

## Determination of Aerosol Optical Thickness from SCIAMACHY L1 Data

Project: SIAValCal 50 EE0012

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### Outline:

Present situation

Approaches for SCIAMACHY aerosol retrieval

Results

Validation

Conclusions, Outlook

## Problems in Aerosol Remote Sensing, using SCIAMACHY

Aerosol remote sensing relies very sensitive on an accurate determination of TOA reflectance

$$\rho_{TOA}(\lambda) = \frac{\pi \cdot L(\lambda, z_S, a_S)}{E_0(\lambda) \cdot \cos z_0}$$
$$\rho_{Aer}(\lambda) = \rho_{TOA}(\lambda) - \rho_{Ray}(\lambda) - \rho_{Surf}(\lambda)$$

SCIAMACHY TOA reflectance of regular L1 L1c processing until now doesn't fit the requirements for an aerosol remote sensing:

TOA reflectance is significantly too low for this purpose, e.g. present radiance calibration underestimates the TOA reflectance significantly.

Bias from E – W side of the scan, caused by the polarization correction.

– Both aerosol products (AAI, AOT) suffer from this insufficient radiometric calibration. (AAI ~ 8, AOT < 0)

## Overview of the Results of the Project

Validation data for AOT

Own measurements with the CIMEL sun- / sky-radiometer

AERONET data

Development and test of an Retrieval Program for the determination of spectral AOT – called BAER (Bremen AErosol Retrieval)

Tested with SeaWiFS, MERIS und MODIS L1 data  
validated with the validation data

First test now with SCIAMACHY L1c data

## Validation Data, Instruments

ASP-5



CIMEL 318



## Spectral AOT measurements in Bremen

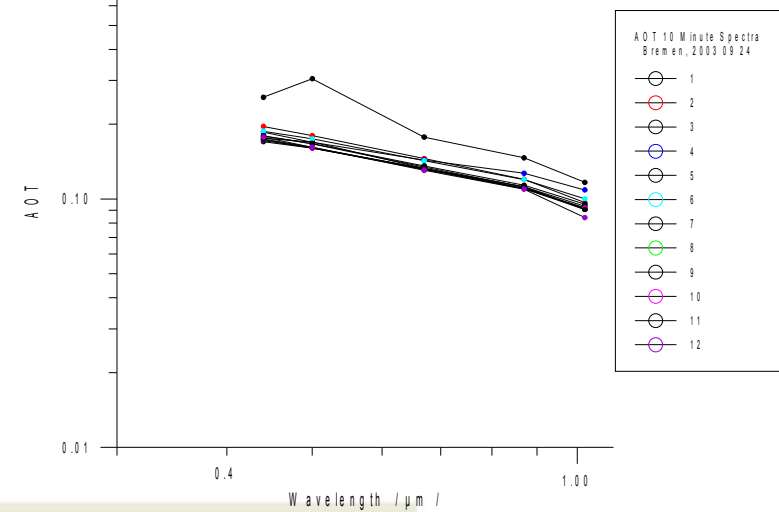
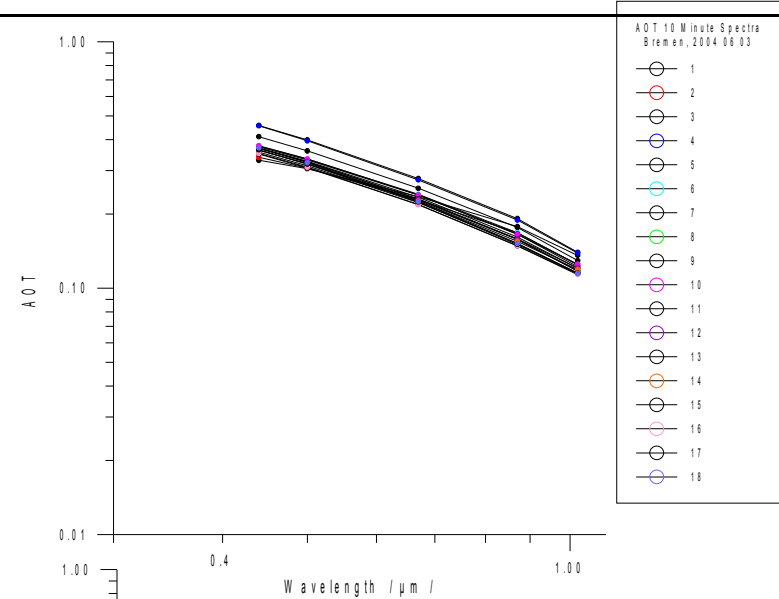
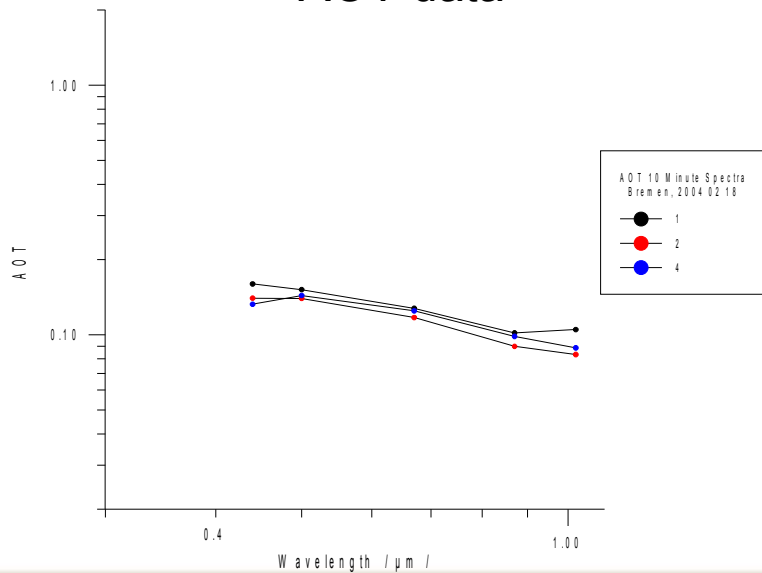
Time: Sept. 2002 – Dec. 2004

