SCIAMACHY SCIENCE ADVISORY GROUP

25th Meeting

September 12th, 2002

at ESTEC in Noordwijk, The Netherlands

SCIAMACHY Level 2 Off-line Data Processor

Albrecht von Bargen, Bernd Aberle, Wolfgang Balzer, Adrian Doicu,

Dorit Huber, Klaus Kretschel, Sander Slijkhuis, Ulrich Steinbrecher

Presentation Overview

- **Algorithm Baseline**
- **Data Processor Outline**
- **Test Strategy**
- **Status**
- **Update Wish-List for Future Processor Versions**

Algorithm Baseline

NADIR UV/VIS

Basis:	GDP V2.4
Settings Fit-Windows:	GDP V2.7
Database:	Newest Versions (see also SADDU documents)

NADIR IR

***B**asic **I**nfrared **A**bsorption **S**pectroscopy*

Direct VCD-Retrieval

US-Standard-Climatology

(developed by R. Spurr, SAO)

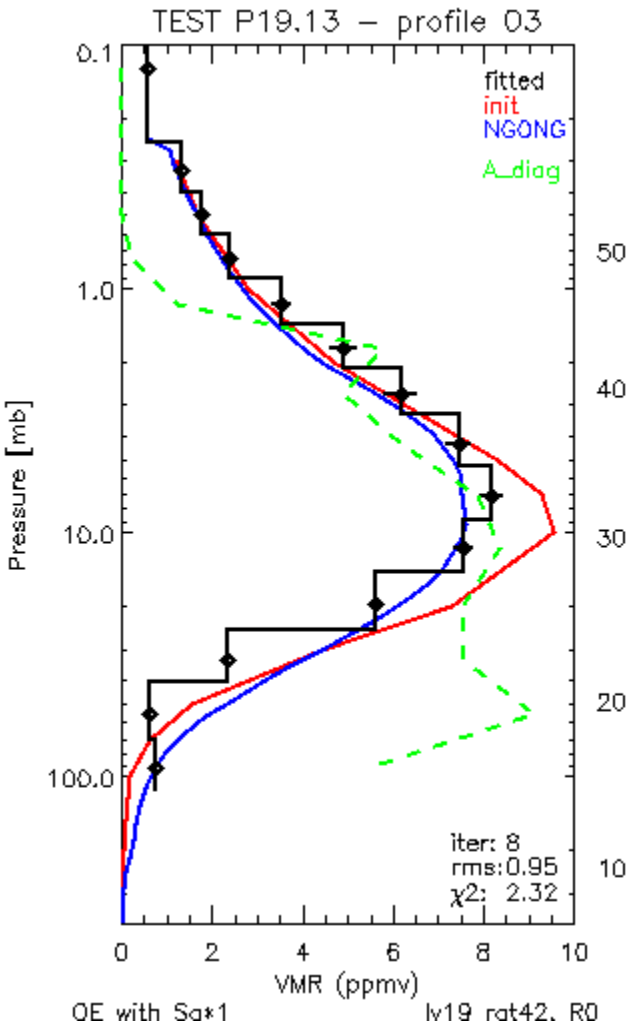
Limb

Retrieval Methods: Optimal Estimation, General Least Squares

Forward Model:	Single-Scattering	(developed by R. Spurr, SAO)
Extension 1:	+ Multiple Scattering LUT	(CDI-PI of IFE Bremen)
Extension 2:	p,T-Retrieval	(developed by DLR, but not yet implemented)

Excursion 1: Results from the Limb Retrieval Prototype (I)

- Limb scenario above the southern Sahara selected
- Calibration by DLR Level 0-1b processor with on-ground calibration data
- Spectral calibration adjusted
- Swath width around 250 km, integration time 0.375 s
- No calibrated solar measurement available
- Limb retrieval by applying “Scan ratio” method
  - Selection of one Limb scan height as reference, others ratioed to reference
  - Successful elimination of calibration errors
- Comparison of result to preliminary GOME NRT service (NGONG) at DLR
- Comment: Simulation retrievals have been “off” and were not representative !


