SCIAMACHY	Operation Change Request	OCR No: 021
		Issue: A

Title: Improvement of limb/nadir matching for subsolar orbits

Description of Request:
During orbits containing a subsolar measurement the matching between limb states (executed before the subsolar measurement) and nadir states (executed after the subsolar measurement) is not perfect. This results in regular data gaps during retrievals which combine limb and nadir data.
Therefore it is proposed to optimise the limb/nadir matching for these orbits by a modification of the related timelines.

Originator: S. Noël, A. Richter	Date of Issue: 16 Nov 2004	Signature: via e-mail S. Noël 16 Nov 2004

Assessment of SSAG (necessary for requests by scientists):
An overall good match between limb and nadir measurements is one of the driving requirements for SCIA operations. Its stems from the scientific requirement to separate tropospheric and stratospheric concentrations by measurements, which is a one of the unique features of SCIAMACHY. An investigation to improve the limb/nadir matching for subsolar orbits is therefore recommended. Before final implementation the expected improvement in tropospheric retrieval needs to be assessed.

SSAG: H. Bovensmann	Date: 29.11.2004	Signature: e-mail, 29.11.2004

Classification of OCR:

OCR Analysis (incl. Implementation Option):
The non-perfect limb/nadir matching in the second part of subsolar orbits is the result of the fact that such orbits are composed of 3 timelines. To establish the required strict time relation between the limb states in the timeline running prior to the subsolar event and the associated nadir states in the timeline after the subsolar event is not trivial.

Option 1 (discarded):
We propose to test an improved limb/nadir matching. The current timelines 49 and 52, which execute the subsolar state sscs01 and then a sequence of nadir and limb states without idle gaps are split into 2 timelines each (test set 09). Timelines 49 and 52 become timelines only executing the subsolar state sscs01. In the timeline header information the parameter *t/l_pad* exists, which is included in the timeline duration. This parameter was once introduced to separate consecutive timelines by a specified time period. The ENVISAT MPS does only process the timeline duration. Thus consecutive timelines are scheduled by MPS according to the selected *t/l_pad*. The t/l_pad of timelines 49 and 52 are set to 21.68 and 34.37 sec. The overall duration of timelines 49 and 52 is then equivalent to either a limb state or a nadir state, taking the timeline setup of the succeeding timeline and the cleanup of the preceeding timeline into account. Succeeding timelines get IDs 31 and 32. They are of type NF_FB, i.e. the first state starts when timelines 49 or 52 have run to completion. Additionally the timelines 48 and 51, preceeding subsolar timelines 49 and 52, must be defined as type NF_BF (currently NF_FL) to ensure that they end just when the subsolar timeline starts. This results in an idle gap at the end of the SO&C window of twice the current size (maximum size will occur in January and will amount to 100 sec).

Caused by the re-definition of timeline type the sequence of limb and nadir states have to be updated as well to ensure execution of the states with optimum PET settings.

If the test proves to be successful, a complete new timeline set 34 for nominal operations has to be generated and uploaded.

Provided that approval of the proposed option is received quickly, the test timelines can be included in the next planning cycle for execution in the second half of January 2005. In order to have a high probability to receive the measurement data in NRT for quick analysis, test timelines shall be executed for at least 5 days (1 orbit/day). The new timeline set 34 would then become operational end of February 2005/early March 2005 at the earliest.

Option 2:
Because of the conflict with OCLO measurents described below, a second implementation option is outlined here. It does not lead to a perfect limb/nadir matching as this always requires to fix the last state in the timeline preceeding the subsolar event w.r.t. to the subsolar state, but it improves the current situation.

Presently, pairs of timelines exist for limb/nadir sequence 1 (48/49) and 2 (51/52). In timeline 48 the state sequence ends with a nadir state and timeline 49 starts science measurements with a limb state. In timelines 51 and 52 this is reversed. Due to the

- seasonal variation of the time interval between end of SO&C window and subsolar event
- fact that timelines 48 and 51 are floating (NF_FL)
- durations of the timeline cleanup (48 & 51) and setup (49 & 52)
- duration of the subsolar state sscs01

the gap between two subsequent nadir or limb states right at the joint of timelines 48/49 and 51/52 amounts to 115-127 sec. For a perfect limb/nadir match this should either be 55.87 sec in the first case (the gap duration must be equivalent to a limb state) or 68.56 sec in the second case (nadir state).

