

Latest developments and performances in ARPEGE and ALADIN-France

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18th ALADIN / HIRLAM Workshop, Bruxelles, 7-10 April 2008

Plan

- Recent operational evolutions and current parallel e-suite
- Latest developments in physics
- Perspectives

Recent operational evolutions and current parallel e-suite

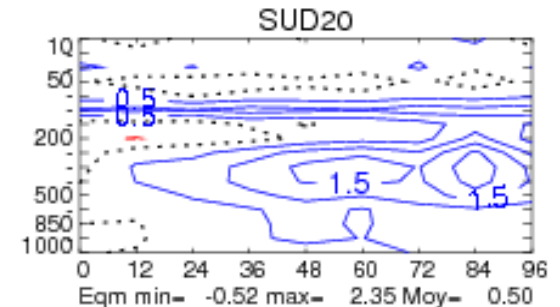
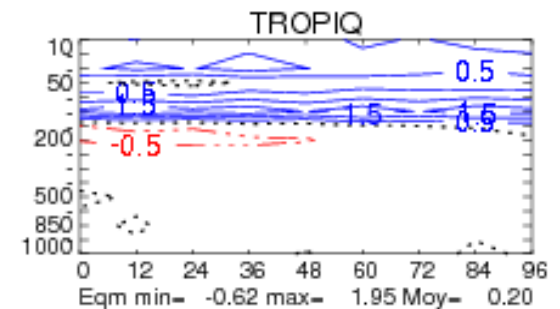
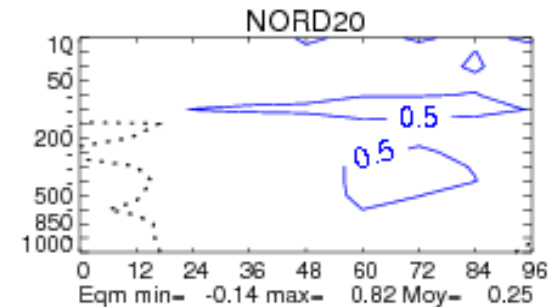
ARPEGE and ALADIN operational configurations at Météo-France

- ARPEGE « Metropole » (stretching factor 2.4) with 4D-Var DA
 - ARPEGE « Tropics » (regular grid), soon in dynamical adaptation
 - Short range ensemble forecasting system with ARPEGE (« PEARP »)
 - ALADIN « France » with 3D-VAR DA (coupling model of AROME)
 - ALADIN « Réunion » (over Indian Ocean) with 3D-Var DA
 - Several ALADIN in dynamical adaptation over Qatar, Israel, Libya, etc.
- ⇒ ARPEGE and ALADIN-France : same physics, same vertical levels, same dynamics, similar observations assimilated: very convenient to implement new ALADIN domain anywhere and to transfer developments from ARPEGE to ALADIN (or the opposite)

Operational update in September 2007

- GPS radio-occultation: COSMIC(6), CHAMP, GRACE A/B
- ATOVS on MetOp (AMSU-A, MHS)
- AMI scatterometer on ERS2
- Use of the new SST NESDIS analysis (1/12°)
- 10m wind SYNOP over land in ALADIN 3D-Var only
- Reduction of strong evaporation for stratiform precipitation

GPS RO impact, RS scores, 41days, March-April 07
RMS Geopotential

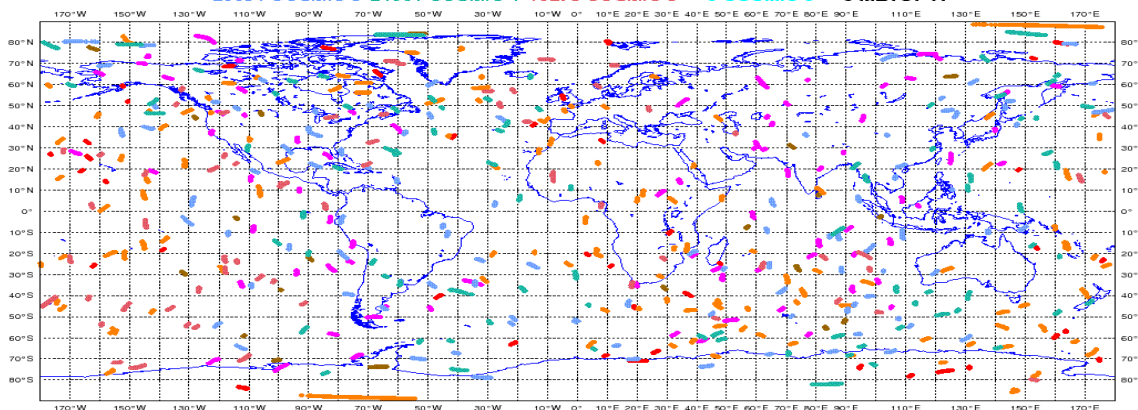


METEO-FRANCE couverture de donnees - GPS satellite

2007/10/14 00H UTC cut-off long

Nombre total d'observations avant screening : 141605

6529 CHAMP 3247 GRACE A 0 GRACE B 23371 COSMIC 1 36285 COSMIC 2
29034 COSMIC 3 24864 COSMIC 4 18275 COSMIC 5 0 COSMIC 6 0 METOP A



For a 6h time window: ~ 500 vertical profiles with ~ 280 obs. each

Operational update in February 2008

- New resolutions for ARPEGE (horizontal & vertical) and ALADIN (vertical)
- Use of a finite element scheme for the vertical discretization (ECMWF)
- Updated background error statistics coherent with new resolutions (obtained via an ensemble of assimilations)
- Variational Bias Correction for satellite radiances
- ASCAT assimilation on MetOp
- Increase of turbulent mixing in free atmosphere
- Incremental DFI, non linear balance equation in ALADIN 3D-Var (previously integrated in ARPEGE)

