AROME-France 1.3 km (Model part) Status and plans

Y. Seity

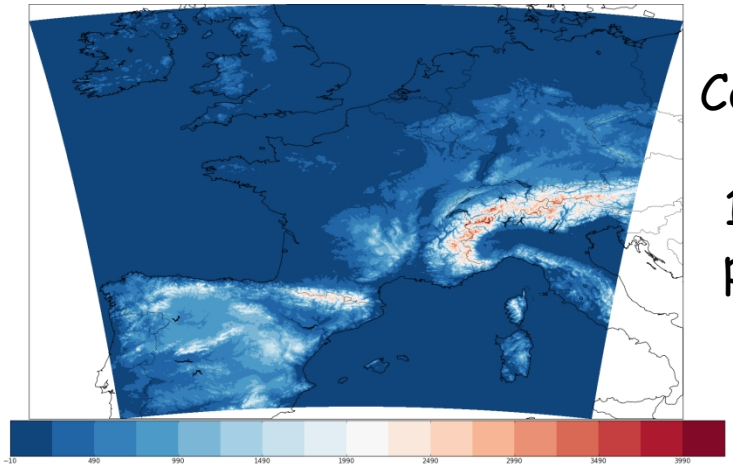
OUTLINE

- Overview of the operational configuration
  - Dynamics
  - Physics
  - Technics
- Objective evaluation
- To prepare the future (microphysics)
- Conclusions

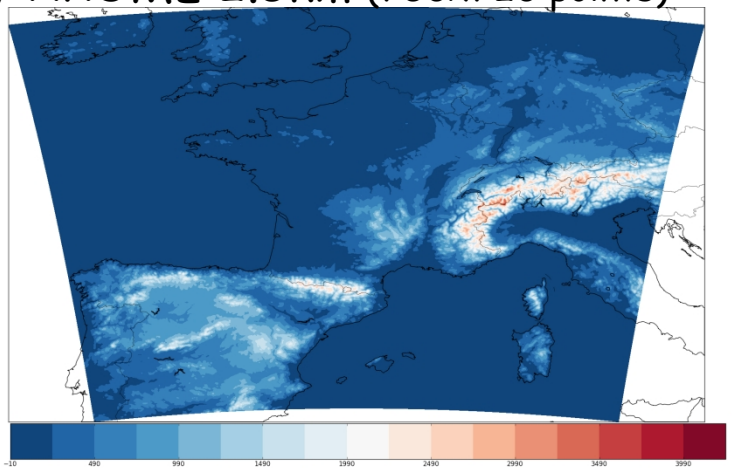
Horizontal grid AROME-France 1.3km

- Domaine FRAMG slightly larger (in the N) than current FRANGP

Orography AROME 1.3km (1440x1536 points) : AROME 2.5km (750x720 points)



Coupling area 16 / 8 points



From GMTED2010 250m

From GTOPO30 1 km

Horizontal grid AROME-France 1.3km

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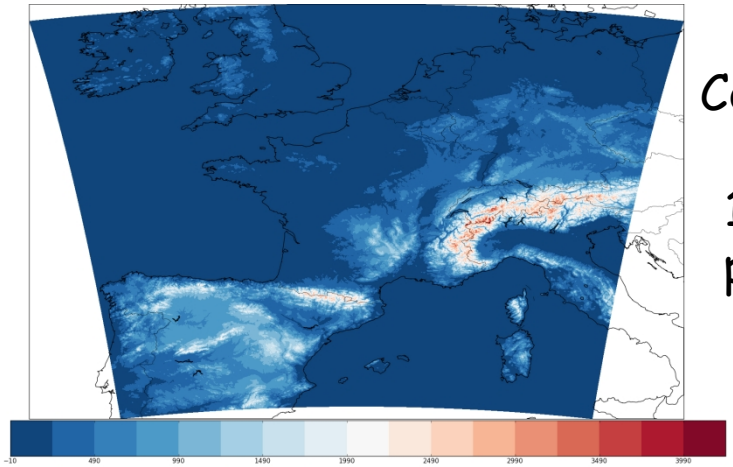

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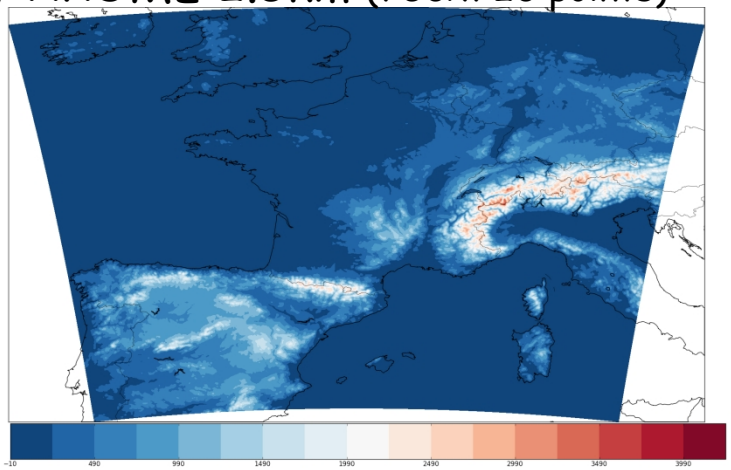

From GMTED2010 250m

From GTOPO30 1 km

Max Slope	38°	23°
Mt Blanc (4807m)	4272 m	3870 m
Aneto (3404m)	3008 m	2812 m
ABS(Mean altitude gap between model and SYNOP+RADOME)	20.6 m	58 m

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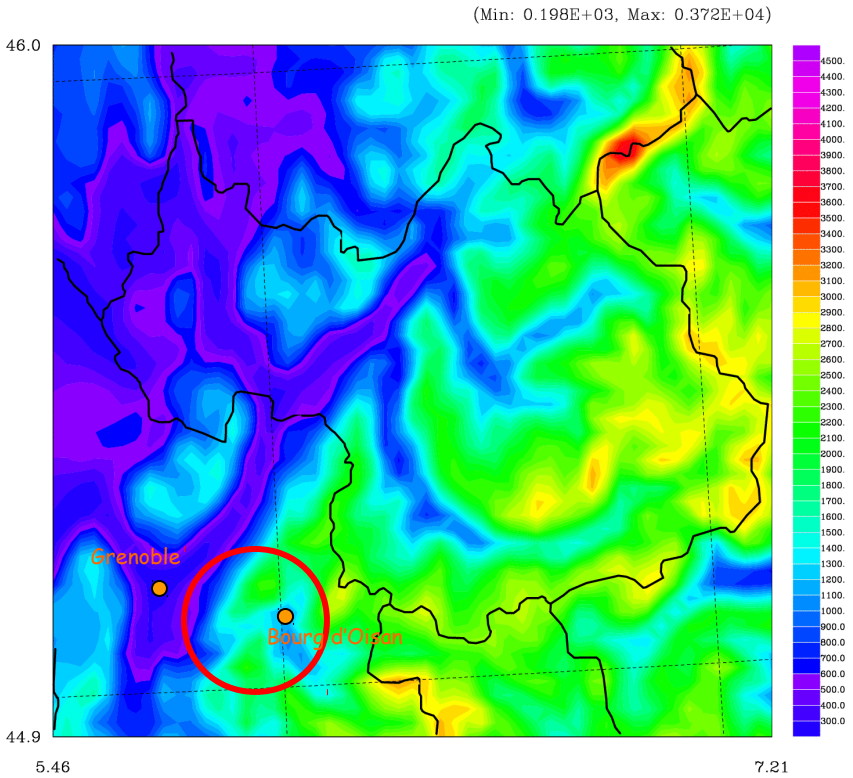
Horizontal grid AROME-France 1.3km : zoom over the Alps

