Data Assimilation over Antarctica

Aurélie Bouchard, Alex Doerenbecher, Nadia Fourrié, Vincent Guidard, Fatima Karbou, Thomas Pangaud, Florence Rabier

CNRS/Météo-France/CNES

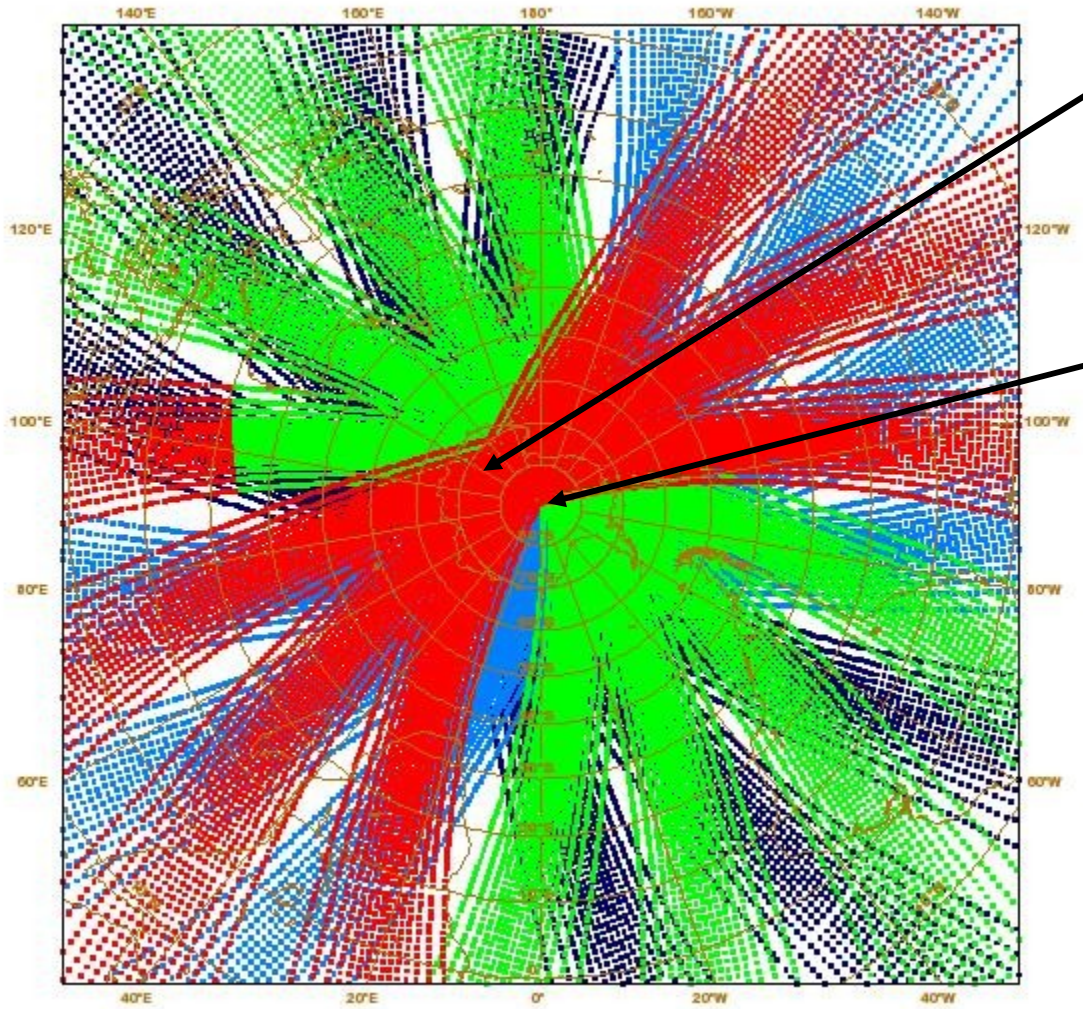
Ghislain Picard

LGGE

Overview

- 1. Data assimilation of IASI radiances at Météo-France
- 2. Specific tuning for data assimilation over Antarctica
  - 2.1 Change of geometry
  - 2.2 Microwave surface emissivity
- 3. Open Issues – Extra-data targeting

1. Coverage of Antarctica by MetOp (IASI)



Concordia

South Pole

is on the edge of the swath

1. Current status of IASI (& AIRS) assimilation at MF

- In operations:
  - 20 stratospheric AIRS channels are assimilated + 73 channels monitored
- In pre-operations:
  - 314 (/8461) IASI channels are monitored (subset commonly chosen with other NWP centres)
  - 20 stratospheric AIRS channels are assimilated + 73 channels monitored
- In research mode:
  - 49 IASI channels assimilated (peaking between 120 hPa and 620 hPa)
  - ~50 AIRS channels assimilated (20 stratospheric + ~30 upper-tropospheric)

