

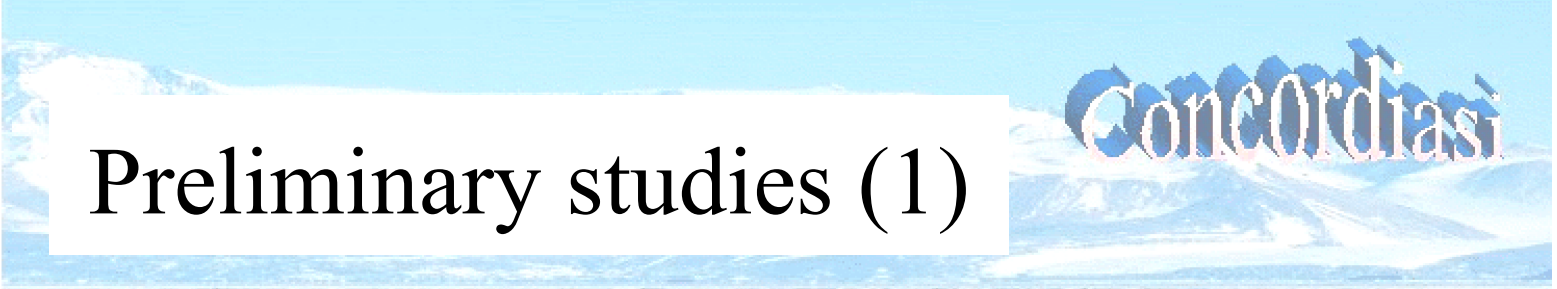
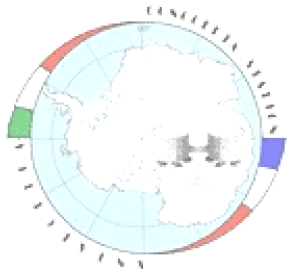


IASI retrievals at Concordia using data from Concordiasi

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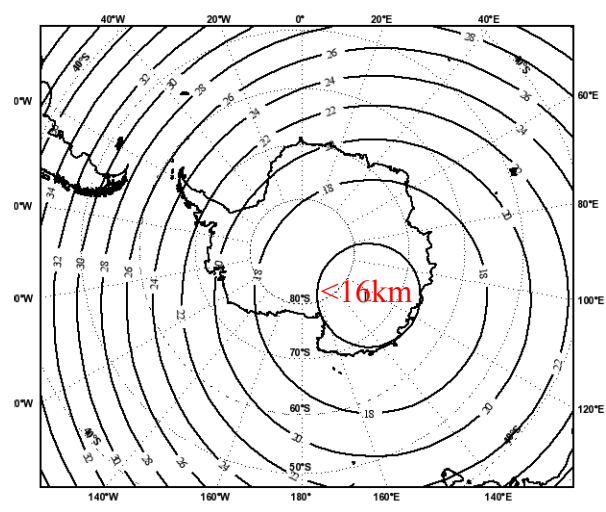
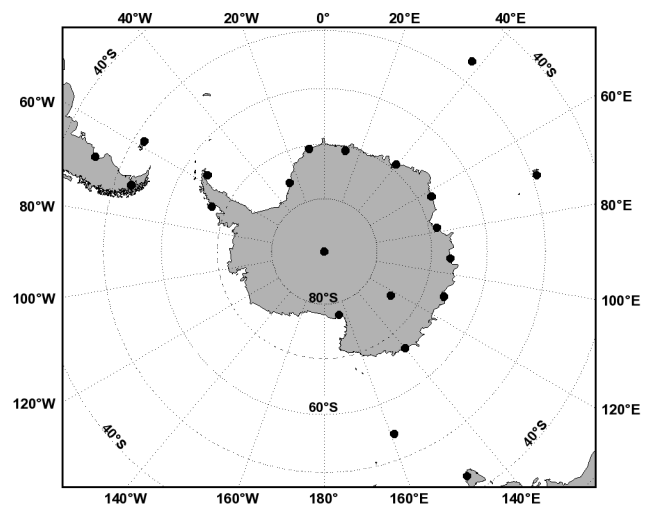


Preliminary studies (1)

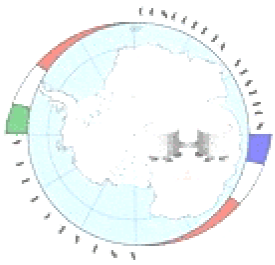
- Concordias : Field experiment during austral spring 2008-2009- 2010. Part of International Polar Year
- Aims : Improve the assimilation of infrared and microwave satellite observations over high latitudes by comparison with in-situ observations

➡ *Rabier et al, BAMS, 2010; Guedj et al, IEEE, 2010 et Bouchard et al., MWR, 2010*

☀ Tuned the meteorological model ARPEGE for Antarctica studies



Better horizontal resolution of the model
→ Better representation of the orography



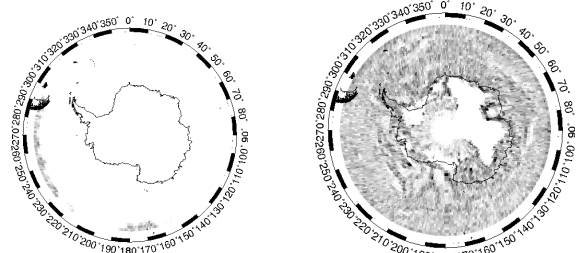
Preliminary studies (2)

