



CENTRE NATIONAL D'ÉTUDES SPATIALES

# CNES ACTIVITIES ON IASI AND PROJECTS

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## ROLE OF CNES IN IASI DEVELOPMENT

- **Conception, design**
- **Cooperation agreement with EUMETSAT :**
  - ♦ co-funding of 3 flight models to be embarked on the MetOp series
  - ♦ CNES developed the instrument and the Level 1 ground segment
  - ♦ CNES in charge of monitoring the instrument and performances at Level 1 (includes commissioning the instrument and Level 1 Cal/Val)
  - ♦ ISSWG advisory group, contribution to Level 2 processing

### ...DURING IASI EXPLOITATION

#### ISSWG

Foster development of applications

Support science

R & D

Promotion and outreach



## IASI ON MetOp-A STATUS

- Working very well
  - Only a few interruptions due to SEU
  - Last update of instrument parameters on July
- 
- Level 1 processing
  - Level 2 processing



## IASI FOR MetOp-B AND C

- Flight models were tested (OVT in 2005 and 2006).
- Performances similar to IASI first flying model
  - ◆ Slight modifications???
- Delivered to EADS for integration on the platforms
- Stored at EADS
- Tested and commissioned
  
- New tests planned when next flight is decided
  - ◆ Thermal vacuum test, System tests (SSVT)
  - ◆ Pre-launch operations



## **CAL/VAL AND CONTINUOUS MONITORING**

- **Role of the Technical Expertise Centre (TEC)**
- **Activities in Cal/Val described on poster by Ines Gaudel**
- **A plan of tasks for continuous monitoring has been established**
- **Weekly teleconference with Eumetsat**

## ORGANIZATION FOR FUTURE ACTIVITIES

- **KM actions to maintain a high level of expertise specially in industry all along the IASI programme**
- **Exploitation team to deal with the model on flight, the Level 1 ground segment, the next models**
- **TEC**
- **Project scientist**
  - ◆ **ISSWG-2**  
Follows scientific activities in the labs
  - ◆ **Development of products and applications**



## SUPPORT TO FRENCH THE LABS ON IASI

- [illegible]



## PROMOTION OF IASI

- **IASI data at Ether, the national data centre for atmospheric chemistry**
  - ◆ IASI Level1 c data, together with other satellite data (Gome-2, TOMS, ENVISAT) networks (NDACC), data from campaigns
  - ◆ IASI level2 from Eumetsat
  - ◆ Level 2 products developed from labs for test in parallel and on systematic basis
  - ◆ Level 3 and 4 (assimilation)
  - ◆ a test bench for MACC (GMES atmosphere)
- **IASI website**





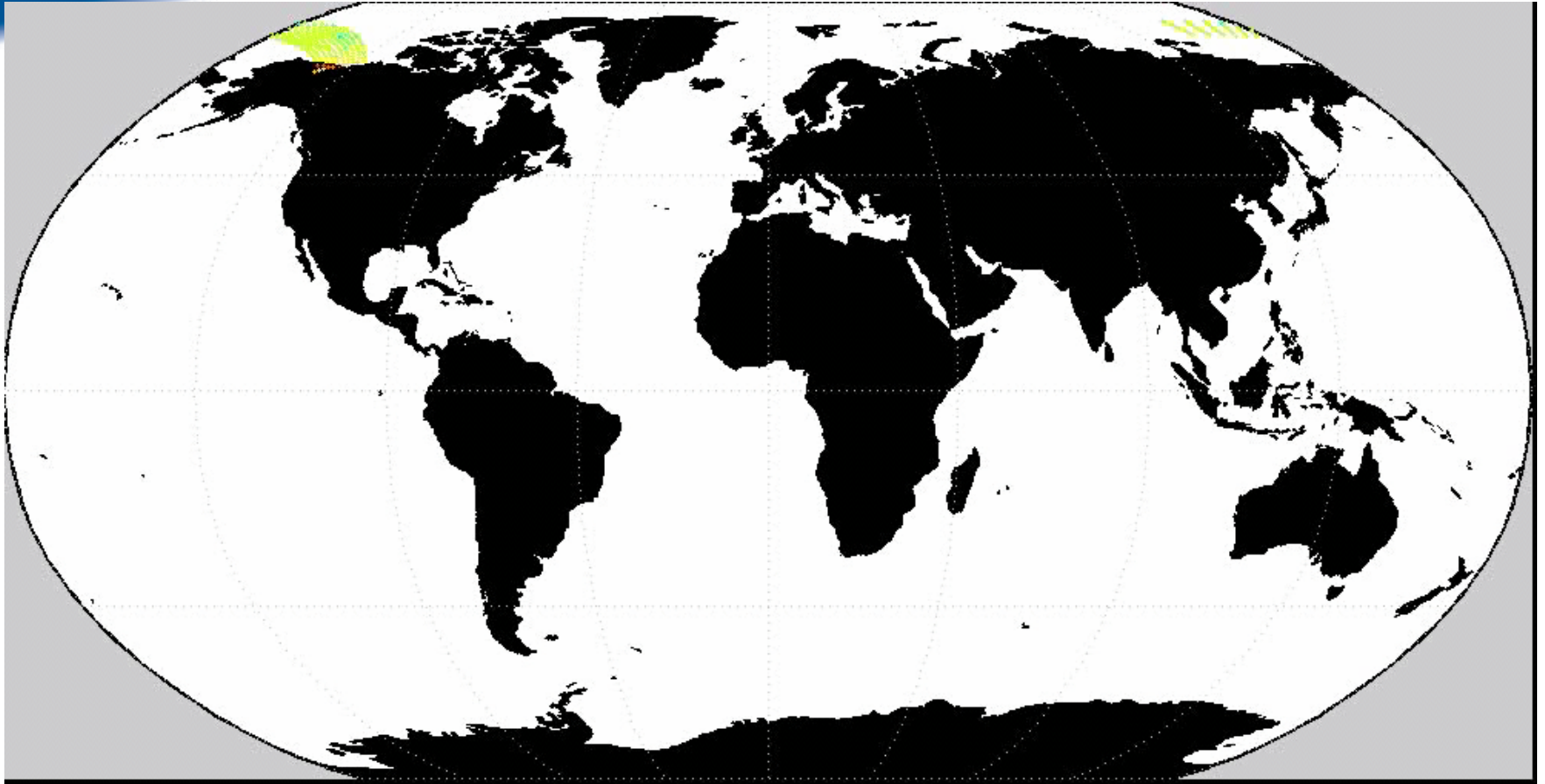
## Internal work

- **Explore IASI capabilities**
  - ◆ To improve the cloud mask
  - ◆ To retrieve innovative products
  - ◆ To initiate new studies
  