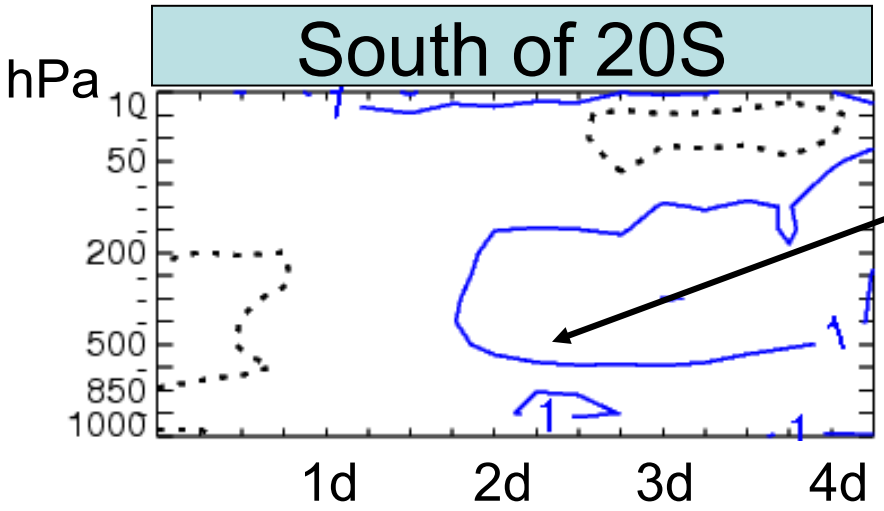
No assimilation of tropospheric data neither over land, nor over sea ice
But studies are planned

1. Impact of tropospheric IASI data assimilation

- Comparison to ECMWF analyses for geopotential height

  IASI data assimilation *versus* no IASI data assimilation

  over a 3-week period of August 2007



Positive impact in troposphere

- A specific tuning of the assimilation for Antarctica would improve the impact of IASI

2. Different ways to improve the model over Antarctica …

- A new geometry
- Additional observations: driftsondes, increase the frequency of the RS at Concordia and Dumont d'Urville
- Improve data assimilation
  - Microwave sensors
  - Infrared sensors

2.1 A new geometry

- Model used: ARPEGE of Météo-France/ECMWF using an advanced data assimilation system
- Spectral model with a variable resolution on a stretched grid

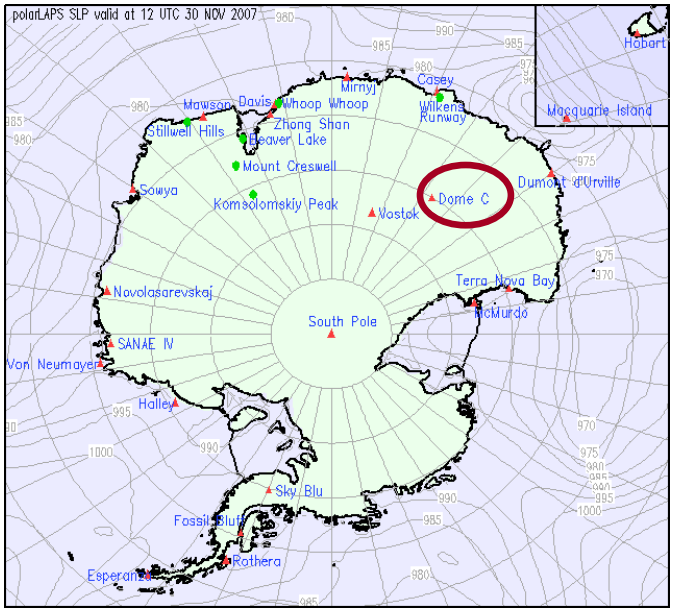
<u>Change</u> :

First :

- Move of the centre of the Arpege model : Dome C (75,12S; 123,37 E)

Second :

