Status of the 3D-VAR assimilation in Aladin

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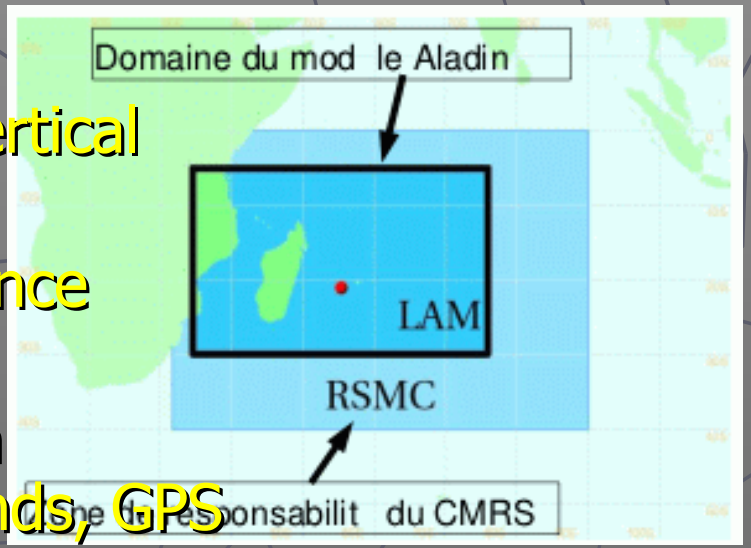
Günther Haase (Hirlam)

Overview

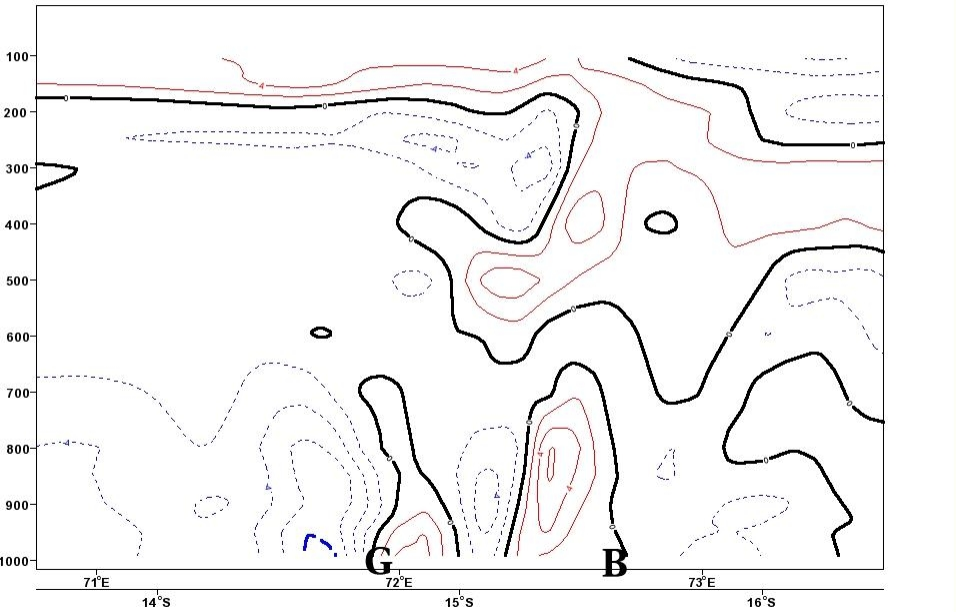
- Algorithmics: NL/Ω balance, RUC
- Observations: satellite, windprofiler, radar data
- Local implementations
- Outlook

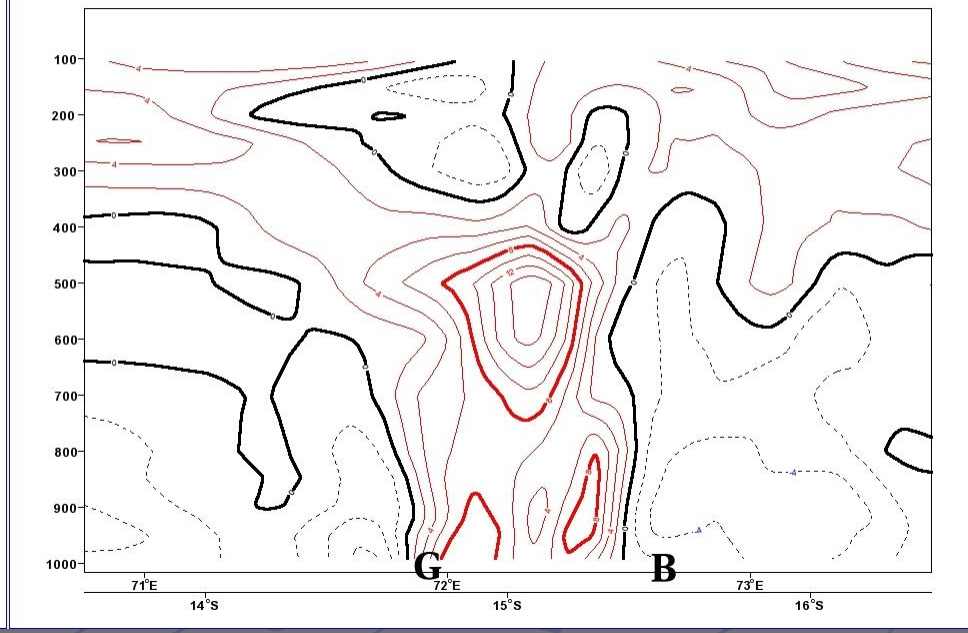
Impact of NL and Ω balances in the Aladin-Réunion 3D-VAR

- What is Aladin-Réunion ?
  - 10 km resolution, follows Arpège vertical discretization
  - 6h 3D-VAR following the Aladin-France implementation
  - neither SEVIRI IR radiances nor 2m observations, but scatterometer winds, GPS ZTD's and various polar-orbiting satellite data are more important in this system
  - Target for Indian Ocean cyclone prediction and warning system (MF is WMO Specialized Regional Met Center for the South-Western Indian Ocean)



NON LINEAR AND OMEGA BALANCES: case of tropical cyclone Darren (G. Faure, S. Westrelin)

