Preparation of new configurations of Arome-France and Arpege models

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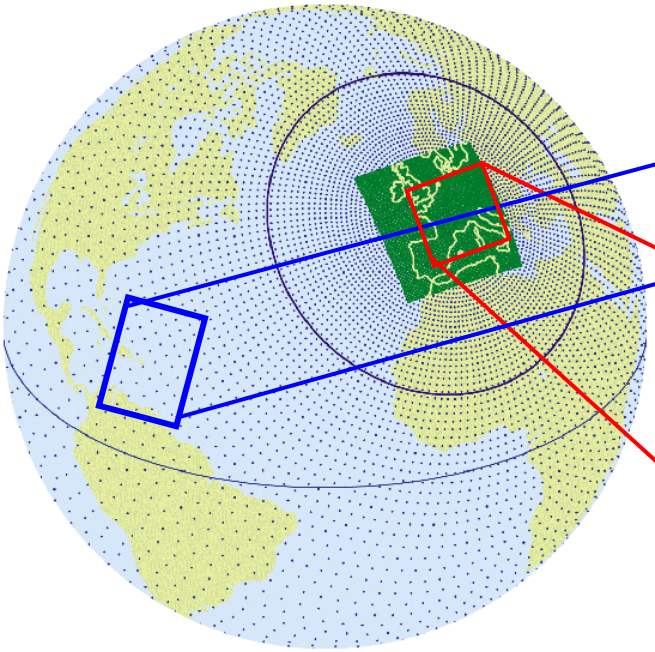
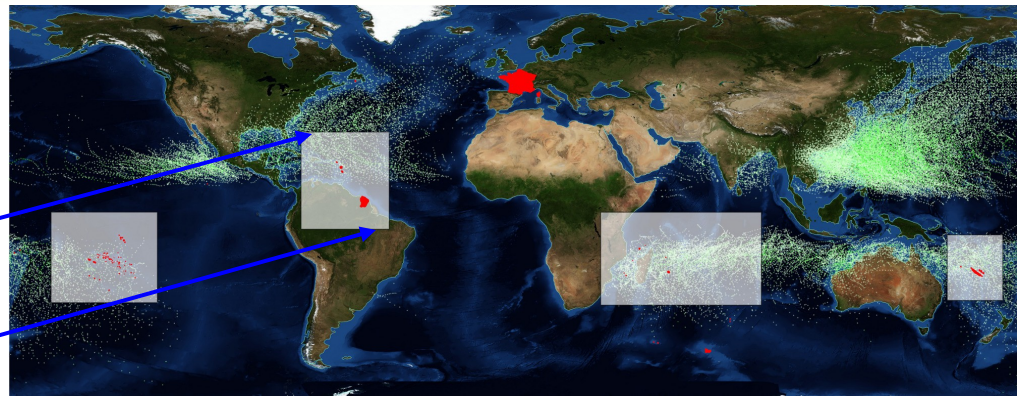
Summary

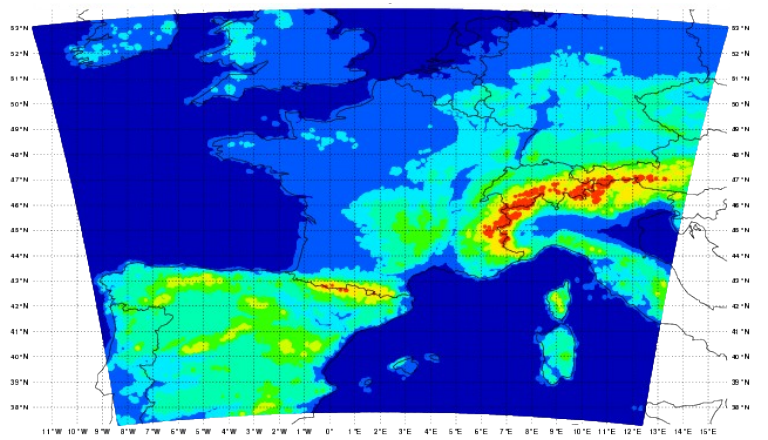
- Operational configurations
- AROME-France 1.3km
- ARPEGE HR with new convection schemes
- Perspectives

Oper NWP deterministic systems with assim





LAM ALADIN : ~3-days forecasts, dx~8km, 70 vertical levels, dt=450s - *3DVar Data Assimilation*



Global ARPEGE : T798c2.4L70
~4-days forecasts every 6 hours
dx~10km over France, ~60km over antipodes,
dt~9mn, 70 vertical levels
4DVar incremental Data Assimilation
Low resolutions : T107c1L70 (~180km)
and T323c1L70 (~60km)

