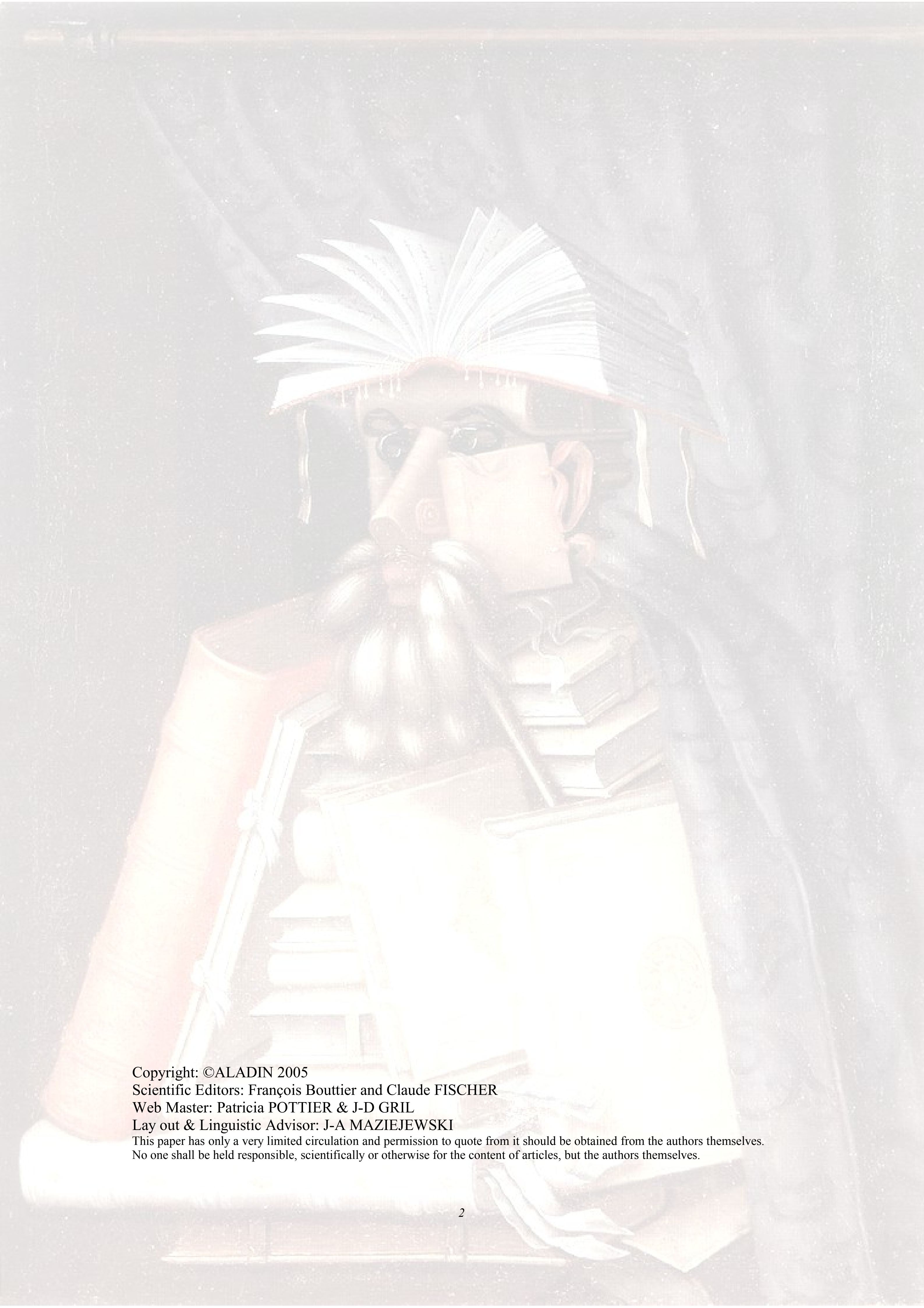
ALADIN

NEWSLETTER 29

July-December 2005



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1. EDITORIAL

Foreword: Fischer C.

Bis repetita: quo vadis, Aladin?

For the last three years, the ALADIN project has undergone a series of transformations, driven both by scientific and political needs. The scientific changes certainly have been strongly motivated by the start of the development phase of Météo-France's AROME NWP tool. The political changes have been recently inspired by the writing of the third Memorandum of Understanding, with additional inputs brought in by the convergence with the HIRLAM consortium. It is the author's belief that the situation has led during those three years to a mixture of strongly reinforced coordination (in data assimilation, in dynamics, with more workshops and meetings) along with areas of more widespread activity (physics, project coordination). Our Slovakian colleagues summarized this state of confusion during the last workshop in Bratislava with the question mark: "Quo vadis, Aladin ?". At the time when this foreword is written, we are in between our first "PAC" and our first "General Assembly", as defined in the new policy of Aladin-2. We cannot anticipate what the new structures can bring us, whether "good" or "bad", in scientific and technical achievements, or daily managerial questions. We certainly can, not only wish, but firmly expect, that the quality of human relationships and daily tolerance will remain a pillar of our project. They should help us keeping a reasonable control over our widespread operational activities and a watchful eye on our common long-term goals. Let this be my golden rule number 1.

Will our new structures remove all misunderstandings ? Most likely not. Misunderstandings (better say: differences of opinions) belong to a multi-sided project, as ALADIN actually always has been. The important thing is to give ourselves both the opportunities to identify and discuss them (a matter that can be considered as part of a governance), and possibly to leave them aside, waiting for better times to solve them without harming the overall run of the project. For about ten years, one could argue that ALADIN has lived happily under the misunderstanding that a project was one and the same thing as an NWP tool: consortium = model. This identity has been smashed into pieces with the context evaluation done for AROME: NWP centres at local level should concentrate on convective scale forecasts. The counter-analysis, stating that convective-scale NWP was not reachable by all partners before a decade or so, immediately opened the door for multiple scientific approaches, thus multiple software libraries, in the mid-term. Whatever the scientific wishes, political claims and national ambitions, I do state quite firmly my golden rule number 2. The major bet and constraint for all of us must be the "development quality" of our NWP tools: maintenance (phasing, but also software design and upstream scientific foundation of an idea), documentation, an improvement of our operational preparations, a more intense and objective usage of ECMWF resources (for boundary conditions, transversal activities like EPS).

Finally, before answering the "Quo vadis" question, another interrogation should come to (y)our minds: "Would Météo-France eventually always do the job for us(you) ?". Météo-France is the historical driving force of the ALADIN project, in many respects. To what extent it would shrink the volume if its involvement depends both on aspects that scientists do not control, and on items that they do partially master: scientific and managerial initiatives, quality of the networking, self-criticism (and criticism towards Météo-France), acceptance for responsibility. The third golden rule might be that all of us are put at the challenge to be innovative, not only adaptive. Imagination and some free spirit certainly are not forbidden.

In the coming months, a number of meetings will help us to settle the new governance: the ALADIN workshop in Sofia, held most likely together with the Hirlam all staff meeting around mi-May, and along with the CSSI meeting; the traditional EWGLAM/SRNWP workshop; the thematic SRNWP workshops; the end of the year PAC and regular General Assembly. More information on all these meetings will be available in due time on the Aladin web site.

1.1. EVENTS

1.1.1. Policy Advisory Committee: Vienna Austria 26 January 2006.

1.1.2. General Assembly of ALADIN Partners: Brussels 23 February 2006.

1.1.3. LACE Steering Committee: Budapest 15-17 February 2006.

1.1.4. ARPEGE/IFS coordination meeting: Reading 23d March 2006.

1.2. ANNOUNCEMENTS

1.2.1. ALADIN CSSI & HIRLAM M.G. Meeting :Sofia Bulgaria 14 May 2006.

1.2.2. 16th ALADIN Workshop & HIRLAM All Staff Meeting: Sofia Bulgaria 16-19 May 2006.

1.2.3. 3d SRNWP Meso scale verification workshop: Sofia Bulgaria 17-18 May 2006.

1.2.4. EWGLAM & SRNWP Meeting: Zurich Switzerland 9-12 October 2006.

1.2.5. ALADIN/HIRLAM practical training on ODB & 3 DVAR.6th - 10th JUNE 2006.

1.2.6. NetFAM summer school: St Peterbourg 11th-17th JUNE 2006.

1.2.7. LACE steering committee: Zagreb 14th - 15th September 2006.

1.2.8. Policy Advisory Committee: Lisbon 21st – 22d September 2006.

1.2.9. Annual EWGLAM/SRNWP meeting: Zürich 9th - 11th October 2006.

1.1.1. Regular GA of ALADIN partners: Budapest 9th - 10th November 2006.

1.3. ALADIN 2

1.4. GOSSIP

(J-A.Maziejewski - j*ean.maziejewski@meteo.fr*)

No time for gossip in this issue, but for Florence who's expecting.

2. OPERATIONS

M. Derkova - *(maria.derkova@shmu.sk)*

2.1. INTRODUCTION

The general update of the climate and coupling files for all ARPEGE and ALADIN suites was scheduled for the end of 2005.

For physiography files, the purpose was to introduce new input climatological databases for orography and for climatological/relaxation surface fields. Moreover, this was an opportunity to get rid of some long-lasting known weaknesses (inconsistency of snow cover computation in c923 and e923), to update some very old physiography files, to redefine some model and/or post-processing domains, to retune orography smoothing etc.

For coupling files, new fields for physical parametrisations could be added (ozone, aerosols, new snow variables), vertical levels could be changed following , and new parameter for monitoring of the coupling update frequency could be used.

Besides that, the new eggx header (NCADFORM=1 in namelist & NAMOPH) was set as new default.

(Some work was scheduled, but not finished, on the optimization of the content of the coupling files and the second order packing.)

Partners were informed by many e-mails, presentations and (informal) meetings along workshops, article in the Newsletter.

2.1.1. WORK

The information about the operational domains, their horizontal and vertical resolution, orography tuning, and on the required content of the new files was collected. The new climate files were centrally produced in Toulouse (although some Partners prepared them themselves). A testing set of coupling files from the ARPEGE e-suite using those new climate files was prepared as well. All Partners were asked to test these files, fields and consequently all operational applications.

2.1.2. ENCOUNTERED PROBLEMS

- ✗ - The disappointing behavior of ARPEGE e-suite in some situations led to reduction of the e-suite content (withdrawal of 46 levels and microphysics). What remains is the new clims, improvement in the soil freezing assimilation, and new stuff for observations (detailed elsewhere in the Newsletter).
- ✗ - The importance of using consistent namelists (in the definition of domain parameters) in e923 and e927 was emphasized. The check in echien routine is more strict with new cadre, sometimes even the check had to be relaxed (1-2 more digits).
- ✗ - Some applications had problems with new cadre => detailed eggx documentation was provided
- ✗ - Operational suites using assimilation had to be restarted using cold-start, otherwise inconsistency between guess and analysis fields has been observed as well as rather bad scores of MSLP.
- ✗ - When using higher resolution input databases, a (long known) problem of correct values of climatological parameters to be assigned over new regions appeared, in case of mismatch between interpolated and real land-sea marshes. This was visible e.g. on spurious values of surface temperature near the costs. New algorithm in e923 had to be coded.
- ✗ - A problem with clim files for lat/lon fullpos files was detected (wrong initialization of ELAT0/ELON0 in case of lat/lon). Bug was corrected and clims for lat/lon fullpos files were rebuilt.
- ✗ - A problem with clim files with linear grid was detected (mistyping in script), the files were rebuilt « in extremis ».

When evaluating the parallel suites, worse scores for 2m relative humidity (both in ARPEGE and ALADIN) and temperature (for ALADIN-France only), probably due to a model bias, previously unduly countered by poor surface condition, but now, with more accurate fields, more visisble, especially in assimilation mode.

In the new clim files, the surface is more wet, which leads to a too wet model through relaxation in soil assimilation surface.

After solving the majority of above mentioned problems (and despite some of them), the general switch was scheduled for 23/01/2006 00UTC long cut-off for assimilation, and 06UTC early cut-off for production. For Partners who were not ready to switch the provisional solution of using non-incremental interpolations in e927 procedure (to avoid potential problems when using inconsistent sets of climate files) was adopted.

2.1.3. STATUS on 15/02/2006

ARPEGE, ALADIN/FRANCE and ALADIN/LACE have switched simultaneously on 23/01/2006. SELAM, Tunisia and Poland have switched on 30/01/2006, Morocco on 08/02/2006. Belgium is scheduled on 20/02/2006. The only remaining country to switch is Portugal.

2.1.4. LESSON FOR THE FUTURE

It took us all together almost one year from the first coordination e-mails to the switch!

Reading and answering coordination e-mails helps to make the work of concerned people more efficient, to avoid useless work duplication and to speed up whole process.

Do not forget that similar exercise (coordinated switch of operational suites) waits for us in the near future with SURFEX.

2.1.5. ACKNOWLEDGEMENTS

Huge work to collect and spread all necessary information was done by D. Giard, with the help of M. Derkova. F. Taillefer debugged and upgraded e923 configuration, with help from F. Bouyssel. GCO team prepared all clim files and the set of coupling files for testing. After D. Giard left GMAP, C. Fischer took over the coordination work

2.2. CYCLES

2.2.1. Bouteloup Y and all: CY30T1

CY30T1 has been declared the last week before christmas hollidays, main modifications with CY30 are listed below in a total disorder.

Francoise TAILLEFER:

1) Bugfix to run CANARI on cycle 30

2) Phasing modifications of 923 from CY29T2

Jean-Daniel Grill:

1) Bugfix in ALADIN geometry

Yves BOUTELOUP :

1) Phasing of physics from e-suite (cy29t2_op2.08)

2) Modification in order to compute moisture convergence when q is grid point. Two technics are coded, first a new spectral GFL is introduced and derivatives are used. Second, semi-lagrangian advection of a new grid point GFL is used.

Paul POLI:

1) Developments required for assimilation of ground-based GPS data

Ryad El Khatib with Sylvie Malardel and Gwenaelle Hello for point 2:

1) Compliancy with PGI compiler. Huge routines have been split into shorter "contained" subroutines in order to make the compilation safe and fast. Too long subroutines could lead to memory fault (arp/phys_ec/*, xrd/*, uti/*, ald/c9xx/cchien.F90).

2) Change of geometry and fields from an ALADIN file to an AROME file (mse/*, arp/*), including the handling of either one single surface mask (land vs. sea) or two surface masks (land mask and sea mask) ; post-processing of sea surface temperature. The use of two surface masks imposes that only the target climatology could be used for the time being.

Rachida El Ouaraini:

1) Post-processing of Warning index for coupling file

Yann Seity and Pierre Tulet for point 1 to 4:

1) Add MesoNH chemistry in AROME

2) Phasing of externalised surface, version 1.1

3) Rename some routines with suffix "_aro", to separate AROME routines from pure Meso-NH routines.

4) Add new files to handle chemistry from Meso-NH

5) Bugfix to run AROME on IBM.

GCO:

1) Miscellaneous stuff from current parallel suite.

Filip VANA:

1) Setup of LSLHD

Karim Yesad and Radmila Brozkova:

1) modset to allow B-Level parallelization for NH model (and reduces CPU cost).

2) AD+TL codes for variable mesh.

3) Correct formulation for entropy and conversion term in the NH model (CPDYDDH).

4) A-level parallelisation of conf 911.

5) In NH model, cleaning for d4 ; removal of the auxiliary variable ; make d4 available in ARPEGE.

6) SI scheme coded in ALADIN like in ARPEGE (removal of array SIEHEL)

7) Adaptation of LTRAJHR to METEO-FRANCE applications, with the possibility to read

the trajectory on ARPEGE files.

A bugfix has been also developped as a base for the contribution to CY31. The contains are listed below in a total disorder:

Yves Bouteloup:

1) Bugfix to avoid a random blowup in RADHEAT15. This bug is present in CY29T2 but not in CY29T1

2) Bugfix to run MTS (Model To Satellite facility) in CY30 with RTTOV8.

Dominique Puech:

A lot of modifications in BATOR, among other things, introduction of LAMFLAG.

There is still some problems in CY30T1:

1) Always a problem with LTC=.TRUE. in the 4DVAR. It's the main blocking point which prevents a use of CY30 for an e-suite.

2) Problem on IBM, a lot of observations are rejected.

3) Always a problem in configuration 401 with ALADIN in multiprocessor mode.

4) A problem in conf 1 with SL3TL-NH + physics + predictor corrector scheme in multiprocessormode.

5) Problem in ARPEGE with Full-Pos in-line fullpos and use of climatology (NFPCLI>1).

CY30R2 is awaited for the 9 of february. The deadline for contributions to CY31 is 10 of february.

List of awaited contributions in a total disorder:

Karim Yessad : Stretched SI

François Bouyssel : Around SURFEX (externalised surface)

Sylvie Malardel : 1D model in the 3D

Antoinette Alias : Modset to run climat configuration.

Yann Seity : Last version of SURFEX

Jure Cedilnik : Rationalisation of GFL setup

Radmila Brozkova : LAVALLOC (Modifications given to late for CY30T1 !)

Bernard Chapnik : Correction on JK

Jean-Marcel Piriou : DDH in AROME

Yves Bouteloup and François Bouyssel : Last modifications for new physics

2.3. Transversal informations

M. Derkova - *(maria.derkova@shmu.sk)*

The hardware platform for ALADIN and HIRLAM operational and post-processing suite – 31.12.2005

Country	The HPCS platform				The post-processing platform			
	type	number of CPU's	size of RAM	size of disk storage	type	number of CPU's	size of RAM	size of disk storage
Austria	SGI Origin 3400	28	28 GB	500 GB	SGI Origin 3400	28	28 GB	500 GB
Belgium	SGI Origin 3400 (current) SGI Altix 3700BX2 (march 2006)	24 28	24 GB 104 GB	2 TB 2 TB	SGI Origin 3400 (current)	24	24 GB	2 TB
Bulgaria	Linux PC	2	2 GB	300 GB	Linux PC	2	2 GB	300 GB
Croatia	SGI Origin 3400	16	12 GB	300 GB	SGI Origin 3400 Linux PC (HP KAYAK i686) Linux Red Hat 6,2	16 2xIntel Pentium II 667 MHz	12 GB 2x128 MB	166 GB 69,2 GB
Czech Republic	NEC SX6/4B-32	4	32GB	2,5 TB	Bull Express 5800 120Mf server Linux Debian	2x Intel Xeon	6 GB	360 GB
Denmark	NEC/SX6	64	320 GB	2,5 TB	NEC/SX6 Itarium Linux	64	320 GB	2,5 TB
Finland	SGI Altix BX2	48-256	48-256 GB	200 GB	SGI Altix BX2	48-256	48-256 GB	200 GB
France	Fujitsu VPP5000	60	50*4GB 10*8GB	3,1 TB	Fujitsu VPP5000 HP servers	60	50*4GB 10*8GB	3,1 TB
Hungary	IBM p69 Regatta IBM p655	32 32	64 GB 128 GB	1,2 TB 1,2 TB	IBM p69 Regatta	32	64 GB	1,2 TB
Ireland	IBM RS/6000 SP	36 (9 nodes x 4)	18 GB (2x9)	150 GB	IBM RS/6000 SP	36	18 GB	150 GB
Morocco	IBM RS6000	36	19 GB	1 TB	IBM RS6000	36	19 GB	1 TB
Netherlands	Sun Fire 15K	50	100 GB	35 GB	Sun Fire 15K	50	100 GB	35 GB
Norway	SGI Origin 3800	512 (200 in oper)	512 GB	500 GB (for oper)	Intel Xeon	16 (2 hots x 8)	7 GB (3,5 x 2)	300 GB
Poland	SGI Origin 2800	16 x R14k	16 GB	20 GB HDD + 2 TB tape	SGI Origin 2800 Linux Server	16 x R14k 2 x Xeon	16 GB 2 GB	20 GB HDD + 2 TB tape 72 GB
Portugal	DEC Alpha XP1000	1	1 GB	10 GB	DEC Alpha XP1000	1	500 MB	6 GB
Romania	SUN E4500	8	8*1 GB	108 GB	SUN E4500 DEC	8 1	8*1 GB 704 MB	108 GB 6 GB
Slovakia	IBM p690 Regatta	32	32 GB	1,5 TB	IBM p690 Regatta DEC Alpha XP1000 (Compacq)	32 1	32 GB 1 GB	1,5 TB 36 GB
Slovenia	Linux cluster	28	28 GB	3,5 TB	Linux cluster	28	28 GB	3,5 TB
Spain	CRAY X1E	128	320 GB	4 TB	CRAY X1E	128	320 GB	4 TB
Sweden	Linux Cluster	120	240 GB	3,8 TB	Alpha Server 4000	2	5 GB (2,5 x 2)	
Tunisia	IBM p690	8	16 GB	360 GB	IBM p690	8	16 GB	360 GB

2.4. Changes in the Operational Version of ARPEGE

(more details joel.stein@meteo.fr)

2.4.1. Stein J.: Validation of the 3DVAR assimilation scheme (version 2005_02).

Abstract:

From the 25 July 2005 at 6 UTC, the ALADIN model starts from its own 3DVAR variational analysis and it is no more only a dynamical adaptation of the ARPEGE model. This is a very important modification. The 3DVAR scheme provides an analysis for the altitude fields. There is no surface analysis and the surface fields are deduced by spatial interpolation from the ARPEGE ones. An assimilation cycle with 4 assimilations per day with long cut-off has been created. The guesses of the analyses are provided by 6 hours forecasts, whose boundary conditions are given by the ARPEGE forecasts of the assimilation scheme. A production cycle has also been created and their analysis uses the same first guess as for the assimilation cycle but the analysis cut-off is reduced compared to the assimilation cycle.

The assimilated observations are the same as for ARPEGE but limited to the ALDIN simulation domain. Nevertheless, the satellite data QUIKSCAT are not used and the SEVIRI radiances coming from METEOSAT 8 are added. For the observations used by both models, there is no specific extraction from the databases for the ALADIN. The same coefficients are used for ALADIN as for ARPEGE to remove the bias of the satellite radiances ATOVS.

The SEVIRI radiances, which are the originality of this analysis are issued from a specific product elaborated by the laboratory CMS LANNION at full resolution. We assimilate 5 of the 8 channels (IR 3.9 and 13.4 micrometers and O3 9.7 micrometers are blacklisted) and use the cloud classification to select the data, one pixel every 5 leads to an effective resolution of 25 km. A specific removal of the bias is applied to these Meteosat 8 radiances.

The initialisation with digital filters is still present with the same amplitude as for the dynamical adaptation. The analysis before this filtering is not stored. Moreover, there is no change in the forecast model.

Among the main points, we note:

- Important rain reduction during day J with a reduction of the false alarms between 0 and 12
- The error for the wind field is reduced by 50 % in the initial state and a less important but still visible improvement is present for the temperature and the humidity. These improvements are continuously reduced and are negligible after 12 hours of simulation
- A small warm bias (0.1 to 0.2K) at the low levels (1000- 925hPa) between 12 et 15UTC (day D, and strongly reduced for day D+1), is probably related to a lower surface soil moisture than in the dynamical adaptation, but without a noticeable increase of the CAPE.
- A positive bias of 0.3hPa for the reduced pressure is present between 0 et 12H (this point must be further analysed in the next months).

The ALADIN outputs are available with a 5 minutes delay in comparison with the actual situation, because of the analysis time, even if this analysis is performed on 5 processors of the Fujitsu (VPP5000). The ALADIN-FRANCE model (PLAD0) starts from its own 3DVAR analysis with an ultra-short cut-off. This model is coupled with the PACOURT version of ARPEGE (with also an ultra-short cut-off) and is therefore delayed by 5 minutes .

References **:**

Documentation GCO :

http://gco.meteo.fr/qualite/doc/memo/cy29t1.pdf

http://gco.meteo.fr/qualite/doc/chaine/aladin/aladin_3dvar.pdf

Impact of this new version - Development of the comparison

The comparison has been performed in two steps: the first part extends from 02 June 2005 until 15 June 2005 and has been marked by the discovery of a major bug in the selection of the SEVIRI data according the cloud classification. The second part has started from the 16 June 2005 and stopped the 25 July 2005 with the transformation of this test version into the operational one.

Monitoring of ALADIN 3DVAR from 16/06 until 25/07

A monitoring of the observations assimilated by the ALADIN model has been developed and is independent of the ARPEGE one. We present on Figure 1 the mean numbers of assimilated observations, classified by observation type. We note that the surface data are the most numerous at 0 UTC because the temperature and humidity at 2 m AGL are used in the analysis of the altitude fields. Moreover, the data coming from the French RADOME network have been added to the SYNOP messages. Another important point is the low number of satellite data (HIRS, AMSU-A et AMSU-B) assimilated by the ARPEGE model over the ALADIN domain. Because of the short cut-off of the production cycle, we see that the AMSU-A data are completely absent. The SEVIRI satellite data, used at a very fine resolution, provide thus a very important supplementary source of information for the ALADIN assimilation scheme to complement the radio soundings and the airplane data.

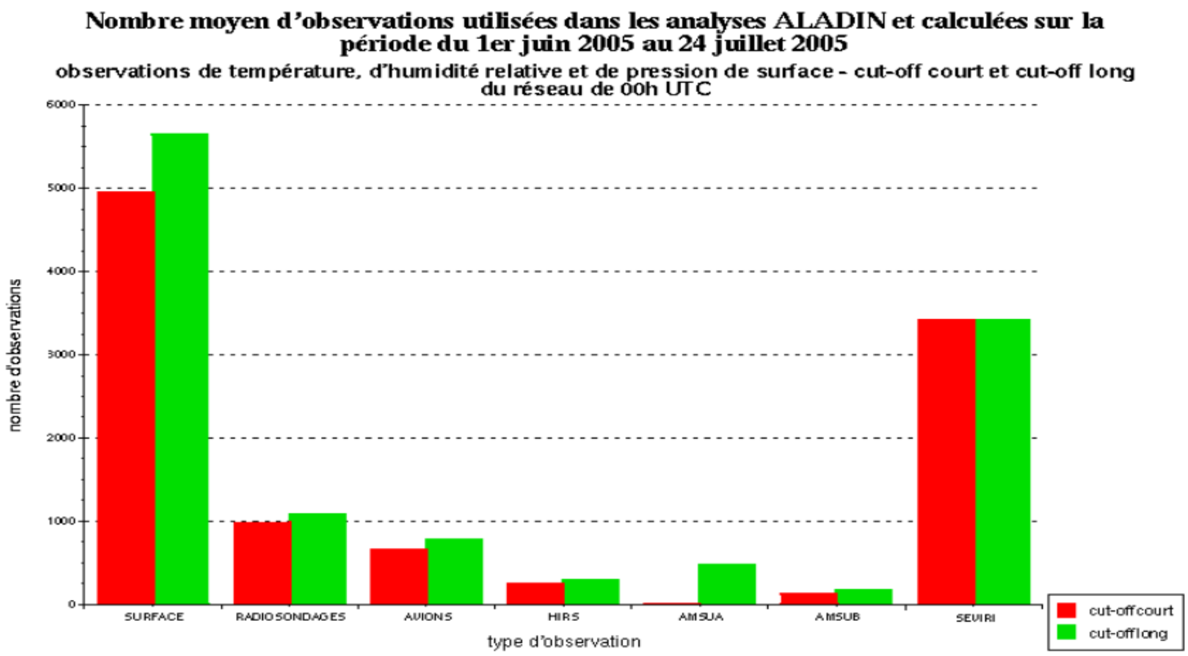
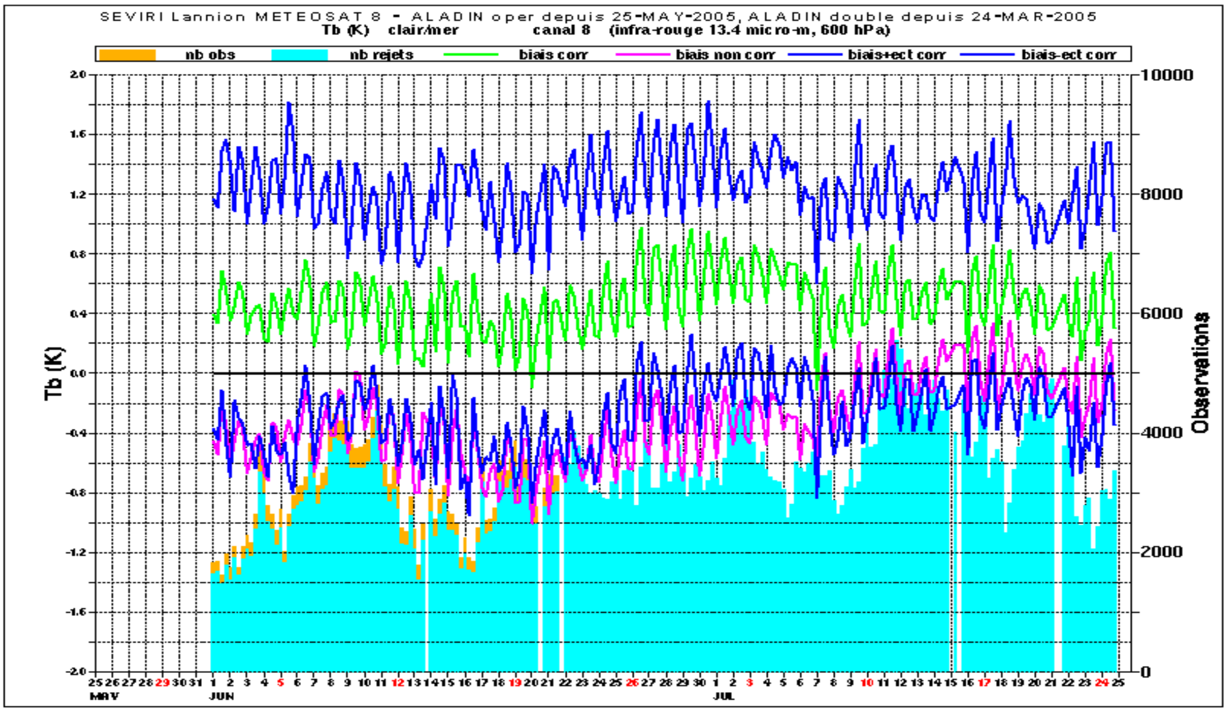


Figure 1 : Mean numbers of observations used by the 3DVAR assimilation scheme for ALADIN in the period from 01/06/2005 until 24/07/2005. These numbers are classified along the observations types. The red columns correspond to the production cycle and the green ones to the assimilation cycle. We only consider in these calculations the temperature, humidity and surface pressure data.

The comparison of the numbers for the two cycles shows a strong increase of the AMSU-A observations and a relative stability for the other types of observations. We can follow on the monitoring of the channel 8 of SEVIRI (Figure 2) that the removal of the instrumental bias is not correct. This has lead to add this channel to the blacklist for the ALADIN assimilation on the 23d June. This was justified by a further increase of this bias after this date!

Figure 2 : monitoring over 2 months for the channel 8 of the instrument SEVIRI of Meteosat 8 : histograms of the numbers of observations taken into account (yellow) and rejected (blue); curves of the bias before (pink) and after (green) the bias reduction. The two blue curves represent the borders of the interval corresponding to + and – the standard deviation.



Objective scores of the 3DVAR ALADIN version

The first reference to evaluate the behaviour of this new version of the model is provided by the radio soundings located in the simulation domain. Their number is equal to 48 spread quasi uniformly in this domain.

We plot on Figure 3 the mean errors over the domain FRANX01 (roughly the whole Europe) averaged over the second temporal period of the comparison.

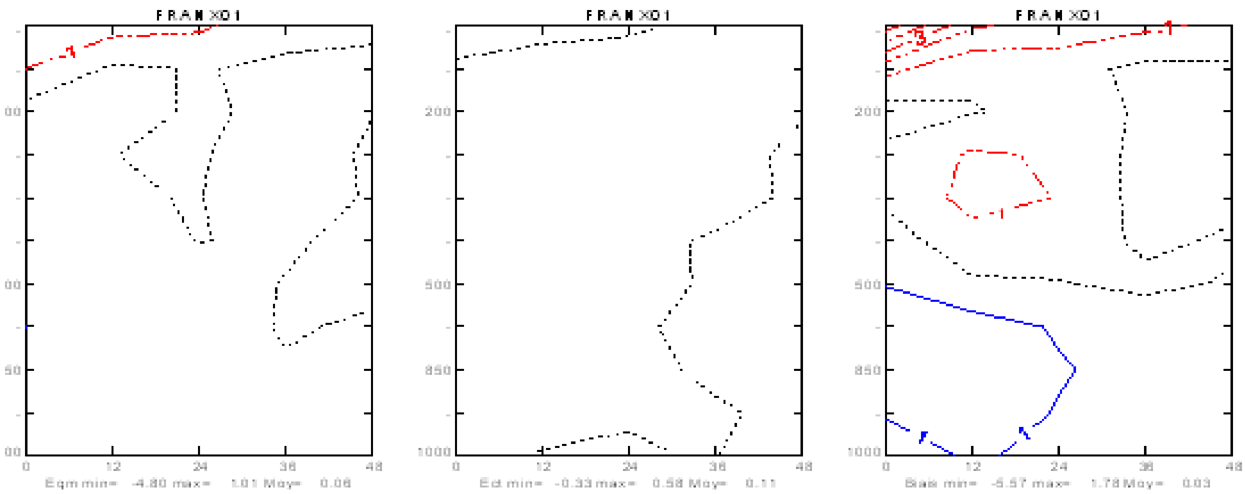


Figure 3 : diagram of the difference of the errors for the geopotential height (in m) of the operational version of ALADIN and its 3DVAR version: root mean squared error (left), standard deviation (centre) and absolute value of the bias (right). The horizontal axis corresponds to the duration in hours of the simulation and the vertical axis corresponds to the pressure. The reference is provided by the radio soundings over the domain FRANX01. The results are temporal averages from 16/06 until 25/07. The isolines are plotted every meter and the blue isolines correspond to an improvement in the quality of the forecast for the 3DVAR version and red ones to a deterioration.

