Evolution of Météo-France operational models

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CNRM/GAME Météo-France/CNRS

EWGLAM/SRNWP meeting

29th of September / 2nd of October

METEO FRANCE

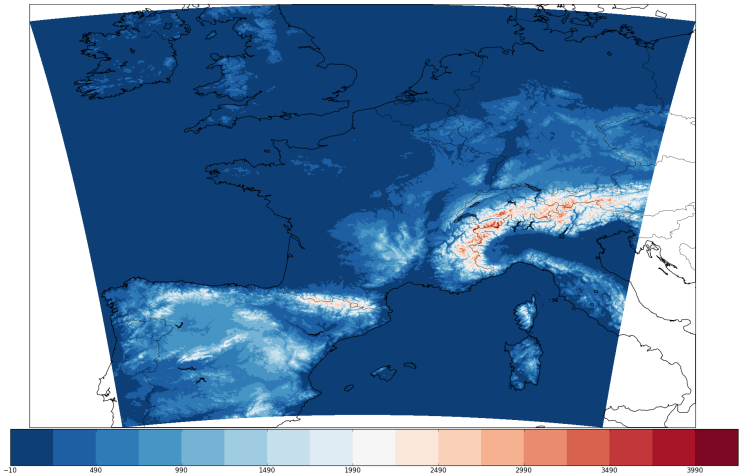
Toujours un temps d'avance

Outlines

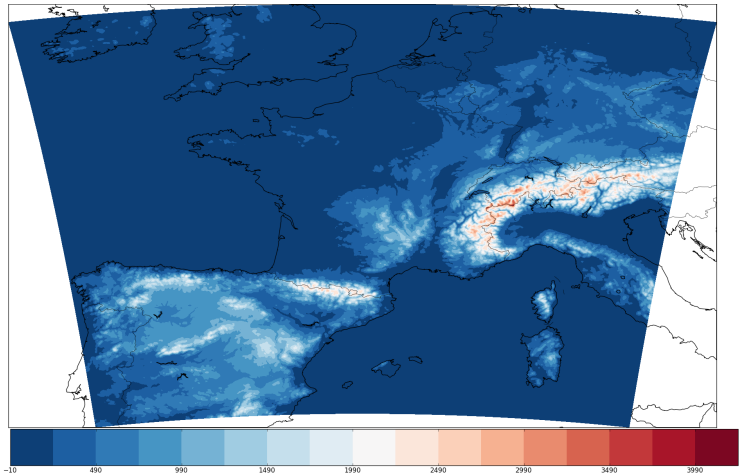
Outlines

New Arome 1.3km domain

Arome 1.3*km*(1440*X*1536)



Arome 2.5*km*(750*X*720)



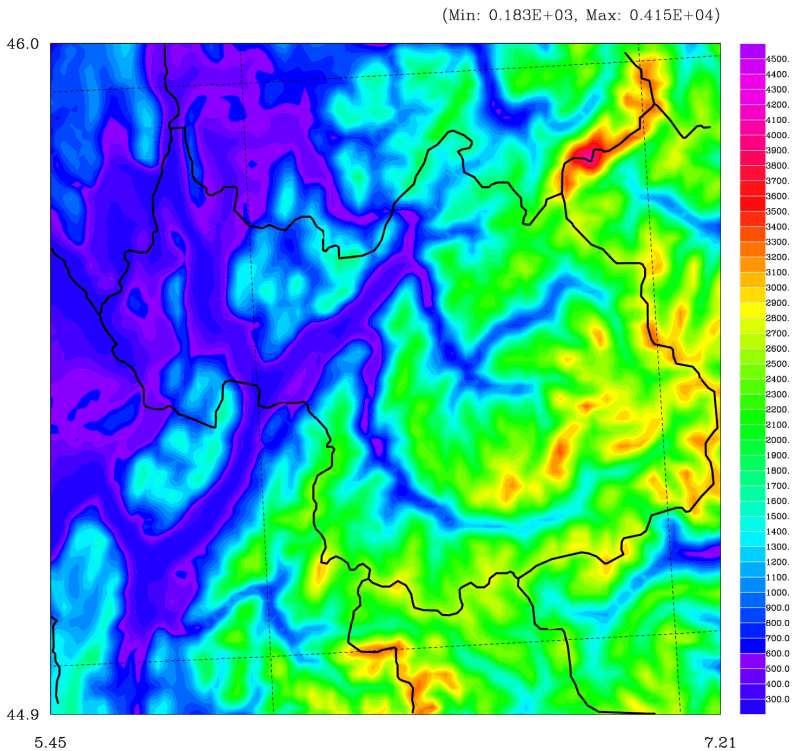
	Arome 1.3*km*	*Arome* 2.5*km*
Max slope	38 °	23 °
Mont Blanc (4807m)	4272m	3870m
Aneto (3404m)	3008m	2812m
MAX(ABS($Z_{model} - Z_{synop}$))	20.6m	58m

Zoom over Alpes

1.3km ZOOM Savoie
Relief

25/02/11 09H40M22
PGDFILE-BRET 46.dia

Arome* 1.3 *km



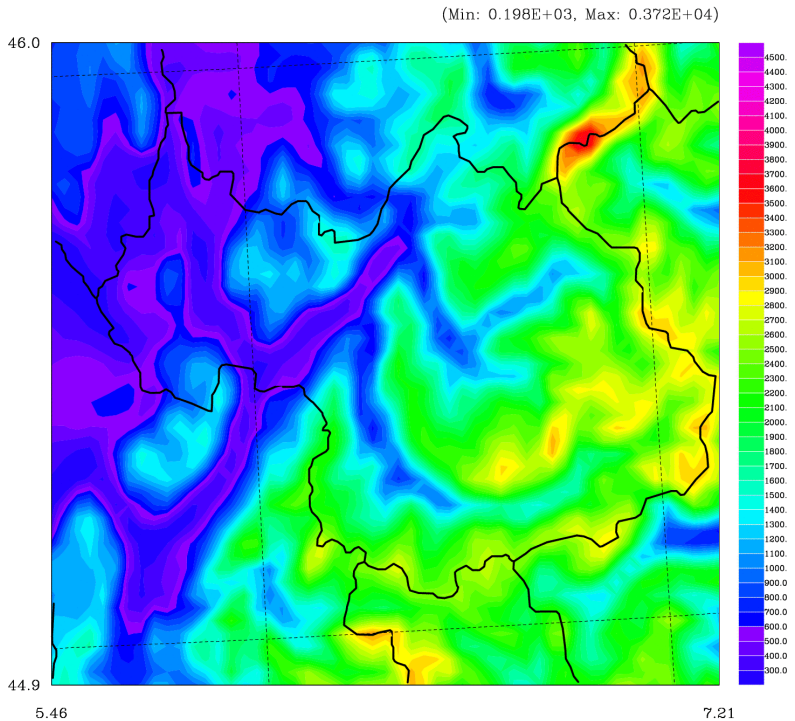
PROJECTION LAMBERT

GMTED2010 (250m)