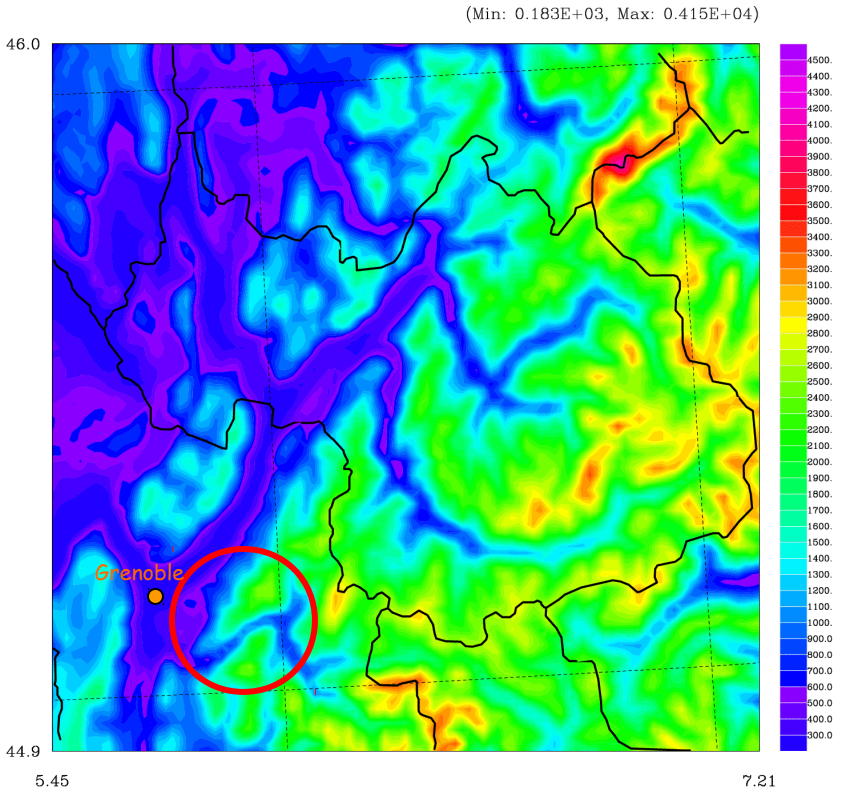
- Deeper valleys, higher peaks

09H40M22
)RET 46.dia

Zoom_Savoie_2.5km :



Zoom_Savoie_1.3km :



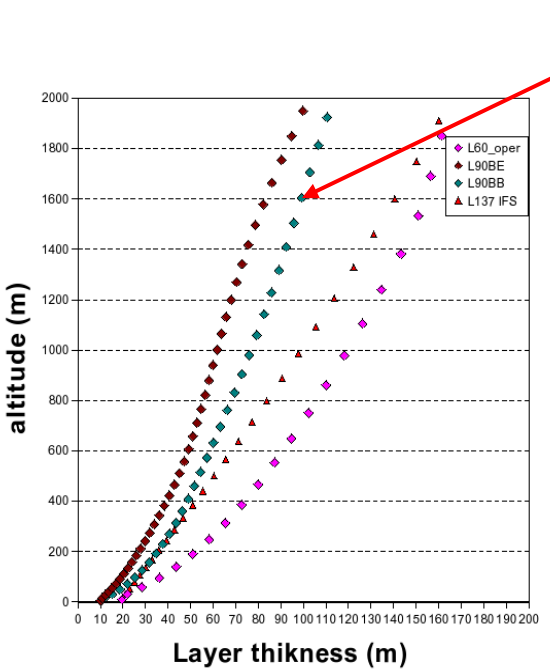
PROJECTION LAMBERT

PROJECTION LAMBERT

ZS M

Vertical grid AROME-France 1.3km

	AROME 1,3km	AROME 2,5km
Nb vertical levels	90	60
Top model level	10 hPa	1 hPa
Lowest model level	5m	10m
Nb levels < 2000m	33	21



L90/L60 : Regular increasment for all layers

AROME-France 1,3km Dynamics

- In CY40_op1 / oper in 38t1_op1

	AROME 1,3km	AROME 2,5km
dt	45s	60s
P/C scheme (NSITER=1)	T	F
P/C cheap	T	F
LGWDADV / LRDBBC	T / F	F / T
ND4SYS	2	1
LSLHD_OLD	F	T
New SL interpolators (COMAD)	T	F
Coupling zone (Davies)	16 points	8 points
Top spectral relaxation	T (retuned)	T

AROME-France 1,3km Physics

- No big modifications :

- Microphysics (retuning of snow autoconversion threshold (cf Balazs talk))

- Surfex : version update (v6+ -> v7.2), Z01D orographic drag (tuning)

AROME-France 1,3km Technics

- Optimisations

- I/O server (P, Marguinaud)
- MesoNH physics is now called with the same vertical levels ordering as ARPEGE
- Bottom and top additional points (KLEV+2) no more necessary except for turbulence (-> cleaning of apl_arome)

- <274 nodes of our Bull (> 1/4 of the machine) will be required to perform AROME 1,3 km 24h forecast in 30' (with mixed MPI/OpenMP parallelisation)

- Preparation of initial surfex file has been MPI parallelised (providing the fact an FA PGD is used in input).

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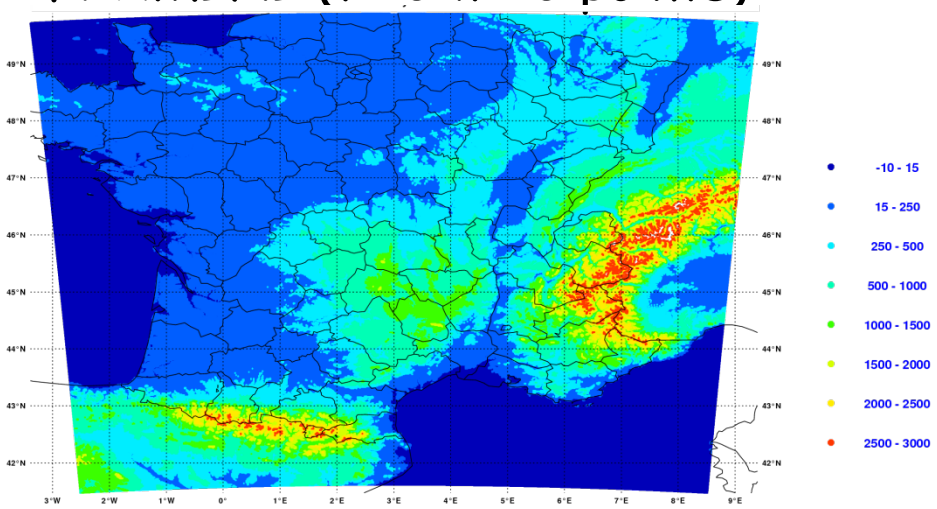
Evaluation on small domain (Prototype)

- FRAMINI (720x720 points)



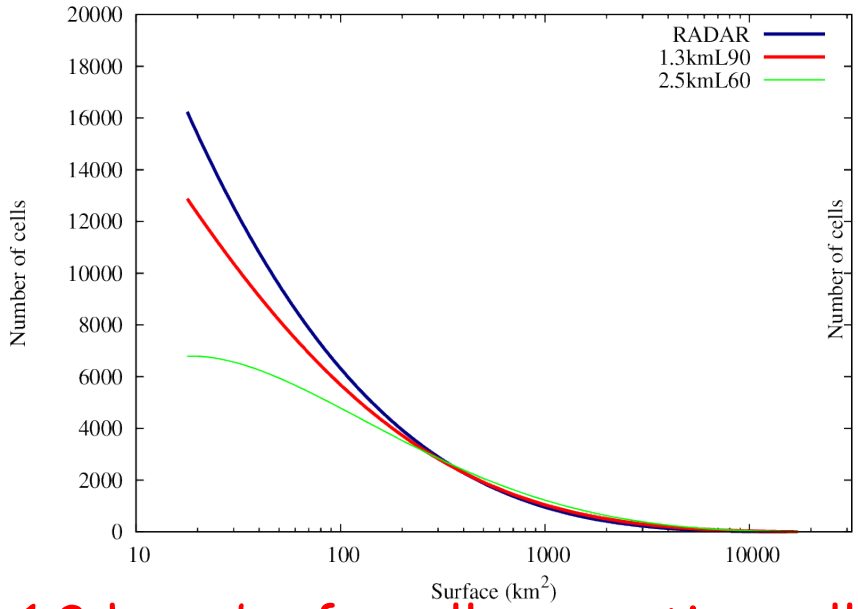
- Daily runs r0 +30h since 1st June 2012

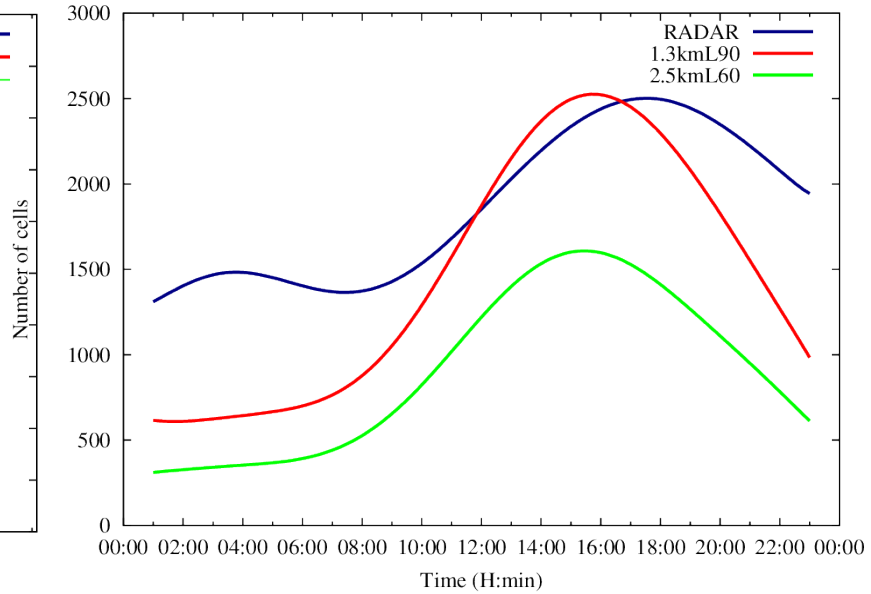
(without data assimilation, starting from AROME-oper 2.5km)

Statistics on convective cells

NWC SAF "RDT" software (Morel et al., 2002) to detect convective cells based on simulated reflectivity. Threshold used at 40 dBz.

