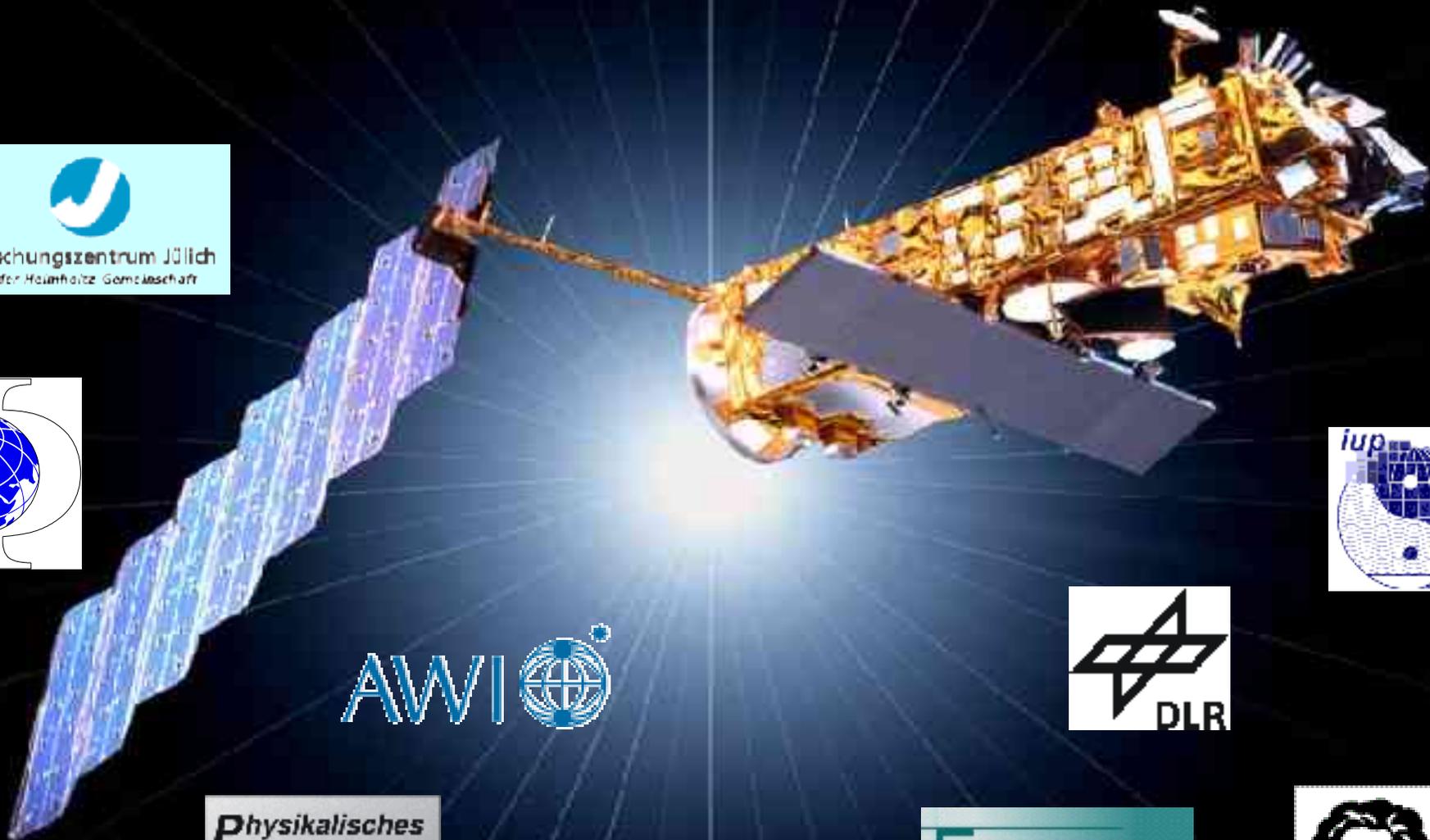
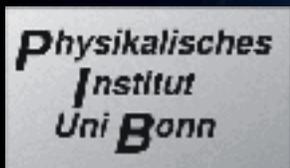
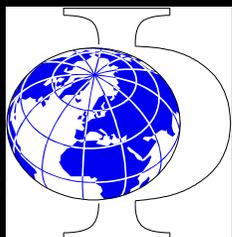


German SCIAMACHY Validation



How everything began!



