ATSR-2, AATSR, GOME, SCIAMACHY, OMI

TNO Physics and Electronics Laboratory

Gerrit de Leeuw

with contributions from Thomas Holzer Popp and others

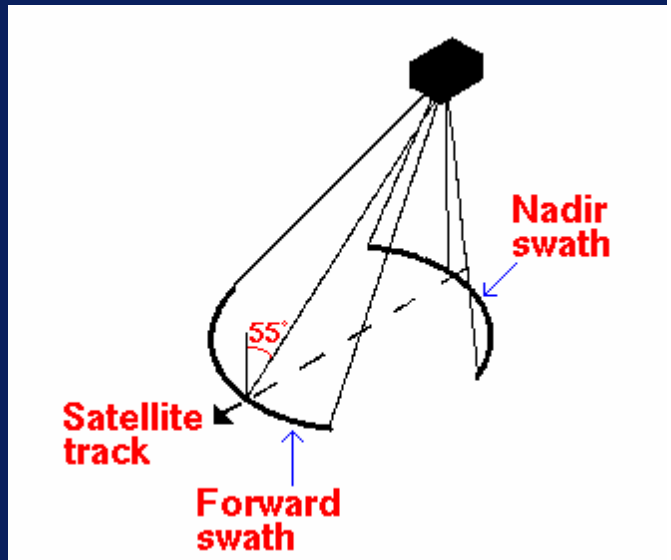
Aerosol retrieval

- **Cloud detection**
- **Separate surface contributions**
- **Separate Rayleigh contributions**
- **Choice of aerosol type and distinction between aerosol types**
  - Particle size distribution
  - Complex refractive index
  - Mixture: external or internal
- **Minimizing error function to determine optimum mixture**
- **Provides:**
  - Aerosol Optical Depth (AOD)
  - Angstrom coefficient
  - Aerosol type mixing ratio
  - Aerosol index (AI)

Aerosol retrieval algorithms

- **Single view:**
  - Nadir
  - Forward
  - Dark surfaces
  - Over water:
    - Correction for whitecap cover [f(u)], chlorophyl
    - Sunglint
    - Fresnel reflection

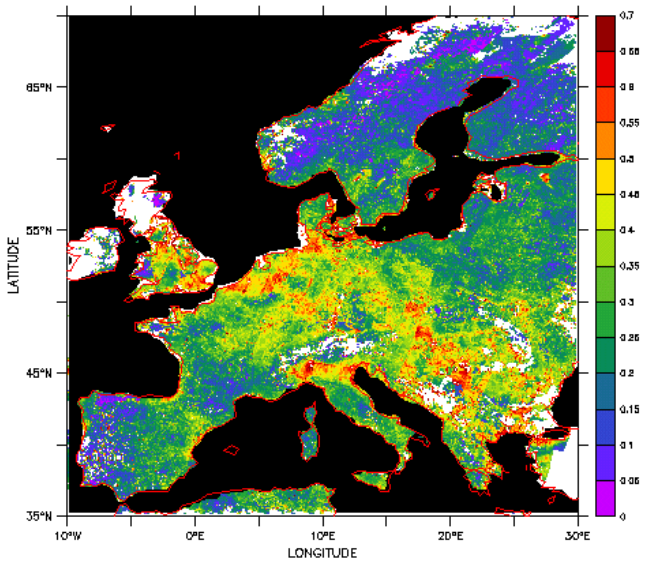
- **Dual view**
  - Eliminates land surface contributions

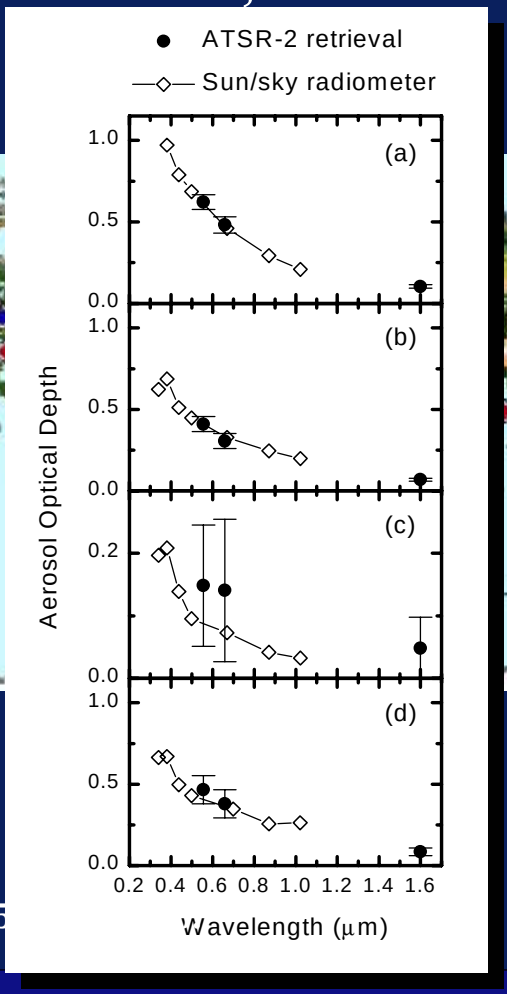


ATSR-2

- AOD retrieval over Europe from ATSR-2
- Evaluation with Sunphotometer data (AERONET, PHOTONS)

August 1997





- C. Robles-Gonzalez, J.P. Veefkind and G. de Leeuw, G R L 27, 95

Ångström Parameter

- **Aerosol Optical Depth:**
- **AOD (λ) = $\lambda^{-\alpha}$**

  λ wavelength

  α Ångström parameter

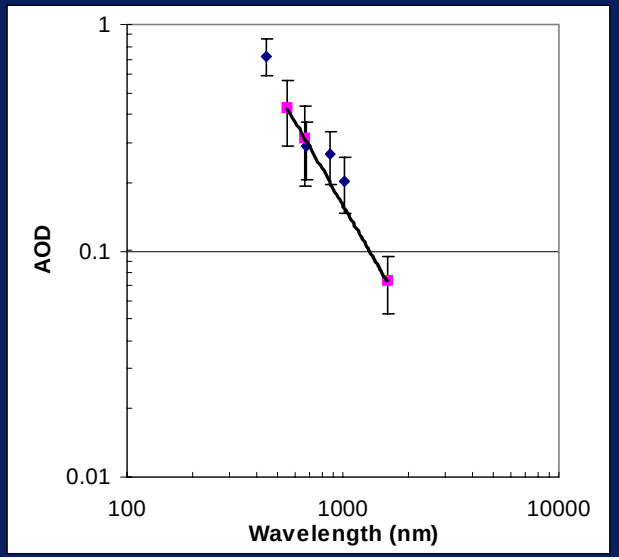
Particle size distribution:

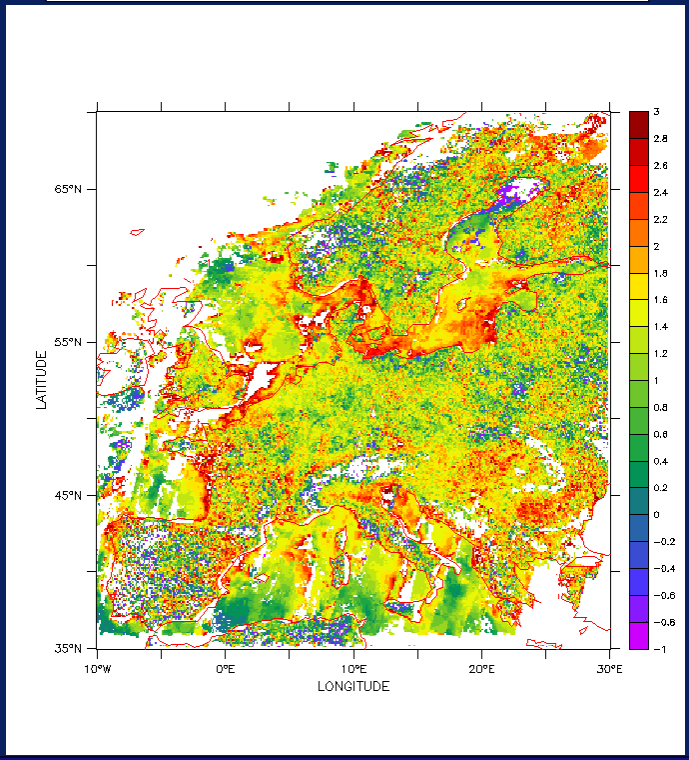
dN/dD = $D^{-\nu}$

ν Junge exponent

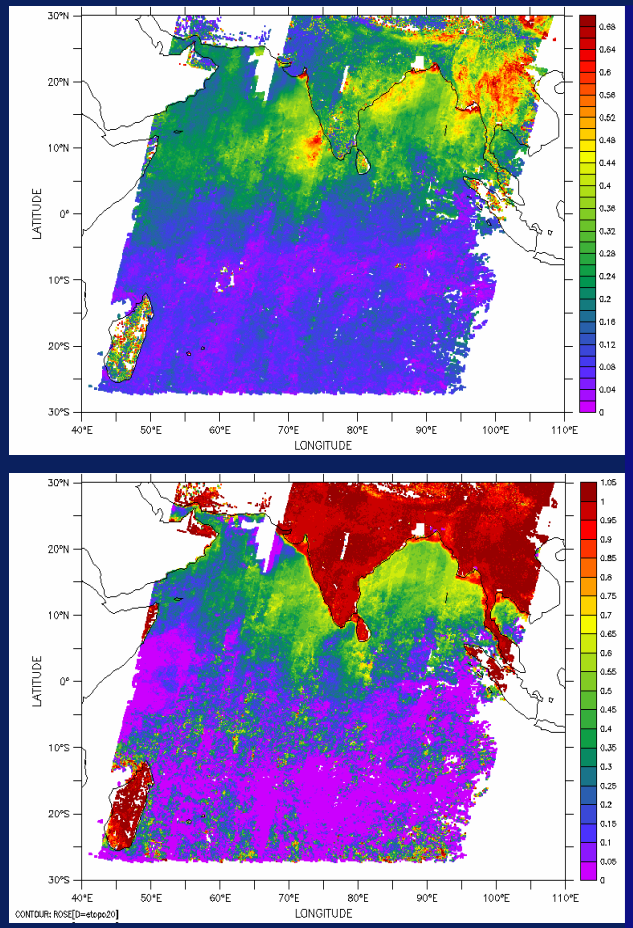
ν = α + 3

Ångström Parameter is **not** independent of wavelength





ATSR-2: INDOEX



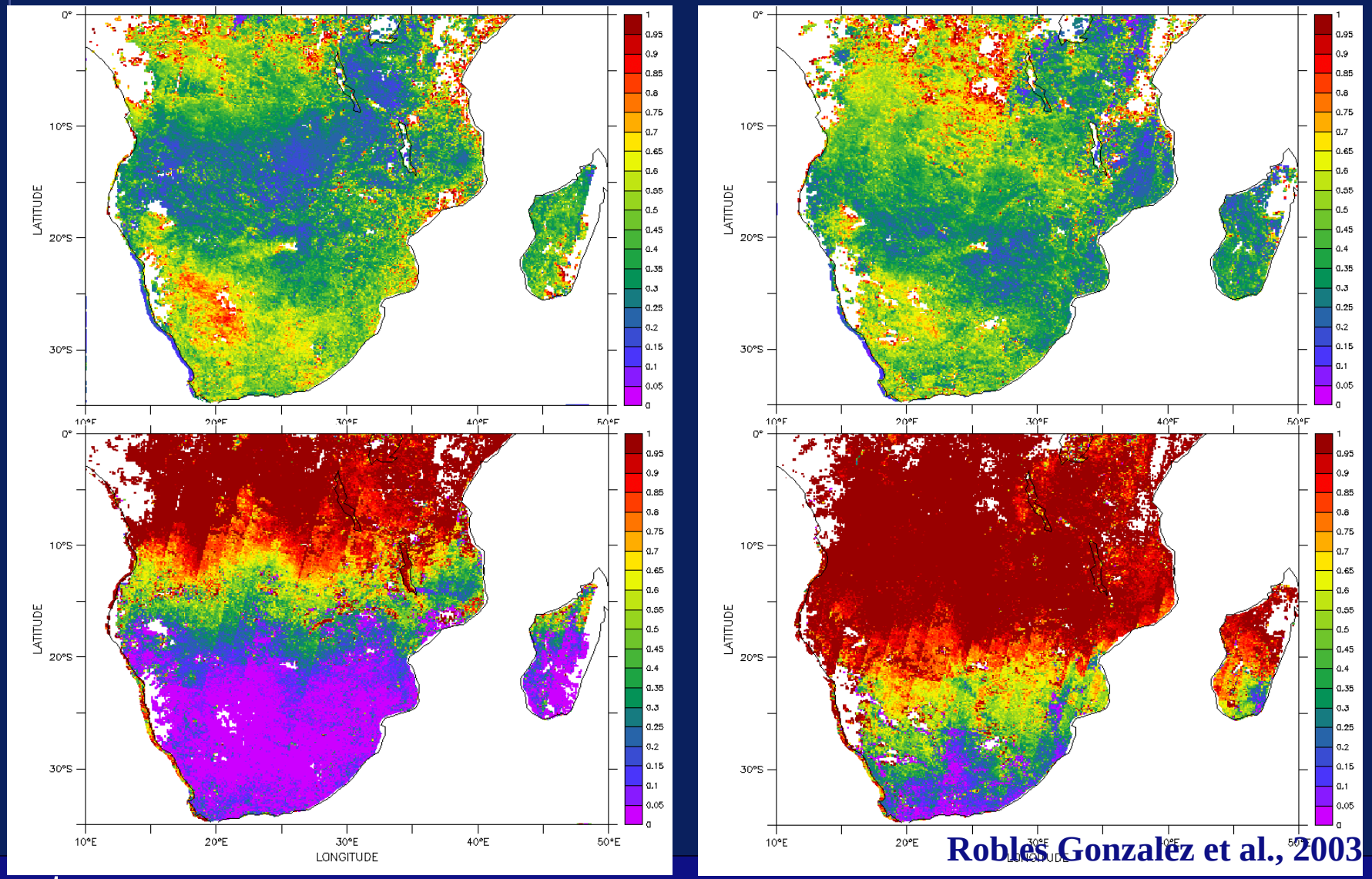
- **Mixture of continentally influenced and sea salt aerosol**
- **Minimizing error function to determine optimum mixture**
- **Provides:**
  - AOD
  - Angstrom coefficient
  - Mixture
- **Over the ocean the mixture gradually changes from continental to sea salt**

