Assimilation of IASI in Polar Regions & Concordiasi

Vincent GUIDARD

Florence RABIER, Nadia FOURRIÉ, Aurélie BOUCHARD, Thomas PANGAUD
Roger RANDRIAMAMPIANINA, Fiona HILTON,
Louis GARAND, Andrew COLLARD

Assimilation of IASI in Polar Regions

- 1. What NWP centres do in operations
- 2. Cloud properties in polar regions
- 3. Case study at mesoscale
- 4. Background impact on radiance assimilation

1. What NWP centres do in operations

- All NWP centres have different strategies for polar regions, mainly depending on the surface type:
  - Land
  - Sea-ice
  - Ocean

- Over open ocean:
  - Same channel selection as for other latitudes
    no specific action

1. What NWP centres do in operations

- Over sea-ice:
  - Some assimilate data as for ocean
    (ECMWF: ISEM emissivity as for ocean)
  - Some assimilate data but discarding channels affected by surface cautious decision because of feared problem with emissivity description
    (MF: ISEM emissivity as for ocean)
  - Others do not assimilate data at all
    (HIRLAM, MetOffice)
    - Possible problem of sea-ice mask
    - Possible problem of sea-ice description (as surface emissivity)

1. What NWP centres do in operations

- Over land:
  - Some assimilate data but discarding channels affected by surface
    cautious decision because of feared problem with emissivity description and surface temperature
    (MF: fixed emissivity of 0.98)
    (MetOffice: rejection over high orography)
    (HIRLAM: less than 10 channels)

  - Others do not assimilate data at all
    (ECMWF: land is OK but not when including Antarctica)

2. Cloud properties in polar regions

Antarctic Cloud Top Pressure (July 2008):

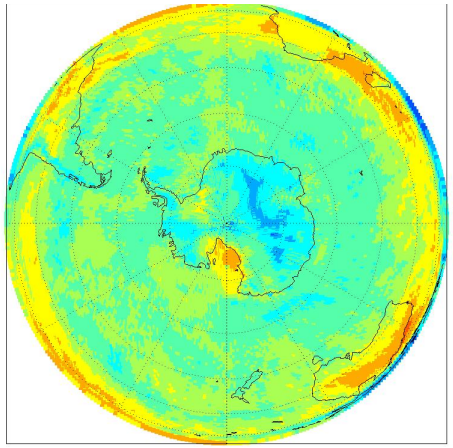
Cloud parameters comparison with independent data sources

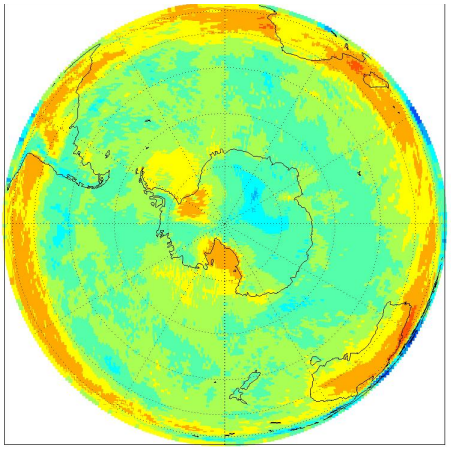
AIRS (CO_2-slicing) – observed

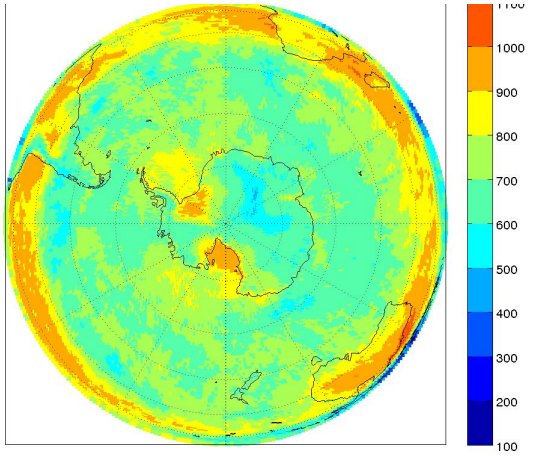
AIRS (CO_2-slicing) – simulated

3-9h forecast

9-15h forecast



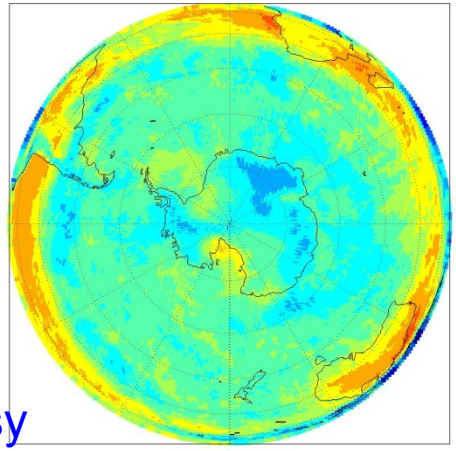


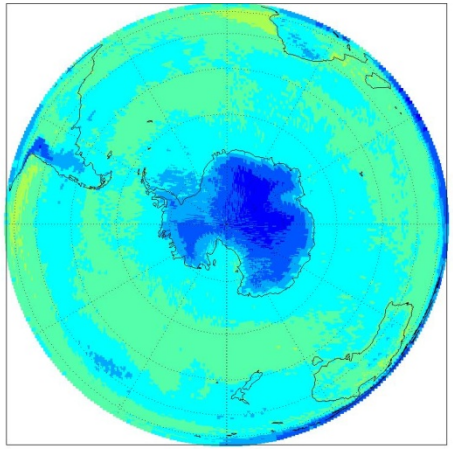


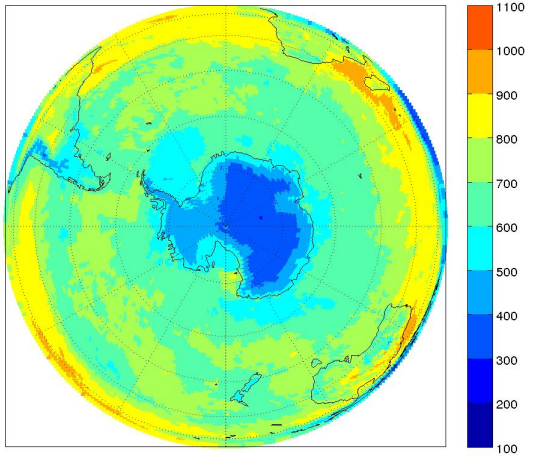
AIRS (Direct model output)

AIRS (official product)

MODIS







Courtesy
O. Pancrati, L. Garand, S. Heilliette

Source: AIRS science team

Source: MODIS science team

2. Cloud properties in polar regions

Antarctic Cloud Fraction (July 2008):

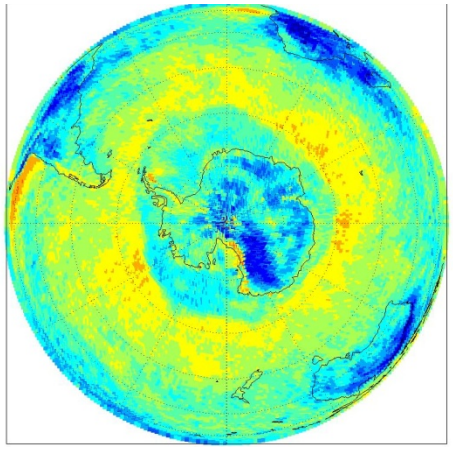
Cloud parameters comparison with independent data sources

