Overview of AROME status and plans

ASM, Utrecht May 12-15 2009

Y. Seity, P. Brousseau, E. Bazile

Overview of AROME status and plans

- Main changes since last year

- Plans for 2009 : AROME_v2
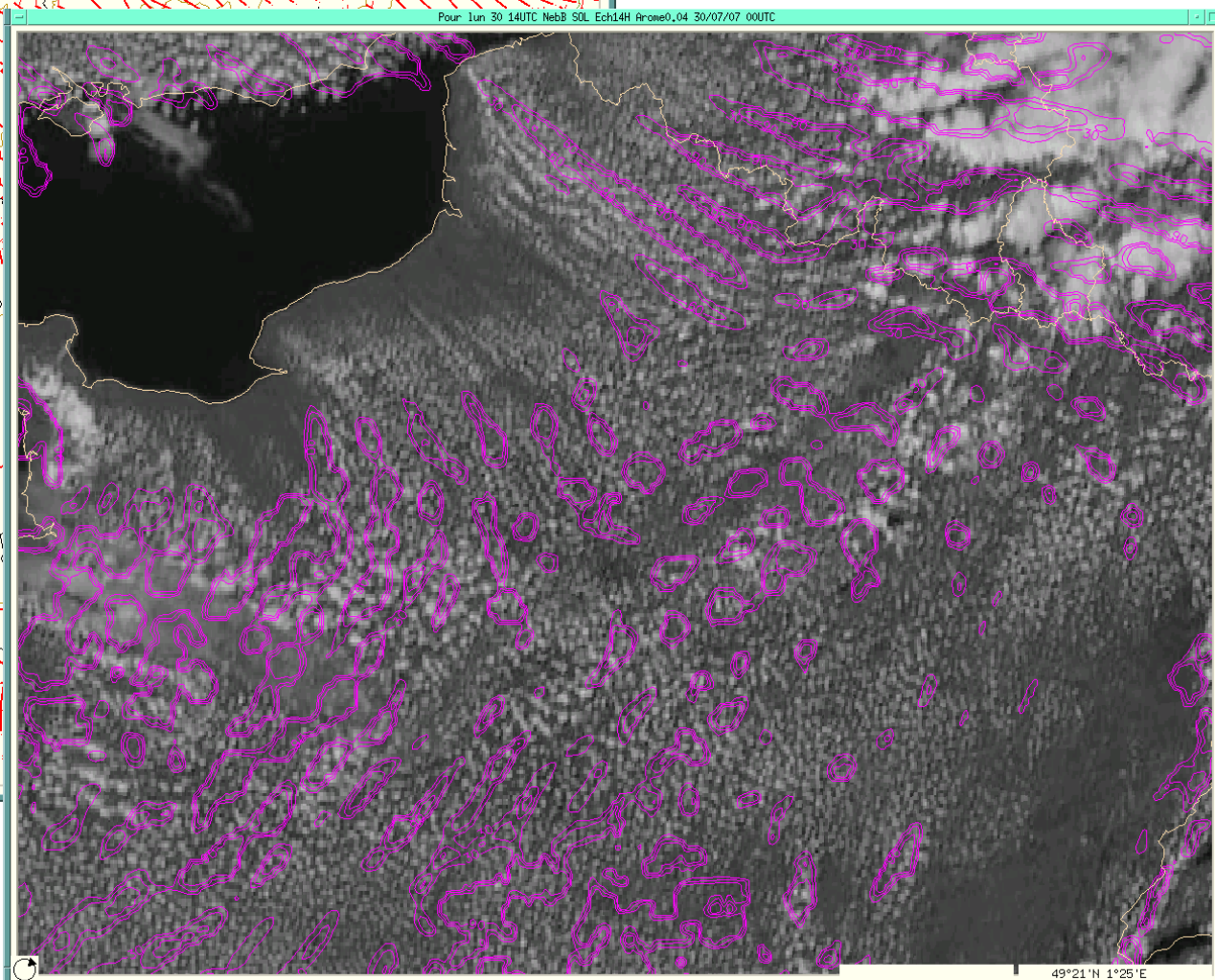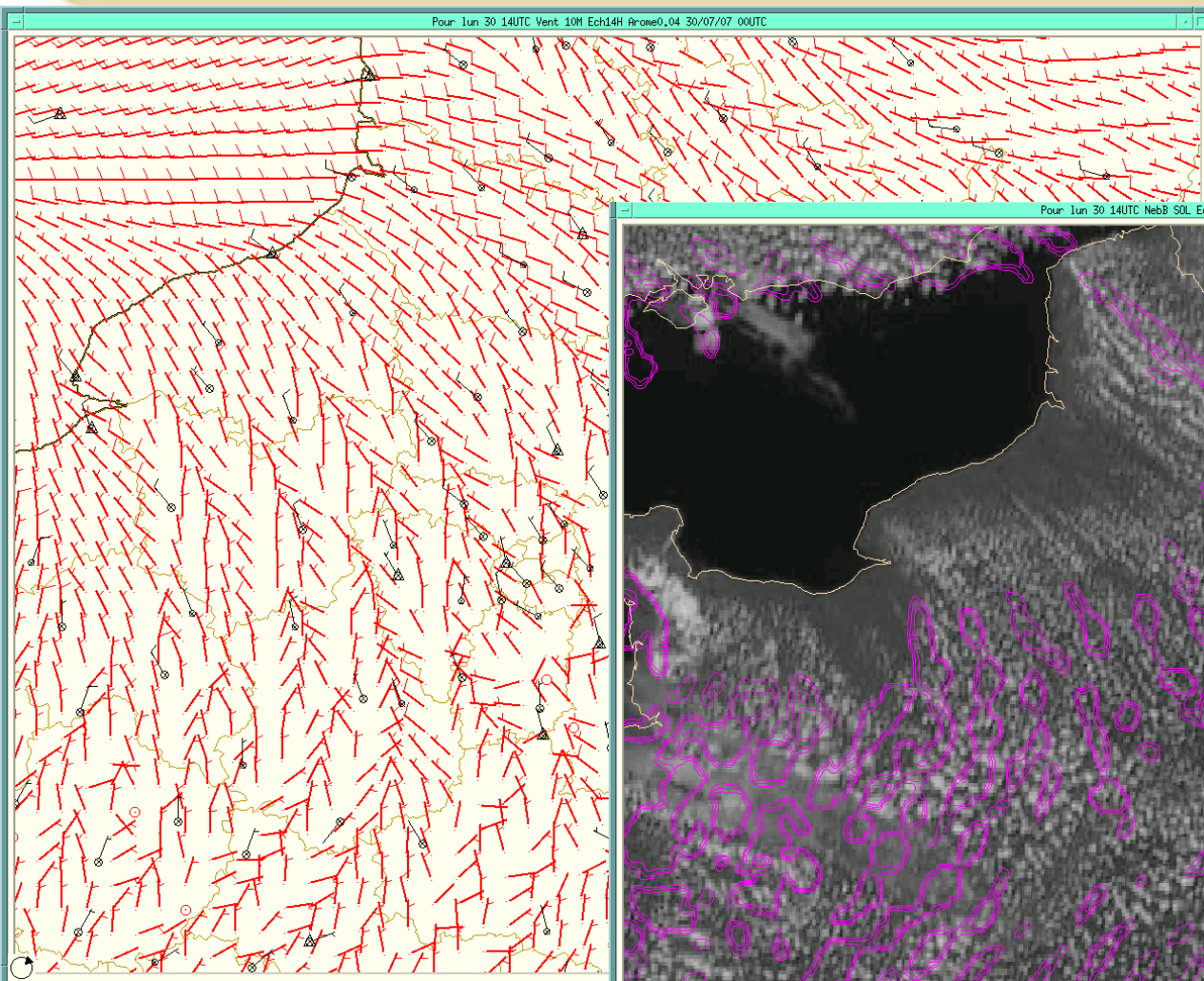
- Plans for 2010

Overview of AROME status and plans

- Main changes since last year :
  - EDKF (Sept. 11th 2008)
  - SLHD (Sept. 11th 2008)
  - Assimilation T_{2m} Hu_{2m} (Nov. 6th 2008)
  - (more details in assimilation in T. Montmerle talk, doppler winds for example)
  - Evaluation of AROME-oper

- Plans for 2009 : AROME_v2

- Plans for 2010

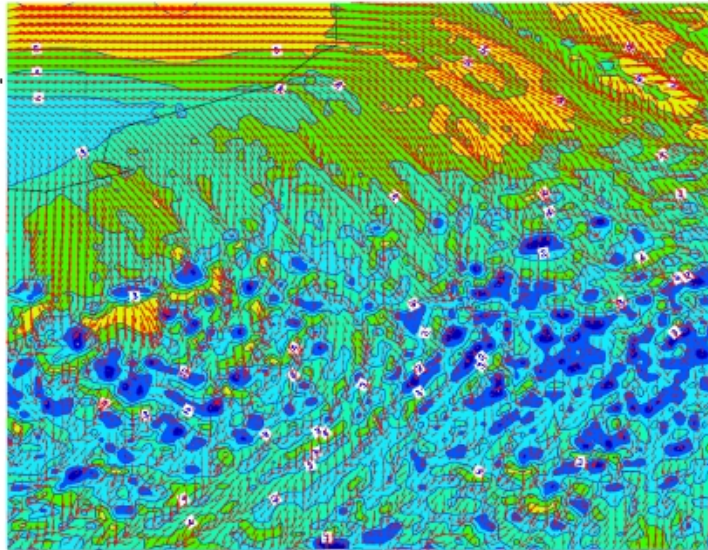# Unrealistic 'herringbones' structures (2007-07-30)
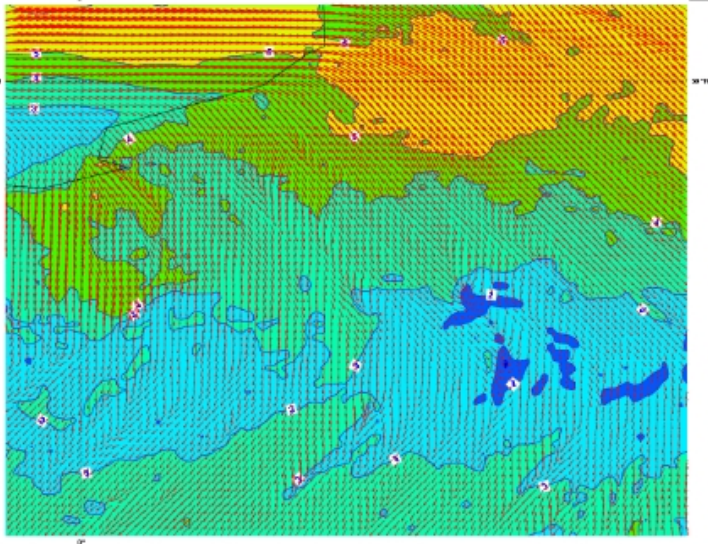

AROME

Nebul

V_{10m}

AROME without EDKF

EDKF performs a mixing in dry boundary layers

AROME EDKF

ALADIN-Fr oper physics at 2.5km
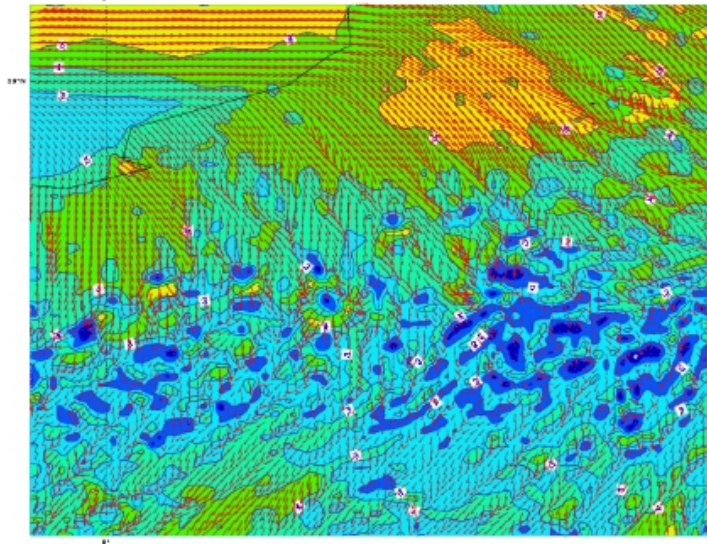
RR24 Scores over France June 2007
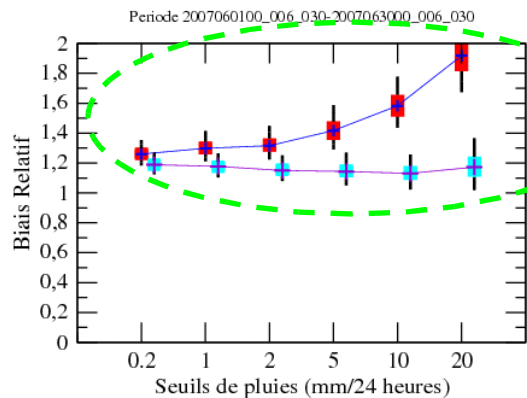
No diffusion on water condensates