Robles Gonzalez et al., 2003

ATSR-2: SAFARI

August 2000

September 2000



Robles Gonzalez et al., 2003

TEMIS activities

- Conversion scientific to operational algorithm

  Integration of different routines in a single algo:

  ATSR-2, AATSR
- Application on regional scale (Europe and European seas)
  - Testing for 2000 over Europe
  - Evaluation with AERONET data
  - Presentation on TEMIS website
  - Implementation DV&SV algos at KNMI:
    - AOD over Europe, end 1995-early 2001

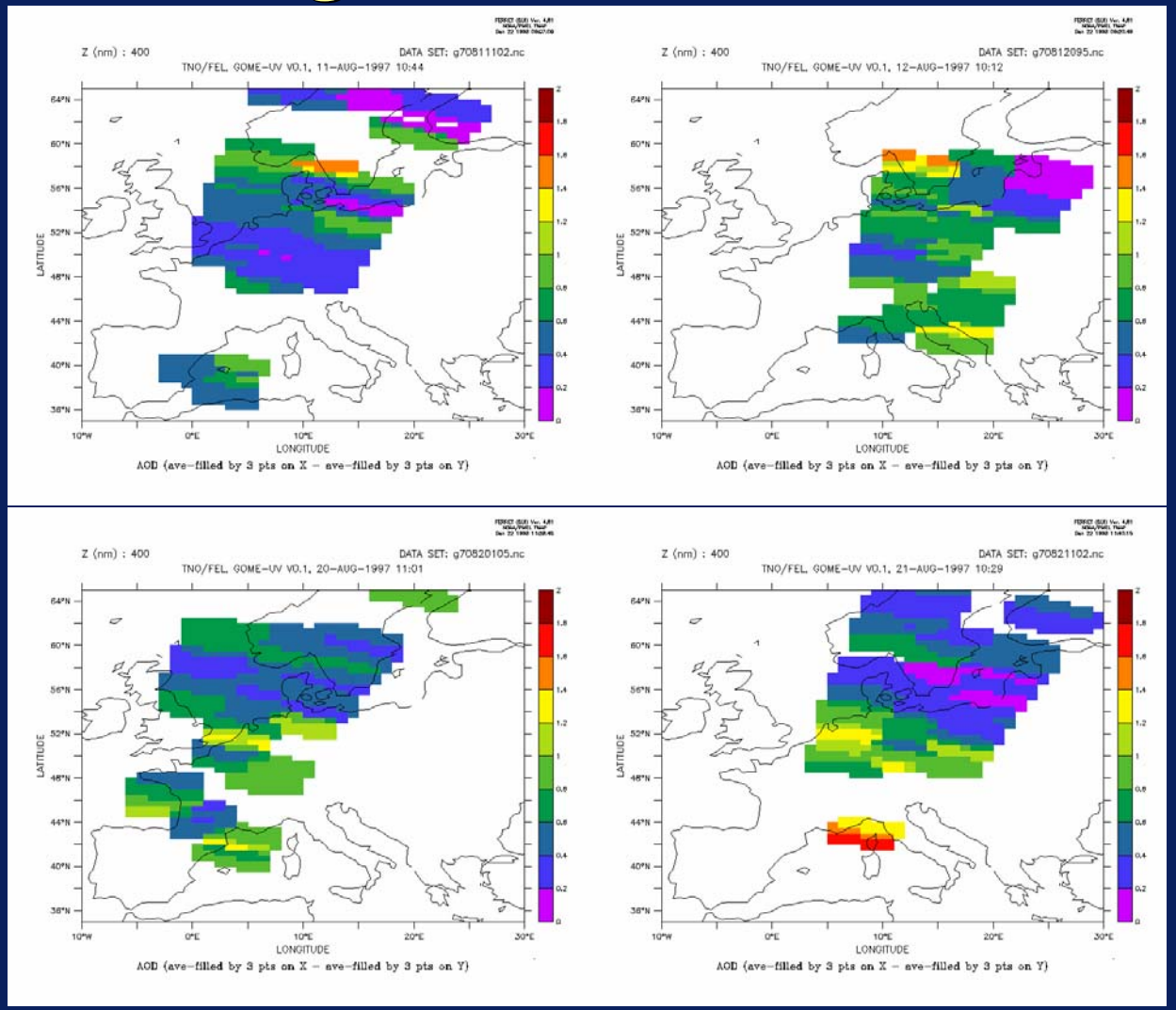
Global Ozone Monitoring Experiment

- Spectrometer on ERS-2
- Wavelength range 0.240 to 0.790 µm
- Spectral resolution 0.2 to 0.4 nm
- Pixel size 320x40 km^2, in validation phase 80x40 km^2