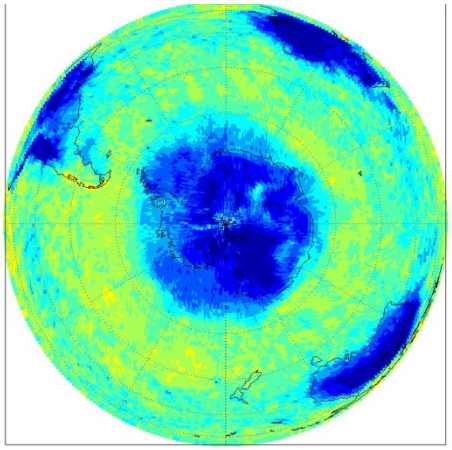
AIRS (CO_2-slicing) – observed

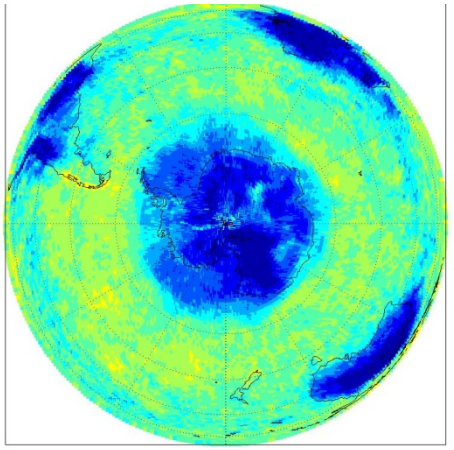
AIRS (CO_2-slicing) – simulated

3-9h forecast

9-15h forecast



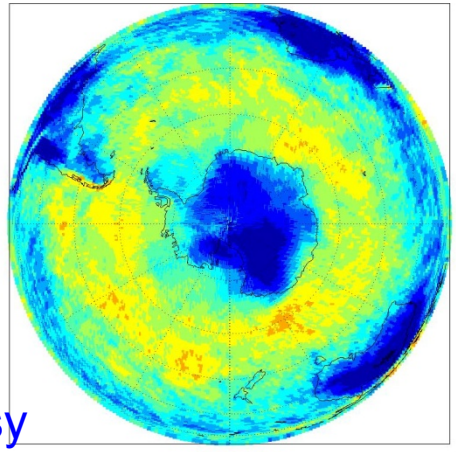


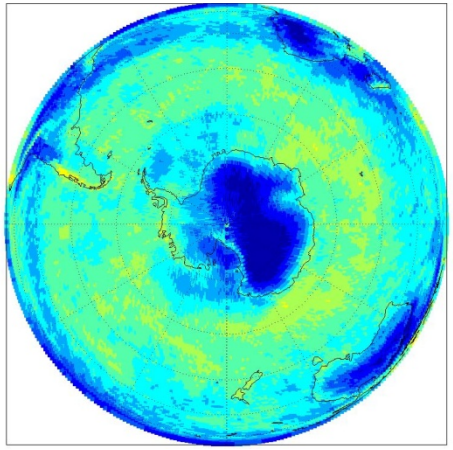


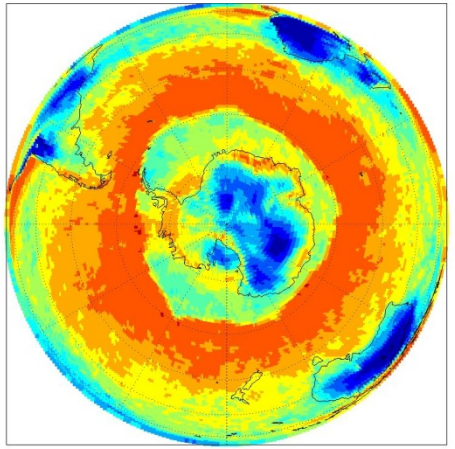
AIRS (Direct model output)

AIRS (official product)

MODIS







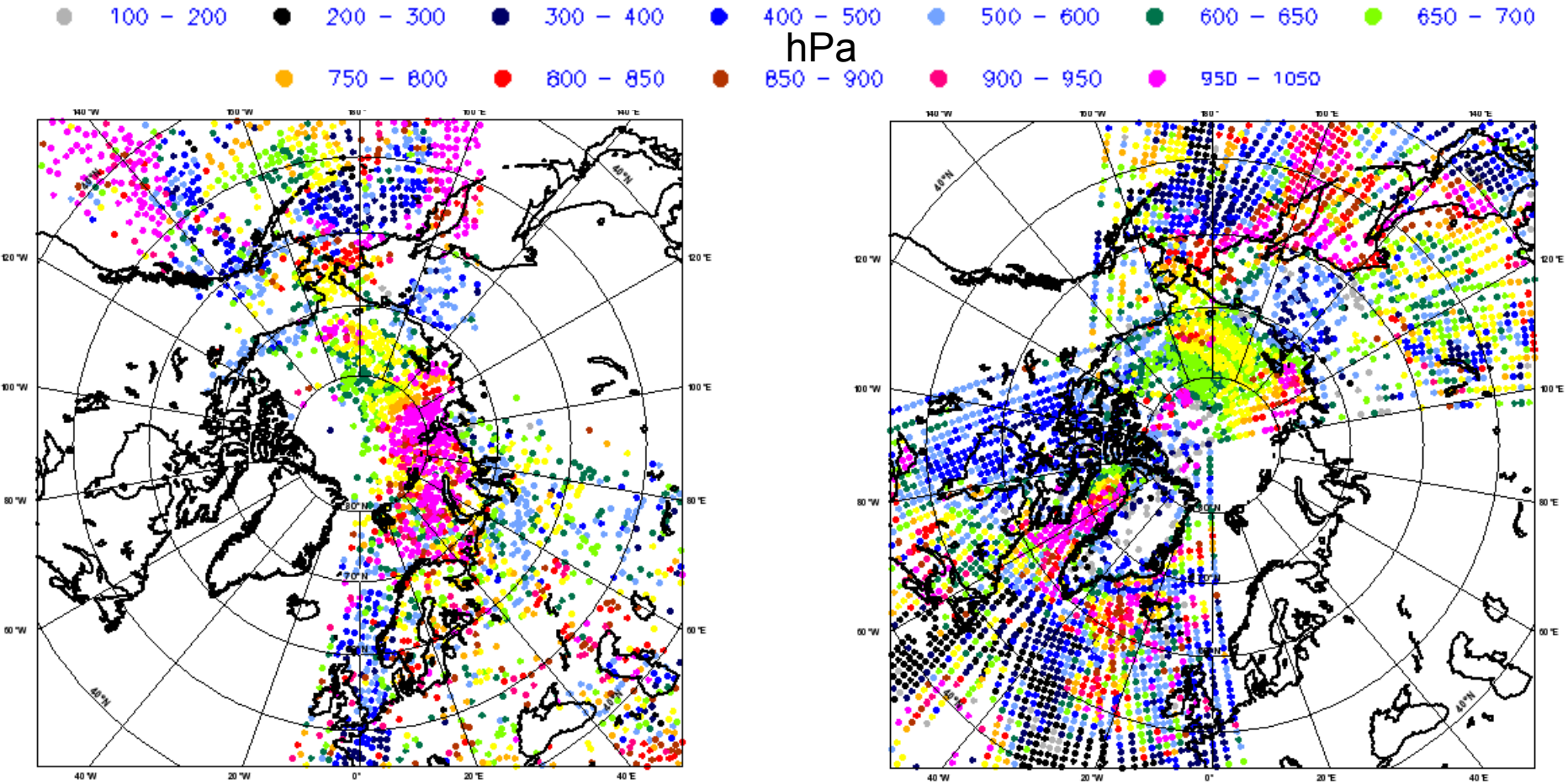
Courtesy
O. Pancrati, L. Garand, S. Heilliette

Source: AIRS science team

Source: MODIS science team

2. Cloud properties in polar regions

- Comparison of Cloud Top Pressures retrieved with CO2-slicing method
  North Pole – 4 March 2009 (6-hour period)