OPER ZOOM Savoie
Relief

25/02/11 09H3
PGDFILE-FRANGP.dia

Arome* 2.5 *km

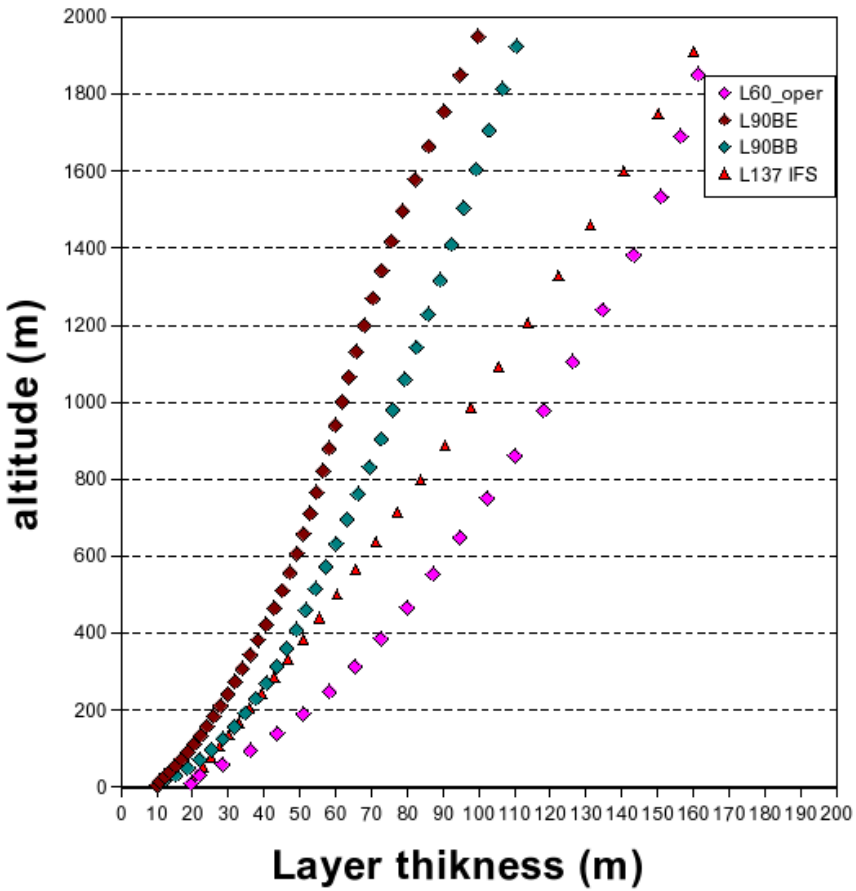


ZS M PROJECTION LAMBERT

GTOPO30 (1km)

Vertical resolution

	Arome 1.3*km*	*Arome* 2.5*km*
Nb vertical levels	90	60
Top model level	10 hpa	1 hpa
Lowest model level	5m	10m
Nb levels $<$ 2000m	33	21



Outlines

Arome 1.3 km : Dynamic

	Arome 1.3*km*	*Arome* 2.5*km*
Δt	45s	60s
P/C scheme (NSITER=1)	T	F
P/C cheap	T	F
New SL interpolator (COMAD)	T	F
Coupling zone (Davies)	16 points	8 points
Top spectral relaxation	T (retuned)	T

COMAD : New SL interpolator

Modified weigths (Ricard, Malardel and Yessad)

For linear weights (λ_x, λ_y) new weigths are defined :

$$\begin{cases} \lambda'_x = \lambda_x D_x + 0.5(1 - D_x) \\ \lambda'_y = \lambda_y D_y + 0.5(1 - D_y) \end{cases}$$

D_x and D_y are deformation factors. They take into account the deformation of air parcels along each direction :

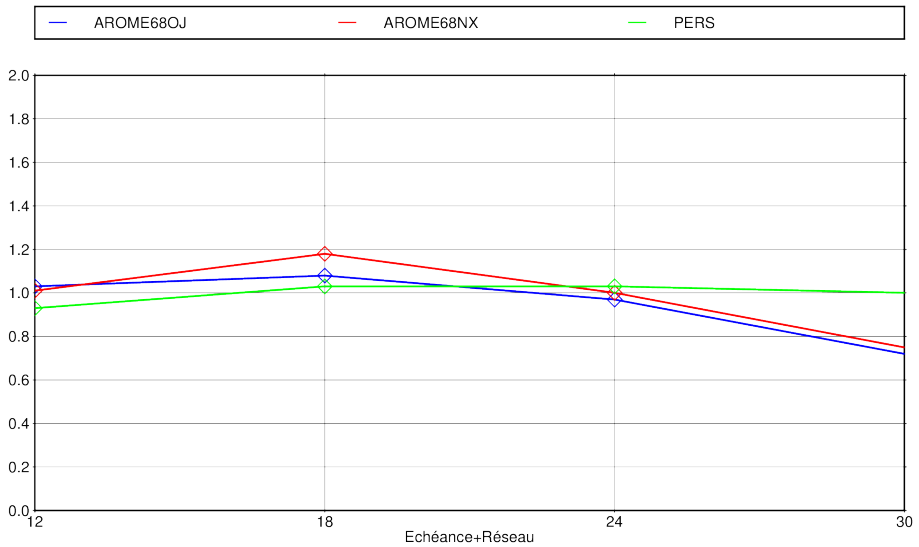
$$D_x = 1 + \frac{\partial U}{\partial x}\Delta t$$

$$D_y = 1 + \frac{\partial V}{\partial y}\Delta t$$

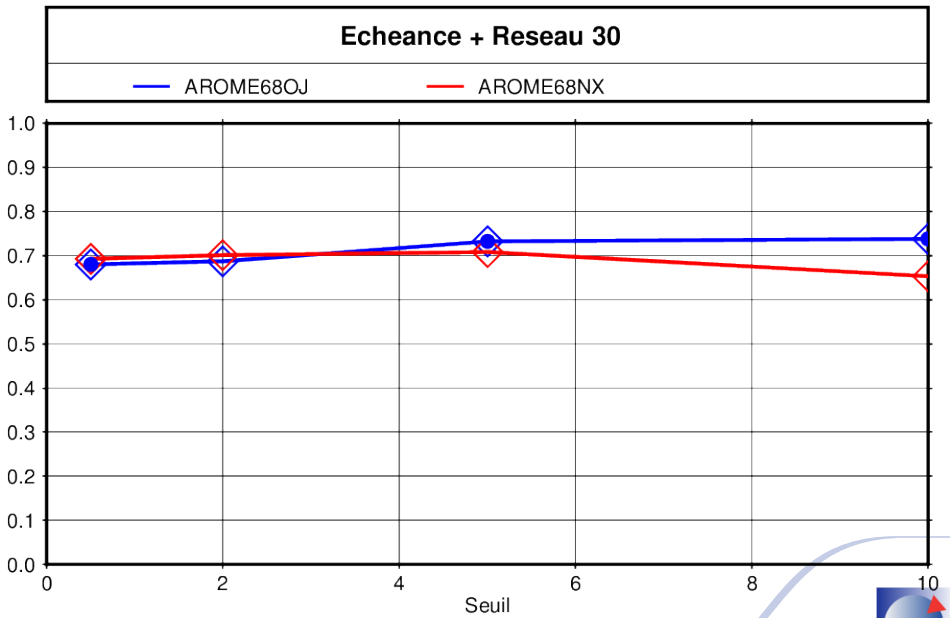
Impact of new SL interpolators. Precipitation July 2014

