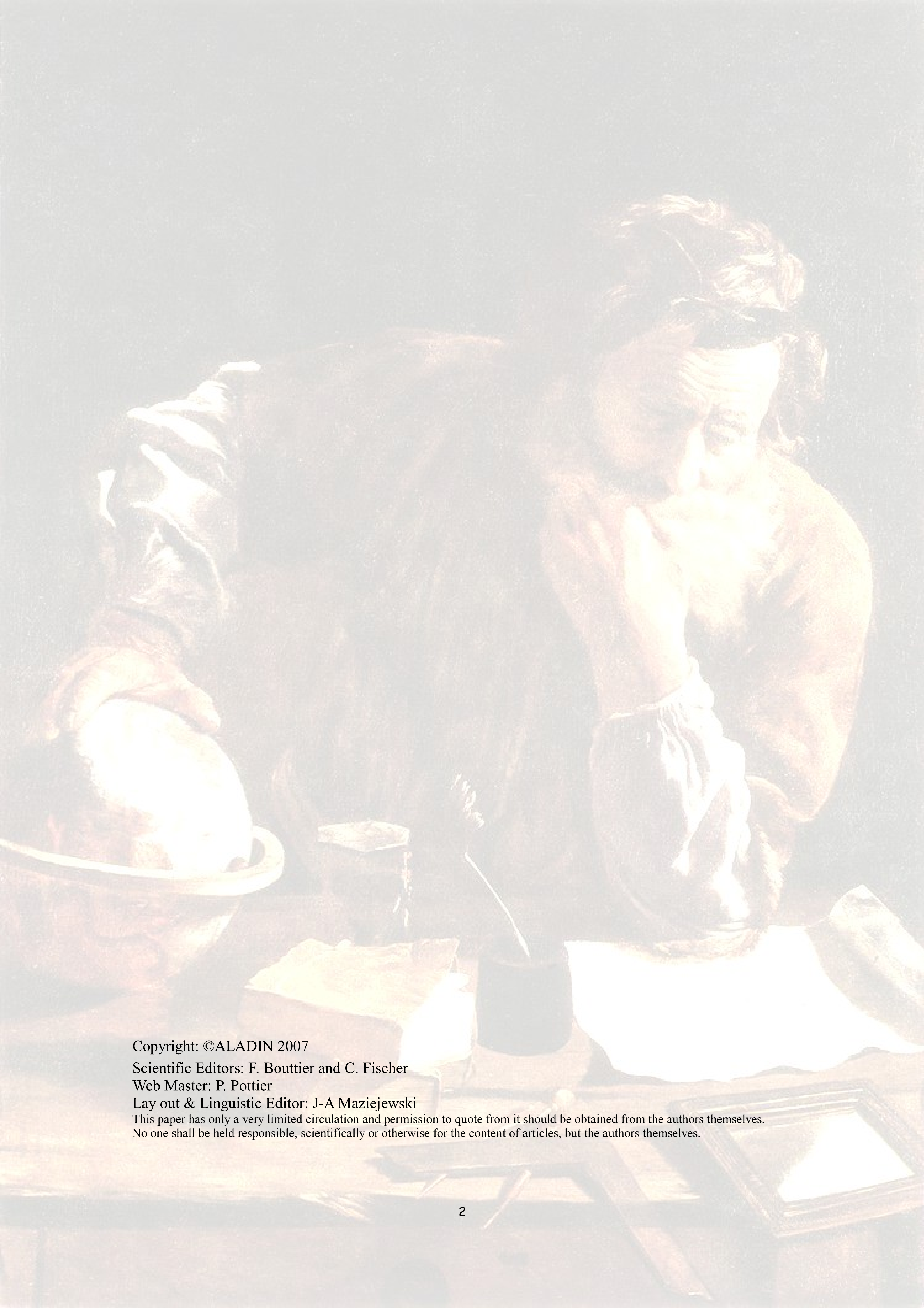
ALADIN NEWSLETTER 33

July-December 2007



Scientific Editors: F. Bouttier and C. Fischer
Web Master: P. Pottier
Lay out & Linguistic Editor: J-A Maziejewski

CONTENT

1. EDITORIAL

1.1. Foreword by *András Horányi*

Dear Readers of the ALADIN Newsletter,

I think, inevitably the most important achievement of the last half year is the final redaction of the ALADIN strategy document, which was formally accepted by the ALADIN General Assembly (http://www.cnrm.meteo.fr/aladin/scientific/ALADIN_strategy.pdf) with some fine tuning after the Assembly. I believe the existence of such a basic document for the ALADIN project is essential and also symbolizes those changes, which were encountered since the signature of the last MoU in autumn, 2005. The Strategy clearly demonstrates those objectives, which are ahead of the project (for the next 10 years) and hopefully helps in keeping such a long-term cohesion of the project, which is essential for the efficient evolution of the ALADIN project. Certainly one should not forget that the Strategy is just one, basic ingredient, which will be followed by medium-term and than shorter term scientific plans, which will be the next challenging planning tasks ahead of the project. The entire planning process will give a very good background for the scientific work and also will help in the recognition of the many-folded ALADIN activities in front of the managers of the ALADIN partners. Many-many thanks for those, who meaningfully contributed to the Strategy document and good luck to those who will work on the medium-term version.

Another important (and very recent) event is the joining of Turkey as full member of the ALADIN Consortium (after a short period of being acceding member). Big-big welcome to Turkey among the ALADIN troops and good luck for this new challenge for them!

I believe it is also important to speak a bit about the “changing international environment”, i.e. about the changes to come as far as the cooperation between the different LAM Consortia (LACE, COSMO, HIRLAM and MetOffice beside ALADIN) is concerned inside the EUMETNET/SRNWP (Short Range Numerical Weather Prediction) project. Hereafter just two new features are emphasised with a bit more detail. The first one is the creation of the SRNWP Expert Teams (ETs in short), which will be some kind of “cross-consortia working groups” along given subjects of interest (data assimilation, physics, dynamics, predictability etc.). It means that the thematic planning will be realised not only among each Consortia, but also between them. Hopefully it will step-by-step enhance the task-sharing between the different LAM Consortia. The other important aspect is the kick-off of the “interoperability” project, which will be supported by EUMETNET and aiming at an increased level of interoperability between those LAM Consortia (for instance inter-changeable outputs or possibly use of any lateral boundary conditions for a LAM). All this and other characteristics of the SRNWP programme can be seen at the new webpage of the project under http://srnwp.met.hu. I am convinced that the future success of ALADIN will also strongly depend on the participation of the project in these “brand-new” endeavours.

Finally, please allow me (and forgive me!) some personal remarks on the occasion that after more than 16 years of work for ALADIN I have formally quitted the project since 1st of January 2008. I have to admit that I will preserve extremely nice memories about the ALADIN project from those times, when I was a beginner in the project (and I knew basically nothing about NWP) through the establishment of lot of friendship with people from different cultural and social background until the times, when I could have some slight opportunity to influence the evolution of the project. I am very grateful for all these nice times (many thanks for all of you, who made it possible and contributed to it) and I wish a similarly nice and scientifically and emotionally interesting continuation at least for the next 16 years. Please note that having my role as coordinator of the SRNWP project I have to be “positioned” from equal distance from each Consortia, but be sure that although I will do my best to be objective and fair to each Consortia, I will remain “aladinist” forever (please don’t tell it to the other Consortia).

1.2. EVENTS

The 29th Meeting of the European Working Group on Limited Area Modelling (EWGLAM) and the 14th Meeting of the Short-Range Numerical Weather Prediction (SRNWP) Programme took place 8 - 11 October 2007 in Dubrovnik, Croatia. The meetings were hosted by the Meteorological and Hydrological Service of Croatia and supported by the Croatian Ministry of Science, education and sports, City of Dubrovnik and the Silicon Graphics Croatia.

73 participants from 23 countries discussed a wide range of numerical weather prediction and limited area modelling issues in 5 presentations of Consortia, 22 scientific and 20 national poster presentations.

Further information on: http://meteo.hr/EWGLAM07/

1.3. ANNOUNCEMENTS

The 2nd AROME training course will be held in Lisbon from the 4th to the 7th of March 2008. This will be a joint organisation between the Portuguese Meteorological Service and Météo-France. http://www.meteo.pt/en/eventos/AROME08/home.html

For any further questions contact through the e-mail address: arome2008@meteo.pt

18th ALADIN Workshop and HIRLAM All Staff Meeting 2008, Bruxelles, 7-10 April 2008

The 4th PAN-GCSS meeting on Advances in Modeling and Observing Clouds and Convection will take place at Meteo-France, Toulouse (CIC), from 2 to 6 June 2008.

CORRIGENDUM

In the article by C. Faccani and T. Montmerle: **Assimilation of Doppler radar radial velocities in ALADIN/AROME,** *ALADIN Newsletter* **N32**, under the heading: Doppler radar wind errors, $V_N = \lambda (PRT/4)$ should be replaced by $V_N = \lambda / 4\text{PRT}$

2. OPERATIONS

2.1. INTRODUCTION

2.2. CYCLES

C. Fischer

*CY32: declared locally in December 2006 (common with ECMWF/IFS) *

*CY32T0: declared early February 2007 *

- Bugfixes for LAM 3D-VAR
- Catch-up of MF E-suite for operations
- Optimisation for NEC platforms
- (final) bugfix for LAM geometry

*CY32T1: declared April 2007 *

- ALARO0 code updated within the official releases; R&D updates for 3MT
- OpenMP and AROME optimisations

This cycle became an export version for the Aladin partners.

*CY32T2: declared June 2007 *

- Climate group contribution for Arpège-Climat
- Stronger compression option for GRIB fields (second-order compacting)
- BATOR adaptations for reading GRIB instead of RGB libraries for SEVIRI data (useful for the assimilation of SEVIRI radiances in Aladin-Hungary)
- Corrections in the call to the externalized surface scheme
- SURFEX in Arpège and Aladin-France
- Optimisation of FGAT configuration for LAM
- MPI bugfix for the NEC SX8
- Bugfixes from phasing for ALARO and configurations 401/501/601/801 LAM
- Adaptations for the use of ASCAT data in Arpège and LAM
- Further adaptations and bugfixes for the "Diagnostiques Horizontaux", zonal and local horizontal model diagnostics (DDH)
- Adaptations for the use of METOP sensors and SEVIRI Clear Sky Radiances in Arpège and LAM
- New pre-processing for ground-based GPS (ZTD)
- Adaptations for the use of GPS radio-occultations in Arpège and LAM
- Version 2 of SURFEX in AROME; consistency checks on physiographic fields; get PBL fields directly from SURFEX (for diagnostic purposes only, so far)
- MASDEV4.7 version of Méso-NH physics for AROME
- Implementation of the 1D Bayesian retrieval code within the Arpège/IFS assimilation software, for radar reflectivity assimilation
- Implementation of the radar radial wind observation operator in Arpège/IFS
- Update to HIRLAM physics on CY32
- Miscellaneous cleanings in the dynamics code
- Adjoint of the SL advection scheme for LAM

For CY32T1, the total amount of modified or new routines is about 1200. The new version of the AROME physics package represents about 50 % of this figure.

*CY32T3: declared end of September 2007 *

- Further changes for the Arpège/SURFEX interface
- Use PBL fields directly from input file (possibly computed by SURFEX previously) under logical key

- Corrections for ALARO0 physics to match the operational version at CHMI
- Protections against too aggressive optimisation by NEC compiler
- New treatment of surface emissivity for microwave radiances over land
- Adapt DDH for 3MT and prognostic microphysics
- NEC optimisation features for AROME
- Bugfixes for CANARI OI scheme
- Optimisation of SL/AD code
- Screening of radar radial winds made available within Arpège/IFS software
- Adapt code for the assimilation of relative humidity retrievals from the 1D Bayesian inversion of reflectivities
- Further cleanings in dynamics; setup for vertical finite element-NH code

This cycle has become an export version for the Aladin partners.

*CY33: released early December 2007 (common with ECMWF/IFS) *

CY33T0: in January 2008

- Catch-up of changes for the Arpège HR E-suite from CY32T0_op2

*CY33T1: early-March/mid-April 2008 *

- Assimilation:
  - Plug-in LAM wavelet code
  - Code adaptations for reading in maps of (small ensemble derived) sigma-b's
  - Variational bias correction adapted for Aladin (to SEVIRI HR radiances)
  - New humidity control variable (E. Holm's dev.) in Aladin
  - adaptations in obs part for HR AMDAR and AMSUB (G. Bölöni)
- Arpège and Aladin-FR Physics:
  - final versions of TKE and SURFEX plug-in
  - Store exchange coefficients for vertical diffusion from the HR trajectory and read them in the TL/AD integrations
  - 3MT (mixed turbulence/convection scheme) for Arpège and Aladin
  - /Complete the setup for VFE in the NH model (if this has not been included before in CY33 by Mats and Karim or been implemented in a CY33R1)/
  - Rationalisation of the SL Interpolators (plus pruning some options) – Jan Masek
- AROME:
  - Surfex3 including CANOPY scheme for PBL diagnostics,
  - EDKF shallow convection scheme,
  - Hail as an option in the microphysics,
  - New handling of surfex output files (as atmospheric output files) - Optimisations for initial surfex files reading.
  - Arome compliant version of DDH (horizontal diagnostic averages for physics tendencies) - "version 0" (before further dataflow and logic re-structuration)
  - ALARO0 vertical diffusion implicit coupling with SURFEX

33T1 will become an export cycle for Aladin partners.

***CY34: to be started on May, 19th, 2008**

CY35: cleaning cycle to be produced immediately after CY34, mid-June/mid-July 08

- renaming and moving routines in the source code Projects

2.3. Transversal informations

2.4. ALGERIA

2.5. AUSTRIA

christoph.wittmann@zamg.ac.at

2.5.1. Introduction

Concerning the operational ALADIN model used at ZAMG a major change can be reported for the second half of 2007. After 50 days of parallel run CY32T1 using ALARO-0 physics (minus 3MT) was set into operational status on 12/09/2007. Verification showed that compared to the preceding operational ALADIN version used at ZAMG (CY25T1 using diagnostic typed microphysics) the use of ALARO-0 microphysics (yet minus 3MT) primarily brings improvements for precipitation fields. This could be mainly seen in the comparison of areal mean precipitation amounts, whereas on observation side INCA precipitation analysis was used. When comparing grid-point based scores (like ETS, FAR or POD) a neutral to slightly positive impact could be found. A comparison of surface and free atmosphere fields showed a neutral behaviour.

2.5.2. Operational setting

ALADIN-AUSTRIA runs four times per day. The forecast range is 72h hours for the main runs (00 and 12 UTC) and 60 hours for the intermediate runs (06 and 18 UTC). ALADIN-AUSTRIA uses an additional routine (acnebsk) to improve the forecast in the case of low stratus (Seidl-Kann-scheme).

Model Version:	**CY32T1**
Horizontal resolution:	**9,6 km**
Number of levels:	**45**
Number of gridpoints:	**300 x 270**
Time-step:	**415 sec**
Coupling model:	**ARPEGE**
Coupling frequency:	**3 hours**
Forecast range:	**72h / 60h**
Output every:	**1 hour**
Physics:	**ALARO-0 (without 3MT), Seidl-Kann sub inversion scheme, SLHD, pTKE**
Orography:	**envelope**
Grid:	**quadratic**
Hardware:	**NEC SX-8R, 16 CPU with 0.51 Tflop (32 Gflops/CPU), 128 GB RAM, 4.4TB storage**

2.5.3. ALADIN-LAEF:

The work on the ALADIN-LAEF (Limited Area Ensemble Forecasting) system continued during the last months. The method used for this LAM-EPS is dynamical donwnscaling of ECMWF-EPS members. The system was further optimized to have products (epsgrams, probability charts, etc) available earlier. It is now in a quasi-operational status. See also the Newsletter 33 contribution "*ZAMG/Meteo-France's Participation on WMO/WWRP Project B08RDP*" .

2.6. BELGIUM

2.7. BULGARIA

2.8. CROATIA

Martina Tudor, Stjepan Ivatek-Šahdan, Alica Bajić, Tomislav Kovačić and Antonio Stanešić

2.8.1. Summary

A plan to simplify the operational suite is set-up based on a number of reductions and a new computer for visualization is provided to replace 5 computers used now.

The operational suite is run on the same computer using two set-ups, one with AL29T2mxl and another using the Alaro0 physics based on the same cycle. The first will be stopped early in 2008 to simplify the maintenance of the operational suite. The forecast runs on 8km resolution, starting from Arpege analysis with DFI, twice a day for 00 and 12 UTC runs, up to 72 hours.

High resolution dynamical adaptation of wind will move from 6 small domains to a large one.

The visualization and post-processing software is being ported to the new machine that will be used as an Aladin html intranet server. The corresponding intranet pages are already created and some of the software is already ported and used operationally (gribeuse, GrADS, HRID). The software that process the measured data and does the model to measurements comparison is waiting for the effort from persons involved in the data-assimilation.

Internet address with some of the ALADIN products, like total precipitation and 10 m wind: http://prognoza.hr/aladin_prognoza_e.html .

2.8.2. Operational suite

❑ **Porting**

AL32T3 is ported. Using optimisation level 1, the strange cputime per timestep behaviour of AL32T1 with optimisation level 2 is not reproduced, but the overall cost is larger due to lower optimisation level. The possible usage of it for the Alaro0 operational set-up is still being considered. The switch would happen simultaneously with the already mentioned reduction in operational suite.

❑ **New high resolution dynamical adaptation domain**

High resolution dynamical adaptation of the wind field from 8 to 2 km resolution is still done on 6 small domains shown in Figure 1, on the left. Since 7th November 2007, high resolution dynamical adaptation of the wind field is done on a single large domain, shown in Figure 1, on the right.

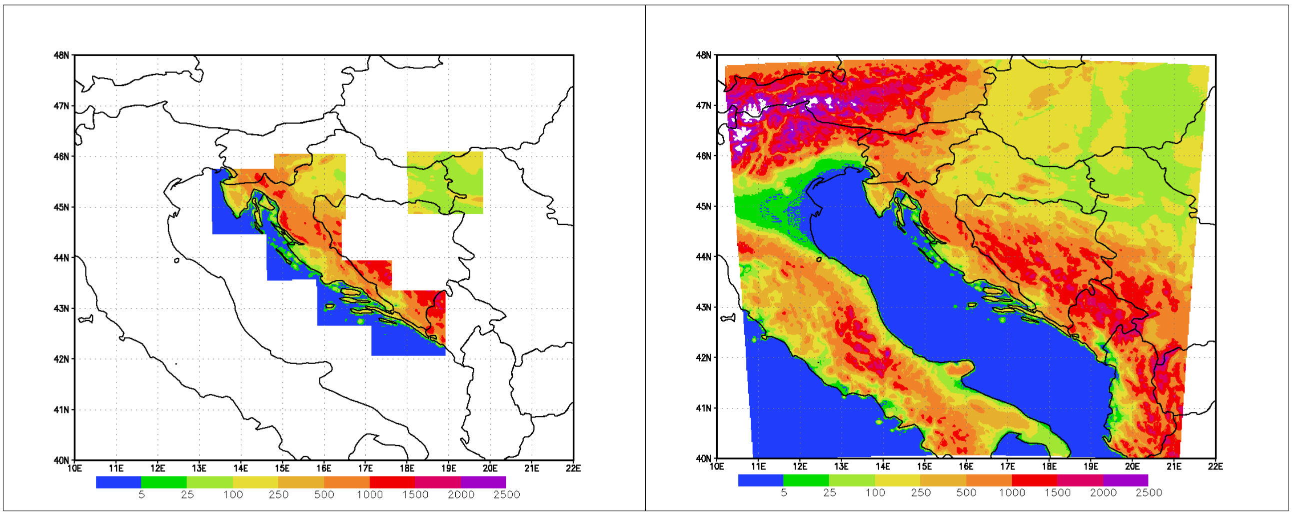


Fig. 1. 6 small 2-km resolution dynamical adaptation domains (left) used so far and the single large domain (right) to be used.

Running the dynamical adaptation operationally on the 6 small domains will be stopped in the beginning of 2008 simultaneously with other actions planned for the big switch.

- ❑ **New post-processing products**
  - ☑ **Hourly HRID**

So far, the pseudo-TEMP data has been extracted from Aladin forecasts with a 3-hourly interval to provide input for HRID. With the new visualization computer being introduced, a number of modifications has been proposed, one of them being to move to 1hour interval. The new product is not only more informative, but also avoids some strange behaviour present in the one using the 3hour interval, but unfortunately not all.

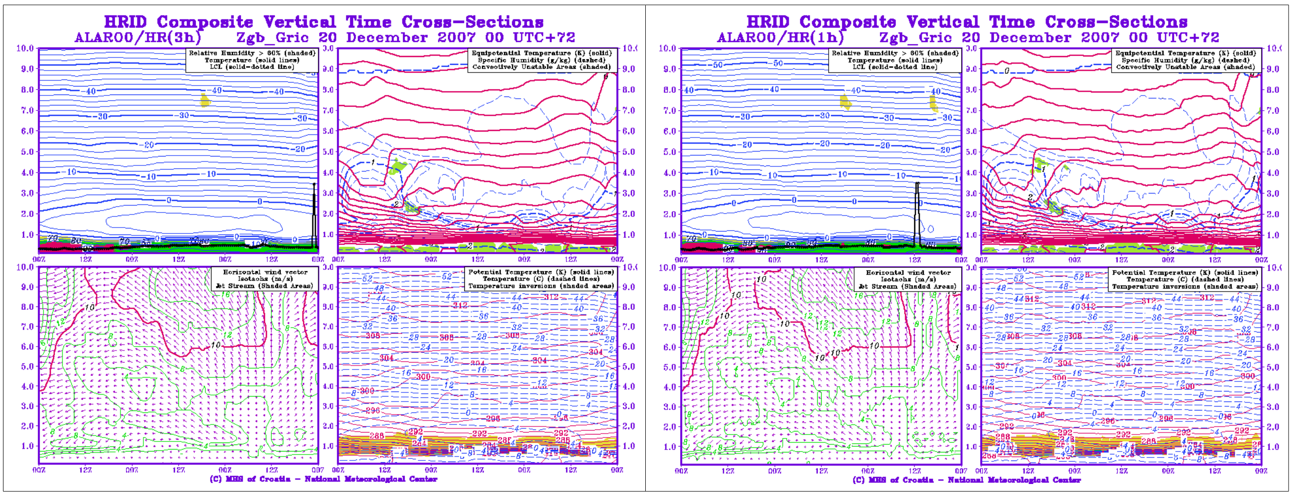


Fig. 2. HRID composite vertical cross-sections using 3hourly input data (left) and 1 hourly input data (right), top left panel: relative humidity >60% (shaded area), temperature (solid lines), LCL (dotted line), top right panel: equipotential temperature (K) (solid lines), specific humidity (g/kg) (dashed), convectively unstable areas (shaded), bottom left panel horizontal wind vectors and isotachs (m/s), bottom right panel: potential temperature (K) (solid lines), temperature (C) (dashed lines) and temperature inversion (shaded area).

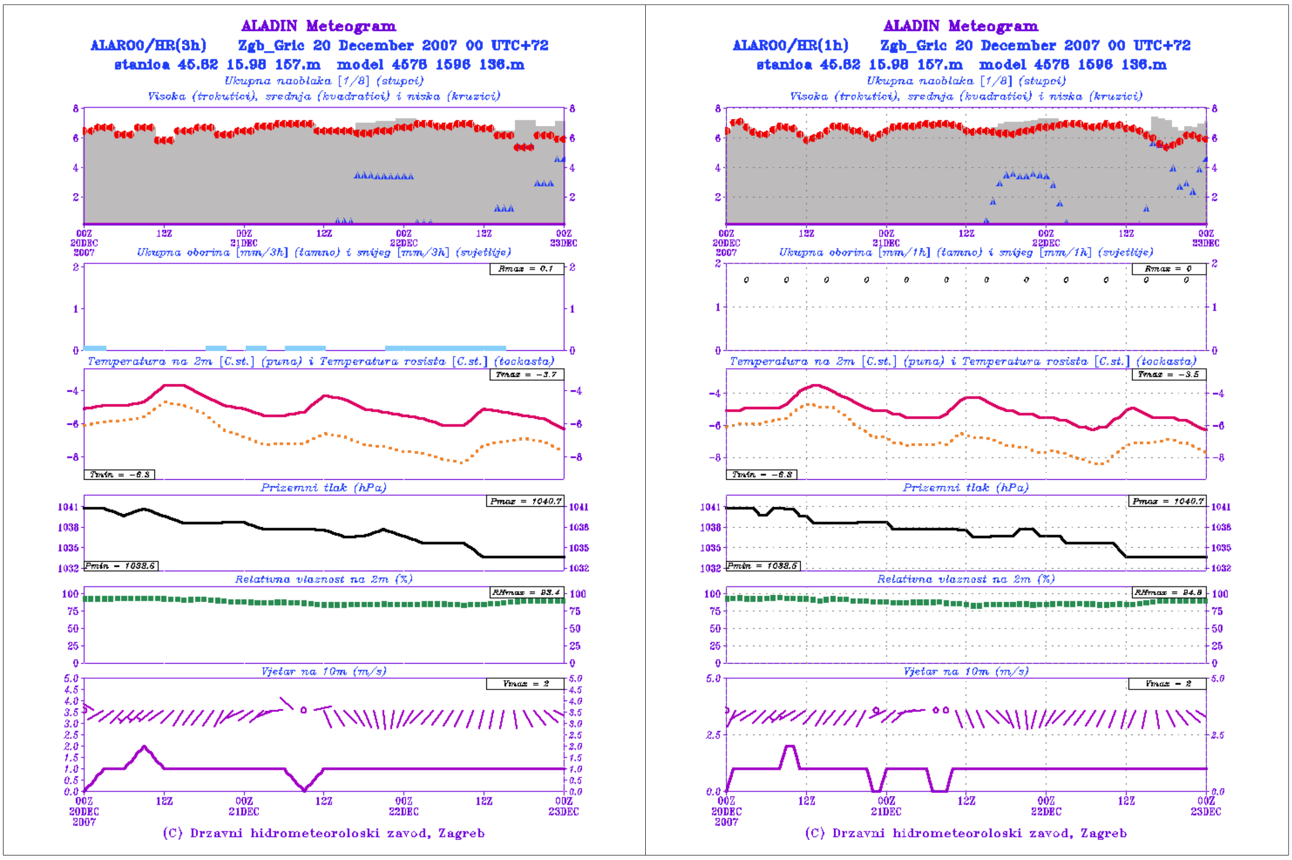


Fig. 3. Meteograms using 3hourly input data (left) and 1 hourly input data (right) showing total, low, medium and high cloudiness (top row), total precipitation and snow (second row), 2m temperature and dew point (third row), msl pressure (fourth row), 2m relative humidity (fifth row),10m wind speed and direction (bottom row).

☑ ANEMO-ALARM

The Numerical modelling department of the Croatian NMS participates in the ANEMO-ALARM project which aim is to develop and apply operational warning service for maintain road traffic safety in regions with severe bura winds. The ANEMO-ALARM is based on the ALADIN forecast products as a main triggering mechanism for assigning different alarm status. The possibility of the ALADIN to forecast the strength and onset time of bora wind has been studied on the base of 10 most intense severe bura cases during the period 2003-2006 as the first stage of the program. Obtained results show that the ALADIN give appropriate tool to solve the users demands and maintain road traffic safety.

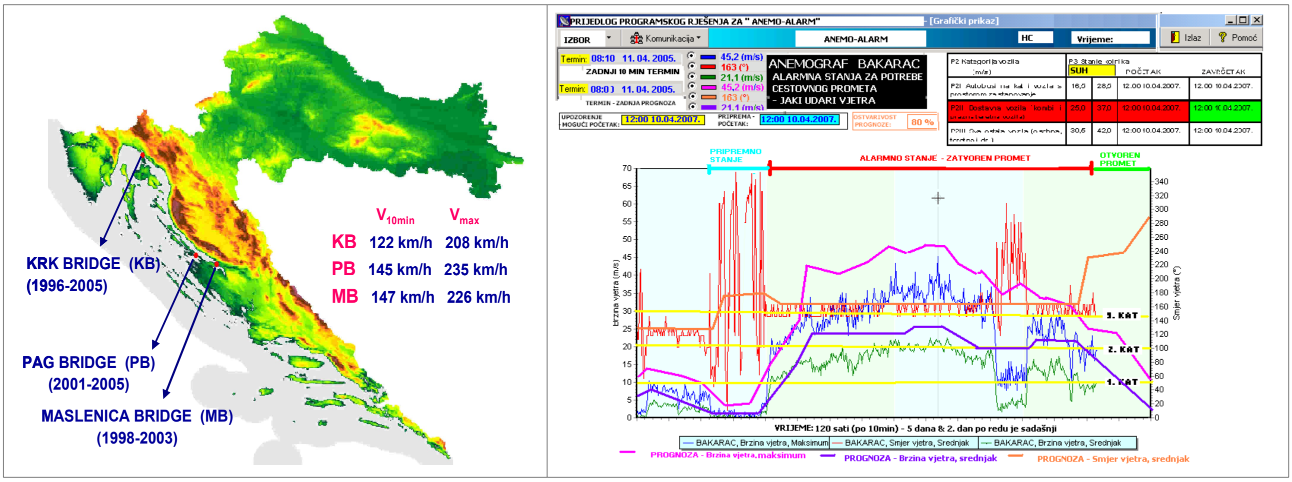


Fig. 4. Locations with the measured maximum bora wind speeds. V_{10min} – 10-minutes wind speed, V_{max} - maximum wind gusts (left) and an example of the ANEMO-ALARM warning system screen that will be available for the operational road maintenance service (PROGNOZA=forecast).

☑ Visualization of the new fields from Alaro0

Alaro0 provides 5 new forecast fields, as cloud water and ice, rain and snow as well as TKE became available. To avoid hyper-production of output figures produced by the operational suite, forecasters have defined those they find the most important. Modifications in ASCS software that would allow plotting more than two variables have also been considered. Unfortunately, this had to be given up due to lack of manpower and very short time available to switch to the new operational visualization regime.

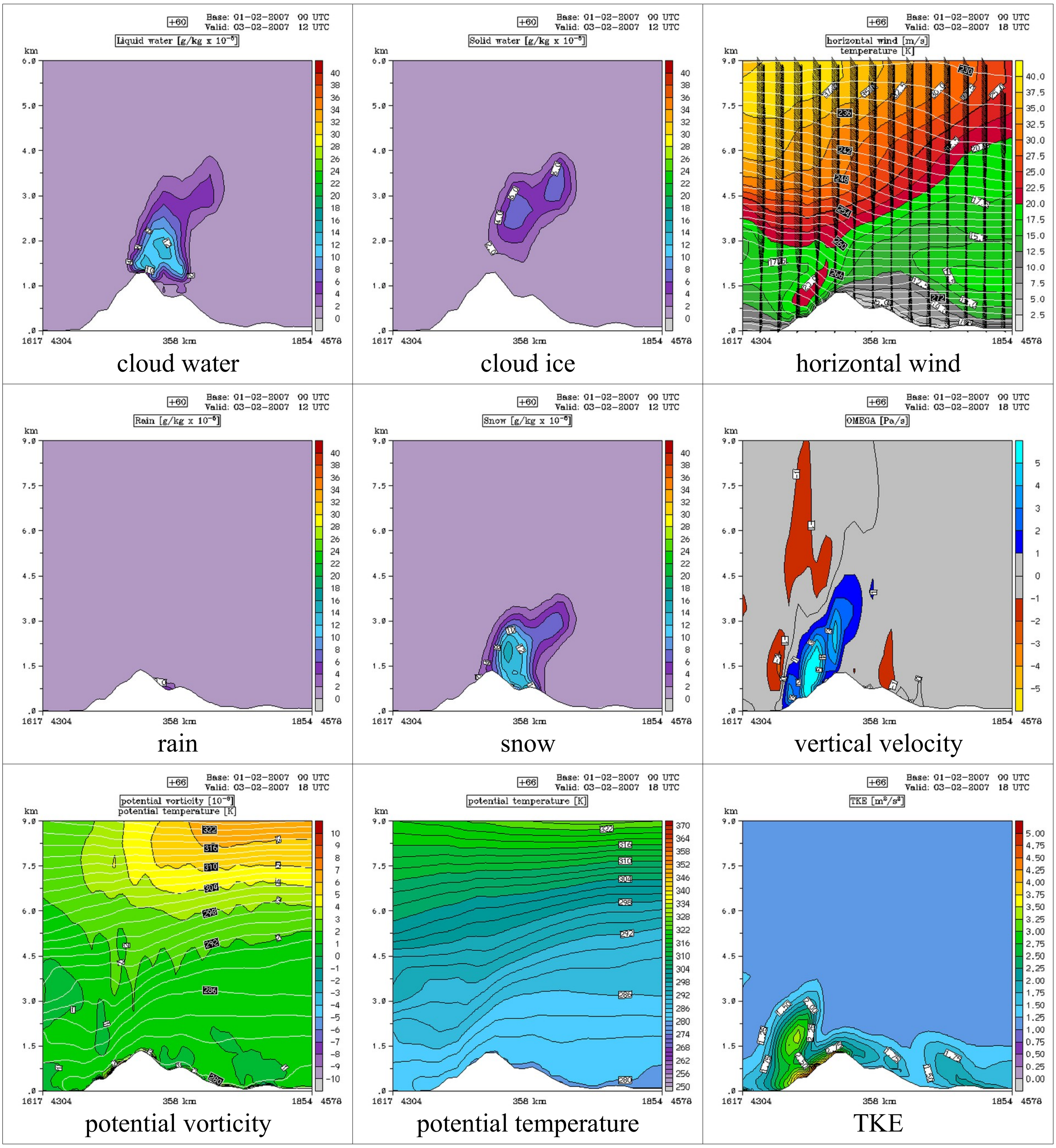


Fig. 5. Vertical cross-sections through Split and Osijek ploted using ASCS.

2.8.3. Research

The research on EPS, coupling of physics to dynamics, air-sea interaction, NH dynamics and SLHD in high resolution has continued.

2.8.4. EMEP4HR

EMEP4HR is a joint MHSC - Met.no project on developing air quality modelling capabilities at MHSC. The project has two main aspects, scientific and operational. Operational aspects include two work packages. First package aims at linking Unified EMEP model - an Eulerian chemical transport model, together with ALADIN NWP model as its meteorological driver. In the second package, high resolution emission inventories for Croatia will be made.

2.8.5. Data assimilation

The main goal of work on data assimilation in Croatia is to install and validate 3DVAR. Our strategy is, as simple as possible, to investigate whole line from creation of OBSOUL file to 3DVAR run.

We installed ODB CY30T1 and started to modify OULAN. It was a quite time consuming job because of lack of documentation and very few comments within the code. The help came from Hungarian colleagues who gave us their modification of OULAN. It was easy to insert subroutines that read our data in it. We have overridden subroutines for SYNOP and TEMP data.

Next step was to run program BATOR with test OBSOUL file containing SYNOP observations to create ECMA data basis. There were problems with compiling BATOR, too. Some file's containing subroutines called in BATOR were not compiled because they were marked as obsolete. There was also missing mpi_END statement at the end of BATOR. After eliminating this problems ECMA data basis was produced, but when we dumped data in ASCII file with MANDALAY there was just one line of data which was repeated. We tried BATOR from CY32 and it gave good ECMA.

Then we decided to switch on CY32. We took CY32T3, after some difficulty with CY32T1. Installation was preformed as with CY30T1 (with compiling some files in odb/extras) but now the new problem arose. Running BATOR an error was reported because in call of generic function GEN_CODB_GET variable inform_progress was undefined. We put .FALSE. instead of it and got good ECMA data basis, LAMFLAG worked fine, and SHUFFLE as well. We also tested ECMA data base on one CANARI run.

At the time being we work on SCREENING.

Our comment is that the main problem with installation of ODB software and other programs used to prepare data for ODB is insufficient technical documentation.

2.9. CZECH REPUBLIC

2.10. FRANCE:

2.10.1. “Arpège, Aladin-France and AROME models”

Progress of operations at Météo-France *(claude.fischer@meteo.fr)*

*E-suite on CY32T0 containing

CY32T0

- assimilation of GPS radio-occultation (8 satellites, based on COSMIC constellation)
- modified pre-treatment and data selection for ground based GPS delays, leading to the assimilation of more GPS zenital delays (20 to 30 % more data)
- assimilation of AMSU-A (12 channels) and MHS (formerly AMSU-B, all channels) sensor radiances from METOP
- assimilation of scatterometer data from ERS-2; monitoring of scatterometer data from ASCAT onboard METOP
- modified clear sky IR radiance selection (placed before sampling/thinning, rather than after). This change allows for about 10 % more clear-sky IR radiance data to pass screening
- stop assimilating some AMSU-A channels from NOAA 16
- reduction of the rate of evaporation of precipitations, in order to avoid spurious too strong local circulations in the Aladin-France forecasts
- in the Aladin-FR assimilation: assimilation of 10 m SYNOP and MESONET observations
- new NESDIS SST data (on a 1/12 deg grid resolution)
- correction of a bug in the treatment of soil water content in the surface CANARI analysis (Françoise and Alena Trojakova)

This E-suite has turned into operations on September 5^th , 2007.

PEARP Version 1.5

- same basis as the current PEARP version (10+1 members at TL358C2.4),
- 55 vertical levels,
- revised initial perturbations: 16 targetted SV for Europe/Northern Atlantic, 10 SV on the complementary domain to Eur/N.Atl., 10 SV over Northern Hemisphere, 10 SV in the Tropical band (+/-30 deg.), 20 SV in the Southern Hemisphere. All SV are computed in T95L55, over 12 h optimization time. Additionally, 24 h evolved perturbations from previous day run are used.
- All initial perturbations are combined and scaled by the σb's of the day (obtained from the small 3D-VAR FGAT ensemble of analyses of Arpège)
- Completion of PEARP contribution to TIGGE (Tmin, Tmax).