- | | |
|-------------------|--|
| 20.12.1996 | SCIAMACHY Validation Document |
| 10.09.1997 | SCIAMACHY Validation Requirements – Document V8 |
| 18.02.1998 | SCIAMACHY Data Product Validation
The Needs and the German Response
U. Platt and J. P. Burrows |
| 20.03.1998 | SCIAMACHY - Validation Concept
U. Platt and J. P. Burrow |
| 23.03.1999 | Validation coordination Meeting at DLR – Bonn |
| 21.04.1999 | SCIAMACHY - Core Validation Concept
The German perspective
U. Platt, J. P. Burrows, K. Künzi, and K. Pfeilsticker |
| Nov. 1999 | First proposals for validation of SCIAMACHY
submitted to DLR |

The four Pillars of the German SCIAMACHY Validation



Ground-Based and Ship-Borne Validation

Ground based:
DOAS, FTIR
MW, LIDAR
Aerosol

Ship:
DOAS, FTIR

10 Projects

Aircraft-borne Validation

OLEX
ASUR
AMAXDOAS

4 Projects

Satellite Validation

GOME, OSIRIS
TOMS, HALOE
SAGE II + III,
SBUV II
SABER,
SOLSTICE
SUSIM
POAM III
MIPAS, GOMOS

1 Project

Balloon-borne Validation

