

The FDR4ATMOS Project

G. Lichtenberg & FDR4Atmos Team

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Knowledge for Tomorrow



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Introduction

- The Fundamental Data Record for ATMOSpheric Composition (FDR4ATMOS) project is part of the ESA Long Term Data Preservation (LTDP) programme
- It has two main tasks
 - **Task A:** Correction of SCIAMACHY degradation
 - **Task B:** Creating a cross instrument time series of radiances (Level 1) of GOME-1 and SCIAMACHY
- The project successfully concluded phase 1 with preparatory work
- Phase 2 has just started with an end in October 2022



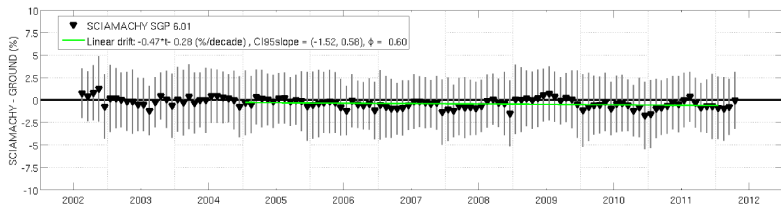
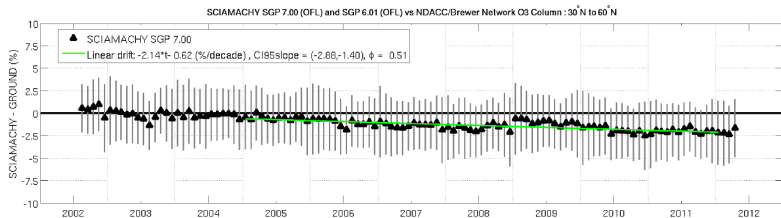
Goals Task A

- After the re-processing of SCIAMACHY data with the latest version, O_3 total column data showed a drift
- The previous processor version did not show a drift
- Algorithms for the retrieval were not changed w.r.t. previous processor version
- ⇒ Changes in Level 1 algorithms led to the observed O_3 drift
- The major Level 1 change in the new version was the degradation correction
- Subtle spectral changes mis-interpreted as a O_3 signature could lead to a trend
- In Task A the degradation correction will be updated to correct the drift



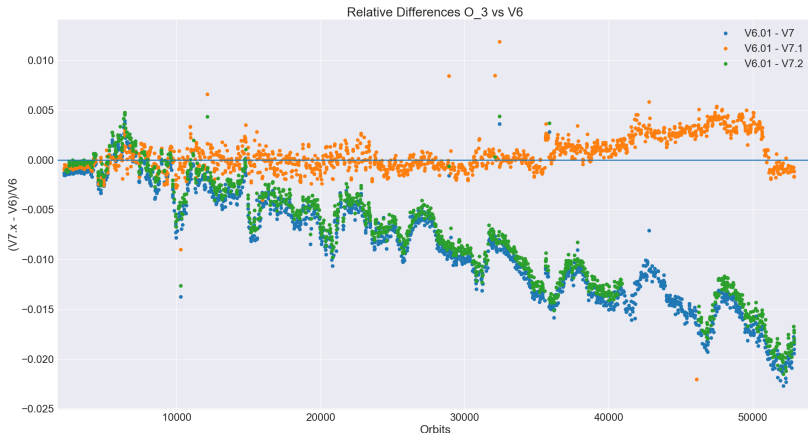
Task A: O₃ Validation

- Top: V7 with drift
- Bottom: Previous version (no drift)



Task A: Quick Look

- Check with V6 (that showed no trend): two variants of updates (green, orange)
- Validation on-going



Task A: Results

- Different solutions were checked
- The best solution leads to an overall degradation correction similar to the previous Level 1 version.
- The solution is empirical, the actual cause of the total ozone trend is not yet clarified.
- The derived total ozone is very similar to Level 2 version 6.01 with deviations below 0.3 % and no trend added.
- Validation using ground based data with an extended data set is under way



What is a FDR?

Definition (FDR)

A FDR is a long-term record of selected EO Level 1 parameters, possibly multi-instrument, which provides improvements of performance with respect to the individual mission datasets.