When we group timelines 48/52 and 51/49, nadir and limb states around the subsolar event are arranged such that the gap between nadir and limb states is 59-71 sec. This is much closer to the required durations. To execute sequence 1 (48/52) will result in a maximum shift of the first nadir state in timeline 52 as compared to the ideal position of 15 sec early February. The first limb state in timeline 49 will be shifted by only up to 6 sec. Limb states of the subsolar preceeding timeline should thus already overlap with the first nadir state of the succeeding timeline. Results of a test schdule for mid January is attached (figures 1-4). These figures prove the the option 2 concept.

Neither testtimelines nor new timelines are required. In order to maintain the same level of limb/nadir matching in subsolar orbits when the moon is visible, it is required to run timeline 51 instead of 48 in all orbit_moon_daily_calibration_1 orbits (timeline starts with 3 limb states instead of 4 as in timeline 48). The approach described here can already be implemented in the next planning cycle starting January 15th.

SOST: : Gottwald, DLR-IMF (ESA, Industry if necessary)	Date: 25/11/2004 & 30/11/2004	Signature: via e-mail 25/11/2004 & 30/11/2004

Approval of Proposed Implementation:

The proposed implementation option 1 has the drawback that – due to our understanding - the idle time after the SO&C window will double in January, on cost of the first limb measurements after SO&C. The first 1-2 limb measurements after SO&C in January are very valuable ones, because OClO (indicator for the stratospheric chlorine activation and load) is only detectable in these measurements (SZA > 85°, see figure below). Assuming a slightly asymmetric polar vortex and the loss of 1-2 limb measurements at high latitudes with SZA>85° per day this will result in a significant loss of approx. 10-20% of all OclO measurements. It is therefore recommended to asses, if an implementation option exists, which assures that limb measurements will be executed in NH winter directly after SO&C.
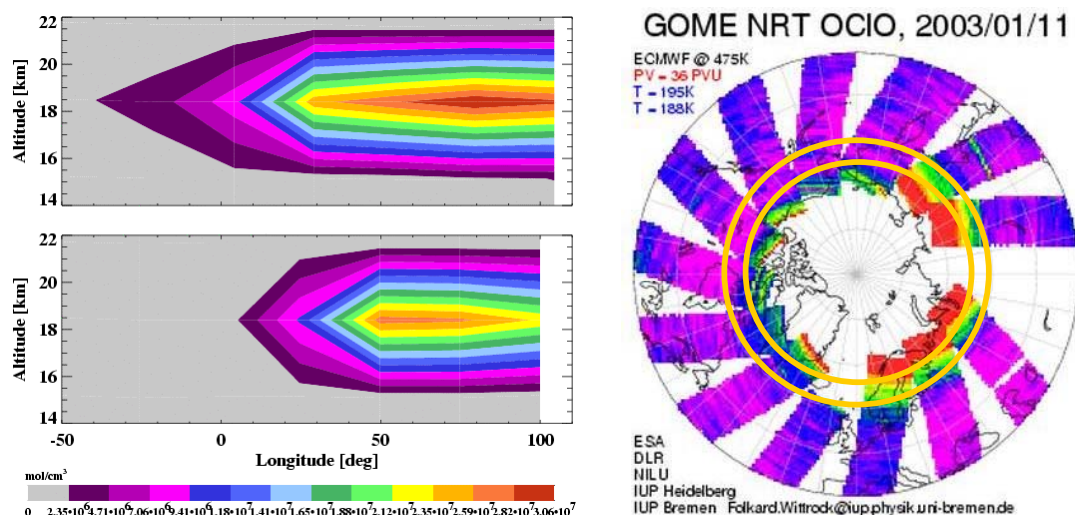
Longitudinal Cross Section of SCIAMACHY OClO-profiles on 11.1.2003. Upper Left: 65,5° N (inner circle right),SZA= 89,5°.Lower Left: 62,2° N (outer ring right), SZA= 86,4°.Right: OClO-Slant Column and location of OclO profile cross section.

As a result of a telecon between H. Bovensmann/S. Noël and M. Gottwald (30/11/2004) it has been decided that option 2 seems to improve the situation in subsolar orbits significantly. It is therefore recommended to implement this solution.

Originator Approval: S. Noël,	Date: 30/11/2004	Signature: via e-mail 30/11/2004
SSAG Approval: H. Bovensmann	Date: 30/11/2004	Signature: via e-mail 30/11/2004

Decision / Approval:
The proposed option 2 shall be implemented.

DLR Approval: Ch. Chlebek	Date: 2004-12-01	Signature: e-mail, 2004-12-01

Implementation by SOST :
With the next planning cycle, subsolar orbits will be executed with the timeline sequences 48/52 and 51/49. This cycle will start in orbit 15044 (January 15th).