This Arpège EPS version has become operational on January 28th, 18UTC run.

E-suite for global higher resolution: CY32T0

- TL538L60C2.4 for Arpège, with 4D-VAR minimization increments at TL107/TL224(C1.0) and 25/30 iterations per outer loop. This leads to about 15 km resolution over France. Increased vertical resolution is around the tropopause and in the lower stratosphere.
- Variational bias correction
- Assimilation of METOP/ASCAT
- Monitoring of some IASI channels (314)
- PDF-based sedimentation for the Advanced Prognostic Cloud Scheme (formerly

"Lopez-scheme")

- Increased asymptotic mixing length in turbulence for momentum
- Vertical finite element discretized scheme

Aladin-France: incremental digital filters (stop-band edge at 2h), retuned global REDNMC (1.2 instead of 1.5), L60 vertical levels (same as Arpège) but horizontal resolution kept at 9.5 km

Technical start has taken place on November 5th 2007. Switch to operations is planned for early February 2008.

2.10.2. The new High Resolution e-suite of ARPEGE and ALADIN-FRANCE

(Joël.Stein@meteo.fr)

Description of the e-suite

The main changes of the ARPEGE e-suite are listed below:

The horizontal resolution is increased and varies from 15 km over France to 89 km over New-Zeeland, this corresponds to a spectral troncature of T538C2.4. The time step is equal to 900 s. The number of vertical levels increases from 46 to 60. Most of the supplementary levels are added around the tropopause. The vertical discretization scheme uses a finite elements technique.

1. The assimilation scheme is composed of 2 steps: a first minimisation at T107L60C1 and a second one at T224L60C1. This leads to an equivalent uniform resolution of 90 km. The statistics of the error for the guess are computed from an assimilation ensemble that is run in parallel with the same vertical grid (L60) but for a reduced troncature.
2. Before their assimilation, the bias of the satellite radiances was previously removed according to the ARPEGE model using a fixed regression taking into account ARPEGE fields. The parameters of the regression were computed for a 3 weeks learning period and then used daily. This methodology is replaced by the computation of these parameters during the minimisation i.e. the parameters are considered as new ARPEGE variables.
3. The surface winds over sea deduced from the diffusiometer ASCAT of the METOP satellite are assimilated. A new bias correction for the winds deduced from the diffusiometer AMI of the satellite ERS is introduced.
4. The intensity of the numerical diffusion is increased for the wind, in particular at the tropopause level.
5. The explicit microphysical scheme includes a statistical sedimentation scheme.

The related changes for the ALADIN-France e-suite are listed below:

1. The LAM uses the same vertical grid as ARPEGE (L60) and the same vertical discretization scheme based on a finite elements technique
2. The ARPEGE changes for the sedimentation, numerical diffusion are also present in ALADIN-France
3. The bias correction for the satellite data assimilated by ALADIN-France is deduced from the ARPEGE variationnal correction of the model bias. The statistics for the guess error are also deduced from an assimilation ensemble with 60 levels.
4. The new ASCAT data are also assimilated and the correction for the AMI winds is also used.
5. The 3DVAR analysis provides the initial coupling file
6. A new dynamical initialization is performed by using digital filters only for the increments of the analysis.
7. A non-linear balance similar to the ARPEGE balance is used in the variational analysis and the relative confidence guess against observation is increased.

The e-suite and the operational suites have been compared from 6 October 2007 to 5 February 2008, i.e. during 4 months. The objective and subjective validations conclude to the superiority of the e-suite for every references, every physical field and every verification domain. Geopotential heights scores are presented in Figure 1 and they are improved at all levels.

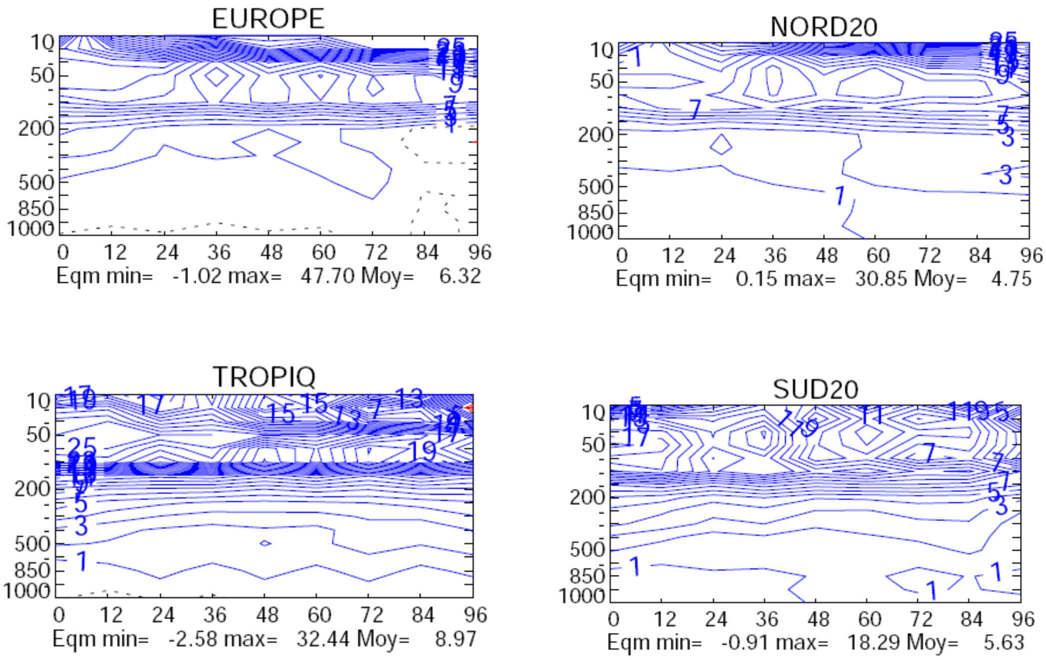


Figure 1: Differences (in meters) of the root mean squared errors (RMS) for the geopotential height in function of the duration of the forecast performed by the ARPEGE e-suite and the operational suite. If the e-suite improves the operational ARPEGE model, the isolignes are coloured in blue and red in the opposite case. The error is computed against the reference provided by the radio soundings belonging to 4 different spatial domains: Europe (top left), the domain extending from 20° North to North pole (top right), the tropical domain between 20° North and 20 ° South (bottom left) and the domain extending from 20° South to South pole (bottom right). The RMS is computed every day from 06 October 2007 to 05 February 2008 and averaged over this temporal period.

The variational correction of the model bias leads to a reduction of the differences between observations and guesses for the brightness temperatures but also for the radiosoundings.

The subjective verification concludes of a better forecast of the large scale features but an increase of the number of spurious numerical cyclogenesis of small scale should be noted. The quantitative precipitation forecast was improved with a reduction of the bias of ARPEGE but this reduction was too important in some cases of heavy rainfalls.

The same improvements were recovered for the ALADIN-France forecasts coupled with the ARPEGE e-suite and Figure 2 shows a similar information as Figure 1 but for a verification domain reduced to the ALADIN-France domain.

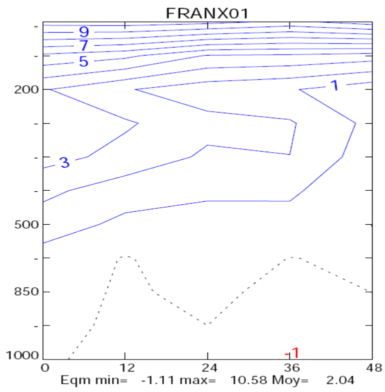


Figure 2: same legend as Figure 1 but the forecast are performed by the ALADIN-France model. The verification domain corresponds to the ALADIN-France domain (FRANX01) and the temporal period extends from 19 December 2007 to 05 February 2008.

2.11. HUNGARY

2.11.1. The operational ALADIN models

(kullmann.l@met.hu)

There were only small changes in the operational version of the ALADIN/HU model during the second half of 2007:

1. We use Ensemble B matrix operationally.
2. WINDPROFILER data are used operationally.

- **The main characteristics of the recent operational suite:**

1. ALADIN cycle: cy30t1
2. Horizontal resolution: 8 km
3. Vertical levels: 49
4. Grid: linear
5. Data assimilation: 3d-var with 6h cycling
6. Observations: SYNOP (geopotential), TEMP (temperature, wind components, humidity, geopotential), AMDAR (temperature, wind components), ATOVS:AMSU-A and AMSU-B radiances, MSG/GEOWIND (AMV), SYNOP SHIP, WINDPROFILER.
7. Production is performed 4 times per day: 0 UTC (+54h), 6 UTC (+48h), 12 UTC (+48h), 18 UTC (+36h).

- **Parallel suites during the period:**

- Dynamical adaptation as a reference to 3d-var system at same vertical and horizontal resolution (cy28t3 is used).
- ALADIN 3d-var with WINDPROFILER data.
- ALADIN 3d-var with SEVIRI and SYNOP (T2m, RH2m) data.
- ALADIN 3d-var with NOAA-18 data.

2.12. MOROCCO

2.13. POLAND

2.14. PORTUGAL

2.15. ROMANIA

Doina Banciu (doina.banciu@meteo.inmh.ro), Simona Stefanescu, Simona Tascu

- **The operational suite is still based on the cy28t3, with no modifications of of the model set-up or the integration domain.**

The main modifications of the operational suite carried out since last report concern:

- Extension of the forecast range for the 06 and 18 run up to 54 h , following the request for hydrological applications
- Increase the output frequency (hourly up to 54 h ; each 3 hours after that)
- Modification of the operational post-processing procedures and scripts for variable output frequency

- **Increasing the type and number of products on the intranet Aladin web site**

- **Implementation of cy32t3**

The export version cy32t3 of the Aladin model was implemented and partially validated on a Linux Cluster platform.

2.16. SLOVAKIA

Status of ALADIN operational activities at SHMU (December 2007) (*Oldrich Španiel*)

- **HARDWARE**

- Computer [no change]:
- IBM Regatta
- 32 CPUs of 1.7 Ghz
- 32 GB RAM
- 1.5 TB disk array

- Archiving facility [no change]:
- IBM Total Storage 3584 Tape Library with IBM Tivoli Storage Manager
- current capacity of tapes around 24 TB
- used for automatic backup of ICMSH files, GRIBs and selected products

- **OPERATIONAL SUITE**

- Domain and geometry [no change]:
- 309 x 277 points (C + I zone)
- dx = 9.0 km
- quadratic truncation
- 37 vertical levels

- Operational model version [no change]:
- al28t3 with "czech physics"
- Integrations [no change]:
- 4 runs per day (00, 06, 12 UTC up to 72 hours, 18 UTC up to 60 hours)

OTHER OPERATIONAL ACTIVITIES

- INCA T2m analysis is operational, precipitation analysis is in pre operational mode. After interfacing with new raingauge database it will be run operationally.

- Operational implementation of upper air blending is done.

- Selected fields from ARPEGE, ALADIN/AT,CZ,HR,HU,SI,SK, RO and DWD/LM are visualized on RC LACE web page.

PLANS

- Operational switch to ALARO-0 minus 3MT.
- Increased number of vertical levels, linear grid (???).
- Operational implementation of INCA precipitation nowcasting.

PORTING STATUS

- ALARO-0 minus 3MT was ported, validations are going on.

ARPEGE LBC DOWNLOAD

- Both assimilation and production LBC are downloaded 4 times per day.
  Primary channel is internet/BDPE. Backup of production LBC is done via ECMWF and ZAMG, backup of assimilation LBC is still missing.

2.17. SLOVENIA

Slovenia (the second half of 2007) (more details neva.pristov@rzs-hm.si)

The main characteristics of the operational suite has remained unchanged. Only production of few more products for the users has been added.

We have started with installation of nowcasting system INCA (developed by ZAMG). After defining the Slovenian domain (400x300km), it was prepared by T. Haiden. The input model fields are prepared from ALADIN/SI and additional local observations are used, including Slovenian radar data. At the moment the analysis of 2m temperature, relative humidity. 10 m wind, precipitation (with type) are regularly prepared in a testing suite.

We were impatiently waiting for to a heavy and shiny 'gift' delivered to the Environmental Agency of Slovenia a bit in advance by Santa Claus at the end of November.

The new computer is SGI Altix ICE 8200 system, a (almost) cable-less high density blade system. It was (as usual) a big challenge to bring heavy monster (1200 kg) into the computing center, however, due to good preparation the machine was up and running after 16 hours of screwdriver work. After hardware installation the whole machine was reinstalled from scratch and the first users got accounts on a new machine at the end of December.

The ALADIN code was already ported to the new environment (the export cycle cy32t3 is prepared with gmkpack and Intel 10.1 compiler) and we have started the migration process of operational suite onto the new computer.

The first results are very promising: we are able to run our current ALADIN/SI model configuration on a single cluster node (8 cores) for around 30% faster than on whole previous operational cluster with 24 processors. Rough computation tells that the new machine is 40-50 times more powerful than the previous one.

Some technical characteristics of the system are:

- 35 compute nodes installed in a single rack,
- every compute node has a 8 GB of memory and 2 Quad core Intel Xeon 5355 processors,
- 300 cores are currently installed,
- two Infiniband DDR networks, one for IO and the other for MPI communication,
- additional 7 service nodes are used for login, management, control and IO operations,
- a dedicated NAS IO node is installed with 15 TB FC disk array,
- additional 4 IO nodes will be installed for distributed cluster file system.

New machine is running SGI ProPack on top of SLES 10. Scali MPI Connect is used for MPI and Altair PBSPro for a queuing system. Fortran compiler is Intel 10.1.

2.18. TUNISIA

2.19. TURKEY

2.20. HIRLAM

3. RSEARCH & DEVELOPMENTS

3.1. ALGERIA

3.2. AUSTRIA

3.3. BELGIUM

3.4. BULGARIA

3.5. CROATIA

3.6. CZECH REPUBLIC

3.7. FRANCE

3.8. HUNGARY

3.8.1. Major ALADIN developments (*kullmann.l@met.hu*)

The main scientific orientation of the Hungarian Meteorological Service for the ALADIN project is unchanged: data assimilation, short range ensemble prediction and high resolution meso-gamma scale modelling (AROME model).

The main scientific developments for the second half of 2007 can be summarized as follows:

- **DATA ASSIMILATION:**

- Use of an Ensemble B matrix. A B matrix based on a downscaled ARPEGE ensemble was introduced into the operational 3DVAR of the ALADIN/HU model. The modification results in a small but consistent improvement of the forecast of all variables compared to the ECMWF analysis.

- Assimilation of SEVIRI data. This work has been continued by Alena Trojáková from Czech Republic (RC LACE stay). SEVIRI data were used together with SYNOP T and RH data. Both in case studies and longer period runs the precipitation forecasts (PC, FAR, POD) improved due to the new observations. A decision was taken to implement SEVIRI together with SYNOP T and RH data in the ALADIN/HU 3DVAR. A preliminary report is available from Alena Trojáková.

- Parallel suite using AMSU-A and MHS data from NOAA-18. AMSU-A and MHS data were used from NOAA-18 in several parallel suites. The data do not give a clear improvement of the forecasts. With the refreshment of bias correction files and reducing the number of bias correction predictors (neglect two thickness layers) the scores can be improved but the results were still not satisfactory.

- **LAMEPS:**

Work has been continued with the ALADIN singular vectors and the results were presented at several workshops (EMS workshop, SRNWP/EPS workshop). On the basis of the careful examination of the singular vectors it seems that they are realistic and can be used for creating initial perturbations for a LAMEPS system. Simultaneously the exploration of the applied techniques for creating initial perturbations from the singular vectors was realised (Meteo France and ECMWF methods). See more details in a separate article by Edit Hagel of this Newsletter.

Work had been carried out to prepare the quasi-operational dynamical downscaling of Meteo

France's PEARP system by the ALADIN model. The operational production of the PEARP coupling information started at the end of November in Toulouse and its downscaling will be regularly performed soon afterwards. The main characteristics of this ALADIN model version is as follows:

a) Domain covering basically the continental Europe
b) Horizontal resolution: 12 km
c) Vertical resolution: 46 levels
d) Integration once per day to 60h starting from the 18 UTC data
e) Boundary conditions updated three hourly by the ARPEGE EPS (PEARP) system.

- **AROME:**

We run case studies with AROME on lower resolution (8km) with hydrostatic dynamics and compared the results with ALADIN forecast. The aim was to see whether the better forecast of precipitation in AROME is mainly due to the NH dynamics, the resolution or the better physical parametrization. We found that in the case where only the parametrization was different (same resolution and same dynamics was used) the forecast of AROME is still better.

We compared the different soil parametrization schemes: Force-Restore (FR) scheme and Diffusion (DIFF) scheme available in AROME. We run three experiments: FR, DIFF with 3 layer and DIFF with 10 layer for 3 week period and compared the verification of 2m temperatures. We found that the Diffusion scheme with 10 layers is better than FR but with 3 layers is worse. We also had to modify the code because the initialization of soil water content in case of diffusion scheme was inconsistent with the calculation of melting/freezing processes.

3.9. MOROCCO

3.10. POLAND

3.11. PORTUGAL

3.12. ROMANIA

3.12.1. The evaluation of the Aladin 2m temperature forecast during the summer of 2007

(*Simona Ştefănescu, Simona Taşcu*)

The performance of the Aladin model for 2m temperature have been evaluated for the summer of 2007, characterized by periods of very high temperatures over the Romanian territory. The Aladin 2m maximum, minimum and 3h temperature forecast has been evaluated for a three month period (June-August) using 3h temperature observations from SYNOP stations located over the whole country.

The Aladin 48h forecasts for 00 and 12 UTC integrations have been used. For the comparison with station observations, the nearest land grid point has been chosen, except the cases where the model-station altitude difference was greater than 50m, for which the grid point with the smallest altitude difference has been chosen from a cell of 4 points. No correction related to the model-station altitude difference has been applied.

Initially, 86 observation stations have been taken into account for this evaluation study, but due to the incomplete reports during the whole period, a final set of 46 stations has been retained. For this set of 46 stations, the maximum model-station altitude difference was around 50m.

Statistical scores (bias, standard deviation, root mean square error, scatter index and symmetrical slope) have been computed for Aladin 2m maximum, minimum and 3h temperature for the June-August 2007 period (table 1).

T 2m	N	Obs. mean	Model mean	Bias	STD	RMSE	Scatter index	Symm. slope
3h 1d 00	33856	22.47	23.03	0.55	2.09	2.16	0.09	1.02
3h 2d 00	33856	22.47	23.57	1.09	2.27	2.52	0.10	1.05
3h 1d 12	33856	22.47	23.23	0.75	2.08	2.21	0.09	1.03
3h 2d 12	33856	22.47	23.58	1.11	2.29	2.55	0.10	1.05
Max1 00	4232	29.38	28.64	-0.74	2.15	2.28	0.07	0.98
Max2 00	4232	29.38	29.21	-0.17	2.27	2.27	0.08	1.00
Max1 12	4232	29.38	29.02	-0.36	2.16	2.19	0.07	0.99
Min1 00	4231	16.03	18.03	1.99	2.12	2.91	0.13	1.12
Min1 12	4231	16.03	17.80	1.77	2.03	2.70	0.13	1.11
Min2 12	4231	16.03	18.18	2.15	2.22	3.09	0.14	1.13

Table1: Statistical scores for Aladin 2m temperature forecast for: 3h temperature 1st day forecast (forecast ranges between 00 and 21h) for 00 UTC run (3h 1d 00); 3h temperature 2nd day forecast (forecast ranges between 24 and 45h) for 00 UTC run (3h 2d 00); 3h temperature 1st day forecast for 12 UTC run (3h 1d 12); 3h temperature 2nd day forecast for 12UTC run (3h 2d 12); 1st maximum (occurred between 06 and 18h forecast ranges) for 00 UTC run (Max1 00); 2nd maximum (occurred between 30 and 42h forecast ranges) for 00 UTC run (Max2 00); 1st maximum (occurred between 18 and 30h forecast ranges) for 12 UTC run (Max1 12); 1st minimum (occurred between 18 and 30h forecast ranges) for 00 UTC run (Min1 00); 1st minimum (occurred between 06 and 18h forecast ranges) for 12 UTC run (Min1 12) and 2nd minimum (occurred between 30 and 42h forecast ranges) for 12 UTC run (Min2 12).

The model overestimates the 3h temperature and the scores for 1st day of forecast are better than that ones for the 2nd day. The maximum temperature is slightly underestimated by the model, but the symmetrical slope has very good values. The minimum temperature is overestimated by the model with about 2 ºC. This model behavior can also be observed in figures 1, 2 and 3 which show the scatter diagrams for the 3h, maximum and minimum temperature forecasts. We should notice that the highest maximum temperatures (> 35ºC) are very well predicted by the model. In comparison, the minimum temperatures are overall overestimated.

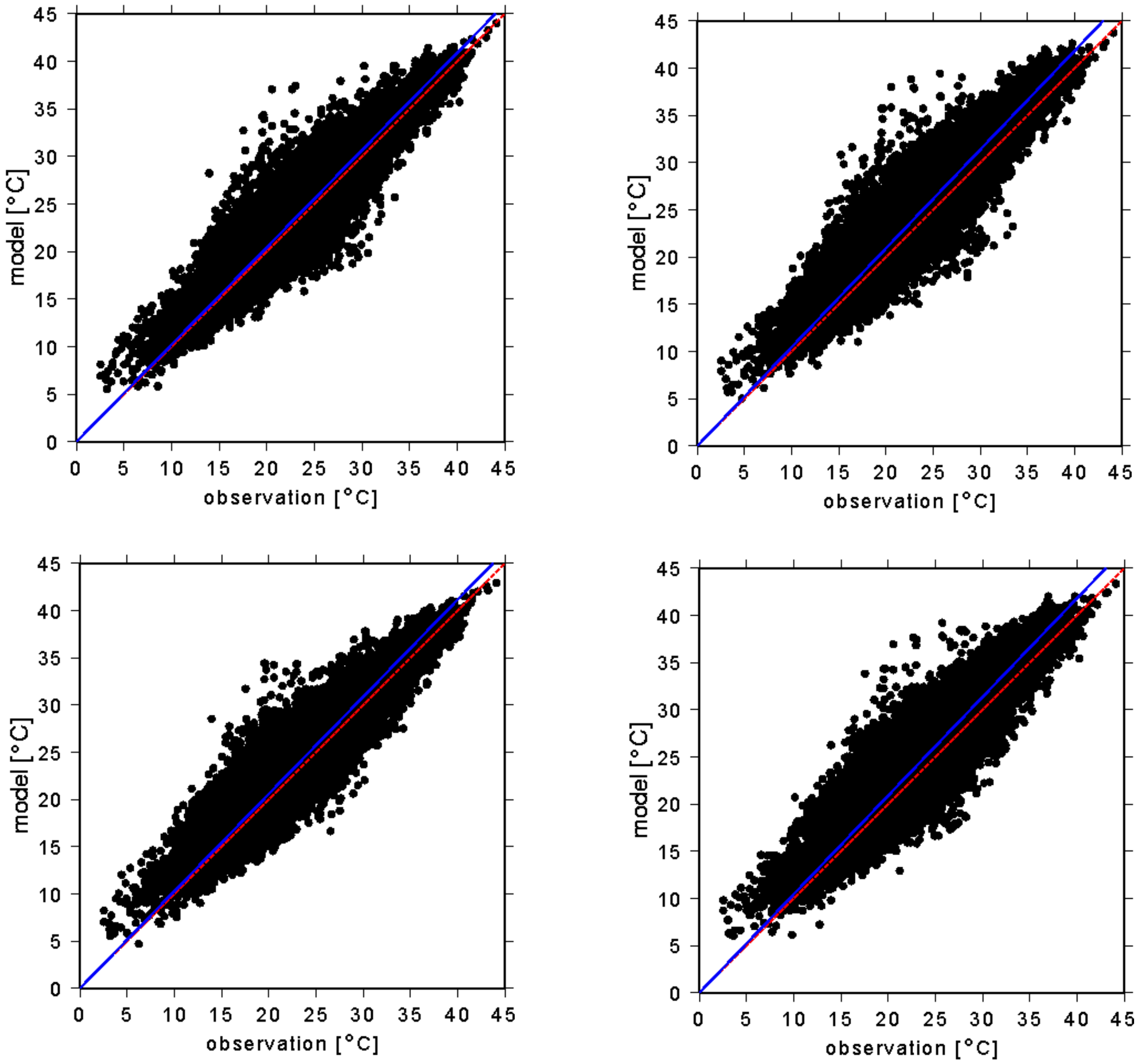


Fig.1: The scatter diagrams for 3h temperature: top left - 1st day 00 UTC run (1d 00); top right - 2nd day 00 UTC run (2d- 00); bottom left - 1st day 12 UTC run (1d -12) and bottom right - 2nd day 12 UTC run (2d -12).

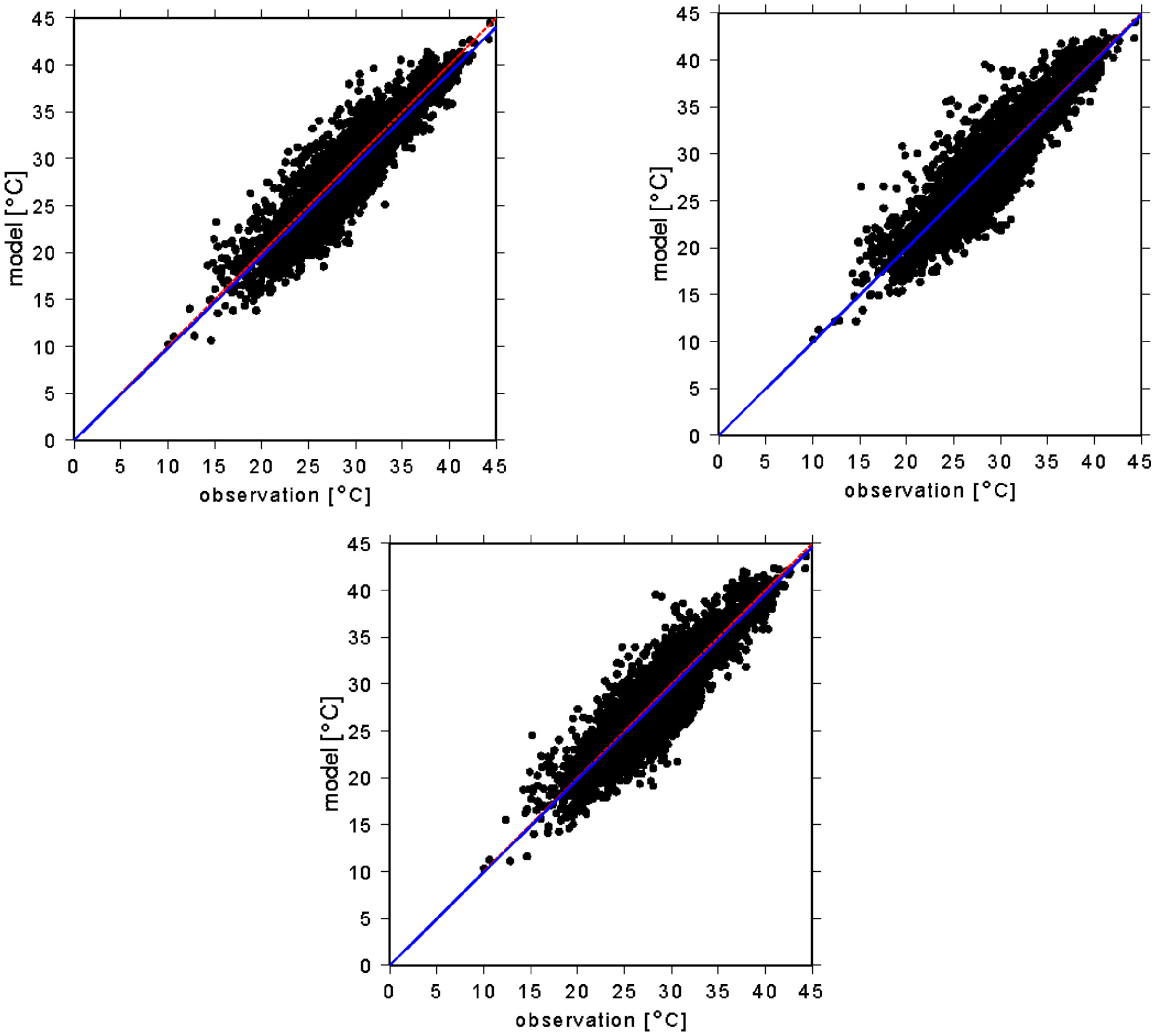
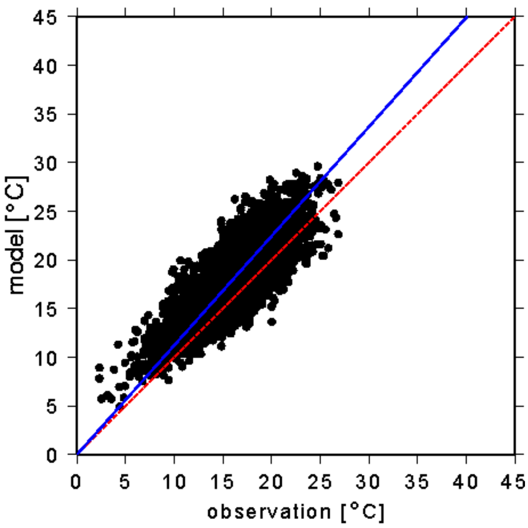


Fig.2: The scatter diagrams for maximum temperature: top left - 1st maximum 00 UTC run (Max1 00); top right - 2nd maximum 00 UTC run (Max2 00) and bottom - 1st maximum 12 UTC run (Max 1 12)



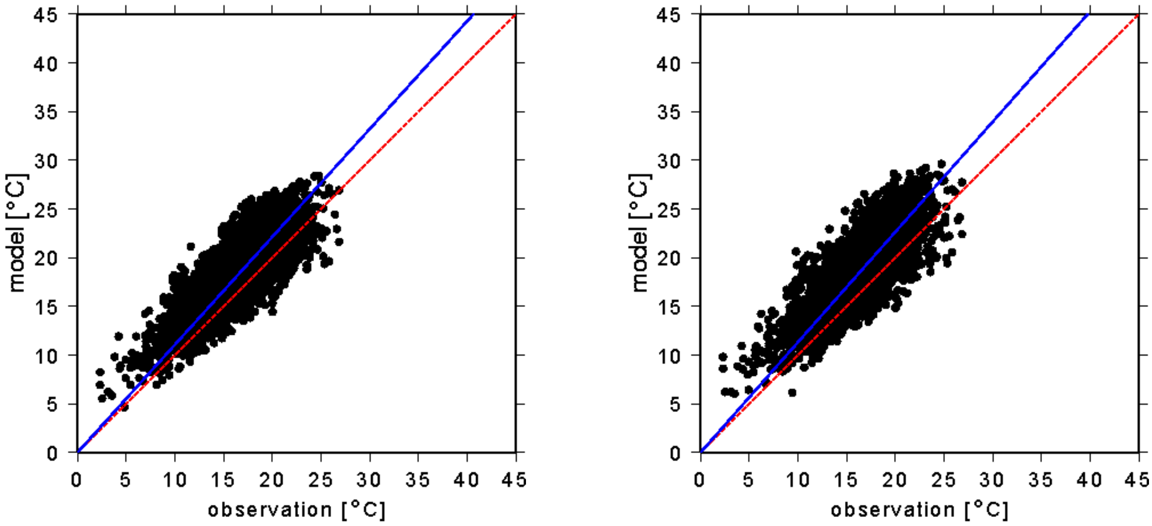
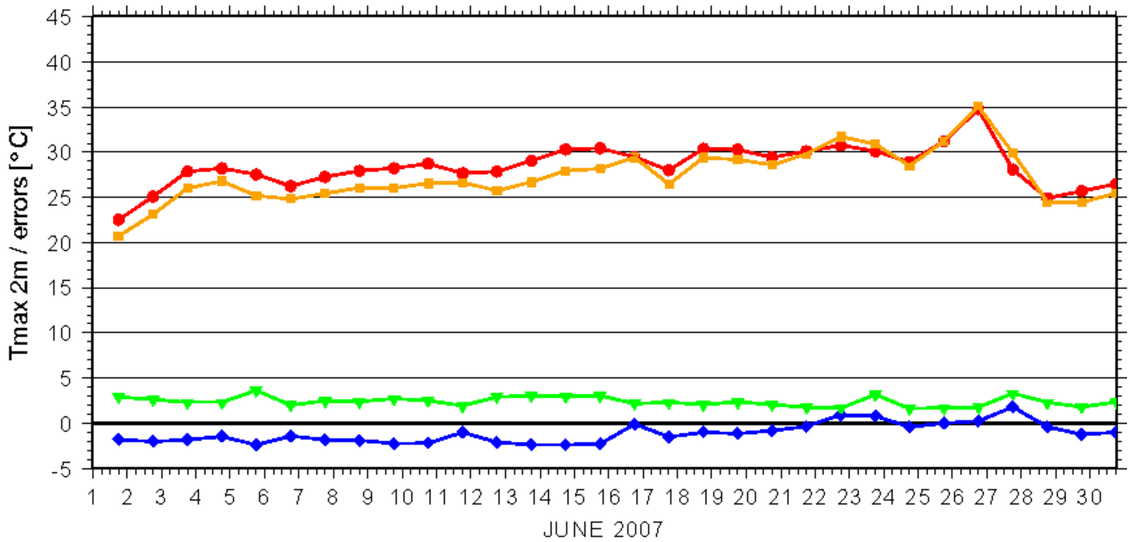
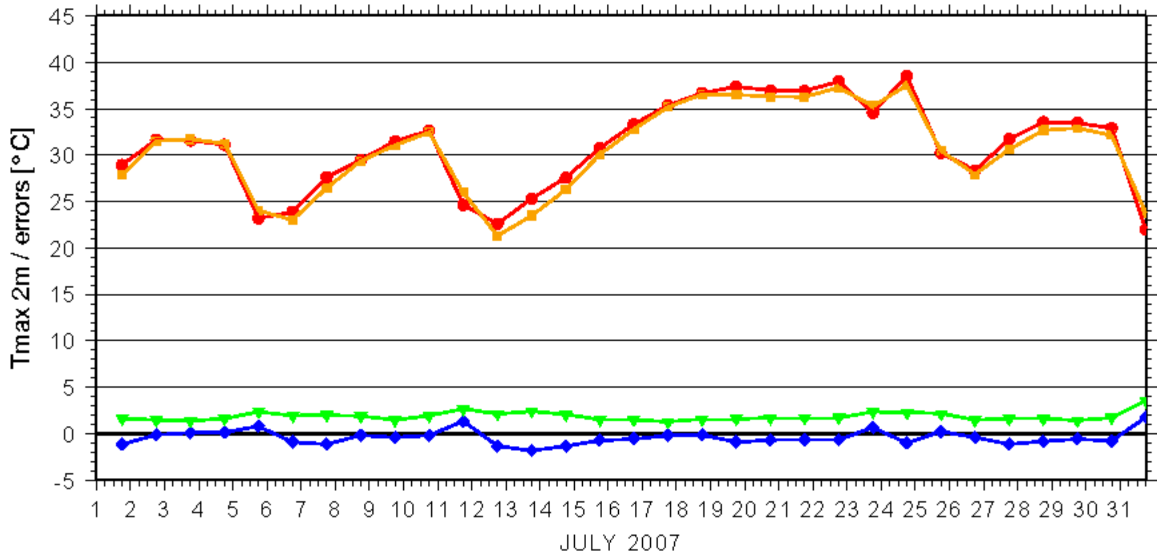


Fig.3: The scatter diagrams for minimum temperature: top - 1st minimum 00 UTC run (Min1 00); bottom left- 1st minimum 12 UTC run (Min1- 12) and bottom right- 2nd minimum 12 UTC run (Min 2 - 12).

Daily variations of mean observed (MOBS) and forecasted values (MMOD), bias and rmse for maximum and minimum temperatures are plotted in figures 4,5, and 6 (scores computed over the 46 stations). The periods with high temperatures (> 35 ºC) very well forecasted by Aladin model can be clearly observed: 26 June, 17-24 July, 23-25 August. Figure 6 seems to indicate a systematic overestimation of minimum temperature by the model.





