

Report from the 2nd ACVE Workshop
Frascati, Italy, 3-7 May 2004

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International Space Science Institute



ENVISAT Atm. Chem. Payload

- MIPAS: Michelson Interferometer for Passive Atmospheric Sounding. Near to mid-IR. O_3 , H_2O , CH_4 , N_2O , HNO_3 , T. ΔZ 3 km. Z 5-150 km.
- GOMOS: Global Ozone Monitoring by Occultation of Stars. UV/Vis/IR. O_3 , NO_2 , NO_3 , $OCIO$, T, H_2O . $\Delta Z < 2$ km. Z tropop. - 100 km.
- SCIAMACHY: SCanning Imaging Absorption SpectroMeter for Atmospheric CHartography (« GOME II »). UV/Vis/IR. O_2 , O_3 , ClO , H_2O , CH_4 ... ΔZ 3 km. Z 0 - 100 km.

ACVE-2 Purpose:

- To discuss instrument by instrument and species by species the validation results
- To reassess the quality of the data products
- To refine the error bars for the products
- Participants: ACVT
(Atm. Chem. Valid. Teams)
- 1rst ACVE Workshop: Frascati, Dec. 2002

CONCLUSIONS ACVE-1 (Dec. 2002):

SCIAMACHY: Errors in Level 1 products related to the instrument calibration propagate into Level 2 products → Operational products do not meet the required accuracy → additional work on calibration and updates to the algorithms required.

MIPAS Level 1 datasets ~ OK. Release of Level 1 products recommended. Additional improvements to Level 2 products to correct for the effect of cloud cover at altitudes below 20 km required.

GOMOS O3 ~ OK (!). Improvements to the GOMOS algorithms, updated Level 2 products, and continued validation work recommended.

Validation Dataset April 2004

(black: sufficient quality for validation)

(red: sparse data or non mature algorithms)

GOMOS	MIPAS	MIPAS	SCIAMACHY	SCIAMACHY	SCIAMACHY
GOPR6.0	IPF4.61	IPF4.61	IPF5.01		
Dark Limb	NRT	Offline	Nadir	Nadir	Limb
density	P	P			
T	T	T			
O ₂					
O ₃	O ₃	O ₃	O ₃	O ₃	O ₃
H ₂ O	H ₂ O	H ₂ O	H ₂ O	H ₂ O	H ₂ O
NO ₂	NO ₂	NO ₂	NO ₂	NO ₂	NO ₂
	N ₂ O	N ₂ O	N ₂ O	N ₂ O	N ₂ O
NO ₃					
	HNO ₃	HNO ₃			
OCIO, Aerosol	CH ₄	CH ₄	OCIO, BrO, H ₂ CO, CO, CH ₄ , SO ₂ , Clouds, Aerosol	OCIO, BrO, H ₂ CO, CO, CH ₄ , SO ₂ , Clouds, Aerosol	OCIO, BrO, H ₂ CO, CO, CH ₄ , SO ₂ , Clouds, Aerosol

Mandatory: use the reprocessed ENVISAT
Cal/Val dataset released in early 2004

Status of MW Data in Cal/Val DB:

Kiruna	IRF	220	O ₃	Raffalski
Lauder	NIWA	214	O ₃	Bodeker
Mauna Loa	UMass	257	O ₃	Bodeker
Ny Alesund	UBremen	10	O ₃	Kuenzi
Payerne	MCH	688	O ₃	Kaempfer
Rome	UAquila	68	IWV	Ciotti
Zugspitze	FZK	6	O ₃	Hochschild