48 convective days in 2012





1.3 km: nb of small convective cells increased and nb of big cells decreased

1.3 km is closer to observed radar reflectivity

(J. Léger, D. Ricard, Y. Seity)

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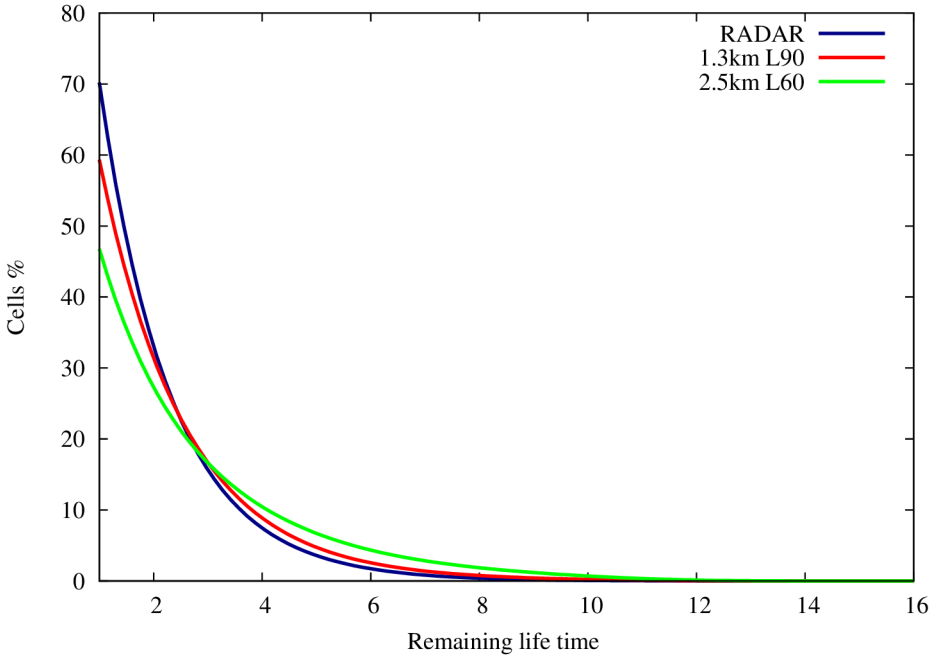
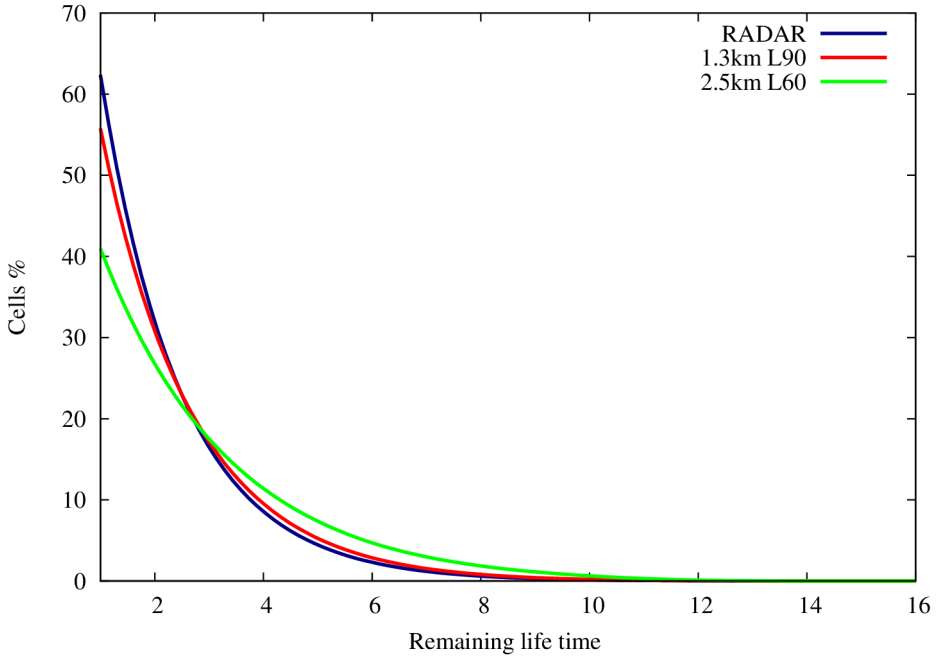
Statistics on convective cells

21 June 2012



4 July 2012



1.3 km: nb of cells with remaining life time < 15' increases, >1h decreases

1.3 km is closer to radar observation

R. Ben Rohmdane

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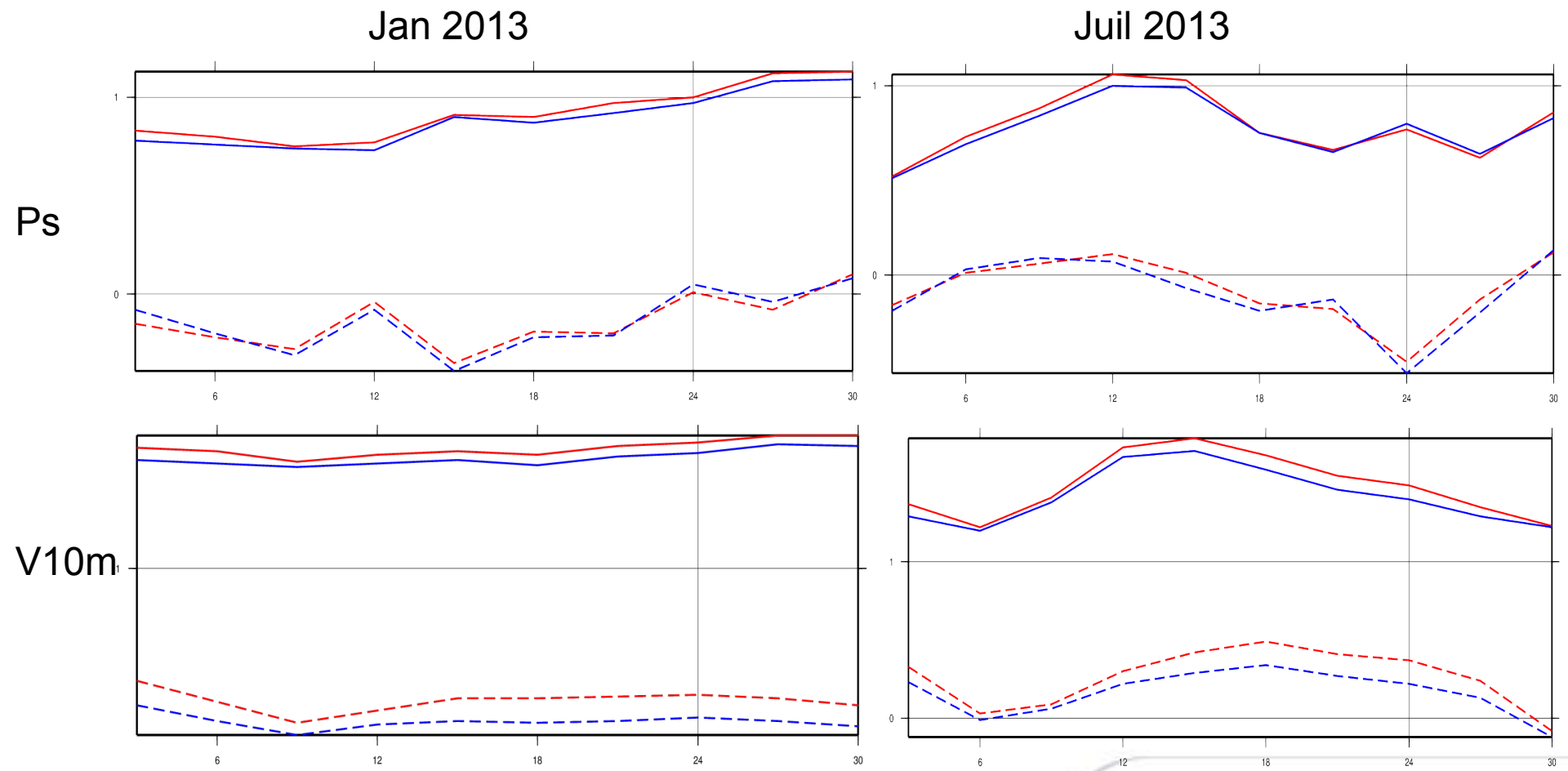
Evaluation on the full domain (on Bull)