- More vertical levels : 46 → 60 levels

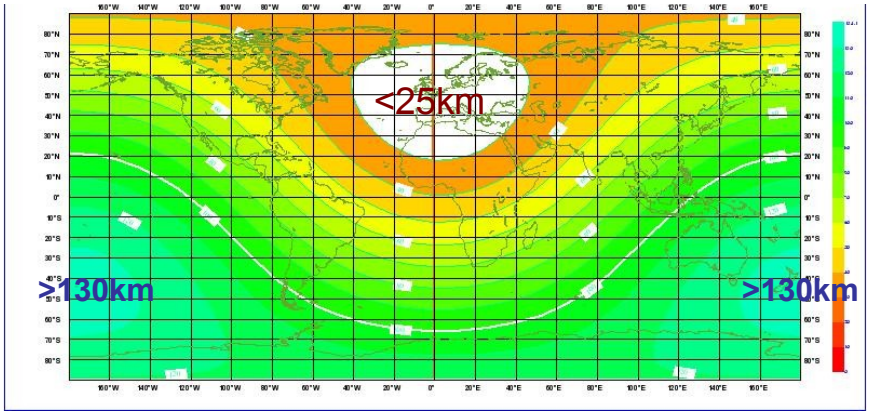


http://www.bom.gov.au/bmrc/mdev/expt/antarctic/antarctica.shtml

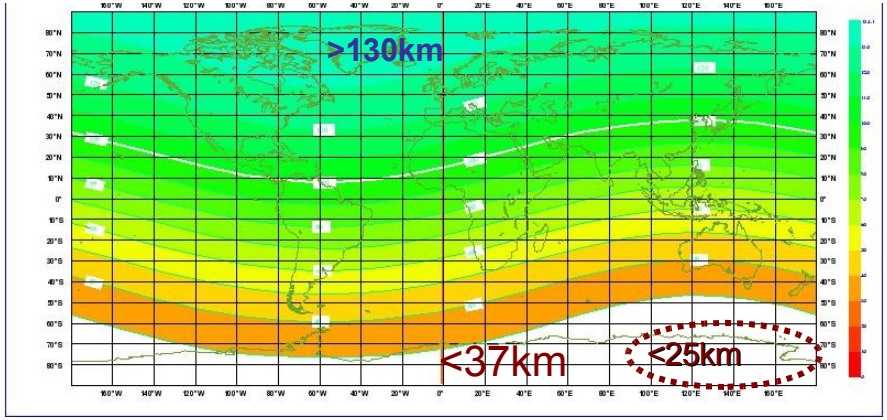
METEO FRANCE
Toujours un temps d'avance

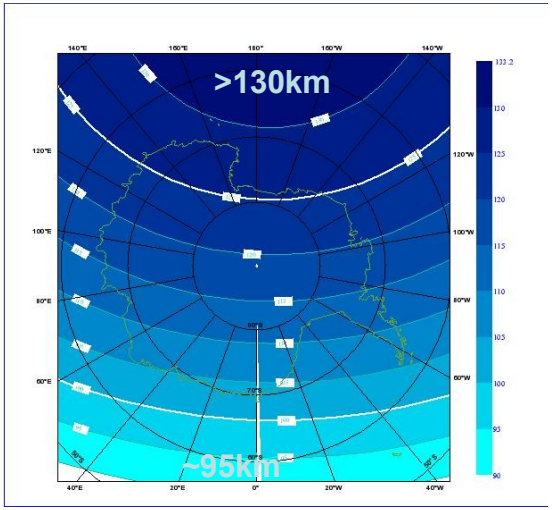
2.1 A new geometry : a new centre

1: In operations: centre = France

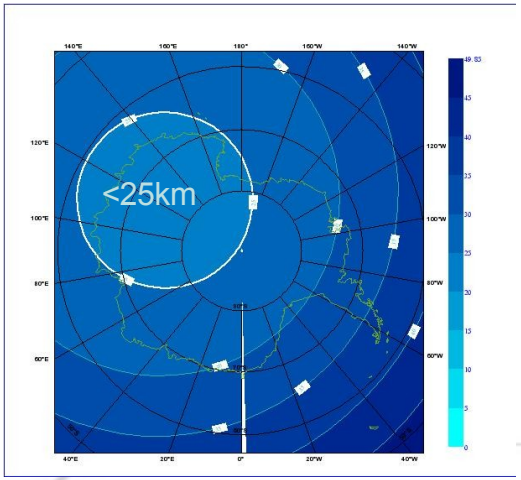


2: Concordiasi tuning: centre = Dome C





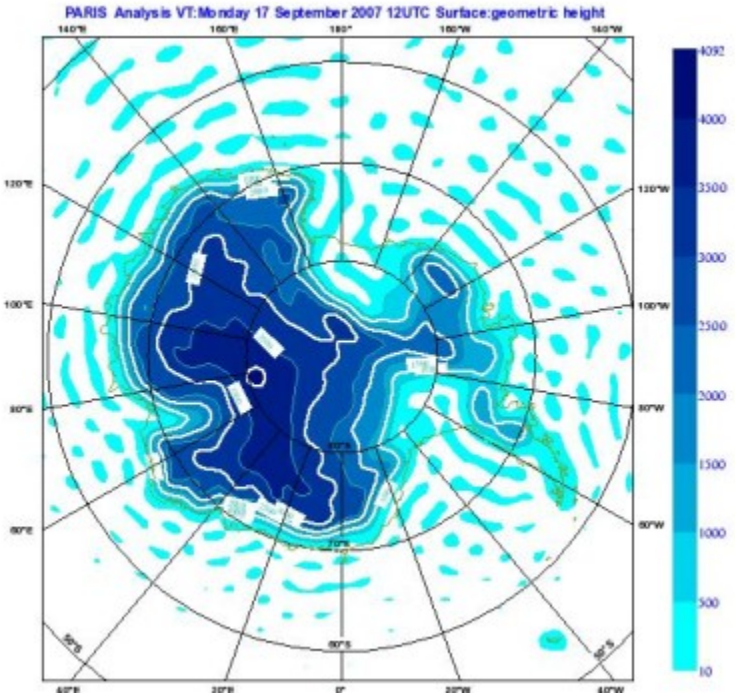
Over Antarctica…