AIRS

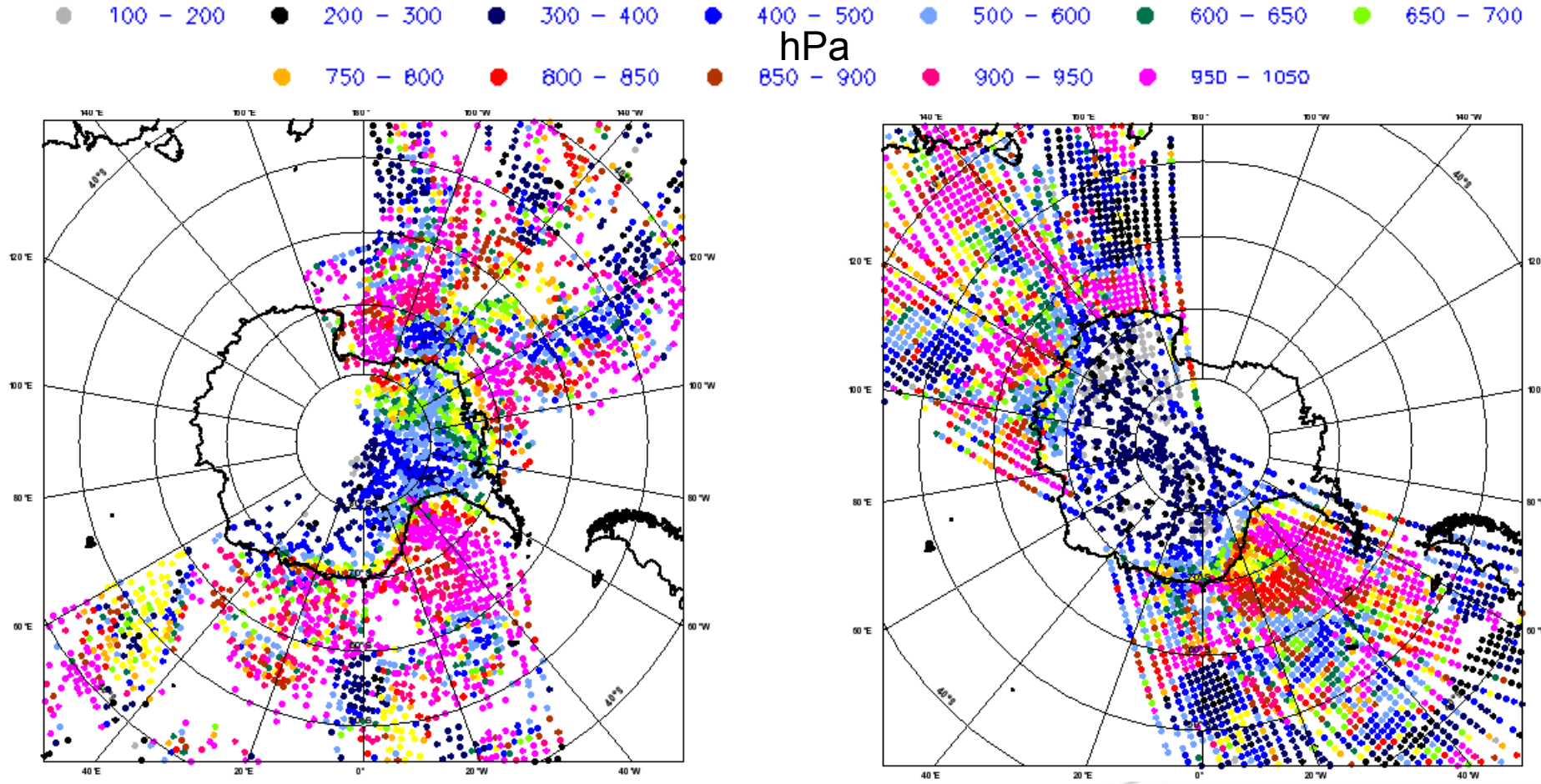
IASI

Thomas Pangaud

METEO FRANCE
Toujours un temps d'avance

2. Cloud properties in polar regions

- Comparison of Cloud Top Pressures retrieved with CO2-slicing method
  South Pole – 4 March 2009 (6-hour period)