Arome
Arome COMAD

Bias

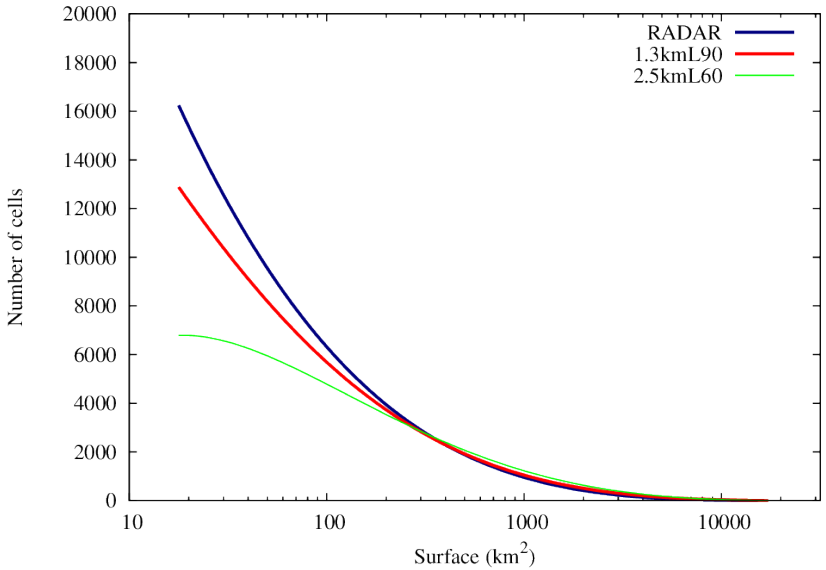


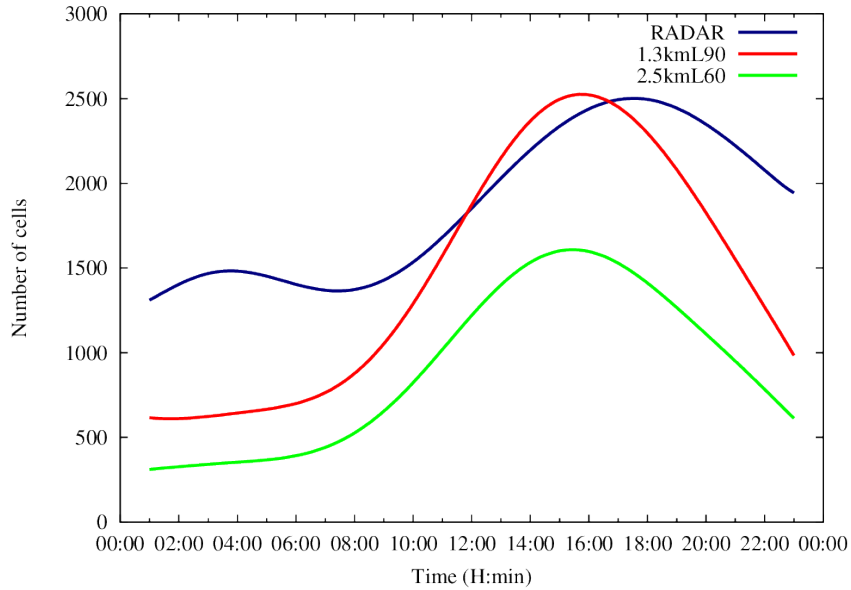
BSS



Statistics on convective cells

- 41 dBz threshold, one picture per hour
- 48 convective days in 2012

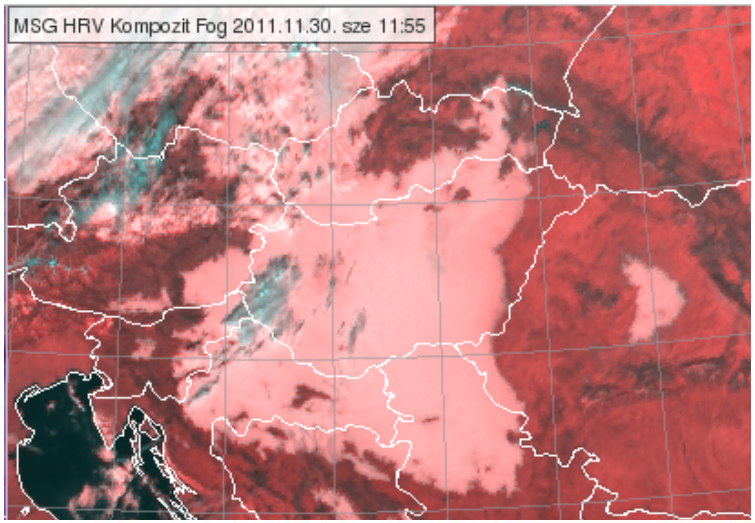


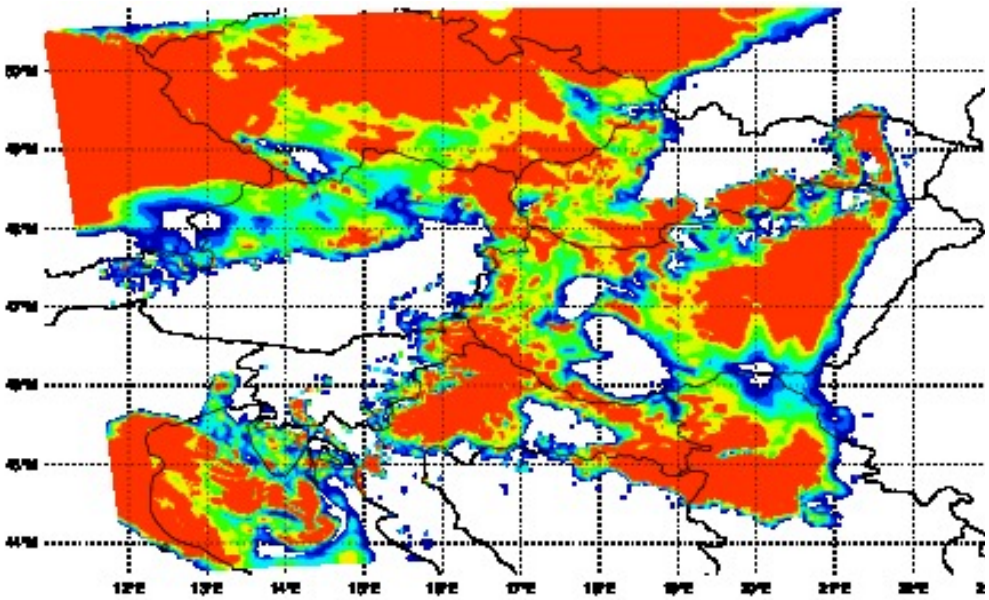


- More small cells in Arome 1.3km
- Arome 1.3km is closer to radar observations

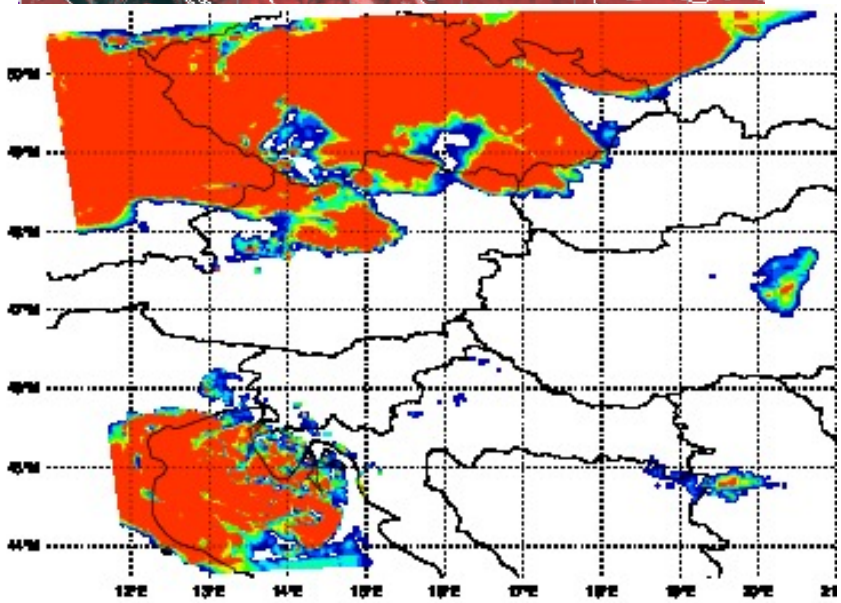
Winter fogs/stratus

Over Hungria in winter, fog disappears in Arome (not in Arpege)
Problem studied in the frame of Balaton project (E. Bazile, Y. Seity and B. Szintaï)