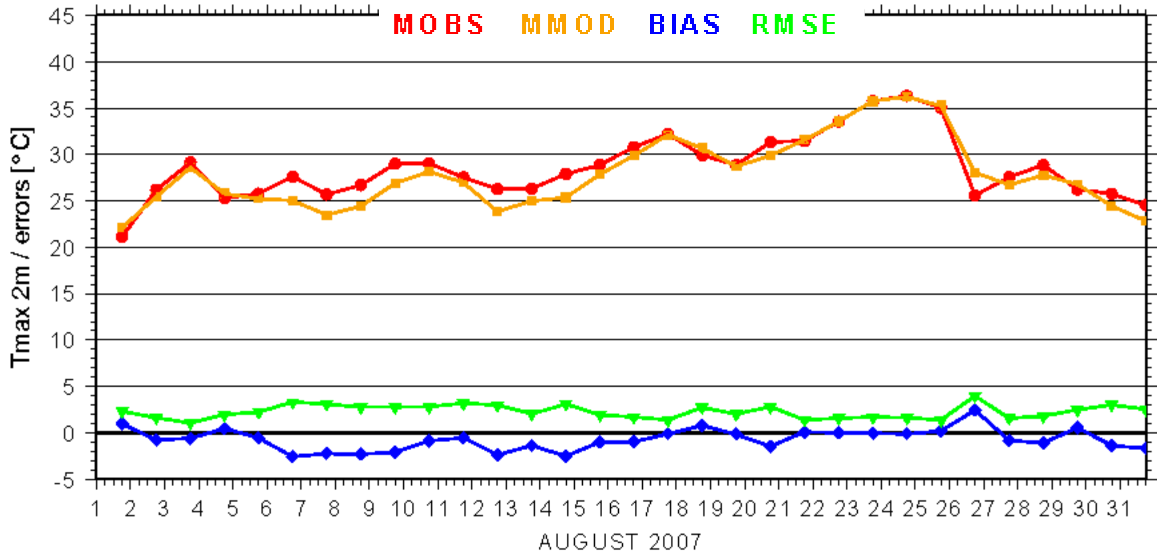
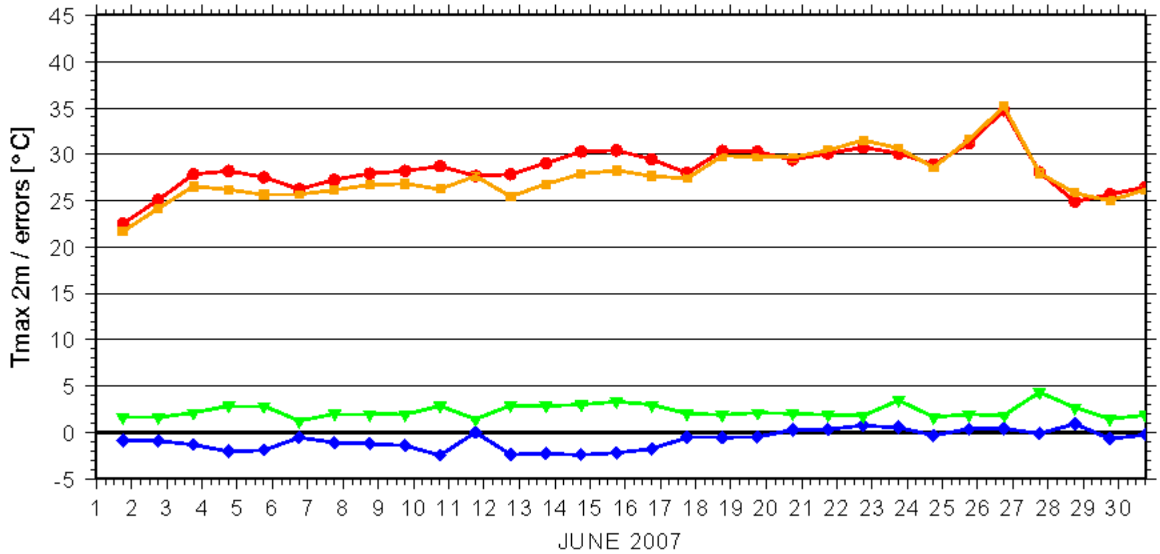


Fig. 4: Daily variations for 1st maximum temperature 00 UTC run (Max1 00).



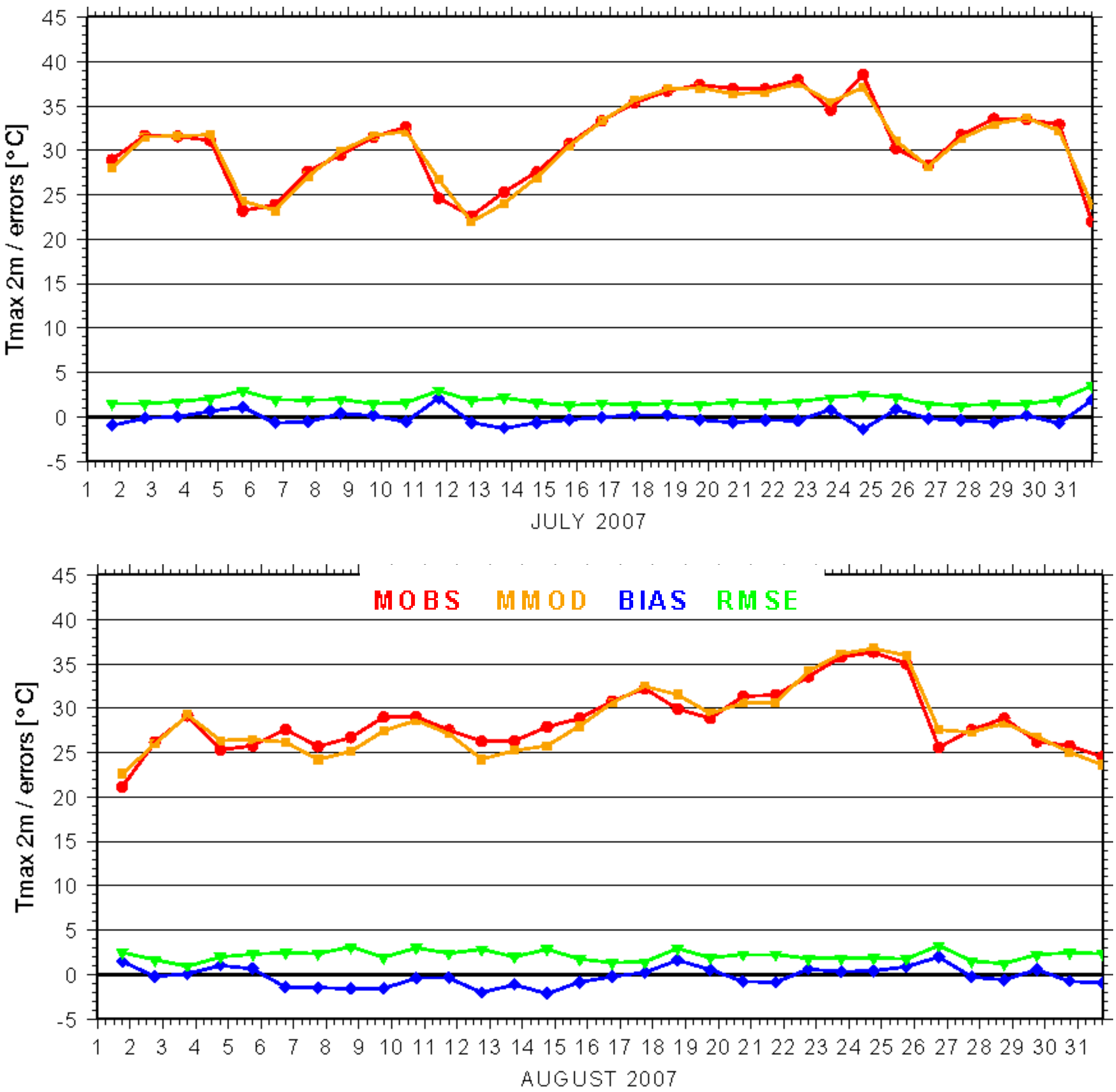
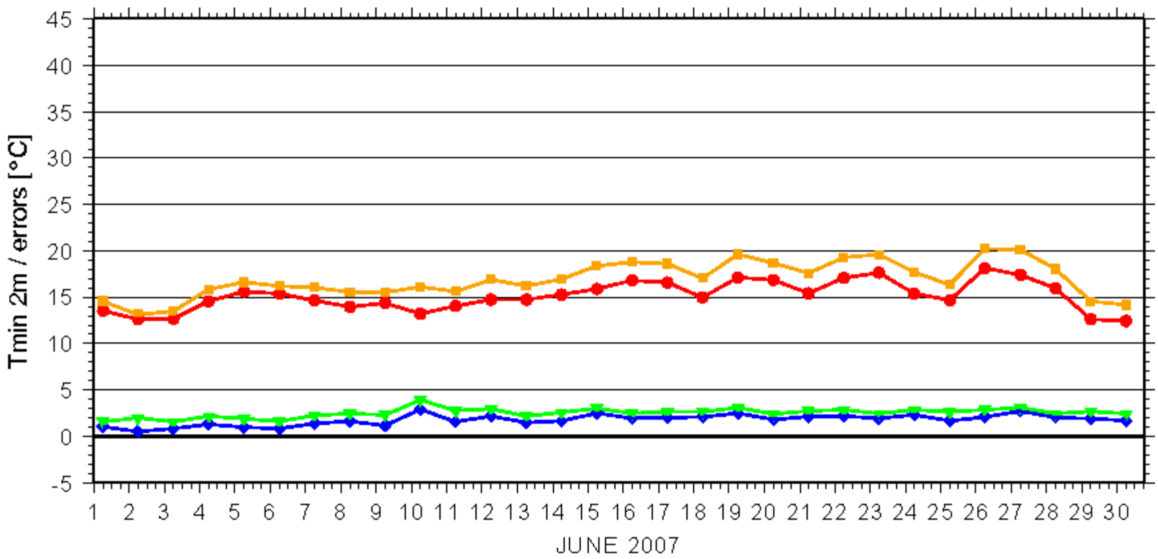


Fig. 5: Daily variations for 1st maximum temperature 12 UTC run (Max1 - 12)



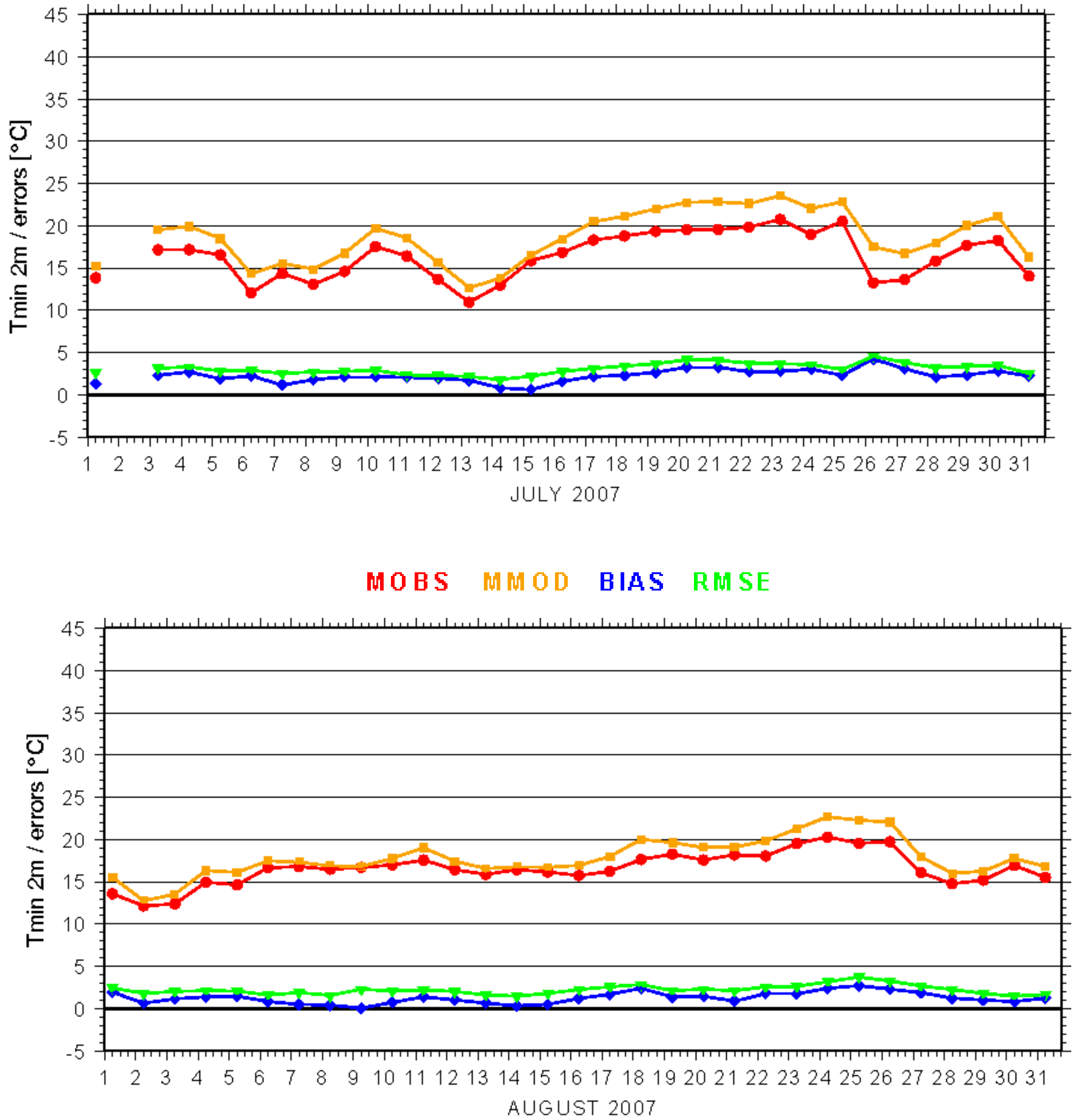


Fig. 6: Daily variations for 1st minimum temperature 12 UTC run (Min1 – 12)

On 24th of July 2007, the maximum temperature for July has been recorded at station Calafat: 44.3 ºC. This value is in fact very close to the maximum temperature record for Romania:44.5 ºC (August 1951). The Aladin 00 UTC predicted 44.4 and 44 ºC(1st and 2nd maxima) and the Aladin 12 UTC run predicted 43.6 ºC (1st maximum). Figure 7 shows the observed and forecasted 2m maximum temperature over Romania on 24th of July 2007. Very high temperatures (over 40 ºC) have been recorded (and very well predicted by the Aladin model) in the South and South-Western part of Romania.

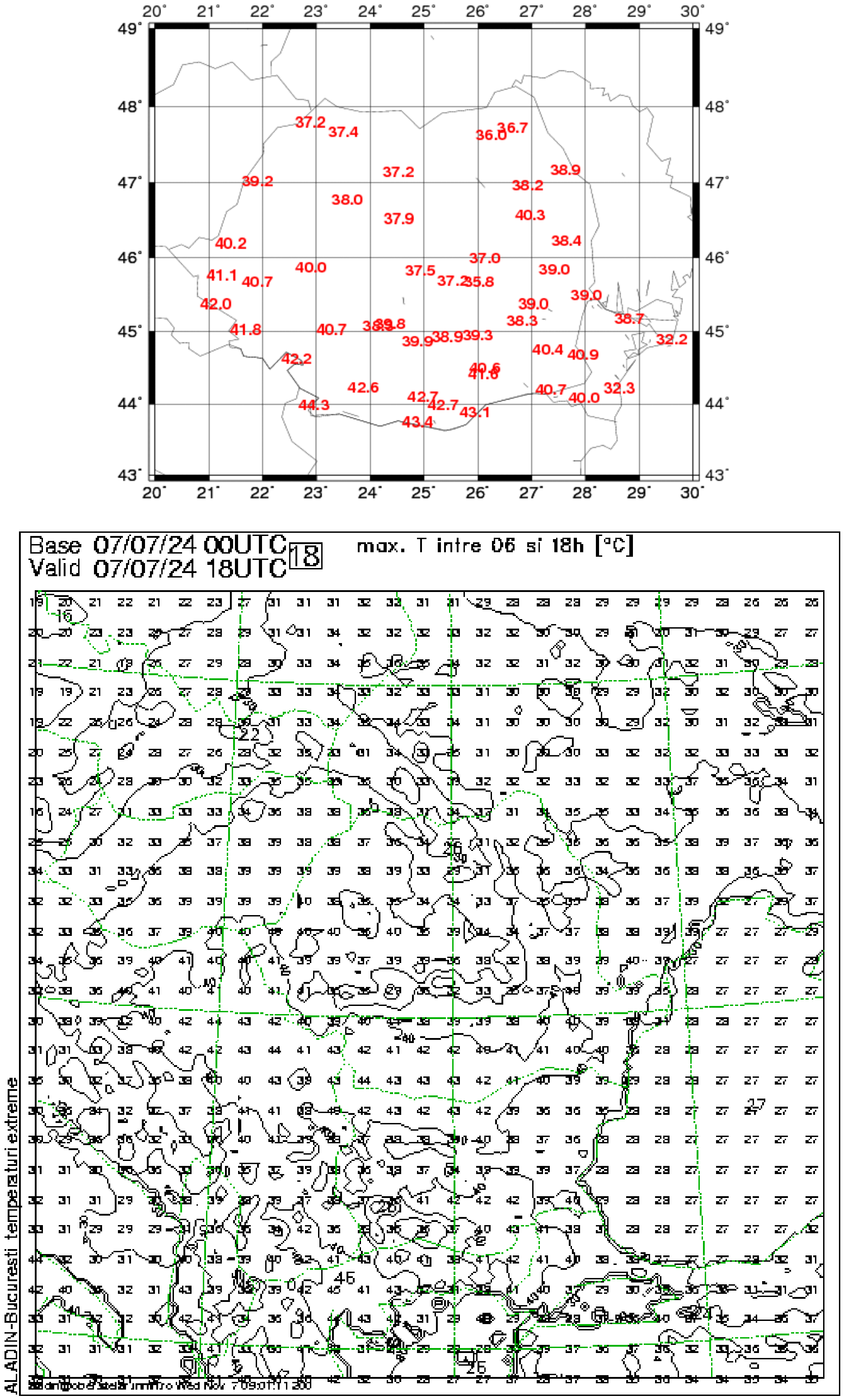


Fig. 7 : The observed (top) and forecasted (bottom) 2m maximum temperature on 24th of July 2007.

Figure 8 presents the daily variations of maximum temperature and its bias at Calafat station. One can notice the very good agreement between the forecast and observed values.

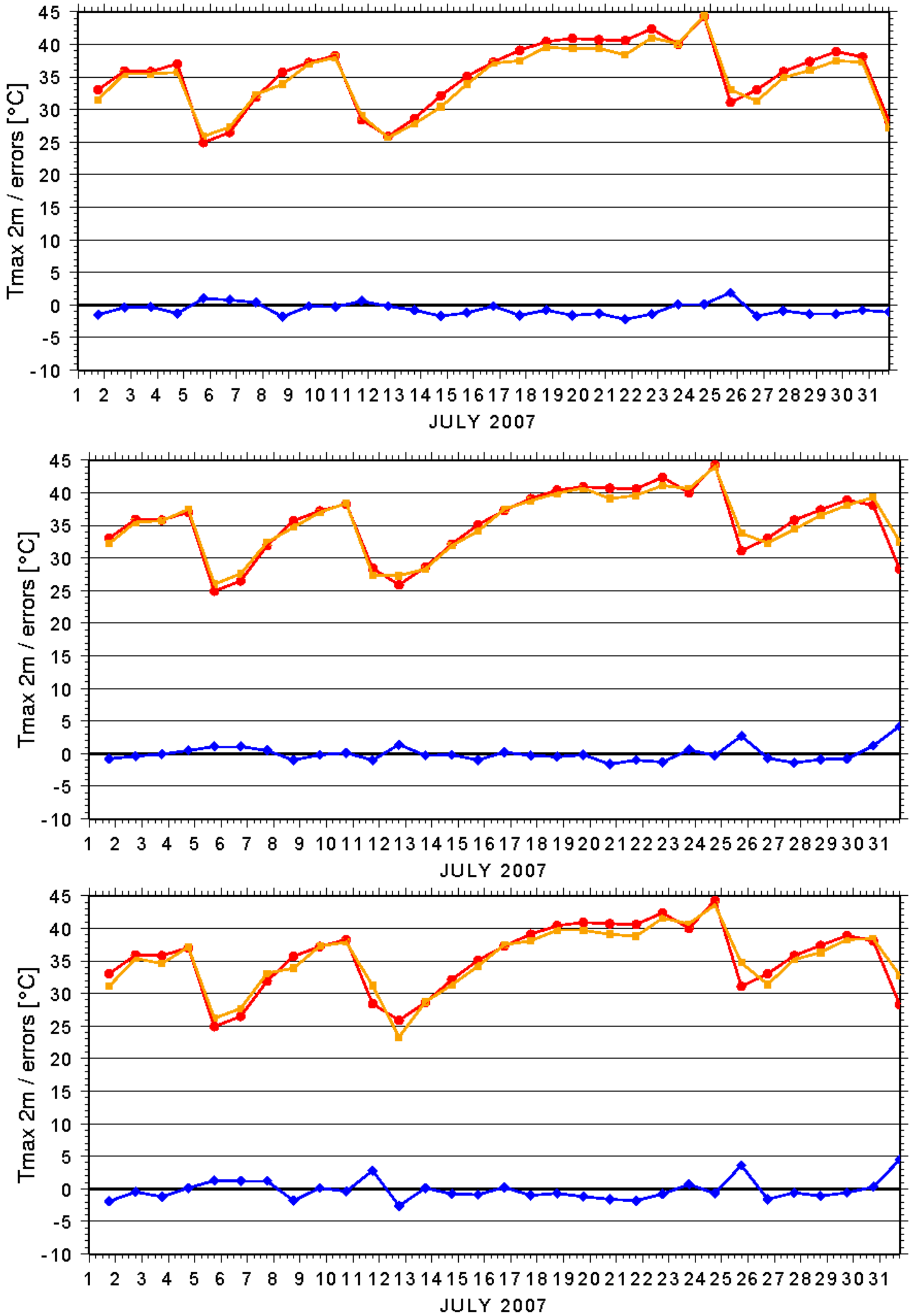


Fig. 8: Daily variations of maximum observed (red) and forecasted (orange) 2m temperature and bias (blue) at Calafat station: top - 1st maximum 00 UTC run (Max1 - 00), middle - 2nd maximum 00 UTC run (Max2 - 00) and bottom - 1st maximum 12 UTC run (Max1- 12).

In conclusion, the evaluation of 2m temperature forecast shown good performance of the Aladin model during the summer of 2007. The Aladin forecast is very good for the maximum temperatures (especially for the periods with very high temperatures), for both 00 and 12 UTC runs and for both 1st and 2nd maxima. During June-August 2007 the Aladin model overestimated the minimum temperatures.

3.12.2. Validation of 3MT part of ALARO-0 (Doina Banciu)

During a Lace stay in Prague, together with Radmila Brozkova and Jean-Francois Geleyn, an intense effort was put on the validation of the prognostic convective updraft and downdraft code, leading to the modification of the condensation computation to be fully compatible with that of updraft transport one (upstream implicit) and to the inversion of the sense of the downdraft transport computation. A preliminary tunning of the of the auto conversion rate parameters was carried out. The sensitivity to the variation of some free parameters was studied as well. The existence of the operational version of ALARO-0 without 3MT part (well validated and tuned) and the DDH tool played an important role in the diagnosis and tuning process.

3.12.3. Case studies

The operational Aladin model output is usually used by the forecasters in co-operation with the ALADIN team members in analyzing different cases, especially for extreme events. The ALAR0-0 model was used as well for a case of intense frontal precipitation. The comparison of the 24 h cumulated precipitation of the operational Aladin model and the results of ALARO-0 with and without 3MT in respect with the observed precipitation showed a more realistic structure and displacement of the precipitation band for the ALARO simulations (see figure 9 and 10).

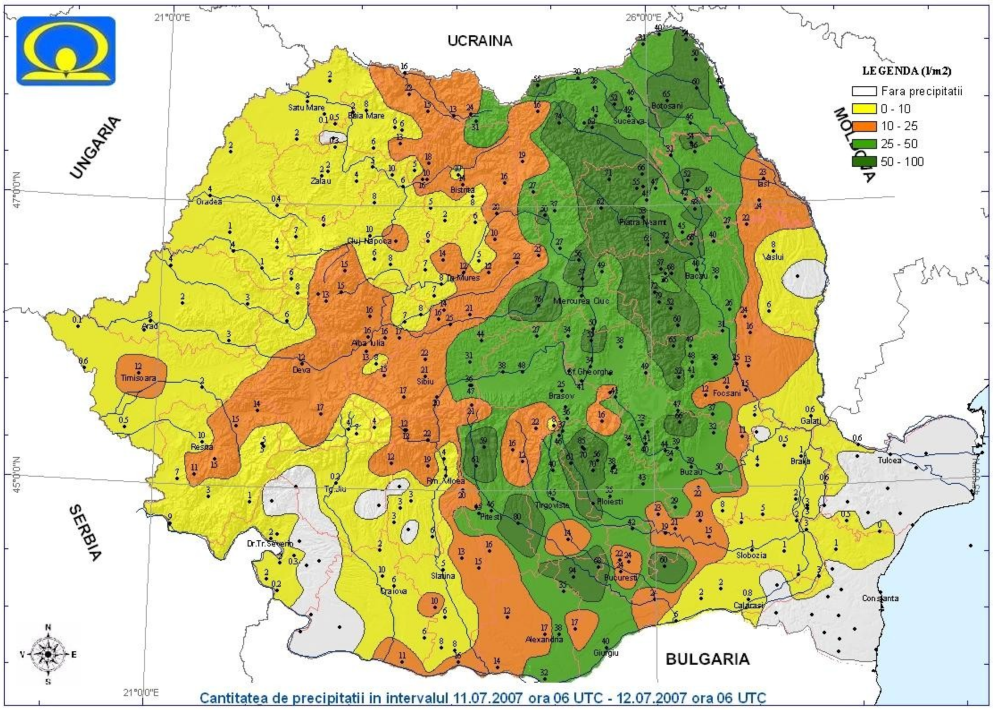


Fig. 9: Observed cumulated precipitation : 11.07.2007, 06 UTC – 12.07.2007, 06-UTC

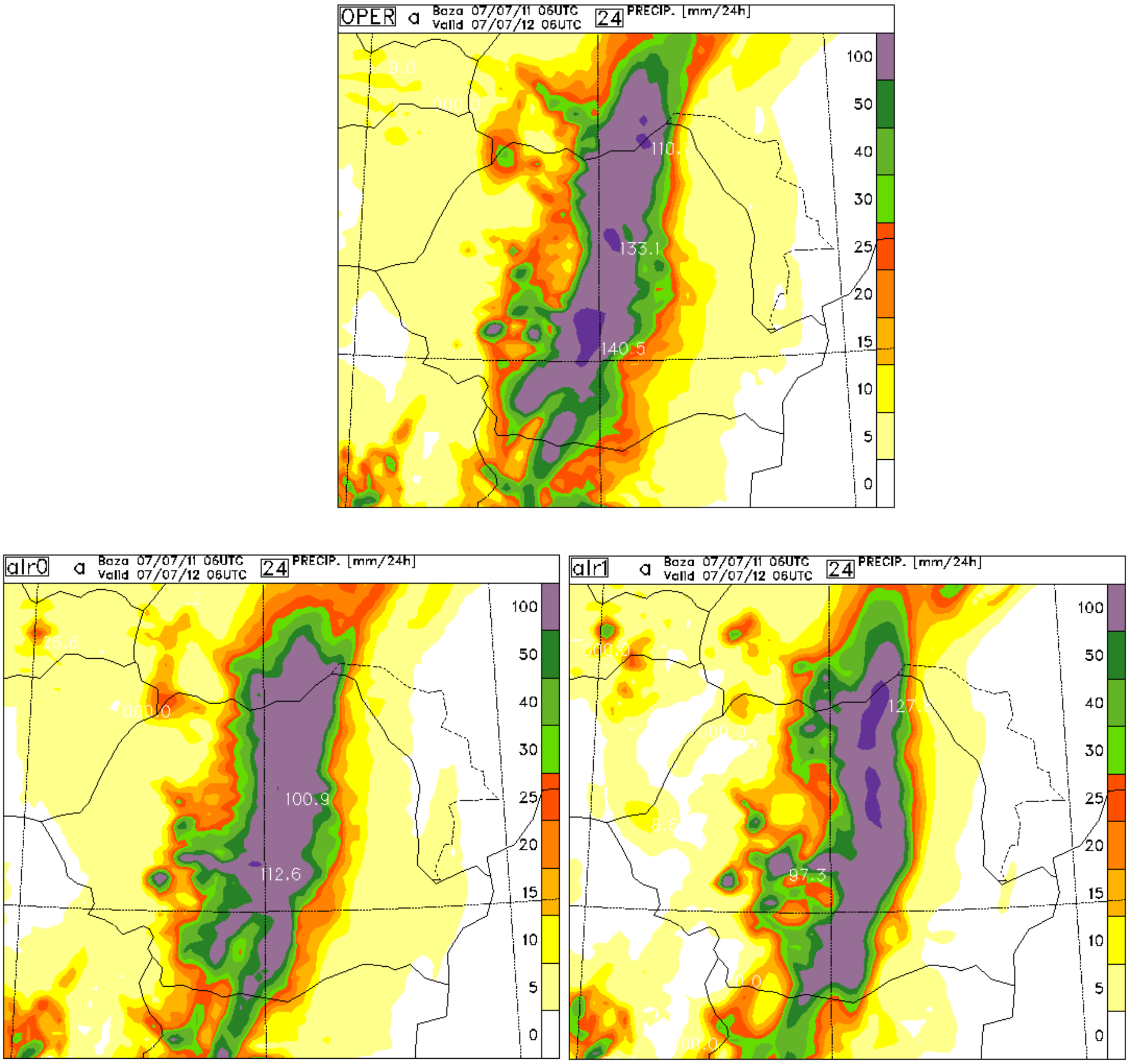


Fig. 10: 24 h cumulated precipitation 11.07.2007, 06 UTC and 12.07.2007, 06-UTC) , forecast by operational Aladin model (top), ALARO-0 without 3MT (bottom left) and ALARO-0 with 3MT (bottom-right)

3.12.4. A Multi-model Ensemble Short-Range Forecast System (Mihaela Caian, Raluca Radu, Rodica Dumitrache, Simona Taşcu)

A multi-model ensemble system for short-range was built using three different limited area forecast models: ALADIN, LM and HRM (models running operationally four times a day at NMA at different resolutions, respectively, 10km, 14km and 28km). Different methods were used to produce the ensemble members (multi-IC/BC and multi-model) in order to allow an extended sampling of the atmospheric variability and to increase the forecast skill by combining independent information obtained from individual forecast members. The forecasts of 2m temperature and total precipitation were analyzed. Ensemble calibration and statistical verification were computed for the year 2007 (only Aladin and HRM), showing better skill for the multi-model solution. Those skills were correlated with each models set-up and internal variability over the available dataset. It was noticed higher variability of the multi-ensemble in Summer.

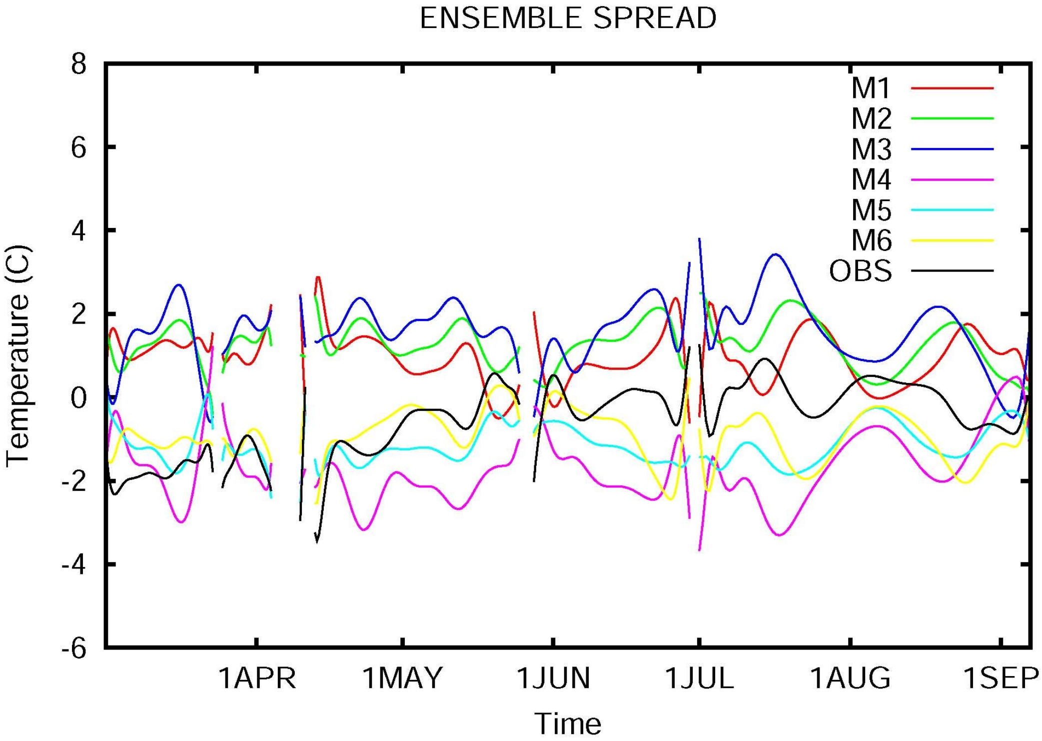


Fig.11: Multi-model ensemble spread (M1, M2, M3 – Aladin members, M4, M5, M6 - HRM members)

3.12.5. Spectral nudging for Aladin Climate (Raluca Radu)

The performance of regional climate model (ALADIN-Climate) to simulate regional climate, in the frame of perfect model approach (represented here by a global model) was evaluated for 25 years simulations using ARPEGE and ALADIN models at the same resolution (50km), by employing spectral nudging method to nest the large-scales from the driving model (ARPEGE) into limited area model (ALADIN). It was shown that spectral nudging is able to avoid the deviation of ALADIN from the large-scale state given, considered to be perfect in order to neglect other model errors and to consider only errors due to nesting procedure. It was underlined that ALADIN solution deviates from ARPEGE solution with the classical approach of treating the lateral boundary conditions. It was also demonstrated that ALADIN using spectral nudging is able to predict as well the large scales present in the driving global fields as the small scales. However, it was found that spectral nudging tends to enhance heavy precipitation, which corrects a drying artifact of the RCM in summer, but artificially increases precipitation events in winter.

3.13. SLOVAKIA

3.14. SLOVENIA

Slovenia (the second half of 2007) (more details neva.pristov@rzs-hm.si)

3.14.1. Spin-up in AROME

During a four week stay in Toulouse Jure Cedilnik was examining the spin-up problems in AROME. Rather large oscillations have been observed in AROME after each analysis. Such oscillations are much more pronounced in the mountainous areas and sometime reach rather large amplitudes - a few degrees Kelvin. These oscillations do not exhibit $2\Delta t2\Delta z$ pattern, but are more or less smooth in the vertical (only $2\Delta t$ behavior). This was also proved by setting the over-implicitness parameter in the MesoNH's TKE scheme to 1.5 and obtaining the same results. Incremental digital filter approach (following what is implemented in current ALADIN double suite at Meteo-France) was performed in a hope to cure this, but the model crashed in the microphysics part.

3.14.2. Evaluation of 3MT on an extreme precipitation case

The latest version of the 3MT scheme (beginning of December 2007) has been used in an operational environment on an extreme precipitation case. During the 12 hours on 18 September 2007 lines of severe quasi-stationary convective cells dumped locally more than 300 mm of rain over the western Slovenia. It occurred as moderate pre-frontal south-westerly flow of warm and humid air hit the steep slopes, forcefully lifting the air up to the level of free convection thus triggering the release of convective instability. We were interested in finding out how different versions of the ALADIN model describe this phenomenon.

The operational ALADIN configuration did a decent job enabling the weather service to issue timely warnings one day ahead of the event. The amount of precipitation however was still severely underestimated. Also the parallel configuration of ALARO-0 roughly repeated this forecast but with slightly reduced local maxima due to advection of clouds.

During the visit of Ligia Amorim from the Portuguese weather service (first 2 weeks in December 2007) within ALADIN flat-rate framework, ALARO-0 with 3MT scheme was run for the selected case. Figure 1 shows how profoundly the course of events can be affected by the interplay between the physics and dynamics in the model. The dynamics is of course identical in the two runs. In addition to changing the location of the strongest rainfall, we were also happy to see that the 3MT distribution of rainfall accumulation corresponds to the observed one much more closely than that from ALARO-0 without 3MT. Still, the amount of rainfall is not much improved. However, as we already know, after performing studies on much higher resolution down to 1.5 km, that the model resolution affects rain intensity in such situation. The dynamic forcing by topographically conditioned low-level convergence is namely the prevailing factor here. In the described case we have also found indications of local cold pools that cannot be described at the resolution of our ALARO-0 setup.

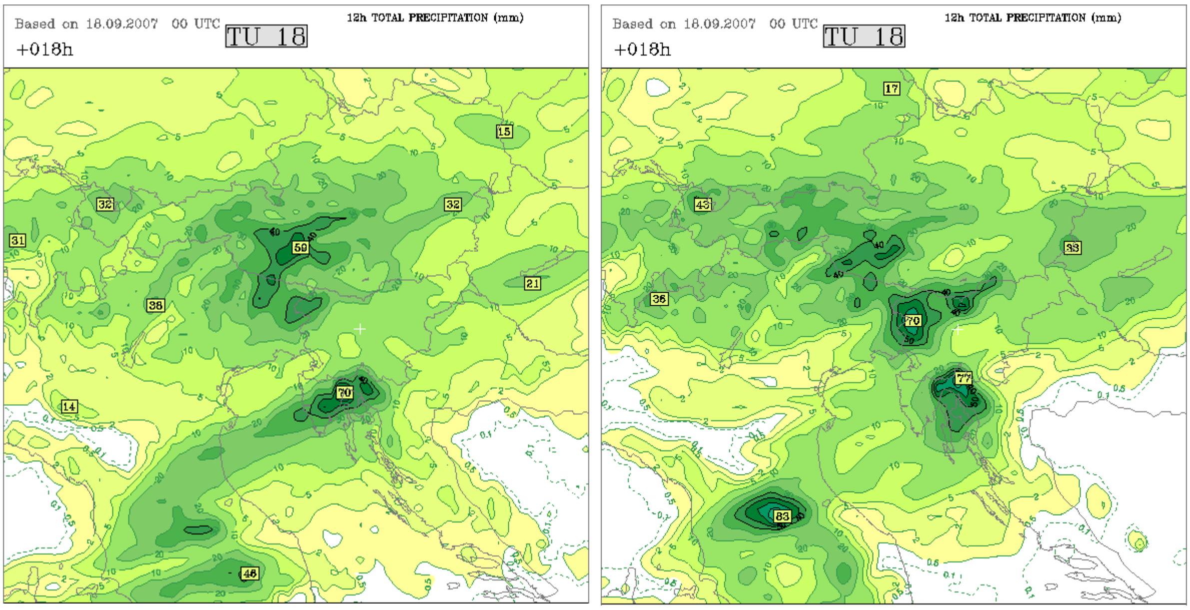


Figure 1: 12h precipitation using ALARO-0 without (left) and with 3MT (right), 18 September 2007.