AROME_1.3km / AROME_2.5km



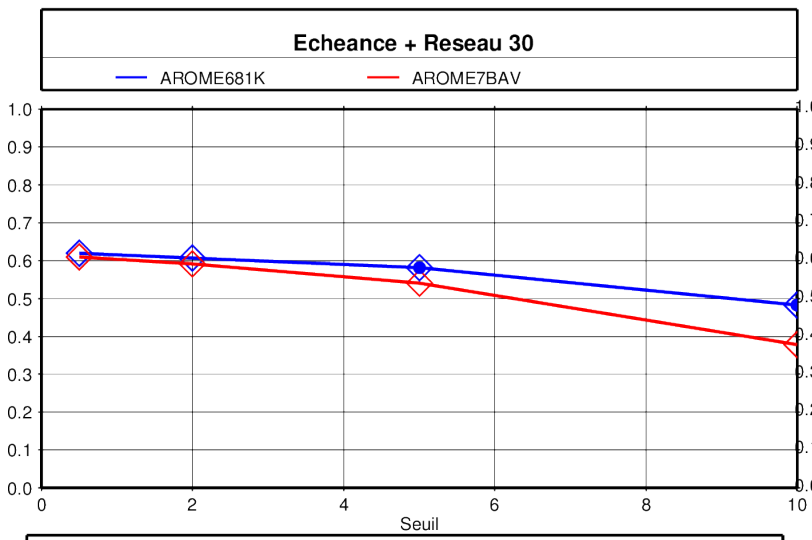
Improvments on Ps, V10m

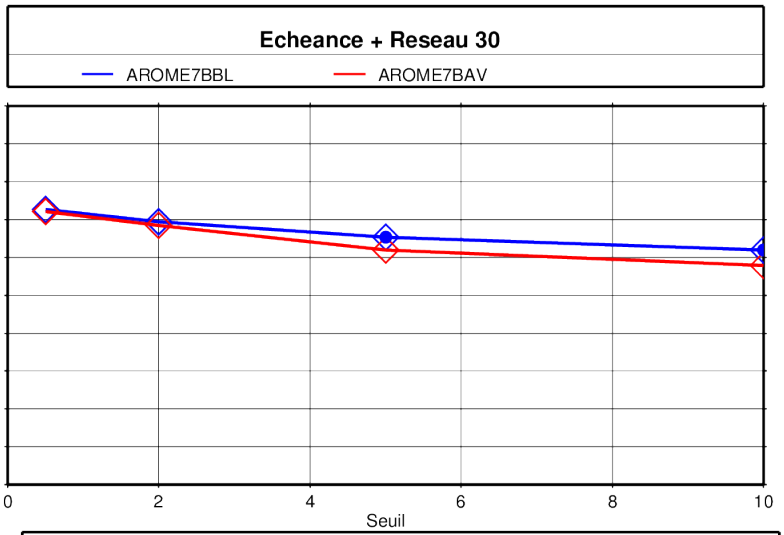
METEO FRANCE
Toujours un temps d'avance

Evaluation on the full domain (on Bull)

Jan 2013 AROME_1.3km /AROME_2.5km Juil 2013

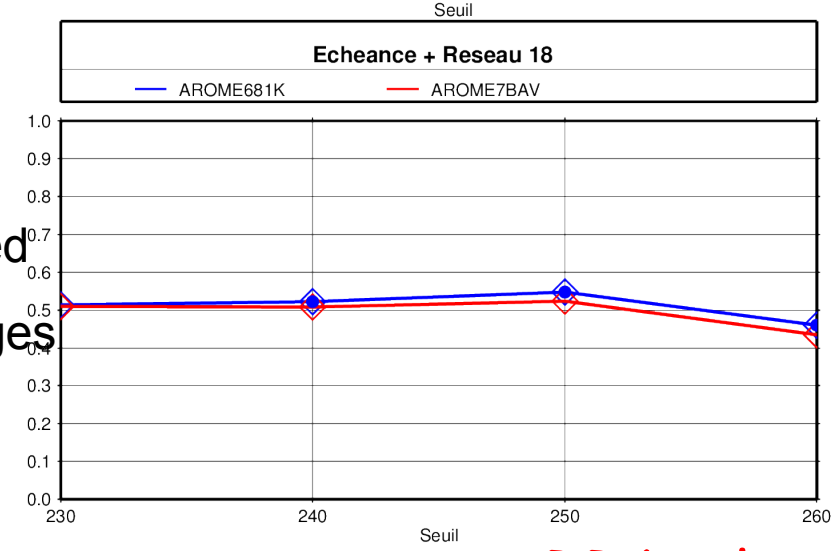
RR6

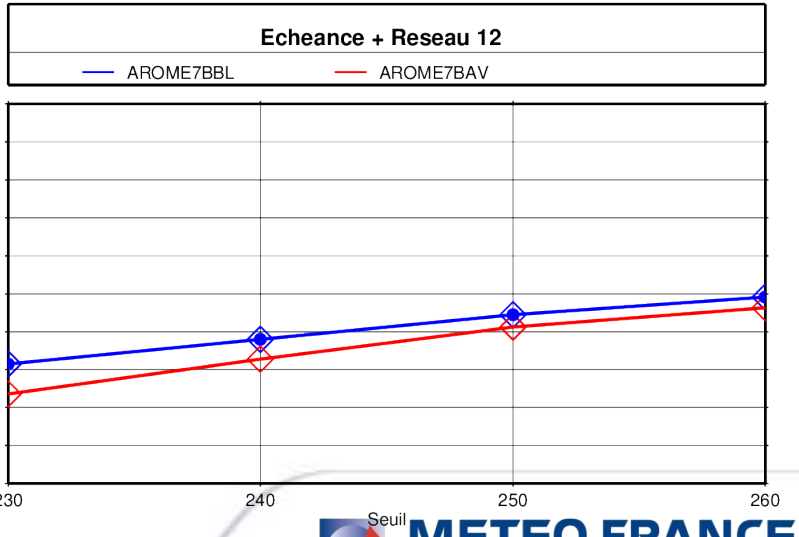




Simulated

Sat images





Improvement on RR6, cloud cover

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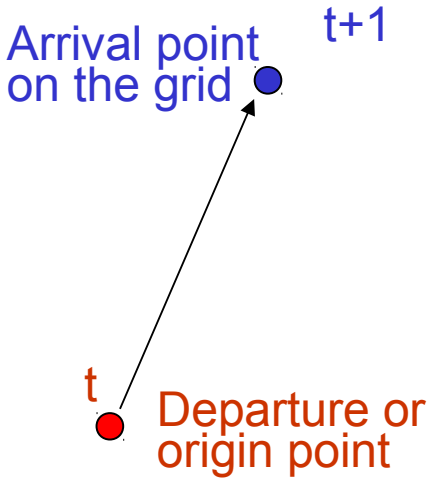
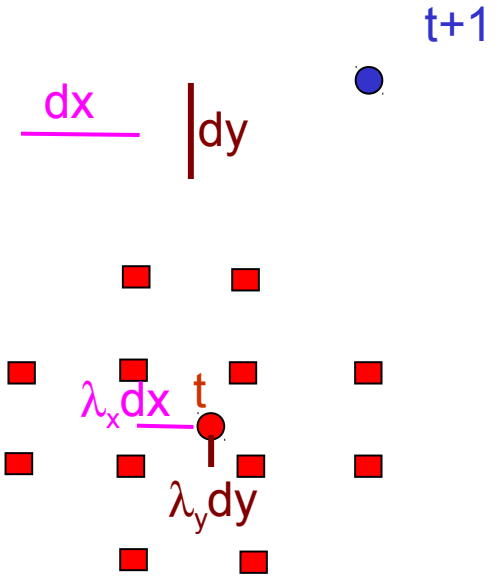
Toujours un temps d'avance