LPMA/DOAS
MIPAS B
TRIPLE

5 Projects

Ground-based Validation



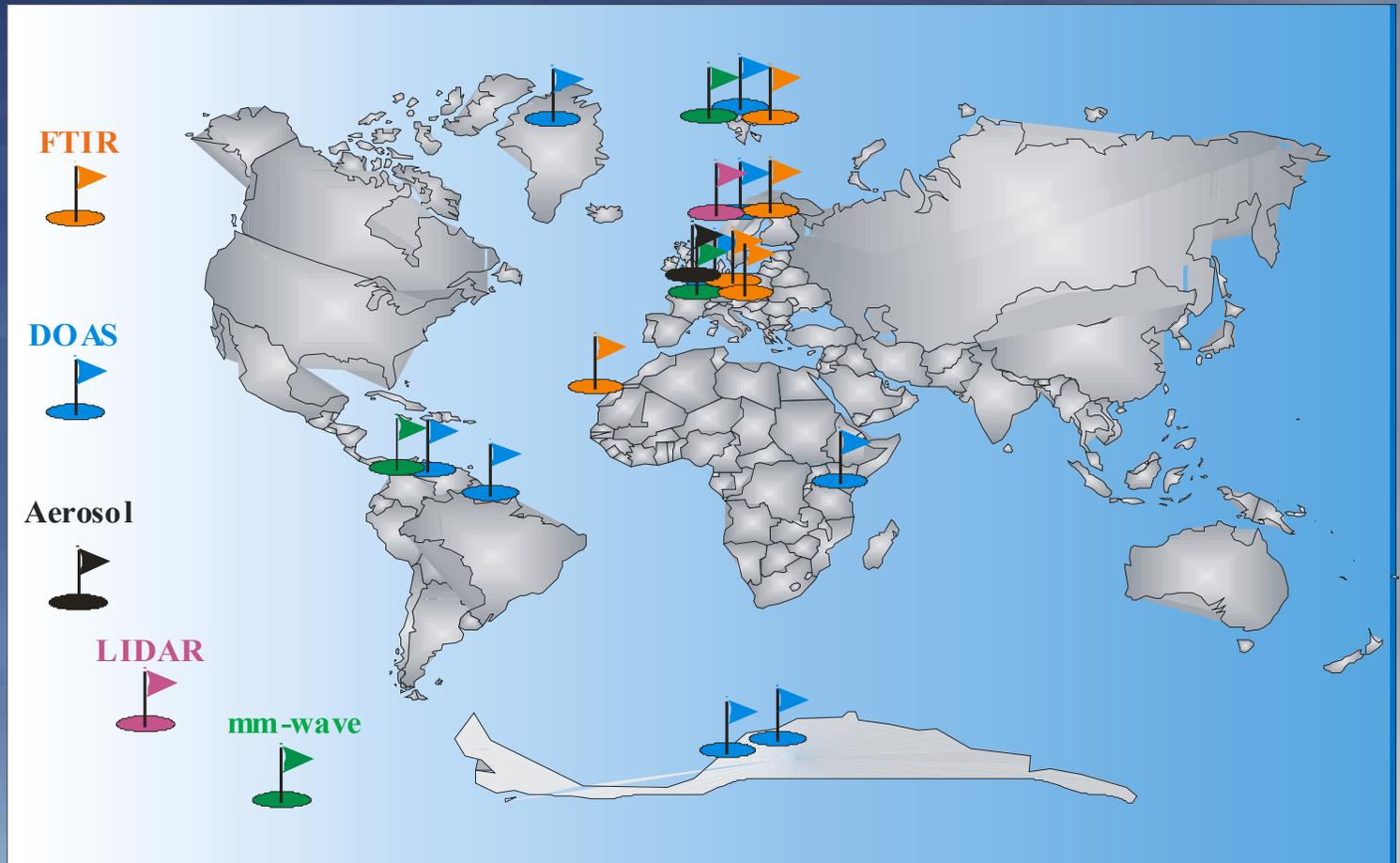
9 DOAS
Instruments

5 FTIR
Instruments

2 Microwave
Instruments

1 Lidar

1 Aerosol
Instrument



Ship-borne Validation



MultiAxisDOAS

ANT-XIX

7. Nov. 2001 until 30. May 2002*

ANT-XX

26. October 2002 until 17. Feb. 2003

ANT-XXI

20. October 2003 until 02. July 2004

ANT-XXII

12. October 2004 until 15. June 2005

FTIR

ANT-XX

26. October 2002 until 17. Feb. 2003

ANT-XXI

20. October 2003 until 02. July 2004



Route of the ANT XIX cruise
7 November 2001 until 3 June 2002

GB and Ship-borne Measurements



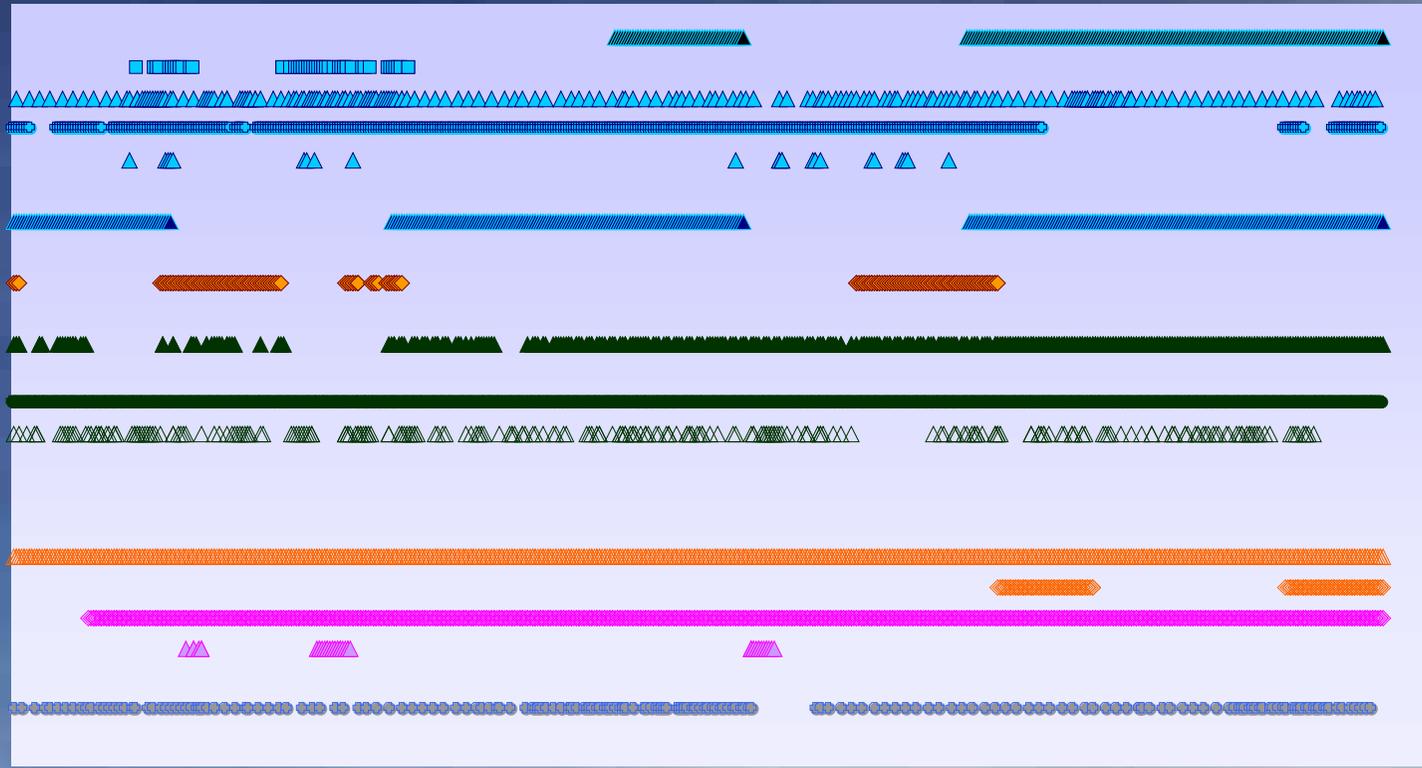
Instrument	Products
DOAS	Columns of O ₃ , NO ₂ , BrO, IO, OClO, SO ₂ , H ₂ O, O ₄ , HCHO Profiles of NO ₂
mm-wave	Profiles of O ₃ , N ₂ O, ClO, HNO ₃ , Water vapour Columns of water vapour
FTIR	CH ₂ O, CH ₄ , CO, CO ₂ , H ₂ O, HDO, N ₂ O, NO, O ₃ , NO ₂
Aerosol	AOT
Lidar	Profiles of aerosol and temperature

