SCIAMACHY	Operation Change Request	OCR No: 017 Issue: A

Title: Increase signal for high northern & southern latitudes

Description of Request:
The implementation of OCR 12 (improved limb/nadir matching in early orbit phase) included the use of State N5 instead of states N1-N4. As a consequence, exposure times at higher latitudes are significantly shorter, resulting in higher spatial resolution (which is appreciated) but also in a reduced signal-to-noise ratio (SNR). In the wavelength region around 450 nm (NO_2 fitting window, exposure time 0.125 s) the signal at high solar zenith angles is about 50-200 BU which is close to the detector readout noise of about 5 BU. Further investigations revealed, contrary to earlier estimates, that the reduced SNR results in a reduced quality of the retrieved NO_2 columns for solar zenith angles larger than about 90° which can not be compensated by on-ground coadding. Therefore it is requested to change to pixel exposure times in the NO_2 fitting window to about 1 s for solar zenith angles larger than 90° to increase the SNR. The integration times below 90° solar zenith angle shall not be changed.

A possible implementation option would be to change the timelines such that for solar zenith angles larger than 90° a different state (with appropriate exposure time settings) is used.
Note: This state should have the same duration as N5 to keep the improved limb/nadir matching.

Originator: A. Richter/S. Noël IFE/IUP	Date of Issue: 28 May 2004	Signature: e-mail, S. Noël 28 May 2004

Assessment of SSAG (necessary for requests by scientists):

SSAG:	Date: 2004-02-11	Signature: 29.SSAG, MoM

Classification of OCR: D

<u>OCR Analysis (incl. Implementation Option):</u>

This OCR requires modification of CTI parameter tables, i.e. the Pixel Exposure Time table and timelines. Since all timelines starting after the SO&C window and ending before the eclipse phase are affected, it is required to generate a new timeline set for routine measurements. There exist two options to implement the OCR.

<u>Option 1:</u>

Use states nad01-nad04. Assign orbital phase ranges as listed in attached table. Below 0 deg and above 180 deg (approx. equivalent to solar zenith angles > 90 deg) the states nad01 and nad02 apply. Above 0 deg / below 26 deg and above 154 deg / below 180 deg states nad03 and nad04 are used. The PET table N3 (nad03) & N4 (nad04) are identical to the current table N5 (nad05) while tables N1 & N2 are identical to N5 except in channel 3 where a PET of 1 sec is used. Nadir states for small swath width and nadir_pointing scenarios are used correspondingly.

<u>Option 2:</u>

Use state nad01. Assign orbital phase < 0 deg and > 180 deg (approx. equivalent to solar zenith angles > 90 deg) to nad01. The PET table N1 is identical to N5 except in channel 3 where a PET of 1 sec is used. Nadir states for small swath width and nadir_pointing scenarios are used correspondingly.

In both options the state duration of nad01-nad04 is maintained at a value to leave the limb/nadir matching unchanged, i.e. the State Duration table for nad01-nad03 needs update as well.

Option 1 provides maximum flexibility in case future OCRs require to modify additional settings in orbital phases < 26 deg or > 154 deg. Such modifications would then be possible by only changing CTI parameter tabels and no timelines as long as the orbit phases remain largely untouched. This would decouple OCR implementation from mission planning cycles.

Option 2 has the advantage to leave a few nadir state IDs unused which could be used for other purposes. The associated disadvantage is that it might be required to always generate complete timeline sets for routine operations. This is much more timeconsuming than pure CTI parameter changes. There could also exist limitations from a configuration control point of view.

It is proposed to prepare 6 test timelines with the selected option and run these for 2 days at the beginning of the next planning cycle, i.e. end of July. The test timelines are timelines 47-52. In case careful data analysis proves that the settings are ok, the complete new timeline set will be generated, submitted to ESOC and uploaded at the earliest possible date. This could be around August 22nd.

Note that SOST-IFE had to check whether the modification of the PET in channel 3 to 1 sec and of the State Duration for nad01-nad03 is sufficient (all other settings, e.g. co-adding would remain unchanged with above implementation). After the analysis of SOST-IFE the following modifications are required for the new state N1:

All settings of N1 should be identical to N5 except (note that the state duration has to be the same as for N5):

a) set channel 3 PET to 1 s.
b) set all coadding factors for channel 3 (i.e. clusters 12-20) to 1

For Option 1 the settings of N1 and N2 are identical, and the settings of N3 and N4 are identical to those of state N5. The resulting new PET and Coadd settings for Option 1 are listed in the Annex. The settings are compliant with the data rate limitations.

For Option 2 only the N1 settings need to be changed.

