

Retrievals of O_3 profiles from IASI

results and validation with MOZAIC and radiosoundings

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Retrieval of O₃ profiles from IASI

Objectives

Fast retrieval of global O₃ profiles from IASI

Outlook

- The SOftware for a Fast Retrieval of IASI Data: SOFRID
- Ozone profiles database for *a priori* data and validation
- Characterization of the O₃ retrievals
- Validation → radiosoundings+MOZAIC
- preliminary O₃ over Africa

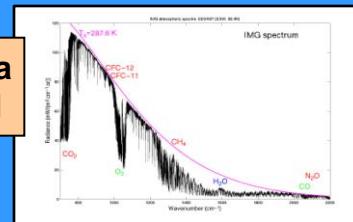


SOFRID

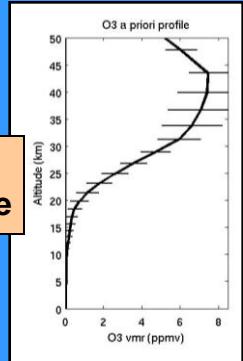
Meteorological parameters :
• H₂O: ECMWF analyses
• Atm. Temp: IASI L2



Calibrated spectra
Ether -> L1C IASI



a priori data
Ozone database



Pré-processing → pixels inputs

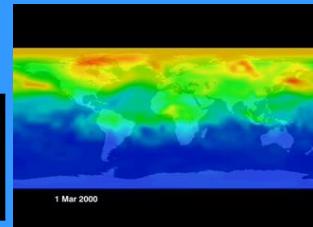
Cloud ?
(L2 cloud cover < 13%)

RTTOV ←→ 1D-Var

Ozone

Post-processing → L2 product

Retrieved O₃ in the
Tropo. / UTLS / Strato.

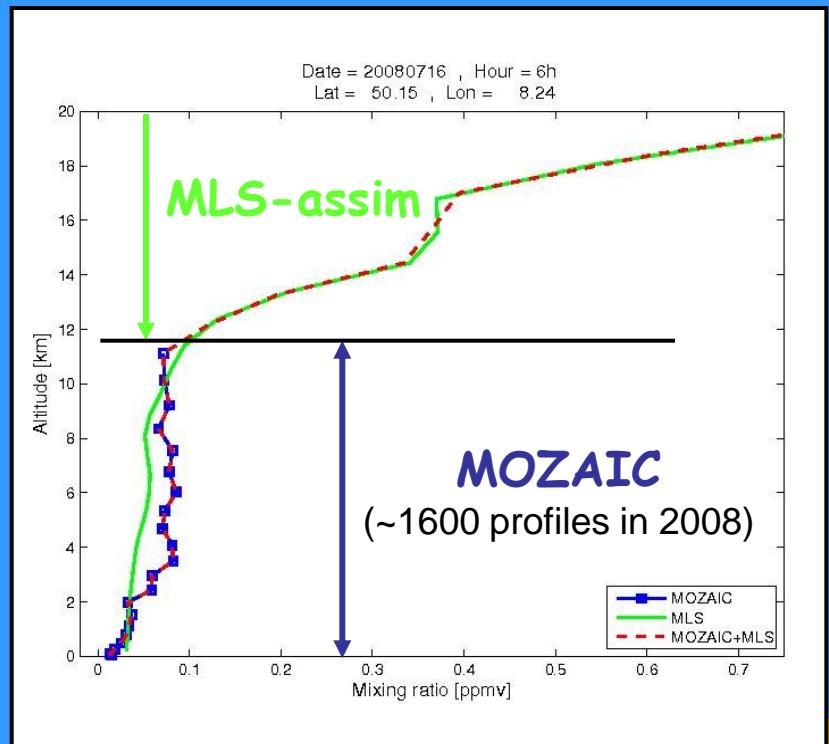
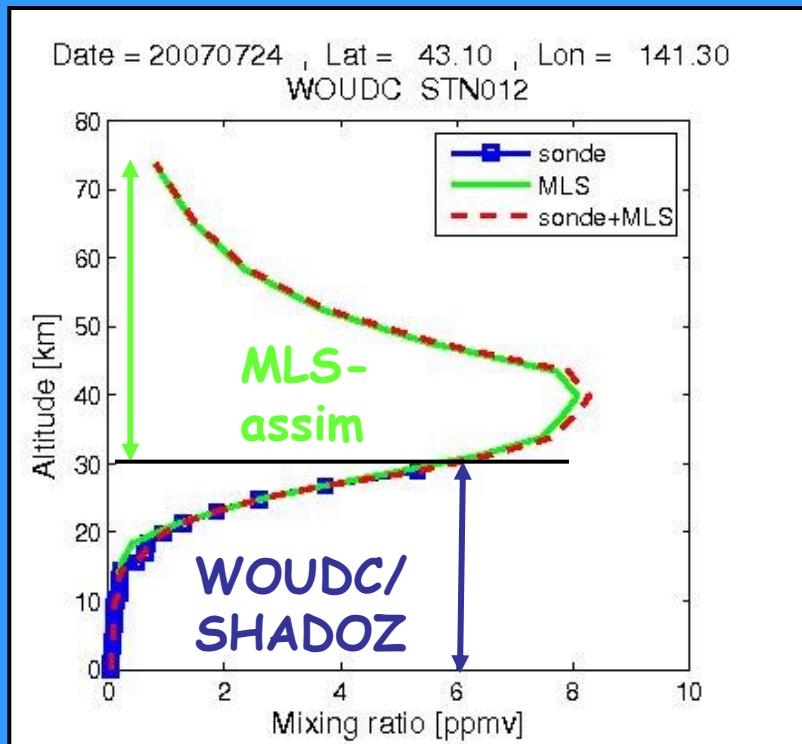