3.14.3. ALADIN verification project

France and Poland have started with sending model data from their ALADIN operational model. French model data are prepared also for previous years, so data are starting from March 2005. Data from Poland model are available from November 2007.

3.15. TUNISIA

3.16. TURKEY

3.17. HIRLAM

4. PAPERS and ARTICLES

4.1. Status of AROME Model developments

Y. Seity [1], P. Brousseau [1], S. Malardel [1],V. Masson [1]F. Bouttier[1], G. Hello [1]
[1] Météo-France CNRM/GAME 42, av. G. Coriolis 31057 Toulouse Cedex France
E-mail: *yann.seity@meteo.fr*

Abstract : We present the recent developments in the new Non-Hydrostatic 2.5 km resolution model AROME. This model is planned to be operational over mainland France before the end of the year 2008. This article gives an overview of the current pre-operational suite that runs daily in Météo-France as well as preliminary results.

4.1.1. INTRODUCTION

Thanks to the use of the new supercomputer NEC available at Météo-France since end of 2007, the AROME prototype that was previously tested on small domain (over a quarter of France) since June 2005 now runs over the entire metropolitan French area. AROME is still planned to be used operationally at Météo-France before the end of the year 2008. The domain chosen for this first operational application is presented in Figure 1.

With its 2.5 km horizontal grid mesh and a time step of 60 seconds, this model is designed for short range forecasts (less than 2 days forecast). It merges research outcomes and operational progress : the physical package used is extracted from the Meso-NH research model and has been interfaced into the Non-Hydrostactic version of the ALADIN software (Bubnova et al. 1995 ; Benard 2004). AROME mesoscale data assimilation system has been developed in 2006 and 2007 based on ALADIN 3D-Var system (Fischer et al. 2006).

In the following lines, We will present the main components of the current AROME "pre-operational" suite (section 2), then we will show some results (section 3), we will focus on some recent developments (section 4) before drawing concluding remarks (section 5).

4.1.2. DESIGN OF THE CURRENT "PRE-OPERATIONAL' SUITE

A current "pre-operational" system including data assimilation cycle is presented in Figure 2, with 3-hourly data analysis frequency. Four times a day (at 00, 06, 12, 18) we performed 30 hour forecasts over a 600x512 domain (Figure 1), with 41 vertical levels. On 64 processors, with a time step of 60 seconds it needs about 30 minutes of elapsed time to produce 24 hours forecast. AROME is coupled every hour with ALADIN-France.

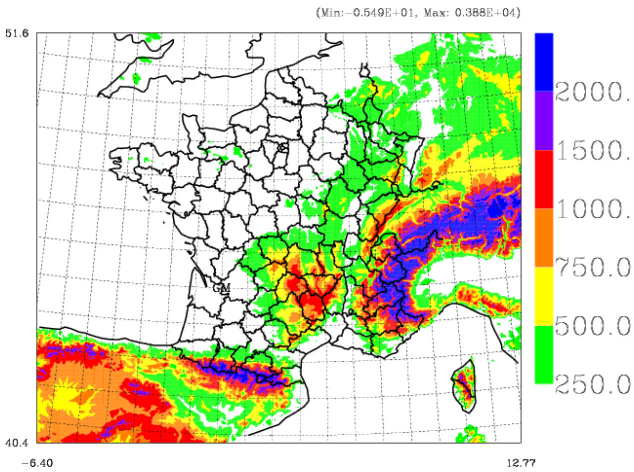


Fig. 1 : AROME-France Domain.

❑ Main characteristics of the model part

The dynamical core of the AROME prototype is using the setup of the Aladin-Nh dynamics (Bubnova et al. 1995, Bénard 2004) and is described in a lot of presentations that are available on the ALADIN website (http://www.cnrm.meteo.fr/aladin/).

This year we have tested some aspects :

- We finally switch off the predictor/corrector scheme that was proved until now to be not needed for the test-suite (no impact on the objective scores and no numerical instability with the setup of the dynamics used in the prototype)
- We have to draw attention to the setting of the numerical diffusion (see section 4)
- We have increased the frequency of the coupling with Aladin boundary conditions to one hour (instead of 3 hours)

The physical parameterizations used in AROME are the following :

- the ICE3 Meso-NH microphysical scheme with five prognostic species of condensed water (Pinty and Jabouille 1998). It contains three precipitating species (rain, snow and graupel) and 2 non precipitating ones (ice crystals and cloud droplets)
- the Meso-NH 1D turbulence parameterization (Cuxart et al., 2000) with Bougeault Lacarrère mixing lengths (Bougeault and Lacarrere 1998)
- the externalized version of SURFEX, the Meso-NH detailed surface scheme (Noilhan and Planton 1989, Masson 2000)
- the operational ECMWF radiation code which is called every 15 minutes.
- the Meso-NH shallow convection scheme (Bechtold et al. 2001).

These aspects are also documented on the ALADIN website and also on the meso-Nh one (http://mesonh.aero.obs-mip.fr/mesonh/).

This year some developments of the physical package were handled by the meso-nh and SURFEX team, it includes :

- The development of a specific scheme for boundary layer diagnostics (see section 4) in the SURFEX surface scheme
- The inclusion of a new flux formulation over sea based on campaign measurements (named "ECUME fluxes") also in the SURFEX surface scheme.
- The development of a new shallow convection scheme that is not yet in the prototype but currently in test and will be documented in a forthcoming Aladin newsletter
- The implementation of a statistical sedimentation scheme (see section 4) in ICE3 as well as the possibility to activate the sedimentation of small droplets for the dissipation of fog (not currently activated in the prototype for the time being)

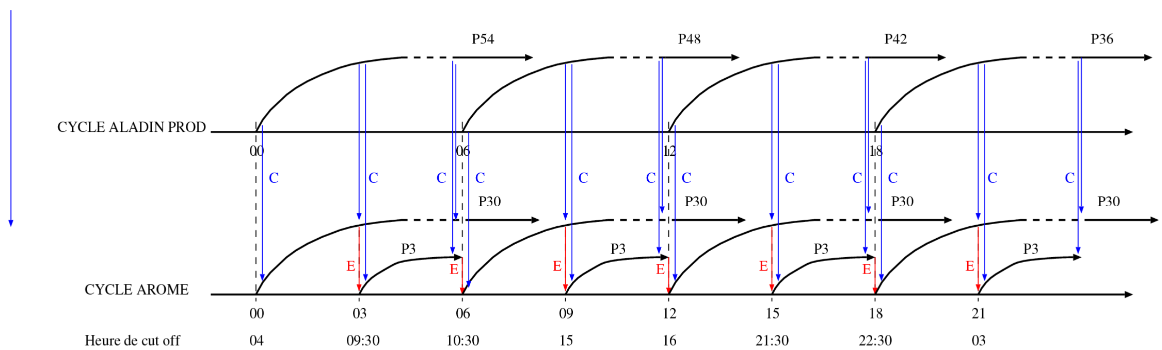


Fig. 2 : Technical overview of the AROME suite.

- **Main characteristics of the assimilation part**

The data assimilation system setup for the AROME prototype is described in the newsletter Aladin number 30 (P. Brousseau and Y. Seity, 2006). It is designed in order to use high temporal and spatial frequency observations (such as RADAR measurements for example) to the best possible advantage, using a rapid forward intermittent assimilation cycle in order to compensate for the lack of d temporal dimension in the 3D-Var scheme. The assimilation has been switched on by mid-november 2007 in the "pre-operational" suite. In terms of observations, the system assimilates the same types of observations as the ones operationally used in Aladin-France. The assimilation of wind measurements from doppler radars is currently in test and will be incorporated into the prototype as soon as possible. In terms of algorithms, the fields that are analyzed are the wind, the temperature, the specific humidity and the surface pressure. The fields that could not be initialized (such as Non-hydrostatic and microphysics fields) are cycled from the guess state. Background-error statistics for AROME share the same multivariate formulation as in ALADIN-FRANCE (Berre 2000). These statistics have been calculated using an ensemble-based method (Berre et al. 2006), with a six member ensemble of AROME forecasts in spin-up mode carried out over two 15-day periods. Initial and lateral conditions were provided by a perturbed ARPEGE/ALADIN-FRANCE assimilation ensemble.

The comparison of the prototype based on a dynamical adaptation from Aladin-France and the one based on the data assimilation cycle described above on the network of 00 UTC shows a clear benefit of the data assimilation on the quality of the forecasts for the first twelve hours range. An example of such a comparison is shown in Figure 3.

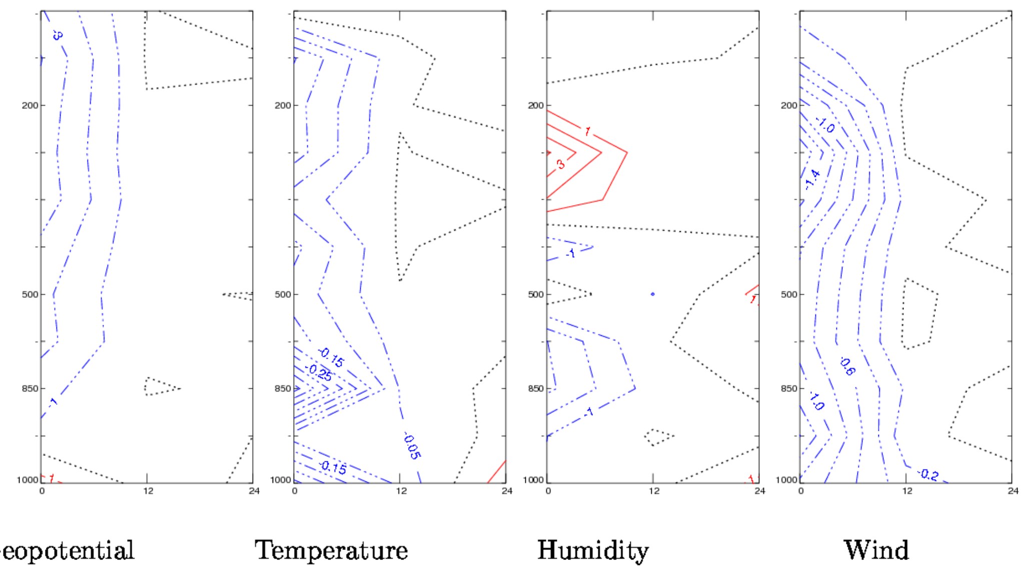


Fig. 3 : Relative differences of the root mean square (rms) of the radiosonde observations minus forecast difference between AROME using pin-up mode and AROME using AROME analysis for geopotential (m), temperature (K), relative humidity (%) and wind (m/s). For each panel, x-axis : forecast range (hour), y-axis : pressure (hPa). Negative values (dashed blue line) : improvement with data assimilation, positive values (plain red line) : deterioration. The domain used is not the one of AROME-France but is over the Alps in order to cover the COPS campaign.

4.1.3. RESULTS

The prototype was continuously evaluated during this year. It was done objectively by the processing of scores and also subjectively by the forecasters. First some problems were detected leading to some model tests and tuning or developments. They are the followings:

- Systematic bias in 2m temperature that was improved by the activation of the Canopy scheme (see section 4)
- Overestimation of convective downdrafts that could be reduced by the re-tuning of numerical horizontal diffusion (see section 4)

Other problems are currently still under tests or investigations. They are the followings :

- Too divergent wind in cases of cold air convection that could be corrected by the activation of the EDKF new scheme (not shown here)
- Lack of cloudiness sometimes over seas, a problem still under investigation.

Apart from these teething problems of the prototype, it has already showed improvements in forecasts quality in different kind of meteorological situations.

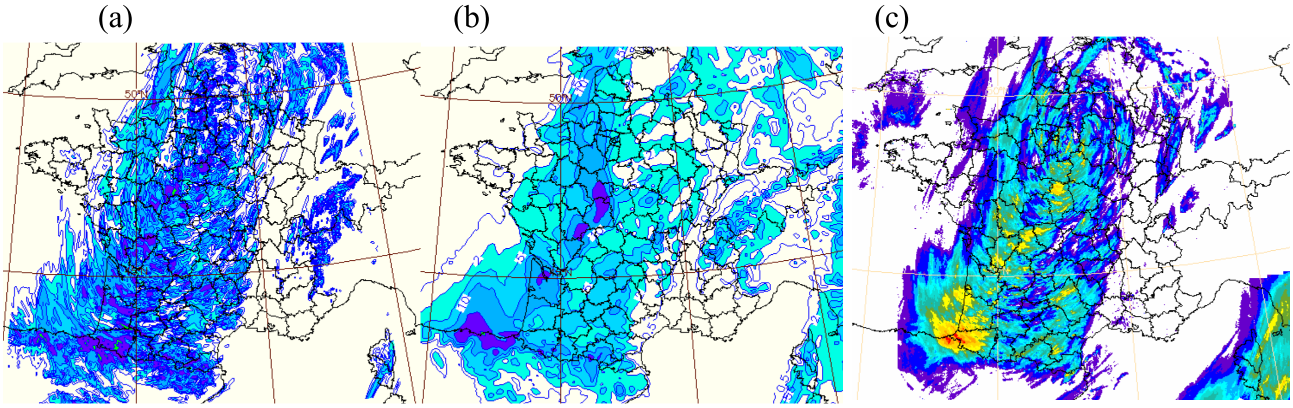


Fig. 4 : 24 hour cumulative rainfalls for 23rd August 2007
a) AROME-France b) ALADIN-France c) Radar network.

For example, orographic effects are better represented than in ALADIN-France thanks to the 4 time smaller grid mesh. Urban effects are well captured by the model thanks to the town scheme TEB (Town Energy Budget). The structure of precipitating patterns is often more realistic in AROME, as shown in Figure 4, even if the model has a tendency to overestimate the maxima of cumulated rainfall. Forecasters also remarked the the ability of the prototype to :

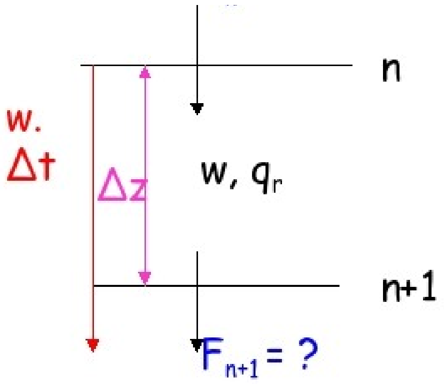
- locate correctly the extrema of rainfalls (but sometimes overestimated in magnitude that is also detected in objective scores)
- give interesting forecasts of cloudiness (geographical extension, transition between clear sky and cloudy sky) specially for low clouds, fog and marine inflows
- catch most of times the triggering of diurnal convection

The model is also judged by forecasters as an interesting tool to handle the understanding and the forecast of the activity of the precipitating systems.

4.1.4. RECENT DEVELOPMENTS

- **Statistical sedimentation scheme**

In the first version of the AROME prototype, the sedimentation of precipitating species (rain, snow and graupel) was performed with an Eulerian scheme which used a time-splitting algorithm (with an effective time step around 4 seconds). Following ideas from J.F. Geleyn in ALARO and Yves Bouteloup in ALADIN, we have implemented a so called ‘statistical sedimentation scheme’ in AROME. It runs with the model time step and it reduces by 15% the cost of the model physics. The principle is relatively simple. For each column, we start from the highest model level in which there are no precipitating species (it is in the stratosphere) and we compute the fluxes according to the algorithm presented in Figure 5.



$$P_1 = \min\left(1, \frac{w\,\Delta t}{\Delta z}\right)$$

$$P_2 = \max\left(0, 1 - \frac{\Delta z}{w\Delta t}\right)$$

$$F_{n+1} = P_1 . \frac{\rho . q_r . \Delta z}{\Delta t} + P_2 . F_n$$

Fig. 5 : algorithm of statistical sedimentation scheme

- **Boundary layer diagnostics**

When comparing AROME diagnosed 2m temperature with surface observations, we observed a systematic positive bias in stable situations especially during the night. The diagnostic used in AROME to compute 2m temperature starts from lowest model level temperature (17.5 m) and uses surface boundary layer laws to compute 2 meters temperature. A new scheme named CANOPY has been developed by Masson (2007) inside the surface code. It consists of 6 added levels between soil and lowest model level. 2 meter and 10 meter diagnostics are computed using a turbulence scheme on these 6 added levels. The cost of this new scheme is ‘marginal’. The scheme has been evaluated on 2 months over South-Eastern France, January and July 2007. The comparison with observations is improved as showed in Figure 6: 2 meter temperature and humidity bias and root mean square errors are reduced. Concerning the wind, results are improved during the day, but slightly worsen with respects to the reference during the night. Contrary to previous surface boundary layer diagnostics, CANOPY scheme affects all the results of the numerical simulation. Indeed, fluxes sent by the surface to the atmosphere are changed.

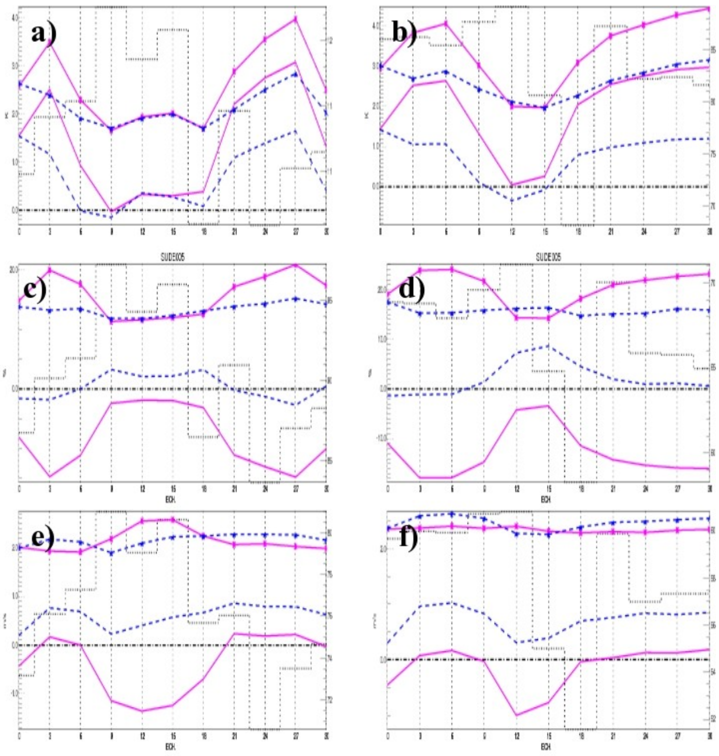


Fig. 6 : Evaluation of CANOPY scheme over South-East France domain : AROME-reference full line, AROME-Canopy dotted line. Root mean square error are on the top , bias on the bottom of each panel, as functions of the forecast range (hours). a) Temperature at 2m during July 2007, b) Temperature at 2m during January 2007, c) 2m relative humidity (%) in July 2007, d) 2m relative humidity (%) in January 2007, e) strength of 10m wind in July 2007, f) strength of 10m wind in January 2007

- **Setup of numerical diffusion**

In some situations, we have observed an over-estimation of convective downdrafts. As shown in Figure 7, AROME forecast a strong isolated thundercell, whereas the equivalent Meso-NH simulation forecast smaller individual cells. This AROME behaviour is the same if we switch to Hydrostatic mode. One possible explanation is the strength of numerical diffusion which was four time stronger in AROME than in Meso-NH. AROME simulation with reduced numerical diffusion is more similar to Meso-NH solution.

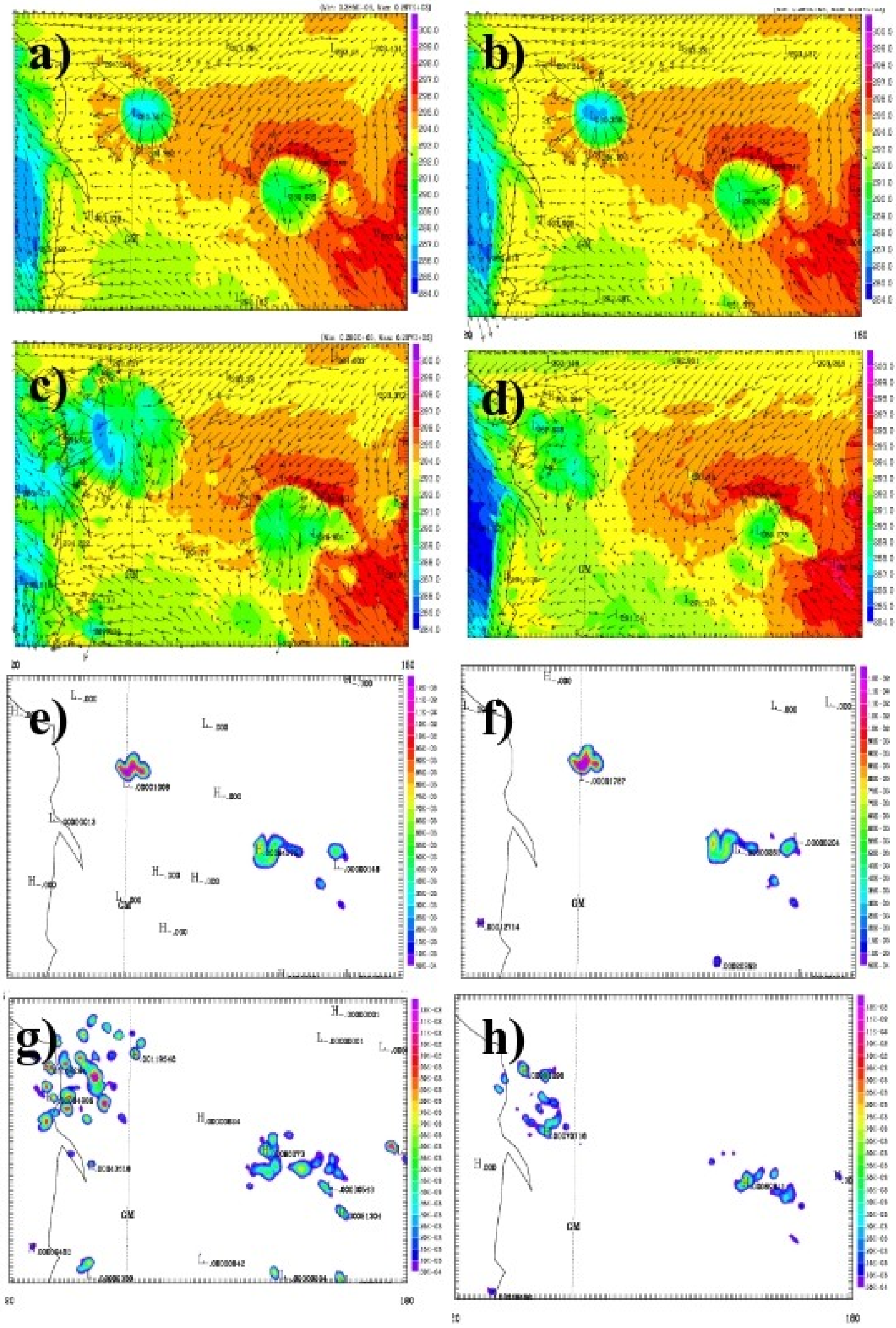


Fig. 7: 10m wind strength and direction and instantaneous rainfalls on 11th April 2007 at 15TU. a-e) AROME-Reference, b-f) AROME Hydrostatique, c-g) AROME with reduced numerical diffusion, d-h) Meso-NH equivalent simulation.

4.1.5. CONCLUSION AND OUTLOOK

AROME is on its way to be operational at Météo-France. It has its own data assimilation scheme, based on ALADIN 3D-Var scheme. It already has a correct behaviour in most situations. Some improvements in the efficiency of the code has been performed, as the use of a statistical sedimentation scheme for precipitating species for example. A new surface boundary layer (CANOPY) scheme has been implemented in the surface scheme SURFEX. It improves the comparison with surface observations. The strength of numerical diffusion has been reduced. It corrects some problems of over-estimated downdrafts under convective cells and is more similar to the one used in Meso-NH.

Daily evaluation of the model will continue with more and more interaction with forecasters. Data assimilation will be expanded by the use of Doppler radar winds which has already shown positive impacts. Results from the MAP-DPHASE campaign will be interesting to compare hour results with other similar models. We are also starting to evaluate the AROME behaviour at 1km and 500m resolution to prepare future plans. Concerning the physics, a new shallow convection scheme named EDKF is under daily evaluation, and the activation of hail in the microphysical scheme is under tests.

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4.2. Spectral blending by digital filter and pseudo assimilation cycle at SHMU

Martin Belluš (martin.bellus@shmu.sk) & Mária Derková (maria.derkova@shmu.sk)

4.2.1. Introduction

Spectral blending by digital filter is a technique allowing for the obtaining of a more exact initial state for the integration of the limited area numerical weather prediction system, by a combination of large scale information coming from the driving model with small scale features resolved by the high resolution (limited area) model. It is considered, that the meso-scale features obtained by a short-range forecast of the high resolution model are closer to reality thanks to a better balance with the orographic/surface forcing. While, in the global model analysis, this short wave part of spectra is a result of pure mathematical interpolations.

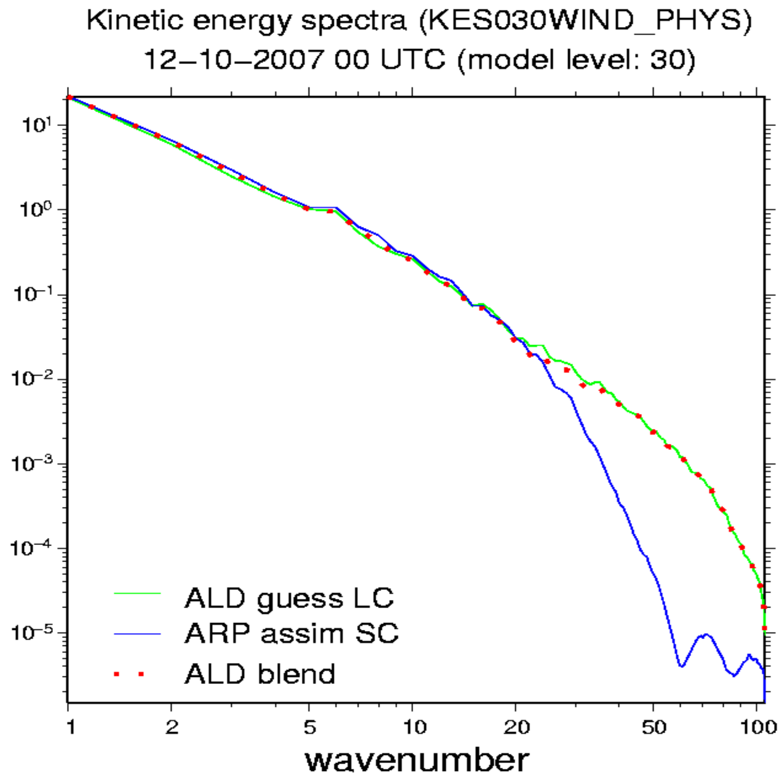

FIG. 1 Kinetic energy spectra comparison.

Such scale mixing is illustrated in the Figure 1, by a kinetic energy spectra at the model level close to the surface computed over the whole domain. The blue line represents ARPEGE short cut-off analysis, the green line represents ALADIN 6h guess from the pseudo assimilation cycling and the red dots stand for the resulting new blended initial state ready for further integration. It can be clearly seen, that for the small wave numbers the new spectra matches the ARPEGE analysis, while for the big wave numbers (short waves) it converges towards ALADIN guess. The transition between these two parts of spectra remains smooth and continuous thanks to the used technique.

The blending by digital filter can be written in the notation of ARPEGE/ALADIN system as the following well known equation. ***I*** denotes the new blended initial state, ***A*** is the ARPEGE global model analysis and ***G*** is the ALADIN guess (short range forecast). Subscript *LOW* represents the lower blending spectral resolution and *HIGH* the full model resolution. The bars stay for filtered state.

$$I = G^{ALD} + (\overline{A_{LOW}^{ARP}} - \overline{G_{LOW}^{ALD}})_{HIGH}$$

As the observations are not directly used here (their information enters through the analysis of the driving model), the blending might be considered as the pseudo data assimilation.

4.2.2. Operational implementation

The operational implementation of both pseudo assimilation cycle and production by blending within our home-made run_app system can be expressed in the following diagram (Figure 2).

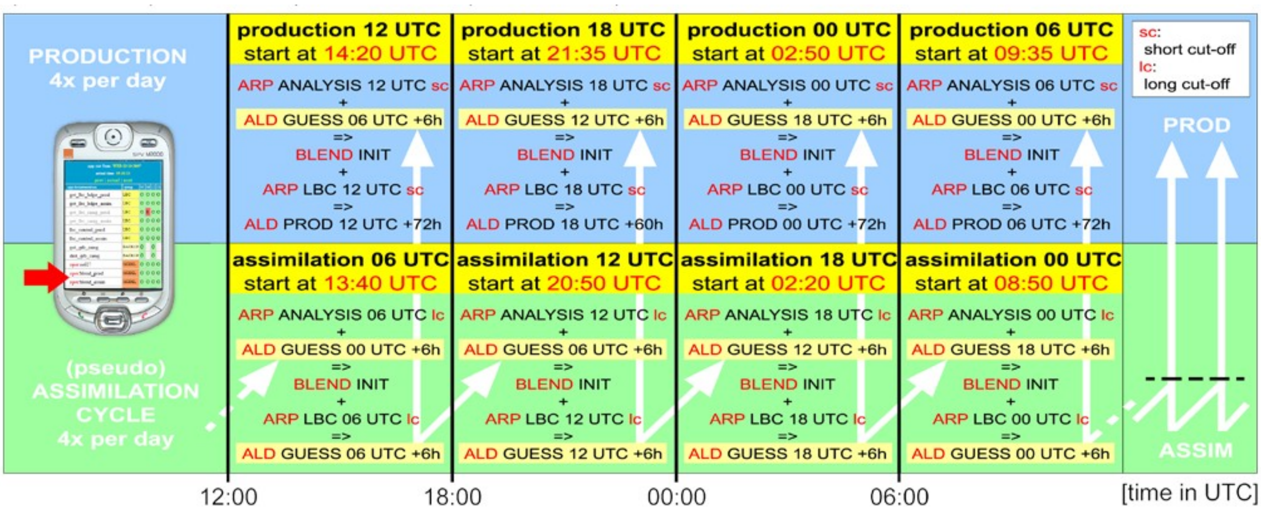

FIG. 1 Scheme of the operational implementation of blending procedures.

Blending application works in two modes:

a) pseudo assimilation cycling, where long cut-off LBCs from Météo France and 6h ALADIN guess from previous cycle are used to produce blended initial state followed by a 6h integration. As a result the new ALADIN guess is created.

b) production, where new blended initial state is produced as a combination of that 6h ALADIN guess (produced by the pseudo assimilation cycle) and actual short cut-off LBC from Toulouse.

This flexibility is achieved thanks to usage of several functions, which are capable to do different operations according to different input parameters. The fully automatic switch to dynamical adaptation in case of a problem with ALADIN guess (and back) is also implemented within this single application. No human intervention is needed and operational staff will be immediately informed about the switch by SMS/email message.

4.2.3. Testing

Prior the operational implementation the forecasts based on blending pseudoassimilation were compared with the operational forecast (dynamical adaptation) and with the measurements, with the emphasis on the precipitation fields.

The correct precipitation analysis is very difficult task, as the amount of observing stations is limited, they are not regularly distributed and the measurements are normally taken in different times (for different type of stations). Hence, to analyze the precipitation fields, we are using sophisticated INCA software, which can take into account both the station data and the radar data (the precipitation estimate according to the radar reflectivity). The result is an intelligent composition and interpolation of such data and it is the best (even if far from perfect) precipitation analysis we can get. (INCA software was originally developed at ZAMG in Austria and later implemented also at SHMÚ for Slovak territory with the help of Austrian colleagues.)

Spectral blending by digital filter in pseudo assimilation cycle and in production was used while 24 hour forecast was compared to the operational one during 5 weeks of testing in parallel suite. Positive impact on precipitation fields (both positioning and amounts) was observed within the whole forecast period. Improvement in precipitation forecast is shown on the right side of the Figure 3 (two map columns - each for different case; from the top: difference between parsuite and operational precipitation forecast, INCA analysis, operational forecast, parsuite forecast with blending). In the first case, the precipitation amount accumulated for the first 12 hours of forecast initialized by blending represents the field analyzed by INCA system better than the forecast initialized by dynamical adaptation. The amount in south eastern borders of Slovakia is realistically increased, while dummy rain in the north eastern Slovakia is partly removed. Wrongly placed rain near the south western borders is also decreased, but the second precipitation core in the south is still not captured. In the second case, highly overestimated precipitation amount (accumulated for the first 18 hours) in the western Slovakia was realistically corrected by blending.

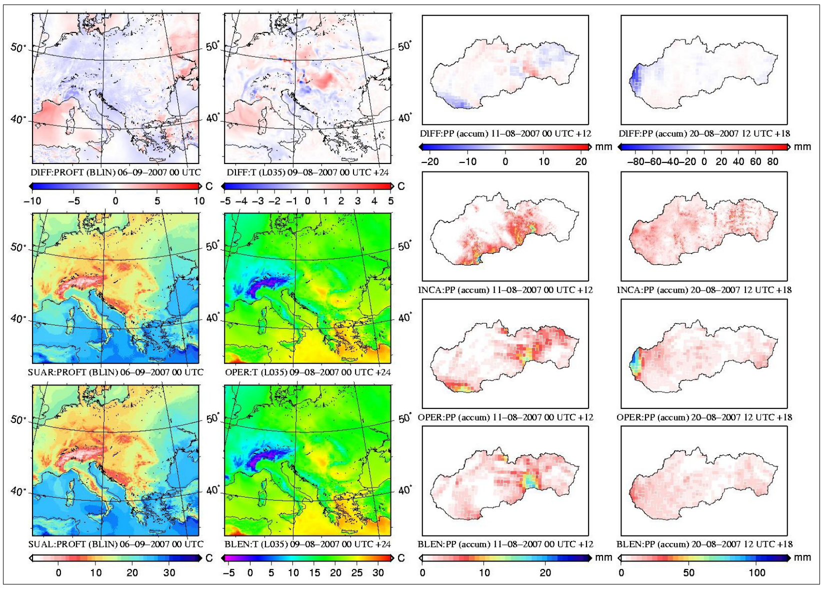

FIG. 2 Blending results in comparison with dynamical adaptation.

Blending was implemented only for model's atmospheric fields. To prevent possible surface drift from climatology after longer cycling period, we are using for the time being (in blended INIT file) surface fields from ARPEGE analysis rather than the ones from ALADIN guess. Such drift for soil temperature after one month of cycling with usage of ALADIN guess surface fields in blended INIT file is shown on the left side of the Figure 3 (first column from the top: soil temperature drift due to cycling without relaxation to the ARPEGE surface fields, soil temperature initialization by blending if ARPEGE surface fields are used, the same but with usage of ALADIN guess surface fields after one month of cycling). The second column from the left compares 24 hour temperature forecast initialized by blending (bottom) with dynamical adaptation (middle) on the model level near the surface. The difference is shown on the top.

4.2.4. Monitoring (reliability)

After successful testing in parallel suite (both technically and scientifically) the blending was switched into operations at SHMU in the middle of September 2007 (all four runs per day).

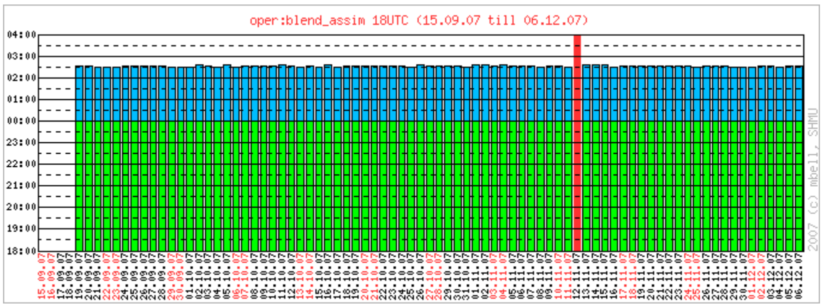

FIG. 3 Pseudoassimilation by blending - 18 UTC (application monitoring).

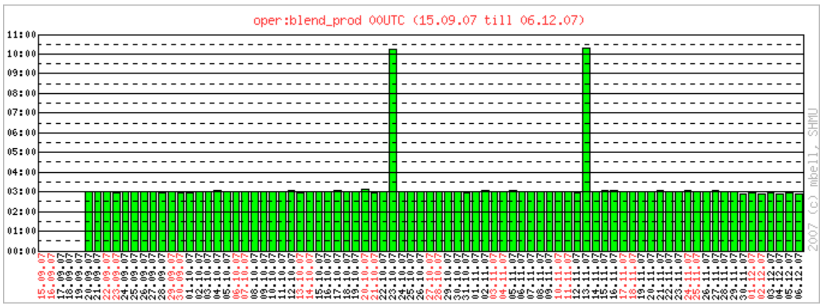

FIG. 4 Production by blending - 00 UTC (application monitoring).

The two charts above show successful finish time of pseudo assimilation cycle at 18 UTC (Figure 4) and related production (blending only) at 00 UTC (Figure 5) for the whole operational period up to now. Two delayed runs (the first one only for production) are corresponding to the HW/ SW problems in Toulouse.

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4.3. Singular vector experiments at the Hungarian Meteorological Service

Edit HÁGEL: Hungarian Meteorological Service, Division for Numerical Modelling and Climate Dynamics. hagel.e@met.hu

4.3.1. Summary

By perturbing the initial state of a numerical weather prediction (NWP) model it is possible to take into account the impact of the errors in the initial conditions (the fully exact description of the initial state is not achievable due to observation errors, errors in the data assimilation techniques etc.). Then the model is integrated from these different initial conditions forming an ensemble of numerical weather predictions. The spread of this ensemble provides valuable information on the predictability of the atmospheric state and on the probability of different weather events which is very useful e.g. for the prediction of severe weather. One possible way to create such an ensemble is to use the singular vector method to perturb the initial conditions of the model. The aim is to find perturbations for a given initial state which grow most rapidly according to the chosen norm (e.g. total energy norm) focusing on a specific area (the optimization area) during a given time interval (optimization time).