To improve the assimilation of satellite observations in Météo-France global meteorological model ARPEGE

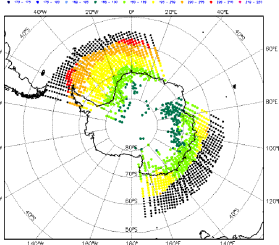
☀ Studies on the microwave emissivity to improve the assimilation of AMSU-A & -B

Based on Karbou's approach (Karbou et al., 2006): estimation of emissivity from satellite observations → Method applied & adjusted to sea-ice surface for AMSU -A & -B sensors

☀ Assimilation experiment over sea-ice and land with more satellite data infrared & microwave

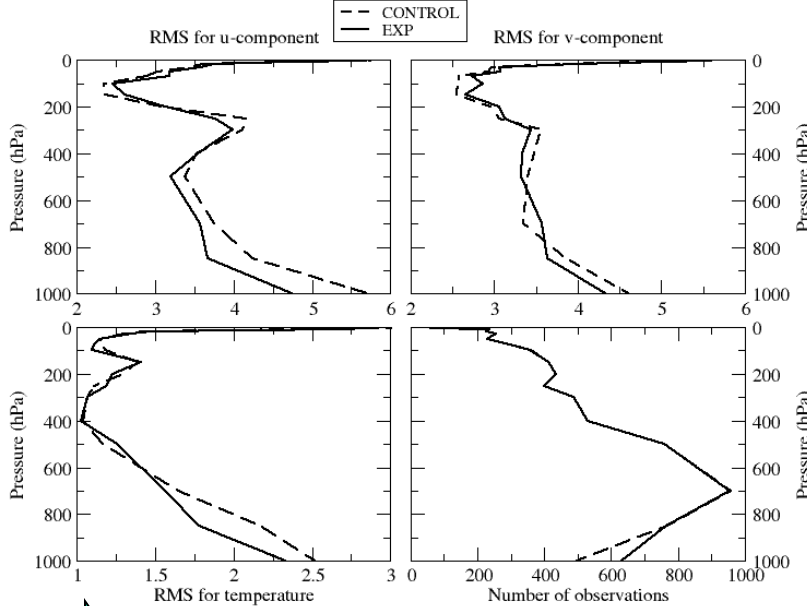


AMSU-B, channel 3: before (left) after modification (right)



Black : without additional data
Color : additional IR data

EXP : Additional data (IR and MW)

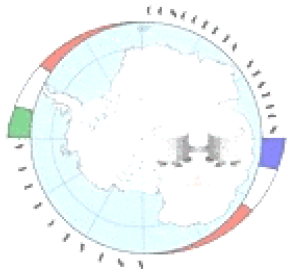


Comparison (RMS) to Radiosounding for area : 65°S - South Pole

Number of observations between 300 and 900

More obs. in EXP in lower part of troposphere

➔ Better fit to ground and airborne observations



Datasets :

Austral Spring 2008 and 2009



- Time Period : from the **15 September 2008 to 30 November 2008** and **19 November 2009 to 13 December 2009**
- Observations launched :
 - **2008** : Radiosounding at **DomeC** (75°S ; 123°E) & **Dumont d'Urville** (66,40°S;140°E) stations in order to have 2 observations each day at each station, at 0UTC and 12UTC. **Complementary launch at the same time of IASI overpass.**
 - **2009** : As 2008 for DomeC station + Surface measurements (vertical profile of the ts from -10m to -1m) at the time of the sounding.

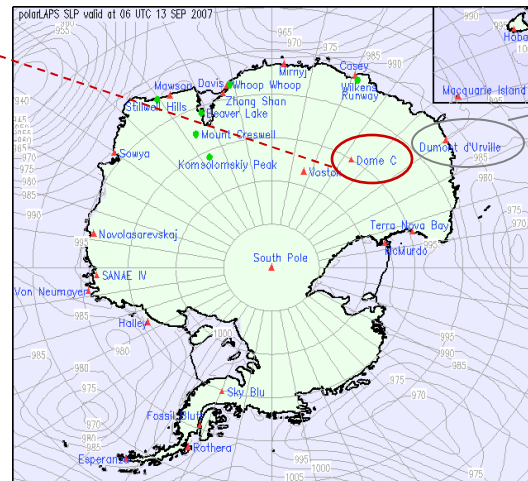
DomeC

-Additional data for Concordiasi: 0UTC

- Meteorological conditions :
 over 120 cases in 2008: **62% clear sky**
 over 17 cases in 2009: **59% clear sky**

-Surface Parameters (in 2009):

- Ps : 648hPa
- Ts measured by Automatic Weather Station (AWS) :
-35.3 °C
- Ts from **manual measurement** at the snow surface : -33.5°C



Dumont d'Urville

-Additional RS for Concordiasi: 12UTC

- Meteorological conditions :
 over 149 cases in 2008: **19% clear sky**

➔ Most of time : clear case at DomeC

First Results (1)