GB and Ship-borne Measurements Time Table

15. 07. 2002 - 01. 12. 2004



- ▲ DOAS Summit
- Lidar NyAl.
- ▲ O3-sonde NyAl.
- MW NyAl.
- ▲ FTIR NyAl. (lunar)
- ▲ FTIR NyAl.
- ▲ DOAS NyAl.
- ▲ FTIR Kiruna
- ◆ DOAS Kiruna
- ◆ Lidar Esrange
- ▲ MW Bremen
- ▲ FTIR Bremen
- DOAS Bremen
- △ FTIR Zugspitze
- △ DOAS Zugspitze
- △ MW Zugspitze
- △ FTIR Tenerife
- △ DOAS Surinam
- ◆ DOAS Merida
- ◆ DOAS Nairobi
- ▲ FTIR Polarstern
- ▲ DOAS Polarstern
- O3-sonde Neumayer
- DOAS Neumayer
- DOAS Arrival Heights



Jul. 02 Sep. 02 Nov. 02 Dez. 02 Feb. 03 Apr. 03 Jun. 03 Aug. 03 Okt. 03 Dez. 03 Jan. 04 Mrz. 04 Mai. 04 Jul. 04 Sep. 04 Nov. 04 Dez. 04

Ground Based and Ship-borne Instruments



Lidar in Esrange



FTIR on Germany highest mountain: Zugspitze



FTIR and DOAS on Polarstern



DOAS in Surinam



DOAS in Nairobi



mm-wave in Merida



Aircraft Validation with the German research aircraft Falcon



- **ASUR (Airborne SUBmilimeter Radiometer)**

Profiles of O_3 , H_2O , N_2O , ClO and BrO in the stratosphere

- **OLEX (Ozone Lidar Experiment)**

Profiles of O_3 , aerosol extinction, aerosol/molecular backscatter ratios and particle depolarisation in the stratosphere