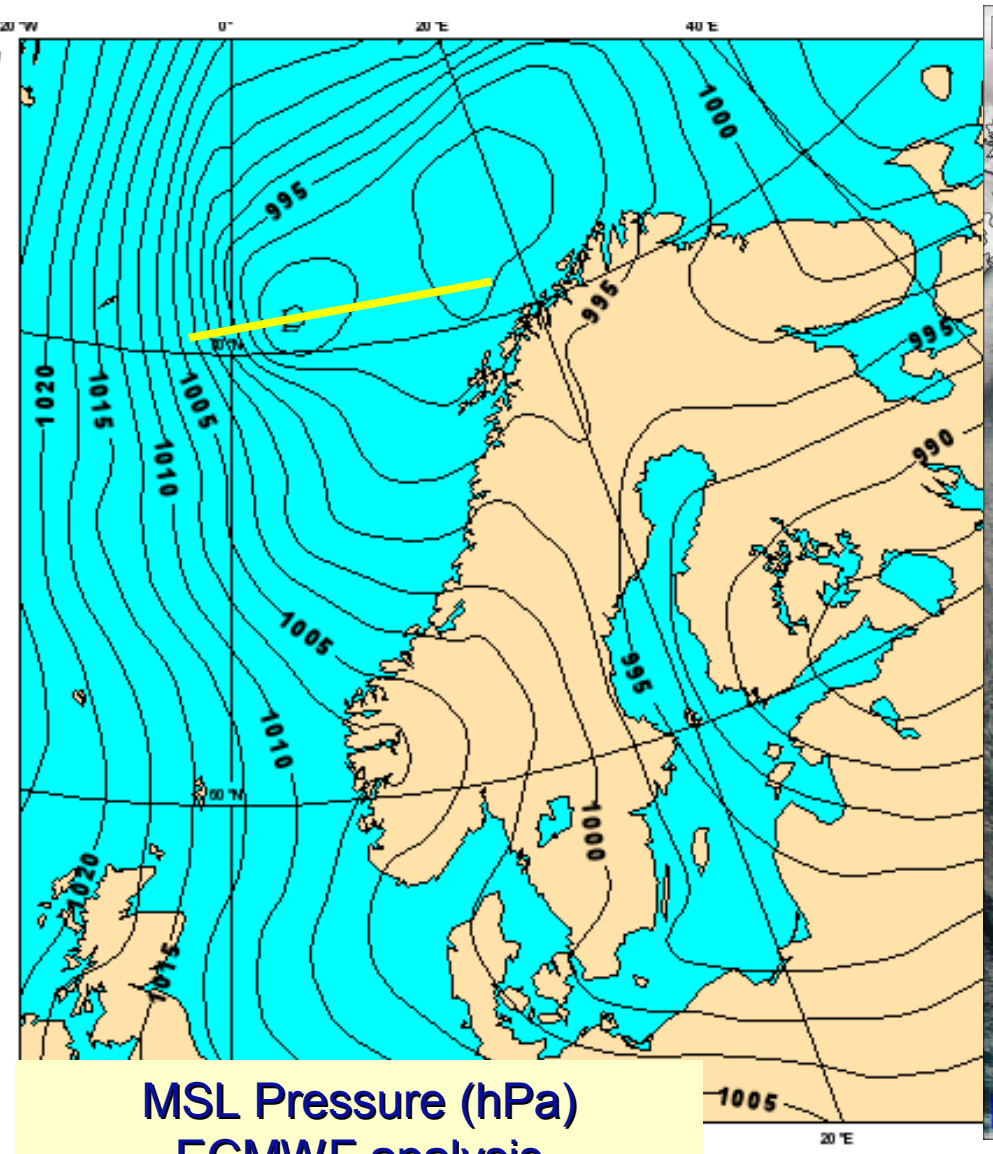
AIRS

IASI

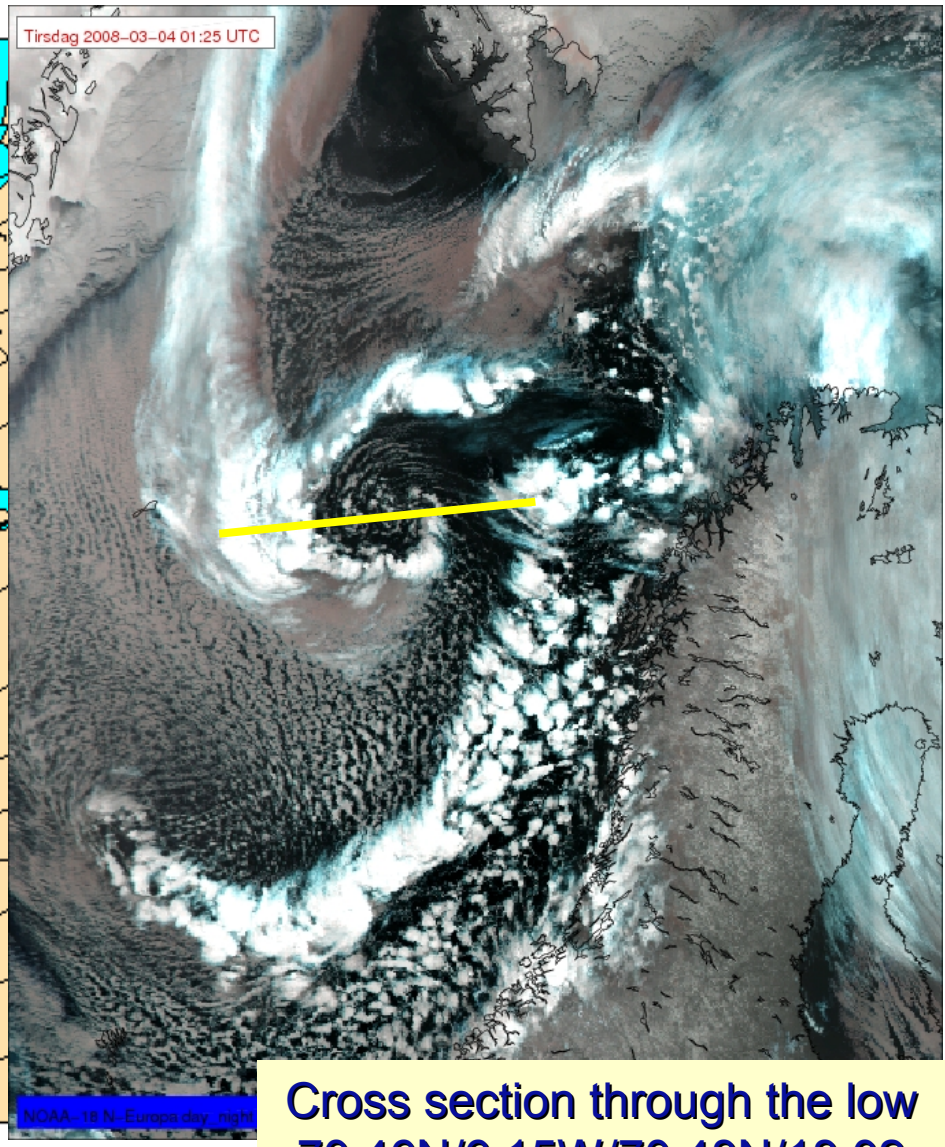
Thomas Pangaud

METEO FRANCE
Toujours un temps d'avance

3. Case study: polar low 4 March 2008 00 UTC



MSL Pressure (hPa)
ECMWF analysis

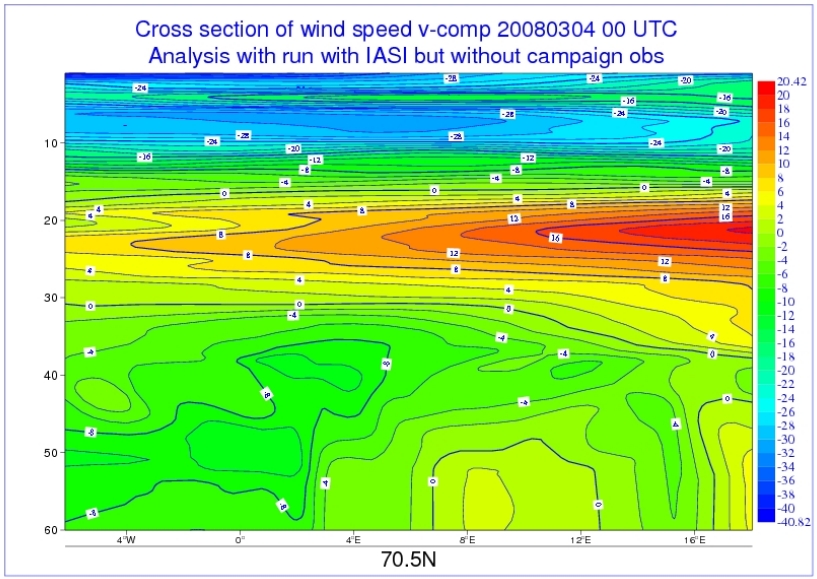


Cross section through the low
70.46N/6.15W/70.48N/18.02

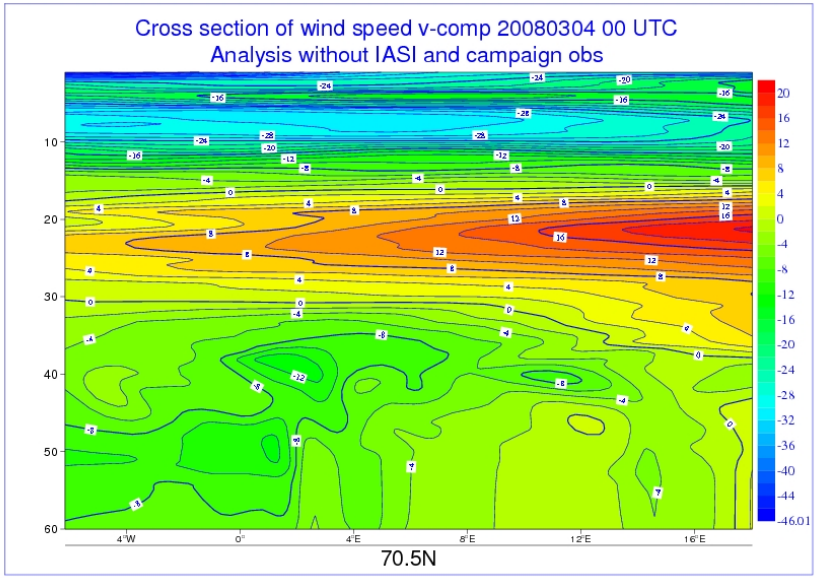
3. Case study: polar low 4 March 2008 00 UTC

Different meridional wind

With IASI data



Without IASI data



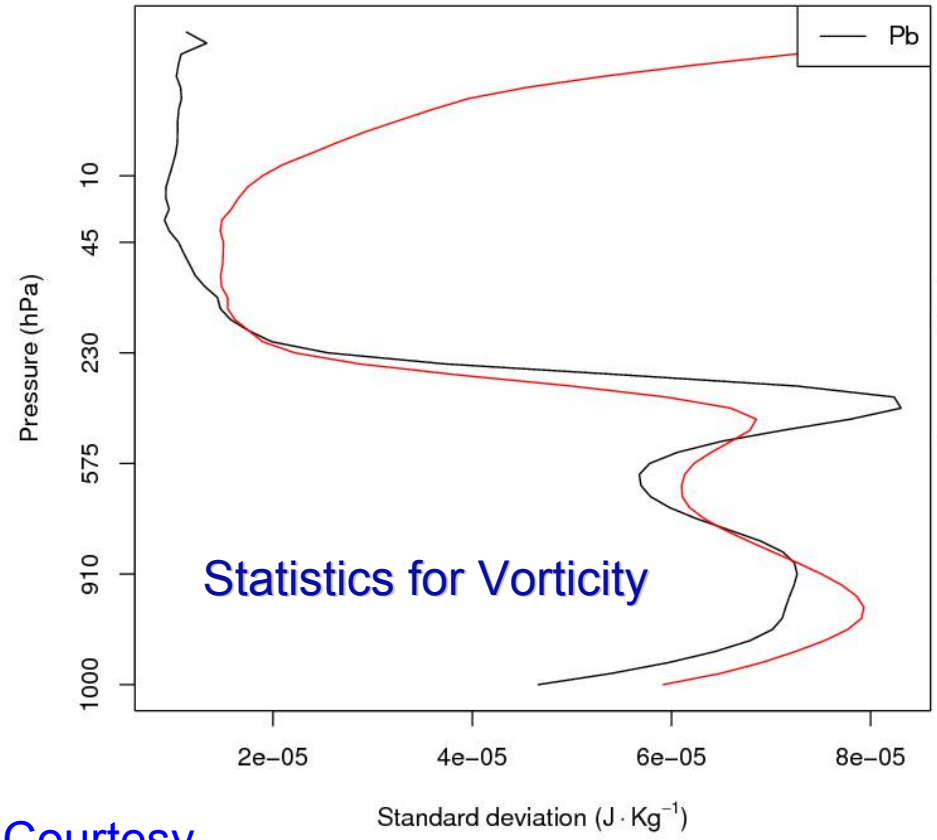
Better description of meridional wind intensity in the low region