The 3DVAR version performs a better job in the low troposphere (+1m) for the bias during the first day. Both version have the same quality for the 2 other parameters in the whole troposphere. Moreover, the bias for the 3DVAR version is stronger in the upper troposphere (-1 m) and get worse with the altitude leading also to a worsening of the root mean squared error above

150 hPa. This feature can be explained by the reduction (in comparison to the previous version 2005_01 of the 3DVAR ALADIN) of the coefficient of the return toward the observations. In the 3DVAR assimilation it has a value similar the ARPEGE one. The wind error (Figure 4) is still in favour of the 3DVAR version but the improvement is reduced in comparison to 2005_01 still for the same reason. This reduction remains important and about a quarter of the RMS error for the wind vector is removed with this 3DVAR version of ALADIN.

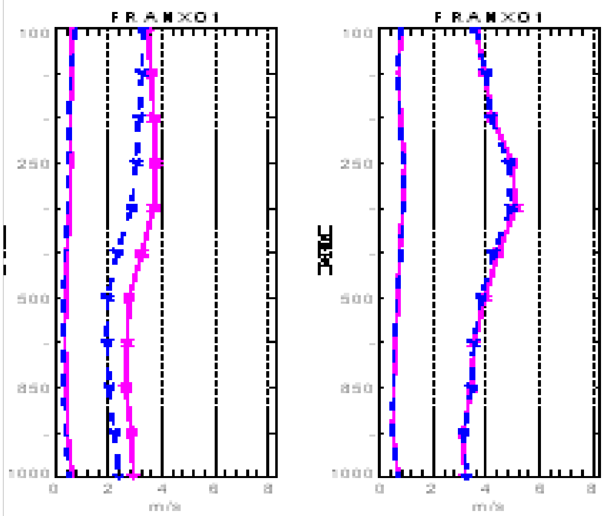


Figure 4 : vertical profile of the bias and of the RMS error for the vectorial wind of the 3DVAR version (blue) and of the operational version (pink) for 0 UTC (left) and 12 UTC (right). The reference is provided by the radio soundings of the domain FRANX01.

Figure 4 shows that the improvement in the 3DVAR version doesn't significantly last more than 12 hours. Figure 5 helps us to follow the temporal evolution of the different errors for the wind and to check that this new version is neutral in comparison to the operational dynamical adaptation after 12 hours.

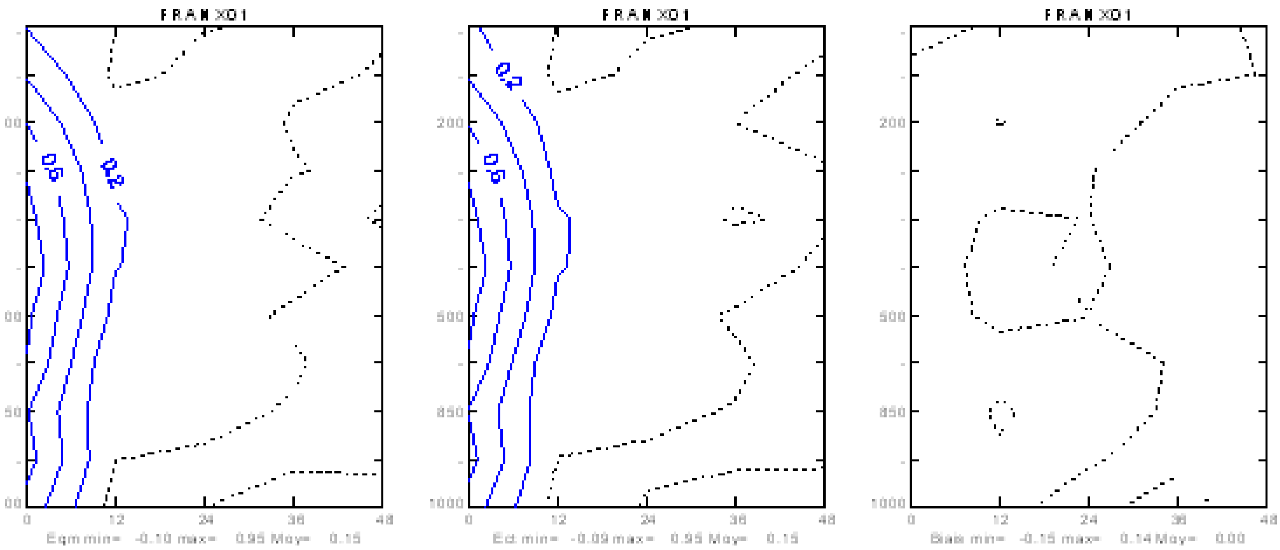


Figure 5 : same legend than Figure 2 but for the vectorail wind. The isolines are plotted every 0.2 m/s.

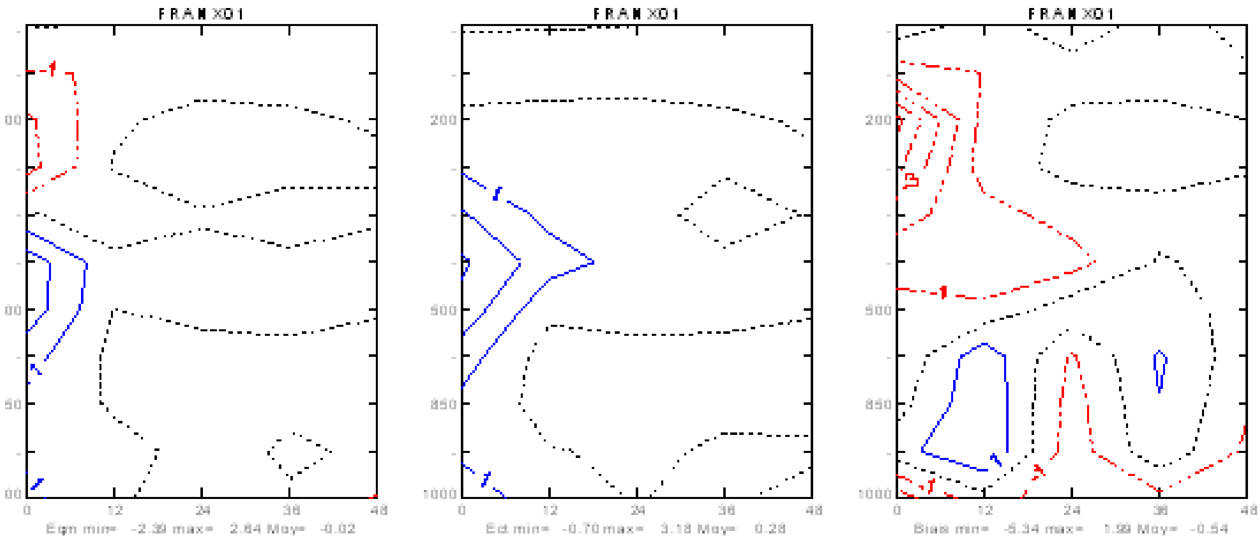


Figure 6 : same legend than Figure 2 but for the the relative humidity. The isolines are plotted every %.

The humidity scores (Figure 6) shows that the 3DVAR analysis brings a useful information in the troposphere with a decrease of 3 % for the RMS error in comparison to the operational version. As for the wind, this improvement is only limited to the first 12 hours. We can also note some problems at the tropopause linked with a bias increase in the 3DVAR version.

We now present the comparison of both ALADIN versions with a new reference: the analysis of the ECMWF on the same spatial domain FRANX01 but with a spatial resolution of 0.5° in latitude and longitude instead of 0.1° (nominal resolution of the ALADIN outputs). We will name this domain FRANX05.

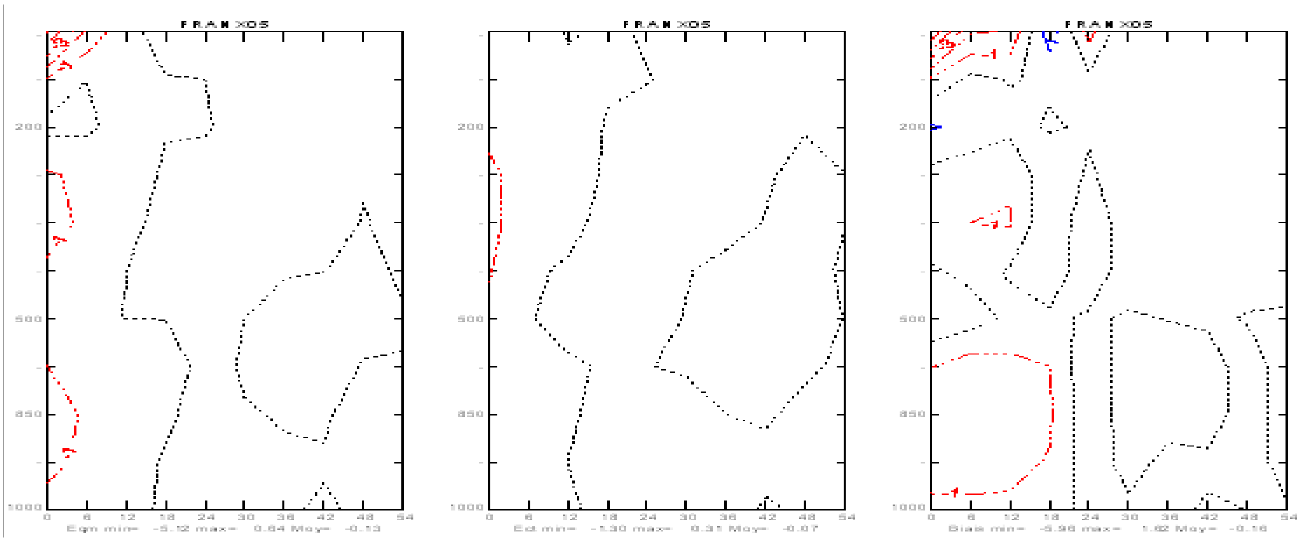
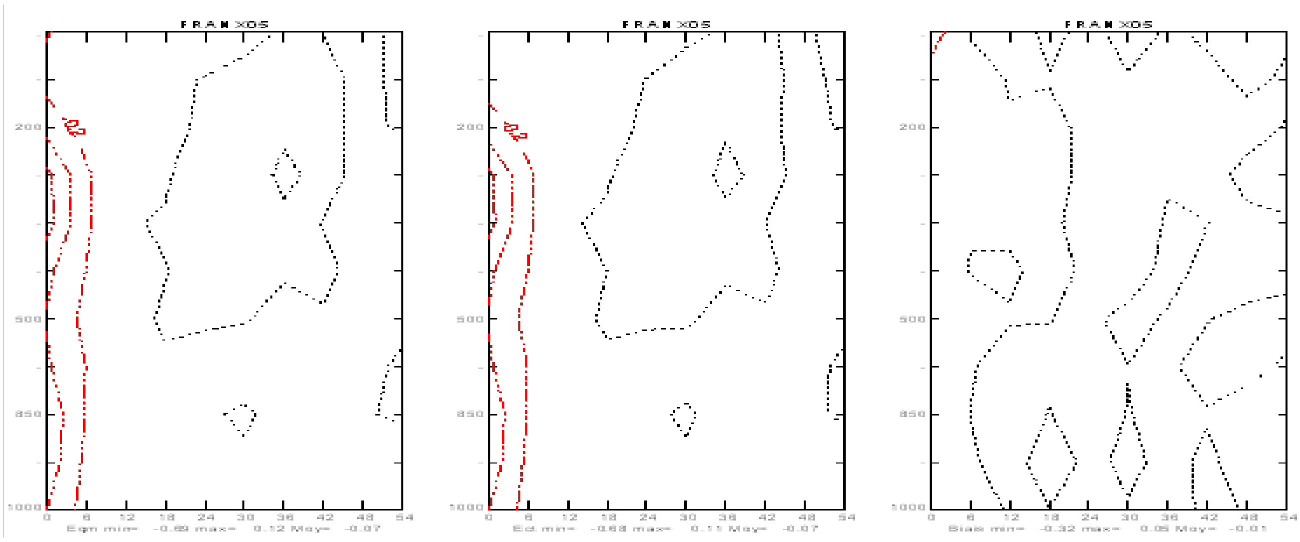


Figure 7 : same legend than Figure 3 but the reference is the ECMWF analysis of the geopotential height. The isolines are plotted every meter.

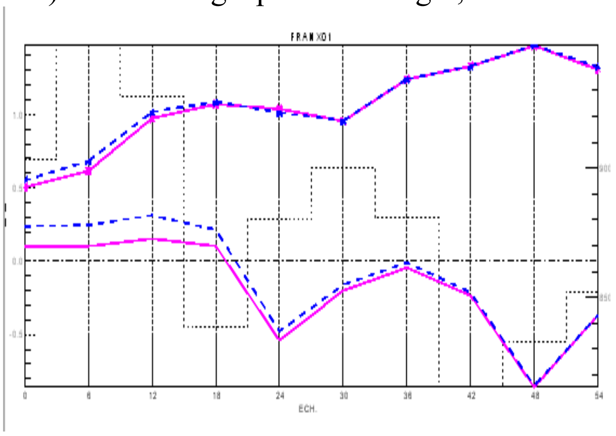
The stratospheric bias for the geopotential height also exists with this new reference (Figure 7) but its amplitude decreases more quickly with time than with the radio soundings. Moreover, the worsening of the bias against this reference confirms that the ALADIN analysis is nearer to the observations than the larger scale analyses. After 6 hours, the RMS error is negligible and the 3DVAR and operational forecasts are equivalent.

Figure 8 : same legend than Figure 5 but the reference is the ECMWF analysis of the vectorial wind. The isolines are

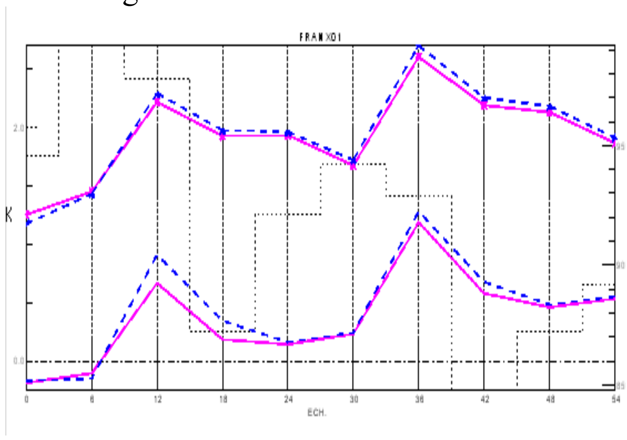


plotted every 0.2 m/s

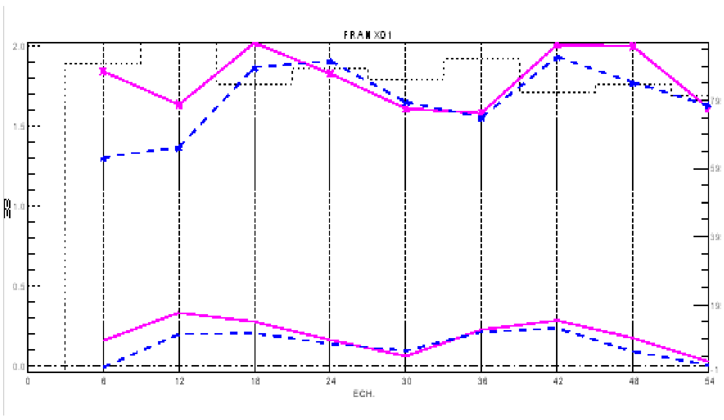
We note that all the improvements of the 3DVAR analysis (maximum of 0.8 m/s) correspond to a worsening of the scores with the reference given by the ECMWF analysis (minimum of –0.6 m/s). As for the geopotential height, we have no significant signal after 6 hours.



(a)



(b)



(c)

Figure 9 : bias et RMS for the domain FRANX01 in function of time (0-54 hours) for the reduced pressure in hPa (a), the corrected temperature in K (b) and the daily accumulated precipitation in mm (c). The reference is provided by the SYNOP messages and the operational model results are plotted in pink and the 3DVAR ones in pink.

The examination of the scores for the surface data shows that the bias of the test version is higher by 0.25 hPa during the first 18 hours in comparison to the operational version. Then, the bias become similar. The RMS errors are not significantly different. For the temperature, only the bias at 12 hours is increased by 0.2 K but no signal is present on the RMS errors. For precipitation, there is a strong improvement with a reduction of the bias and the RMS error until 18 hours. Then, the signal is less clear. We add the study of the precipitation scores by the analysis of the contingency tables for both versions. The accumulated rain between 6 and 12 hours (Table 1) show a clear advantage for the 3DVAR version with a strong increase of accuracy (or fraction correct) for the 3DVAR due to a better forecast of the no-rain class. The simulations, starting from the 3DVAR analysis, have a strong correct tendency to generate less rain during the beginning of the simulation. For the heavy rain category, we note a positive impact of the 3DVAR version with a joint improvement of the false alarm and non-detection rates.

PREVISION ALADIN DOUBLE ECHEANCE 12 H.							**PREVISION ALADIN OPER ECHEANCE 12 H.**					
OBS/PRE	Nulles	0.1<=P<2	2<=P<10	10<=P	Total		OBS/PRE	Nulles	0.1<=P<2	2<=P<10	10<=P	Total
Nulles	**69.1%**	17.0%	1.9%	0.1%	88.1%		Nulles	**61.8%**	21.6%	3.4%	0.2%	87.0%
0.1<=P<2	1.6%	**4.1%**	1.4%	0.0%	7.2%		0.1<=P<2	1.3%	**4.6%**	2.0%	0.1%	8.0%
2<=P<10	0.2%	1.5%	**2.2%**	0.3%	4.2%		2<=P<10	0.1%	1.8%	**2.2%**	0.4%	4.5%
10<=P	0.1%	0.1%	0.1%	**0.2%**	0.5%		10<=P	0.0%	0.1%	0.2%	**0.1%**	0.5%
Total	71.1%	22.7%	5.6%	0.6%	5042		Total	63.2%	28.1%	7.9%	0.8%	5317
onnes Prévi :	75.6%	0.65	Heidke :	0.31			**Bonnes Prévi :**	68.7%	0.58	Heidke :	0.26	
TFA 0,1 :	66%	TND 0,1 :	17%				TFA 0,1 :	69%	TND 0,1 :	11%		
TFA 2 :	55%	TND 2 :	41%				TFA 2 :	66%	TND 2 :	41%		
TFA 10 :	67%	TND 10 :	62%				TFA 10 :	84%	TND 10 :	74%		

Table 1 : Contingency tables between precipitation accumulated from 6 until 12 h TU observed (line of the tables) and forecasted by the ALADIN test version (left) and the operational one (right). We give under the table the fraction correct (Bonnes Previ in French), the Heidke score, the false alarm rate (TFA) and the non-detection rate for 3 different thresholds.

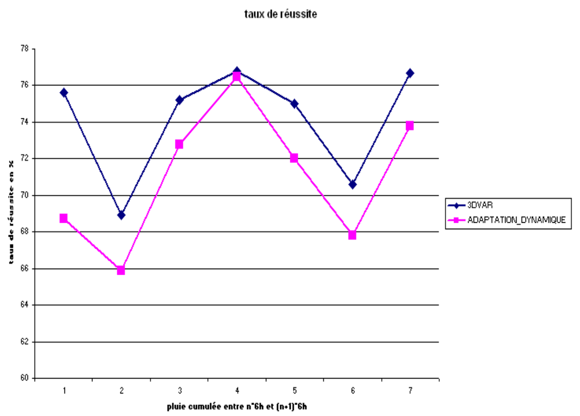
The contingency table for accumulated rain from 6 to 12 hours (Table 2) for the day after (i.e. between 30 and 36 hours of simulation) shows a reduced impact of the 3DVAR version of ALADIN. We only note still a progress in the forecast of the no-rain class. This leads to an improvement by 3 % of the correct forecast fraction. On the contrary, its false alarm and non-detection rates are similar to their operational counterparts.

The temporal evolution of the fraction correct for these 2 versions, plotted every 6 hours (Figure 10) shows the superiority of the forecasts starting from the 3DVAR analysis, which is maximum during the first hours of simulation but stabilizes after 18 hours around 2 %. This temporal evolution is coherent with the temporal evolution of the bias or the RMS errors for the precipitation (Figure 9c). The Heidke score is a bit different regarding the relative long-term behaviour of the precipitation for both versions because the improvement is present only during less than 12 hours and the Heidke scores of both versions are equal after.

PREVISION ALADIN DOUBLE ECHEANCE 36 H.					
OBS/PRE	Nulles	0.1<=P<2	2<=P<10	10<=P	Total
Nulles	**69.5%**	15.3%	3.1%	0.1%	87.9%
0.1<=P<2	2.0%	**3.5%**	1.6%	0.1%	7.3%
2<=P<10	0.5%	1.6%	**2.0%**	0.3%	4.3%
10<=P	0.1%	0.1%	0.2%	**0.0%**	0.5%
Total	72.1%	20.5%	6.9%	0.5%	4904
onnes Prévi :	75.0%		Heidke :	0.28	
TFA 0,1 :	66%	TND 0,1 :	21%		
TFA 2 :	66%	TND 2 :	48%		
TFA 10 :	91%	TND 10 :	92%		

PREVISION ALADIN OPER ECHEANCE 36 H.					
OBS/PRE	Nulles	0.1<=P<2	2<=P<10	10<=P	Total
Nulles	**65.7%**	18.0%	2.8%	0.2%	86.6%
0.1<=P<2	1.9%	**4.1%**	1.9%	0.2%	8.0%
2<=P<10	0.5%	1.9%	**2.1%**	0.2%	4.7%
10<=P	0.1%	0.2%	0.3%	**0.1%**	0.6%
Total	68.1%	24.2%	7.0%	0.7%	5317
Bonnes Prévi :	72.0%		Heidke :	0.28	
TFA 0,1 :	66%	TND 0,1 :	18%		
TFA 2 :	65%	TND 2 :	50%		
TFA 10 :	86%	TND 10 :	85%		

Table 2 : same legend as Table 1, but for the accumulated rain from 6 et 12 h UTC of the day after.



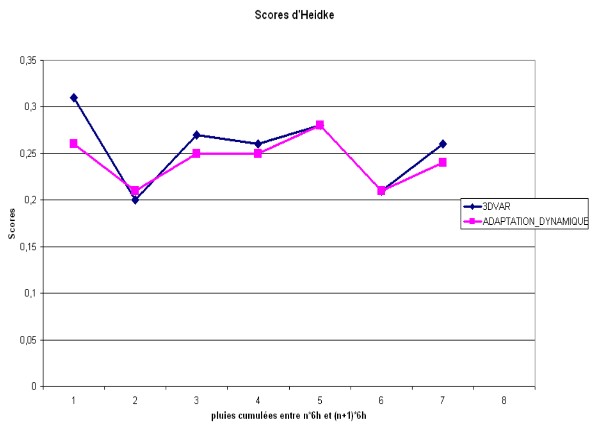


Figure 10 : Temporal evolutions of the succes rate (left) and the Heidke still score (right) of the 3DVAR ALADIN version in blue and of the operational version in pink every 6 hours starting from the accumulated rain from 6 until 12 hours of simulation.

Subjective validation

The subjective control of this test version has been realized in the COMPAS team over France and by the forecasters of the regional centre of the South-East of France (CMIRSE) over their own region. The number of situations studied by COMPAS (37 cases from 2 June until 11 July) is the double of the number of situation for the CMIRSE (20 cases from 8 June until 30 June). Nevertheless, the conclusions of both subjective controls are consistent. The summaries on the impact of the 3DVAR version are collected in the following table:

	positive > 9 hours	positive < 9 hours	neutral	negative
COMPAS	8	5	19	5
CMIR SE	8		8	4

We list the most remarkable points of this comparison:

- The forecasts starting from the 3DVAR analyses present more balanced structures than those coming from the spatial interpolation of the ARPEGE analysis. This leads, in the test version, to a strong decrease of light rain occurring during the first hours of simulation of the operational version. This change is visible in the false alarm rate which is strongly reduced.
- We have noted a decrease of the convective activity due to the decrease of the wet potential temperatures in the low levels of the atmosphere. This gives less triggering of the convection scheme. This is likely a consequence of the use of the temperature and humidity at 2 m AGL in the altitude assimilation scheme, which provides this useful correction. This gives an important decrease of the convection but also of the grid-point storms in the test version.
- The positive bias for the rain accumulated during 24 hours, is reduced in this test version.

Nevertheless, the improvement of the 3DVAR test version is mixed with some spurious convection triggering in this version. This happens frequently when the wet potential temperatures of the boundary layer are high. This sometimes produces (case of the 9 and 10 July) forecasts which are not informative on the distribution of the convection over France. Thus, during the 4 episodes of orange alert, which have occurred during the period of comparison, the 3DVAR version has not brought significantly better information in all cases:

(1) 13 June (convection over the South-East of France) neutral
(2) 23 June (strong convection over Paris) non-detection by both models
(3) 24 June (convection over the Centre-East and South-East of France) models not informative
(4) 27 June (convection over the South-West of France) The storm which happens over Bordeaux was forecasted offshore.

We can add to these 4 cases, the night between the 3 and 4 July, where both models have forecasted strong convection in the North of France, which was lightly under-estimated but informative regarding the storm which has been observed.

Conclusion:

A new version of the operational ALADIN model has started from the 25 July 2005: this model has its own assimilation scheme based on the 3DVAR method. This analysis assimilates the observations of the ARPEGE model after the same screening but also the SEVIRI radiances of METEOSAT 8 and the temperatures and humidity measured at 2m AGL in the altitude analysis. The scores of the forecasts starting from this analysis are better than those of the dynamical adaptation. This is mainly visible during the first hours of simulation for the wind and the temperature, when we compare them with the radio soundings data. This improvement is also present for the precipitation: we observe a strong reduction of the bias due to a reduction of the false alarms of convective rains during this summer period. A bias of 0.25 hPa exists for the reduced pressure in the first hours of simulation and we have to monitor during the next months.

2.4.2. Fischer C.: Summary of the GMAP/COMPAS documentation on the E-suite.

Of November 2005-January 2006
"new clim files", CY29T2_op2, GCO, January 19, 2006.
translated into English by C. Fischer, February 5, 2006.

Overview:

1. transmission, coupling and computational domain climatological (clim) files have all been re-built, for all MF models as well as all known domains from partner institutes. New geometry modules (JDG) and new file "cadre" specifications have been applied (new "cadres" are only accessible to centres who run CY26T1 or more). Several bugfixes have been taken into account in e923 (see appendix).
2. on Diapason, QuikSCAT, AQUA (AIRS and AMSU-A/B), GEOWIND extraction processes have been modified. This change concerns the BUFR format extraction and the "oulan" extraction tool. On VPP, the operational data handling of these observations has been adapted accordingly. QuikSCAT pre-treatment is now performed on VPP.
3. the original E-suite (August 2005) contained Lopez microphysics and 46 levels. These have been discarded end of November.
4. AIRS monitoring has been suspended in production (Arpège short cut-off and long range production forecasts). This change implies a different "bator_map" procedure between assimilation (long cut-off extraction for the assimilation cycle) and production.
5. new radiosonde bias correction (inspired from ECMWF), in order to counter the problem with temperature and geopotential in the stratosphere due to the radiation scheme.
6. new bias correction coefficients for SEVIRI data
7. optimisations for memory usage
8. update of the most frequently used BDM flags

Appendix: new clim files

Description of modifications in configuration 923:

- the code changes are based on cycle CY29T2 (bugfix number 2) instead of CY25T1 used before. The changes mostly concern part 1 of configuration 923, plus some other updates in other parts. The changes do not have significant consequences on the values of the fields.
- Aerosols and ozone fields (7 fields on the whole) are now properly added to the clim data in parts 8 and 9 (they had to be added manually before).
- A finer orography input database is used in part 1, in order to improve the representation of orography (GTOPT030 instead of GLOB95). A modified land/sea mask has been introduced accordingly (for instance: 150 points in Arpège high resolution, mostly located near the poles).
- The input files for part 6 of c923 have been changed. Therefore, surface and deep soil temperature, surface and total water contents, soil snow content, all are modified for all 12 months. Temperature and snow content input fields have been obtained from Arpège data processed over the period 01/09/98 and 31/08/00, when the operational Arpège model was in T199C3.5. Model fields have been cast on a 1 deg. by 1 deg. grid, and averaged for every month. For soil water content, the input data have been obtained from the GSWP (Global Soil Wetness Project), using Arpège vegetation data from 1987/1988, also processed over a 1 deg. by 1 deg. grid (these fields were obtained before from a set of Arpège analyses, taken over 1 year in T79C1, with a 1.5 deg. by 1.5 deg. resolution).

List of modified input fields:

Due to change in orography:

- SURF GEOPOTENTIEL: g times grid-point orography
- SPEC SURFGEOPOTEN: g times spectral orography
- SURF ET.GEOPOTENT: g times sub-grid orography standard deviation
- SURF VAR.GEOP.ANI: sub-grid orography anisotropy
- SURF VAR.GEOP.DIR: sub-grid orography dominant direction
- SURF Z0REL.FOIS.G: g times bare soil roughness length
- SURF Z0.FOIS.G : g times mean soil roughness length

Due to change in part 6:

- SURF TEMPERATURE: surface temperature
- PROF TEMPERATURE: deep soil temperature
- RELA TEMPERATURE: relaxation value for soil temperature
- SURF RESERV.NEIGE: soil snow content, expressed in equivalent water content
- SURF PROP.RMAX.EA: surface water content
- PROF PROP.RMAX.EA: deep soil water content
- RELA PROP.RMAX.EA : relaxation value for soil water content

Expected impact:

The biggest changes due to the new orography appear near the poles (due to the modified land/sea mask), and over significant mountain ridges (Antarctica, Andes, Himalaya). Elsewhere, differences are rather small, and globally negligible. Impact studies in Arpège have shown a rather neutral impact in terms of scores.

Changes due to the modified surface fields, and applied also in the surface analysis and for the model climatology (relaxation), have a negligible impact on altitude fields. They provide however a more realistic representation of soil water contents and snow contents, at large scale and over all continents. This allows for a better consistency between forecast and analysis, as concerns surface and soil fields.

Note that Fullpos also uses the new clim surface fields to post-process surface fields. Therefore, it is wise to modify also all post-processing clim files (Arpège, Aladin, BDAP). For old dates, a specific Olive task has been created to switch from old to new clim data.

2.4.3. Bouttier F.: The launch of the "Lopez/L46" parallel suite in Toulouse:

(preliminary documentation by C. Fischer, Météo-France, as of 22 February 2006)

A new Arpège parallel suite has been launched with the 18UTC assimilation run of 20 February 2006.

Its notable components are the following:

* 46 levels in the model and 4DVar data assimilation
* LREGETA + RW2TLFF dynamical switches changed
* no more linearized parametrization of stratiform precipitations in the second inner loop of 4DVar
* linearized physics are applied at the start of the semi-Lagrangian tarjectory
* "modified Lopez" parametrization of microphysics with 4 new prognostic variables (liquid water, ice, rain and snow)
* phys/dyn interface uses fluxes compatible with the laws of Catry-Geleyn
* microphysical adjustment on conservative cloudy variables, after turbulence
* RRTM longwave radiation scheme from ECMWF
* short wave radiation scheme from ECMWF (with 2 short-wave bands in ARPEGE instead of 6 at ECMWF)
* modified sea surface albedo and emissivity for ECMWF radiation scheme
* MODIS winds in assimilation from AQUA and TERRA satellites
* variational quality control
* channel 13 of AMSU-A is assimilated
* modified threshold for SSMI quality control
* NOAA18 is accepted in the code
* observation error standard deviations: AMSU-A channels 11 (0.5 K instead of 0.6), 12 (0.8 K instead of 1.2); 13 (1.2 K)
* ground-based GPS monitored
* Arpège forecasts at ranges 57, 63, 69 hours are added to the production
* new fields are available in the model files: resolved and convective clouds (compressed), extra radiation fields.
* the cycle used is 30T1 plus bugfixes, release ID is cy30t1_op1.01.L0209 on 20/2/2006

A more complete documentation, hopefully in English, will follow.

An Aladin-France E-suite is planned for week 12, with all the above plus the activation of Quikscat winds in the assimilation

Aladin Lopez fields will be cycled in assimilation mode, but never coupled.