- **Manage new developments in R & D**

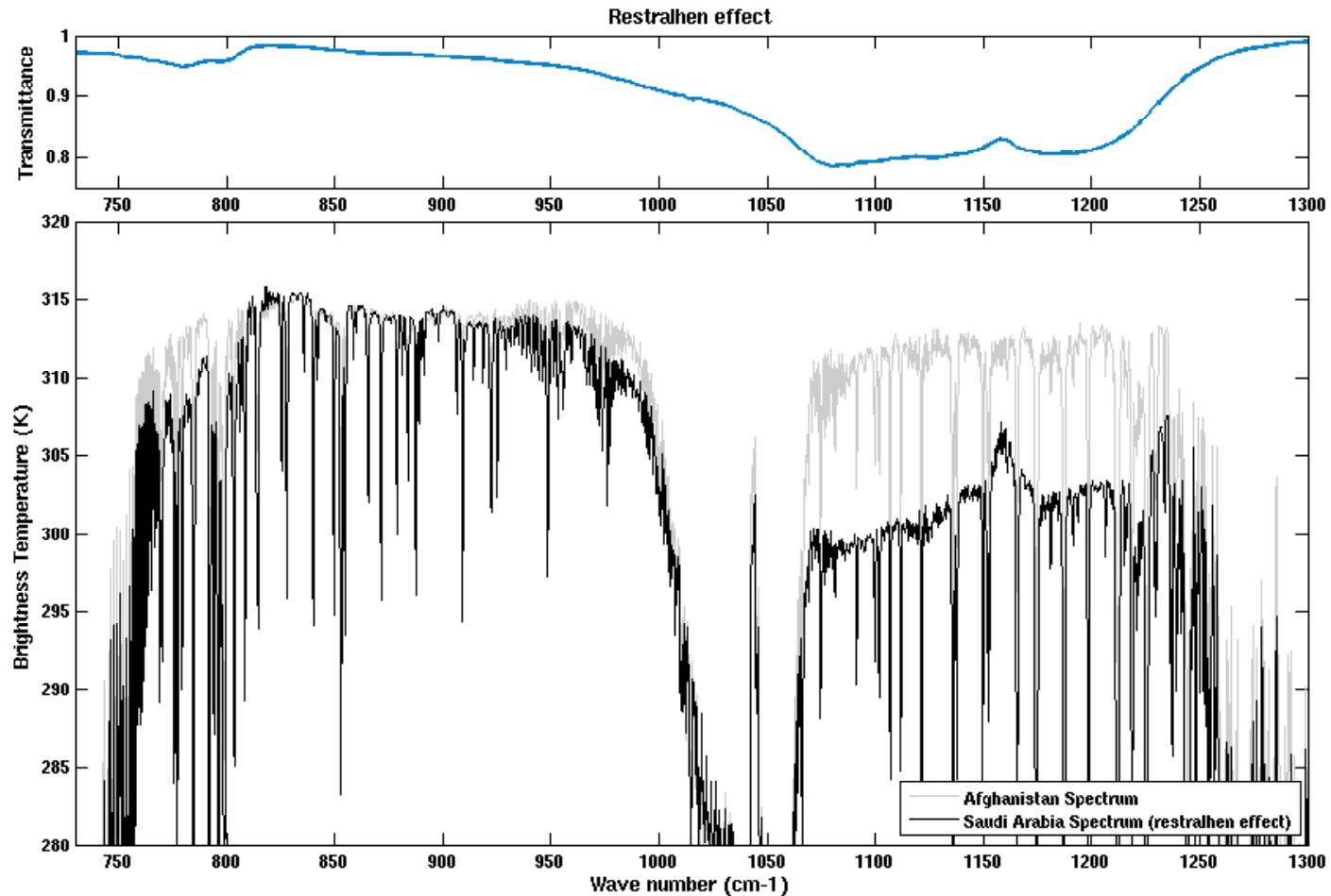


- Check or demonstrate that thanks to its design and actual performances, IASI is a very good instrument for its assigned objectives
- Illustrate in showing that
  - ♦ Spectra are so good that they permit to monitor atmospheric parameters requesting a very good accuracy like GHG
  - ♦ Data quality is good enough to map atmospheric parameters (at level1) and interpret these maps showing that geographic distribution is consistent with what is already known and that no apparent artefacts are induced by quality defects