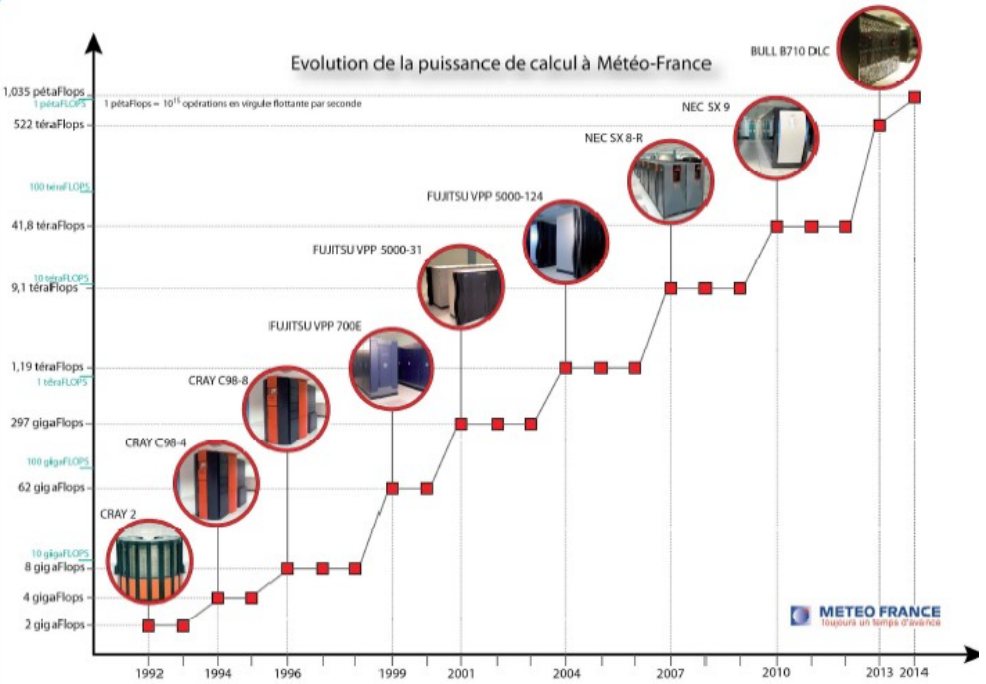
LAM Cloud Resolving Model AROME
30 h forecasts every 6h
dx=2.5km, 60 vertical levels, dt=1mn
3DVar Data Assimilation (RUC3h)

Physical parameterizations

	ARPEGE/ALADIN NWP	AROME NWP
Turbulence	Cuxart et al. (2000) {tke}	
Mixing length	Bougeault-Lacarrère (1989)	
Shallow convection	KFB (Bechtold, 2001)	PMMC09 (Pergaud et al., 2009)
Clouds (PDF)	Smith (1990)	Bougeault (1982)
Microphysics	Lopez (2002) Bouteloup et al (2005) {ql,qi,qr,qs}	ICE3 (Pinty and Jabouille, 1998) {ql,qi,qr,qs,qg}
Deep convection	Bougeault (85) / Gerard (99)	
GWD	Catry-Geleyn (2008)	
Radiation	RRTM for LW (Mlawer et al. 1997) and Morcrette et al. 2001 for SW (6b)	
Surface	ISBA 2L, ECUME	SURFEX (ISBA 3L, TEB, ECUME)

Evolution of supercomputing infrastructure

On-going migration from NEC SX9 to
BULL (bullx DLC) & INTEL (Ivy Bridge EP)
1008 nodes with 24 cores
522 Tflops peak
Operational suite on new computer planed for December 2013



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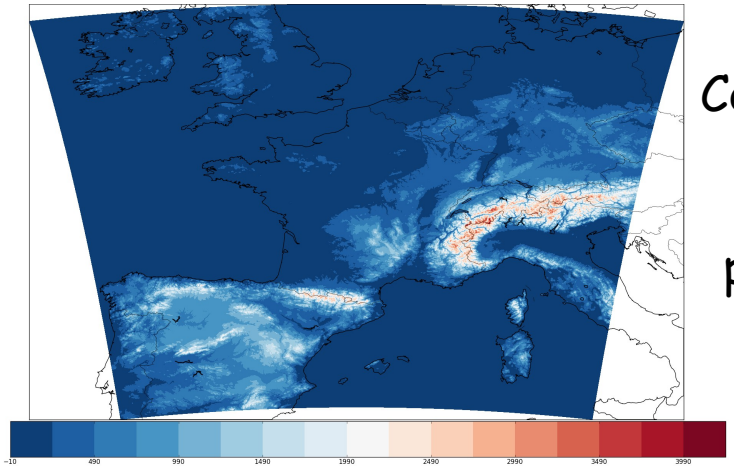
AROME 1.3km: horizontal resolution

- Small extension northwards of the geographical domain

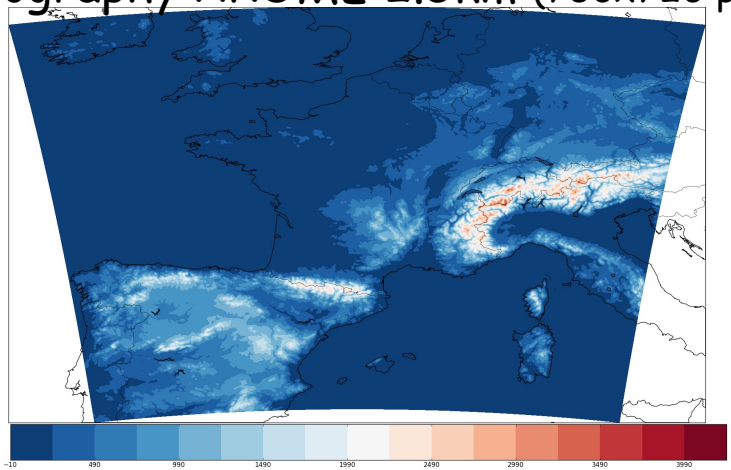
Orography AROME 1.3km (1536x1440 pts)



Coupling zone 16/8 points

GMTED2010 database at 250m

Orography AROME 2.5km (750x720 pts)

