374628	170.833
319	2452.633565	2517.155992	64.522
327	504.533029	592.002065	87.469
334	2417.935747	2539.134918	121.199
341	463.990642	599.570545	135.580
348	2363.744860	2549.501392	185.757
355	467.241847	634.960020	167.718
362	2413.567443	2524.461457	110.894
369	501.872169	613.112625	111.240
377	2410.051191	2531.192991	121.142
384	463.990642	609.339118	145.348
391	2373.707508	2549.501392	175.794
398	463.990642	625.535659	161.545
405	2399.132364	2531.761581	132.629
412	495.578709	622.905058	127.326
420	2402.171557	2523.254106	121.083
427	470.906480	619.124641	148.218
434	2386.084691	2549.501392	163.417
441	463.990642	616.101847	152.111
448	2391.259598	2539.057017	147.797
455	489.283931	632.715342	143.431
463	2394.296427	2515.318188	121.022
470	480.500914	628.927760	148.427

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)
477	2398.427669	2549.501392	151.074
484	463.990642	606.658916	142.668
491	2383.391588	2546.347625	162.956
498	482.987859	642.544246	159.556

Table 3.7.1.3: RA-2 acquisition segments in ascending and descending pass over Himalayan zone.

3.7.2 INDIVIDUAL ECHOES MODE

1. The baseline scenario is applicable also to the Individual Echoes mode.

2. Until cycle 30 (September 2004) the background IE measurements were re-started once per day during all the ascending passes just after the Himalayan zone (see below Table 3.7.2.1 and Figure 3.7.2.1).

TARGET	LAT (dec deg)	LONG (dec deg)
Segment	45.00	from 69.128 to 94.211

Table 3.7.2.1: Location of the IE acquisition start segment (until cycle 30).

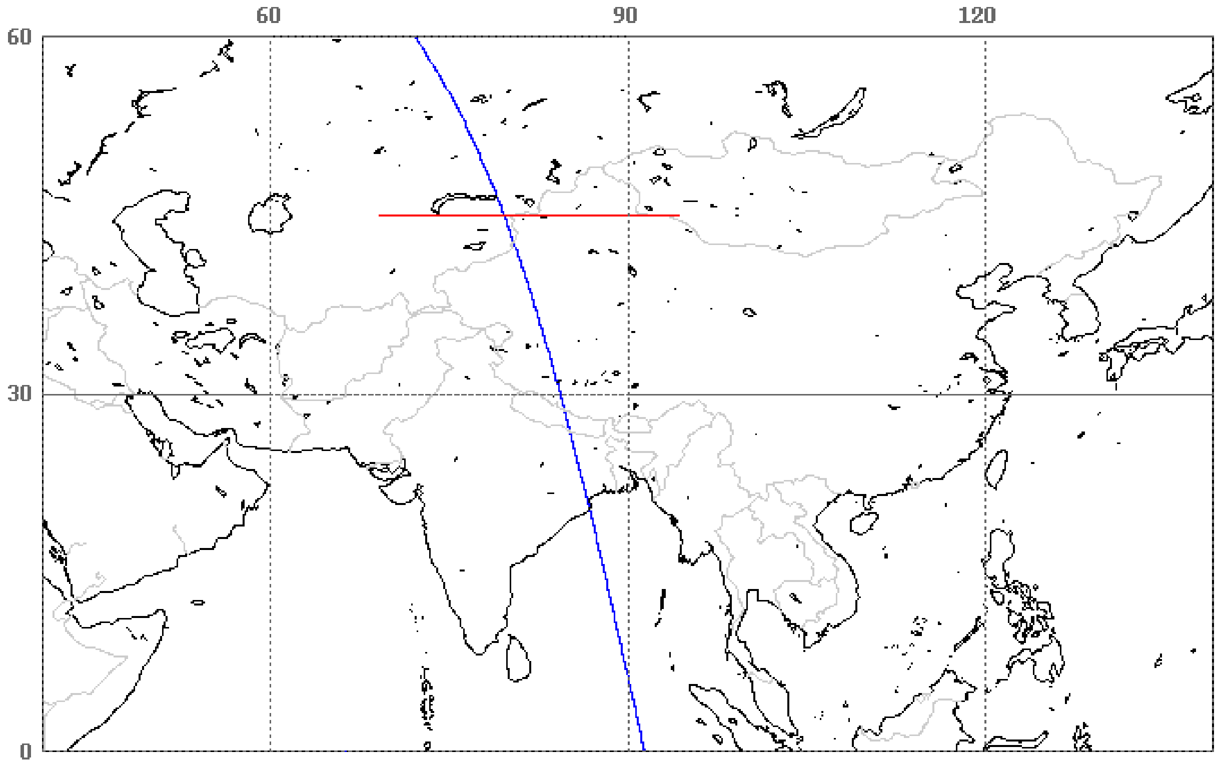

Figure 3.7.2.1: An example of RA-2 ascending pass over Himalayas. The red line defines the beginning of the background IE acquisition.

3. The duration of the acquisitions was set to 1 second length with 469 repetitions, which corresponded to coverage of almost fourteen orbits (i.e. one day). The Table 3.7.2.2 shows the IE background acquisitions coverage during a complete repeat cycle.

START REL ORB (#)	START ANX (sec)	STOP REL ORB (#)	STOP ANX (sec)
12	761.156076	26	375.188064
26	761.156076	40	375.188064
40	761.156076	55	375.188064
55	761.156076	69	375.188064
69	761.156076	83	375.188064
83	761.156076	97	375.188064
97	761.156076	112	375.188064
112	761.156076	126	375.188064
126	761.156076	140	375.188064

START REL ORB (#)	START ANX (sec)	STOP REL ORB (#)	STOP ANX (sec)
140	761.156076	155	375.188064
155	761.156076	169	375.188064
169	761.156076	183	375.188064
183	761.156076	198	375.188064
198	761.156076	212	375.188064
212	761.156076	226	375.188064
226	761.156076	241	375.188064
241	761.156076	255	375.188064
255	761.156076	269	375.188064
269	761.156076	284	375.188064
284	761.156076	298	375.188064
298	761.156076	312	375.188064
312	761.156076	327	375.188064
327	761.156076	341	375.188064
341	761.156076	355	375.188064
355	761.156076	369	375.188064
369	761.156076	384	375.188064
384	761.156076	398	375.188064
398	761.156076	412	375.188064
412	761.156076	427	375.188064
427	761.156076	441	375.188064
441	761.156076	455	375.188064
455	761.156076	470	375.188064
470	761.156076	484	375.188064
484	761.156076	498	375.188064
498	761.156076	12	375.188064

Table 3.7.2.2: RA-2 acquisition segments in background IE mode until cycle 30.

4. Starting from cycle 31 (October 2004) the background IE measurements are re-started twice per day during both ascending and descending passes just after the Himalayan zone (see below Table 3.7.2.3 and Figure 3.7.2.2).

TARGET	LAT (dec deg)	LONG (dec deg)
Upper segment	45.00	from 69.128 to 94.211
Down segment	20.00	from 69.500 to 95.000

Table 3.7.2.3: Location of the IE acquisition start segments (since cycle 31).