Ozone profiles database

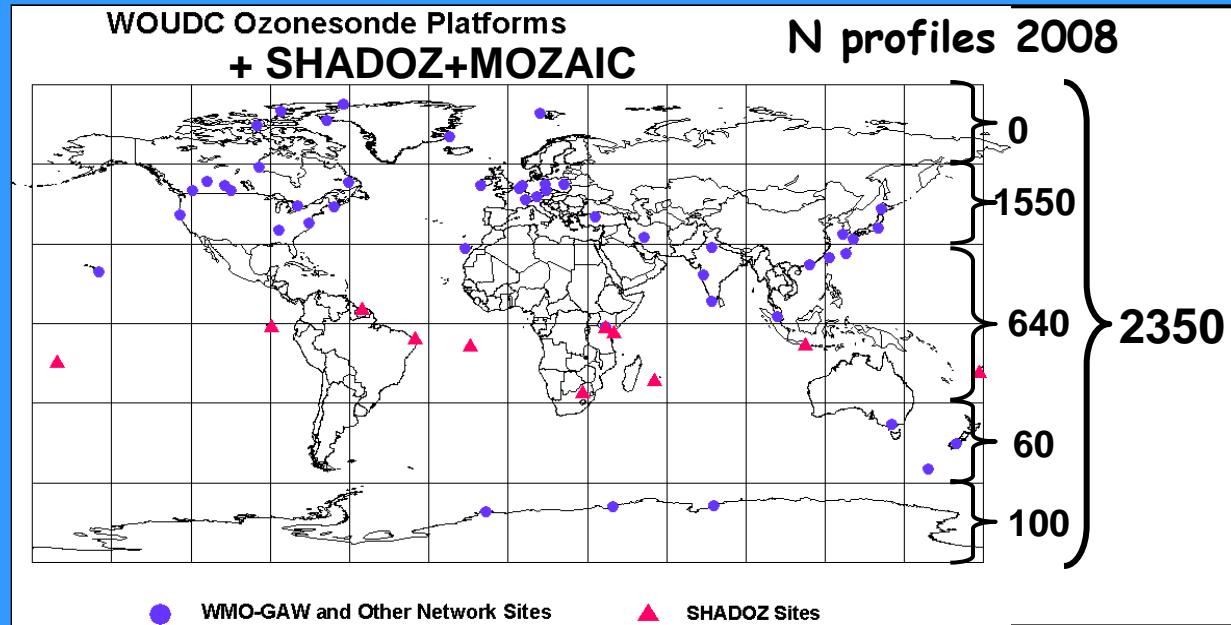
Objective: Database of O₃ profiles from the surface to the mesosphere to build *a priori* data and validate IASI retrievals

Data used:

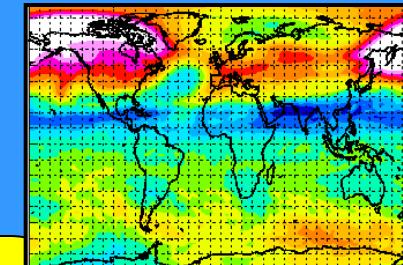
- WOUDC/SHADOZ sondes (up to 25-35 km) and MOZAIC (troposphere)
- Aura/MLS data (UT to mesosphere) assimilated with MOCAGE-VALENTINA