1D-VAR

Main Aim : Study the assimilation of more IASI channels over high latitudes

→ Choice of DomeC station – statistics : mostly clear cases

Software used : **1D-VAR** of the **Met Office**, part of the NWP SAF

Principle : from observation and background profile → profil retrieved by minimising the cost function $J(x)$

Error covariance matrix of the observations \mathbf{R} , of the background profile \mathbf{B}

$$J(x) = (x - x_0)^T B^{-1} (x - x_0) + (y - y(x))^T R^{-1} (y - y(x))$$

x_0 : background profile (T, RH)

y : observations (BT) and $y(x)$ the observed radiance for a given atmospheric state x

Methodology

1) Tuning of 1D-VAR in Direct mode:

BASE : operational configuration of ARPEGE

→ Bias correction, output of Arpege, used on observations y

→ Choice of RTTOV coefficient used : K-CARTA

→ Use of R-Matrix of ARPEGE, tuned and B-Matrix of Met Office

2) Retrieval with 1D-VAR

In order to assimilate more IASI channels

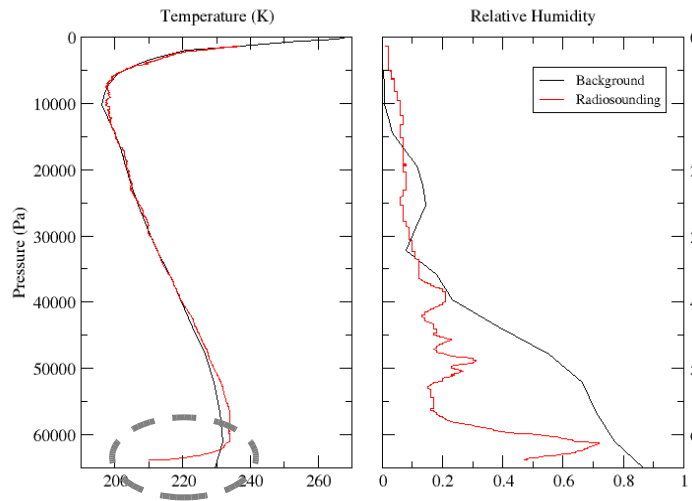
→ Study of \mathbf{B} -matrix

→ Surface parameter : skin temperature, emissivity

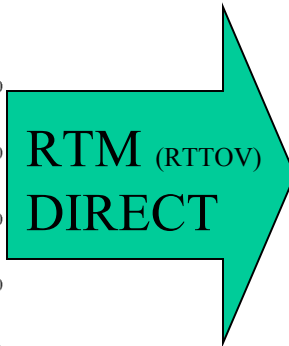
First Results (2)

Study at DomeC with Radiosounding at 0UTC : case 10/05/2008

Temperature & relative humidity profiles

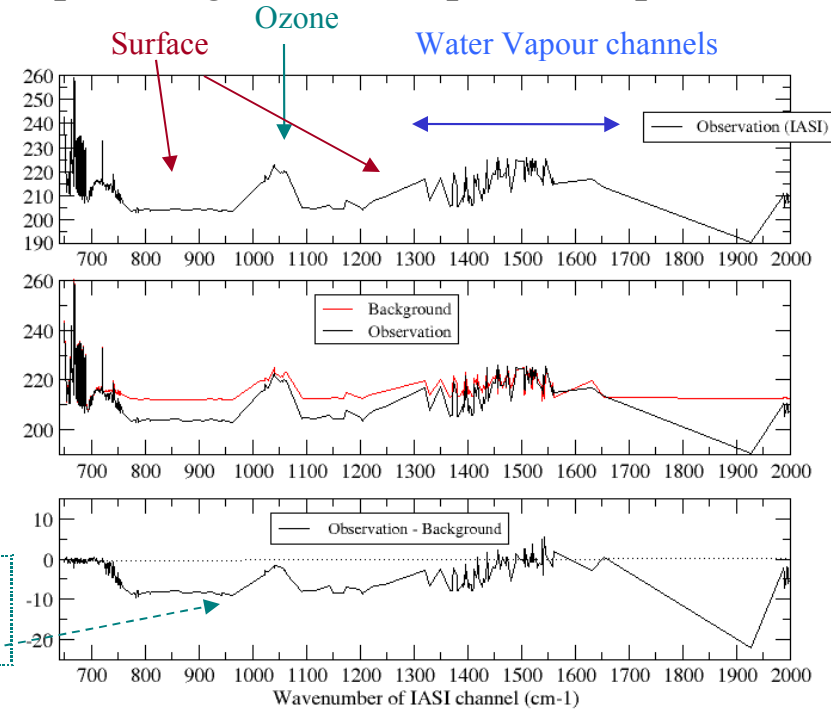


Inversion not seen in model



Observation (IASI)
- Background

Output: Brightness Temperature spectra



Profiles come from:

- Radiosounding (red line)
- Background extracted from the model (black line)

To decrease the bias between IASI & Background :

-impact of the model parameters :

→ the error covariance matrix of the background (B-matrix)

-impact of the surface parameters:

→ skin temperature

First Results (3)

Impact of surface parameter

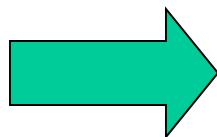
Toward the assimilation of more IASI channels ...