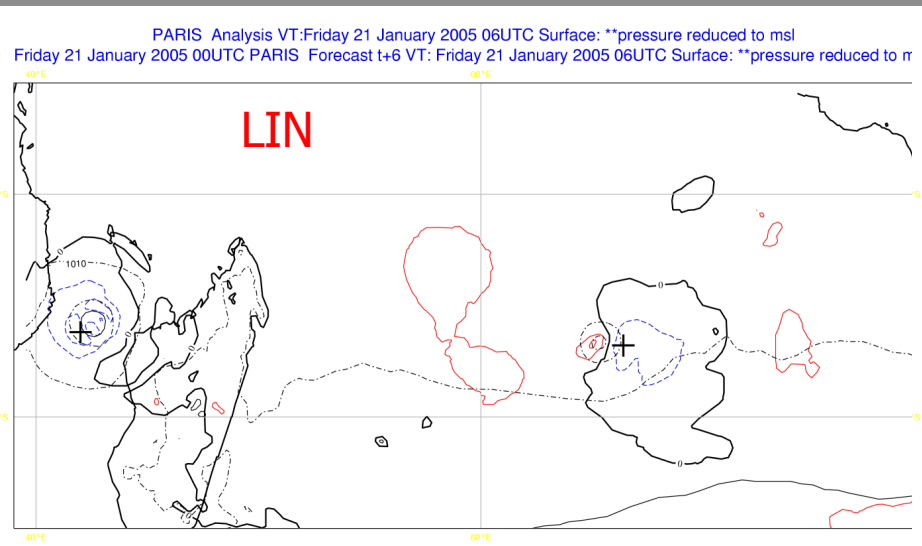


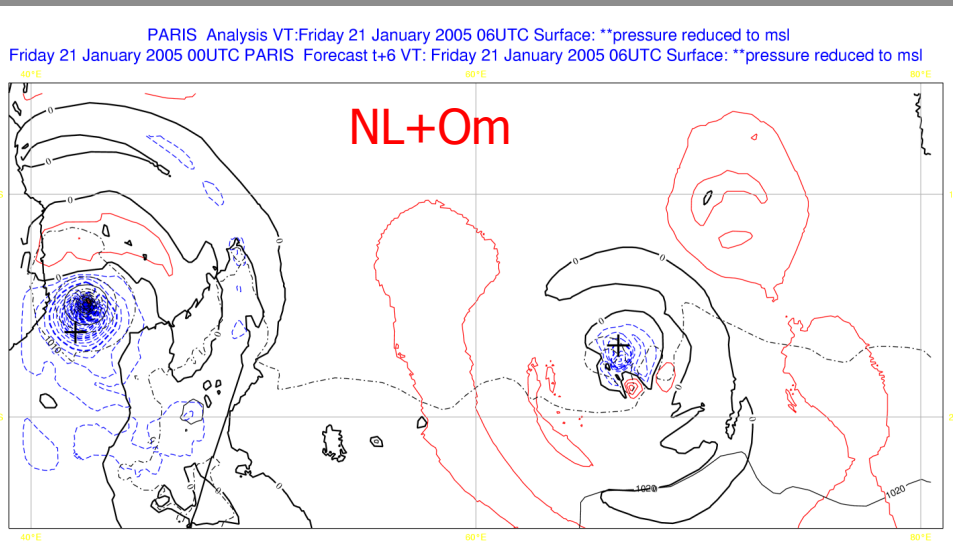


$$\Delta Pbal = -\nabla.(V\psi.\nabla V\psi + fk \wedge V\psi)$$

$$(\sigma\Delta + f_0{}^2 \frac{\partial^2}{\partial p^2})\omega = -2\nabla Q$$

NON LINEAR AND OMEGA BALANCES: case of tropical cyclones Darren & Ernest (2/2)





$$\Delta Pbal = -\nabla.(V\psi.\nabla V\psi + fk \wedge V\psi)$$

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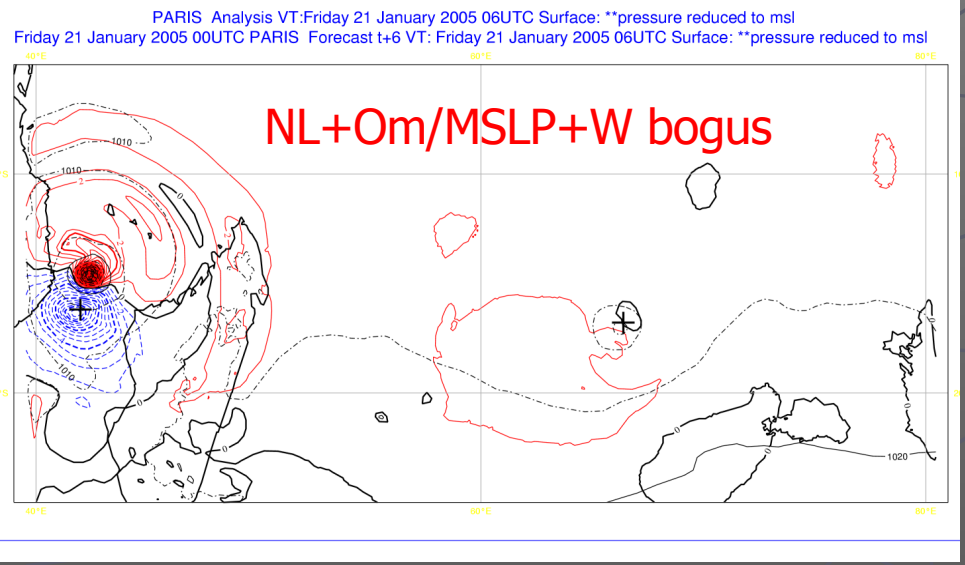
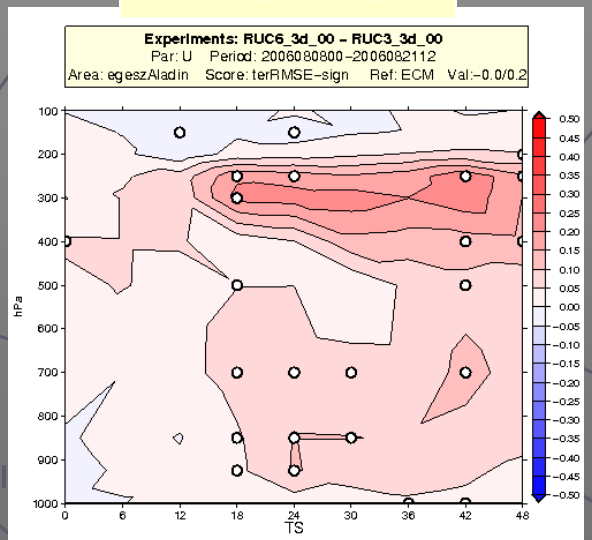


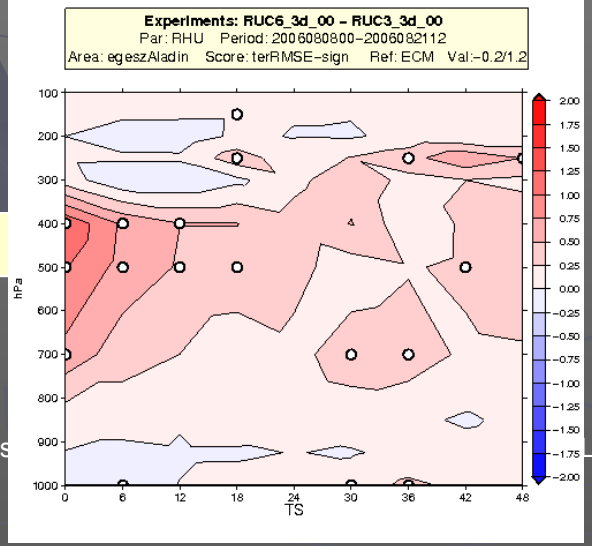
Aladin Rapid Update Cycle (Ald-Hun)

RMSE difference

U



RHU



Expected extra from 3-hourly cycling:

- more SYNOPs (P_s only)
- more AMDAR
- more AMV
- more Wind Profiler
- smaller error in the innovation vector for ATOVS (due to more frequent analysis)

Preliminary results:

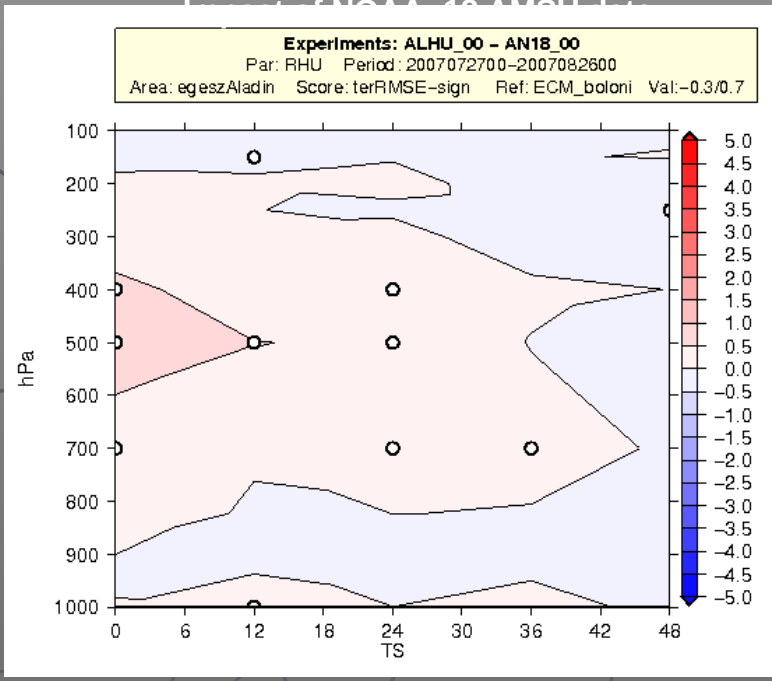
- improvement for all fields (see figures on the left where red shades indicate that 3h cycling is better than 6h cycling)

Next:

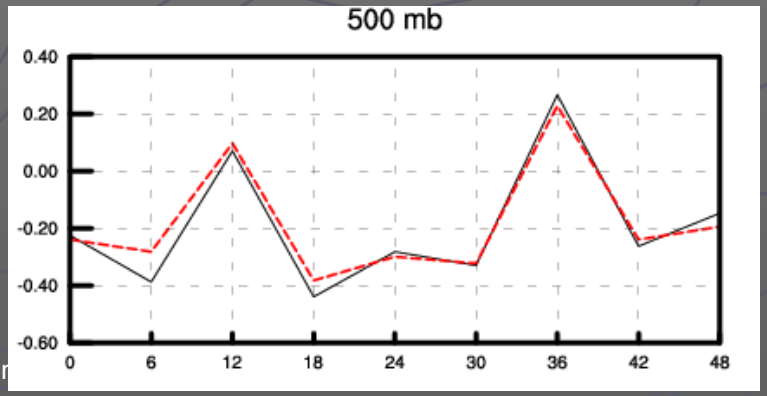
- diagnose spin-up in the 3h background forecast

Use of observations in the Aladin-Hungary system

- Satellite data:
  - NOAA-18 AMSU-A,B added (before only NOAA15, 16, 17) → improvement
  - new local bias correction (automatic update based on the last 30 days)
  - experiments with MSG/SEVIRI data



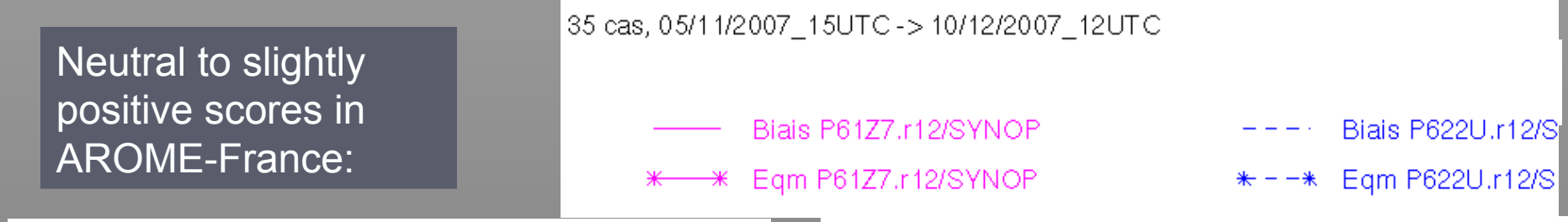
- Windprofiler:
  - Meteo France blacklist is used (data from 4 sites between 700 and 400 hPa)
  - very small impact (mostly neutral results)
  - example of reducing wind bias on the right

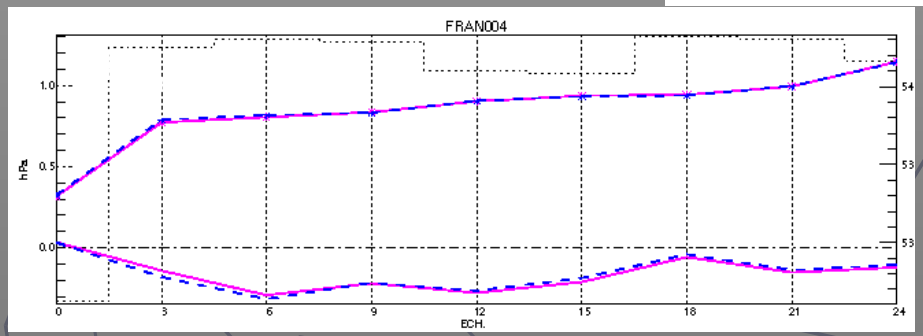


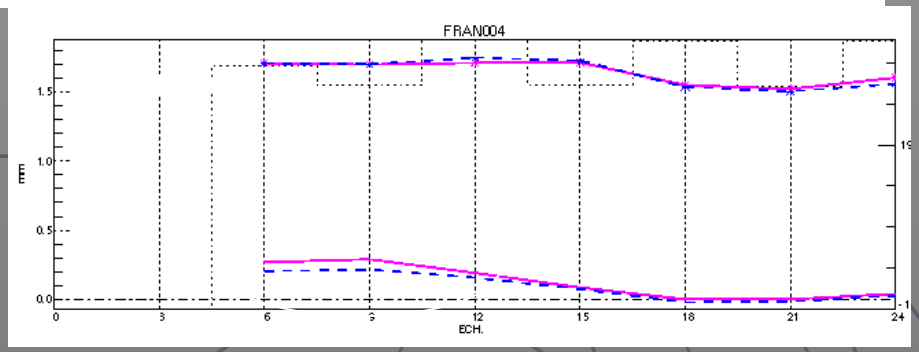
Radar data assimilation

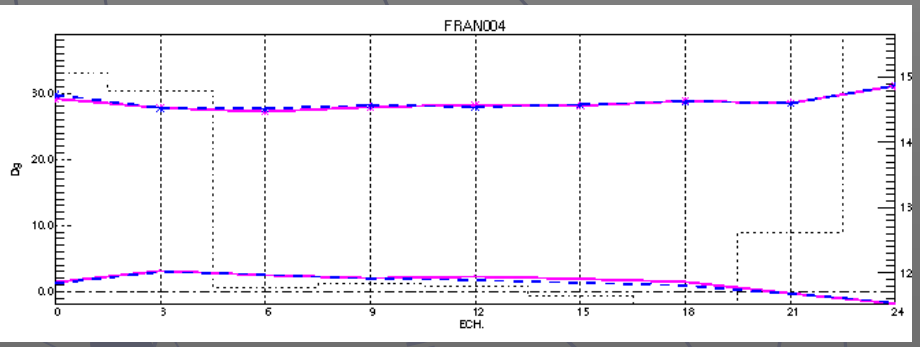
- Doppler radial winds (Vr)
- Reflectivities