SCIAMACHY O3 Profile Validation

E. Brinksma, KNMI



Available SCIAMACHY limb ozone profiles

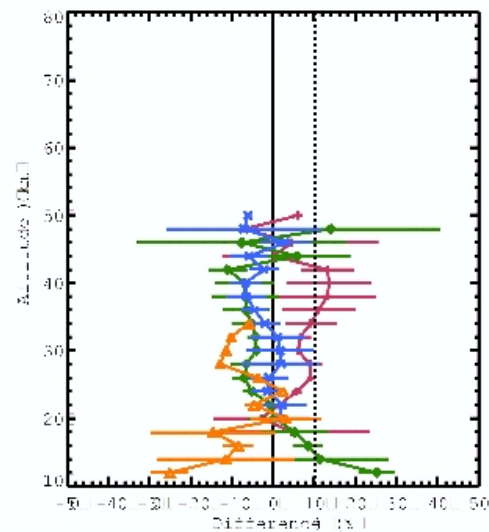
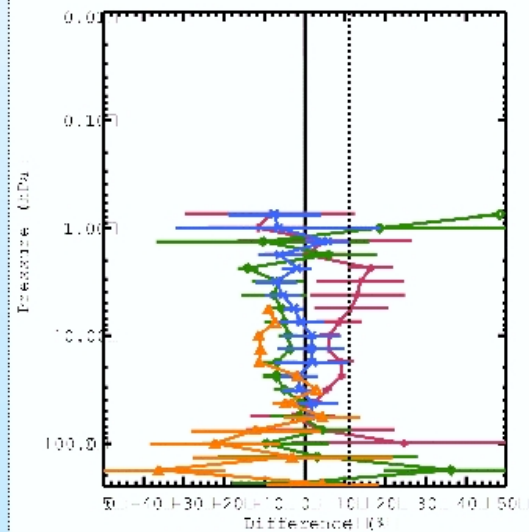
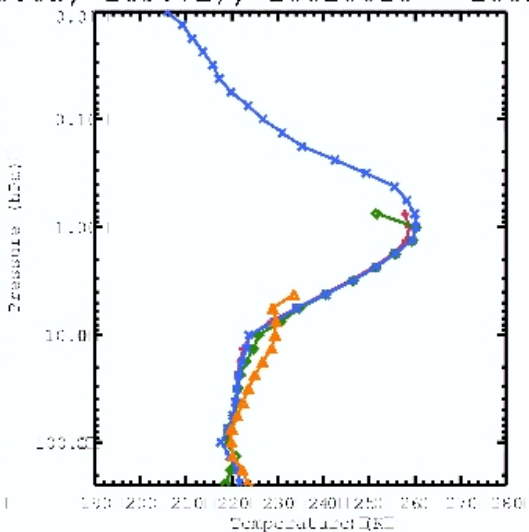
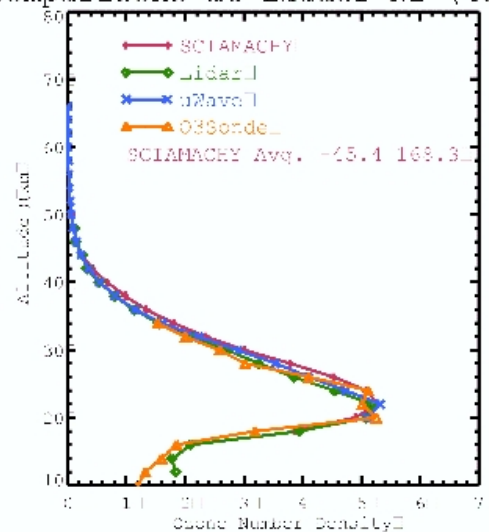
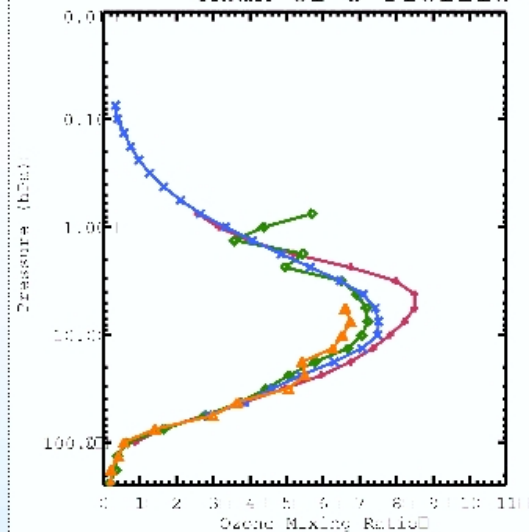
- **SCIAMACHY Offline limb ozone profiles (version 2.1)**
 - UV wavelengths (to be extended to UV-VIS)
 - 4 ozone profiles per swath, lined up in across-track direction
 - No altitude correction implemented (pointing inaccurate in 2002)
 - Data in altitude or pressure vs. partial columns or mixing ratios

- **SCIAMACHY IFE-Bremen limb ozone profiles (version 1.6)**
 - Generated from Level 1 data.
 - Chappuis band (VIS)
 - No altitude correction implemented
 - Data in altitude vs. number density

Other SCIAMACHY ozone profiles

- Nadir profiles (Van der A, KNMI; L1 calibration insufficient)
- Differential SCD profiles (Wagner, Univ. Heidelberg; experimental)
- Mesospheric ozone profiles (IFE - Univ. Bremen)
- Solar (50-70°N) & lunar (30-90 °S) occultation (IFE - Univ. Bremen)
 - * SCIA on order of 10% (solar) too high compared with SAGE II in 15-35 km region (Amekudze et al., EGU poster)

Mean of 3 Profile Comparisons at Lauder NZ (45.0S, 169.7E), 20020820 - 20020822



Difference Calculation: $\frac{(\text{Instrument Mean}) - \text{Mean}}{\text{Mean}} \times 100$
 Error Bars = $2 \times \text{Std. Dev.} / \sqrt{n}$
 Selection Criteria: $\pm 24\text{hr}$
 Satellite Lat range: -2.5 lon range:
 SCIAMACHY O3 err max (%): 25%

INSTRUMENTS:
 SCIAMACHY_v2.1
 Lidar
 uWave_Dy
 O3Sonde

SCIAMACHY V2.1 -OL
 MID-LAYER CORRECTION MADE
 LDR COMPOSITE ATMOSPHERE

Conclusions Lauder & Mauna Loa (number density profiles)

Lauder (45°S)	<u>Offline v2.1</u> [11 pairs]	<u>IFE v1.6</u> [12 pairs]
lidar & mwave:	$\pm 5\%$ (4%) 17-40 km	

Offset -1.5 km applied to both data sets.

Mauna Loa (20 °N)	<u>Offline v2.1</u> [4 pairs]	<u>IFE v1.6</u> [21 pairs]
lidar & mwave:	$\pm 3\%$ (4%) 20-40 km	

GOMOS Level 2 Processor Status

O. Fanton d'Andon, ACRI



GOMOS level 2 algorithms

Users Recommendations - December 2002

Main lessons : bright limb/scintillation effects/
underestimation of errors/ Lack of knowledge about
model contribution/ More information about observations conditions.