Reminder GOME-1 and SCIAMACHY

Both instruments span 17 years of data. The table shows only the relevant channels for FDR4ATMOS

	GOME	SCIAMACHY
Launch	April 21st 1995	March 1st 2002
End of Mission	July 2nd 2011	April 8th 2012
Orbit	sun-synchronous, 790 km	sun-synchronous, 799.8km
Local Time (DNX)	10:30 am	10:00 am \pm 5 Min
Observation Geometries	Nadir	Nadir, Limb, Occultation
Ground Pixel Size	40 \times 320 km ²	32 \times 233 km ² to 26 \times 30 km ²
Number of channels	3	8
Pixel Per Channel	1024	1024
Total Spectral Range	237 - 793 nm	212 - 2386 nm
UV Channel Range/Resolution	311 - 405 nm/0.17 nm	300 - 412 nm/0.26 nm
VIS Channel Range/Resolution	405 - 611 nm/0.29 nm	383 - 628 nm/0.44 nm
NIR Channel Range/Resolution	595 - 793 nm/0.33 nm	595 - 812 nm/0.48 nm



Goals Task B

- The main objective of the FDR4ATMOS project is to develop a cross-instrument Level 1 product for GOME-1 and SCIAMACHY for the UV, VIS and NIR spectral range
- The focus on the spectral windows used for O₃, SO₂, NO₂ total column retrieval and the determination of cloud properties.
- Contrary to other projects, we do **not** aim to build harmonised time series based on Level 2 products (geophysical parameters)
- The FDR4ATMOS products will be based on Level 1, i.e. radiances and reflectances.
- The goal of the FDR4ATMOS project is to generate harmonised data sets that allows to use them directly in long-term trend analysis, independently of the instrument.



Challenges and open points

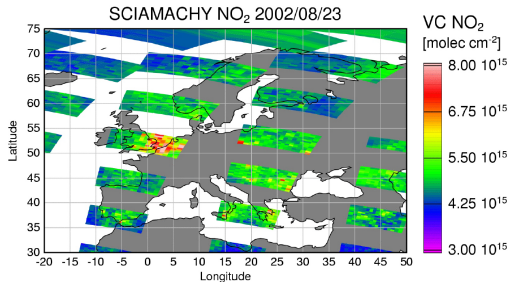
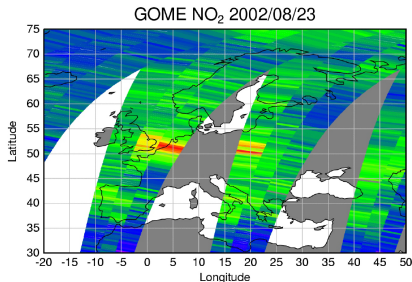
- GOME-1 and SCIAMACHY do not have exact co-locations (different orbits)
- To avoid a bias due to instrument effects comparison scenes have to cover
 - different observation geometries
 - different signal intensities
 - different signal polarisations
- Spatial resolution of GOME-1 is coarse, but downscaling SCIAMACHY is not useful for Level 2
- Contrary to previous cross-calibrations (e.g. FIDUCEO project) harmonisation has to be done on a highly resolved spectral grid



Challenges and open points - spatial resolution

Coarser GOME resolution consequences

- less cloud free pixels
- hampers detection of sources
- makes ground based validation less representative



Preparations and Input

Task Breakdown:

➤ Preparations:

- Assessment of current Level 1 data
- Establishment of requirements (from Level 2 point of view)
- Updates of degradation corrections (for SCIAMACHY see task A)
- Determination of the error sources and uncertainties

➤ Input data

- Define matching scene criteria
- Collect matching scenes
- Review on-ground data (for uncertainty analysis)



GOME Degradation

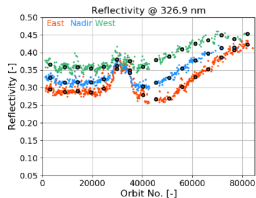
- Reflectivity changes with time, i.e. differential degradation of radiance and irradiance light paths
- Degradation depends on
 - Viewing angle (east, nadir, west)
 - Spectral region (UV, VIS, NIR)
- More scenes will be investigated, e.g., ocean, ice, deep convective clouds