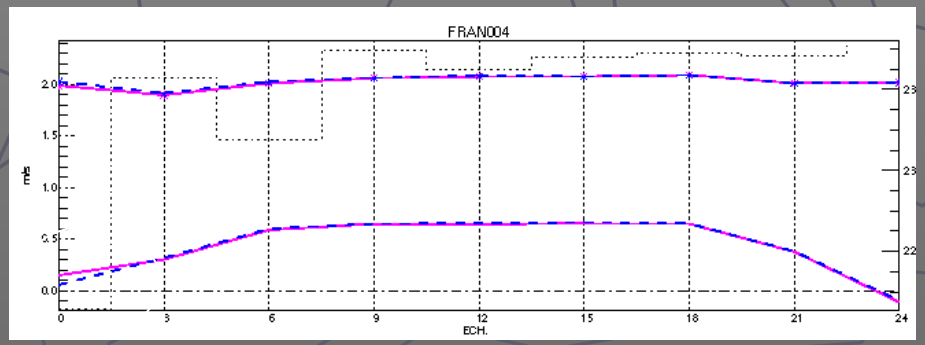
Neutral to slightly positive scores in AROME-France:

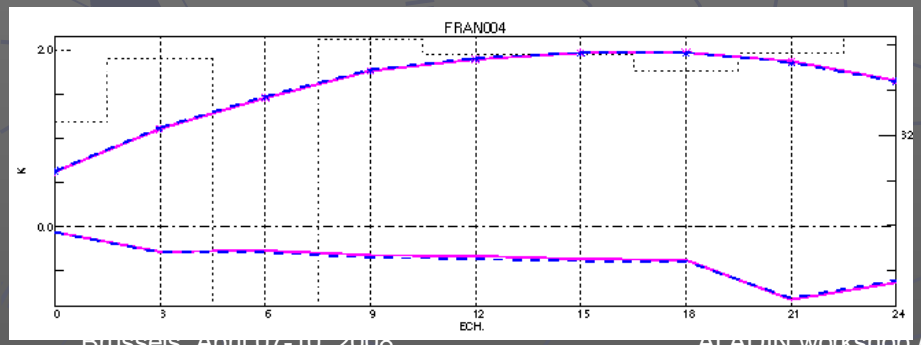


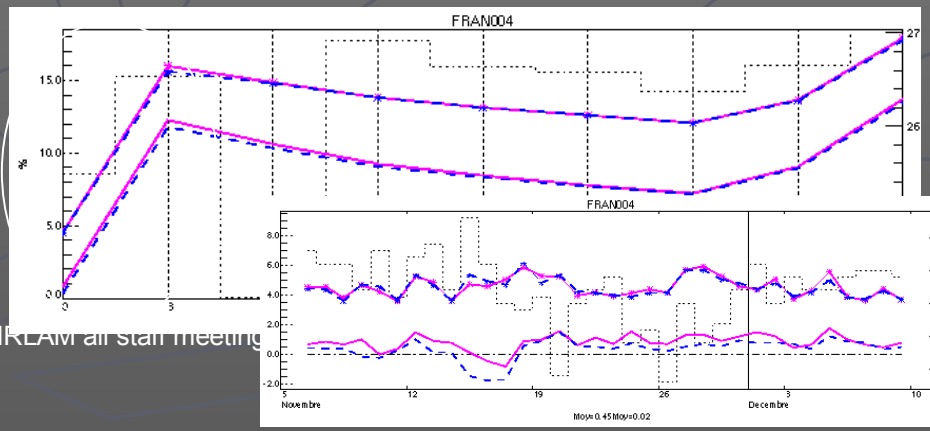






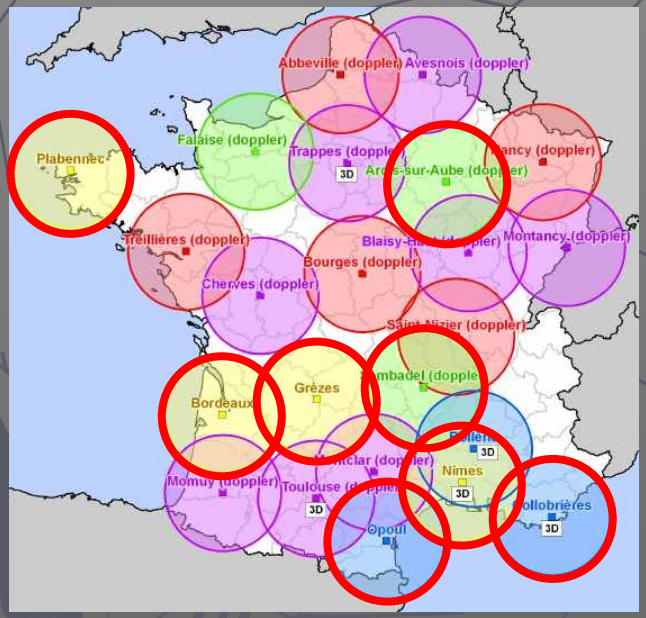




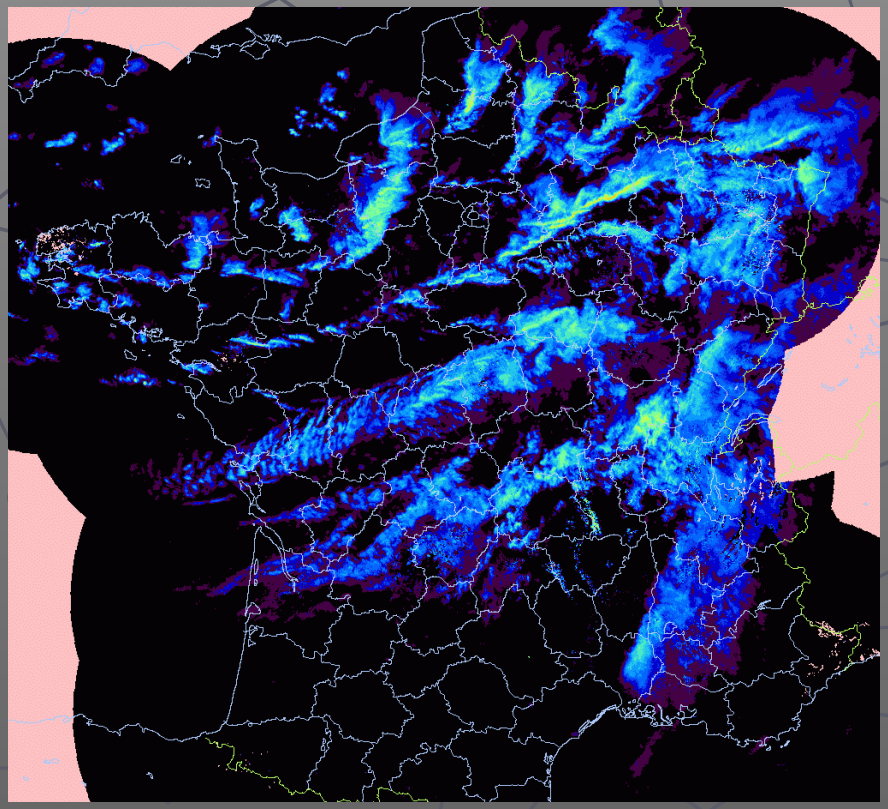


QPF scores:

Severe wind situation on Northern France (early December 2007):



non Doppler radars

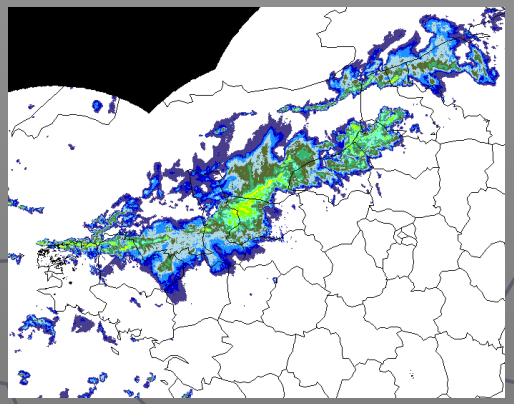


December 3rd, 00 UTC

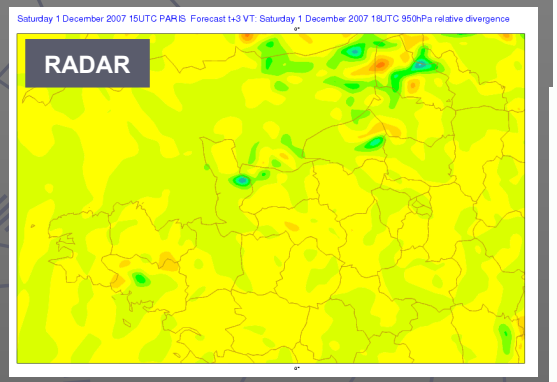
⇒ area of interest is well covered with radar wind information

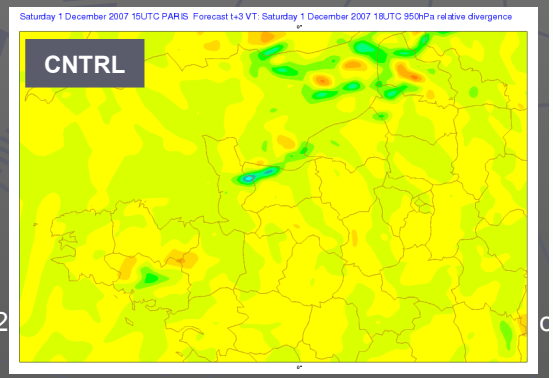
December 1st 2007

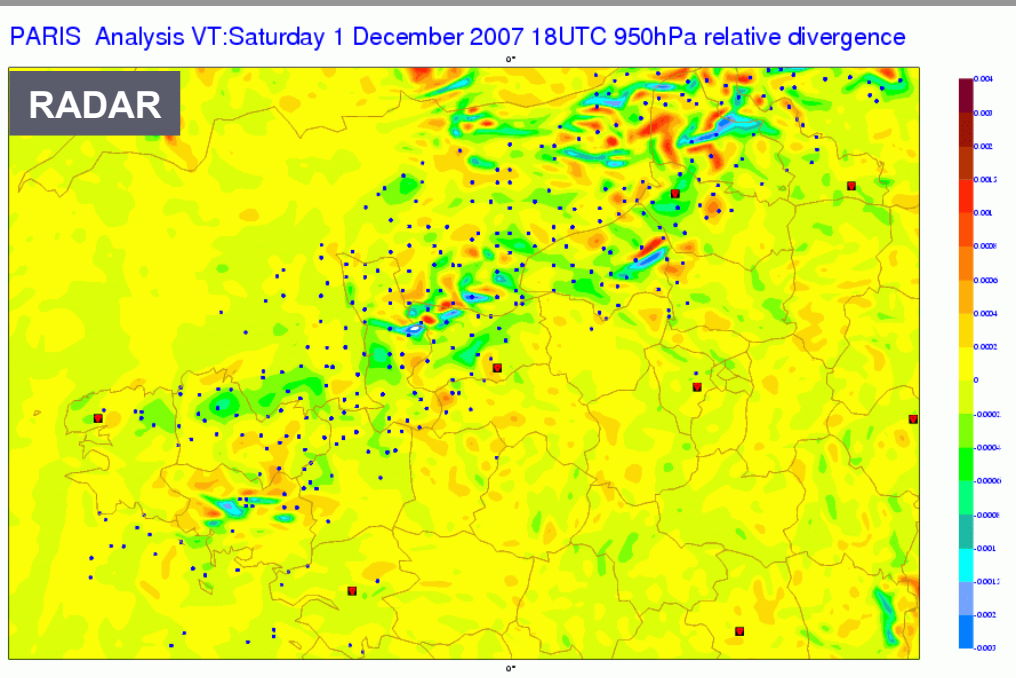
Analysis of divergence at 950 hPa 18 UTC