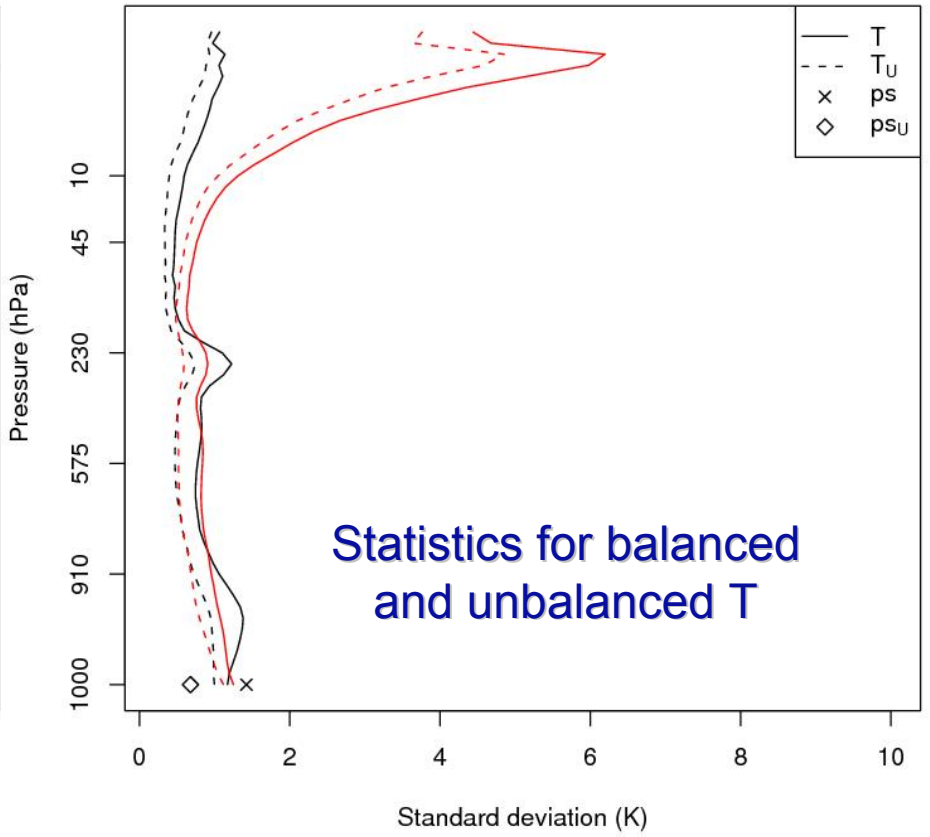
Courtesy
Roger Randriamampianina

4. Background impact on radiance assimilation

- Description of **background error statistics** example of statistics in HIRLAM (LAM) high variability depending on the season

Black- summer stats
Red - winter stats
using
„NMC" technique

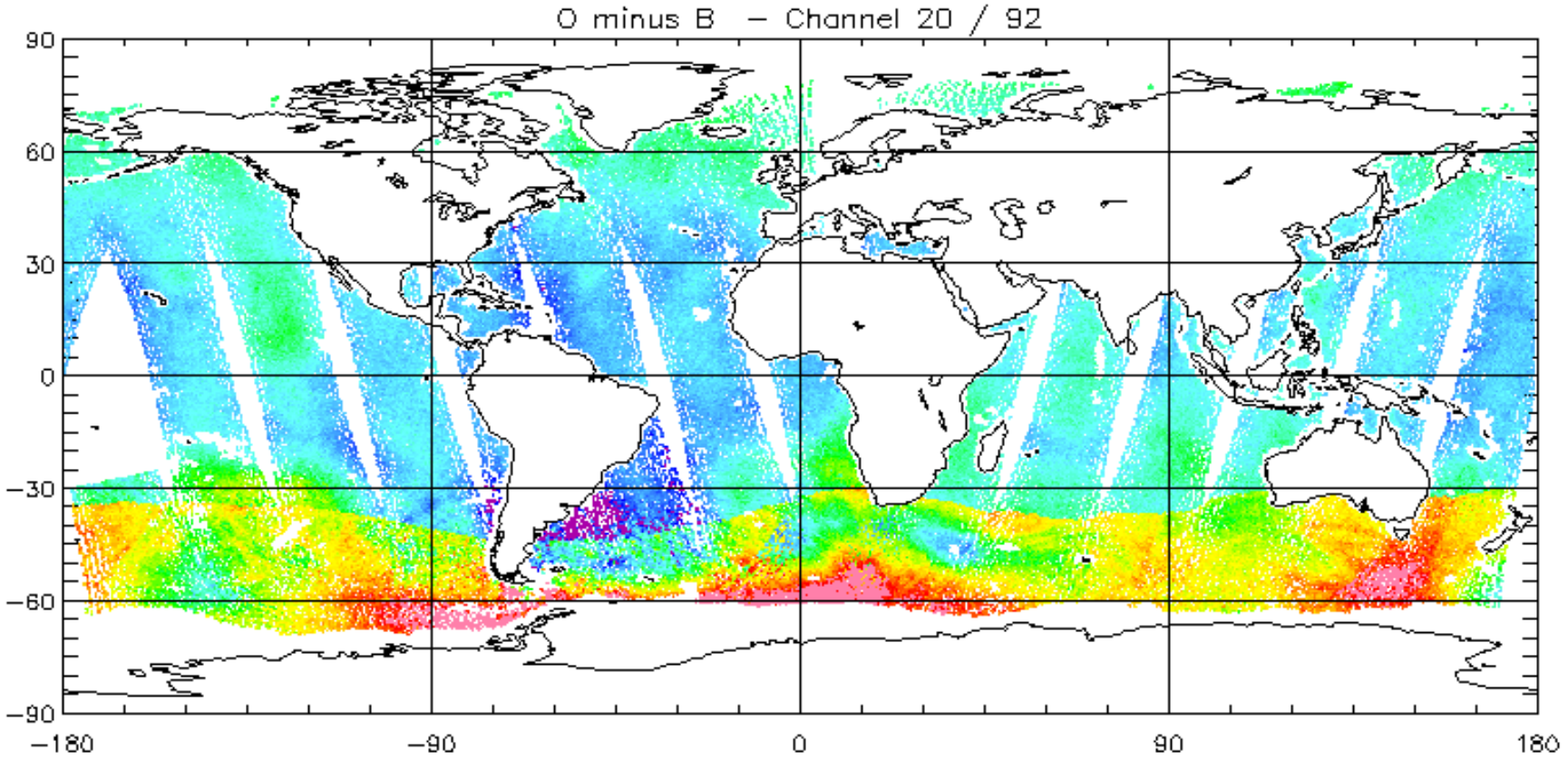




Courtesy
Roger Randriamampianina

4. Background's impact on radiance assimilation

- Potential bad quality of **simulation from background** (so-called $H(x^b)$) example of "obs. minus background" for channel 92 (very high stratosphere) at the MetOffice



Courtesy Fiona Hilton

Assimilation of IASI in Polar Regions

- In conclusions:
  - Characterization of **sea-ice extent** seems crucial for some centres
  - **Surface emissivity** modelisation will help a more extensive assimilation of IASI **over land** region (in particular Antarctica)
  - **High orography** over Antarctica may lead to reject observations in some algorithms
  - **Quality of the background** may be a limitation, especially in the Southern Hemisphere