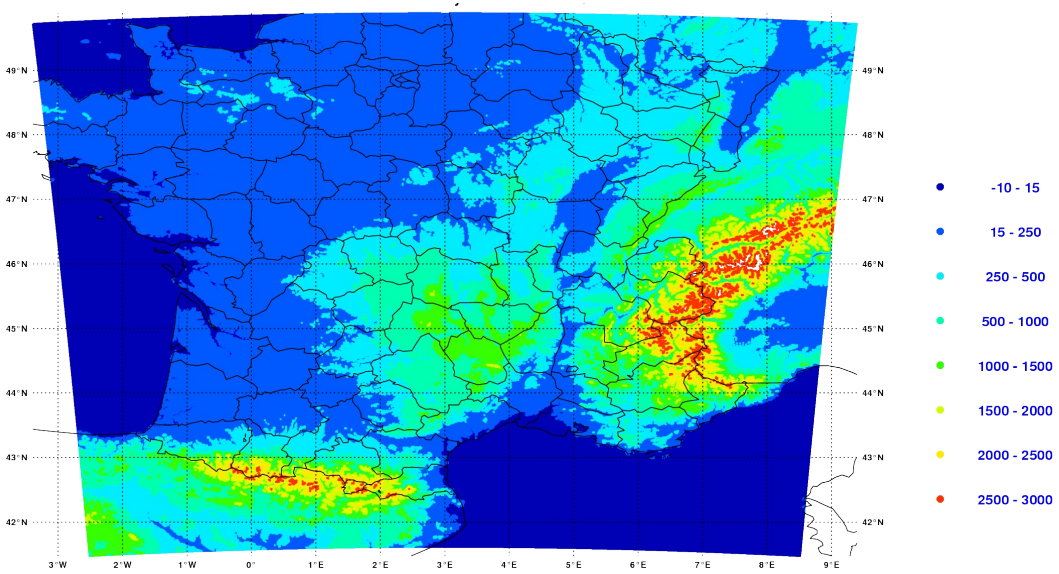


GTOP030 database at 1 km

Maximum slope	38°	23°
Mt Blanc	4272 m	3870 m
Distance to SYNOP+RADOME	20.6 m	58 m

Prototype AROME 1.3km

- Evaluation on smaller domain (720x720 points)



Daily forecast r0 +30h since 1st June 2012

Dynamical adaptation AROME oper 2.5km

Predictor-corrector scheme (one iteration)

Time-step=45s

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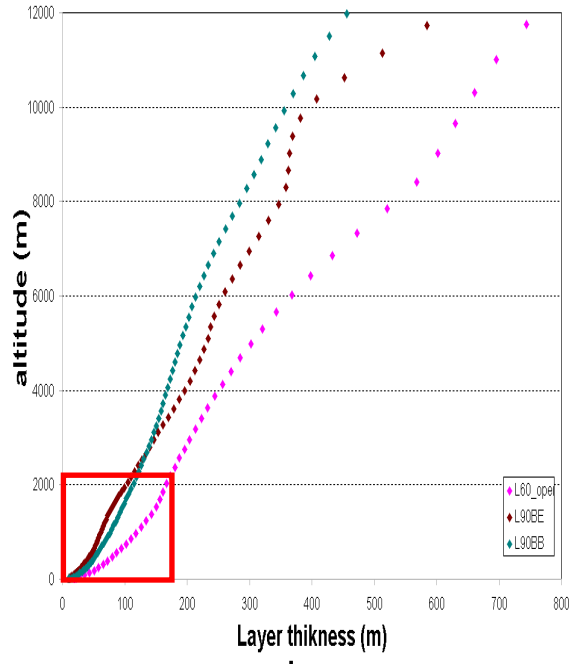
AROME 1.3km: vertical resolution

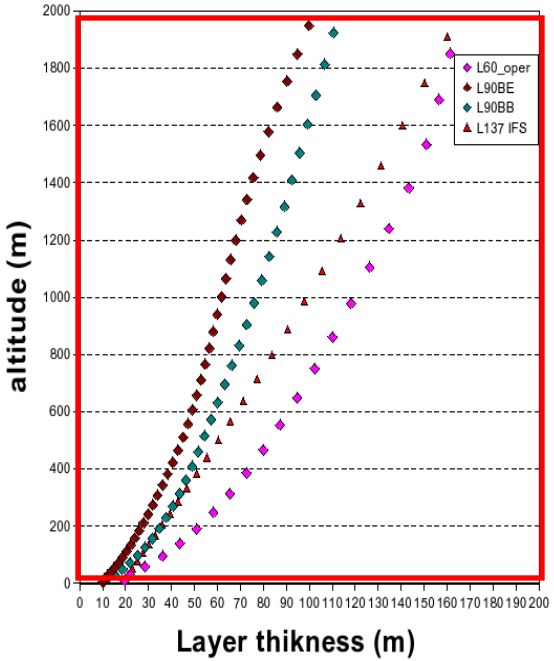
Several sets of 90 and 120 vertical levels tested: impact on forecasts (convection, precipitations, clouds, surface parameters), stability, etc.

