

# Status of ARPEGE and ALADIN-France models

F. Bouyssel, E. Bazile, S. Belamari, Y. Bouteloup, G. Faure,  
J.F.Gueremy, S. Malardel, P. Marquet, V. Masson, J.M. Piriou,

...

CNRM, Météo-France

24-25 November 2008

# Plan

- Operational configurations
- Current parallel suite
- Perspectives

# 1) Operational configurations

# ARPEGE and ALADIN operational NWP configurations at Météo-France

- ARPEGE « Metropole » (stretching=2.4) with 4D-Var DA (15km <  $\Delta x$  < 90km, L60 up to 10 Pa,  $\Delta t=900s$ )
- Ensemble of assimilations ARPEGE with 3D-FGAT DA (25km <  $\Delta x$  < 150km, L55, 6 members)
- Short range ensemble forecasting system with ARPEGE (« PEARP ») (25km <  $\Delta x$  < 150km, L55, 11 members)
- ARPEGE « Tropics » (non stretched), in dynamical adaptation ( $\Delta x=37km$ , L55,  $\Delta t= 1350s$ )
- ALADIN-France with 3D-VAR DA (coupling model of AROME) ( $\Delta x=9.5km$ , L60,  $\Delta t=450s$ )
- ALADIN-Réunion (Indian Ocean) with 3D-Var DA ( $\Delta x=9.5km$ , L60,  $\Delta t=450s$ )
- Several ALADIN in dynamical adaptation

# Some characteristics

- Dynamics : Hydrostatic shallow-atmosphere approximation, pressure-based hybrid vertical coordinate, two-time-level semi-lagrangian semi-implicit time integration scheme, spectral horizontal representation, finite-element vertical representation, spectral horizontal diffusion
- Development of common physics for NWP & Climat for ARPEGE and ALADIN-MF, having several parameterisations in common with AROME (multiscale validations, increase collaboration on physics)
- Parallel physics, Physics is done before the dynamics
- Pronostic variables : U, V, T, Qv, Ql, Qi, Qr (rain), Qs (snow) + surface

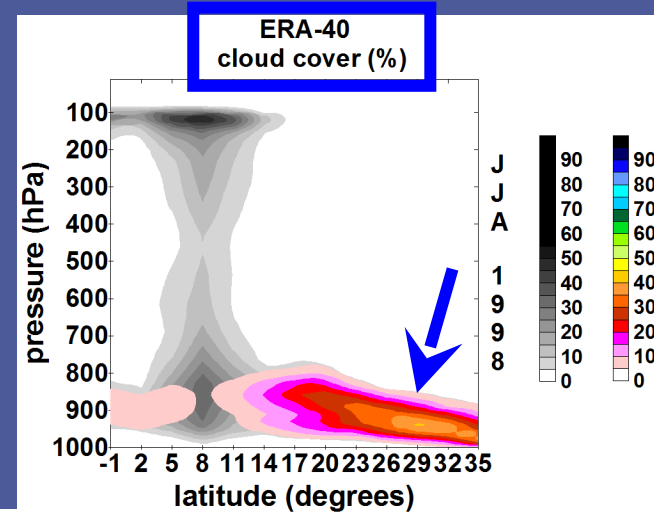
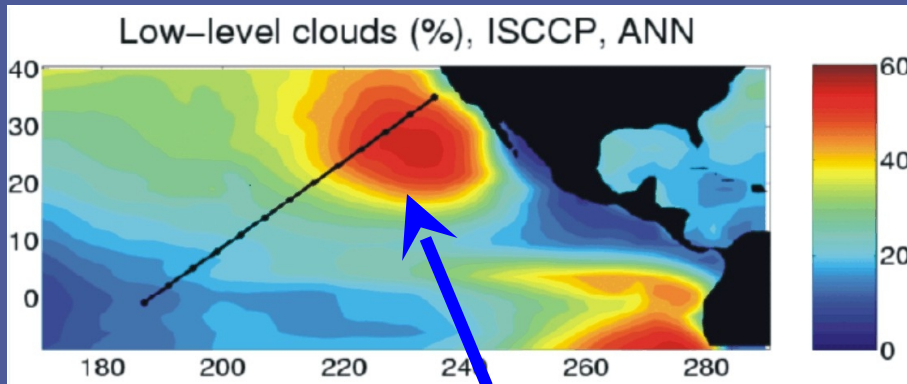
## 2) Current parallel suite