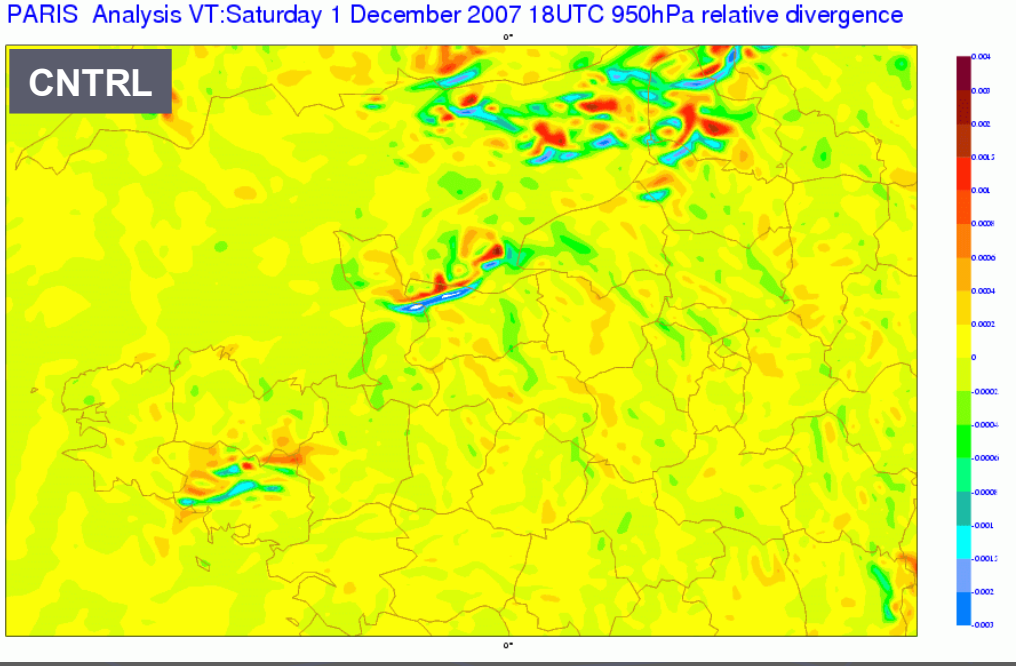


Guess



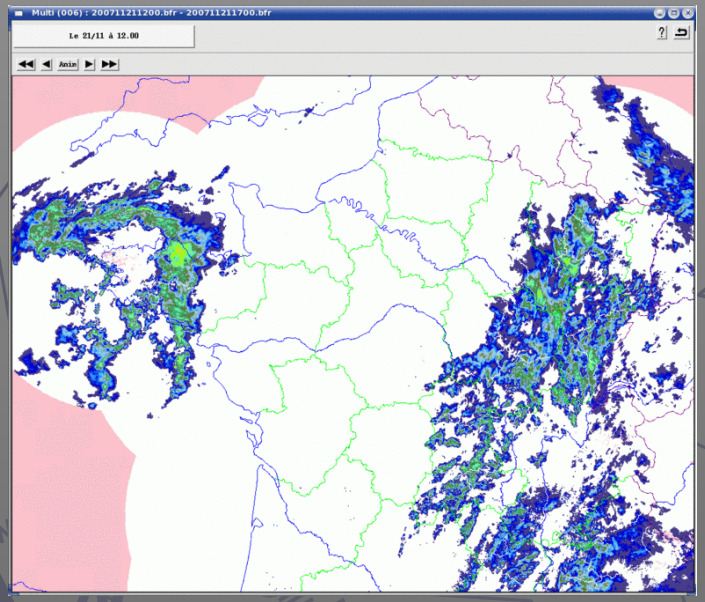


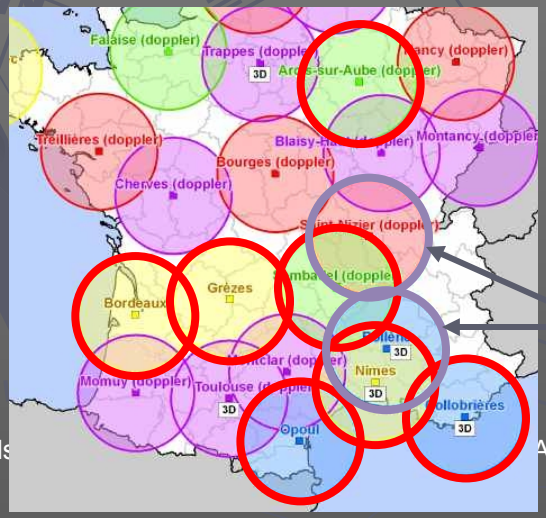


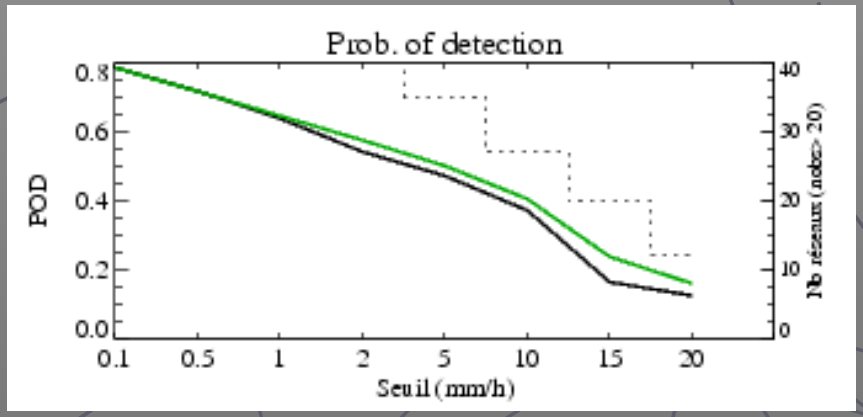


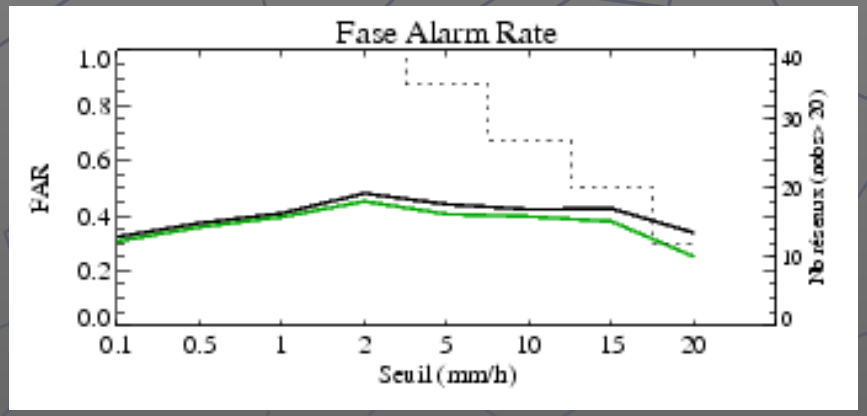
QPF scores:

A more difficult period for the radar experiment: **Nov. 19th, 00 UTC -> Nov. 24th 00 UTC**
Precipitations over Eastern France