2.4.4. Gril J-D.: The new geometry routines in the ALADIN model – Janvier 2006

Translated from French by « Tłumacz »

They are composed of :

- EGGPACK.F90,
- EGGANGLES.F90,
- EGGMRT.F90,

replacing the old ones :

- EGGX.F90,
- EGGMLT.F90,
- EGGDIR.F90,
- EGGRVS.F90.

Nevertheless, some restrictions have been set up :

- ➔ projections will be tangent to the globe (ERPK=sin(ELAT0);
- ➔ there will be no rotation of the pole of projection, i.e. options (NROTEQ > 0, ELONR, ELATR) are suppressed as well as parameters (ELONR, ELATR) in new « cadre »; NROTEQ is still used in « cadre »;
- ➔ the EBETA angle will no longer be used any more, since it is implicitly replaced by the use of ELON0, except for the Mercator projection;
- ➔ the « latlon » case is handled outside these routines.

You may not know it, but for a few cycles you are already using the new "EGGX package" (EGGPACK), apart from those still very late. Actually, for compatibility reasons (limited to the above restrictions), the old EGGX is only used by ECHIEN when reading a file which has an old frame (aladiners say « cadre ») (figure1). All other domain definitions and projections use EGGPACK (e.g. MAKDO).

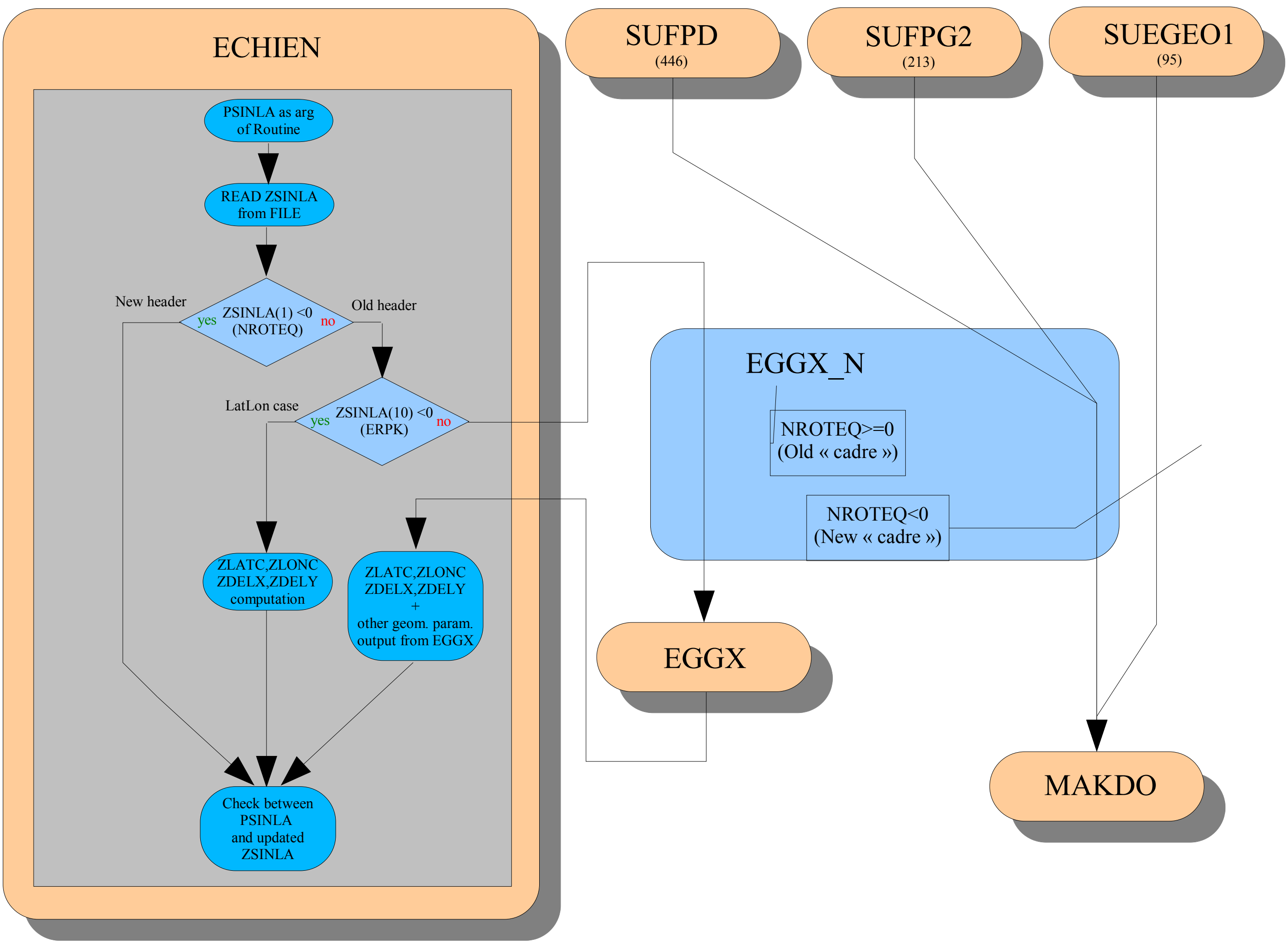


Figure 1 : Calling tree for ALADIN geometry

The first parameter from array ZSINLA (corresponding to NROTEQ) determines whether a file is either from the new or the old geometry. If it is equal to -1 (Lambert/Stereo.Pol/Mercator), or to -2 (Mercator rotated/tilted), then the « cadre » is from the new geometry, otherwise, if equal to 0, it is from the old geometry.

As shown in table 2 and figure 3, the meaning of the ZSINLA parameters is different according to the type of geometry (old or new).

	Parameters		Projections :					ZSINLA
	Model:	FullPos:	LatLon	Lambert	StereoPolar	Mercator	Merc.Rot.Tilt	Index
NCADFORM=1	LMRT	LFPMRT	(False)	(False)	(False)	(False)	True	-
	(NROTEQ)		{-1}	{-1}	{-1}	{-1}	{-2}	1
	ERPK	FPRPK	<0	]0,1[	{1}	{0}	{0}	2
	ELON0	FPLON0	{0}	]-180,180]	]-180,180]	]-180,180]	]-180,180]	3
	ELAT0	FPLAT0	{0}	]-90,90[	{-90,90}	{0}	{0}	4
	ELONC	RLONC	]-180,180]	]-180,180]	]-180,180]	]-180,180]	]-180,180]	5
	ELATC	RLATC	[-90,90]	[-90,90]	[-90,90]	[-90,90]	[-90,90]	6
	EDELX	RDELX	Degrees	Meters	Meters	Meters	Meters	7
	EDELY	RDELY	Degrees	Meters	Meters	Meters	Meters	8
	(ELX)		Degrees	Meters	Meters	Meters	Meters	9
	(ELY)		Degrees	Meters	Meters	Meters	Meters	10
	(EXWN)							11
	(EYWN)							12
	ELON1	RLONW	]-180,180]	]-180,180]	]-180,180]	]-180,180]	]-180,180]	13
	ELAT1	RLATS	[-90,90]	[-90,90]	[-90,90]	[-90,90]	[-90,90]	14
	ELON2	RLONE	]-180,180]	]-180,180]	]-180,180]	]-180,180]	]-180,180]	15
	ELAT2	RLATN	[-90,90]	[-90,90]	[-90,90]	[-90,90]	[-90,90]	16
NCADFORM=0	LMRT	LFPMRT	(False)	(False)	(False)	(False)	(False)	-
	(NROTEQ)		{0}	{0}	{0}	{0}	-	1
	(PLONR)		{0}	{0}	{0}	{0}	-	2
	(PLATR)		{0}	{0}	{0}	{0}	-	3
	ELON1	RLONW	]-180,180]	]-180,180]	]-180,180]	]-180,180]	-	4
	ELAT1	RLATS	[-90,90]	[-90,90]	[-90,90]	[-90,90]	-	5
	ELON2	RLONE	]-180,180]	]-180,180]	]-180,180]	]-180,180]	-	6
	ELAT2	RLATN	[-90,90]	[-90,90]	[-90,90]	[-90,90]	-	7
	ELON0	FPLON0	{0}	]-180,180]	]-180,180]	]-180,180]	-	8
	ELAT0	FPLAT0	{0}	]-90,90[	{-90,90}	{0}	-	9
	ERPK	FPRPK	<0	]0,1[	{1}	{0}	-	10
	(NSOTRP)		{0}	{0}	{0}	{0}	-	11
	(NGIVO)		{0}	{0}	{0}	{0}	-	12
	(ELX)		Degrees	Meters	Meters	Meters	-	13
	(ELY)		Degrees	Meters	Meters	Meters	-	14
	EDELX	RDELX	Degrees	Meters	Meters	Meters	-	15
	EDELY	RDELY	Degrees	Meters	Meters	Meters	-	16

NB: input parameters are in green; to be noted that for NCADFORM=0, ELATC, ELONC are absent despite having been used to create some geometry with the new EGGX (MAKDO). The LMRT/LFPMRT value (false) is the value by default.

Table 2 : Definition intervals and links between « ZSINLA » array and geometrical parameters

For compatibility sake, it is possible, even if the routines used in the model are those of the new EGGX (EGGPACK),to specify a type of « cadre » for FA file (old or new). Key NCADFORM (figures 3 & 4) makes this possible. At this stage, the default value is set at 0, which means that the « cadre » is of the old type. In the future, the default value should be set at 1 (new type of « cadre ») as we will shift to the new geometry in climatological files and the remaining of the suite. In the meantime, NCADFORM = 1 should always be specified so that the « cadre » should be compatible with the new geometry.

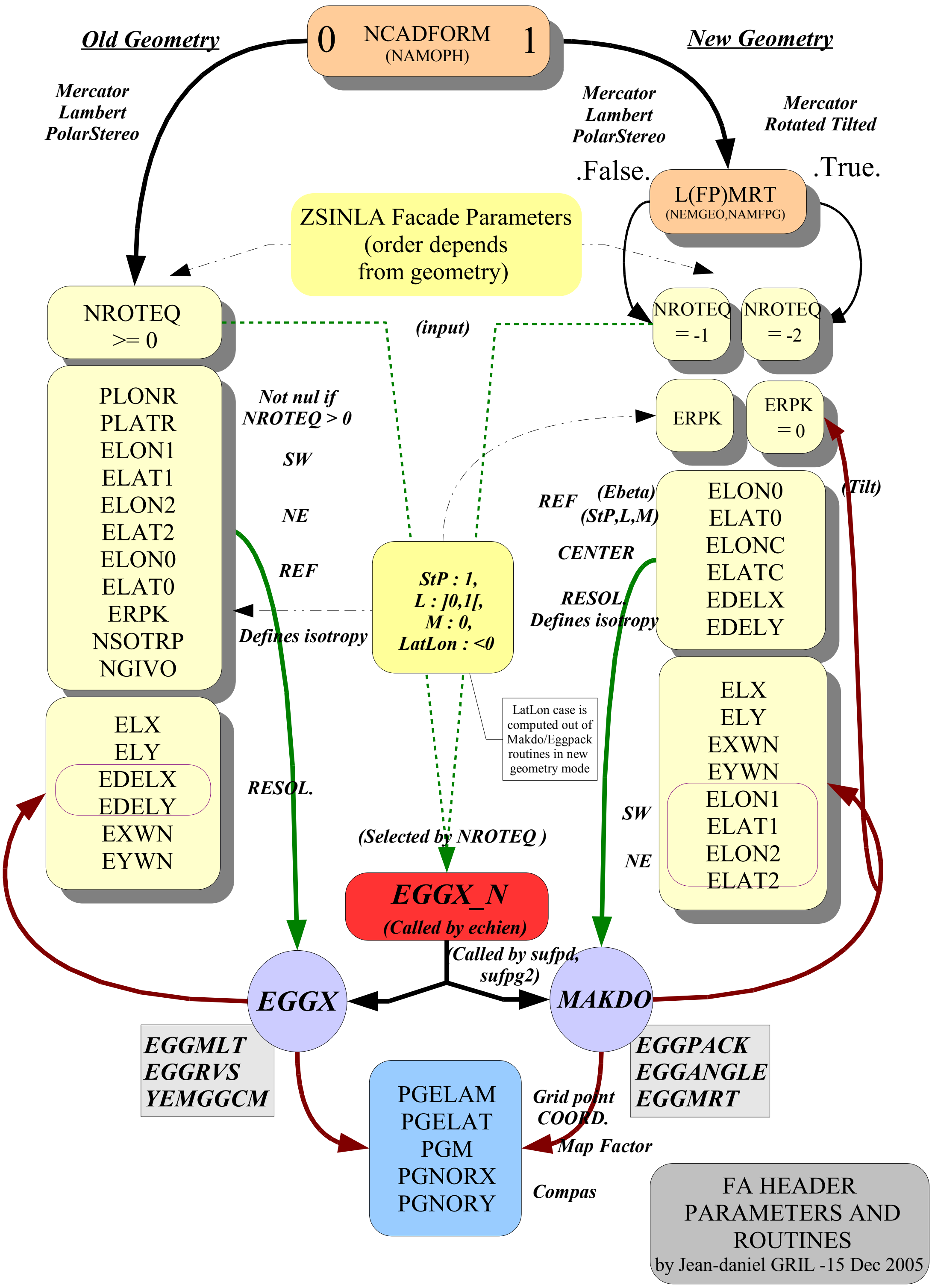


Figure 3 : Meaning of geometrical parameters, read in FA file « cadre » or set up by model

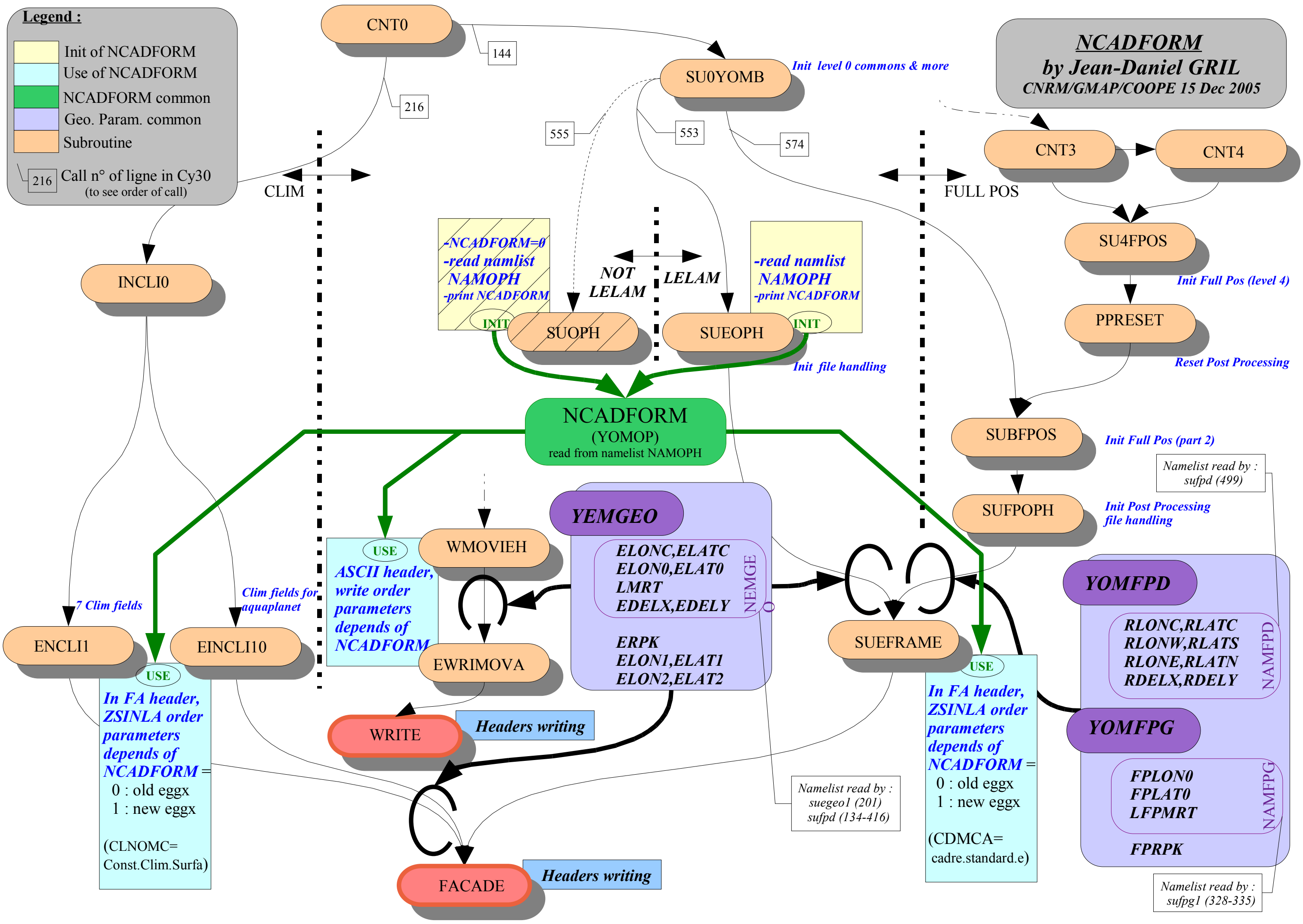


Figure 4 : Dataflow for geometry in the model. Left : e923; Middle : forecast; Right : FullPos/e927 (cy30)

Let me remind you once more that, the management of the « latlon » mode is independent from EGGPACK. One chooses either « latlon » or « projection » mode (see the values of parameters in table 2).

Until cycle 30T1 (incl.), a problem occurred with « latlon ». It will be corrected soon. It has to do with « latlon » climatological files created with ELAT0, ELON0 not explicitly defined in namelist (« latlon » choice should set them at 0°). As a matter of fact, these files have for values 10° and of 60° (values by default).In SUFPG1 (during the FullPos creation of « latlon » coupling files), the equivalent (FPLAT0, FPLON0) parameters are initialized at (ELAT0, ELON0) (which should not generate an error) but, whatever values are read in NAMFPG (if they are specified, which should not be required in « latlon » mode), these values (FPLAT0, FPLON0) are forced to 0° (which is normal for « latlon ») which, in turn, induces an error in ECHIEN (table 5). That is why we had to give you new climatological files with (ELAT0, ELON0) set to 0°.

LELAM	PART	CFPFMT	GAUSS	MODEL	LATLON	LELAM
FALSE	SETUP	N° LIGNE	132	132	161	187
		FPLAT0	0	0	0	f(CFPDOM)
		FPLON0	0	0	0	
		FPRPK	-9	-9	-9	?
		LFPMRT	F	F	F	F
		FPLX	0	0	0	RDELX
		FPLY	0	0	0	RDELY
	READ NAMFPG namelist at LINE 328					
	CHECK	N° LIGNE	425	349	370	448
		FPLAT0	0	0	0	(no check)
		FPLON0	0	0	0	
		FPRPK	-9	?	-9	
		LFPMRT	F	F	F	
		FPLX	0	0	0	
		FPLY	0	0	0	
		LFMAP	T	T	T	
TRUE	SETUP	N° LIGNE	251	297	274	297
		FPLAT0	0	ELAT0	ELAT0	ELAT0
		FPLON0	0	ELON0	ELON0	ELON0
		FPRPK	-9	?	?	?
		LFPMRT	F	F	F	F
		FPLX	0	ELX	ELX	ELX
		FPLY	0	ELY	ELY	ELY
	READ NAMFPG namelist at LINE 328					
	CHECK	N° LIGNE	425	403	370	448
		FPLAT0	0	ELAT0	0	(no check)
		FPLON0	0	ELON0	0	
		FPRPK	-9	?	-9	
		LFPMRT	F	LMRT	F	
		FPLX	0	ELX	0	
		FPLY	0	ELY	0	
		LFMAP	T	LMAP	T	

Table 5 : Default setup and parameter check (after namelist has been read), in SUFPG1 (cy30)

Briefly :

- as long as the default value of NCADFORM is not 1, it must be specified when using your programs.
- For security sake for the present time, it is necessary to explicitly define (ELAT0, ELON0) (at 0°) when creating climatological files.
- May I remind you to test your configurations using « cadres » of files FA as well as your side applications using the new geometry before the switch scheduled within the end January 2006.
- Please note that, the WMOVIEH et EWRIMOVA routines are modified so as to take into account the presence of the Mercator Rotated/Tilted geometry.
- WARNING : since cy29T2 (incl.) and until the corrected version 2005.0927 of EGGPACK , an error occurred in Mercator case, in routines LATLON_TO_XY_S (near line 911) and LATLON_TO_XY_V (near line 974)[1]

1 Some new amendments have been made since the publication of the article and will be inserted in next Newsletter.

2.5. AUSTRIA

2.6. BELGIUM

J. Vandergorght - (more details Josette.Vanderborght@oma.be)

2.6.1. Main feature:

- Model version: AL28T3.
- Initial conditions: 4d-var data assimilation coming from Météo-France.
- 60 hours production forecasts twice a day (midnight and midday), with an upgrade to four in March 2006.
- Lateral boundary conditions (LBC) from Aladin-France and Arpege. Midnight run: Coupling with Aladin-France for 0-54 hours range and with Arpege for 54-60 hours range.
  Midday run: Coupling with Aladin-France for 0-42 hours range and with Arpege for 42-60 hours range.

2.6.2. Model geometry:

- 7 km horizontal resolution (240*240 grid points).
- 41 vertical model levels.
- Linear spectral truncation.
- Lambert projection.

2.6.3. Forecast settings:

- Digital filter initialization (DFI).
- 300 s time step (two level semi-implicit semi-Lagrangian advection scheme).
- LBC coupling at every 3 hours.
- Hourly postprocessing on four different combinations of domains (small and big) and projections (latitude-longitude and lambert).
-

2.6.4. The computer system:

Present:

- SGI ORIGIN 3400.
- 24 processors MIPS RISC, 700 Mhz.
- Total memory: 24 Gb.
- Operating system: IRIX ASE 6.5.
- Batch queuing system: PBS Pro 5.0.

Future (February 2006):

- SGI Altix 3700BX2.
- 56 processors Itanium2, 1.5 Ghz.
- Total memory: 104 Gb.
- Peak performance: 0.23 Tflops.

New integrated scheme for clouds and convection (Luc Gerard)

The work is going on, with experiments at different resolutions.

We further refined some parts of the parametrizations, like the representation of the Bergeron effect.

The work on a simplified version developed for Alaro was the occasion for reviewing and rationalizing. The behaviour at 4 and 2km still requires further tuning.

2.7. BULGARIA

A. Bogatchev - *(more details andrey.bogatchev@meteo.bg)*

During 2005, several changes occured in operational suite of ALADIN-BG:

In March, operations were switched to the new integration domain with linear grid, which was implemented in the autumn of 2004. Domain characteristics look as follows:

- number of points 108x80 (91x69)
- linear grid
- horizontal reslution 12.0 km
- time step 514.28571 s.

Also was implemented latlon domain for post processing with resolution 0.1x0.1 degrees, using climatology files.

In April the scripts for retrieving coupling files were completely rewritten due to the change of the fire wall software at Meteo France.

During the autumn of 2004, the porting of the export of cy29t2 was done. The installation was done only for the model part, thus the routines concerning ODB were removed from the pack, leaving only the *.h files. There were no serious problems during the porting, but more or less usual things:

- misplaced declarations, duplicate declaration, way of initialising of character variables, using Hollerit notation and so on.
- In xrd/svipc/svipc.c were added definitions for MIN and MAX under ifdef LINUX.
- Compilation was done, using Intel compiler v 9.0.
- For loading the wrapper sld, which emulates the vpp incremental loader was used.
- Since December it was put to parallel suite.

Successfull switching to the new coupling and climatology files happened on 30 of January 2006. It might happen earlier, but there were some problems with climatology files for the integration domain.

AL29T2 was upgraded to AL29T2_OP2 and put to parallel suite.

2.8. CROATIA

M. Tudor and S. Ivatek-Šahdan - *(more details tudor@cirus.dhz.hr & ivateks@cirus.dhz.hr)*

2.8.1. Summary

The operational suite has changed significantly. The “big” switch happened with the 00 UTC run on 1st December 2005. The research on EPS has continued. NH dynamics and SLHD have been tested in high resolution (2 km).

2.8.2. Operational suite

✗ **Status**

ALADIN is operationally run twice a day, for 00 and 12 UTC. Coupling files are retrieved from ARPEGE (Meteo-France global model) via Internet and RETIM2000. Model resolution is 8 km for Croatian and 2 km for the high-resolution dynamical adaptation domains. The execution of the suite is controlled by the OpenPBS (Portable Batch System) as the queuing system.

Initialisation of ALADIN on Croatian domain is provided by Digital Filter Initialisation (DFI). Coupling frequency and frequency of output files is 3 hours. The forecast range is prolonged to 54 hours. The operational version of Aladin is AL28T3 including some additional modifications linked with SLHD and physics parametrizations.

Visualisation of numerous meteorological fields are done on LINUX PC. Comparison of forecasts with SYNOP data are done hourly for today's and yesterday’s forecast. Similar comparison with measurements from automatic stations has been introduced on 9th January 2006. The products are available on the Intranet & Internet. Internet address with some of the ALADIN products, like total precipitation and 10 m wind: http://prognoza.hr/aladin_prognoza_e.html.

✗ **Domains**

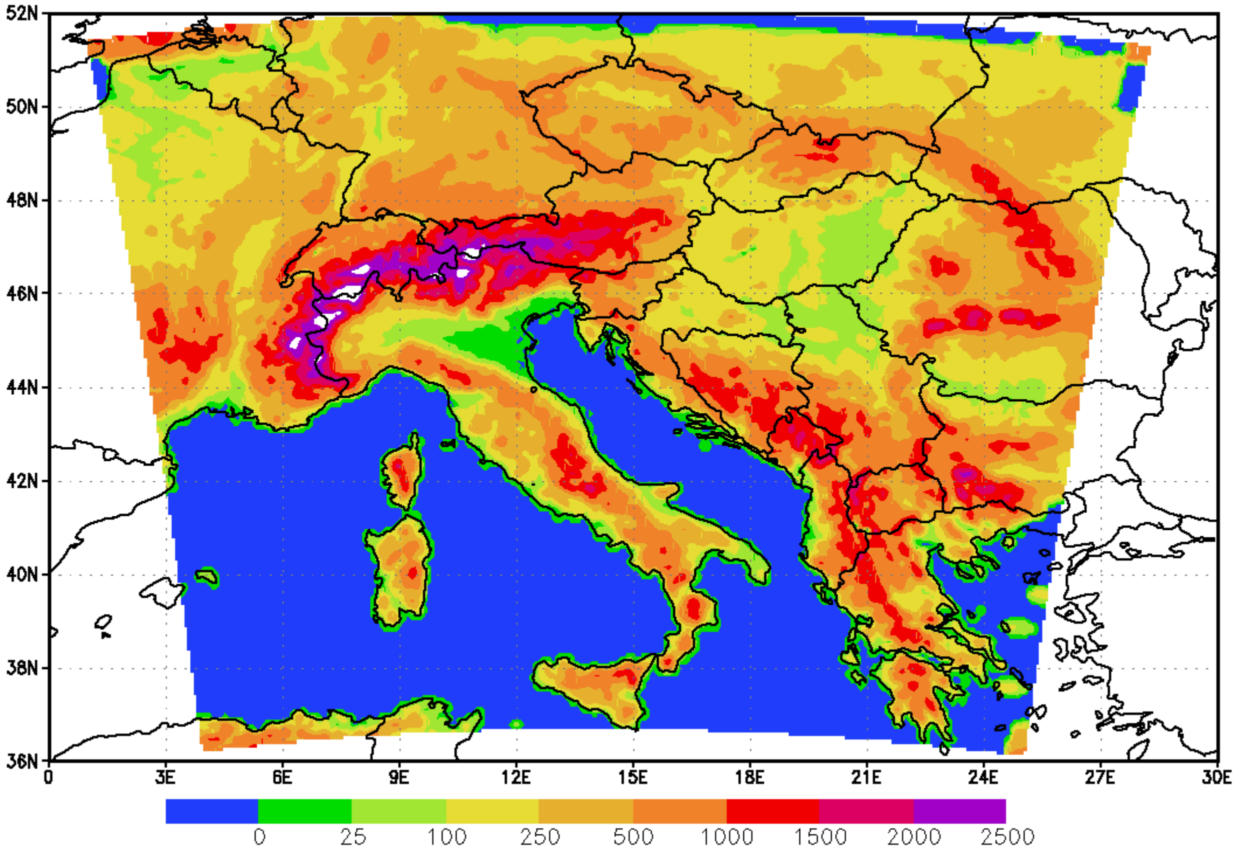


Figure 1. The new Croatian domain.

Horizontal resolution of the Croatian domain is 8 km, 37 levels in the vertical, time-step 327 sec, 229x205 grid points (240x216 with extension zone). Corners: SW (36.18,3.90), NE (50.68,26.90).

The only change related to the 6 domains for the dynamical adaptation of the wind field in the lower troposphere to 2-km resolution orography for mountainous parts of Croatia is the removal of envelope. Dynamical adaptation is run sequentially for each output file, with 3 hour interval. In the dynamical adaptation meteorological fields are first interpolated from input 8-km resolution to the dynamical adaptation 2-km resolution. The same file is used as a initial file and as a coupling file that contains boundary conditions for the model.

✗ **Operational model version**

The operational version of Aladin is AL28T3 including the modifications introduced in Prague, mostly linked with physics parametrizations; orography is without envelope, modified gwd scheme is used, cloudiness and radiation packages and semi-Lagrangian horizontal diffusion.

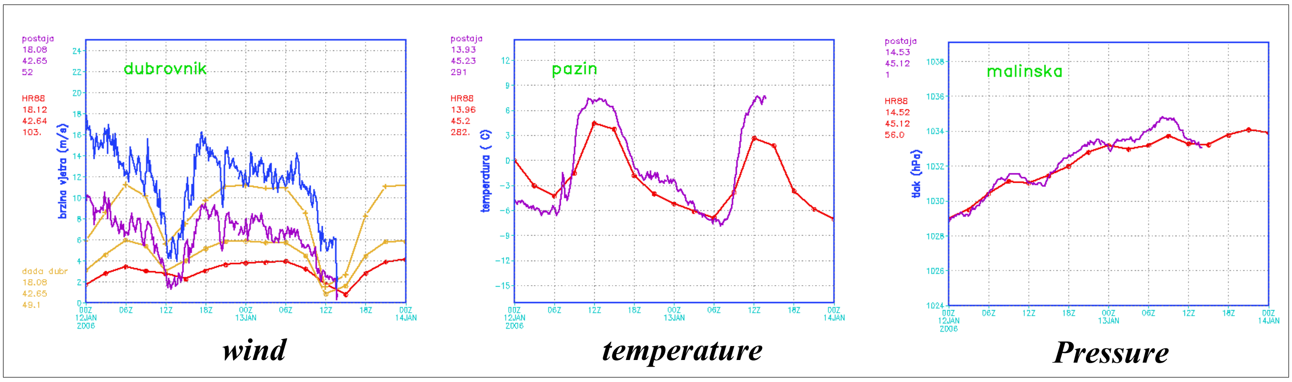


Figure 2. Comparison of forecasts with to the measurements from automatic stations for 10m wind in Dubrovnik (left), temperature in Pazin (center) and pressure in Malinska (right), 8-km resolution forecast is in red, 2-km resolution average wind speed and gusts are in orange, measured 10-minute average is purple and measured 10-minute maximum is blue.

✗ **Plans**

The new snow scheme will be used after the required fields become available in the coupling files. The forecast range will be prolonged if the range of coupling files will. The increase of the vertical resolution is being considered, but requires a stronger computer.

ALARO0 should be ported and run at least on a daily basis. The size of domain and forecast range will be set depending on the its cost.

A possibility to use smaller number of larger high resolution dynamical adaptation domains is considered. Also, using SLHD and NH dynamics in this part of the operational suite would be beneficial.

2.9. CZECH REPUBLIC

2.10. FRANCE

2.11. HUNGARY

I. Bujdoso - *(more details bujdoso.i@met.hu)*

Basically, the operational model version was kept unchanged in the second half of 2005 with the following characteristics:

- ALADIN cycle: cy28t3
- Horizontal resolution: 8 km
- Vertical levels: 49
- Grid: linear
- Data assimilation: 3d-var
- Observations: SYNOP, TEMP, AMDAR, ATOVS:AMSU-A

Parellel suites during the period:

- ALADIN dynamical adaptation at 8km horizontal and 49 levels vertical resolution
- ALADIN 3d-var using AMSU-B data
- ALADIN dynamical adaptation using "Czech physics"

2.12. MOROCCO

2.13. POLAND

2.14. PORTUGAL

M. Lopez - (*more details manuel.lopes@meteo.pt*)

- Significant effort was devoted to the tuition of 2 new ALADIN team elements, in the last semester of 2005.
- The AL28T3 cycle was installed by the end of the year. It was found that AL28T3 takes 2s longer per time step than the AL12_bf02.
- The dissemination of ALADIN derived products was optimized and some meteorological applications were migrated from OpenVMS to UNIX.
-

2.15. ROMANIA

2.16. SLOVAKIA

M. Derkova - *(more details maria.derkova@shmu.sk)*

2.16.1. Operational ALADIN/SHMU system

The setup of ALADIN/SHMU model domain and version was not changed during the 2d half of 2005.