Ozone *a priori* data

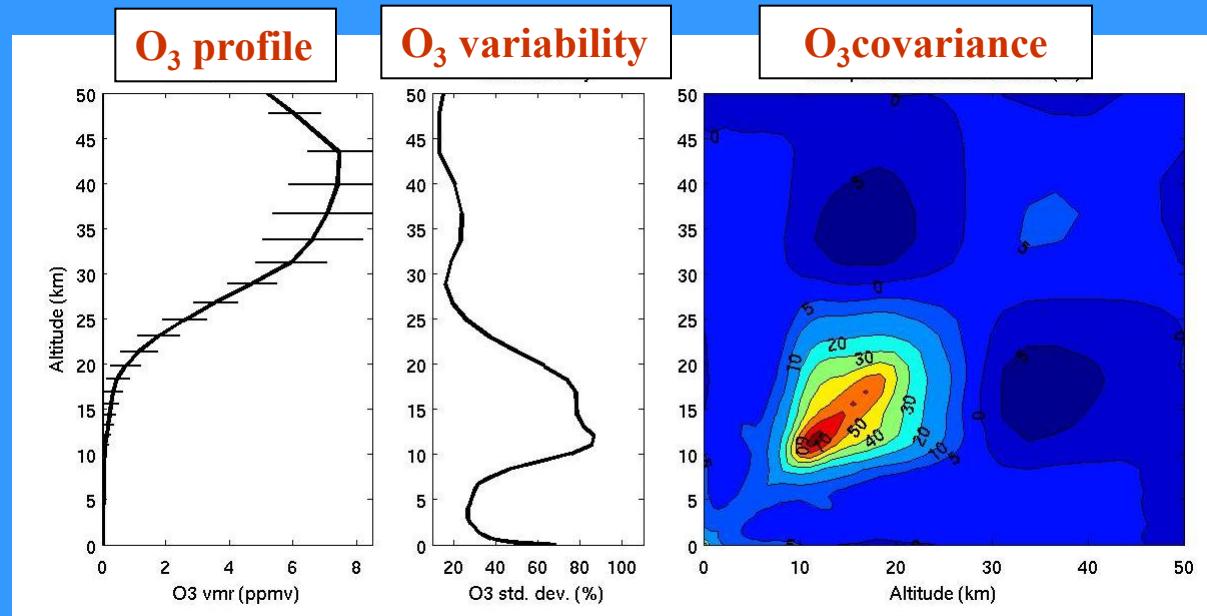


+ Aura/MLS-Assim



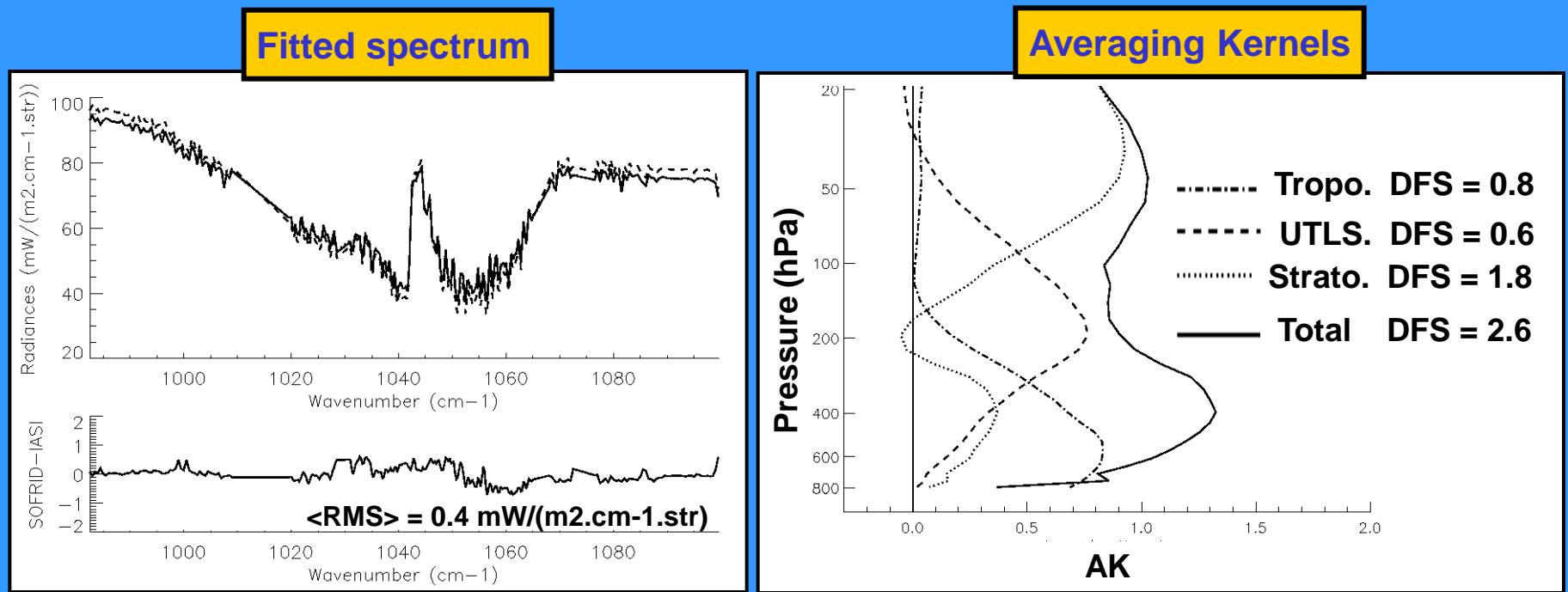
WOUDC/SHADOZ +MOZAIC

- NH midlat. / Tropics
- Max variability UTLS
- High variability LT



Retrieval characterization

- **Method:** optimal estimation (1D-Var)
- **Spectral Window:** $980\text{-}1100\text{ cm}^{-1}$ with exclusions for H_2O absorptions
- **a priori data:** WOUDC-SHADOZ-MOZAIC+MLS-Assim
- **Mean radiometric noise:** $0.6\text{ mW}/(\text{m}^2\cdot\text{cm}^{-1}\cdot\text{str})$



Validation of retrieved O₃

Profile comparisons

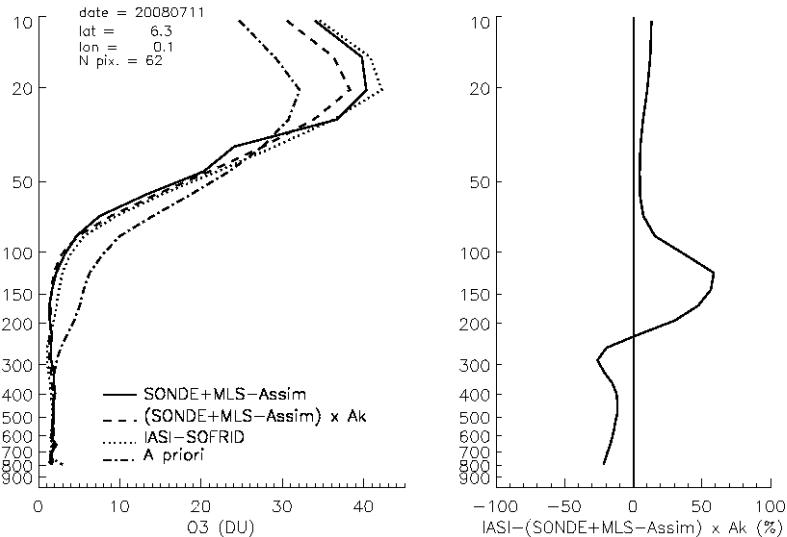
Tropics (MOZAIC)

Accra, Ghana, 5°N, 0°E

20080711

62 pixels

DFS=2.6 (0.6/UTLS, 0.8/tropo.)



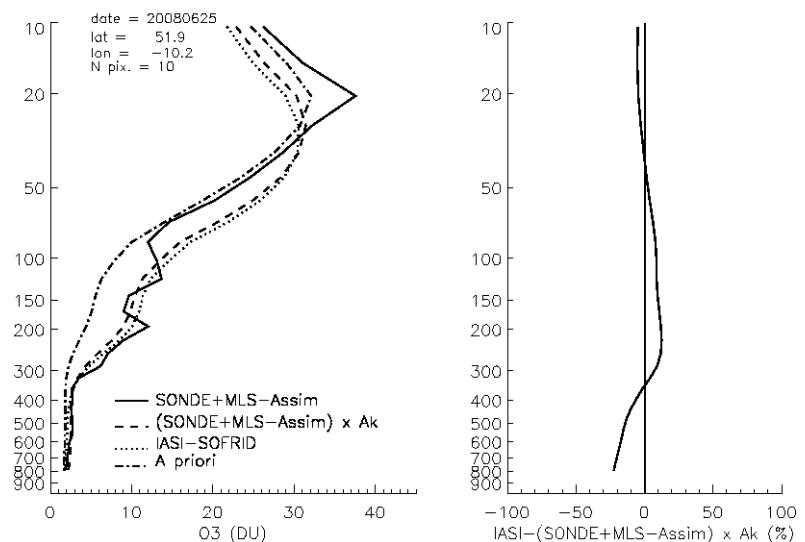
Midlat. NH (WOUDC)

Valentia, Irland 51°N, 10°W

20080625

10 pixels

DFS=2.1 (0.6/UTLS, 0.6/tropo.)