→ Aim : **170** channels assimilated over land

- 119 channels in CO₂ band

- 29 channels in WV band

- 22 channels in Window Channel



Modifications /Problems tied to the increase of the number of IASI channels assimilated

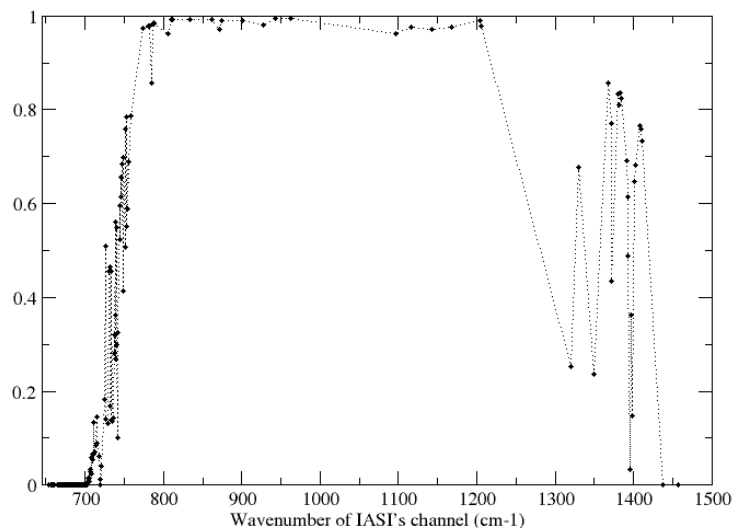
→ Minor impact of the emissivity compared to the surface/skin temperature

→ Problem of the estimation of the skin temperature

→ Increase of the value of the B-matrix for the surface/skin temperature

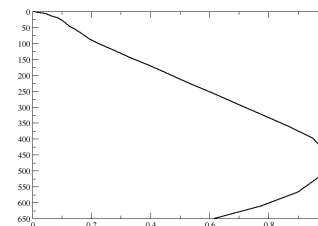
→ Tests of the use of another source of observations to estimate skin temperature :
Retrieval of surface temperature from a IASI window channel

Fig : Jacobian of the skin temperature for 170 channels, 11/20/2009



Weighting function of channel 267 (711.5cm⁻¹) at DomeC

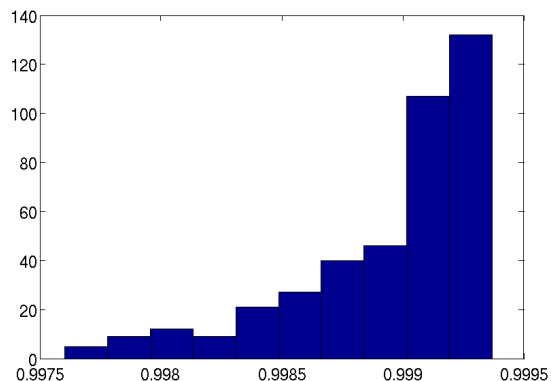
→ Sensibility to the surface



First Results (4)

Impact of surface parameter

Retrieval from a window channel of IASI sensor



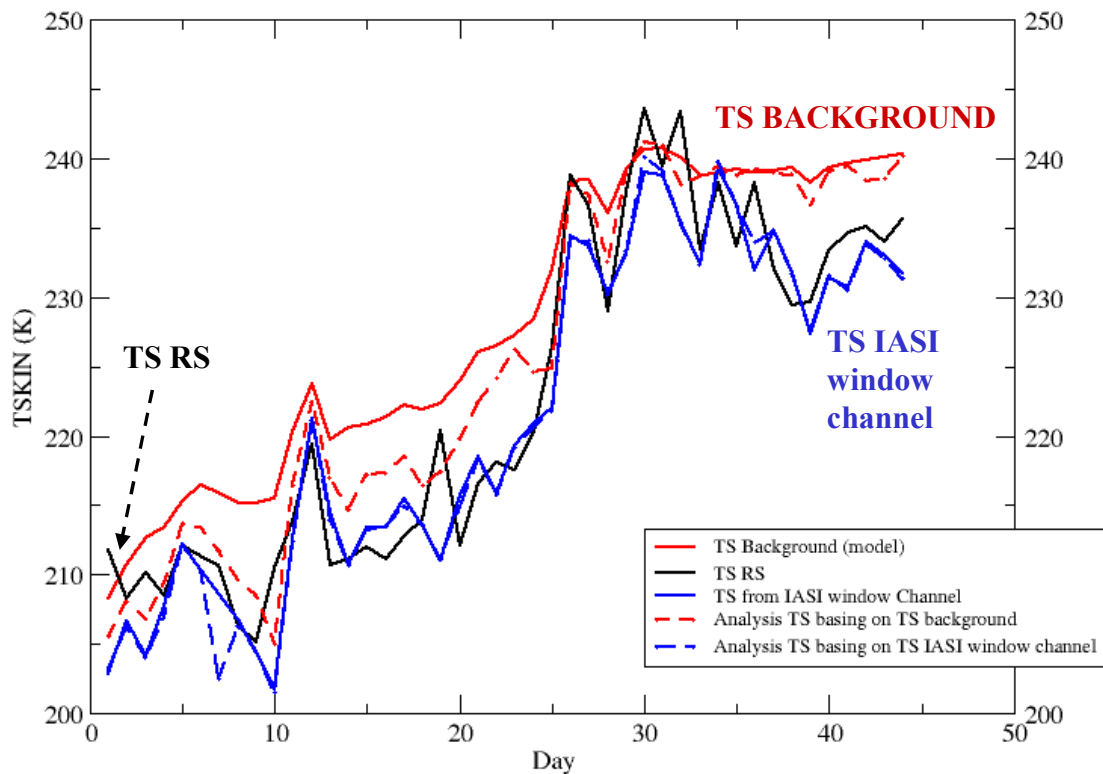
1) Choose of a window channel with a high transmittance: channel 1194 ($943,25\text{cm}^{-1}$) - Mean τ : 0.9989