Cloud-free overflight times of ENVISAT

Available over web-page:

[www.iup.physik.uni-bremen/~hoyning](http://www.iup.physik.uni-bremen/~hoyning)

### AOT data



## Attempts to overcome AOT retrieval problems for SCIAMACHY

Situation: for SCIAMACHY aerosol products:

validation data, however no aerosol product to validate, because of calibration issues of L1 data

Determination of 'correction factors'  
Comparisons with RTM (DAK - KNMI)  
other satellite observations  
(IUP)

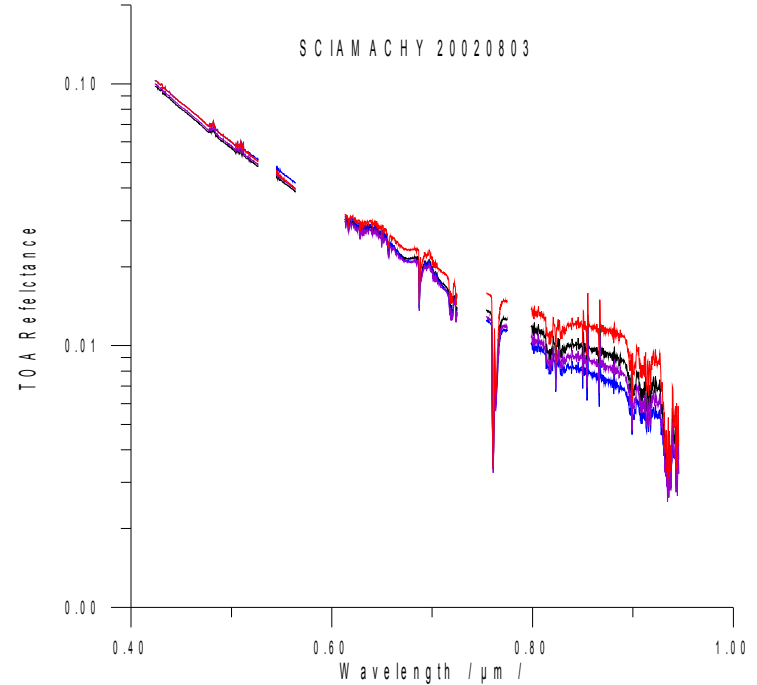
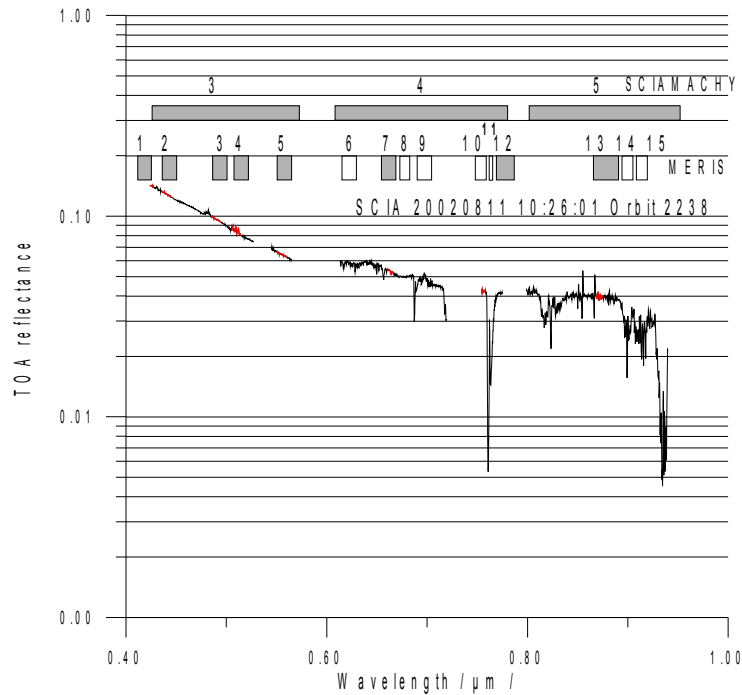
Comparisons with  
(GOME, MERIS – KNMI,