Actions in 2003

1. Algorithms improvements
2. Error estimates
3. Products content

GOMOS Profiles Validation

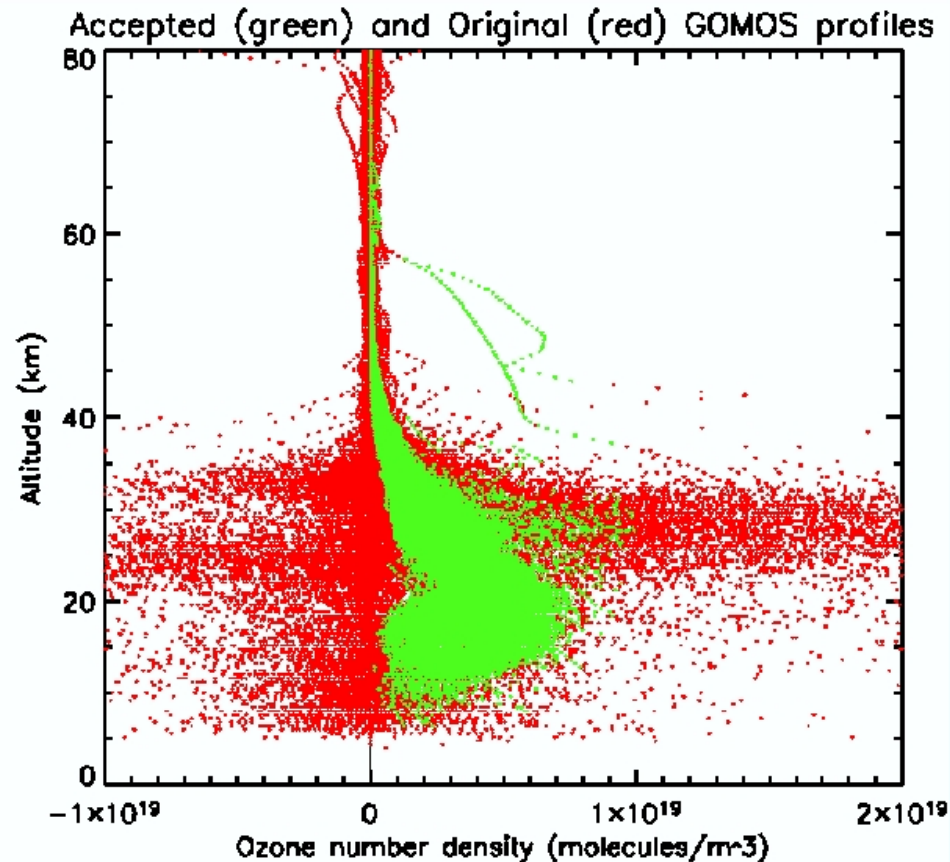
Y. Meijer, RIVM and TU Eindhoven



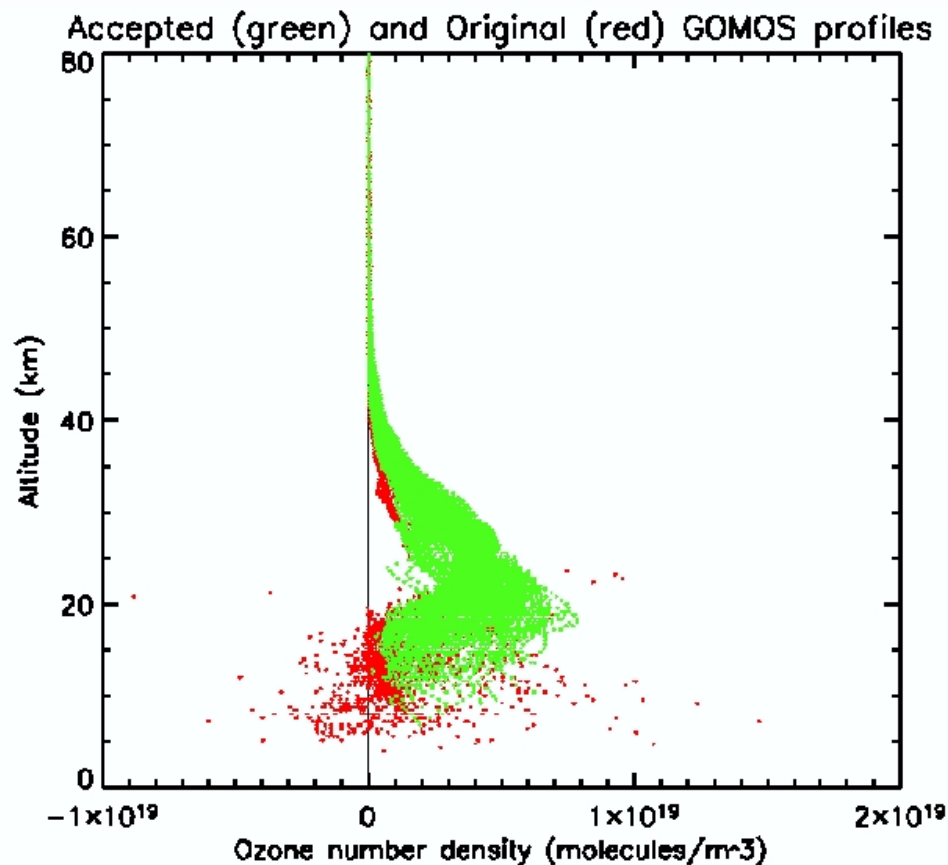
GOMOS profiles

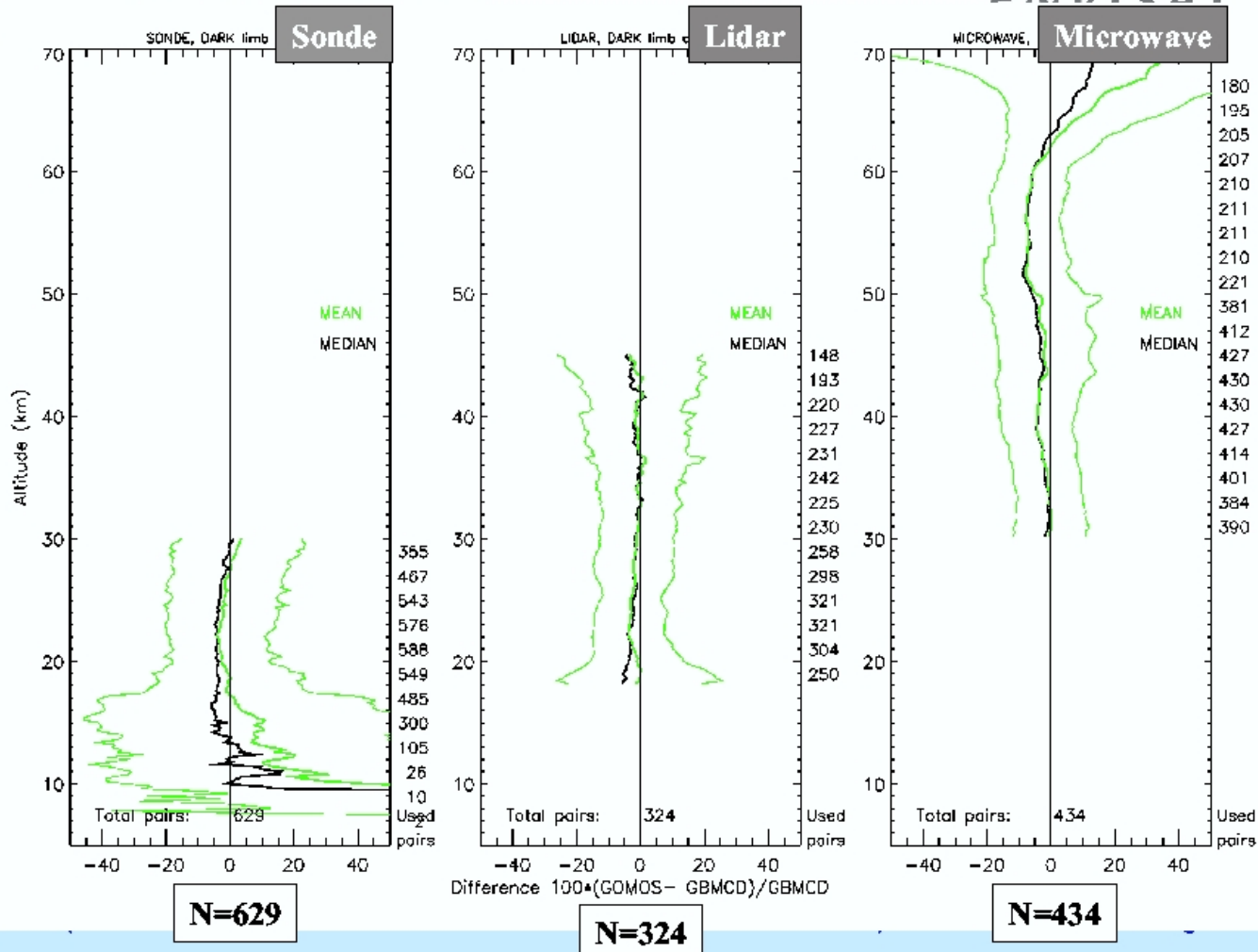


ALL
data



**Dark,
467
(462)**





Conclusions on GOMOS $O_3(r)$

- Selected GOMOS data: $SZA > 108^\circ$
- Between 18-62 km altitude, bias -10 to 0%, std. dev. 11-15%
- Analyzed parameters:
 - Star T: NO influence on bias. Data of cold stars have less data points > 50 km
 - Star M_v : NO influence on bias. Smaller std. dev. of differences with strong stars
 - Geo-location: in Polar regions GOMOS has slightly larger negative bias
 - Correlative instrument: NO influence on bias.
 - Collocation criteria: NO influence on bias.