2) Retrieval of skin temperature (T_{skin}) from this channel using RTTOV model – Radiative Transfer Equation, with a surface emissivity fixed at 0.99

→ Time evolution of the T_{skin} , over 44 cases cloud or not, from 1st October to 29 November 2008

→ TS from IASI channel close to TS from RS

→ Use of 1D-VAR cloud detection



First Results (5)

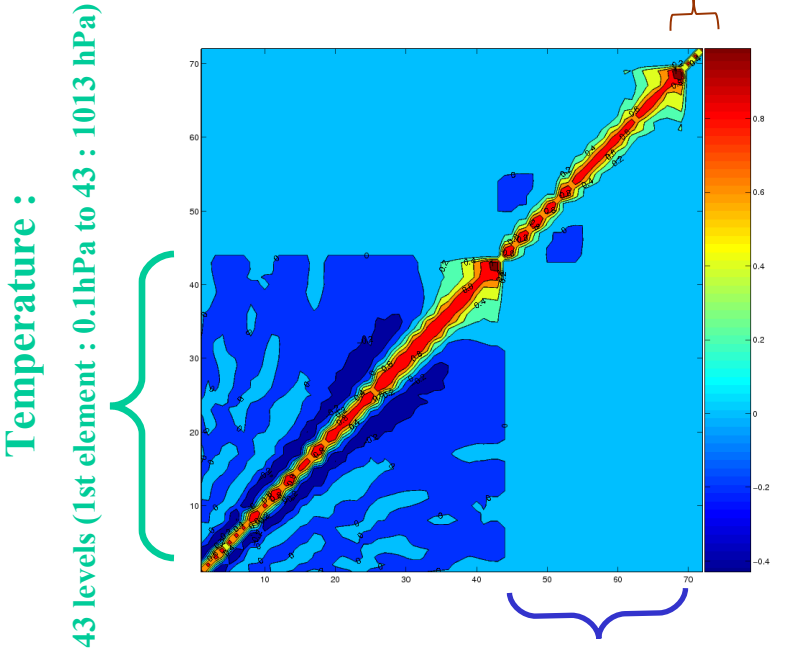
Impact of model parameter : **B-matrix of Met Office**

Matrix of the correlation (on RTTOV levels)



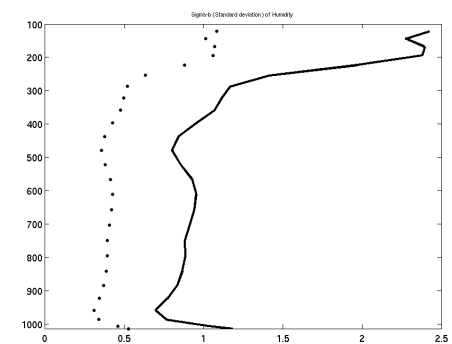
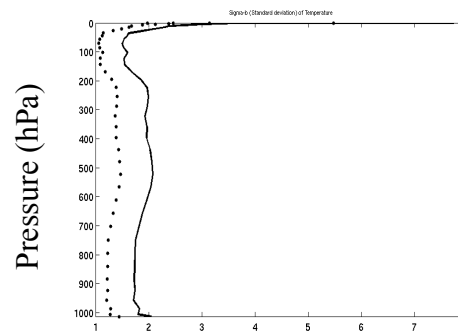
Tests have shown a good impact on the increase of B-matrix for T (*2) and Humidity (*5) part.

Surface



Profile of standard deviation of covariance matrix (sigmab)