### MERIS comparison

Recalculation of the radiometric key data (IUP)  
Spectralon calibration, S. Noel, K. Gerilowski

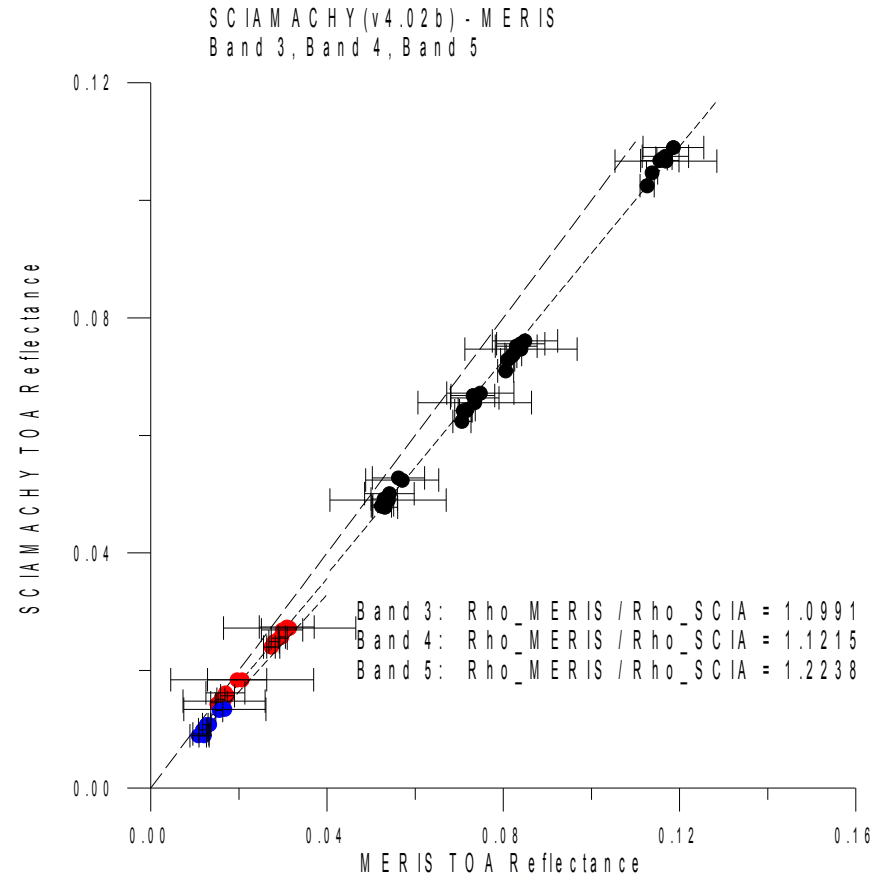
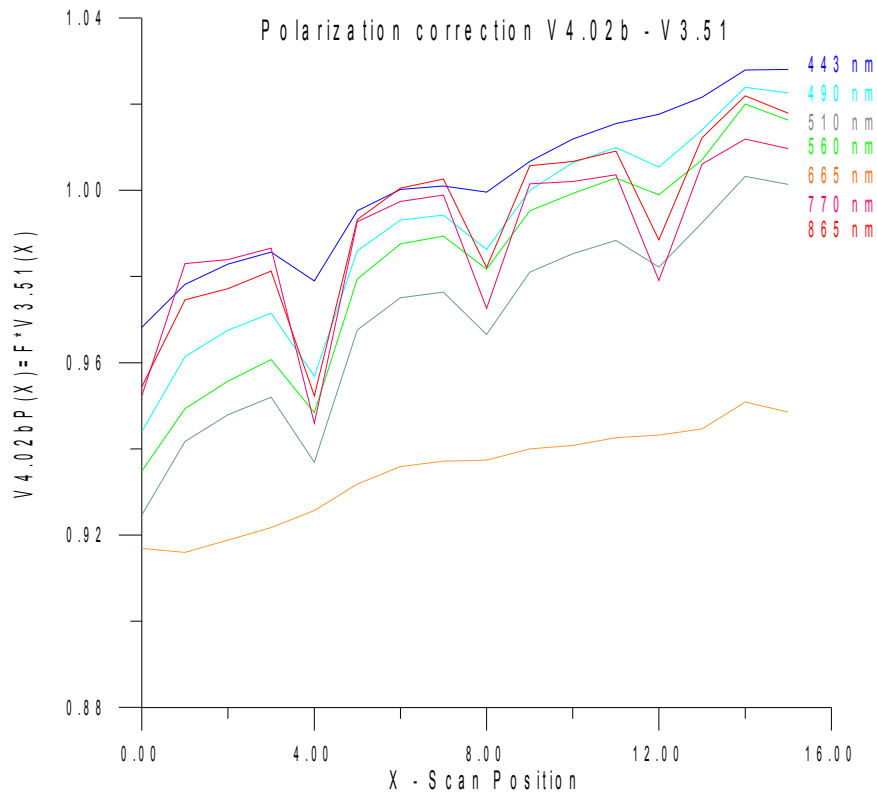
direct way,  
now first processed data from SRON