Research with singular vectors computed with the ALADIN limited area model is going on at the Hungarian Meteorological Service. The final aim is to generate perturbations from the singular vectors, which then will be used to perturb the initial conditions of a limited area ensemble prediction system based on the ALADIN model. An overview about the first results is given in this article.

4.3.2. Introduction

The problem we are trying to solve is the following: we search for the most rapidly growing perturbations to a given atmospheric state. One possible solution of this problem is the use of the singular vector (SV) technique. The fastest growing perturbations (δX) are those which maximize the following ratio:

$$\frac{\langle [\delta X]_{NSTOP}, [\delta X]_{NSTOP} \rangle}{\langle [\delta X]_0, [\delta X]_0 \rangle}$$

where $[\delta X]_{NSTOP}$ is the evolution of the perturbation by the tangent linear model from the initial perturbation $[\delta X]_0$ (*0* denotes the initial time and *NSTOP* denotes the final time). To solve this problem some assumptions and choices are needed. The main assumption is that the perturbations grow linearly in time which then allows the use of the tangent linear model. The choices one has to take are the following:

- How to measure the size of a perturbation (choice of norm(s) at initial and final time)?
- What region(s) to focus on (optimization area)?
- Between which two model layers to allow the perturbations to grow?
- How long to allow the perturbations to grow for (optimization time)?

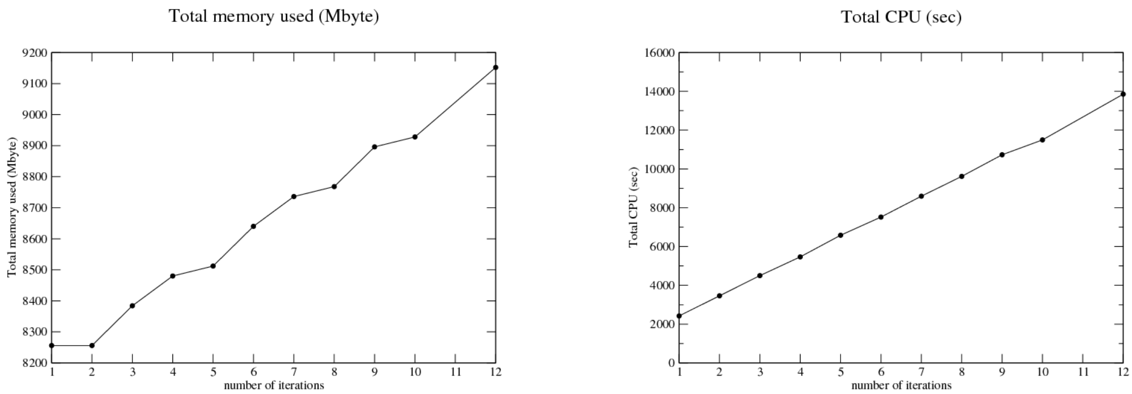
Besides these there are some other important issues as well:

- What resolution should be used for the singular vector computations?
- How many SVs should be computed?
- How many iterations are necessary for that?
- What to use as coupling files and coupling frequency during the SV computations?

4.3.3. Testing the singular vector code

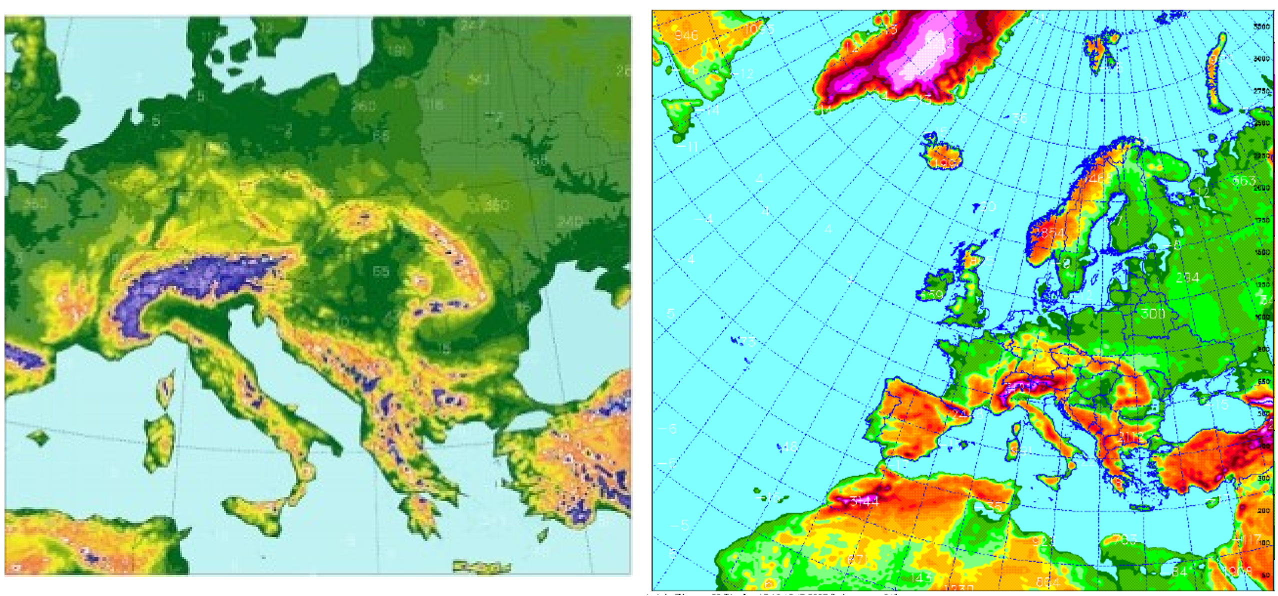
❑ Memory and CPU usage, number of iterations

As a first step the tangent linear and the adjoint codes were tested in cycle30 on the supercomputer of Météo-France (which was a Fujitsu VPP5000 machine - "tora" - at the time of the experiments). After these tests work could start with the singular vector configuration. As a first step the memory (Fig. 1/a) and CPU (Fig. 1/b) usage was tested as a function of the number of iterations. The characteristics of the experiments were the following. The domain (Fig. 2/a) is given by NLON x NLAT x NLEV = 150 x 135 x 46 with a horizontal resolution of 20 km. The SV optimization time was set to 12 hours with a time step of 90 sec. The dry total energy norm was used both at initial and final time.



(a) **(b)**

Figure 1: (a) Total memory usage as a function of the number of iterations. One can see that each additional iteration costs approximately 100 Mbyte. (b) Total CPU usage as a function of the number of iterations. One can see that each additional iteration costs approximately 1000 sec. Experiments were performed on the supercomputer of Météo-France (which was a Fujitsu VPP5000 machine - "tora" - at the time of the experiments) with cycle30.



(a) (b)

Figure 2: (a) The so called "LACE" domain, covering most of continental Europe. (b) The GLAMEPS domain.

The number of iterations necessary to obtain a singular value with appropriate precision was also tested. It can be said that in general one needs three times more iterations than the number of stable SVs desired (Fig. 3). E.g. for 20 SVs one needs to perform about 60 iterations. It is in agreement with the results which can be found in other papers about SVs.

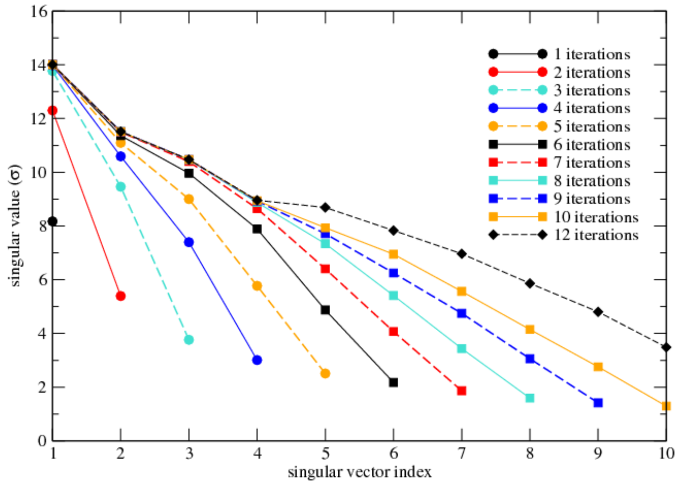


Figure 3: Singular values as a function of the number of iterations performed. It can be said that in general one needs about three times more iterations than the number of stable SVs desired. Experiments were performed on the supercomputer of Météo-France (which was a Fujitsu VPP5000 machine - "tora" - at the time of the experiments) with cycle30.

❑ Case studies

So far experiments have been performed for two different dates. First one was from 2006 (28 June 2006, starting from the 12UTC analysis) and the second from 2007 (27 August 2007, starting from the 00UTC analysis). In the first case the domain was the so called "LACE" domain (Fig. 2/a) with 20 km resolution. Optimization of SVs was performed on the whole domain. In the second case the domain was the "GLAMEPS"[1] domain (Fig. 2/b), however (due to the high computational costs) optimization of SVs was only performed on a subdomain (which was the "LACE" domain).

☑ Case study #1: 28 June 2006

The characteristics of the first case study were the following. The domain is given by NLON x NLAT x NLEV = 150 x 135 x 46 with a horizontal resolution of 20 km. The SV optimization time was set to 12 hours with a time step of 90 sec. The optimization area was the whole domain (Fig. 2/a). The dry total energy norm was used both at initial and final time. Computations were started from the 12 UTC analysis on 28 June 2006. Lateral boundary conditions were obtained from ARPEGE every 3 hours. Singular values are plotted on Fig. 4. Leading singular value is around 14.

1 GLAMEPS: (Grand Limited Area Model Ensemble Prediction System) is a joint joint ALADIN and HIRLAM project for short range ensemble forecasting. For more information about GLAMEPS consult Iversen, 2007.

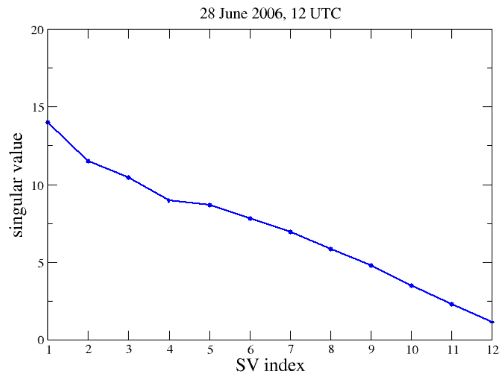
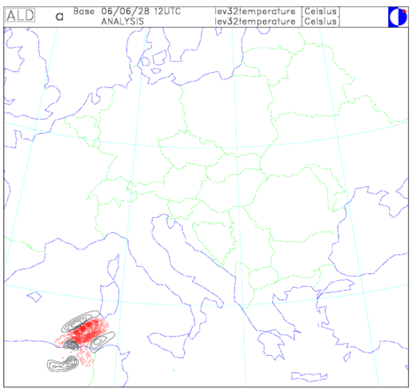


Figure 4: Singular values as a function of the number of iterations performed.

For comparison, SVs were computed with different models: ALADIN and ARPEGE. The optimization time and area was the same for both models but the resolution was different. In case of ALADIN the horizontal resolution was 20 km, while for ARPEGE a truncation of T95 was used. For comparison temperature fields on model level 32 (about 727 hPa) are shown for both models on Fig. 5 and Fig. 6 (for ARPEGE only at initial time, for ALADIN both at initial and final time). One can realize that the location is quite similar at initial time for both models but the values and the area covered are different.



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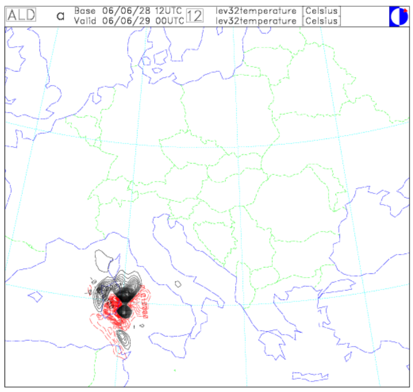


(b)

Figure 5: ALADIN leading singular vector at initial (left) and final (right) time for 28 June 2006, 12UTC. The parameter is temperature on model level 32 (around 727 hPa). Contour interval: 0.01 Celsius. Resolution used for computations was 20 km and the optimization time was 12 hours. Experiments were performed on the supercomputer of Météo-France (which was a Fujitsu VPP5000 machine - “tora” - at the time of the experiments) with cycle30.

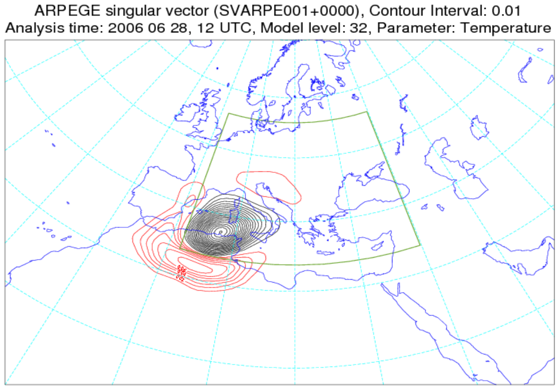
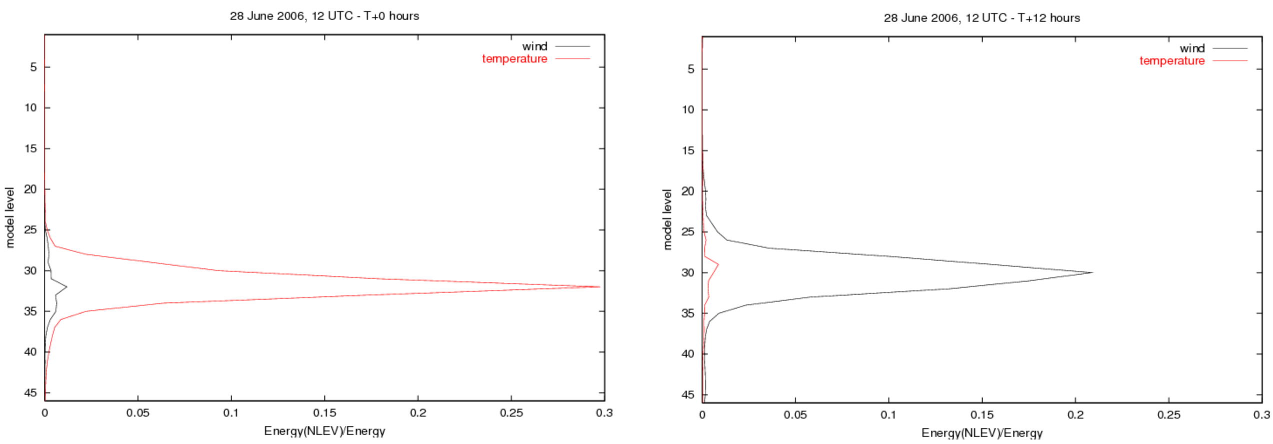


Figure 6: ARPEGE leading singular vector at initial time for 28 June 2006, 12UTC. The parameter is temperature on model level 32 (around 727 hPa). Contour interval: 0.01 Celsius. Truncation used for computations was T95 and the optimization time was 12 hours. Optimization area was the same as for the ALADIN model, shown in green in the figure. Experiments were performed on the supercomputer of Météo-France (which was a Fujitsu VPP5000 machine - "tora" - at the time of the experiments).

Comparing the leading ALADIN SV at initial and final time it can be realized that the structure is slightly moved to the east during the evolution of the SV and also the area covered became somewhat larger.

Energy distribution was plotted separately for the wind and the temperature component of the total energy (surface pressure part was not included in the computations). Figures 7/a and 7/b reveal that at initial time the total energy is dominated by the temperature component, while at final time the wind component is more dominant. It can also be mentioned that the total energy propagates rather upwards than downwards. The maximum of the energy was around model level 30-32 (660-727 hPa). This seems to be in agreement with the values that can be found in different articles about the behaviour of global SVs. These articles mention the value of 700 hPa as the level of the maximal energy.



(a) **(b)**

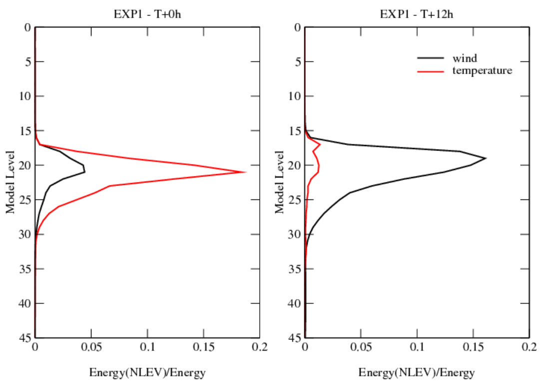
Figure 7: Vertical energy distribution of the leading SV for 28 June 2006, 12UTC. Wind (black) and temperature (red) component of the total energy is plotted at initial time. Energy of each model level is normalized by the total energy of all levels. The optimization time was 12 hours and the resolution was 20 km. Experiments were performed on the supercomputer of Météo-France (which was a Fujitsu VPP5000 machine - "tora" - at the time of the experiments) with cycle30.

Comparison with HIRLAM singular vectors is going on for this case (for information about HIRLAM SV research see Stappers and Barkmeijer, 2007).

☑ Case study #2: 27 August 2007

For this experiment a larger integration domain (Fig. 2/b) was used with two different resolutions: 22 and 44 km. The domains can be given by NLON x NLAT x NLEV = 320 x 300 x 46 for 22 km and NLON x NLAT x NLEV = 160 x 150 x 46 for 44 km. Two different optimization times were used: 12 hours and 24 hours, both with a time step of 90 sec. The optimization area was not covering the whole domain, it was the same as in the previous experiment. The dry total energy norm was used both at initial and final time. Computations were started from 00 UTC analysis on 27 August 2007. Lateral boundary conditions were obtained from ARPEGE every 3 hours.

Energy distribution was plotted separately for the wind and the temperature component of the total energy (surface pressure part was not included in the computations). Figures reveal that at initial time the total energy is dominated by the temperature component, while at final time the wind component is more dominant (Fig. 8). It can also be mentioned that the total energy propagates rather upwards than downwards. Compared to the previous case study, it should be mentioned that the maximum of the energy was much higher in this second case, around model level 20. Is it a normal behaviour? Does it depend a lot on the synoptic situation? Further case studies are needed to investigate this.



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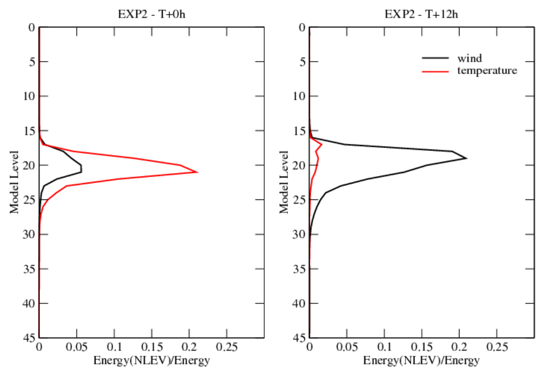

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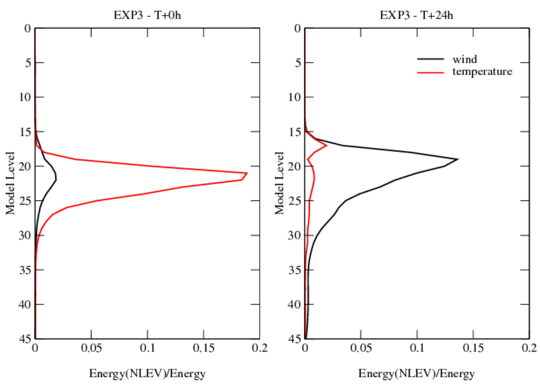

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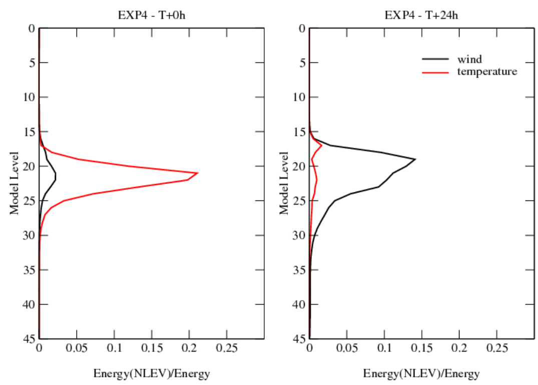

(d)

Figure 8: Vertical energy distribution of the leading SV for 27 August 2007, 00UTC. Wind (black) and temperature (red) component of the total energy are plotted separately both for initial (left) and final (right) time. Energy of each model level is normalized by the total energy of all levels. (a) Optimization time was 12 hours and resolution was 44 km. (b) 12 hours optimization time and 22 km resolution. (c) 24 hours optimization time and 44 km resolution (d) 24 hours optimization time and 22 km reolution. Experiments were performed on the supercomputer of Météo-France (the new NEC machine "tori").

Singular vectors were also plotted for the different experiments performed with the use of different resolution and optimization time (Fig.10-13). Results show that the difference in the resolution on which the SVs were computed does not have a large effect on the structure and location of the SVs. On the other hand there is a difference in the singular values (Fig. 9). It was found that if the resolution is higher, the singular values are larger as well .

The difference in the optimization time has the effect of changing the location of the SVs. With 24 hours optimization time SVs are located more to the west at initial time compared to those computed with 12 hours optimization time. There is a difference at final time as well. 24 hours SVs cover a considerably larger area at final time than 12 hours SVs.

One can also note from the plots of the SVs - in agreement with the energy distributions - that at the initial time the temperature fields have larger values, while at final time the wind components are more dominant.

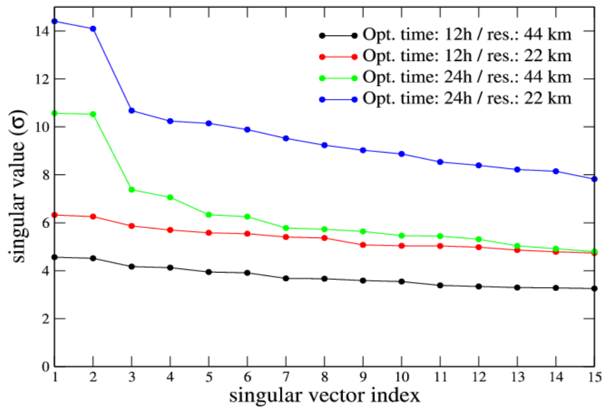

Figure 9: Singular values of the first 15 singular vectors for 27 August 2007, 00UTC with different optimization times and different resolutions. Experiments were performed on the supercomputer of Météo-France (the new NEC machine "tori").

4.3.4. Further plans

Comparison with SVs computed with the HIRLAM limited area model has already started and it is planned to be continued more intensely in the near future. Comparison with global SVs (ARPEGE and possibly IFS) is also an important issue which has to be continued. The final aim is to use the ALADIN SVs to generate perturbations which then could be used to perturb the initial conditions for an ALADIN ensemble system. Such an ensemble system could be a valuable component in the HIRLAM-ALADIN initiative: GLAMEPS. Concerning such an ensemble system one has to think about the following questions:

- How to build the perturbations from the SVs? Possible methods e.g. would be the ones used at Météo-France or at ECMWF. Is there a significant difference when using one method or the other?
- What to use as lateral boundary conditions for such an ensemble forecast? Possible choices could be the ARPEGE EPS members or members of the ECMWF EPS. Does it have a significant effect on the SVs or on the ensemble forecasts made by the use of these SVs?

These questions should definitely be investigated in the future.

Acknowledgement

The author is grateful to the international ARPEGE/ALADIN team for the development of the ARPEGE/ALADIN model family. The support and help of the members of the NWP team of the Hungarian Meteorological Service is very much appreciated. Special thanks goes to Jan Barkmeijer and Roeland Stappers from KNMI and Martin Leutbecher from ECMWF. This work was supported by the Hungarian National Research Fund (OTKA, grant N° T/F 047295) and the Hungarian National Office for Research and Technology (NKFP, grant N° 3A/051/2004 and JÁP, grant N° 2/007/2005).

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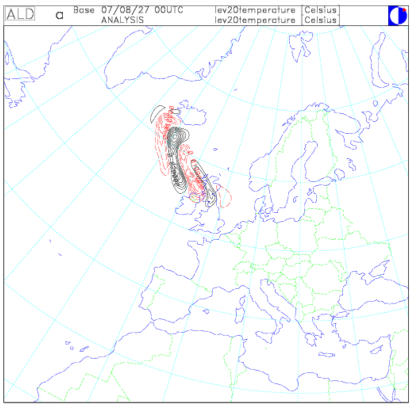
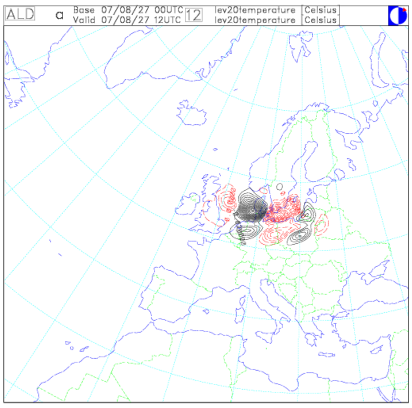
Stappers, R., Barkmeijer, J., 2007: Hirlam singular vectors. HIRLAM Newsletter no. 52

(a)





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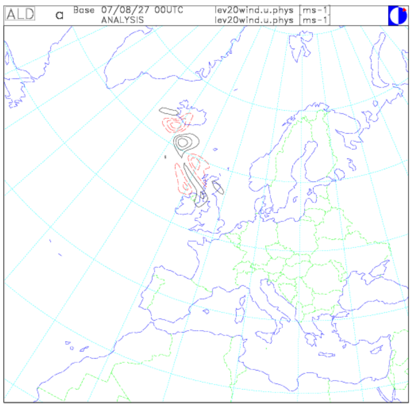

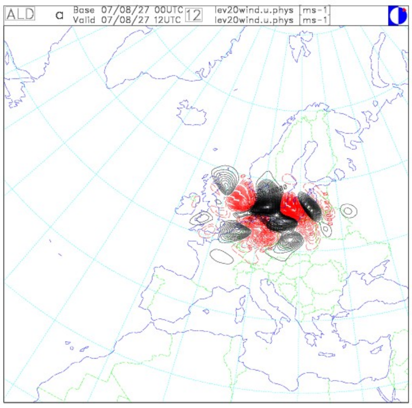

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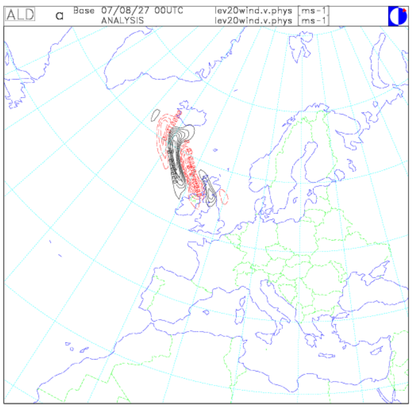
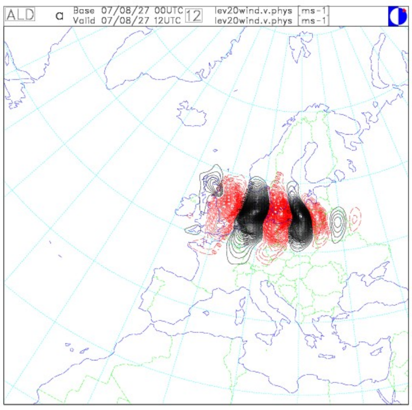
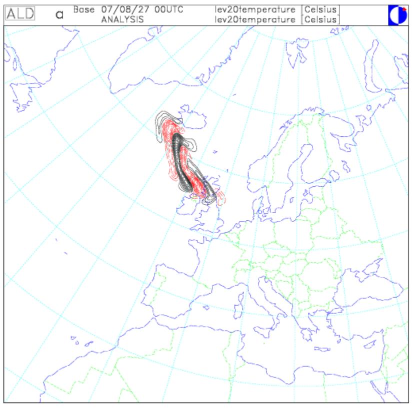




(f)

Figure 10: Leading singular vector at initial time for 27 August 2007, 00UTC at initial and final time. The parameters are temperature (initial time: a, final time: b), u component of wind (initial time: c, final time: d) and v component of wind (initial time: e, final time: f) on model level 20. Contour interval: 0.01. Resolution used for computations was 44km and the optimization time was 12 hours. Experiments were performed on the supercomputer of Météo-France (the new NEC machine "tori").



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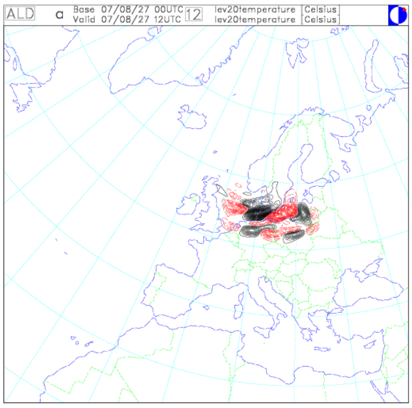

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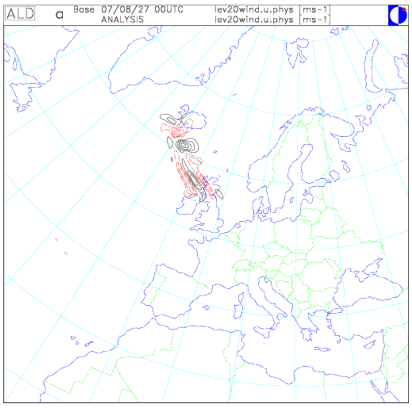

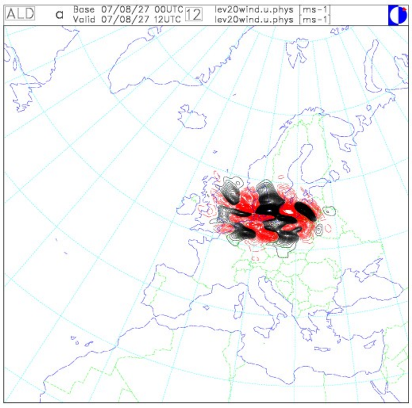

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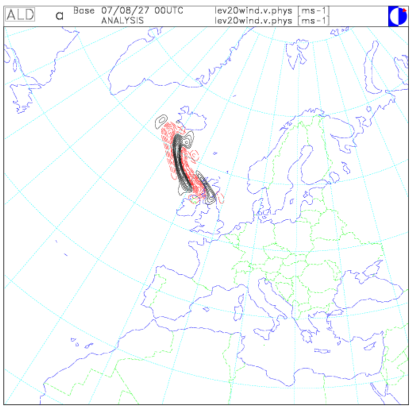

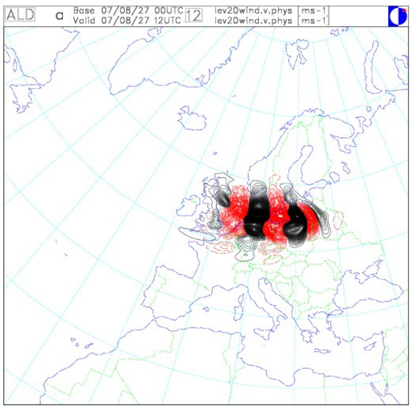

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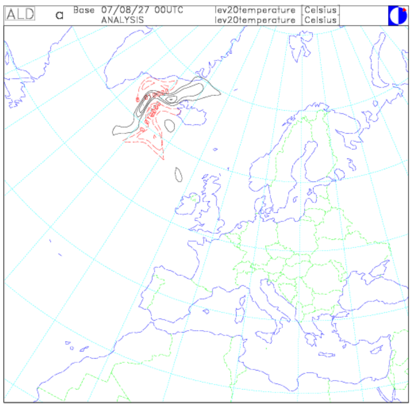
Figure 11: Leading singular vector at initial time for 27 August 2007, 00UTC at initial and final time. The parameters are temperature (initial time: a, final time: b), u component of wind (initial time: c, final time: d) and v component of wind (initial time: e, final time: f) on model level 20. Contour interval: 0.01. Resolution used for computations was 22km and the optimization time was 12 hours. Experiments were performed on the supercomputer of Météo-France (the new NEC machine "tori").



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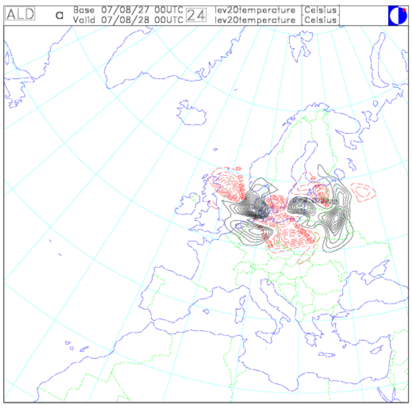

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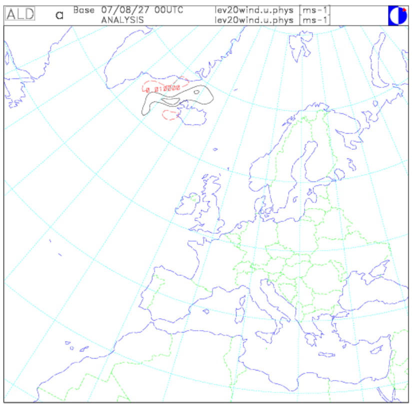

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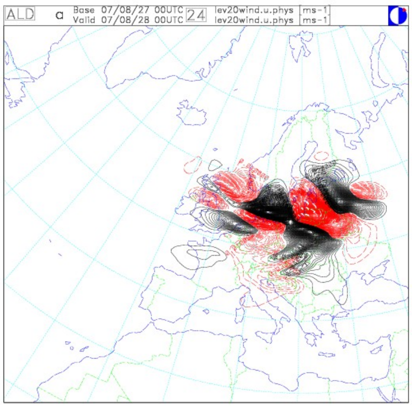

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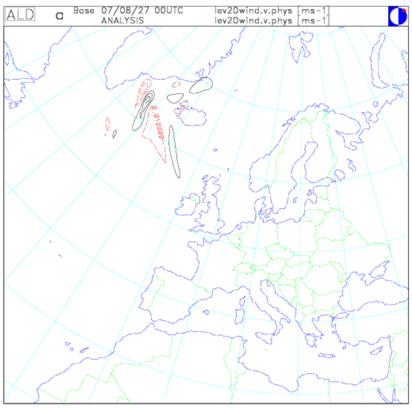

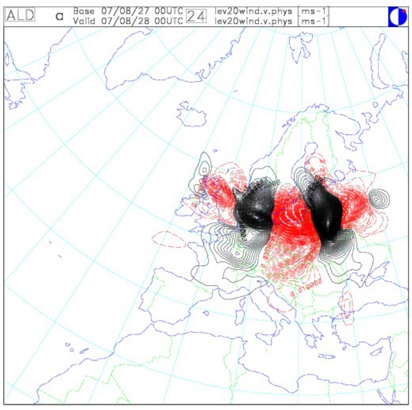

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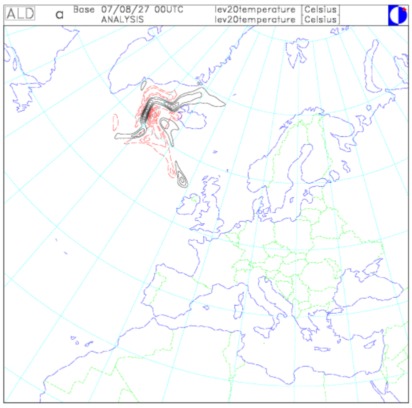
Figure 12: Leading singular vector at initial time for 27 August 2007, 00UTC at initial and final time. The parameters are temperature (initial time: a, final time: b), u component of wind (initial time: c, final time: d) and v component of wind (initial time: e, final time: f) on model level 20. Contour interval: 0.01. Resolution used for computations was 44km and the optimization time was 24 hours. Experiments were performed on the supercomputer of Météo-France (the new NEC machine "tori").



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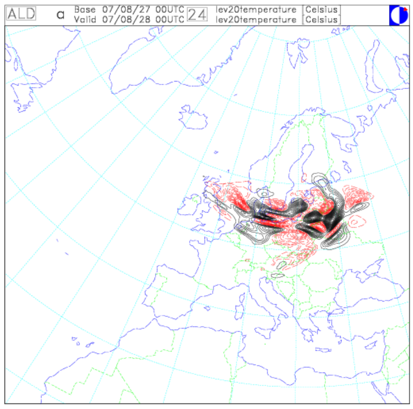

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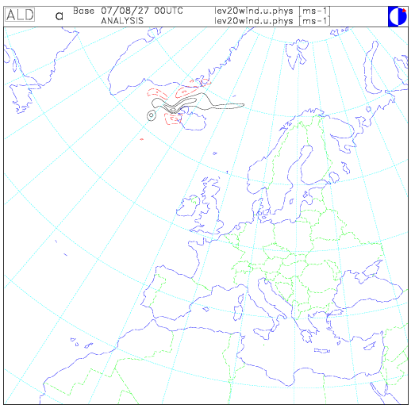

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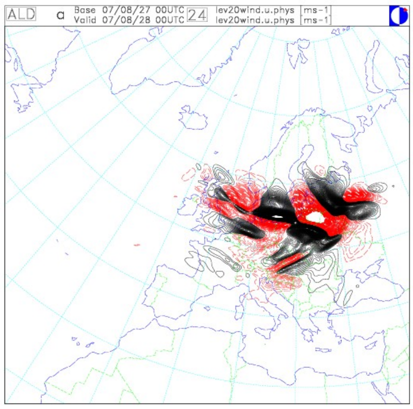

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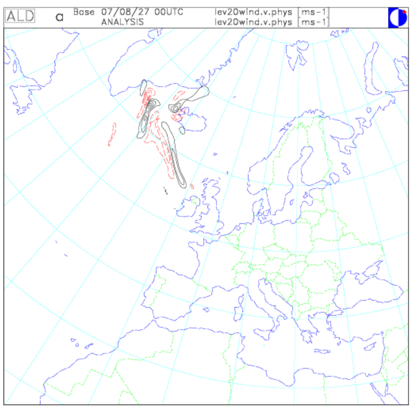

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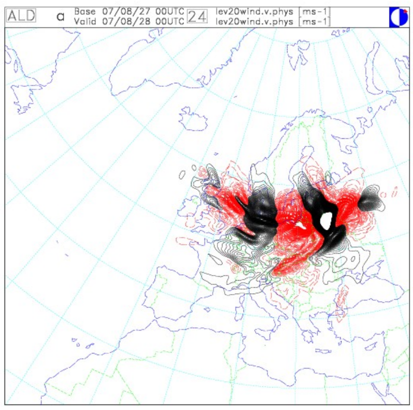

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Figure 13: Leading singular vector at initial time for 27 August 2007, 00UTC at initial and final time. The parameters are temperature (initial time: a, final time: b), u component of wind (initial time: c, final time: d) and v component of wind (initial time: e, final time: f) on model level 20. Contour interval: 0.01. Resolution used for computations was 22km and the optimization time was 24 hours. Experiments were performed on the supercomputer of Météo-France (the new NEC machine "tori").