- B-matrix modified (T*2 and H*5)
- ■ ■ ■ ■ B-matrix initial



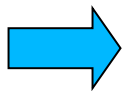
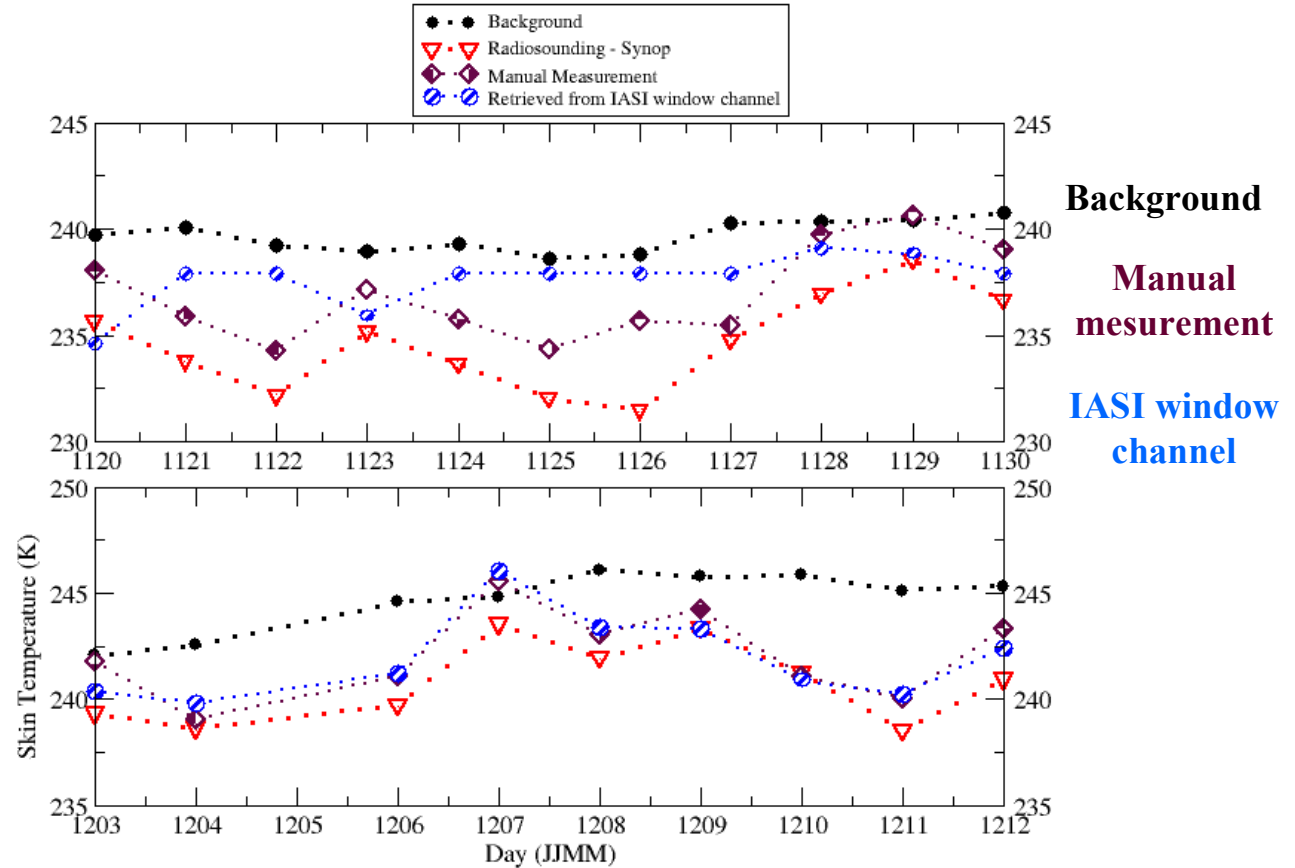
Temperature

Humidity

First Results (6)

Statistics on datasets of 2009 at DomeC station, 0TU: 20 November to 12 December 2009

Temporal evolution of
the skin temperature
(K)

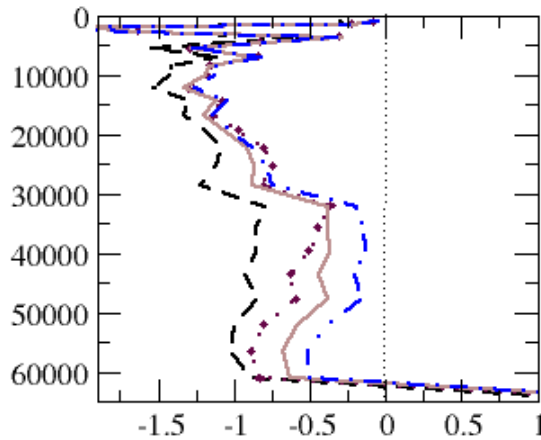


Good agreement between skin temperature retrieved from IASI window channel and the one manually measured

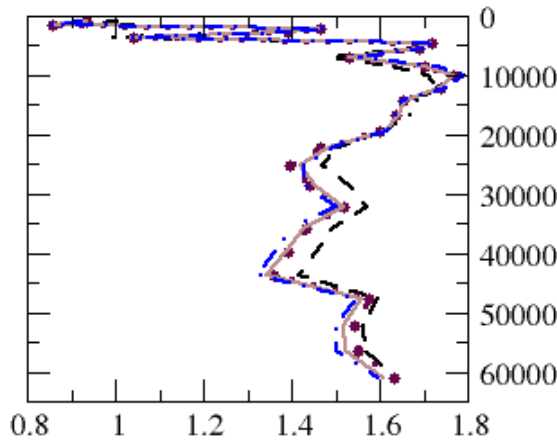
First Results (7)

Statistics on datasets of 2009 at DomeC station, 0TU, Clear Cases : 20 November to 12 December 2009

BIAS - 12 clear cases
Temperature (K)



RMS
T(K)