## Intercomparison SCIAMACHY – MERIS Data



Collocated MERIS + SCIAMACHY scenes  
MERIS  
comparison of TOA reflectance of both instruments  
TOA reflectance integrated to SCIAMACHY  
resolution

# SCIAMACHY - MERIS



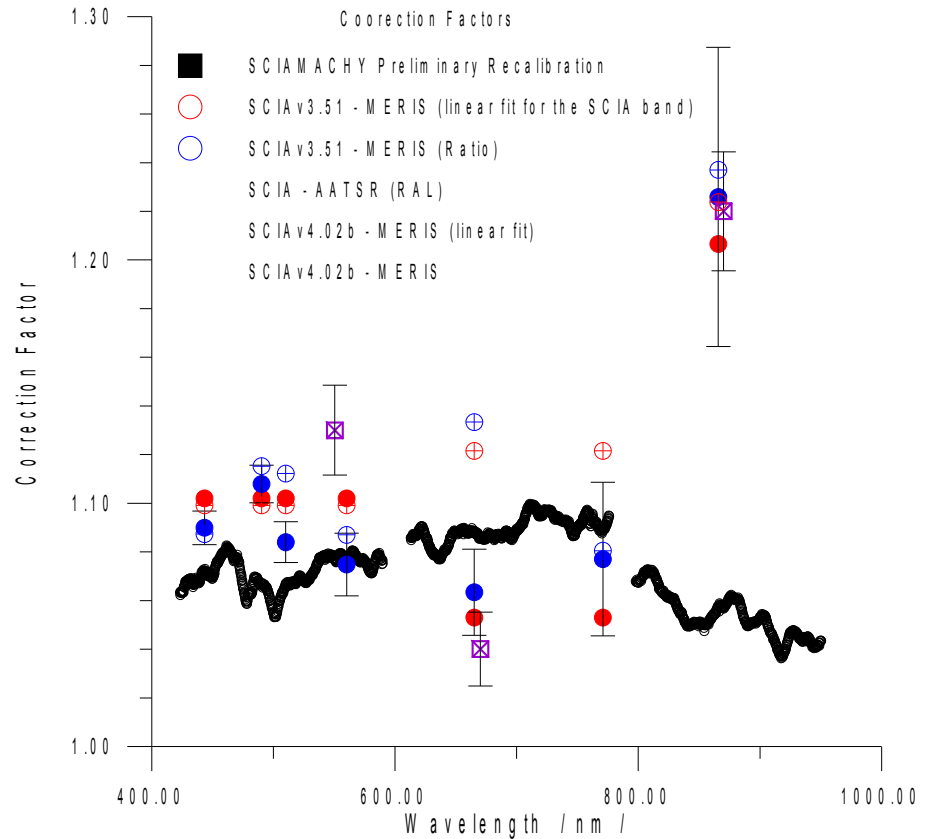


## Comparison of Correction Factors

Correction factors to the TOA reflectance obtained with L1 data from V4.02b for different comparisons:  
**MERIS**  
 AATSR (RAL data)