SOST: M. Gottwald, DLR-IMF (ESA, Industry if necessary)	Date: 01/06/2004	Signature: via e-mail 01/06/2004

<u>Approval of Proposed Implementation:</u>

Option 1 should be implemented because it provides a larger flexibility. Note that similar problems with S/N can be expected for other wavelength regions / data products. Therefore it may be required to further adapt the state settings at a later time, but this will be covered (if necessary) by a new OCR.

Originator Approval: S. Noël	Date: 15. June 2004	Signature: email 15 June 2004

SSAG Approval: H. Bovensmann	Date: 15. June 2004	Signature: given during PCR Meeting at DLR Bonn

Decision / Approval:

The proposed test timelines shall be performed. Originator /SSAG shall review the measurement data from these test measurements. The approval for the final implementation will be given only after having received a positive statement by the SSAG based on the results of the test measurements.

Status after test measurements: Stefan Noël stated that IFE analysis of the test measurements for OCR 17 performed on 23/24 July 2004 shows an improvement of the channel 3 NO_2 results (SNR) - see e-mail, S.Noël, 2004-07-27. Therefore the final implementation of the new timelines/states shall be done as described.

DLR Approval: Ch. Chlebek	Date: 2004-06-17 & 2004-07-28	Signature: Ch. Chlebek

Implementation by SOST:

Option 1 implementation for the test case includes generation of

- 3 Scanner State CTI tables (states nad01-nad03)
- 4 PET CTI tables (states nad01-nad04 for PET N1-N4)
- 3 State Duration CTI tables (nad01-nad03)
- 4 Co-adding CTI tables (21-24)
- 6 timelines (test set 09, t/l ID 47-52, sub-ID 03)

Note that only those nadir tables are modified which are used in the test timelines. The states with nadir small swath width and nadir pointing are not modified for the test run.

The test timelines are planned for execution in orbits 11525-11552 (23/24 July). After the test, the state parameters and timelines are reset to the nominal settings.

The final implementation of option 1 – provided that the test is successful - includes generation of

- 9 Scanner State CTI tables (states nad01-nad03, nad09-nad11, nad23-nad25)
- 12 PET CTI tables (states nad01-nad04, nad09-nad12, nad23-nad26 for PET N1-N4)
- 9 State Duration CTI tables (nad01-nad03, nad09-nad11, nad23-nad25)
- 4 Co-adding CTI tables (21-24)
- a complete new timeline set 33 for nominal operations (alternating limb/nadir, wide swath – final flight set FFT_0408025)

Since the parameter modifications are permanent (final flight set FFS_040825), they must be reflected in the ERCORMS file. The associated SCIAMACHY Operation Change Request will be generated and submitted to ESOC accordingly. Please note that the eclipse timeline 44 executing state nad09 is also affected by OCR_017 since the maximum PET of 10 sec is reduced to 1 sec and state duration is reduced from 80 sec to 65 sec, i.e. co-adding has to be done on-ground.

Final implementation of option 1 is forseen on August 25th. Note that this date has been finally shifted to September 6th (orbit 13172) for logistics reasons, i.e. the final flight state and timeline configurations will become FFS_040906 and FFT_040906 (instead (FFS_040825 and FFT_040825 as proposed above).

SOST: M. Gottwald, DLR-IMF	Date: 18/06/2004 & 28/07/2004	Signature: via e-mail 18/06/2004 & 28/07/2004

Appendix 1:
Orbital positions for nadir states used in timelines as proposed in OCR_017 implementation

Option 1:

Orbital Position (deg)	Nadir (960 km)	Nadir (120 km)	Nadir (pointing)
<-3	nad01	nad09	nad23
-3 to 0	nad02	nad10	nad24
0 to 16	nad03	nad11	nad25
16 to 26	nad04	nad12	nad26
26 to 36	nad05	nad13	nad27
36 to 70	nad06	nad14	nad28
70 to 110	nad07	nad15	nad29
110 to 144	nad06	nad14	nad28
144 to 154	nad05	nad13	nad27
154 to 164	nad04	nad12	nad26
164 to 180	nad03	nad11	nad25
180 to 183	nad02	nad10	nad24
>183	nad01	nad09	nad23

Option 2:

Orbital Position (deg)	Nadir (960 km)	Nadir (120 km)	Nadir (pointing)
<0	nad01	nad09	nad23
0 to 36	nad05	nad13	nad27
36 to 70	nad06	nad14	nad28
70 to 110	nad07	nad15	nad29
110 to 144	nad06	nad14	nad28
144 to 180	nad05	nad13	nad27
>180	nad01	nad09	nad23

Appendix 2:
New PET and coadd settings for Option 1

PET settings for Option 1 (changes are marked yellow)