- **AMAX – (Airborne Multi Axis) DOAS**

Columns of O_3 , NO_2 , BrO and $OCIO$ in the stratosphere and troposphere



Aircraft Validation with the German Falcon



North: 03.09.02 - 07.09.02

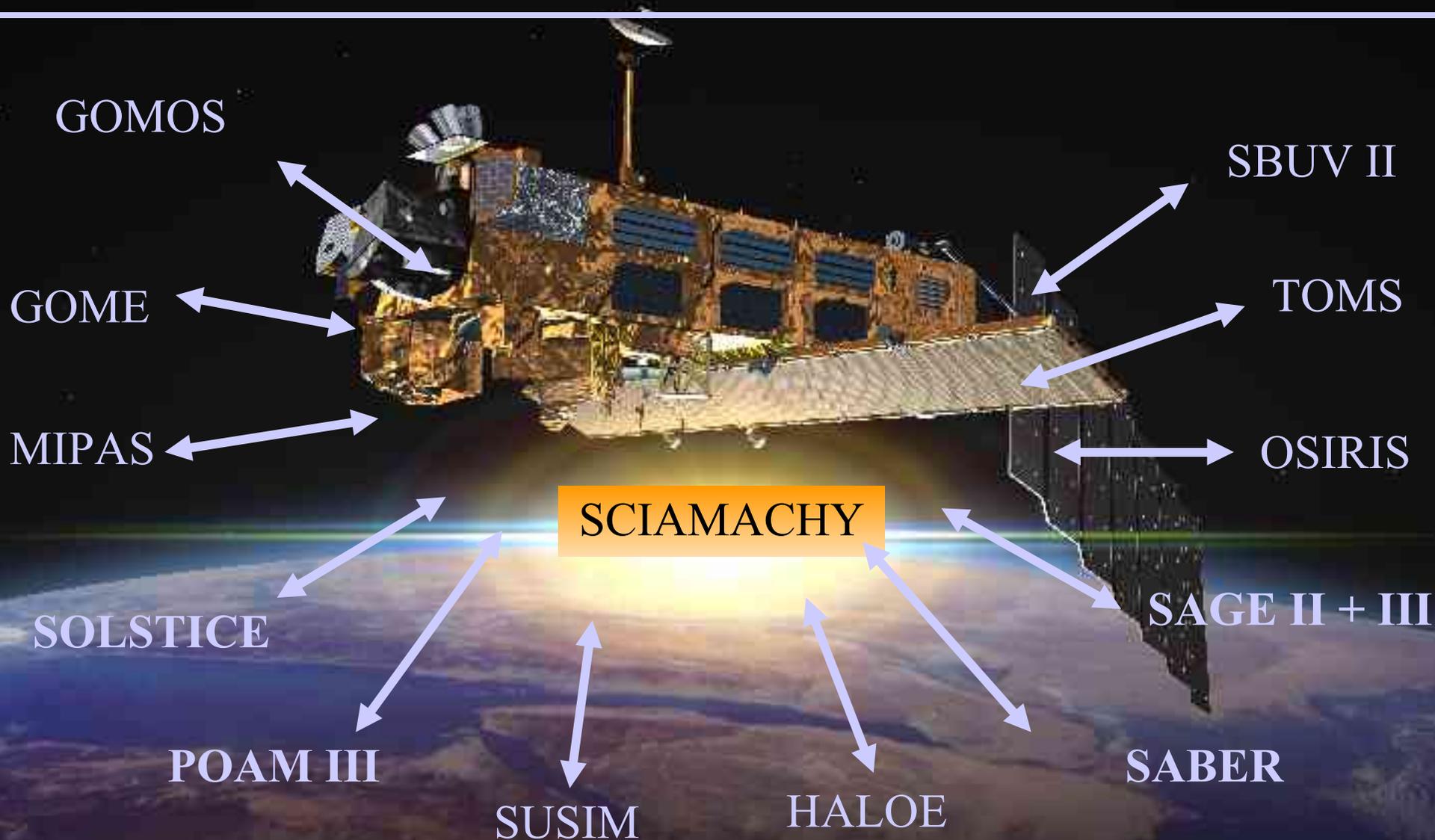
South: 15.09.02 - 28.09.02

South: 19.02.03 - 03.03.03

North: 10.03.03 - 19.03.03



Satellite Validation -1



Satellite Validation -2



Instrument	Products
SCIAMACHY	O ₃ , O ₂ , O ₂ (1D), O ₄ , NO, NO ₂ , N ₂ O, BrO, OCIO CO, H ₂ O, SO ₂ , HCHO, CO, CO ₂ , CH ₄ , aerosols, p, T
GOME	O ₃ , NO ₂ , H ₂ O BrO, OCIO, SO ₂ , HCHO, clouds and aerosols
OSIRIS	O ₃ , O ₂ , O ₄ , NO, NO ₂ , aerosols, T, p
TOMS,	O ₃ , SO ₂
HALOE	CO ₂ , H ₂ O, O ₃ , NO ₂ , HF, HCl, CH ₄ , NO
SAGE II + III	O ₃ , OCIO, BrO, NO ₂ , NO ₃ aerosols, water vapour, T, p
SBUV II	O ₃
SABER	O ₃ , H ₂ O profiles
SOLSTICE	solar UV radiation (115 to 430nm)
SUSIM	solar ultraviolet energy
POAM III	NO ₂ , O ₃ , H ₂ O, aerosols
MIPAS	O ₃ , H ₂ O, N ₂ O, NO _x , N ₂ O ₅ ClONO ₂ , CH ₄ , CFCs, p, T
GOMOS	O ₃ , NO ₂ , NO ₃ , H ₂ O, T and aerosols

Balloon-borne Validation -1



- **LPMA/DOAS**

(Limb Profile Monitoring of the Atmosphere FTIR

+ Differential Optical Absorption Spectrometry)