-> Highest model level fixed at 10hPa

-> Benefits of very fine resolution near surface for modelling radiative fog, but constraint on time-step : lowest model level fixed at 5m

-> No additional benefit from L120 compared with L90





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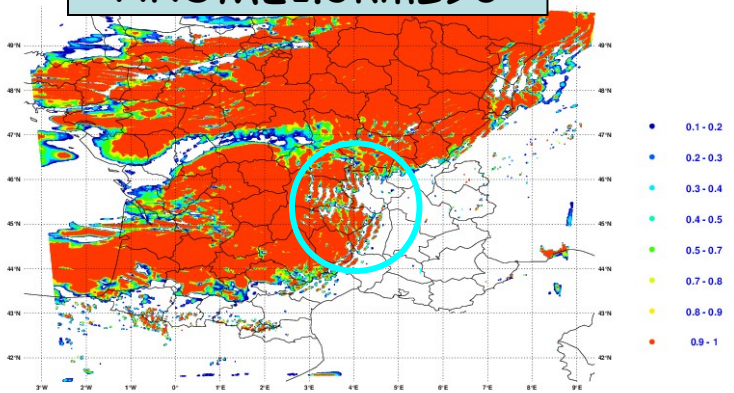
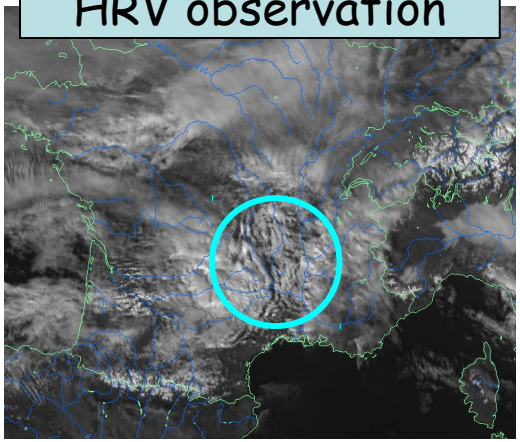
31-01-2013 (+14h)

Low level cloudiness AROME

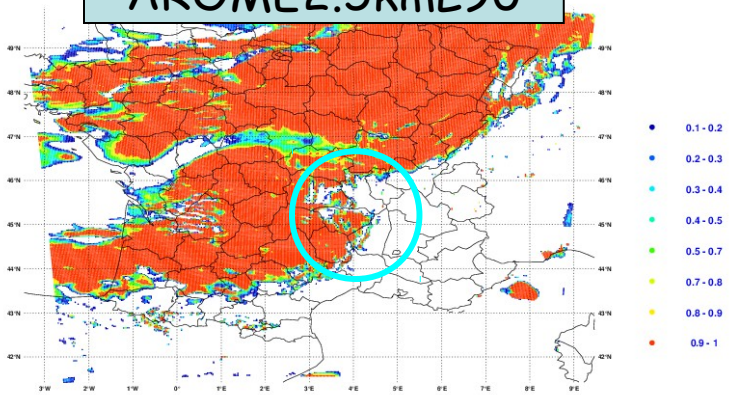
AROME1.3kmL90



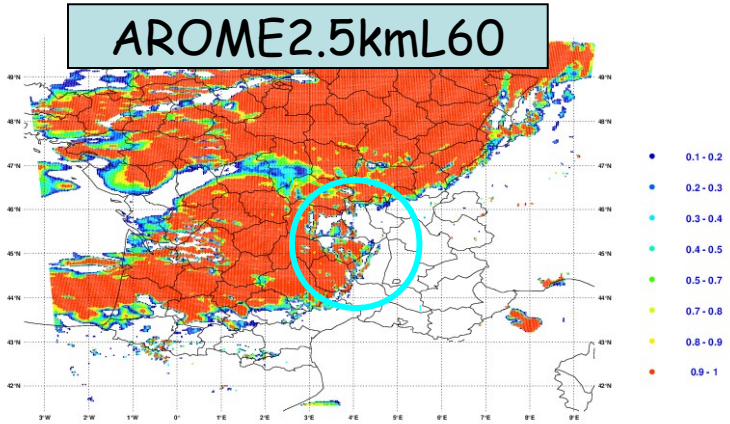
HRV observation



AROME2.5kmL90



AROME2.5kmL60



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AROME 1.3km: objective scores

Scores computed on summer 2012 and winter 2012-2013 (Y.Seity, LAuger)

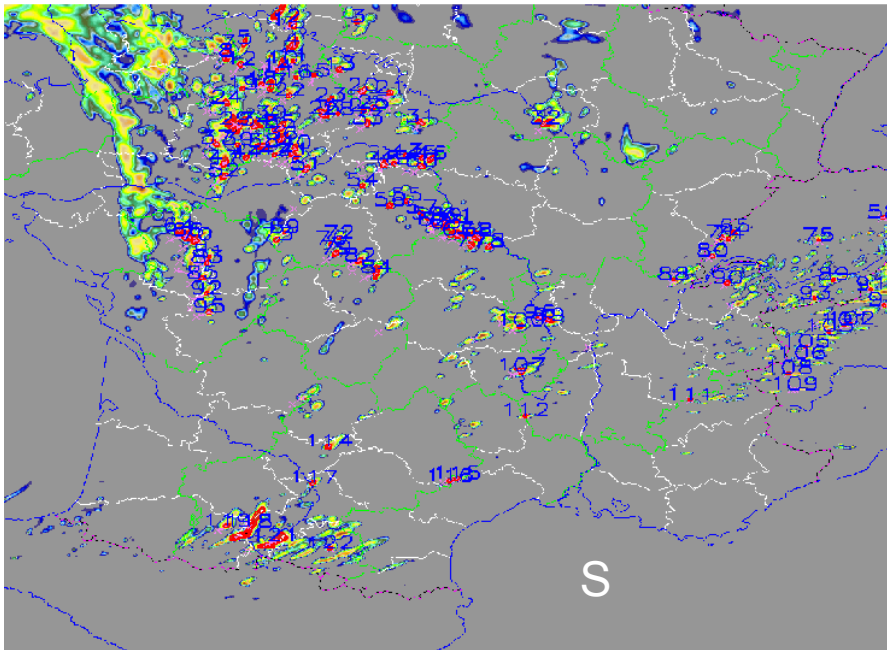
	Scores (Bias, RMS)			Brier skill scores (Amodei and Stein, 2008)			
Parameters	T2m	H2m	V10m	RR24	RR6	Gust1h	TB
Vertical resolution	-	-	+	=	-	=	=
Horizontal resolution	-	-	+	+	+	+	+
Both	-	-	+	+	+	+	+