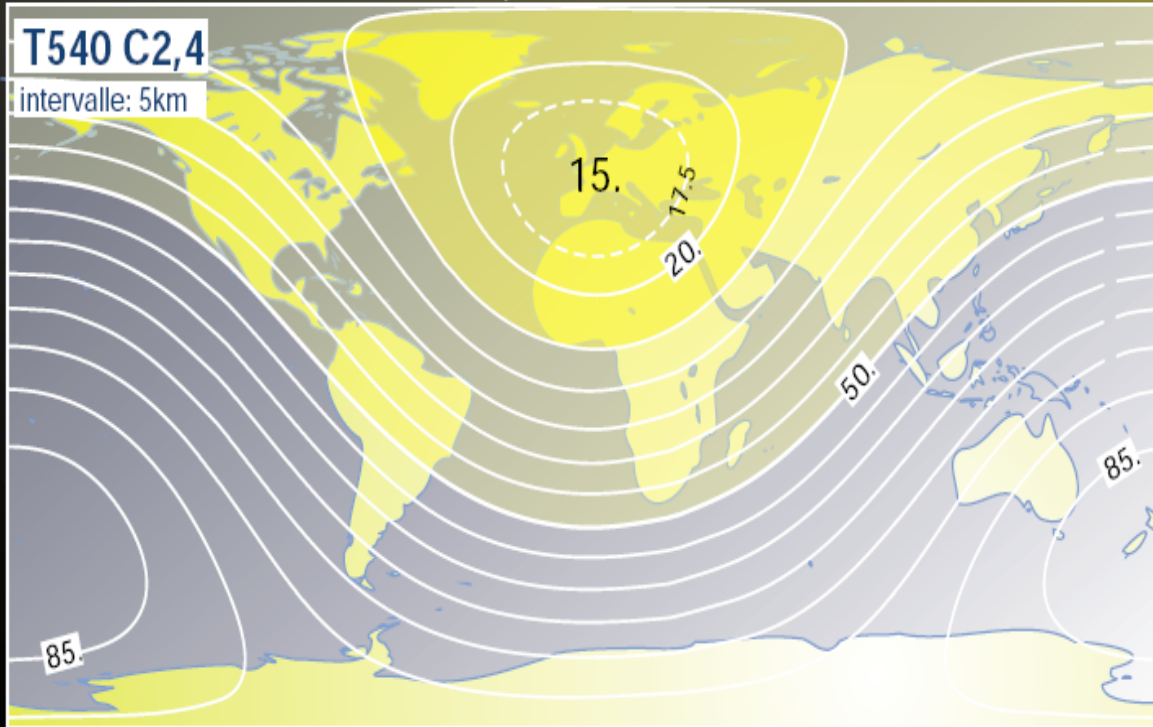


ARPEGE new resolutions

ARPEGE, résolution horizontale visée en 2007

T540 C2,4

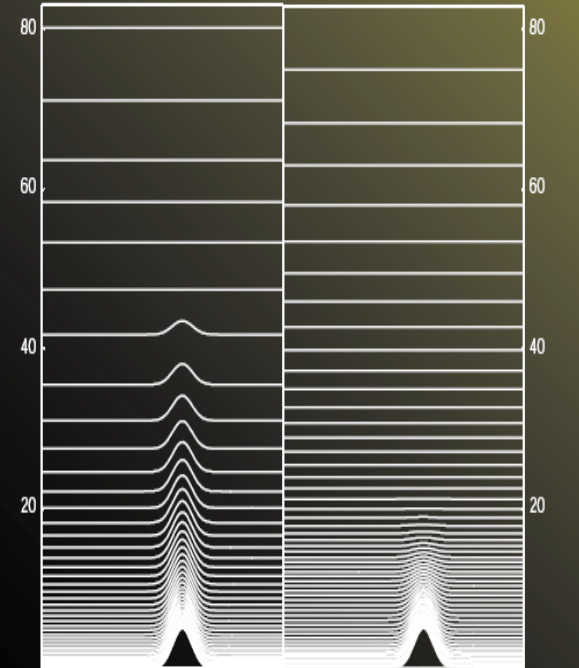
intervalle: 5km



L46

L60

Z (km)



(also ALADIN)

- Forecasts, Screening, Trajectories : **T538C2.4L60** $\Delta t=900s$
- 1st minimisation : T107C1.0**L60** ; $\Delta t=1800s$; 25 iterations
- 2nd minimisation : **T224C1.0L60** ; $\Delta t=1800s$; **30 iterations**

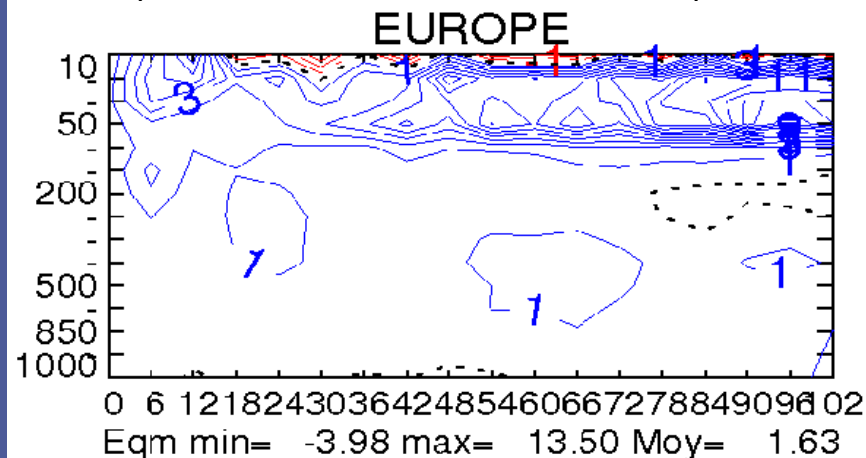
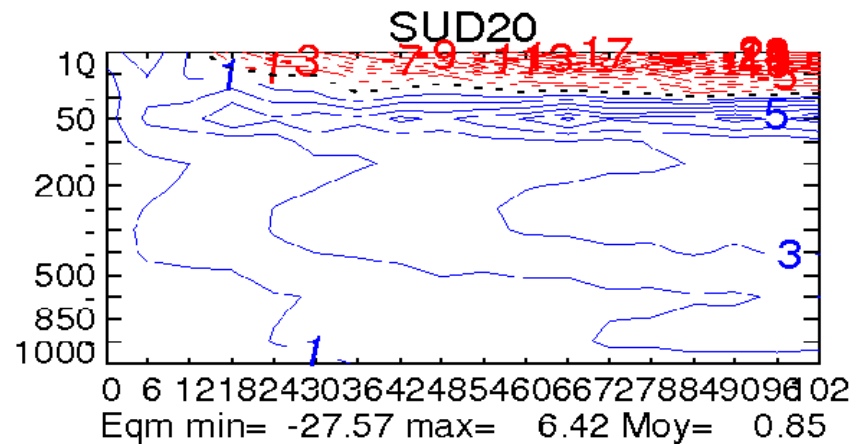
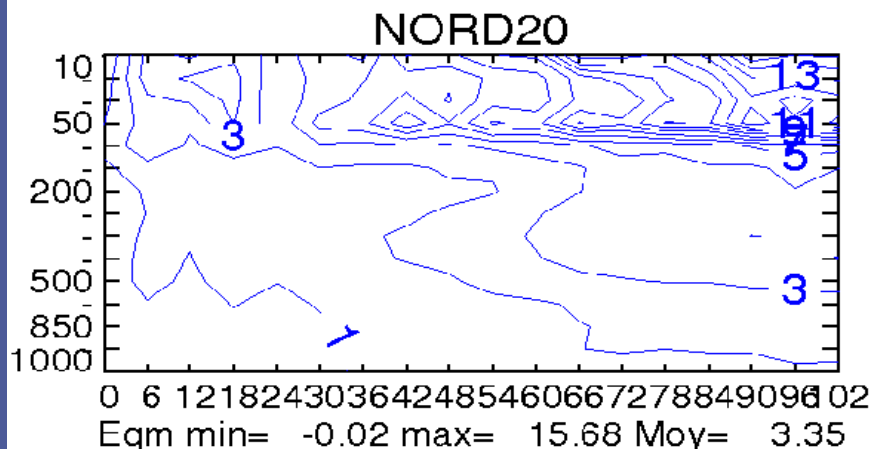
~ 90 km



METEO FRANCE
Toujours un temps d'avance

Impact of the parallel e-suite

Objectives scores to analyses, 117 days, 6/10/2007 au 4/02/2008
RMS Geopotential



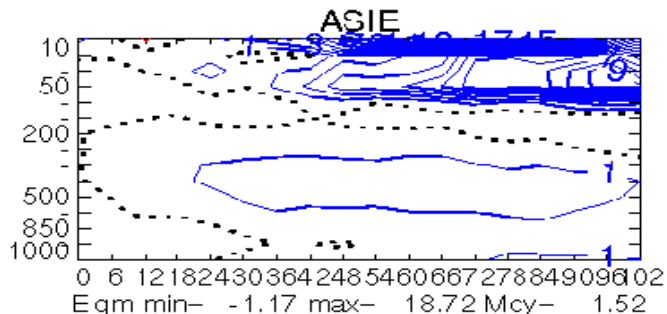
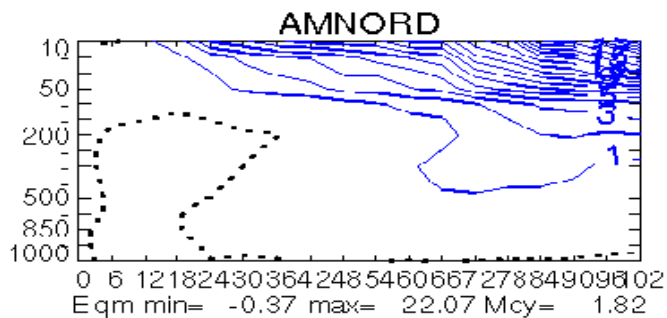
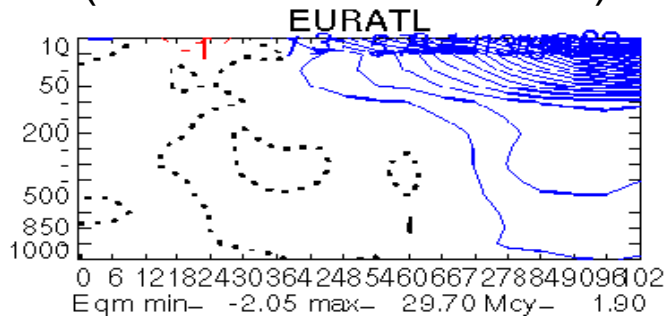
Current parallel e-suite