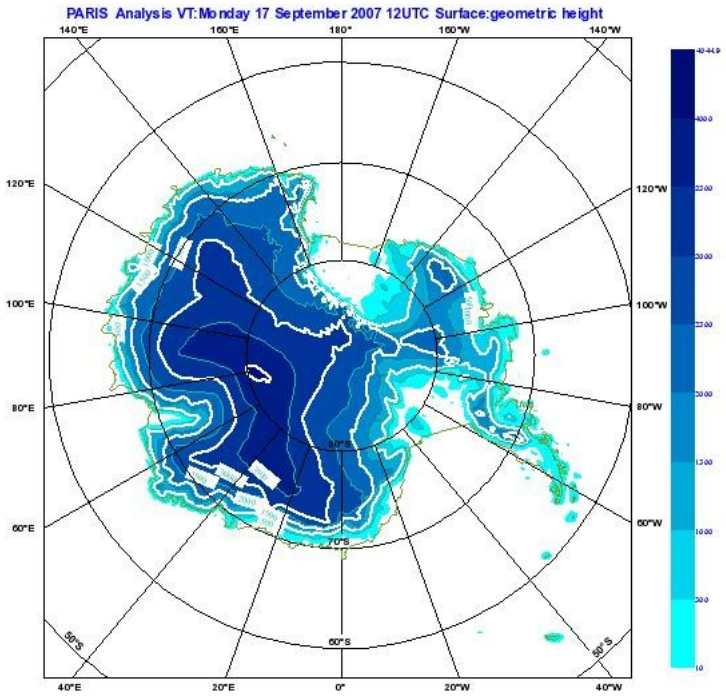
METEO FRANCE
Toujours un temps d'avance

2.1 A new geometry : ex.:orography

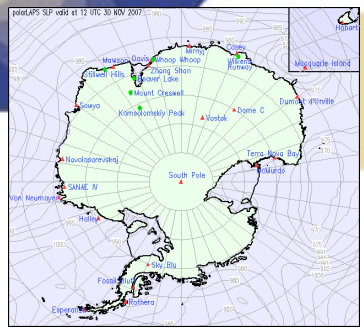
1: In operations: centre = France



2: Concordiasi tuning: centre = Dome C

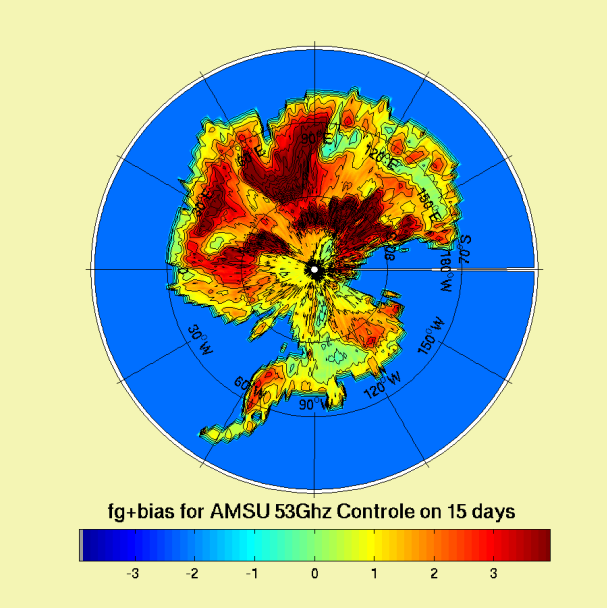


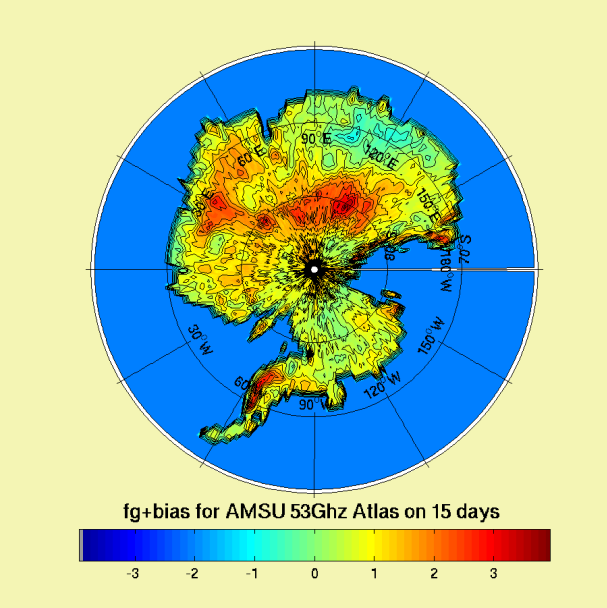
=> Better agreement with available RS



2.2 Microwave emissivity

- Studies based on F. Karbou's work (Karbou et al., 2006)
- Adaptation of the method for Arpege centred at Dome C