⇒ More benefits of increasing horizontal resolution than vertical one

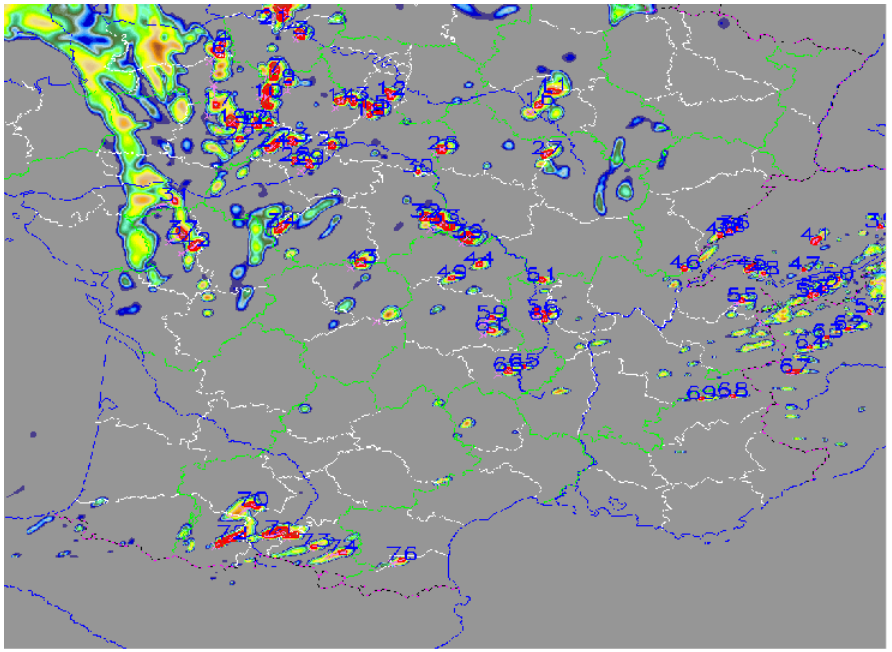
Automatic detection of convective cells

NWC SAF "RDT" software (Morel et al., 2002) to detect convective cells based on simulated reflectivity. Threshold used at 41 dBz.