- HIRS on Metop
- SSM/I F14
- Emissivity parametrisation over land for micro-wave
- Clear Sky Radiances of SEVIRI on Meteosat
- IASI on MetOp (~50 channels)
- Ensemble of six 3D-fgat assimilations ARPEGE (T358C1L60) $\Rightarrow \sigma B$
- Modifications in GWD parametrization (Catry et al., 2008)
- More vertical mixing on (TI, qt) in stable conditions (« Fh » Louis's function)
- Use of a PDF based sedimentation scheme (instead of a semi-lagrangian)
- Assimilation of T_{2m} , H_{2m} SYNOP in 3D-Var ALADIN during daytime only

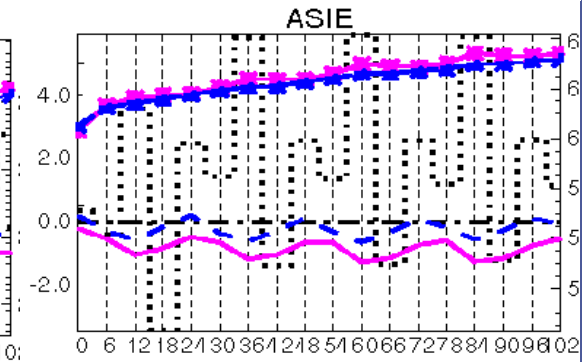
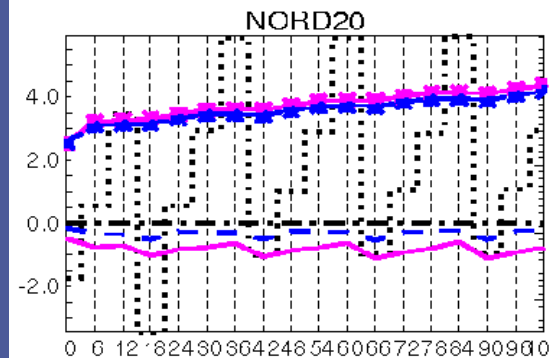
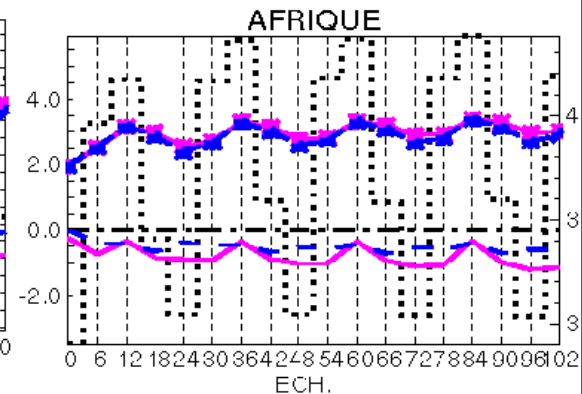
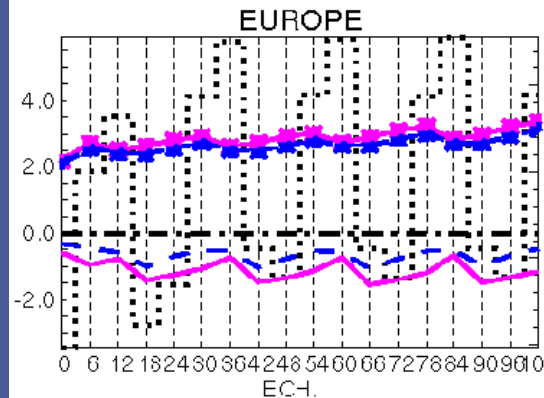


Impact of physical modifications only: GWD + Turbulence

Z scores versus ECMWF
analyses
(6/01/2008 - 3/02/2008)



T2m scores versus SYNOP
(6/01/2008 - 3/02/2008)



OPER (in pink) & NEW (in blue)



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Toujours un temps d'avance

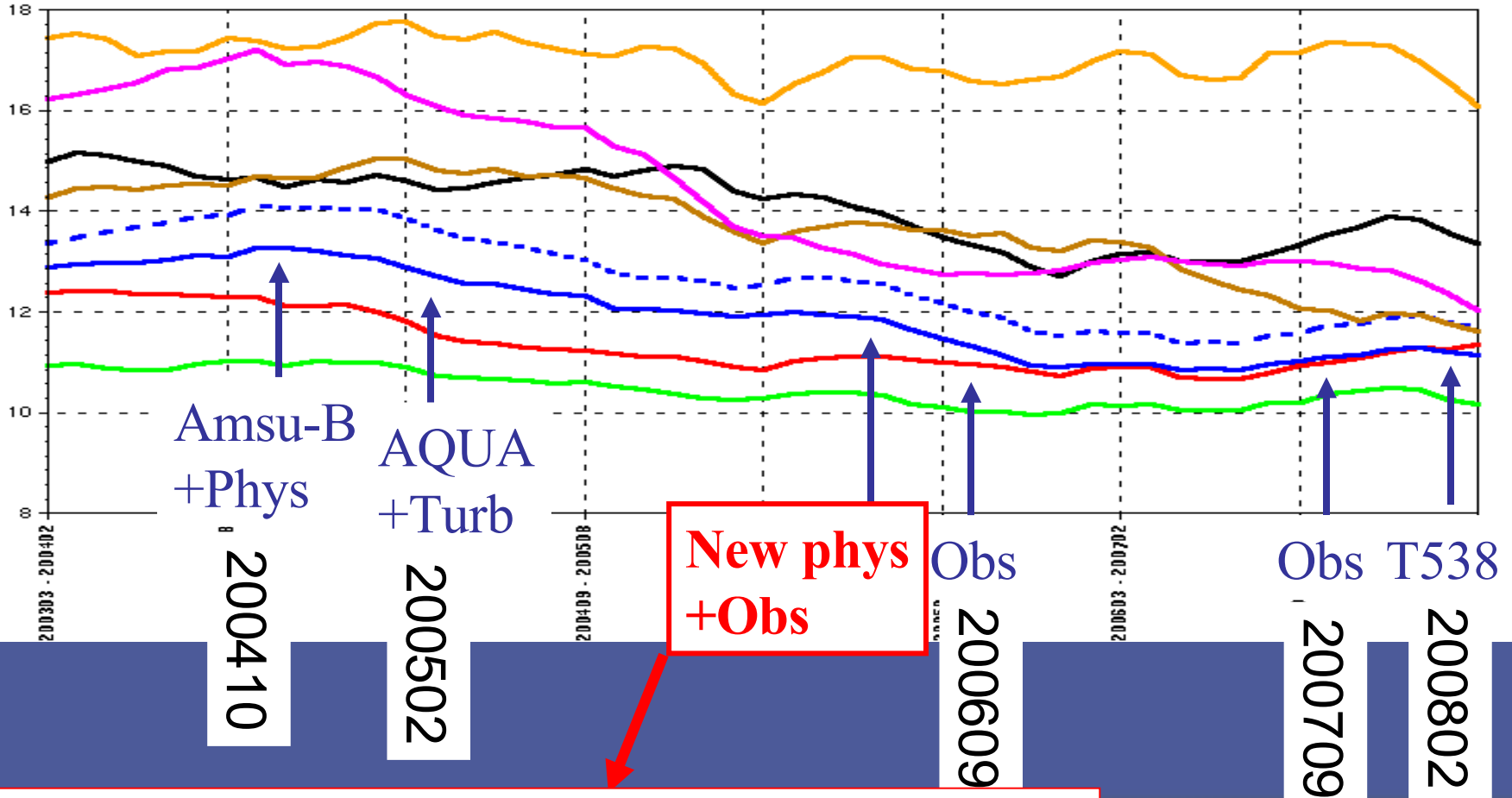
Scores to RS over Europe (Z500 at 24h)