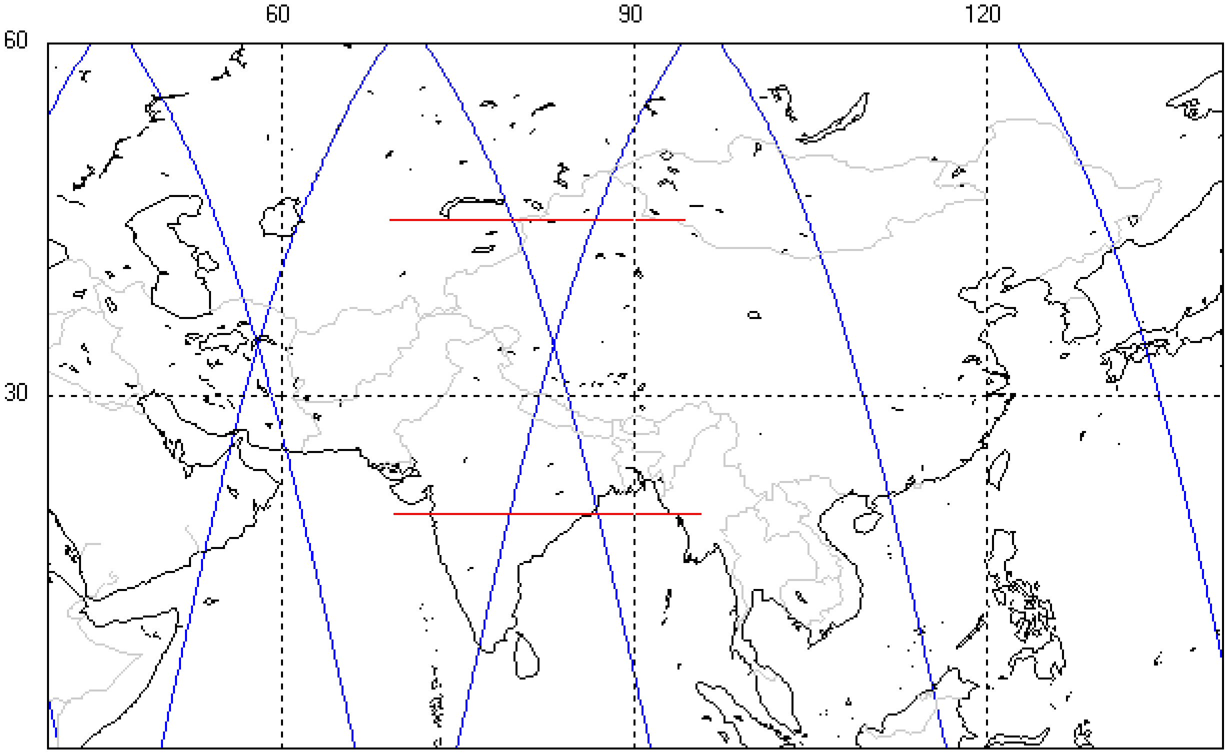

Figure 3.7.2.2: An example of RA-2 ascending and descending passes over Himalayas. The red lines define the beginning of the background IE acquisitions.

5. The duration of the acquisitions is set to 1 second length with 220 repetitions, which corresponded to coverage of more or less 6-7 orbits (i.e. half day). The Table 3.7.2.4 shows the IE background acquisitions coverage during a complete repeat cycle.

START REL ORB (#)	START ANX (sec)	STOP REL ORB (#)	STOP ANX (sec)
5	2675.794024	11	5918.105162
12	761.156076	18	4003.467214

START REL ORB (#)	START ANX (sec)	STOP REL ORB (#)	STOP ANX (sec)
19	2675.794024	25	5918.105162
26	761.156076	32	4003.467214
33	2675.794024	39	5918.105162
40	761.156076	46	4003.467214
48	2675.794024	54	5918.105162
55	761.156076	61	4003.467214
62	2675.794024	68	5918.105162
69	761.156076	75	4003.467214
76	2675.794024	82	5918.105162
83	761.156076	89	4003.467214
90	2675.794024	96	5918.105162
97	761.156076	103	4003.467214
105	2675.794024	111	5918.105162
112	761.156076	118	4003.467214
119	2675.794024	125	5918.105162
126	761.156076	132	4003.467214
133	2675.794024	139	5918.105162
140	761.156076	146	4003.467214
148	2675.794024	154	5918.105162
155	761.156076	161	4003.467214
162	2675.794024	168	5918.105162
169	761.156076	175	4003.467214
176	2675.794024	182	5918.105162
183	761.156076	189	4003.467214
191	2675.794024	197	5918.105162
198	761.156076	204	4003.467214
205	2675.794024	211	5918.105162
212	761.156076	218	4003.467214
219	2675.794024	225	5918.105162
226	761.156076	232	4003.467214
234	2675.794024	240	5918.105162
241	761.156076	247	4003.467214
248	2675.794024	254	5918.105162
255	761.156076	261	4003.467214

START REL ORB (#)	START ANX (sec)	STOP REL ORB (#)	STOP ANX (sec)
262	2675.794024	268	5918.105162
269	761.156076	275	4003.467214
277	2675.794024	283	5918.105162
284	761.156076	290	4003.467214
291	2675.794024	297	5918.105162
298	761.156076	304	4003.467214
305	2675.794024	311	5918.105162
312	761.156076	318	4003.467214
319	2675.794024	325	5918.105162
327	761.156076	333	4003.467214
334	2675.794024	340	5918.105162
341	761.156076	347	4003.467214
348	2675.794024	354	5918.105162
355	761.156076	361	4003.467214
362	2675.794024	368	5918.105162
369	761.156076	375	4003.467214
377	2675.794024	383	5918.105162
384	761.156076	390	4003.467214
391	2675.794024	397	5918.105162
398	761.156076	404	4003.467214
405	2675.794024	411	5918.105162
412	761.156076	418	4003.467214
420	2675.794024	426	5918.105162
427	761.156076	433	4003.467214
434	2675.794024	440	5918.105162
441	761.156076	447	4003.467214
448	2675.794024	454	5918.105162
455	761.156076	461	4003.467214
463	2675.794024	469	5918.105162
470	761.156076	476	4003.467214
477	2675.794024	483	5918.105162
484	761.156076	490	4003.467214
491	2675.794024	497	5918.105162
498	761.156076	504	4003.467214

Table 3.7.2.4: RA-2 acquisition segments in background IE mode, ascending and descending passes.

6. Other IE acquisitions can take place under users' request.

3.7.3 PRESET TRACKING AND PRESET LOOP OUTPUT MODE

1. Currently no Preset Tracking mode acquisitions are planned during the 35 days repeat cycle.

2. The Absolute Sigma-0 calibration activity consists of acquisitions in Preset Loop Output mode over ESA transponders located in Italy (see Table 3.7.3.1). The relative acquisitions are listed in Table 3.7.3.2 (below).

TARGET	LAT (dec deg)	LONG (dec deg)	HEIGHT (m)	DELAY (μs)
Orb_43 (test)	41.7875	13.2112	576.0	55.080
Orb_208 (test)	41.8605	12.2385	6.9	55.080
Orb_315 (test)	41.8472	12.4819	28.6	55.080
Orb_437 (test)	41.7673	12.9247	276.0	55.080

Table 3.7.3.1: ESA Sigma-0 transponders future location.

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)	PASS FLAG	MIN SEP (m)	P-H-N
43	696.7421	716.7421	20	asc	10	07
208	2295.5059	2315.5059	20	desc	52	07
315	697.7618	717.7618	20	asc	31	07
437	2297.0983	2317.0983	20	desc	85	07

Table 3.7.3.2: RA-2 acquisition segments over ESA Sigma-0 transponders.

3. Users requests can be taken into account for Preset Loop Output measurements.

4. From cycle 14 to 20 (February – October 2003) other PLO acquisitions have been requested by the GAVDOS project team. The locations of the three Austrian's transponders are listed in Table 3.7.3.3 (below) and the acquisitions take place during all the ascending and descending passes over these transponders (Table 3.7.3.4).

TARGET	LAT (dec deg)	LONG (dec deg)	HEIGHT (m)	DELAY (µs)
Gabe	47.0535	14.8634	1543	0.013
Gues	47.0536	16.2995	222	0.013
Lass	47.0535	15.5809	501	0.013

Table 3.7.3.3: GAVDOS transponders location.

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)	PASS FLAG	MIN SEP (m)	P-H-N
143	781.882438	811.882438	30	asc	825	07
165	2201.676166	2231.676166	30	desc	791	07
186	781.878058	811.878058	30	asc	753	07
394	2201.674596	2231.674596	30	desc	791	07
415	781.881029	811.881029	30	asc	831	07
437	2201.673314	2231.673314	30	desc	712	07

Table 3.7.3.4: RA-2 acquisition segments over GAVDOS transponders.

5. During cycle 17 to 20 (June – October 2003) the PLO acquisitions have also been requested in support to the CRYOSAT project. The transponder location and the RA-2 acquisition segment in descending pass over it are shown in Tables 3.7.3.5 and 3.7.3.6.

TARGET	LAT (dec deg)	LONG (dec deg)	HEIGHT (m)	DELAY (µs)
Cryosat	55.886195	12.549557	37.530	0.013

Table 3.7.3.5: CRYOSAT project transponder location.

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)	PASS FLAG	MIN SEP (m)	P-H-N
380	2049.186751	2079.186751	30	desc	20	07

Table 3.7.3.6: RA-2 acquisition segment over CRYOSAT project transponder.

6. Starting from cycle 21 (October 2003) the GAVDOS project team has requested PLO acquisitions during ascending pass over Creta location (Table 3.7.3.7 and Table 3.7.3.8).