Concordiasi

The Concordiasi Experiment over Antarctica

Major goal

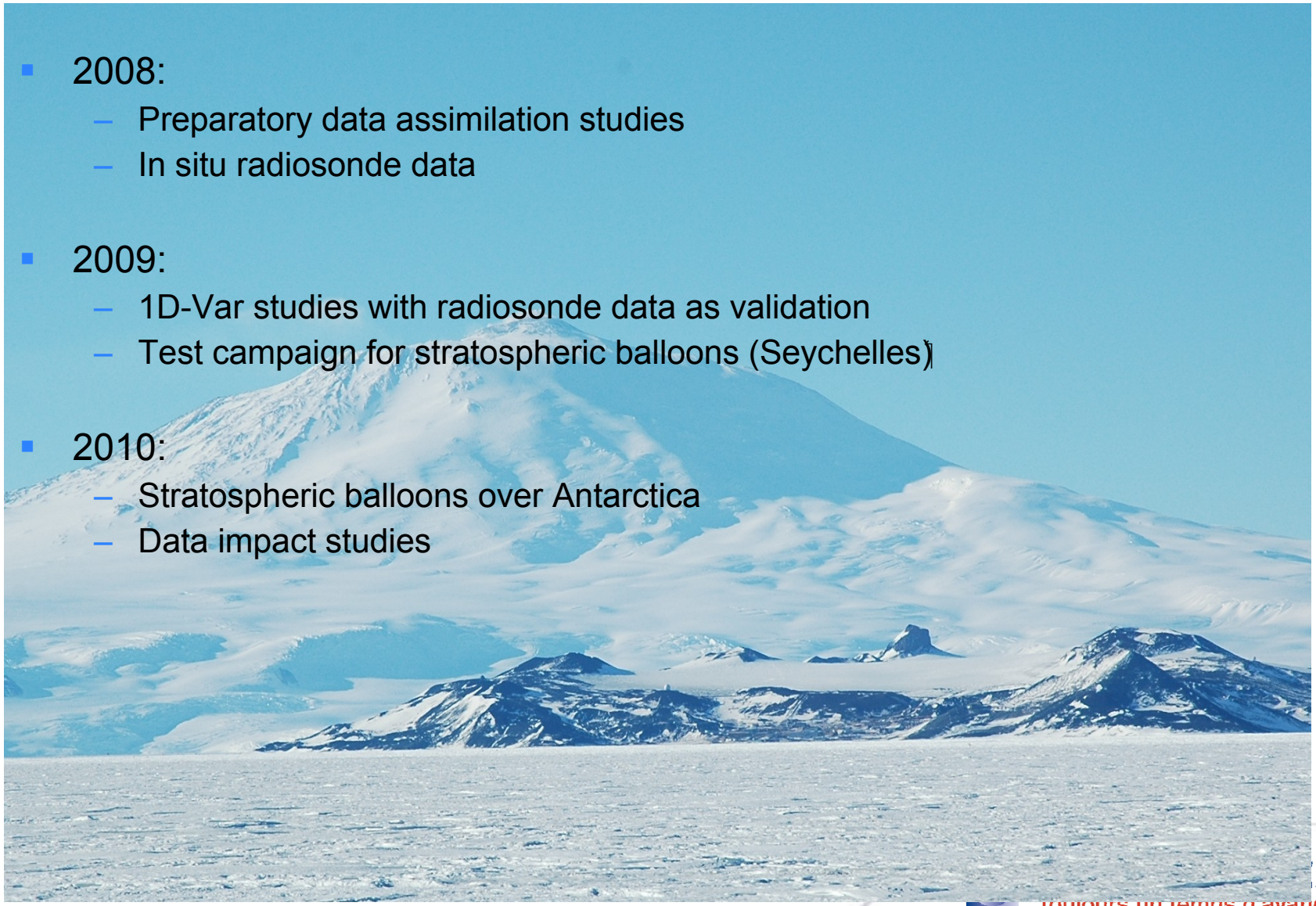
Improve the assimilation of satellite data at high latitudes,
for NWP (forecasts locally and impact at lower latitudes) and re-analyses
In particular for hyperspectral infrared sounders like IASI

Collaborating institutes

CNES, IPEV, CNRS, LGGE, LMD, Météo-France	France
NSF, NCAR, U. Wyoming, Purdue U., U. Colorado, UMBC/GMAO,UCLA	USA
PNRA	Italy
ECMWF	International
CAWCR	Australia

METEO FRANCE
Toujours un temps d'avance

Schedule

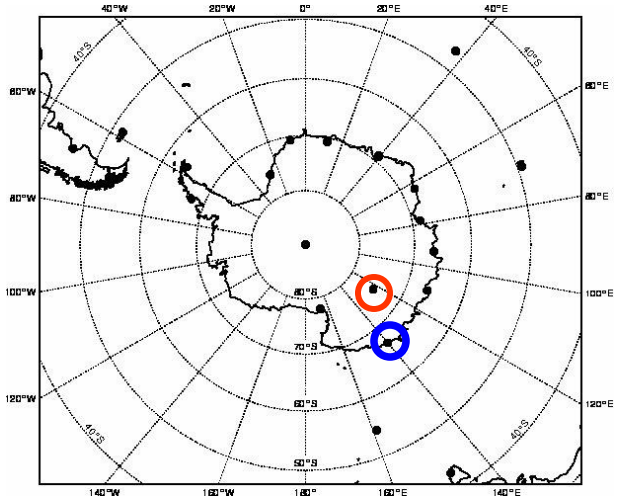


- 2008:
  - Preparatory data assimilation studies
  - In situ radiosonde data
- 2009:
  - 1D-Var studies with radiosonde data as validation
  - Test campaign for stratospheric balloons (Seychelles)
- 2010:
  - Stratospheric balloons over Antarctica
  - Data impact studies

Overview of the field experiment

2008

- 150 radiosoundings from Concordia,
- 75 from Dumont d'Urville
- Were provided on GTS
- High resolution profiles available on demand
- In situ measurements at Concordia



2010

- 18 Stratospheric balloons
  - Meteorological sensors, ozone sensors
  - Particle counter to study stratospheric clouds
  - GPS radio-occultations

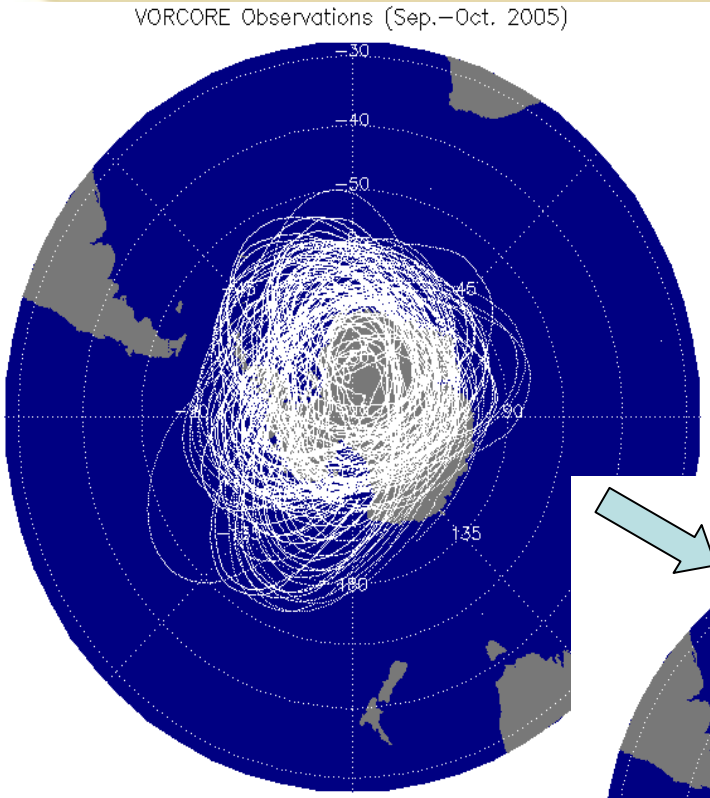
- 12 driftsondes with 50 dropsondes in each

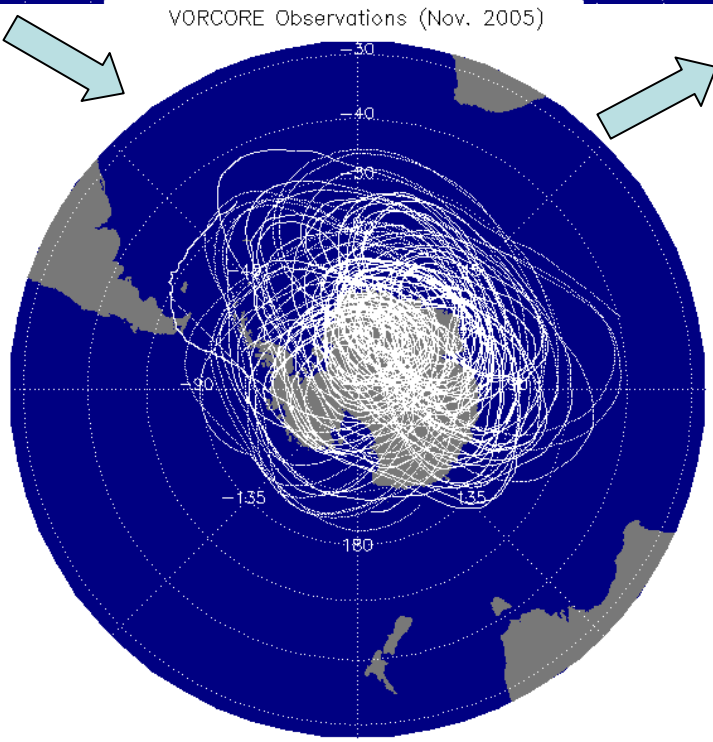
- ACAR-like data and dropsonde data will be provided on GTS