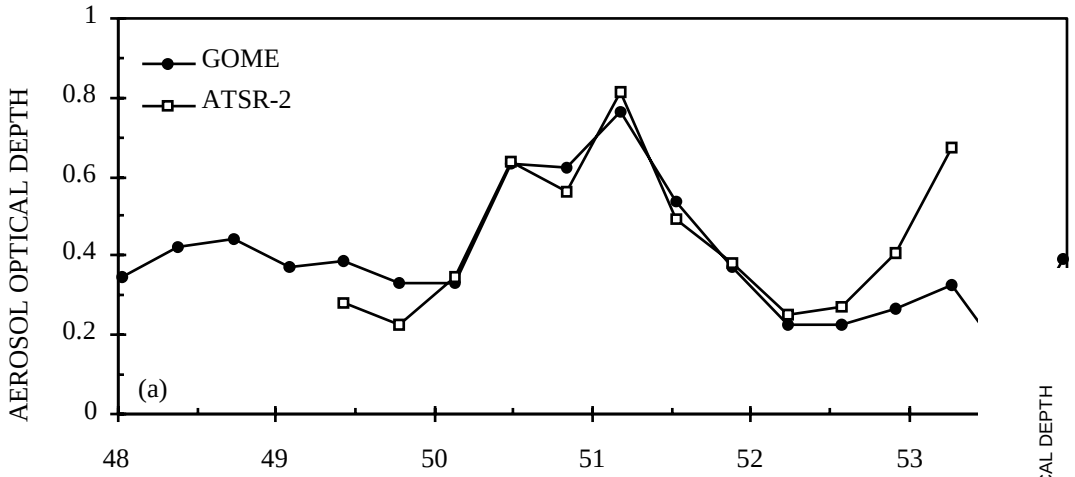
Retrieval:

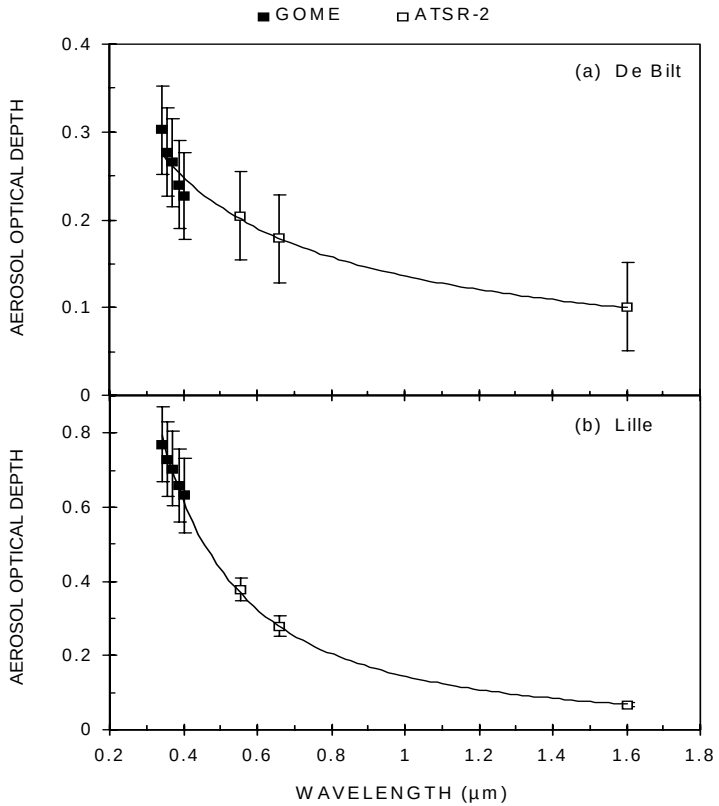
- Five wavelength bands between 0.340 and 0.400 µm, width 1 nm
- Albedo of land surfaces is low
- Assumptions are made on surface albedo
- Bi-modal aerosol model

GOME August 1997



Comparison of retrieval methods





Synergetic aerosol retrieval

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AEROCOM meeting

June 2003

- **SYNAER** uses GOME/ATSR-2 or SCIAMACHY/AATSR
- SYNAER delivers **AOT and type** over land and ocean
- spatial resolution: 80x40 km^2 / 60x30 km^2
- temporal resolution: **weekly** coverage (ENVISAT),
  only 3 days per month from ERS-2
- data acquisition through ESA AO projects (operational from 2004)
- available: **"3 day" climatology 7/1997-8/1998 Europe/Africa**,
  selected episodes 1995-2003 global
- to be negotiated with ESA: "3 day" climatology for 2000
- **regular global monitoring planned from 2004**
- **backprocessing of ENVISAT data is possible up to mid 2002**

Based on SYNAER evaluation of GOME / ATSR-2 data
July 1997 – March 1998 (3 days per month), extension to Aug 1998
5 x 5 degree grid

