TASTE - TECHNICAL ASSISTANCE TO ENVISAT VALIDATION BY SOUNDINGS, SPECTROMETERS AND RADIOMETERS

ANNUAL REPORT #3
MARCH 2006 – MAY 2007

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CONTENTS

A. INTRODUCTION

The TASTE project provides ESA with Technical ASsistance To Envisat atmospheric chemistry validation throughout the satellite lifetime. The project involves an international consortium gathering complementary expertise in remote sensing and satellite validation, namely, BIRA-IASB (Uccle, Belgium), CNRS/SA (Verrières-le-Buisson/Paris, France), FMI-ARC (Sodankylä, Finland), IFE/IUP (Bremen, Germany), IFU/FZK (Garmisch-Partenkirchen, Germany), IMK/FZK (Karlsruhe, Germany), INTA (Torrejón de Ardoz, Spain), KMI-IRM (Uccle, Belgium), KNMI (De Bilt, Netherlands), NIWA (Lauder, New Zealand), and SPbSU (Saint Petersburg, Russia), and their collaborators. Main tasks relate to the collection and delivery of correlative data to the Envisat Cal/Val database operated at NILU on behalf of ESA, the monitoring of those data sets, geophysical validation studies based on comparisons between Envisat (GOMOS, MIPAS and SCIAMACHY) and ground-based data sets, and the valorisation of the validation results.

The present document reports on activities carried out in the third term of TASTE (CCN-1 to contract No. 3-10885/03/NL/MM), from March 2006 to May 2007. Section B reviews the provision of correlative data records. Section C gives an overview of the validation work performed during the reporting period and to which members of the consortium have contributed. It includes contributions to ACVE-3 and to the Envisat Quality Working Groups (QWGs). Section D reports on the valorisation of the validation results. Section E and F conclude with perspectives for next term and with a list of publications associated with the project.

B. CORRELATIVE DATABASE

B.1. Overview of activities

The following correlative measurements have been collected for Envisat validation purposes:

- O_3 columns by Dobson and Brewer UV spectrophotometers and by M-124 UV filter radiometer;
- O_3 profiles from balloon-borne electrochemical ozonesonde and from millimetre wave radiometer;
- O_3, NO_2, BrO and OClO columns by UV-VIS Differential Optical Absorption spectrometer;
- O_3, NO_2, CO, CH_4, HNO_3, and N_2O data from (Fourier Transform) infrared (FT)IR spectrometer.

Correlative measurements have been collected at the geographical locations identified in Figure **1.** They cover a variety of major geophysical features in the polar and middle latitudes of both hemispheres and in the tropics. In general, there is at least one representative of every instrument technique by latitude region. The list includes the five primary stations (Arctic, Alpine, Hawaii, New Zealand and Antarctic) of the international Network for the Detection of Atmospheric Composition Change (NDACC, formerly the NDSC, see http://www.ndacc.org) plus a list of complementary stations. The ozonometric network operated by Russia and the New Independent States (NIS) enhances considerably the geographical sampling of Eurasia.

Collected data sets have been converted into the agreed HDF 4.1.3 format and uploaded to the Envisat Cal/Val database. Upload Status Tables presented in Subsections B.3 to B.8 display, month by month, an estimate of the number of measurement days uploaded to the Cal/Val centre. Except a few stations, the upload of 2006 data is near completion. The upload of 2007 data is progressing. Nearly all instruments have worked nominally and for a majority of them correlative data acquired directly by members of the consortium have been uploaded within a few months after data acquisition. The larger delay or some minor data gaps experienced at some stations or with some instruments can be justified in most cases by field realities. Uploads of data acquired partly by third parties, sometimes on a best effort basis (e.g. ozone columns measured at a few stations of the M-124 network and the SAOZ network), are sometimes experiencing larger delays, but it must be pointed out that most of those delayed data sets have still already been available to Envisat validation through other means. In any cases uploads of delayed data sets are progressing. Data have also been uploaded from optional stations.

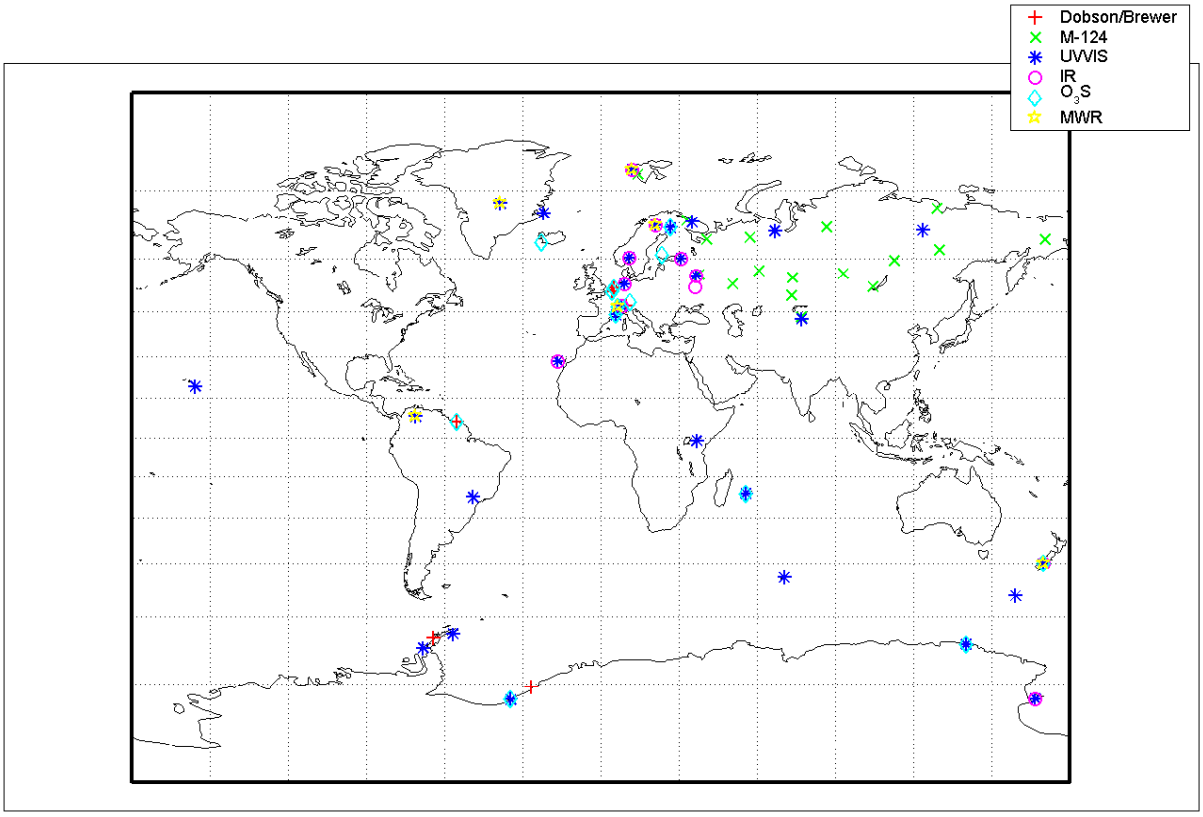

Figure 1. *Ground-based instrumentation contributing to TASTE: Dobson and Brewer UV spectrophotometers, M-124 UV filter radiometers, UV-visible DOAS spectrometers (UVVIS), IR and FTIR spectrometers (IR), balloon-borne ozonesondes (O_3S), and millimetre wave radiometers (MWR).*

It is timely to recall that, although the TASTE project requires formally only data from January 2004 onwards, the consortium has contributed data of 2002 and 2003 as well to bridge the gap between the preliminary Commissioning Phase validation and the "routine" validation phase addressed by the project. Uploads of 2002 and 2003 "historical" data sets are complete and reported in Subsections B.3/B.4.

To get a consistent overview despite the wide variety of ground-based techniques, numbers reported in the Upload Status Tables of Subsections B.3 to B.8 represent the amount of days for which there is at least one measurement suitable for Envisat validation. It should be noted that the actual amount of individual measurements acquired by an instrument and stored on Cal/Val vary with:

- The type of ground-based instrument: e.g. direct sun observations (Brewer, Dobson, FTIR and M-124) depend on weather conditions while scattered-light UVVIS observations are feasible virtually in all weather;
- The latitude: e.g., most of standard techniques do not provide measurements during polar night;
- The data type and file format adopted by the Data Submitter: some stations store data in monthly files, others in daily files, and others by individual measurement; some Brewer or microwave data files report one measurement every 30 min (reaching sometimes several thousands a month) while others provide only daily averages (thus a maximum of 31 values a month);
- The type of data processing: SAOZ/UVVIS data at remote stations processed in real-time by the built-in software and transmitted to CNRS via the ARGOS satellite system, include only one average value for each twilight, while reprocessing at the central laboratory of all the recorded spectra yields one value for every individual measurement.

B.2. Climatological verification (reminder)

A large part of the contributing instruments are part of the NDACC, a major contributor to WMO's Global Atmosphere Watch programme (GAW). The NDACC Data Protocol is structured to ensure excellent data quality while providing ready data access. It recognises that, in order to produce a verifiable data product, sufficient time is needed to collect, reduce, calibrate, test, analyse, and inter-compare the streams of preliminary analyses at every NDACC site. Among others, seasonal analyses may be required for observations from both individual and multiple sites and it is expected that such a procedure shall yield the verifiable product referred to as "NDACC data" within a two-year period after acquisition. The faster data availability aimed at by the project implies that limited time only is available to recalibration, state-of-the-art processing or simply quality verification. Therefore we have developed and implemented verification procedures to check first-order quality/consistency of the fresh near-real-time (NRT) data collected in the frame of the project.

The quite large number of contributing instruments and stations implies the use of automated routines flagging non-standard events, which can be looked at more carefully once detected. At ground stations where long enough time-series are available in the NDACC and WOUDC databases, the verification procedure consists in comparing fresh data to climatological means and standard deviations that we calculate on low-pass filtered time-series acquired, if possible, since 1995. A log file is created, which identifies in a first time aberrant data, e.g. impossible Dobson data during polar night or sunrise NO_2 columns exceeding systematically sunset NO_2 columns. Then, column values deviating from the climatological mean by more than 2σ and 3σ are pointed out. Trains of consecutive values falling out of the $\pm 3\sigma$ interval are looked at carefully to determine whether such persistent deviations may be due to data quality issues, to natural atmospheric variability, or to unexpected atmospheric features like the 2002 Antarctic vortex split. Single values falling out of the $\pm 3\sigma$ interval without belonging to a justifiable 2σ train are flagged accordingly but not rejected systematically since they could be associated e.g. to real events of extreme variability or to tropospheric pollution episodes enhanced by multiple scattering within clouds. For newer stations with shorter time-series, consistency checks are based on data already stored at NILU Cal/Val, acquired by other instruments at nearly collocated stations, or even by the same instrument. The climatological verification method is further illustrated in the *TASTE Progress Report January-October 2004* issued in November 2004.