SOST: M. Gottwald, DLR-IMF	Date: 01/12/2004	Signature: via e-mail 01/12/2004

SCIAMACHY Swath Geolocation Display for Nadir/Limb in Orbit 15039—15039 within LAT Limit (−90.00,90.00)

ANX_TIME   = 14−JAN−2005 16:51:56.537   ANX_LONGITUDE   = 077.019730<deg> (ROE) 077.019730<deg> (ESOV)

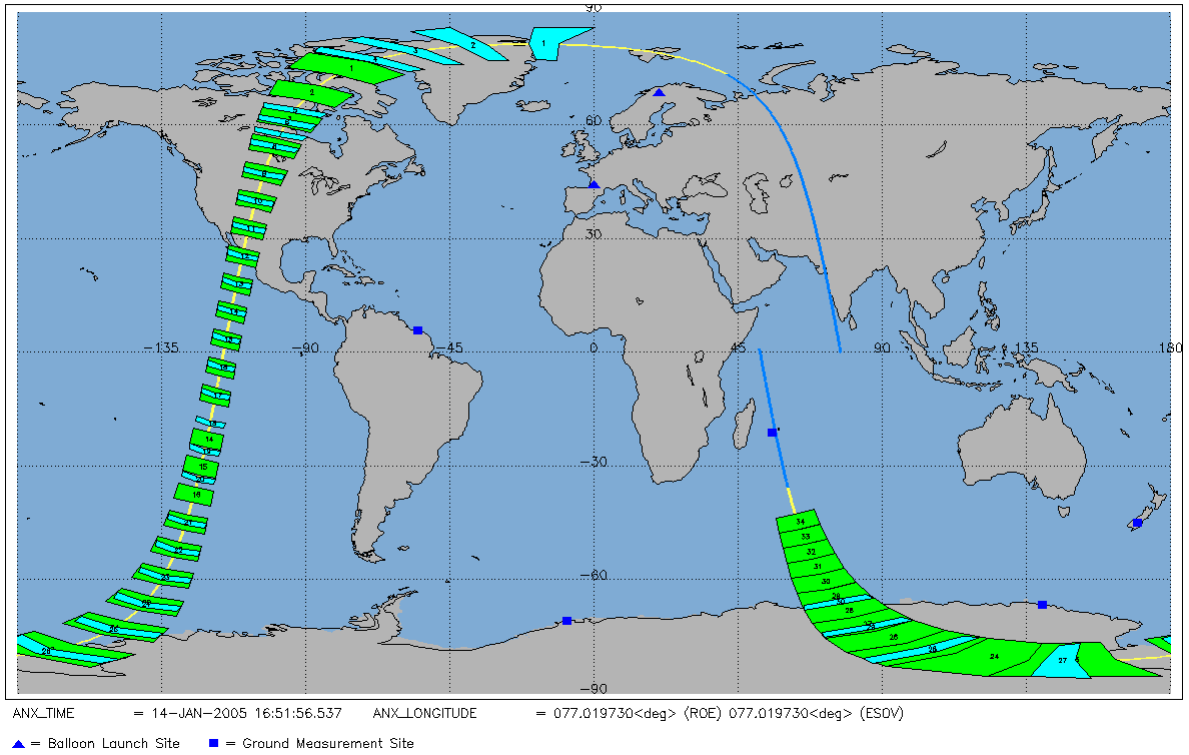▲ = Balloon Launch Site   ■ = Ground Measurement Site

Fig. 1: Limb/nadir matching in a subsolar orbit with timeline sequence 48/49 (current status)

SCIAMACHY Swath Geolocation Display for Nadir/Limb in Orbit 14982—14982 within LAT Limit (−90.00,90.00)

ANX_TIME   = 10−JAN−2005 17:17:48.633   ANX_LONGITUDE   = 070.552666<deg> (ROE) 070.552666<deg> (ESOV)