# Parallel suite in ARPEGE / ALADIN-MF

- “CBR” turbulence (Cuxart, Bougeault, Redelsperger, 2000)
- “BL89” mixing length (Bougeault and Lacarrere, 1989) Red: in AROME
- “KFB” moist shallow convection (Bechtold et al., 2001)
- Production term of TKE and modification of mixing length from “KFB” scheme
- Microphysics on “turbulent” and “shallow convection” condensations
- Modification of mixing length from deep convection scheme
- Top PBL entrainment (Grenier, Bretherton)
- “ECUME” parameterisation for oceanic fluxes (iterative algorithm)
- Use of 6 spectral bands (previously 2) in shortwave radiation (Fouquart and Morcrette)
- Use of ECMWF ozone climatology (Fortuin and Langematz, 1995)
- Tuning of the diagnostic parameterisation for deep convective clouds
- Removal of divergence damping in horizontal diffusion

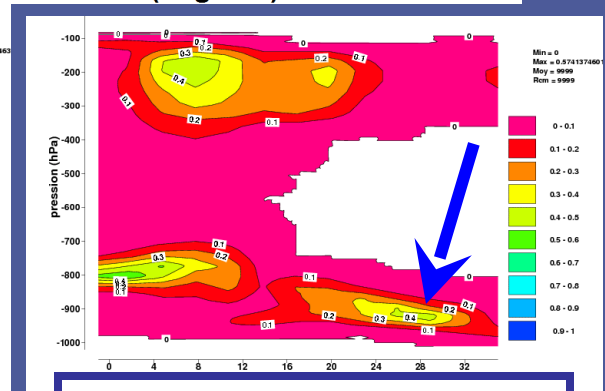
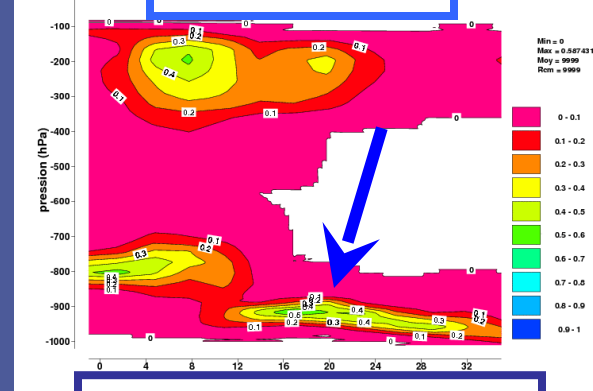
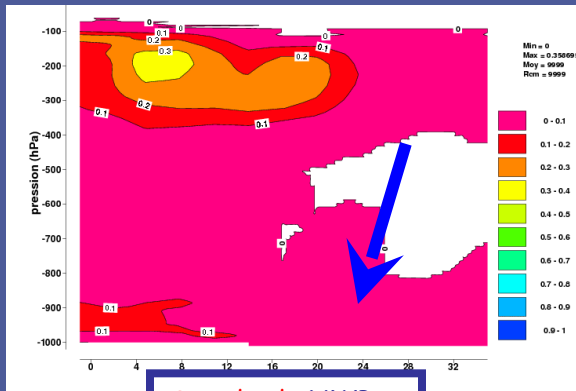


# The top-PBL-entrainment parameterization



Courtesy Cecile Hannay (NCAR)

## Cloud Cover



- a) **NWP results** : largely improved with the test prognostic physics
- b) An important improvement due to the **Top-PBL vertical entrainment**
  - a better top-PBL : less “too-moist” ; less “too-cloudy”
  - the maximum of Sc at 28 N : much more realistic