- Sonde+MLS-Assim
- - - (Sonde+MLS-Assim)*Ak
- IASI
- · - · *a priori*

Validation of retrieved O₃

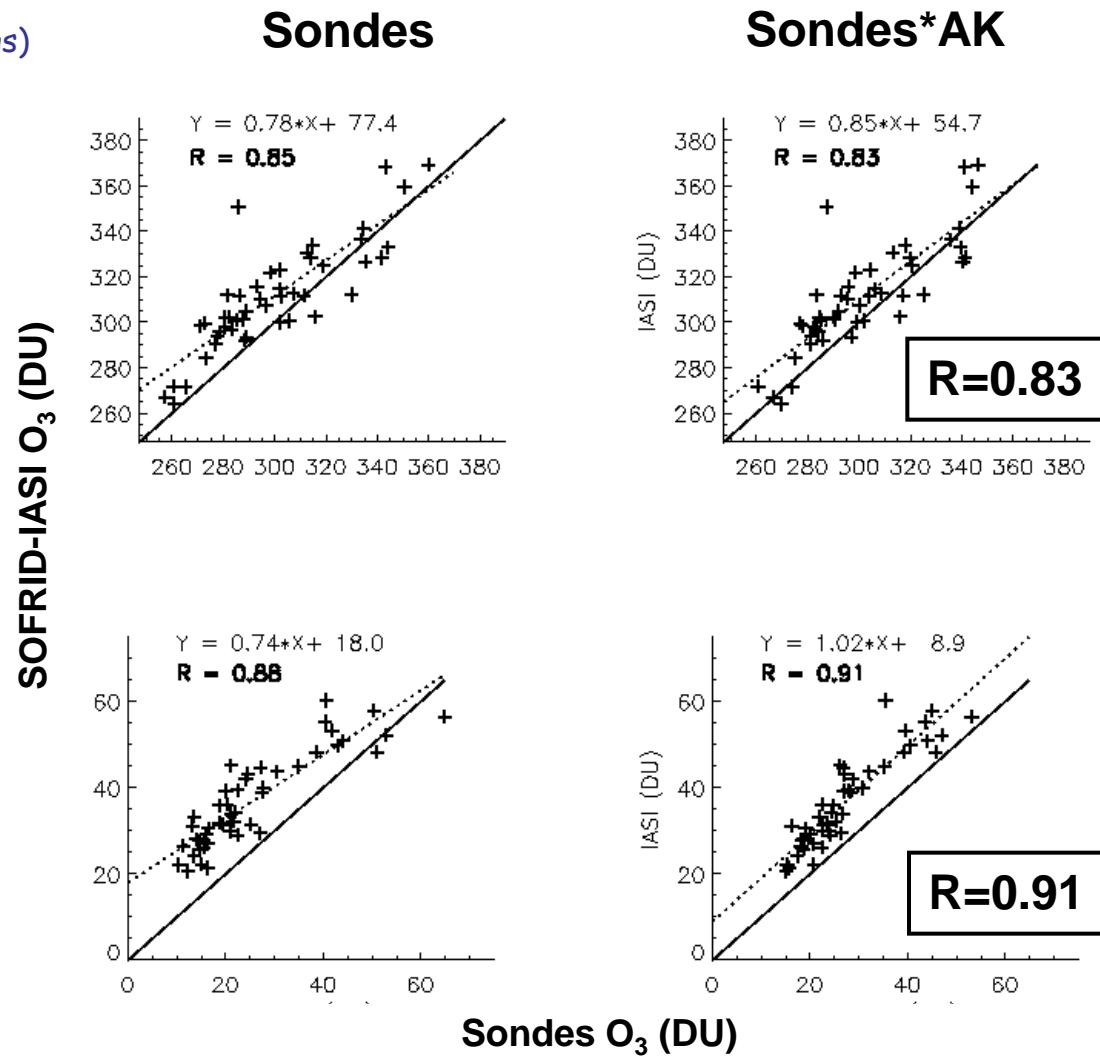
Columns

JJA 2008

(600 pixels/50 radiosoundings)