COMAD weights for SL interpolations



- Computation of the trajectories: no modification

COMAD weights for SL interpolations



•Computation of the trajectories: no modification

•Computation of advected variables at the origin point: modification of the SL interpolation weights:

For linear weights (λ_x , λ_y):

modified weights are defined as :

$\lambda_x' = \lambda_x * D_x + 0.5*(1- D_x)$

$\lambda_y' = \lambda_y * D_y + 0.5*(1- D_y)$

also used after for computing cubic weights

take into account the deformation of air parcels along each direction, with deformation factor defined as :

$D_x = 1 + \partial U/ \partial x * dt$

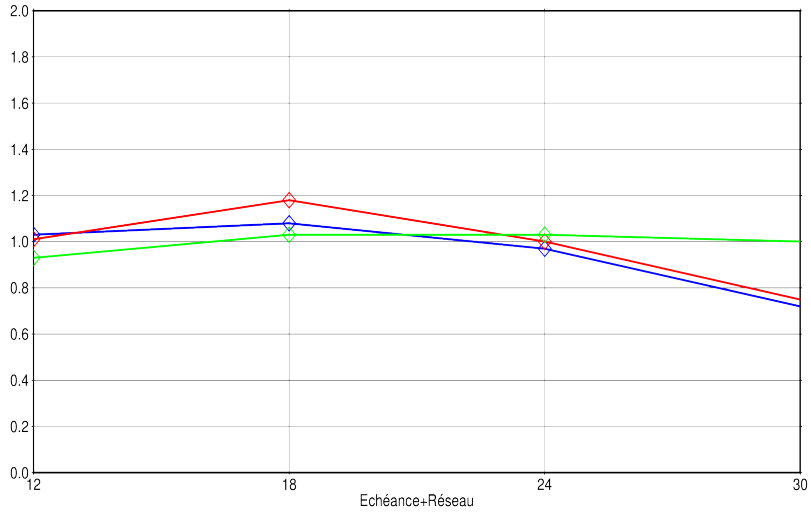
$D_y = 1 + \partial V/ \partial y * dt$

SL_COMAD

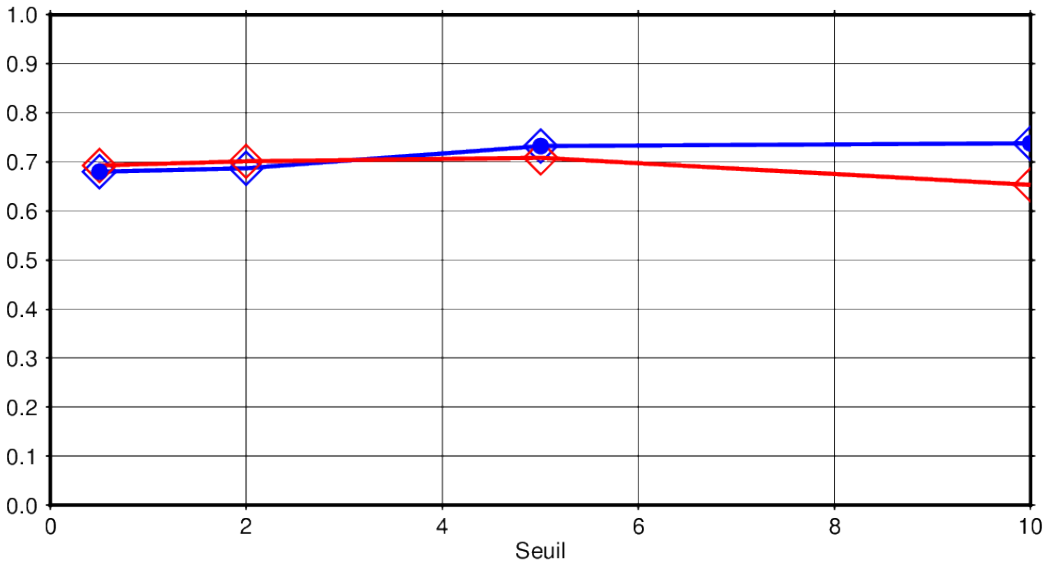
RR6 AROME_1.3km_SLCOMAD / AROME_1.3km

July 2013

Bias :



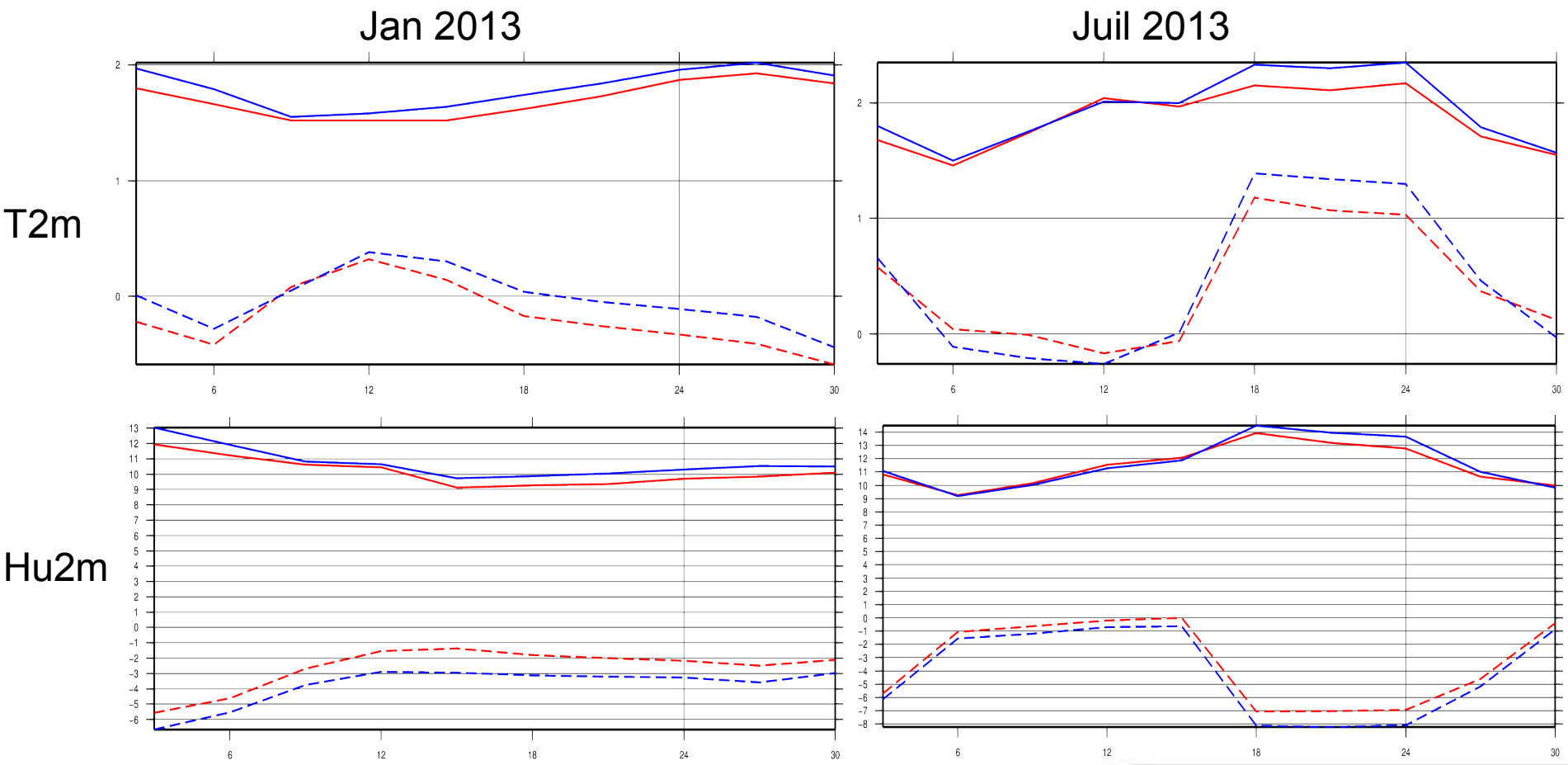
Brier Skill Score 30h



Positive impact on RR6 scores

Evaluation on the full domain (on Bull)