Correction with new radiometric key data

good agreement in VIS  
 discrepancy in NIR region



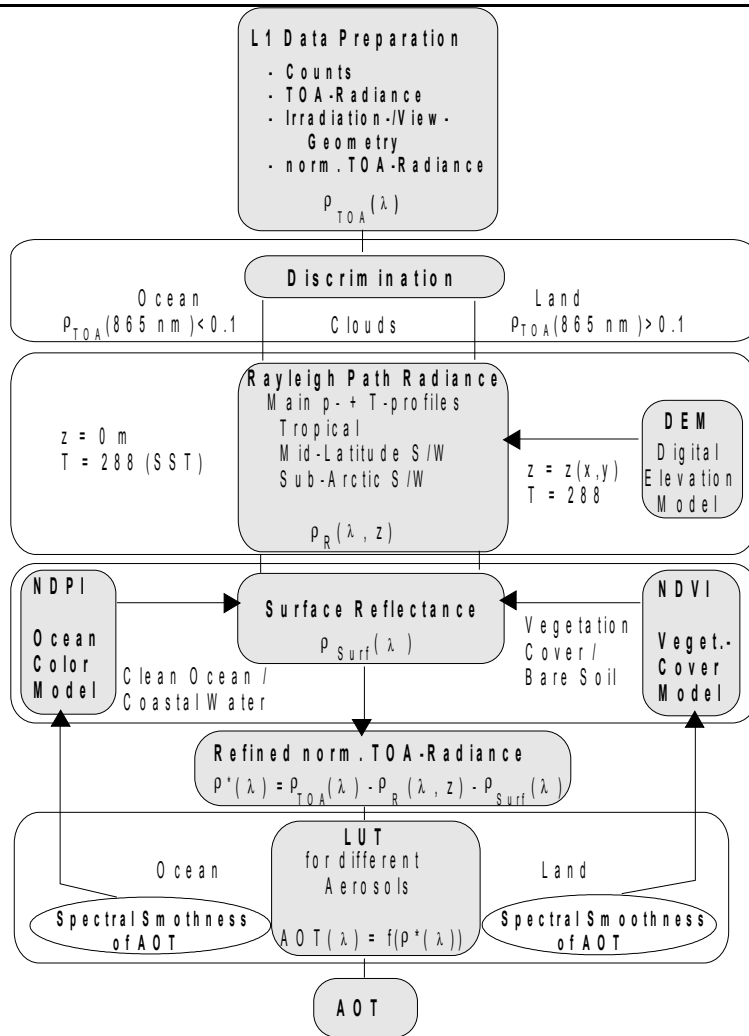
## AOT Retrieval

BAER (Bremen AErosol Retrieval) approach used

Special versions for MERIS and SCIAMACHY developed

Interface to SCIAMACHY L1c data

- a) with correction factors
- b) with new radiometric key data



Data preparation

Case discrimination

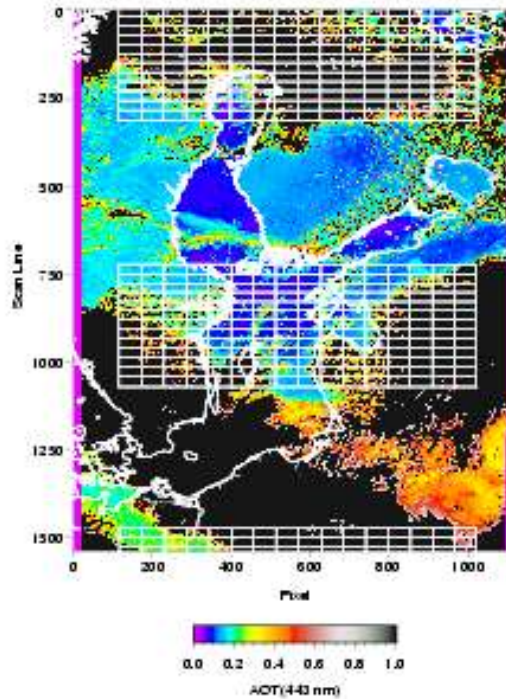
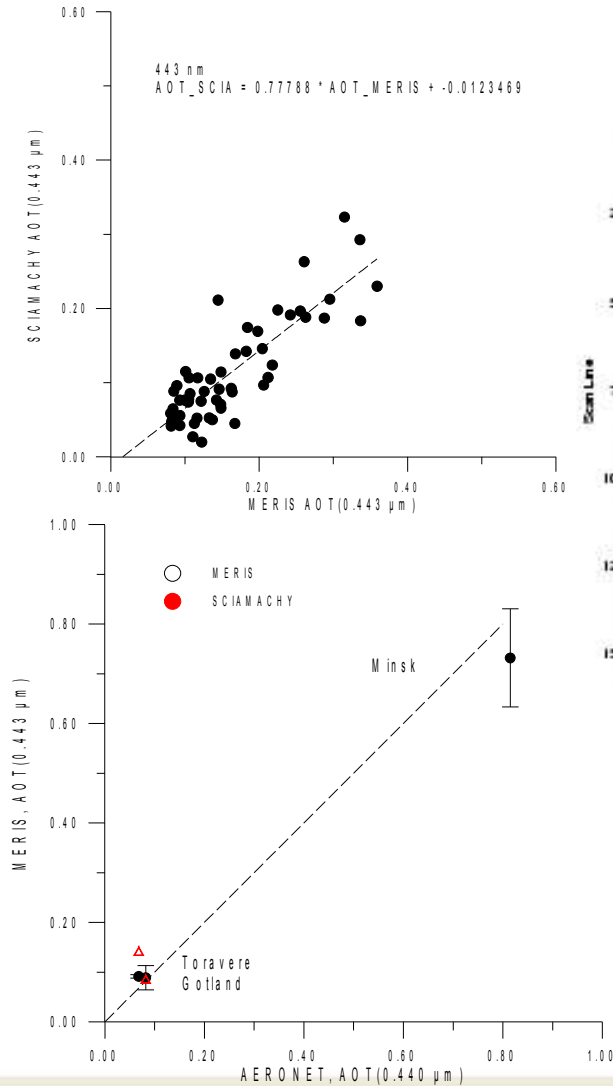
Subtracting Rayleigh path reflectance