4.4. On orography in the ALADIN telecommunication coupling files

Martin Janoušek chmi

Summary

A study evaluating various orography choices in ALADIN telecommunication coupling files is presented. It is shown that different choices in either orography envelope type or orography spectral fit function in the telecommunication domain has no significant impact on the successive model integration. It is therefore proposed orography settings in all ALADIN telecommunication domains be unified.

4.4.1. Introduction

Creation of so called *telecommunication coupling files* (TCF) containing ARPEGE analysis and forecast extracted over limited area on a grid of comparable horizontal resolution to ARPEGE is a usual first step of creation of coupling data for ALADIN applications running outside Météo-France. Each ALADIN operational implementation or a group of them (like in the case of RC LACE) use their own geographic set-up of the telecommunication domain covering the integration domain of the target application. Since 2005 TCFs can also differ in the type of orography (envelope or mean) and the type of cost function for the orography fit (Bouteloup or Jerczynski). This extra customization requires maintaining more domain-specific namelists in the climate file creation procedures at Météo-France and extra care in the changes in the climate files because an orography-type misfit of TCF and telecommunication climate file is very difficult to detect[1]. This short study tries to evaluate the influence of various choices in the TCF orography on final ALADIN results aiming at possible reduction of choices whenever not really necessary.

Current ARPEGE/ALADIN operational applications can differ in *the orography type* (mean, envelope or semi-envelope) on the integration domains. Choices were made depending on the local type and setting of the gravity wave drag (GWD) parametrization scheme and, for ALADIN local implementations in particular, depending on local emphases on specific weather phenomena. There is a well advanced effort to replace effects of orography envelope completely by improved and tuned GWD scheme and but its complete implementation to all ALADIN operational applications can be still a long process.

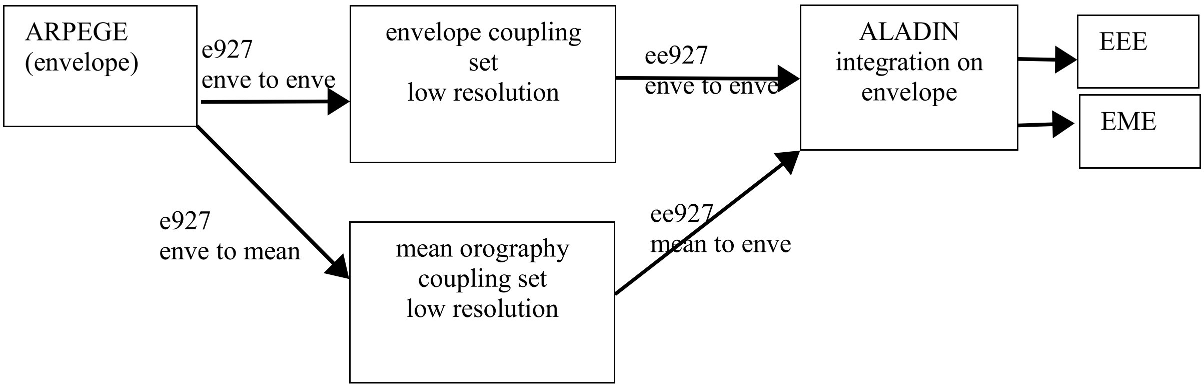
ALADIN operational domains were also produced with different choices of *the orography spectral fit function* aiming at the best orography representation over each integration domain. Generally Jerczynski cost function produces steeper slopes and higher isolated mountains than using the Bouteloup function. There is no ideal solution and the choice will stay domain-specific, at least as far as the integration grid is concerned.

The previous two paragraphs concerned the choices in the integration grid orography. As far as the TCF orography is concerned it should ideally be a sort of compromise between driving ARPEGE and driven ALADIN. But the compromise is not obvious. Hence if we aim at unifying of TCF orography choices let us first evaluate whether they have a significant impact on the ALADIN forecast. For example, assuming ALADIN will (very probably, sooner or later) change to the mean orography on the integration grid one can ask what would happen if we switch to mean orography of TCF already now. And similar question: what will happen if we stick to Bouteloup cost function in the TCF? In general, is there any impact of TCF orography choice on the successive ALADIN forecast?

1 The same climate file used for a TCF creation at Toulouse must be used for subsequent ee927 at the ALADIN site. If due to some organization mistake this is not the case it is very difficult to detect because there is no consistency check for orography type like for domain geometry setup.

4.4.2. Envelope versus mean orography in TCF

- **Experiment set-up**



We start from ARPEGE using the envelope orography. To address the mean/envelope issue two sets of TCFs were created: one set on the envelope orography and the second on the mean orography. Then we transformed (using EE927) both sets to the final ALADIN coupling files choosing the envelope orography. Next, we run two forecasts EEE (envelope-envelope-envelope) and EME (envelope-mean-envelope) and compared them. Obviously, EME suffered from two changes of orography type but if it was acceptably close to EEE one can conclude the choice of orography in TCF be insignificant.

- **Kyril storm, 18. January 2007**

A strong-wind case from January 2007 was chosen trying to find differences between the EEE and EME forecasts of 10 m wind and precipitation. The differences are however very small. The maximum difference in the 24-h precipitation amounts reaches 5 mm in the areas with absolute values over 100 mm/24h. Differences in 10 m wind are even more subtle: the biggest difference found in the Eastern Switzerland is less then 3 m/s but it is in a place with rather weak variable winds (fig. 1). No significant differences can be found in areas of strong winds.

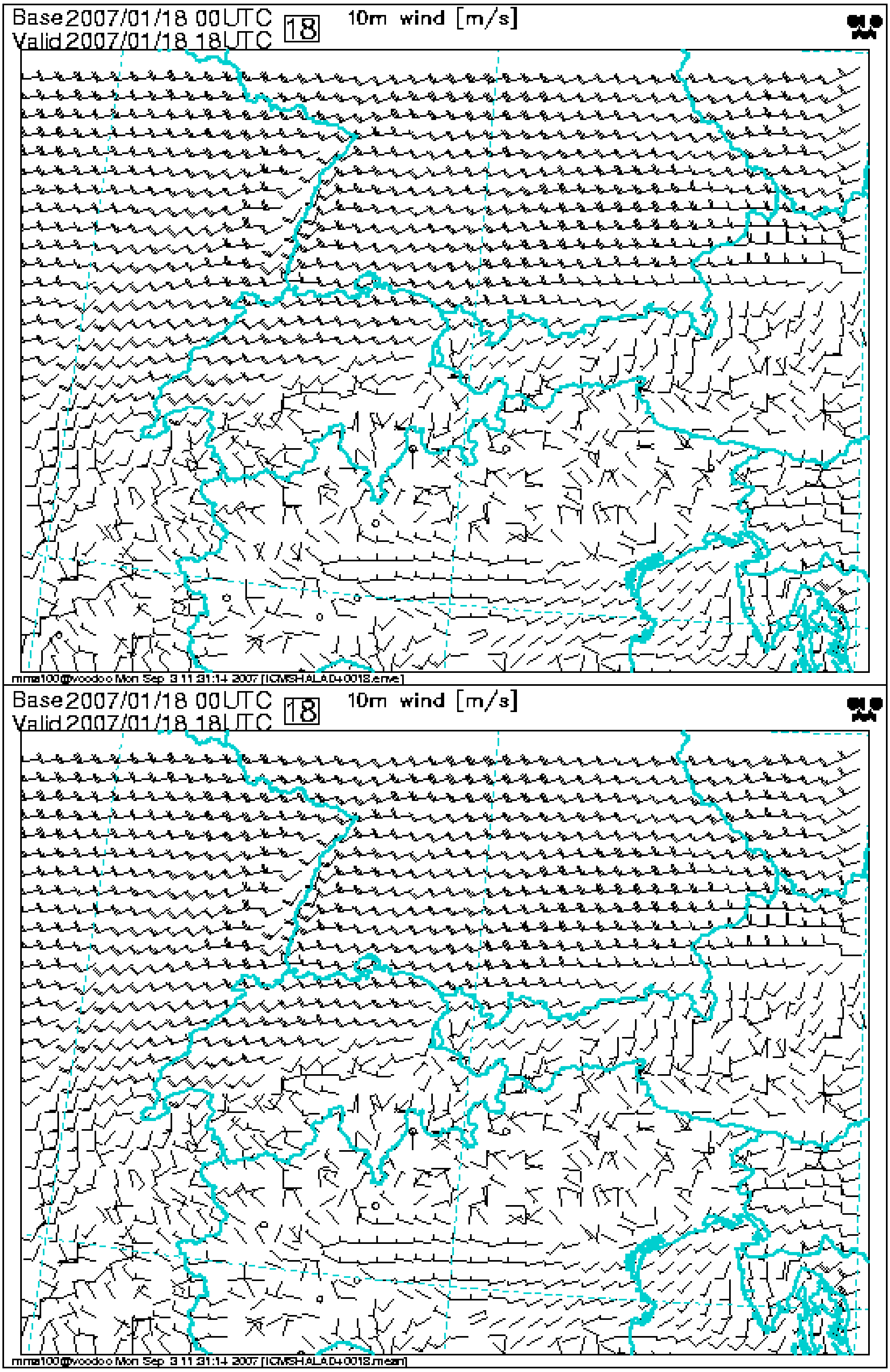


FIG.1 Comparison of differences of the Kyril case integration for different choices of orography envelope in TCFs.

❑ **Long run series**

Eleven 48h forecasts were run in the period 10 – 20 January 2007 and basic skill scores of standard quantities against observations were calculated (fig. 2). The differences between skill scores of EEE and EME are negligible. The only visible difference can be found in the mean-sea-level pressure where the bias of EME (red line) is slightly higher than EEE, it is however judged as acceptably small difference.

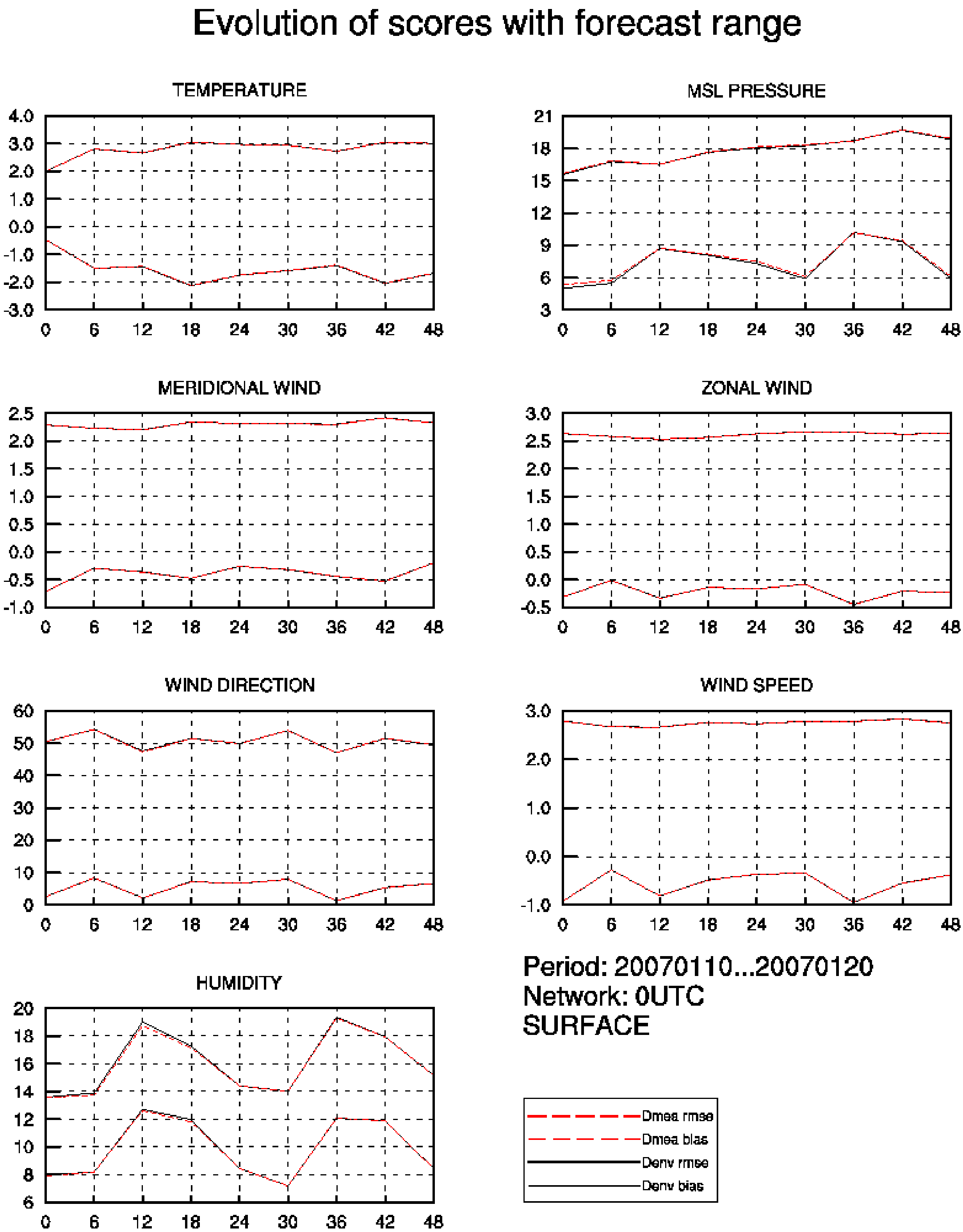


FIG. 2. Averaged skill scores of 10 model integrations driven by TCFs with mean and envelope orographies.

☑ **Experiments summary**

The study of extremely windy case has shown no individual forecast sensitivity to the orography type in TCFs. A longer series of forecasts has shown that except for a very small increase of MSL pressure bias there would be no deterioration of the skill scores caused by mean orography in TCFs even for ALADIN models running on envelope orography.

4.4.3. Cost function choice in TCF

Different choices of the orography fit cost function have the most visible impact in the areas of steep slopes or isolated mountains (mountainous islands like Corsica). Jerczynski cost function produces steeper slopes and higher isolated mountains than using the Bouteloup function. For example, on mean orography, Corsica highest point changes from 1000 m to 1500 m whilst the top peaks of Alps keep the same when creating the LACE TCF (20 km resolution) first with Bouteloup and then with Jerczynski cost functions. The orography differences are very spotty but in average (e.g. over the whole Europe) their magnitude is one order less the differences between mean and envelope (fig.3).

In order to assess an impact of the cost function choice the Kyril case was rerun but this time from LACE TCF created using Jerczynski cost function. Comparing with reference shows no significant differences in the 24h forecast fields of precipitation and wind, even smaller than differences between mean/envelope Kiril runs (EME vs. EEE). Comparing both forecasts against observations (albeit computed from just one integration run) show no signal in the scores differences (fig.4).

Therefore one can conclude from this limited experiment the choice of the cost function in TCF has no significant impact on the resulting ALADIN forecast.

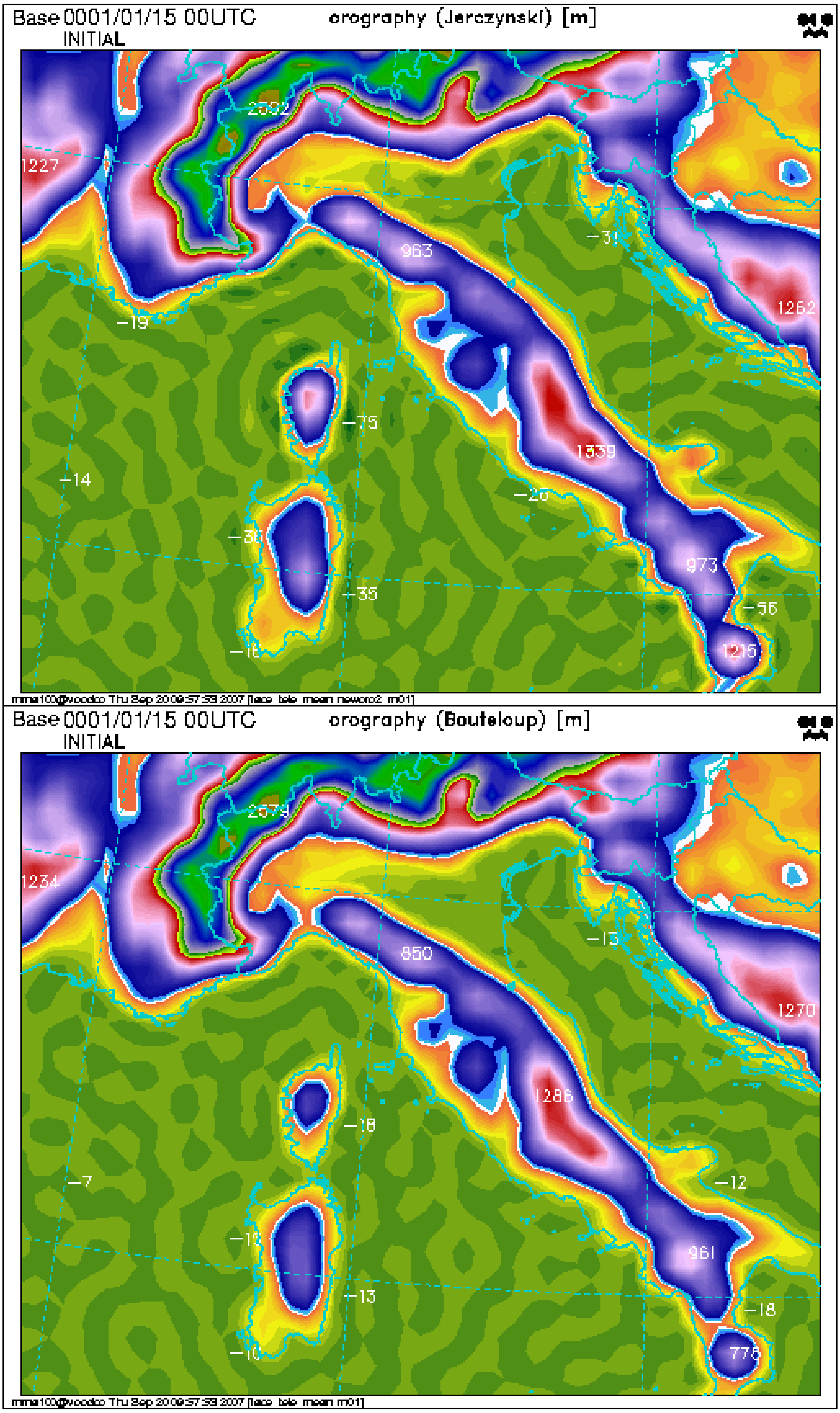


FIG. 3 Orography of LACE TCF created with Jerczynski (top) and Bouteloup (bottom) cost functions.

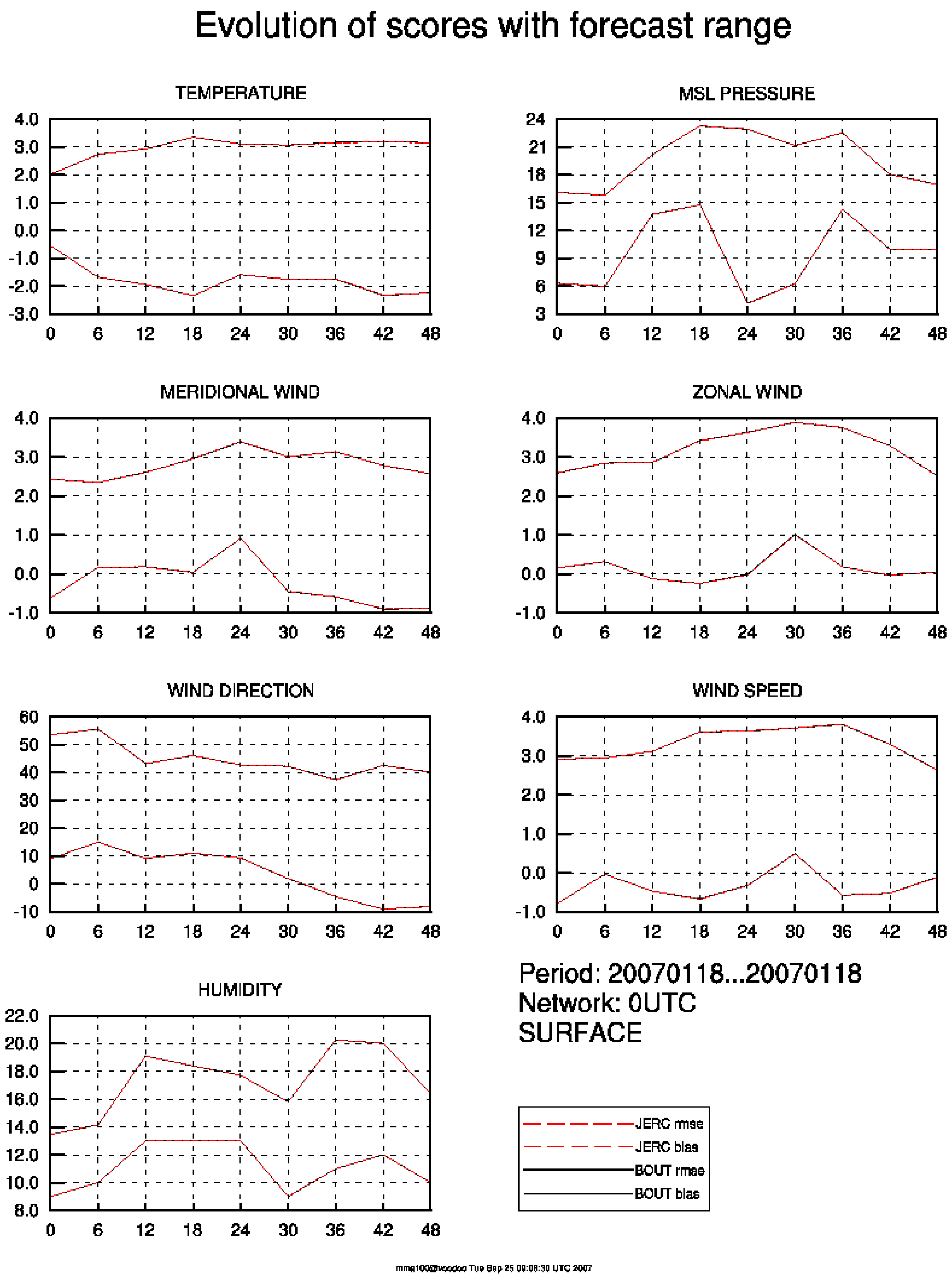


FIG. 4 Skill scores evolution for model integration driven by TCF with different cost functions.

4.4.4. Conclusion and recommendations

Since the result of this study demonstrates small or none influence of orography type in the TCF in the light of the march to the mean orography in ALADIN integration it is proposed to unify all TCFs‘ orography switching from the envelope to the mean.

Further, the test of the orography cost function choice in TCF exhibited even lesser impact on the resulting ALADIN forecast. It is therefore proposed to follow the choice of ALADIN/France and to keep using the Bouteloup's cost function in TCF.

The unification of orography setup in TCFs aims at the isolation of individual orography choices in ALADIN applications from the coupling files generation at Météo-France. ALADIN sites will be free to decide to change orography settings in their integration grid without any need of coordination with Météo-France. Météo-France will have less TCF-specific 923 namelist keys to maintain and the only remaining set of parameters specific to every TCF will be the domain size and geometry (inconsistencies in domain/geometry are easily detected by ee927 consistency checks).

Appendix: Implementation proposal

The orography in a TCF is defined by the orography from the climate file used in the TCF creation. Hence to unify all TCFs to the new *default* orography (default meaning the mean orography with Bouteloup's cost function) the corresponding climate files must be changed. It is therefore proposed that **any change of TCFs parameters (resolution, domain size etc.) will also include the change of orography to the *default* type in the corresponding climate file**. After the new climate files (which serve as the output climate files in e927 at Météo-France and as the input climate files in ee927 at ALADIN sites) are installed at operational suites of Météo-France and corresponding ALADIN site(s) the new TCFs will automatically switch to the *default* orography.

What the proposed rule (if agreed) will mean for each ALADIN site practically? Only to install new climate files synchronously with Toulouse. No change in local namelists or scripts.

I stress again the proposed rule concerns TCFs only. The type of orography of *integration* domains will be of course completely in hands of every ALADIN site. The following table overview the current 923 settings and the proposed change for every coupling domain:

domain	current 923 settings		future 923 settings	
	enve/mean	cost function	enve/mean	cost function
Poland	*mean*	*Jerczynski*	*mean*	**Bouteloup**
Portugal	*envelope*	*Jerczynski*	**mean**	**Bouteloup**
Belgium	*envelope*	*Bouteloup*	**mean**	*Bouteloup*
LACE	*envelope*	*Bouteloup*	**mean**	*Bouteloup*
SELAM	*mean*	*Jerczynski*	*mean*	**Bouteloup**
Tunisia	*envelope*	*Bouteloup*	**mean**	*Bouteloup*
Morocco	*envelope*	*Bouteloup*	**mean**	*Bouteloup*
MFSTEP (CHMI)	*envelope*	*Bouteloup*	**mean**	*Bouteloup*
Afghanistan (CHMI)	*envelope*	*Jerczynski*	**mean**	**Bouteloup**

NAMCLA settings

mean orography:	envelope orography:
FENVN=0.	FENVN=1.
Bouteloup cost fnct:	Jerczynski cost fnct:
LNEWORO=.T.	LNEWORO=.F.
LNEWORO2=.F.	LNEWORO2=.T.
QMAX=4.	QMAX=2500.
QMIN=2.	QMIN=1.

All climate files with the proposed default orography type were generated by the author of this study and are available via:

ftp from cougar.meteo.fr directory /cnrm2_a/mrpe/mrpe686/clim/env_mean/domains/

4.5. Dust emission simulation by SURFEX coupled to ALADIN model

m.mokhtari@meteo.dz; o.akkou@meteo.dz

Summary

This work which was realized at Meteo-France consisted on coupling SURFEX to ALADIN/ Algérie model. It represents a continuation of the dust simulations on offline mode. Here we deal with the dust simulation by SURFEX on inline mode, coupled to ALADIN model.

4.5.1. Introduction

The main aim of the SURFEX project is to separate the surface variables from the atmospheric ones. Doing so allows utilizing only one surface scheme for several numerical weather prediction models. The SURFEX conception permit also to simulate a number of phenomena related to the earth-atmosphere interaction. The dust mobilization (uprising), object of this study, represent one of these phenomena, its forecasting is very complicated and is not yet mastered. This work represents a continuation of that published in the newsletter N°32. After simulating the dust uprising by the off line mode of SURFEX (i.e.: forcing SURFEX by the atmospheric fields of ALADIN without taking into account the influence of the surface variables on the atmospheric fields), we propose, here, to simulate two situations characterized by a dust uprising in the south west of the Algerian Sahara, with SURFEX on online mode. To achieve that, we coupled SURFEX to ALADIN model and we activated the dust emission in SURFEX.

4.5.2. Coupling of SURFEX to the ALADIN model

The coupling of the external surface SURFEX to ALADIN model is achieved according to the three following steps: **PGD, PREP** and the **forecasting**, which consists on:

- **PGD**

This first step is considered as the pre-processing one, it serves to build the climatological files which are used to run ALADIN coupled with SURFEX. The difference with the e923 configuration is that, in this case of PGD, one file is constructed for all the twelve months of the year. The achievement of this step needs the use of: FAO data related to the spatial distribution of the clay and sand parameters, GTOPO data (topographic) with 30 seconds of horizontal resolution and ECOCLIMAP data.

- **PREP**

This step consists on the initialisation of the prognostic variables related to the surface state. It has the same utilities as the e927 configuration, but it is executed only for the network 00h00, to generate the adequate analysis.

- **The forecasting**

After the generation of the climatological file, the topographic file, the initialisation of the surface state by the PREP step and the production of the coupling files by the e927 configuration, the forecasting is launched with the e001 configuration, to forecast the atmospheric parameters including dust fluxes in the domain of interest.

4.5.3. Activation of the dust emission process in ALADIN

The passive scalars are activated in SURFEX according to the statements defined in the atmospheric model. As this step is initially coded for its integration to AROME project, we adapted the same routines to initiate the scalar variables for ALADIN project.

- **Scalar variables activation in the atmospheric model**

To initiate the passive scalars in ALADIN, task which is not done until now, we used the **aroini_nsv0.mnh** routine**.** In the frame of ALADIN project, this routine is called by a new key (LDSTALD), which is different from the one of AROME and declared in the routine **sudim1.f90**.

- **Activation of the emission processes in SURFEX**

The emission processes are activated in SURFEX by filling the character string **CSV** associated to the passive scalars via the **aroini_nsv.mnh** routine. This last routine is called by the **suphmse.f90** routine**.**

The input arguments of the **aroini_nsv.mnh** routine are already defined in the previous step (**aroini_nsv0.mnh**). The output of the aroini_nsv.mnh routine is the **CSV** vector of the passive scalars which is archived in the module **modd_nsv.mnh.**

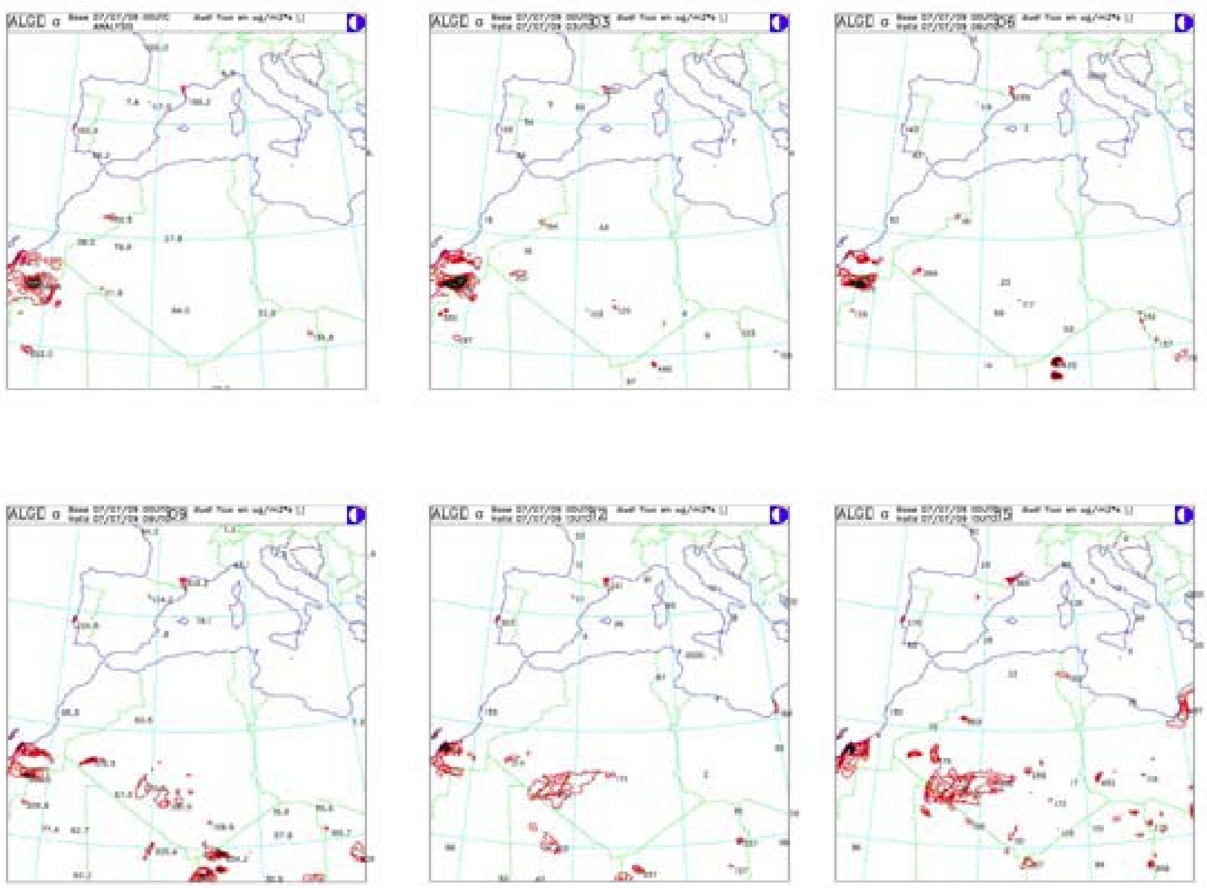
The dimensioning of the scalar variables in SURFEX is done by the routine **init_surf_atm_n.mnh**, which is called by the routine **aroini_surf.mnh.**

4.5.4. Results of the simulations and some comments

To test the behaviour of SURFEX coupled to ALADIN in the simulation of the dust surface fluxes, we simulated two situations (July 9th and 14th for 48 hours forecast). The results of the simulations were compared to the RGB composite dust product of EUMETSAT satellite images.

The results shown below were obtained from the run of SURFEX on inline mode and plotted with Chagal.