Limitation:
3 days per month only
Cloudiness
Bright surface albedo

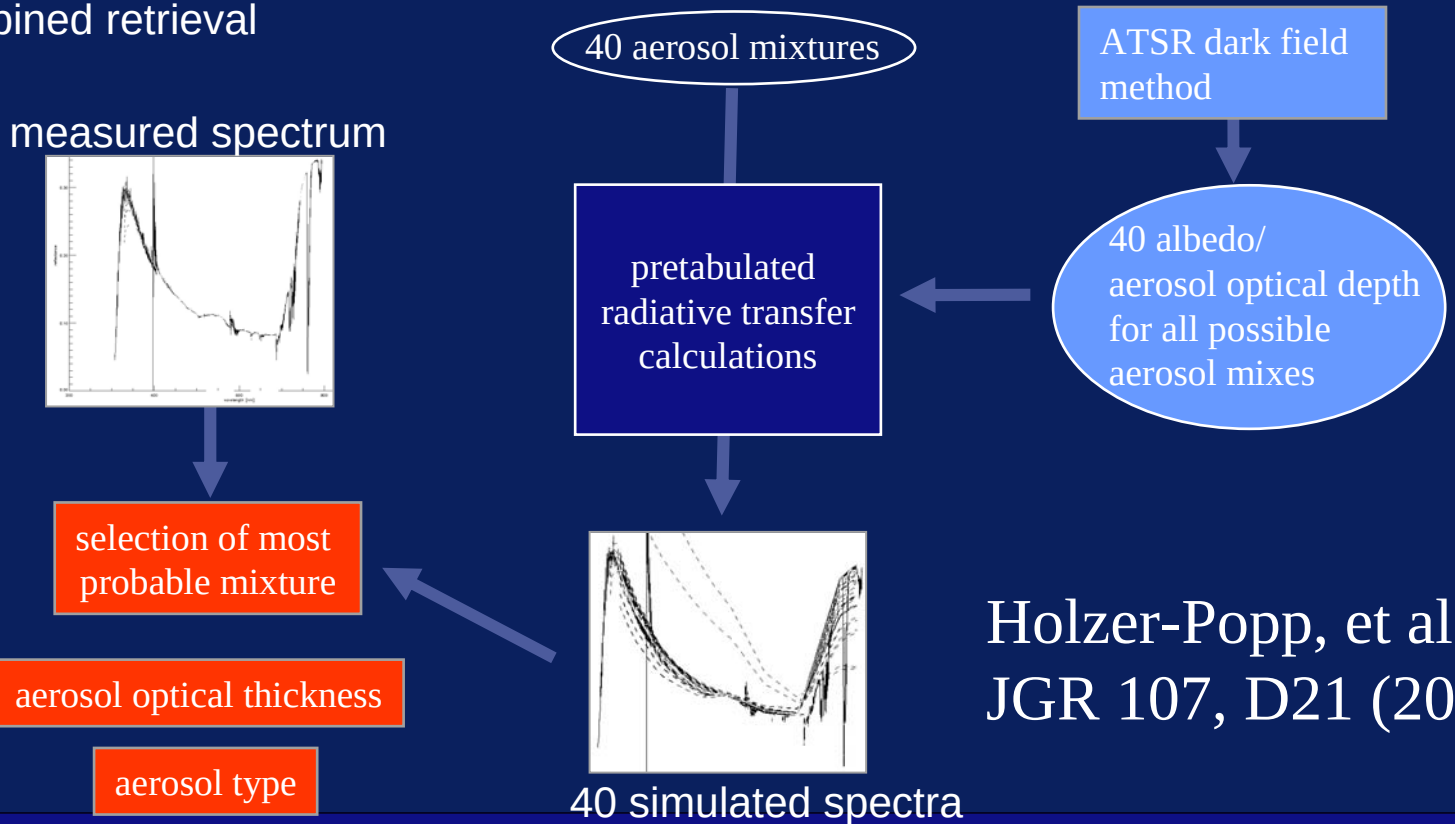
Quality check / ambiguity test:
Surface albedo 670 nm less than 0.07 (0.015) over land (ocean)
Cloud fraction in GOME pixel less than 50%
Fit error GOME spectrum less than 0.025
Number of contributing orbits per box 2 or more (mean: 4)
Number of contributing GOME pixels per box 5 or more (mean: 19)
Component analysis only for AOT > 0.1

SYNAER aerosol retrieval

ATSR delivers aerosol optical depth and surface albedo but needs aerosol type.

GOME delivers aerosol type, but needs aerosol optical depth and surface albedo first.

-> combined retrieval



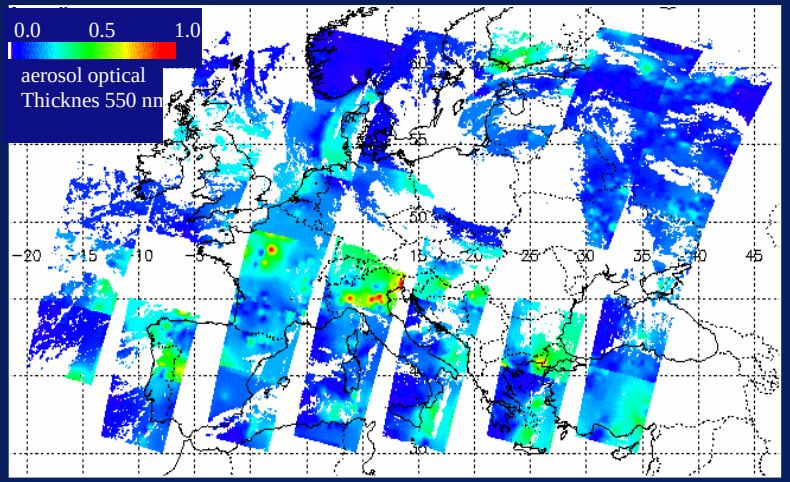
Holzer-Popp, et al.
JGR 107, D21 (2002)

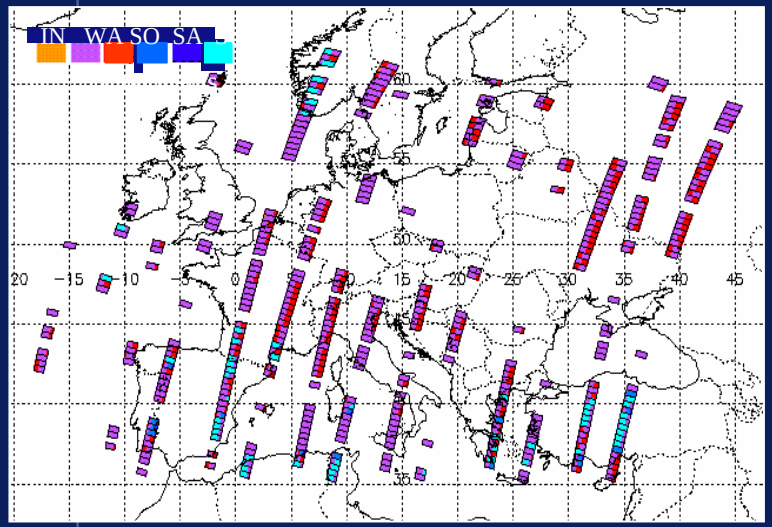
Αεροσολ ΟΤ ανδ χομπονεντ μαπσ φρομ ΓΟΜΕ/ΑΤΣΡ–2 (ΣΧΙΑ/ΑΑΤΣΡ)