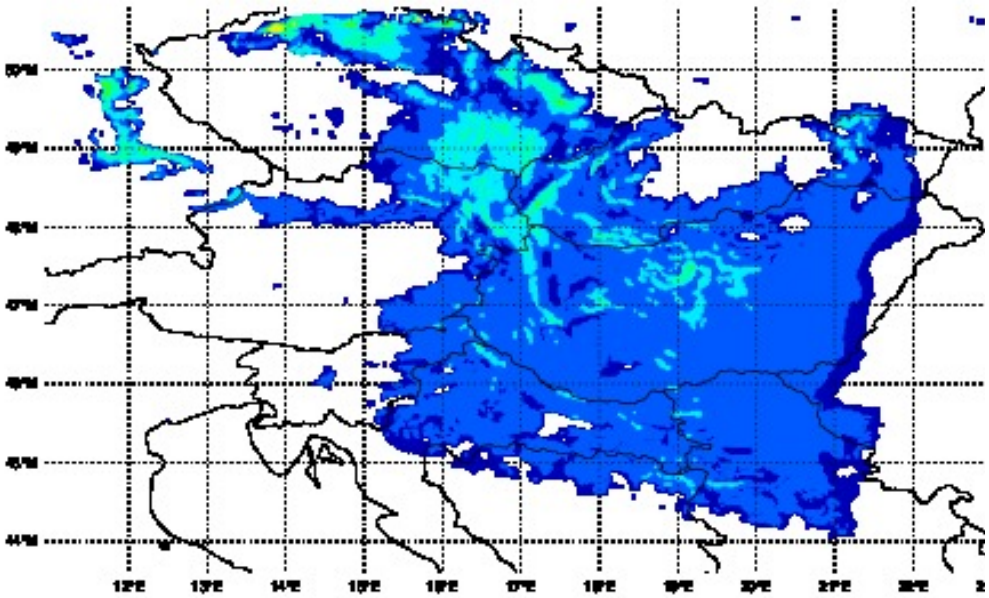


Arpege

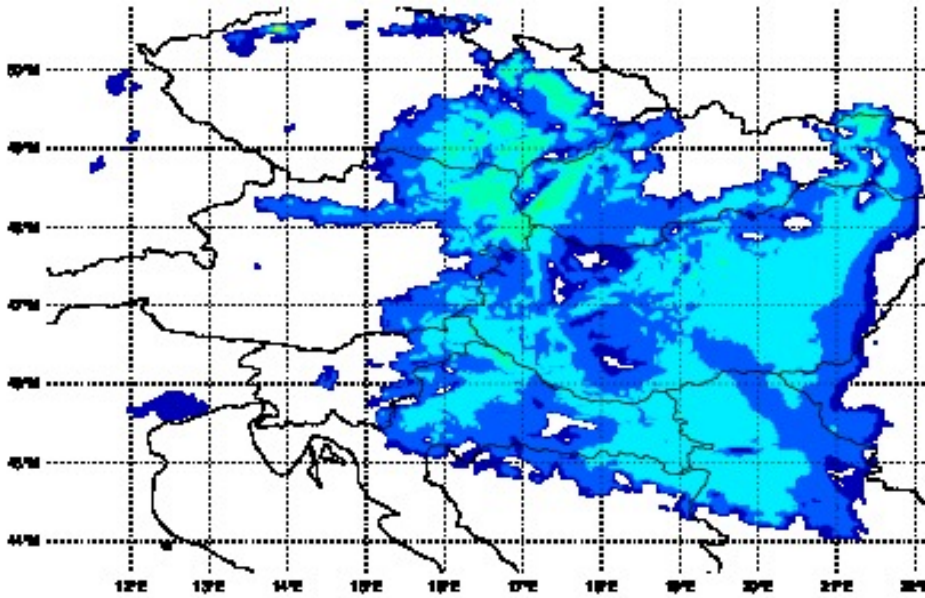


Arome

Winter fogs/stratus ⇒ More snow in Arome



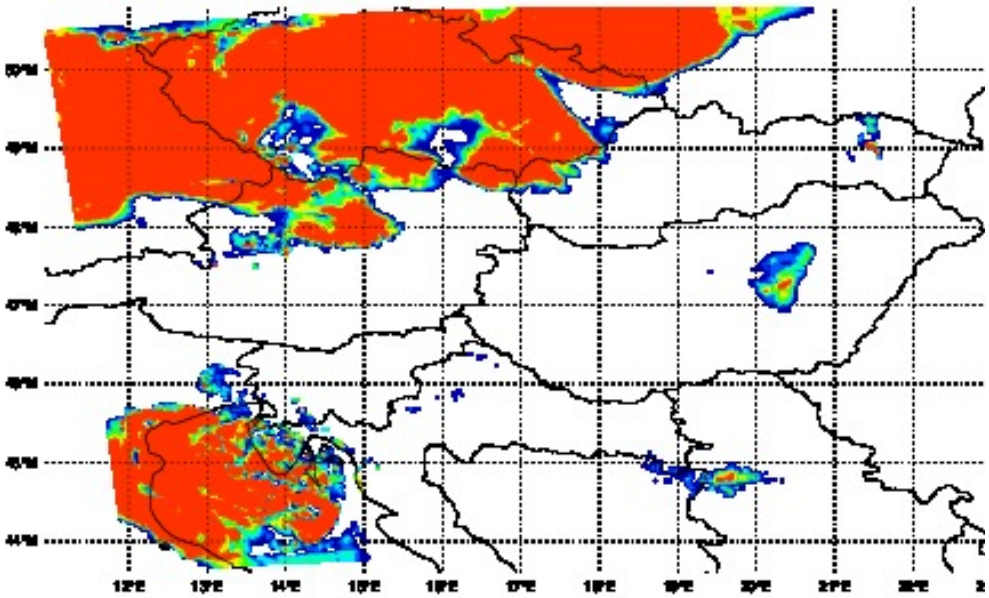
Arpege



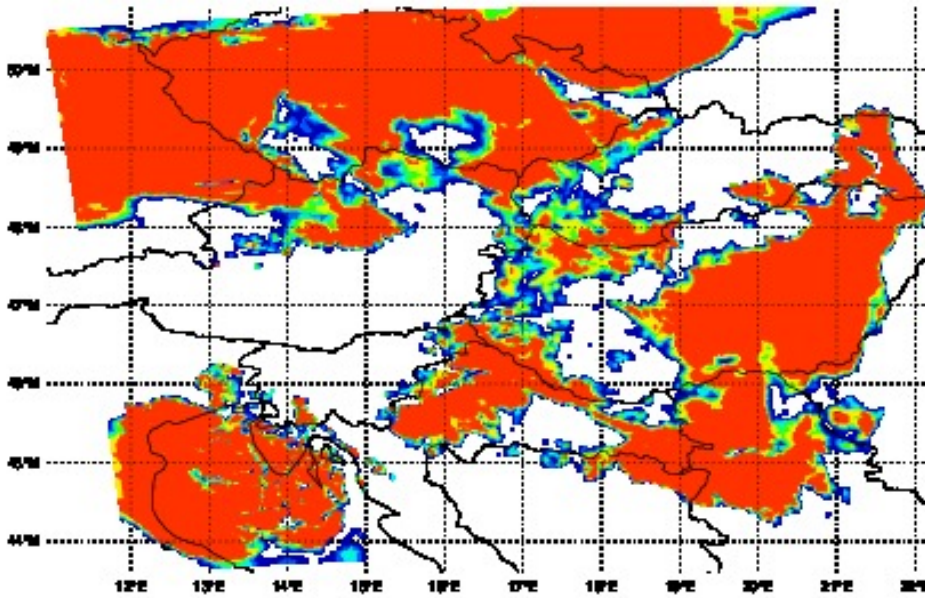
Arome

In Arome, snow growth is due to vapor deposition, a process not taken into account in Arpege microphysics