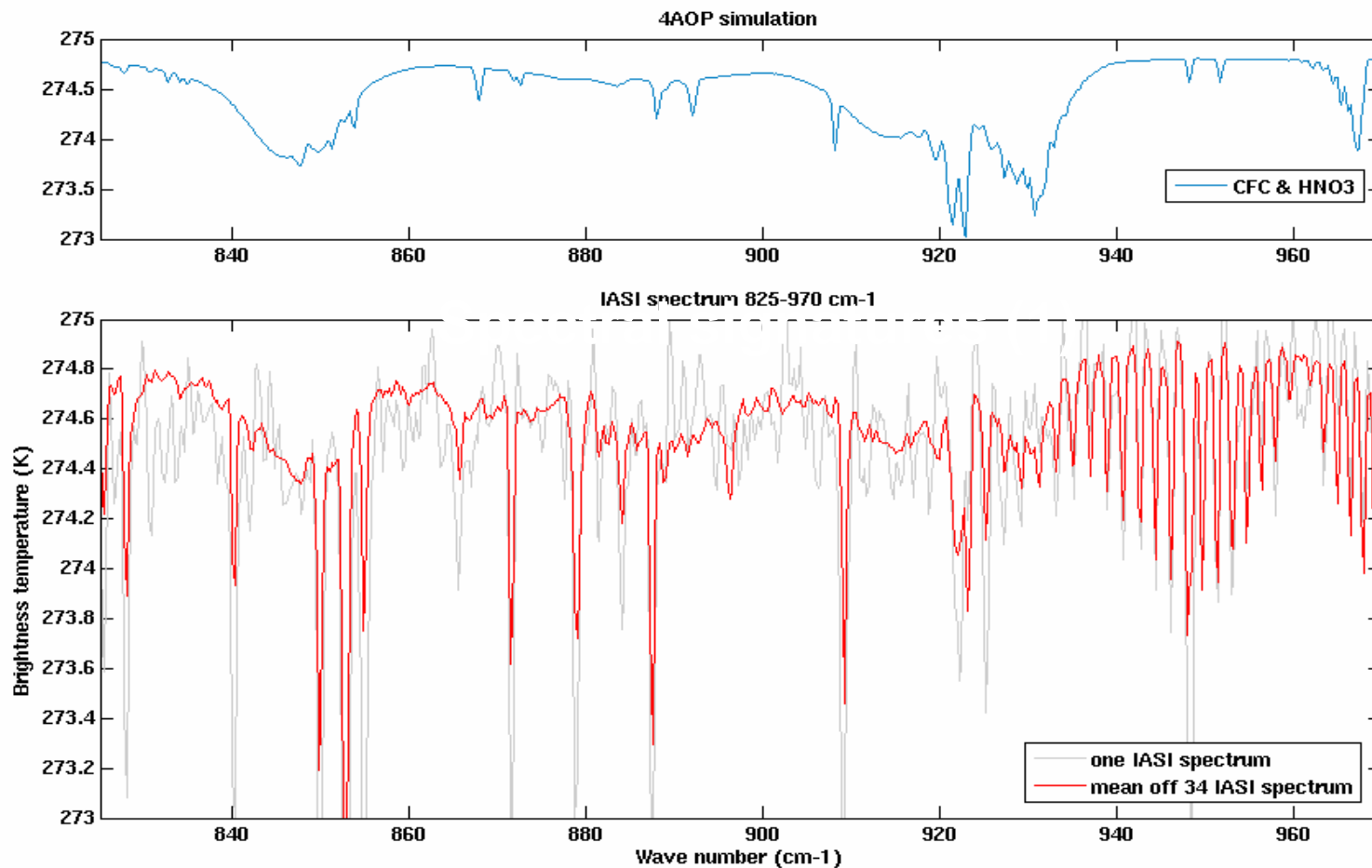




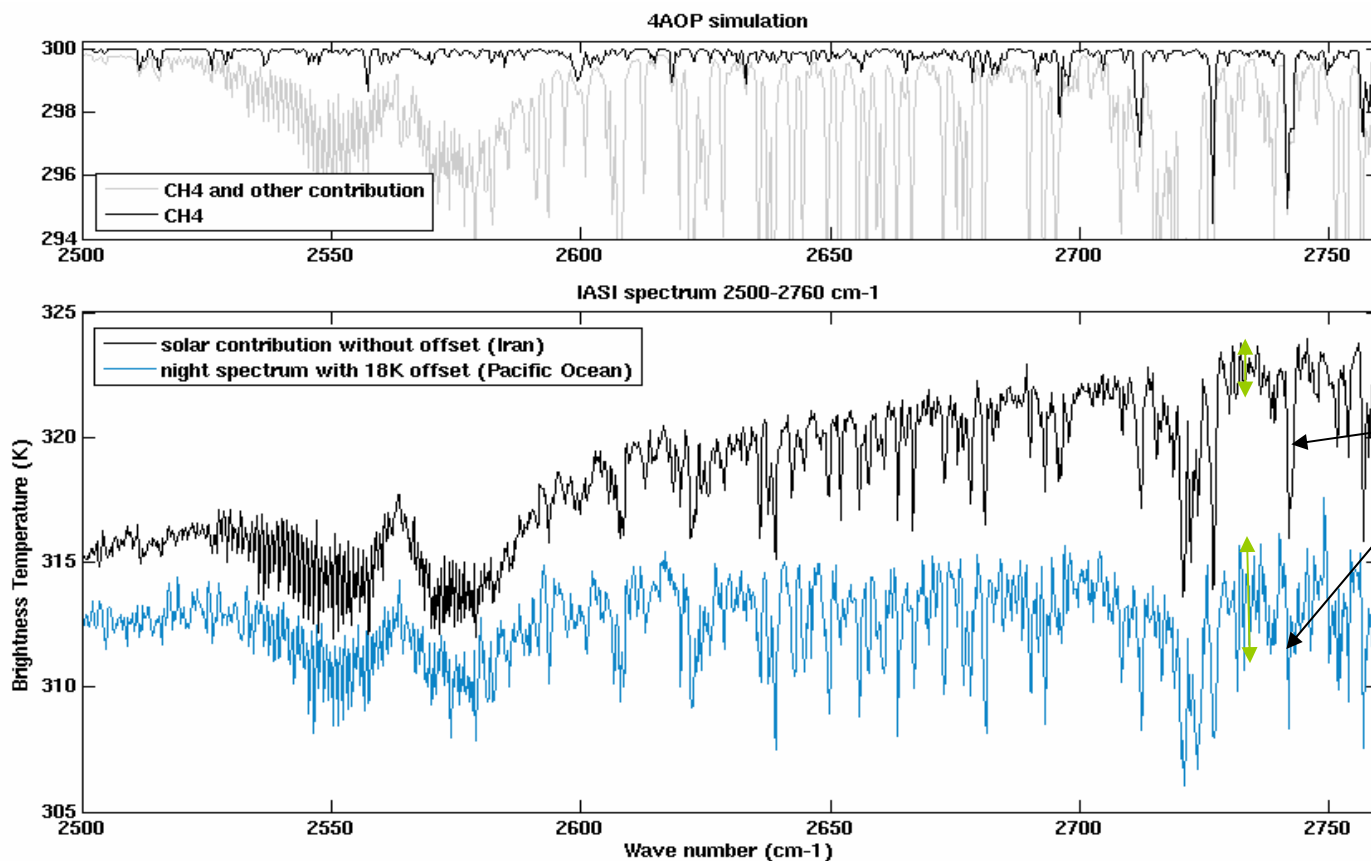
## Emissivity



## CFC and HNO<sub>3</sub>



## Methane



Noise reduction

CH<sub>4</sub> line at 2742 cm⁻¹



## Conclusions

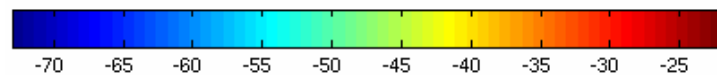
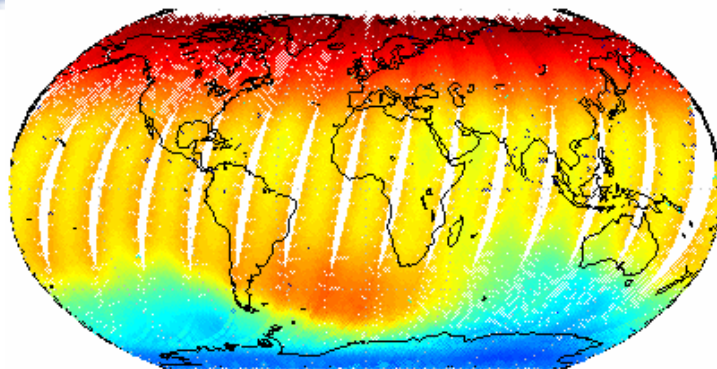
- Atmospheric parameters like CFCs (11, 12),  $\text{HNO}_3$ ,  $\text{CH}_4$  (or even  $\text{CO}_2$ ) with a slow time evolution or with constant/zonal distribution could be derived by averaging measurements to reduce noise and dependency on atmospheric profiles or cloud cover.
- Sun reflected signal from 2400 to 2760  $\text{cm}^{-1}$  increases the signal/noise and is an advantage to retrieve  $\text{CH}_4$  (and probably  $\text{CO}_2$  and aerosols).

## Pseudo-channels

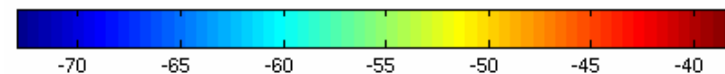
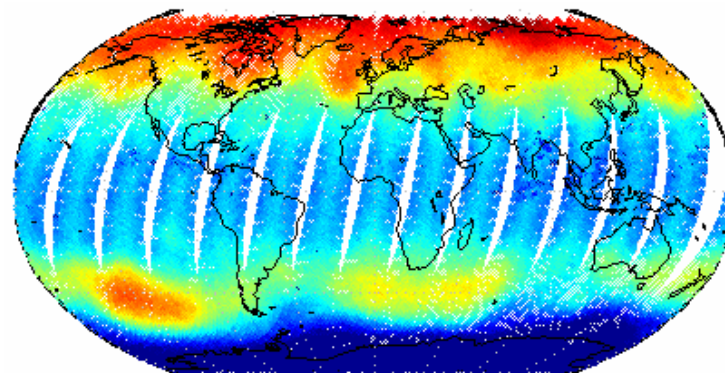
- **Linear Combination of channels showing the same high sensitivity (Jacobian) to a given parameter and a low to others**
- **Advantage**
  - ◆ Noise reduction
  - ◆ Subtraction of temperature dependence.
  - ◆ Simulation of channels of other instruments
- **Examples**
  - ◆ Super-channel in B3 for the SST (sum of channels with transmittance higher than 0.965) or super-channel in B1
  - ◆ AVHRR 4 or AVHRR 5
  - ◆ Atmospheric profiles
  - ◆ Ozone channels (for column)