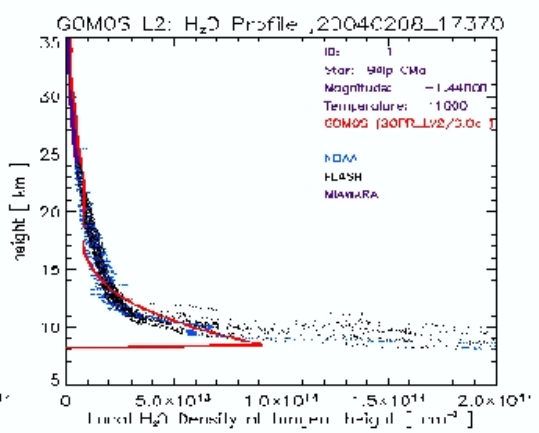
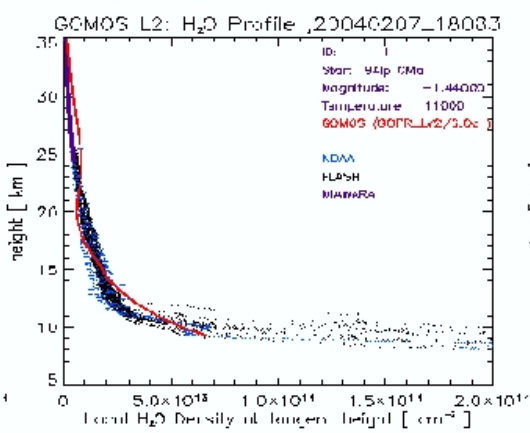
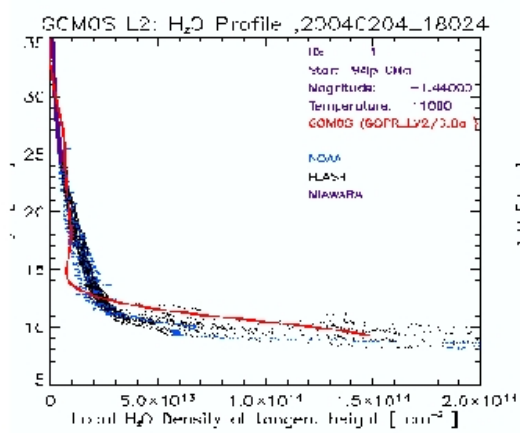
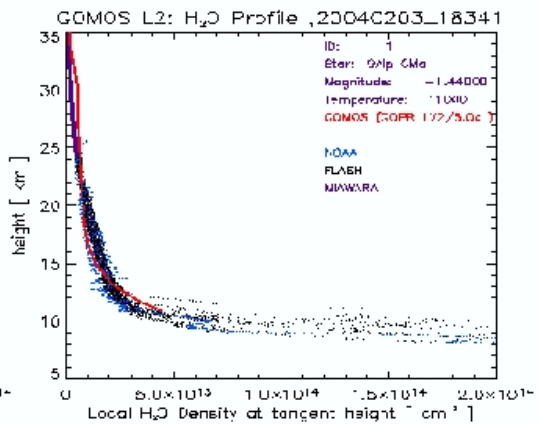
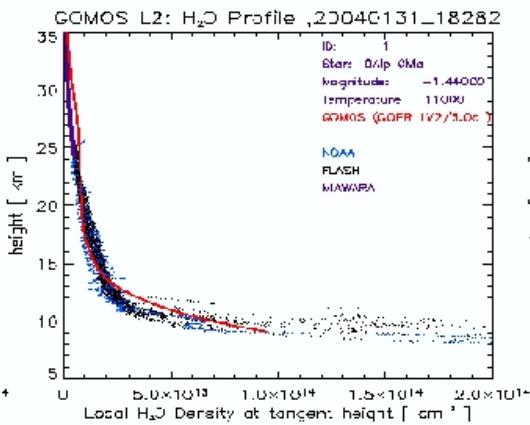
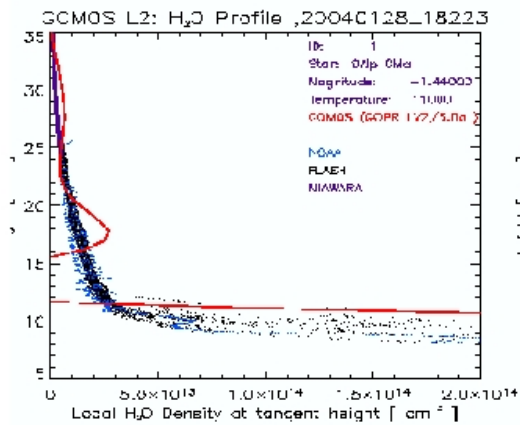
GOMOS H₂O Profiles

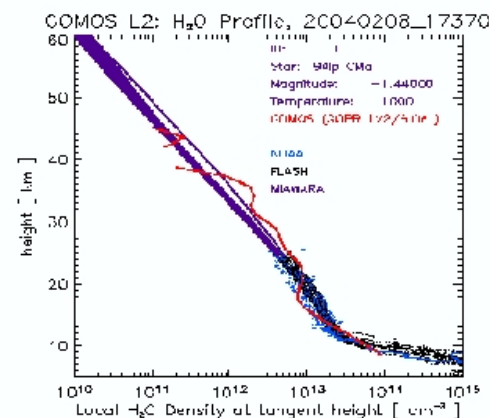
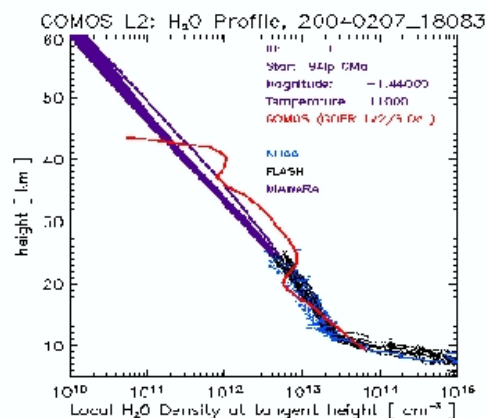
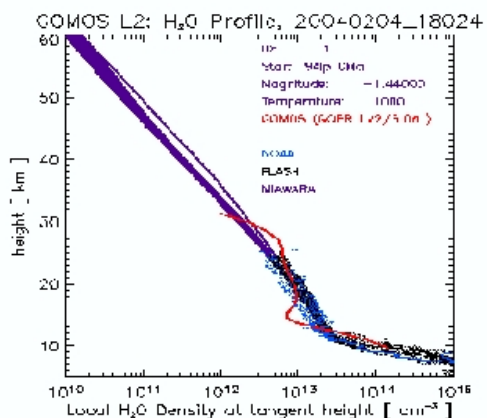
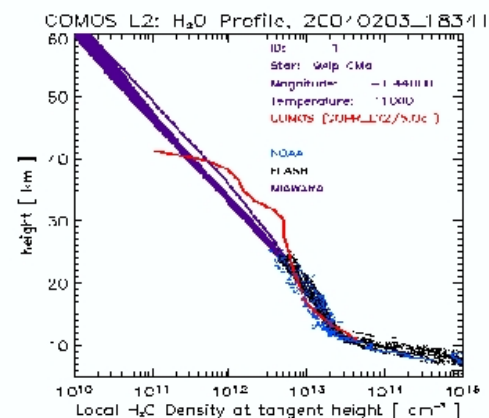
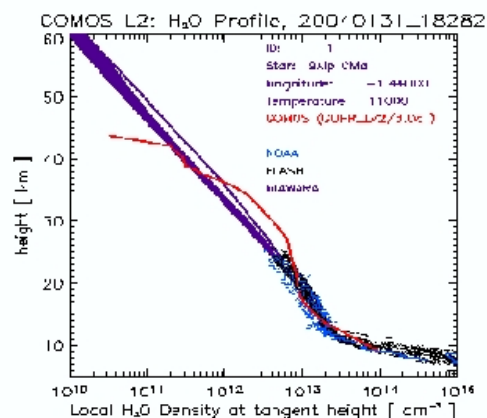
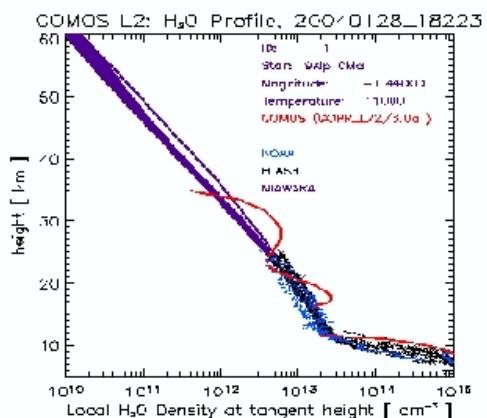
T. Suortti, Finnish Met. Inst.