Winter fogs/stratus ⇒ Tuning of autoconversion



Arome $q_{i0} = 0.2\,10^{-4}$



Arome $q_{i0} = 1.\,10^{-3}$

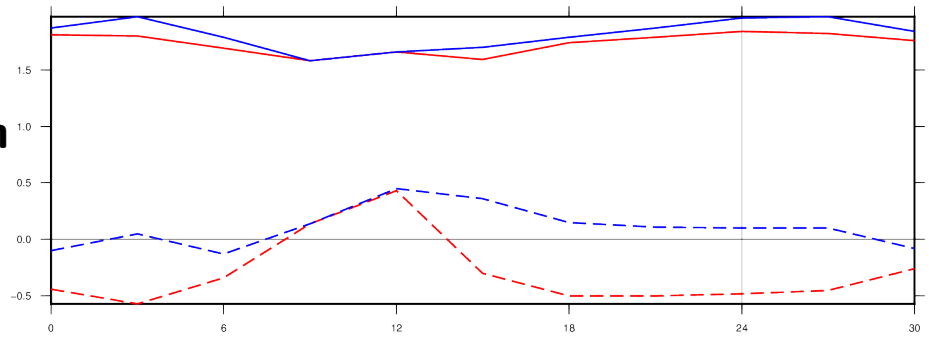
- In the experimental suite it was decided to set $q_{i0} = 0.2\,10^{-3}$
- This modification has no impact on the quality of precipitation forecasts

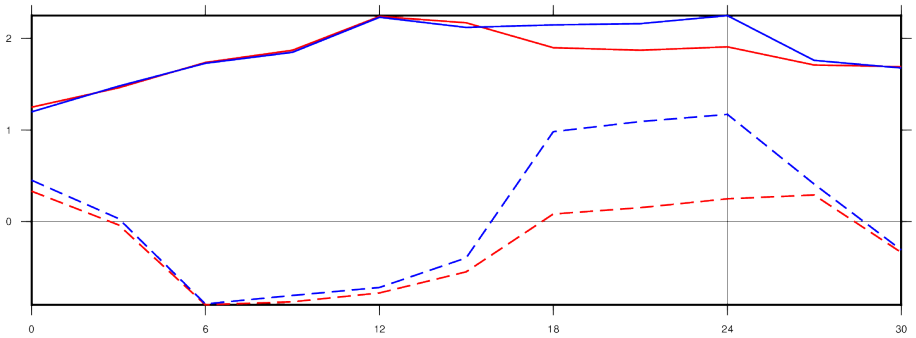
Impact of Canopy Surface Boundary Layer scheme