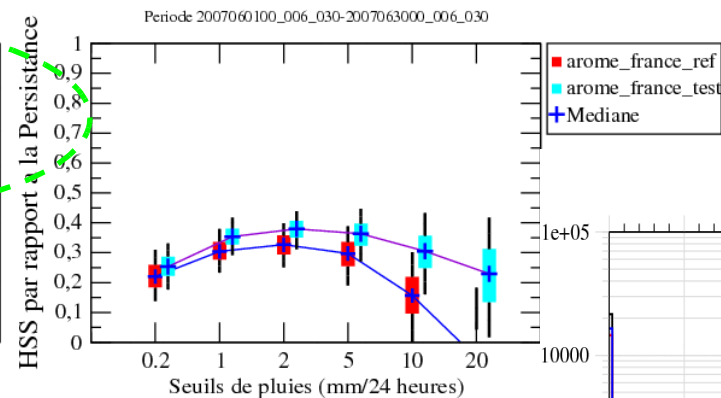SLHD on $q_c q_r q_i q_s q_g$

Strong impact on heavy rains

Neutral scores compared with radiosoundings or T_{2m} Hu_{2m} V_{10m} observations
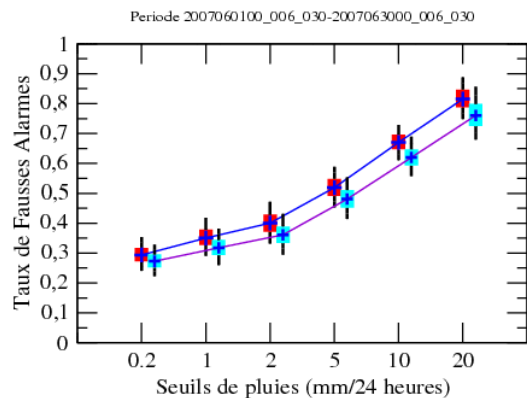

Experience: 62SR_62UB
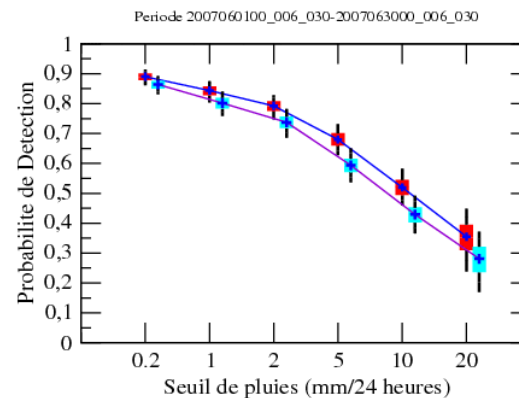
Nombre de valeurs par seuil de 0.2 mm/j
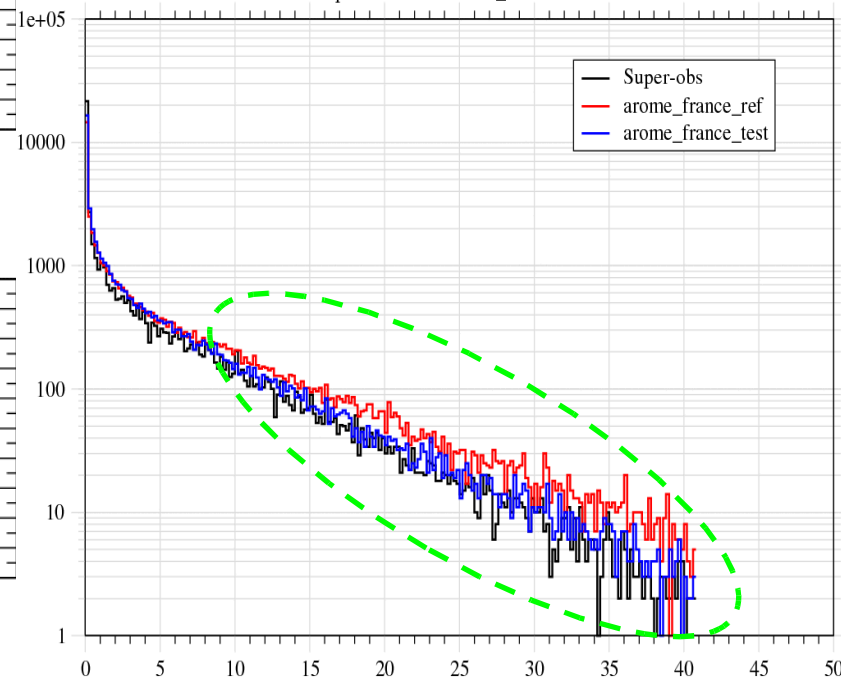
RR24 Scores FRAN June 2007

AROME+SLHDcrisg+EDKF / AROME+SLHDcrisg

EDKF improves scores for light rains

(produced nebulosity enters in the microphysics)
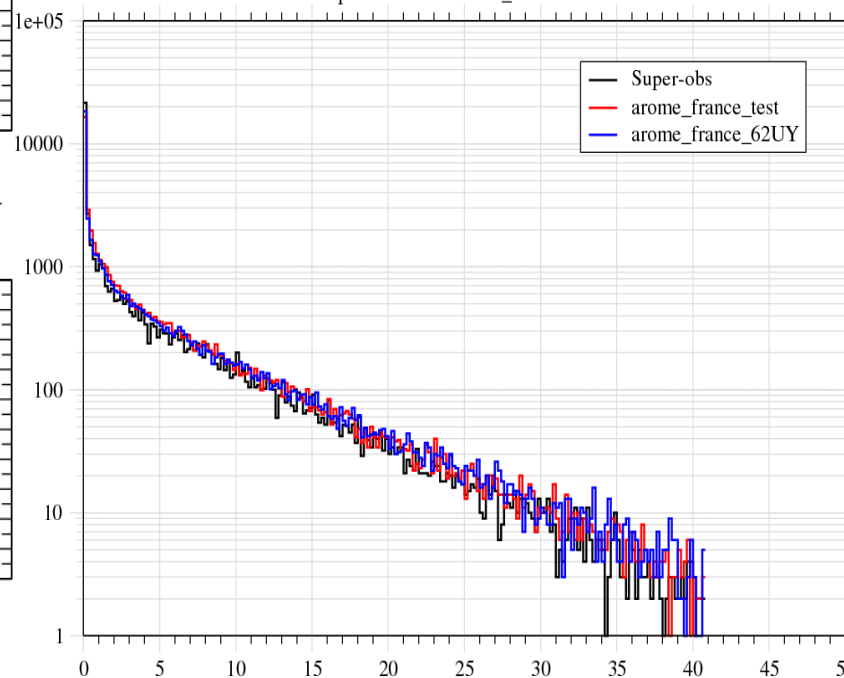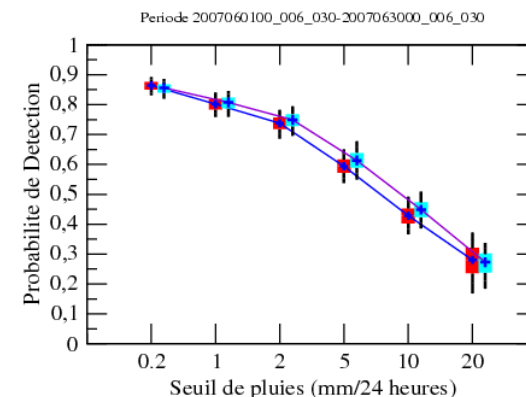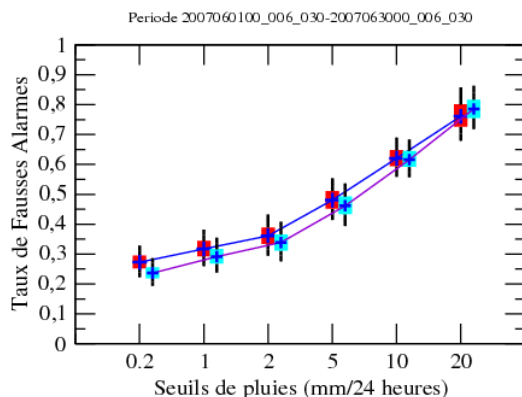
Assimilation of T_{2m}, Hu_{2m} in AROME 3DVar

Before, observations were compared to re-computed T_{2m} :

Ta (Guess)

Last model level (17m)

T_{2m}

Sol

Ts Canari (2D OI analysis based on T2m/HU2m obs)

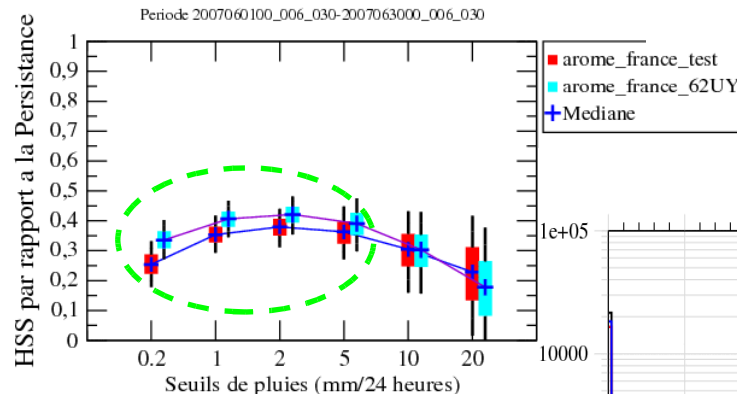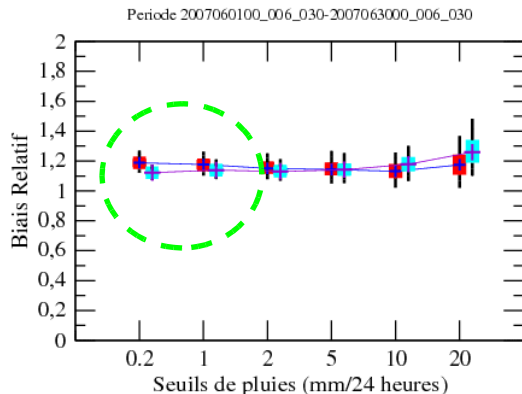**Since november, 6th : observations are compared to CANOPY diagnostic from the guess**

Ta (Guess)

Last model level (17m)

T_{2m} (Gues)

Sol

Ts (Guess)
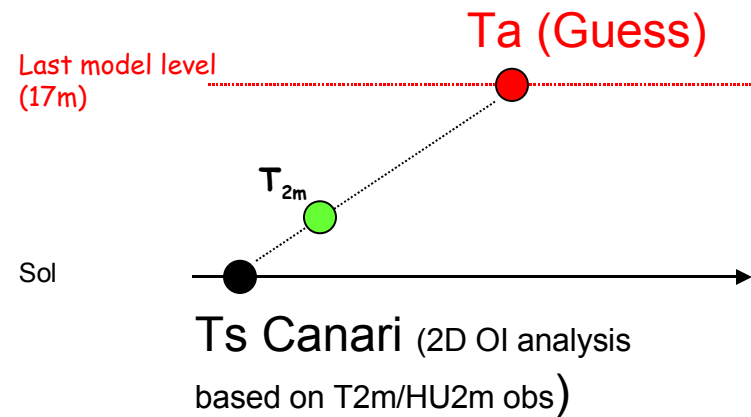
- Strong differences in stable cases