GOMOS measurements during the LAUTLOS-WAVAP campaign on 28. Jan – 26. Feb 2004 at Sodankylä

Date m/dd/yy	H2O Measurements (UTC)			Specifications of the GOMOS occultation							Validation results	
	Balloon	MIAWARA	GOMOS	Orbit	Star	Mv	T (K)	TGP alt. (Km)	Type	Q. Flag	Direct match	
1.28.04		24h	18:22	10001	1	-1.440	11000	135.6	7.8	twilight	Reasonable	None
1.29.04	18:00	24h										
1.30.04	17:30	24h										
1.31.04	16:30	24h	18:28	10044	1	-1.440	11000	139.5	8.6	twilight	Reasonable	All
2.1.04		24h										
2.2.04		24h										
2.3.04			18:34	10087	1	-1.440	11000	135.3	10.3	twilight	Reasonable	None
2.4.04		24h	18:02	10101	1	-1.440	11000	136.1	8.5	twilight	Reasonable	MW
2.5.04		24h	19:09	10116	179			133.1	14.3	twilight	Zeros	MW
2.6.04	19:55	24h										
2.7.04		24h	18:08	10144	1	-1.440	11000	139.8	8.8	twilight	Reasonable	MW
2.8.04			17:37	10158	1	-1.440	11000	138.0	7.8	twilight	Reasonable	None
2.9.04			18:43	10173	179	3.032	3.032	136.5	14.4	twilight	Zeros	None
2.10.04			18:12	10187	179	3.032	3.032	136.1	15.1	twilight	Zeros	None
2.11.04	17:30	24h										
2.12.04		24h										
2.13.04		24h										
2.14.04		24h										
2.15.04	17:30	24h	18:54	10259	132	2.903	6900	137.3	15.9	twilight	Zeros	All
2.16.04	17:30	24h										
2.17.04	17:30	24h										
2.18.04	17:30	24h	19:00	10302	132	2.903	6900	135.8	16.1	twilight	Zeros	All
2.19.04		24h	18:29	10316	132	2.903	6900	139.2	15.6	twilight	Zeros	MW
2.20.04		24h										
2.21.04		24h	19:06	10316	132	2.903	6900	137.5	15.4	twilight	Zeros	MW
2.22.04		24h										
2.23.04	17:30	24h										
2.24.04	17:30	24h										
2.25.04	17:30	24h										
2.26.04	17:30	24h										





GOMOS H₂O GMBCD Conclusions

- Difficult to calculate error bars for GOMOS L2 H₂O profiles from GMBCD comparisons due to lack of suitable occultations

- Some qualitative results:
 - Bright limb occultations:
 - » Not usable
 - Twilight occultations:
 - » Brightest star (star ID 1) produced sensible H₂O profiles
 - » Due to lack of matching measurements statistic analysis was not possible
 - Dark limb:
 - » No data available for validation purposes

MIPAS L2 Changes

B. Carli, IFAC - CNR



L2 upgrades

Important dates

- **23.07.2003** updated spectroscopic database
(hitran_mipas_pf3.1)
- **04.11.2003** extension of retrieval range and
reduction of retrieval error with off-line operation