The July 09th 2007 situation



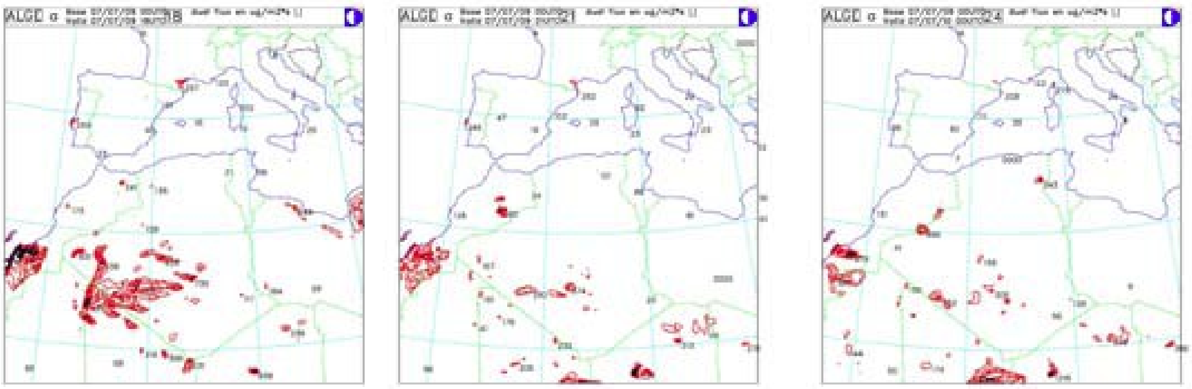


Fig.1. Dust surface fluxes simulated by SURFEX coupled to ALADIN for July 9th

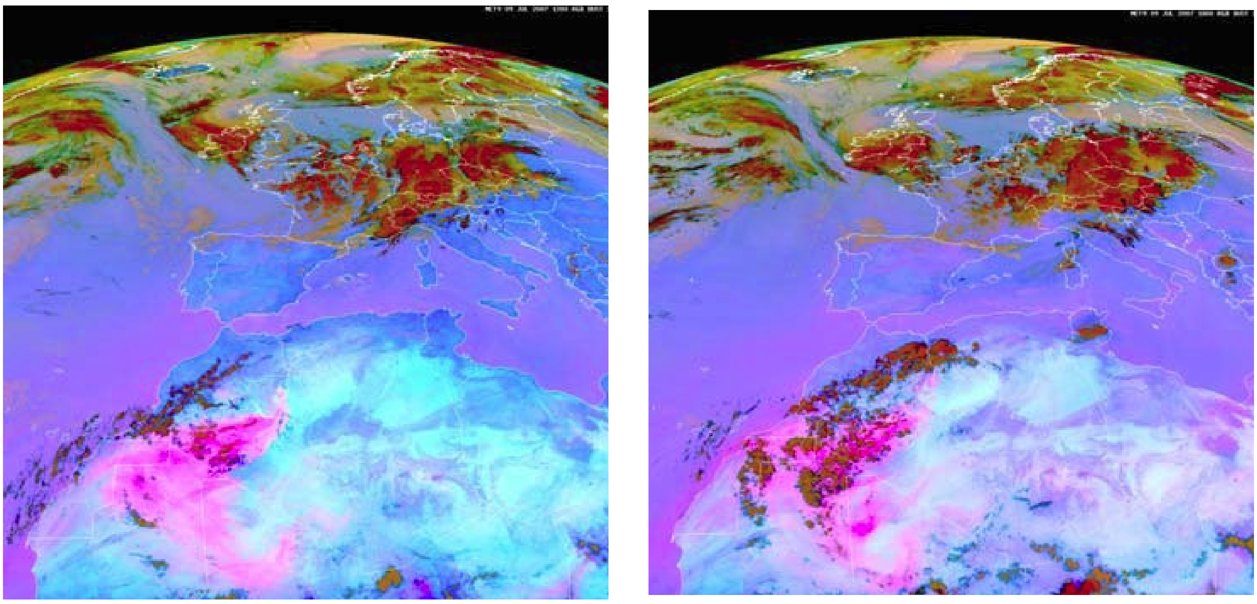


Fig.2. The RGB composite dust product of EUMETSAT for July 9that 12H00 and 18H00 (dust is represented by the magenta colour)

The July 10th 2007 situation

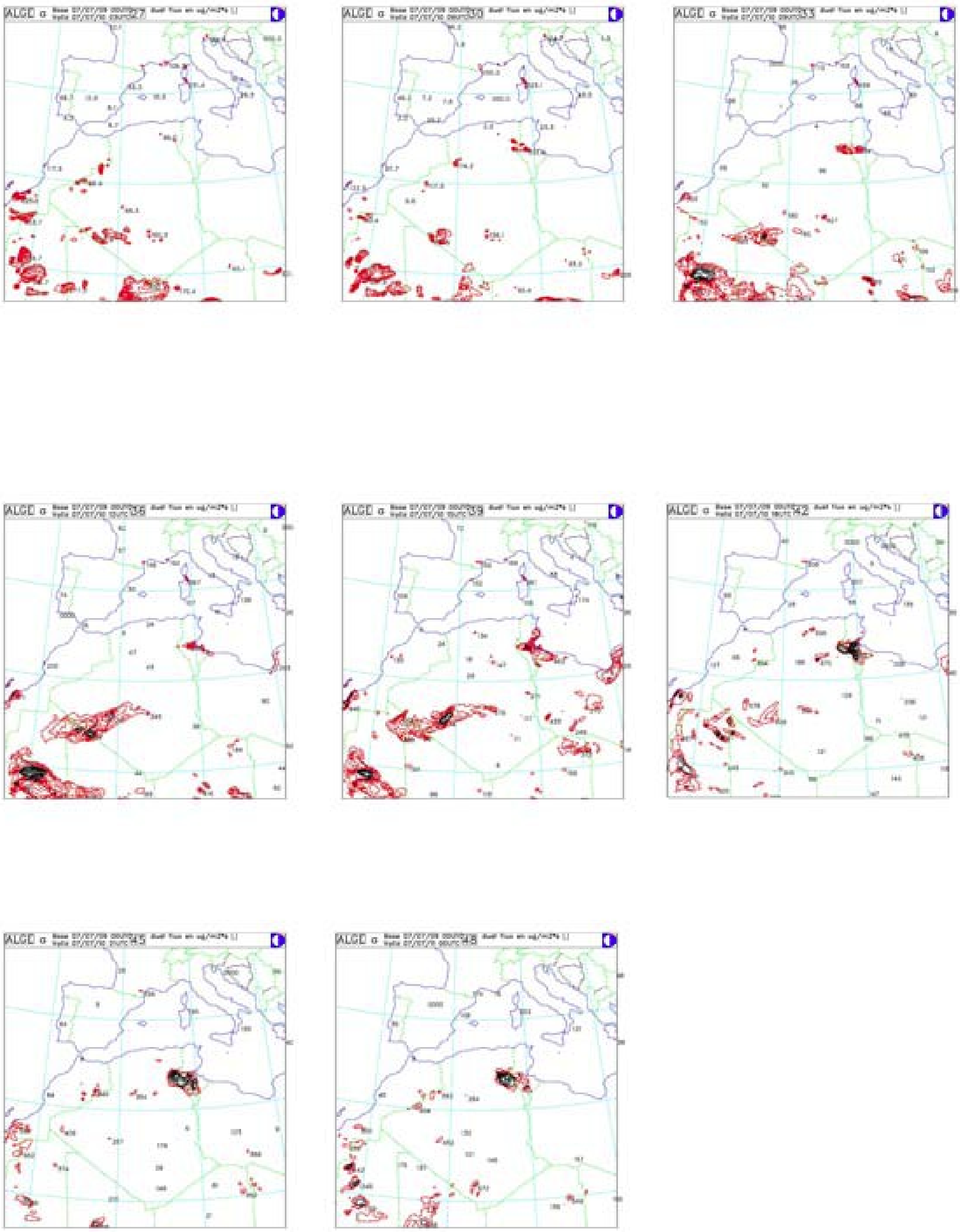


Fig.3 Dust surface fluxes simulated by SURFEX coupled to ALADIN for July 10th

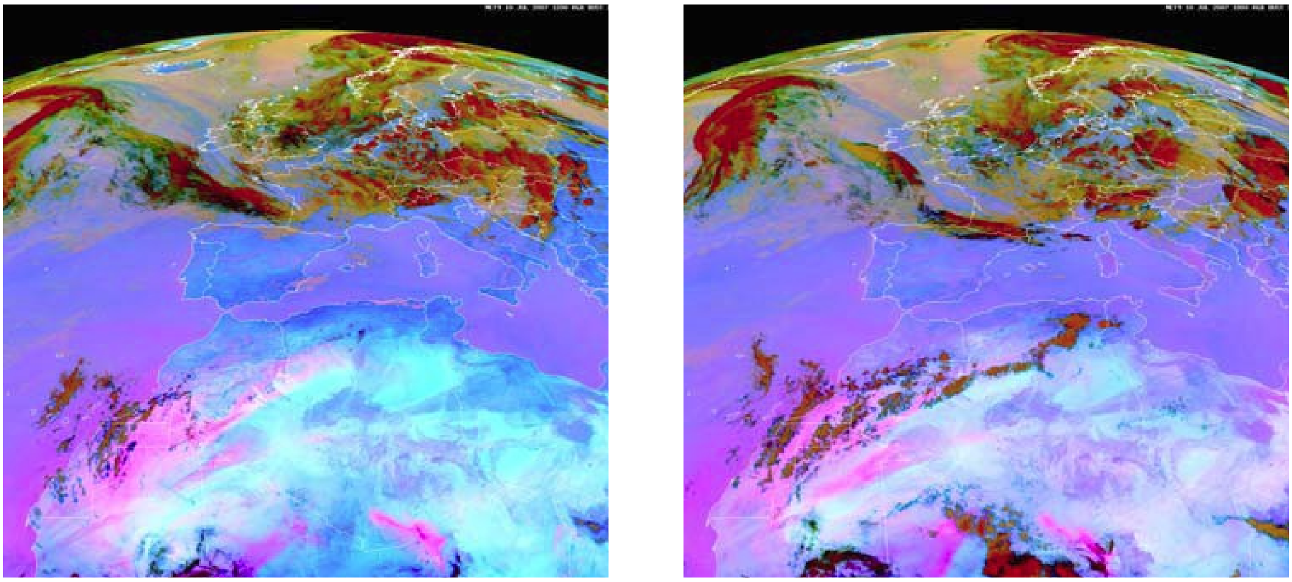
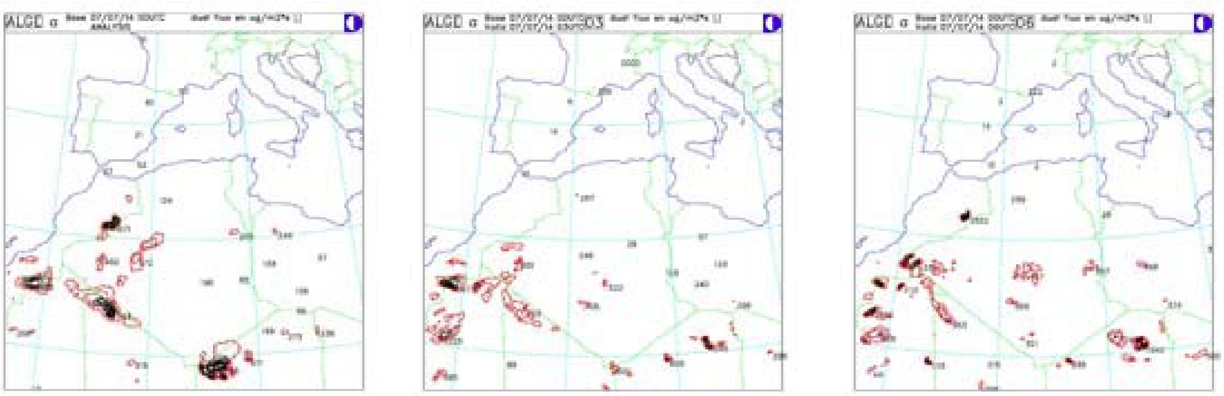


Fig.4 The RGB composite dust product of EUMETSAT for July 10th at 12H00 and 18H00 (dust is represented by the magenta colour)

The analysis of the dust surface fluxes maps forecasted by SURFEX coupled to ALADIN model, shows that the dust uprising is well located over south Morocco between 00H00 and 06H00 UTC for the July 9th meteorological situation. After 06H00 UTC, dust cores started to take place over the central part of the Algerian Sahara. These cores extend eastward and westward at midday, to cover a wide region. This is due to the strengthening of the thermal contrast between the soil and the surface boundary layer. The comparison of these maps with the satellite images shows a concordance between the localization of the upraised dust shown by the satellite images and the one forecasted by SURFEX.

For July 10th, SURFEX maintained and increased the dust uprising fluxes. We noticed also, the appearance of another strong core located over the southern part of Tunisia, but which is not present on the EUMETSAT images. The other remark which can be pointed out for this simulation is the occurrence of dust uprising cores in regions which are not potentially dust sources. This is due to the extending of the rock and bare soil to these regions, despite its low fraction. It's necessary to carry attention to this case, to avoid wrong interpretations.

The July 14th 2007 situation



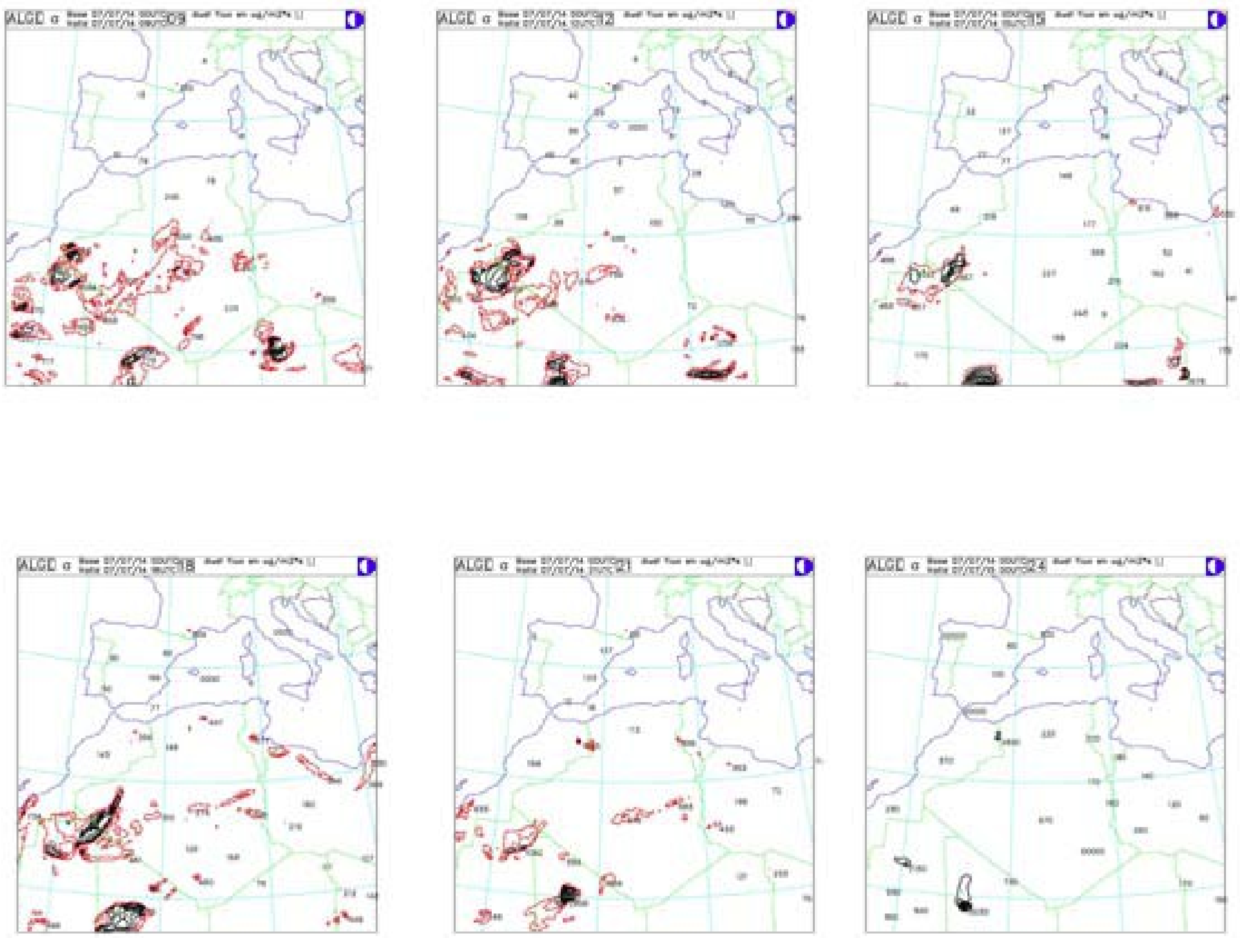


Fig.5 Predicted dust surface fluxes by SURFEX coupled to ALADIN for July 14th

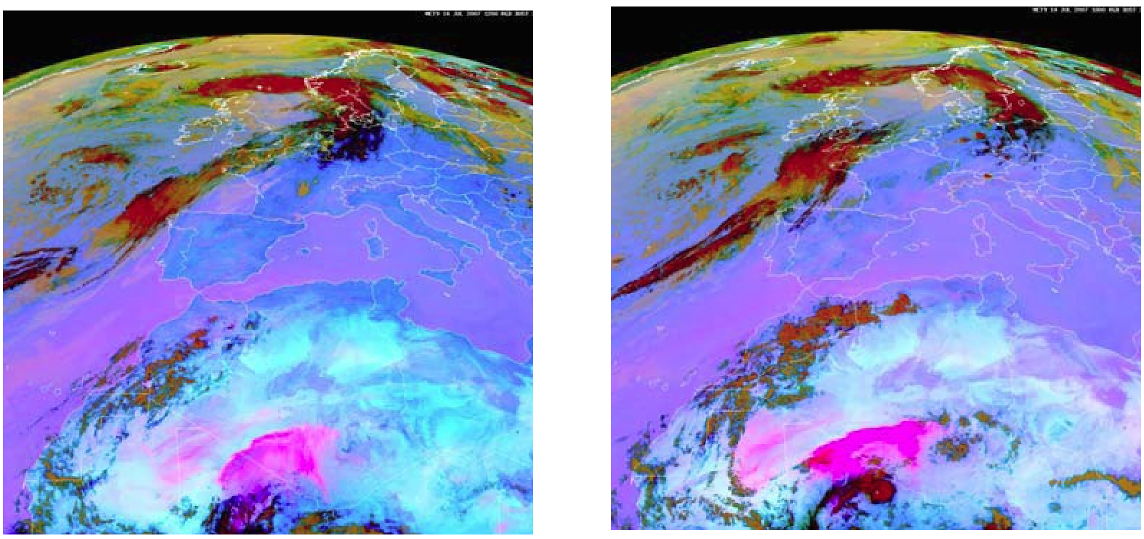


Fig.6 The RGB composite dust product of EUMETSAT for July 14th at 12H00 and 18H00 UTC (dustisrepresentedbythemagentacolour)

The July 15th 2007 situation

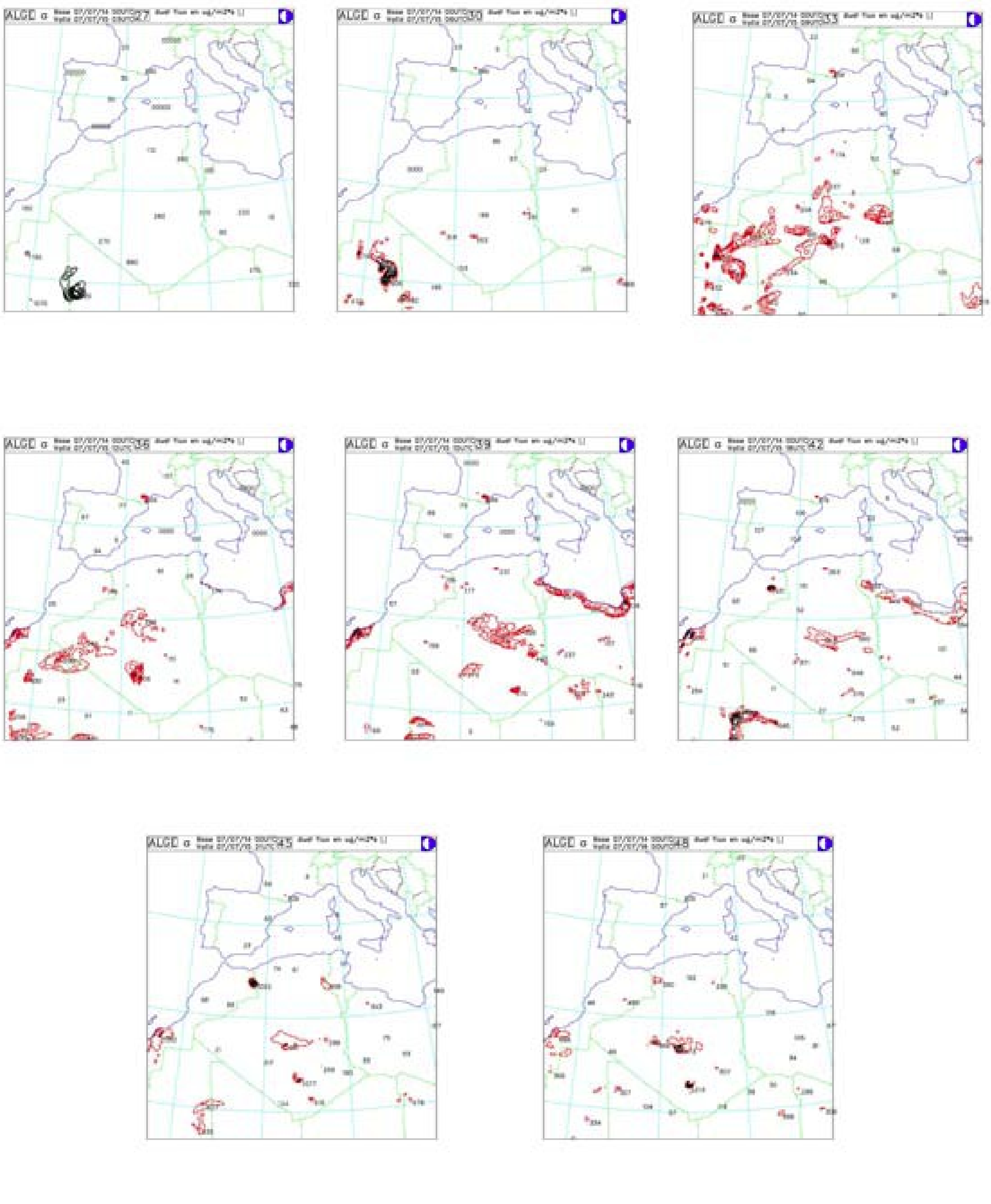


Fig.7 Predicted dust surface fluxes by SURFEX coupled to ALADIN model for July 10th

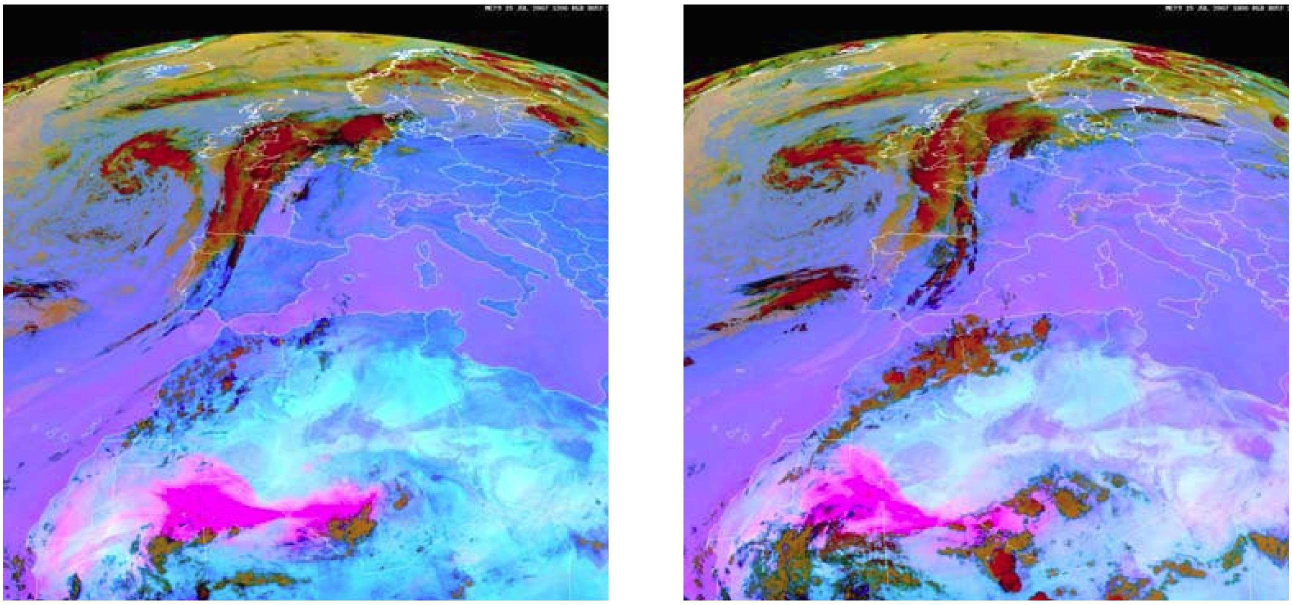


Fig.8 The RGB composite dust product of EUMETSAT for July 15th at 12H00 and 18H00 UTC (dust is represented by the magenta colour)

The figures 5 and 7 shows the surface dust fluxes simulated by SURFEX for the July 14th and 15th which are characterized by a strong dust uprising over the southern part of the Algerian Sahara and north Mali, as it is shown by the RGB composite dust products of EUMETSAT (figures 6 and 8). The dust mobilization seems to be well predicted by SURFEX and agree with the satellite images on the localisation of that uprising in the south; however we underline the appearance of undesirable cores in the north particularly over the Libyan seaside regions.

4.5.5. Conclusion

Throughout this note, we tried to evaluate the skills of SURFEX, coupled to ALADIN, on forecasting surface dust fluxes, over the Algerian Sahara. First we made the coupling of the externalized surface SURFEX to ALADIN/Algérie model by adapting the routines of AROME coupling project to ALADIN. Then, we gave emphasize on the adjustment realized on some routines in order to adapt them to the SURFEX/ALADIN coupling project. Once the coupling is realized successfully, we made two simulations in order to test the behaviour of SURFEX in forecasting dust mobilization.

The main conclusions which can be taken out from the analysis of the two simulated situations are as follow: the most important dust events are generally well predicted by SURFEX mainly in the extreme south where the dust sources are conform to the reality; however SURFEX predict other undesirable cores in the north particularly over the seaside regions.

Finally, it's good to make relevant that the use of the RGB composite dust products of EUMETSAT on the continent, has to be done with attention, because of the weak contrast between the temperature of the suspended aerosols and the soil. Besides, the aerosols at the stage of rising are rarely pictured above the continent. Measurements of dust concentration are necessary to validate the forecasts of SURFEX coupled with ALADIN model.

Références:

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Anne-Laure Gibelin, Janvier 2003: Externalisation du schéma de surface ISBA du modèle de circulation générale ARPEGE-CLIMAT. CNRM/GMGEC/UDC.

Rashyd Zaaboul, Avril 2006: Branchement de la physique de la surface externalisée sous APL_AROME et des diagnostics sous STEPO, CNRM/SPN.

4.6. VERIFICATION OF ALADIN/Algérie MODEL: Period: September to December 2006

i.djemai@meteo.dz;b.hamadache@meteo.dz;k.bouchouicha@meteo.dz;h.benrekta@meteo.dz

Abstract

The present work consist on the verification of some ALADIN/Algérie model outputs as geopotential and temperature at 500 and 850 hPa, temperature at 2 meters, mean sea level pressure and accumulated rainfall.

Some of these parameters are controlled in relation to the model analysis and others in relation to the observations. The used methods are the ones witch are recommended by the World Meteorological Organisation.

4.6.1. Introduction

Verification is a key component for the weather forecast. It allows determining the nature of the error forecast, in order to refine the forecast at short and medium range. The verification of the numerical weather prediction (NWP) model outputs, allows detecting these systematic errors which point out the weak sides of the models. The methods which are used depend on the nature of the parameter which we want to control. The Contingency table, the mean error and root mean square error etc., are the most used tools, in the verification of the numerical weather prediction outputs.

Regarding to our work, in a first approach, the control was made on grid point fields, with regard to the analysis of the model, while in the second; the control was made with regard to the observations. Concerning the last one, the selection of the stations in the synoptic network of the Algerian Met service, was made so as to have an optimal spatial cover of the country. The period retained within the framework of this work extends from September, till December, 2006.

4.6.2. Verification conducted in relation to the ALADIN/Algérie model analysis

The methods which are used to control the ALADIN/Algérie model outputs are: calculating the BIAS, the RMSE, the AC and the MAE.

The control is performed by comparing the predicted parameters by the model with those of the analysis.

The results are represented in the form of maps, representing monthly averages at the following validities: 24 and 48 hours, using the network of 00h00utc. The controlled parameters are:

- The temperature at 500 and 850 hPa;
- The geopotential at 500 and 850 hPa;
- MSLP

❑ Presentation of the results

☑ 24 Hours verification statistics

		Sept.2006	Oct.2006	Nov. 2006	Déc.2006
MSLP	**RMSE**	1.06	0.94	0.96	0.98
	AC	0.9611	0.9788	0.9861	0.9835
Temperature at 500 hPa	**RMSE**	0.77	0.63	0.6	0.71
	AC	0.9579	0.9434	0.9596	0.9591
Temperature at 850 hPa	**RMSE**	0.66	0.62	0.6	0.65
	AC	0.8385	0.9045	0.9220	0.9360
Geopotential at 500 hPa	**RMSE**	8.95	9.01	7.31	9.15
	AC	0.9990	0.9876	0.9936	0.9833
Geopotential at 850 hPa	**RMSE**	5.53	5.60	4.55	5.03
	AC	0.9958	0.9900	0.9915	0.9917

☑ 48 Hours verification statistics

		Sept.2006	Oct.2006	Nov.2006	Déc.2006
MSLP	**RMSE**	1.29	1.18	1.20	1.22
	AC	0.9312	0.9641	0.9709	0.9643
Temperature at 500 hPa	**RMSE**	1.05	0.93	0.93	1.1
	AC	0.9005	0.9735	0.9820	0.9899
Temperature at 850 hPa	**RMSE**	0.9	0.87	0.85	0.93
	AC	0.7860	0.8415	0.8649	0.8487
Geopotential at 500 hPa	**RMSE**	15.52	15.08	12.68	15.52
	AC	0.9956	0.9658	0.9812	0.9876
Geopotential at 850 hPa	**RMSE**	8.88	8.81	6.86	8.39
	AC	0.9904	0.9735	0.982	0.9899

Fig. 1: BIAS and RMSE for the geopotential at 500hPa**.**

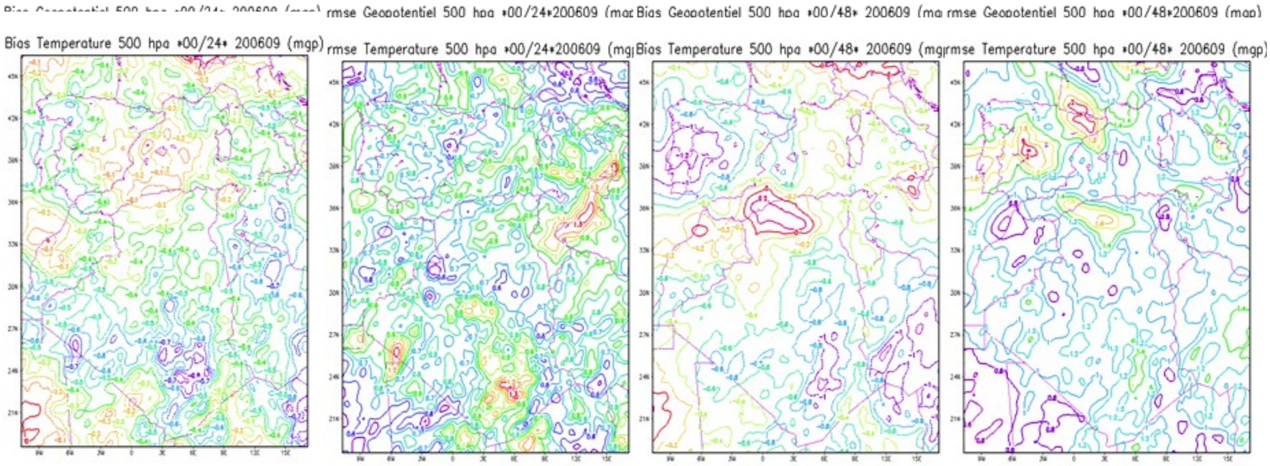


Fig. 2: BIAS and RMSE for the temperature at 500hPa

- **Discussion**

According to the results obtained in the calculation of the BIAS, we noticed that the model has instead tended to underestimate the major part of the controlled parameters. The analysis of these results for the temperature highlights that on average, the model presents relatively weak error throughout the country and relatively important error on Hoggar/Tassili, what lets suppose that the topography on this region is not well considered by the model, especially for the level 850 hPa, which is in the neighbourhood of 1500 meters, while Hoggar/Tassili presents peaks approaching 3000 meters. As regards to the geopotential, we noticed that the calculation of the RMSE confirms that the model behaves indeed on the North of the country and less and less indeed as we go southward, because of the increase of the amplitude of the error. This can be attributed to the availability of the observations on the North, which allows to realize a good analysis and thus a good forecast, while because of the not availability of the observations in number being enough for the South, some points of the guess-field are taken like it is in the analysis, what echoes on the quality of the forecast which depends strictly on the quality of the analysis. As for the mean sea level pressure, the results indicates that the model gives practically the same results, for all forecast ranges, for the networks of 00h00 and 12h00tu, and that it behaves less well on the mountainous regions than on the coastal regions, what means that the dynamic adaptation does not still allow to restore well the relief.

4.6.3. Verification conducted in relation to the observation

In this part, the control of the surface parameters (Mean Sea Level Pressure, temperature at 2 meters and accumulated rain) was made by comparison of the observation to the closest grid point to the station. The following results are the ones for the period extending from September to December 2006.

The selected stations are the following ones:

Table 1: Characteristics of the used stations

Station	Latitude	Longitude	Altitude of the station (AS) (m)	Altitude of the closest grid point (AP) (m)	Difference AP - AS
Dar el Beida	36.68° N	3.22° E	24	47	+23
Bejaia	36.72° N	5.07° E	169	414	+245
Miliana	36.30° N	2.23 °E	715	261	-454
Tlemcen	35.02° N	1.47 °W	805	1152	+347
Illizi	26.50° N	8.43 °E	558	608	+50

The controlled parameters are: the temperature at 2m, the mean sea level pressure (MSLP) and the accumulated rain, for the validity of 24 hours. The scores used within the framework of this work to control the parameters: temperature at 2 m and MSLP, are the RMSE, MAE and the BIAS, while for the control of the accumulated rain, they are the contingency tables uni and multi-categorical with different scores, which were used.

- **Presentation of the results for the accumulated rainfall**

Table 2: Station of DAR EL BEIDA

	Sept.	Oct.	Nov.	Dec.
TS	0.78	0.70	0.83	0.65
FAR	0.27	0.36	0.11	0.43
BIAS	0.78	0.76	0.96	0.74
PC (%)	73.33	70	80	60

Table 3: Station of BEJAIA –AEROPORT

	Sept.	Oct.	Nov.	Dec.
TS	0.71	0.69	0.80	0.48
FAR	0.33	0.45	0.20	0.78
BIAS	0.78	0.68	0.86	0.61
PC (%)	70	70	80	43.33

Table 4: Station of MILIANA

	Sept.	Oct.	Nov.	Dec.
TS	0.83	0.76	0.83	0.43
FAR	0.20	0.30	0.15	0.91
BIAS	0.83	0.76	0.89	0.57
PC (%)	83.33	76.66	83.33	36.66

Table 5: Station of TLEMCEN –ZENATA

	Sept.	Oct.	Nov.	Dec.
TS	0.63	0.90	0.82	0.68
FAR	0.57	0.03	0.11	0.31
BIAS	0.63	1.03	0.96	0.81
PC (%)	63.33	90	80	66.66

Table 6: Station of ILLIZI

	Sept.	Oct.	Nov.	Dec.
TS	0.66	0.93	1	1
FAR	0.5	0.03	0	0
BIAS	0.66	0.93	1	1
PC (%)	66.66	93.33	100	100

According to the results of the various obtained scores, we noticed that: for Dar El Beida's station, the proportion corrects (PC) for the following months: September, October and November varies between 70 and 80 %, while for December this percentage falls in 60 %. This is probably due to the fact that statistically it's more raining in December than during the previous months.

We find moreover this tendency for the majority of the other stations of the North, where the percentage of proportion correct (PC) varies on average from 60 to 85 % and it falls in approximately 45 % on December. In other words, the analysis of the monthly results of the control reveals that on average two forecasts of precipitation on three are correct during September to November, while for December, it is only one on two.

For the stations of the Southern part of Algeria, it's the opposite which occurs; it is the scores of November and December that are the most increase. This is due to the fact that, it's not the rainy season on these regions.

Because of the discontinuity of the parameter precipitation, the monthly control does not still supply the appropriate information, allowing to be fixed to the quality of the model, as regards to the forecast of this parameter. That is why, to have a better idea on the behaviour of the model concerning this parameter, a second control was made, this time, on the duration of 4 months, for the stations of Dar El Beida and Bejaia. The contingency tables, as well as the various results of the calculated scores are recorded as follow:

Table 7: Station of DAR EL BEIDA

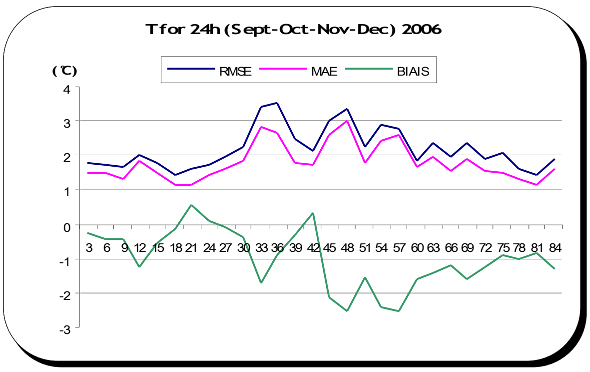
	oui	non	total
oui	13	1	14
non	19	84	103
total	32	85	117
TS=	0.3939394		
FAR=	0.07142858		
HD=	1.011		
PC=	82.9059		

Table 8: Station of BEJAIA

	oui	non	total
oui	10	2	12
non	25	83	108
total	35	85	120
TS=	0.2702703		
FAR=	0.1666667		
HD=	1.011		
PC=	77.5		

Compared with the results of the monthly analysis, these quarterly indications show a net improvement of the scores when we spread the period over four months. At the station of Dar El Beida, the percentage of proportion correct passes in 83 % with a percentage of false alarms which borders zero % and a threat score of nearly 40 %. The analysis of the scores related to the stations of Dar El Beida and Bejaia, shows that on the coastal regions, the percentage of proportion correct is around 80 %. In other words, it means that three forecasts out of four are correct at the 24 hours range.

- ❑ **Presentation of the results for the temperature at 2 meters**
  - ☑ **DAR EL BEIDA**



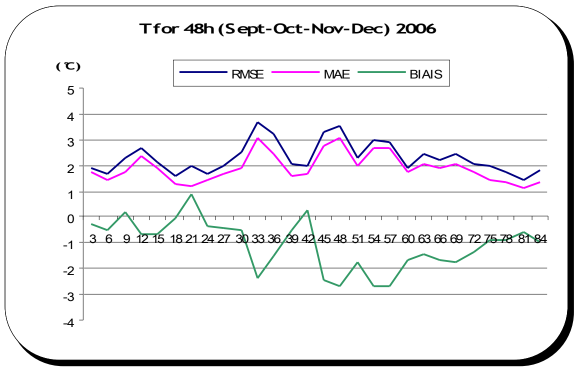
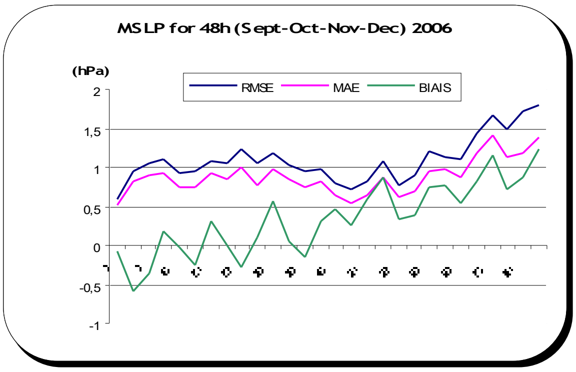


Fig. 3: Results of the control for the temperature at 2m for the two validities.



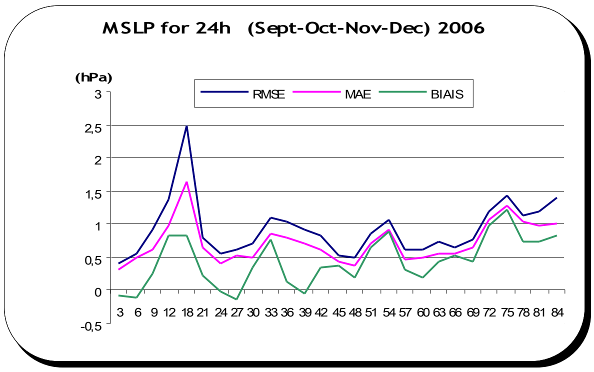


Fig. 4: Results of the control for the MSLP for the two validities.