DPrév/COMPAS
13/03/08

Erreur Quadratique Moyenne de prévision à 24 heures par rapport aux radiosondages

GÉOPOTENTIEL à 500 hPa - Domaine EUROPE
Moyenne glissante sur un an (M-5 à M+6)

Pays	
FRANCE	ECMWF
UKMO	NCEP
CMC	JMA
DWD	TROPIQ



June 2006 : Prognostic microphysics (Qv, Ql, Qi, Qr, Qs)
RRTM, new SW

2) Latest developments in physics

Operational parametrizations

Pronostic variables : U, V, T, Qv, Ql, Qi, Qr (rain), Qs (snow) + surface

- Radiation: ECMWF scheme (LW: RRTM, SW:Fouquart Morcrette (2sb))
- Ozone, Aerosols: 2D monthly climatologies
- SSO: Z0_eff, envelop orography, GWD scheme (Catry et al.,2008)
- Turbulence: 1st order scheme (Louis, 1982), « Ri » formulations in stable conditions, interactive mixing lengths computed from diagnosed PBL height
- Shallow convection: « Ri » modification
- Large scale cloud and precipitation (Lopez, 2002) : PDF cloud scheme, autoconversion, collection, evaporation, melting, sedimentation
- Convection (Bougeault): mass flux scheme, based on moisture convergence, variables detrainment and entrainment rates, momentum transport, downdrafts
- Land surface scheme « ISBA »



Strategy for the evolution of ARPEGE / ALADIN-Fr physics

Develop a common physical package for NWP and Climate simulations (with inputs that may originate from our collaborations with ECMWF, ALADIN, HIRLAM, IPSL/CNRS)

And, when possible scientifically, use same physical parametrizations as in AROME (surface, turbulence, shallow convection, radiation ?)



Current developments / validations

New set of physical modifications tested in ARPEGE / ALADIN both NWP and Climat:

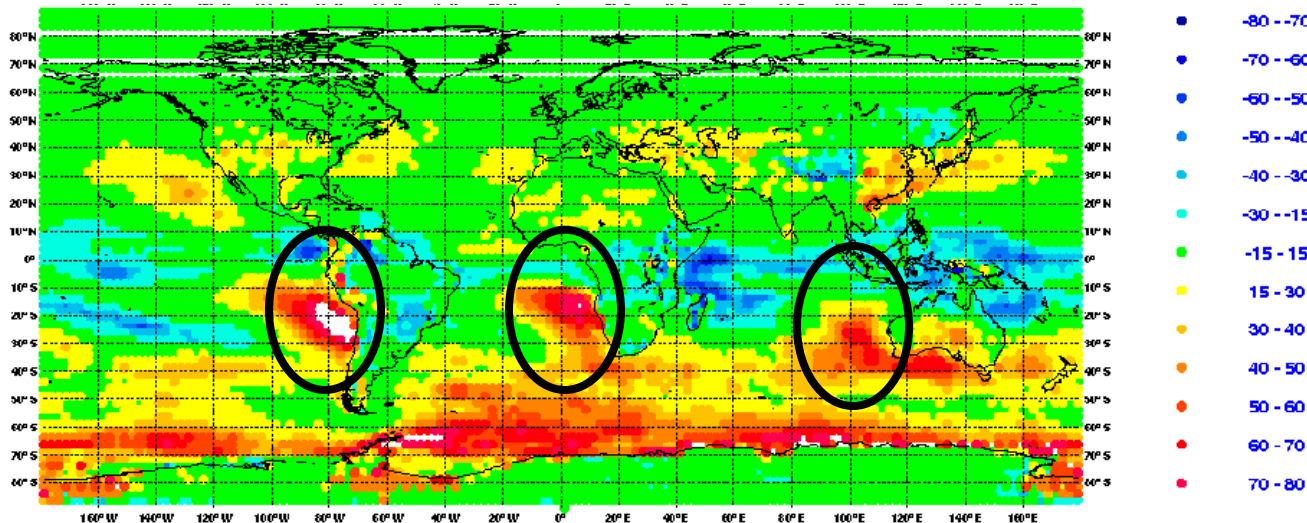
- Prognostic moist turbulence scheme « CBR » with BL89 mixing length (Cuxart, Bougeault, Redelsperger, 2000)
- Shallow convection mass flux scheme « KFB » (Bechtold et al., 2001)
- Top PBL entrainment scheme (Grenier, 2001)
- New parametrization for surface fluxes over ocean « ECUME »
- Use of 6 spectral bands in the SW scheme
- Additional tunings (convective clouds, microphysics, ...)

Used in AROME

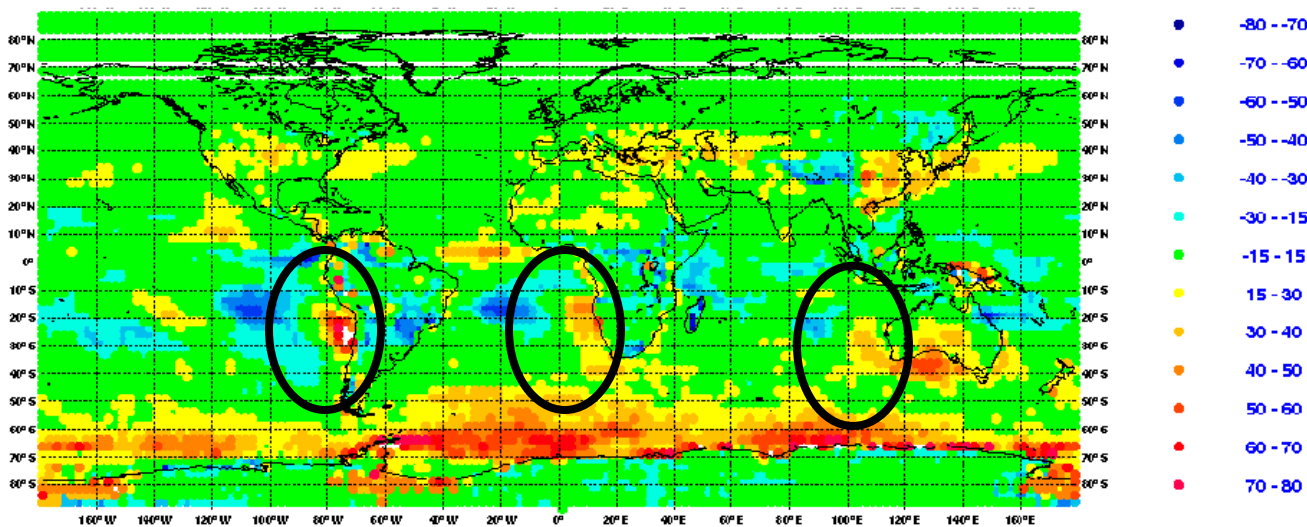


Some encouraging results ...