TEST P19.13 – profile 03
fitted
init
NGONG
A_diag
Pressure [mb]
0.1
1.0
10.0
100.0
50
40
30
20
10
iter: 8
rms:0.95
χ2: 2.32
0
2
4
6
8
10
VMR (ppmv)
OE with Sa*1
lv19 rat42, R0

Excursion 2: Development of p- and T- Retrieval at DLR (I)

Retrieval flow

(1) Input of T (or p) dependent on h from climatology

(2) Define h retrieval grid for which p (or T) should be derived

(3) Use forward model as in Limb VMR retrieval, but reverse parameterisation

(4) Retrieve p (or T) at given retrieval grid and take into account that solution must be “close” to barometric formula.

(4) If needed, extrapolate / interpolate p (T) profile using barometric formula

Retrieval Method

Iteratively Regularised Gauss-Newton Method

(Tikhonov regularisation with variable regularisation parameter)

Excursion 2: Development of p- and T- Retrieval at DLR (II)

Retrieval Method Description

- Regularisation Matrix
  - ⇨ Combination of different derivative orders
  - ⇨ Diagonal weighted matrix
  - ⇨ Exponential decay for a-priori covariance matrix
- Sequence of regularisation parameters
  - ⇨ L-curve criterion
  - ⇨ Noise level criterion
- Stopping Rule: Discrepancy principle

Pressure Retrieval:

- ln(p) instead p
- L2-regularisation matrix
- L-curve criterion

Temperature Retrieval:

- L1-regularisation matrix
- L-curve criterion

Preliminary Results with self-consistent test data:

- Synthetic initial profile which deviates around 10% from “true” profile.
- Results agree within 1% with “true” profile for p; and within 1 K for T.

Data Processor Outline (I)

Goal:

- Open System: flexible and extensible
- Well-defined System-test Procedures
- Integration of different languages (worlds)

Constraint:

- Speed

Realisation:

- Object-oriented Design
- System-design UML-supported
- Well-defined Interfaces

Data Processor Outline (II)

Note: Change in architecture

Application shifted to Retrieval Server

Ground Segment (D-PAC)

PSM-Connection

Main Control

Retrieval Input

Retrieval Output

DISPATCHER

Database Server

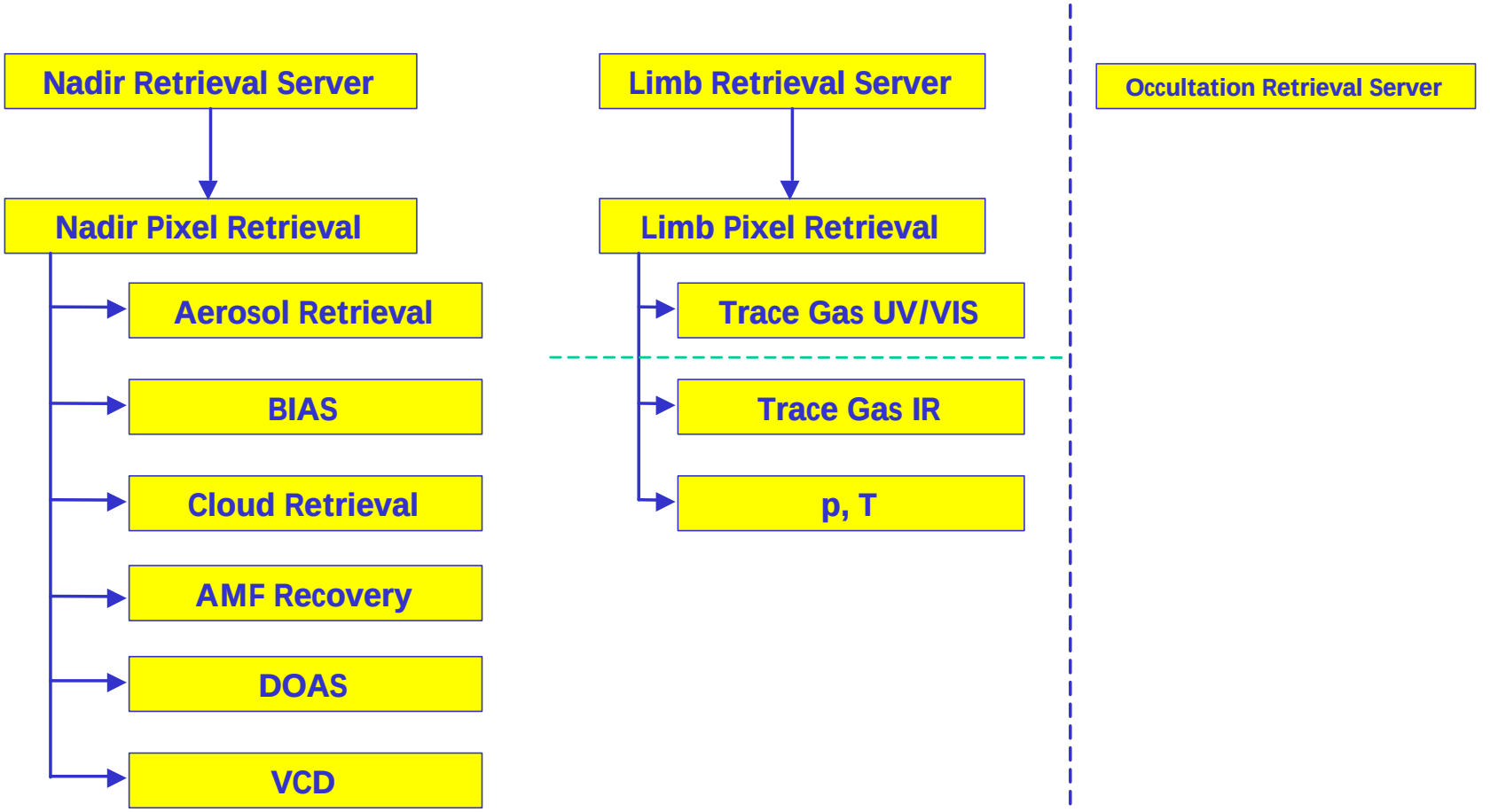
Parallel Processing of States (up to around 70 Retrieval Server):

