Recent evolutions in Arpege and Aladin-MF models

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21st Workshop / All Staff Meeting, Norrköping, Sweden, 5-8 April, 2011
Outcome

- Latest operational changes and current e-suite
- Modifications in microphysics and convection
- Use of Surfex in Aladin
- Perspectives
**Latest operational changes and current e-suite**

**April 2010**: Arpege new resolution T798L70C2.4 (~10km over France and 60 km over New Zealand, analysis increment ~60km), Aladin suites at 8km, higher density of satellite observations

**November 2010**: Assimilation of new observations: SSMI/S F16 & F17, GPS/GRAS, GPS satellite between 25 and 36 km, more SATOB over the poles, AMSU-A & AMSU-B tropospheric channels over sea-ice; SYNOP Hu2m during daytime, new bias correction for RS, use of EnsDA $\sigma_b$ in screening and use of $\sigma_b$ for HU. Use of SST Ostia analysis. Changes in roughness lengths and microphysics. RT as spectral variable (issue with DFI). Simulated brightness temperature with RTTOV.

**December 2010**: Version 3 of PEARP (EPS with Arpege). Still 35 members and linked with AEARP (EnsDA), but increased spatial resolution T538C2.4L65 (~15km over France) and 10 physics (instead of 8), singular vectors on 7 domains (instead 4)

**Current e-suite**: Assimilation of new observations: ATOVS RARS, SSMI/S F18, use of $\sigma_b$ from EnsDA including model error representation, tuning of simplified resolved condensation/precipitation scheme, modifications in deep convection scheme, SURFEX in Aladin
OMM scores

Annual mean RMS for Z500 48h vs RS over EUROPE

04-2010
New resolution
New density obs

Heidke Skill Score against persistence
Precipitation threshold 20 mm/day

Arpege in blue

03-2007
02-2011
04-2010
Changes in roughness lengths

- Effective roughness length is increased (like in Surfex)
- Suppress subgrid orographic contribution in turbulent exchange coefficient for heat and humidity at surface (like in Surfex)

ARPEGE 96h forecasts (20091215-20100201)

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⇒ Improvement of T2m, H2m, V10m over mountains
⇒ Improvement of synoptic atmospheric scores in dynamical situations over mountains
Microphysics (1)

- Sedimentation of cloud ice crystals and cloud droplets with constant terminal velocities, respectively 8 cm/s et 2 cm/s (about 300m and 70m in one hour, several vertical levels near surface) ⇒ realistic decrease of high level clouds (cirrus) and very low clouds which has allows some beneficial revisions of old modifications and tunings that were compensating errors!

- Adding missing physical processus : conversion of liquid precipitation in solid precipitation in case of negative air temperature
Microphysics (2)

High cloud cover averaged over DJF 2007/2008

⇒ Improvement at mid and high latitudes (preponderance of resolved cloud scheme)
⇒ Some positive and negative impacts due to weaknesses in convective cloudiness
Deep convection (1)

- Problem of « grid-point » storm (too intense resolved vertical velocity), which generates small scale and sometimes deep cyclogenesis, mainly over ocean in cold front area.

- Modifications: increase the intensity of deep convection parameterization in case of excessive resolved vertical velocity (kind of “security” scheme, such as existing in UK global model (CAPE consumption in one time-step) or in JMA global model (targeted diffusion on humidity):
  - Moisture consumption and convective entrainment are respectively increased and decreased in case of strong resolved vertical velocity
  - Resolved condensation is computed after subgrid condensation

- These modifications are supposed to be temporary fix before a complete renewal of the deep convection scheme on better scientifically bases.
Deep convection (2)

ANASYG 11 / 10 / 2010 00 UTC

MSLP P60 valid at 13/10/2010 12 UTC
(analysis / reference / test)

ANASYG 12 / 10 / 2010 00 UTC
Deep convection (3)

REF : RR resolved (P36-P24)
Max=148mm

TEST : RR resolved (P36-P24)
Max=21mm

REF : RR subgrid (P36-P24)
Max=42mm

TEST : RR subgrid (P36-P24)
Max=79mm
On-going works on convection

- **Shallow convection scheme**: implementation (already done) and evaluation (started) in Arpege/Aladin of EDKF scheme (Pergaud et al., 2009) used in Arome. The use of long time-step (~600s) created some instability problems linked with vertical advection, that have been solved now. (Y. Bouteloup)

- **Deep convection scheme**: validation of PCMT (Prognostic Condensates Microphysics and Transport) scheme. Some links with 3MT scheme, but more prognostic variables for convective clouds, possibility of moisture convergence or CAPE closures, etc. (J.M. Piriou, J.F. Gueremy, ...)

- **1D simulations of transition regimes** (cumulus<->stratocumulus) in the framework of Euclipse/FP7 project (E. Bazile, I. Beau)
Planning of operational Surfex implementation:

- **Aladin suites with assimilation** (3D-Var upperair and OI surface analyses):
  - Aladin-France + 4 Aladin suites over tropical domains (*current e-suite*)
- **Aladin suites in dynamical adaptation** (*before end of 2011*)
- **Arpege NWP** (*in 2012*), since already used in Arpege-Climat

**SURFEX configuration in ALADIN-MF** (as close as possible to AROME one), which means several changes compared with current operational surface schemes:

- **GTOP030** (1km), **ECOCLIMAP** (1km), **FAO** (10km): strong improvements in term of spatial resolution compared with current databases, ~5km, ~10km, ~100km resp
- 3 tiles (sea, lake, nature) compared with homogeneous surface (water or land)
- **ISBA-3L** instead **ISBA-2L**
- snow scheme: 1 layer with prognostic albedo and snow density (Douville, 95)
- sea surface fluxes (“ECUME” scheme, already operational in Arpege/Aladin-MF)
- prognostic CLS scheme “CANOPY” over continent
- different surface turbulent exchange coefficients, soil/vegetation heat capacities
SBL scores (summer period)

92 Aladin-France r0+54h forecasts in dynamical adaptation (20100601-20100902)

Bias and RMS without SURFEX (in red) and with SURFEX (in blue)

⇒ Neutral on Pmsl, surface RR, total cloudiness, 10m wind direction (not shown)
⇒ Large improvement on T2m, H2m during night time, and on FF10m.
SBL scores (winter period)

90 Aladin-France r0+54h forecasts in dynamical adaptation (20101201-20110302)

Bias and RMS without SURFEX (in red) and with SURFEX (in blue)

⇒ Neutral on Pmsl, surface RR, total cloudiness, 10m wind direction (not shown)
⇒ Large improvement on T2m bias and on FF10m.
Perspectives

- Continue implementation/evaluation of Arome parameterizations in Arpege/Aladin-MF ("EDKF" and "Surfex", already done for radiation, turbulence and previous version of shallow convection scheme "KFB").

- Renewal of deep convection parameterization (priority on "PCMT", support for implementation/evaluation of "3MT" with Arpege physics)

- Wish for an evolution of physics interfaces ("Aplpar" & "Apl_arome"). Possible connexions with Oops? Continue the implementation/evaluation of the more flexible physics/dynamics interface (D. Degrauwe)

- Need for improving further the 1D model "MUSC" which is crucial for model physics development, validation and collaboration. (E. Bazile ‘s talk)