Malfunctions at Bollène and St Nizier

RADAR

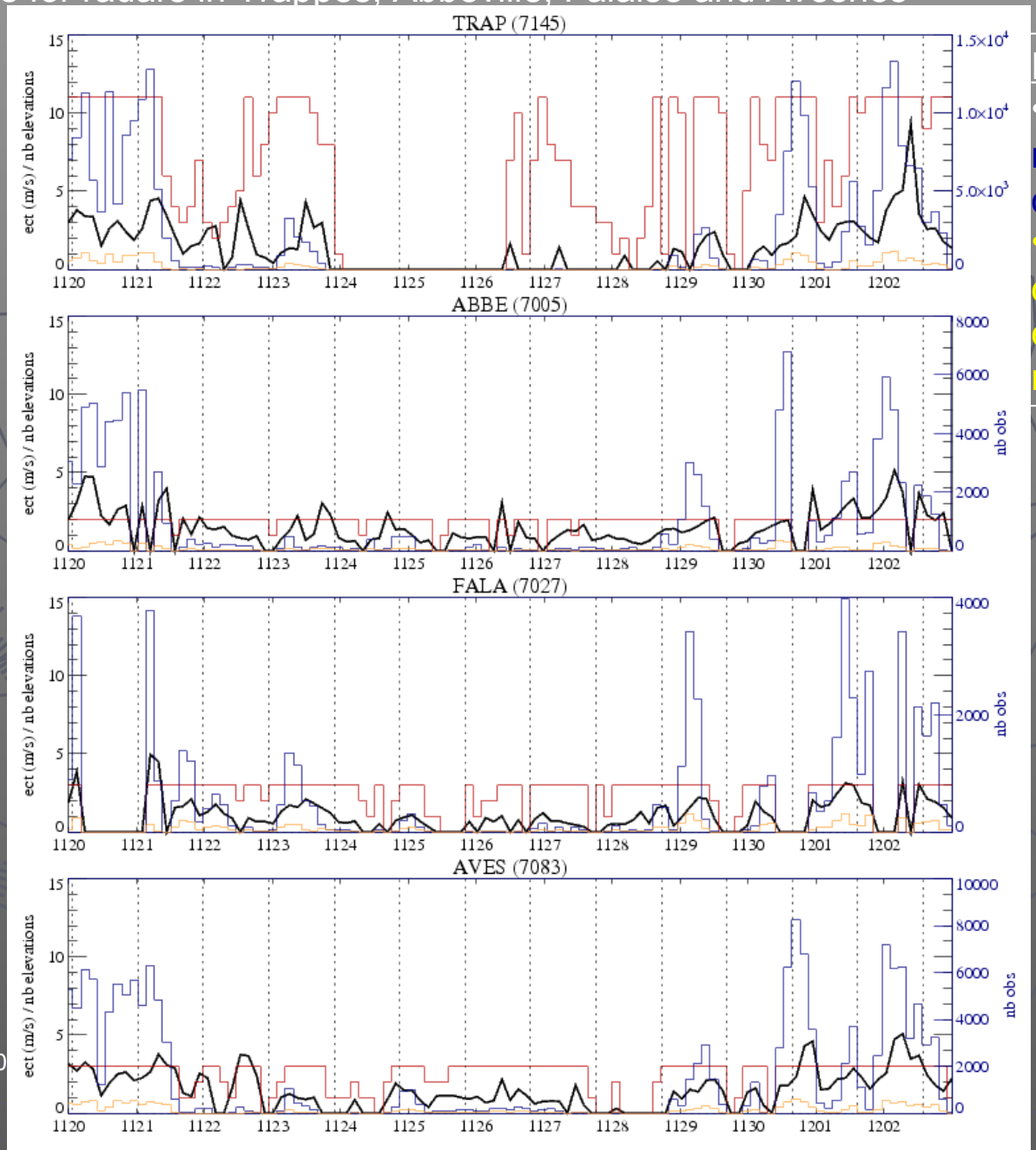
CNTRL

Monitoring of radar radial wind observations

Example of 15 days for radars in Trappes, Abbeville, Falaise and Avesnes

Red: number of elevations

Black: mean variance of Vr computed over slices of 10 deg. Site angle, per elevation



Histograms:

- Blue: total number of observations
- Yellow: number of observations entering minimization

Next steps for radar data assimilation

- Vr:
  - find an optimal horizontal range for each radar data selection (150 km ?),
  - further tuning of QC,
  - bias correction (compare with VAD winds ?),
  - monitor Vr's in Aladin-France
- Reflectivities:

Status on reflectivities

- Simulator fairly completed and tested in Arome (incl. QC)
- Further tests planned with the orography masking software provided by Hirlam
- Bayesian retrievals (columns of RH):
  - ready for basic assimilation;
  - more work on QC and impact studies to be performed;
  - assess the use of a climatological database of model RH-column references;
  - compute statistics of analysis increments versus innovations
- Improve monitoring of reflectivities and RH-retrievals (in pseudo-oper mode)
- Refer to Eric W.'s talk at the 2nd Arome training course (Lisbon, March 4-7th 2008)

Local installations of data assimilation

CZ:

- CY32T1
- Validated: OULAN, BATOR, ODBTOOLS, ALDODB (c. 701, 002, 131)
- ODB: SYNOP, TEMP, SEVIRI (Seviri modset for CY32T2)
- B matrix ready (standard and lagged NMC)

HR:

- CY32T3
- Validated: OULAN, BATOR, ODBTOOLS, ALDODB (c. 701)
- ODB: SYNOP, TEMP soon

RO:

- CY32T3
- „ALDODB” compiled CY32T3
- „Festat” installed
- no validations

MO:

- daily runs, not yet all possible satellite radiances in
- ensemble B

Outlook

- Incremental DFI now operational in Aladin-FR/RE
- FGAT in oper ? (FGAT is also the target for Arome)
- Surface CANARI O.I. analysis to start with …
- Observations: country-dependent =>
  - France: RH2m and T2m only daytime, radial radar winds, METOP/ASCAT winds, METOP IASI & HIRS, SSM/I over land
  - Hungary: AMV, AMSU-B/HIRS, SEVIRI, T2m/RH2m
  - Morocco: highest priority is on building the local satellite facility for assimilation
- R&D:
  - Very strong link with Arome
  - Common Aladin-Hirlam 4-year plan (listen to Nils' talk !)

