

Status of ARPEGE and AROME physics

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Plan

-> Arome and Arpege experimental suite

- AROME

- ARPEGE

- Not yet in present e-suite ! → PCMT and PMMC09 (partly due to time constraints, e-suite must be short)

-> On going work

- High resolution in ARPEGE (T1200 C=2.2 L105 → 7km over France and first level around 10m, 17m presently)

- High resolution in AROME (1.3km L90 Dt=45s first level at 5m) (Yann Seity)

- Grey zone of turbulence (Rachel Honnert)

AROME and ARPEGE e-suite (cy38t1)

-> Arome

- Correction of negative humidity at the end of analysis
- New version of SURFEX (v7.2)
- Deactivation of CANOPY over sea to avoid instability in case of strong wind

-> Arpege

- Modification in deep convection scheme to avoid unexpected cyclogenesis (François Bouyssel)
- Modification of the thermal inertia, albedo and z0 for glacier (Eric Bazile)
- Modification in KFB shallow convection scheme (Eric Bazile)

Modification of the thermal inertia, albedo and z0 for glacier (type 2) in ARPEGE. (Eric bazile)

For the CONCORDIASI experiment, and thanks to a comparison done with E.Brun with Surfex-Crocus, the thermal inertia, albedo and roughness length of glacier were modified to obtain a better diurnal cycle at DomeC.

Z0=0.01 instead of 0.001,

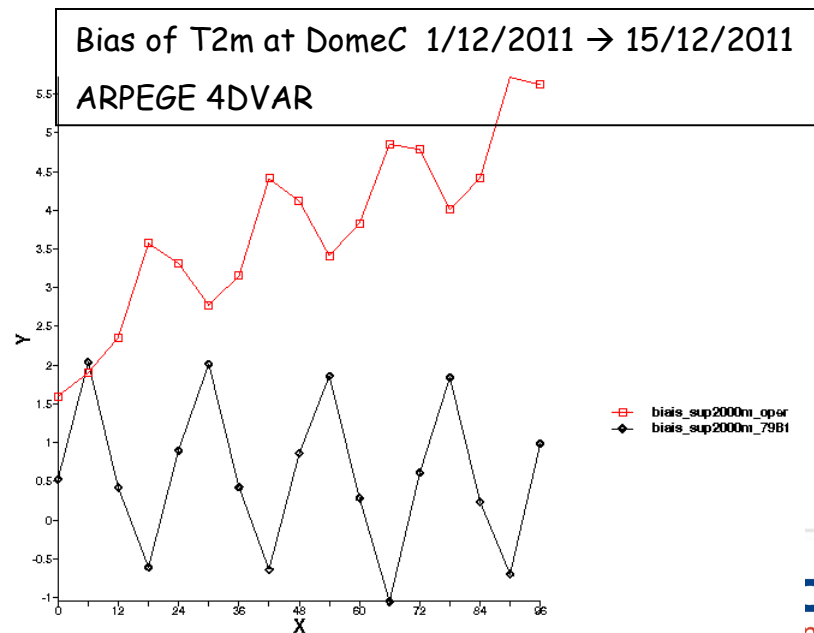
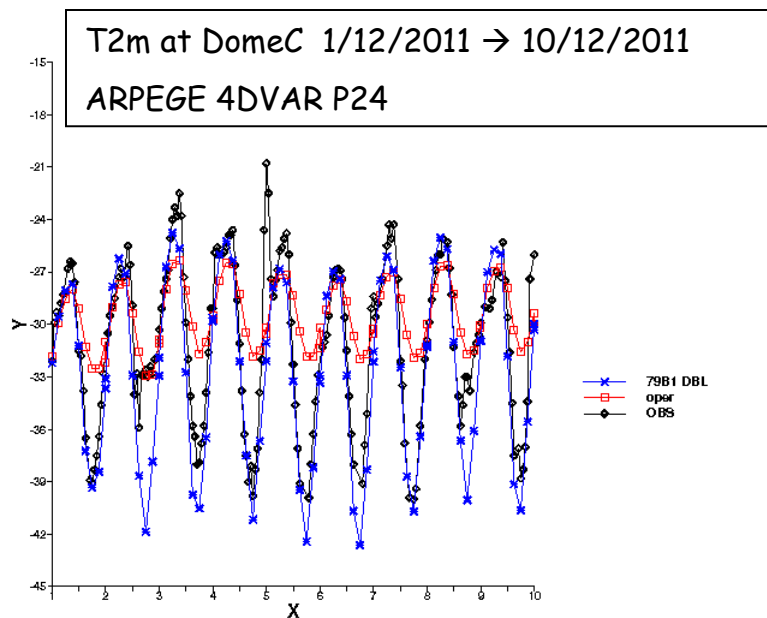
Albedo=0.81 instead of 0.75

Cn= from Douville (95) formulation instead of a constant value 0.55E-5(Km2/J)

$$Cn = 2 * \sqrt{\frac{7.777 e^{-12}}{\rho^{2.885}}}$$

for a density of 0.3 Cn=3.16E-5

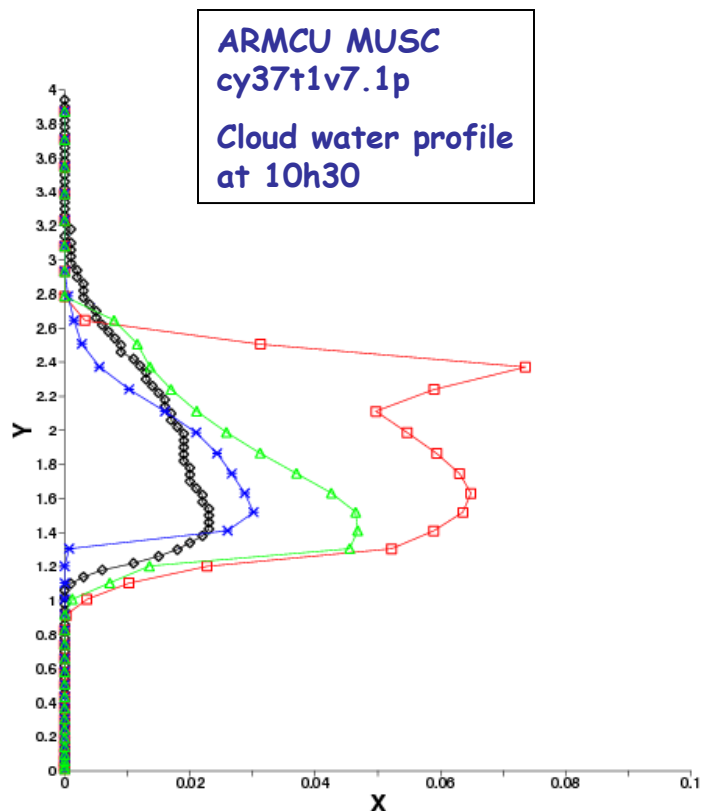
for a density of 0.1 Cn=15.5E-5



Modification in the ARPEGE shallow convection scheme KFB (Eric bazile)

Motivations:

1. Reduce the cloud water content and suppress the maximum of q_c at the cloud top
2. Increase the connection with the TKE scheme via $W_{up} = f(TKE)$ (oper 1m/s) and the temperature perturbation $f(TKE)$ instead of a fixed value: 0.3K



$$q_c^{cvpp}(j) = \tau_{KFB} \frac{\partial q_c(j)}{\partial t} \times \frac{M_f(j)}{\max(M_f)}$$

3600s → 7200s

$$W_{up} = XAW * \sqrt{TKE/3} + XBW$$

Oper XAW=0. XBW=1.