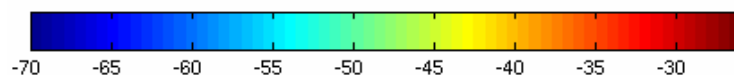
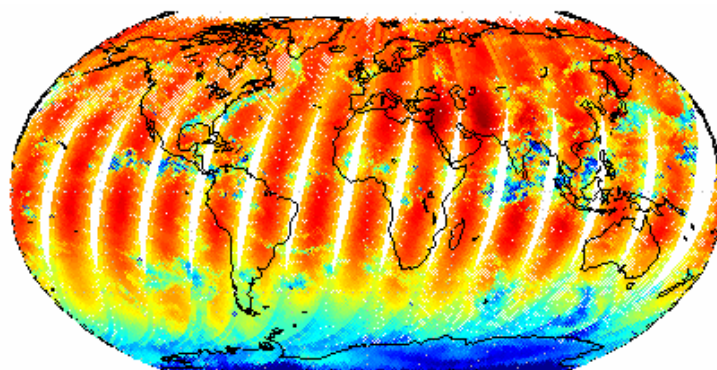
**0-50 hPa**



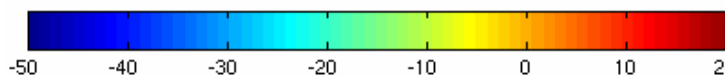
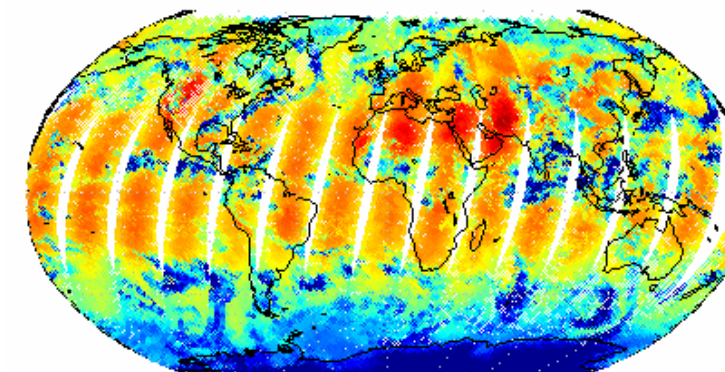
**50-200 hPa**



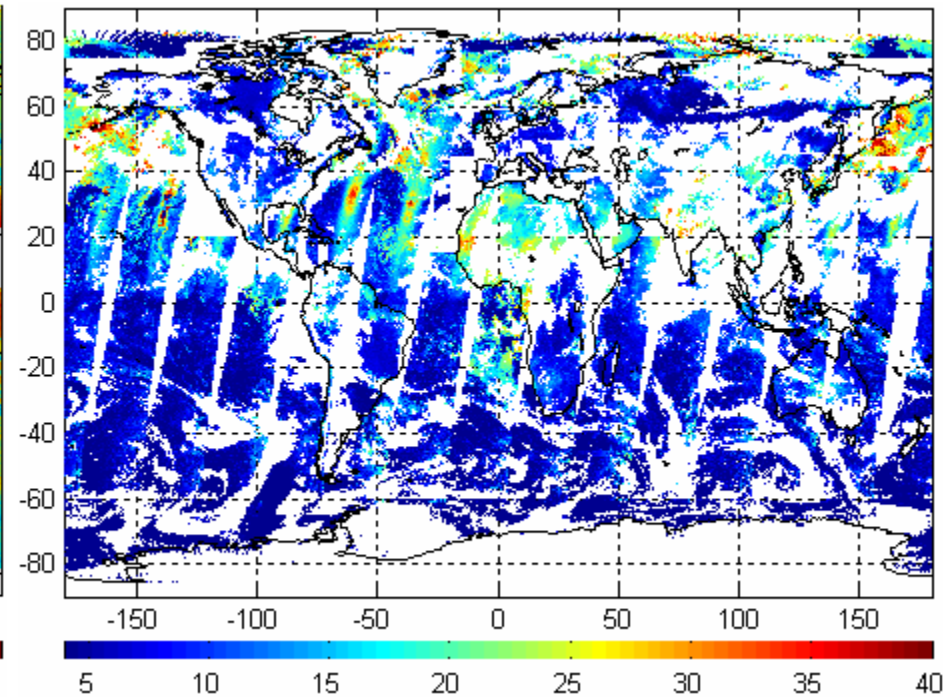
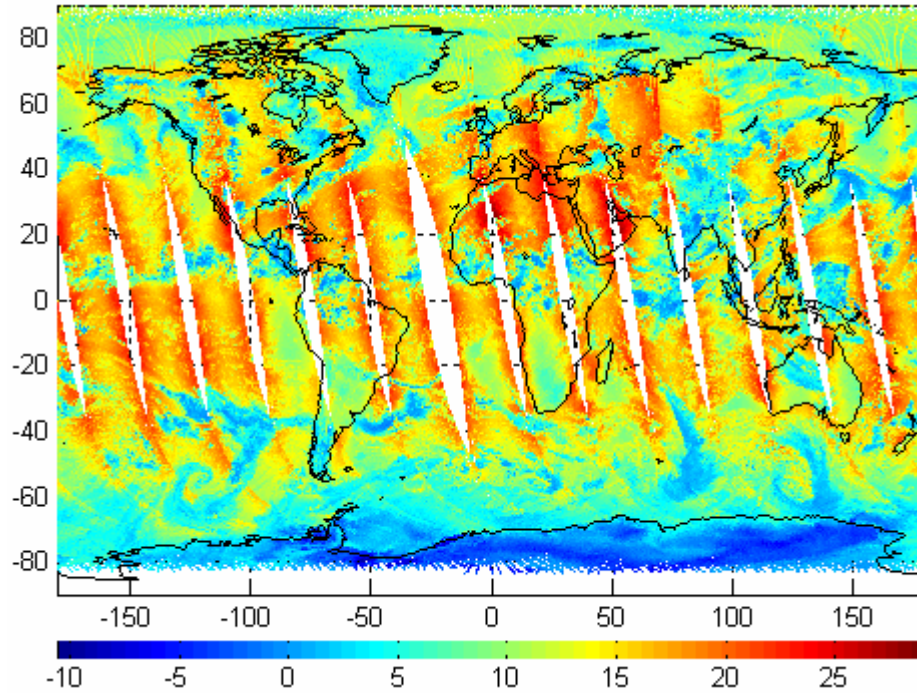
**500-750 hPa**