OPER : mean=7.9 W/m² std=23 W/m²



TEST : mean=3.4 W/m² std=19 W/m²



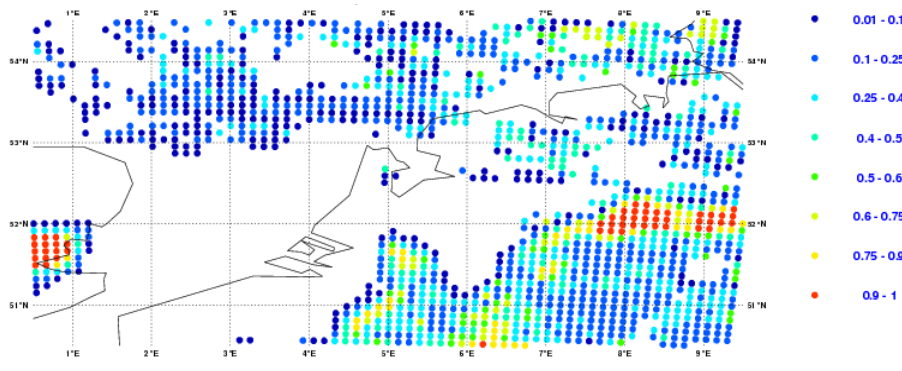
Evaluation
against satellite
climatologies
SW TOA
DJF
Model - CERES



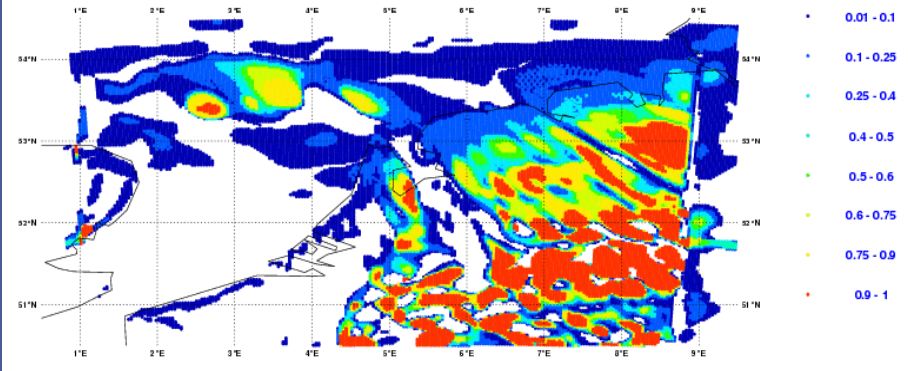
Benefits of using similar PBL parametrizations in ALADIN and AROME ?

Case study: 6 June 2005. 15h forecast of low level cloudiness

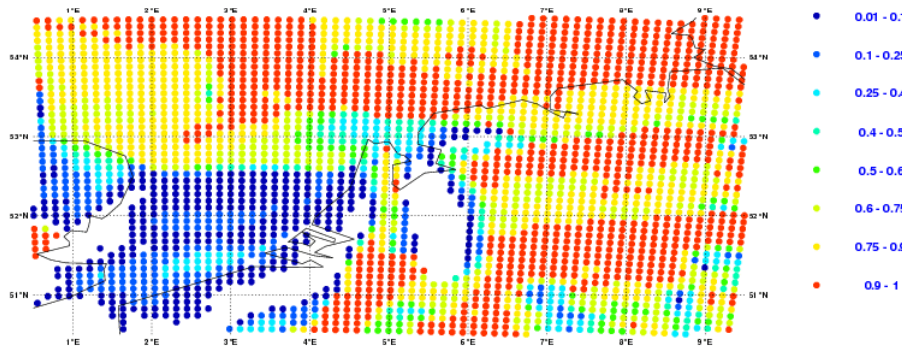
ALADIN oper



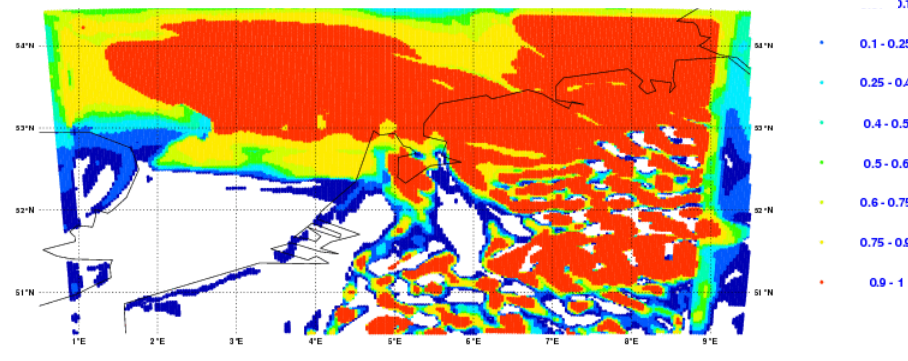
AROME coupled with ALADIN oper



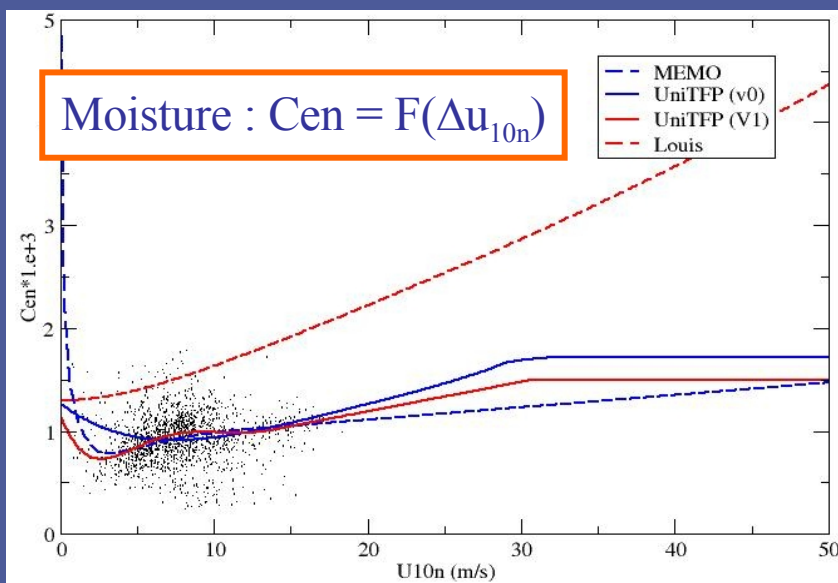
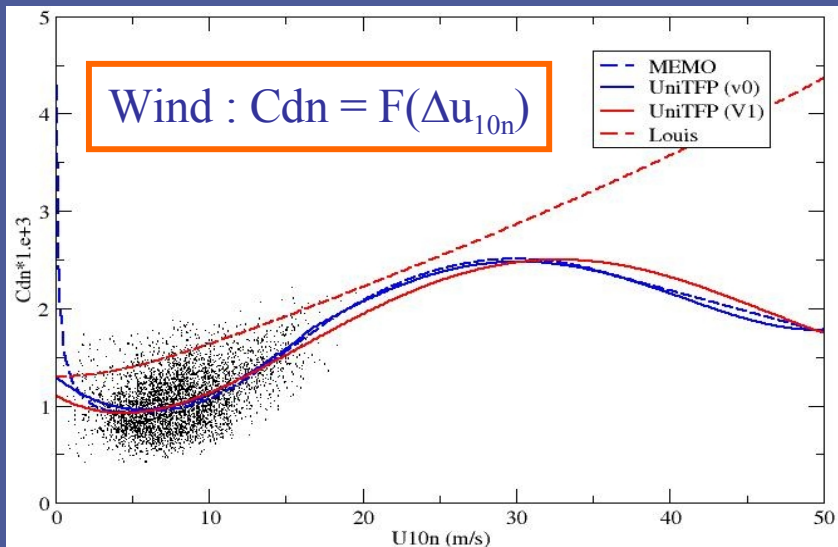
ALADIN "test" (CBR+KFB+CVP_lim)



AROME coupled with ALADIN "test"



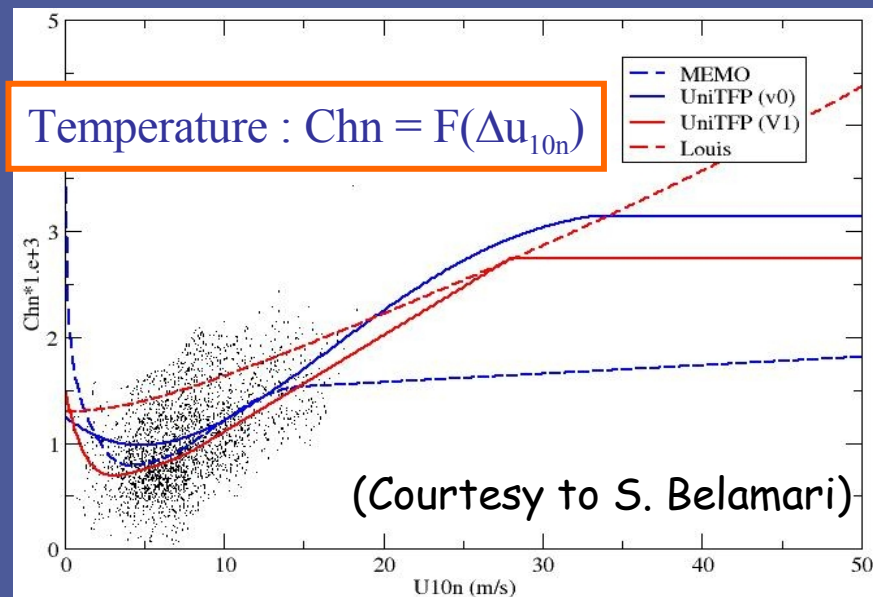
New parametrization for ocean surface fluxes « ECUME »