DBL XAW=1. XBW=0.5

$$\delta T = \left(a \frac{TKE}{C_p} + b \right) \times XDTPERT$$

Oper a=0. b=1. XDTPERT=0.3

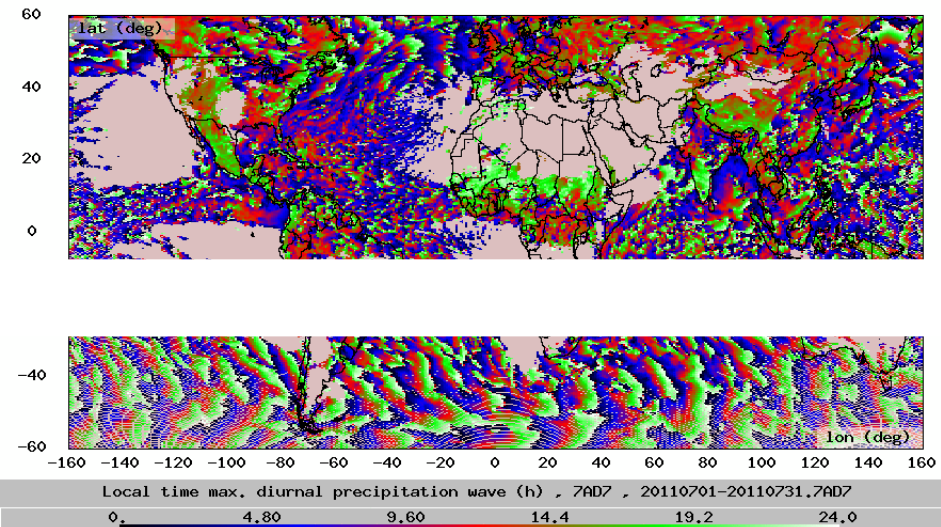
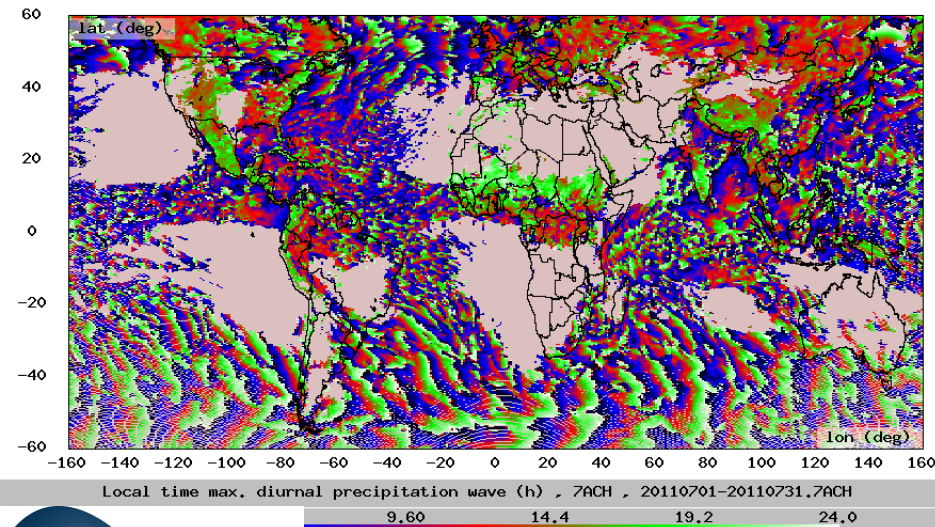
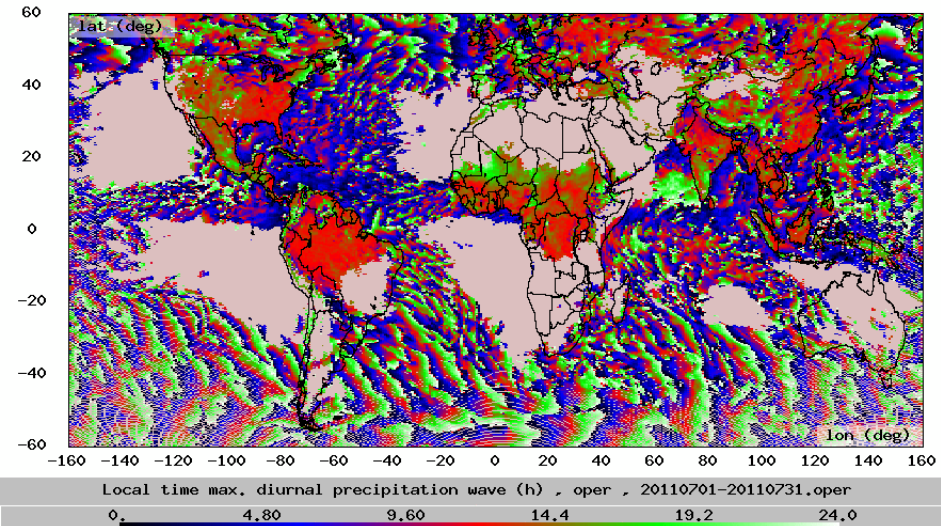
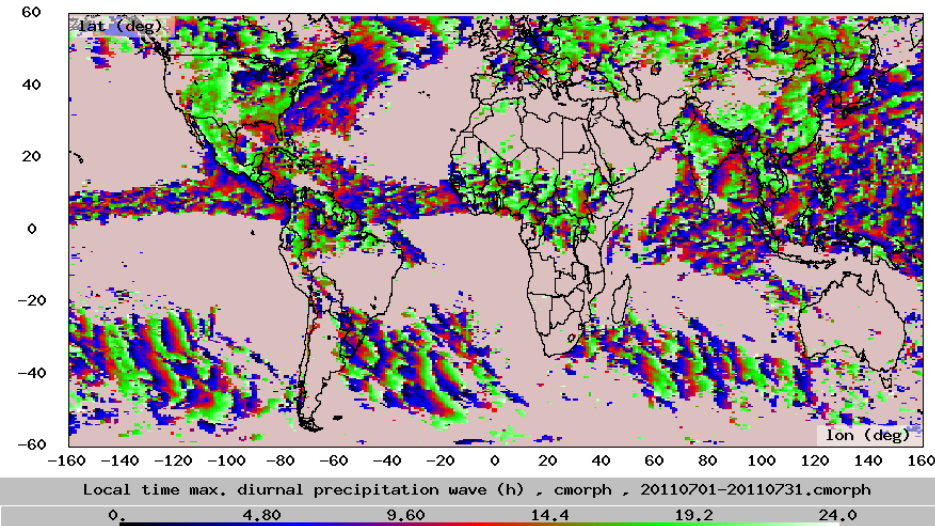
DBL a=500 b=0.5 XDTPERT=0.3

▲ ARPEGE DBL
× AROME
◻ ARPEGE
◆ LES

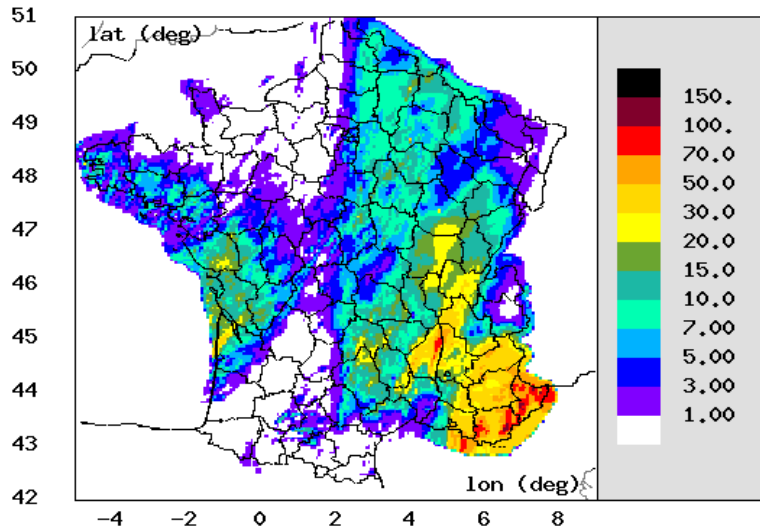
PCMT(Jean-Marcel Piriou) : diurnal cycle

Observation (CMORPH)

ARPEGE operational



PCMT : better coast behaviour

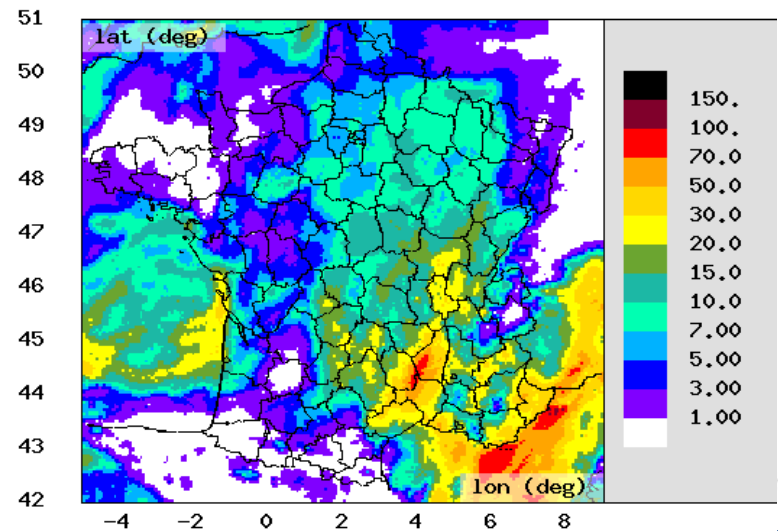
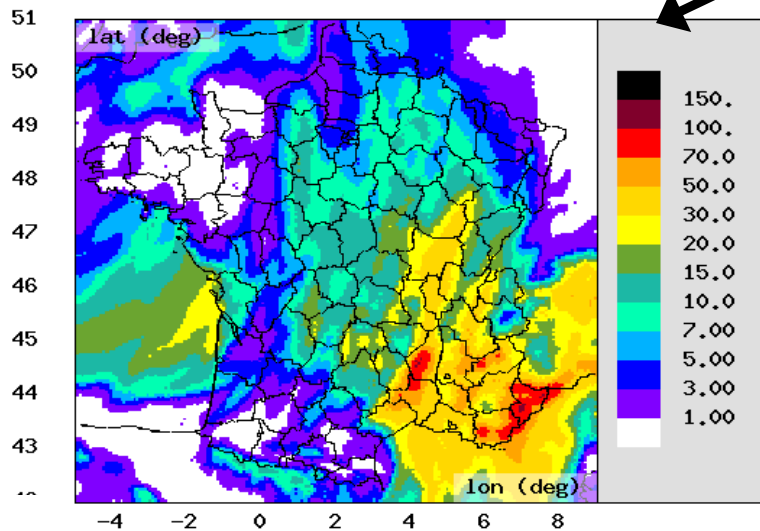