- Allows assimilation in intermediate assimilation times (no more need of CANARI Ts)

1D lower boundary layer model embedded into surfex (6 vertical levels added + use a turbulence scheme)

METEO FRANCE
Toujours un temps d'avance
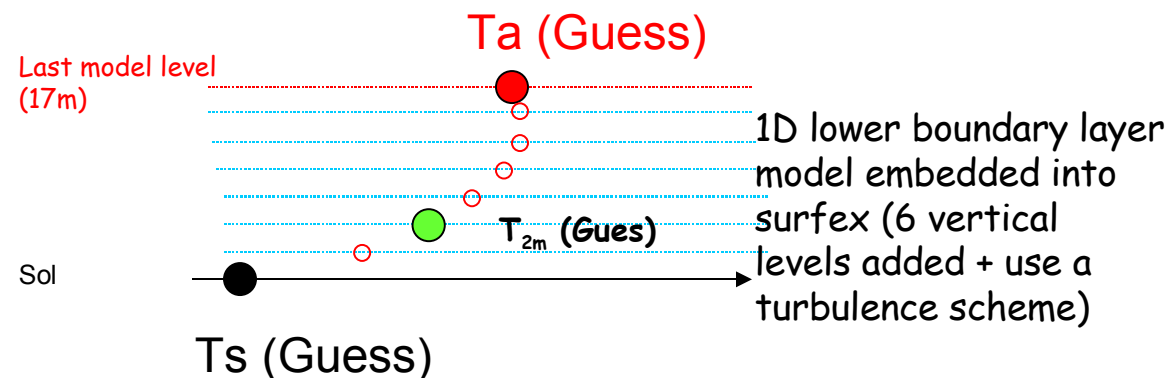
Assimilation of T_{2m}, Hu_{2m}

Corrects a lack of consistency between consecutive assimilation cycle forcasts.

Low clouds : successive forecasts valid at the same time (8TU October 11th, 2008)

FC base 12h	FC base 18h	FC base 0h

oper_r12_ech20   oper_r18_ech14   oper_r0_ech08
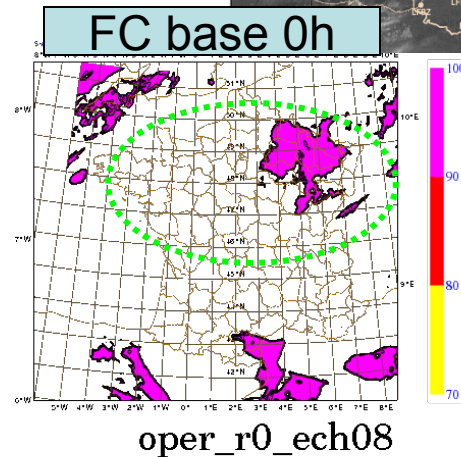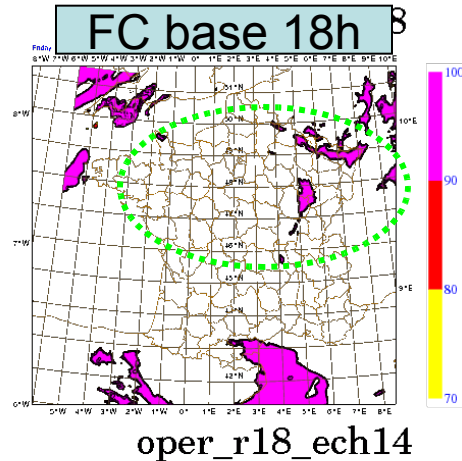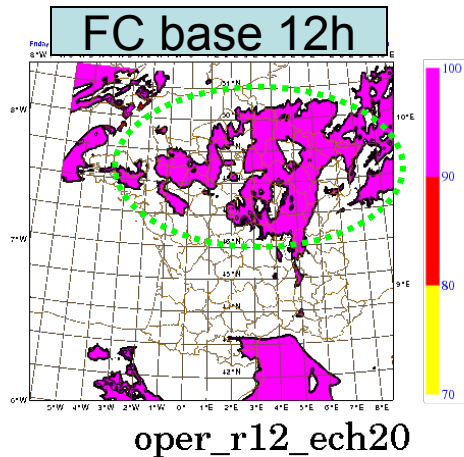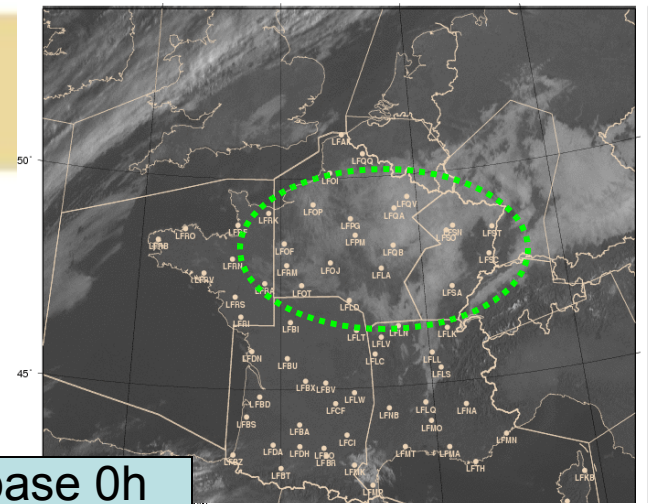
Without T_{2m}, Hu_{2m} assimilation

636U_r12_ech20   636U_r18_ech14   636U_r0_ech08
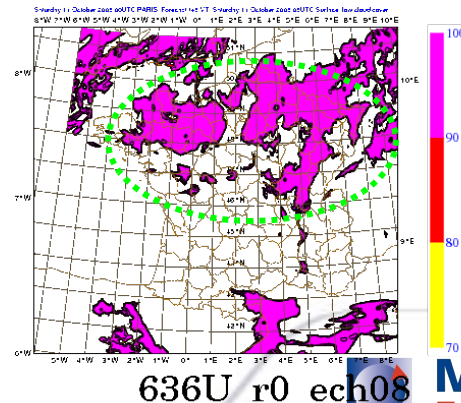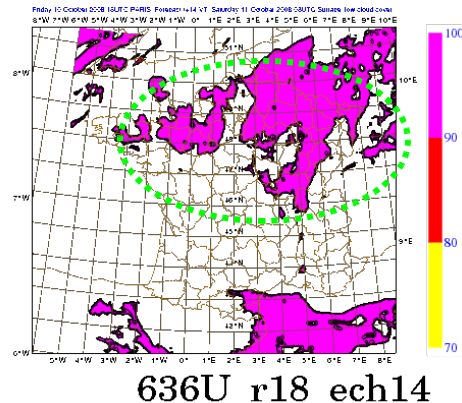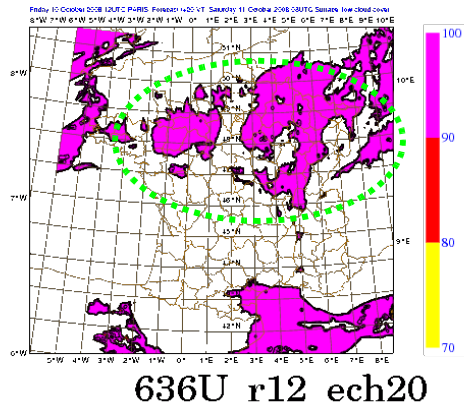
With T_{2m}, Hu_{2m} assimilation

METEO FRANCE
Toujours un temps d'avance

AROME-France is operational since December 18th 2008

■ Domain

600x512pts, Dx=2.5km, 41L, Dt=1mn
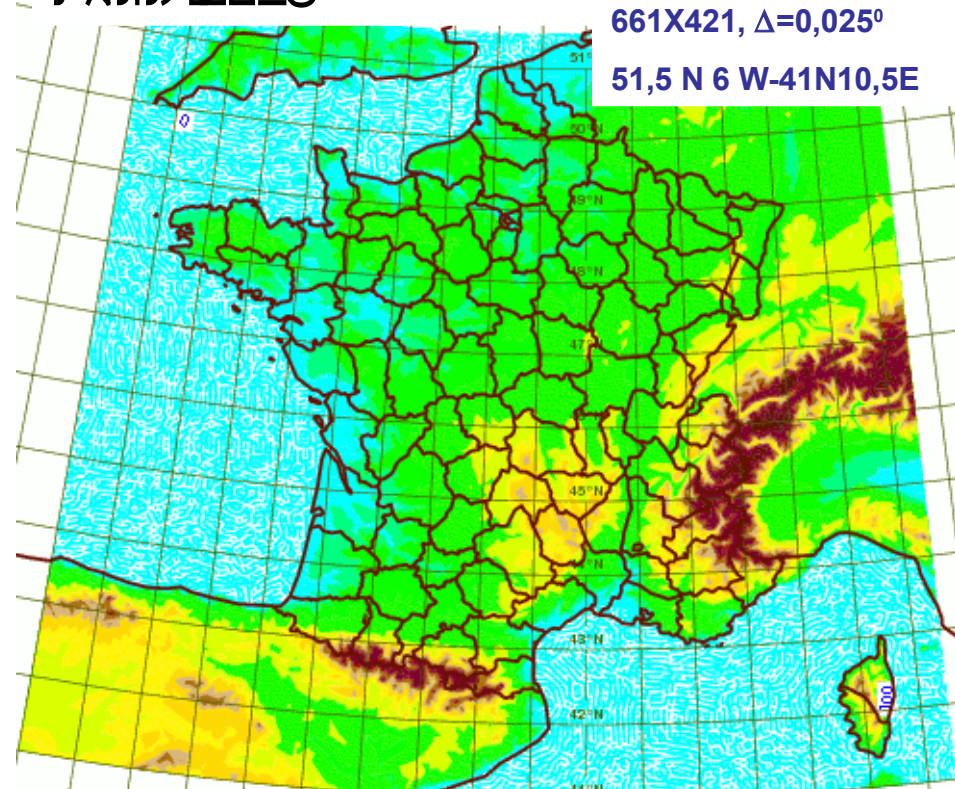
661X412, Dlon=0.025°,
Pressure & Z-level

Cutoff time:

ANsurface · ANsurface · ANsurface · ANsurface

1:30 · 3:30 · 3:50 · 3:30 · 2:30 · 3:30 · 3:50 · 3:30

P03 · P03, Surf03 · P03 · P03, Surf03 · P03 · P03, Surf03 · P03 · P03, Surf03

00 · 03 · 06 · 09 · 12 · 15 · 18 · 21

ALD-Fr every hour

ALD

30 H forecasts · 30 H forecasts · 30 H forecasts · 30 H forecasts
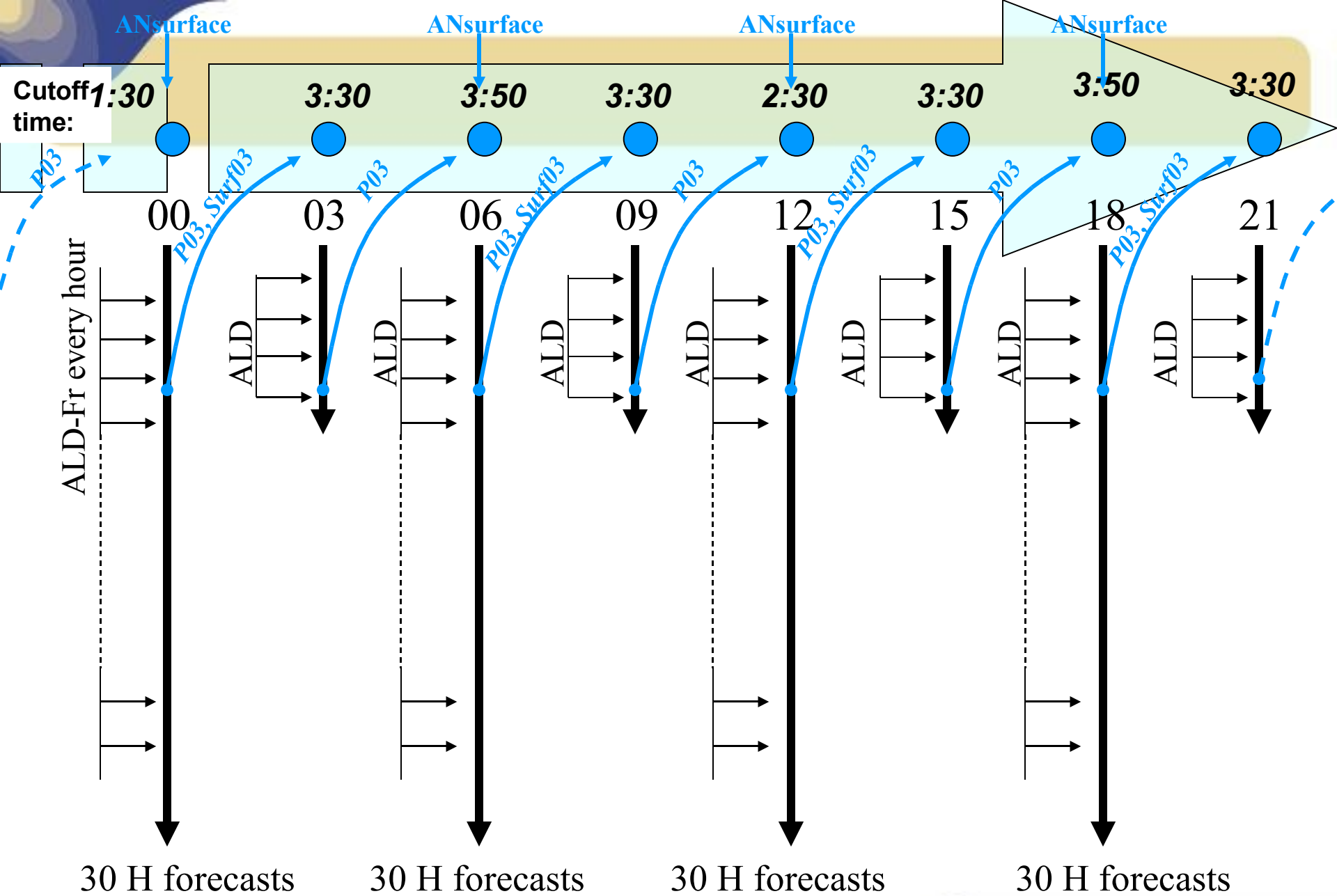
3h-RUC, with +30h forecasts every 6h

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Toujours un temps d'avance

Scores (Nov08-April09) AROME – ALADIN

RMS T_{2m} |Biais| RMS Hu_{2m} |Biais|
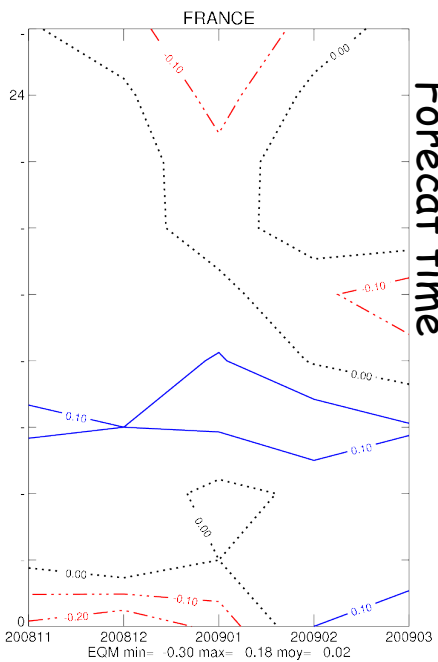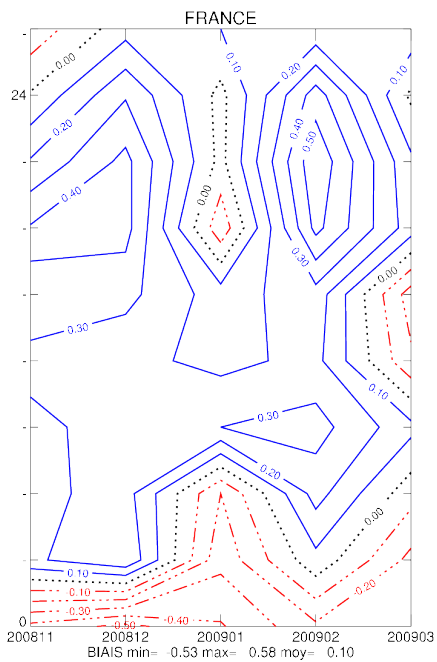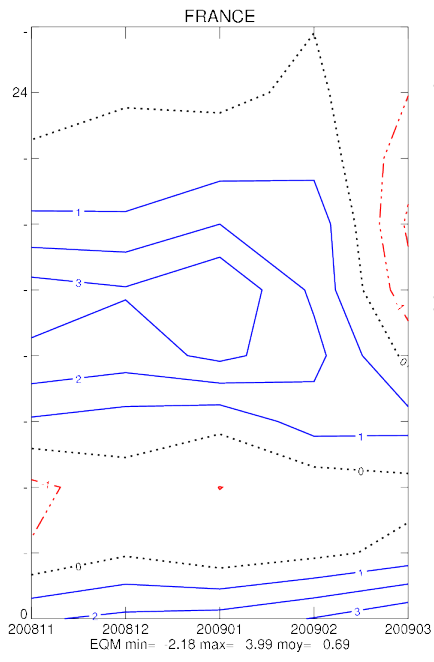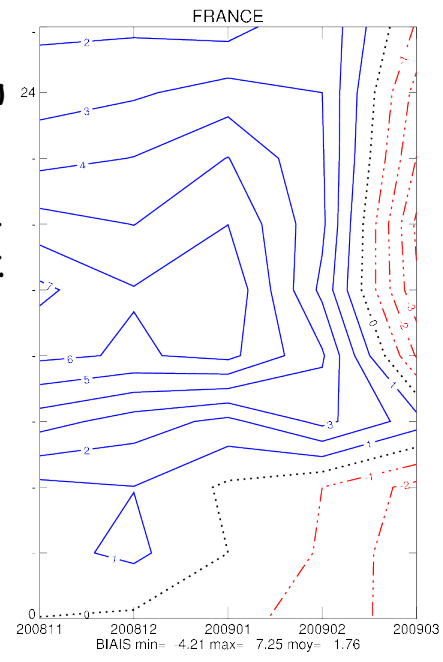
Date   Date   Date   Date

Improvement on T_{2m} and Hu_{2m} bias and RMS

Scores (Nov08-April09) AROME – ALADIN
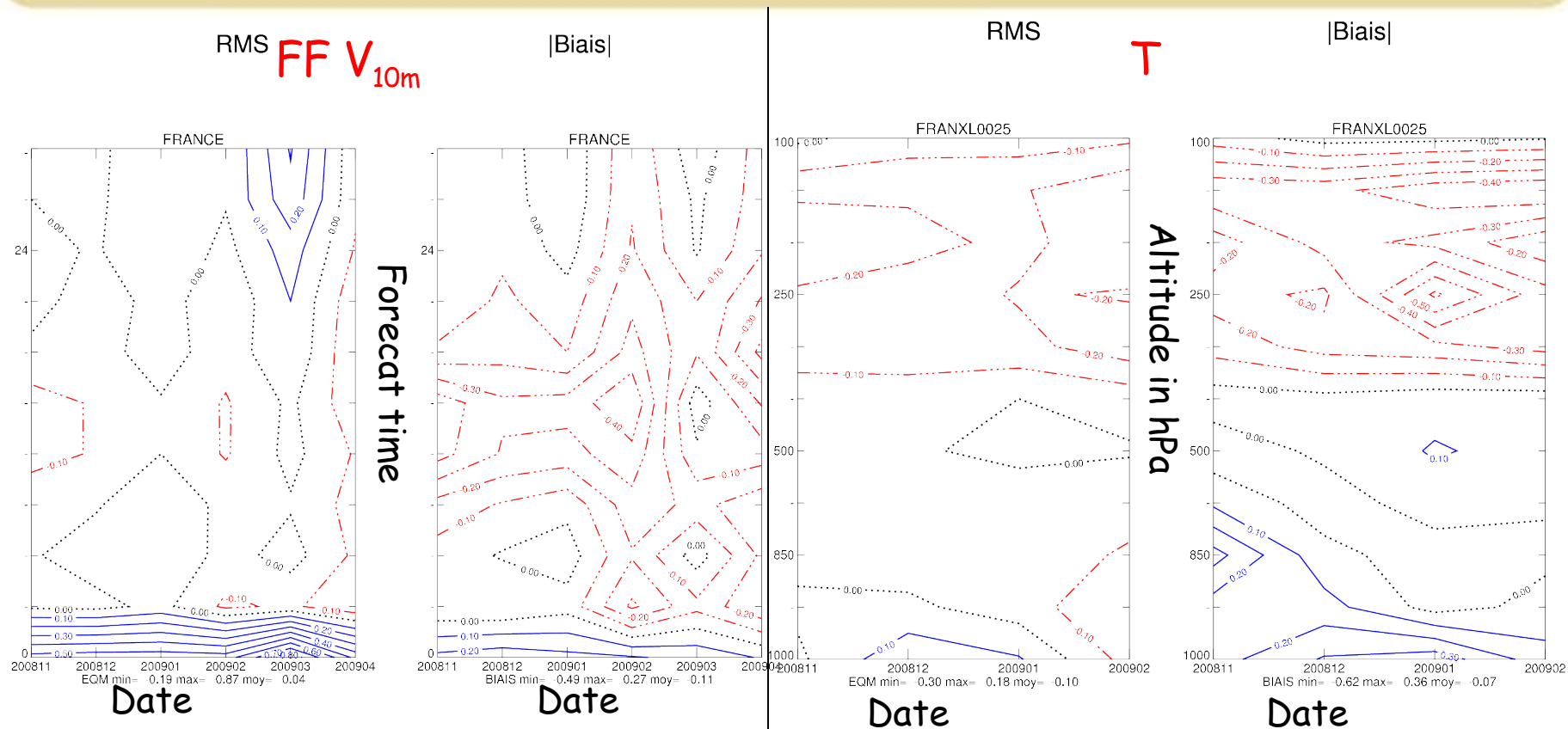
Not as good as ALADIN for V_{10m} (especially over montains) and in altitude (P < 300 hPa)

Rainfall scores (RR24h)

Summer (ASO 2008) :   Winter (ND 2008 J 2009) :
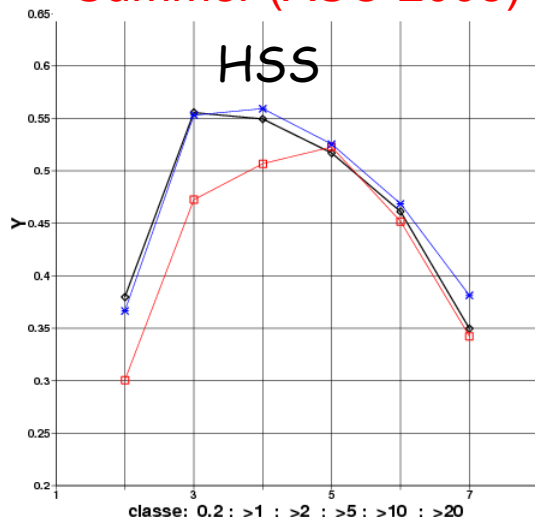
AROME, **ALADIN-oper**, **ALADIN-dble**

HSS

HSS

In summer, improvement of HSS for RR24 < 5mm and of frequency bias.