ECUME = Exchange Coefficients from Unified Multi-campaigns Estimates

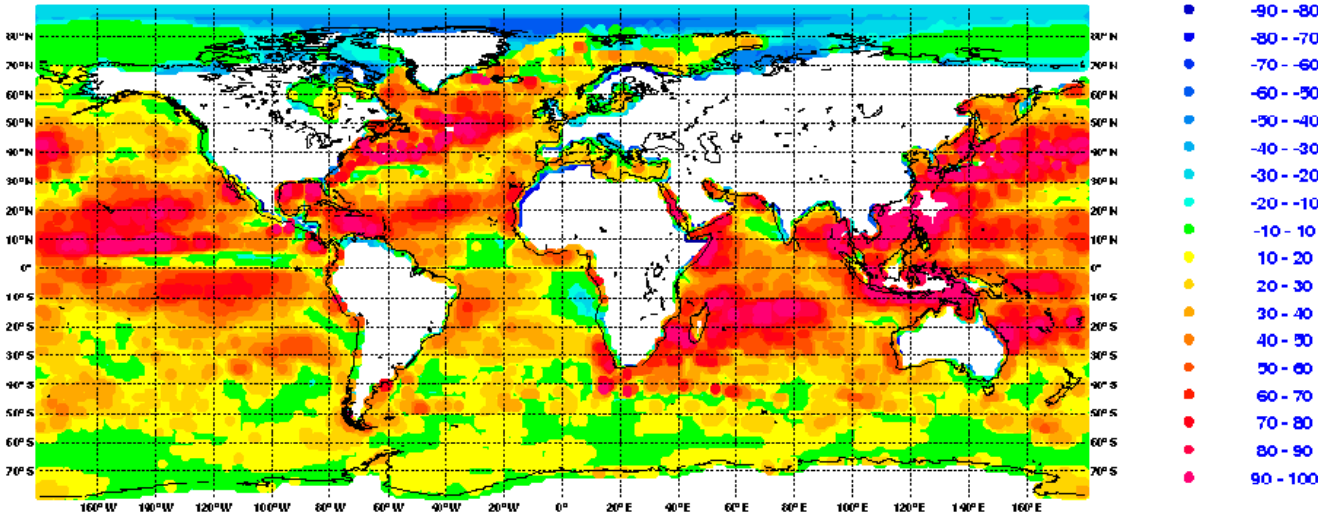
FETCH (1998), EQUALANT (1999), POMME (2001)