← Radar observation

ARPEGE PCMT

ARPEGE oper

Lame d'eau ANTILOPE (mm/24h) , Cumul 24h le 2011-10-25
 Min = 0., Max = 129., Moy = 5.04, Ect = 10.6



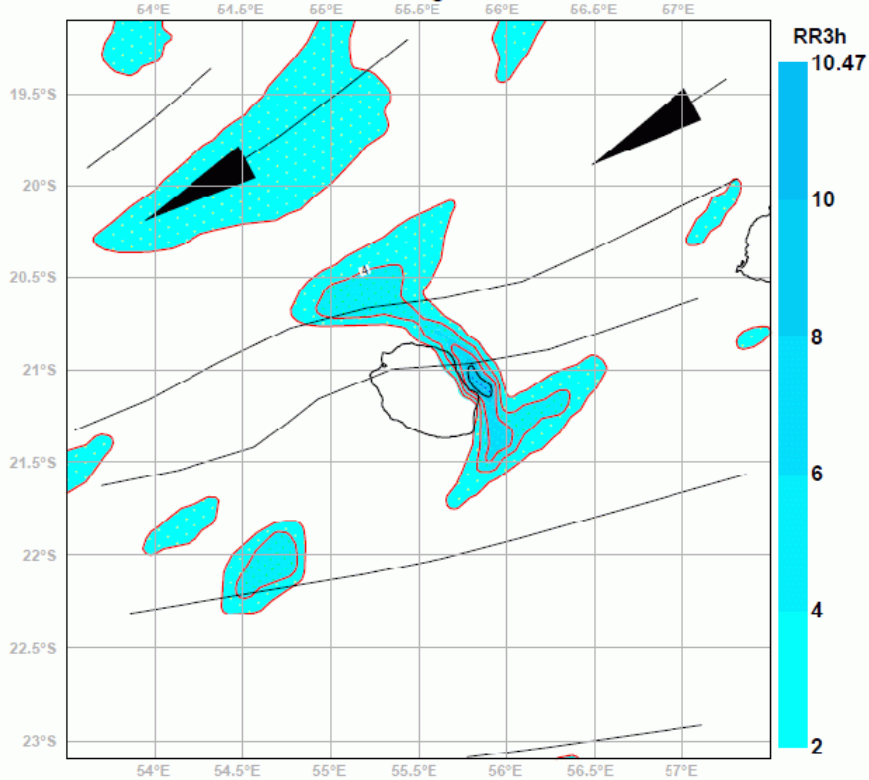
ARPEGE 7ACG (mm/24h) , Cumul 24h le 2011-10-25
 Min = -5.13E-3, Max = 120., Moy = 11.2, Ect = 14.2

ARPEGE oper (mm/24h) , Cumul 24h le 2011-10-25
 Min = -6.86E-3, Max = 126., Moy = 10.2, Ect = 13.3

PCMT : Better coast behaviour : La Réunion island

----- PREVISION sur 09S pour Aladin à 18h (base : 2012-02-13 00:00:00) -----

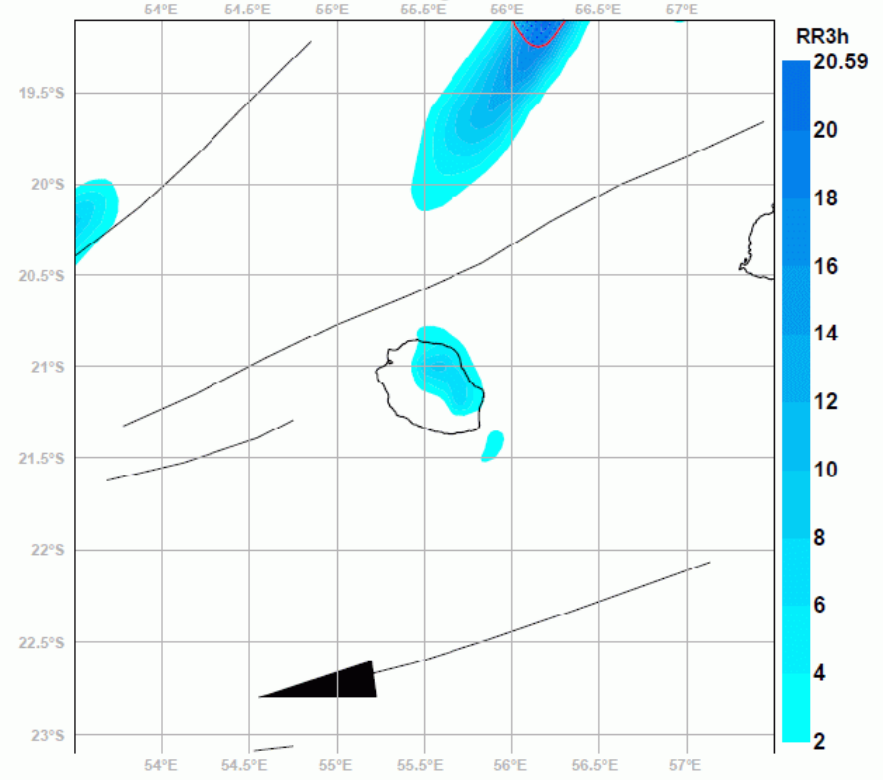
RR3h et lignes de flux



ARPEGE oper

----- PREVISION sur 09S pour AladinPCMT à 18h (base : 2012-02-13 00:00:00) -----

RR3h et lignes de flux

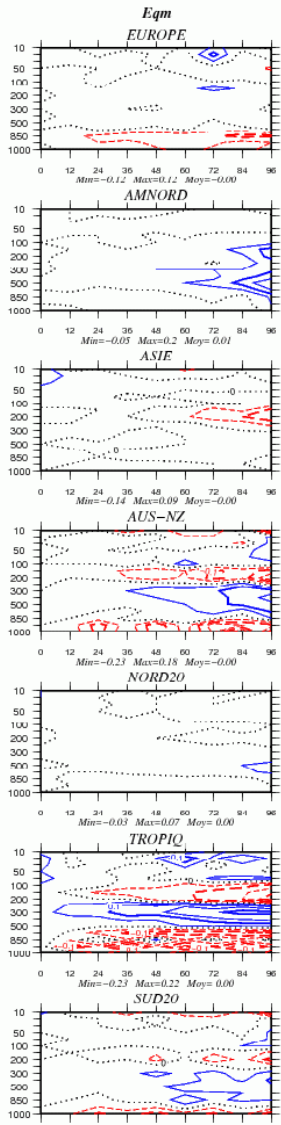


ARPEGE PCMT

PCMT : scores vs TEMP, Jan-Fev 2012

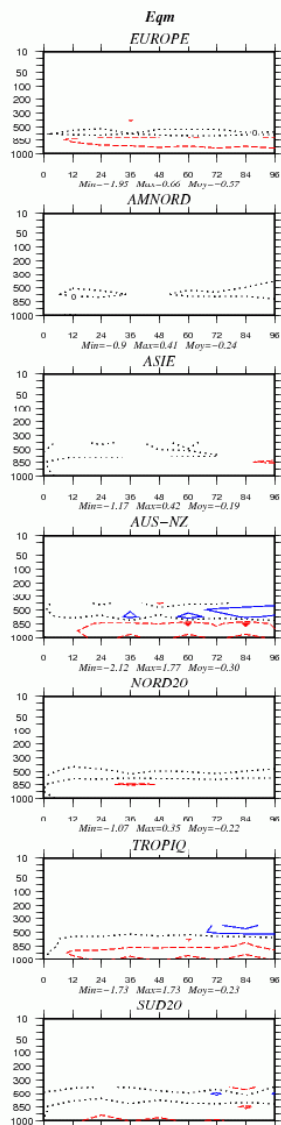
TEMPERATURE:

56 simulations



HUMIDITE:PA

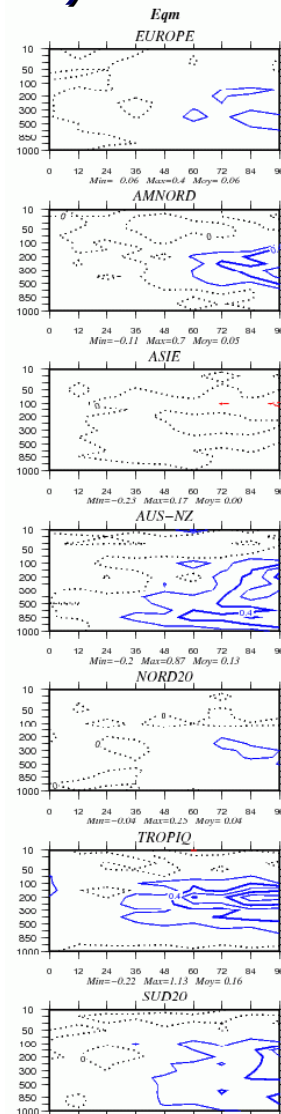
56 simulations



(force)

VENT:PA.r (

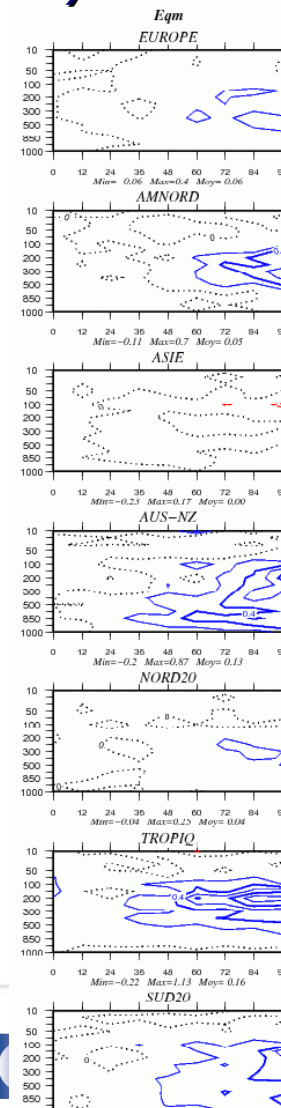
56 simulations



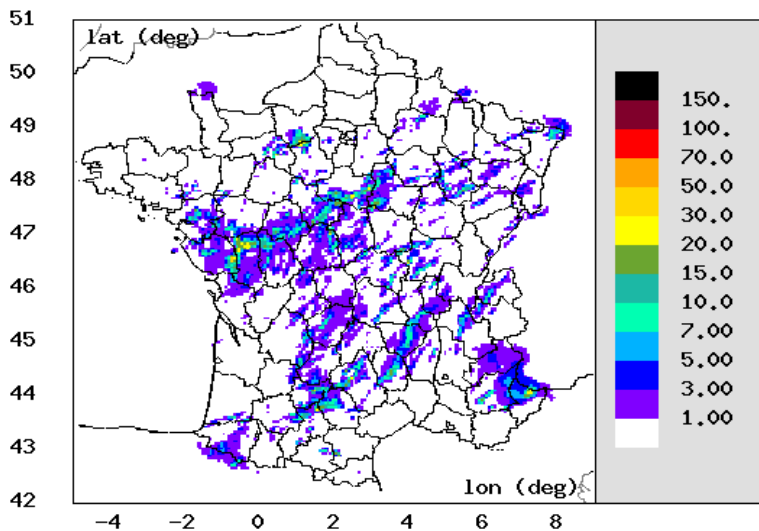
(vector)

VENT:PA.r

56 simulations



PCMT : Some problems with horizontal variability over France

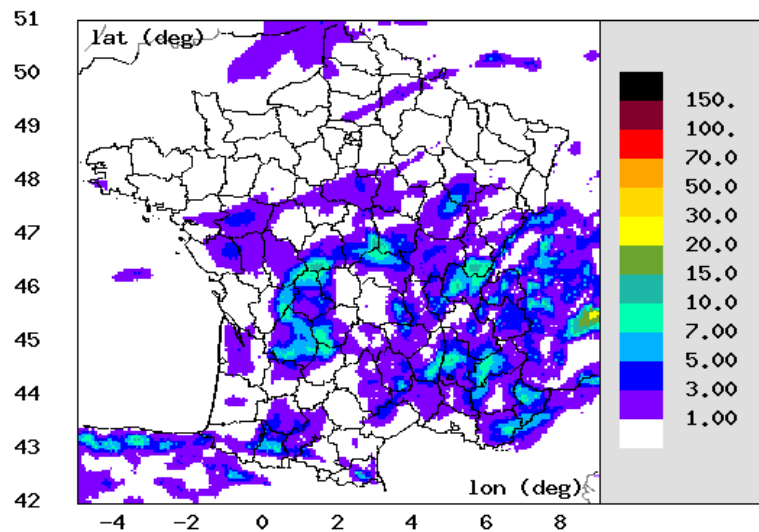
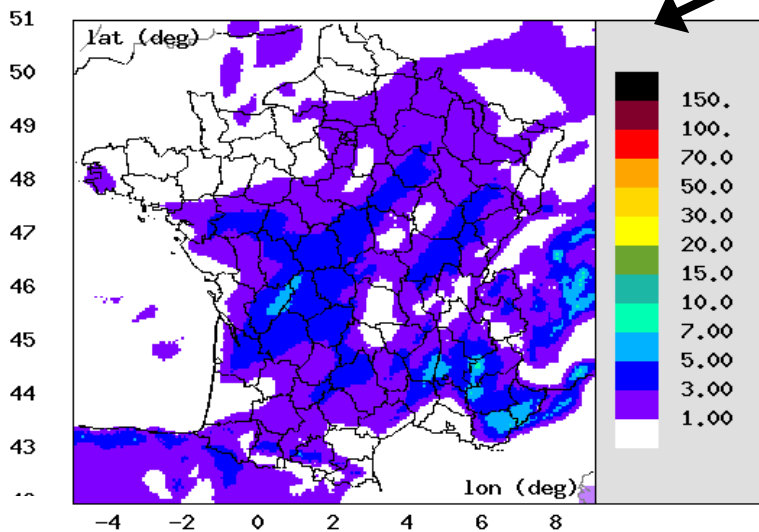


← Radar observation

ARPEGE PCMT

ARPEGE oper

Lame d'eau ANTILOPE (mm/3h) , Valid 2012-05-05-15 UTC
 Min = 0., Max = 32.2, Moy = 0.540, Ect = 1.72