TARGET	LAT (dec deg)	LONG (dec deg)	HEIGHT (m)	DELAY (µs)
Creta *I*	34.82222	24.08889	200	0.013
Creta *II*	34.83818	24.09095	256.146	0.013
Creta *III*	34.84570	24.02880	310	0.013
Gavdos *I*	34.83818	24.09095	255	0.013
Gavdos *II*	34.82150	24.09100	249	0.013

Table 3.7.3.7: GAVDOS transponder locations (Creta I cycles 21-23, Creta II cycles 24-25, Creta III cycles 26-27, Gavdos I cycles 28-29, Gavdos II from cycle 30).

REL ORB (#)	STARTANX (sec)	STOP ANX (sec)	DURATION (sec)	PASS FLAG	MIN SEP (m)	P-H-N
286 (*Creta I*)	573.016080	603.016080	30	asc	3654	07
286 (*Creta II*)	573.264393	603.264393	30	asc	4254	07
286 *(Creta III)*	573.264321	603.264321	30	asc	4253	07
286 *(Gavdos II)*	572.997378	602.997378	30	asc	3823	07

Table 3.7.3.8: RA-2 acquisition segment over GAVDOS transponder.

7. Starting from cycle 42 (October 2005) the 4 acquisitions over ESA transponders located in Italy have been substituted by the only one pass over the location of Table 3.7.3.9.

TARGET	LAT (dec deg)	LONG (dec deg)	HEIGHT (m)	DELAY (µs)
Cryosat TRP	41.871908	12.473100	73.580	55.080

Table 3.7.3.9: ESA Sigma-0 transponder location.

REL ORB (#)	START ANX (sec)	STOP ANX (sec)	DURATION (sec)	PASS FLAG	MIN SEP (m)	P-H-N
315	698.184777	718.184777	20	asc	55	07

Table 3.7.3.10: RA-2 acquisition segment over the ESA Sigma-0 transponder.

3.8 SCIAMACHY

1. In order to guarantee the quality of the acquired Level 0 data, a variety of different calibration measurements are performed by SCIAMACHY. They can be on an orbital, a daily, a weekly or a monthly basis.

2. Scenarios for the in-flight calibration and monitoring measurements are distinguished between moon and no-moon visibility. Typically for non-nominal events, which require fast re-calibration of the instrument, nominal calibrations excluding moon measurements are performed.

3.8.1 ORBITAL CALIBRATION

1. The sequence of the orbital calibrations is listed in Table 3.8.1.1.

ORB (#)	**CALIBRATION**
1	Sun Occultation & calibration
	Moon Occultation & calibration (pointing)
	ADC calibration
	Dark current calibration (deep space)

Table 3.8.1.1: SCIAMACHY orbital calibrations.

3.8.2 DAILY CALIBRATION

1. SCIAMACHY daily calibrations are listed in Table 3.8.2.1.

ORB (#)	**CALIBRATION**
1	Sun Occultation & calibration
	Sun calibration (pointing)
	Sun calibration (fast sweep scan)
	Sun over ESM diffuser (NDFM in)
	Sub-Solar calibration (fast sweep scan)
	Moon Occultation & calibration (pointing)
	Moon calibration (nominal scan)
	Moon extra mirror calibration (nominal scan)

ORB (#)	CALIBRATION
	ADC calibration
	Dark current calibration (deep space)
2	Sun extra mirror calibration (fast sweep scan)

Table 3.8.2.1: SCIAMACHY daily calibrations.

3.8.3 WEEKLY CALIBRATION

1. Sequence of the weekly calibrations is listed in Table 3.8.3.1.

ORB (#)	CALIBRATION
1	Sun Occultation & calibration
	Sun calibration (pointing)
	Sun calibration (fast sweep scan)
	Sun over ESM diffuser (NDFM in)
	Sub-Solar calibration (fast sweep scan)
	Moon Occultation & calibration (pointing)
	Moon calibration (nominal scan)
	Moon extra mirror calibration (nominal scan)
	SLS calibration
	WLS calibration
	ADC calibration
	Dark current calibration (deep space)
2	Sun extra mirror calibration (fast sweep scan)
	Sun extra mirror calibration (fast sweep scan)
	Sun extra mirror calibration (fast sweep scan)

Table 3.8.3.1: SCIAMACHY weekly calibrations.

3.8.4 MONTHLY CALIBRATION

1. The SCIAMACHY monthly calibrations are listed in Table 3.8.4.1.

ORB (#)	CALIBRATION
1	Sun Occultation & calibration
	Sun calibration (pointing)
	Sun calibration (fast sweep scan)
	Sun over ESM diffuser (NDFM in)
	Sub-Solar calibration (fast sweep scan)
	Moon Occultation & calibration (pointing)
	Moon calibration (nominal scan)
	Moon extra mirror calibration (nominal scan)
	SLS calibration
	WLS calibration
	ADC calibration
	Dark current calibration (deep space)
2	Sun extra mirror calibration (fast sweep scan)
	Sun over ESM diffuser (NDFM out)
	Sub-Solar calibration (nominal scan)
	Dark current calibration (deep space)
3	Sun extra mirror calibration (pointing)
	Sun extra mirror calibration (pointing)
	Sub-Solar calibration (pointing)
	SLS calibration over diffuser
	WLS calibration over diffuser
	Dark current calibration (deep space)

Table 3.8.4.1: SCIAMACHY monthly calibrations.