B.3. Monthly data distribution for 2002

Brewer	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Sodankylä	67°N		0	0	0	1	0	0	24	30	24	3		82
Jokioinen	61°N	0	0	0	0	0	0	0	18	28	29	15	1	91
De Bilt	52°N	0	0	0	0	1	30	31	31	30	31	30	31	215
Uccle	51°N	31	28	31	13	0	1	29	31	27	31	28	31	281
Arosa	46°N	27	24	24	26	25	27	24	25	22	25	18	20	287
Paramaribo	6°N	2	2	0	0	0	28	31	31	30	22	25	31	202

Dobson	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Uccle	51°N	19	18	17	9	0	0	0	0	0	0	0	0	63
Arosa	46°N	29	21	26	23	22	26	27	26	19	28	14	21	282
Lauder	45°S	22	18	19	19	25	16	24	22	21	28	20	15	249
Vernadsky	65°S	31	28	31	30	Polar night			31	30	31	30	31	273
Halley	76°S	31	28	31	15				6	30	31	30	31	233

UV-Vis	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Ny-Ålesund	79°N	Polar night		0	0	0	0	30	31	29	24	Polar night		114
Scoresbysund	70°N	14	24	27	22	26	26	18	24	30	29	4		244
Kiruna	68°N	23	28	31	30	31	1	21	31	24	21	28	2	271
Sodankylä	67°N	30	28	30	30	31	30	31	31	30	31	30	31	363
Zhigansk	67°N	30	28	31	30	29	27	28	31	19	31	28	24	336
Harestua	60°N	0	0	0	0	0	26	22	23	30	25	29	29	184
St Petersburg	60°N	0	0	0	0	0	0	30	30	25	28	0	0	113
Zvenigorod (optional)	*55°N*	0	0	0	0	0	0	20	31	30	0	0	0	81
Bremen	53°N	0	0	0	0	0	0	28	31	30	31	30	0	150
Jungfraujoch	47°N	0	0	0	0	31	30	31	31	30	31	30	31	245
O.H.P.	44°N	31	24	29	30	31	30	31	31	21	23	28	31	340
Issyk-Kul (optional)	*43°N*	0	0	0	0	0	0	31	29	22	31	30	29	172
Izaña	28°N	0	0	0	0	0	0	31	28	28	31	20	12	150
Mauna Loa	19°N	31	28	30	30	31	30	31	23	30	31	30	31	356
Nairobi	1°S	-	-	-	-	-	-	-	-	30	31	30	31	122
Saint Denis	21°S	25	21	28	20	0	0	0	0	0	0	13	31	138
Bauru	22°S	29	21	27	27	31	30	22	26	27	31	24	31	326
Lauder	45°S	31	28	31	30	31	30	31	28	29	31	29	31	360
Kerguelen	49°S	20	28	31	30	31	30	31	31	30	31	29	31	353
Macquarie	55°S	31	28	31	30	1	30	31	31	29	31	30	31	334
Marambio	64°S	31	28	29	29	18	0	8	30	28	28	27	31	287
Dumont d'Urville	67°S	31	28	31	30	31	30	31	31	30	31	30	31	365
Rothera	68°S	29	26	29	27	27	20	29	28	29	28	29	29	330
Belgrano	78°S		10	23	19	Polar night			11	28	29	Polar day		120
Arrival Heights	78°S		12	31	22				11	30	25			131

(FT)IR	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Ny-Ålesund	79°N	*Polar night*		0	6	8	10	5	7	8	0	*Polar night*		44
Kiruna	68°N							15	13	4	9	5		46
St Petersburg	60°N							7	13	11	0	0	0	31
Obninsk (optional)	*55°N*							6	14	6	2	3	3	34
Zvenigorod (optional)	*55°N*							8	6	9	2	0	6	31
Bremen	53°N							0	1	8	2	3	4	18
Zugspitze	47°N							1	1	0	1	0	0	3
Izaña	28°N							8	15	13	9	8	4	57
Lauder	45°S	13	17	21	12	13	11	16	10	15	12	13	11	164
Arrival Heights	78°S	8	5	3	0	*Polar night*				9	10	6	8	49

M124	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Barentsburg	78°N							30	0	0	0			30
Tiksi	72°N							30	0	0	0			30
Murmansk	69°N							29	29	0	0	0		58
Igarka	67°N							0	21	0	0	0		21
Markovo	65°N							31	27	29	15	0	0	102
Petchora	65°N							31	30	30	25	0	0	116
Arhangelsk	65°N							29	25	23	21	0	0	98
Yakutsk	62°N							30	17	30	14	0	0	91
St Petersburg	60°N							30	30	25	28	0	0	113
Vitim	59°N							30	30	26	17	0	0	103
Krasnoyarsk	56°N							29	29	28	23	0	0	109
Moscow	56°N							31	31	26	0	0	0	88
Omsk	55°N							31	31	29	29	0	0	120
Samara	53°N							31	30	29	26	0	0	116
Irkutsk	52°N							30	31	28	26	0	0	115
Karaganda	50°N							30	31	30	21	0	0	112

Ozonesonde	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Sodankylä	67°N			1	1	1	0	0	6	5	5	10	13	42
Keflavik	64°N							0	0	0	0	0	8	8
Jokioinen	61°N							0	0	3	5	0	3	11
De Bilt	52°N					3	4	4	6	7	6	4	3	37
Uccle	51°N							9	9	13	15	11	11	69
Hohenpeißenberg	48°N	13	11	13	11	9	8	10	8	8	8	12	11	122
Payerne	46°N					0	0	14	14	11	13	11	10	73
Paramaribo	6°N					0	4	5	4	4	5	3	3	28
Lauder	45°S					3	4	5	4	4	10	11	5	46
Marambio	64°S							1	6	6	8	8	7	36
Dumont d'Urville	67°S							4	4	6	6	3	2	25
Belgrano	78°S			1	1	1	3	3	3	4	5	2	2	25

MicroWave	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Kiruna	68°N	-	-	-	-	-	-	-	-	-	-	3	30	33
Payerne	46°N							26	27	29	30	23	30	165
Lauder	45°S							31	27	22	16	21	24	141

B.4. Monthly data distribution for 2003

Brewer	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Sodankylä	67°N		17	31	30	31	30	28	31	29	25	5		257
Jokioinen	61°N	6	25	28	29	29	25	31	28	30	30	16	3	280
De Bilt	52°N	31	28	31	30	31	30	31	31	30	31	29	31	364
Uccle	51°N	16	28	30	7	31	30	30	31	30	30	30	30	323
Arosa	46°N	21	23	27	25	28	28	27	28	27	22	24	23	303
Paramaribo	6°N	31	28	29	28	31	30	31	31	28	31	30	31	359

Dobson	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Arosa	46°N	22	22	28	26	31	30	27	29	23	22	21	22	303
Lauder	45°S	12	12	19	13	16	18	21	16	18	15	17	16	193
Vernadsky	65°S	31	28	31	30	*Polar night*			31	30	31	30	31	273
Halley	76°S	31	27	31	16				7	30	31	30	31	234

UV-Vis	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Ny-Ålesund	79°N	*Polar night*		0	27	31	29	31	30	30	23	*Polar night*		201
Summit	72°N			(a)	(a)	(a)	(a)	(a)	31	22	31			84
Scoresbysund	70°N	8	26	29	27	27	27	30	27	30	31	21		283
Kiruna	68°N	23	28	31	30	31	1	21	31	30	31	30	3	290
Sodankylä	67°N	31	21	31	30	31	30	31	31	30	31	30	31	358
Zhigansk	67°N	11	25	30	30	31	29	21	28	16	7	26	0	254
Salekhard	67°N										31	30	31	92
Harestua	60°N	31	28	27	27	31	26	31	31	30	31	30	30	353
Zvenigorod (optional)	*55°N*	0	0	0	19	23	21	27	30	29	30	20	15	214
Jungfraujoch	47°N	18	24	31	30	31	28	30	31	30	31	30	31	345
O.H.P.	44°N	31	28	31	30	31	30	31	31	30	24	30	25	352
Izaña	28°N	28	24	7	24	25	14	31	30	21	17	28	17	266
Mauna Loa	19°N	31	24	26	0	0	30	30	31	30	31	30	28	291
Nairobi	1°S	31	28	31	30	31	30	31	31	30	31	30	31	365
Saint Denis	21°S	31	28	31	30	31	30	30	31	27	20	30	31	350
Bauru	22°S	30	23	30	29	31	30	29	28	30	30	26	25	341
Lauder	45°S	29	24	31	30	30	30	31	29	30	31	30	31	356
Kerguelen	49°S	31	28	31	30	31	30	31	31	30	31	30	31	365
Macquarie	55°S	31	27	31	30	31	30	31	31	30	24	28	31	355
Marambio	64°S	31	28	31	24	31	20	26	29	30	31	30	31	342
Dumont d'Urville	67°S	31	28	31	30	31	30	31	30	30	31	30	31	364
Rothera	68°S	30	24	29	27	30	28	29	28	29	30	29	29	342
Belgrano	78°S		16	29	10	*Polar night*			9	28	28	*Polar day*		120
Arrival Heights	78°S		12	31	22				10	30	25			130

(a) New station; measurements available since summer 2003.