Subtracting surface reflectance

Applying look-up-tables and smoothness criteria

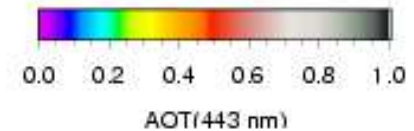
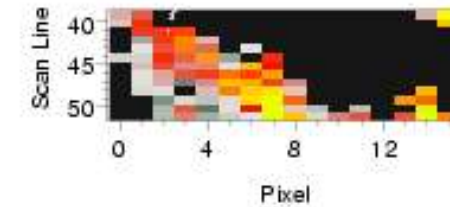
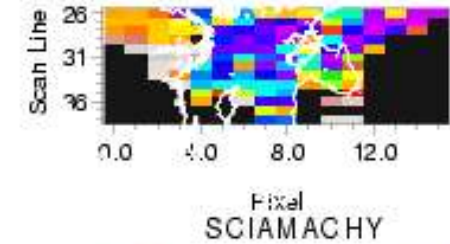
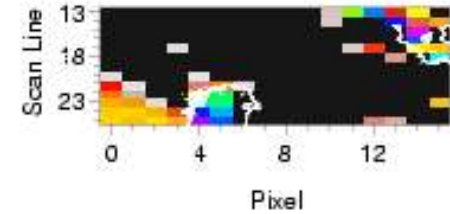
von Hoyningen-Huene et al.: JGR vol 108 No D9 4260. 2003

# AOT Retrieval



MERIS

Correction factors applied,  
 BAER approach used,  
 AOT for central part of  
 scene comparable