Arome with SBL scheme / Arome without SBL scheme

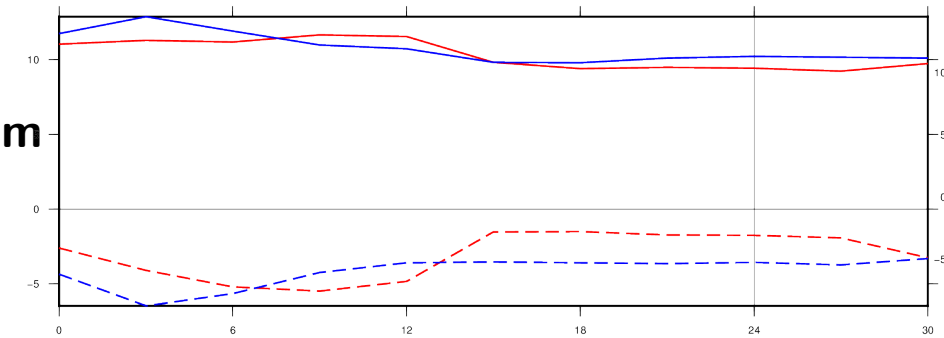
Jan 2013 | **Jul 2013**

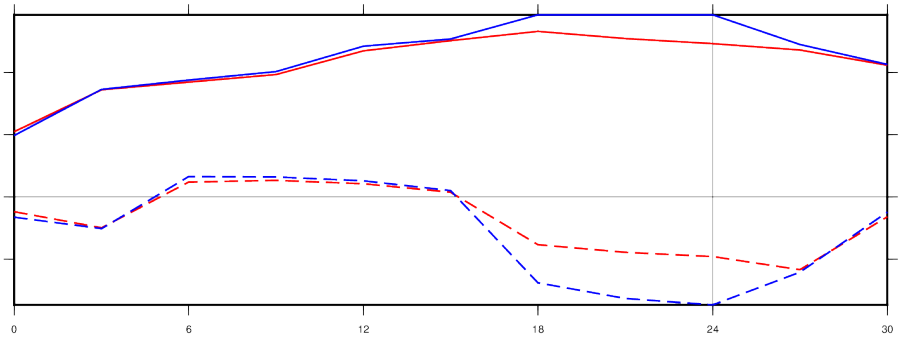
T2m





Hu2m





Results are better without Canopy Boundary Layer Scheme

Outlines

Structure of the high resolution Arpege 4DVAR e-suite

Structure of the future 4DVAR Arpege

- T1198 L105 C=2.2 ($\approx 7km$) $\delta t = 360s$
- 40 iterations T149 ($\delta t = 1350s$) + 40 iterations T399 ($\delta t = 900s$)
- 25 members EDA (6 presently) T479 ($\delta t = 720s$)

Physics evolution

- PCMT (New deep convection scheme)
- PMMC09 with some adjustments (Shallow convection scheme of Arome)

PCMT a new deep convection scheme for Arpege

Motivations

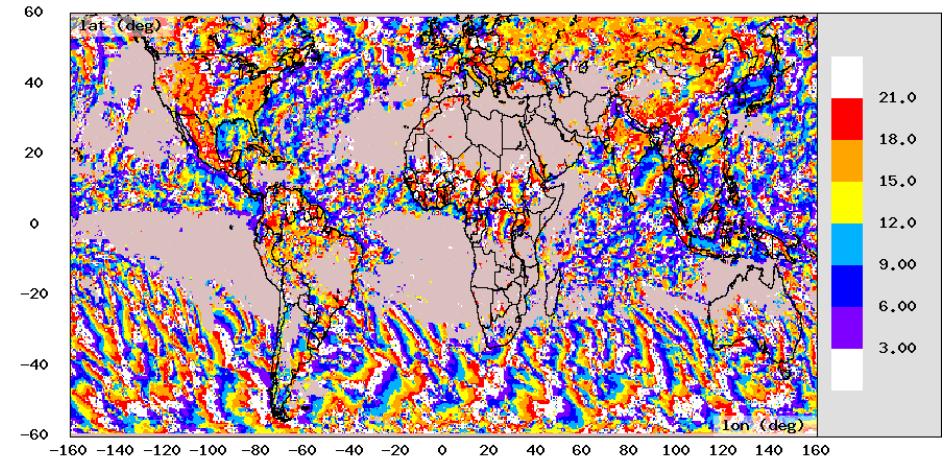
- More intermittent convective precipitation
- Delayed diurnal cycle
- Reduction of unexpected cyclogenesis
- Decreasing of high troposphere tropical cold bias

General characteristics

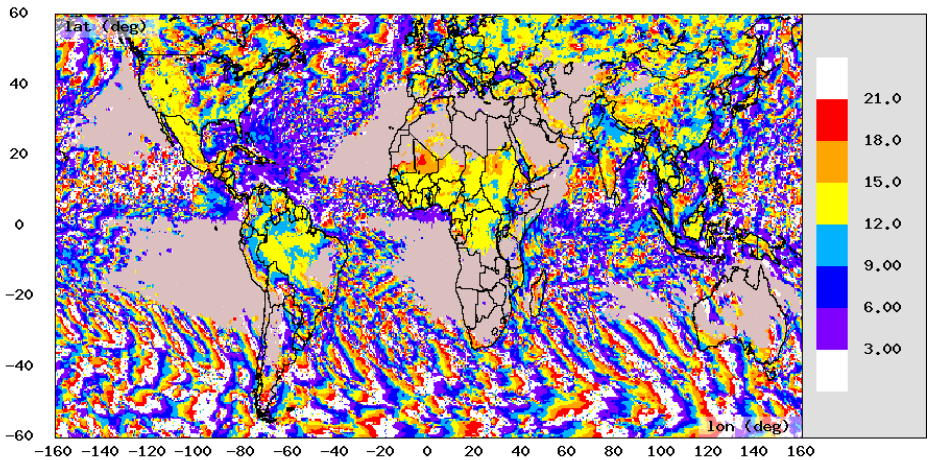
- Separation between microphysics and transport (Piriou 2007) [1]
- 5 new prognostic variables w_u q_l q_i q_r q_s
- Same microphysics scheme as for stratiform precipitation
- Several formulations for entrainment, detrainment and closure

1. Piriou, J.-M., Redelsperger, J.L., Geleyn, J.-F., Lafore, J.-P., and Guichard, F. (2007). An approach for convective parametrization with memory : separating microphysics and transport in grid-scale equations. *J. Atmos. Sci.*, **64** :4127-4139.

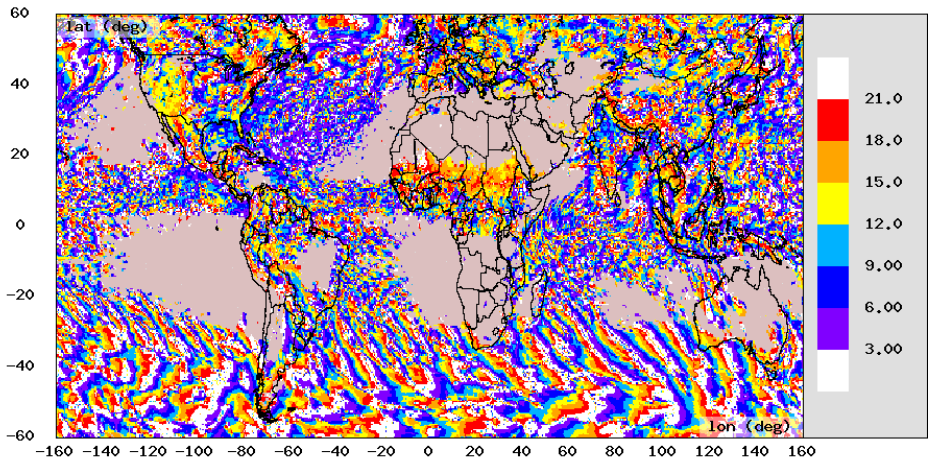
PCMT : Improvement of diurnal cycle



Local time max. diurnal precipitation wave (h) , cmorph , 20130701-20130731.cmorph
Min = 2.88E-3, Max = 24.0, Moy = 12.2, Rcm = 13.7