4 APPENDICES

4.1 Reference Orbit Event File

4.1.1 MPL_ORB_EV.14

```
FILE  ; Reference Orbit Event File
;---------------------------------------------------
RECORD fhr  ; Fixed header

  FILENAME="MPL_ORB_EVVRGT20021108_094447_00000000_00000004_20021209_215929_20030811_215929.N1"

  DESTINATION="PDCC,MUL "
  PHASE_START=+002
  CYCLE_START=+012
  REL_START_ORBIT=+00001
  ABS_START_ORBIT=+04063

ENDRECORD fhr
;---------------------------------------------------
RECORD oef_vhr  ; Variable header

  PHASE_STOP=+002
  CYCLE_STOP=+018
  REL_STOP_ORBIT=+00501
  ABS_STOP_ORBIT=+07569

  ORBIT_SCENARIO_FILE="MPL_ORB_SCVRGT20020305_174240_00000000_00000002_20020301_025355_20781231_235959.N1"
  NUM_ORBIT_CHANGES=+003
  NUM_SUN_OCC_BY_MOON=+003
  NUM_ORBITS=+03507

ENDRECORD oef_vhr
;---------------------------------------------------
LIST num_osf_rec=003

  RECORD osf_rec
    RECORD orbit: ABS=+00001 REL=+00462 CYCLE=+001 PHASE=+000 ENDRECORD
    RECORD cycle: DAYS=+035 ORBITS=+00501 ANX_LONG=+286.525113<deg> MLST="22:00:00" ENDRECORD
    RECORD anx_time: UTC="01-MAR-2002 02:53:55.245278" ENDRECORD
  ENDRECORD osf_rec

  RECORD osf_rec
    RECORD orbit: ABS=+00020 REL=+02426 CYCLE=+002 PHASE=+001 ENDRECORD
    RECORD cycle: DAYS=+194 ORBITS=+02775 ANX_LONG=+168.680802<deg> MLST="22:00:00" ENDRECORD
    RECORD anx_time: UTC="02-MAR-2002 10:45:17.880009" ENDRECORD
  ENDRECORD osf_rec

  RECORD osf_rec
    RECORD orbit: ABS=+00486 REL=+00432 CYCLE=+004 PHASE=+002 ENDRECORD
    RECORD cycle: DAYS=+035 ORBITS=+00501 ANX_LONG=+320.612542<deg> MLST="22:00:00" ENDRECORD
    RECORD anx_time: UTC="04-APR-2002 00:37:34.262318" ENDRECORD
  ENDRECORD osf_rec

ENDLIST num_osf_rec
;---------------------------------------------------
LIST num_sun_occ_by_moon=003  ; Sun occultations by Moon
```

```
  RECORD sun_occ_by_moon
    RECORD entry: ABS_ORBIT=+06528 TIME=+1837.023315<s> ENDRECORD
    RECORD exit: ABS_ORBIT=+06528 TIME=+2334.141846<s> ENDRECORD
  ENDRECORD sun_occ_by_moon

  RECORD sun_occ_by_moon
    RECORD entry: ABS_ORBIT=+06529 TIME=+0486.831665<s> ENDRECORD
    RECORD exit: ABS_ORBIT=+06529 TIME=+2003.577881<s> ENDRECORD
  ENDRECORD sun_occ_by_moon

  RECORD sun_occ_by_moon
    RECORD entry: ABS_ORBIT=+06530 TIME=+0431.802368<s> ENDRECORD
    RECORD exit: ABS_ORBIT=+06530 TIME=+0977.750244<s> ENDRECORD
  ENDRECORD sun_occ_by_moon

ENDLIST num_sun_occ_by_moon
;---------------------------------------------------
LIST num_oef_rec=03507  ; Orbit Records

  RECORD oef_rec
    RECORD orbit: ABS=+04063 REL=+00001 CYCLE=+012 PHASE=+002 ENDRECORD
    RECORD cycle: DAYS=+035 ORBITS=+00501 ANX_LONG=+000.133500<deg> MLST="22:00:00" ENDRECORD
    RECORD anx_time: UTC="09-DEC-2002 21:59:29.232378" ENDRECORD
    RECORD anx_pos: X=+7165274.767<m> Y=+0016695.235<m> Z=-0000000.000<m> ENDRECORD
    RECORD anx_vel: VX=-0004.890103<m/s> VY=-1630.873926<m/s> VZ=+7377.385722<m/s> ENDRECORD
    RECORD kepler: A=+7159496.305<m> E=+0.001165000 I=+098.549475<deg> RA=+048.475851<deg> AP=+090.000000<deg>
M=+270.133357<deg> ENDRECORD
    RECORD eclipse: EXIT=+1323.314787<s> ENTRY=+5434.826588<s> ENDRECORD
    LIST num_sza=002  ; time of reaching specific Sun Zenith Angles
      RECORD sza: SZA=+090.000<deg> DOWN=+1868.463602<s> UP=+4888.042613<s> ENDRECORD
      RECORD sza: SZA=+080.000<deg> DOWN=+2061.013893<s> UP=+4694.342723<s> ENDRECORD
    ENDLIST num_sza
  ENDRECORD oef_rec

  RECORD oef_rec
    RECORD orbit: ABS=+04064 REL=+00002 CYCLE=+012 PHASE=+002 ENDRECORD
    RECORD cycle: DAYS=+035 ORBITS=+00501 ANX_LONG=+334.983799<deg> MLST="22:00:00" ENDRECORD
    RECORD anx_time: UTC="09-DEC-2002 23:40:05.160522" ENDRECORD
    RECORD anx_pos: X=+6493105.460<m> Y=-3030020.249<m> Z=-0000000.000<m> ENDRECORD
    RECORD anx_vel: VX=-0697.523135<m/s> VY=-1474.189660<m/s> VZ=+7377.385722<m/s> ENDRECORD
    RECORD kepler: A=+7159496.305<m> E=+0.001165000 I=+098.549475<deg> RA=+048.544708<deg> AP=+090.000000<deg>
M=+270.133357<deg> ENDRECORD
    RECORD eclipse: EXIT=+1323.406003<s> ENTRY=+5434.998376<s> ENDRECORD
    LIST num_sza=002  ; time of reaching specific Sun Zenith Angles
      RECORD sza: SZA=+090.000<deg> DOWN=+1868.596091<s> UP=+4888.175329<s> ENDRECORD
      RECORD sza: SZA=+080.000<deg> DOWN=+2061.159231<s> UP=+4694.462436<s> ENDRECORD
    ENDLIST num_sza
  ENDRECORD oef_rec

  RECORD oef_rec
    RECORD orbit: ABS=+04065 REL=+00003 CYCLE=+012 PHASE=+002 ENDRECORD
    RECORD cycle: DAYS=+035 ORBITS=+00501 ANX_LONG=+309.834099<deg> MLST="22:00:00" ENDRECORD
    RECORD anx_time: UTC="10-DEC-2002 01:20:41.088666" ENDRECORD
    RECORD anx_pos: X=+4589849.736<m> Y=-5502246.870<m> Z=-0000000.000<m> ENDRECORD
    RECORD anx_vel: VX=-1257.906466<m/s> VY=-1038.000482<m/s> VZ=+7377.385722<m/s> ENDRECORD
    RECORD kepler: A=+7159496.305<m> E=+0.001165000 I=+098.549475<deg> RA=+048.613566<deg> AP=+090.000000<deg>
M=+270.133357<deg> ENDRECORD
    RECORD eclipse: EXIT=+1323.496676<s> ENTRY=+5435.169643<s> ENDRECORD
    LIST num_sza=002  ; time of reaching specific Sun Zenith Angles
      RECORD sza: SZA=+090.000<deg> DOWN=+1868.727905<s> UP=+4888.307368<s> ENDRECORD
      RECORD sza: SZA=+080.000<deg> DOWN=+2061.303916<s> UP=+4694.581449<s> ENDRECORD
    ENDLIST num_sza
  ENDRECORD oef_rec
… … …
```

4.2 Cycle definition

4.2.1 TABLE: CYCLE DEFINITION

CYCLE (#)	**FIRST ABS ORBIT (#)**	**LAST ABS ORBIT (#)**	**ANX UTC**
1	1	19	01 Mar 2002 02:53:55
2	20	369	02 Mar 2002 10:45:18
3	370	485	26 Mar 2002 21:59:53
4	486	555	04 Apr 2002 00:37:34
5	556	1056	08 Apr 2002 21:59:29
6	1057	1557	13 May 2002 21:59:29
7	1558	2058	17 Jun 2002 21:59:29
8	2059	2559	22 Jul 2002 21:59:29
9	2560	3060	26 Aug 2002 21:59:29
10	3061	3561	30 Sep 2002 21:59:29
11	3562	4062	04 Nov 2002 21:59:29
12	4063	4563	09 Dec 2002 21:59:29
13	4564	5064	13 Jan 2003 21:59:29
14	5065	5565	17 Feb 2003 21:59:29
15	5566	6066	24 Mar 2003 21:59:29
16	6067	6567	28 Apr 2003 21:59:29
17	6568	7068	02 Jun 2003 21:59:29
18	7069	7569	07 Jul 2003 21:59:29
19	7570	8070	11 Aug 2003 21:59:29
20	8071	8571	15 Sep 2003 21:59:29
21	8572	9072	20 Oct 2003 21:59:29
22	9073	9573	24 Nov 2003 21:59:29
23	9574	10074	29 Dec 2003 21:59:29
24	10075	10575	02 Feb 2004 21:59:29
25	10576	11076	08 Mar 2004 21:59:29
26	11077	11577	12 Apr 2004 21:59:29
27	11578	12078	17 May 2004 21:59:29
28	12079	12579	21 Jun 2004 21:59:29

CYCLE (#)	FIRST ABS ORBIT (#)	LAST ABS ORBIT (#)	ANX UTC
29	12580	13080	26 Jul 2004 21:59:29
30	13081	13581	30 Aug 2004 21:59:29
31	13582	14082	04 Oct 2004 21:59:29
32	14083	14583	08 Nov 2004 21:59:29
33	14584	15084	13 Dec 2004 21:59:29
34	15085	15585	17 Jan 2005 21:59:29
35	15586	16086	21 Feb 2005 21:59:29
36	16087	16587	28 Mar 2005 21:59:29
37	16588	17088	02 May 2005 21:59:29
38	17089	17589	06 Jun 2005 21:59:29
39	17590	18090	11 Jul 2005 21:59:29
40	18091	18591	15 Aug 2005 21:59:29
41	18592	19092	19 Sep 2005 21:59:29
42	19093	19593	24 Oct 2005 21:59:29
43	19594	20094	28 Nov 2005 21:59:29
44	20095	20595	02 Jan 2006 21:59:29
45	20596	21096	06 Feb 2006 21:59:29
46	21097	21597	13 Mar 2006 21:59:29
47	21598	22098	17 Apr 2006 21:59:29
48	22099	22599	22 May 2006 21:59:29
49	22600	23100	26 Jun 2006 21:59:29
50	23101	23601	31 Jul 2006 21:59:29
51	23602	24102	04 Sep 2006 21:59:29
52	24103	24603	09 Oct 2006 21:59:29
53	24604	25104	13 Nov 2006 21:59:29
54	25105	25605	18 Dec 2006 21:59:29
55	25606	26106	22 Jan 2007 21:59:29
56	26107	26607	26 Feb 2007 21:59:29
57	26608	27108	02 Apr 2007 21:59:29
58	27109	27609	07 May 2007 21:59:29
59	27610	28110	11 Jun 2007 21:59:29
60	28111	28611	16 Jul 2007 21:59:29
61	28612	29112	20 Aug 2007 21:59:29
62	29113	29613	24 Sep 2007 21:59:29