Simulated radar reflectivity at 1500m on 21 June 2012 at 12TU



1.3km : 122 convective cells > 41dBZ

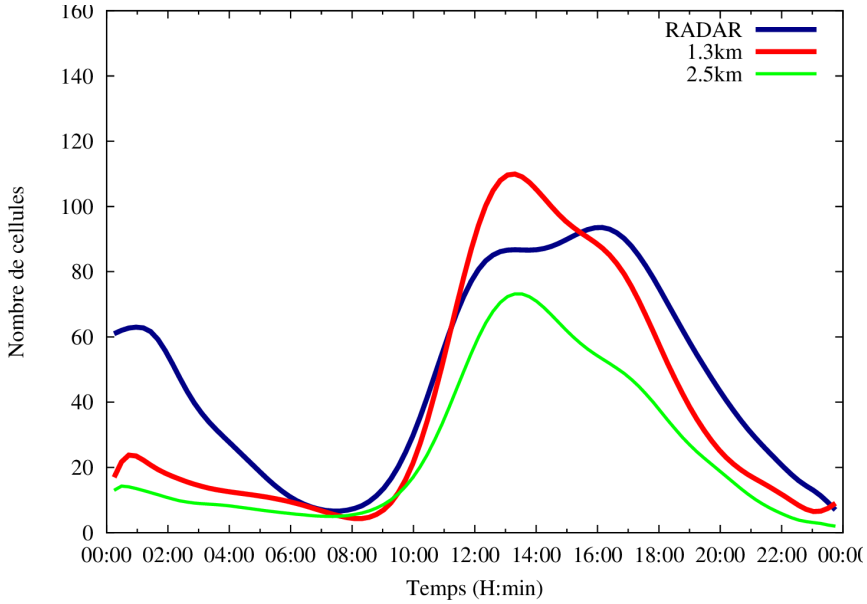


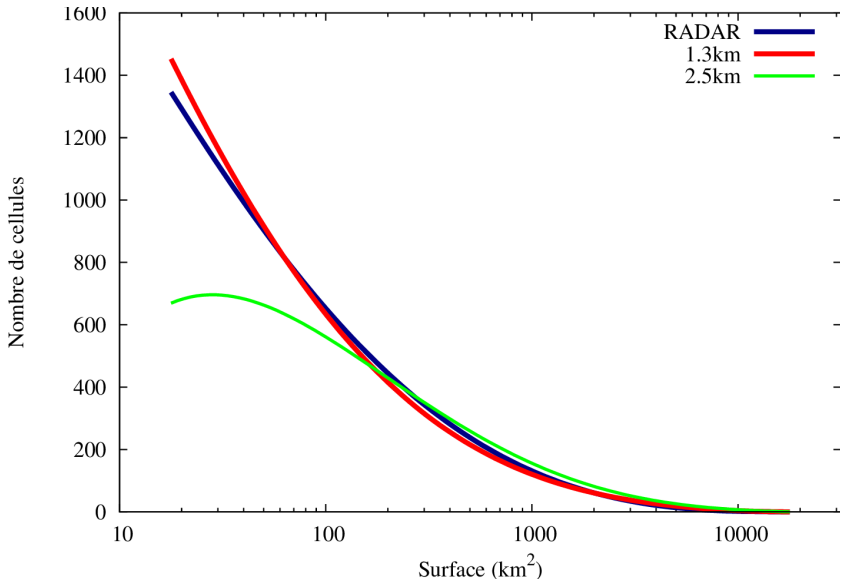
2.5km : 76 convective cells > 41dBZ

(J. Léger, D. Ricard, Y. Seity)

Automatic detection of convective cells

21 June 2012 : 41dBz





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

1.3 km: closer to observed radar reflectivity

Strong impact of semi-lagrangian horizontal diffusion (not shown)

Small impact of spectral diffusion and time-step (not shown)

(J. Léger, D. Ricard, Y. Seity)

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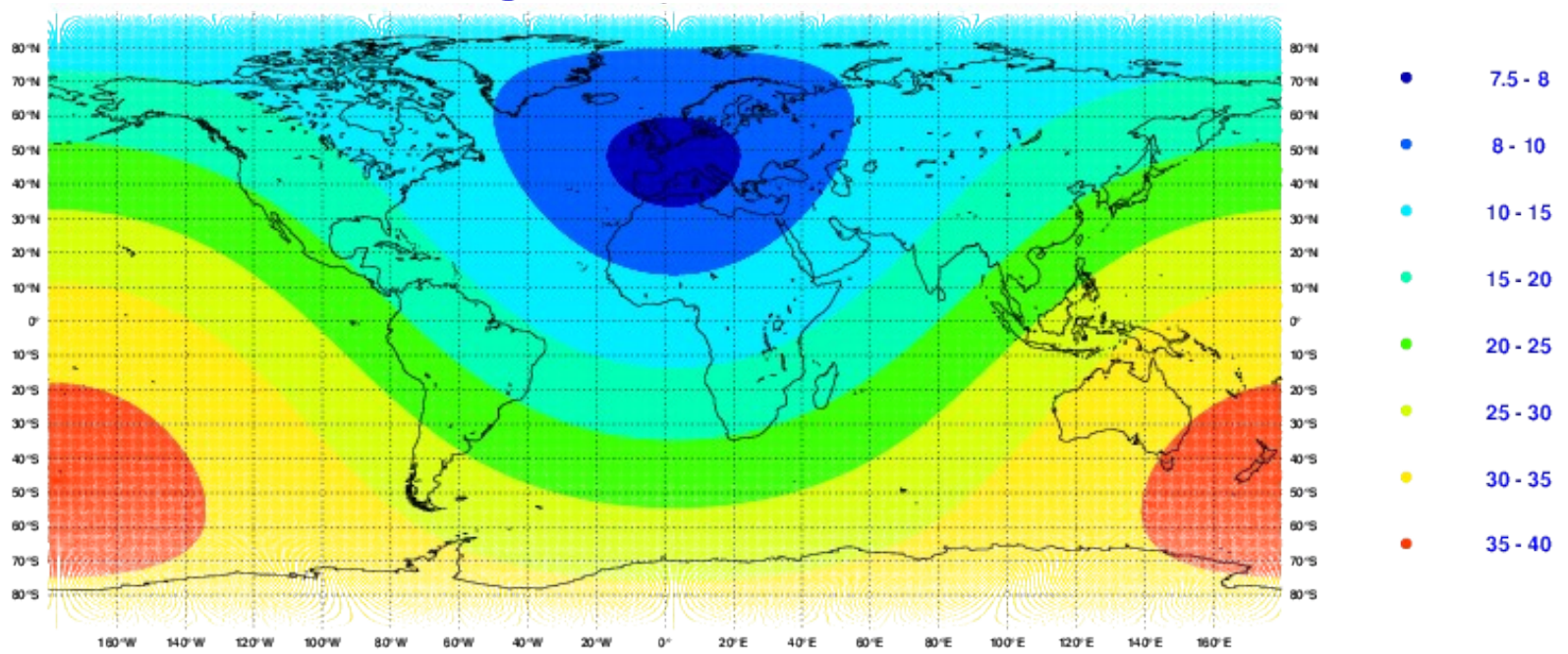
Arpege HR: new resolutions

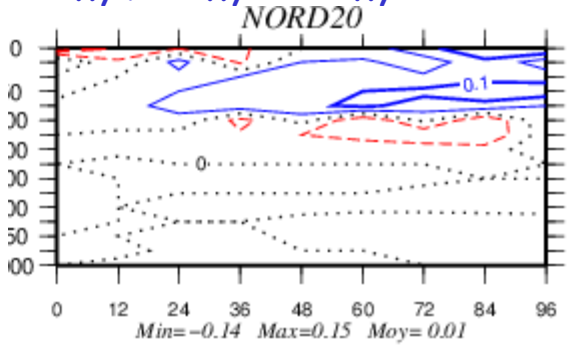
New horizontal resolution Tl1198 with stretching factor 2.2
(~7.5km over France, ~36km over antipodes)
From 70 to 105 vertical levels. Highest model level unchanged (0.1hPa).
Lowest model level changed from 17m to 10m.