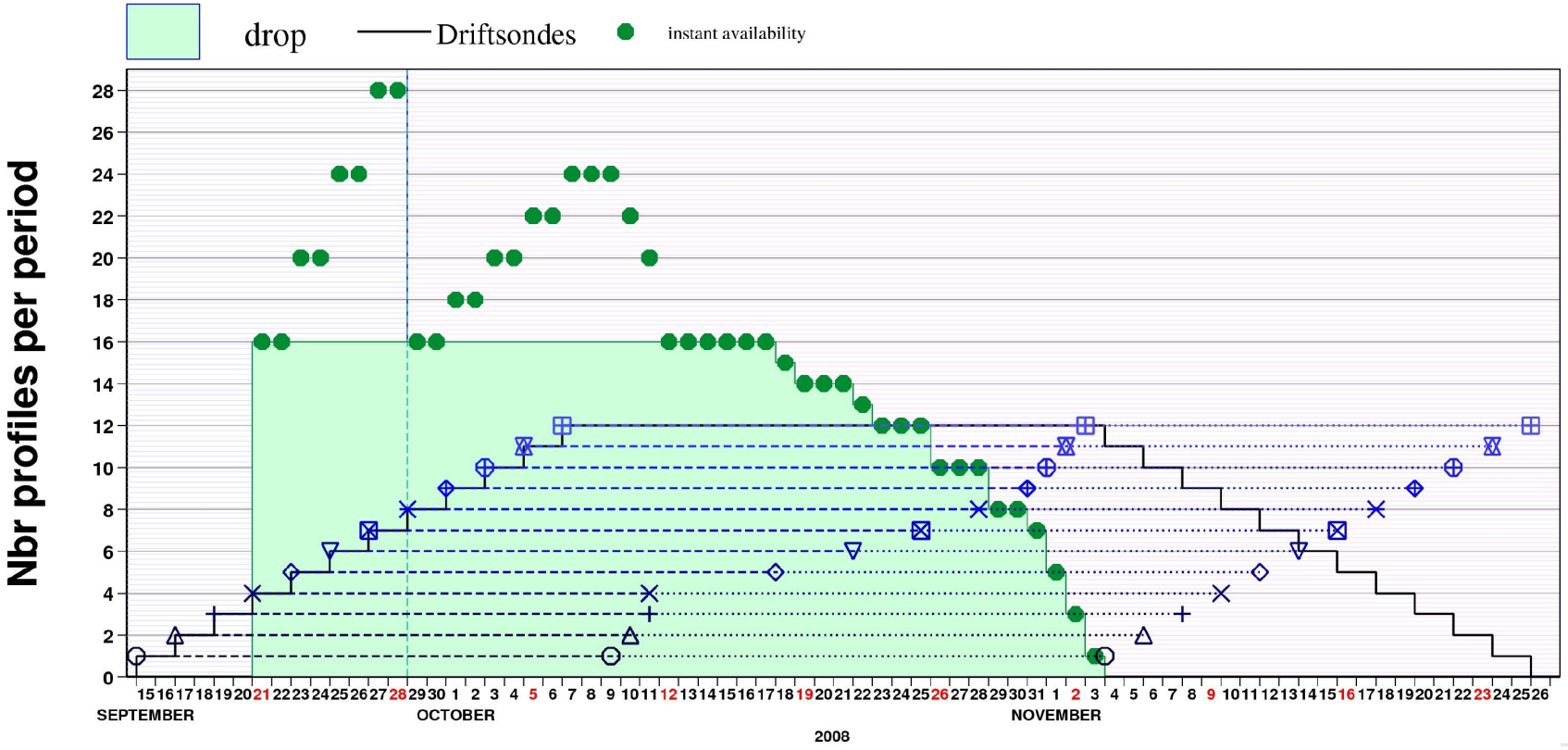
Channel 5 : +

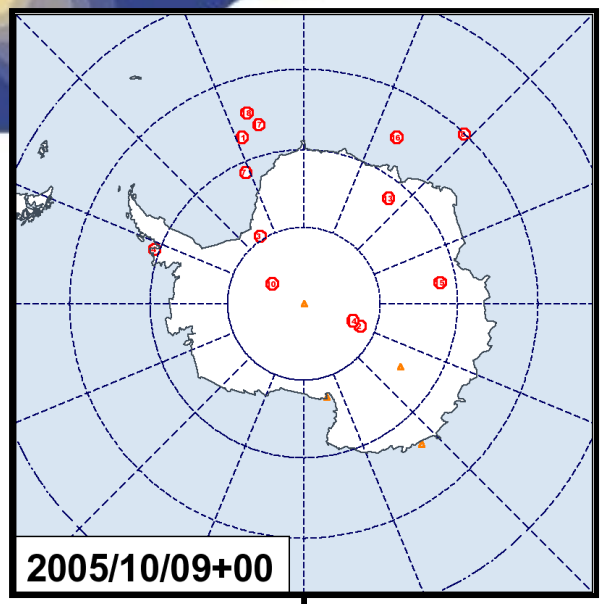
41% data

- Collaboration with LGGE (snow model of emissivity – Picard, 2007) and optimisation of the estimation of the emissivity and surface temperature
  - Emissivity time series (6 months) -> clustering technique to define emissivity snow classes (frequency, observation angle…) -> to improve the simulation of the Tb in the Arpege model
  - Comparison with the snow model of LGGE for the Ts
  - How would an improved assimilation over Antarctica impact the analysis and the forecast over the Globe?

3. Open issues : simulation of deployment

Simulated number of profiles (from dropsondes) per period of 24h (600/0)
Experiment ID: 0000 / starting date: 2008/09/14 at 00 TU / ending date: 2008/11/28 at 00 TU
Number of driftsondes: 12 / Launch period: 48h / initial delay: 144h / life: 50days
Ndrops (per drift): 50 / dropping period: [6,12]h (shift after 336h) / drop limit (per 24h period): 16





VORCORE data

3days forecast

6h

time (real)

days

day n

day n+1

day n+2

day n+3

analysis time (day n at 00)

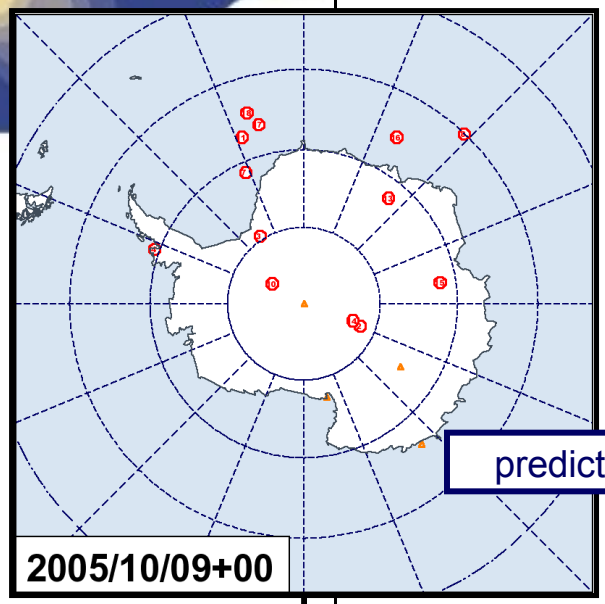
obs time (day n+1 at 12)

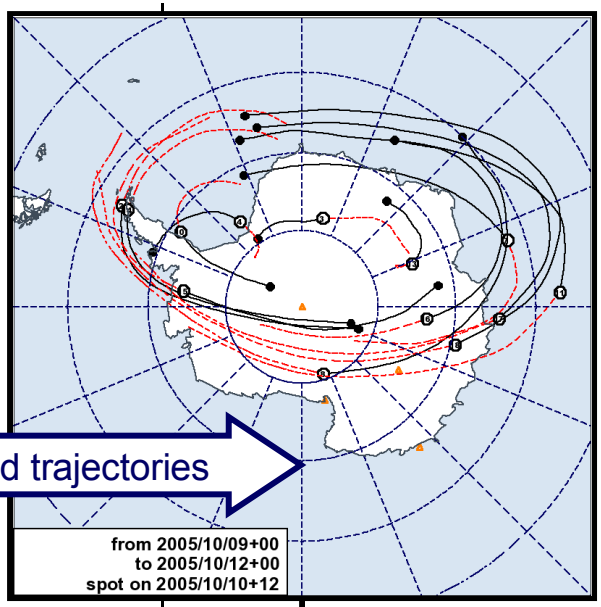
verification time (day n+3 at 00)