Stratosphere
Above 200 hPa

UTLS
200-100 hPa



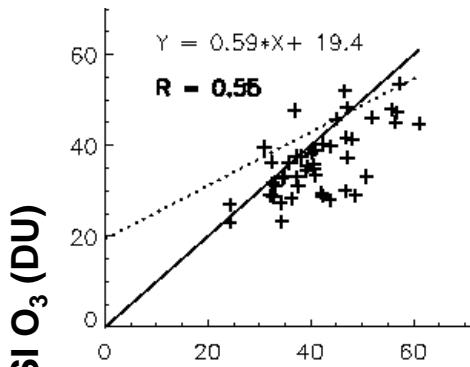
Validation of retrieved O₃

Columns
JJA 2008

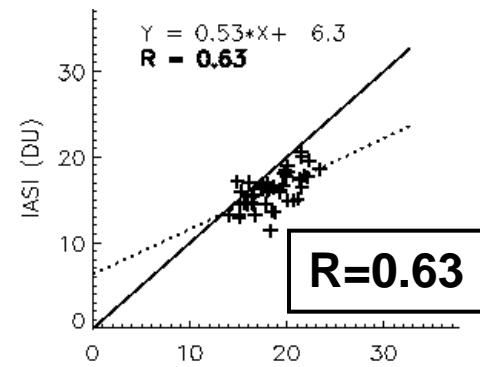
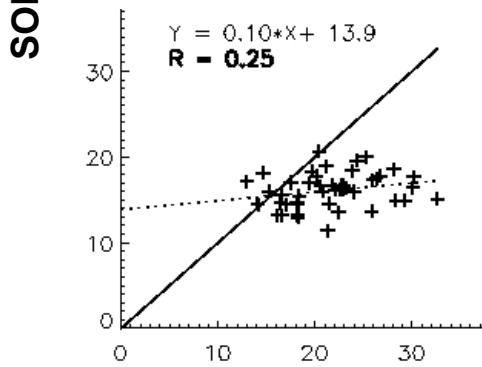
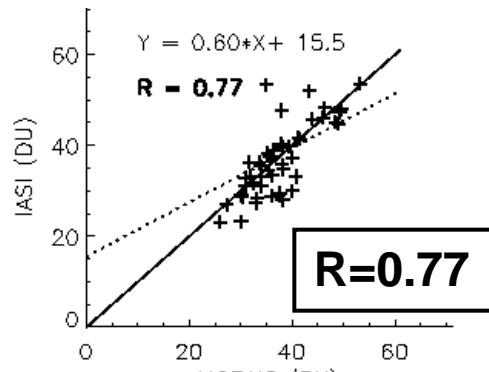
Troposphere
Below 200 hPa

Lower
troposphere
Below 480 hPa

Sondes



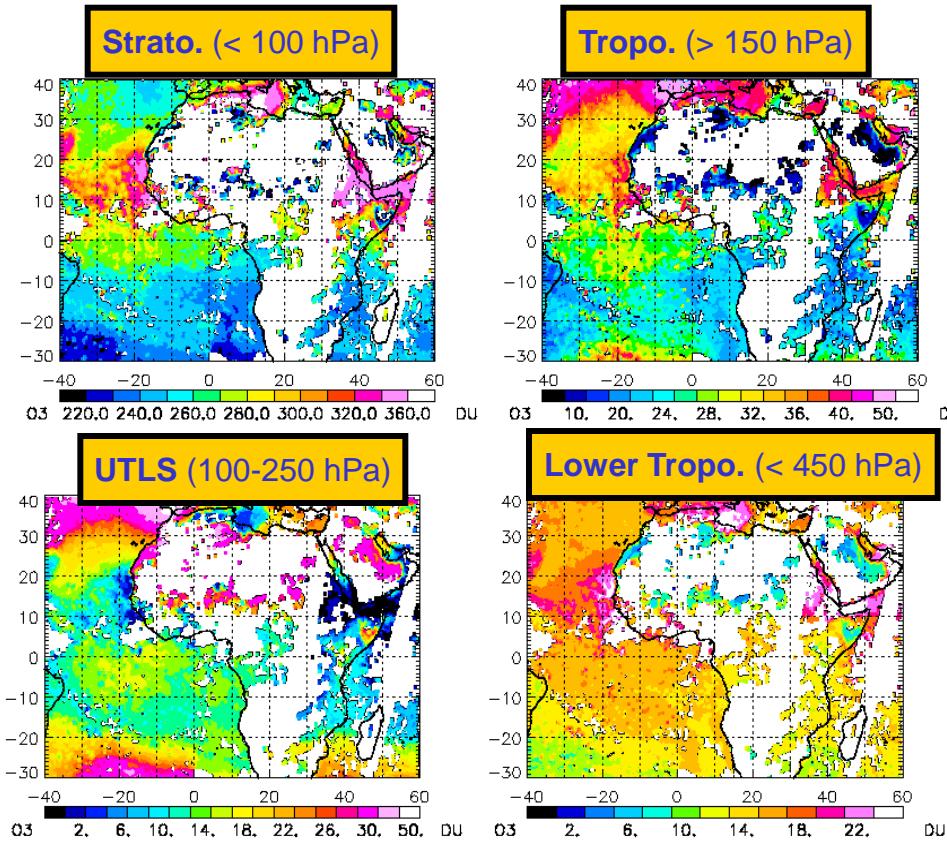
Sondes*AK



Sondes O₃ (DU)

IASI O₃ over Africa: NH summer

14-16 July 2008 / 51% cloudy



- **Strato.** North-South gradient well reproduced
- **UTLS:** Maxima south of 20°S / north of 30°N
→ Extratropical lower strato.
- **UTLS/Tropo.:** high O₃ columns over Tropical Atlantic
→ Biomass Burning/LiNO_x + export

- High O₃ in Strato./Tropo. and low O₃ in UTLS over North-Atlantic, South Med., Red sea... → Desert dust ?
- Few pixels/low Tropo. O₃ over Sahara → Emissivity ?