MIPAS O3 Profiles

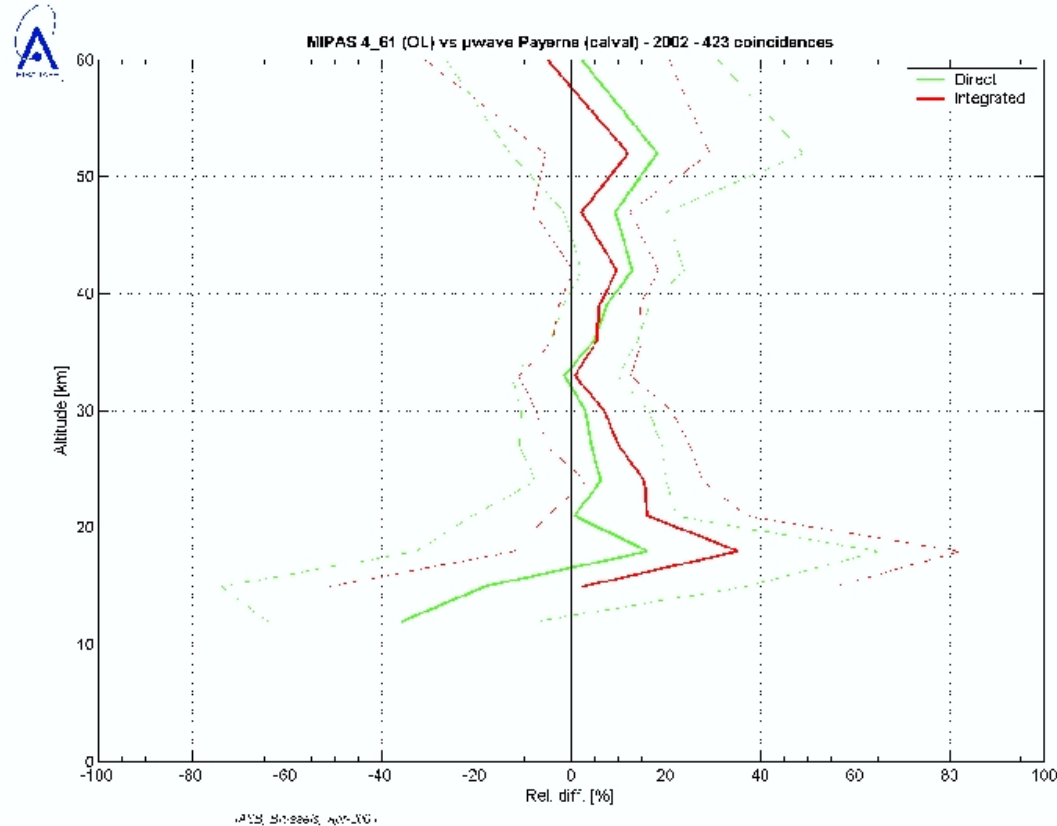
T. Blumenstock, IMK/FZK



MWR

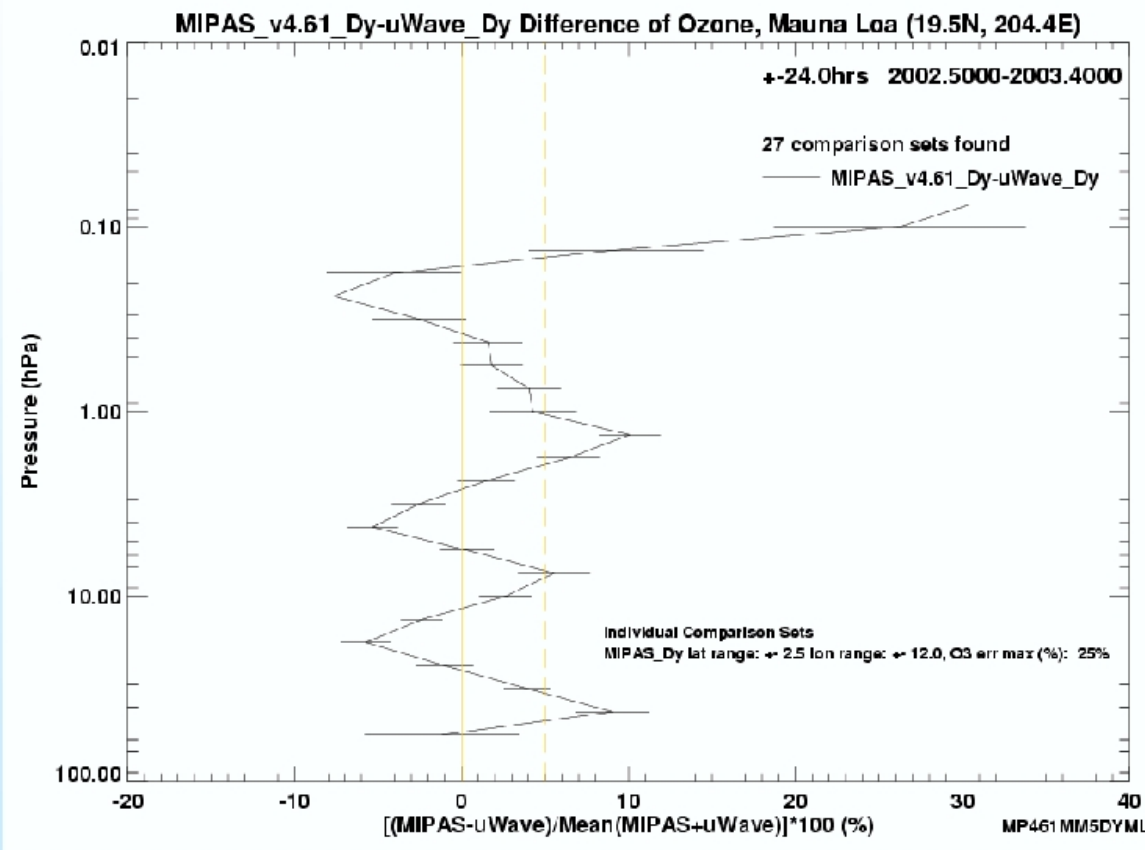
Microwave
Radiometer
Payeme, CH
Y. Calisesi