Frequency bias
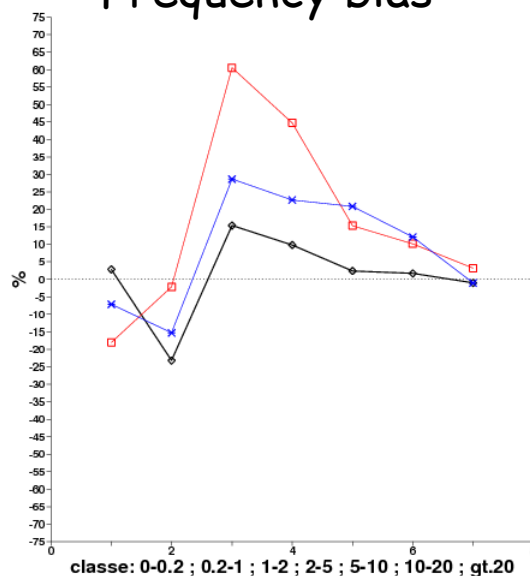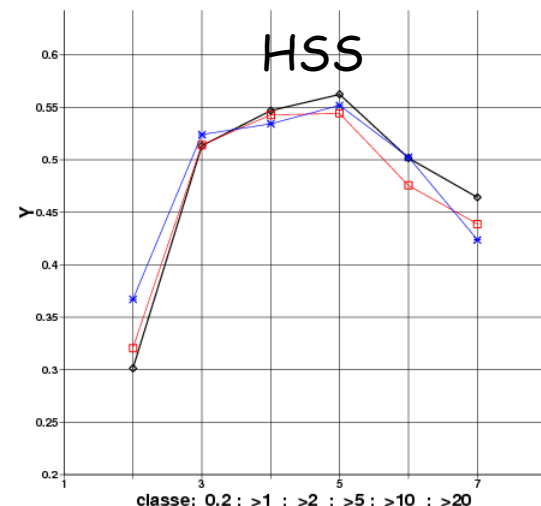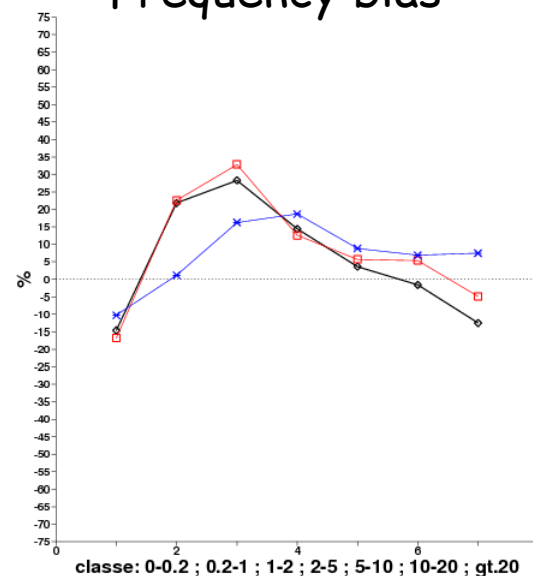
Frequency bias

In winter, less differences with ALADIN. Improvements of HSS for RR24 > 2mm, frequency bias is reduced but is negative for RR > 20mm

Overview of AROME status and plans

- Main changes since last year :
    departure of Gwenaëlle Hello
    and Sylvie Malardel (ECMWF) (replaced since 1st May by Sebastien Riette)

- Plans for 2009 : AROME_v2

- Plans for 2010

METEO FRANCE
Toujours un temps d'avance

Overview of AROME status and plans

- Main changes since last year

- Plans for 2009 : AROME_v2 :
  - L60
  - EDKF2
  - Coupling on the top of the model
  - Corrections q_c,q_i < 0
  - diagnostics (Gusts, V_{10m}, Simulated satellite images)
  - Assimilation of radar reflectivities (cf talk of E. Wattrelot)

- Plans for 2010

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Toujours un temps d'avance

L60 for AROME-v2
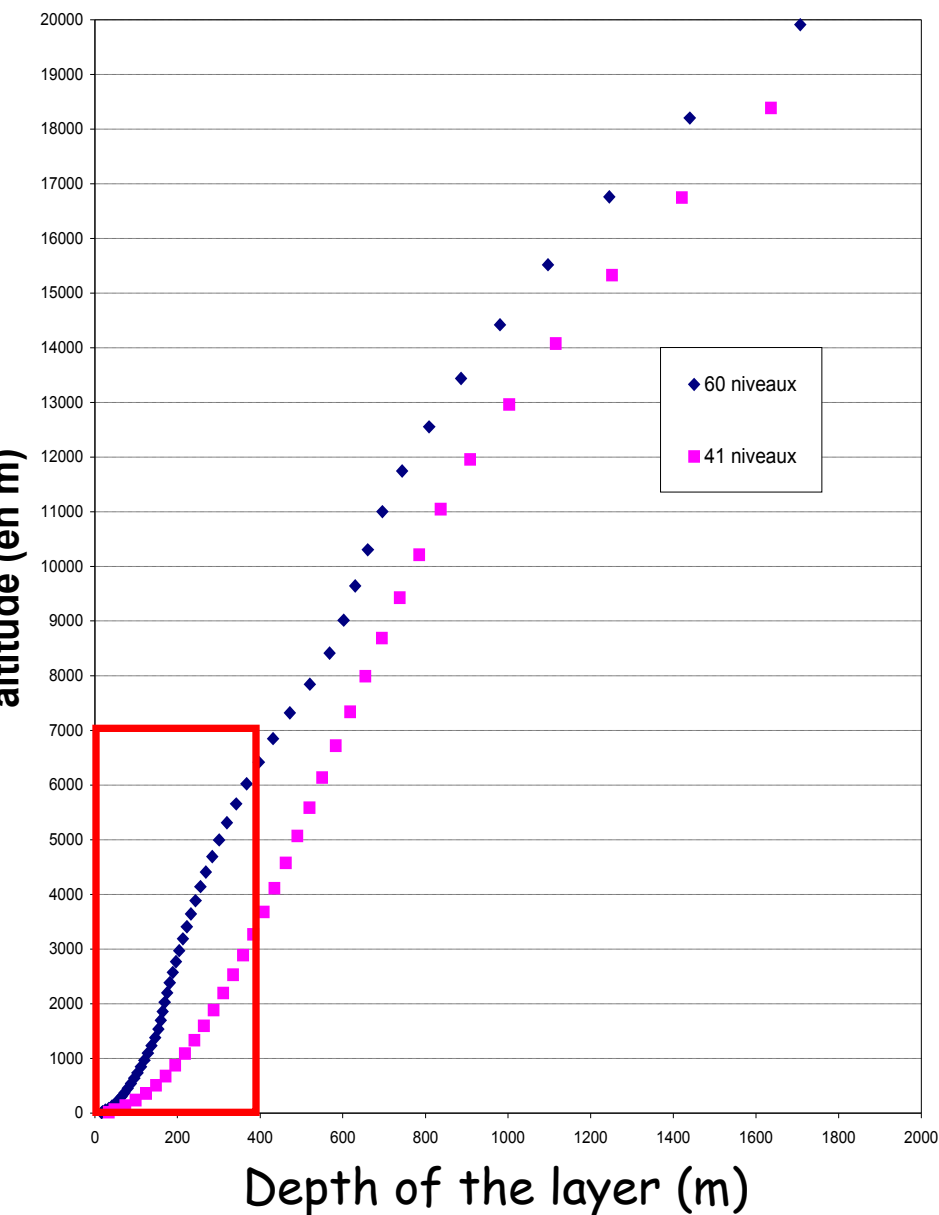
Added levels mostly near the surface
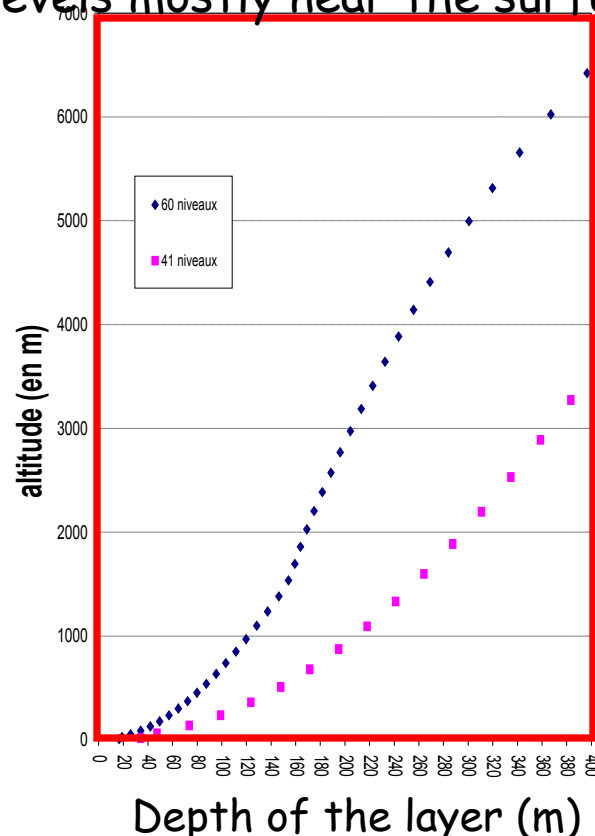
Depth of the layer (m)

from L41 to L60 (+ 37% CPU)

1st level at 10m (17m in L41)

27 levels below 3000m (15 in L41)

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Scores Jan 1st – Fev 12th 2009

AROME- L60 / AROME-L41
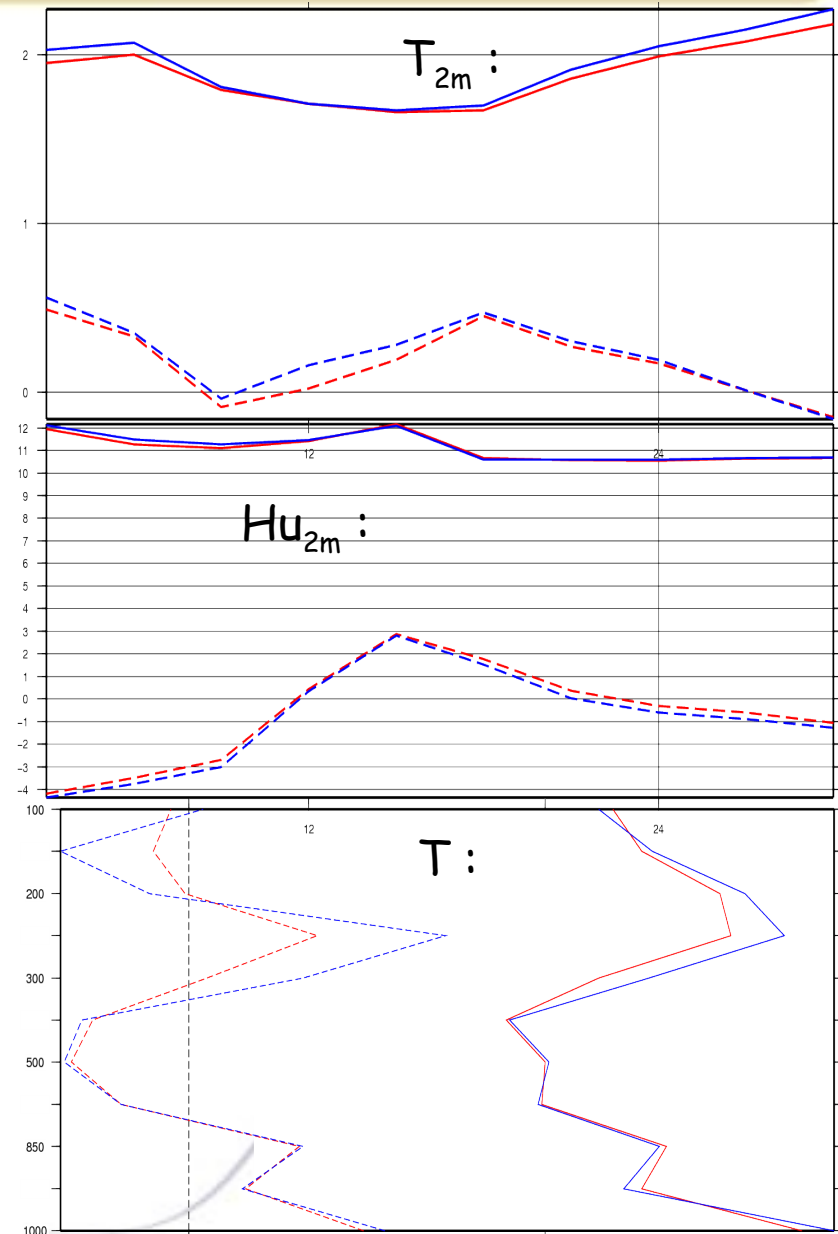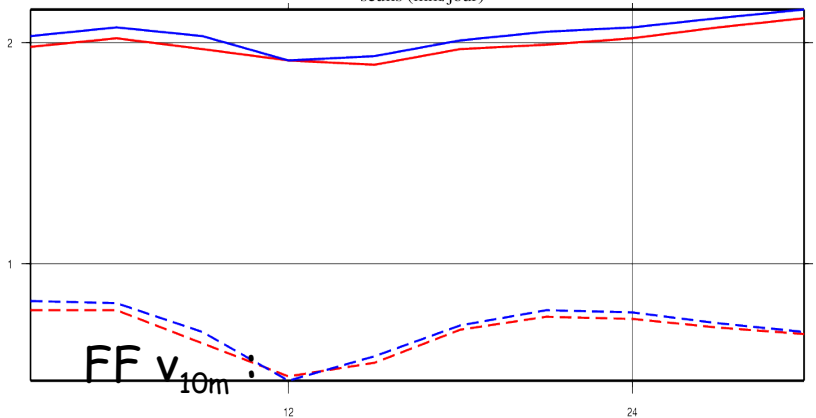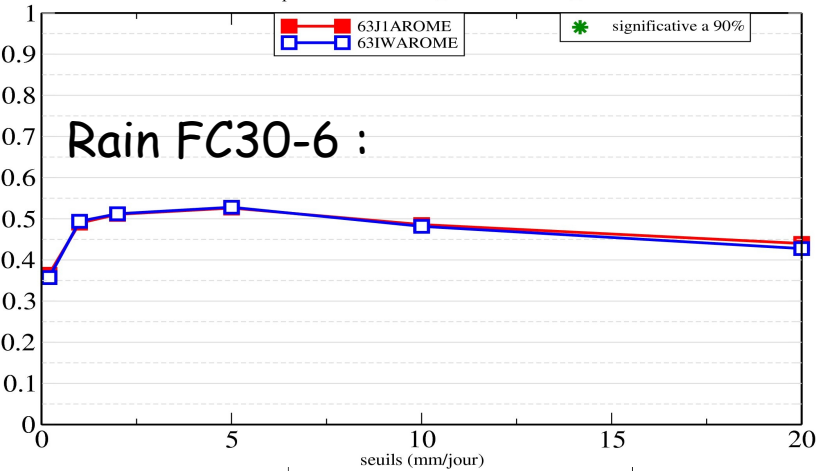
No impact on precipitations, but improvements on FFv$_{10m}$, T$_{2m}$, Hu$_{2m}$, T