CYCLE (#)	FIRST ABS ORBIT (#)	LAST ABS ORBIT (#)	ANX UTC
63	29614	30114	29 Oct 2007 21:59:29
64	30115	30615	03 Dec 2007 21:59:29
65	30616	31116	07 Jan 2008 21:59:29
66	31117	31617	11 Feb 2008 21:59:29
67	31618	32118	17 Mar 2008 21:59:29
68	32119	32619	21 Apr 2008 21:59:29
69	32620	33120	26 May 2008 21:59:29
70	33121	33621	30 Jun 2008 21:59:29
71	33622	34122	04 Aug 2008 21:59:29
72	34123	34623	08 Sep 2008 21:59:29
73	34624	35124	13 Oct 2008 21:59:29
74	35125	35625	17 Nov 2008 21:59:29
75	35626	36126	22 Dec 2008 21:59:29
76	36127	36627	26 Jan 2009 21:59:29
77	36628	37128	02 Mar 2009 21:59:29
78	37129	37629	06 Apr 2009 21:59:29
79	37630	38130	11 May 2009 21:59:29
80	38131	38631	15 Jun 2009 21:59:29
81	38632	39132	20 Jul 2009 21:59:29
82	39133	39633	24 Aug 2009 21:59:29
83	39634	40134	28 Sep 2009 21:59:29
84	40135	40635	02 Nov 2009 21:59:29
85	40636	41136	07 Dec 2009 21:59:29
86	41137	41637	11 Jan 2010 21:59:29
…	…	…	…

4.2.2 TABLE: RELATIVE ORBIT ANX TIME

REL ORBIT (#)	DAY SHIFT (#)	ANX UTC
1	0	21:59:29

REL ORBIT (#)	DAY SHIFT (#)	ANX UTC
2	1	23:40:04

REL ORBIT (#)	DAY SHIFT (#)	ANX UTC
3	1	01:20:40
4	1	03:01:16
5	1	04:41:52
6	1	06:22:28
7	1	08:03:04
8	1	09:43:40
9	1	11:24:16
10	1	13:04:52
11	1	14:45:28
12	1	16:26:04
13	1	18:06:40
14	1	19:47:16
15	1	21:27:51
16	2	23:08:27
17	2	00:49:03
18	2	02:29:39
19	2	04:10:15
20	2	05:50:51
21	2	07:31:27
22	2	09:12:03
23	2	10:52:39
24	2	12:33:15
25	2	14:13:51
26	2	15:54:27
27	2	17:35:03
28	2	19:15:39
29	2	20:56:14
30	3	22:36:50
31	3	00:17:26
32	3	01:58:02
33	3	03:38:38
34	3	05:19:14
35	3	06:59:50
36	3	08:40:26

REL ORBIT (#)	DAY SHIFT (#)	ANX UTC
37	3	10:21:02
38	3	12:01:38
39	3	13:42:14
40	3	15:22:50
41	3	17:03:26
42	3	18:44:02
43	3	20:24:37
44	4	22:05:13
45	4	23:45:49
46	4	01:26:25
47	4	03:07:01
48	4	04:47:37
49	4	06:28:13
50	4	08:08:49
51	4	09:49:25
52	4	11:30:01
53	4	13:10:37
54	4	14:51:13
55	4	16:31:49
56	4	18:12:25
57	4	19:53:00
58	4	21:33:36
59	5	23:14:12
60	5	00:54:48
61	5	02:35:24
62	5	04:16:00
63	5	05:56:36
64	5	07:37:12
65	5	09:17:48
66	5	10:58:24
67	5	12:39:00
68	5	14:19:36
69	5	16:00:12
70	5	17:40:48

REL ORBIT (#)	DAY SHIFT (#)	ANX UTC
71	5	19:21:23
72	5	21:01:59
73	6	22:42:35
74	6	00:23:11
75	6	02:03:47
76	6	03:44:23
77	6	05:24:59
78	6	07:05:35
79	6	08:46:11
80	6	10:26:47
81	6	12:07:23
82	6	13:47:59
83	6	15:28:35
84	6	17:09:11
85	6	18:49:46
86	6	20:30:22
87	7	22:10:58
88	7	23:51:34
89	7	01:32:10
90	7	03:12:46
91	7	04:53:22
92	7	06:33:58
93	7	08:14:34
94	7	09:55:10
95	7	11:35:46
96	7	13:16:22
97	7	14:56:58
98	7	16:37:34
99	7	18:18:09
100	7	19:58:45
101	7	21:39:21
102	8	23:19:57
103	8	01:00:33
104	8	02:41:09

REL ORBIT (#)	DAY SHIFT (#)	ANX UTC
105	8	04:21:45
106	8	06:02:21
107	8	07:42:57
108	8	09:23:33
109	8	11:04:09
110	8	12:44:45
111	8	14:25:21
112	8	16:05:57
113	8	17:46:32
114	8	19:27:08
115	8	21:07:44
116	9	22:48:20
117	9	00:28:56
118	9	02:09:32
119	9	03:50:08
120	9	05:30:44
121	9	07:11:20
122	9	08:51:56
123	9	10:32:32
124	9	12:13:08
125	9	13:53:44
126	9	15:34:20
127	9	17:14:55
128	9	18:55:31
129	9	20:36:07
130	10	22:16:43
131	10	23:57:19
132	10	01:37:55
133	10	03:18:31
134	10	04:59:07
135	10	06:39:43
136	10	08:20:19
137	10	10:00:55
138	10	11:41:31

REL ORBIT (#)	DAY SHIFT (#)	ANX UTC
139	10	13:22:07
140	10	15:02:43
141	10	16:43:18
142	10	18:23:54
143	10	20:04:30
144	10	21:45:06
145	11	23:25:42
146	11	01:06:18
147	11	02:46:54
148	11	04:27:30
149	11	06:08:06
150	11	07:48:42
151	11	09:29:18
152	11	11:09:54
153	11	12:50:30
154	11	14:31:06
155	11	16:11:41
156	11	17:52:17
157	11	19:32:53
158	11	21:13:29
159	12	22:54:05
160	12	00:34:41
161	12	02:15:17
162	12	03:55:53
163	12	05:36:29
164	12	07:17:05
165	12	08:57:41
166	12	10:38:17
167	12	12:18:53
168	12	13:59:29
169	12	15:40:04
170	12	17:20:40
171	12	19:01:16
172	12	20:41:52

REL ORBIT (#)	DAY SHIFT (#)	ANX UTC
173	13	22:22:28
174	13	00:03:04
175	13	01:43:40
176	13	03:24:16
177	13	05:04:52
178	13	06:45:28
179	13	08:26:04
180	13	10:06:40
181	13	11:47:16
182	13	13:27:51
183	13	15:08:27
184	13	16:49:03
185	13	18:29:39
186	13	20:10:15
187	13	21:50:51
188	14	23:31:27
189	14	01:12:03
190	14	02:52:39
191	14	04:33:15
192	14	06:13:51
193	14	07:54:27
194	14	09:35:03
195	14	11:15:39
196	14	12:56:14
197	14	14:36:50
198	14	16:17:26
199	14	17:58:02
200	14	19:38:38
201	14	21:19:14
202	15	22:59:50
203	15	00:40:26
204	15	02:21:02
205	15	04:01:38
206	15	05:42:14

REL ORBIT (#)	DAY SHIFT (#)	ANX UTC
207	15	07:22:50
208	15	09:03:26
209	15	10:44:02
210	15	12:24:37
211	15	14:05:13
212	15	15:45:49
213	15	17:26:25
214	15	19:07:01
215	15	20:47:37
216	16	22:28:13
217	16	00:08:49
218	16	01:49:25
219	16	03:30:01
220	16	05:10:37
221	16	06:51:13
222	16	08:31:49
223	16	10:12:25
224	16	11:53:00
225	16	13:33:36
226	16	15:14:12
227	16	16:54:48
228	16	18:35:24
229	16	20:16:00
230	16	21:56:36
231	17	23:37:12
232	17	01:17:48
233	17	02:58:24
234	17	04:39:00
235	17	06:19:36
236	17	08:00:12
237	17	09:40:48
238	17	11:21:23
239	17	13:01:59
240	17	14:42:35

REL ORBIT (#)	DAY SHIFT (#)	ANX UTC
241	17	16:23:11
242	17	18:03:47
243	17	19:44:23
244	17	21:24:59
245	18	23:05:35
246	18	00:46:11
247	18	02:26:47
248	18	04:07:23
249	18	05:47:59
250	18	07:28:35
251	18	09:09:11
252	18	10:49:46
253	18	12:30:22
254	18	14:10:58
255	18	15:51:34
256	18	17:32:10
257	18	19:12:46
258	18	20:53:22
259	19	22:33:58
260	19	00:14:34
261	19	01:55:10
262	19	03:35:46
263	19	05:16:22
264	19	06:56:58
265	19	08:37:34
266	19	10:18:09
267	19	11:58:45
268	19	13:39:21
269	19	15:19:57
270	19	17:00:33
271	19	18:41:09
272	19	20:21:45
273	20	22:02:21
274	20	23:42:57