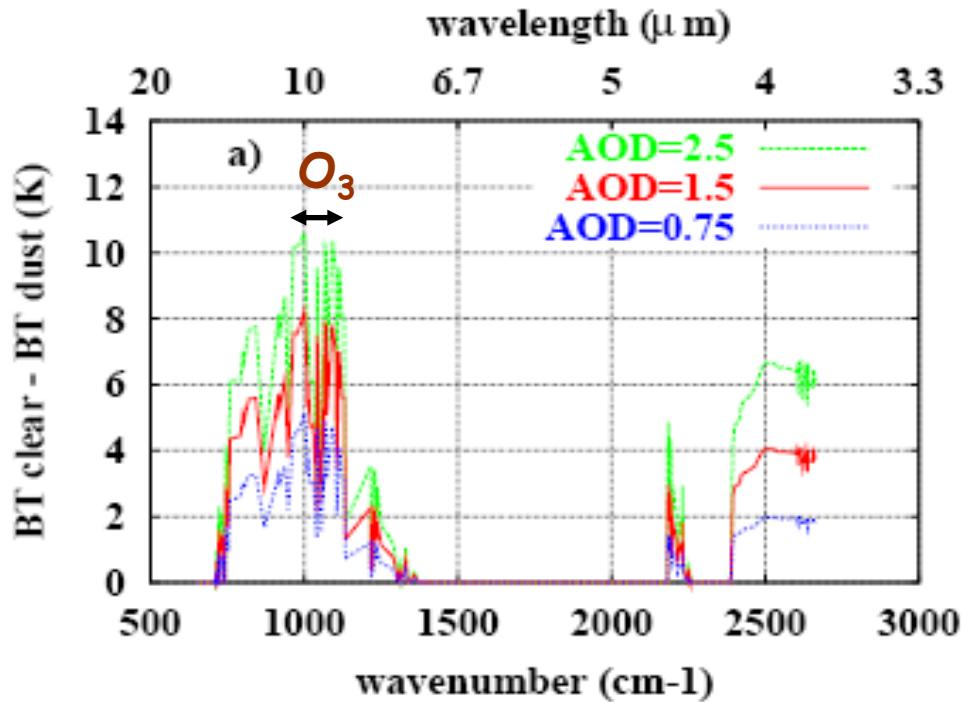


Impact of the aerosols in thermal IR

African aerosols:

- **Desert dust:**
large aerosols (μm) with a strong impact around $10 \mu\text{m}$
- **BB:**
fine aerosols (sub μm) with low impact at $10 \mu\text{m}$

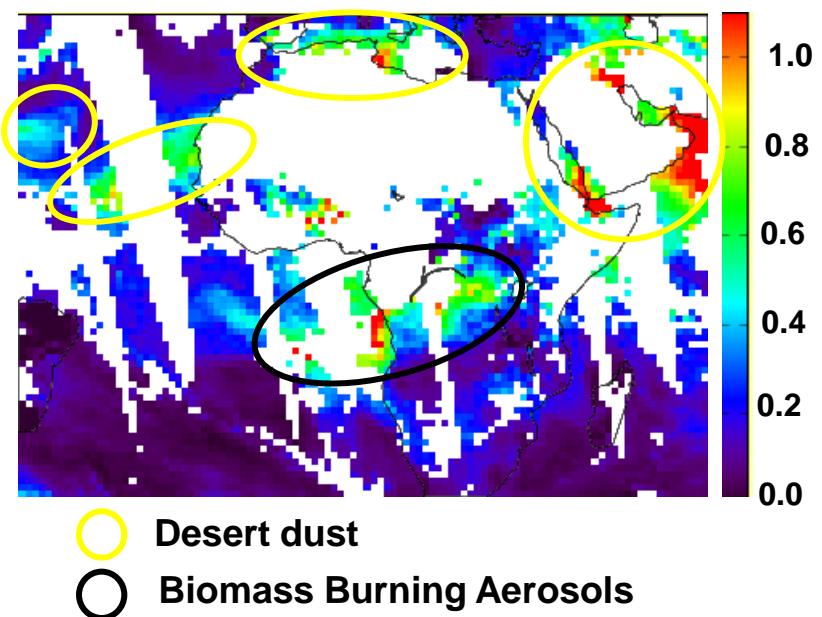
Effect of mineral dust on AIRS Bright. Temp.



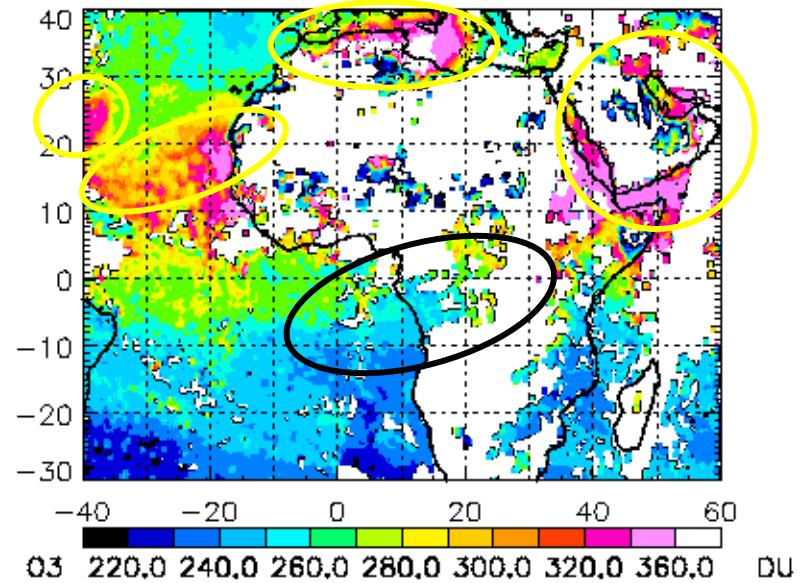
Pierangelo *et al.*, *Atmos. Chem. Phys.* (2004)