A case with low clouds

20090218r0 + 03 : Improvement with L60 (more low clouds)

AROME-oper :

ALADIN-oper :

AROME-oper :

Satellite :

Synops :

AROME-L60:

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Toujours un temps d'avance
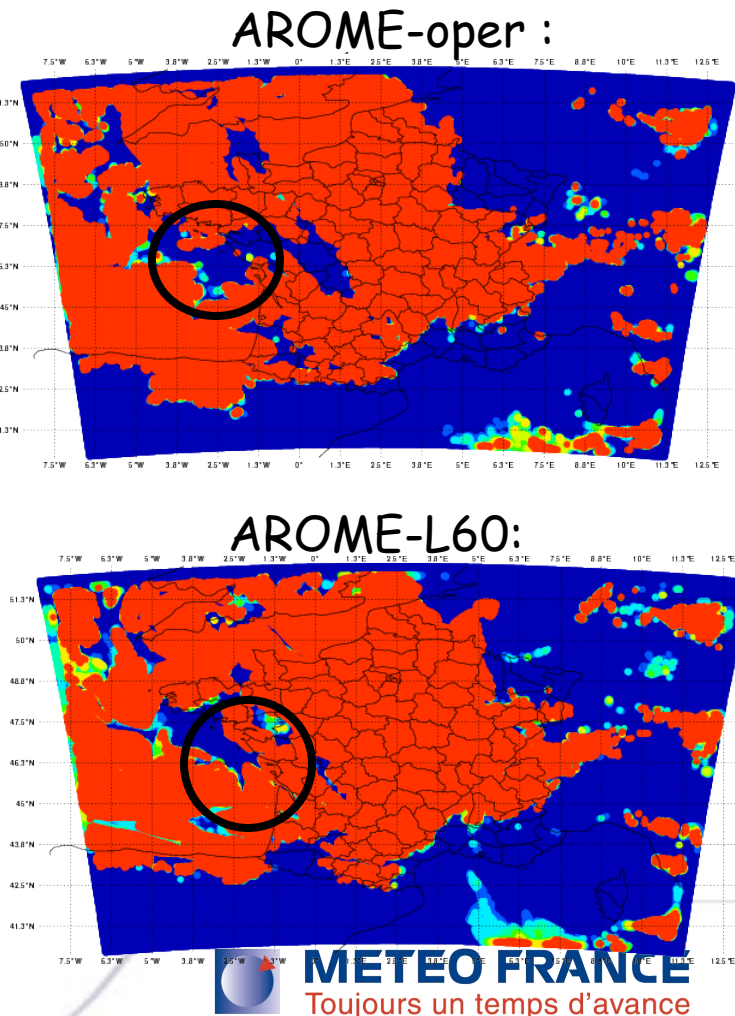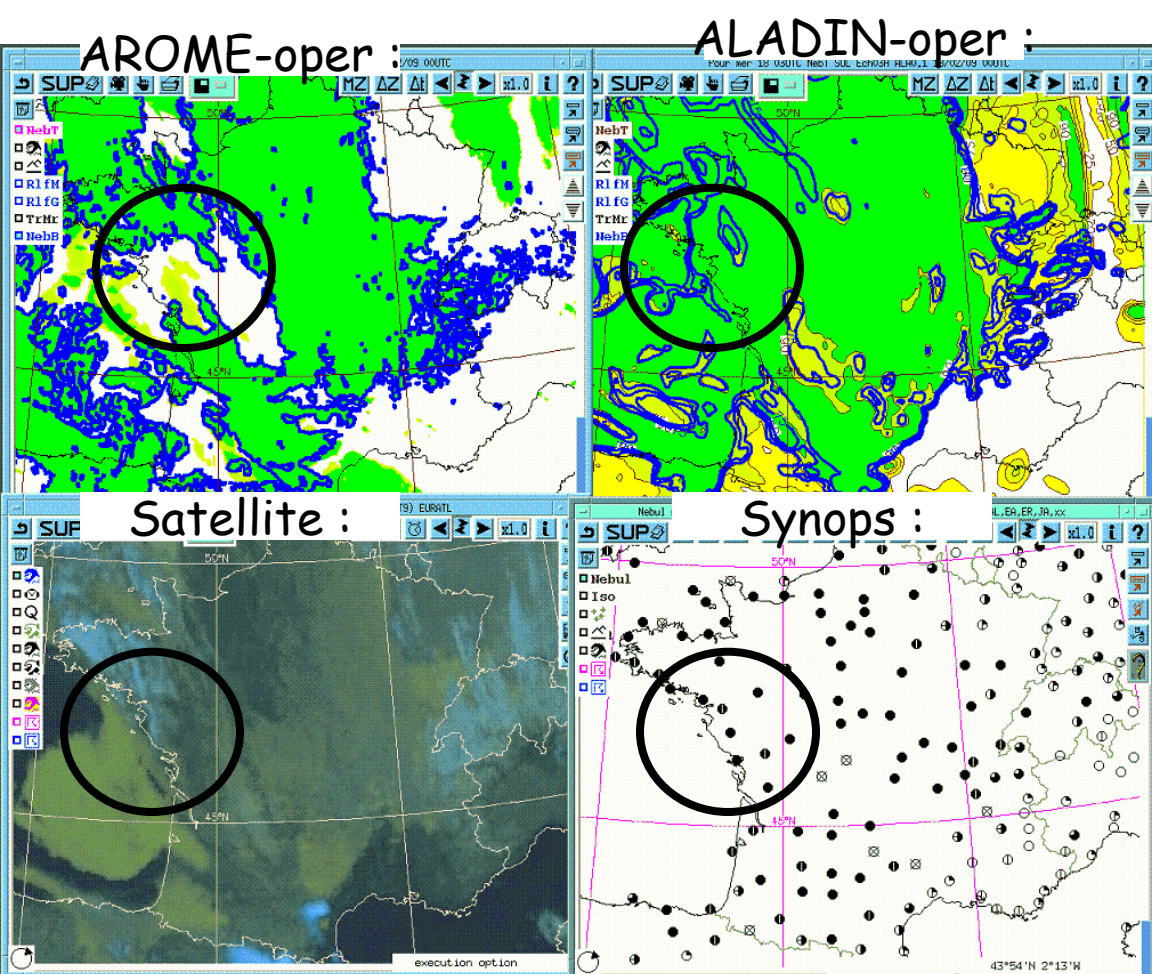
EDKF2

-Included in CY36

- Improvement of the entrainment formulation in dry boundary layer
(which now changes according to flotability and updraft vertical velocity)

- No impact on scores

Coupling to Aladin at the highest levels

- Method used to solve some instabilities in cases at 500m in the top of the model. Suspected to occur also at 2.5 km in some particular cases.
- Unrealistic mean increments variability in the highest model levels, and strong biais and RMSE encourage us to activate it at 2.5km

$$X_{arome}(t) = (1-\alpha)X_{arome}(t) + \alpha X_{aladin}(t)$$

- Coupling with ALADIN, for spectral fields :
  – Vor,div,T
  – On the 12 highest levels (higher than 200 hPa)
  – For the 20 first wave numbers (based on variancy spectrums of coupling files)

Obstat : Wind strength / Radiosoundings, AROME ALADIN

Mean increments :

inc moy T
inc moy FF

RMS

BIAS

background departure o-b(ref)
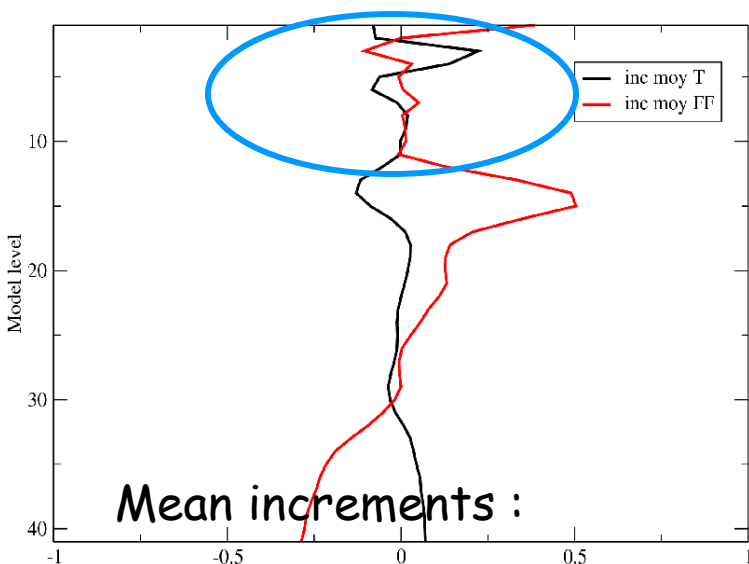background departure o-b
analysis departure o-a(ref)
analysis departure o-a
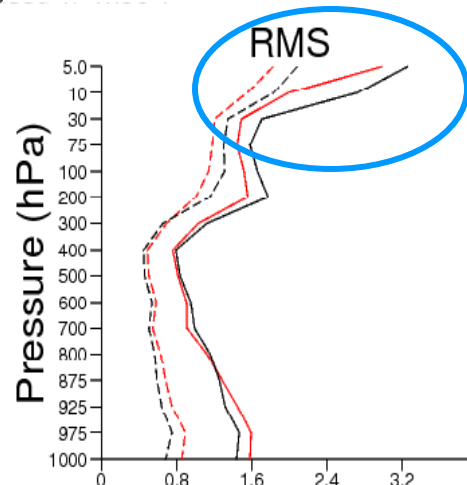
exp -ref	nobsexp
-13	527
-109	3173
-251	6838
-257	4042
-80	4685
-62	6858
-38	5848
32	4384
-37	4438
-40	3407
-33	4324
-30	2614
-17	2990
+3	2514
+52	923
+133	1044
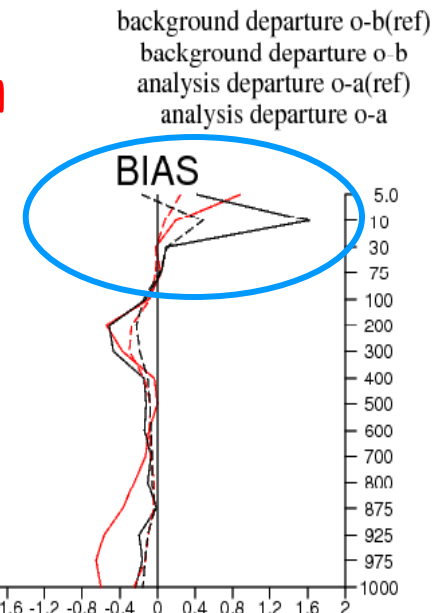
Impact on forecast scores