Table	Channel 1a	Channel 1b	Channel 2a	Channel 2b	Channel 3	Channel 4	Channel 5	Channel 6	Channel 7	Channel 8
N1	1	0,5	0,5	0,5	1	0,125	0,25	0,125	1	1
N2	1	0,5	0,5	0,5	1	0,125	0,25	0,125	1	1
N3	1	0,5	0,5	0,5	0,125	0,125	0,25	0,125	1	1
N4	1	0,5	0,5	0,5	0,125	0,125	0,25	0,125	1	1

Coadding tables for Option 1 (changes are marked yellow)

CO_ADDING 21 (N1)

Cluster Index	1	2	3	4	5	6	7	8
Co_Adding Factor	1	1	1	1	1	2	2	2
Cluster Index	9	10	11	12	13	14	15	16
Co_Adding Factor	1	1	2	1	1	1	1	1
Cluster Index	17	18	19	20	21	22	23	24
Co_Adding Factor	1	1	1	1	8	8	8	1
Cluster Index	25	26	27	28	29	30	31	32
Co_Adding Factor	8	1	8	8	4	4	4	1
Cluster Index	33	34	35	36	37	38	39	40
Co_Adding Factor	4	1	4	8	2	8	1	8
Cluster Index	41	42	43	44	45	46	47	48
Co_Adding Factor	1	8	1	8	1	8	8	1
Cluster Index	49	50	51	52	53	54	55	56
Co_Adding Factor	1	1	1	1	1	1	1	1
Cluster Index	57	58	59	60	61	62	63	64
Co_Adding Factor	0	0	0	0	0	0	0	0

CO_ADDING 22 (N2)

Cluster Index	1	2	3	4	5	6	7	8
Co_Adding Factor	1	1	1	1	1	2	2	2
Cluster Index	9	10	11	12	13	14	15	16
Co_Adding Factor	1	1	2	1	1	1	1	1
Cluster Index	17	18	19	20	21	22	23	24
Co_Adding Factor	1	1	1	1	8	8	8	1
Cluster Index	25	26	27	28	29	30	31	32
Co_Adding Factor	8	1	8	8	4	4	4	1
Cluster Index	33	34	35	36	37	38	39	40
Co_Adding Factor	4	1	4	8	2	8	1	8
Cluster Index	41	42	43	44	45	46	47	48
Co_Adding Factor	1	8	1	8	1	8	8	1
Cluster Index	49	50	51	52	53	54	55	56
Co_Adding Factor	1	1	1	1	1	1	1	1
Cluster Index	57	58	59	60	61	62	63	64
Co_Adding Factor	0	0	0	0	0	0	0	0

Coadding tables for Option 1 (changes are marked yellow), contd.

CO_ADDING 23 (N3)

Cluster Index	1	2	3	4	5	6	7	8
Co_Adding Factor	1	1	1	1	1	2	2	2
Cluster Index	9	10	11	12	13	14	15	16
Co_Adding Factor	1	1	2	8	8	1	1	8
Cluster Index	17	18	19	20	21	22	23	24
Co_Adding Factor	1	8	8	8	8	8	8	1
Cluster Index	25	26	27	28	29	30	31	32
Co_Adding Factor	8	1	8	8	4	4	4	1
Cluster Index	33	34	35	36	37	38	39	40
Co_Adding Factor	4	1	4	8	2	8	1	8
Cluster Index	41	42	43	44	45	46	47	48
Co_Adding Factor	1	8	1	8	1	8	8	1
Cluster Index	49	50	51	52	53	54	55	56
Co_Adding Factor	1	1	1	1	1	1	1	1
Cluster Index	57	58	59	60	61	62	63	64
Co_Adding Factor	0	0	0	0	0	0	0	0

CO_ADDING 24 (N4)

Cluster Index	1	2	3	4	5	6	7	8
Co_Adding Factor	1	1	1	1	1	2	2	2
Cluster Index	9	10	11	12	13	14	15	16
Co_Adding Factor	1	1	2	8	8	1	1	8
Cluster Index	17	18	19	20	21	22	23	24
Co_Adding Factor	1	8	8	8	8	8	8	1
Cluster Index	25	26	27	28	29	30	31	32
Co_Adding Factor	8	1	8	8	4	4	4	1
Cluster Index	33	34	35	36	37	38	39	40
Co_Adding Factor	4	1	4	8	2	8	1	8
Cluster Index	41	42	43	44	45	46	47	48
Co_Adding Factor	1	8	1	8	1	8	8	1
Cluster Index	49	50	51	52	53	54	55	56
Co_Adding Factor	1	1	1	1	1	1	1	1
Cluster Index	57	58	59	60	61	62	63	64
Co_Adding Factor	0	0	0	0	0	0	0	0