T. Holzer-Popp and M. Schroedter, DLR-DFD

Method and case study validation published in: JGR 107 (2002), D21 and D24

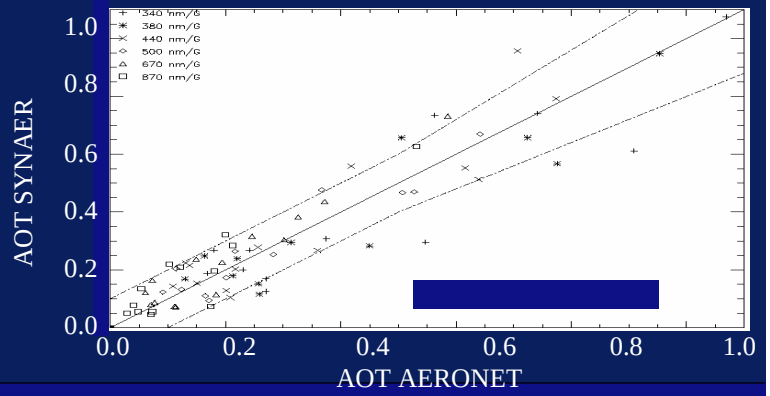
Europe 1-3 September 1995
full resolution OT map (right)
component map (below)





IN=insoluble, WA=watersoluble, SO=soot, SA=sea salt accumulation mode, SC=sea salt coarse mode, MT=mineral transported

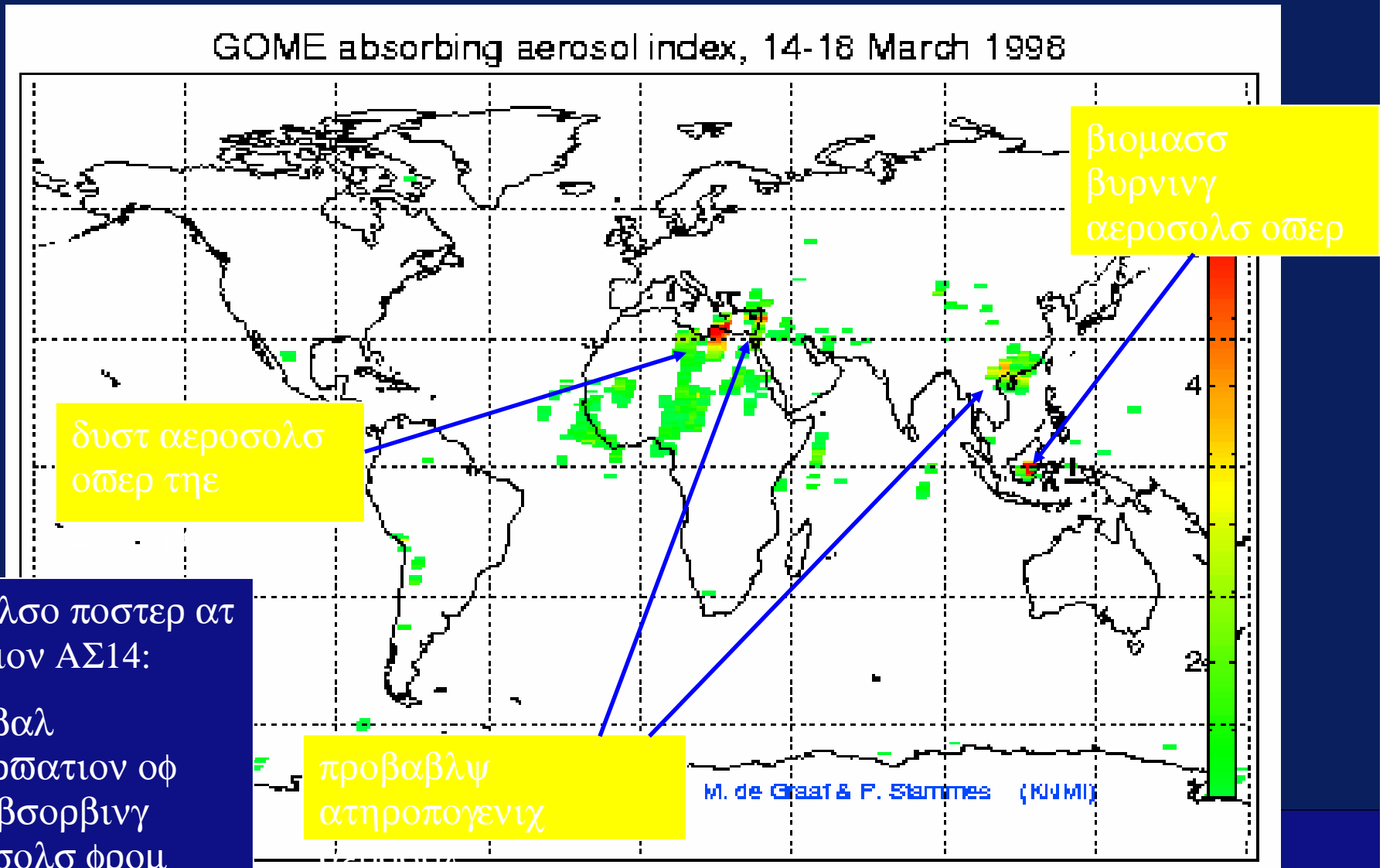
Case study validation against AERONET sun photometers from 340 to 870 nm indicates to selecting the right aerosol OT and mixture