(FT)IR	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Ny-Ålesund	79°N	*Polar night*		3	6	1	1	1	3	0	0	*Polar night*		15
Kiruna	68°N	5	9	18	9	2	5	14	8	13	8	0		91
Bremen	53°N	1	9	5	3	1	2	2	2	4	2	1	1	33
Zugspitze	47°N	0	0	0	0	0	1	0	0	0	0	0	0	1
Izaña	28°N	8	4	9	13	15	12	4	0	0	0	0	0	65
Lauder	45°S	15	18	19	17	13	11	14	14	14	15	16	16	182
Arrival Heights	78°S	10	6	8	2	*Polar night*				6	10	14	10	66

Ozonesonde	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Sodankylä	67°N	17	6	12	5	4	4	6	4	2	5	4	4	73
Keflavik	64°N	6	6	5	0	0	0	0	0	0	0	0	1	18
Jokioinen	61°N	6	3	7	0	0	0	0	0	0	0	0	0	16
De Bilt	52°N	5	4	4	6	2	4	5	4	4	4	4	5	51
Uccle	51°N	13	14	13	12	11	12	4	11	13	14	10	11	138
Hohenpeißenberg	48°N	11	10	12	11	8	5	9	8	9	9	11	13	116
Payerne	46°N	14	8	12	10	12	12	12	12	12	11	13	13	141
Paramaribo	6°N	6	3	5	4	5	4	5	5	4	4	3	2	50
Lauder	45°S	4	3	9	5	4	4	5	4	4	6	11	6	65
Marambio	64°S	2	2	2	1	2	9	13	13	10	9	7	6	76
Dumont d'Urville	67°S	2	1	1	2	4	8	8	9	9	4	2	2	52
Belgrano	78°S	1	1	3	2	2	4	11	12	9	8	4	1	58

MicroWave	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Ny-Ålesund	79°N	0	9	31	29	0	0	30	20	23	31	30	30	233
Kiruna	68°N	22	25	23	28	24	21	18	21	25	26	27	28	288
Zugspitze	47°N	-	11	25	13	20	20	16	-	-	-	-	-	105
Payerne	46°N	29	28	27	30	30	30	31	21	27	28	27	31	339
Lauder	45°S	22	24	27	0	0	0	0	0	0	0	0	0	73

B.5. Monthly data distribution for 2004

Brewer	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Sodankylä	67°N		18	30	30	31	23	31	31	29	23	2		248
Jokioinen	61°N	3	26	30	30	30	27	30	29	29	31	16	0	281
De Bilt	52°N	30	29	31	30	31	30	31	30	30	31	30	30	363
Uccle	51°N	29	29	30	30	31	30	31	30	30	30	30	26	356
Arosa	46°N	22	26	26	23	26	24	26	25	23	28	23	24	296
Paramaribo	6°N	31	29	24	29	31	30	27	30	30	28	24	27	340

Dobson	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Arosa	46°N	21	24	20	25	24	22	28	25	24	29	22	23	287
Lauder	45°S	17	17	17	18	16	17	19	19	16	17	20	19	212
Vernadsky	65°S	31	29	31	30	*Polar night*			31	30	31	30	31	274
Halley	76°S	31	26	29	15				4	30	31	30	31	227
Arrival Heights	78°S	0	1	8	0				0	10	22	16	15	72

UV-Vis	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Ny-Ålesund	79°N	*Polar night*		31	29	31	30	31	31	30	25	*Polar night*		238
Summit (d)	72°N			27	29	15	0	0	8	30	31			140
Scoresbysund	70°N		0	16	30	31	30	25	28	30	27	18		235
Kiruna	68°N	23	16	31	27	31	0	0	23	30	31	30	2	244
Sodankylä	67°N	22	29	25	30	31	29	31	31	30	31	30	30	349
Zhigansk	67°N	3	17	3	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	23
Salekhard	67°N	29	27	29	30	31	30	30	31	28	30	30	30	355
Harestua	60°N	29	29	31	28	31	30	27	28	30	29	29	29	350
St Petersburg	60°N	27	23	29	29	31	30	29	28	29	30	26	26	337
Zvenigorod (optional)	*55°N*	13	25	15	0	0	0	15	30	30	26	25	22	201
Bremen	53°N	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)
Jungfraujoch	47°N	17	29	31	25	27	25	12	10	25	31	22	29	283
O.H.P.	44°N	20	29	31	30	31	28	30	31	30	31	17	0	308
Issyk-Kul (optional)	*43°N*	31	28	30	27	31	30	30	31	26	30	30	13	337
Izaña	28°N	6	27	30	26	31	27	30	28	30	30	29	29	323
Mauna Loa	19°N	30	27	31	30	30	5	0	30	22	31	30	31	297
Mérida	8°N		(c)	3	2	16	28	4	(c)	(c)	7	25	4	89
Nairobi	1°S	29	28	30	30	30	28	26	30	21	23	27	31	333
Saint Denis	21°S	22	18	24	26	31	30	30	19	30	10	22	21	283
Bauru	22°S	14	27	28	27	29	27	31	31	28	28	12	26	308
Lauder	45°S	30	29	31	28	29	30	31	31	30	28	30	30	357
Kerguelen	49°S	15	28	31	30	31	30	30	30	30	31	30	29	345
Macquarie	55°S	24	29	30	30	31	30	31	31	30	19	30	31	346
Marambio	64°S	29	28	28	29	31	30	31	30	30	30	29	30	355
Dumont d'Urville	67°S	18	29	31	30	31	30	31	31	30	31	30	30	352
Rothera	68°S	29	28	28	28	29	27	31	31	30	30	30	30	351
Belgrano	78°S		15	30	23	*Polar night*			12	30	30	*Polar day*		140
Arrival Heights	78°S		13	31	22				11	30	24			131

(a) SAOZ instrument in Zhigansk broke down in March 2004 and resumed operation in January 2006.
(b) Computer clock malfunction in 2004 that might impact the accuracy of the air mass factor. Possible solutions are under investigation.
(c) New UVVIS instrument installed and operated in Mérida; many data gaps in time series as result of power failures.
(d) Station no longer operational after 2004.

(FT)IR	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Ny-Ålesund	79°N	*Polar night*		1	0	5	3	4	2	2	0	*Polar night*		17
Kiruna	68°N	2	10	8	10	14	3	8	12	10	7	3		87
St Petersburg	60°N	2	2	10	24	9	12	5	11	4	6	2	1	88
Zvenigorod (optional)	*55°N*	1	6	11	12	10	8	4	15	4	4	5	0	80
Bremen	53°N	0	2	4	2	0	2	8	10	8	5	2	4	47
Zugspitze	47°N	0	0	0	0	0	0	0	0	0	0	0	0	0
Izaña	28°N	8	5	7	6	8	0	0	11	12	5	6	1	69
Lauder	45°S	15	15	8	19	6	10	9	12	9	6	8	9	126
Arrival Heights	78°S	5	3	8	1	*Polar night*				7	14	12	10	60

M124	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Murmansk	69°N		19	26	21	0	27	29	30	26	0	4		182
Markovo	65°N	9	20	0	0	0	0	0	0	0	0	0	0	29
Petchora	65°N	7	17	25	28	29	29	31	28	29	0	0	0	223
Arhangelsk	65°N	6	16	25	27	27	29	31	30	27	0	0	0	218
Yakutsk	62°N	0	0	21	30	29	30	24	30	26	0	13	7	210
St Petersburg	60°N	27	23	29	29	31	30	29	28	29	30	26	26	337
Vitim	59°N	0	0	21	26	29	12	30	30	26	0	22	14	210
Krasnoyarsk	56°N	22	19	22	25	28	29	31	30	27	25	21	16	295
Samara	53°N	16	20	24	24	30	28	30	31	29	23	19	8	282
Irkutsk	52°N	0	0	0	0	0	15	30	28	30	30	30	24	187

(a) Barentsburg, Tiksi, Igarka, Moscow, Karaganda: instrument removal, namely due to the degradation of optic filters which are not produced in Russia anymore.

Ozonesonde	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Sodankylä	67°N	3	2	5	4	4	5	3	4	5	4	4	6	49
Keflavik	64°N	1	3	3	0	0	0	0	0	0	0	0	1	8
Jokioinen	61°N	0	0	0	0	0	0	0	0	0	0	0	1	1
De Bilt	52°N	4	4	2	4	4	4	5	5	4	4	4	5	49
Uccle	51°N	11	12	14	12	11	12	11	10	13	12	10	11	139
Hohenpeißenberg	48°N	10	12	13	10	8	7	7	9	11	9	11	12	119
Payerne	46°N	13	9	13	13	13	13	12	13	13	11	13	11	147
Paramaribo	6°N	4	4	3	4	4	3	5	3	5	5	4	4	48
Lauder	45°S	4	5	5	4	4	5	3	4	4	4	1	2	45
Marambio	64°S	2	2	2	2	1	2	6	4	4	6	8	6	45
Dumont d'Urville	67°S	1	1	1	0	4	2	3	3	6	5	4	3	33
Belgrano	78°S	2	3	2	2	3	3	3	3	6	4	3	2	36

MicroWave	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Ny-Ålesund	79°N							(a)	(a)	(a)	(a)	(a)	(a)	0
Kiruna	68°N	0	0	0	0	10	27	23	24	23	27	27	13	174
Bremen	53°N	24	22	19	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	65
Payerne	46°N	27	24	30	30	30	27	27	29	30	23	24	28	329
Mérida	8°N				(c)	4	18	14	29	30	27	28	24	174

(a) Instrumental problems between autumn 2004 and December 2006, with little chance to retrieve trace gas concentrations. Data after.
(b) No measurements after March 2004 due to lack of funding.
(c) New measurements starting in May 2004.

B.6. Monthly data distribution for 2005

Brewer	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Sodankylä	67°N		19	30	30	31	30	31	29	26	25	1		252
Jokioinen	61°N	5	23	30	28	31	30	28	30	4	31	19	0	259
De Bilt	52°N	31	28	31	30	31	30	31	31	30	31	28	31	363
Uccle	51°N	29	27	0	0	0	2	0	0	30	31	26	31	176
Arosa	46°N	22	19	26	26	26	27	26	22	26	26	23	20	289
Paramaribo	6°N	29	25	31	27	31	30	3	(a)	(a)	(a)	(a)	(a)	176

(a) Inconsistencies found in the ozone data, possibly related to instrument pointing issues. Investigation ongoing.