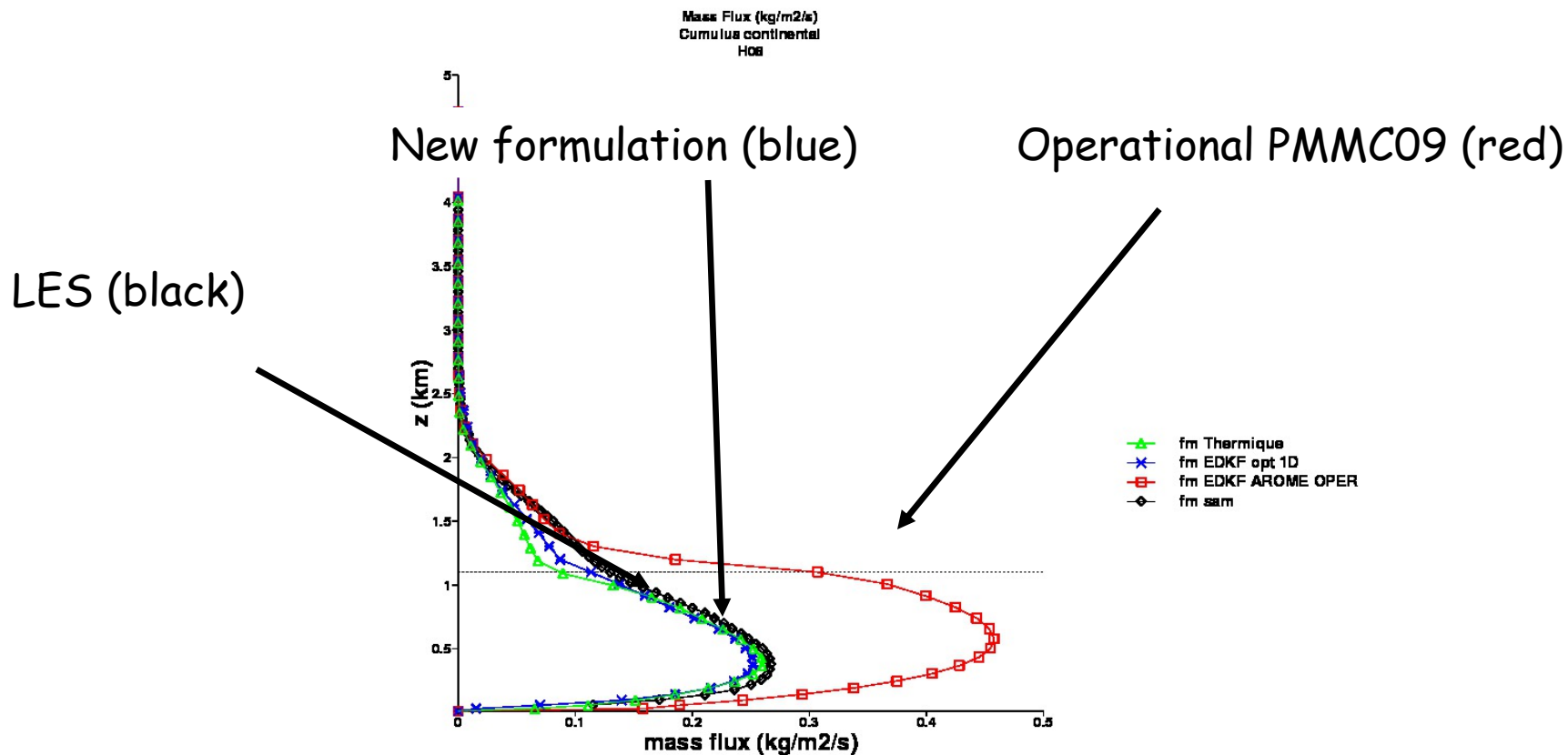


ARPEGE 7ADG P36-P39 (mm/3h) , Valid 2012-05-05 15 UTC
 Min = -6.17E-3, Max = 8.72, Moy = 1.44, Ect = 1.39

ARPEGE oper P36-P39 (mm/3h) , Valid 2012-05-05 15 UTC
 Min = -1.47E-3, Max = 22.7, Moy = 1.14, Ect = 1.77

PMMC09 in ARPEGE

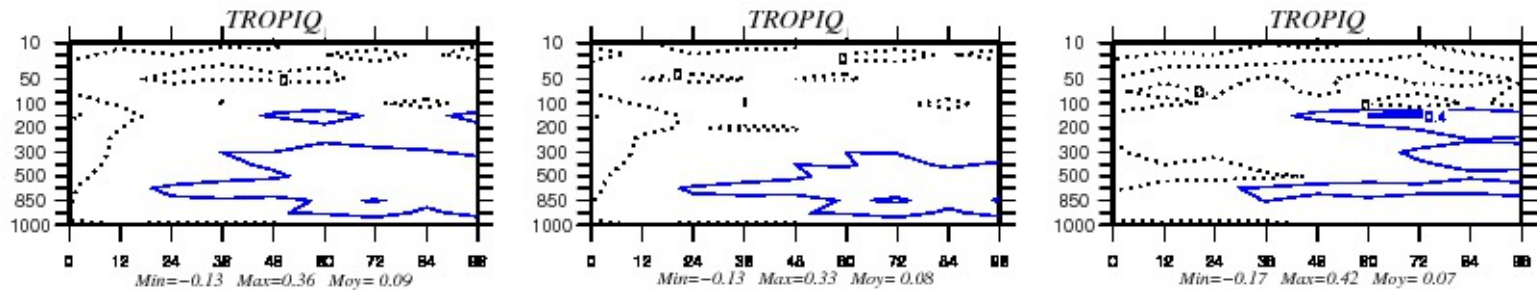
- New formulations of entrainment and detrainment from Rio et al (2010) allow to retrieve results close to LES simulation. For the 1D case ARM cumulus over land.



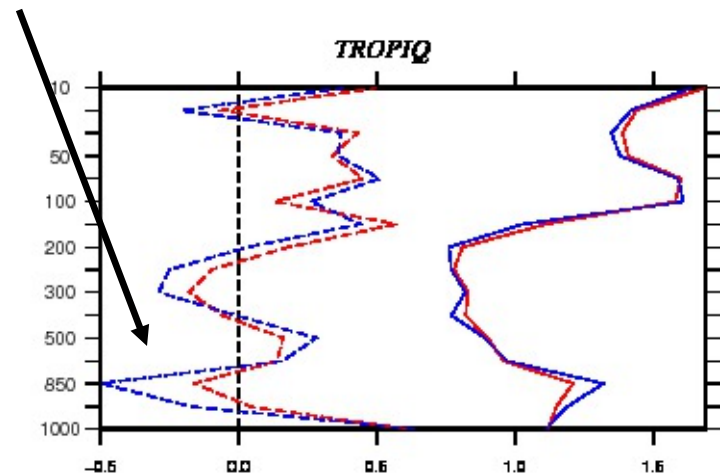
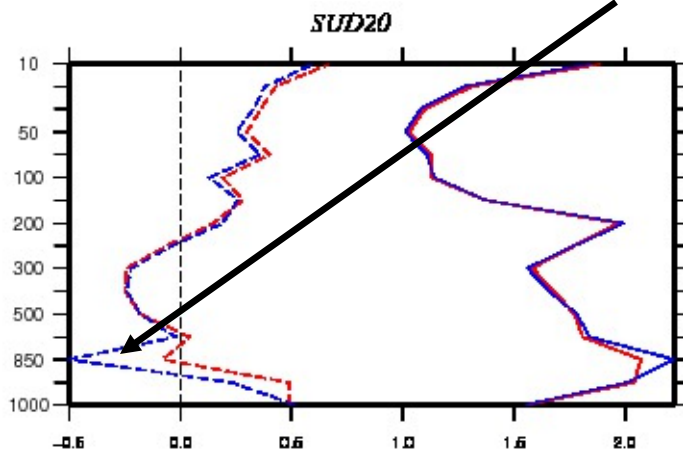
Mass flux Arm Cumulus case after 8 hours

PMMC09 in ARPEGE

Improvement of wind in the tropical area

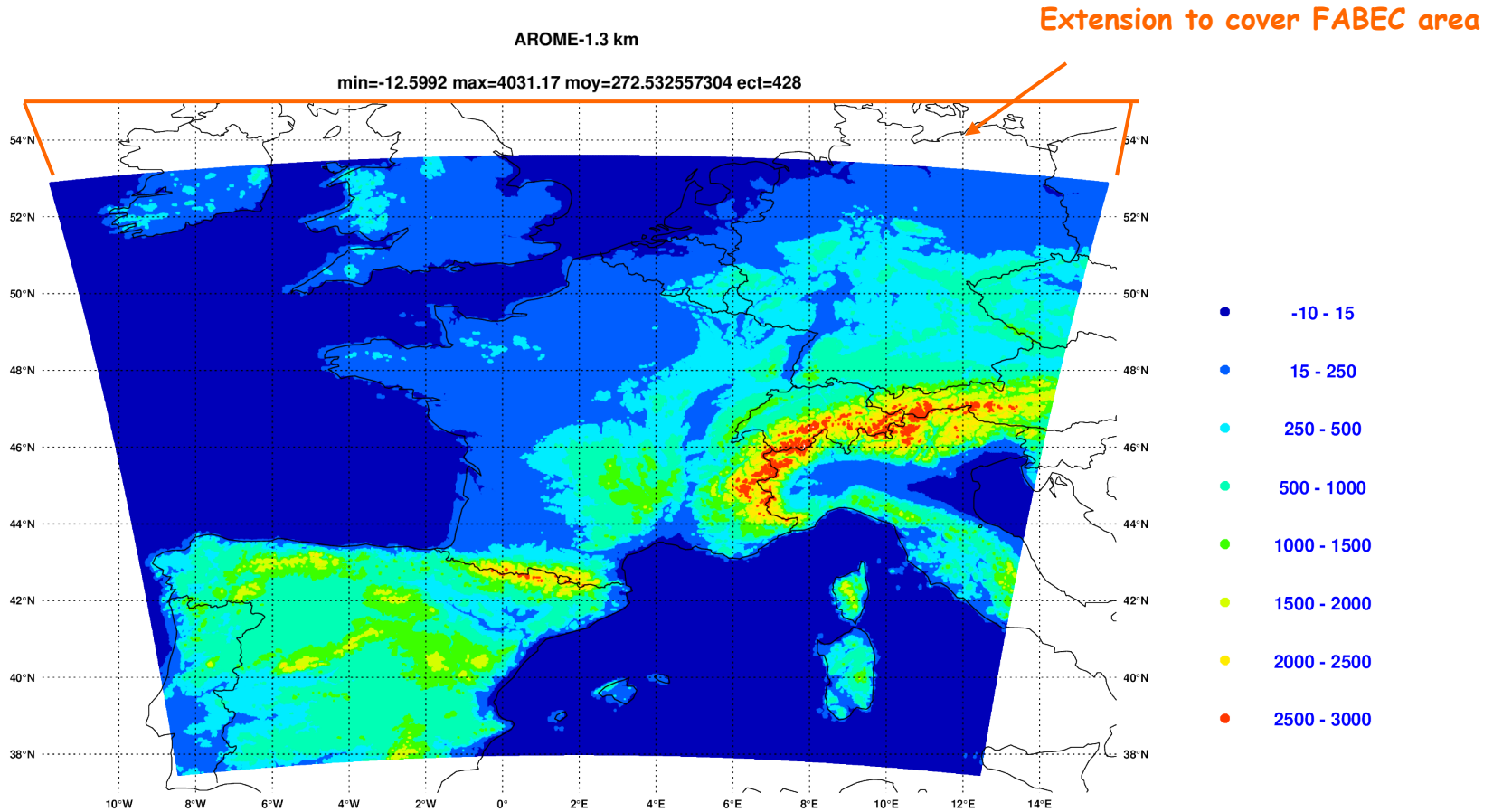


But always a cold bias at 850 hpa



High resolution AROME : 1.3km

■ AROME : $Dx \sim 1.3$ km larger domain than the one use during the benchmark ($\sim 1500 \times 1440$ points) against (1350x1440 points)