REL ORBIT (#)	DAY SHIFT (#)	ANX UTC
275	20	01:23:33
276	20	03:04:09
277	20	04:44:45
278	20	06:25:21
279	20	08:05:57
280	20	09:46:32
281	20	11:27:08
282	20	13:07:44
283	20	14:48:20
284	20	16:28:56
285	20	18:09:32
286	20	19:50:08
287	20	21:30:44
288	21	23:11:20
289	21	00:51:56
290	21	02:32:32
291	21	04:13:08
292	21	05:53:44
293	21	07:34:20
294	21	09:14:55
295	21	10:55:31
296	21	12:36:07
297	21	14:16:43
298	21	15:57:19
299	21	17:37:55
300	21	19:18:31
301	21	20:59:07
302	22	22:39:43
303	22	00:20:19
304	22	02:00:55
305	22	03:41:31
306	22	05:22:07
307	22	07:02:43
308	22	08:43:18

REL ORBIT (#)	DAY SHIFT (#)	ANX UTC
309	22	10:23:54
310	22	12:04:30
311	22	13:45:06
312	22	15:25:42
313	22	17:06:18
314	22	18:46:54
315	22	20:27:30
316	23	22:08:06
317	23	23:48:42
318	23	01:29:18
319	23	03:09:54
320	23	04:50:30
321	23	06:31:06
322	23	08:11:41
323	23	09:52:17
324	23	11:32:53
325	23	13:13:29
326	23	14:54:05
327	23	16:34:41
328	23	18:15:17
329	23	19:55:53
330	23	21:36:29
331	24	23:17:05
332	24	00:57:41
333	24	02:38:17
334	24	04:18:53
335	24	05:59:29
336	24	07:40:04
337	24	09:20:40
338	24	11:01:16
339	24	12:41:52
340	24	14:22:28
341	24	16:03:04
342	24	17:43:40

REL ORBIT (#)	DAY SHIFT (#)	ANX UTC
343	24	19:24:16
344	24	21:04:52
345	25	22:45:28
346	25	00:26:04
347	25	02:06:40
348	25	03:47:16
349	25	05:27:51
350	25	07:08:27
351	25	08:49:03
352	25	10:29:39
353	25	12:10:15
354	25	13:50:51
355	25	15:31:27
356	25	17:12:03
357	25	18:52:39
358	25	20:33:15
359	26	22:13:51
360	26	23:54:27
361	26	01:35:03
362	26	03:15:39
363	26	04:56:14
364	26	06:36:50
365	26	08:17:26
366	26	09:58:02
367	26	11:38:38
368	26	13:19:14
369	26	14:59:50
370	26	16:40:26
371	26	18:21:02
372	26	20:01:38
373	26	21:42:14
374	27	23:22:50
375	27	01:03:26
376	27	02:44:02

REL ORBIT (#)	DAY SHIFT (#)	ANX UTC
377	27	04:24:37
378	27	06:05:13
379	27	07:45:49
380	27	09:26:25
381	27	11:07:01
382	27	12:47:37
383	27	14:28:13
384	27	16:08:49
385	27	17:49:25
386	27	19:30:01
387	27	21:10:37
388	28	22:51:13
389	28	00:31:49
390	28	02:12:25
391	28	03:53:00
392	28	05:33:36
393	28	07:14:12
394	28	08:54:48
395	28	10:35:24
396	28	12:16:00
397	28	13:56:36
398	28	15:37:12
399	28	17:17:48
400	28	18:58:24
401	28	20:39:00
402	29	22:19:36
403	29	00:00:12
404	29	01:40:48
405	29	03:21:23
406	29	05:01:59
407	29	06:42:35
408	29	08:23:11
409	29	10:03:47
410	29	11:44:23

REL ORBIT (#)	DAY SHIFT (#)	ANX UTC
411	29	13:24:59
412	29	15:05:35
413	29	16:46:11
414	29	18:26:47
415	29	20:07:23
416	29	21:47:59
417	30	23:28:35
418	30	01:09:11
419	30	02:49:46
420	30	04:30:22
421	30	06:10:58
422	30	07:51:34
423	30	09:32:10
424	30	11:12:46
425	30	12:53:22
426	30	14:33:58
427	30	16:14:34
428	30	17:55:10
429	30	19:35:46
430	30	21:16:22
431	31	22:56:58
432	31	00:37:34
433	31	02:18:09
434	31	03:58:45
435	31	05:39:21
436	31	07:19:57
437	31	09:00:33
438	31	10:41:09
439	31	12:21:45
440	31	14:02:21
441	31	15:42:57
442	31	17:23:33
443	31	19:04:09
444	31	20:44:45

REL ORBIT (#)	DAY SHIFT (#)	ANX UTC
445	32	22:25:21
446	32	00:05:57
447	32	01:46:32
448	32	03:27:08
449	32	05:07:44
450	32	06:48:20
451	32	08:28:56
452	32	10:09:32
453	32	11:50:08
454	32	13:30:44
455	32	15:11:20
456	32	16:51:56
457	32	18:32:32
458	32	20:13:08
459	32	21:53:44
460	33	23:34:20
461	33	01:14:55
462	33	02:55:31
463	33	04:36:07
464	33	06:16:43
465	33	07:57:19
466	33	09:37:55
467	33	11:18:31
468	33	12:59:07
469	33	14:39:43
470	33	16:20:19
471	33	18:00:55
472	33	19:41:31
473	33	21:22:07
474	34	23:02:43
475	34	00:43:18
476	34	02:23:54
477	34	04:04:30
478	34	05:45:06

REL ORBIT (#)	DAY SHIFT (#)	ANX UTC
479	34	07:25:42
480	34	09:06:18
481	34	10:46:54
482	34	12:27:30
483	34	14:08:06
484	34	15:48:42
485	34	17:29:18
486	34	19:09:54
487	34	20:50:30
488	35	22:31:06
489	35	00:11:41
490	35	01:52:17

REL ORBIT (#)	DAY SHIFT (#)	ANX UTC
491	35	03:32:53
492	35	05:13:29
493	35	06:54:05
494	35	08:34:41
495	35	10:15:17
496	35	11:55:53
497	35	13:36:29
498	35	15:17:05
499	35	16:57:41
500	35	18:38:17
501	35	20:18:53

4.3 AATSR cal/val sites

4.3.1 TABLE: AATSR ACQUISITION SITES FOR VALIDATION ACTIVITIES

ID	LAT (dec deg)	LONG (dec deg)	RAD (km)
Arabia 1	18.38	46.26	
	19.38	46.26	
	19.38	47.26	
	18.38	47.26	
Arabia 2	19.63	50.46	
	20.63	50.46	
	20.63	51.46	
	19.63	51.46	
Arabia 3	28.42	43.23	
	29.42	43.23	

ID	LAT (dec deg)	LONG (dec deg)	RAD (km)
	29.42	44.23	
	28.42	44.23	
Sudan 1	21.24	27.72	
	22.24	27.72	
	22.24	28.72	
	21.24	28.72	
Niger 1	19.17	9.31	
	20.17	9.31	
	20.17	10.31	
	19.17	10.31	

ID	LAT (dec deg)	LONG (dec deg)	RAD (km)
Niger 2	20.87	10.09	
	21.87	10.09	
	21.87	11.09	
	20.87	11.09	
Niger 3	21.07	7.46	
	22.07	7.46	
	22.07	8.46	
	21.07	8.46	
Egypt 1	26.62	25.60	
	27.62	25.60	
	27.62	26.60	
	26.62	26.60	
Lybia 1	23.92	12.85	
	24.92	12.85	
	24.92	13.85	
	23.92	13.85	
Lybia 2	24.55	19.98	
	25.55	19.98	
	25.55	20.98	
	24.55	20.98	
Lybia 3	22.65	22.60	
	23.65	22.60	
	23.65	23.60	
	22.65	23.60	
Lybia 4	28.05	22.89	
	29.05	22.89	
	29.05	23.89	
	28.05	23.89	
Algeria 1	23.30	-0.90	
	24.30	-0.90	
	24.30	0.10	
	23.30	0.10	
Algeria 2	25.59	-1.88	