Courtesy E. Bazile



**METEO FRANCE**



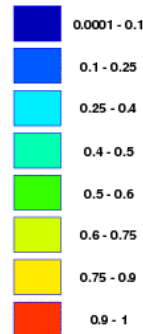
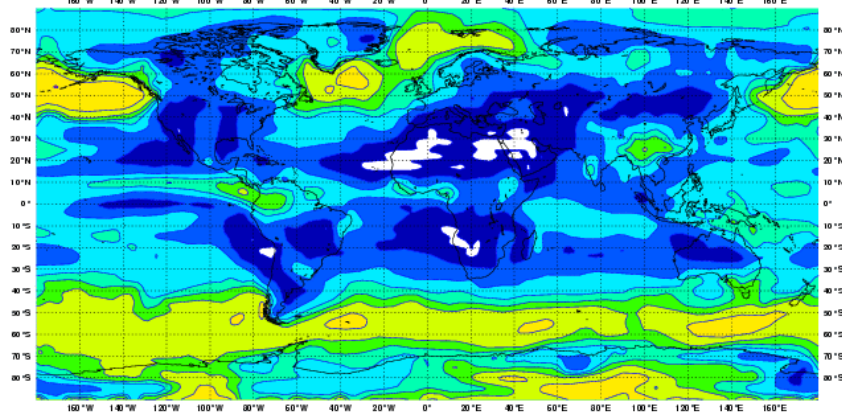
# Importance of links between KFB and CBR

## Low levels clouds

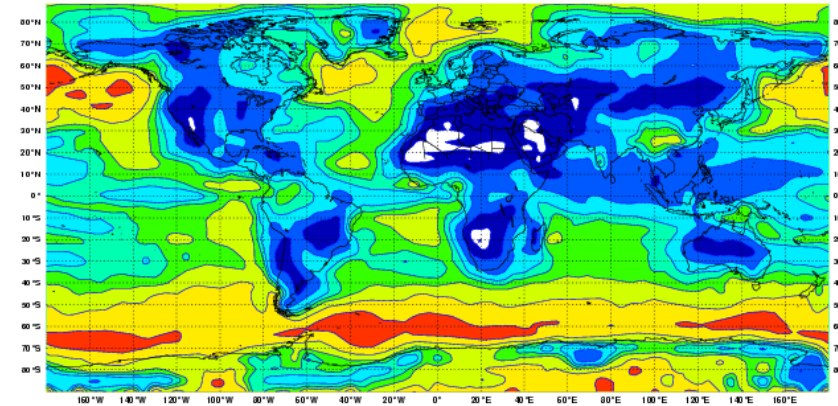
Oper

oper:NEB\_BAS\_200706\_P06\_moy

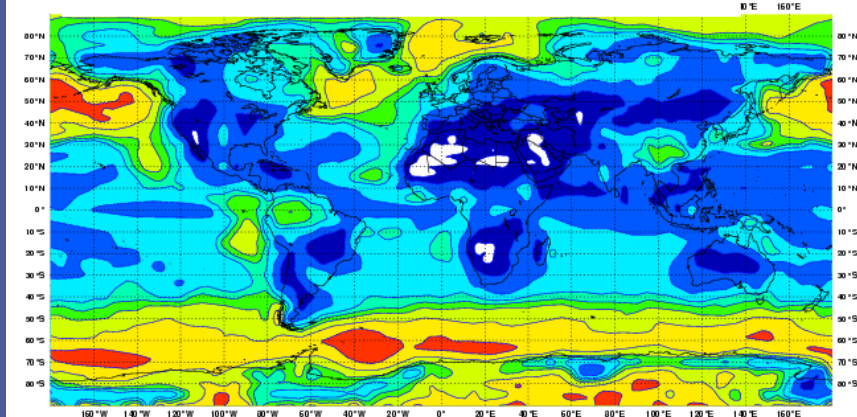
min=0 max=0.920074 moy=0.315487579738 ect=9999



TKE+KFB+Top Entrainment(TE)