Concerning the hardware, the IBM Total Storage Tape Library (24TB) with Tivoli Storage Manager archive device was put to operations, for the time being with interactive access only.

In the operational suite, the main modifications were the introduction of the **additional runs** at **06UTC** (25/07/2005) and **18UTC** (29/09/2005), both up to **+54h**; and the introduction of the **dynamical adaptation** of the wind field over the territory of Slovakia with a 2.5km resolution (21/09/2005). An example of the dynamical adaptation usage is shown in figures 1 and 2: 36h forecast of the wind field and the wind gusts for 30/12/2005 12UTC - an episode when strong wind in combination with snow have caused serious car accidents, with 4 casualties, on the roads of West Slovakia. The structure of the wind field reflecting the local topography is better represented with a 2.5km resolution, as was expected.

Among new products generated from ALADIN/SHMU outputs, the automatic point forecast has its graphical version - meteogram, and it is verified in the same graphical format (verifmet). In figures 3 and 4, an example for BRATISLAVA station is shown.

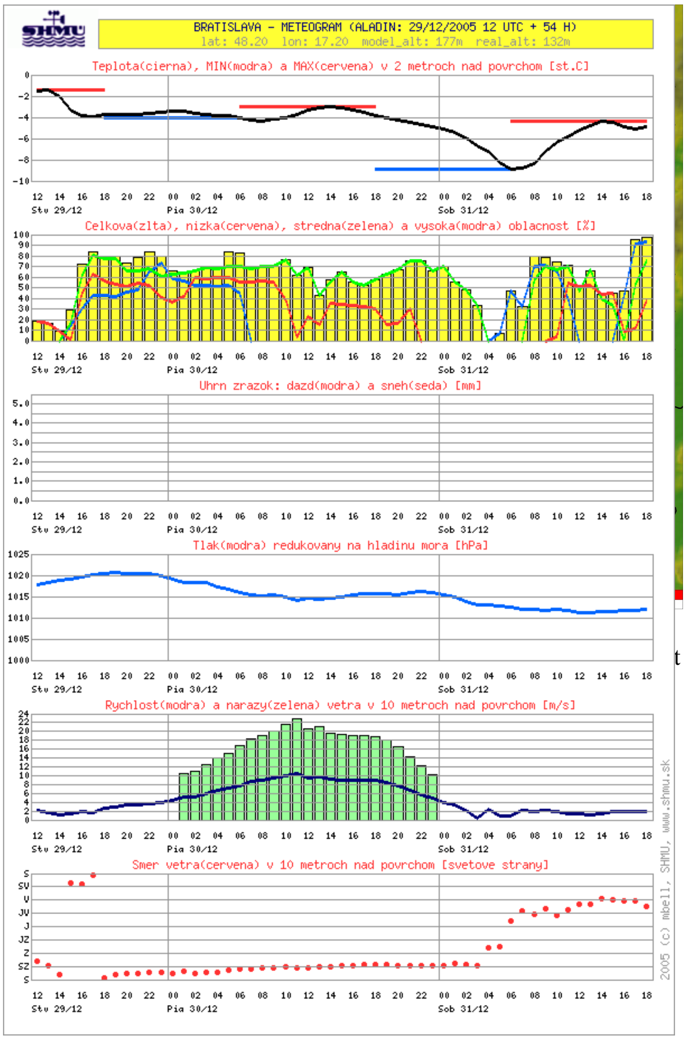


Figure 3: Meteogram

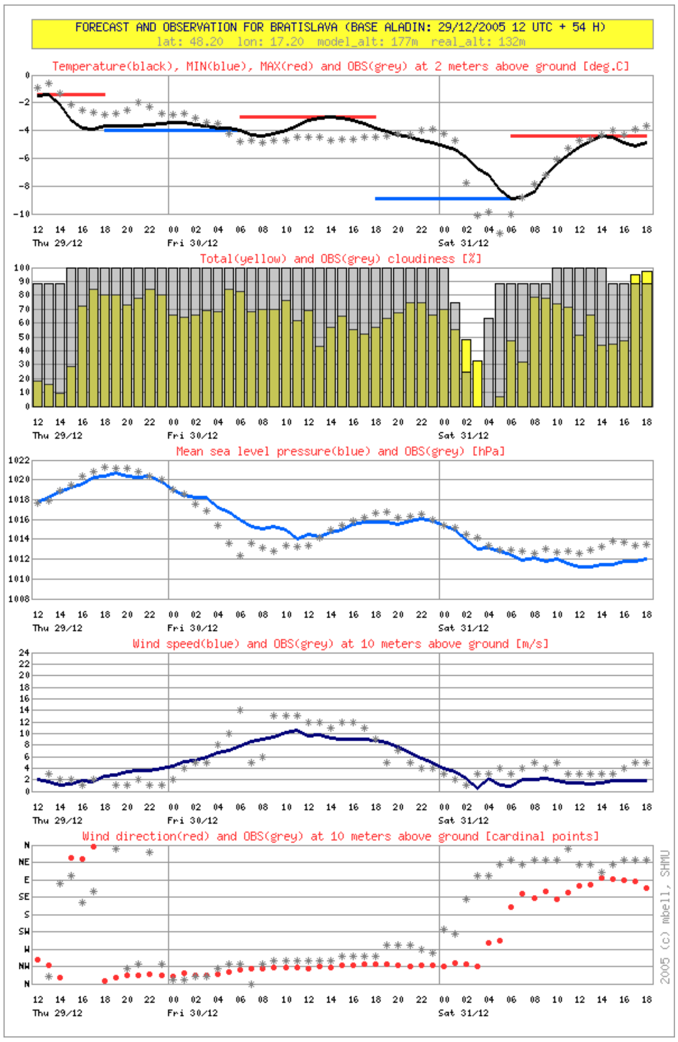


Figure 4: Meteogram verification

2.17. SLOVENIA

N. Pristov - *(more details neva.pristov@rzs-hm.si)*

Forecast length was prolongated up to 54h on 20/07/2005. The ALADIN operational suite was switched to cy29t2 on 07/12/2005. Changes in physical parameterization for cloudiness and radiation and SLHD were introduced.

The computer system and operational suite has been controlled by NAGIOS supervision system since the end of July. Failures and problems are reported to e-mails and via SMS messages to mobile phones. This has been found as very useful, number of cases with delays were reduced, although there is regular operational supervision only during working hours and voluntarily during the rest.

The transfer of coupling files from ARPEGE model via Internet from Toulouse was very stable. Few times in July happened that the transfer rate in the afternoon was slow (10kB/s) and three times during six months coupling files were not available because of the problems at Meteo-France. Files were significantly delayed (available after 4:30/16:30 UTC) 8 times.

Some efforts were devoted to the OpenMP version of ALADIN model. The OpenMP version is running but it has not been put in to the operational suite yet. It is planned to do so in forthcoming months due to decreased memory consumption and good execution efficiency.

2.18. TUNISIA

2.19. HIRLAM

3. RSEARCH & DEVELOPMENTS

3.1. AUSTRIA

3.2. BELGIUM

3.3. BULGARIA

3.4. CROATIA

M. Tudor & S. Ivatek-Šahdan - *(more details tudor@cirus.dhz.hr & ivateks@cirus.dhz.hr)*

3.4.1. Impact of SLHD, NH dynamics and different orography representations on high resolution forecast

The study has been performed on one of the 6 domains for the dynamical adaptation of the wind field in the lower troposphere to 2-km resolution orography for mountainous parts of Croatia that are used operationally. The most thoroughly studied phenomenon in this context is bura, particularly one case of severe bura on 14th November 2004.

3.4.2. LAM EPS

The research on downscaling of the ECMWF EPS members has continued.

3.5. CZECH REPUBLIC

3.6. FRANCE

See articles in this Newsletter.

3.7. HUNGARY

I. Bujdoso - *(more details bujdoso.i@met.hu)*

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

The main events of the second part of 2005 can be summarised as follows:

a) Shortly after the operational implementation of the three-dimensional variational data assimilation scheme the activities around its improvements had been continued:

- Impact studies using ATOVS:AMSU-B satellite data. It was decided to put this new data source also into operations for the first part of 2006 (for more details, see the article of Roger Randriamampianina in the same Newsletter).
- EUCOS impact studies: the ALADIN 3d-var system was running for the original LACE domain (12 km resolution) with bondary conditions from ECMWF/IFS data in order to study the relative importance of the space and terrestrial components of the observing system. Basically the evaluation of a longer winter period was almost completed.

The following set of impact studies were considered (as demanded by the EUCOS team):

1. Baseline version (BL): all satellite data (ATOVS AMSU-A, AMSU-B, AMV: Atmospheric Motion Winds), surface observations and limited number of radiosonde data
2. BL + aircraft data
3. BL + additional radiosounding wind dat
4. BL + additional radiosounding temperature and wind data

5. BL + windprofiler data
6. as 4. + aircraft data
7. as 4. + additional radiosounding humidity data
8. full combined data assimilation system (all available data)

The evaluation of these experiments are based on classical scores for upper-air and surface parameters, verification of weather parameters (e.g. Precipitation) and investigation of significance tests.

The preliminary results of the impact studies (for the winter period) will be presented to EUCOS around spring.

- A stay was devoted by Kristian Horvath to the computation and study of the ensemble background errors in ALADIN (supervised by Gergely Boloni).
- A stay was devoted by Steluta Vasiliu about the first tests of 3D-FGAT (3D First Guess at Appropriate Time) scheme (supervised by Sándor Kertész),

b) The sensitivity of global singular vector computation with respect to its target domain and time was continued and completed until the end of 2005. The final results confirm that although the proper choice of the target domain and time can improve the global (and limited area) ensemble system, the studied limited area ensemble system cannot provide reasonable improvements by the direct downscaling of the gloabal system (see more detailed report in the same Newsletter).

c) The adaptation of the AROME prototype had been continued: several technical and practical hurdles were overtaken and the first case studies started to be investigated (see the report of László Kullmann in the same Newsletter).

3.8. MOROCCO

3.9. POLAND

3.10. PORTUGAL

3.11. ROMANIA

R. Radu - *(more details raluca.radu@meteo.ro)*

3.11.1. A case study using spectral coupling method (Raluca Radu)

The impact of spectral coupling behavior at finer resolution in local phenomena such as a tornado event (Movilita, Romania, 07.05.2005) was studied (see previous Newsletter). The results correlated with the observations show the capacity of different coupling methods to simulate this event.

Different mechanisms were identified for the frontogenesis phases: first phase of diabatic nature which was generated in PBL at 35 (11 UTC) (Figure 1a, Figure2a) was characterized by a rapid development at small scale through topographic forcing and PBL nonstationarity (mechanism 1). This phase was better represented with the operational gridpoint coupling scheme. The second phase of the frontogenesis regeneration produced after 3h by the nonlinear interactions between the large and the small scales (mechanism 2) was represented more realistically with the spectral coupling method. The energy exchange here was sustained from the upper levels (Figure 1b, Figure 2b). Preliminary results support idea of spectral coupling application in the case of situations developed through scale interaction.

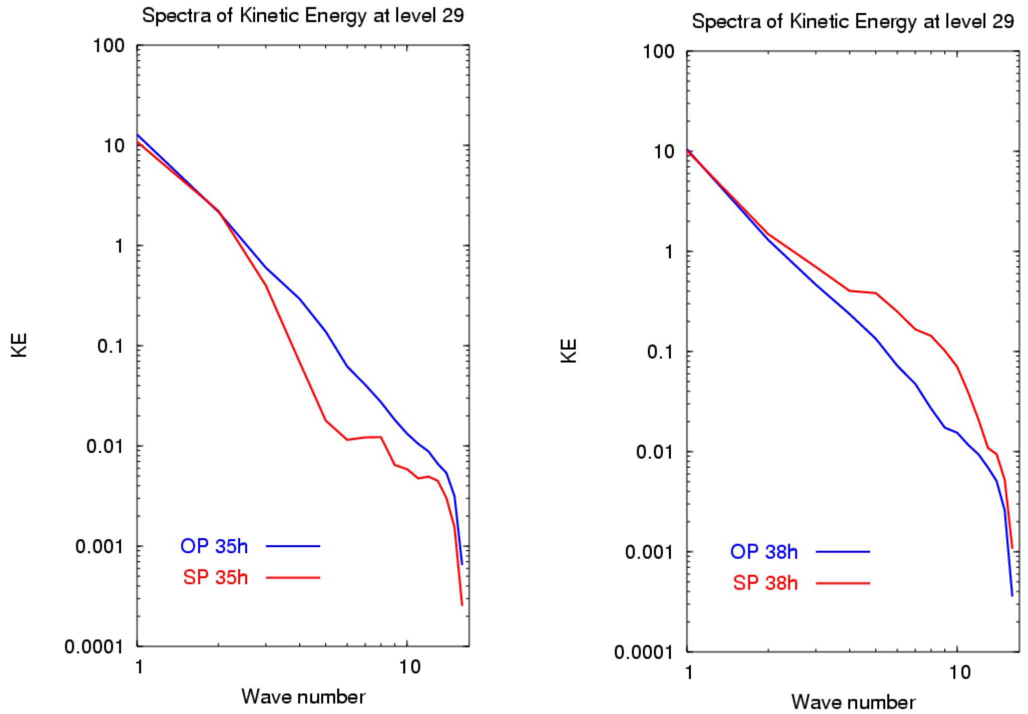


Figure 1: spectra of kinetic energy with gridpoint coupling (blue) and spectral coupling (red) left - a) first phase (mechanism 1), right - b) second phase (mechanism 2)

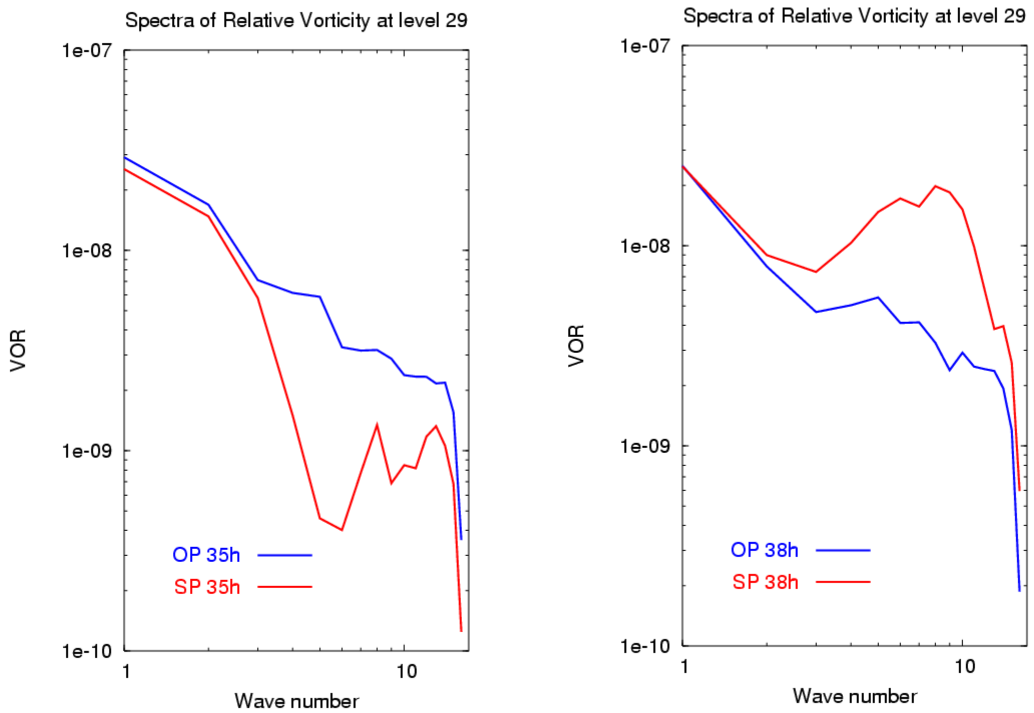


Figure 2: spectra of vorticity with gridpoint coupling (blue) and spectral coupling (red) left - a) first phase (mechanism 1), right - b) second phase (mechanism 2)

3.11.2. Flow-dependent background standard deviations for Arpege 4D-Var (Simona Stefanescu)

During a 2 month stay at Meteo-France, a study related to the flow-dependent background standard deviations has been started. Using perturbed observations in Arpege 4D-Var scheme, a 6-member ensemble of analyses and 6h forecasts has been generated for a one month period (18 January 2005 – 18 February 2005). The daily standard deviations for vorticity have been computed and a filter (of type cos^2) has been applied in order to remove the noise related to the use of a small-size ensemble. The filtered vorticity standard deviation at model level 26 (around 500 hPa) have been compared with the geopotential height field at 500 hPa. Large values of vorticity standard deviations associated with low geopotential areas have been observed. The computation of vorticity standard deviation for January period has been done at Meteo-France and then the continuation of work for February period has been done in Romania.

3.11.3. Formulation of the closure assumption and entrainment rate within the deep convection parameterization scheme (Doina Banciu)

New ideas based on Jean-Marcel Piriou PhD thesis and Dimitri Mironov (Proceedings HIRLAM/NetFAM Workshop on Convection an Clouds, Tartu, January 2005), which could be used in the ALARO frame, were introduced in the present Aladin/Arpege convection scheme under the supervision of Jean-Francois Geleyn. They concern the closure assumption and the formulation of the entrainment rate. The specific implementation followed the suggestions of Jean-Francois:

- the closure assumption is a continuous combination between CAPE and humidity convergence formulations
- the historical formulation of the entrainment rate is based on vertical integral buoyancy
- the entrainment rate was completed by a turbulent part depending on the derivative of the CAPE integral

The modifications were tested within the frame of the 1D version, for TOGA-COARE and EUROCS cases, for which a first tuning of the free parameters was carried out.

Many thanks to Jean-Marcel Piriou who made available to us the last version of the 1D model and the data for the specific cases. The advice of Jean-Francois and Jean-Marcel are acknowledged as well.

3.12. SLOVAKIA

3.12.1. The work on case study of the 19 November 2004 windstorm (more details from andre.simon@shmu.sk and jozef.vivoda@shmu.sk)

The work on case study of the 19 November 2004 windstorm (Simon and Vivoda, 2005) continued in the second half of the 2005. The ALADIN non-hydrostatic dynamics of cycles 25t2 and 29t1 were under investigation. The tests showed that the results of the non-hydrostatic run having a 2.5 km horizontal resolution are very sensitive to the choice of the prognostic variables. Correct results were achieved with cycle 25t2, using the prognostic variable d4 described by Bénard *et al.*, 2005. The forecasts of the 10 m wind (Fig.1) and wind gusts (Fig.2) are qualitatively similar to the performance of the hydrostatic run with the same horizontal resolution (Fig. 3 and 4), although the maximum predicted wind gusts (45 m/s at southeastern flank of High Tatras) were not as high as with hydrostatic integration (51 m/s). The computation with prognostic variable d3 (Bénard *et al.*, 2004) in cycle 25t2 was unstable and forecasted not realistic fields of mean sea level pressure and wind gusts (Fig. 5 and 6).

With more recent version of the ALADIN model (cycle 29t1) with different physical parameterisaton setup the start of the event is shifted forward, compared to the reference operational run (Fig. 7 and 8). This leads to differences in the wind field distribution of the 15 hour forecast, and to weaker wind gusts (maximum speed of 35 m/s). The forecast valid for 18 UTC shows already results similar to 2.5 km hydrostatic run and higher speed of wind gusts up to 50 m/s.

References:

Bénard, P., Laprise, R., Vivoda, J., Smolíková, P., 2004: Stability of Leap-Frog Constant-Coefficients Semi-Implicit Schemes for the Fully Elastic System of Euler Equations. Flat-Terrain Case. *Mon. Wea. Rev.*, 132, 1306-1318

- Bénard, P., Mašek, J., Smolíková, P., 2005: Stability of Leapfrog Constant-Coefficients Semi-Implicit Schemes for the Fully Elastic System of Euler Equations: Case with Orography. *Mon. Wea. Rev.*, 133, 1065–1075.

Simon, A., Vivoda, J., 2005: Severe windstorm in High Tatras on 19th November 2004, ALADIN Newsletter, 27

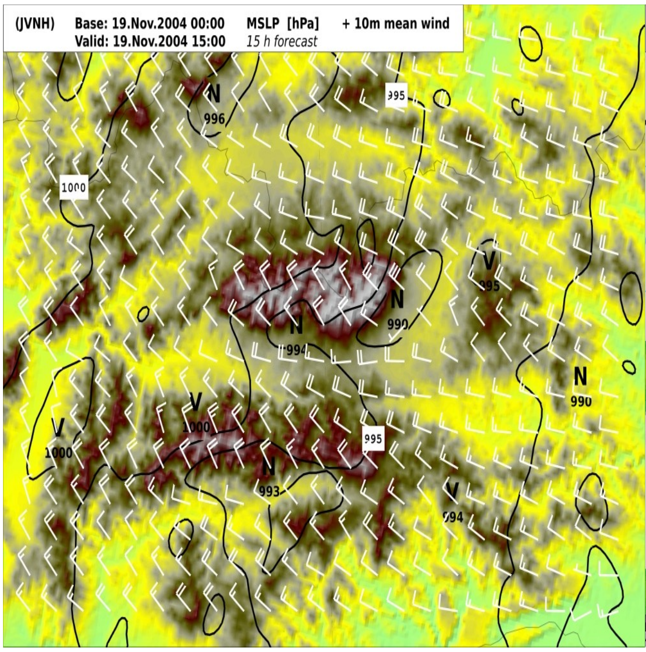


Figure 1: 15h forecast of the 10m wind and MSLP; 2.5km non-hydrostatic run with AL25T2 (d4 variable)

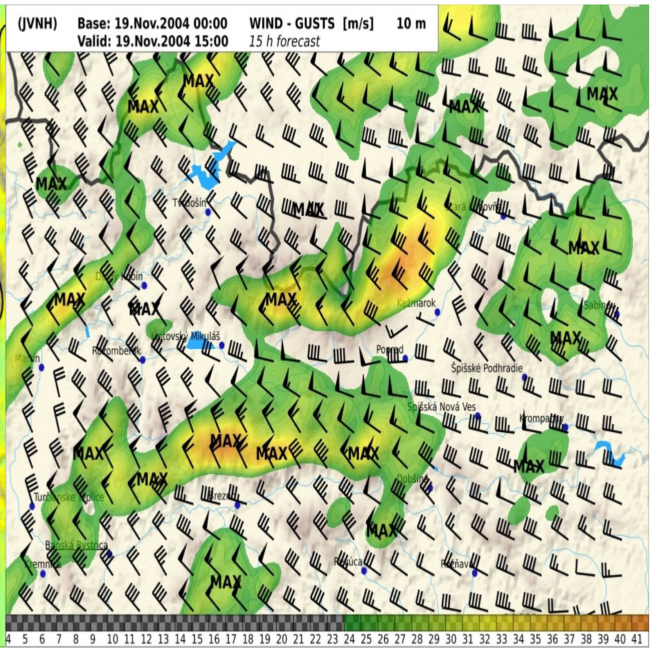


Figure 2: The same as the previous figure, but for wind gust

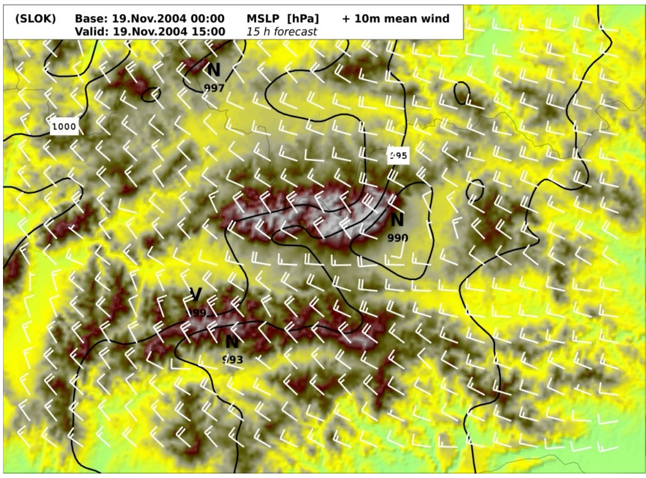


Figure 3: The same as figure 1, but hydrostatic run

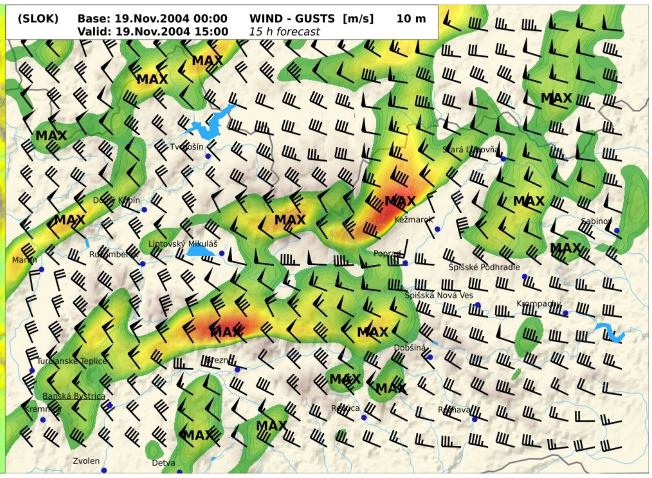
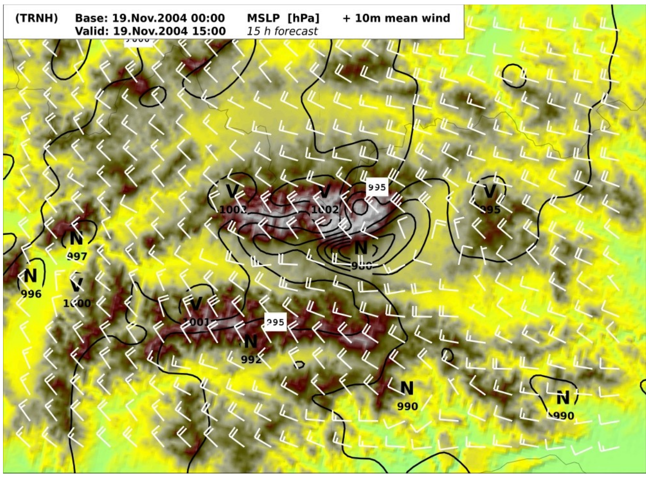


Figure 4: The same as the previous figure, but for wind gust



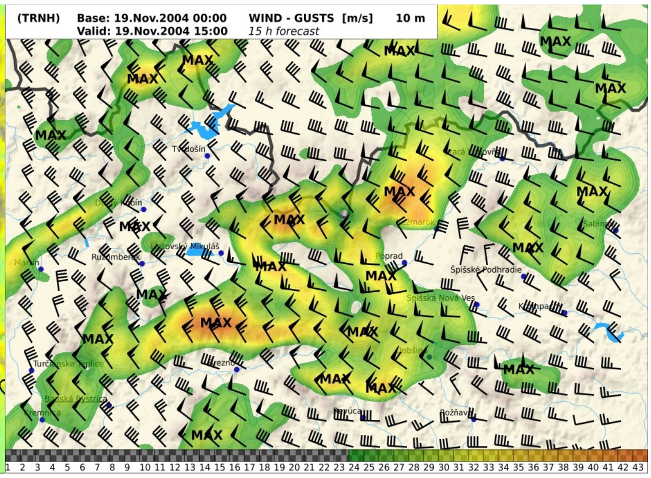
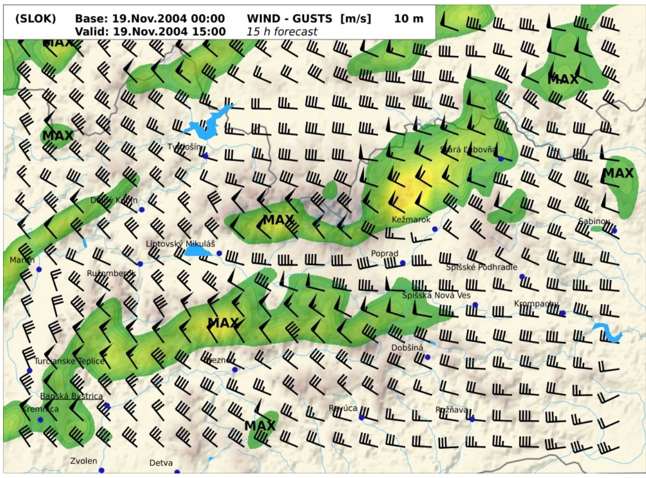


Figure 5: The same as figure 1, but with d3 variable	Figure 6: The same as the previous figure, but for wind gust



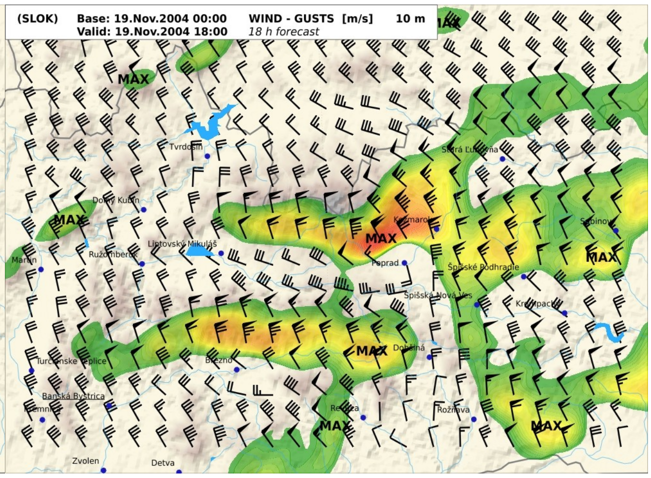


Figure 7: The same as figure 2, but with AL29T1	Figure 8: The same as figure 7, but +18h forecast

3.12.2. Verifications

(more details from jozef.vivoda@shmu.sk and martin.bellus@shmu.sk)

Long term verification of the ALADIN precipitation forecast was made for 62 river catchments, as defined in the frame of the POVAPSYS Project (Flood Warning and Forecasts System in the Slovak Republic), over Slovakia (see fig. 9). Period from July 1996 till August 2005 was verified.

In the first step, the sensitivity of the scores to the size of the river catchment area was evaluated. Standard verifications scores (based on the contingency table) were computed for the areas between 250 and 1500km^2, for the 0.1, 5 and 20mm tresholds. No sensitivity was found for the river catchment areas larger than 500km^2. This is illustrated for BIAS and POD on figures 10and11.