ID	LAT (dec deg)	LONG (dec deg)	RAD (km)
	26.59	-1.88	
	26.59	-0.88	
	25.59	-0.88	
Algeria 3	29.82	7.16	
	30.82	7.16	
	30.82	8.16	
	29.82	8.16	
Algeria 4	29.54	5.09	
	30.54	5.09	
	30.54	6.09	
	29.54	6.09	
Algeria 5	30.52	1.73	
	31.52	1.73	
	31.52	2.73	
	30.52	2.73	
Mali 1	18.62	-5.35	
	19.62	-5.35	
	19.62	-4.35	
	18.62	-4.35	
Mauritania 1	18.90	-9.80	
	19.90	-9.80	
	19.90	-8.80	
	18.90	-8.80	
Mauritania 2	20.35	-9.28	
	21.35	-9.28	
	21.35	-8.28	
	20.35	-8.28	
Libyan Desert	21.00	29.00	
	21.00	28.00	
	23.00	28.00	
	23.00	29.00	
Dunhuang	40.17	94.01	
	40.17	94.30	

ID	LAT (dec deg)	LONG (dec deg)	RAD (km)
	40.02	94.30	
	40.02	94.01	
Sonora	32.06	-114.18	
	32.06	-113.54	
	31.54	-113.54	
	31.54	-114.18	
Hay	-34.13	145.04	
	-34.13	145.54	
	-34.63	145.54	
	-34.63	145.04	
Amburla	-23.04	132.87	
	-23.04	133.37	
	-23.54	133.37	
	-23.54	132.87	
Thangoo	-17.95	122.01	
	-17.95	122.51	
	-18.35	122.51	
	-18.35	122.01	
Ishigaki	25.10	123.00	
	25.10	124.00	
	24.10	124.00	
	24.10	123.00	
Barrow 2	71.80	-157.30	
	71.80	-156.30	
	70.80	-156.30	
	70.80	-157.30	
Syowa 2	-68.50	39.10	
	-68.50	40.10	
	-69.50	40.10	
	-69.50	39.10	
Baikal	56.00	102.50	
	56.00	110.00	
	51.00	110.00	

ID	LAT (dec deg)	LONG (dec deg)	RAD (km)
	51.00	102.50	
Balearics	40.00	2.00	
	40.00	5.00	
	36.00	5.00	
	36.00	2.00	
Greece	40.00	20.00	
	40.00	30.00	
	32.00	30.00	
	32.00	20.00	
Gulf	43.00	79.00	
	43.00	65.00	
	33.50	65.00	
	33.50	79.00	
Italy	44.00	10.00	
	44.00	19.00	
	35.00	19.00	
	35.00	10.00	
Jordan	34.00	34.00	
	34.00	38.00	
	29.00	38.00	
	29.00	34.00	
Lybia	30.00	12.00	
	30.00	29.00	
	21.00	29.00	
	21.00	12.00	
Morocco	36.00	17.00	
	36.00	1.00	
	21.00	1.00	
	21.00	17.00	
Spain	39.57	4.38	
	39.57	0.38	
	37.62	0.38	
	37.62	4.38	

ID	LAT (dec deg)	LONG (dec deg)	RAD (km)
UK	60.00	12.00	
	60.00	2.50	
	49.00	2.50	
	49.00	12.00	
Marrakesh	33.50	8.50	
	33.50	7.00	
	30.00	7.00	
	30.00	8.50	
Murzuq	25.92	12.85	
	26.92	13.85	
	23.50	13.85	
	23.50	12.85	
Greenland 2	79.75	-40.00	976
Lake Tahoo	39.00	-120.00	50
Geesthacht	53.30	11.00	500
Cabau Fischer	52.15	5.00	500
Lindenberg	52.15	14.00	500

4.3.2 TABLE: AATSR ACQUISITION SITES FOR THE VALIDATION OF LAND SURFACE TEMPERATURE PRODUCT

ID	LAT (dec deg)	LONG (dec deg)	RAD (km)
Stroeve 1	69.57	-49.30	10
Stroeve 2	69.88	-46.97	10
Stroeve 3	73.83	-49.50	10
Stroeve 4	77.14	-61.10	10
Stroeve 5	78.53	-56.83	10
Stroeve 6	72.58	-38.50	10
Stroeve 7	78.02	-33.99	10
Stroeve 8	66.49	-46.28	10
Stroeve 9	69.50	-49.68	10
Stroeve 10	66.00	-44.50	10
Stroeve 11	63.15	-44.82	10
Stroeve 12	75.00	-30.00	10
Stroeve 13	69.91	-46.85	10
Stroeve 14	75.10	-42.33	10
Stroeve 15	66.48	-42.50	10
Stroeve 16	69.70	-33.00	10
Stroeve 17	69.42	-50.12	10
Stroeve 18	65.76	-39.60	10
Fort Peck	48.31	-105.10	10
Boulder	41.12	-105.10	10
Greenland	74.00	-40.00	25
Canada	54.00	-105.00	25
Borneo	-1.50	113.00	25
Spain	39.00	-1.00	25
Sahara	30.00	0.00	25
Siberia	68.00	114.00	25
Kamtchatka	56.00	158.00	25

4.4 MERIS cal/val sites

4.4.1 TABLE: MERIS ACQUISITION SITES FOR ABSOLUTE CALIBRATION BY VICARIOUS METHODS

ID	LAT (dec deg)	LONG (dec deg)
ClimSPac1	-22.5	-128.5
	-22.5	-90.5
	-43.5	-90.5
	-43.5	-128.5
ClimNPac1	21.5	141
	21.5	164.5
	11.5	164.5
	11.5	141
ClimNPac2	22	-178.5
	22	-160.5
	16.5	-160.5
	16.5	-178.5
ClimNAtl1	25.5	-61
	25.5	-45.5
	18.5	-45.5
	18.5	-61
ClimSAtl1	-11.5	-31
	-11.5	-12.5
	-18.5	-12.5
	-18.5	-31
ClimInd1	-22.5	91
	-22.5	98.5
	-28.5	98.5
	-28.5	91
ClimMadag	-27.5	55.5
	-27.5	73.5

ID	LAT (dec deg)	LONG (dec deg)
	-30	73.5
	-30	55.5
ClimSAustra	-40.5	128.5
	-40.5	131.5
	-41.5	131.5
	-41.5	128.5
ClimMoby	20	-159
	20	-156.5
	18	-156.5
	18	-159
ClimGAlaska	45.5	-143.5
	45.5	-139.5
	44.5	-139.5
	44.5	-143.5
ClimDomeCR	17	-118.5
	17	-109.5
	14.5	-109.5
	14.5	-118.5
ClimGYucat	20	-85
	20	-80
	17	-80
	17	-85
ClimGMex	24.5	-92.5
	24.5	-87.5
	23.5	-87.5
	23.5	-92.5

ID	LAT (dec deg)	LONG (dec deg)
Algeria 1	24.3	-0.9
	24.3	0.1
	23.3	0.1
	23.3	-0.9
Algeria 2	26.59	-1.88
	26.59	-0.88
	25.59	-0.88
	25.59	-1.88
Algeria 3	30.82	7.16
	30.82	8.16
	29.82	8.16
	29.82	7.16
Algeria 4	30.54	5.09
	30.54	6.09
	29.54	6.09
	29.54	5.09
Algeria 5	31.52	1.73
	31.52	2.73
	30.52	2.73
	30.52	1.73
Arabia 1	19.38	46.26
	19.38	47.26
	18.38	47.26
	18.38	46.26
Arabia 2	20.63	50.46
	20.63	51.46
	19.63	51.46
	19.63	50.46
Arabia 3	29.42	43.23
	29.42	44.23
	28.42	44.23
	28.42	43.23
Sudan 1	22.24	27.72

ID	LAT (dec deg)	LONG (dec deg)
	22.24	28.72
	21.24	28.72
	21.24	27.72
Niger 1	20.17	9.31
	20.17	10.31
	19.17	10.31
	19.17	9.31
Niger 2	21.87	10.09
	21.87	11.09
	20.87	11.09
	20.87	10.09
Niger 3	22.07	7.46
	22.07	8.46
	21.07	8.46
	21.07	7.46
Egypt 1	27.62	25.6
	27.62	26.6
	26.62	26.6
	26.62	25.6
Libya 1	24.92	12.85
	24.92	13.85
	23.92	13.85
	23.92	12.85
Libya 2	25.55	19.98
	25.55	20.98
	24.55	20.98
	24.55	19.98
Libya 3	23.65	22.6
	23.65	23.6
	22.65	23.6
	22.65	22.6
Libya 4	29.05	22.89
	29.05	23.89