- Profiles of O_3 , O_4 , NO_2 , NO_3 , BrO , $OCIO$, CH_4 ,

CO , N_2O , CO_2 , $ClONO_2$, T , P ,

- **MIPAS-B** ^{Solar Irradiance (level-1)}

(Middle Infrared Passive Atmospheric Sounder
- Balloon Version)

Profiles of O_3 , N_2O , H_2O , CH_4 , NO_2 , T



Balloon-borne Validation -2



▪ TRIPLE

(Resonance fluorescence ClO/BrO instrument

+ in-situ Fluorescence Induced Stratospheric Hygrometer FISH

+ Total Air sampler

+ Diode Laser H₂O, CH₄ sensor

+ Compact High altitude in-situ laser diode spectrometer CHILD)

Profiles of

O₃, H₂O, BrO, ClO/OCIO, NO, CH₄, CO₂, F11,
F12, F22, F113, CCl₄, CH₃CCl₃, CH₃Cl, SF₆

▪ Meteorology for Validation (METVAL)

meteorological documentation,
meteorological analyses and forecasts,
for- and backward trajectories,



Balloon-borne Validation -3 Flights in 2002



Flight Date	Location	Payload
2002		
18./19. August	Kiruna	Testflight Mini DOAS
24./25 September	Air sur l'Adour	MIPAS-B
24. September	Air sur l'Adour	TRIPLE
07. December	Kiruna	MIPAS-B (AFO 2000)

Balloon-borne Validation -4 Flights in 2003 and 2004



Flight Date	Location	Payload
2003		
06. March	Kiruna	TRIPLE
20./21- March	Kiruna	MIPAS-B
23. March	Kiruna	LPMA-DOAS
09. June	Kiruna	TRIPLE
03. July	Kiruna	MIPAS-B
15. September	Air sur l'Adour	LPMA-DOAS
2004		
24. March	Kiruna	LPMA-DOAS
04. December	Teresina	TRIPLE
06. December	Teresina	MIPAS-B

Summary -Activities



- 30 Months of observations at 18 Ground-based stations
from the Arctic to Antarctica
- 6 Expedition with the German Research vessel “Polarstern”
- 4 Campaigns with the meteorological research aircraft Falcon 20
(D-CMET)
- 12 different Satellites are used to compare SCIAMACHY data
- 11 Balloon flights during 7 different balloon campaigns

Summary - Validation

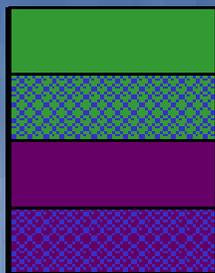


operational products

Nadir (NRT)			Limb (OL)		
UV/Vis	NIR	UV/IR	UV/Vis	NIR	UV/IR
O ₃ (v)	H ₂ O (v)	cloud fr	O ₃ (p)	H ₂ O (p)	Aerosol
NO ₂ (v)	N ₂ O (v)	cloud tp	NO ₂ (p)	N ₂ O (p)	
BrO (s)	CO (v)	AAI	BrO (p)	CO (p)	
SO ₂ (s)	CO ₂ (v)			CO ₂ (p)	
OCIO (s)	CH ₄ (v)			CH ₄ (p)	
HCHO (s)				p,T (p)	
UV index					

non-operational products

Nadir			Limb	Nadir+Limb
UV/Vis	NIR	UV/IR	UV/Vis	UV/Vis
O ₃ (v/p)	N ₂ O (v)	cloud fr	O ₃ (p)	NO ₂ (t)
NO ₂ (s/v/t)	CO (v)	cloud tp	NO ₂ (p)	
BrO (v)	CO ₂ (v)	AAI	BrO (p)	
SO ₂ (s/v)	CH ₄ (v)	AOT	OCIO (p)	
OCIO (s/v)				Occult.
HCHO (v)				O ₃
H ₂ O (v)				NO ₂
UV index /dose				NO ₃



prel. validation: OK

prel. validation: problems

verification: OK

verification: problems

Summary - Publications



- More than 70 papers published (<http://www.iup.physik.uni-bremen.de/gcvos/>)
- Two special issues of Atmospheric Chemistry and Physics (ACP):
 - 3) „Probing the atmosphere in three dimensions for SCIAMACHY“
All manuscripts in ACPD, presently in review process for ACP
 - 4) „Geophysical validation of SCIAMACHY: 2002-2004“
Deadline for submission: 4. Feb. 2005.
(<http://www.sciamachy-validation.org/sv/>)