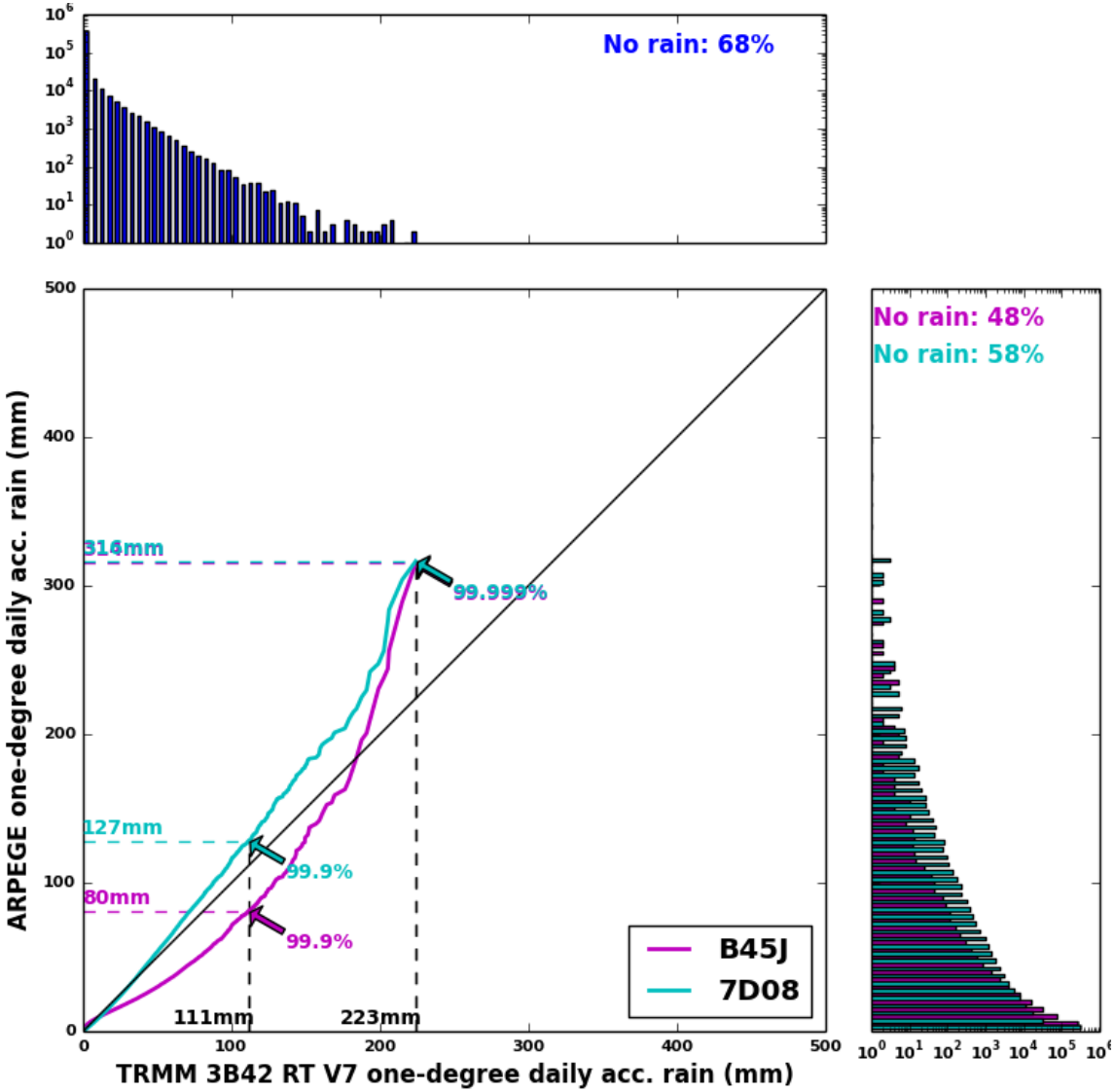


Local time max. diurnal precipitation wave (h) , B45J , 20140701-20140731.B45J
Min = 1.19E-3, Max = 24.0, Moy = 11.1, Rcm = 12.5