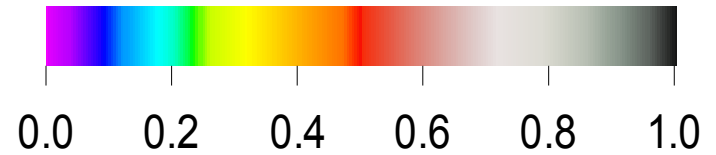
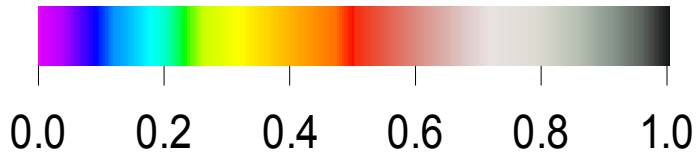
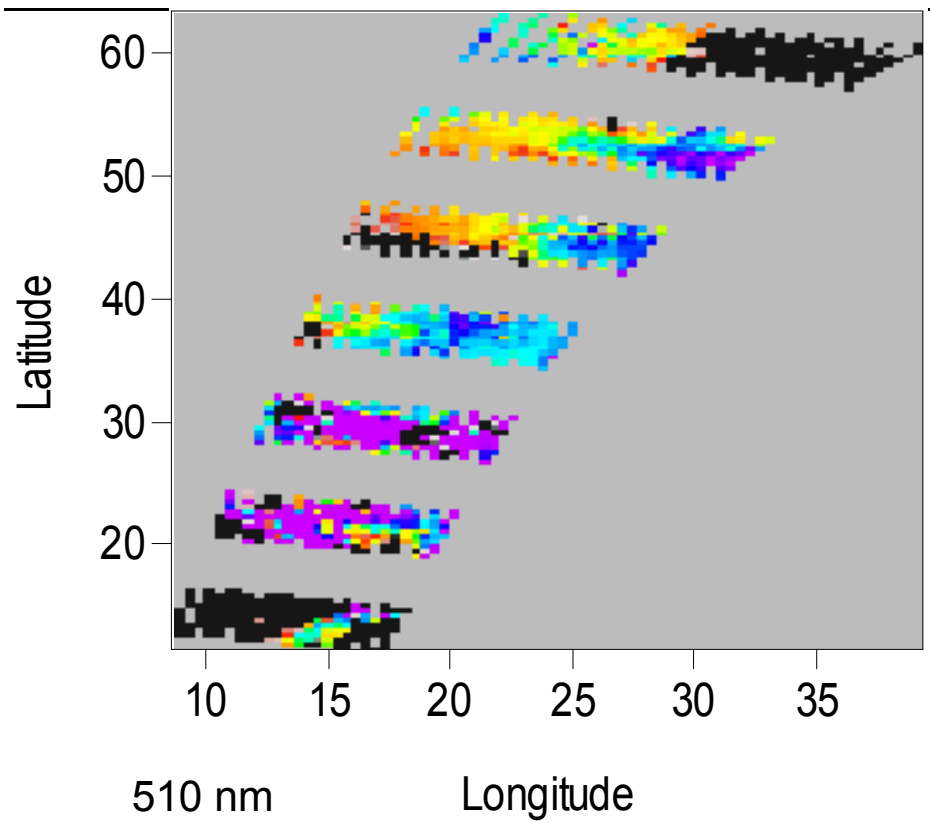
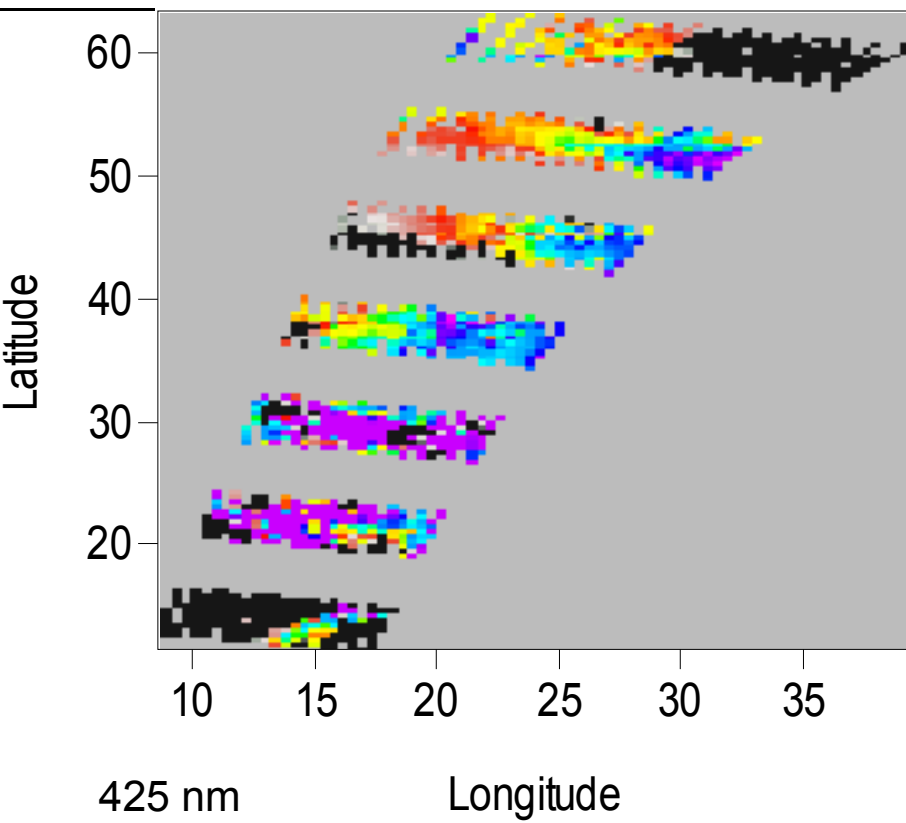
## SCIAMACHY AOT Retrieval