AROME_1.3km / AROME_2.5km



Worsening on T2m, Hu2m

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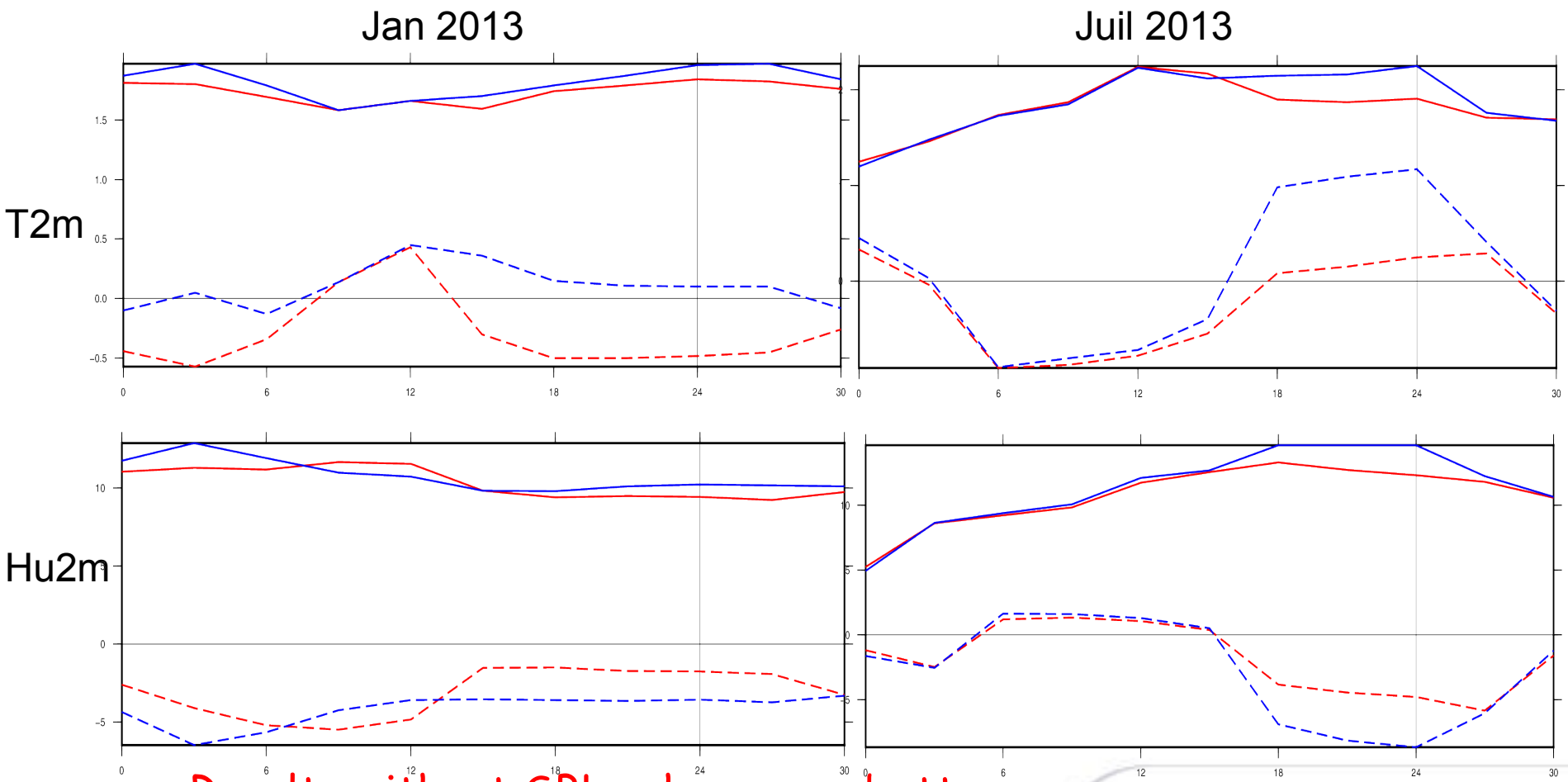
Evaluation on the full domain (on Bull)

AROME_1.3km / AROME_1.3km without SBL scheme in SURFEX



Results without SBL scheme are better,

Further tests will be done …

METEO FRANCE
Toujours un temps d'avance

OUTLINE

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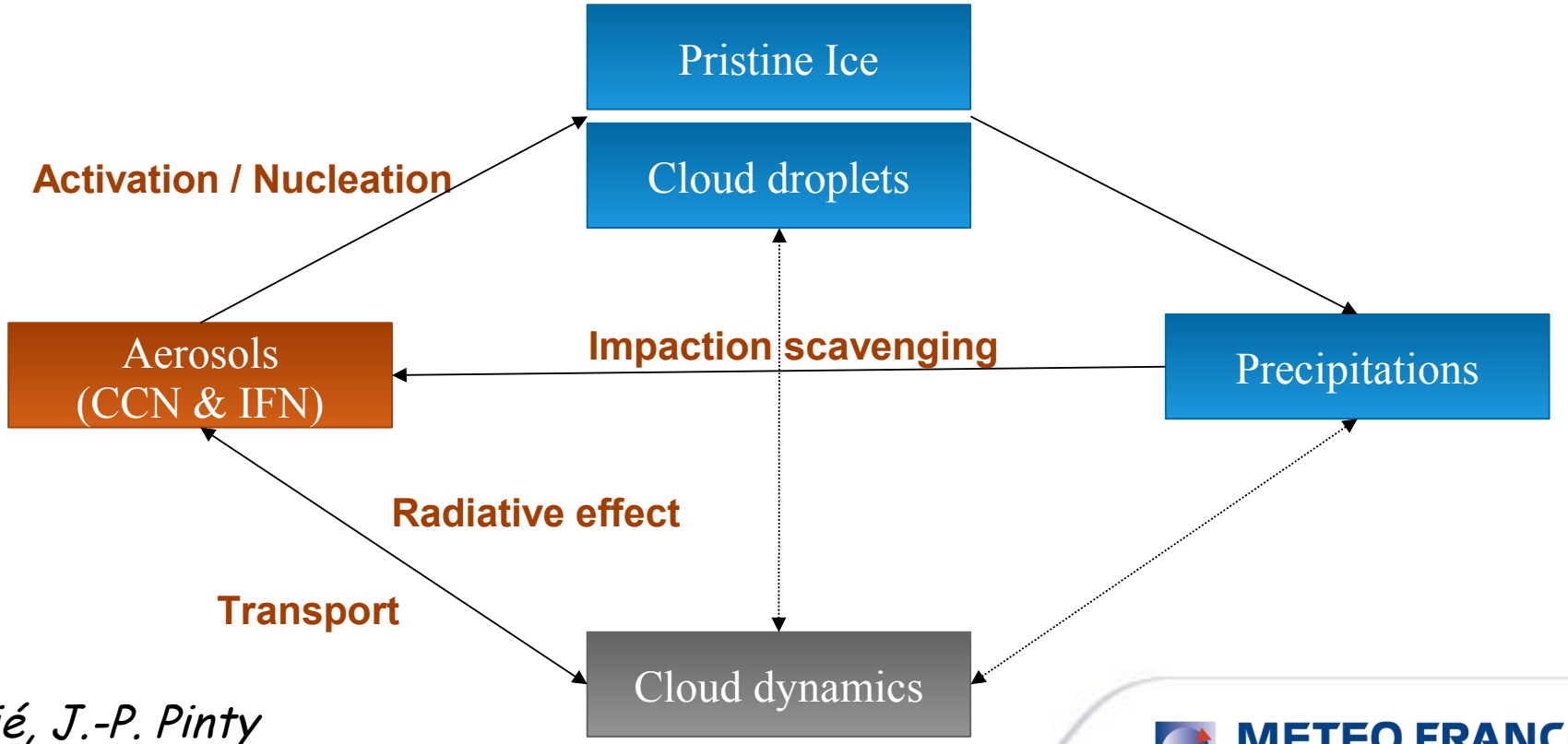
- To prepare the future (2-moments microphysics)
- Conclusions

New microphysics scheme : Liquid Ice Multiple Aerosols (LIMA)

= a 2-moments microphysics scheme developped in Meso-NH in order to improve the modelisation of complex aerosols – clouds – precipitations interactions