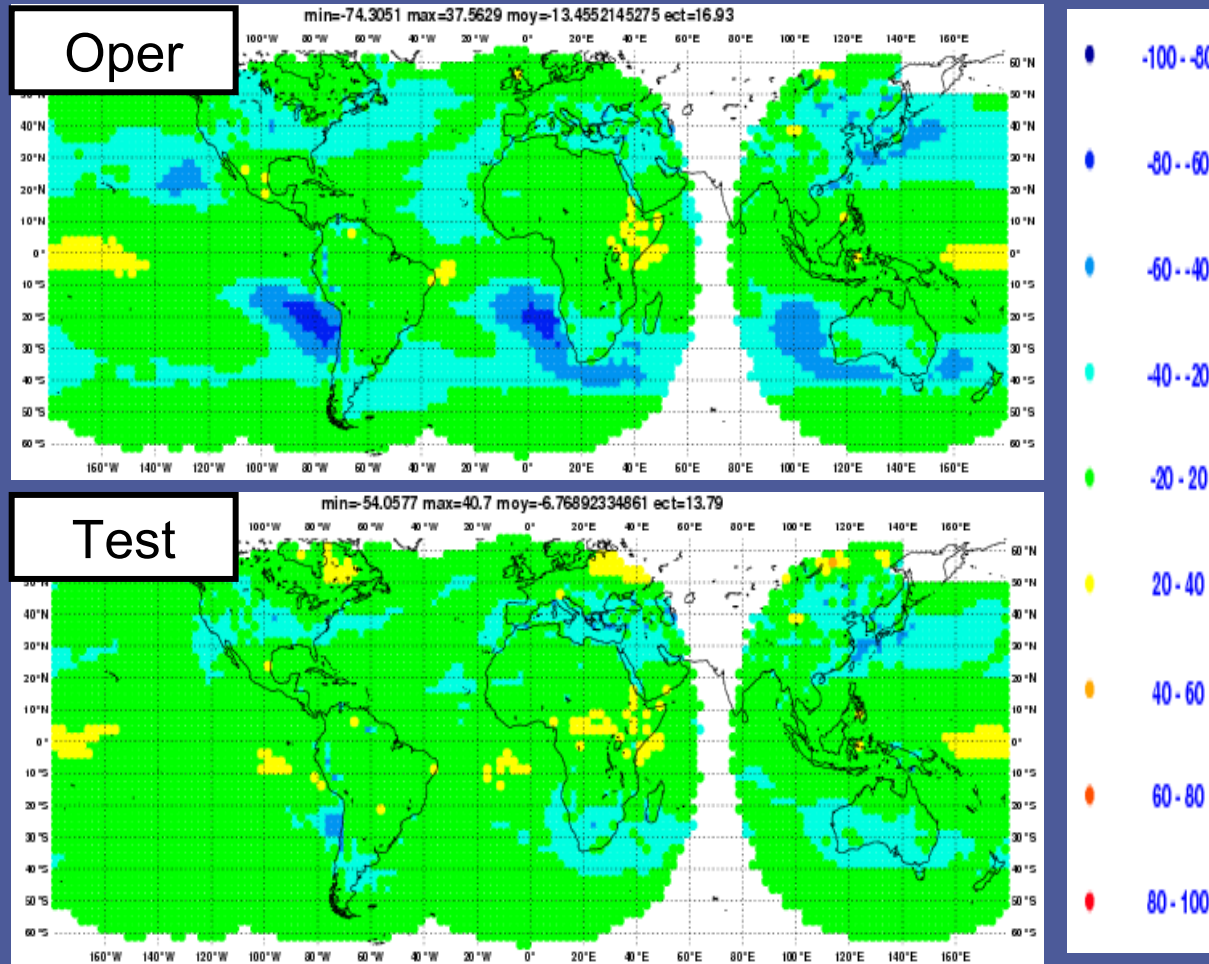


TKE+KFB+TE+ ThPr+Lmod.