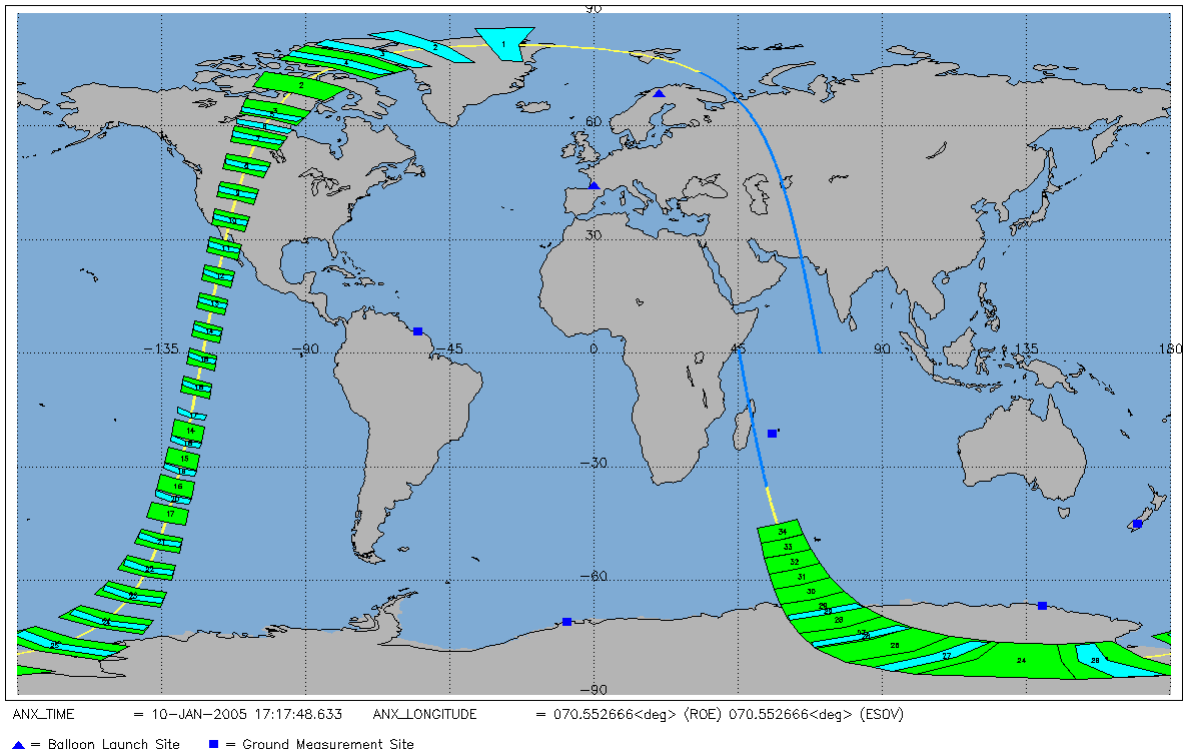▲ = Balloon Launch Site   ■ = Ground Measurement Site

Fig. 2: Limb/nadir matching in a subsolar orbit with timeline sequence 51/52 (current status)

SCIAMACHY Swath Geolocation Display for Nadir/Limb in Orbit 15054-15054 within LAT Limit (-90.00,90.00)

ANX_TIME   = 15-JAN-2005 18:00:55.459   ANX_LONGITUDE   = 059.774220<deg> (ROE) 059.774220<deg> (ESOV)

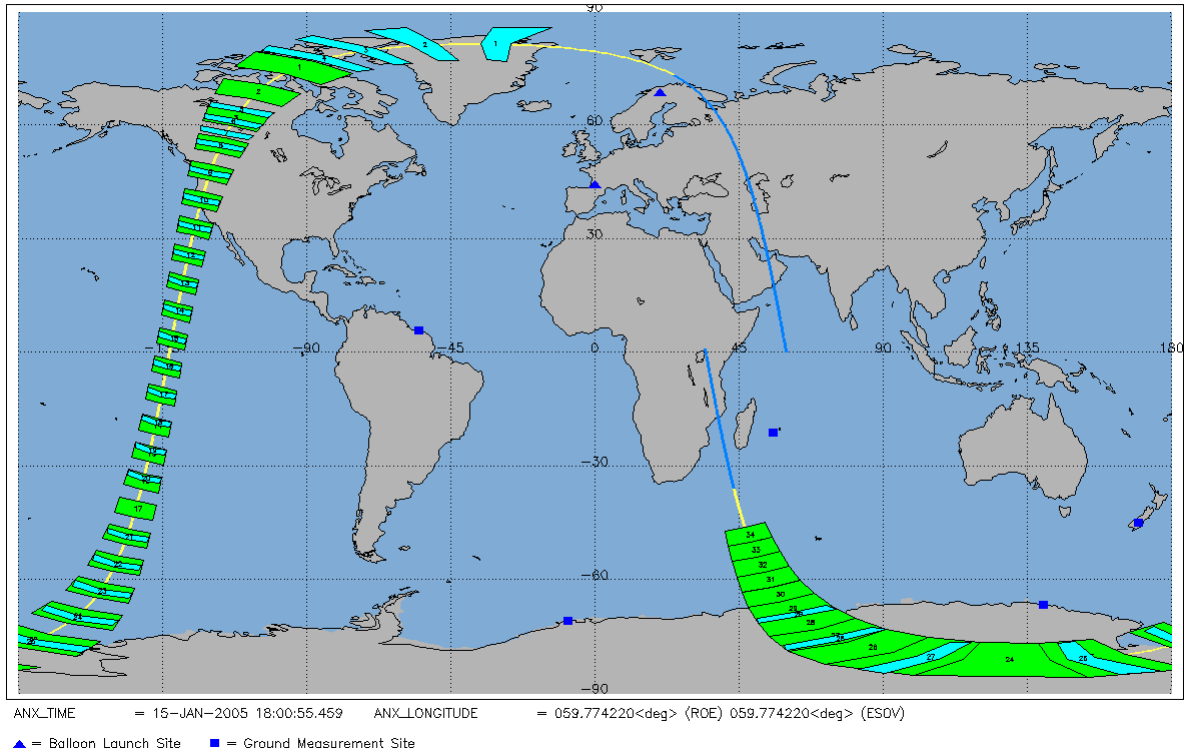▲ = Balloon Launch Site   ■ = Ground Measurement Site