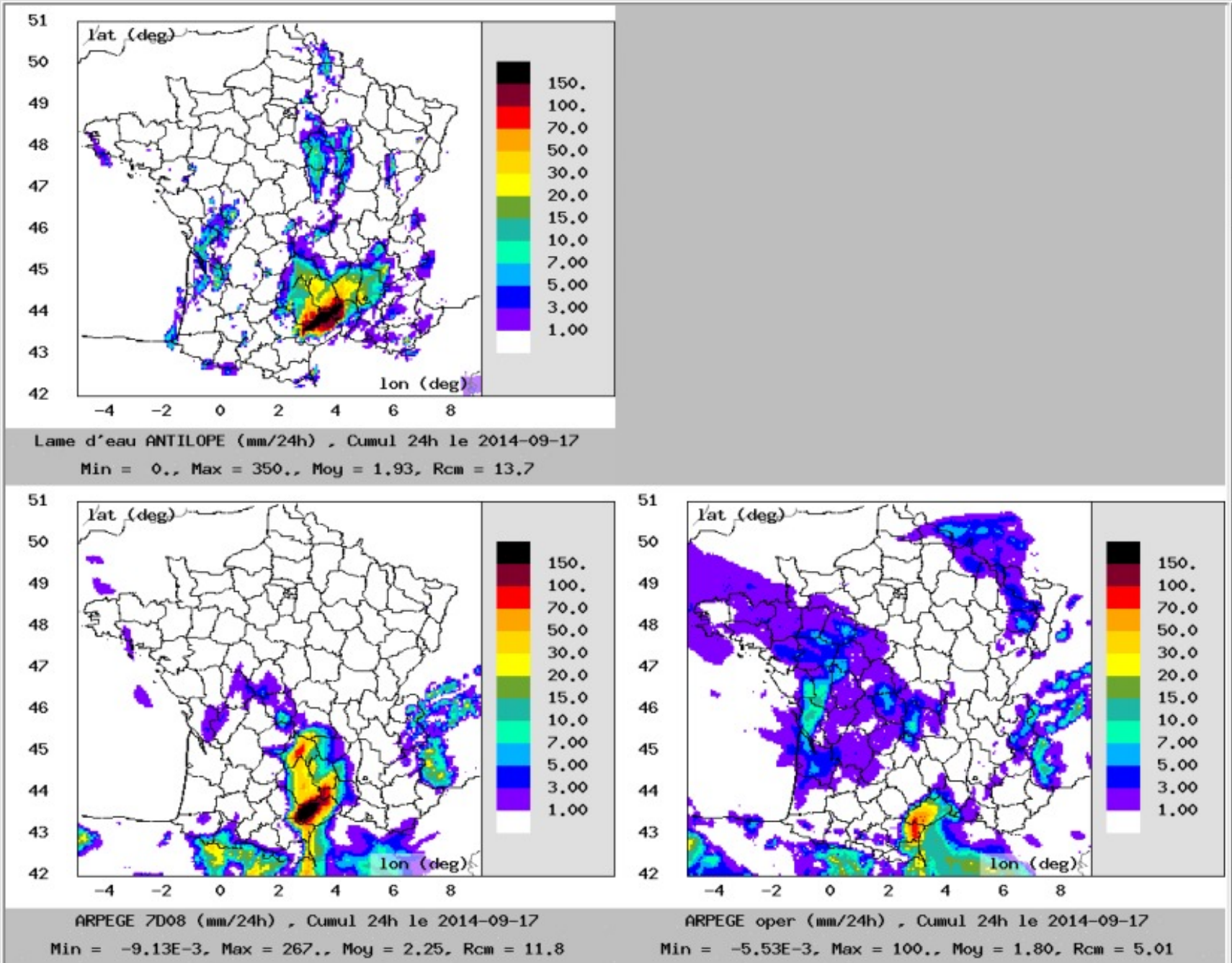


Local time max. diurnal precipitation wave (h) , 7D08 , 20140701-20140731.7D08
Min = 3.11E-3, Max = 24.0, Moy = 11.3, Rcm = 12.9

PCMT : Improvement of precipitation statistics (24h-48h)



PCMT : 17 of September cévenol event



PMMC09 in ARPEGE

Modifications to use PMMC09 in ARPEGE

- Numerical stabilization by implicit resolution of full EDMF equation : $\left(\frac{\partial \psi}{\partial t}\right)_{edmf} = \frac{1}{\rho}\frac{\partial}{\partial z}\left(-k\frac{\partial \psi}{\partial z} + M\left(\psi_{up} - \overline{\psi}\right)\right)$
- New formulation of entrainment and detrainement (Rio et al 2011) [2]
- Optionally, new formulation of closure (Hourdin et al 2002) [3]

3. Rio C, Hourdin F, Couvreux F, Jam A (2010) Resolved versus parameterized boundary-layer plumes. Part II : continuous formulations of mixing rates for mass-flux schemes. *Boun. Layer Meteor.* **135** :469-483.

4. Hourdin F, Couvreux F, Menut L (2002) Parameterization of the dry convective boundary layer based on a mass flux representation of thermals. *J Atmos Sci* **59** :1105-1122

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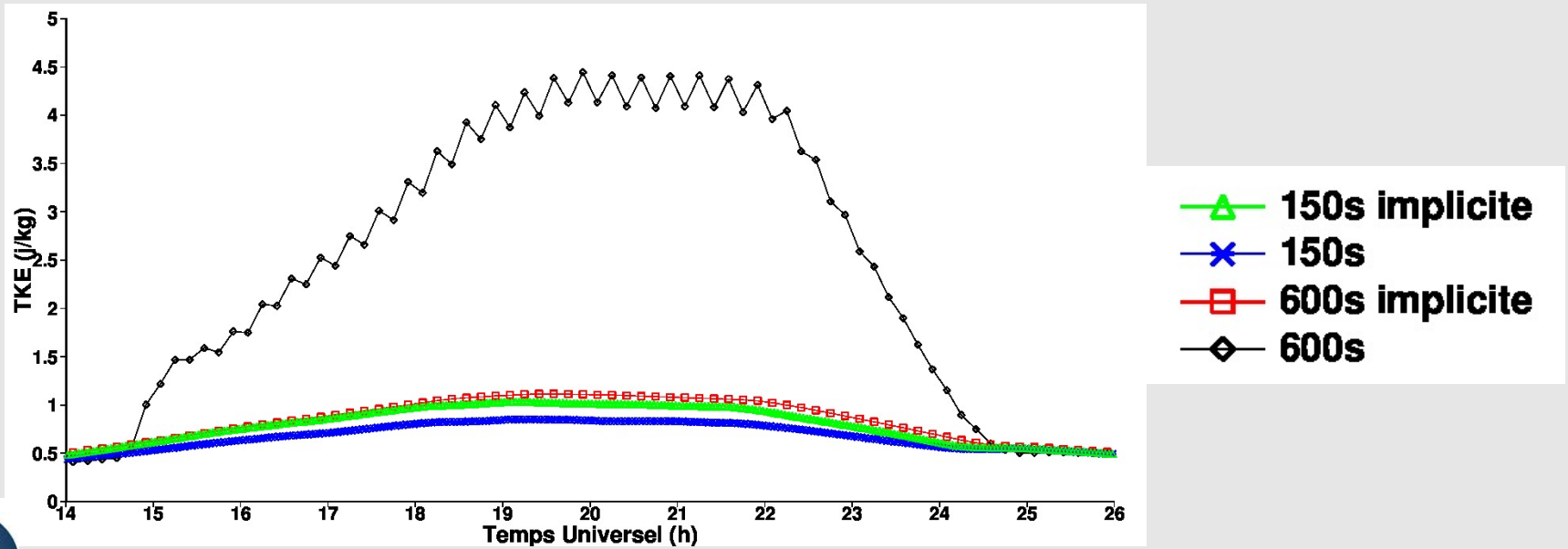
Numerical stabilization : TKE lowest level 1D Arm Cu case



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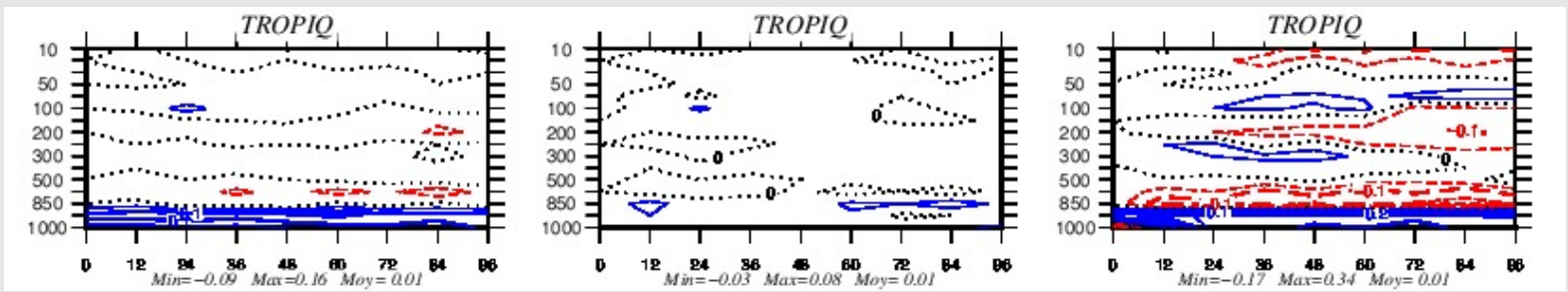
PCMT+PMMC09 against PCMT alone (Temperature)



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Outlines

Schedule of the high resolution e-suite

- Start of the e-suite in July under GMAP control
- Transfer to operational control in september
- Adjustment in October (Arpege physics evolution if ok)
- Operational in March 2015


Thank you
Some questions ?
METEO FRANCE
Toujours un temps d'avance