Impact of aerosols on O_3 retrievals

Aqua/MODIS AOD (550 nm) 14-07-2008



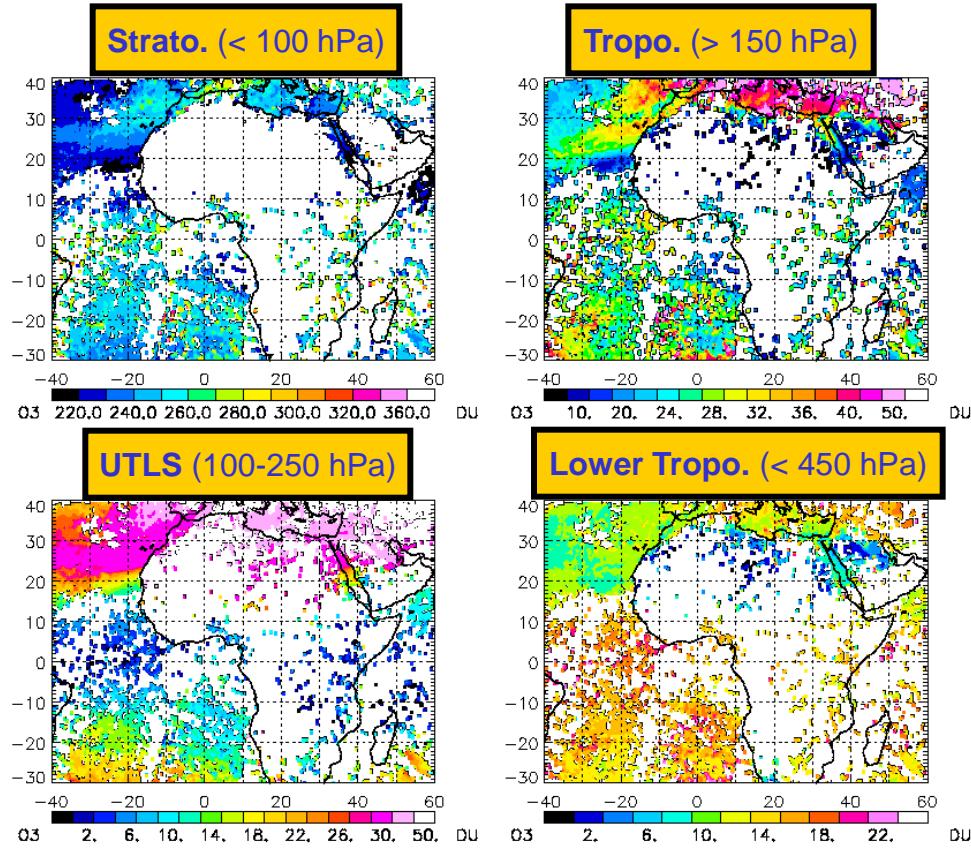
IASI O_3 (Strato.) 14-16/07/2008



- **Desert dust:** strong impact upon O_3 retrievals
- **BB aerosols:** low impact...

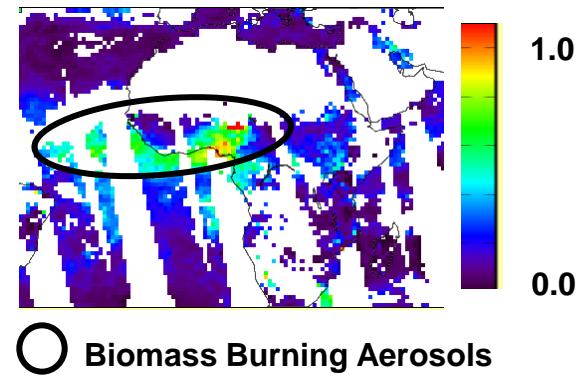
IASI O₃ over Africa: NH winter

14-16 January 2008 / 82% cloudy



- **Strato.** Lat. gradient reversed
- **UTLS** strong intrusions of extratropics lower strato. over North Atlantic
- **Tropo.** high O₃ over Tropical Atlantic → BB/LiNOx + export

Aqua/MODIS AOD (550 nm) 14-01-2008

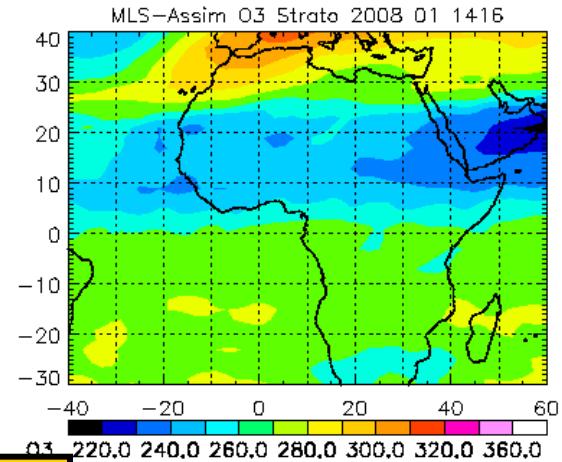
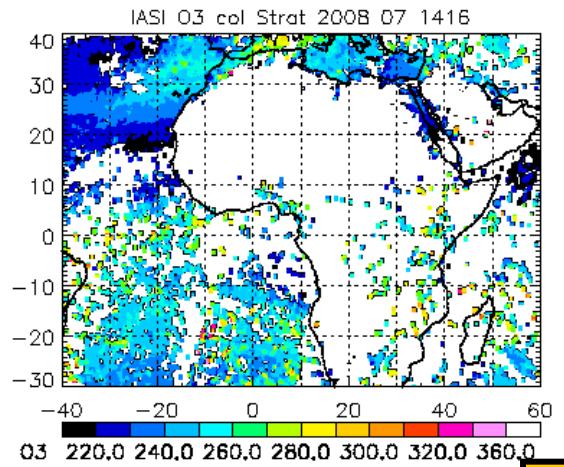


IASI O₃ over Africa: comparison with MLS-Assim.

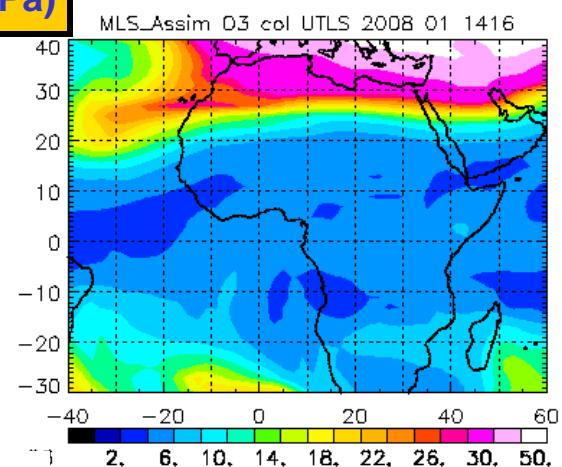
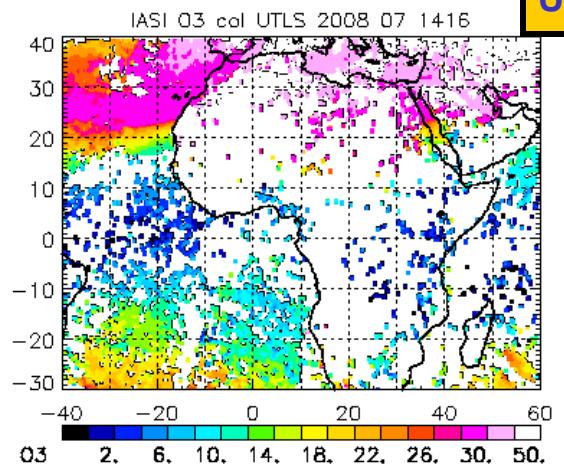
IASI-SOFRID