Dobson	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Arosa	46°N	22	18	22	22	26	26	28	22	24	28	23	20	281
Lauder	45°S	20	17	16	18	13	18	17	21	20	20	21	17	218
Vernadsky	65°S	31	28	31	30				31	30	31	30	31	273
Halley	76°S	31	28	30	12	*Polar night*			4	30	31	30	31	227
Arrival Heights	78°S	8	8	1	0				0	9	16	13	14	69

UV-Vis	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Ny-Ålesund	79°N	*Polar night*		29	30	31	18	0	31	30	0	*Polar night*		169
Scoresbysund	70°N	13	27	30	0	28	30	31	31	27	31	21		269
Kiruna	68°N	23	28	31	30	31	0	22	31	30	31	30	3	290
Sodankylä	67°N	31	28	31	30	31	30	31	31	30	31	30	30	364
Salekhard	67°N	31	28	30	30	31	30	31	31	30	31	28	28	359
Harestua	60°N	26	28	30	28	31	30	27	28	27	31	30	4	320
St Petersburg	60°N	29	27	31	27	29	29	31	31	30	30	26	27	347
Bremen	53°N	31	27	31	29	29	27	26	31	25	26	28	30	340
Jungfraujoch	47°N	31	28	31	26	12	16	24	12	20	31	26	25	282
O.H.P.	44°N	31	28	31	30	27	30	31	31	30	31	30	30	360
Issyk-Kul (optional)	*43°N*	26	28	30	29	30	30	31	31	29	30	30	29	353
Izaña	28°N	31	16	27	30	30	28	31	29	29	30	30	31	342
Mauna Loa	19°N	31	28	31	30	31	29	26	29	29	31	28	31	354
Mérida	8°N	25	28	31	21	23	19	20	26	21	28	30	30	302
Nairobi	1°S	31	28	29	30	31	30	30	31	28	30	0	0	298
Saint Denis	21°S	22	28	31	30	27	30	28	28	30	25	22	11	312
Bauru	22°S	25	28	30	30	28	30	31	26	29	31	30	22	340
Lauder	45°S	30	18	31	30	31	30	31	31	30	31	30	31	354
Kerguelen	49°S	30	26	31	30	30	23	31	30	29	29	29	27	345
Macquarie	55°S	31	28	31	16	31	28	31	31	30	31	30	19	337
Marambio	64°S	30	28	31	29	31	30	31	31	30	30	30	31	362
Dumont d'Urville	67°S	31	28	31	30	31	30	31	31	30	31	30	30	364
Rothera	68°S	28	28	31	30	31	26	25	26	30	30	30	31	346
Belgrano	78°S		16	28	17	*Polar night*			14	27	27	*Polar day*		129
Arrival Heights	78°S		12	31	22				11	30	24			130

(FT)IR	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Ny-Ålesund	79°N	*Polar night*		4	9	6	5	3	3	3	0	*Polar night*		33
Kiruna	68°N	2	10	9	11	11	6	2	10	7	7	3		78
St Petersburg	60°N	1	5	15	12	8	10	12	10	7	10	1	0	91
Bremen	53°N	2	1	4	2	1	3	0	1	0	1	0	0	15
Zugspitze	47°N	0	0	0	0	0	0	0	0	0	0	0	0	0
Izaña	28°N	6	1	11	14	7	9	16	11	5	5	0	0	85
Lauder	45°S	16	8	10	14	8	11	6	10	9	9	10	5	116
Arrival Heights	78°S	8	8	2	0	*Polar night*				4	8	6	8	44

M124	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Murmansk	69°N		19	24	25	20	22	26	27	28	27	5		223
Petchora	65°N	11	27	28	27	21	30	31	30	30	30	20	0	285
Arhangelsk	65°N	7	25	26	26	23	29	31	31	29	28	17	0	272
Yakutsk	62°N	7	13	18	29	21	30	31	29	30	24	14	7	253
St Petersburg	60°N	29	27	31	27	29	29	31	31	30	30	26	27	347
Vitim	59°N	19	24	16	29	22	28	29	30	28	16	18	13	272
Krasnoyarsk	56°N	18	23	27	25	23	29	31	31	28	28	18	25	306
Samara	53°N	18	18	22	27	22	29	30	31	30	30	24	15	296
Irkutsk	52°N	30	27	30	27	23	23	30	28	28	31	21	19	317

Ozonesonde	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Sodankylä	67°N	6	9	7	3	4	4	4	5	3	4	5	3	57
Keflavik	64°N	8	7	10	0	0	0	0	0	0	0	0	1	26
Jokioinen	61°N	5	7	7	0	0	0	0	0	0	0	0	0	19
De Bilt	52°N	4	6	6	4	6	8	4	4	4	3	5	3	57
Uccle	51°N	11	12	12	13	11	13	12	13	15	11	11	10	144
Hohenpeißenberg	48°N	12	13	12	13	9	9	10	10	9	9	13	12	131
Payerne	46°N	11	12	11	13	13	13	14	13	14	13	12	12	151
Paramaribo	6°N	0	3	8	2	3	4	3	4	2	7	5	3	44
Lauder	45°S	3	4	5	5	4	4	4	5	5	5	4	3	51
Marambio	64°S	2	2	1	2	2	7	8	6	5	10	9	7	61
Dumont d'Urville	67°S	1	1	1	2	3	2	3	2	5	5	3	2	30
Belgrano	78°S	2	3	2	2	1	3	3	4	4	5	3	2	34

MicroWave	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Ny-Ålesund	79°N	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	0
Kiruna	68°N	22	21	27	0	0	0	0	0	0	20	28	29	147
Payerne	46°N	29	28	27	12	0	0	0	0	0	0	28	30	154
Mérida	8°N	12	28	31	20	28	22	16	0	0	6	18	2	183

(a) Instrumental problems between autumn 2004 and December 2006, with little chance to retrieve trace gas concentrations. Data after.

B.7. Monthly data distribution for 2006

Brewer	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Sodankylä	67°N		13	31	30	31	23	31	31	30	22	3		245
Jokioinen	61°N	11	23	27	30	30	28	28	30	30	30	14	0	281
De Bilt	52°N	31	28	31	30	31	30	31	31	30	31	30	31	365
Uccle	51°N	30	28	31	30	31	30	31	31	29	31	30	31	363
Arosa	46°N	25	28	26	28	26	27	27	25	25	26	27	23	313
Paramaribo	6°N	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	0

(a) Inconsistencies found in the ozone data, possibly related to instrument pointing issues. Investigation ongoing.

Dobson	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Arosa	46°N	25	23	16	21	21	27	25	22	26	26	24	24	280
Lauder	45°S	5	5	17	11	15	19	15	2	18	21	20	15	163
Vernadsky	65°S	31	28	31	20				31	30	12	0	0	183
Halley	76°S	31	27	31	15	*Polar night*			6	29	31	30	7	207
Arrival Heights	78°S	18	6	4	0				0	2	13	15	13	71

UV-Vis	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Ny-Ålesund	79°N	*Polar night*		31	30	31	9	31	31	26	23	*Polar night*		212
Scoresbysund	70°N	14	28	31	30	31	30	31	31	30	31	23		310
Kiruna	68°N	23	26	31	30	31	1	22	18	20	31	30	3	266
Sodankylä	67°N	31	28	30	30	31	26	30	31	30	31	30	31	359
Zhigansk	67°N	26	11	30	26	29	28	29	31	30	31	30	27	328
Salekhard	67°N	26	28	31	30	31	30	31	31	30	31	28	28	355
Harestua	60°N	0	23	31	30	31	30	28	31	30	30	25	30	319
St Petersburg	60°N	0	27	30	30	30	28	30	31	30	28	26	0	290
Bremen	53°N	29	12	24	28	30	23	18	24	(a)	22	30	29	269
Jungfraujoch	47°N	31	28	28	2	16	21	18	0	0	31	30	31	236
O.H.P.	44°N	31	28	31	30	31	30	31	31	30	31	30	31	365
Issyk-Kul (optional)	*43°N*	31	26	29	30	31	30	31	31	29	31	30	31	360
Izaña	28°N	31	28	31	30	31	28	28	29	30	31	30	31	358
Mauna Loa	19°N	31	28	31	30	30	30	31	31	29	26	28	31	356
Mérida	8°N	27	23	25	26	18	24	20	28	0	26	17	31	265
Nairobi	1°S	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	(b)	0
Saint Denis	21°S	31	28	30	30	31	30	31	28	30	31	29	31	360
Bauru	22°S	14	28	31	30	31	30	31	31	30	31	29	27	343
Lauder	45°S	31	28	31	30	24	30	31	31	30	31	30	21	348
Kerguelen	49°S	31	28	31	30	31	30	31	31	30	31	30	31	365
Macquarie	55°S	31	27	31	7	21	26	30	23	0	0	0	0	196
Marambio	64°S	30	27	31	30	30	29	31	31	30	31	30	31	361
Dumont d'Urville	67°S	31	28	31	30	31	30	30	31	30	31	29	31	363
Rothera	68°S	31	28	31	29	31	30	30	27	10	0	0	0	247
Belgrano	78°S		14	29	22	*Polar night*			0	18	31	*Polar day*		114
Arrival Heights	78°S		12	31	22				11	30	25			131

(a) DOAS instrument temporally removed from Bremen and operated in Cabauw during the DANDELIONS validation campaign.
(b) DOAS instrument temporally dismantled by the local operators. It is intended to reinstall it.

(FT)IR	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Ny-Ålesund	79°N	*Polar night*		2	3	5	0	(a)	(a)	(a)	(a)	*Polar night*		10
Kiruna	68°N	0	9	13	7	10	12	6	13	0	0	0		70
St Petersburg	60°N	6	10	14	4	2	11	10	4	9	0	0	0	70
Bremen	53°N	2	2	4	5	6	6	7	3	9	5	1	1	51
Zugspitze	47°N	0	0	0	0	0	0	0	0	0	0	0	0	0
Izaña	28°N	0	0	0	0	0	0	0	0	0	0	0	0	0
Lauder	45°S	8	11	4	9	11	8	5	11	7	11	6	3	94
Arrival Heights	78°S	9	4	3	2	*Polar night*				2	4	5	0	29

(a) Solar tracker serviced from July 2006 to April 2007; no measurements acquired during this period.

M124	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Murmansk	69°N		0	0	29	27	29	31	29	25	0	0		170
Petchora	65°N	11	27	30	30	31	28	28	31	30	25	0	0	271
Arhangelsk	65°N	0	0	0	0	0	0	0	0	29	25	0	0	54
Yakutsk	62°N	9	14	22	29	30	30	30	27	28	26	10	0	255
St Petersburg	60°N	0	27	30	30	30	28	30	31	30	28	26	0	290
Vitim	59°N	15	19	21	22	27	24	26	28	28	26	19	0	255
Krasnoyarsk	56°N	0	0	0	0	0	0	0	0	29	23	19	17	88
Omsk	55°N	28	26	30	29	31	30	28	30	30	30	26	28	346
Samara	53°N	21	18	28	28	30	30	30	28	30	28	24	18	313
Irkutsk	52°N	28	25	31	30	30	27	28	30	30	29	24	30	342

Ozonesonde	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Sodankylä	67°N	3	4	13	12	4	4	4	5	4	4	5	4	66
De Bilt	52°N	4	3	4	4	4	4	4	5	6	3	5	4	50
Uccle	51°N	12	12	14	11	12	11	11	12	13	13	11	9	141
Hohenpeißenberg	48°N	10	12	13	11	10	7	9	9	8	8	12	11	120
Payerne	46°N	15	12	14	10	12	12	12	14	12	12	13	12	150
Paramaribo	6°N	4	4	5	4	3	3	3	3	4	3	4	3	43
Lauder	45°S	3	4	4	2	2	4	4	4	4	4	3	2	40
Marambio	64°S	2	2	3	2	2	6	7	6	4	8	9	5	56
Dumont d'Urville	67°S	1	1	0	1	1	1	2	2	3	3	3	3	21
Belgrano	78°S	3	1	3	2	4	2	2	5	5	5	4	3	39

MicroWave	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Ny-Ålesund	79°N	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)	0
Kiruna	68°N	31	28	30	0	20	12	0	0	20	30	30	31	232
Payerne	46°N	30	28	31	30	24	30	25	29	30	31	30	29	347
Mérida	8°N	0	4	0	22	1	18	13	26	0	0	0	0	84

(a) Instrumental problems between autumn 2004 and December 2006, with little chance to retrieve trace gas concentrations. Data after.