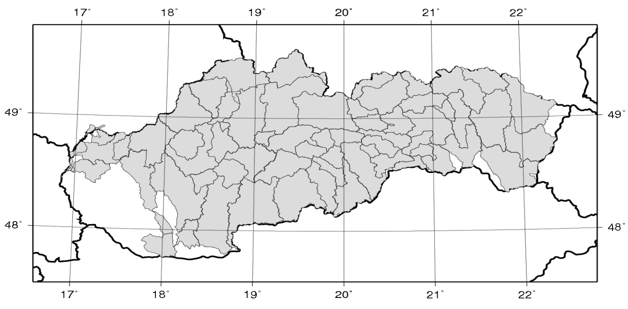


Figure 9: The river catchments

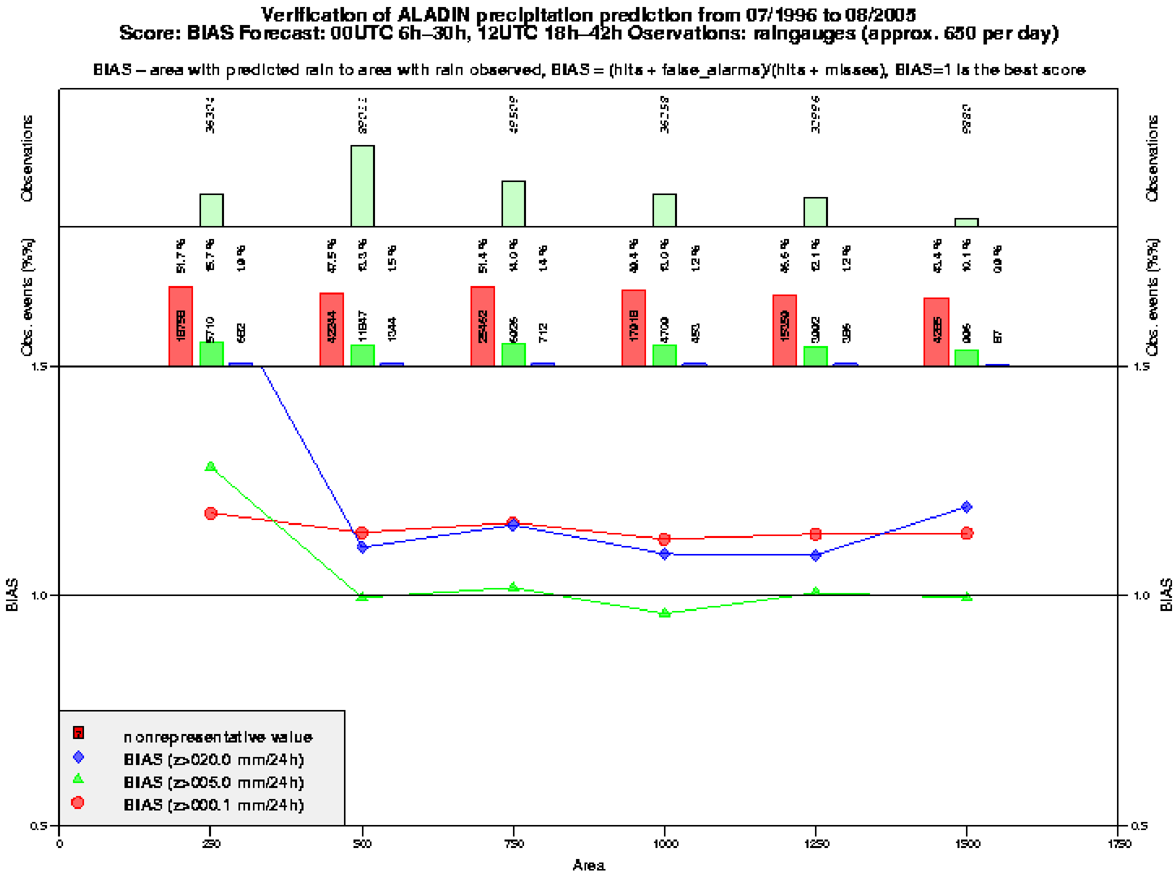


Figure 10: The precipitation score (BIAS) according to the size of verified area

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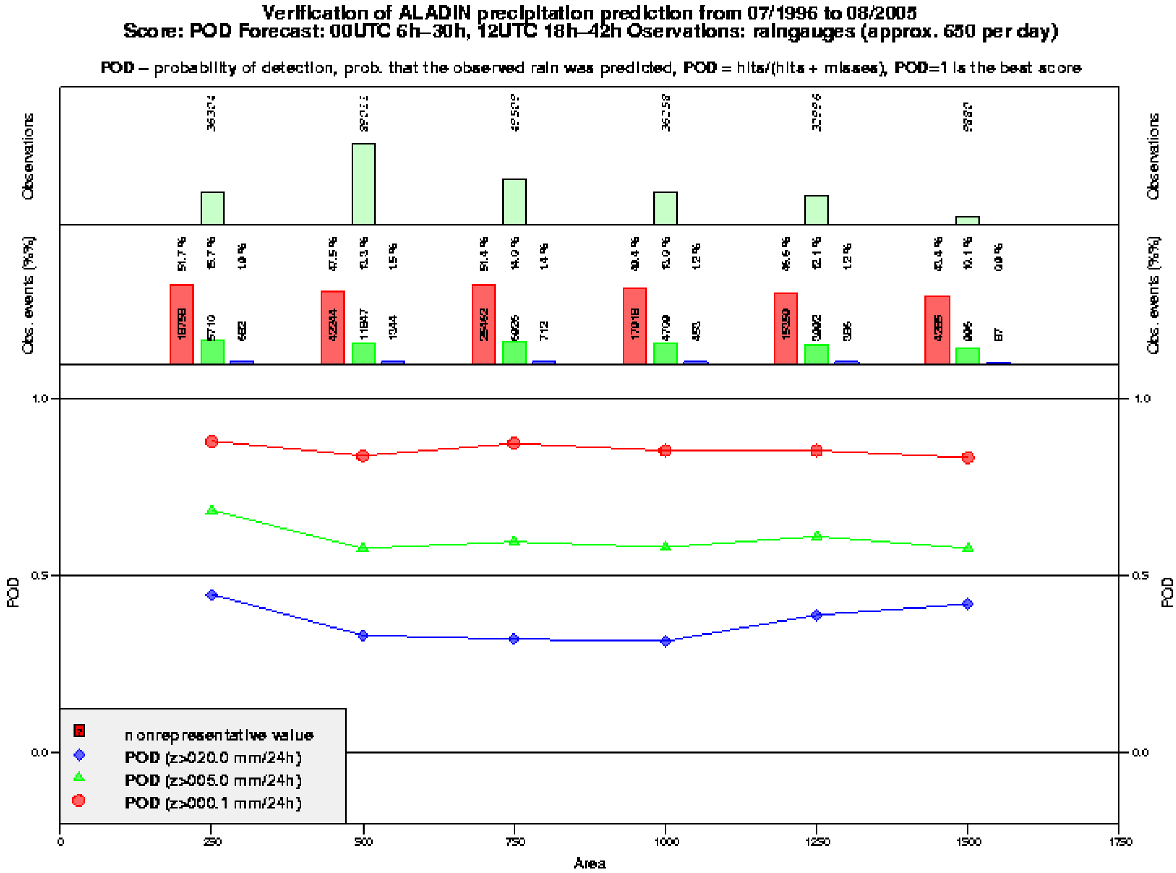


Figure 11: The same as previous figure, but POD (Probability of detection)

Then, for the river catchments displayed on fig. 9, the 24h precipitations cumulated between +06h and +30h, valid at 06UTC next day, were compared to the measurements - 24h cumulated precipitation from the 650 raingauges sites. Both predicted and measured precipitation were averaged over the river catchments, with the tresholds of 0.1, 5 and 10mm.

The results were presented in the poster form. Generally it was concluded, that the frequency of forecasted precipitation (more than 0.1mm) is overestimated in the summer, and underestimated in winter. Probability, that the predicted precipitations were measured, has significant annual variation: 90% in summer and 75% in winter. For the 5 and 10mm tresholds, the probability is about 50%. The false alarm rate was about 25% for 0.1mm treshold, 40% for 5mm and about 50% for 10mm treshold.

The future work will concentrate on the usage of radar precipitation observations.

Other local verification tool (POVER - POint VERification) used to compute scores of surface parameters for SYNOP stations was upgraded to MySQL technology, and runs very fast now. BIAS and RMSE scores of 2m temperature, 10m wind speed and total cloudiness are computed. Direct comparison of the forecast for the 1st and for the 2nd day to observations, scores by ranges and time evolution of the scores can be plotted. The tool and the results are available on intranet. The examples of the POVER outputs for Bratislava station, 2m temperature, are on figures 12, 13 and 14.

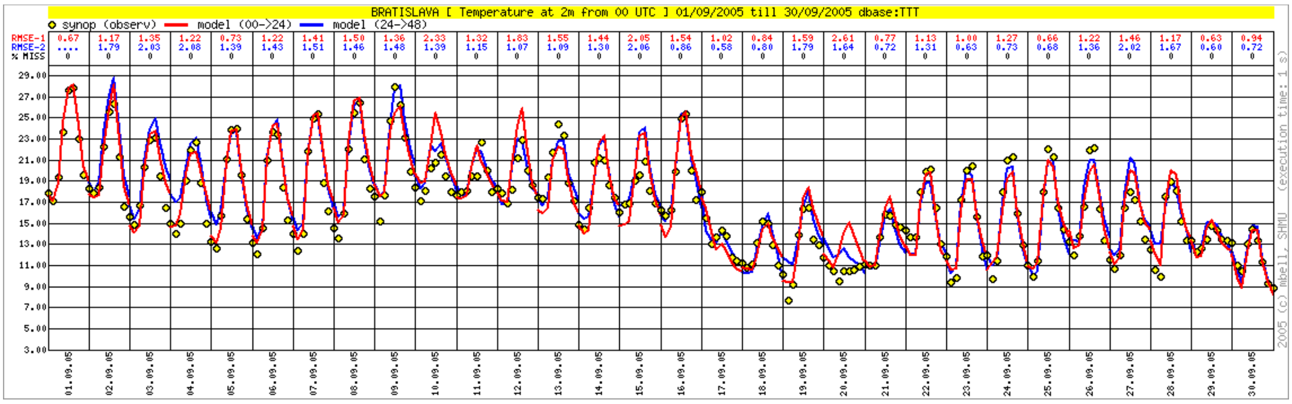


Figure 12: POVER - 2m temperature for Bratislava (1-30/09/2005) - direct comparison with observations. Forecast for the 1st day in red, for the 2nd day in blue, observations with dots

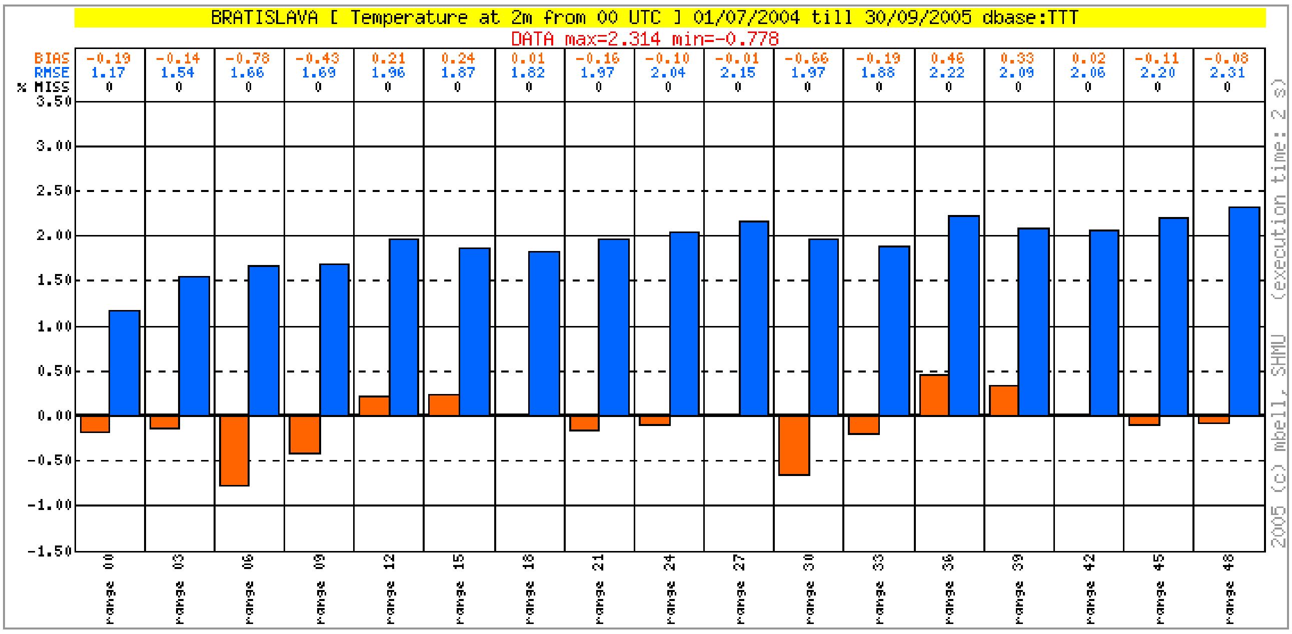


Figure 13: POVER - 2m temperature for Bratislava (01/07/2004 - 30/09/2005) - by forecast ranges. BIAS in red, RMSE in blue

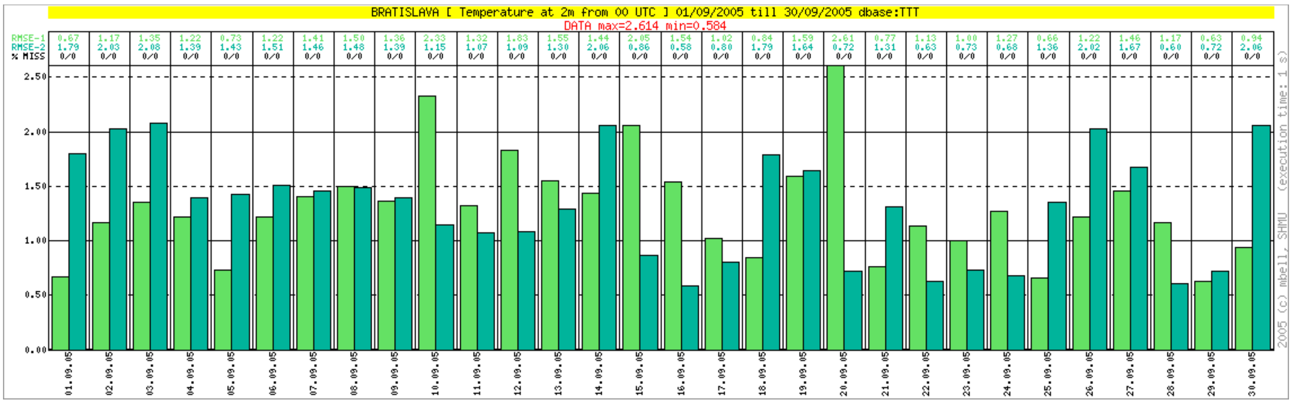


Figure 14: POVER - 2m temperature for Bratislava (1-30/09/2005) - RMSE by days. Forecast for the 1st day in light green, for the 2nd day in dark green.

3.13. Cloud optical properties (more details from jan.masek@shmu.sk)

During two month LACE stay in Prague (J. Masek, August-September 2005) new parameterization of cloud optical properties for ALARO-0 was proposed. There are two modifications with respect to old ACRANEB:

1) cloud optical properties depend on ice/liquid water content

2) saturation effect (weakening of broadband absorption/scattering coefficient with increasing optical depth) depends on cloud thickness and geometry

Since point 2 (namely the treatmnent of cloud geometry) was not fully finished during the stay, work continued locally in October. Final configuration of the new scheme and its coding into ALARO-0 should be done in early 2006.

3.14. Other local ALADIN-related work

The ODB software was succesfully implemented on our HPC, and the necessary tools to run verif.pack were tested (bator, mandalay, aladodb). Currently the programs to convert observations to OBSOUL format are being developed and the interface to veral.visr is being finalized.

New climate and coupling files have been extensively tested in order to prepare the switch scheduled for January 2006.

Other local work has been focused on the organisation of the **20th RC LACE Council** and **10th General Assembly of ALADIN Partners** (October 2005 in Bratislava). Both meetings successfully ended with the signatures of new Memorandums of Understanding.

J. Masek and J. Vivoda gave lectures on NH dynamics during the AROME training course in Brasov, the time needed for this preparation was surely not negligible.

3.15. SLOVENIA

N. Pristov - *(more details neva.pristov@rzs-hm.si)*

Our group was mainly focused on two topics: the developments of physical parameterizations and common ALADIN verification project. Significant effort was also dedicated to the organization of the EWGLAM and SRNWP meetings.

During the Jure's Cedilnik stay in Prague first version of prognostic turbulent kinetic energy was coded and prepared for initial tests. A prognostic precipitation scheme (prognostic precipitating water and ice, use of the pseudo-fluxes between 5 water phases, collection, sedimentation of precipitation) prepared by Bart Carty was implemented into ALADIN cycle29 (modifications to data flow, corresponding interfaces were introduced) and tested (Dunja Drvar 3 weeks stay in Ljubljana).

Coding of consistent setup of GFL structure (for transparent use of GFLs and their attributes) for ALADIN/ARPEGE/AROME was done in Toulouse.

To continue work on the ALADIN verification project one student was engaged. Many developments were done in the application on the new server. To obtain better time performance some changes in table definitions and optimization of request to database were introduced and tested. Modification were done also in calculation and visualization part.

Lovro Kalin was working for 3 weeks (December) in Ljubljana. He prepared proposal for content of automatic monthly verification report. In the first step report will be prepared for each station, various graphs (2m temperature, maximum/minimum temperature, 10m wind, pmsl, ...) and contingency tables (precipitation, cloudiness) will be included. The coding is currently in a process.

Migration to the new server is still on going, main problems are with observation data flow which is going to be changed at our service.

3.16. TUNISIA

3.17. HIRLAM

4. PAPERS and ARTICLES

4.1. Bouttier F., G. Hello, Y. Seity, S. Malardel and C. Lac: Status of the AROME project in MF in winter 2006.

4.1.1. Introduction: AROME documentation

The AROME project has been presented numerous times in this Newsletter series. Some presentations can be found online on the Aladin website,

http://www.cnrm.meteo.fr/aladin/aladin2.html which features an up-to-date technical documentation of the AROME model. The AROME R&D on data assimilation is currently identical to the ALADIN 3D-Var assimilation, which is documented in the Newsletters and on the Aladin website. The most recent AROME (very short) publication is:

Bouttier, F., G. Hello, Y. Seity and S. Malardel, 2006: Progress of the AROME mesoscale NWP project. *CAS/JSC WGNE "Blue Book" annual report "Research Activities in Atmospheric and Ocean Modelling"*, Ed. J. Côté, 2pp.

A major AROME international event took place in late November 2005: the ALADIN/HIRLAM first AROME training course, in Poiana Brasov, Romania, whose program and presentations are available as links through the Aladin website.

The AROME project itself has mostly been managed through monthly meetings at CNRM in Toulouse, the substance of these meeting reports (in French) is summarized below.

4.1.2. Daily runs and case studies

The AROME 2.5-km model has been run for several months over 400km-wide domains, usually on SW and SE France in near real time, and for some case studies over Paris or Brittany, which included convective systems, orographic and coastal effects, synoptic storms and fronts, mediterranean, temperate and cold wintertime weather. The plots from the daily runs are available to the ALADIN partners in a password-protected area of the Aladin website (known to the local Aladin correspondents).

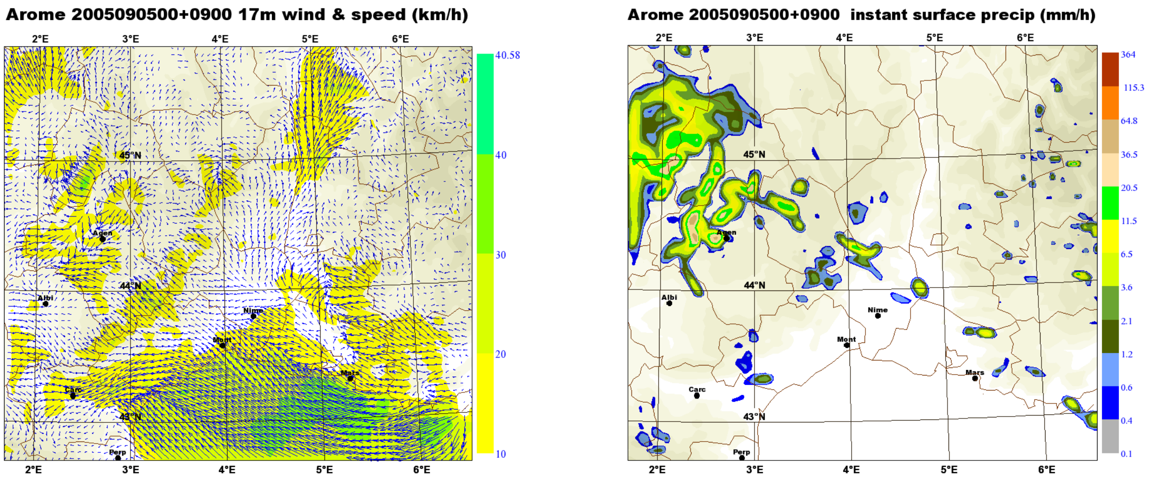
The AROME performance was subjectively assessed with reference to in-situ routine data, radar and satellite imagery, and human forecasters. The performance is good, both in absolute terms and relatively to the lower-resolution ALADIN model. The added value (over ALADIN-France and other available models on the area) is very clear on low-level wind and temperature forecasts, thanks to the dynamical adaptation to complex orography and physiography. The sensible depiction of urban heat effects was a good surprise. The most spectacular improvements were experienced in convective situations, where AROME was able to depict realistic details (anvils, gust fronts, texture and maximum of the precipitation field) of the weather which are completely absent from lower resolution models. The positioning of convective cells is still imprecise due to the lack of a fine-scale assimilation, and the added value is mostly in the information on the probabilistic distribution of weather features at scales of the order of 50km, i.e. much larger than the actual model grid size. In some situations, the location and timing of rain and convective cells are spectacularly precise, presumably because they are the result of orographically-driven wind circulations, which are highly predictable when the model has sufficient resolution.

A 3-day Mediterranean flooding case occurred close to Marseilles in September 2005. Such events are characterized by synoptically-driven convective cells in warm, moist air, that keep regenerating for many hours in a row over coastal orographic features. In this particular case, large-scale models (global models from ECMWF and Météo-France) gave a good depiction of the synoptic context, and AROME improved the quantitative precipitation forecast on scales of the order of 20 to 50km. Interestingly, AROME also improved larger-scale aspects of the precipitation forecasts, compared to ALADIN, presumably because of feedback from the convective cloud microphysics and small-scale turbulence to the generation of cold pools (by rain evaporation), to the triggering of precipitation, and to the humidity and vorticity fields on larger scales.

4.1.3. Known problems

The future work will concentrate on adapting the ALADIN 3DVar analysis system to the higher resolution of AROME and to using radar and satellite data. Benefits will need to be assessed not just in terms of the analysis algorithm itself, but also in terms of the interplay of model and observations during assimilation cycles. On the model side, the known weaknesses of the current AROME version are being adressed:

- the representation of non-convective, non-frontal clouds is very poor, which is very harmful in anticyclonic wintertime weather. The introduction of a subgrid shallow convection scheme is expected to improve cloud cover and its feedback with radiation. Interestingly, the AROME explicit production of fog itself currently is rather poor, but the high relative humidities forecast by AROME often are a spectacularly precise predictor of the likelihood of fog.
- the forecasts are adversely affected by lateral boundary effects at up to 80km of the border. The numerics of the lateral boundary coupling are being revisited. One (expected) problem is a spurious perturbation of the convective circulations near the exit border: when one moves the domain, the location and intensity of precipitations near the border are significantly altered. The problem is multivariate and seems an unavoidable consequence of having resolved convective circulations in AROME which do not exist in the forcing model. Another problem is the generation of spurious clouds over high mountains close to the input border, presumably due to a poor vertical interpolation of humidity between the forcing (ALADIN-10km) model and AROME.
- the specification of surface conditions e.g. town heating source term, soil moisture, coastal physiographies, need to be improved. Currently some bugs are visible on the temperature along coastlines.
- the diffusion along terrain-following model surfaces is inappropriate in narrow valleys, in stably stratified atmospheres, which are more horizontal in nature. A case-sensitive formulation of the diffusion is being considered, that plays with the diffusive nature of the semi-Lagrangian advection (based on Filip Vana's SLHD scheme).
- the precipitation field forecast is often poor during the first 2 hours of forecast, which will certainly be much alleviated by the planned introduction of an AROME assimilation cycle to initialize the AROME forecasts.



Examples of fields forecast by the AROME 2.5km model: low-level wind vectors (color shading according to speed), and instantaneous precipitation field, on the SouthEast of France.

4.1.4. Highlights of recent internal AROME model meetings

- subgrid convection

Experiments show no sign that a subgrid deep convection scheme is needed in AROME. However, it seems that weaknesses in cloud cover prediction, and in the texture of the rain forecast fields (e.g. too well-structured intense bands), are linked to the lack of a **representation of subgrid shallow convection.** The 3MT convection parametrisation project (cf. JM Piriou, L. Gérard, etc, presented by J-F. Geleyn at an AROME meeting) is a very interesting framework, but is primarily aimed at deep convection and is in a preliminary state (it is incompatible with the current MésoNH model software structure). It will be very interesting to enable it in AROME for experimentation when 3MT is fit for preoperational use. This will take too long for the AROME operational commitments, so interim solutions are sought.

As a short-term fix, the subgrid cloud cover and the shallow part of the Kain-Fritsch Bechtold (KFB) scheme have been activated in the AROME runs around October 2005, with an immediate beneficial impact (work mostly done by S. Malardel). The CNRM contact point on the AROME strategy in convection is Jean-Marcel Piriou.

Turbulence

According to Méso-NH experimentation (done specially for the benefit of AROME by the CNRM/GMME Méso-NH group) the (1D) turbulence scheme suffers from

(a) the lack of a counter-gradient term in the PBL (planetary boundary layer),

(b) insufficient entrainment at the top of the PBL,

(c) poor cloud representation in the upper part of the PBL.

For dry PBLs, the Méso-NH 1D turbulence scheme has been extended by some TOMs (turbulence third order moments) and a mass-flux scheme (P. Soares), which are being tested (both approaches are somewhat competing so some selection is going to occur). (C. Lac)

For moist PBLs, an improved KFB scheme and the Soares scheme are being tested.

- Microphysics

The representation of cirrus clouds is being looked into, primarily by tuning some autconversion processes. A satellite radiance simulation tool is being developed for AROME as a validation tool.

1D-column tests have proven that the correct representation of **fog and low clouds** requires sedimentation of cloud droplets, which has significant effects. The affordability of increasing the vertical resolution of AROME near the ground is being looked into, in the hope that it can improve the fog prediction.

The numerics of the sedimentation of microphysical fields is being rewritten in order to cope with the timesteps used in AROME (longer than in Méso-NH).

- Radiation

The work is common with Méso-NH and ARPEGE/ALADIN models. There have been some issues with the specification of aerosols, of cloud overlap, of the number of visible bands. The improvements and bugfixes have gone into an ARPEGE/ALADIN parallel suite in February 2006 and are thus available to all partners in the default software configuration.

- Chemistry

An interactive inline chemistry (with aerosols and dust) capability has been plugged into AROME (work mostly done by P. Tulet and Y. Seity). Basically it is a migration of the existing Méso-NH chemistry facility into AROME, which provides vastly superior computational efficiency for more or less the same scientific content. The surface interaction part (which is important, e.g. the dust production on deserts) is going into the SURFEX software and thus will soon be available for ALADIN and ALARO. The chemistry in AROME produced interesting simulations such as the urban ozone in the Marseilles area (ESCOMPTE field experiment case), and Saharian dust plumes.

This feasibility study demonstrated that aerosol/chemistry developments done in Méso-NH (which has an active scientific team in Laboratoire d'Aérologie in Toulouse, and also works on cloud electricity and NOx) will be rather easy to migrate into AROME if and when desired, which is expected in a couple of years, depending on future evolution of the mesoscale chemistry activity in the Méso-NH and MOCAGE groups. The provision of coupling fields to CTMs (chemical transport models) is the preferred option for shorter-term operational applications.

- Interfaces and surface

The AROME/SURFEX interface has been rewritten in order to facilitate the plugging of SURFEX into ALADIN/ALARO, since there where parallelization issues in the I/Os (work by G. Hello). The SURFEX developments for ALARO are well under way, only the ARPEGE global geometry and some les simportant technical features which have received low priority due to lack of manpower. The main action for the INTERFACES project of ALADIN-2 is currently the development of DDH-like physics diagnostics for AROME (work initiated by T. Kovacic, now with a strong implication of J.-. Piriou).

- Dynamics and software

There are intense and diverse activities, mostly for cleaning up the code and its user interface. The entire AROME software is now part of the ALADIN export libraries with very little lag behind the in-house MF version and the latest Méso-NH and SURFEX versions. And the AROME model launch is now available under the OLIVE experimentation preparation tool in MF.

The dynamics configuration used in the AROME daily runs is cy29t4 d4 p/c with one semi-implicit iteration, plus (since Nov 2005) the SLHD and LRDBBC options which significantly improved the precipitation over orography by eliminating the so-called "chimney" spurious numerical artifacts (thanks Radmila and Filip !).

4.1.5. Cooperations around AROME

A very intense advertising effort around AROME in 2005 has produced a large number of cooperations, beside the official explicit mention of AROME in the ALADIN and HIRLAM *Memoranda of Understanding*, mostly thanks to the efforts of G. Hello:

- AROME over Hungary (L. Kullman)
- AROME for Slovenia (J. Cedilnik)
- AROME on Austria (contact point in MF: E. Bazile) for quantitative precipitation studies
- AROME for HIRLAM: domains on Sweden (S. Niemela), Denmark (B. H. Sass), South Finland (S. Niemela), installation on ECMWF HPCF (with R. El Khatib)
- AROME for coastal oceanography: optimization of output fields for a 3D ocean model (with the French Navy).
- AROME for air pollution accidents: testbench in the Paris area (with a specialized French Agency) and other customers.
- AROME for wind farms: testbench in the South of France (with a French Electricity Utility).
- AROME on field experiments: ongoing contacts for AMMA (GPS validation and assimilation, with French research labs), COPS and MAP D-PHASE (European experiments)

In 2006, the priority on creating new external cooperations will decrease, and the emphasis will shift towards improving the model numerical efficiency, alleviating its physical weaknesses, and testing the assimilation/forecast interactions.

4.2. Hágel E. and A. Horányi: Sensitivity experiments of global singular vectors at the Hungarian Meteorological Service.

4.2.1. Introduction

In the last couple of years intensive research has started to develop short-range global and limited area ensemble prediction systems (LAMEPS) for the mesoscale. Most of the studies show the benefits of limited area ensemble forecasting, but it is not yet clear, which is the best method for the short-range mesoscale application. Motivated by these results research started on this field at the Hungarian Meteorological Service (HMS) too. It was decided to start with the direct downscaling of global ensemble members. The so-called PEACE[1] system was used to provide initial and lateral boundary conditions for the limited area experiments. In PEACE, targeted singular vectors are used to generate the initial perturbations.

When applying the singular vector method to generate initial perturbations for ensemble forecasting one has to keep in mind the importance of the singular vector target domain and target time (*Frogner* and *Iversen,* 2001, 2002*; Hersbach et al.,* 2000). These characteristics should be chosen such that they yield perturbations optimized to the area of interest (i.e. Central Europe and particularly Hungary in our case) and to the given forecast length (typically 48 hours). In the PEACE system the SV target domain is a rather large area covering Europe, the northern part of the Atlantic Ocean and even a small part of the North American continent (Figure 2). The SV target time is fixed to 12 hours. Altogether the system was calibrated in order to get enough ensemble spread over Western Europe for wind speed, 500 hPa geopotential height and mean sea level pressure. This raises some important questions as far as the design of a similar system for Central Europe is concerned:

- Are the initial and lateral boundary conditions directly provided by PEACE convenient for a Central European LAMEPS application?
- Is there a large sensitivity with respect to target domain and target time used in the global singular vector computation? If so, what is the optimal configuration for our purposes (i.e. LAMEPS for Central Europe)?

To answer these questions several experiments have been performed. From the beginning this work was divided into two parts. On the one hand the direct downscaling of the PEACE members was examined. On the other hand sensitivity experiments were carried out to investigate the impact of different target domains and target times during the global SV computation. Results of the direct downscaling and the sensitivity experiments were compared to one another and they are going to be presented in this article.

4.2.2. Methodology

The applied models

For the experiments the ARPEGE/ALADIN modeling system was used. The singular vector computations and the global integrations were performed with the ARPEGE model, while the limited area experiments were carried out with the ALADIN model. On the one hand the direct downscaling of the PEACE members was examined. On the other hand sensitivity experiments were carried out to investigate the impact of different target domains and target times during the global SV computation. Therefore a global ARPEGE ensemble system was set up for the experiments based on the PEACE system. The only difference was in the choice of target domain and target time used for the global singular vector computations. For the limited area experiments the ALADIN model was used on 12 km horizontal resolution with 37 vertical levels. The integration domain is shown on Figure 1.

1PEACE: **P**revision d'**E**nsemble **A** **C**ourte **E**chéance, an ARPEGE based global short-range ensemble system which runs operationally at Météo-France.

The initial and lateral boundary conditions were provided by the global ensemble systems described above.

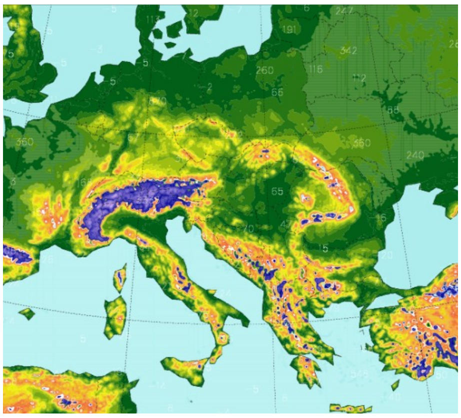


Figure 1. The integration domain and orography of the ALADIN model.

Description of the experiments

Motivated by some earlier results in the field of short-range limited area ensemble forecasting (*Frogner* and *Iversen,* 2001, 2002*; Hersbach et al.,* 2000) it was decided to investigate the sensitivity of the global singular vector computation in terms of target domain and target time with the main goal to find an optimal configuration for a Central European application. First, case studies were investigated for significantly different meteorological situations in order to see whether the change of the target domain and target time for the global singular vector computations can have a significant effect on the quality of the forecasts valid for the Central European area. Target domains were chosen with different size and location as follows (Figure 2):

- Domain 1: covering the Atlantic Ocean and Western Europe (as used in a former PEACE version, when experiments were started at HMS),
- Domain 2: covering Europe and some of the Atlantic Ocean,
- Domain 3: covering nearly whole Europe,
- Domain 4: covering a slightly larger area than Hungary.