Lead-time

optimization

METEO FRANCE
Toujours un temps d'avance





predicted trajectories

VORCORE data

3days forecast

6h

time (real)

days

day n | day n+1 | day n+2 | day n+3

analysis time (day n at 00)

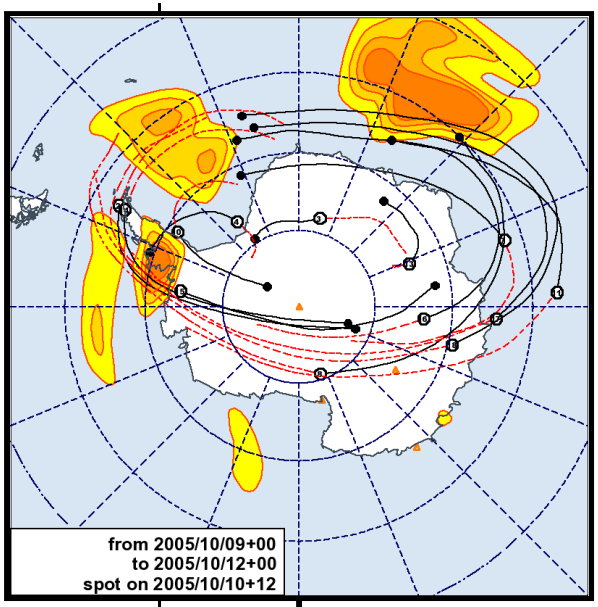
obs time (day n+1 at 12)

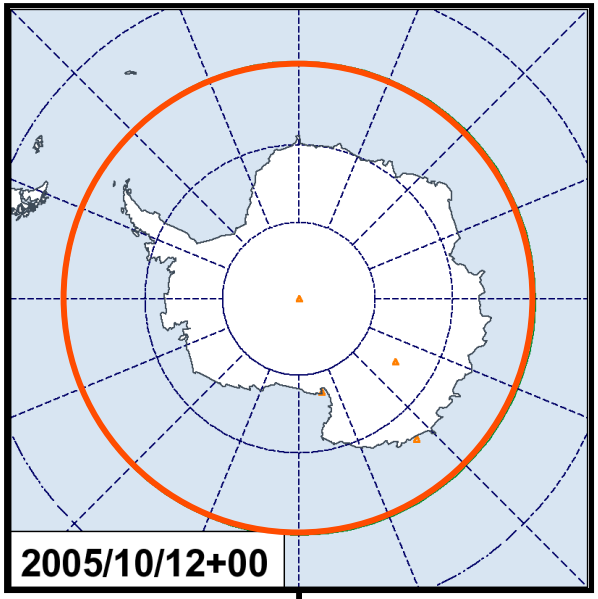
verification time (day n+3 at 00)

Lead-time

optimization

METEO FRANCE
Toujours un temps d'avance





VORCORE data

3days forecast

targeting tool

(Doerenbecher and Bergot, 2001)

decision time
(day n at ??)

6h

time
(real)

days

day n | day n+1 | day n+2 | day n+3

analysis time
(day n at 00)

obs time
(day n+1 at 12)

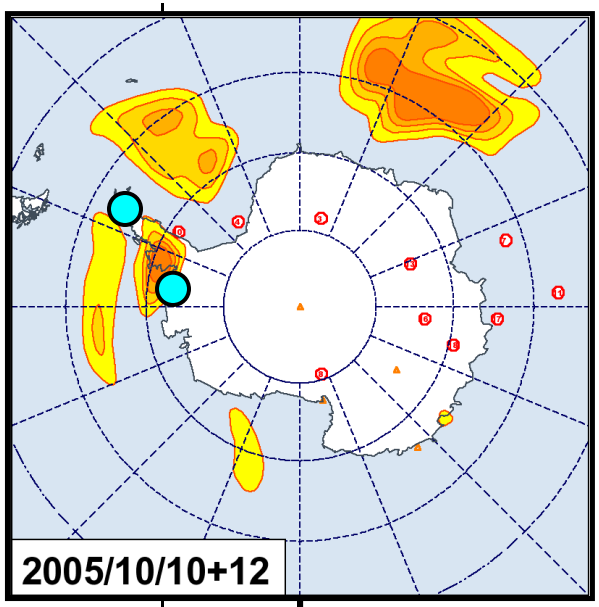
verification time
(day n+3 at 00)

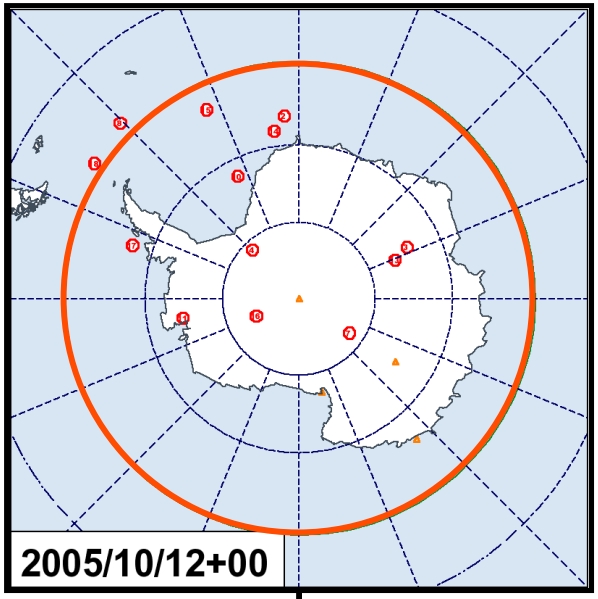
Lead-time

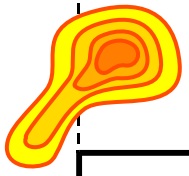
optimization

METEO FRANCE
Toujours un temps d'avance

activated driftsonde







decision time
(day n at ??)