B.8. Monthly data distribution for 2007

Brewer	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Sodankylä	67°N		14	30	30	29	30	11						144
Jokioinen	61°N	7	22	28	30	29	30	11						157
De Bilt	52°N	(a)	(a)	(a)	(a)	(a)	(a)	(a)						0
Uccle	51°N	31	26	30										87
Arosa	46°N	22	26	26										74
Paramaribo	6°N	(b)	(b)	(b)										0

(a) A new instrument runs in parallel with the old one. Data will be submitted only after proper verification of consistency between the two instruments, probably by the end of 2007.
(b) Inconsistencies found in the ozone data, possibly related to instrument pointing issues. Investigation ongoing.

Dobson	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Arosa	46°N	22	19	25										66
Lauder	45°S	19	18	20	16	20	15							108
Vernadsky	65°S	31	28	31	30	*Polar night*								120
Halley	76°S	31	28	31	16									106
Arrival Heights	78°S	10	5	7	0									22

UV-Vis	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Ny-Ålesund	79°N	*Polar night*		28	30							*Polar night*		58
Scoresbysund	70°N	(a)	(a)	(a)	(a)									0
Kiruna	68°N	23	16	30	30	31	1							131
Sodankylä	67°N	(a)	(a)	(a)	(a)									0
Zhigansk	67°N	(a)	(a)	(a)	(a)									0
Salekhard	67°N	(a)	(a)	(a)	(a)									0
Harestua	60°N	30	28	31	30	31	15							165
St Petersburg	60°N	0	27	27	30									84
Bremen	53°N	31	27	28	29	30								145
Jungfraujoch	47°N	31	6	30	30	17	9							123
O.H.P.	44°N	(a)	(a)	(a)	(a)									0
Issyk-Kul (optional)	*43°N*	30	28	30	27	31								146
Izaña	28°N	31	28	31	29	31	20							170
Mauna Loa	19°N	30	24	27	30	30	29							170
Mérida	8°N	14	13	6	13									46
Nairobi	1°S	(b)	(b)	(b)	(b)	(b)	(b)							0
Saint Denis	21°S	(a)	(a)	(a)	(a)									0
Bauru	22°S	(a)	(a)	(a)	(a)									0
Lauder	45°S	29	28	31	30	31	30							179
Kerguelen	49°S	(a)	(a)	(a)	(a)									0
Macquarie	55°S	0	0	0										0
Marambio	64°S	31	26	31	30	31								149
Dumont d'Urville	67°S	(a)	(a)	(a)	(a)									0
Rothera	68°S	27	16	31	30	31	23							158
Belgrano	78°S		16	31	22	*Polar night*						*Polar day*		69
Arrival Heights	78°S		12	31	22									65

(a) Lack of manpower in 2006 and till mid-2007 for format conversion and uploads. Temporary solution found for 2006 data. Newly hired personnel should resume routine submission in autumn 2007.
(b) DOAS instrument temporally dismantled by the local operators. It is intended to reinstall it.

(FT)IR	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Ny-Ålesund	79°N	*Polar night*		(a)	(a)							*Polar night*		0
Kiruna	68°N	0	0	0										0
St Petersburg	60°N	4	11	6										21
Bremen	53°N	2	1	7	9	4								23
Zugspitze	47°N	0	0	0										0
Izaña	28°N	0	0	0										0
Lauder	45°S	5	4	8	4	8								29
Arrival Heights	78°S	4	3	7	2	*Polar night*								16

(a) Solar tracker serviced from July 2006 to April 2007; no measurements acquired during this period.

M124	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Murmansk	69°N			30	28									58
Petchora	65°N	0	27	31	28									86
Arhangelsk	65°N	0	0	27	25									52
Yakutsk	62°N	0	0	26	29									55
St Petersburg	60°N	0	27	27	30									84
Omsk	55°N	31	27	31	30									119
Samara	53°N	0	22	27	28									77
Irkutsk	52°N	27	28	31	30									116
Karaganda	50°N	24	20	28	0									72

Ozonesonde	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Sodankylä	67°N	10	28	9	5	5	4							61
Keflavik	64°N	6	7	5										18
Jokioinen	61°N	7	6	1										14
De Bilt	52°N	5	5	2										12
Uccle	51°N	12	11	13										36
Hohenpeißenberg	48°N	13	11	11	10	9	7							61
Payerne	46°N	14	11	13	11	13	12	1						75
Paramaribo	6°N	4	4	1										9
Lauder	45°S	3	5	2	3	3	2							18
Marambio	64°S	3	2	1	1	3	5							15
Dumont d'Urville	67°S	1	0	0	0									1
Belgrano	78°S	2	3	1	1									7

MicroWave	Lat.	J	F	M	A	M	J	J	A	S	O	N	D	#
Ny-Ålesund	79°N	(a)	(a)	(a)	(a)	(a)								0
Kiruna	68°N	28	26	1										55
Payerne	46°N	29	28	29	25	28	29	10						178
Mérida	8°N	(b)	(b)	(b)										0

(a) Instrumental problems in 2007, hopefully solved soon.

C. VALIDATION ACTIVITIES

During the reporting period, Envisat level-2 products were generated both by Processing and Archiving Centres (PAC) operated at/on behalf of ESA, and by scientific institutes with their homemade retrieval software tools. The TASTE Consortium has performed substantial validation work for all available data products under his duty, and provided detailed quality assessments as well as feedback to Quality Working Groups (QWGs) and algorithm and processing teams in view of the improvement of the Envisat ground segment and level-1-to-2 data processors. Where relevant, validation studies based on correlative data collected within TASTE have been augmented with similar data collected from archives of the NDACC, WOUDC and SHADOZ programmes.

Validation has been carried out both independently by individual partners using their own methods and jointly by all partners using a common approach. This dual approach has generated constructive discussions and yielded a consolidated appreciation of Envisat data quality. Details of the studies fall beyond the scope of this report but they can be found in the reports and publications listed in Section D and F. This section reports on the main achievements of the reporting period.

C.1. GOMOS

In 2006, the entire GOMOS ozone profile data record has been reprocessed with the prototype processor version 6.0f. After Delta validation of this new version, the GOMOS near real time processor was upgraded with the operational implementation IPF 5.0. During the reporting terms, TASTE partners have carried out an extended validation of the GOMOS 6.0f/IPF 5.0 data products. Comparisons have been performed using ozone profile data acquired by ozonesonde, lidar and millimetre wave radiometer and directly collected within TASTE or available through other Envisat validation projects (EQUAL and AO/Cat-1 projects) and other data archives (NDACC, SHADOZ, WOUDC). Results were reported among others during ACVE-3.

C.1.a GOMOS IPF 5.0 / Prototype Processor 6.0f

Ground-based comparisons with correlative data show that, as for previous versions, GOMOS ozone profiles are still strongly affected by the brightness of the limb in which the star occults. Bright limb occultations give poor results, and only dark limb occultations are suitable for validation and scientific use.

For dark limb ozone profiles, the time and vertical structure of the agreement with ozonesondes, lidars and microwave radiometers have been investigated. Figure **2.** illustrates comparisons between GOMOS and, respectively, KNMI ozonesondes at De Bilt and the CNRS lidar at the Observatoire de Haute Provence. The figure shows statistics (mean ± standard deviation) of the percentage relative differences between GOMOS and the two instruments. Between 20 and 50km GOMOS agree well with the ozonesondes and lidar profiles. Mean difference is lower than 7% from 15 to 45km with a 10% standard deviation. Below 15-20km observed differences strongly increase and negative and positive out of range ozone value are observed within the GOMOS profiles. Above 50km, larger differences are observed. Part of this difference could be attributed to increasing lidar error bars above 50km. However, GOMOS-related problems cannot be ruled out.

Similar results are obtained at other ground-based stations. Main conclusions depict a good agreement between GOMOS and correlative data in the stratosphere, between 15-20 and 50 km. Mean differences are within 10% level and even better. Above and below, larger differences are observed. Detailed results of the analysis were reported at ACVE-3 and in the proceedings of the conference (see Section F for references).