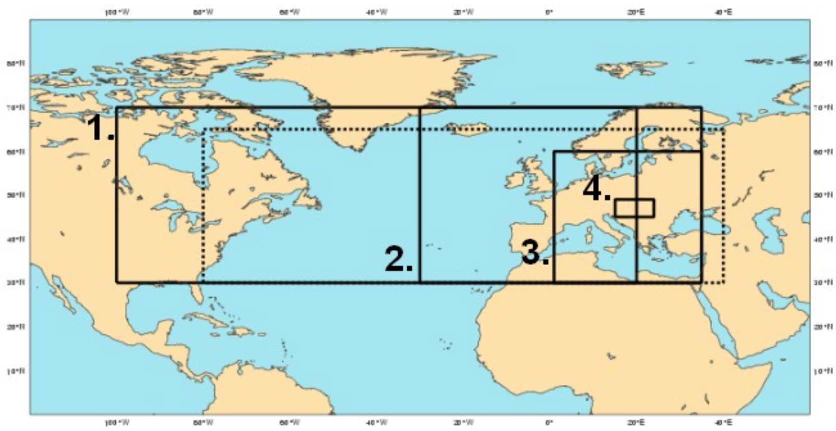


Figure 2. The location of the four different target domains used for the experiments and the target domain used in the present PEACE system (dotted line).

As far as target time is concerned, 12 hours (as used in the PEACE system) and 24 hours were chosen. Due to the linearity assumptions within the theory of SV computations the maximum length of the target time is about 48 hours. However the primary aim is to provide short-range forecasts, therefore a target time considerably less than 48 hours should be chosen for ensuring the desired impact of the perturbations during the forecast range. This argumentation justifies the choice having 12 hours and 24 hours as target times for the experiments.

Based on the results of the case studies (*Hágel* and *Szépszó*, 2004; *Hágel*, 2005), further experiments were carried out for a 10 day summer period. Then the following four configurations were examined in detail:

- SV target domain 1, target time 12 hours (as used in a former PEACE version, when experiments were started at HMS)
- SV target domain 1, target time 24 hours
- SV target domain 2, target time 12 hours
- SV target domain 2, target time 24 hours

Based on the result of the 10 day summer period (*Hágel*, 2005) and inspired by the fact that in between important changes took place in the PEACE system, it was decided to examine the following two configurations for an additional 32 day winter period:

- target domain and target time as used in the present PEACE system (dotted rectangle on Figure 2 as target domain and 12 hours as target time)
- target domain 2 and target time 24 hours

Verification methods

Results of the case studies and the experiments covering longer periods were examined in detail. Both subjective and objective verification were performed. For subjective verification the ensemble members were visualized in the form of probability maps, "stamp" and "plume" diagrams. For the objective verification, different scores were computed and several types of diagrams were derived such as Talagrand diagram, Percentage of outliers, ROC and Reliability diagrams (*Toth et al.,* 2003*; Persson and Grazzini,* 2005). The performance of the ensemble mean and the control forecast was compared to one another. The objective verification was performed against SYNOP (surface) and TEMP (upper air) data. Additionally for the winter period, verification was also carried out with respect to the ECMWF 4d-var analysis. The verification area was the entire integration domain of the ALADIN model (Figure 1).

4.2.3. Results

The experimentation was concentrating on the sensitivity of global singular vectors with respect to their target domain and target time (altogether 5 target domains and 2 target times were considered). Case studies for some significantly different meteorological situations and investigations for longer periods (10 days during summer and 32 days during winter) were analyzed to understand the impact of these important characteristics of the singular vector calculations.

Results of the case studies and the 10 day period were already described in previous articles in the ALADIN Newsletter (*Hágel* and *Szépszó*, 2004; *Hágel*, 2005). Hereafter the results of the 32 day winter period and the overall conclusions of the sensitivity experiments will be presented.

Experiments for a winter period of 32 days

According to previous experiments (case studies, 10 day summer period) it was concluded that great sensitivity (at least in terms of spread) could be found with respect to the target domain and target time used in the global singular vector computation. It was additionally realized that a period of ten days is not sufficiently long for drawing reliable conclusions therefore larger sample is desirable. However it could be concluded that the target domain 2 with target time 24 hours seems to be a better choice for a Central European application than target domain 1 complemented with target time 12 hours (as used in the PEACE system at that time). In addition and simultaneously to these preliminary conclusions, important changes (and operational introduction) had been encountered at Météo-France PEACE system. The following characteristics were changed:

- the resolution used for the SV computation was changed from T63 to T95,
- the target domain became smaller and was shifted towards east,
- the resolution used for the integration was changed from T199 to T358.

Therefore extended experiments were made for another (longer) period (the choice of this period was again arbitrary) covering 32 days in January and February, 2005. It is important to note that this period was characterized by an unusually cold weather.

Altogether two different configurations were examined: the operational PEACE configuration and target domain 2 together with target time 24 hours to be used for the global SV computations. For the objective evaluation Talagrand, ROC and reliability diagrams were drawn, bias and RMSE of the ensemble mean and the control forecast were computed for ARPEGE and ALADIN respectively.

✗ Ensemble mean vs. control forecast

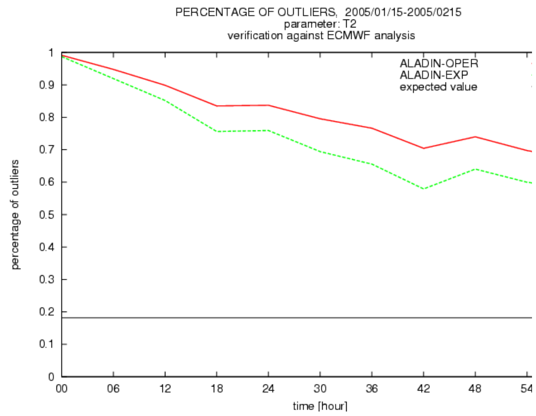
The first, basic validation of an ensemble system is the comparison of the performance of the ensemble mean and the control forecast (the minimum requirement is that the ensemble mean should provide better results than the control run). For every examined parameter (10 meter wind, 2 meter temperature, 500 hPa geopotential height, 850 hPa temperature) the values of the ensemble mean and the control forecast were relatively close to one another with a slight advantage to the ensemble mean (not shown). The improvement of the ensemble mean is more pronounced near the surface. All this only means that the ensemble system meets the above-mentioned (basic) criterion and further evaluations can be performed.

✗ Spread vs. RMSE

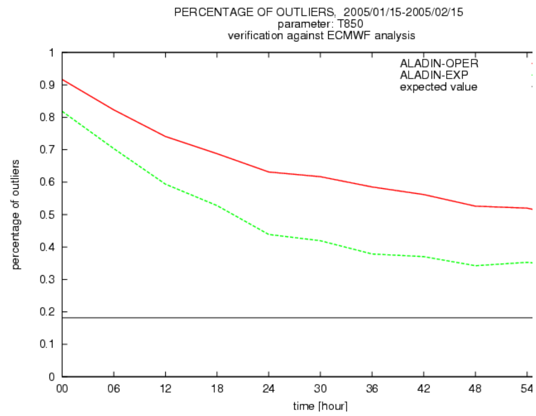
It is expected that the behavior of the ensemble spread and the error is similar (i.e. if the error is small, then the spread should be small as well and vice versa). For the examined parameters it was found that the spread is usually smaller than the error, however the use of the smaller SV target domain (domain 2) and the 24 hours target time reduced the difference between them. Moreover for 500 hPa geopotential the spread became even larger than the RMSE of the ensemble mean (not shown). It can be concluded that there is a discrepancy between the error and the spread, however with the correct choice of SV target domain and target time this can be reduced (especially at higher levels).

✗ Talagrand diagrams and percentage of outliers

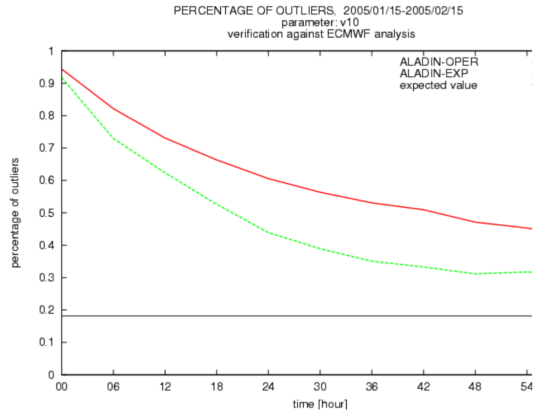
It was found that the change of the target domain and target time during the global SV computation could improve the system's ability to comprise the true state of the atmosphere. For all parameters the Talagrand diagrams became flatter, the distribution moved towards the ideal one (not shown). Looking at the percentage of outliers, clear improvement can be seen especially for upper level parameters, but also to some extent for the surface ones (see Figure 3). It is also interesting to notice that on the surface the improvement for the wind speed is more emphasized than that of the temperature. Moreover the 2 meter temperature is one of the worst parameters in that characteristics (it is expected that the surface wind is a rather good parameter of the dynamical adaptation due to the fine scale surface description, however the erroneous behavior of the temperature is a rather puzzling feature).



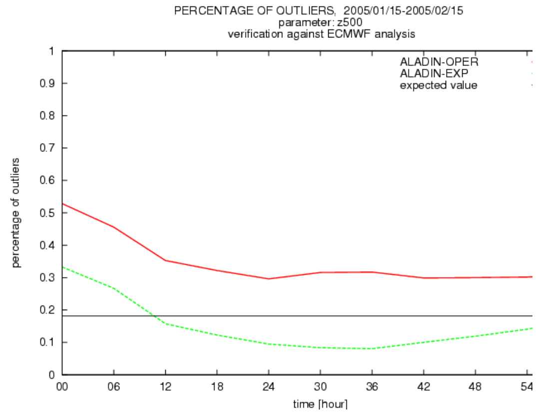
(a.)



(b.)



(c.)



(d.)

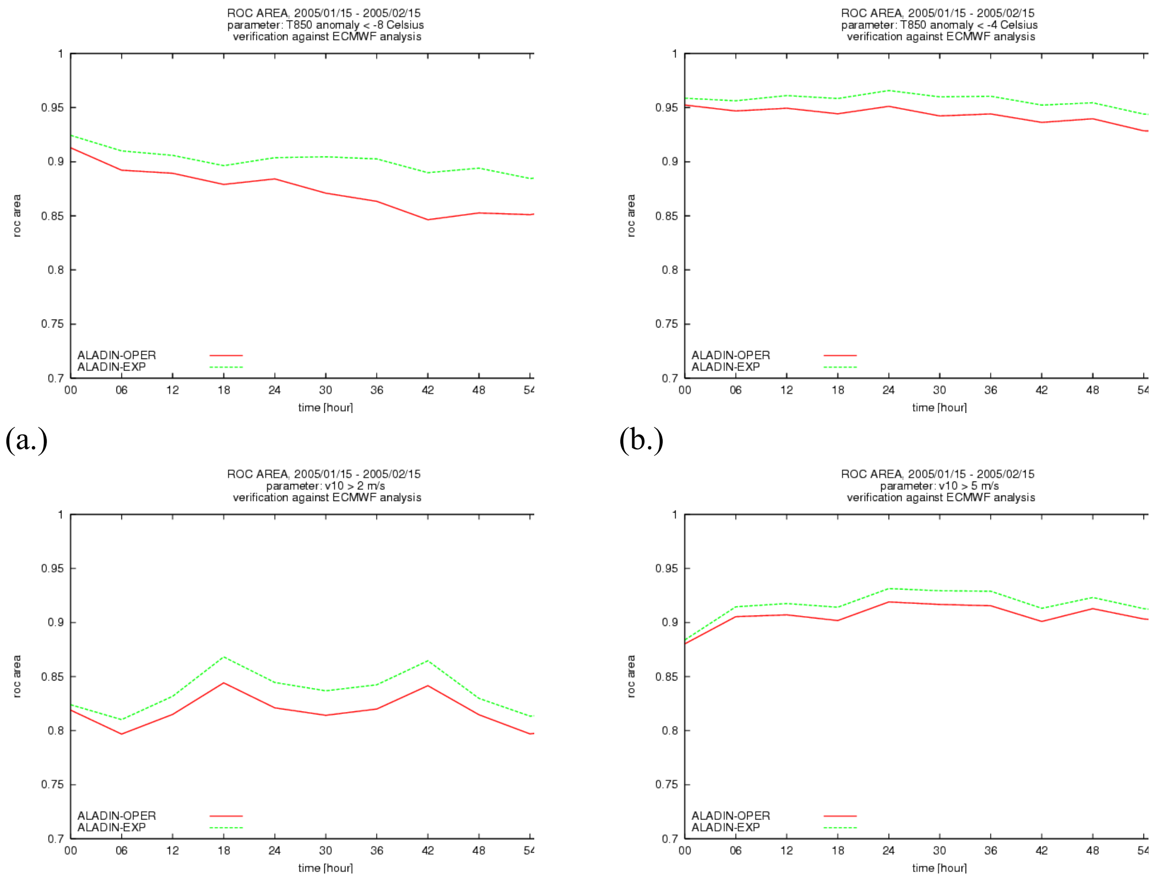
Figure 3. Percentage of outliers diagrams for the ALADIN ensemble system for the period 2005/01/15-2005/02/15. (a.) 2 meter temperature, (b.) 850 hPa temperature, (c.) 10 meter wind speed, (d.) 500 hPa geopotential height. Red line is ALADIN coupled with the operational PEACE forecasts, green line is ALADIN coupled with the experimental set. Verification was performed against ECMWF analysis. The expected value is ~ 0.2 (see the thin horizontal lines).

✗ ROC area

As already mentioned before, changing the singular vector target domain and target time yields clear improvement in terms of spread. ROC diagrams were derived and examined in detail for 10 meter wind speed (with thresholds such as 2, 5, 10 and 15 m/s respectively) and 850 hPa temperature anomaly (with thresholds ±8 Celsius and ±4 Celsius). The integral area under the ROC curve was computed and results from the two configurations (operational and experimental) were compared.

For the 850 hPa temperature anomaly better results were obtained while using the experimental set (using modified target domain and target time for the global SV computation) of global ensemble forecasts as initial and lateral boundary conditions for the ALADIN model (Figure 4). The ROC area shows rather good scores for the –4 Celsius threshold (without loss of quality with the integration time), however the relative improvement is higher for the –8 Celsius threshold value.

For the 10 meter wind speed the improvement is less significant compared to the 850 hPa temperature anomaly. However, the change of the target domain and target time yields clear improvement for this parameter as well (see Figure 4). Maybe two additional features can be further mentioned for the 10 meter wind speed (based also on the figure for 10 m/s threshold, not shown): on the one hand the scores are getting better while using higher threshold values (the quality of the ensemble system increases for stronger wind values which is an encouraging result, especially if one would like to represent correctly extreme events). On the other hand there is a jump in quality for the bigger thresholds just after the analysis time (this might correspond with some spin-up effects).



(c.) (d.)

Figure 4. ROC area for the ALADIN ensemble system for the period 2005/01/15-2005/02/15. (a.) 850 hPa temperature anomaly less than –8 Celsius, (b.) 850 hPa temperature anomaly less then –4 Celsius, (c.) 10 meter wind speed greater than 2 m/s, (d.) 10 meter wind speed greater than 5 m/s. Red line is ALADIN coupled with the operational PEACE forecasts, green line is ALADIN coupled with the experimental set. Verification was performed against ECMWF analysis. (The ROC area of a perfect forecast is 1.)

✗ Reliability diagrams

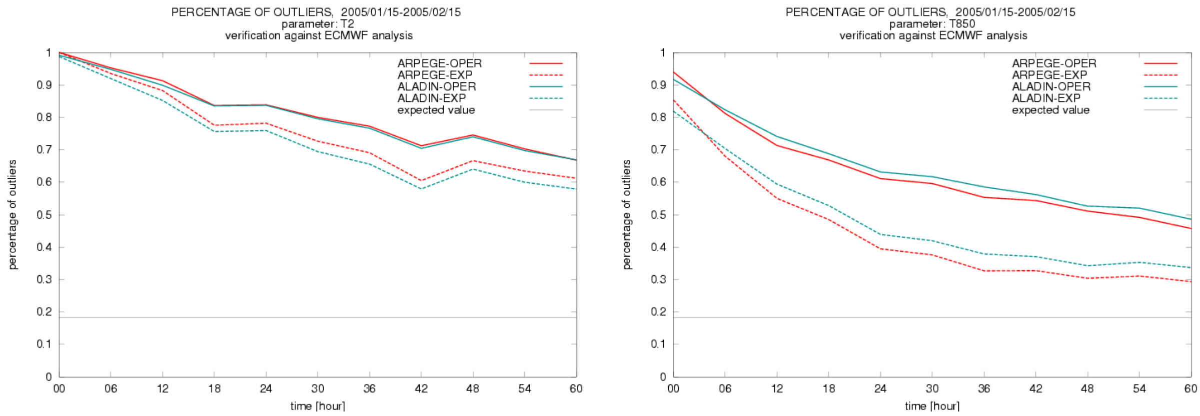
Reliability diagrams were drawn for the same parameters (10 meter wind speed and 850 hPa temperature anomaly) and thresholds as for the ROC diagram. In this case the use of target domain 2 and target time 24 hours did not result in significantly better forecasts, the diagrams of the two ALADIN configurations (ALADIN coupled with the PEACE members and ALADIN coupled with the experimental set) were rather similar (not shown). Nevertheless, it can be concluded that the use of target domain 2 and target time 24 hours kept the same quality of the forecasts in this particular measure.

As an overall conclusion for the 32 day experiment it can be said, that the change of target area from domain 1 to domain 2, together with the change of target time from 12 hours to 24 hours can increase the quality of the ensemble forecasts valid for the verification area. This improvement is true for both the ARPEGE and the ALADIN ensemble systems. For upper level parameters (e.g. 500 hPa geopotential) the improvement is more notable than for some surface parameters. Regarding the surface variables there are large differences between temperature and wind speed: the 2 meter temperature is a rather weak point of the system (seen from the percentage of outliers), while the 10 meter wind speed is proven to be a well-predictable parameter in ensemble sense as well (especially for the higher threshold values). This contradictory surface behavior might be explained by the fact that regarding the surface characteristics only pressure is perturbed in the global ensemble system.

Comparison of global and limited area ensemble systems

When making (ensemble) forecasts with a limited area model it is always a key aspect to consider whether the limited area model is producing more enhanced ensemble forecasts than the global one. Therefore during the objective verification both the ARPEGE (global) and the ALADIN (limited area) models were verified and then inter-compared.

Looking at the percentage of outliers one can conclude that the simple downscaling of the global ensemble system with the ALADIN model does not yield significant improvement. For some parameters the ALADIN forecasts have better scores, for others the ARPEGE ones. In Figure 5 one can see that for 2 meter temperature ALADIN coupled with the experimental set performs better, while for 850 hPa temperature the experimental ARPEGE ensemble system has the best results (for any case the differences are small). This result can be explained with the consideration that the higher resolution ALADIN forecasts are gaining advantage near the surface due to the more precise description of surface characteristics and processes.



(a.) (b.)

Figure 5. Percentage of outliers diagrams for ARPEGE and ALADIN ensemble systems for the period 2005/01/15-2005/02/15. (a.) 2 meter temperature, (b.) 850 hPa temperature. Solid red line is the operational PEACE forecasts (ARPEGE-OPER), solid green line is ALADIN coupled with the operational PEACE members (ALADIN-OPER), dashed red line is the experimental ARPEGE ensemble (ARPEGE-EXP), dashed green line is the ALADIN model coupled with the experimental set (ALADIN-EXP). Verification was performed against ECMWF analysis. The expected value is ~ 0.2 (see the thin horizontal lines).

When examining the ROC area diagrams, for both parameters (10 meter wind, 850 hPa temperature) it seems to be hard to tell whether ALADIN or ARPEGE performs better. For certain thresholds and parameters ALADIN had better scores, for other thresholds ARPEGE was more successful. There were also combinations (in terms of variables and thresholds) when the two models had nearly the same skill (not shown).

As far as the reliability diagrams are concerned (for 10 meter wind speed and 850 hPa temperature) no significant differences can be seen between the results of the global and the limited area ensemble systems (not shown).

As a summary it can be said that generally speaking by the simple downscaling of the ARPEGE ensemble system with the higher resolution ALADIN model it is very difficult to achieve significant improvements. One explanation behind this result might be that on the one hand the resolution difference between the ARPEGE and ALADIN models is too small, on the other hand the influence coming from the lateral boundary conditions results in a rather strong forcing for the results of the limited area model. Additional explanation might come from the fact that the formulation and especially the physical parameterization package of the global (ARPEGE) and the limited area (ALADIN) models are rather similar. For the surface fields, where one would expect improvements (due to the more precise description of surface characteristics in the higher resolution model) maybe the benefits (which are reflected in the near surface wind fields, but not in the temperature field) are compensated by the fact that only the surface pressure as model prognostic variable is perturbed by the global system, therefore the initial uncertainties in the surface description are not properly addressed with the limited area ensemble system.

4.2.4. Summary, conclusions and future plans

Extended experiments were performed to investigate the sensitivity of global singular vector computations in terms of target domain and target time. Global (ARPEGE) ensemble members were downscaled with the limited area model ALADIN. The experimentation consisted of individual case studies, 10 days (in summer) and 32 days (in winter) continuous tests. Results show that the proper choice of the SV target domain and target time are important factors for the increase of the ensemble spread and on average for the improvement of the skill of the ensemble system (at least on average level). This conclusion is valid for ARPEGE global and ALADIN limited area forecasts as well. Thus, changing the target domain and target time can improve the system's ability to comprise the true state of the atmosphere. The improvements are clearly demonstrated for all parameters (especially at upper levels) by the percentage of outliers and ROC area diagrams.

A systematic comparison between ARPEGE and ALADIN ensemble systems was also carried out. From the results one can conclude that the simple downscaling of the ARPEGE ensemble members with the higher resolution ALADIN model does not improve significantly the forecast skill (even more for certain parameters the ARPEGE model performs better). The reason of this feature might be sought in the limited resolution difference between the global and the limited area models, the too strong impact of the lateral boundary conditions, the similarities between the model formulations and the lack of perturbations for the surface fields.

These conclusions indicate that the direct downscaling of the ARPEGE ensemble system is not sufficient to obtain a good, high resolution limited area ensemble system: there is a strong need of the development of methods, which are properly and directly accounting for the mesoscale uncertainties in the initial conditions of the ALADIN model. At the same time research should be pursued towards the consideration of other sources of uncertainties in the limited area models (for instance deficiencies in the description of the parameterized processes) as well.

Acknowledgements - This work was supported by the Hungarian National Research Fund (OTKA, grant Nº T/F 047295) and the Hungarian National Office for Research and Technology (NKFP, grant Nº 3A/051/2004 and JÁP, grant Nº 2/007/2005).

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4.3. Haiden T. and K. von der Emde: Verification of ALADIN global radiation forecasts.

4.3.1. Introduction

Global radiation is one of the ALADIN output fields that is not typically verified operationally. Global radiation forecasts, however, are becoming increasingly important, for example as input for energy consumption forecast models in the power generating industry. Here we report on a comparison of ALADIN global radiation forecasts against surface observations at 4 locations in Austria. Results show a significant negative bias at all stations and seasons.

4.3.2. Data

The 4 stations are located distributed across Austria (Figure 1). Three of them are lowland or valley stations between 200 and 500 m above msl, and one (Sonnblick) is a mountain station at an elevation at 3105 m.

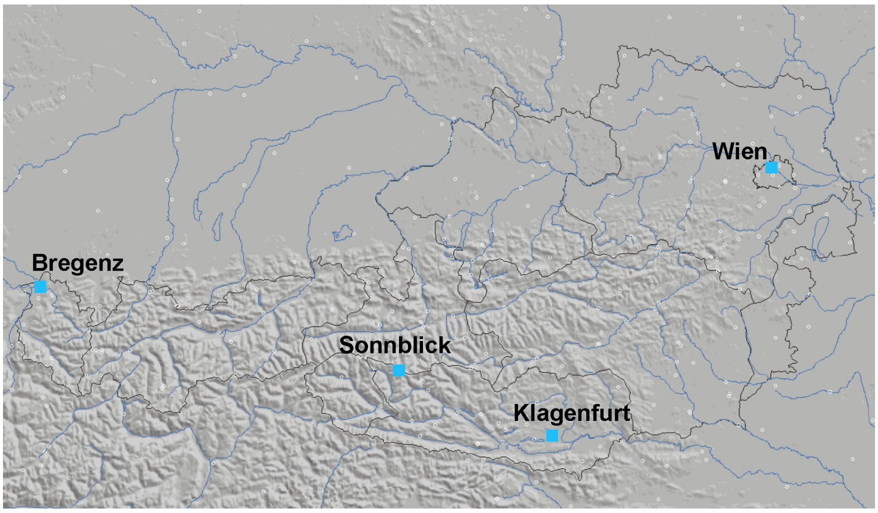


Figure 1: Location of stations used in ALADIN global radiation verification.

The stations measure global (=solar direct+diffuse) radiation in 10-min intervals. For this verification, hourly mean values are used. The verification period is Dec 2004 - Nov 2005 (1 year). The ALADIN output is interpolated bilinearly to the station locations.

4.3.3. Results

Figure 2 shows the annual evolution of observed global radiation at 12Z and of the error (forecast minus observation) of the ALADIN +12 h forecast (00Z runs) for the station Vienna. The forecast has a significant negative bias the magnitude of which mirrors the annual evolution of global radiation. Closer analysis shows that during cloud-free or almost cloud-free periods, i.e. when the observed global radiation is close to its upper envelope, the negative bias is generally small.

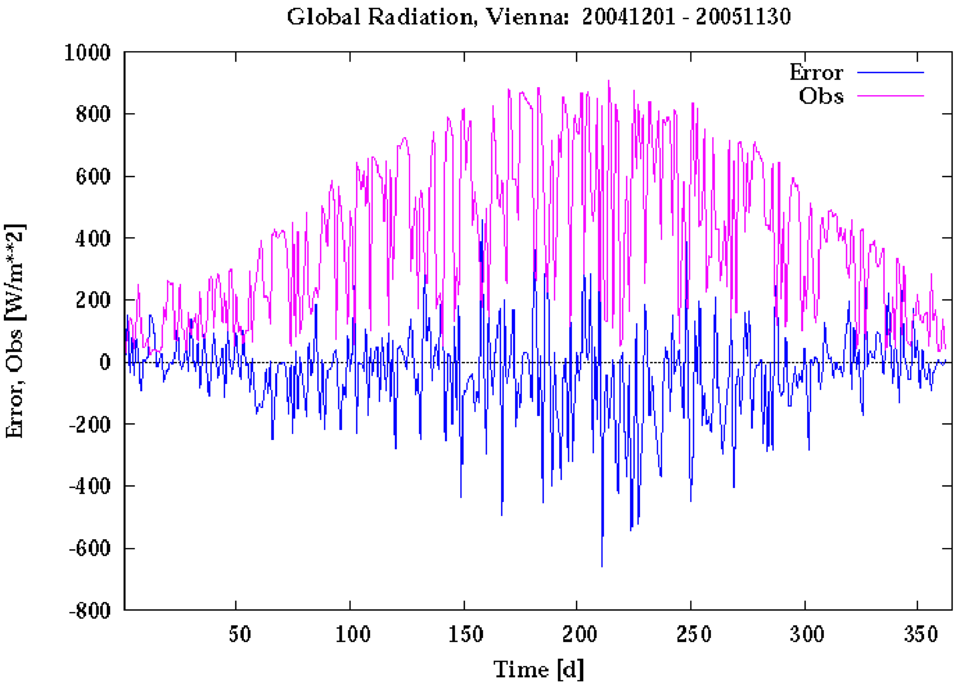


Figure 2: Observed 12Z global radiation (pink) and ALADIN forecast error (blue) within the entire verification period for the station Vienna (203 m).

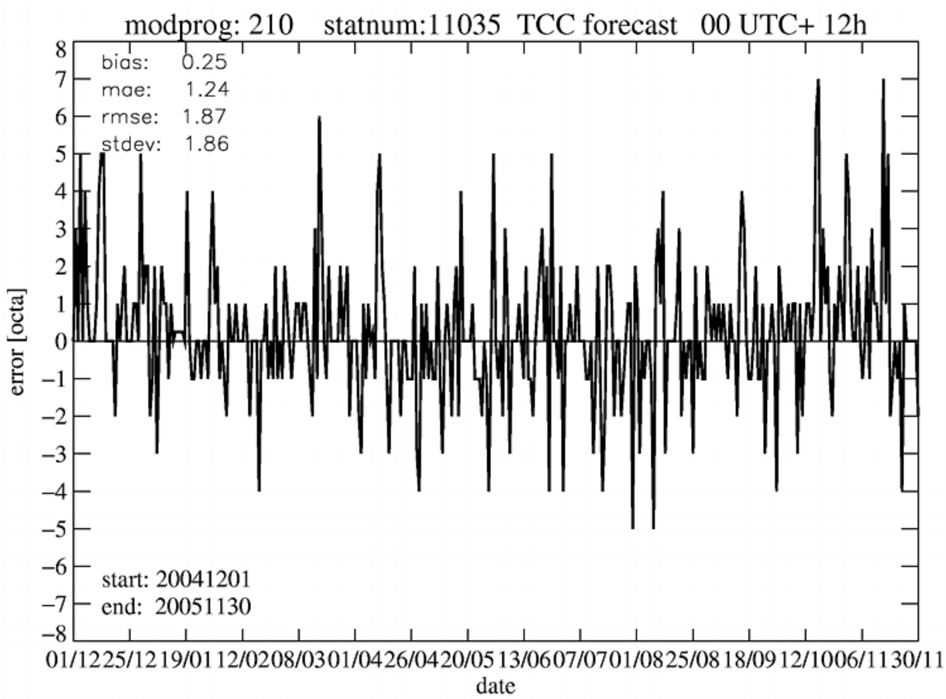


Figure 3: ALADIN 00Z run +12 h total cloudiness forecast error (octa) for Vienna within the 1-year verification period Dec 2004 – Nov 2005. Only a small part of the error is due to a systematic bias.

Examples can be found near days 70, 125, 175, 315. Thus ALADIN predicts surface global radiation satisfactorily under conditions where cloudiness does not play a significant role, but on average underestimates it otherwise. This can be due to (a) an overestimation of cloudiness, or (b) an underestimation of shortwave transmission in clouds, or (c) both. Figure 3 shows that there is indeed an overestimation of total cloudiness in the forecast but it is too small (0.25 octa) to explain the negative global radiation bias. This suggests that the shortwave transmissivity of clouds is too small in ALADIN. The possibility remains, however, that the partition of total cloudiness into low, medium, high, differs between model and observations, even though the bias of total cloudiness is small. This could also lead to a bias in global radiation.

Hourly forecast output of ALADIN during the entire daytime period was used to determine bias and mean absolute error (MAE). In relative terms, the negative bias at the three lowland stations amounts to between 10-20% of the observed global radiation, with highest values occurring during the summer season. The relative MAE is on average twice as large (20-40%) as the bias.

At the mountain station Sonnblick there is an even more pronounced negative bias, on the order of 50%, which may be due to an underestimation in ALADIN of multiple diffuse reflection between the atmosphere and the surface in the presence of snow cover. At this station, snow covers the ground during most of the year. A small contribution to the bias may also come from the fact that the model surface at this location is located at a height of ~2500 m, which is 600 m below the true station height.

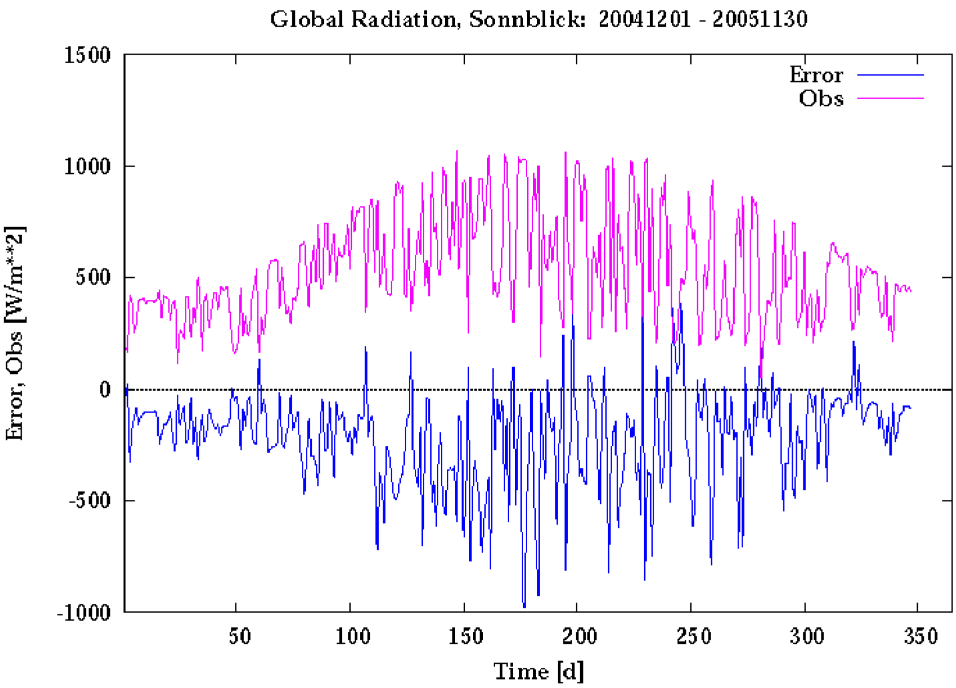


Figure 4: Observed 12Z global radiation (pink) and ALADIN forecast error (blue) within the entire verification period for the mountain station Sonnblick (3105 m).