- Light positive impact compared with radiosoundings or surface observations
- Positive impact also on POD and FAR 30h cumulated rainfall
- Still under investigation (on a longer period)
                    (2008-10-30 to 2008-11-10)

_____ without coupling

_ _ _ with coupling
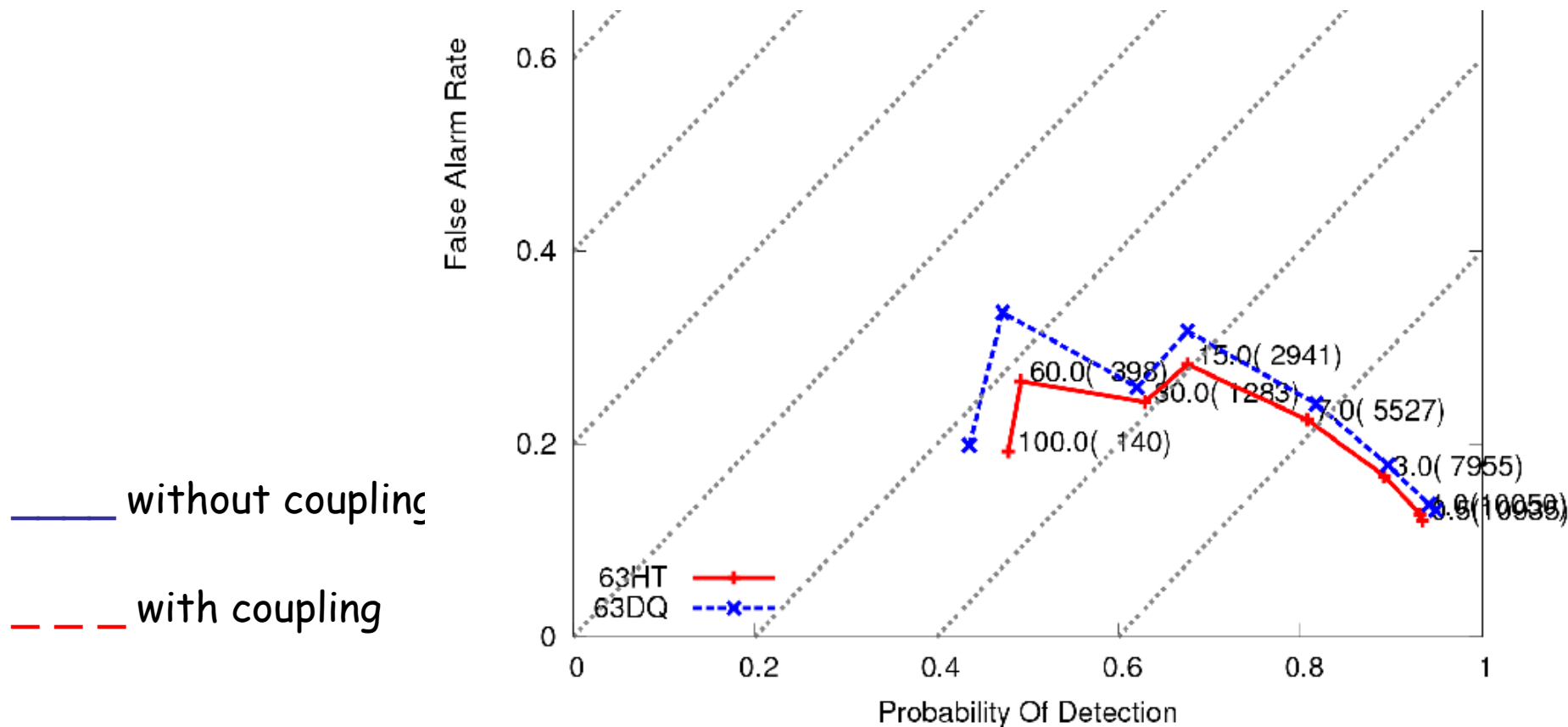
Corrections of qc,qi < 0

DDH profile of q_c tendency for a day with precipitations :
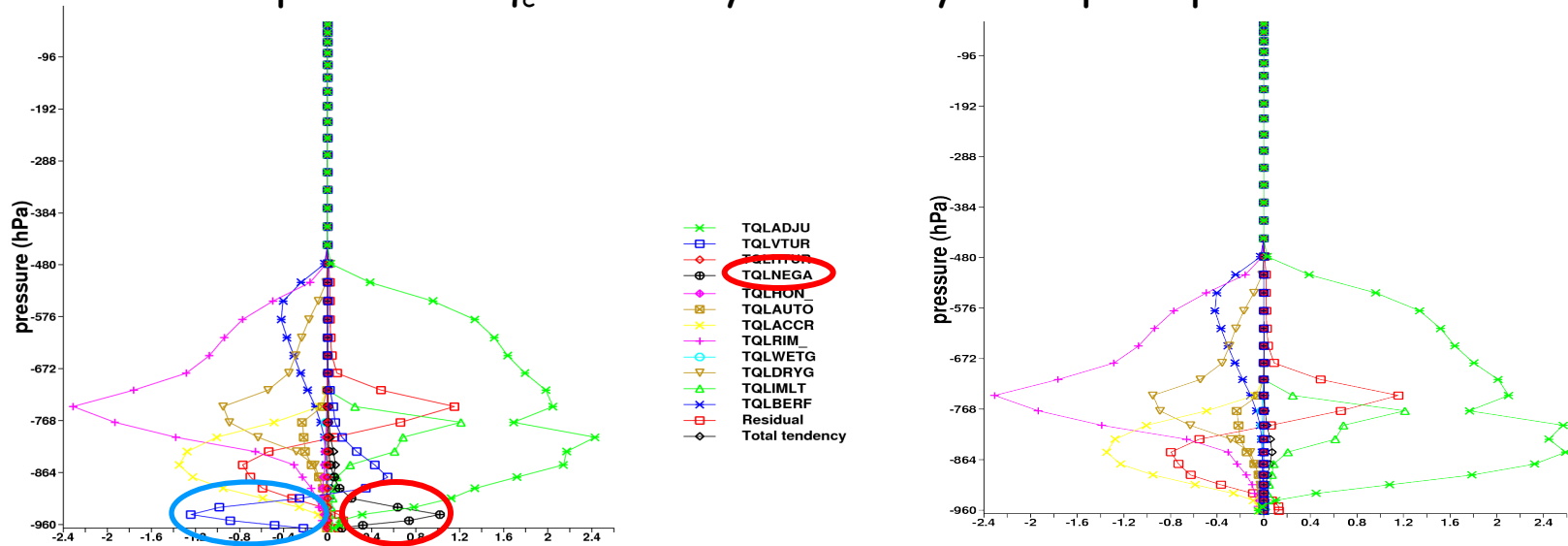
After investigations, it was found that q_c q_i < 0 where created by the turbulence

Solution implemented : turbulence will only provide tendency of q_v, the condensation will be done in the adjustment in the next time step.

Diagnostics : gusts

- Harmonization of calculations between ARPEGE/ALADIN/AROME :
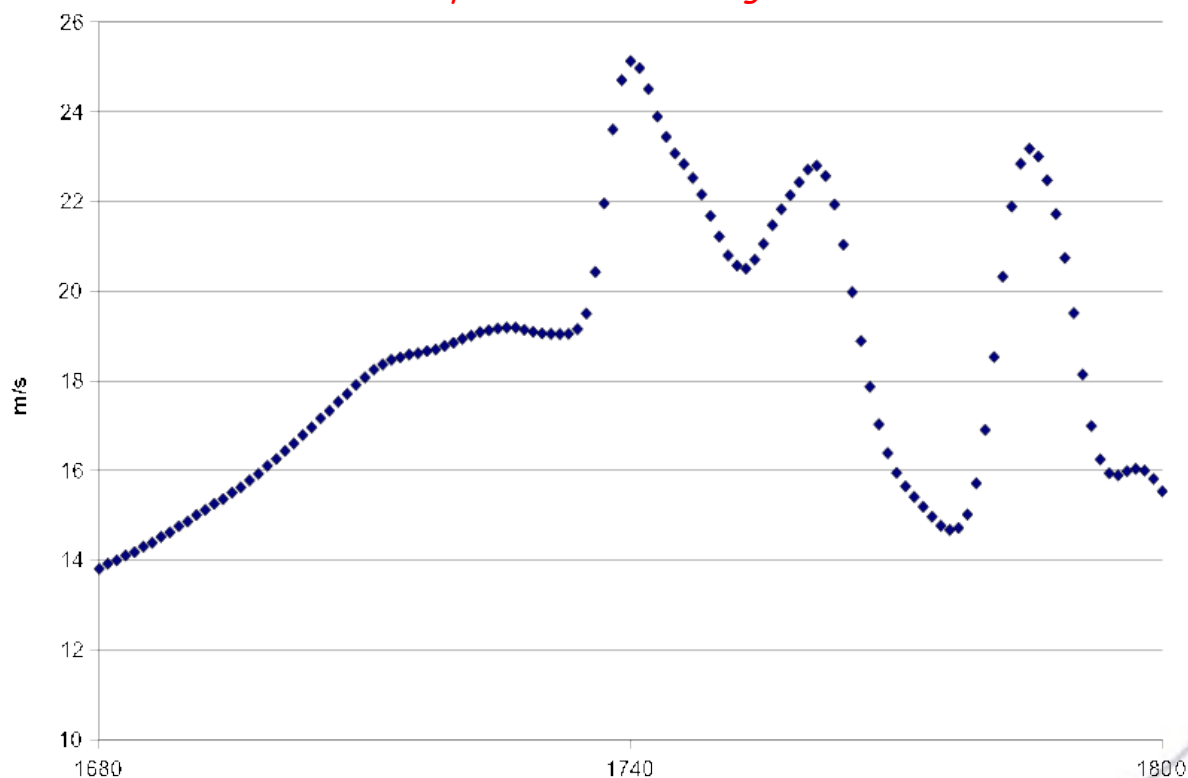$$U_{gust} = U_{10m} + a.TKE(h)^{\frac{1}{2}} \text{ with h (a height) and a in namelist}$$
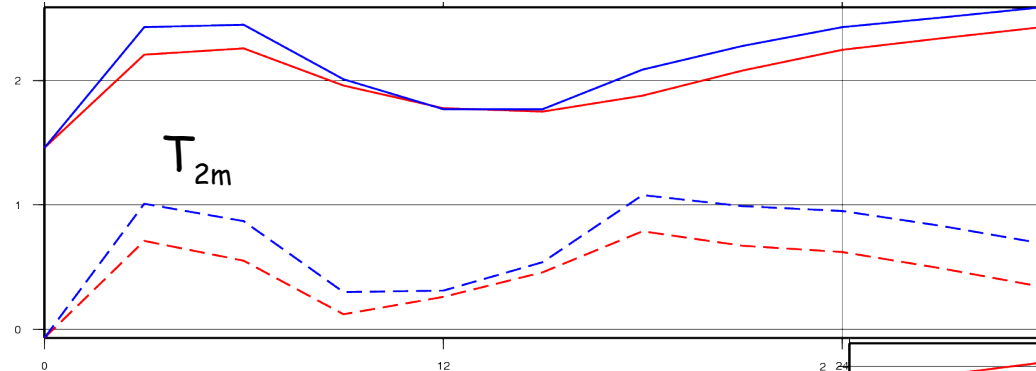
- But : strong variability during 1h and observations = max for 10' or 1h => max for a time period will be implemented in the code (as it exists for Tmax).