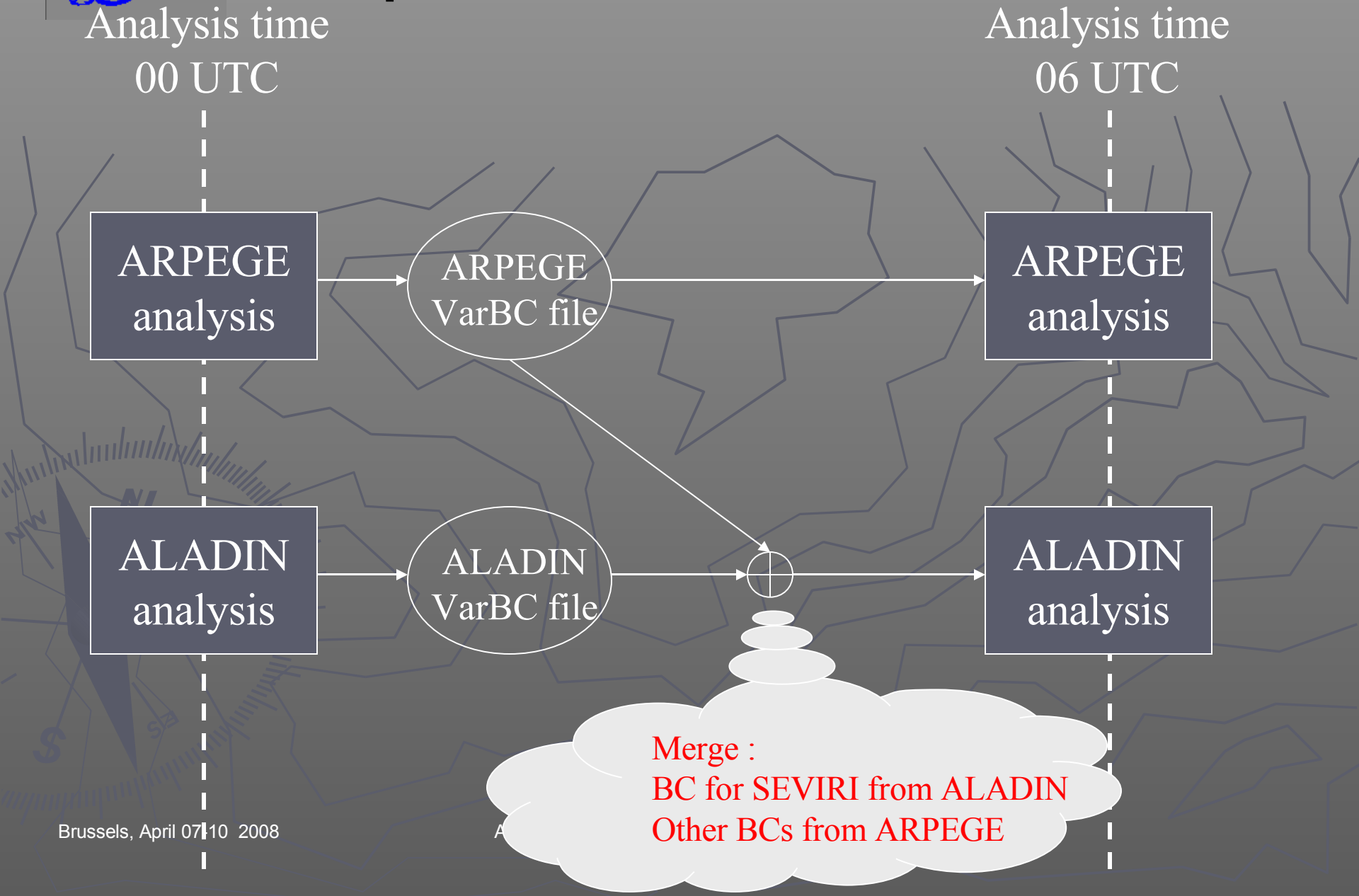
Thank you for your attention

VarBC: How does it work ?

- Satellite radiance data have systematic biases that have to be removed before the assimilation;
- These biases can depend on the scan angle (geometry) and on the flow.
  They can be explained by predictors such as powers of the scan angle, thicknesses of some layers of the atmosphere, skin temperature, etc…, within a multiple linear regression;
- In the VarBC scheme, coefficients of the regression are dynamically adapted at each analysis time.
  They are included in the control variable of the assimilation, and they use other "conventional" data (like radiosonde or aircraft data) as a constraint.

Dee (2004), Auligné *etal*. (2007)

Which implementation in ALADIN?



Recent evaluations in E-suite at MF

Impact of using
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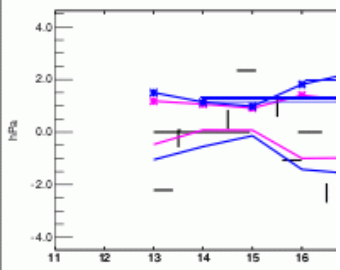
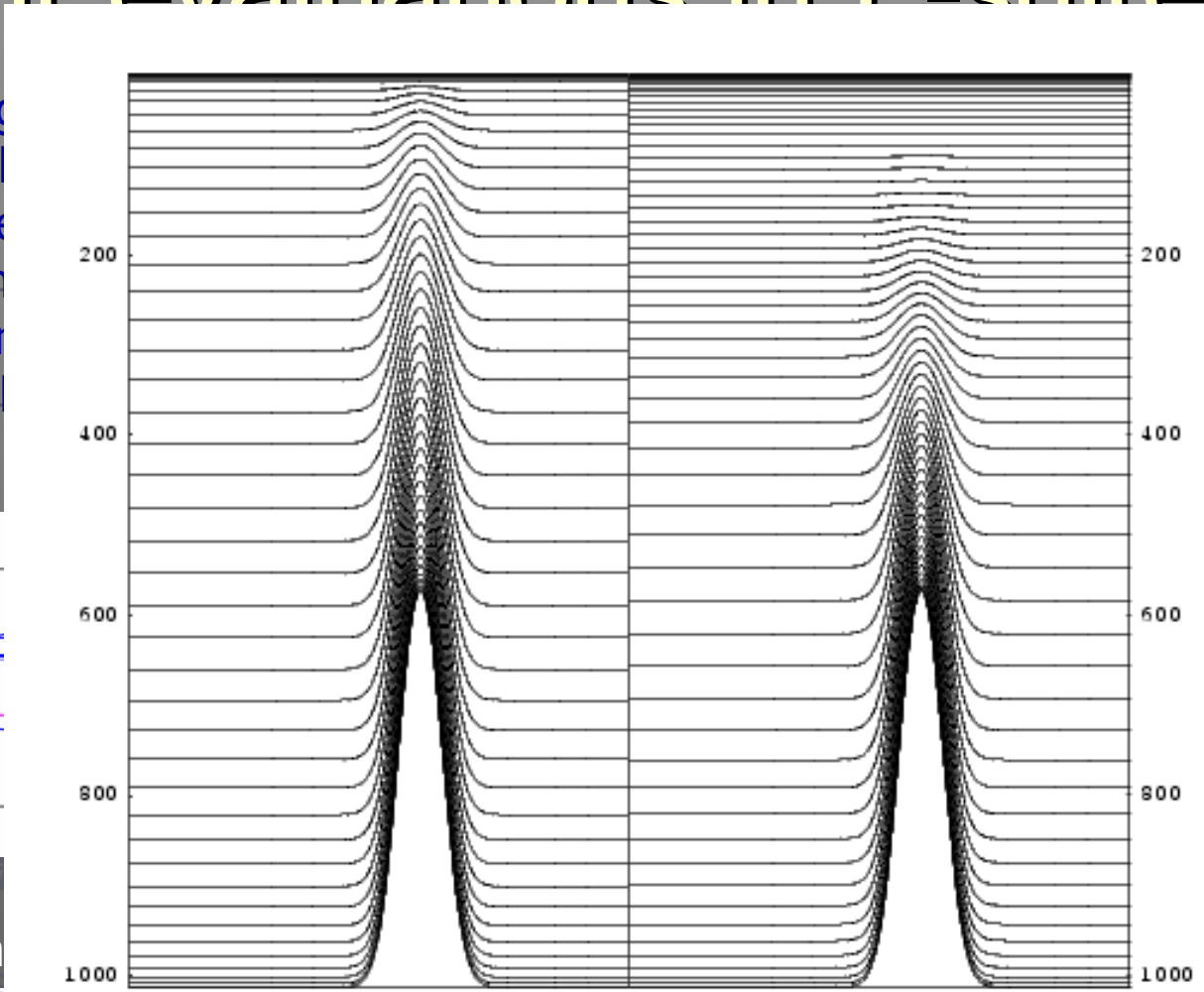
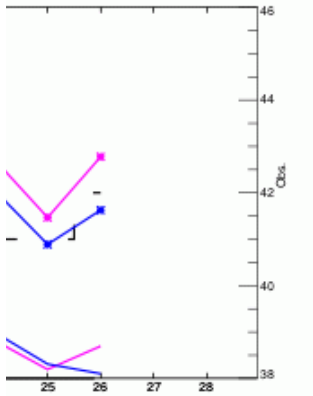
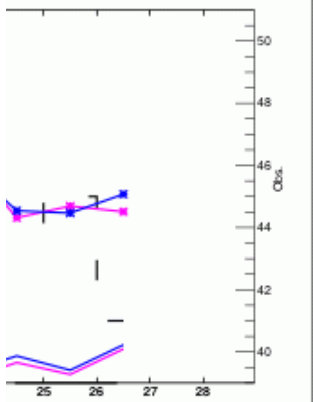
MSLP 48h









Change of B m
interpolated 46
60 level ensemble fct stats (Jan. 19th)

Recent evaluations in E-suite at MF (2/2)

- Incremental DFI, retuned DFI and REDNMC, spatially consistent initial LBC
- 60 vertical levels (as Arpège)
- Earlier in 2007: V10m, METOP AMSU/A-B, ERS-2 scatterometer winds