B.Vié, J.-P. Pinty

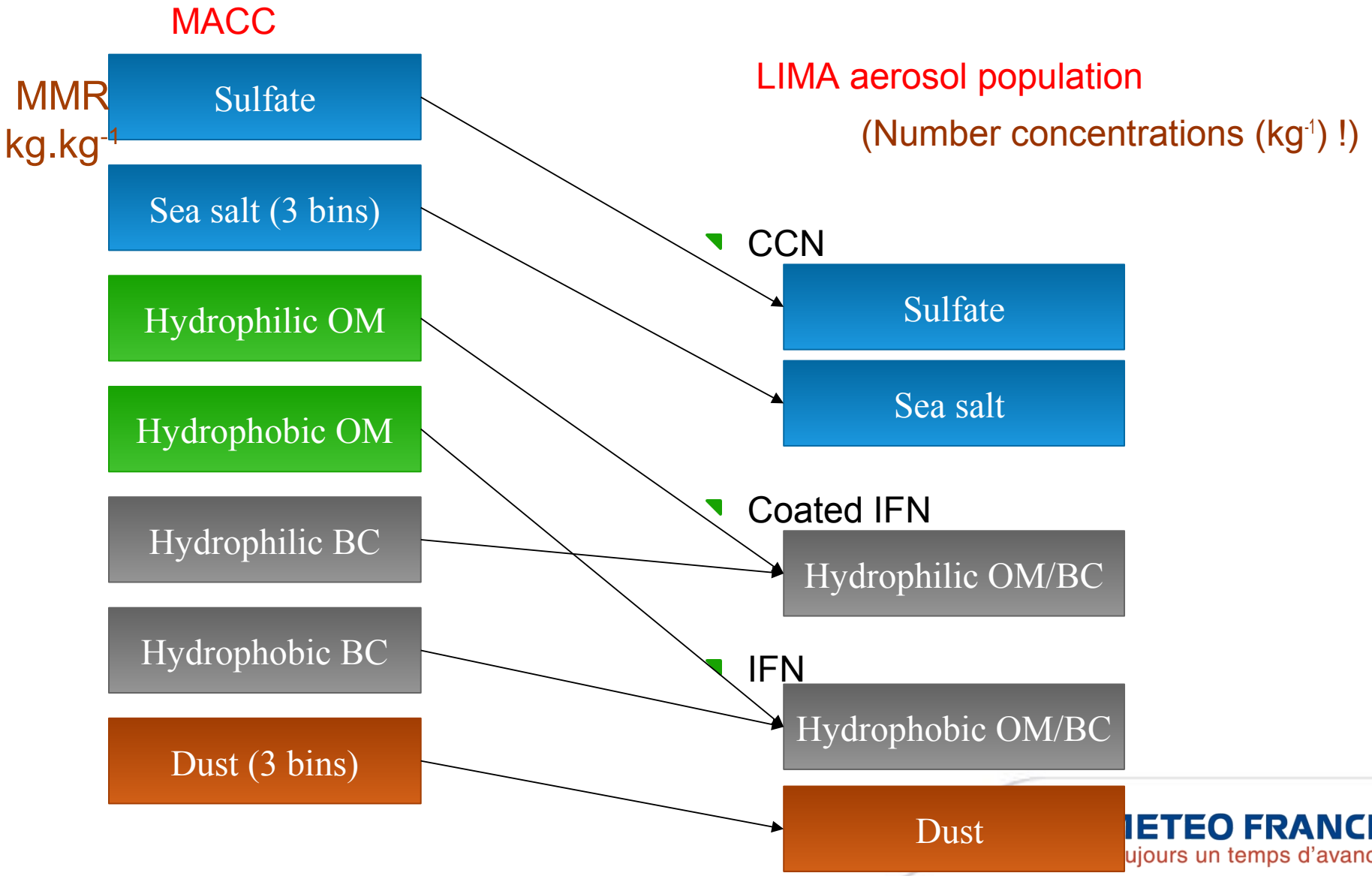
New microphysics scheme : Liquid Ice Multiple Aerosols (LIMA)

- Prognostic 3D variables in LIMA
  - Mixing ratios ($kg.kg^{-1}$) : r_C, r_R, r_I, r_S, r_G
  - Concentrations (kg^{-1}) : N_C, N_R, N_I ← NEW
  - Aerosol concentrations (kg^{-1}, for each mode) : N_{Free}, $N_{Activated}$ ← NEW

- New / Modified processes compared with ICE3
  - Activation / nucleation of aerosols
  - Impaction scavenging of aerosols by rain
  - More physical representation of autoconversion.
  - Over-saturations remains more easely than in ICE3

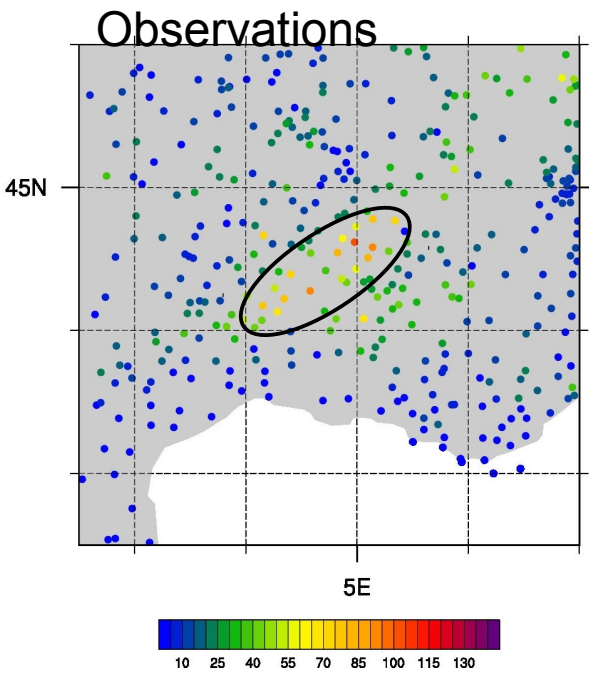
- ICE4 / ICE3 cold processes concerning hail/graupel remains the same (-> improvments in ICE4 scheme will automatically benefit to LIMA).

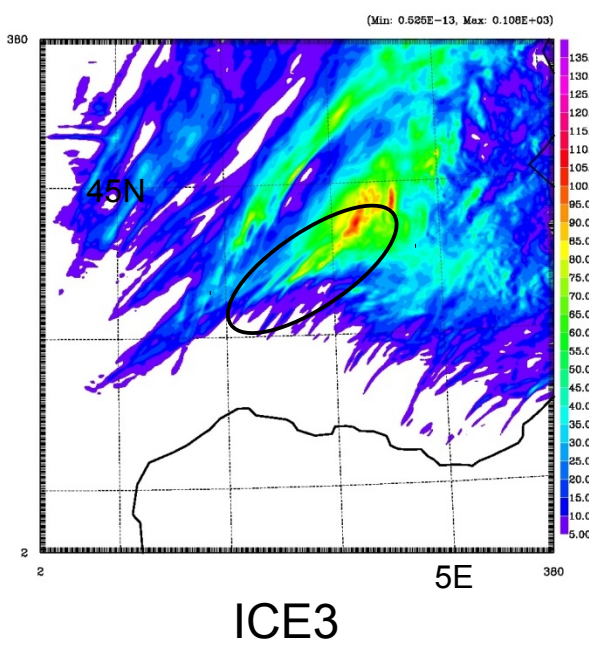
LIMA : Aerosols initialisation



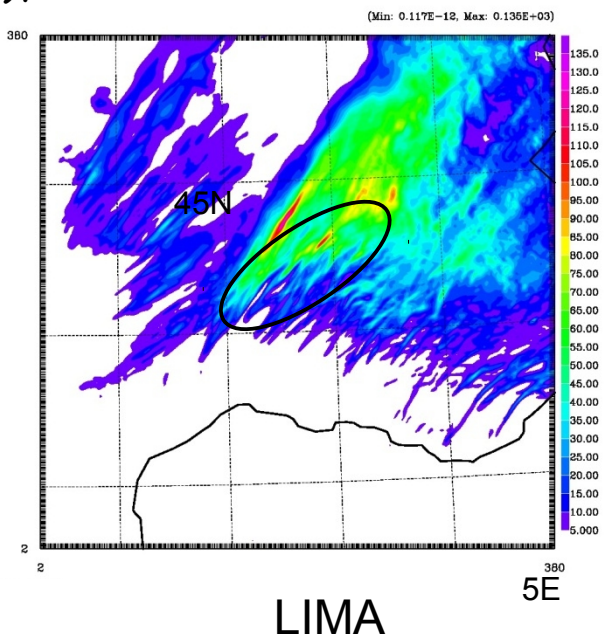
First real case test : HyMeX IOP 6 – 24 sept. 2012

18-h accumulated rainfall (mm), 12UTC :





ICE3



LIMA

Technicaly working,

Valiation/tuning will continue (HYMEX observations)

Reflexions concerning its implementation in AROME will start in autumn 2014 (numerical efficiency -> simplifications in the code, time steping)

Conclusions, Outlooks

- AROME-France 1,3km model configuration is nearly chosen. Evaluation shows significant improvements (RR6, V10m). Still some questions concerning T2m.