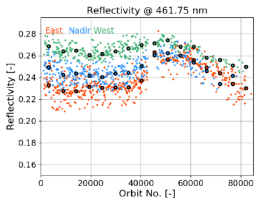
GOME reflectance at PICS Libya-4 (Sahara desert)

UV (326.9nm)

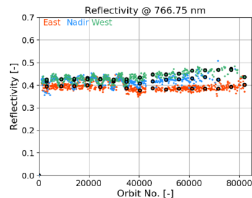
Reflectivity



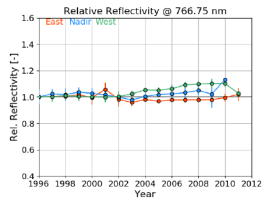
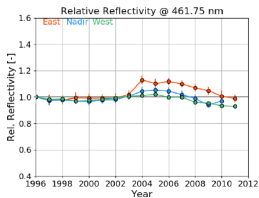
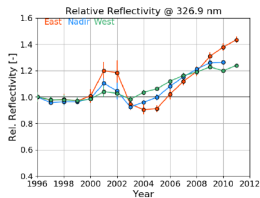
VIS (461.75nm)



NIR (766.75nm)



Relative reflectivity
w.r.t 1995

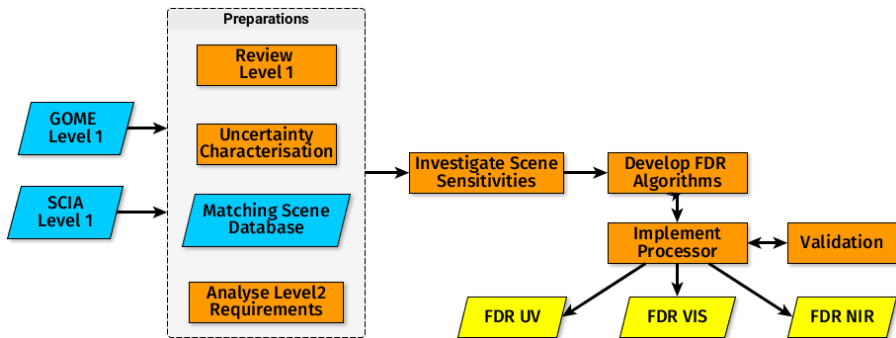


Algorithm Development and Testing

- Algorithm development
 - Investigate scene dependencies
 - Derive harmonisation model
 - Derivation of uncertainties
 - Implement processing chain
- Testing
 - Test against references (e.g. solar irradiances, CEOS ground scenes)
 - Test impact on target Level 2 species



Simplified Flow



Task B Phase 1

In Phase activities

- Summary of calibration chains and first definition of a uncertainty tree
- Assessment of Level 1 data
- Analysis of Level 2 requirements for long term time series
- Establishment of research needs
- Draft of product format
- Draft of validation plan



Summary & Conclusions Task (I)

- The FDR4ATMOS project aims to
 - Deliver high quality SCIAMACHY data by improving the degradation correction
 - Deliver FDRs on [Level 1 Basis](#)
- In phase 1 the SCIAMACHY degradation correction was updated



Summary & Conclusions (II)

- The FDR requirements and research needs were established
- Phase 2 will start in May and aims to
 - Generate FDRs of UV, VIS, NIR spectral regions
 - Build an operational, quality controlled processing chain
 - Deliver FDR products that are in a standard format and easily accessible
- We want to develop methodologies and algorithms for the harmonisation of spectrally resolved data that can also be used for current and future instruments



FDR4ATMOS Team

DLR-IMF (prime) G. Lichtenberg, S. Slijkhuis, M. Hamidouche, M.
Coldewey-Egbers, B. Aberle

IUP Bremen S. Noël, K. Bramstedt, T. Hilbig, T. Bösch

BIRA-IASB J.-C. Lambert, J. van Gent, D. Hubert

NPL UK P. Green, S. Hunt

ESS M. Krijger

ESA A. Dehn

SERCO G. Brizzi