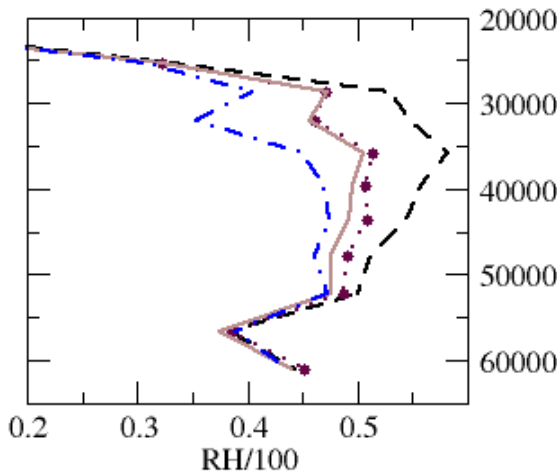
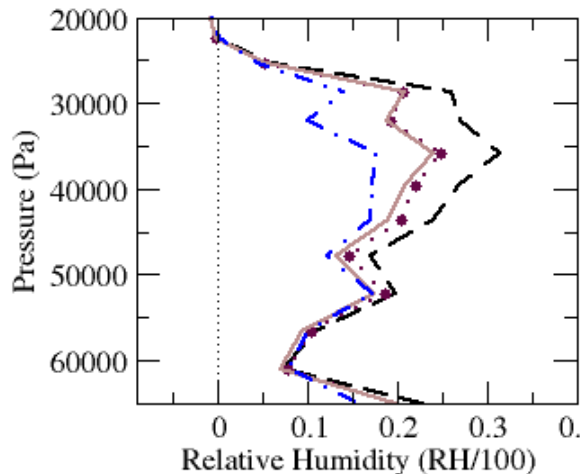
Legend :

Black-dashed line : **Background** – Radiosounding

Maroon-dotted line with circle : **Analysis** – Radiosounding – **CONTROL**

Brown line : **Analysis** – Radiosounding – CONTROL with **Skin T from IASI**

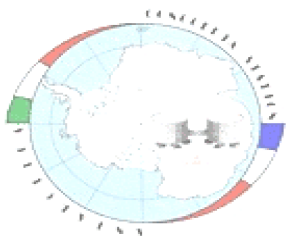
Blue line : **Analysis** – Radiosounding – CONTROL with **Skin T from IASI and B-matrix modified for T and Humidity part**



Decrease of bias and rms

Skin T : Impact on the lower part

B-matrix : Global impact in troposphere with max between 300hPa and 500hPa



Conclusion & Outlook

Study in 1DVAR en 2009

Toward the assimilation of more IASI channels :

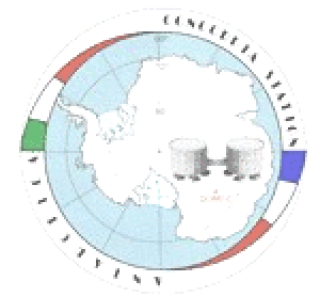
- Importance of the skin temperature used

- Tskin of the model-background seems too large
- Better result with Tskin from Radiosoundings
- Retrieval of Tskin with one IASI window channel promising

Futur work : on cloud detection

-Impact of the model parameters

- Improvement of result with a modified background error covariance matrix :
 - taken into account correlation between surface and other levels for temperature
 - increase of the value of the B-matrix for humidity and temperature part
- Futur work : test of a R-matrix with a correlation between channels (first results promising over sea (Guidard))



Thank you

concordiasi

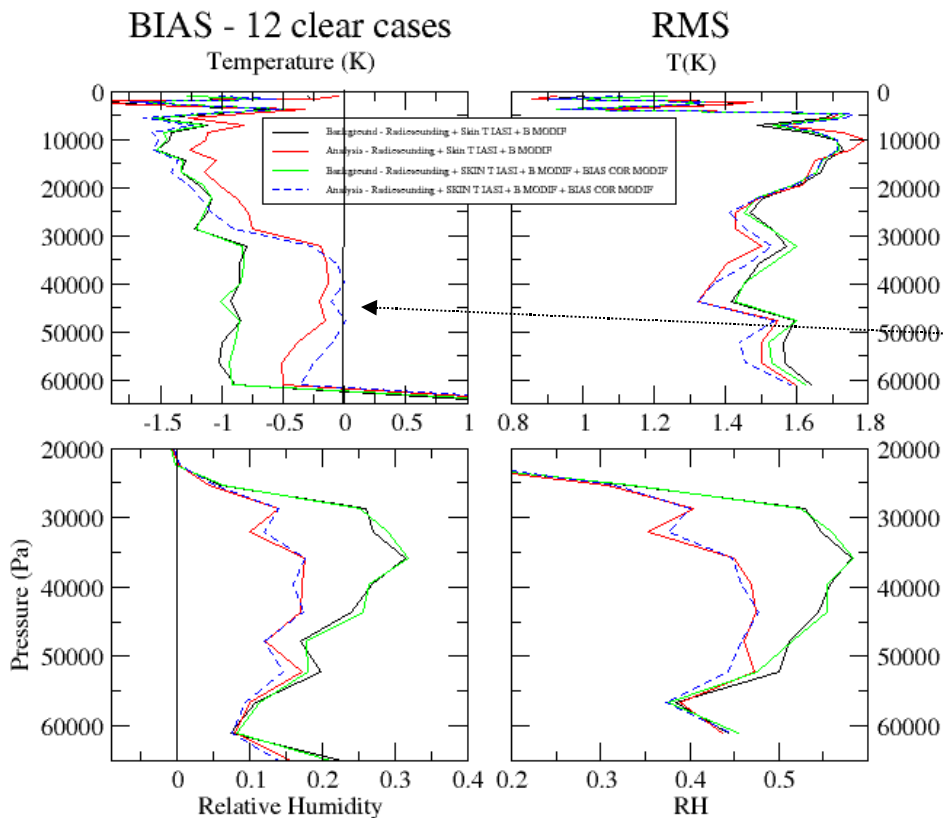
First Results (8)