☑ BEJAIA

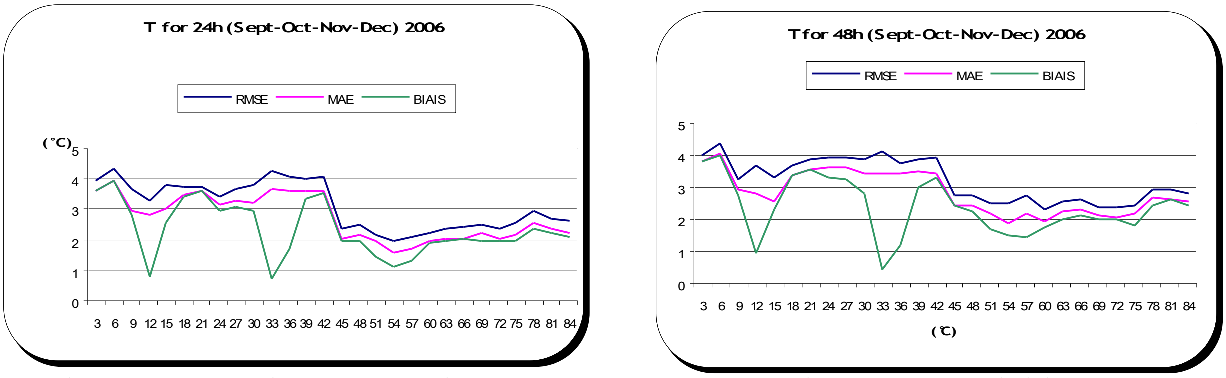


Fig. 5: Results of the control for the temperature at 2m for the two validities.

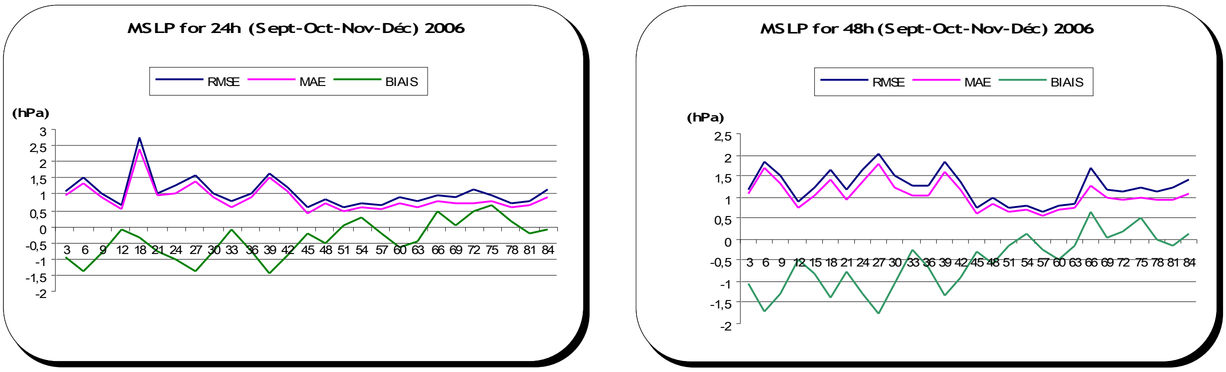


Fig. 6: Results of the control for the MSLP for the two validities

☑ MILIANA

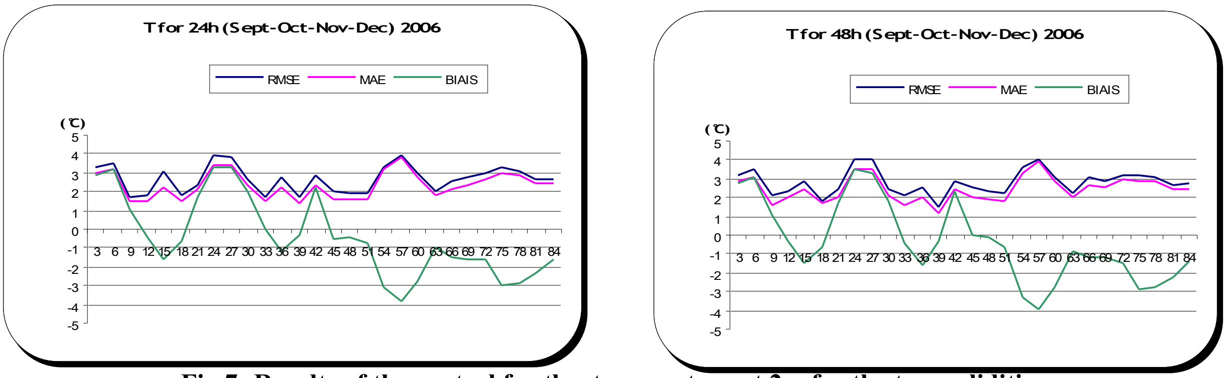


Fig.7: Results of the control for the temperature at 2m for the two validities

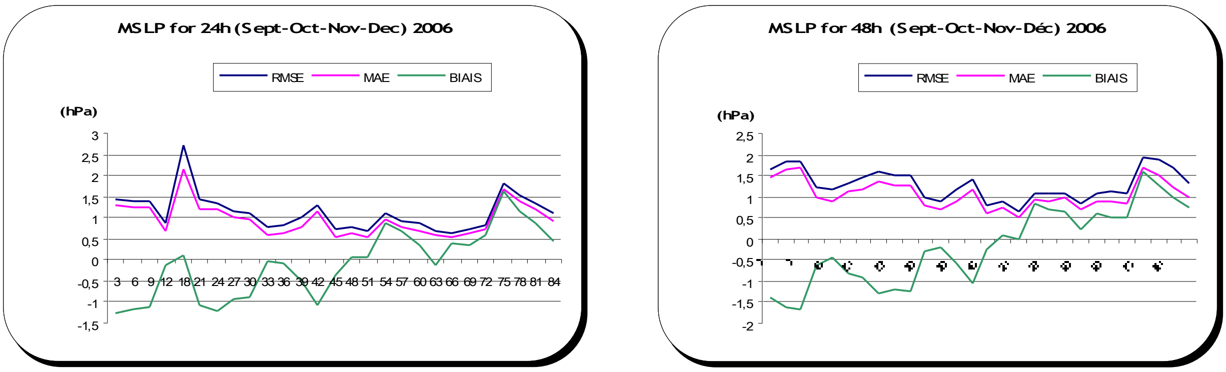
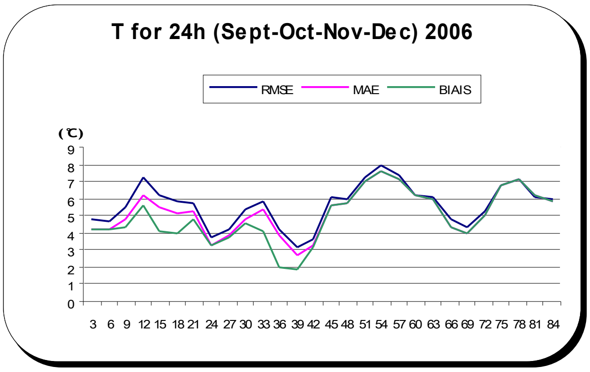


Fig. 8: Results of the control for the MSLP for the two validities

☑ TLEMCEN



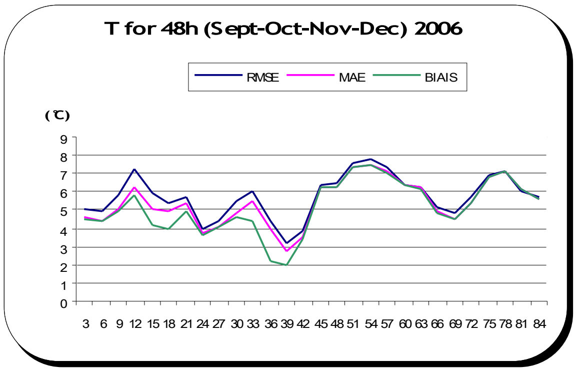
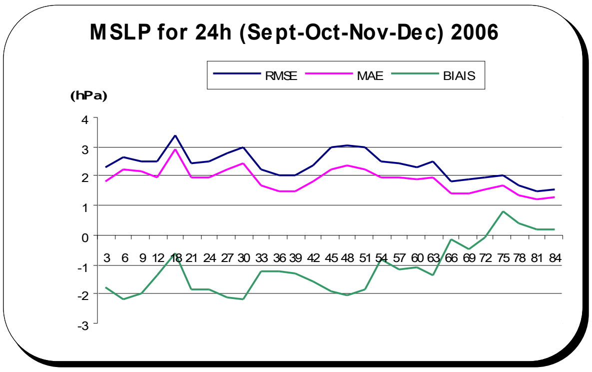


Fig. 9: Results of the control for the temperature to 2m for the two validities



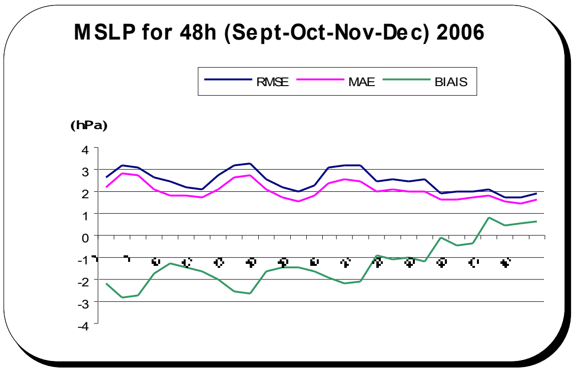
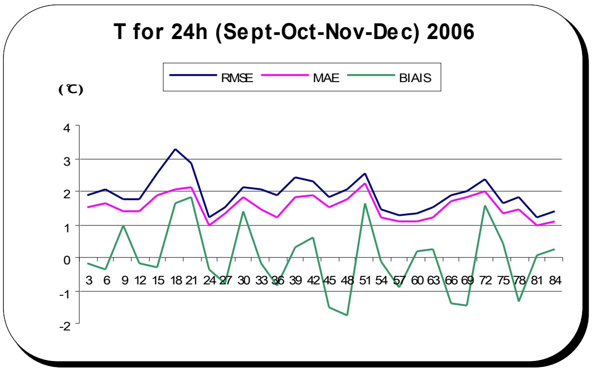


Fig. 10: Results of the control for the MSLP for the two validities.

☑ ILLIZI



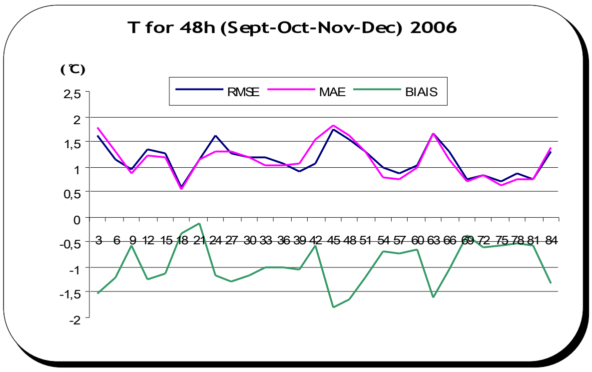
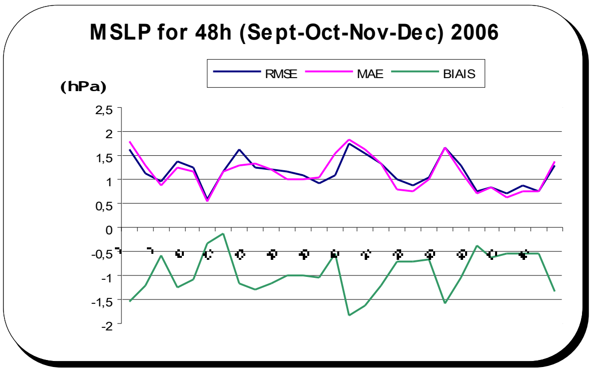


Fig. 11: Results of the control for the temperature to 2m for the two validities.



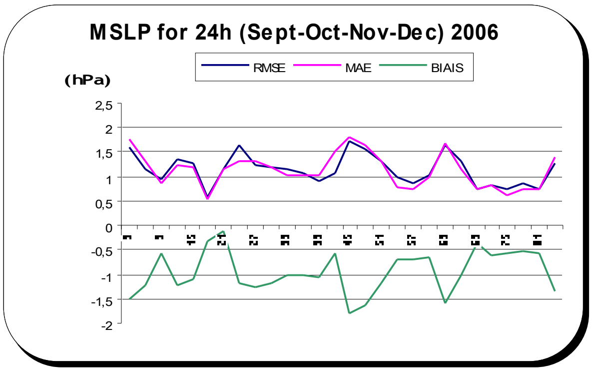


Fig. 12: Results of the control for the MSLP for the two validities.

For the selected meteorological stations, the evolution of the RMSE, the MAE and the BIAS of the parameter Temperature at 2 meters, during the studied period for the validity of 24 hours, puts in evidence a quasi-sinusoidal evolution of the MAE and the RMSE, both indications evolve in phase and do not overtake on average, the value of 04 °C.

The combination of the amplitude of the error of the forecast for the parameter temperature at 2 m (validity of 24 hours) with the bias calculated at the various stations indicates that the model tends to underestimate the temperature of about 2 to 3 °C from the north to the south.

Besides, we noticed that the amplitude of the error is stressed at the stations where the difference between the height of the station and that of the closest point is greater than 200 meters. The case of the station of Tlemcen, where the difference is equal to 347 metres, is typical, because all the curves are confused, with amplitude of the error equal to the double of that of the other stations.

To mitigate this anomaly, a control must be done with a stronger resolution of the model to minimize the distance between the station and the closest grid point to the station.

- **Presentation of the results for the 10 m wind components (u and v)**

Table 9: Presentation of the results of the different scores which are used to control the wind (m/s) at the station of DAR EL BEIDA.

Septembre

ECH	RMSE(u)	MAE(u)	BIAS(u)
3	1.087	0.671	0.431
6	1.108	0.659	0.412
9	1.974	1.496	0.621
12	2.375	2.083	-0.233
15	3.684	3.016	-1.635
18	2.574	2.025	-0.317
21	1.652	1.024	0.540

ECH	RMSE(v)	MAE(v)	BIAS(v)
3	0.785	0.607	-0.251
6	1.826	1.053	-0.510
9	1.624	1.268	0.653
12	2.864	2.398	-0.776
15	3.006	2.482	-1.368
18	1.526	1.068	-0.283
21	1.728	0.848	0.434

Octobre

ECH	RMSE(u)	MAE(u)	BIAS(u)
3	1.111	0.707	0.331
6	1.505	0.712	0.425
9	1.908	1.139	0.688
12	2.241	1.854	1.068
15	2.100	1.763	-0.212
18	1.382	1.064	-0.066
21	1.015	0.828	0.521

ECH	RMSE(v)	MAE(v)	BIAS(v)
3	1.445	0.930	-0.174
6	1.400	1.164	-0.651
9	1.485	0.904	0.337
12	3.134	2.511	-0.856
15	3.260	2.663	-1.964
18	1.577	1.205	-0.313
21	0.902	0.676	-0.124

Novembre

ECH	RMSE(u)	MAE(u)	BIAS(u)
3	1.111	0.707	0.331
6	1.505	0.712	0.425
9	1.908	1.139	0.688
12	2.241	1.854	1.068
15	2.100	1.763	-0.212
18	1.382	1.064	-0.066
21	1.015	0.828	0.521

ECH	RMSE(v)	MAE(v)	BIAS(v)
3	1.911	1.413	0.349
6	1.403	1.219	-0.122
9	1.894	1.405	0.268
12	2.816	2.029	1.134
15	3.098	2.578	-0.407
18	1.727	1.210	-0.040
21	1.957	1.503	-0.582

Décembre

ECH	RMSE(u)	MAE(u)	BIAS(u)
3	2.015	1.760	1.760
6	4.037	3.223	3.223
9	2.212	2.169	1.663
12	3.671	3.309	2.172
15	3.202	2.933	1.507
18	2.825	2.047	1.250
21	3.507	2.579	1.862

ECH	RMSE(v)	MAE(v)	BIAS(v)
3	1.439	1.155	1.055
6	2.063	1.550	0.822
9	2.141	1.799	0.802
12	2.108	1.964	0.257
15	1.742	1.600	-0.137
18	1.779	1.506	0.440
21	1.529	1.270	-0.162

The results of the control concerning the parameter wind at 10 meters, gives weak values not exceeding 4 m/s with an often positive and weak bias approaching on average 1 m/s and this for the component u, contrary to the component v where the bias is mostly negative. For all the stations, the RMSE and MAE do not deviate a lot.

4.6.4. Conclusion

The first objective of the present work was to master the main tools which are recommended by WMO, and which are used by the permanent members of the ALADIN Consortium, for the verification of there Numerical Weather Prediction models. The second and not the slightest, is the interpretation and the exploitation of the data of the control by the forecasters to identify the particular weaknesses, and the statistical bias of the model guides to correct the forecast according to these objective results.

These data will be used in the near future, once chain ALADIN/Algérie installed, to improve the components of the ALADIN/Algérie model, which presented weaknesses. In fact, the control of the model is an integral part of the process of continuous improvement of the forecasting chain. That is why, the mastering of the verification techniques and the interpretations of the results are important, for the orientation of the research, in all the compartments of the ALADIN/Algérie model.

The control realized within the framework of this study, concerned both the upper and surface parameters. The upper ones controlled with regard to the analysis are the following ones: the temperature and the geopotential at 500 and 850 hPa. The surface parameters controlled with regard to the observation are the following ones: MSLP, the temperature at 2 meters and the wind at 10 metres.

The control of the parameters: temperature and geopotential at 500 and 850 hPa, brings to light the good behaviour of the model over North Algeria. On the other hand, it seems less good while moving towards the South of the country.

For the parameter temperature at 2 meters, the results of the control show an amplitude of about +4 °C with a bias of -3°C. Thus, the temperature is underestimated of about +03°C, at the stations where the altitude of the closest grid point is superior of at least 200 meters to that of the station.

On the other hand, the model underestimates the forecasted temperatures of about 01 to 02 °C for the stations where the altitude of the closest grid point is nearly equal to that of the station.

The control of the parameter MSLP, confirms the good behaviour of the model. Indeed, for the considered stations, the forecast is quasi-similar to the observation (plus or minus 01 hPa).

Concerning the parameter wind at 10 meters, the amplitude of the error for the speed is of the order of 2 - 3 m/s, for all the considered stations in the present control, it can be explain by the presence of the relief.

As regards to the u component, the model tends to overestimate it, while the v component is underestimated.

On the other hand, for the parameter rain, the monthly control reveals that the behaviour of the model was not good during December, while the quarterly control improved the scores.

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4.7. ZAMG/Meteo-France's Participation on WMO/WWRP Project B08RDP

Yong WANG, Christoph WITTMANN and Alexander KANN
ZAMG, *Austria*
Francois BOUTTIER and Jean PAILLEUX
Meteo-France, France

Introduction

During the recent years, Limited Area Model Ensemble Prediction System (LAMEPS) has become more important as a scientific tool for improving prediction of high impact weather. To promote the research activities on LAMEPS, a five years international research demonstration project (2005-2009) B08RDP (Beijing 2008 Olympics Meso-scale Ensemble Prediction Research and Development Project, recommended and endorsed by WMO/WWRP) has been originated for research and development of LAMEPS. The B08RDP has a strong connection with the TIGGE. The national weather services of USA, Canada, Japan, Austria/France have decided to participate the project organised by CMA (China Meteorological Administration). The plan of B08RDP is: a) The first three years (2005-2007) are dedicated to research on meso-scale predictability and developing LAMEPS. b) August 2008 is for demonstration. After calibration and validation at the beginning of 2008, each participant will set up its own LAMEPS system centered over Beijing, run them operationally, and transfer the short range (6-36h) probabilistic forecast to Beijing in near real time to support for the decision-making for Olympic events. c) 2009 is for studying the results and inter-comparing those different type LAMEPS systems to improve LAMEPS forecasts in the future.

Two separated LAMEPS activities are proposed for B08RDP:

- The regional EPS Tier-1 is the system with 15km horizontal resolution, covers 3500km x 3000km, be centred at Beijing. The 6-36 hour forecast products of Tier-1 should be provided in near real time.
- The meso-scale EPS Tier-2 is designed specially for the cloud resolving model with 2-4km resolution, covers 1320km x 1100km be centred over Beijing. Tier-2 is the option for research.

In order to encourage international exchange of scientific information on ensemble forecasting, the Austrian weather service ZAMG and Meteo-France have decided to participate in B08RDP jointly (Acting as one single partner, ZAMG/Meteo-France) by using the ALADIN Limited Area Ensemble Forecasting (LAEF) system developed at ZAMG in frame of ALADIN/LACE co-operation.

In this report, the ALADIN-LAEF and the other B08RDP participating systems will be briefly introduced in section 2 and 3. The preliminary results from the B08RDP 2007 Tier-1 test are presented in section 4. The concluding section contains a summary, the recent and ongoing development on LAEF at ZAMG.

4.7.1. ALADIN-LAEF

The LAEF system implemented by ZAMG for Tier 1 of B08RDP project uses the hydrostatic version of limited area model ALADIN for dynamical downscaling of ECMWF-EPS members (16 out of 50). ALADIN is run with a horizontal resolution of 15km, covering a domain of 4140 km x 4140 km, shown in Fig. 1. An 18 member ensemble (16 perturbed members, 1 control run, 1 deterministic run) was computed twice per day (00 UTC and 12 UTC), integrated up to a forecast range of 54h. Initial perturbation and lateral boundary perturbation of the ECMWF EPS system is generated by singular vector approach and further stochastic physics are used for uncertainties in model physics. Further details concerning the ALADIN-LAEF model settings can be found in table 1.

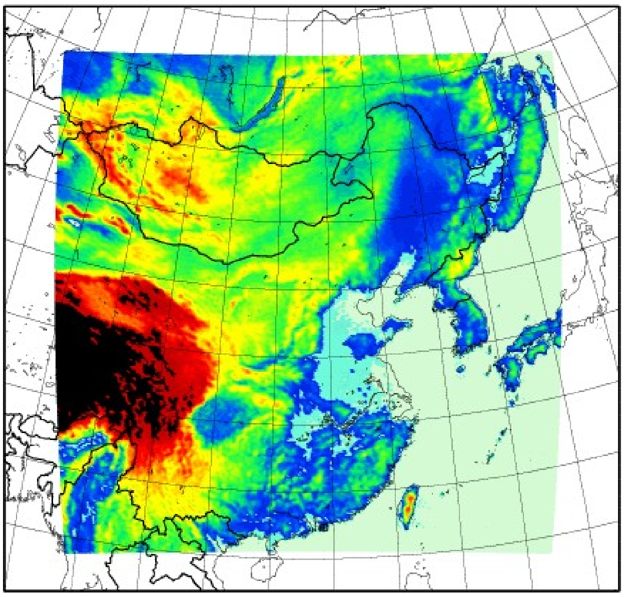


Figure 1: Domain and model topography of ALADIN-LAEF for B08RDP.

Numerical model	ALADIN, hydrostatic version
Forecast period	54 hours with the initial time 00 UTC and 12 UTC
Horizontal mesh	277 x 277 (15 km), Lambert conformal
Vertical levels	37, terrain following pressure based hybrid coordinate
Initial condition	ECMWF: deterministic (T799, 25km), control and 16 perturbed members (T399, 50km)
Surface condition	ARPEGE analysis
Lateral boundary	ECMWF: deterministic (T799, 25km), control and 16 perturbed members (T399, 50km), coupling frequency: 6hours
Initial perturbation	Downscaling of ECMWF-EPS members (SV approach)
Advection	Semi-Langrangian
Time integration	Δt= 600.0 sec, SLSI (semi-Lagrangian semi-implicit)
Moist physics	q as prognostic quantity, diagnostic large-scale precipitation scheme
Convection	Modified mass-flux-type scheme of Bougeault (1985)
Turbulence	Turbulent fluxes modelled using first-order turbulence closure (Louis, 1979, Louis at al., 1982)
Radiation	Based on Geleyn and Ritter (1991), called every hour
Ground temperature	2 prognostic variables: surface temperature, deep soil temperature

Table 1. Specification of ALADIN-LAEF for the B08RDP Tier 1 EPS test 2007

4.7.2. Other B08RDP participating systems

As mentioned in the introduction, there are 6 LAMEPS systems from USA, Japan, Canada, China and Austria/France participating the B08RDP project. The characteristics of those LAMEPS systems are summarised in table 2.

Tier-1 MEP systems 2007

Participants	Model	IC	IC perturbation	LBC
NCEP*	WRF-NMM WRF-ARW	NCEP Global 3DVAR	Breeding	Global EPS
MRI/JMA	JMA-NHM	JMA Regional 4DVAR	Targeted Global SV	JMA Regional Forecast
MSC	GEM	MSC Global 4DVAR	Targeted Global SV	MSC Global EPS
ZAMG & Meteo-Fr.	ALANDIN	ECMWF Global 4DVAR	ECMWF Global SV	ECMWF Global EPS
NMC/CMA	WRF-ARW	WRF-3DVAR	Breeding	Global EPS
CAMS/CMA	GRAPES	GRAPES-3DVAR	Breeding	Global EPS

*EP system of NCEP is as of the 2006 experiment: NCEP submitted results by global EPS in the 2007 experiment

Table 2. Summary of the participating LAMEPS systems for the B08RDP 2007 Tier-1 test.

4.7.3. The preliminary results of B08RDP 2007 Tier-1 test

The B08RDP 2007 Tier-1 test was carried out from 24. July to 24 Aug. 2007. JMA and CMA has verified some results of the 2007 Tier-1 test. The observations on the station has been used for the verification, in particular near surface parameters. In the following, the verification results focused on precipitation from JMA and CMA colleagues (Saito et. al. 2007, Y. Li 2007) will be presented.

a) Verification of ensemble mean forecast, precipitation

Bias and ETS score of 6h accumulated precipitation forecast

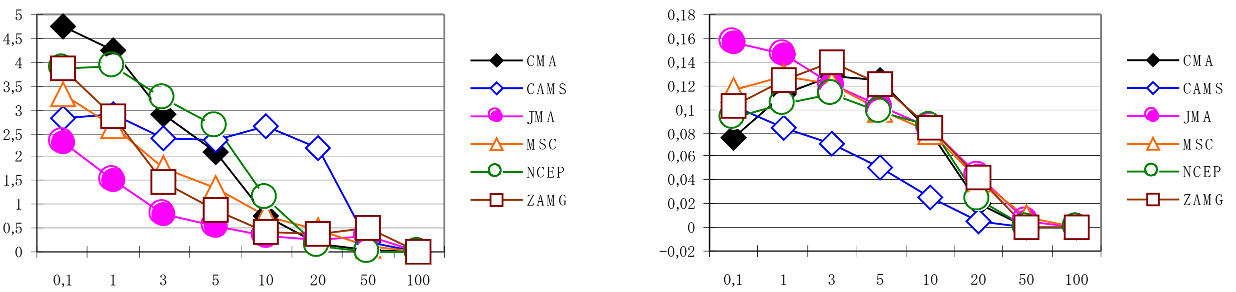


Figure 2: Bias (left) and ETS (right) scores of 6h precipitation forecast of ensemble mean, valid from 26 July to 5 Aug. 2007 (Saito et al. 2007)

Fig. 2 shows the bias score and ETS score of 6h ensemble mean precipitation forecast of the participating systems. ALADIN-LAEF performs overall quite well, except for light rainfall. The problem with light rainfall in LAEF was due to the inconsistent coupling of ALADIN with ECMWF for the surface processes. Studies have shown that this inconsistent coupling introduces large moist bias and cold temperature, in particular, on the day time. An alternative initialization of surface and soil parameters—*Surface blending* in the ALADIN coupling with IFS was tested and showed promising results, reducing the Bias significantly.

b) Case study 1: Thunderstorm over Beijing on 30 July 2007

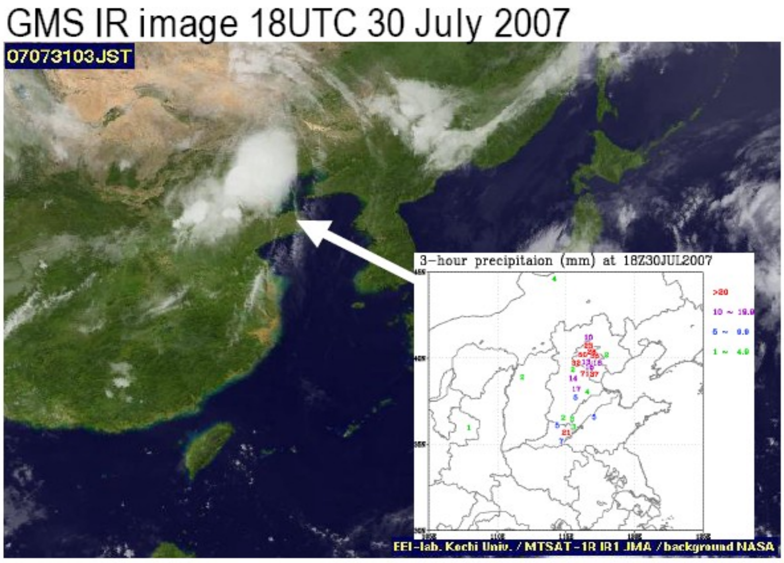


Figure 3: Satellite image and 3h rainfall observation on 18utc, 30. July 2007

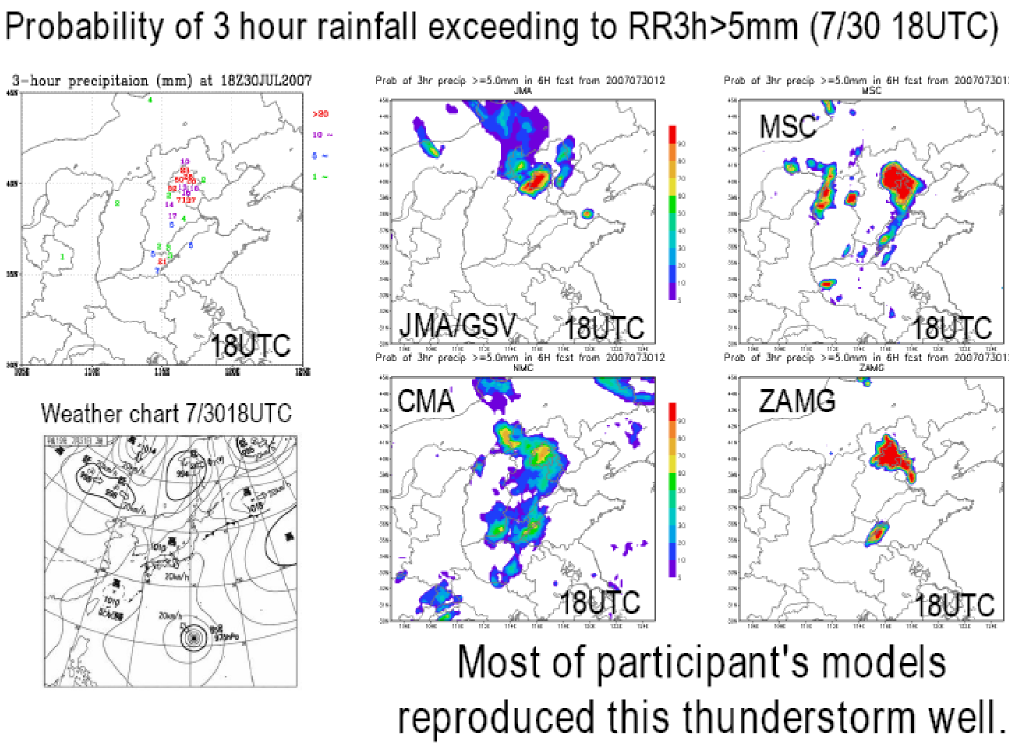
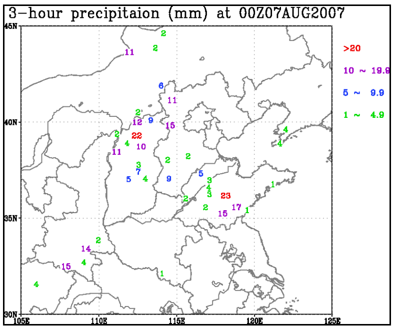


Figure 4: Probability of precipitation over 5mm/3h, 6hour forecast, 18UTC, 30 July 2007. (Seko et al. 2007)

This case was characterised by strong thunderstorm. 70mm precipitation was observed within 3h at 18utc.30 July 2007 (Fig. 4). Four from the six participating regional EPS systems yield a quite high probability for strong rainfall and reproduce the storm well. LAEF forecast catches not only the strong one over Beijing, but also the small convection cell in central China, which can not be found in other participating systems.

c) Case study 2: strong rainfall, 07 August 2007



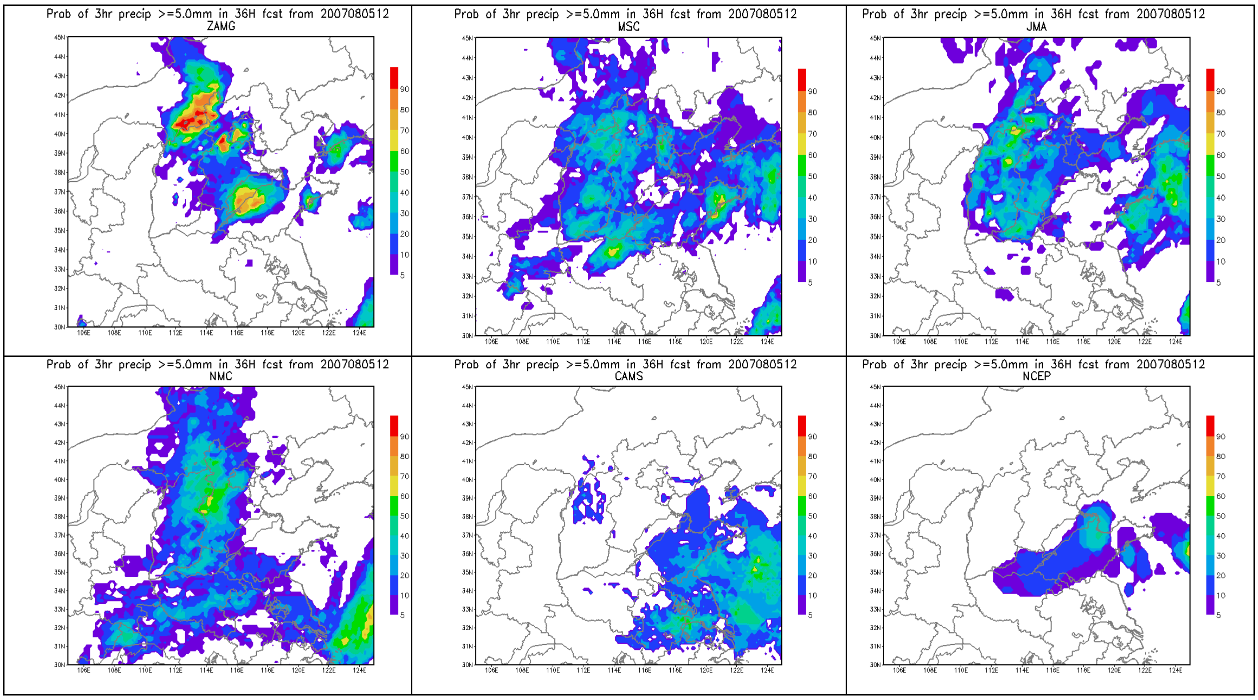


Figure 6: Probability of 3h precipitation forecast over 5mm, 36h forecast for 00utc, 7 August 2007.

Another case is the strong precipitation event over northern China on 7 August 2007. The forecasts of all the participating system and the observation are shown in Fig 6. The coverage of strong precipitation events by LAEF is satisfying, but regional differences in forecast performance can be recognized.

Verification results, like the Brier skill scores and reliability scores of the precipitation forecast, they showed quite contradictory results. More investigation need to be done for useful results. In general, LAEF exhibits quite skilful performance on precipitation forecast. The spread of LAEF is still too small, and not growing fast enough from initial time to forecast hour 54. This behaviour can be found for other surface parameters too (surface temperature, wind, relative humidity, etc.). Strong bias in surface temperature and humidity, in particular on the day time, has been found, which is due to the aforementioned inconsistent surface coupling problem ALADIN with ECMWF IFS.

4.7.4. Summary and ongoing development on LAEF

In this report we briefly introduced the WMO/WWRP B08RDP project and its participating LAMEPS systems. The preliminary result of the 2007 Tier-1 test has been presented. Verification of precipitation and case studies has shown that ALADIN-LAEF with dynamical downscaling of ECMWF EPS performs quite well for the strong rainfall. Two case studies demonstrate the capability of forecasting strong rain of LAEF over China. Problems have been recognized for light rainfall, it is particularly true for the near surface parameters, like 2m Temperature and humidity. Strong cold and moist bias has been found in T2m and humidity. This is due to the inconsistent surface coupling between ALADIN and ECMWF IFS. A method of surface blending , which is designed to combine the ARPEGE surface analysis and ECMWF upper air analysis, has been tested. The strong bias problem can be cured to some extent.

For the further development of LAEF, there are some ongoing activities at ZAMG, most of them have been implemented, and some of them have shown quite encouraging results:

- ✓ Use of the clustering method for having 16 representative members from the 51 ECMWF EPS members. Two different tests will be done: a) simply the 16 representative members from the clusters; b) those 16 members should be centering around the analysis.
- ✓ Implementation of a pseudo-breeding method for perturbation on the surface analysis.
- ✓ Comparison of breeding, ETKF and ET.
- ✓ Combination of the large scale perturbation from ECMWF SV with small scale perturbation generated by ALADIN LAEF native breeding --- ALADIN blending technique.
- ✓ Introduction of the multi-physics option into LAEF for more diversity.
- ✓ Investigation on the impact of LBC perturbation from the global EPS system, which uses different perturbation method, like ECMWF SV, from the native LAM IC perturbation method, like breeding.

Acknowledgement

Special thanks to all the ALADIN/LACE colleagues, who have contributed to the development of LAEF. The cooperation with all the B08RDP partners CMA, JMA, MSC, NCEP and NCAR are kindly acknowledged.

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