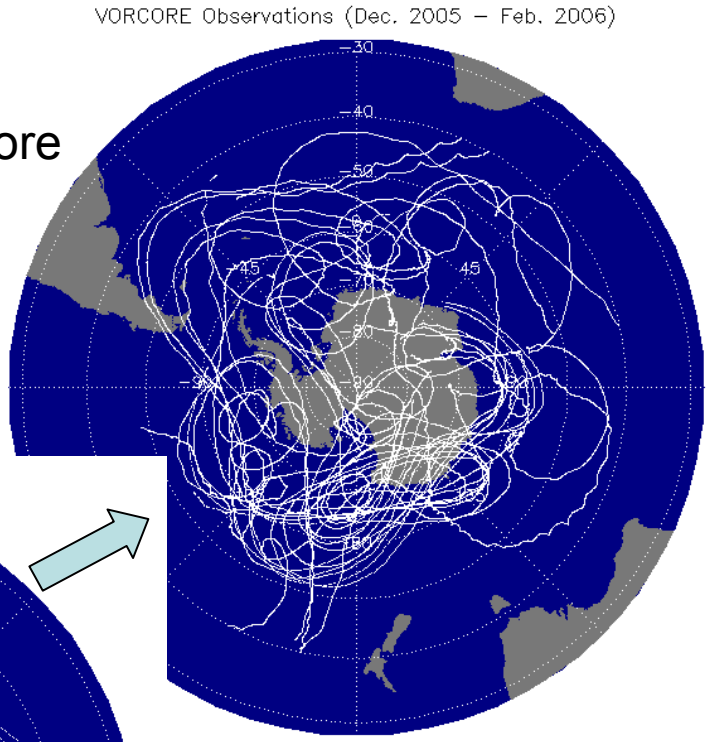
http://www.cnrm.meteo.fr/concordiasi/

Balloon data

Trajectories for late winter/ early spring (Austral) from Vorcore







METEO FRANCE
Toujours un temps d'avance

Concordia and Dumont d'Urville soundings

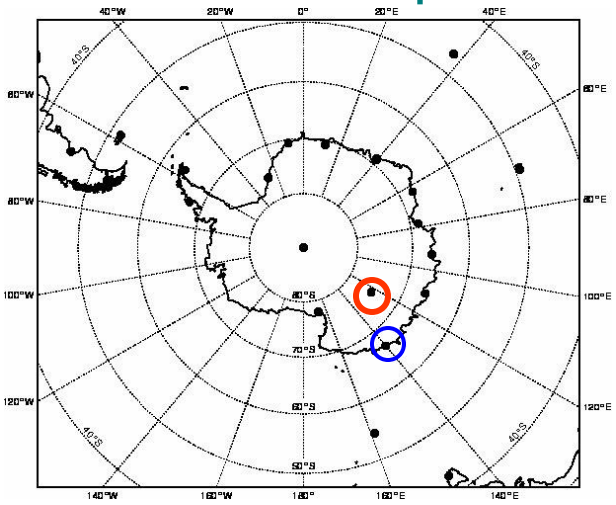
Statistics

Dumont d'Urville (66,40°S;140°E)

- Usual hour of RS launch : 0 UTC
- Addiational RS for Concordiasi : 12 UTC
- Statistics of meteorological conditions over 149 cases:
  - 35% cirrus
  - 39% Ac/As
  - 48% Stratocumulus
  - 19% clear

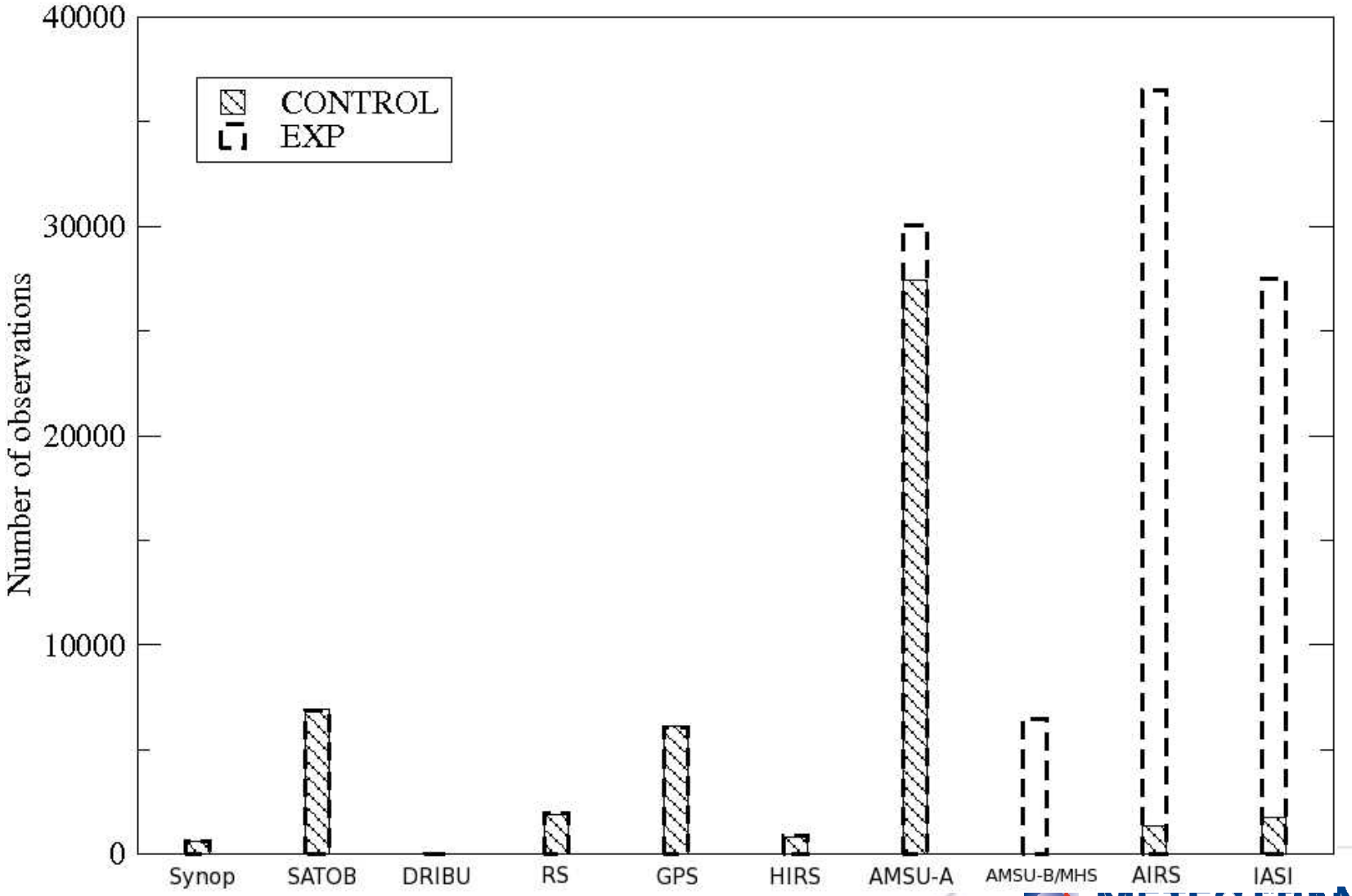
Concordia on DomeC (75°S;123°E)