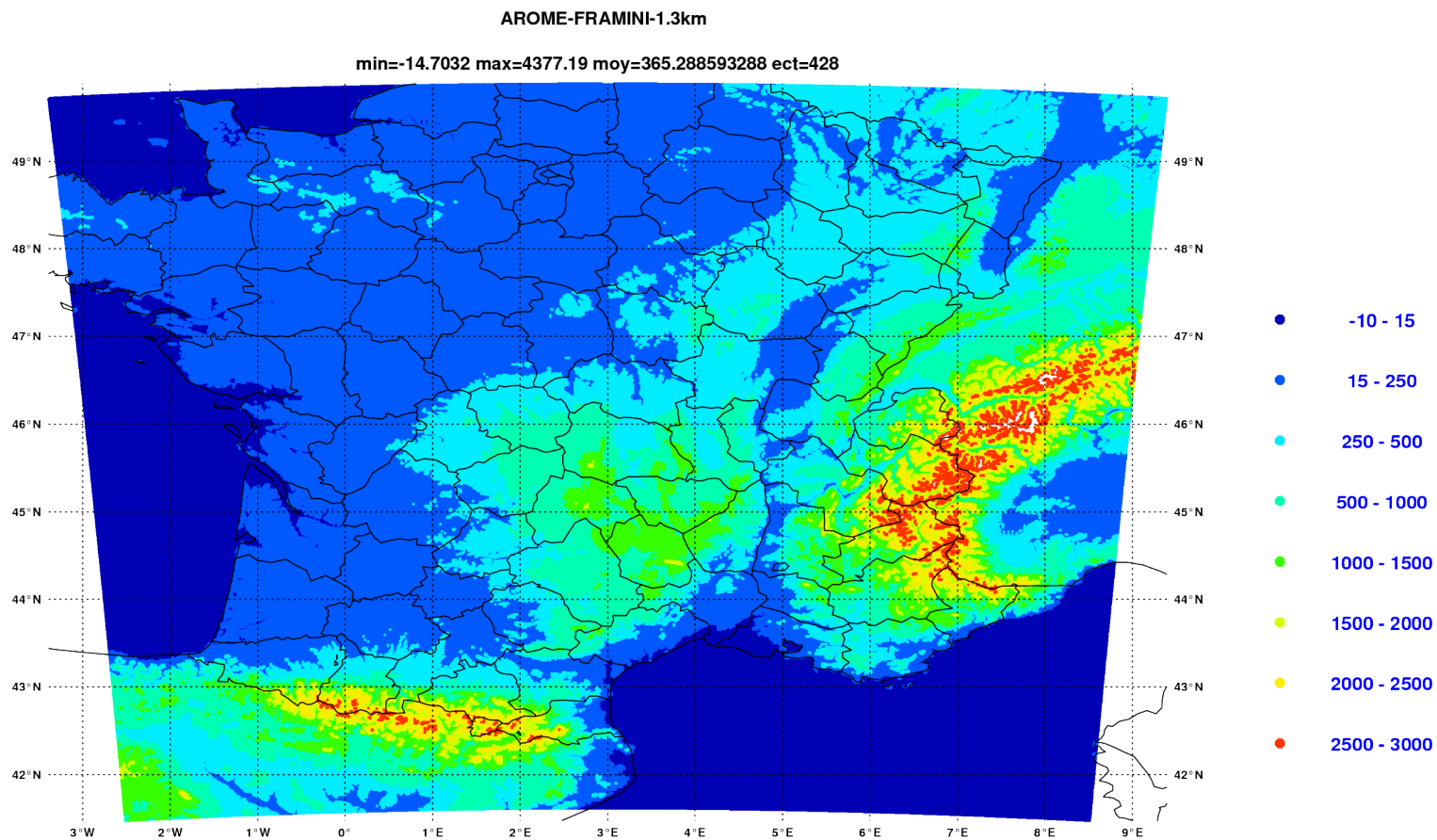
Max slope 39° against 23° in operational 2.5km



METEO FRANCE
Toujours un temps d'avance

Domain of the experimental AROME 1.3km running daily

- (720x720 points)

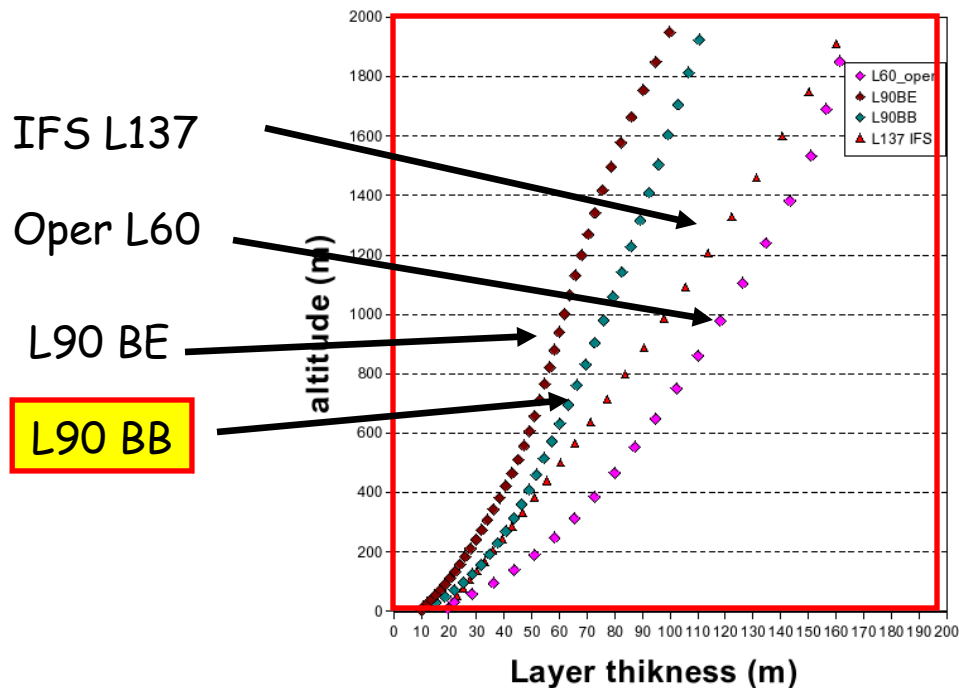
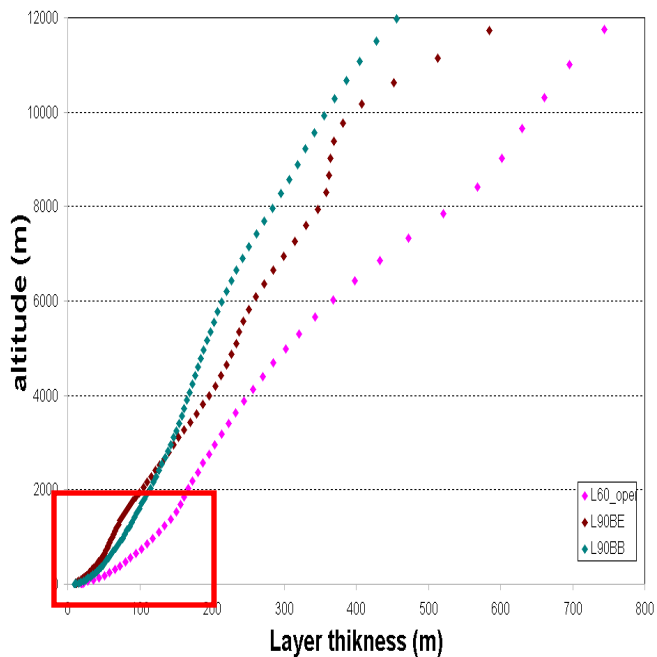


High resolution AROME : 90 levels

Several sets of 90 vertical levels has been tested on Xynthia storm (to test numerical stability) and fog forecast.