# Improvement of low cloudiness in parallel suite

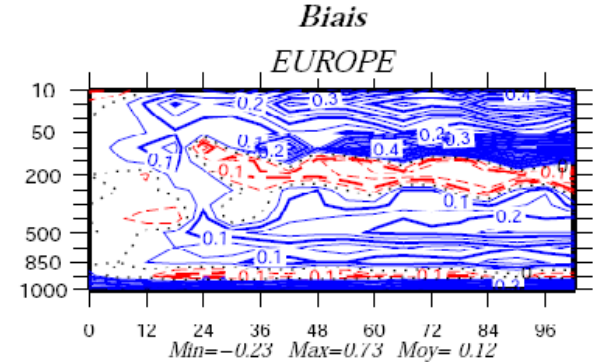
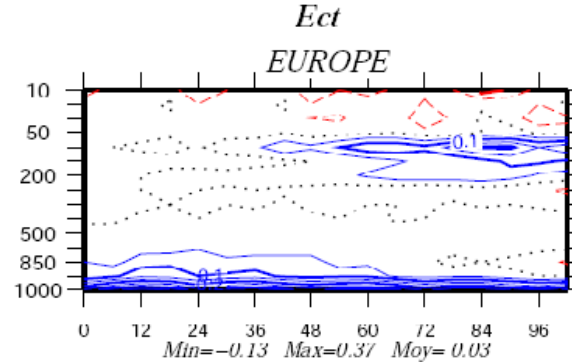
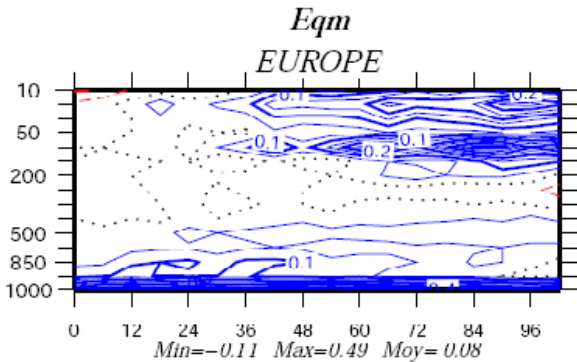
Mean error for total cloudiness (compared with ISCCP satellite climatology (for DJF))



# Improvement of T / RH scores in the PBL

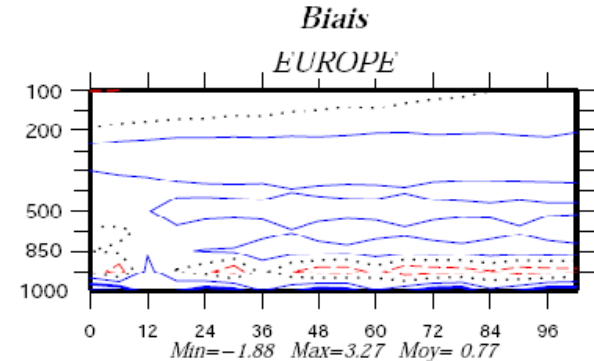
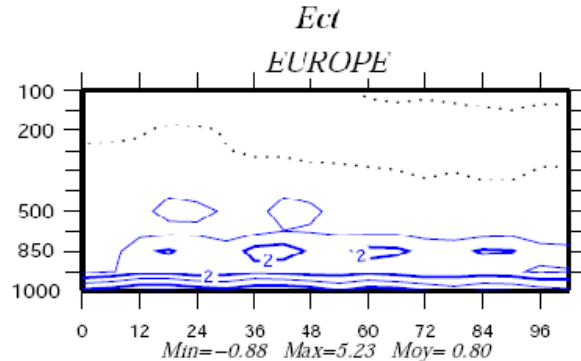
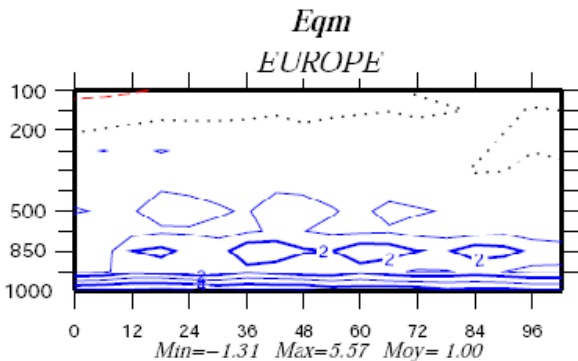
## TEMPERATURE:PA.r 00/AC-PAD.r 00/AC

(0.05 K) Chaîne 2008\_02, Version V1, Chaîne Physique 3G+  
75 simulations de 102 h du 20080702 au 20080918