Evolution of Arpege Ensemble Prediction "PEARP" : targeted horizontal resolution over France around 10km.

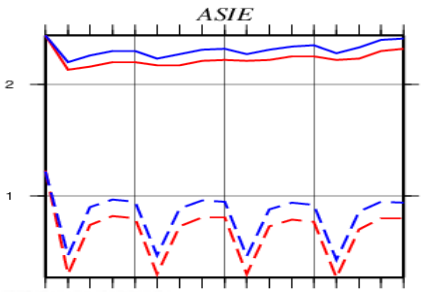
Arpege HR: scores

Evaluation in dynamical adaptation (no assimilation) with operational physics : upper-air (PHI, T, V, HU, Pmer) and surface (T2m, H2m, V10m, RR24, Cloud) scores



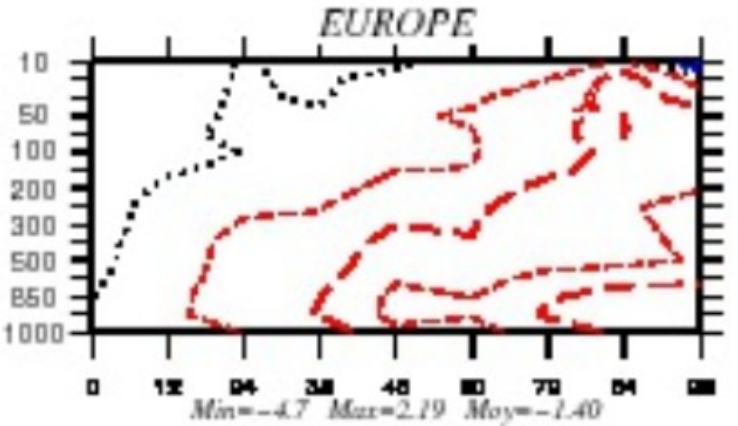
Impact of vertical resolution: neutral except on
- Temperature in the stratosphere and H2m (+)
- V10m (module) (-)

Impact of horizontal resolution: neutral except on
- Geopotentiel in the troposphere (+)
- Wind in the troposphere, V10m (direction, module), Pmer (-)



New orography representation :
- suppress or reduce envelope,
- filtered linear instead of quadratic orography
- tuning GWD parameterization

Impact on geopotentiel scores against RS over Europe when removing envelope orography over a winter period →



Thermal scheme PMMC09 in Arpege

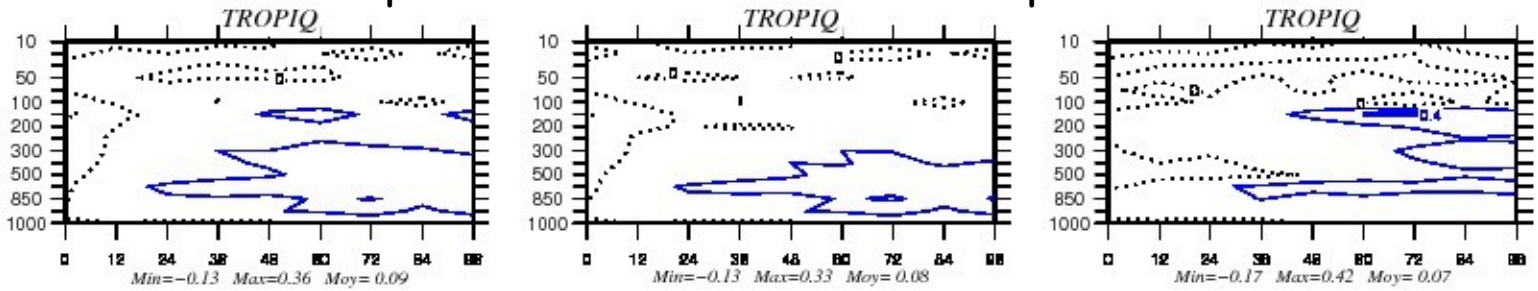
Motivations of evaluating "Pergaud et al, 2009" scheme in Arpege :

Improve representation of thermals (dry thermals, closure, momentum mixing)