Communication via Dispatcher,

Access to Data via Retrieval Input, Retrieval Output, and Database Server

Applicator: 1b to 1c	Applicator: 1b to 1c	Applicator: 1b to 1c	Applicator: 1b to 1c
Retrieval Server	Retrieval Server	Retrieval Server	Retrieval Server
Pixel Retriever	Pixel Retriever	Pixel Retriever	Pixel Retriever

Data Processor Outline (III)



Software Test Strategy

- Every Class is checked for its own by tests of every attribute and method.
- For each class, a standardised test class is defined.
- Comparison against reference data is also standardised.
- Pass/Fail criteria can be set by an “epsilon”.
- Class dependencies are covered by “cascading” tests.
- An implementation is finished, if also the tests are passed.
- Documentation is part of the test procedure.
- The reference data are the NRT test data.
- In case of Limb retrieval, reference data are generated by the original prototype.

Software Implementation Status

- All Retrieval Servers (Nadir / Limb) implemented, integrated and tested.
- All Pixel Retrieval Servers implemented, integrated and tested.
- All algorithm parts (except Limb IR & p/T-Retrieval) implemented, integrated, and tested.
- The Application (Level 1b to Level 1c) has been successfully moved within the architecture, re-integrated, and tested in the operational environment.
- The operational system has been successfully integrated for all parts, the total chain has been successfully tested on the target system (Linux Cluster).
- Performance tests have been undertaken for the operational system on the target system except the Limb part (the latter is ongoing).
- In principle, the SCIAMACHY L2 Off-line Processor is ready, except some test procedures for the operational environment, especially wrt. Limb.
- Performance for Nadir: 8 min / state (2 DOAS windows, all BIAS applciations)
  Thus, we estimate: around 15 min /state for Nadir

Documentation Status

- **Algorithm Theoretical Baseline Document (ATBD), update ongoing**
- **Architectural Design Document (ADD), to be revised**
- **DOC++ Code Documentation (HTML-Format), online update**
- **Software Validation Verification Plan (SVVP), online update**
- **Test Status Report (not public), online update**
- **Code Status Report (not public), online update**

- **A set of documents is provided on November 30th, 2002, including ATBD.**

SCIAMACHY L2 Off-line Updates: Open List

- **Update of Nadir UV/VIS:**
  - **Update of DOAS algorithm to GDP DOAS Version 3.0**
  - **Inclusion of cloud algorithm "FRESCO"**
- **Update of Nadir IR:**
  - **Extension for additional climatologies (AFGL instead US Standard)**
  - **Exchange of numerical fit routines / Exchange of retrieval method**
- **Inclusion of line-by-line code (Spectral region: Infra-red)**
- **Extension of Limb Retrieval:**
  - **Implementation of p, T retrieval**
  - **Extension of multiple scattering correction tables**
  - **Extension to IR spectral region**
- **Please note: This is an open list and you are invited for extension !**