## HUMIDITE:PA.r 00/AC-PAD.r 00/AC

(1. %) Chaîne 2008\_02, Version V1, Chaîne Physique 3G+  
75 simulations de 102 h du 20080702 au 20080918

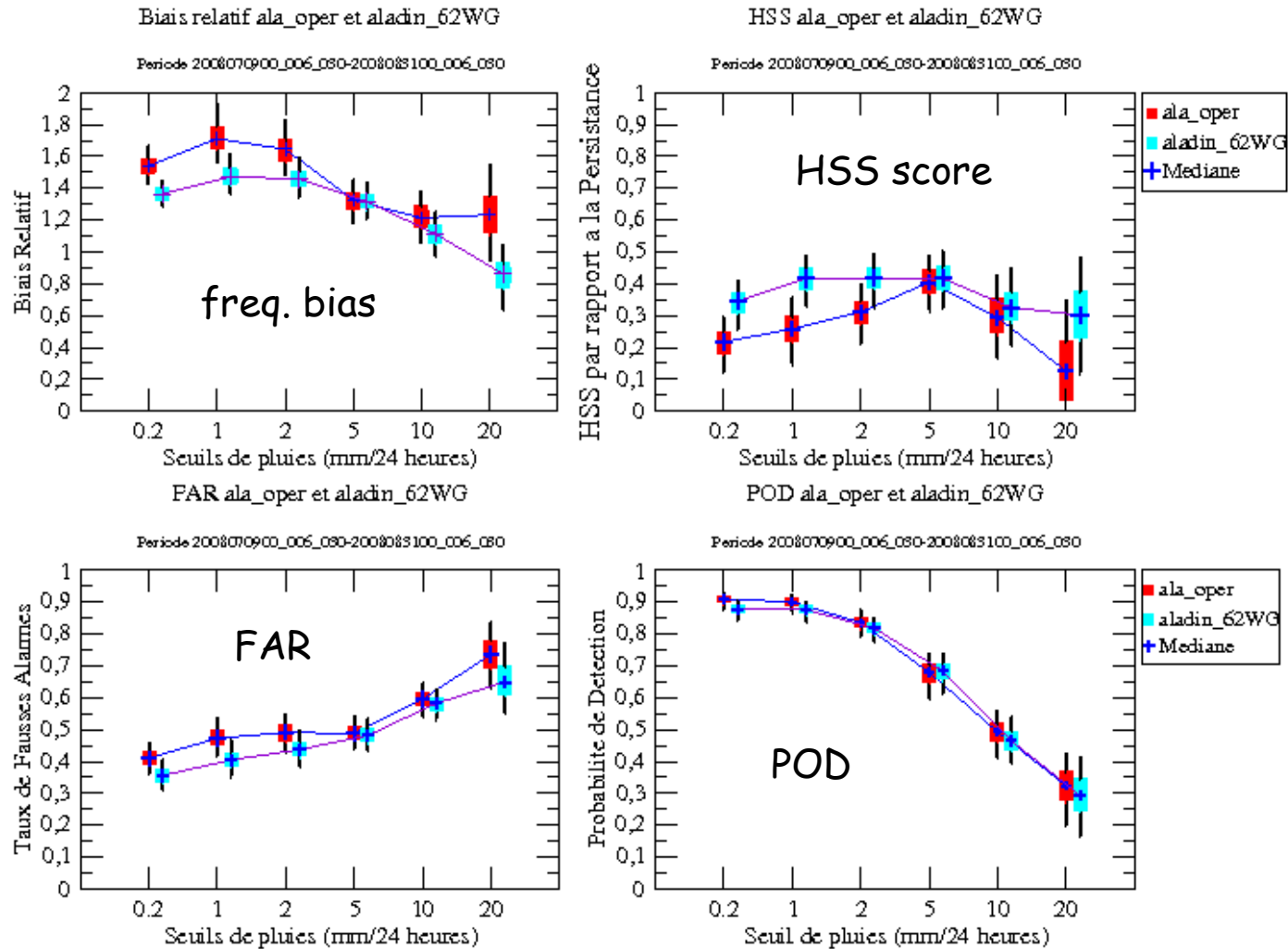


# Improvement of precipitation in summer in ALADIN-Fr

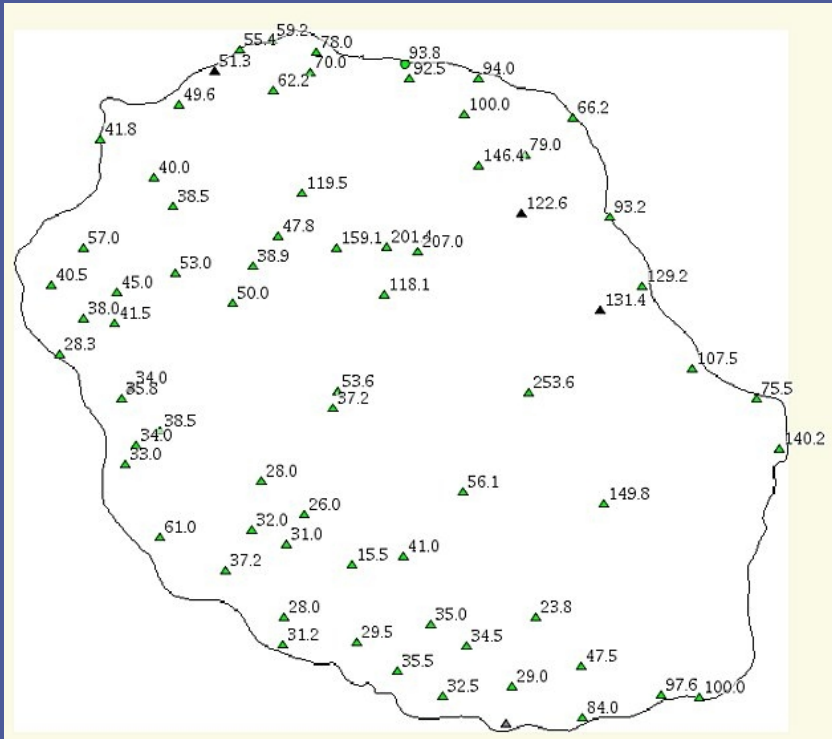
ALDMF oper = Red