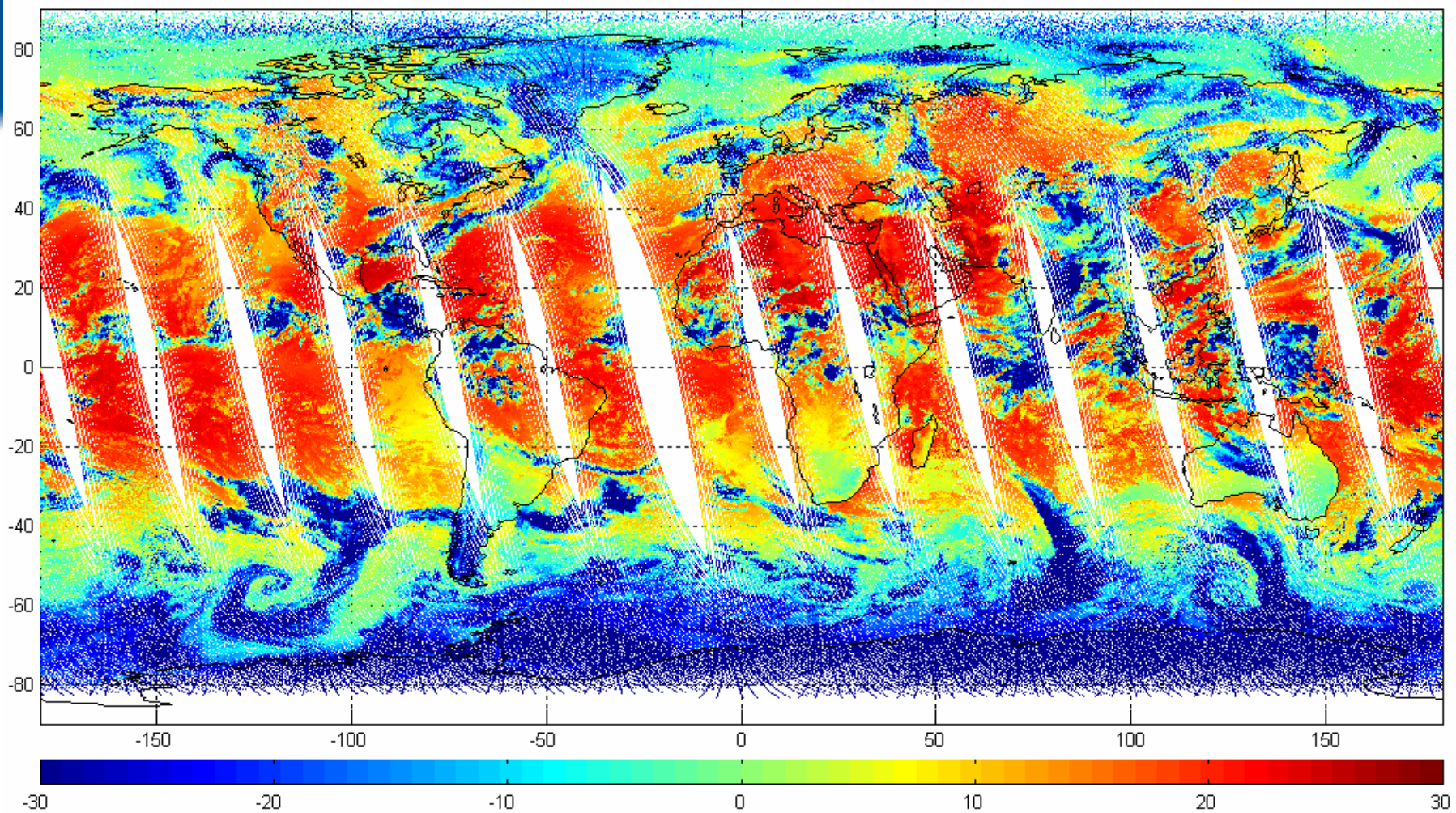
**600-950 hPa**



## Artefacts due to viewing angle and sun reflectance







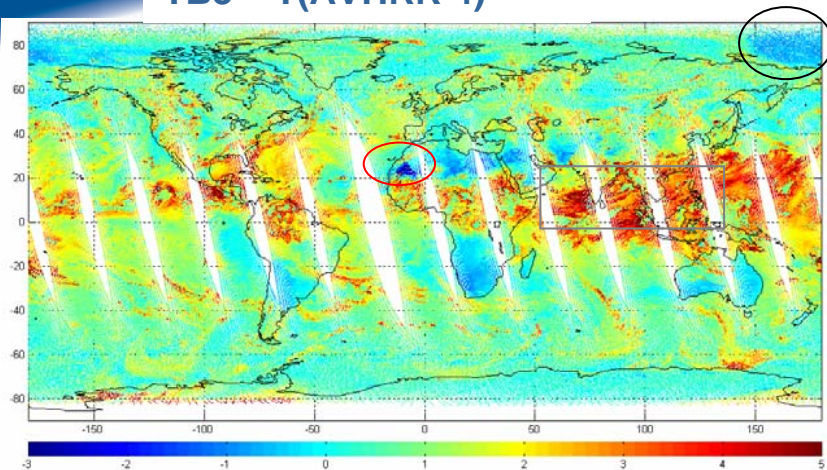
**IASI : Pseudo B1 (window) - ascending orbits (night) on 15 July 2007**



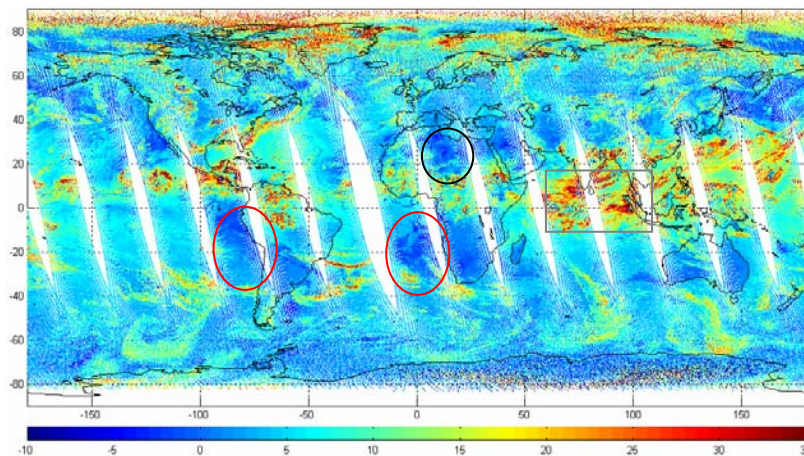


15 July 2007 (night)

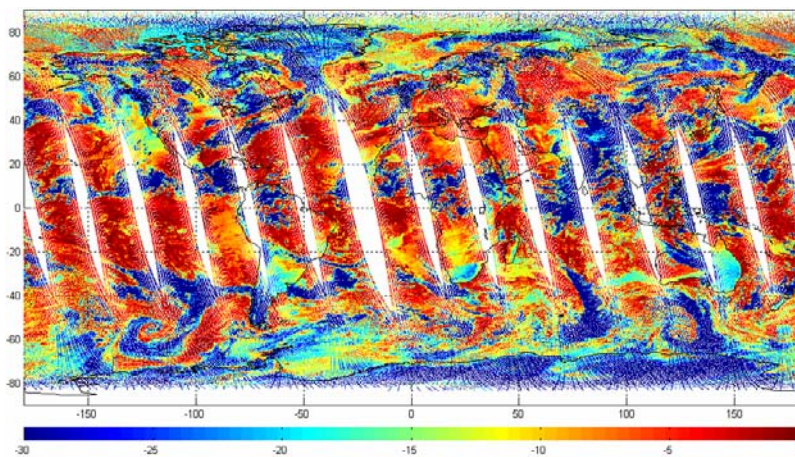
TB3 – T(AVHRR 4)