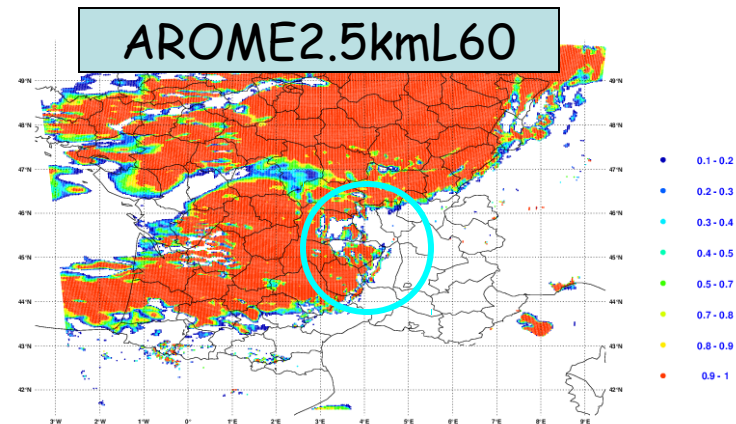
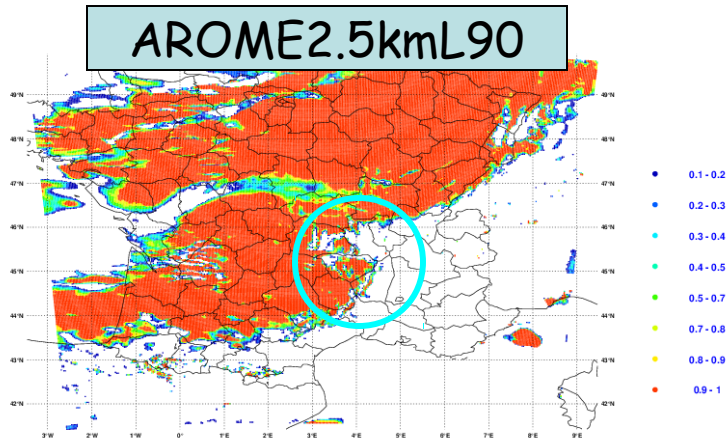
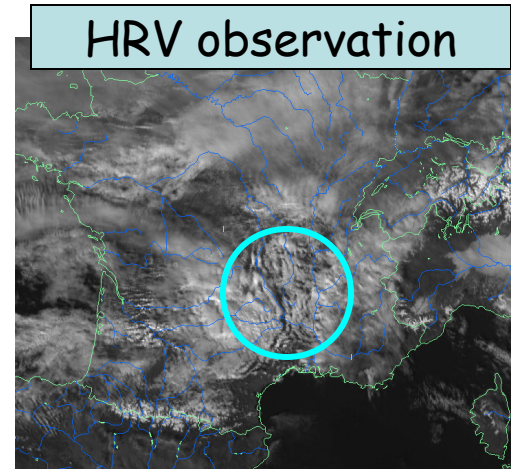
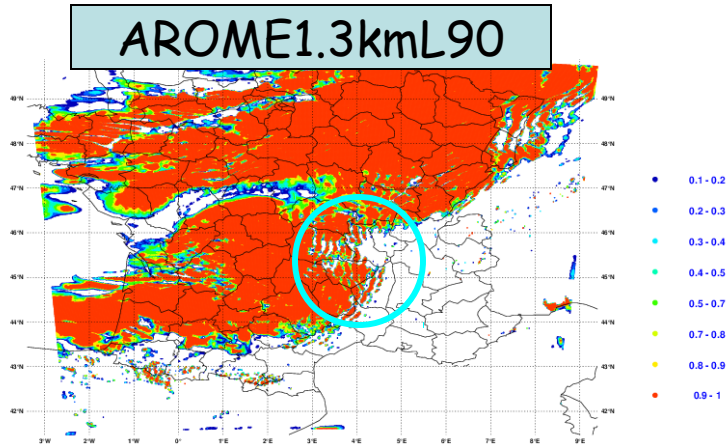
The best compromise between physical results and numerical stability is to set the lowest level at 5 meter (That is the lowest possible level with at time step of 45s on Xynthia storm)

2 sets of 90 vertical levels with the lowest level at 5m has been tested since 1-06-2012. One with 41 levels below 2000m the other one with 33 levels below 2000m (21 levels below 2000m in operation)



AROME 1.3km

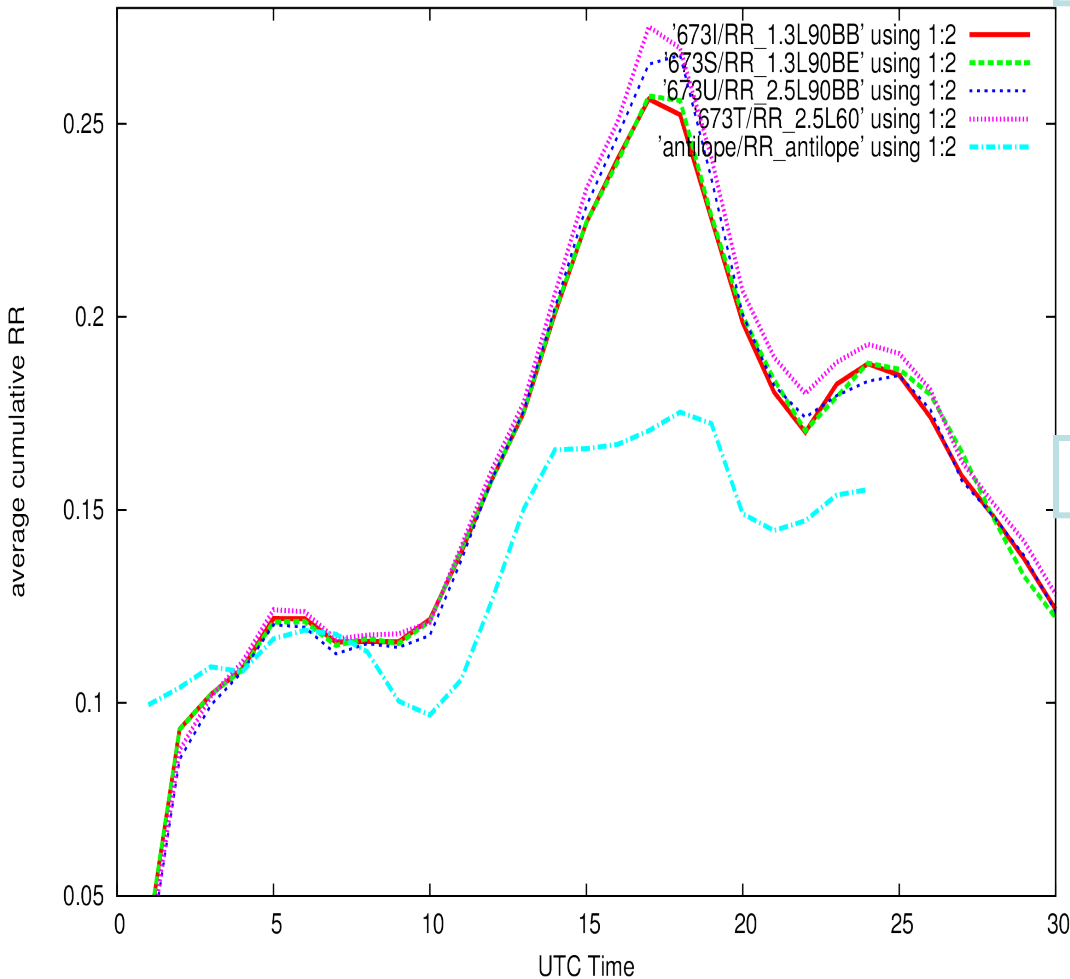
- Runs OK with dt=45s PC_CHEAP (NSITER=1),
- Stronger NH impact at 1.3 km (orographic waves): 31st January 2013 +14TU



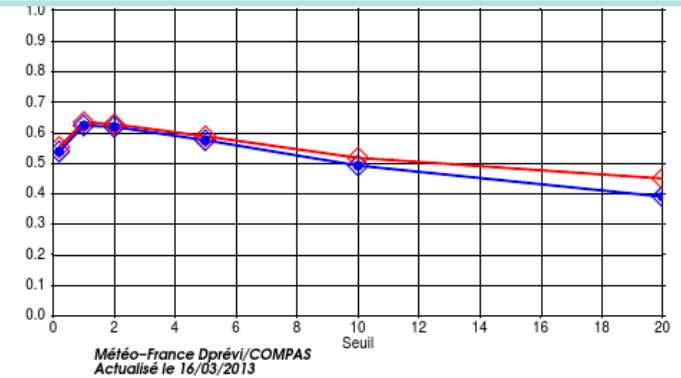
Evaluation of precipitations :