4.4. Kullmann L.: Installation of AROME at HMS.

4.4.1. Summary

We describe briefly the installation and the related problems (sec 2.) of AROME prototype (export version: cy29t1_t2, v05 created by GCO in Toulouse on the 5th of April) on the IBM computer at HMS. In sec. 3 we give some the technical details how we run AROME at HMS. The installation was done on IBM p655 cluster (AIX 5.2). We used the FORTRAN compiler, xlf 8.1.1.8 and the c compiler, xlc 6.0.0.10. We used gmkpack.6.1 to make the compilation. After correcting some bugs in the code the model is running and the comparison of the results obtained in Toulouse with the local run shows good agreement.

4.4.2. Compilation of AROME

The compilation was done with gmkpack. Some minor changes had to be performed on the software:

- Changing the **xlf_wrapper_loc** script, since we were unable to run the code compiled with omp optimization.
- Changing **aux/libspack.sh** script because in the original version all the project libraries were recreated even if one didn't modified the code under that project.
- Modify **aux/unsxrpack.sh** by adding underscore to the file names.

We compiled the code in 3 steps:

1. Setup for compilation: explicit interface routines, dependencies, compilation list. This step was run on 1 proc.
2. Compilation of the source. This was done on 8 proc. The compilation took 4260 *s* on the IBM cluster.
3. Creating libraries and binary. This step was also run on 1 proc. In the script **ics_arome** one should set ICS_START=2 and ICS_STOP=1 to avoid recompilation of the source. After submitting the first time this script the linking will fail due to undefined symbols. Therefore one should place files (0 byte) under src/unsxref/verbose/ with the name of undefined symbols (no trailing underscore should be used), and resubmit the script.
4. Some routines had to be modified in order to be able to run AROME.

Problem with explicit interface in latlon_grid

The subroutine **mse/internals/latlon_grid.mnh** calls some subroutines (e.g. *latlon_gridtype_conf_proj*) with the optional argument: PDIR. (This variable is also optional in *latlon_grid*.) When running the program, PDIR will never be present in *latlon_gridtype_conf_proj* however it is present in *latlon_grid* and the subroutine *latlon_gridtype_conf_proj* is called with argument PDIR.

It turned out that the explicit interface for the subroutine *latlon_gridtype_conf_proj* does not exist in *latlon_grid*. To solve the problem new modules were written containing the interfaces and which are then used by *latlon_grid*:

mse/module/modi_latlon_gridtype_cartesian.mnh

mse/module/modi_latlon_gridtype_conf_proj.mnh

mse/module/modi_latlon_gridtype_lonlat_reg.mnh

Problem of surfex I/O

When writing the surfex file: AROMOUT_{hhh}.lfi the program stops if one runs on more than one processor. The STOP commands are in the *write_surf[xx]_aro* subroutines, where [xx] stands for e.g. x1, x0, n0, depending what kind of variable (scalar, 1 dimensional real vector, etc) should be written to the file.

These subroutines call the routine *fmwrit* with the argument KRESP which is an output error code indicating whether the writing was successful (KRESP=0) or not (KRESP/=0). After there is a condition: IF(KRESP/=0) ... STOP, i.e. if there were a problem with writing the program stops.

The routine *fmwrit* is only called by the first processor (in case of IYPROC=1), i.e. the variable KRESP is initialized only in this case. However the condition checking the value of KRESP is not only done for the first processor. Of course if KRESP were initialized to zero there would be no problem. We tried to compile the code with **–qinitauto** (which should initialize all variable to 0) but it did not work only when we compiled with -O0 flag. So the solution is to change the code in order to call the condition checking KRESP only in case of IYPROC=1.

Problem connected to the value of NPROMA

To run AROME we used first the same namelist that was used in Toulouse. However we encountered a strange problem. If we set NPROMA=1500 (which was used in Toulouse) after 3 hour integration when reading the coupling file the program aborts in *arp/setup/sugridua.F90* subroutine at the line:

IF(MAXVAL(GFL(:,:,YTKE%MP,:)) = = 0.0_JPRB .AND. MINVAL(GFL(:,:,YTKE%MP,:)) = = 0.0_JPRB)

The problem is in MAXVAL() calculation. If one reduces NPROMA (e.g. to the value 1000) then it does not abort. It seems that if the array is too large (since the first dimension of the array GFL is NPROMA) the MAXVAL function does not work properly. After discussing with the french colleagues it turned out that on IBM one should use smaller NPROMA values. Indeed for NPROMA<500 the above problem disappeared.

We faced however other problems related to the variable NPROMA. We discovered that the results are slightly different when running with two different NPROMA value (e.g. 20 and 40). It turned out that the problem comes from microphysics, if one switches off microphysics (LMICRO=.F. in namelist) then the two runs for different NPROMA values give the same result. One source of the problem was found and this is the following:

In subroutine *rain_ice_sedimentation* (which is inside subroutine *rain_ice*) the following calculation is performed:

```
IF( ISEDIM >= 1 ) THEN
  PRRS(:,:,:) = PRRS(:,:,:) * ZTSTEP
  ...
  PRRS(:,:,:)=PRRS(:,:,:) / ZTSTEP
ENDIF
```

In the above expression the value ISEDIM is bigger then 0 only if one of the element of PRRS exceeds a prescribed minimum value (10^{-20}). The first dimension of array PRRS has the size of NPROMA. Let us assume that we run with NPROMA=20 and NPROMA=40. Let us further assume that all the values in PRRS(1:20,:,:) (i.e. for all the values which belong to the first dimension less then 21) are below the threshold. In this case ISEDIM will be 0 if we run with NPROMA=20 so the array PRRS will not be touched. For NPROMA=40 however ISEDIM will be 1 and the array PRRS will be first multiplied by ZTSTEP and at the end of the IF condition will be divided by ZTSTEP. The values of PRRS belonging to the first dimension less then 21 will be not touched during the calculation so those values will be just multiplied and then divided by ZTSTEP. The strange behaviour occurred that the multiplication and division did not give the same value! The difference is small but this small difference will start to grow during the integration. We don't know yet whether this is a compiler bug or not the right compilation options were set.

The code was changed in the way that the multiplication and the division was put outside the IF condition, i.e.:

```
PRRS(:,:,:) = PRRS(:,:,:) * ZTSTEP
IF( ISEDIM >= 1 ) THEN
   ...
ENDIF
PRRS(:,:,:) = PRRS(:,:,:) / ZTSTEP
```

In this case the difference between the two runs with two different NPROMA values still exist (but it is smaller) which indicates that there is still some problem at some other place in the code.

4.4.3. Running AROME at HMS (technical details)

The AROME model is running at HMS on a domain covering just Hungary (see Table I.) with 2.5km horizontal resolution and 49 vertical levels. The integration for 36 hours takes around 7 hour on 16 processors on IBM p655 cluster.

Table I. AROME domain properties

NDLUN	NDLUX	NMSMAX	NDGL	NDGUX	NSMAX
250	240	124	160	150	79
ELONC	ELATC	ELON0	ELAT0	EDELX	EDELY
19.55	47.33	19.55	47.33	2488.67	2488,67

We describe here what are the main steps to run AROME.

1. First an ALADIN forecast should be run to produce initial as well as lateral boundary condition for AROME.
2. One has to run an ee927 configuration on the ALADIN forecast files to interpolate them to AROME geometry. One has to add ozone, and aerosol fields to the output, which is done by an external program, **INIOZOAER** (this step will not be needed in the future since the ARPEGE coupling files contain these fields). One also needs to reinitialize TKE (turbulent kinetic energy) field to bigger value than zero. This latter is done by the external program, **protke**.
3. One has to create a special initial surface file (which is in LFI format) since the externalized surface code can only read this special format. This step can at the present stage of the code only be done in Toulouse:

- Create a PGD file (for every month of the year) containing the physiographic fields. One needs to do this step only once for a given domain.
- Convert the ALADIN +0h forecast to GRIB format.
- Create the surface initial file (TEST.lfi) using the ALADIN initial file (in GRIB format) and the PGD file.

4. After creating the initial and LBC files one can run AROME.
5. Note that the upper air fields will be written to the output files ICMSH*EXPR*+00?? (as usually) while the surface fields will be written to ARMOUT_.???.lfi file (which is <u>not</u> an FA file).
6. To visualize the surface fields we have several options but at HMS we use 2 of them currently:

- Use the MESO-NH program: **diaprog**. One has to convert first the AROME surface output file to *dia.lfi* format with the **conv2dia** program.
- At HMS we use the HAWK visualization system. The advantage is that it is easier to compare

the results with other model output or with observations. The HAWK system reads the data in latlon grid and in netcdf format. A small program was created to interpolate the field from lambert to regular latlon grid and to convert to netcdf format.

7. To visualize the upper-air fields we also use the HAWK system. Latlon fullpos should be run on the forecast output and than convert the PF file to netcdf format. Only adiabatic fullpos can be run since some surface fields are missing from the ICMSH files.

4.5. Rio J. and M. Belo Pereira: Snow fall event in South Portugal.

4.5.1. Introduction

The goal of this work is to evaluate the performance of ALADIN in a snow event over Portugal, which occurred on the 29 of January 2006. In particular, we intend to compare the performance of the operational ALADIN (OPER), which uses cycle AL12_CYCORA_bis, with a new configuration, called AL28. This last configuration uses the cycle 28T3, a climatology created using the cycle 29 and a GTOPT030 database. Moreover, the integration domain used for AL28 is slightly enlarged, mainly to the West (by 3°).

Figure 1 illustrates the evolution of the depression, which caused heavy snowfall in the southern part of Continental Portugal. Figure 2 presents the MSLP and 10m wind forecasted by AL28 valid at 12UTC, which shows a shift to the southeast of the core of the depression.

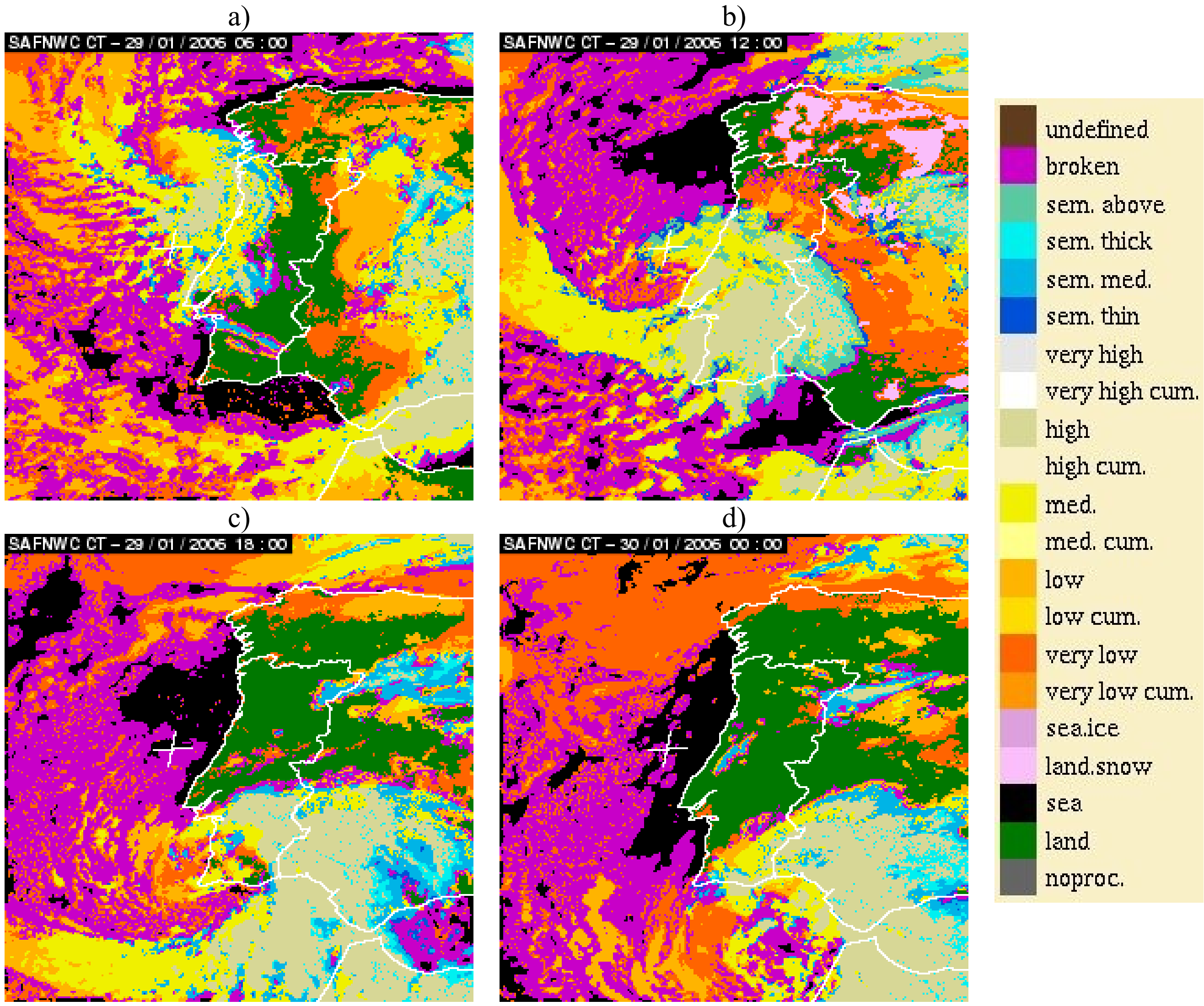


Figure 1 – Cloud type from MSG for 29 January 2006.

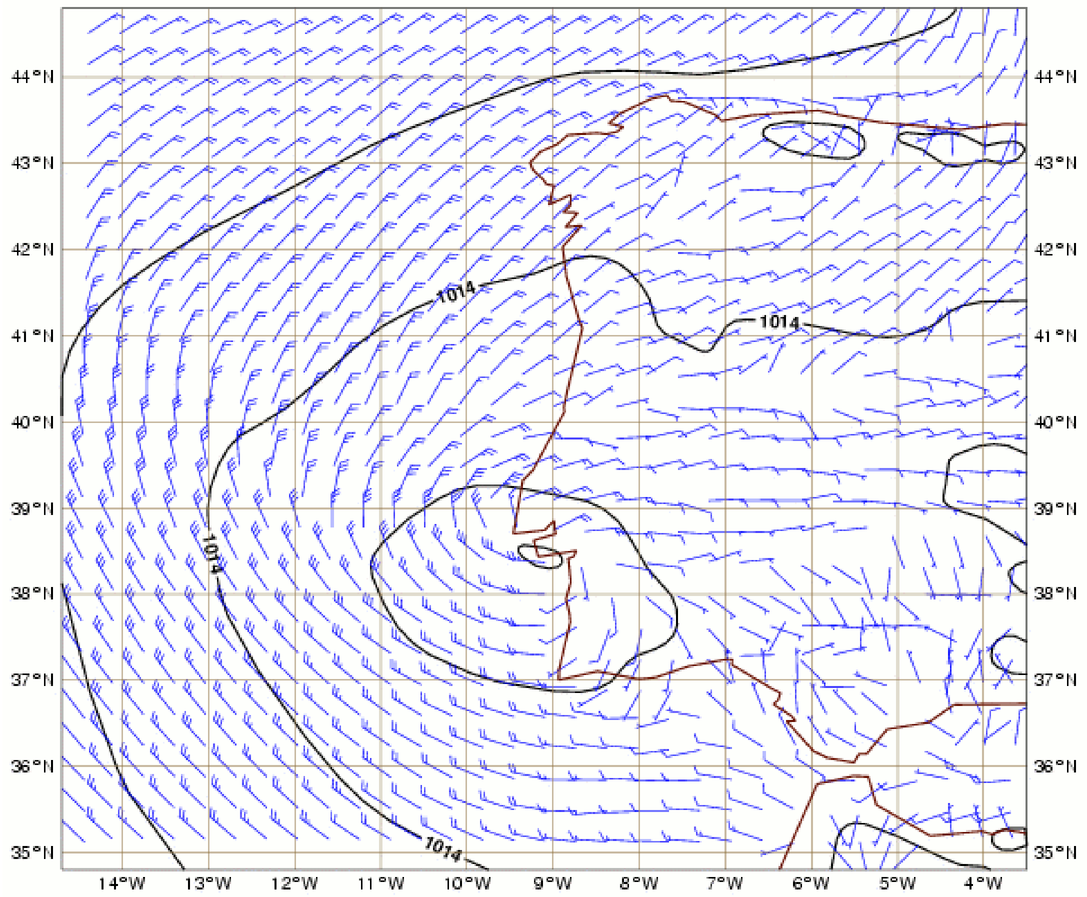


Figure 2 - Mean sea level pressure (hPa) and wind (kt) valid at 12UTC of 29/01/2006, forecasted by the AL28 from the 00UTC run.

4.5.2. Comparison between OPER and AL28 configurations

Figures 3 and 4 show the comparison between the 2m temperature observed and forecasted by the two ALADIN configurations, respectively, from the 12UTC (H+24) and 00UTC (H+12) runs. The OPER cycle from 12UTC run forecasts a local minimum in Algarve, while AL28 places it in the region of Lisbon and Alto Alentejo, which agrees better with observations. Nevertheless, it is visible that this local minimum is shifted to the south relatively to the observations, which is consistent with the forecasted position of the low.

The OPER run from 00UTC forecasts better the position of the local minimum in Alto Alentejo, than the 12UTC run, even though it presents a strong cold bias. On other hand, in this region, the AL28 configuration forecasts temperatures between 0 and 2°C, which is more in accordance with observation.

Figures 5 and 6 presents the 2m relative humidity observed and forecasted by the two ALADIN configurations, respectively, from the12UTC (H+24) and 00UTC (H+12) runs. One can see that in both runs the AL28 seems to outperform the OPER configuration, in particular, in the south and center regions.

Figures 7 and 8 compares the 24h accumulated precipitation observed and forecasted by the two ALADIN configurations, respectively, from the12UTC (H+24) and 00UTC (H+12) runs. Even though the 00UTC run is slightly better than the 12UTC run, both configurations forecast reasonably the area and amount of precipitation. Nevertheless, AL28 appears to agree better with observations, since the area of maximum precipitation is realistically shifted to the north.

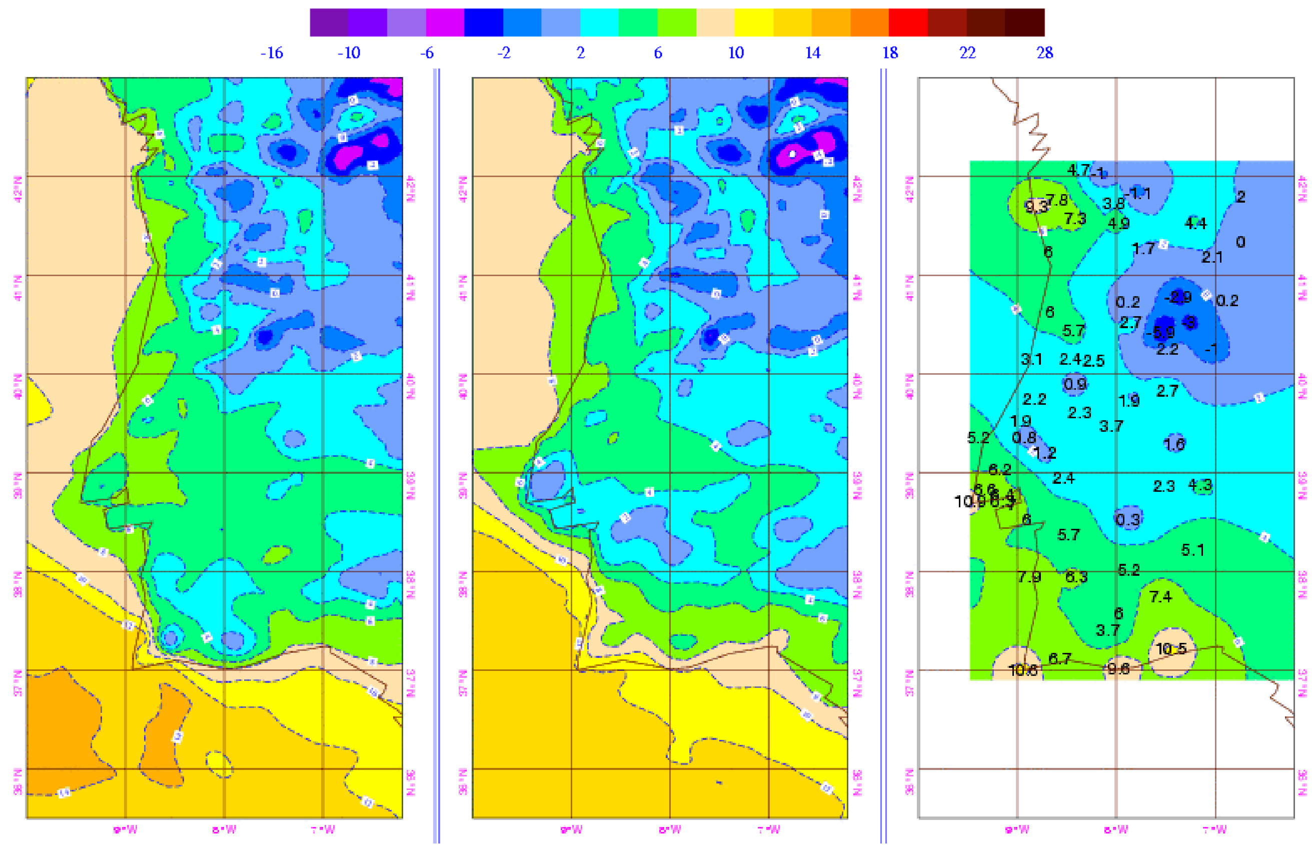


Figure 3 – Temperature at 2m (°C) valid at 12UTC of 29/01/2006, forecasted by operational ALADIN (left) and using AL28 (middle), from the 12UTC run of 28/01/2006. Observations in the right panel.

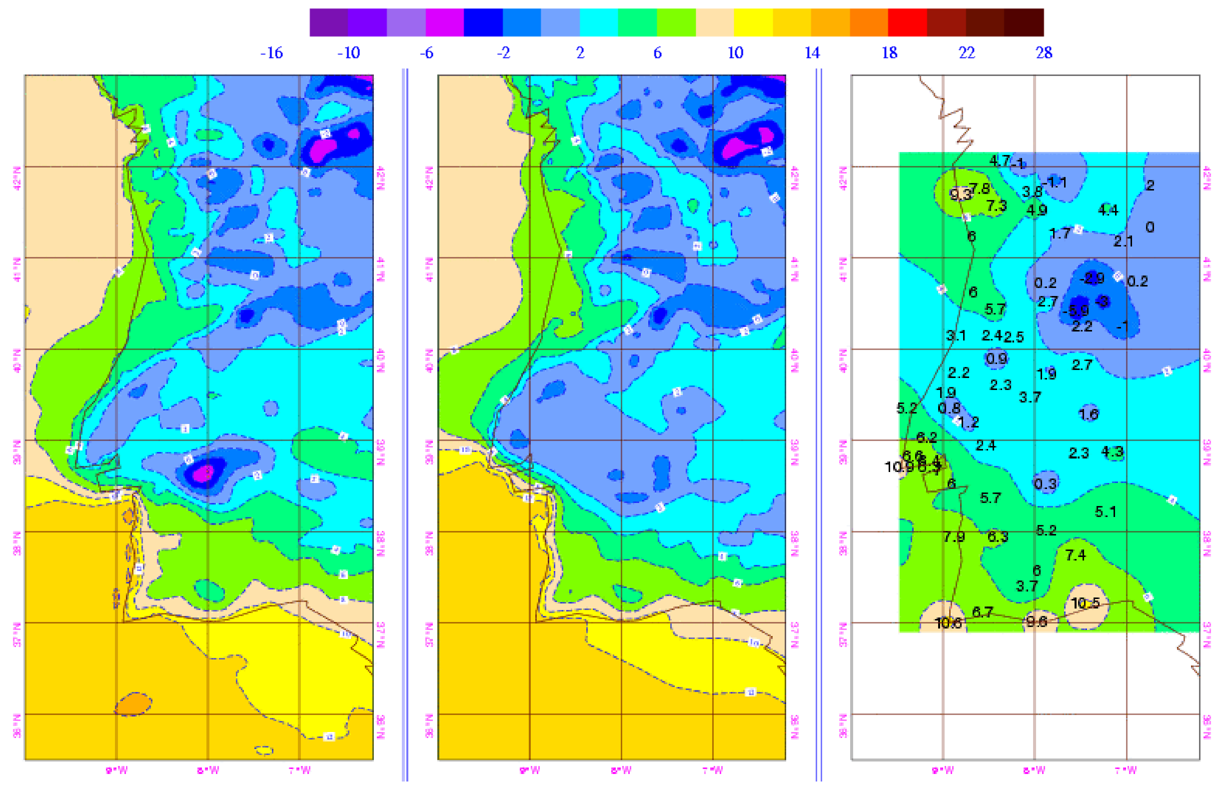


Figure 4 – Temperature at 2m (°C) valid at 12UTC of 29/01/2006, forecasted by operational ALADIN (left) and using AL28 (middle), from the 00UTC run. Observations in the right panel.

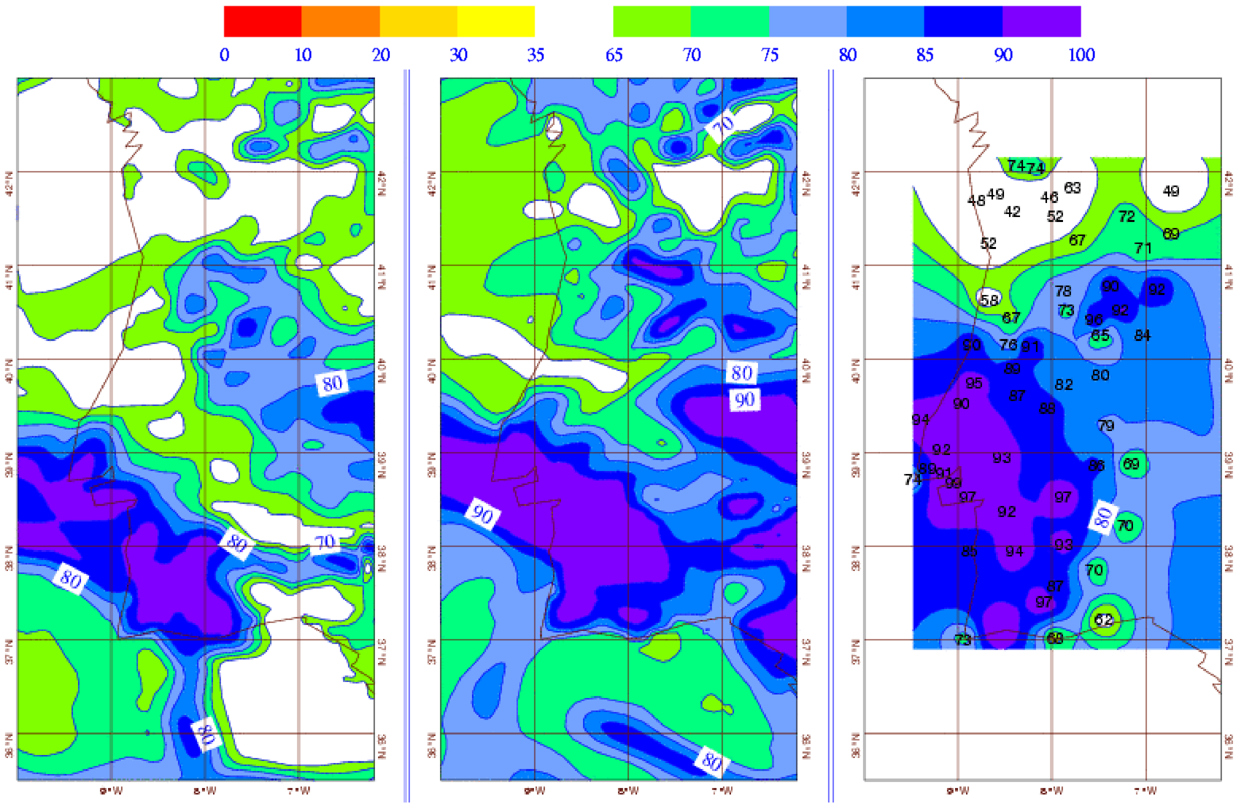


Figure 5 – Relative humidity at 2m (%) valid at 12UTC of 29/01/2006, forecasted by operational ALADIN (left) and using AL28 (middle), from the 12UTC run of 28/01/2006. Observations in the right panel.

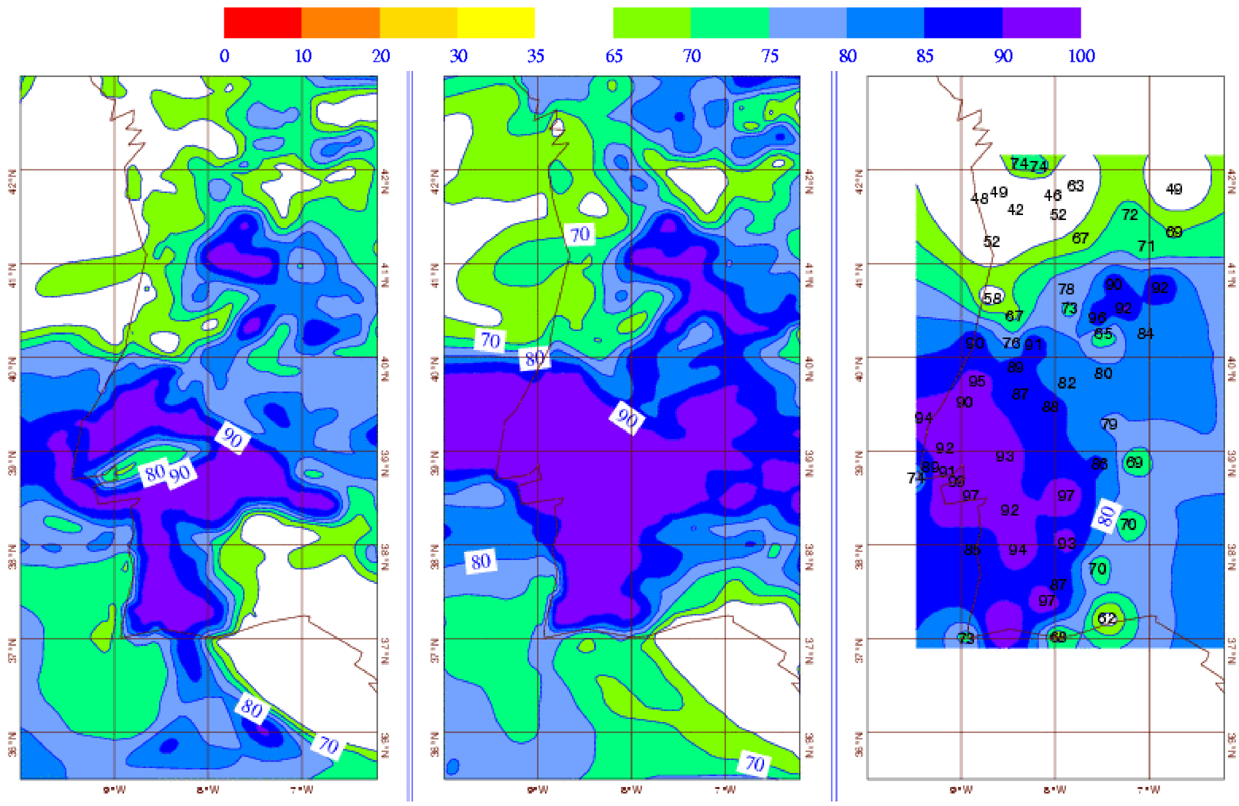


Figure 6 – Relative humidity at 2m (%) valid at 12UTC of 29/01/2006, forecasted by operational ALADIN (left) and using AL28 (middle), from the 00UTC run. Observations in the right panel.