- Usual hour of RS launch : 12 UTC
- Additional RS for Concordiasi : 0UTC
- Stat meteo over 120 cases:
  - 62% clear
  - 29% almost cloudy
  - 10% cloudy



Concordiasi Website: http://www.cnrm.meteo.fr/concordiasi-dataset/

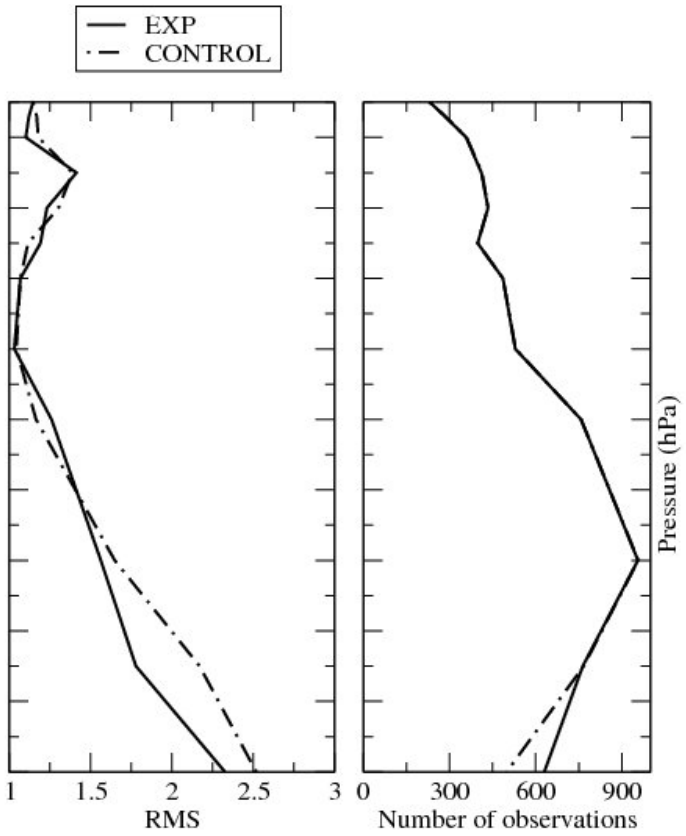
Assimilation and forecast results (1/3)



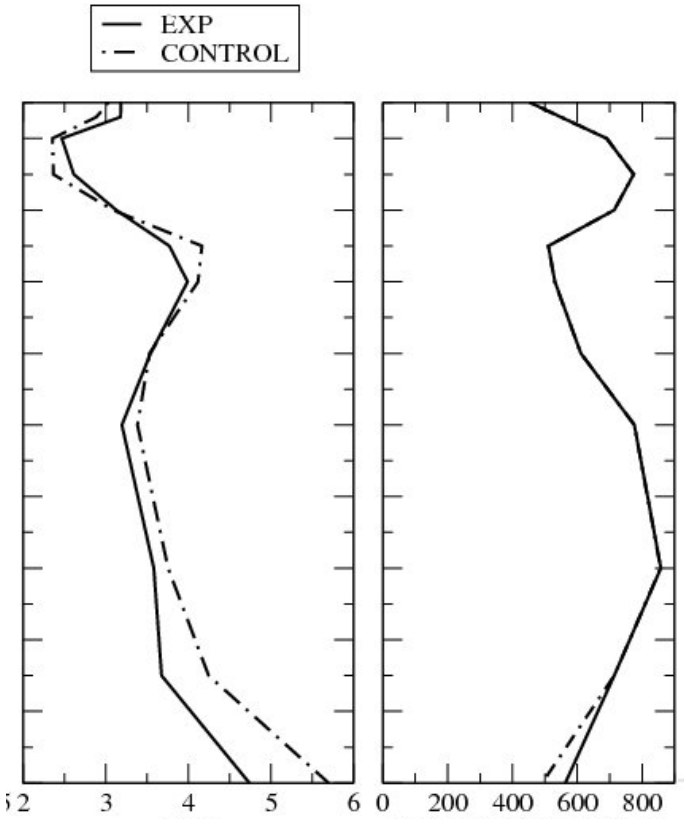
Overall number of data over area

Assimilation and forecast results (2/3)

Temperature



Zonal wind



Data South of 65 S

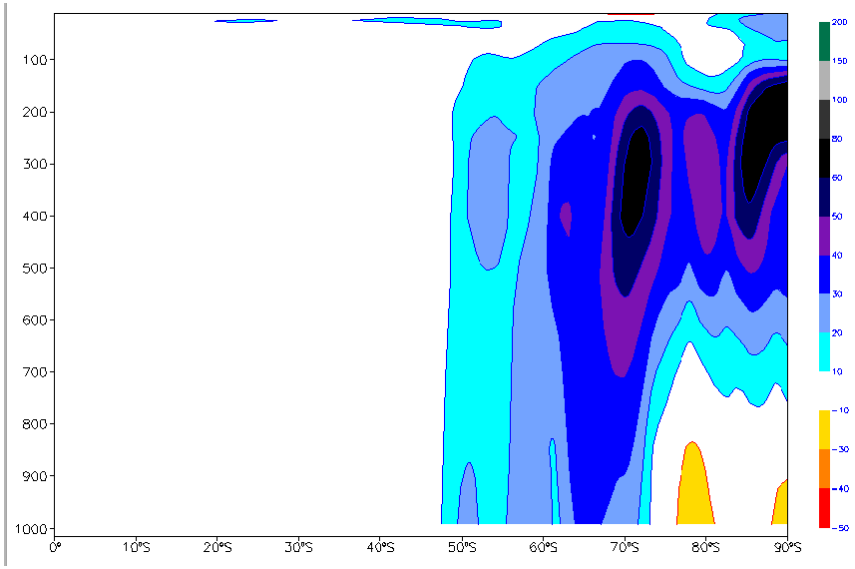
Assimilation and forecast results (3/3)

Impact of the data assimilation on forecast over high latitudes:

Comparison of RMSE for forecasts at 48h and 72h

Error (experiment with additional data (AMSUA/B, AIRS, IASI)) – Error (Control)

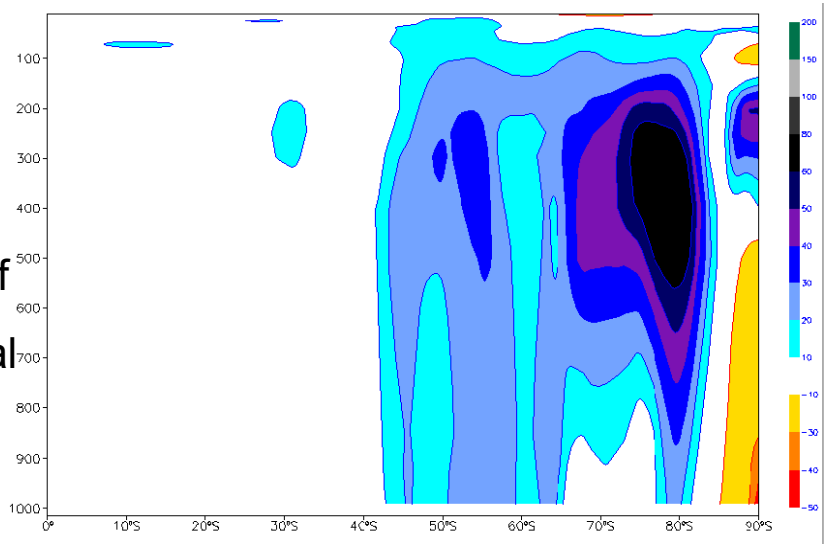
48h



EQ 50°S

Blue: Positive impact of additional data

72h



EQ 40°S

Aurélie Bouchard

Average over latitude, over 20 days (20/07/07--> 8/08/07), Geopotential data

The Concordiasi Experiment over Antarctica

- A unique field campaign over Antarctica, with unprecedented measurements
- Opportunity to validate what we do with IASI data over Antarctica (cloud detection, retrievals, surace emissivity, etc.)
- Contribute to establish a sustainable observing system for climate over Antarctica, taking into account the potential of advanced sounders

Florence Rabier,
PI of the Concordiasi project

METEO FRANCE
Toujours un temps d'avance

Thank you for your attention !

cnrs
dépasser les frontières

METEO FRANCE
Toujours un temps d'avance