6h
days

time
(real)

day n | day n+1 | day n+2 | day n+3

analysis time
(day n at 00)

obs time
(day n+1 at 12)

verification time
(day n+3 at 00)

Lead-time

optimization

METEO FRANCE
Toujours un temps d'avance

Few assumptions **to be discussed** ?

- Météo-France will propose some deployment plans in advance,
- Each plan is unique and valid for a unique day.
- The predictability computations are done once a day
- The predictability deployments are valid for a fixed time in the day, i.e. 0, 6, 12 or 18Z (still to be chosen, the other times correspond to other strategies).

Some delays which duration is critical when planning the predictability computations (but also for other deployment planning strategies)…

- minimal delay needed to request dropping sondes on a particular balloon
- minimal delay to get the latest location of the drifsondes balloons.

http://www.lmd.polytechnique.fr/VORCORE/McMurdo.htm

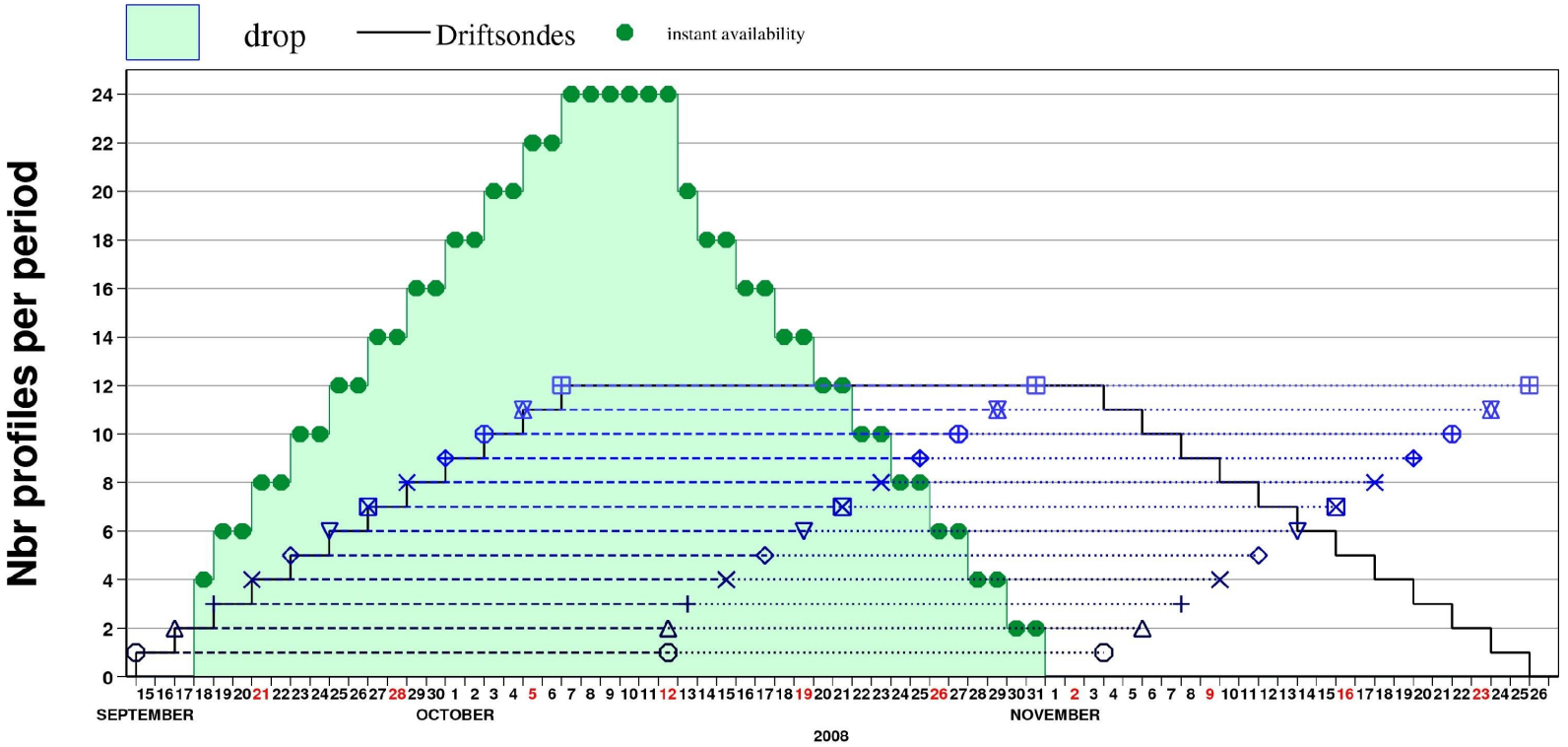
METEO FRANCE
Toujours un temps d'avance

METEO FRANCE

Toujours un temps d'avance

Dropsounding: 2 sondes per day

Simulated number of profiles (from dropsondes) per period of 24h (600/0)
Experiment ID: 0000 / starting date: 2008/09/14 at 00 TU / ending date: 2008/11/28 at 00 TU
Number of driftsondes: 12 / Launch period: 48h / initial delay: 72h / life: 50days
Ndrops (per drift): 50 / dropping period: 12h / drop limit (per 24h period): 100