AOID 158,
C. De Clercq,
J.-C. Lambert



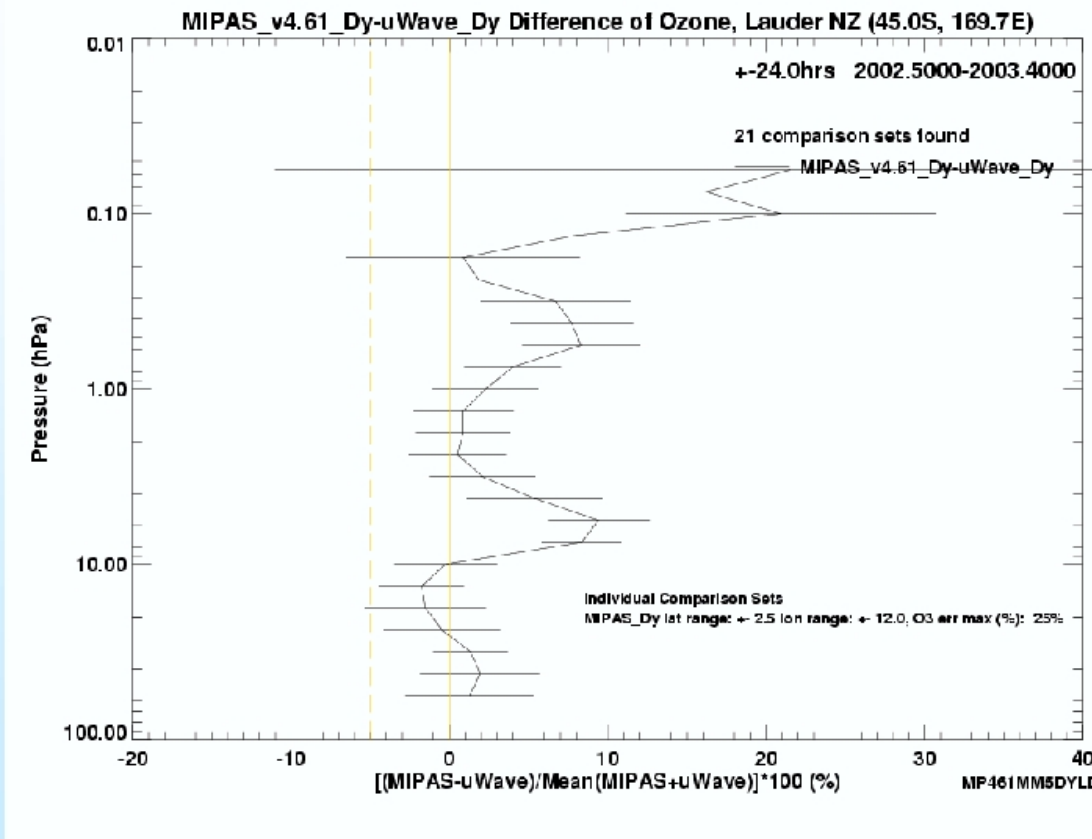
MWR

MWR
Mauna Loa
AOID 179,
I. Boyd



MWR

MWR
Lauder
AOID 179,
I. Boyd

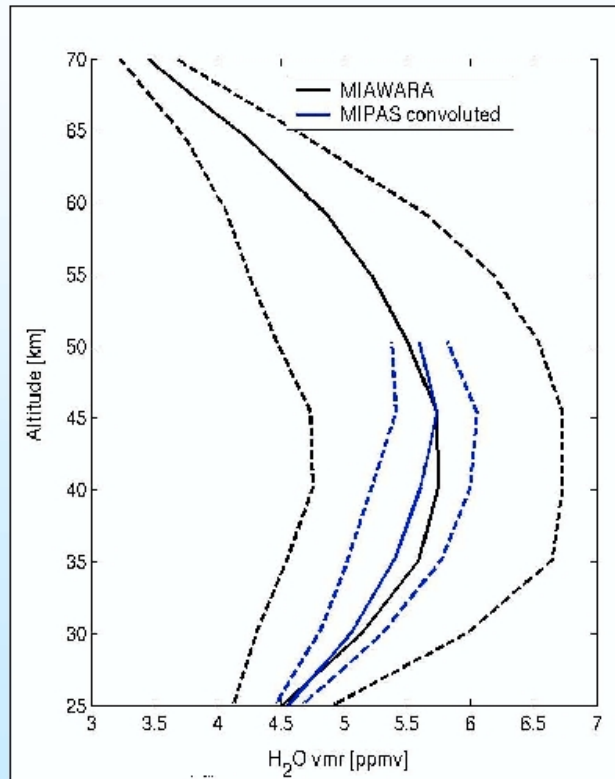


Comparisons with microwave radiometers (MWR)

Differences:

- Lauder: up to ~ 30 km: +/- 5%
- ~ 30 - 50 km: +/- 10%, above increasing
- Mauna Loa: ~ 20 km: +/- 10%; 20 - 40 km: +/- 5%
- ~ 50 km: +/- 10%, above increasing
- Payerne: > ~ 20 km: +/- 10%, below increasing
- Typ. error of MWR O₃ profiles: 20- 40 km: 10 %
- Conclusion: agreement within combined error up to ~50 km

University of Bern



Sample of Intercomparison Feb-17-2003, Bern, Switzerland

Comparison Method:

- Reducing MIPAS profile to lower microwave profile grid
- Folding MIPAS profile with microwave averaging kernels and apriori information

Further Comp. Results (Lidar/Sondes)

- General good agreement
- MIPAS H₂O < Sondes, Lidar 10 - 13 km
- Larger validation dataset would be helpful

MIPAS Summary

H. Fischer, IMK/FZK



General Remarks

- **MIPAS switched-off since March 26, 2004**
 - ❑ Problem with moving the retroreflectors
 - ❑ Investigations ongoing
 - ❑ Instrument will be operated at reduced spectral resolution (by about 41% of the previous one)
 - ❑ Regular data release planned until end of summer

- **MIPAS operational data products generally in good shape**
 - ❑ V4.61 data improved vs. old (v4.5x) versions
 - ❑ Some problem areas (e.g. at lower altitudes, sometimes biases, oscillations, ...) have been identified
 - ❑ Further improvements possible and necessary

ACVE-2 Closing Remarks

P. Snoeij, ESA



Next steps

- Assess the feasibility to incorporate the recommended improvements in the IPF
- (Re-)validate the incorporated improvements
- Start data distribution to all users with disclaimers for products not yet fully validated
- ENVISAT symposium in September 2004 is the ideal platform for more in depth discussions
- ACVE-3 in 2005 to re-address the remaining validation issues

Validation activities after the ACVE-2

- The validation activities will continue throughout the entire mission lifetime.
- More specifically:
 - the main validation phase (i.e. with intensive validation activities) is expected to be completed in 2004,
 - the long term validation phase will be associated to e.g. algorithm improvement or instrument degradation.
- Specific validation working meetings are expected to be held in 2004 - 2007.

More information on:

<http://envisat.esa.int>

<http://nadir.nilu.no/calval>