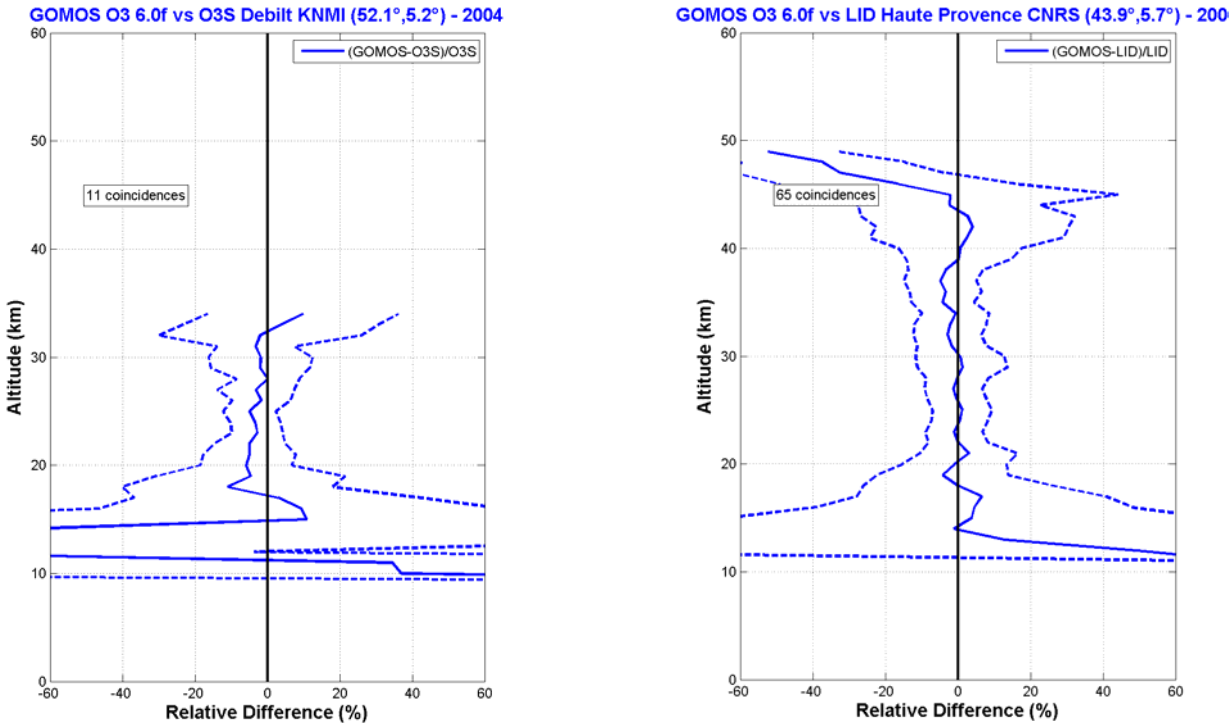

Figure 2. *Mean relative difference (plain) and standard deviation (dashed) between GOMOS and correlative ozone profiles measured in 2004 by ozonesonde at De Bilt in the Netherlands (left) and by lidar at the Observatoire de Haute Provence in France (right).*

C.2. MIPAS

MIPAS recorded atmospheric data in its Full Resolution (FR) mode from July 2002 to March 2004. Full resolution atmospheric profiles of various molecules were retrieved with Off-Line IPF versions 4.61 (covering 2003) and 4.62 (Jul.-Dec. 2002 and Jan./March 2004). The MIPAS FR data set has undergone an extensive validation coordinated by "molecule coordinators" from various institutes. Consolidated results are now being published in a special issue of *Atmospheric Chemistry and Physics (ACP)*. TASTE activities have played a major role in this coordinated effort, providing ground-based geophysical validation of nearly all MIPAS operational products.

A severe instrument anomaly occurs in March 2004. After several tests, MIPAS could resume operation in a Reduced Resolution (RR) mode in February 2005. This new mode of operation requires a totally new retrieval scheme and consequently a new processor. MIPAS RR data set covers 2005-2006. It has been retrieved with version 5.0 of the new processor and is available for validation since March 2007. Preliminary comparisons of MIPAS RR ozone profiles have been performed within TASTE framework.

C.2.a MIPAS IPF 4.61/4.62 (Nominal Resolution)

A summary of TASTE ground-based geophysical validation of MIPAS FR IPF 4.61/4.62 temperature, ozone, nitric acid, nitrous oxide, methane and nitrogen dioxide profiles was presented in previous issue of TASTE annual report. As already mentioned, the work achieved by TASTE partners has massively contributed to an extensive validation published in "MIPAS (Michelson Interferometer for Passive Atmosphere Sounding): potential of the experiment, data processing and validation of results" special issue of *Atmospheric Chemistry and Physics* (ACP). These results were also presented at ACVE-3 and are published in the proceedings of the meeting. (See section F for references)

C.2.b MIPAS IPF 5.0 Ozone (Reduced Resolution)

MIPAS RR ozone profiles have been compared with correlative profiles measured by ozonesonde and lidars directly collected within TASTE or available through other Envisat validation projects (EQUAL and AO/Cat-1 projects) and other data archives (NDACC, SHADOZ, WOUDC). This preliminary validation consists of three steps. First, individual visualisation of each pair of MIPAS RR ozone profile and ground-based measurement allows identifying global features and possible issues in the ozone profiles. Second, a height-resolved time-series analysis is performed at individual stations to enable the detection of time/altitude/latitude variations of the agreement (see e.g. Figure **3.**). This analysis allows the detection of time periods and group of stations with homogeneous behaviour. Finally, where and when statistics are relevant, a quantitative analysis as a function of altitude of the MIPAS/ground difference is performed.

Individual comparisons show that MIPAS RR ozone profiles have a correct shape and are ready for validation. No major issue has been detected. Height-resolved time series analysis highlights the weak number of collocated pairs of MIPAS/GROUND measurements. The new instrument operation strategy, decided after incurred major anomaly, limits the number of measurements days to specific campaigns or to specific scientific interest events. A mean agreement within 10% is observed in the stratosphere. In the troposphere, large differences exceeding 30% appear. The time series analysis does not revealed any evident time structure. Consequently, vertically resolved statistics were calculated over the entire data set. Figure **4.** and Figure **5.** illustrate the obtained results with comparisons between MIPAS RR and ozonesondes profiles from Payerne (Swiss Alps) and Nairobi (Kenya) ground-based stations. The figures show the relative difference observed for each pair of profiles (grey lines). Mean (plain black line) and standard deviation (dashed black lines) are also depicted. At Payerne, as well as at other northern mid-latitude stations, a positive bias of the order of +7% is observed in the stratosphere. In the troposphere, mean difference rapidly increases and reaches more than 40% below 100hPa. At Nairobi, mean difference is lower than 7% in the stratosphere. Non permanent bias is detected. Again in the troposphere relative differences strongly increases and reaches out-of-range values. Similar results are obtained at other ground-based stations.

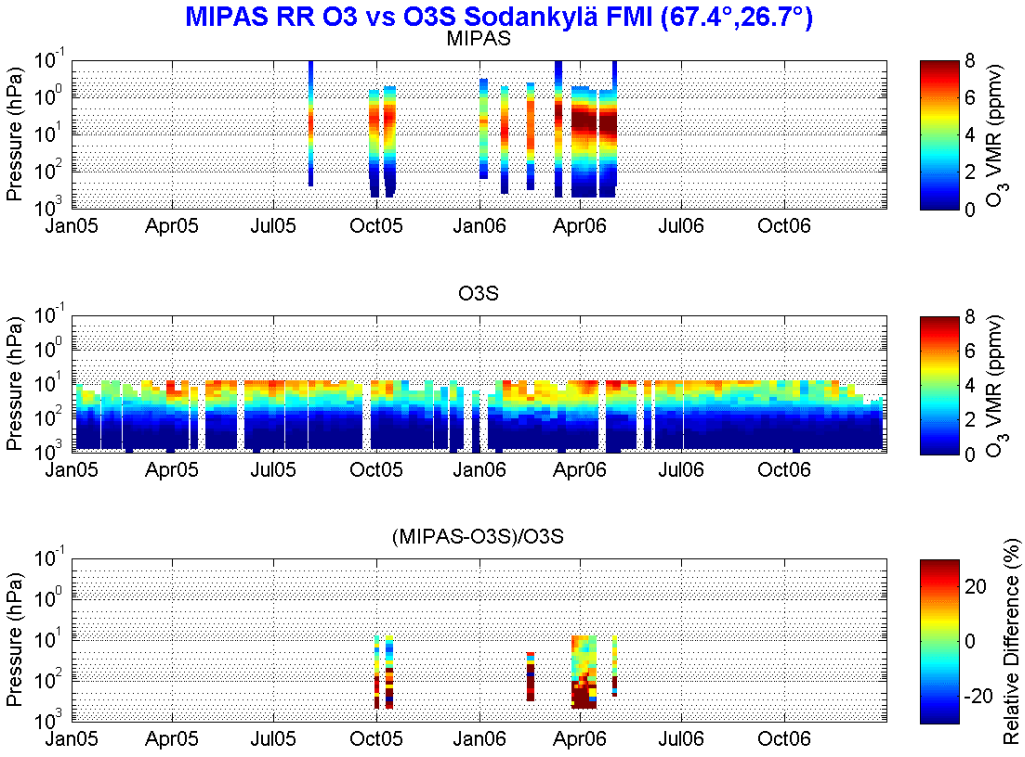

Figure 3. *Ozone VMR measured in 2005-2006 at Sodankylä (Finland) by MIPAS in reduced resolution mode (upper panel) and by ozonesonde (middle panel), and percent relative difference (lower panel).*

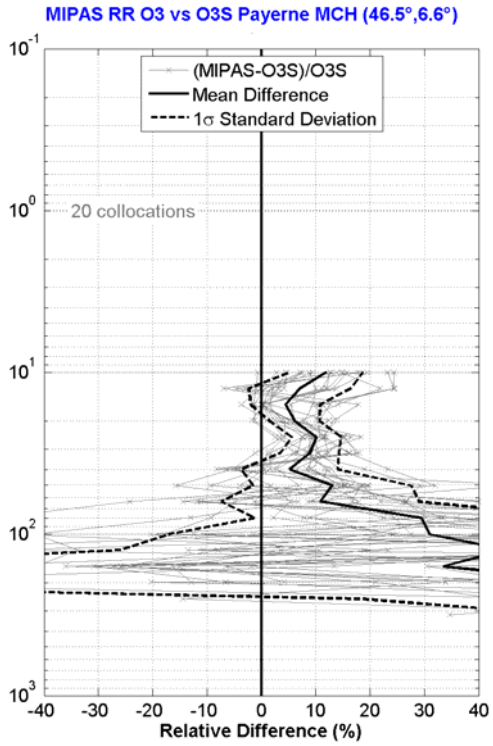

Figure 4. *Vertically-resolved mean relative difference (palin) and standard deviation (dashed) of comparisons between MIPAS RR and correlative ozone profiles from ozonesondes of Payerne in Swiss Alps. Individual difference for each pair of collocated profiles is also depicted (grey lines).*

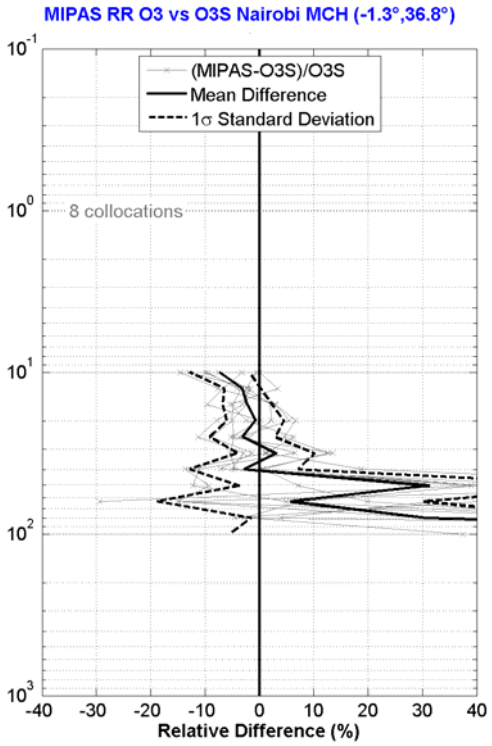

Figure 5. *Same as Figure* **4.** *but for comparisons between MIPAS RR and correlative ozone profile from ozonesondes of Nairobi in Kenya.*

In the stratosphere, this preliminary analysis concludes to a similar quality of MIPAS RR v4.0 ozone profiles as that concluded for previous MIPAS NR 4.61/4.62 profiles. In general mean difference fits within 10% level in the stratosphere. A positive bias of about + 7% is observed at mid-latitude stations in the stratosphere. In the troposphere, MIPAS RR ozone profiles show larger disagreement with ozonesondes profiles. Below 100hPa, mean differences larger than 40% are observed.