Αβσορβινγ αεροσολ ινδεξ (ααι) ρετριεϖαλ φρομ Σχιαμαχηψ ανδ ΓΟΜΕ

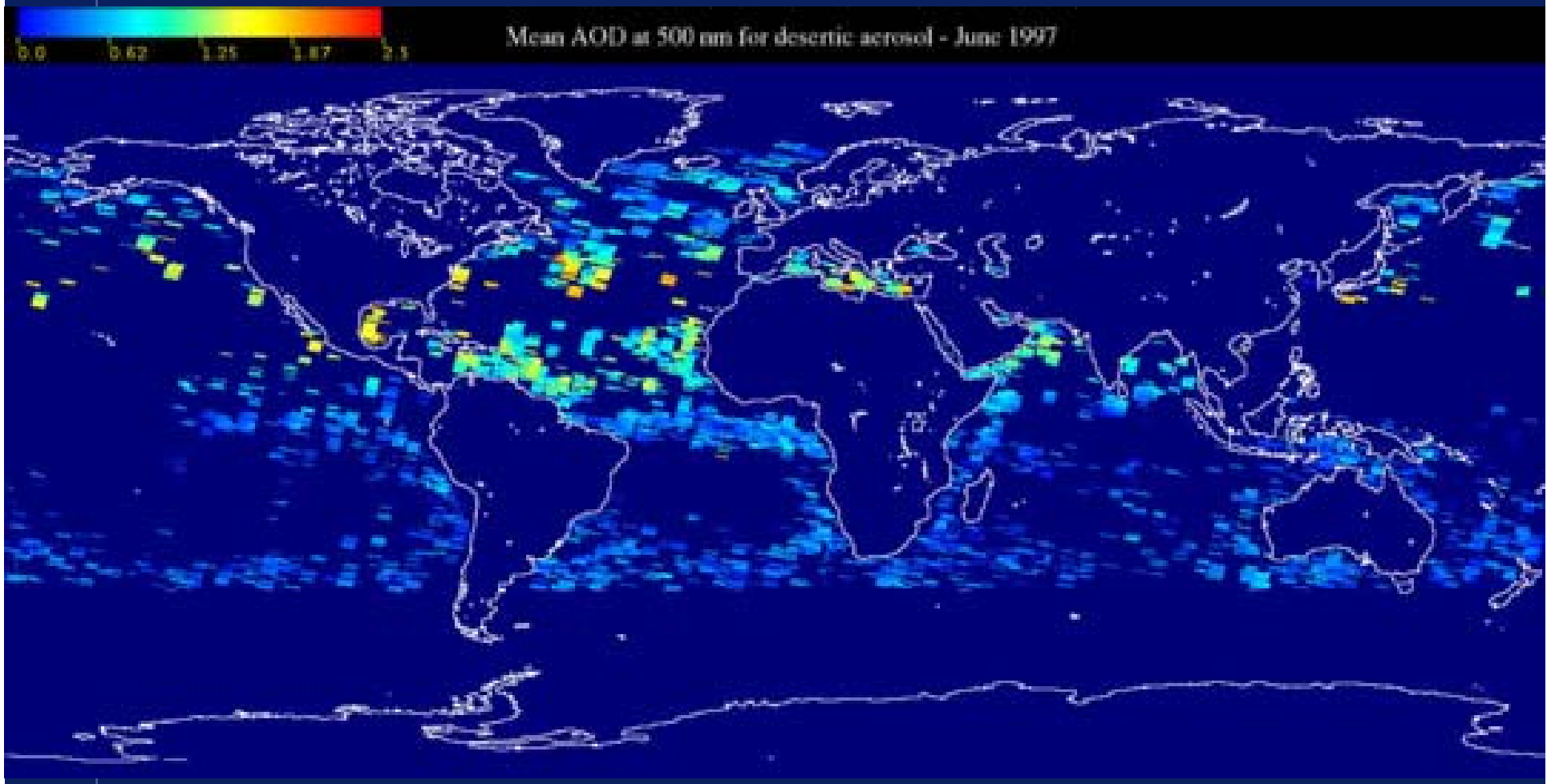
Μαρτιν δε Γρααφ ανδ Πιετ Σταμμεσ, ΚΝΜΙ

$$AAI = -100(\log(P335/P380)_{meas} - \log(P335/P380)_{Rayl})$$



Σεε αλσο ποστερ ατ σεσσιον ΑΣ14:

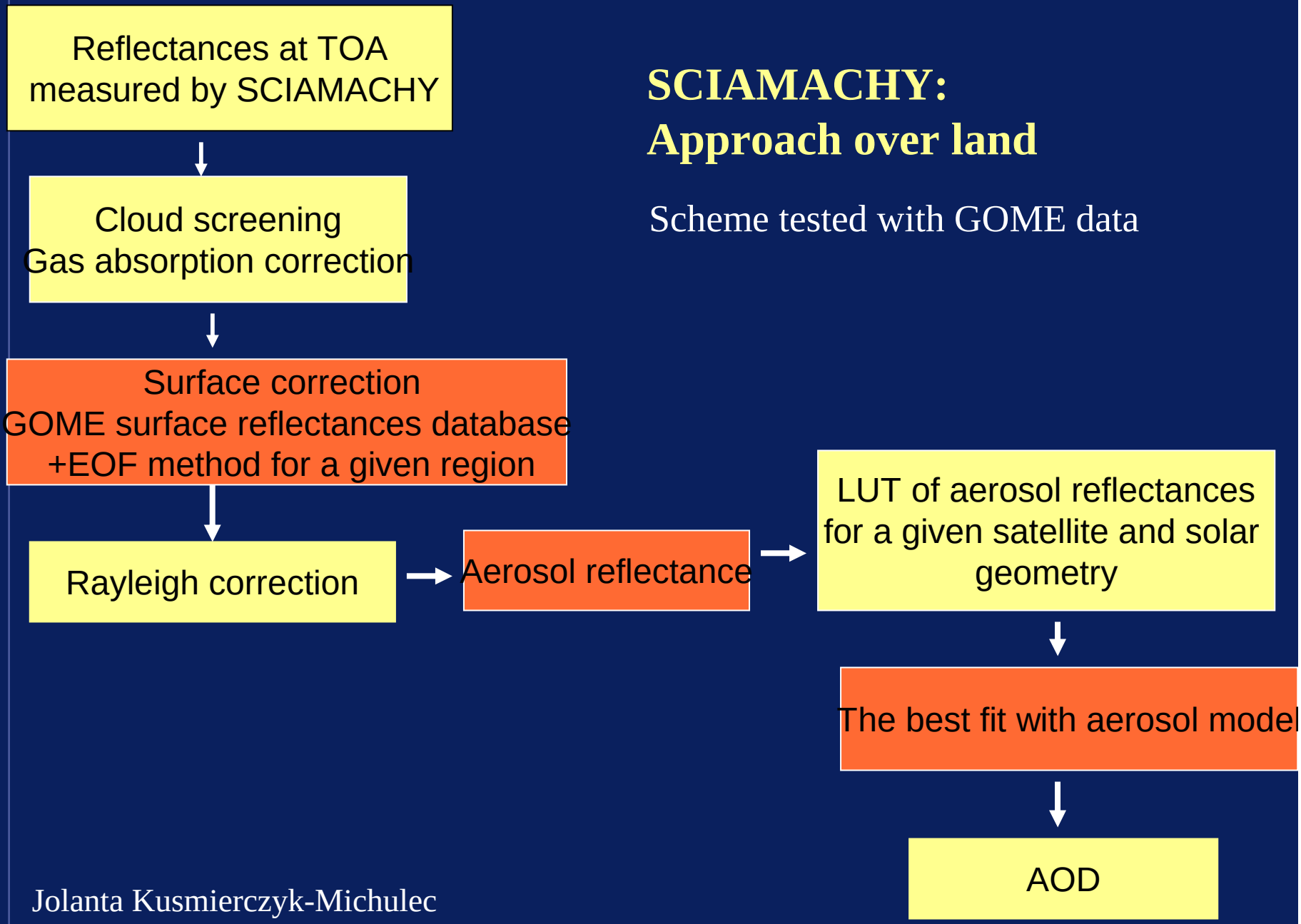
эГλοβαλ οβσερϖατιον οφ Υς–αβσορβινγ αεροσολσ φρομ