ALDMF-new=blue

## Scores of 24-h precipitation over 1 month



# Improvement of precipitation in ALADIN-Réunion (7 June 2008)



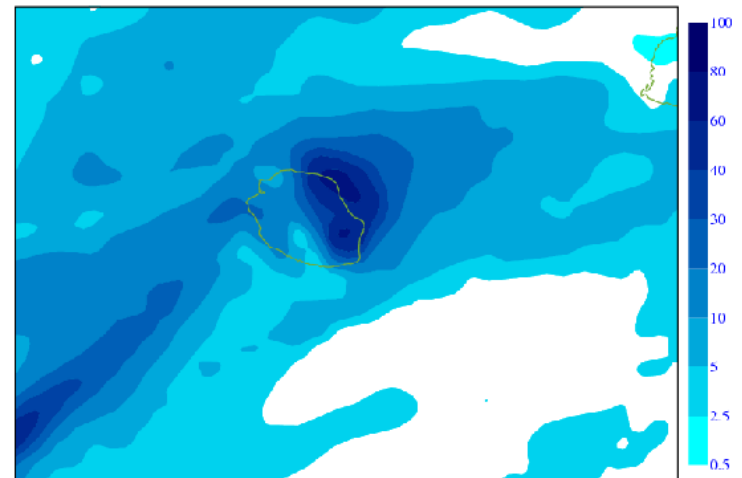
New physics improve significantly precipitation forecast over « la Reunion » (not enough precipitation over the island)

(G. Faure, CRC)