(48 strong events during 2012 summer, from Julien Léger)

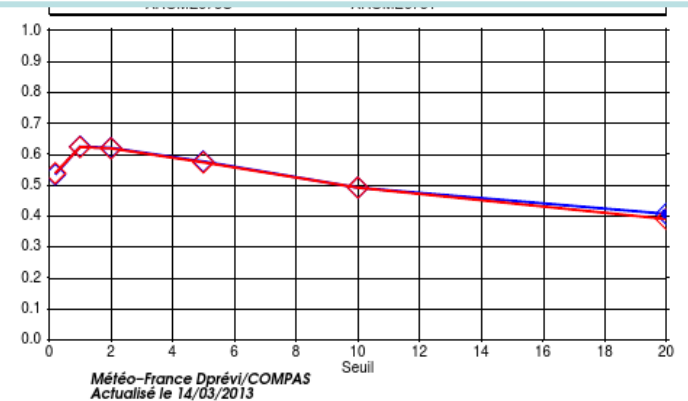
Diurnal cycle of RR1h :



BSS or RR24h: AROME1.3L90/ AROME2.5L90 :

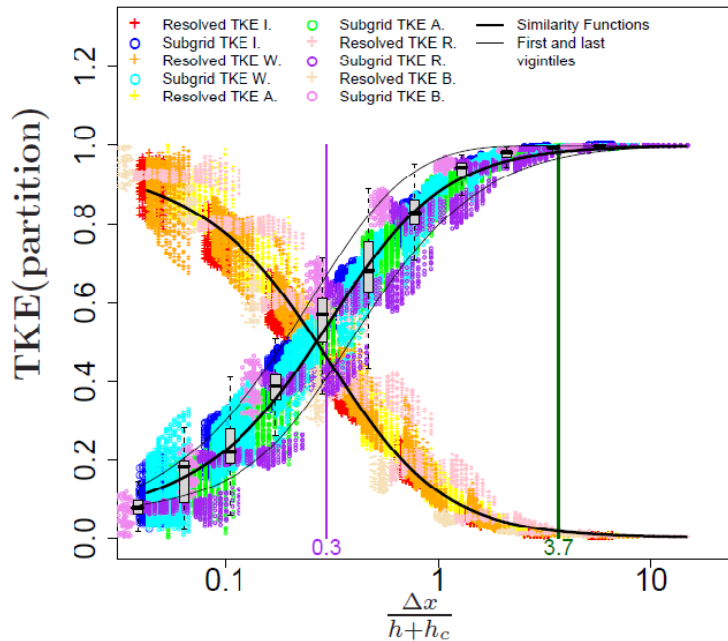


BSS or RR24h: AROME2.5L90/ AROME2.5L60 :

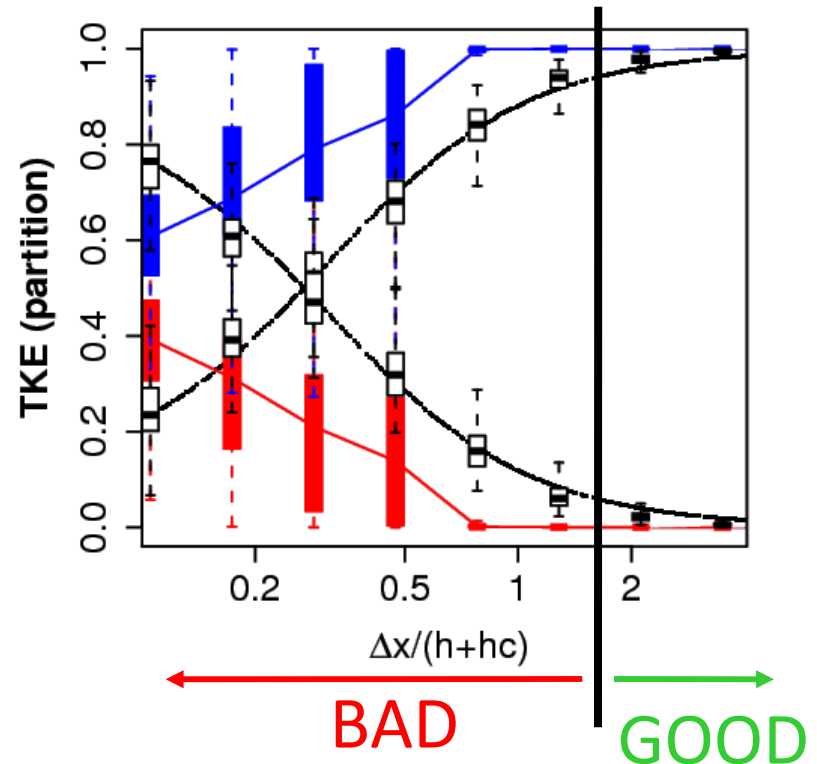


Grey zone of turbulence (1)

(b) $0.05 \leq \frac{z}{h} \leq 0.85$



(f) BL89-1D-PMMC09



- Adaptation of the Mass-Flux scheme equations for the grey zone
- Dependence of the closure on the resolution

Honnert et al. (2011, 2012)

Grey zone of turbulence (2)

New mass flux assumptions in the grey zone :

$$\alpha \ll 1 \Rightarrow \text{FALSE}$$

$$\overline{w} = 0 \Rightarrow \text{FALSE}$$

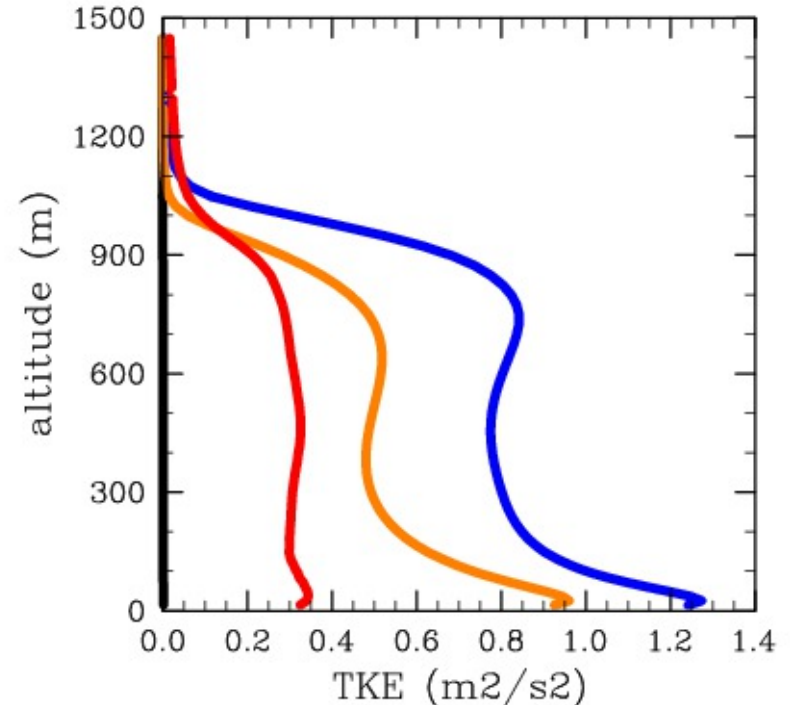
$$\overline{w' \phi}_{MF} = \frac{M_u}{\rho} (\phi_u - \overline{\phi}) \left(\frac{1}{1-\alpha} \right)$$

$$\alpha = \frac{M_u}{\rho (\overline{w_u} - \overline{w})}$$

$$\frac{1}{2} \frac{\partial (\overline{w_u} - \overline{w})^2}{\partial z} = - \left(\frac{\varepsilon}{1-\alpha} + b \right) \overline{w_u} - \overline{w}^2$$

$$- (\overline{w_u} - \overline{w}) \frac{\partial \overline{w_u}}{\partial z} + a (\overline{B_u} - \overline{B})$$

Resolved TKE (IHOP case)
Més0-Nh 12h resolution : 500m



- With PMMC09
- LES
- Honnert et al
- Without PMMC09

Honnert, Masson and Couvreux : A parameterization of the turbulence at the kilometric scales. What is a subgrid thermal at the Kilometric Scale ? QJRMS, submitted.

Prospects

- Increase of the coupling zone for AROME (presently only 8 points)
- Mirror suite on the Bull (autumn 2013)
- High resolution suite (with PCMT and PMMC09 in ARPEGE) (2014 ?)
- SURFEX in ARPEGE, may be in the high resolution suite
- Turbulence in stable cases after Toulouse working days, EFB scheme in CBR. First results on GABLS1 are promising
- Moist thermodynamic, theta_s instead of theta_l in PMMC09 ?

Thank You for your
attention