Scene of 23. Aug. 2003, orbit 2509 of verification orbits

New radiometric key data used  
IFE spectralon calibration,  
SRON processing

No more correction factors for radiance required

Polarization correction of processor version 4.02b,  
no new data available



SCIABAER\_SCIA\_20030823sp\_AOT1R\_s

SCIABAER\_SCIA\_20030823sp\_AOT4R\_s

## Validation

For scene of 23. Aug. 2003

4 AERONET instruments gave data  
within the states processed:

Toravere

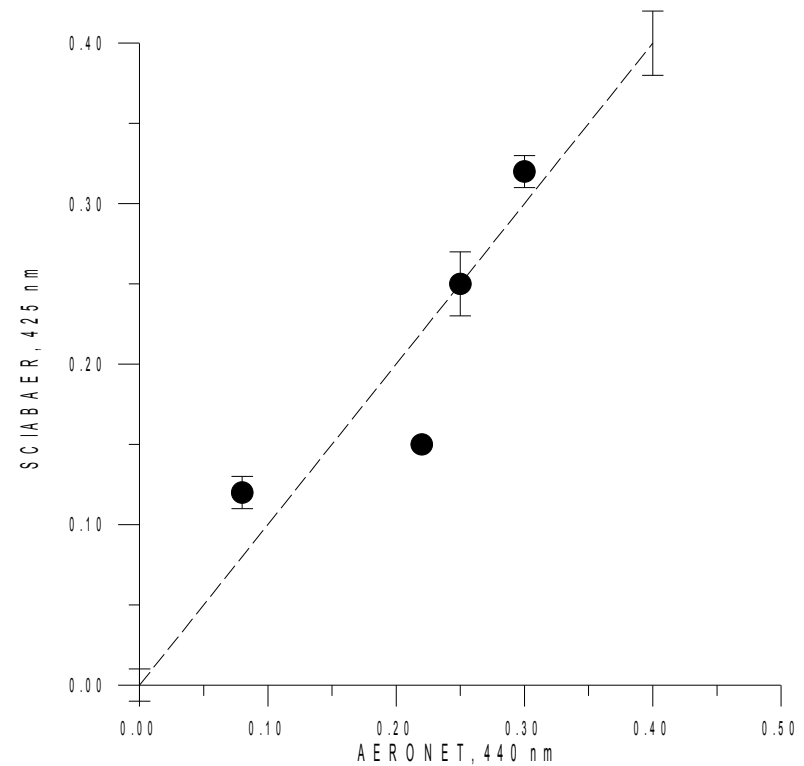
Minsk

Forth Crete

Lecce

SCIA retrieval, 425 nm,  
AERONET, 440 nm

Good agreement !



First results with new spectralon calibration

AOT decreases with increasing wavelength

Angström ALPHA should be

Is in a quite resunable range, validation required

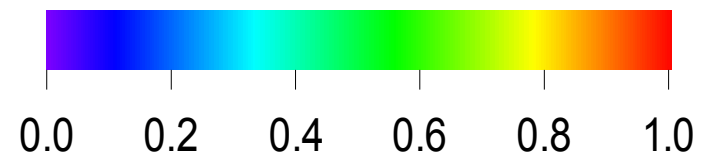
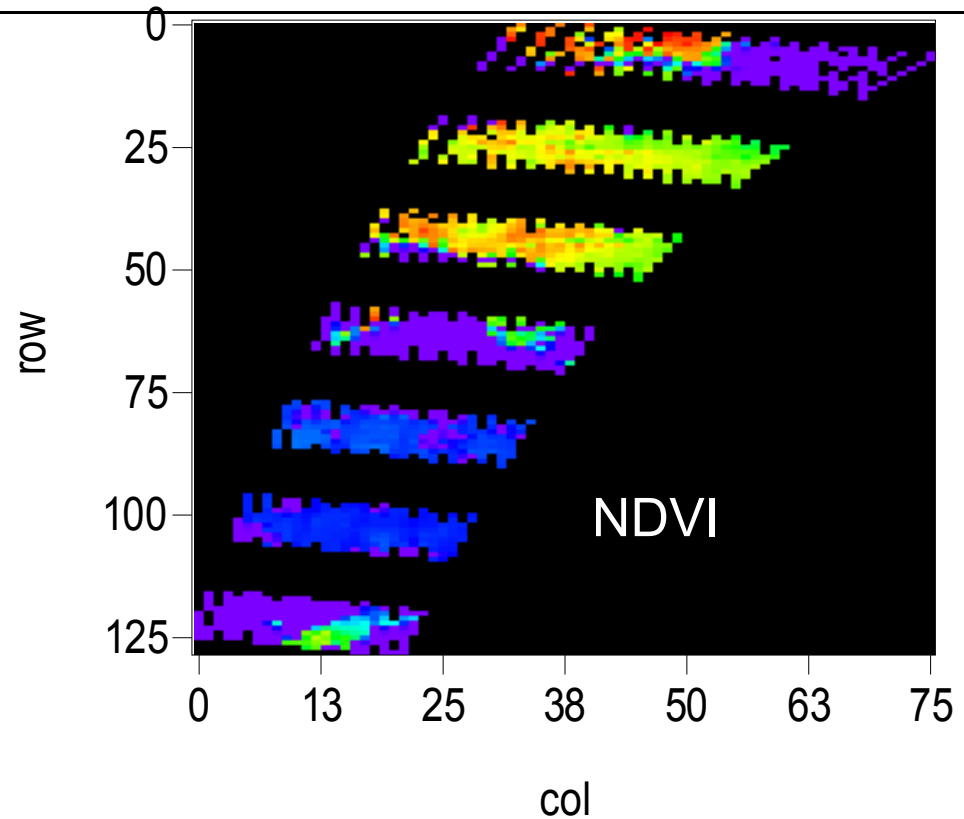
Improvmnts in BAER data bases required

Surface model of BAER use the same mixing, like for the scale of MERIS

NDVI ?

Elevation model GTOPO30 used, scale not adequate for SCIAMACHY

averaged DEM



SCIABAER\_SCI\_A\_20030823sp\_NDVIR



## Conclusions, Outlook

### Conclusions:

SCIAMACHY instrument is sensitive enough for an aerosol remote sensing

The present L1 product is not sufficient for this task because of insufficient radiometric calibration

Regular and off-line aerosol products require either correction factors of new radiometric key data.

New spectralon radiometric key data give reasonable AOT for VIS bands,  
More processed data required

### Outlook:

Set-up of a global processing scheme for spectral AOT, Angström ALPHA

Combination with AAI retrieval for derivation of quantitative information on aerosol absorption  
single scattering albedo