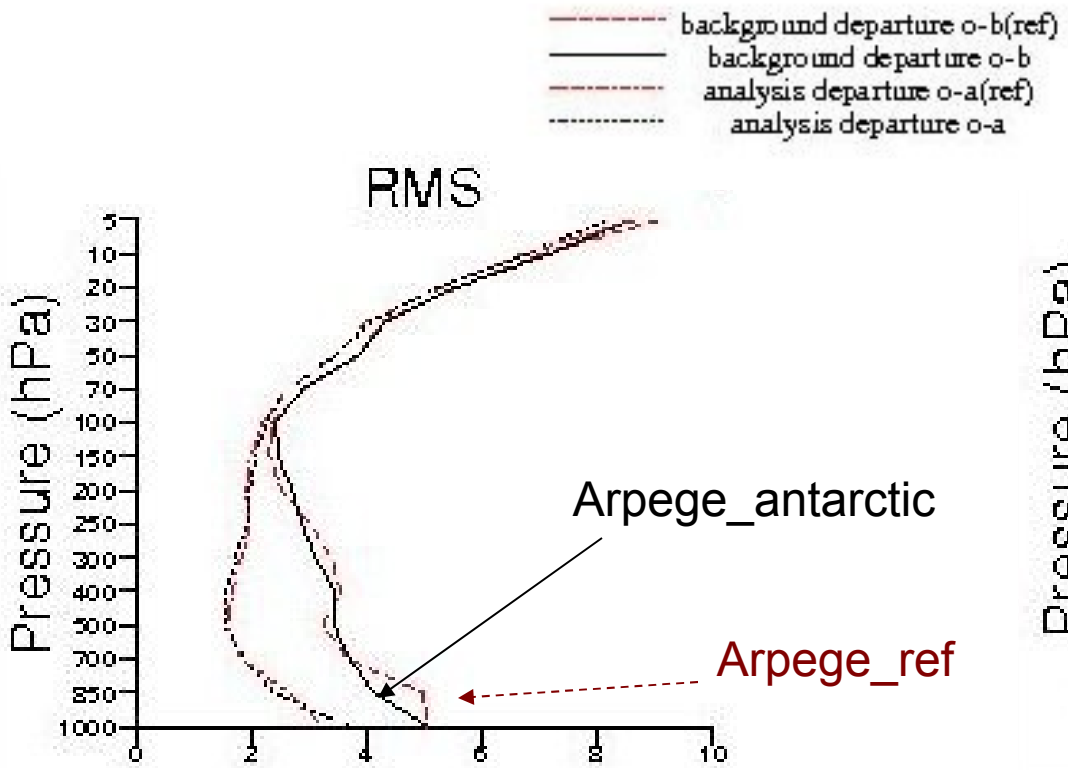
METEO FRANCE
Toujours un temps d'avance

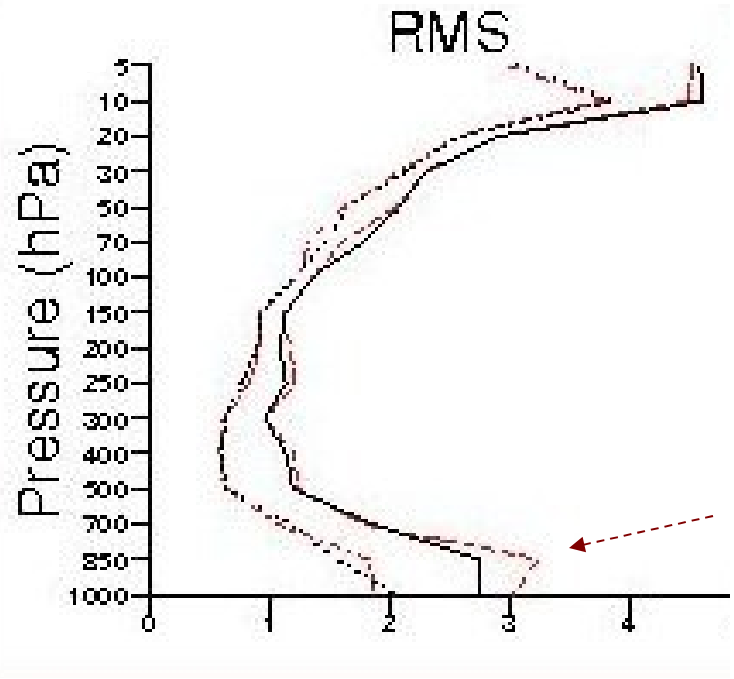
The emissivity 1

- Studies based on F. Karbou work (Karbou et al. 2006; 2007)
- Micro-wave sensors : AMSU A-B on NOAA 15, 16, 17 and 18
- Different cases
  - ‘Atlas’: An atlas of emissivity is calculated on low angles + a parametrisation of the emissivity for the others angles
  - ‘Dynamic’: the emissivity of the channel 3 (50Ghz) of AMSU-A is taken and put to the others channels. Same thing with the channel 1 (89Ghz) for AMSU-B

2.1 A new geometry 4: fit to observations

- Difference between the observations and the model on 15 days
- Important impact on the assimilation of radiosoundings





Zoom on the lead-time period:

	Météo-France	NCAR
00h		
operational products available	Basic predictability computations	?
00h + ?	Get the latest position of the driftsondes	Send the position of balloons
	Predict balloons position at $t_{obs} = t_{ana} + ?$	?
	Targeting tools and Deployment plan	?
00h + ??	Send the deployment plan to NCAR	Get the deployment plan
		Implement the deployment plan valid for day + ?