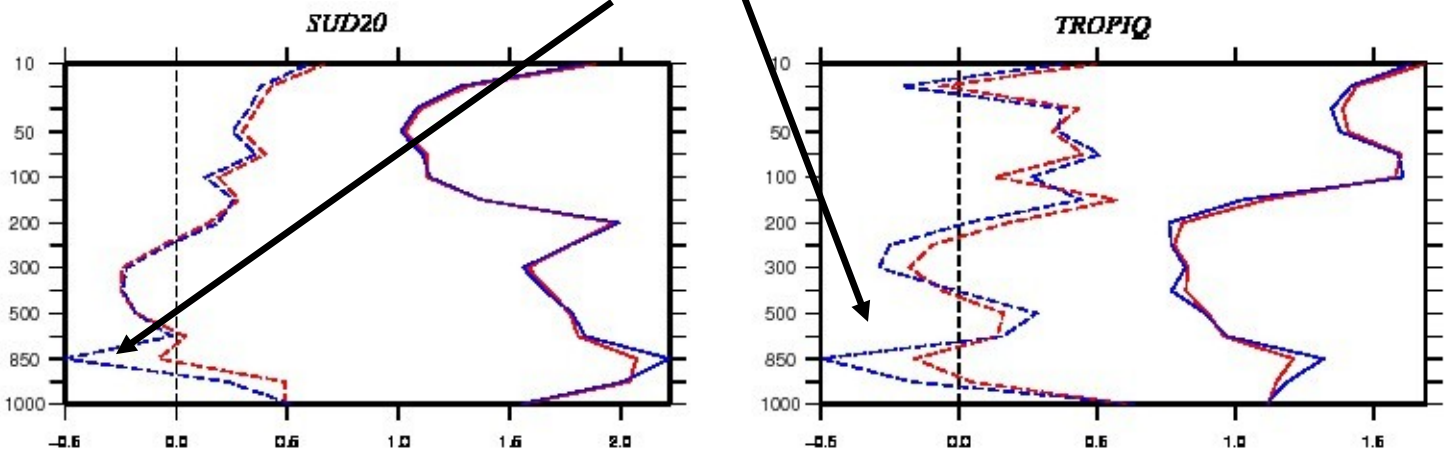
Extend validation of the scheme on the globe

Convergence of PBL schemes with Arome

Improvement of wind in the tropical area



But a cold bias at 850 hPa



New convection scheme PCMT

Developed for Arpege-PNT and Arpege-Climat

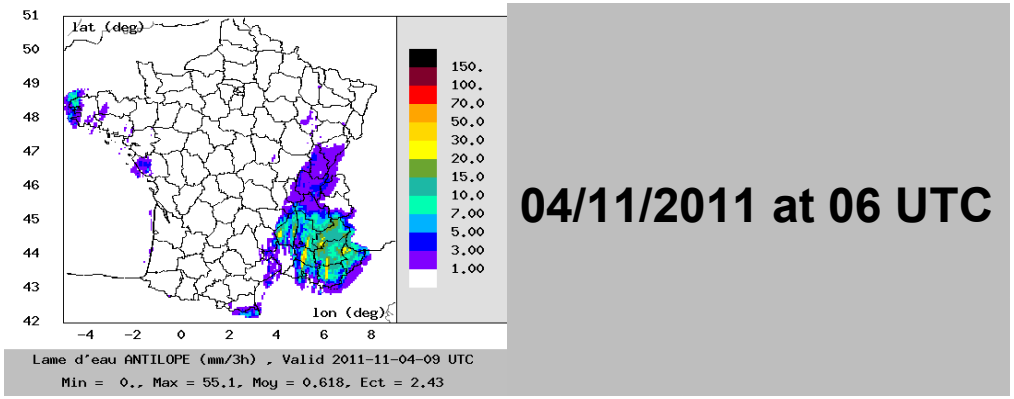
Based on (Piriou 2007) and (Guérémy 2011)

Prognostic equations for convective condensates (ql, qi, qr, qs), vertical velocity (w)

Same microphysics used for resolved and convective precipitations

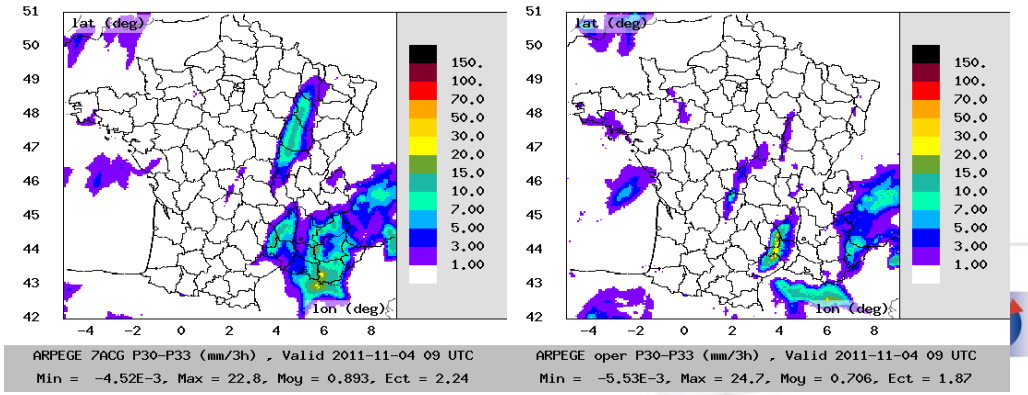
Updraft mesh fraction, entrainment/detrainment function of saturation deficit

Analysis



04/11/2011 at 06 UTC

Arpege with PCMT P33-P30



Arpege Oper P33-P30

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Perspectives

- Arome-France 1.3km:

  - Test modified SL advection scheme taking into account flow deformation (D. Ricard, S. Malardel) and revision of hor. diffusion

  - Adjustments in the physics (SBL scheme Canopy, ECOCLIMAP2, etc.)

  - Validation in assimilation (3D-Var)

- Arpege T1200:

  - Further evaluation of Arpege T1200c2.2L105 with PCMT & PMMC09

  - Fix amount of envelope needed with appropriate tuning of GWD

  - Validation in assimilation (4D-Var+Aearp)

⇒ E-suite start scheduled in June 2014

Thank you
for your attention