Αεροσολ χλιματολογψ οφ Σαηαρα δεσερτ δυστ φρομ ΓΟΜΕ δατα. Ηερε τηε αϖεραγε ϖαλυε οφ δεσερτ δυστ ισ ρεπορτεδ φορ ϑυνε 1997. Τηε ψελλοω–ρεδ ρανγε ινδιχατεσ τηε πρεσενχε οφ δεσερτ δυστ εϖεντσ εμβεδδεδ ιντο α μαριτιμε αεροσολ ανδ ρεσιδυαλ χλουδσ (λιγητ βλυε). (*Ρ. Γυζζι*)

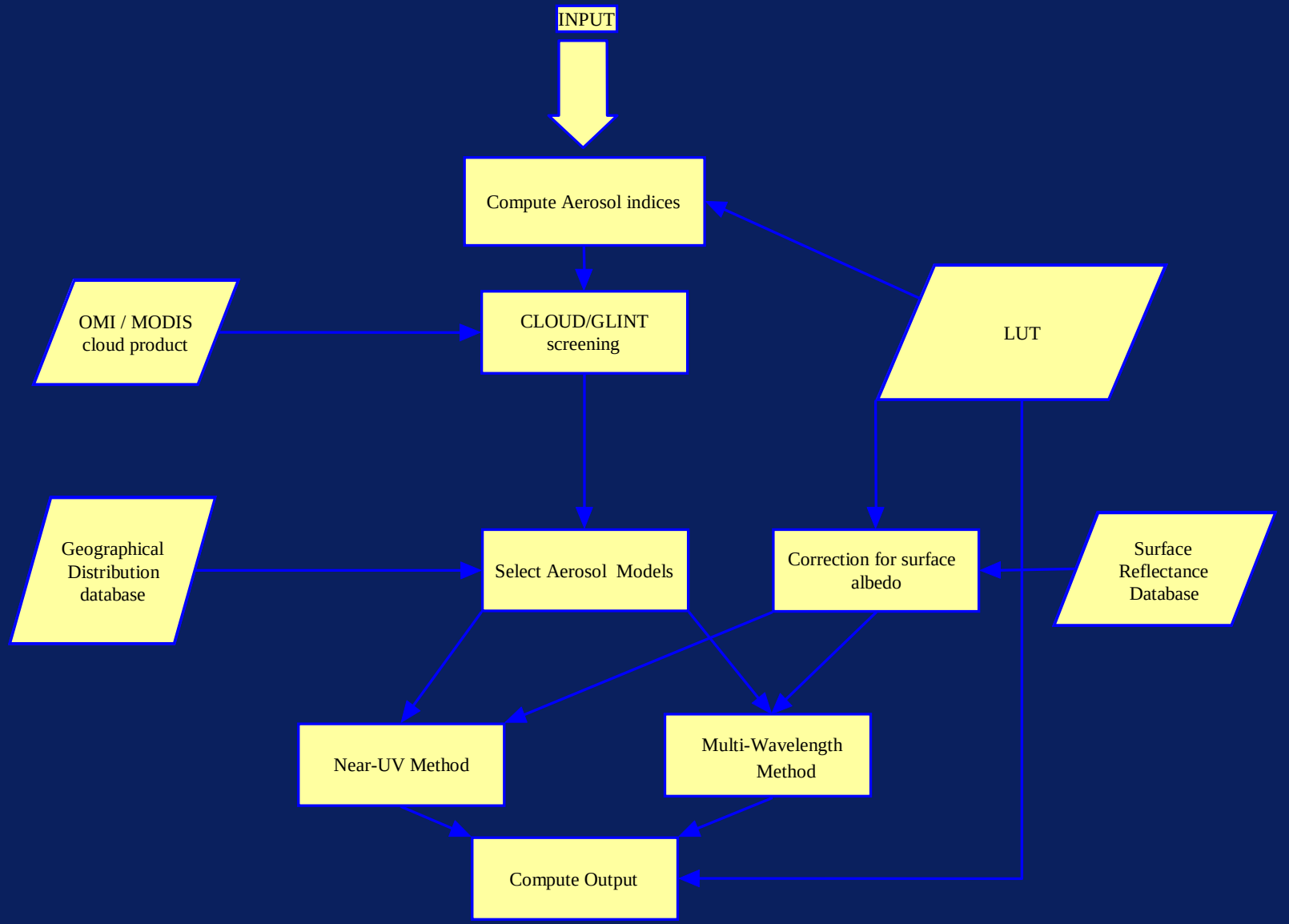
SCIAMACHY: Approach over land

Scheme tested with GOME data



Jolanta Kusmierczyk-Michulec

OMI (EOS Aura, Jan 2004)



Torres, Decae, Veefkind & De Leeuw, OMI ATBD, 2002

Summary

- **Satellite aerosol retrieval products (AOD, type, Angstrom coefficient, AI) are becoming available:**
- **ATSR-2/AATSR (1x1 km2)**
  - 5 months available
  - ATSR-2 for 2000 over Europe (with hopes for 1995-2001)
  - Other areas feasible
  - ATSR-2 series continued with AATSR
  - Available on TEMIS web site
- **GOME**
  - GOME over water product (Guzzi) on TEMIS web site
- **SYNAER**
  - SYNAER (GOME/ATSR-2) climatology (Holzer Popp)
  - Continued with SYNAER (SCIAMACHY/AATSR)
- **SCIAMACHY global product**
- **OMI global product**
- **Synergistic use of satellites**
- **Needs validation/evaluation**

Acknowledgements

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