C.3. SCIAMACHY

During the reporting period, TASTE has provided the validation support to several developments and improvements of SCIAMACHY data processors for limb and nadir products. A special effort has been put to address SCIAMACHY limb pointing issues. SCIAMACHY limb ozone profile data have been processed with the Off-line processor (version 3.0), including limb pointing corrections. In the same time, the improved GOME Data Processor (GDP) version 4 was transferred to the offline SCIAMACHY Ground Processor (SGP) version 3.0 for the retrieval of ozone (O3) and nitrogen dioxide (NO2) column. SCIAMACHY bromine monoxide (BrO) and NIR products are successfully retrieved by scientific processors developed by scientific Institutes.

C.3.a SCIAMACHY OL 3.0 limb ozone profiles

For the first time, the Off-line processor (version 3.0) of SCIAMACHY has generated limb ozone profile data suitable for validation, although for a limited subset of orbits. Previous versions of SCIAMACHY ozone limb profile profiles have demonstrated an altitude shift problem. Investigation of this problem has shown that an incorrect knowledge of the satellite position is responsible of limb pointing error in the Level 0 (and then in Level 1) data sets. The resulting altitude shift in the SCIAMACHY ozone profile varies with latitude and longitude. Corrections for this pointing error have been implemented in the Envisat on-board orbit propagator and in the SCIAMACHY retrieval algorithm.

Before classical comparison between SCIAMACHY ozone profiles and ground-based data records, the altitude pointing of the profiles has been verified. The altitude shift between SCIAMACHY ozonesondes and lidars profile is tested by cross-correlation method. Figure **6.** shows mean shifts according to latitude calculated at all stations where collocations can be found. The mean altitude shift is strongly reduced compared to the previous versions of SCIAMACHY limb ozone profiles, with a mean value lower than 1km and stations where it is quasi null. However, a variation of the shift with geolocation persists. The mean altitude shift is negligible at northern middle latitude stations in Europe and increase up to 1km when going down to the equator. It can not be excluded that the observed structure could be an artefact due to the updates of on-board orbit propagator at permanent locations. Although some remaining features are still present, profile are suitable for a preliminary validation especially over Europe where remaining shift is quasi null.

As for MIPAS and GOMOS ozone profiles, several types of comparisons have been performed, yielding among others individual comparisons, height-resolved time-series and classical vertically resolved statistics of the agreement. Figure **7.** and Figure **8.** illustrate the main results with vertically-resolved comparisons between SCIAMACHY limb ozone profile and correlative data from Payerne (Swiss Alps) ozonesondes and Haute Provence (France) lidar. Comparisons have been made with and without convolving correlative ozone profile with SCIAMACHY averaging kernel matrix and a priori data. The difference gives an estimate of the smoothing error associated with the SCIAMACHY data. Mean (plain) and standard deviation (dashed) of the differences are depicted. At Payerne, the figure highlights a negative bias of the SCIAMACHY ozone profiles of about -15% at the altitude of ozone maximum. At Haute Provence SCIAMACHY ozone concentration are lower than lidar measurements. Negative differences from -10 to -25% are observed in the entire stratosphere. Maximum negative differences are observed around 20km and 40km. Similar results are obtained at other ground-based stations. In general, SCIAMACHY underestimates the ozone maximum between 15 and 25km. Negative differences are also observed at 40km in comparisons with lidars. For other altitude ranges, mean relative difference fits within the ±10% level. Comparisons at equatorial stations depict the largest differences associated with remaining altitude pointing errors. These results were presented at ACVE-3 and are detailed in the proceedings (See Section F for references).

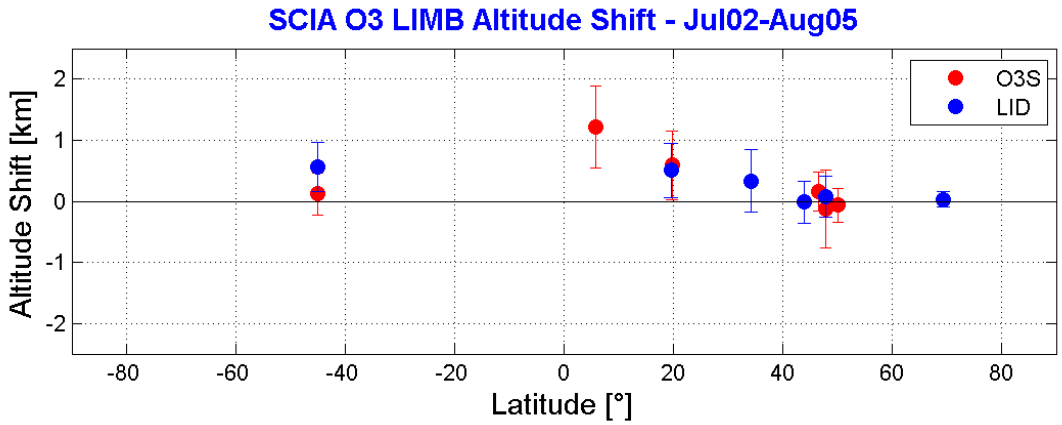

Figure 6. *Mean altitude shifts between SCIAMACHY limb ozone profiles and coincident correlative data plotted according to latitude.*

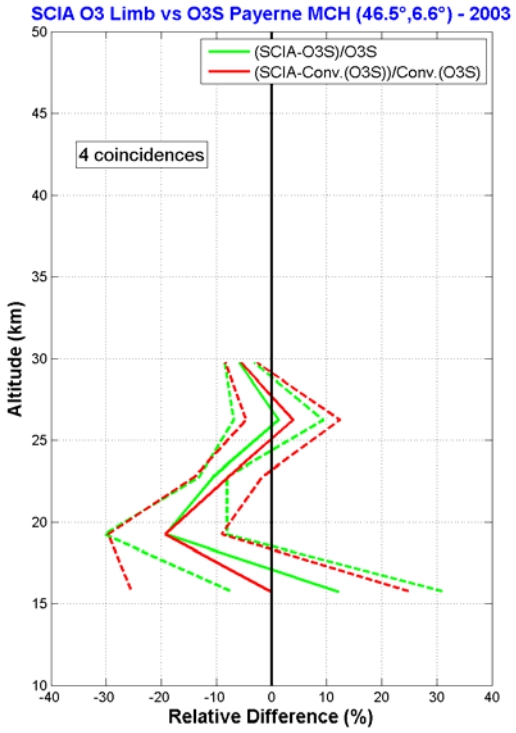

Figure 7. *Mean relative difference and standard deviation between SCIAMACHY and ozonesonde profiles atPayerne (Swiss Alps), in 2003. Corresponding statistic for comparisons with correlative data smoothed to the SCIAMACHY vertical resolution using Averaging kernel matrix and a priori data.*

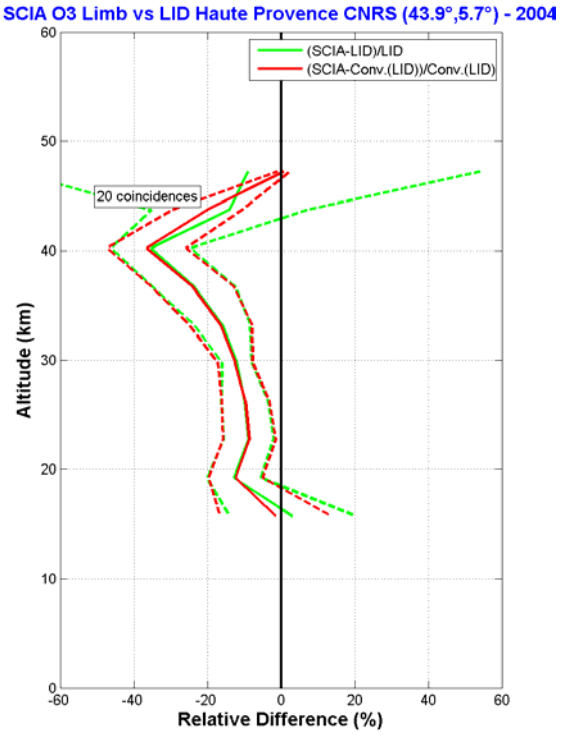

Figure 8. *Same as Figure* **7.**, *but for comparisons between SCIAMACHY and correlative ozone profiles from the lidar at the Observatoire de Haute Provence in France, in 2004.*

C.3.b SCIAMACHY SGP 3.0 ozone and nitrogen dioxide columns

Until mid 2006, SCIAMACHY data processors for the operational retrieval of ozone (O3) and nitrogen dioxide (NO2) column data were based on the historical version 2 of the GOME Data Processor (GDP). On top of known problems inherent to GDP 2, ground-based validations of SCIAMACHY data revealed specific issues, like a large cloud-dependent bias of O3 data occurring in Northern fall or a cloud-dependent offset of NO2 data occurring at Northern latitudes. In 2006, the GDOAS prototype algorithm of the improved GDP version 4 was transferred to the offline SCIAMACHY Ground Processor (SGP) version 3.0. In parallel, the calibration of SCIAMACHY radiometric data was upgraded. Before operational switch-on of SGP 3.0 and public release of upgraded SCIAMACHY NO2 data, we have investigated the accuracy of the algorithm transfer: (a) by checking the consistency of SGP 3.0 with prototype algorithms; and (b) by comparing SGP 3.0 O3 and NO2 data with ground-based observations.