ID	LAT (dec deg)	LONG (dec deg)
	28.05	23.89
	28.05	22.89
Mali 1	19.62	-5.35
	19.62	-4.35
	18.62	-4.35
	18.62	-5.35
Mauritania 1	19.9	-9.8
	19.9	-8.8
	18.9	-8.8
	18.9	-9.8
Mauritania 2	21.35	-9.28
	21.35	-8.28
	20.35	-8.28
	20.35	-9.28
Dunhuang	40.595	93.655
	40.595	94.655
	39.595	94.655
	39.595	93.655
Sonora	32.3	-114.36
	32.3	-113.36
	31.3	-113.36
	31.3	-114.36
Amburla	-22.785	132.619
	-22.785	133.619
	-23.785	133.619
	-23.785	132.619
Thangoo	-17.6	121.76
	-17.6	122.76
	-18.6	122.76
	-18.6	121.76
Hay	-33.88	144.79
	-33.88	145.79
	-34.88	145.79

ID	LAT (dec deg)	LONG (dec deg)
	-34.88	144.79
Dome C	-72.78	111.22
	-70.31	126.14
	-74.1	137.62
	-77.32	120.34
Greenland	76.75	-44
	76.75	-36
	70.75	-36
	70.75	-44
Barrows	72.6	-156.7
	72.6	-154.3
	69.4	-154.3
	69.4	-156.7
Syowa	-70.6	37.1
	-70.6	41.9
	-67.4	41.9
	-67.4	37.1
Ishigaki	26.1	122
	26.1	126
	22.9	126
	22.9	122
Moby	22.6	-158.6
	22.6	-155.4
	19.4	-155.4
	19.4	-158.6
Lybian Desert	22.5	28
	22.5	29
	21.5	29
	21.5	28
Algeria 1 small	23.8764	-0.483547
	23.8764	-0.316453
	23.7236	-0.316453
	23.7236	-0.483547

ID	LAT (dec deg)	LONG (dec deg)
Algeria 2 small	26.1664	-1.46512
	26.1664	-1.29488
	26.0136	-1.29488
	26.0136	-1.46512
Algeria 3 small	30.3964	7.57144
	30.3964	7.74855
	30.2436	7.74855
	30.2436	7.57144
Algeria 4 small	30.1164	5.5017
	30.1164	5.6783
	29.9636	5.6783
	29.9636	5.5017
Algeria 5 small	31.0964	2.1408
	31.0964	2.3192
	30.9436	2.3192
	30.9436	2.1408
Arabia 1 small	18.9564	46.6792
	18.9564	46.8408
	18.8036	46.8408
	18.8036	46.6792
Arabia 2 small	20.2064	50.8786
	20.2064	51.0414
	20.0536	51.0414
	20.0536	50.8786
Arabia 3 small	28.9964	43.6427
	28.9964	43.8173
	28.8436	43.8173
	28.8436	43.6427
Sudan 1 small	21.8164	28.1377
	21.8164	28.3023
	21.6636	28.3023
	21.6636	28.1377
Niger 1 small	19.7464	9.72882

ID	LAT (dec deg)	LONG (dec deg)
	19.7464	9.89118
	19.5936	9.89118
	19.5936	9.72882
Niger 2 small	21.4464	10.5079
	21.4464	10.6721
	21.2936	10.6721
	21.2936	10.5079
Niger 3 small	21.6464	7.8778
	21.6464	8.0422
	21.4936	8.0422
	21.4936	7.8778
Egypt 1 small	27.1964	26.0141
	27.1964	26.1859
	27.0436	26.1859
	27.0436	26.0141
Libya 1 small	24.4964	13.266
	24.4964	13.434
	24.3436	13.434
	24.3436	13.266
Libya 2 small	25.1264	20.3956
	25.1264	20.5644
	24.9736	20.5644
	24.9736	20.3956
Libya 3 small	23.2264	23.0169
	23.2264	23.1831
	23.0736	23.1831
	23.0736	23.0169
Libya 4 small	28.6264	23.303
	28.6264	23.477
	28.4736	23.477
	28.4736	23.303
Mali 1 small	19.1964	-4.93091
	19.1964	-4.76909

ID	LAT (dec deg)	LONG (dec deg)
	19.0436	-4.76909
	19.0436	-4.93091
Mauritania 1 small	19.4764	-9.38104
	19.4764	-9.21896
	19.3236	-9.21896
	19.3236	-9.38104
Mauritania 2 Small	20.9264	-8.8618
	20.9264	-8.6982

ID	LAT (dec deg)	LONG (dec deg)
	20.7736	-8.6982
	20.7736	-8.8618
Lybian Desert small	22.0764	28.4176
	22.0764	28.5824
	21.9236	28.5824
	21.9236	28.4176

4.4.2 TABLE: MERIS ACQUISITION SITES FOR VALIDATION ACTIVITIES

ID	LAT (dec deg)	LONG (dec deg)
AAOT	45.3	12.5
Aek Loba	2.617	99.567
Algoma	47.13	-83.14
Alpilles	43.783	4.25
Alta Foresta	-9.917	-56.107
Angiola	35.947	-119.538
Arm	36.5	-97.5
Atlantic mid lat	43	-30
Atlantic north	49	-6.1
Atlantic tropical	17	-45
Avignon	43.933	4.878
Baie de Seine	50	-1
Baie de Vilaine	47.25	-2.5
Balbina	-1.917	-59.487
Baltic sea	58.961	19.183
Belterra	-2.648	-54.952
Berlin area	53	13

ID	LAT (dec deg)	LONG (dec deg)
Blanes canyon	42	3
Bodensee	47.5	9.5
Bordeaux 1	44	-1
Bordeaux 2	44.788	-0.579
Bordeaux 3	44.788	-0.579
Boreas	53.98	-105.12
Boussole	43.367	7.9
Cabau	52.15	5
Canadian Prairies	52	-105
Canary islands	32	-16
Cape Verde	16.733	-22.935
Cart	36.61	-97.41
Central Europe 1	50.5	18
Central Europe 2	45.75	2
Chilbolton	51.5	-1

ID	LAT (dec deg)	LONG (dec deg)
Danish west coast	57.66	9.83
El Arenosillo	37.1	-6.72
Flensborg fjord	54.8	9.75
Funduela	44.45	36.517
Geesthacht	53.5	10.5
German bight	56	8
Gourma	15.333	-1.533
GSFC	39.03	-76.88
Helgoland	54.183	7.9
Humber	53.5	2
Humboldt Peru	-21.5	-74
Irish sea	52.5	-5.5
Ispra	44.803	8.627
Israel	32	35
Jarsvelia	58.25	27.467
Kattegat	56.17	11.5
Konstanz lake	47.5	9.5
L4	50.25	-4.208
La Jolla	32.5	-117.16
Laprida	-36.983	-60.533
Lille	50.912	2.142
Lindenberg	52.15	14
Mauritania Senegal	20	-20
Mediterranean	33.5	29.5
Moby	20.816	-157.192
Munich	48.08	11.3
Nederland	53.5	4.75
Nezer	44.567	-1.033
North sea 1	52	2.5
North sea 2	52	2.5
Norway	60	7

ID	LAT (dec deg)	LONG (dec deg)
Norwegian Skagerak coast	59.33	9
Norwegian west coast	60.08	5
Outer Oslofjord	59	10.67
Pirrene	43.384	1.291
Prince Georges	52.5	-123.5
Puechabon	43.717	3.65
Railroad Valley playa	38.542	-115.73
Ringkobing	56	7.66
Rio Plata	-35.5	-56.25
Rome Tor Vergata	41.84	12.647
Romilly	48.45	3.6
Sahara 1	24	9
Sahara 2	24	9
Severn estuary	51.5	-4
Skagerrak Hanstholm	57.5	7.66
Skukuza	-24.992	31.587
South Baltic 1	56.5	16
South Baltic 2	56.5	18.75
South Baltic 3	56	18
Stennis	30.368	-89.617
Surinam	5.8	-55.2
Thames	51.5	2
Toulouse	43.562	1.476
Trondheim fjord	63.75	10
Victoria lake	0.083	32.583
Turco	18.233	-68.2
Walker Branch	35.958	-84.287
Wallops	37.942	-75.475

ID	LAT (dec deg)	LONG (dec deg)
West Baltic 1	54.7	12.7
West Baltic 2	54.842	13.5
West Baltic 3	54.077	14.16

ID	LAT (dec deg)	LONG (dec deg)
West Canada ferry	48.8	-123.3
White Sands	32.93	-106.35