Strato. ($p < 150$ hPa)

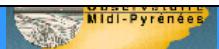
MLS-Assim



UTLS ($100 < p < 250$ hPa)



14-16 January 2008



Conclusions and perspectives

Conclusions

➤ SOFRID: SOftware for a Fast Retrieval of IASI Data

- RTTOV/1D-Var retrieval module adaptation to O₃ retrievals
- coupling between ECMWF analyses / EUMETSAT L2 and L1C data
- cloud filter based on EUMETSAT L2 cloudy fraction
- *a priori* ensemble based on WOUDC/SHADOZ+MOZAIC data and Aura/MLS assimilated fields

➤ Results

- O₃ profiles with ~ 2.5 independent elements of information (DFS)
- good sensitivity in the strato. / UTLS / and tropo.
 - ➔ correlation coefficient of 0.7-0.9 with radiosoundings
- main features of tropo. and UTLS O₃ captured over Africa
- retrievals impacted by desert dust and emissivity over deserts and surrounding areas...

Perspectives

➤ Emissivity: Univ.Wisc. emissivity database, retrieval (PC)

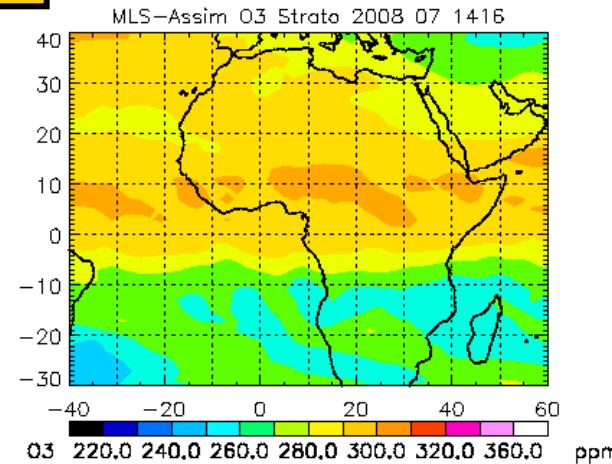
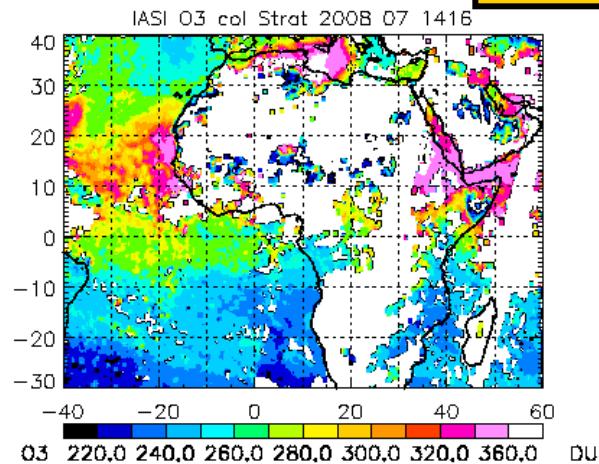
➤ Mineral dust: flag pixels out with BT test, take dust into account with the RTTOV aerosol module... retrieve dust.



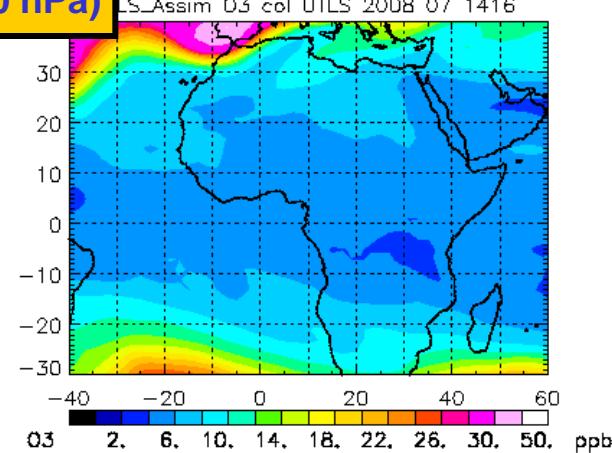
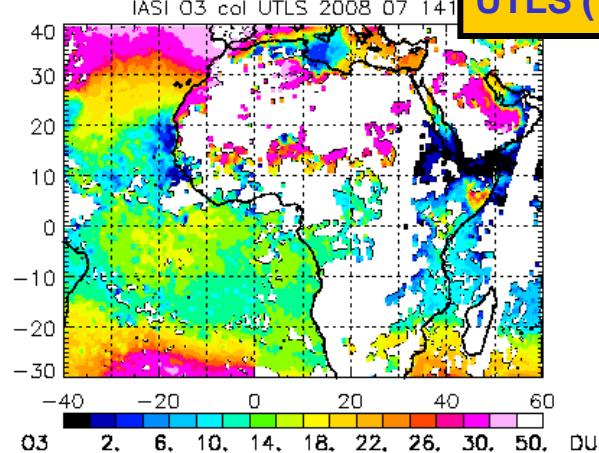
IASI O₃ over Africa

IASI-SOFRID

Strato. ($p < 150$ hPa)



UTLS ($100 < p < 250$ hPa)



14-16 July 2008