REFERENCE

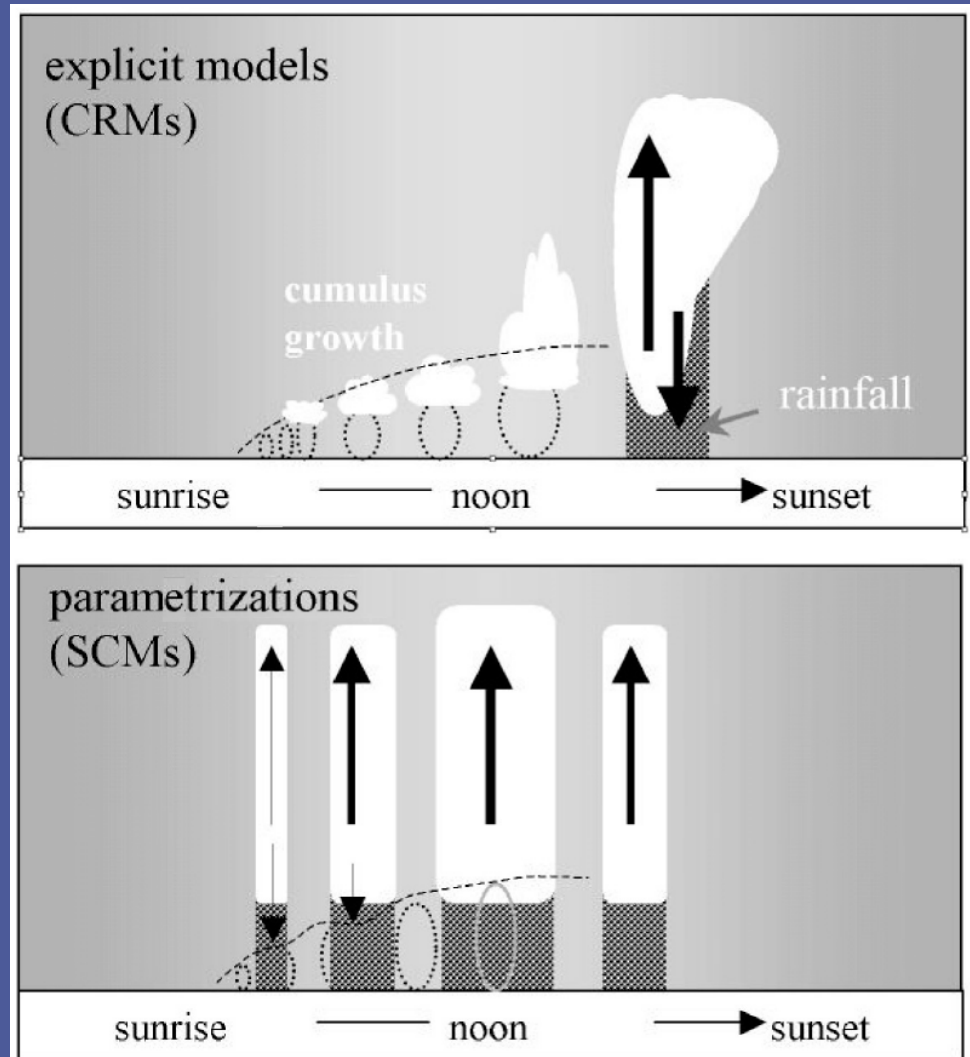


CBR-KFE



# Numerous problems with convection scheme

- Diurnal cycle of convection (start too early, intermittent)
- Precipitation (too many small events), even if improved by parallel suite
- Transition between shallow and deep convection
- Top of convection at neutral level
- Behaviour below 10 km resolution



(Guichard et al., 2004)



**METEO FRANCE**  
Toujours un temps d'avance

# Perspectives

# Perspectives

- Evaluation of « 3MT » as a deep convection scheme with « CBR » turbulence and « KFB » shallow convection scheme in ARPEGE and ALADIN-Fr
  - ⇒ several issues related with microphysics and clouds
  - ⇒ evaluation at the global scale in ARPEGE
  - ⇒ evaluation at 5km and 2.5km in ALADIN to determine the potential of 3MT at AROME resolutions
- Evaluation of the « EDKF » shallow convection scheme (dry, moist thermals) in ARPEGE and ALADIN
- Increase of ARPEGE horizontal and vertical resolutions (10km < Dx < 65km, 70 vertical levels)
- Determination of the best strategy for AROME: coupling to ARPEGE or coupling to ALADIN with an intermediate horizontal resolution around 5km (with « 3MT » convection scheme or without any deep convection scheme)