- Experiments with data assimilation on going (cf Claude talk).

- Modifications in Physics are on the way to prepare future versions :

- LIMA,
- radiation/orography interaction (Collaboration with ZAMG & FMI (C. Wastl, L. Rontu))
- sub-grid precipitations (S. Riette)
- turbulence (3D turbulence not needed at 1km) (R. Honnert)
- …

- AROME-France 1.3 km e-suite should stats before summer

  (with also Ensemble AROME forecasts, AROME-PI (immediate forecasts whith hourly analyses))

AROME-France 1.3 km (Model part) Status and plans

Y. Seity

From 1D to 3D turbulence scheme in AROME

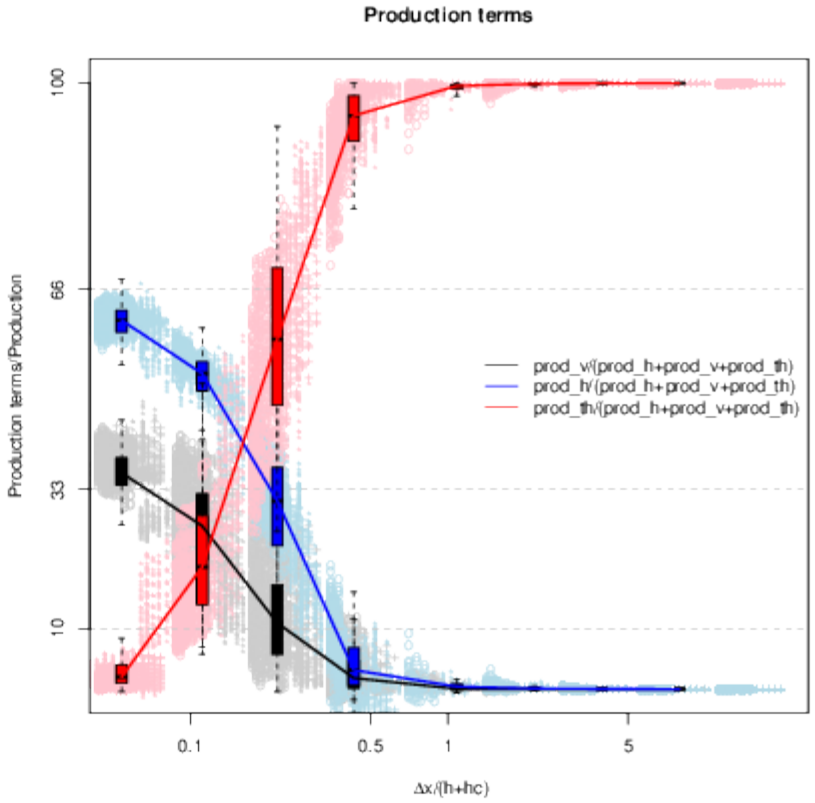


FIGURE: Thermal (red), horizontal dynamic (blue) and vertcal dynamic (green) as a fonction of the resolution in free CBL.

- From LES, vertical and horizontal production terms computed at several resolution in free and forced CBL
- 3D turbulence scheme necessary under 1km resolution

GREY ZONE PROJECT at Météo-France

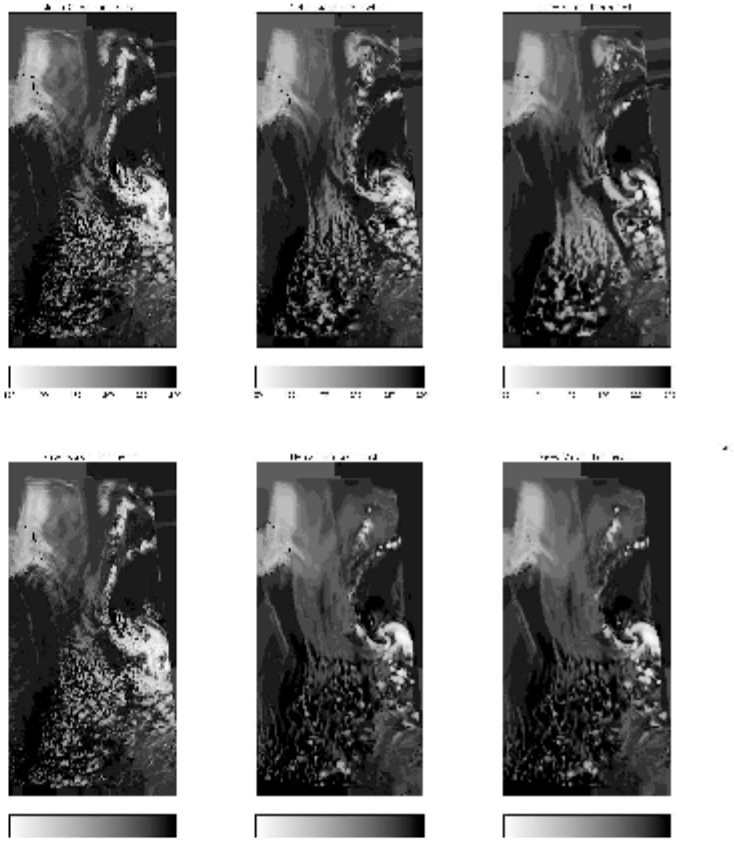


FIGURE: LWup after 24h simulation of AROME. Top : without PMMC09 Bottom : with PMMC09

- ARPEGE : 16 km,8 km,4 km,2 km ; OPER, without shallow convection, without convection
- AROME : 4 km, 2 km, 1ékm ; with and without shallow convection
- MESONH : 8 nested models from 8 km to 100 m

Grey zone of turbulence in a neutral BL

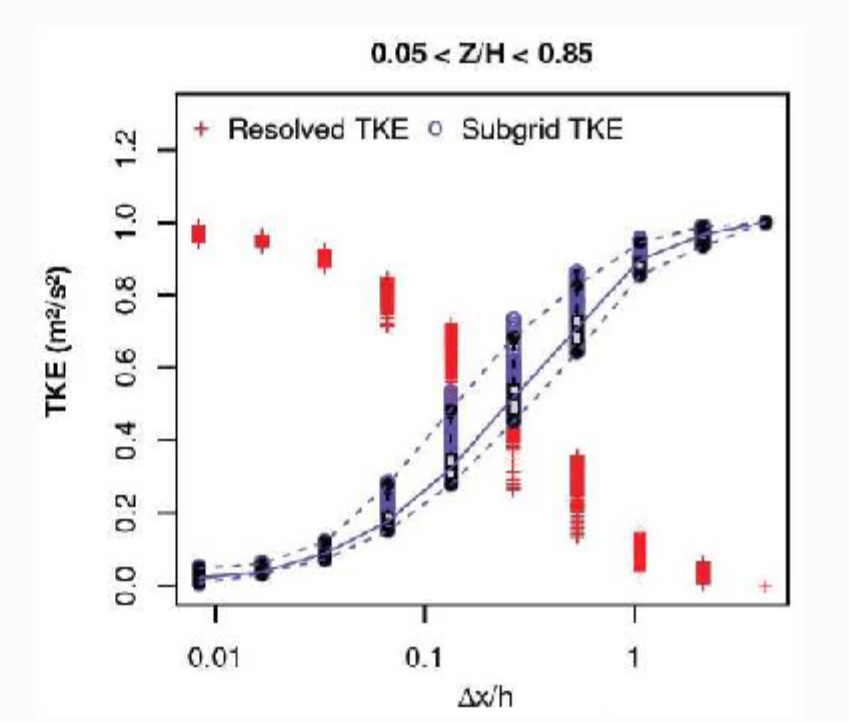


FIGURE: Resolved (red) and Subgrid (blue) part of TKE as a fonction of the resolution normalized by the BL height.

- LES of idealised neutral BL
- Grey zone : Turbulence partly resolved + anisotropy = from 25 m to 800 m resolution
- Perspective : other LES with increasing wind shear

LIMA : Aerosols – clouds interactions

→ *A detailed description of LIMA is presented in J.-P. Pinty's poster*

- CCN activation is based on Cohard and Pinty (2000)
  - Extended to handle a multimodal aerosol population
- IFN heterogeneous nucleation is based on Phillips (2008)
  - Experimental measurements of ice nucleation
  - 3 species of IFN : dust, black carbon, organic matter
- Coated IFN
  - First activated as CCN to form cloud droplets
  - Same nucleation parameterization as insoluble IFN
- Better representation of microphysical processes
  - Explicit deposition/sublimation rates, ice → snow conversion