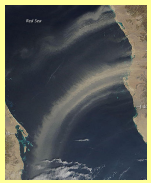

Dust AOD and altitude retrieved from 7 years of infrared sounders observations (AIRS, IASI)

Comparison with other aerosol datasets (MODIS, CALIOP, PARASOL)

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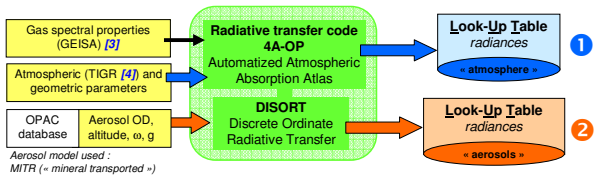
Introduction

Observation from space, being global and quasi-continuous, is a first importance tool for aerosol studies. Remote sensing in the infrared domain is needed for the evaluation of the **total radiative forcing** of aerosols. Infrared sounders provide a way to retrieve other aerosol characteristics, including their **mean altitude** ***[1,2].***

We present **results obtained from AIRS and IASI** sounders, and **comparisons** with other aerosol datasets including **MODIS** & **PARASOL** (AOD) and **CALIOP** (Altitude).

Method

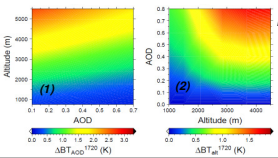
Radiative transfer simulations



Inversion principle

❶ **Determination of an atmospheric situation** the closest to the situation observed (AIRS or IASI) using channels mostly sensitive to temperature and water vapor,

❷ **Simultaneous retrieval of aerosol properties (AOD, altitude)** from BTs of channels mostly sensitive to aerosols.
The proximity recognition in the LUT is made only for atmospheric situations found in step 1.



IASI channel #1720 (1074.75 cm^{-1}, 9.30 µm)

(1) Sensitivity to AOD *as a function of altitude when applying δ_{AOD}=+0.1*

(2) Sensitivity to altitude *as a function of AOD when applying +500m ≤ δ_{Alt} ≤ +800m*

References

[1] Peyridieu et al., *Atmos. Chem. Phys.*, 10, 1953-1967, 2010
[2] Pierangelo et al., *Atmos. Chem. Phys.*, 4, 1813-1822, 2004
[3] Jacquinet-Husson et al., *J. Quant. Spec. Rad. Trans.*, 109, 2008
[4] Chédin et al., *J. Appl. Meteor., 24, 128-144*, 1985
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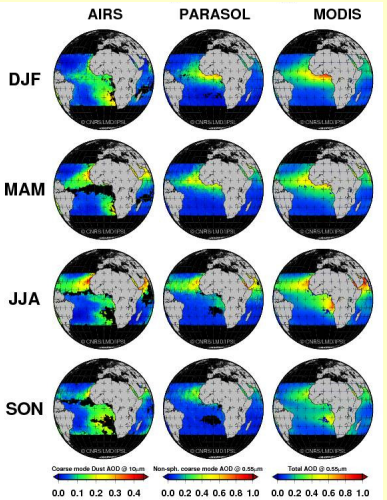
[6] Capelle et al., *in prep*, 2010

Results obtained from AIRS

Aerosol properties have been retrieved over the tropics (30°S-30°N) from AIRS observations covering the period January 2003 – December 2009.

The size of AIRS FOVs is 13.5 km at nadir. Our product is reported on a **1°x1° grid** for each month.
The method is designed to retrieve simultaneously the **dust coarse mode infrared optical depth** and **mean altitude** ***[1,2].***



Aerosol optical depth (AOD)

Comparisons with other aerosol sensors (total AOD from MODIS/Aqua, non-spherical coarse mode AOD from PARASOL) show a good agreement, especially during the **dust season (JJA).**
Time series for different regions of the Atlantic or the Arabian sea confirm the agreement ***[1].***

AIRS vs. MODIS product comparison is used to analyze the relative contributions of the **coarse vs. fine modes** to the AOD.

AIRS vs. PARASOL product comparison illustrates the role of **non-spherical vs. spherical** particles in the coarse mode.