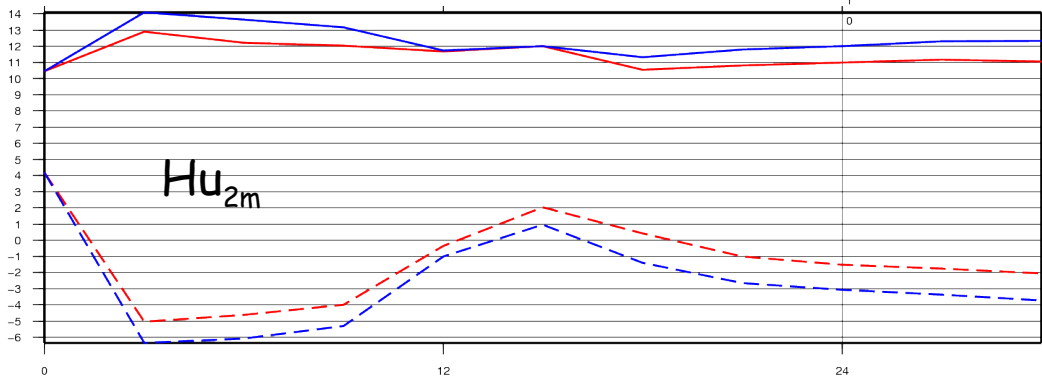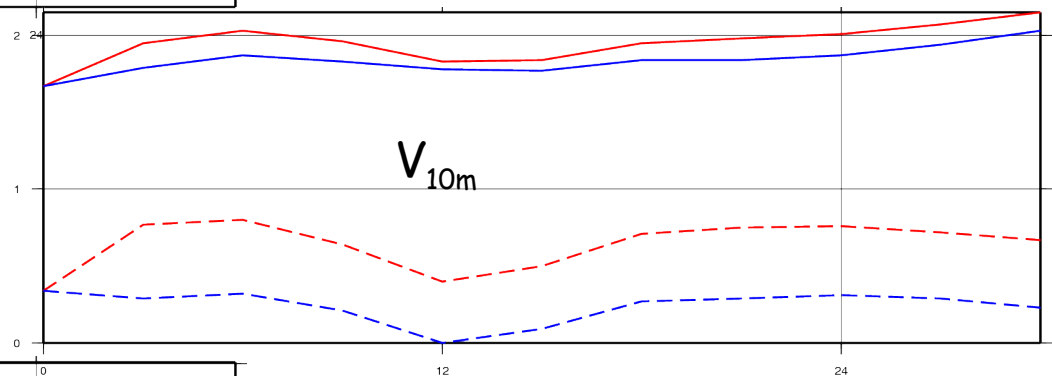*Local temporal evolution of Ugust between 2 hours :*

Diagnostics : 10m winds

- Implementation in surfex5 of Beljaars (2004) orographic drag.

- It reduces bias and RMS of 10m wind but increases T_{2m} and Hu_{2m} biaises

Beljaars/Reference

January 2009, AROME-France domain

T_{2m}

V_{10m}

Hu_{2m}

Diagnostics : Simulated Satellite Pictures

Historic files
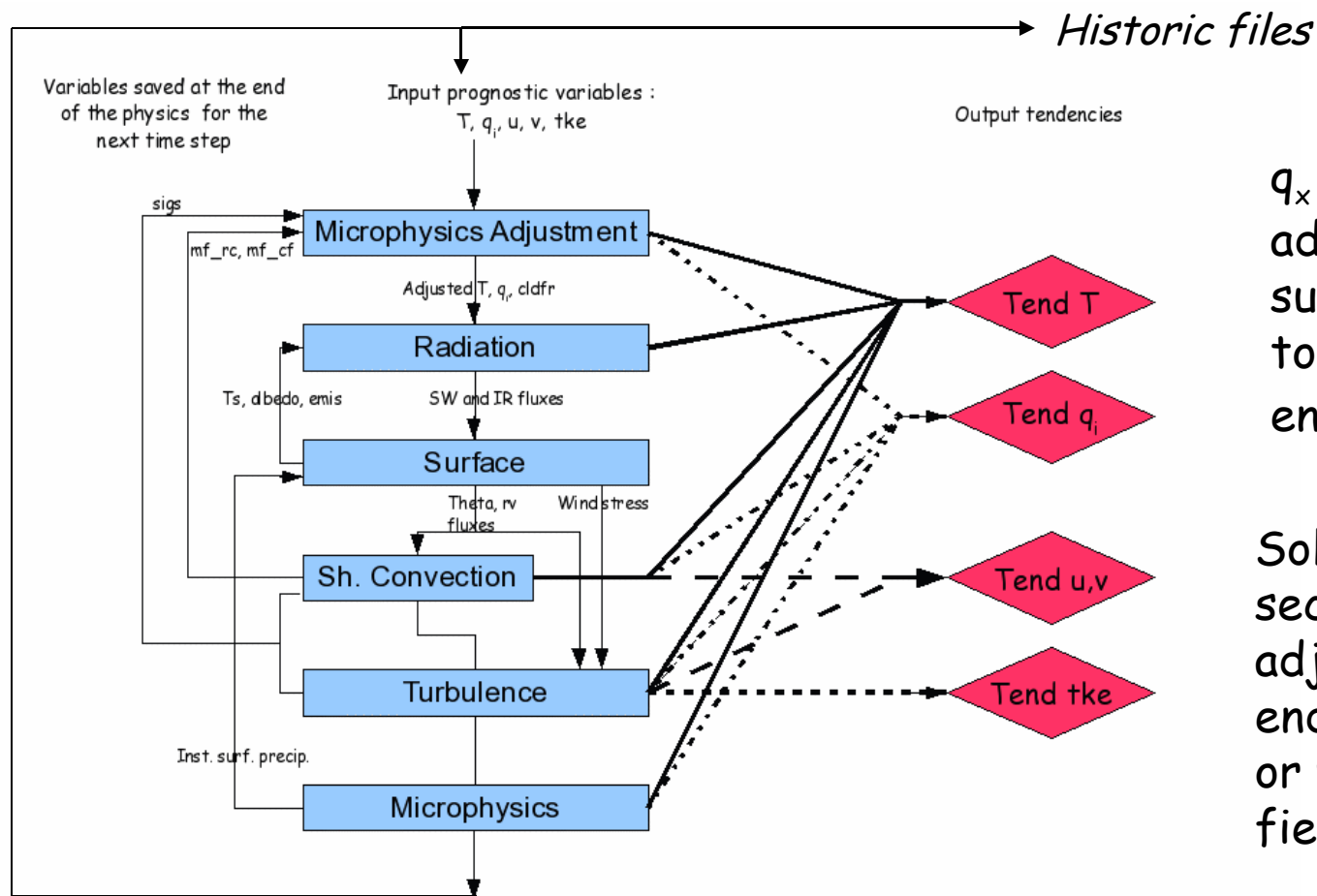
q_x in files are not adjusted : sursaturations => too much q_v, not enough q_c and q_i

Solution : Add a secondary call to adjustment at the end of the physics or write adjusted fields in files

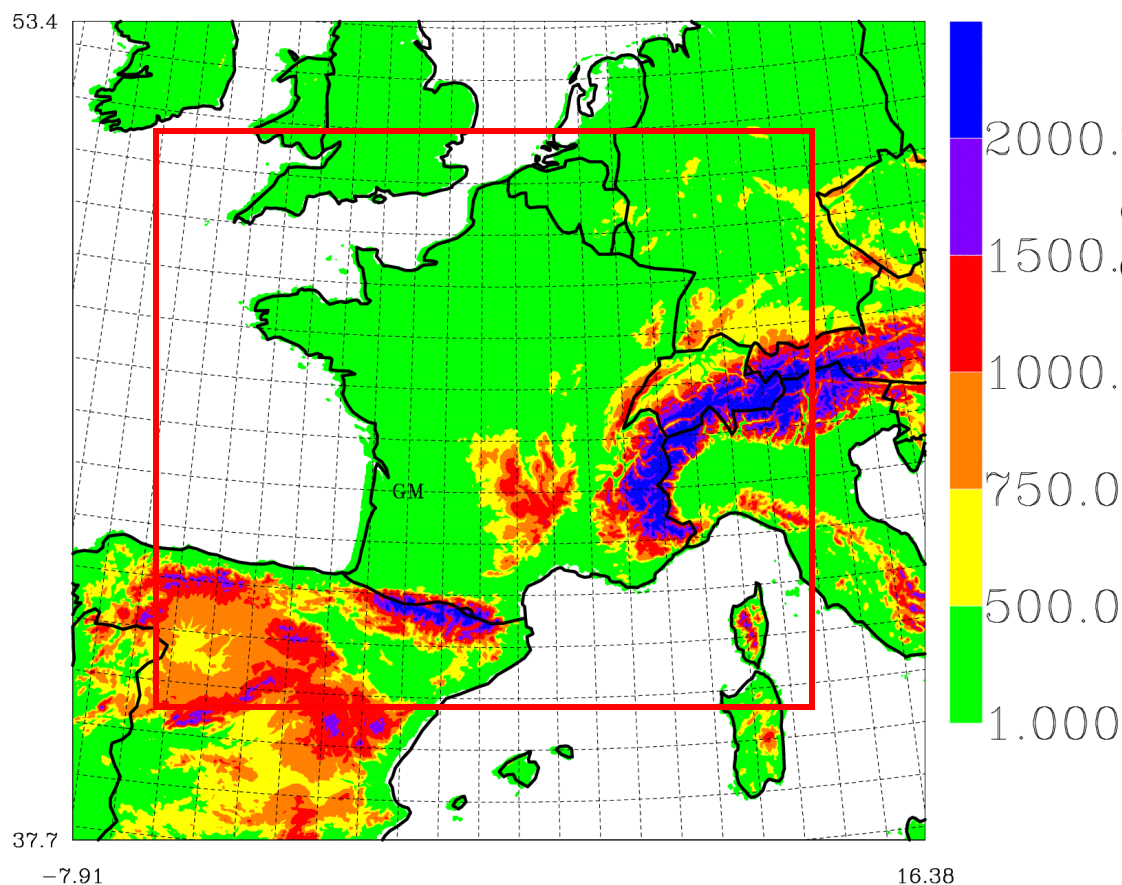METEO FRANCE
Toujours un temps d'avance

Overview of AROME status and plans

- Main changes since last year

- Plans for 2009 : AROME_v2

- Plans for 2010 :
  - Domain FRANXXL
  - Hail (tests will be done this autumn)
  - Corrections for precipitations (academic tests by Sylvie Malardel and Pierre Benard)
  - Surface assimilation (cf talk J-F Mahfouf)
  - 3DVar FGAT (technically working)
  - Work on Jb (cf talk of T. Montmerle)
  - Continue studies at higher resolution (1km, 500m)

METEO FRANCE
Toujours un temps d'avance

AROME-France domain for 2010

- Thanks to added processors on our NEC SX9

Domain 750x720 points

With L60, it represents +151 % compared with our current L41 operational domain

METEO FRANCE
Toujours un temps d'avance

Comparison on Solankyla

- Mini-AROME-MF coupled with ARPEGE r0 r12 for comparison purposes on Solankyla (running since the beginning of April)