Bulk iterative parametrization of surface turbulent fluxes over ocean

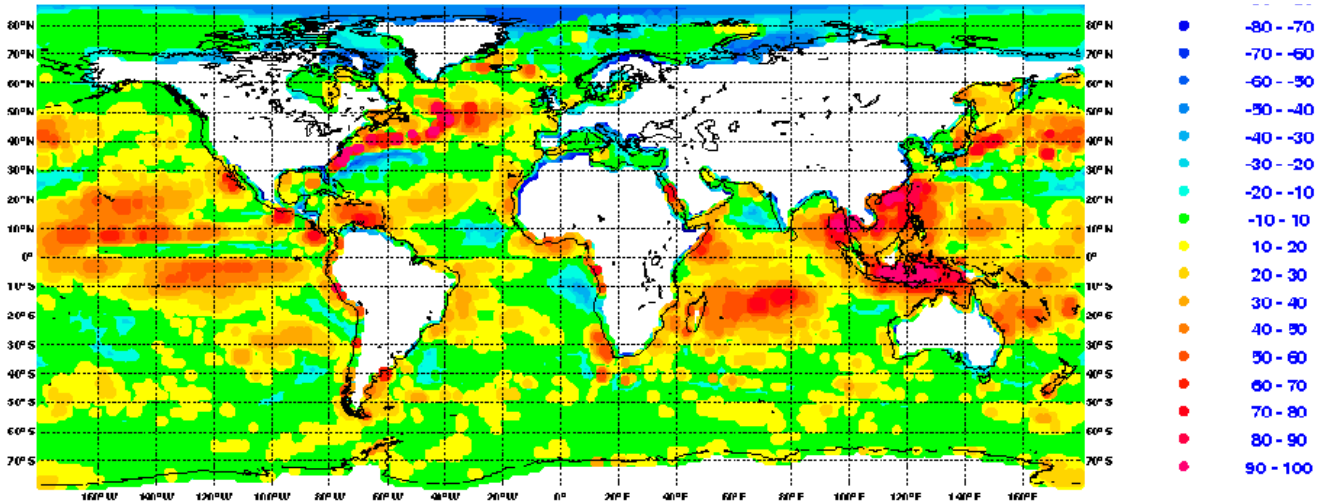


« ECUME » impact in ARPEGE

OPER: mean=16 W/m² std=34 W/m²



NEW: mean=-1.0 W/m² std=24 W/m²



Comparison against
« Da Silva »
climatology

Surface latent heat flux

DJF

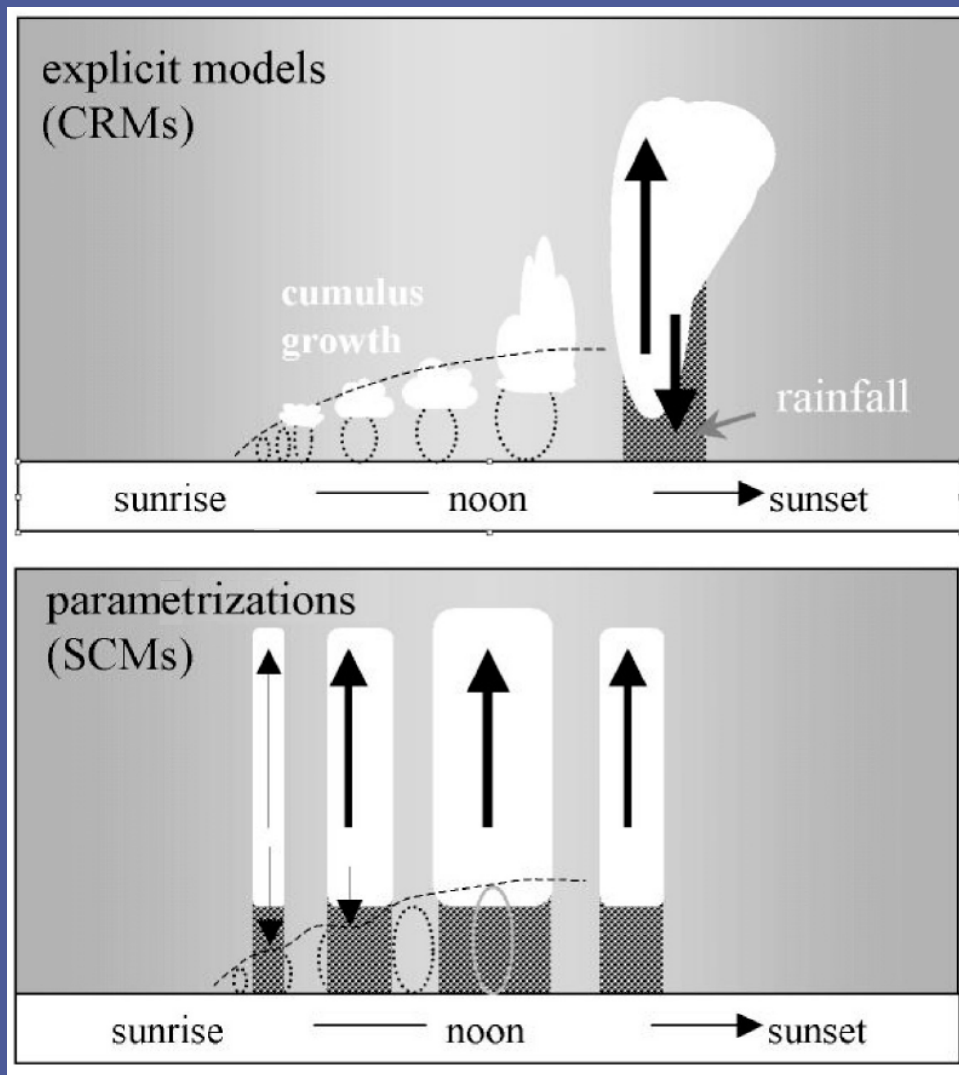
Model - CLIM



Important problems with convection

- Diurnal cycle of convection (start too early, intermittent, transition between shallow and deep convection)
- Overestimation of small precipitations events and underestimation of strong ones,
- Lack of moist convection in case of no synoptic forcing (moisture convergence closure)
- Top of convection at neutral level

⇒ Strong interest to evaluate 3MT in ARPEGE / ALADIN-Fr



(Guichard et al., 2004)



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Toujours un temps d'avance

Perspectives

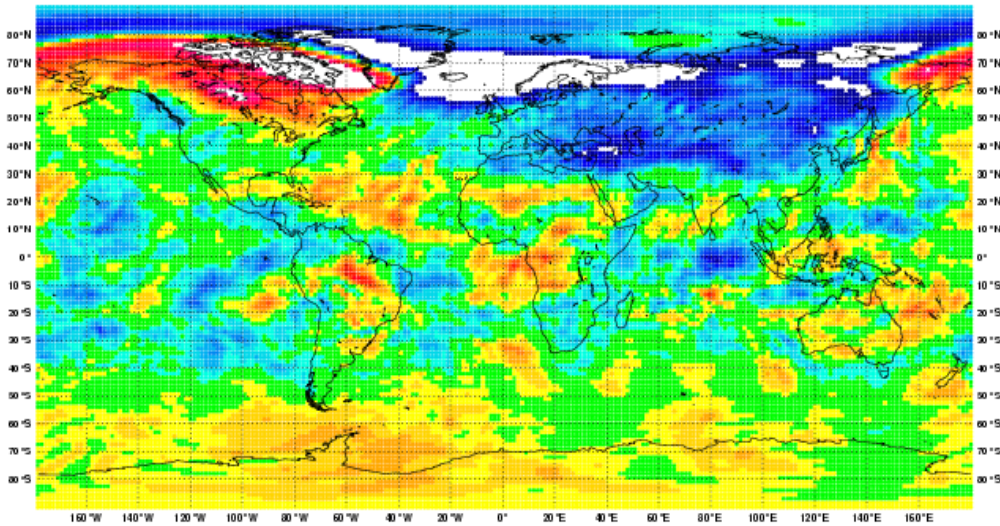
Perspectives

- Current parallel suite might become operational in May 2008 ?
- Parallel suite with new physics (« CBR », « KFB », « ECUME », ...) : June 2008 ?
- Assimilation of new observations (SSMI-S, Doppler radar in ALADIN, ...)
- Increase density of assimilated satellite radiances (by a factor 2 via thinning)
- Improvements linked with the ensemble of assimilations
- Evaluation of « 3MT » convection scheme
- Evaluation of the new shallow convection scheme « EDKF »
- Implementation of SURFEX
- New resolutions: T800C2.4L70 (in 2009)

**Thank you for your
attention**

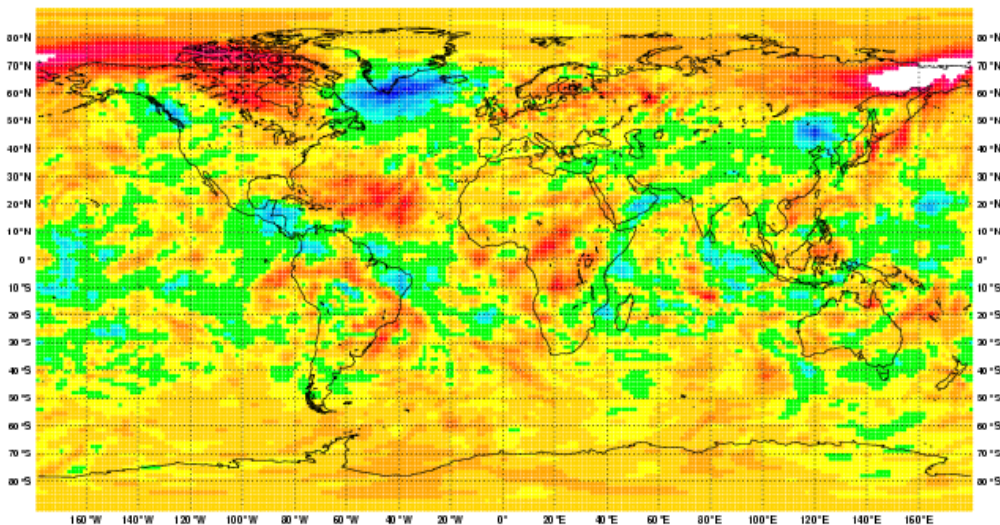
Temperature in the stratosphère (~20hPa)

P96 OPER - ANACEP

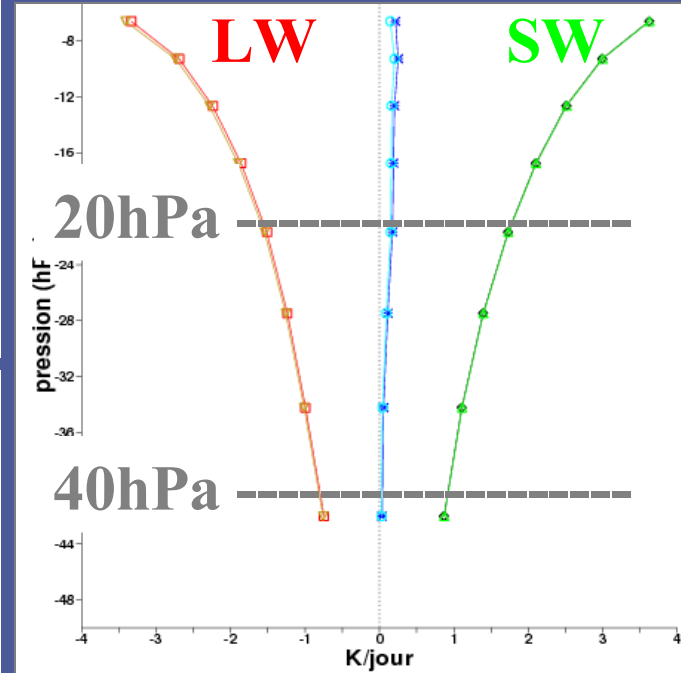


- -5 - -4.5
- -4.5 - -4
- -4 - -3.5
- -3.5 - -3
- -3 - -2.5
- -2.5 - -2
- -2 - -1.5
- -1.5 - -1
- -1 - -0.5
- -0.5 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.5
- 2.5 - 3
- 3 - 3.5
- 3.5 - 4
- 4 - 4.5
- 4.5 - 5