Statistics on datasets of 2009 at DomeC station, 0TU, Clear Cases : 20 November to 12 December 2009

Experiment on the bias correction calculated in ARPEGE with VARBC (Auligne, 2007) :

→ No bias correction for channel 13 of AMSU-A (~57.29Ghz)

→ Bias correction for channel 12 started at 0 at the beginning of the assimilation experiment



Legend :

Black / red : Older Bias correction

Green / Blue : New one

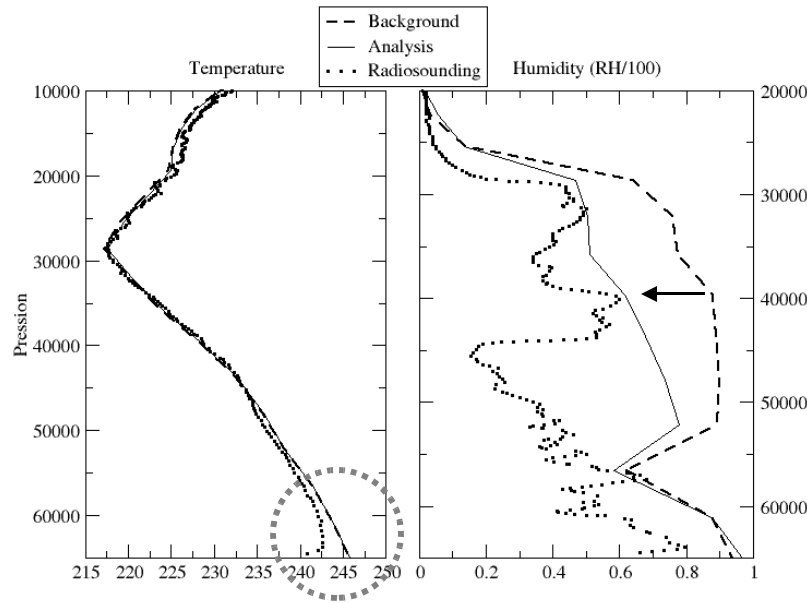
→ Lower bias in temperature : mainly in lower part of the atmosphere

Ex.: For blue curve from 0.5K at 600hPa to 0.3K

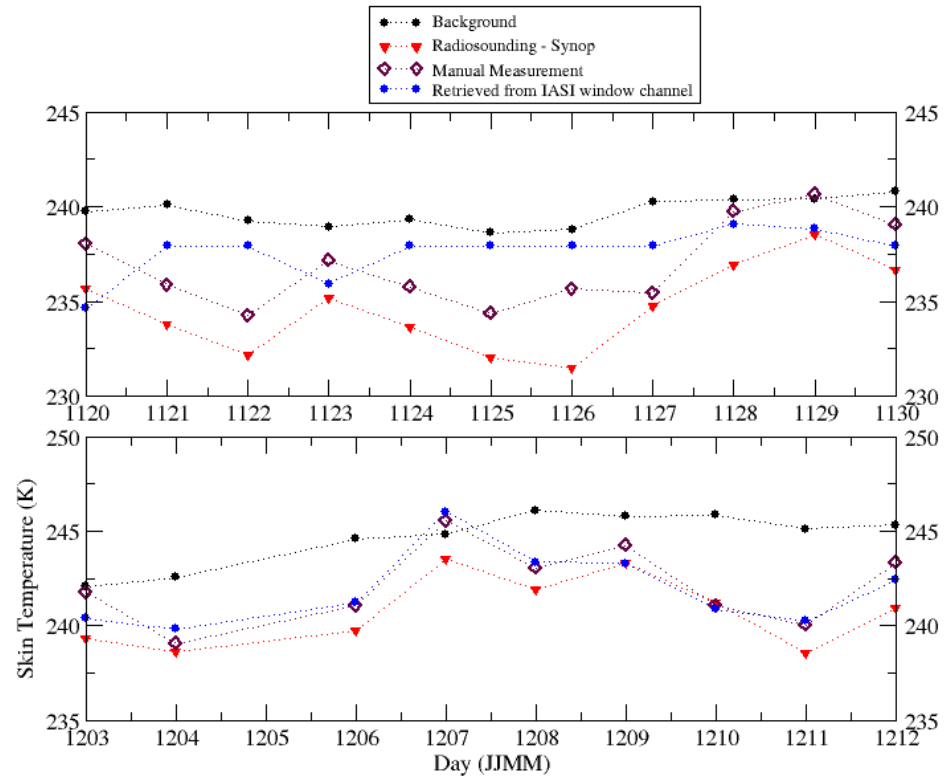
First Results (6)

Statistics on datasets of 2009 at DomeC station, 0TU: 20 November to 12 December 2009

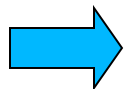
Profile of temperature and relative humidity
for the 12 December 2009



Temporal evolution of the skin temperature (K)



Inversion in T : not seen in model



Good agreement between skin temperature retrieved from IASI window channel and the one manually measured