Fig. 3: Limb/nadir matching in a subsolar orbit with timeline sequence 48/52 (proposed option 2)

SCIAMACHY Swath Geolocation Display for Nadir/Limb in Orbit 15097-15097 within LAT Limit (-90.00,90.00)

ANX_TIME   = 18-JAN-2005 18:06:40.370   ANX_LONGITUDE   = 058.337093<deg> (ROE) 058.337093<deg> (ESOV)

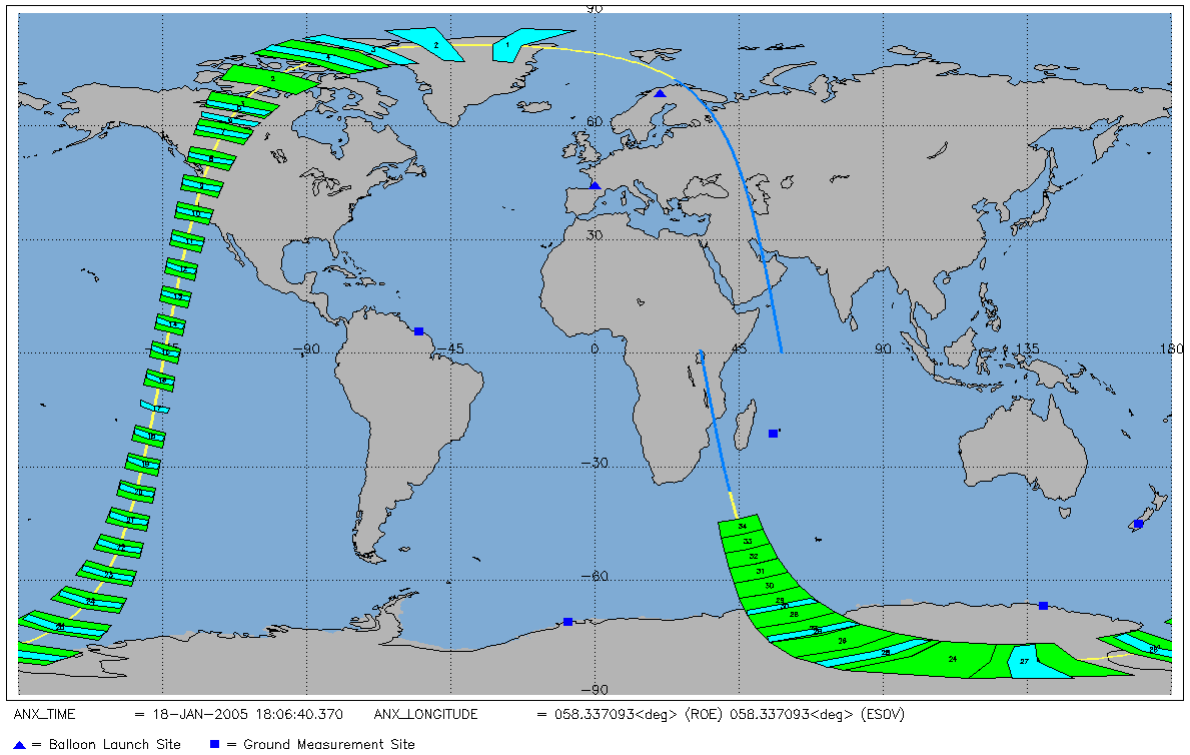▲ = Balloon Launch Site   ■ = Ground Measurement Site

Fig. 4: Limb/nadir matching in a subsolar orbit with timeline sequence 51/49 (proposed option 2)