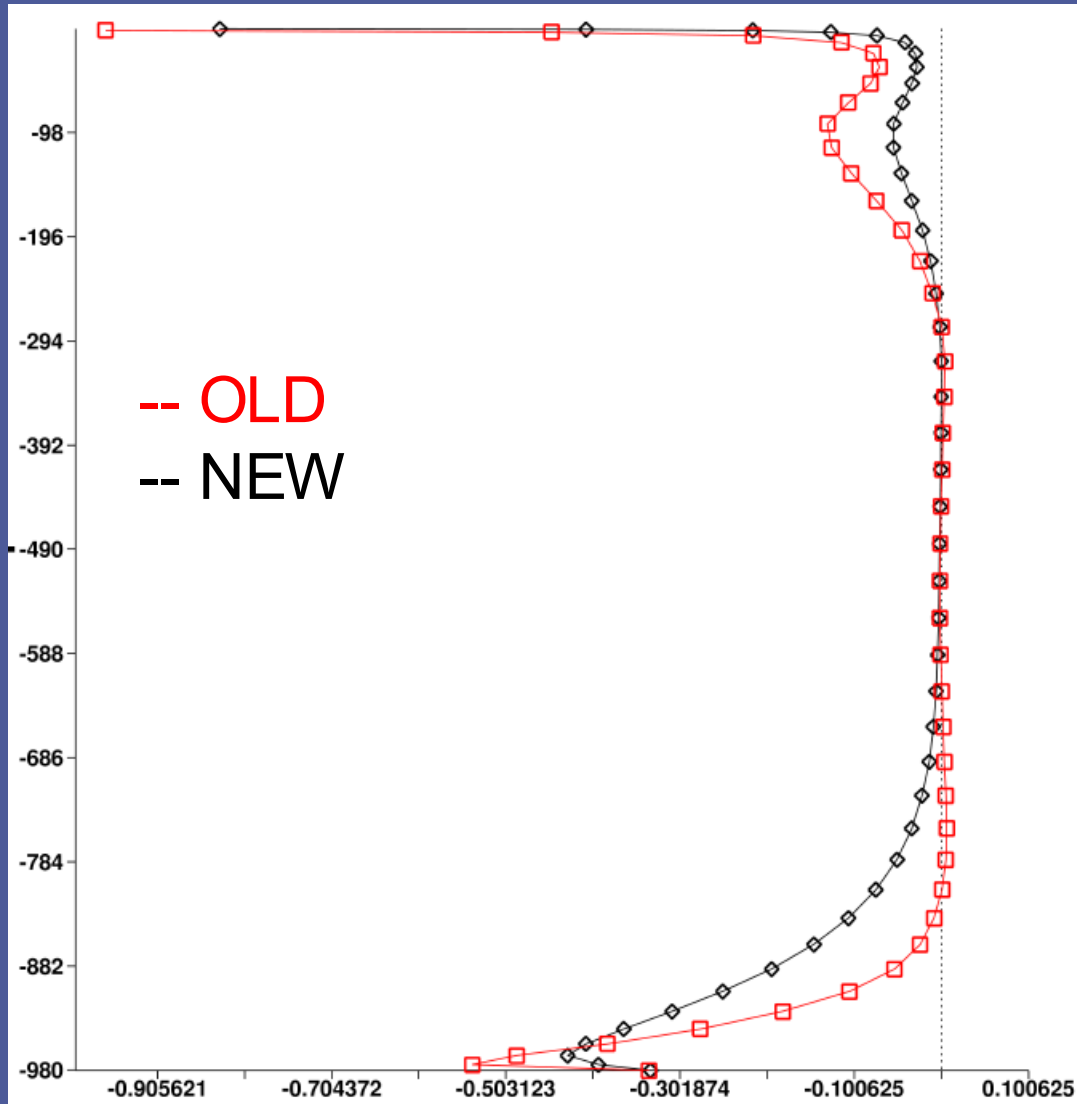
P96 HR - ANACEP



- -5 - -4.5
- -4.5 - -4
- -4 - -3.5
- -3.5 - -3
- -3 - -2.5
- -2.5 - -2
- -2 - -1.5
- -1.5 - -1
- -1 - -0.5
- -0.5 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.5
- 2.5 - 3
- 3 - 3.5
- 3.5 - 4
- 4 - 4.5
- 4.5 - 5



Global tendency on zonal wind GWD due to « GWD » parametrization



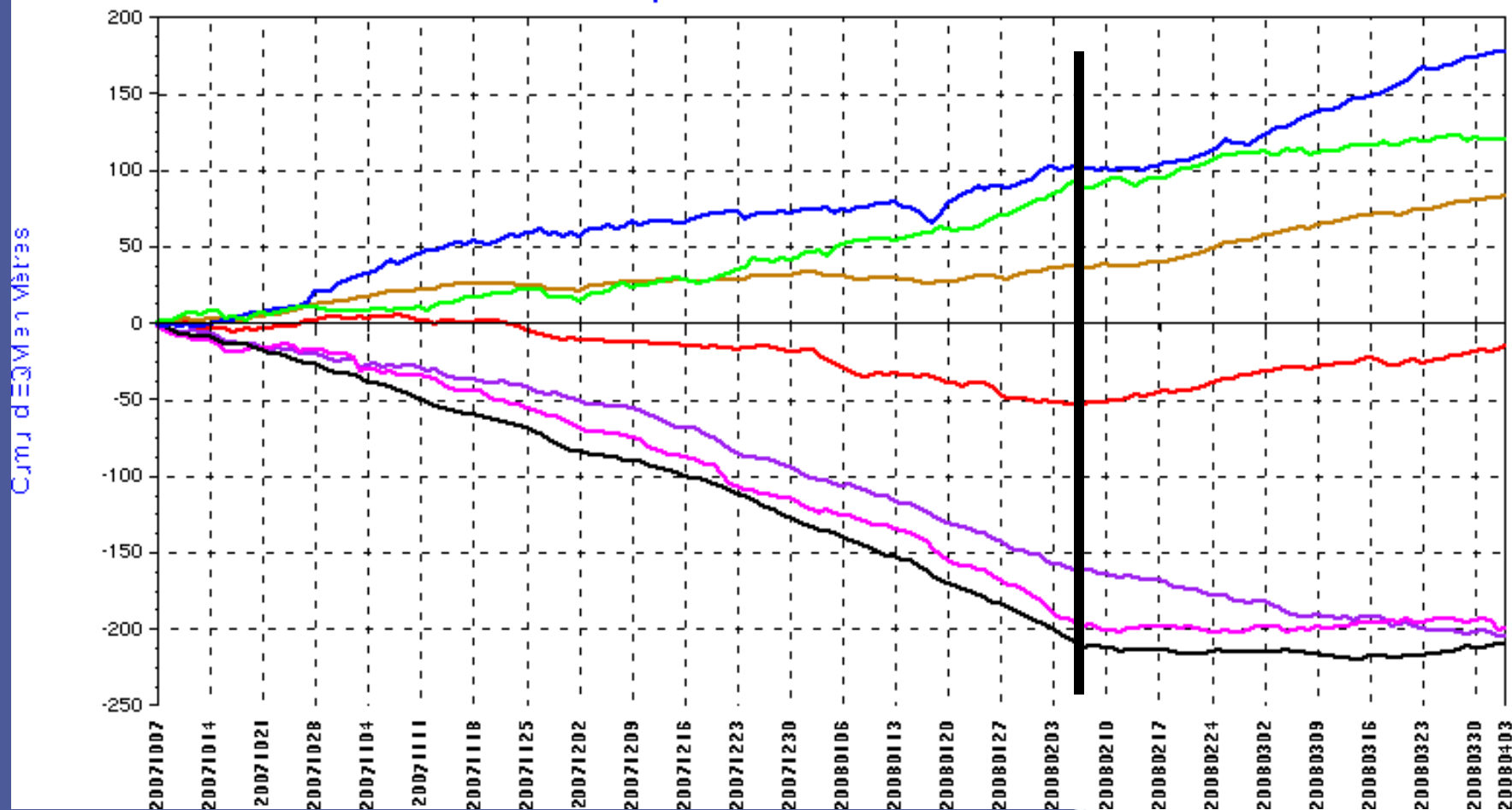
Scores to RS (Z500 at 24h)

DPIPREVICOMPAS
04/04/08

Cumul des différences d'E.Q.M. de prévision à 24 h par rapport aux RS (DWD+CEP+UKMO)-3 x ARPEGE

Géopotential à 500 hPa

- ZONE DE CONTROLE
- AMNORD
 - ASIE
 - AUS/NZ
 - SUD20
 - EUROPE
 - TROPIQ
 - NORD20



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