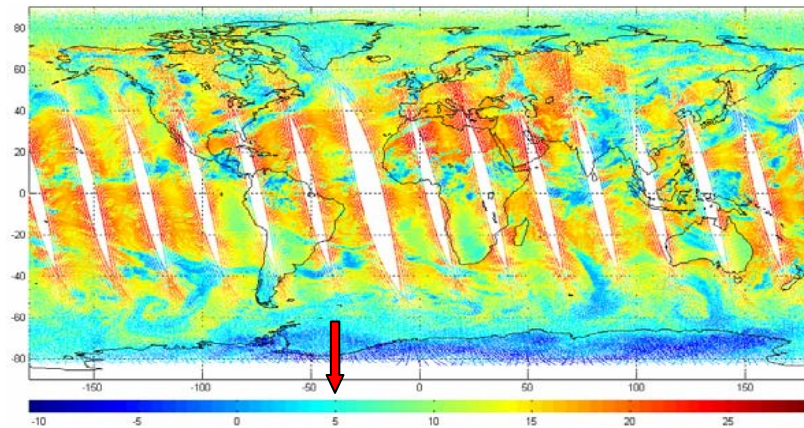
TB3 – T(AVHRR 5)



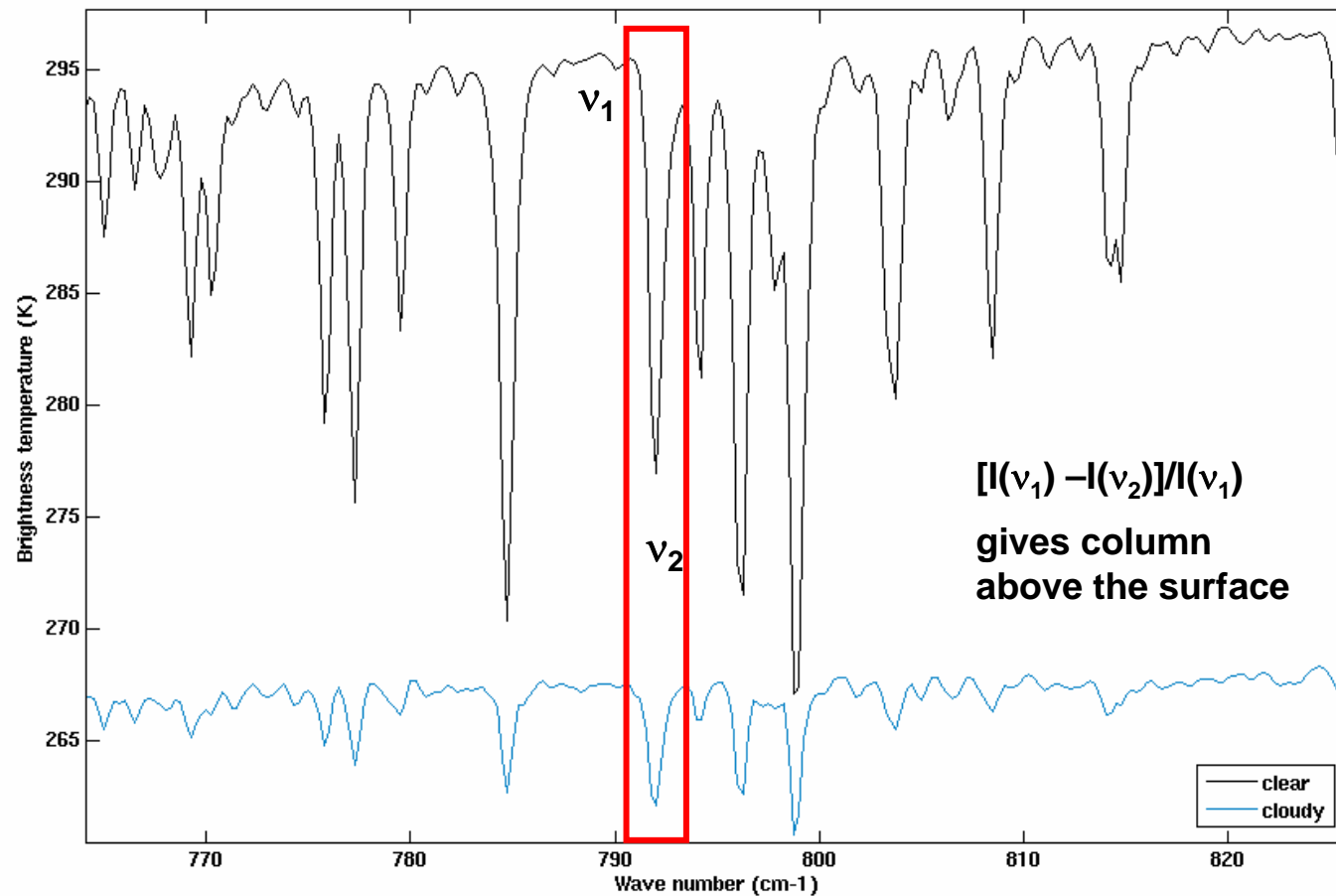
Tmax – TB1



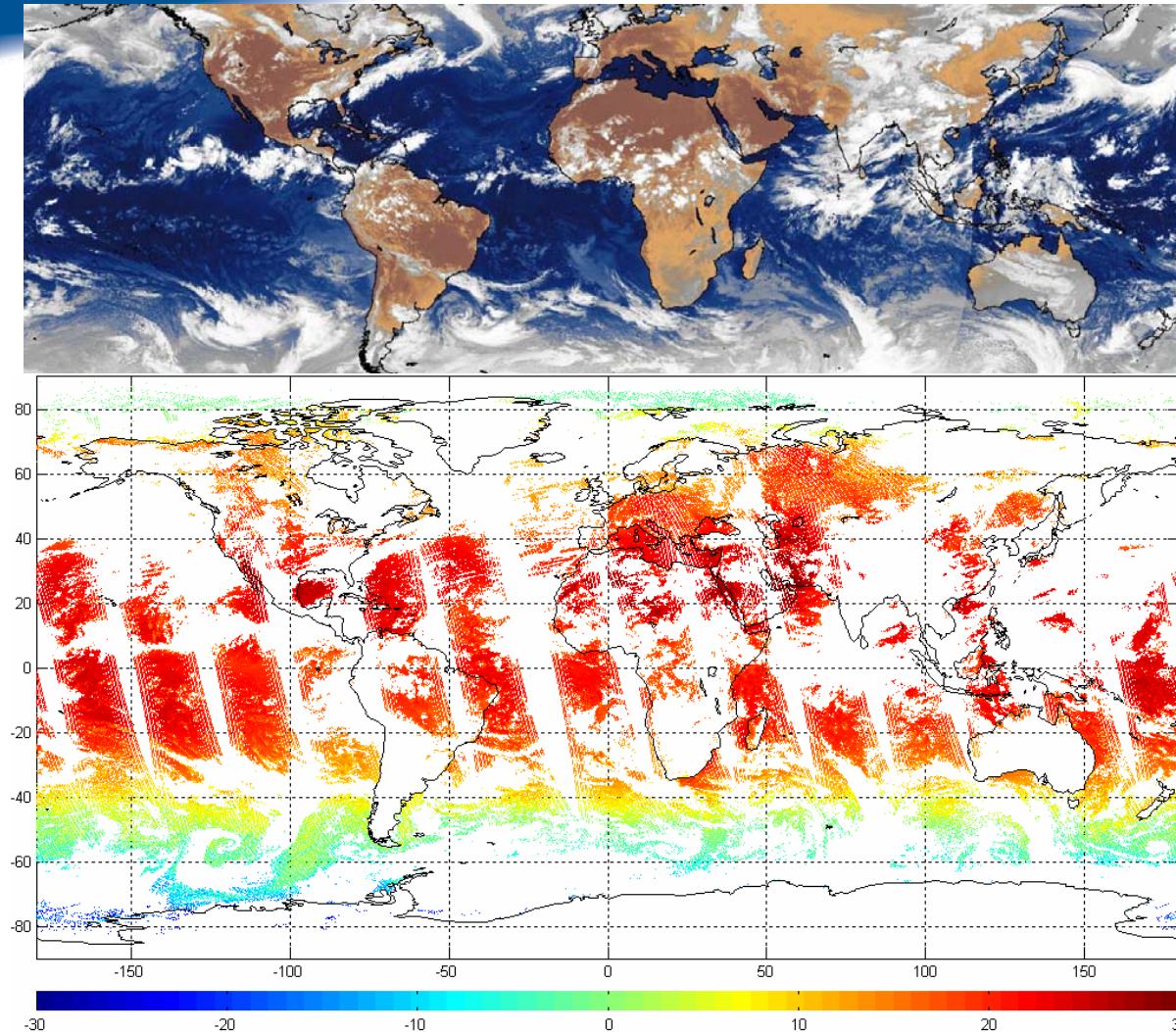
CO<sub>2</sub> line depth @791.75 cm<sup>-1</sup>



**CO<sub>2</sub> line @791.75 cm<sup>-1</sup> gives  
temperature in the lower  
troposphere**

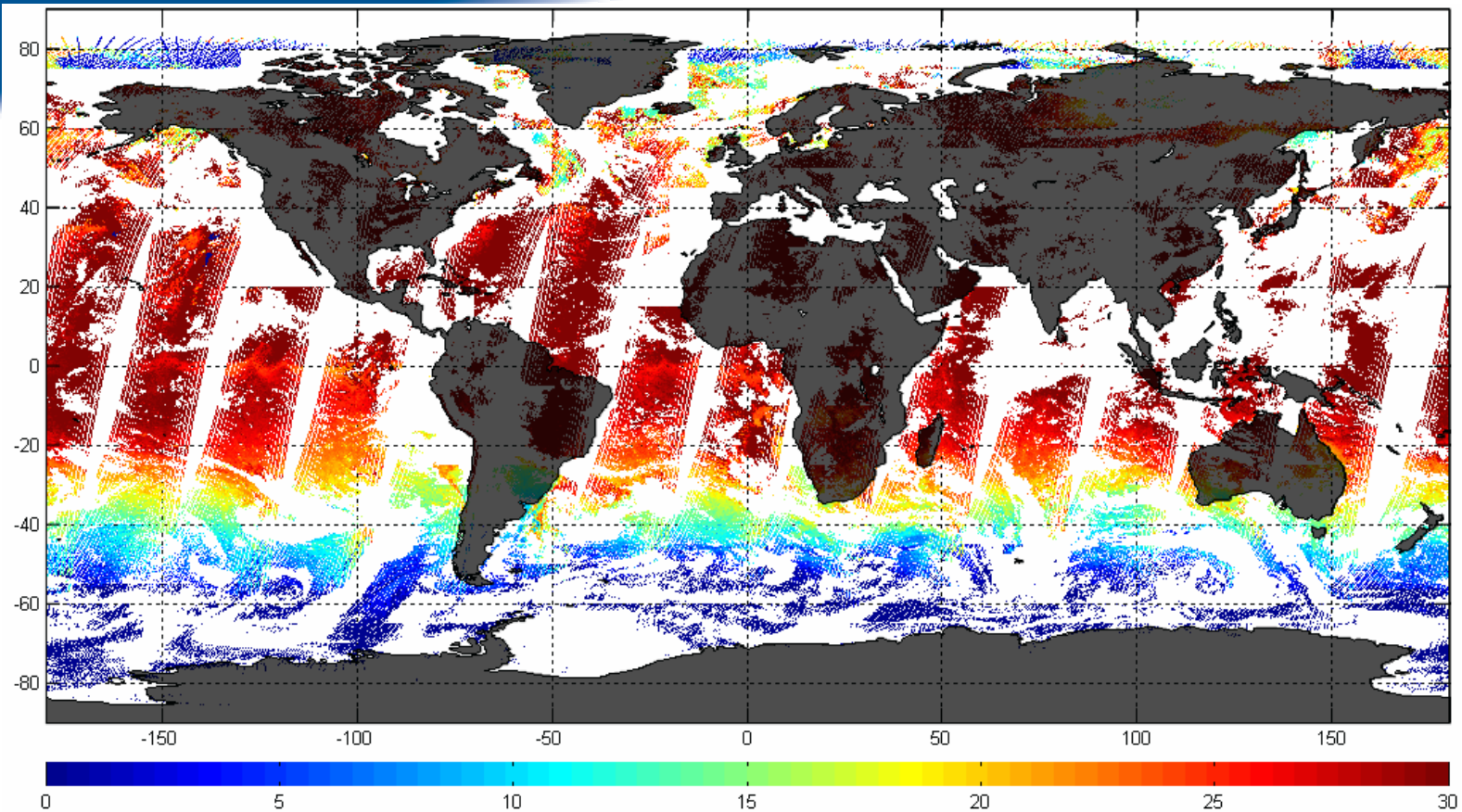






28% cloud free

**Gross mask : Clear if  $TB1 > T_{max} - 10\text{ }^{\circ}\text{C}$  and  $1\text{ }^{\circ}\text{C} < TB3 - T(AVHRR5) < 11\text{ }^{\circ}\text{C}$  and  $T(AVHRR4) - T(AVHRR5) < 3.2\text{ }^{\circ}\text{C}$   $T_{max}$  in boxes of 6 scan lines**



Super B3  
Atmospheric effect  
lower than 0.3 K

## Cloud decontamination scheme

- Actually, IASI pixels contaminated by small clouds or low cover are sometimes misclassified as cloud free
- A better cloud mask is established using AVHRR data in IASI pixels. AVHRR cluster analysis results available in Level 1C IASI products
- It gives up to 7 clusters characterized in the 5 (or 6) AVHRR channels with population, mean, std., position.