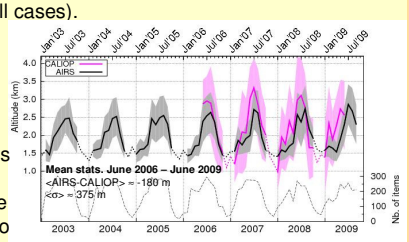
← 7-year AOD seasonal climatology obtained from AIRS (left), compared to PARASOL (center) and MODIS (right) products.

Mean altitude of the aerosol layer

In the infrared, the altitude retrieved is the altitude at which half of the AOD is above and half of the AOD is below.

CALIOP Level-2 (v2.01) aerosol layer product has been used to validate AIRS infrared mean altitude. In this comparison, for a region close to the sources, dust aerosol **single-layer cases** have been considered (64% of all cases).

Time-series of the mean altitude of dust retrieved from AIRS (black) and observed by CALIOP (magenta). The small number of items (dashed, right axis) outside the dust season indicates that altitude retrievals should be considered with caution (dotted lines) ➔



The agreement between the two instruments is satisfactory.
However one should keep in mind the extreme difference in spatial resolution between the two instruments.

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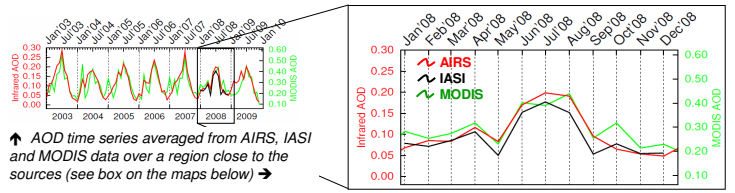
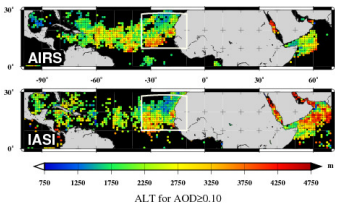
Results from IASI/Metop

The method developped for AIRS has been designed for infrared sounders in general.
In a preliminary phase, IASI channels equivalent to AIRS channels have been selected and results have been obtained from **one full year (2008) of IASI data**.



↑ AOD time series averaged from AIRS, IASI and MODIS data over a region close to the sources (see box on the maps below) ➔

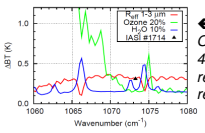


← Maps of the mean altitude retrieved from AIRS (top) and IASI (bottom) July 2008 observations (shown only when corresponding AOD≥0.10).

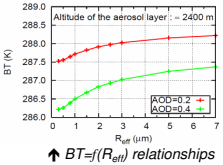
Preliminary results from 2008 IASI observations are encouraging.
A satisfactory agreement is found with AIRS results.

Retrieval of the dust coarse mode effective radius

We are currently retrieving the effective radius of the dust coarse mode from IASI observations (following the method developped for AIRS in ***[5]***).



← Sensitivity of IASI channels around 1070 cm^{-1} to O_3, H_2O and the size of the dust.
4 channels around 1073.25 cm^{-1} are chosen for their relatively high sensitivity to the size of particles and relatively low sensitivity to O_3 and H_2O.



↑ BT=f(R_{eff}) relationships calculated for 2 common aerosol cases.

Once AOD and altitude are determined, R_{eff} can be deduced from a simple BT=*f* (R_{eff}) relationship

Conclusion and future work

We show that aerosol properties – such as **aerosol optical depth** and **mean altitude** – are retrieved from infrared sounders observations (7 years of AIRS, 1 year of IASI at present) and show a good agreement with other aerosol products.
The inversion of aerosol properties from IASI is in progress as the data is made available.

Current and future work include :
- **comparison** with MODIS, PARASOL, CALIOP (v3), ground-based observations
- **retrieval of the dust coarse mode effective radius** ***[5]***
- study of the sensitivity to **other aerosol models**
- **retrieval of aerosol properties over land**, using a database of spectral surface temperature and emissivity retrieved from IASI ***[6].***