SCIAMACHY SGP 3.0 O3 column data have been compared with ground-based observations performed by the Brewer, Dobson and UVVIS networks contributing to WMO's GAW. This delta-validation study shows that the Northern fall bias has disappeared and that the GDP 2 inherited solar zenith angle and latitude dependences have decreased significantly. The GDP 4.0 transfer to SGP 3.0 via the GDOAS/SDOAS prototype is successful within the ±0.2-0.5% level. The general conclusion is that SGP 3.0 is a significant improvement with respect to the previous processor IPF 5.04, offering ozone column data with a quality nearly at the level of the quality of GOME GDP 4.0 data. However, this analysis is based on a limited subset of states. Therefore the future detection of additional features cannot be ruled out.

SCIAMACHY SGP 3.0 NO_2 column data have been compared with ground-based observations reported by the NDACC network of UV-visible DOAS/SAOZ spectrometers. This delta-validation study concludes that SGP 3.0 is a significant improvement with respect to the previous processor IPF 5.04. For three particular SCIAMACHY states, the study reveals unexplained features in the slant columns and air mass factors, although the quantitative impact on SGP 3.0 vertical columns is not significant. Again, this analysis is based on a limited subset of states and the future detection of additional features cannot be ruled out.

C.3.c SCIAMACHY bromine monoxide column

Building on the experience acquired with ERS-2/GOME, a scientific algorithm has been developed at BIRA-IASB for the retrieval of total BrO columns from SCIAMACHY nadir measurements. In order to overcome problems related to anomalies in the polarization response of the SCIAMACHY instrument, specific BrO retrieval settings have been introduced, different from those used for the retrieval of GOME data. The consistency between GOME and SCIAMACHY BrO products has been investigated using the data in the period from July 2002 until June 2003 for which both instruments were operated simultaneously. SCIAMACHY and GOME BrO total VCDs were found to be in good agreement, as to the way they capture the general patterns of atmospheric bromine monoxide. Nevertheless, some systematic features in SCIAMACHY data, in particular due to a strong interference with formaldehyde, have been identified. SCIAMACHY nadir BrO columns have also been compared with independent correlative data sets (photochemically matched to satellite observations), based on the use of ground-based measurements at three NDACC (Network for the Detection of Atmospheric Composition Change) stations, sampling tropical (Reunion Island, 22°S), mid- (Observatoire de Haute-Provence, 44°N) and high-latitudes (Harestua, 60°N). For this purpose, new techniques have been developed to retrieve from ground-based observations, low resolution profiles or vertical columns resolved into their stratospheric and tropospheric contributions. In general, SCIAMACHY BrO vertical columns are found to be in good agreement with the total BrO VCDs inferred from the ground-based observations for the three stations. The seasonal variations (and even short-term variations) of the total BrO VCDs are captured in a similar way by SCIAMACHY and ground-based instruments. It has to be noticed however that systematic discrepancies tend to appear in summer conditions when both satellite and ground-based retrievals have their largest uncertainties. Besides validation results, both satellite and ground-based observations were found consistent with the presence of a tropospheric BrO layer of approximately 1-3 x1013 molec/cm2 in column (corresponding to mixing ratios in the range from 1 to 3 pptv if well mixed in the free troposphere). See paper references in Section F for more details.

C.3.d SCIAMACHY SWIR column products

With additional support from the EU projects Evergreen (http://www.knmi.nl/evergreen) and UFTIR (http://www.nilu.no/uftir), scientific SCIAMACHY SWIR products (CO, CH_4, N_2O and CO_2 columns) retrieved by three different algorithms (IMLM by SRON, IMAP-DOAS by U. Heidelberg and WFM-DOAS by U. Bremen) have been validated using the NDACC network of FTIR stations. The results of this study can be found in ACP. (See Section F for references).

By the end of 2006, the development group at the University of Bremen had released an improved version of their CO and CH4 products using their WFM-DOAS algorithm. We have made an additional evaluation of this new WFM-DOAS data (v0.6 for CO and v1.0 for CH4) using a European network of FTIR stations, harmonised under the UFTIR project. (http://www.nilu.no/uftir). For comparison purposes we have also re-compared the old v0.5 datasets with the same FTIR measurement ensemble. The results of this new intercomparison have been presented at ACVE-3 and are published in the proceedings of the conference. (See Section F for references).

The results from both studies clearly show that, while the ideal target precisions are not yet reached, the data becomes more robust and accurate with each algorithm improvement. While the N_2O and CO_2 products are still in their initial stage of development, the CO and CH_4 products may already be used for specific geophysical studies, keeping in mind their limitations.

D. VALORISATION

D.1. Presentations at meetings and symposia

Results obtained by members of the consortium, either independently or in a concerted way, were reported and discussed at dedicated Envisat QWG and Science Advisory Group meetings and during several scientific workshops and major symposia:

- 3rd International DOAS Workshop, Bremen, Germany (March 20-22, 2006)
- European Geophysical Union General Assembly, Vienna, Austria (April 2–7, 2006)
- ESA Atmospheric Science Conference, Frascati, Italy (May 8-12, 2006)
- NDACC Infrared Working Group Meeting, Tsukuba, Japan (May 1-3, 2006)
- Annual meeting of the Canadian Meteorological and Oceanographic Society (CMOS), "Weather, Oceans and Climate: Exploring the Connections", Toronto, Canada (May 29 - June 1, 2006)
- AT-2 Workshop, Heraklion, Greece (June 5-6, 2006)
- 36th Scientific Assembly of the Committee on Space Research (COSPAR) , Beijing, China (July 16-23, 2006)
- CEOS WGCV Atmospheric Chemistry Subgroup topical meeting, Beijing, China (July 21, 2006)
- SCIAMACHY pre-validation meeting, De Bilt, The Netherlands (September 20, 2006)
- NDACC Steering Committee meeting, Observatoire de Haute Provence, France (September 26-28, 2006)
- SCIAMACHY Scientific Working Subgroup for Algorithm Development and Data Usage (SADDU), Oberpfaffenhofen, Germany (October 16-17, 2006)
- SAUNA Workshop, Puerto de la Cruz, Tenerife, Spain (November 8-11, 2006)
- SCIAMACHY pointing meeting, Bremen, Germany (November 29-30, 2006)
- 3rd Atmospheric Chemistry Validation of Envisat (ACVE-3), Frascati, Italy (December 4-7, 2006)
- 2007 ENVISAT Symposium, Montreux, Switzerland (April 23-27, 2007)
- SCIAMACHY Quality Working Group meeting, Frascati, Italy (May 7, 2007)
- MIPAS QWG meeting, Florence, Italy (June 12-14, 2007)
- SCIAVALIG meeting, Bremen, Germany (June 20, 2007)

The fourth TASTE progress meeting took place on June 26, 2006, at Uccle (Belgium). It included oral presentations on Envisat validation by ground-based FTIR and UVVIS spectrometers, on validation of temperature and ozone data from the three Envisat profilers, and on recent developments of ground-based validation of Envisat NO_2 and BrO profiles.

D.2. Publications and reports

During the reporting term several members of the TASTE consortium contributed to the completion of MIPAS coordinated validation papers. At the time of the present report, all manuscripts submitted to the MIPAS special issue of *Atmospheric Chemistry and Physics* journal (ACP) have been accepted for interactive discussion in ACPD (see http://www.atmos-chem-phys-discuss.net/special_issue26.html). The $ClONO_2$ and NO_2 papers have already been accepted for publication in ACP (see http://www.atmos-chem-phys.net/special_issue70.html).

ACVE-3 took place at ESRIN on December 4-7, 2006. Members of the TASTE consortium have largely contributed to ACVE-3 with a list of oral presentations, poster presentations and associated proceedings.

Members of the TASTE consortium have also contributed to a list of other peer-reviewed papers, conference proceedings and reports, and to the book "SCIAMACHY, Monitoring the Changing Earth's Atmosphere" (see references in Section F).

E. PERSPECTIVES FOR NEXT TERM

E.1. Correlative database

Activities related to the collection of correlative ground-based measurements, their format conversion and their upload to Cal/Val, will continue on the same basis. Thanks to interagency agreements and/or joint AO/Cat-1 proposals involving most of consortium partners, the correlative database is also useful for the validation of ESA's Third Party missions such as SCISAT-1 ACE FTS and MAESTRO, and for the validation of EOS-Aura OMI (joint ESA/NIVR/KNMI AO for OMI) and EUMETSAT GOME-2 and IASI (joint ESA/EUMETSAT RAO for EPS/MetOp). Correlative measurements stored at NILU Cal/Val are also used for the delta-validation of new processor developments in progress for GOME, carried out in the framework of other ESA projects.

E.2. Validation activities

- Continuation of validation of operational GOMOS ozone profile data
- Continuation of validation of operational MIPAS RR data
- Continuation of validation of operational SCIAMACHY SGP 3.0 data
- Once MIPAS RR data set is adequate, verification of consistency between NR and RR
- Consistency of SCIAMACHY SGP 3.0 with GOME GDP 4.1 O_3 and NO_2 columns using ground-based data as a standard transfer

E.3. Valorisation

No major event dedicated directly to Envisat validation has been scheduled for the remaining part of the project. TASTE partners will continue their role in the final process of the MIPAS Validation special issue of ACP. Discussion and dissemination of results will be ensured through the participation to meetings of various communities involved directly in Envisat and ESA's Third Party missions, in working groups of the ground-based network NDACC (e.g. UVVIS WG meeting in Cambridge on 28-30 November 2007), in the SAUNA campaign, and in atmospheric research in general (e.g. EGU meetings).

Validation results produced through TASTE are an important input to the validation of several ESA's GSE PROMOTE services related to ozone, greenhouse gases and aerosols, and air quality (see http://www.gse-promote.org). Several results have already been integrated in the PROMOTE Service Validation Report (document C6), to be available soon via the validation section of the PROMOTE web site. PROMOTE will continue another two years and service leaders whish highly the continuation of TASTE-like activities during the lifetime of this precursor project of the future GMES Atmosphere Service (GAS), a European contribution to GEOSS.

The experience gained by TASTE in the "routine" validation of satellite data by a consortium provides an interesting feedback to GEOMON research (http://www.geomon.eu). As another precursor of the future GAS, the EC FP6 IP GEOMON project aims at integrating ground- and air-based atmospheric monitoring systems over Europe and improving their link with satellite data. In this framework, several TASTE partners work together and with other institutions to further improve satellite validation methods and establish validation standards. The TASTE experience is also useful for the establishment of validation standards and of best practices in data acquisition, collection and management, currently being discussed in the framework of the Working Group on Calibration and Validation/Atmospheric Composition Sub Group of CEOS (WGCV ACSG, see http://wgcv.ceos.org) as another contribution to GEOSS.

F. PUBLICATIONS *(Only new papers or new status during reporting term)*

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