## Cloud decontamination scheme (2)

### Exemple of AVHRR radiance analysis (Level 1C product)

AVHRR vis et IR

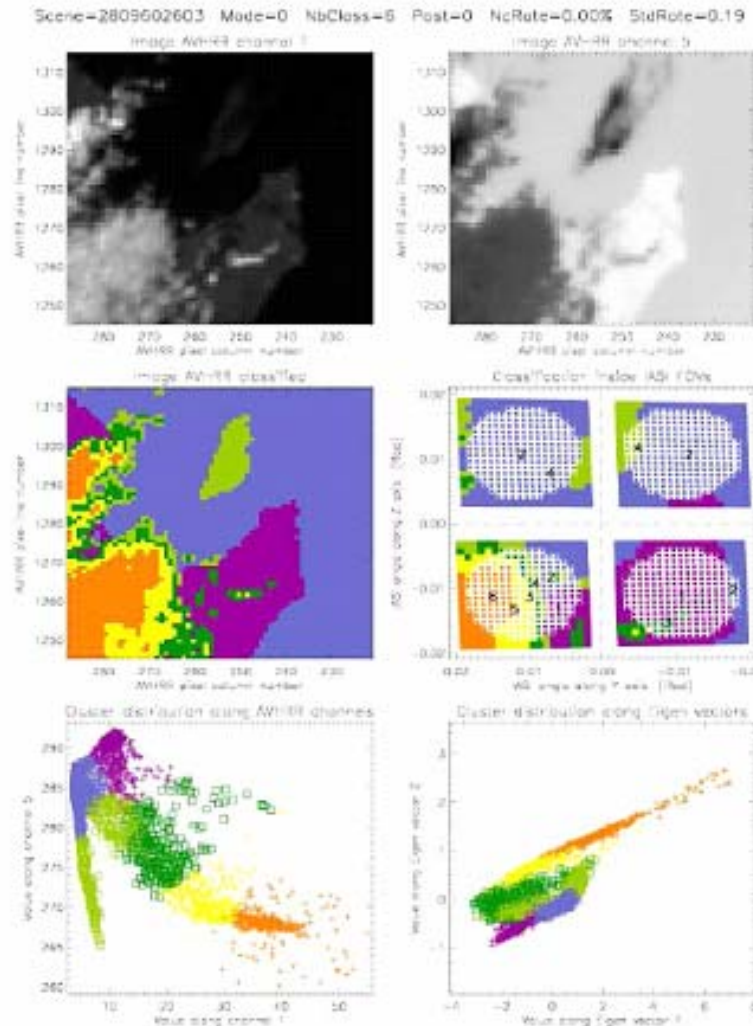
Orbit 28096 (NOAA 14),  
Spring, Day-time,  
Tunisia coast

Surface type:

- Sea
- Land
- Opaque clouds
- Cloud border
- Cirrus

Homogeneous  
component from  
AVHRR radiance  
analysis

Cluster structures in  
the AVHRR channel  
subspaces



- The maps demonstrate that there is no major defect confirming the very good IASI performances assessed during the Cal/Val (See D. Blumstein)
- IASI pseudo-channels maps can be used in global monitoring of surface and atmosphere parameters

Data continuity is very good (very few interruptions)  
and performances are good and stable

- ◆ radiometry (absolute and relative)
- ◆ spectral calibration
- ◆ accurate geolocation



## Conclusions

**We showed that many unexpected applications can be served by IASI**

- **More work is still needed to develop methods to retrieve quantitative products and estimate their accuracy**
- **This work will be coordinated in the ISSWG which will define day 2 products**



# More

## ■ More information on

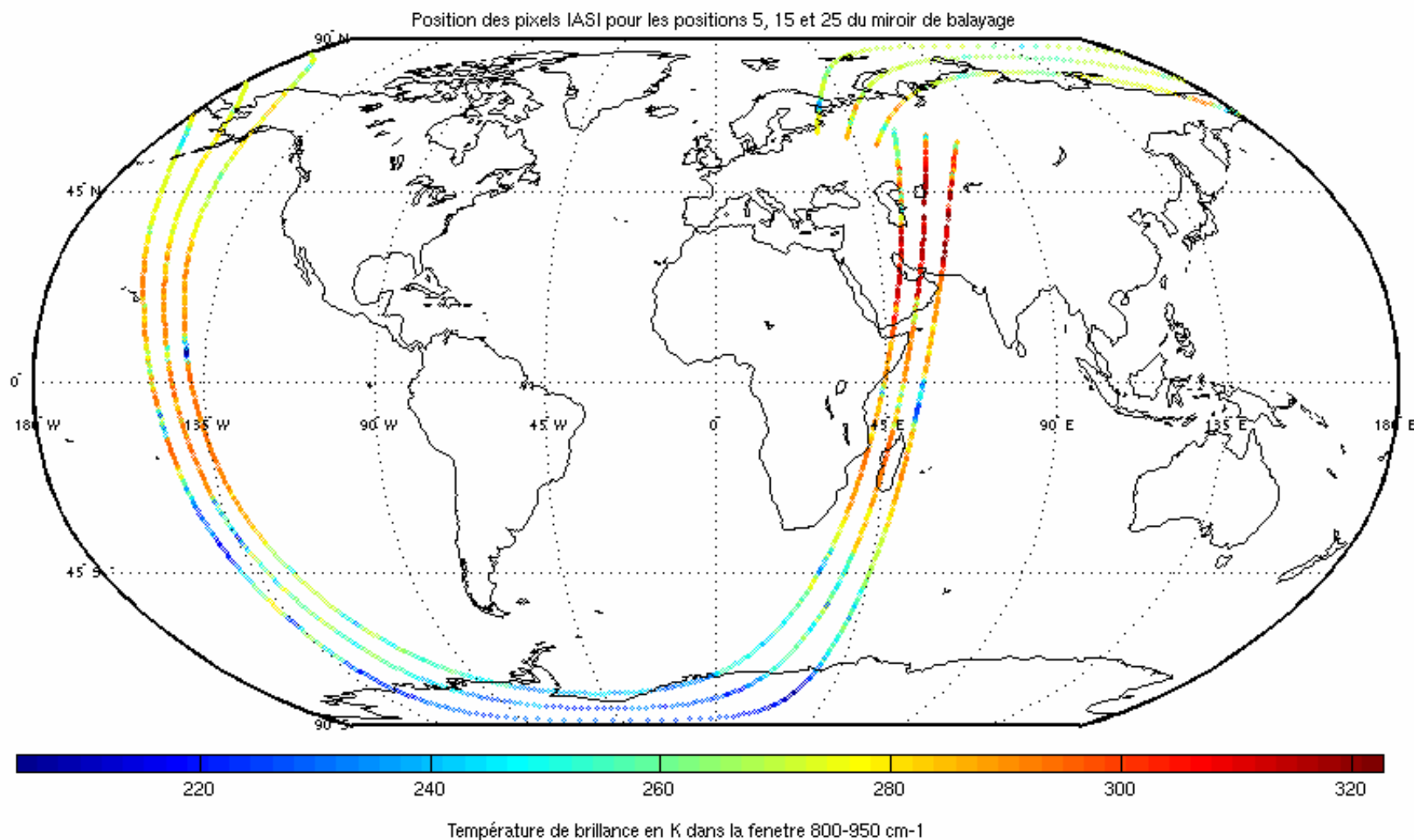
- ♦ <http://smc.cnes.fr/IASI>
- ♦ <http://www.eumetsat.int/>

Thank you



## Back up slides

## Selected spectra





## Humidity profile