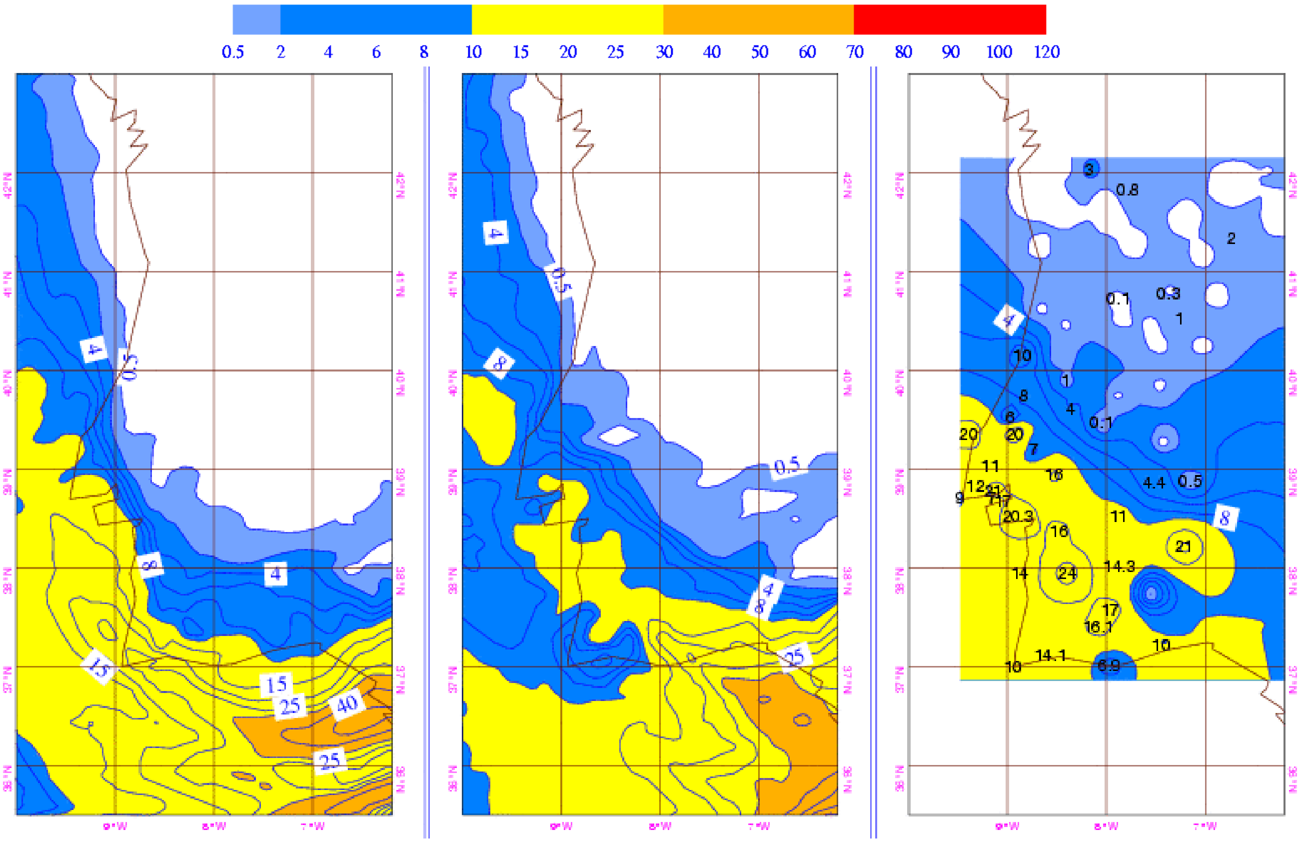


Figure 7: Accumulated precipitation (mm) in 24 h (between 00 and 24UTC of 29/01/2006), forecasted by operational ALADIN (left) and using AL28 (middle), from the 12UTC run of 28/01/2006. Observations in the right panel.

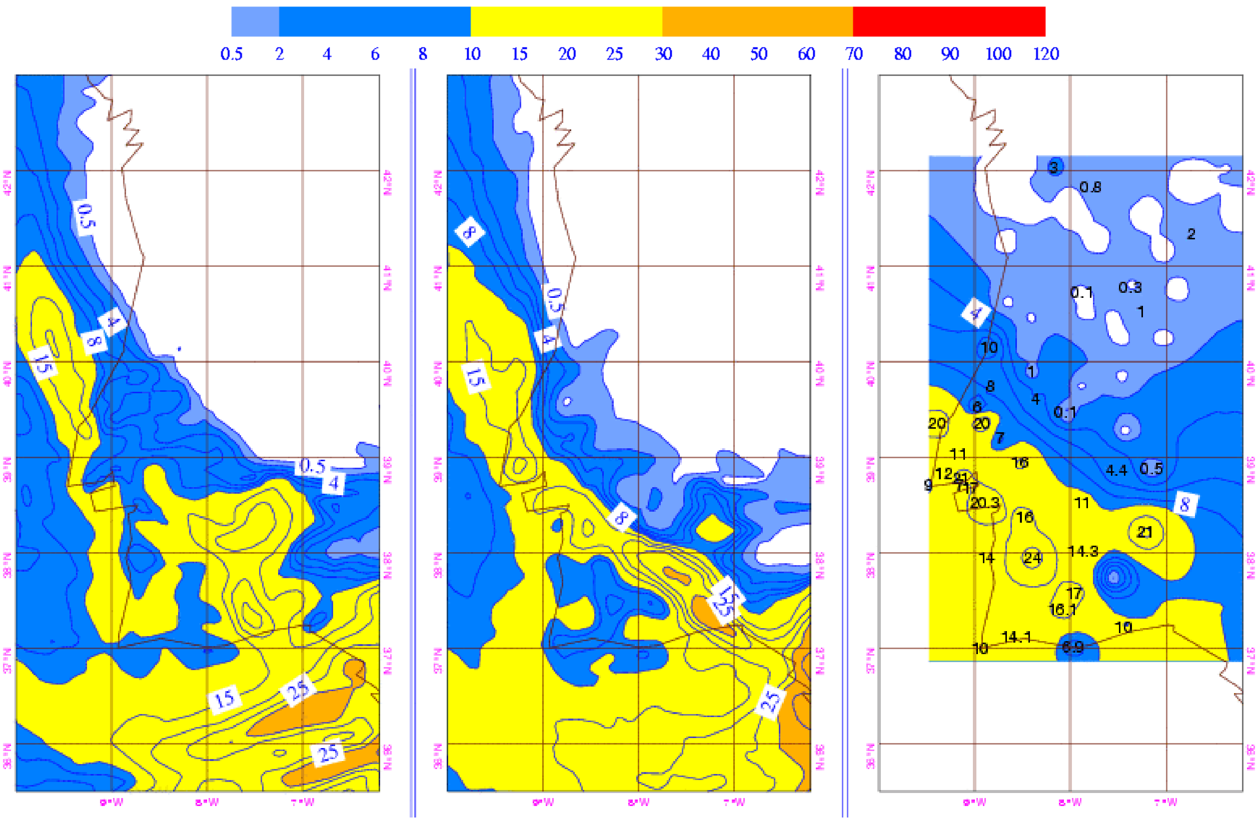


Figure 8: Accumulated precipitation (mm) in 24 h (between 00 and 24UTC of 29/01/2006), forecasted by operational ALADIN (left) and using AL28 (middle), from the 00UTC run. Observations in the right panel.

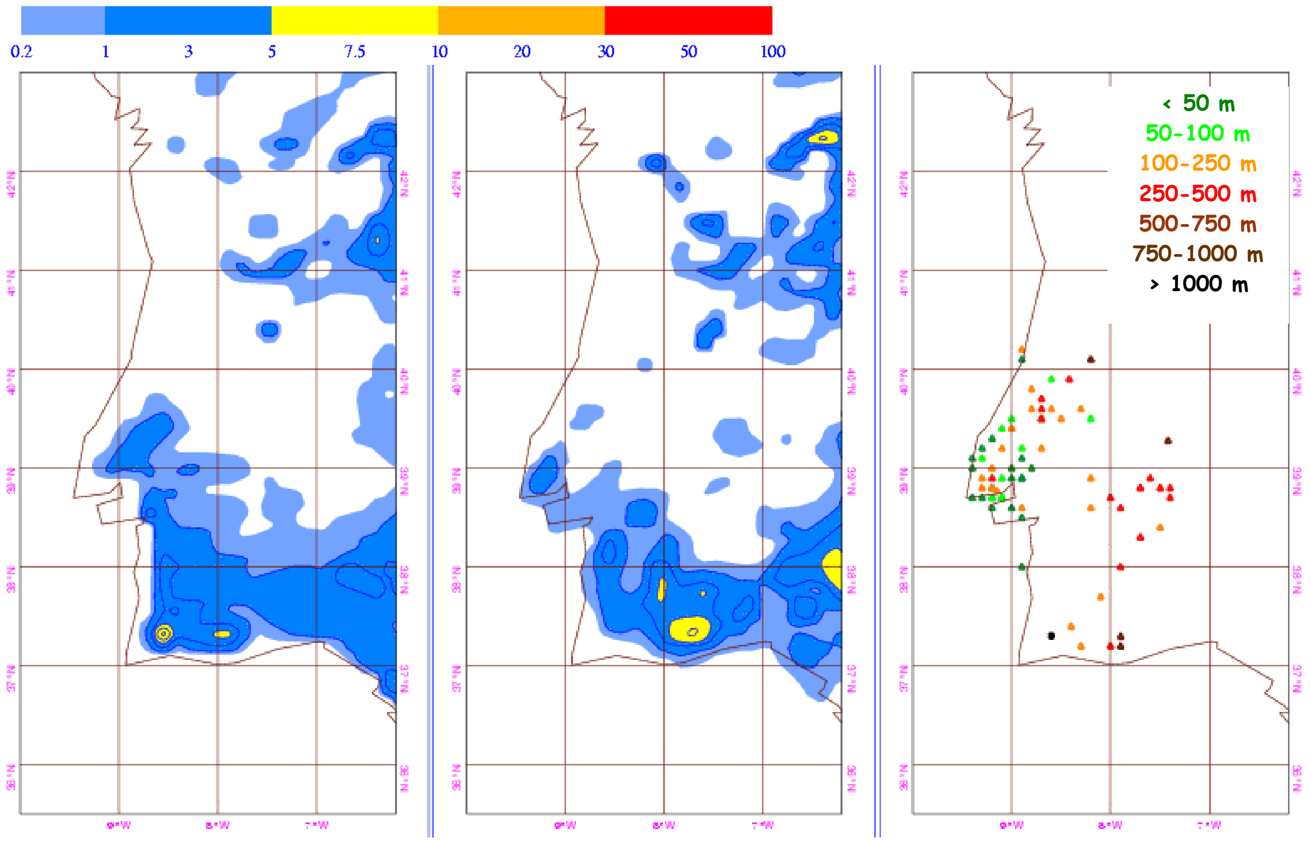


Figure 9: Accumulated snowfall (cm) in 24 h (between 00 and 24UTC of 29/01/2006), forecasted by operational ALADIN (left) and using AL28 (middle), from the 00UTC run. The right panel shows the height of locations where snowfall was observed.

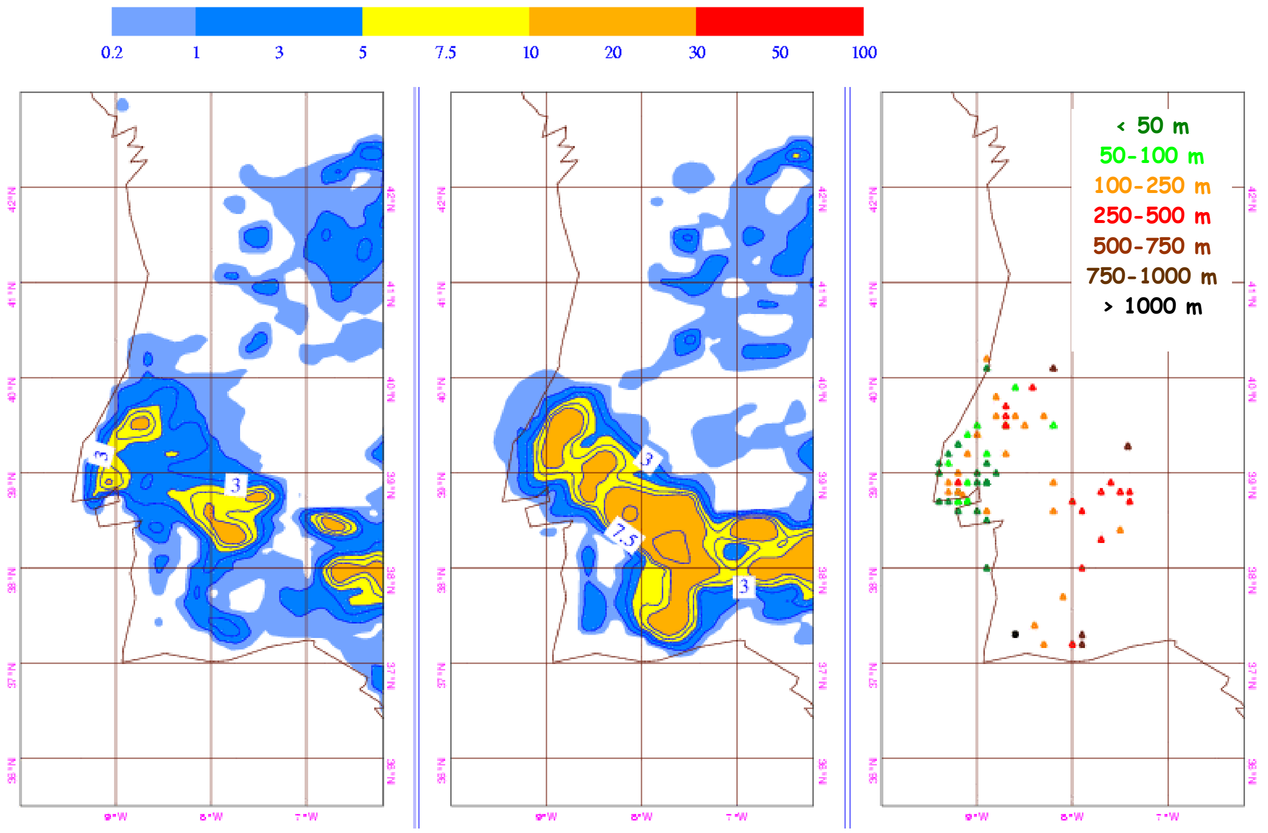


Figure 10: Accumulated snowfall (cm) in 24 h (between 00 and 24UTC of 29/01/2006), forecasted by operationalALADIN (left) and using AL28 (middle), from the 00UTC run. The right panel shows the height of locations where snowfall was observed.

Figures 9 and 10 show the comparison between the 24h accumulated snowfall forecasted by the two ALADIN configurations, respectively, from the12UTC (H+24) and 00UTC (H+12) runs. The height of the locations where snowfall was observed is also presented in these figures. One can see that ALADIN was able to alert to the occurrence of significant snowfall in uncommon areas, mainly in the 00UTC run. In particular, ALADIN forecasted snowfall in coastal areas in center of Portugal and in Southern regions, in locations with low altitude, where the occurrence of snowfall was reported. However, due to the lack of snowfall data it is not possible to validate the snowfall amount.

4.5.3. Conclusions and perspectives

In this particular case, AL28 outperformed the operational ALADIN configuration. In near future we intend to study subjectively the performance of both systems in other extreme weather events and also to make an objective verification.

4.6. Randriamampianina R.: Use and impact of the full grid AMSU-B data in the ALADIN/HU model.

4.6.1. Abstract

In the frame of the continuous development of the ALADIN 3D-Var system at the Hungarian Meteorological Service (HMS) our aim is to use as many observations and in as fine resolution as possible. The AMSU-A data are already implemented in the data assimilation system of the limited area model ALADIN Hungary (ALADIN/HU) and used operationally. Our recent work consists of studying the impact of E-AMDAR, atmospheric motion vectors (AMV) and full grid AMSU-B data on the model analysis and short-range forecasts. We use the locally received ATOVS data as well as the ones pre-processed at EUMETSAT and transmitted through the EUMETCast broadcasting system. In this paper we discuss the implementation and the impact of AMSU-B data assimilated in full grid – one-by-one field of view (FOV) – on the ALADIN/HU model. Update of the model and the bias correction programme was necessary to handle all the 90 scan angles instead of the 30 used in the default ARPEGE/ALADIN code. We observed positive impact of the AMSU-B data on the analysis and short-range forecasts of temperature near the surface, and on short-range forecasts of the temperature and humidity in the lower troposphere. Use of the AMSU-B data improves the short-range forecasts of the precipitation.

4.6.2. Introduction

In most numerical weather prediction (NWP) centres satellite data are assimilated in the form of raw radiances. The positive impact of the AMSU-B data on the global models has been proved by different studies (*English et al*., 2003; *Chouinard* and *Hallé* (2003); *Gérard et al*., 2003). However, the AMSU-B data are not used in their full resolution (not all FOV) in the three- and four-dimensional variational (3D- or 4D-Var) global assimilation system due to the model resolution.

Many investigations have been performed to evaluate the impact of the AMSU-B data in a limited area model (*Jones et al*., 2002; *Candy* (2005)). These studies showed positive impact on the analysis of moisture and short-range forecast of precipitation. Our goal was to improve our short-range forecast of precipitation, assimilating the AMSU-B data in as fine resolution as possible. Thus, different resolution of the AMSU-B (3x3 and 1x1 FOV) data were investigated using the 3D-Var ALADIN/HU, testing different thinning distances in the assimilation process.

This paper investigates the impact of AMSU-B data assimilated in different thinning distances (60-km, 80-km and 120-km) in order find the best improvement in the analysis and short-range forecasts.

Section 2 describes the main characteristics of the ALADIN/HU model and its assimilation system. Section 2.1 illustrates the local pre-processing of satellite data, section 2.2 illustrates briefly the use of different AMSU-B channels in our analysis system, while section 2.3 provides a short description of the bias correction method, used in ALADIN/HU. Section 3. presents the results of the investigation of full grid AMSU-B data, and in section 4. we draw some conclusions and discuss further developments.

4.6.3. The ALADIN/HU model and its assimilation system

At the Hungarian Meteorological Service (HMS) the ALADIN/HU model runs in its hydrostatic version. In this study the cycle Cy28t3 of the ARPEGE/ALADIN codes (see Table 1) was used in 12-km horizontal resolution and with 37 vertical levels from the surface up to 5 hPa height. The 3D-Var system was applied to assimilate both conventional – surface (SYNOP), radisonde (TEMP) and aircraft (AMDAR) – and satellite (ATOVS) observations. As the variational technique computes the observational part of the cost function in the observational space, it was necessary to simulate radiances from the model parameters. In the ARPEGE/ALADIN we use the RTTOV (see table 1) radiative transfer code to perform this transformation (*Saunders et al.*, 1998). In the RTTOV we have 43 vertical levels. Above the top of the model, an extrapolation of the profile is performed using a regression algorithm (*Rabier et al.*, 2001). Below the top of the model, profiles are interpolated to RTTOV pressure levels. A good estimation of the background error covariance matrix is also essential for the variational technique to be successful. The background error covariance - the so-called "B" matrix – was computed using the standard NMC method (*Parrish and Derber,* 1992; *Berre* (2000); *Široká et al.*, 2003). The 3D-Var is running in 6-hour assimilation cycle generating an analysis at 00, 06, 12 and 18 UTC. In this study, we performed a 48-hour forecast once a day (see Table 1).

Table 1: The ALADIN/HU 3D-Var applied in the study

Model	- Hydrostatic version - Horizontal res.: 12km - 37 vertical levels	al28/cy28t3
3D-Var	- Cov. Matrix B: std NMC - 6 hour assim. cycling - RTM model: RTTOV - Coupling files: ARPEGE long cut-off files - Satellite observations: - Selected channels: - Humidity assimilation	RTTOV-7 Coupling: every 3h NOAA-15,16&17 AMSU-A&B AMSU-A(5-12), AMSU-B(3-5) multivariate
Surface	- Surface analysis	No, interpolation of ARPEGE surface fields to ALADIN grid
Forecast:	- 48 hour	From 12 UTC

Pre-processing of satellite data

The ATOVS data are received through our HRPT antenna and pre-processed with the AAPP (ATOVS and AVHRR Pre-processing Package) software package. We used AMSU-A, level 1-C radiances in our study.

For technical reasons our antenna is able to receive data only from two different satellites. To acquire the maximum amount of satellite observations, the NOAA-15 and the NOAA-16 satellites were chosen, that have orbits perpendicular to each other and pass over the ALADIN/HU domain at about 06 and 18 UTC and 00 and 12 UTC, respectively. In addition to our local reception, data retransmitted trough the EUMETCast broadcasting system that contain data measured by NOAA-17 were also investigated.

For each assimilation time we used the satellite observations that were measured within ±3 hours. The number of paths over the ALADIN/HU domain within this 6-hour interval varies up to three.

Use of the AMSU-B channels

In the ARPEGE/ALADIN (*cy28t3*) model AMSU-B channels 3, 4 and 5 are used. From both sides of scanning edges, nine pixels were removed to avoid big biases. Over land only channels 4 and 5 are used with some restrictions related to the model orography. They are used when the model orography is less than 1500 m and 1000 m, respectively. All the above-mentioned three channels are used over sea. The following restrictions are applied to blacklist all channels: 1- where the surface temperature is less than 278 K; 2- where the absolute value of the first-guess departure (observation-minus-background) of the channel 2 is less than 5 K.

Bias correction

The direct assimilation of satellite measurements requires the correction of biases computed as the difference between the observed radiances and those simulated from the model first guess. These biases arising mainly from instrument characteristics or inaccuracies in the radiative transfer model can be significant. The method developed by *Harris and Kelly* (2001) was used to remove this systematic error. This scheme is based on separation of the biases into scan-angle dependent and state dependent components. The air-mass dependent bias is expressed as a linear combination of set of state-dependent predictors.

In the experiments, four predictors computed from the first-guess fields were selected (p1 - the 1000-300hPa thickness, p2 - the 200-50hPa thickness, p3 - the skin temperature and p4 - the total column water) for the AMSU-A data.

A carefully selected sample of background departures for the AMSU-A and channel set was used to estimate the bias, in a two-step procedure. First, scan bias coefficients were computed by separating the scan-position dependent component of the mean departures in the latitude bands. Secondly, after removing the scan bias from the departures, the predictor coefficients for the state-dependent component of the bias were obtained by linear regression. At the end of this estimation procedure, bias coefficients for the AMSU-A were stored in a file. The data assimilation system could then access the coefficients in order to compute bias corrections for the latest observations, using update state information for evaluating the air-mass dependent component of the bias. The brightness temperatures were corrected accordingly, just prior to assimilation. In the ALADIN/HU assimilation system the bias correction file computed by the LAM model is used (*Randriamampianina*, 2005).

As in the cy28t3 of the ARPEGE/ALADIN codes, the default maximum number for the scan angle is 30. The model and the bias correction programme were updated to handle the 90 scan angles of the full-grid AMSU-B.

Description of the experiments

The aim of this investigation was to exploit the AMSU-B data in as fine resolution as possible. From technical point of view the use of these data in 3x3 FOV resolution (same resolution as the AMSU-A data) is the simplest way. This run was compared to the ones with AMSU-B data assimilated in full grid as follows:

NAMV- using surface, radiosonde, aircraft (AMDAR) and satellite (AMSU-A) observations (control observations) in assimilation. This was the control run.

SBX3- using control observations and AMSU-B data reduced in 3x3 FOV, thinned in 80km resolution in the assimilation.

SFB8- using control observations and AMSU-B data in full grid (1x1 FOV), thinned in 80km resolution in the assimilation.

SFB6- using control observations and AMSU-B data in full grid, thinned in 60km resolution in the assimilation.

SFB1- using control observations and AMSU-B data in full grid, thinned in 120km resolution in the assimilation.

A two-week period (07.02.2005-21.02.2005) was chosen to evaluate the impact of different settings of the AMSU-B data in the assimilation system. The scores of each run were evaluated objectively. The bias and root-mean-square error (RMSE) were computed from the differences between the analysis/forecasts and observations (surface and radiosondes). The accumulated amount of precipitation was also compared to the one computed from the surface measurement for a few interesting situations within the period of study.

4.6.4. Results and discussion

The impact of the AMSU-B data was estimated comparing the runs with and without the assimilation of these data. The performance of the different settings in the assimilation of the AMSU-B data was evaluated comparing the scores of the runs to each other. The main results are classified as follows:

Influence of the assimilation of AMSU-B data on temperature and humidity bias

The use of the AMSU-B in the assimilation process caused a weak heating and cooling effect in the troposphere and around the tropopause, respectively (Fig. 1) and resulted in more moist conditions in the troposphere in the analysis and forecast. As it was found during the everyday subjective verification, the forecasts issued from the 3D-Var cycles were more "dry" than those of the spin-up model (or dynamical adaptation). This "drying" effect of the 3D-Var resulted in overestimated temperature and worsened forecast in certain cases. In such situations the "wetting" effect of the AMSU-B data could increase the forecast accuracy. On the other hand, the only humidity observation we had and used was that from radiosonde measurements.

Impact of AMSU-B data on the analysis and short-range forecasts

As discussed above, the systematic addition of moisture in the model leaded to a positive impact not only on the temperature analysis and forecast - except for the 6-hour forecast where remarkable difference in the RMSE could be observed (Fig. 2) - but also on the forecast of relative humidity. Figure 3 shows clear positive impact on the 48-hour forecast of the relative humidity.
The impact on the analysis and forecasts of geopotential, wind speed and wind direction was found to be neutral (not shown).

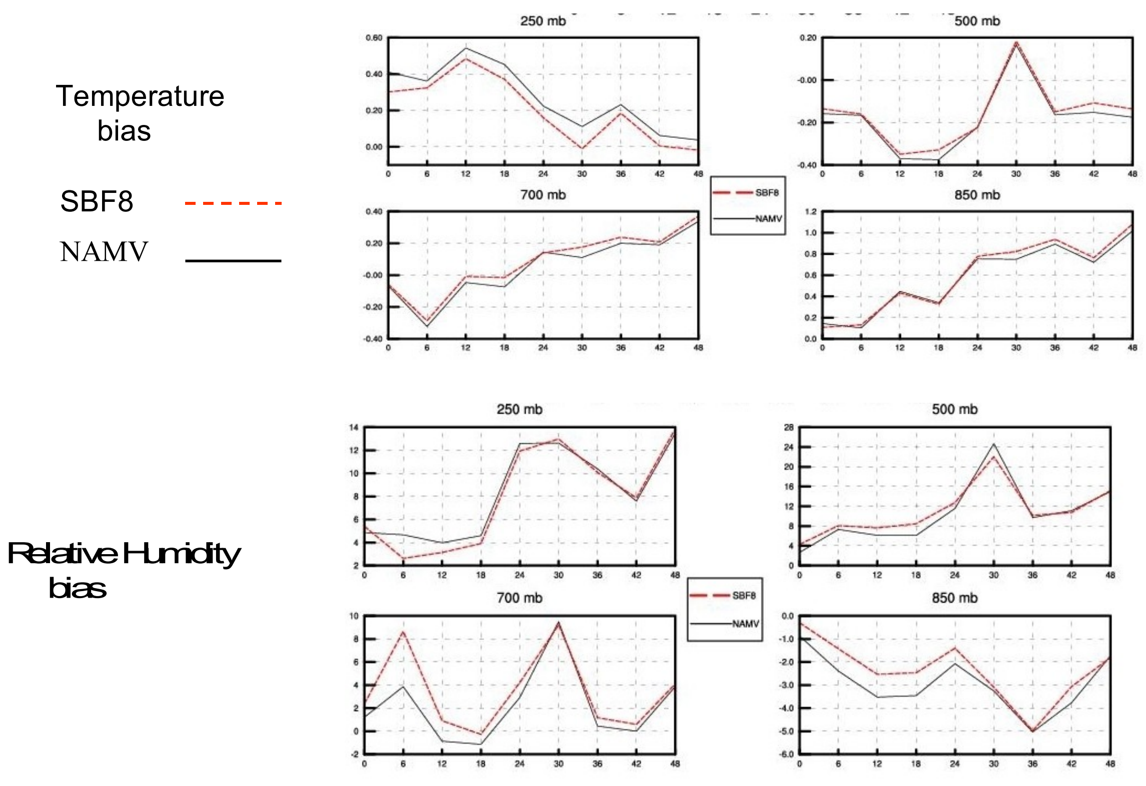


Figure 1. Temperature and relative humidity biases for the runs with (SBF8: dashed line) and without (NAMV: solid line) AMSU-B data at the analysis (0) and subsequent forecast times.

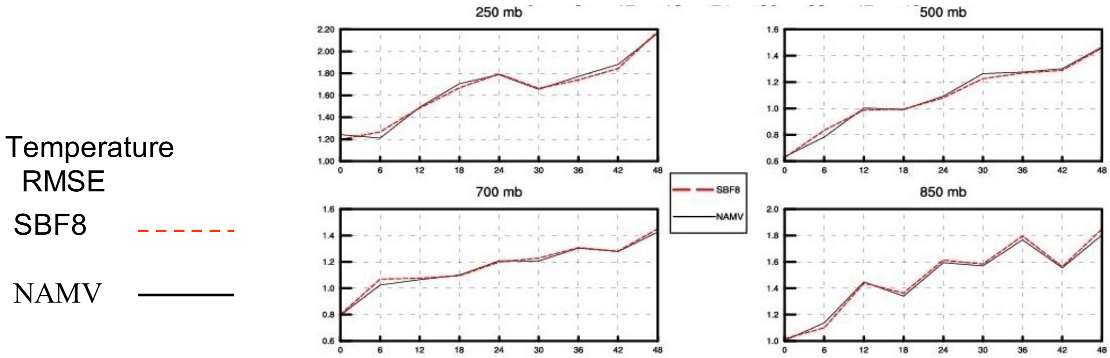


Figure 2. Root-mean-square error (RMSE) of temperature for the runs with (SBF8: dashed line) and without (NAMV: solid line) AMSU-B data at the analysis (0) and subsequent forecast times.

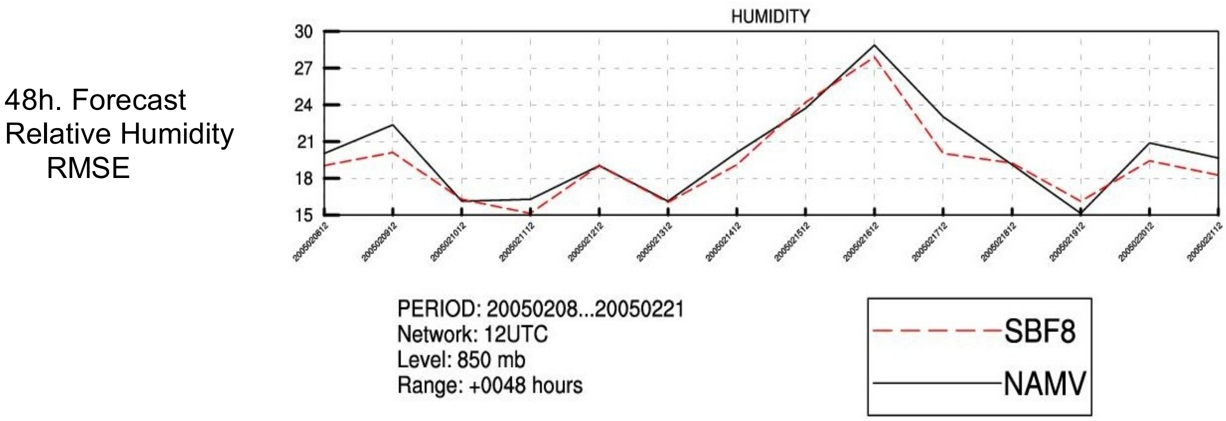
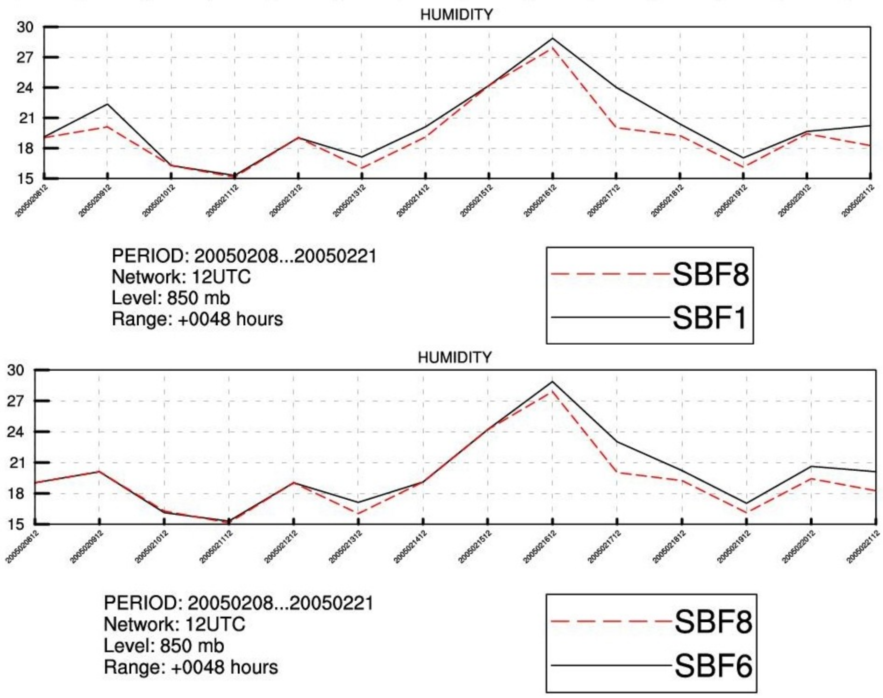


Figure 3. RMSE for the 48-hour forecast of relative humidity for the runs with (SFB8) and without (NAMV) assimilation of AMSU-B data.

Evaluation of the different usage of the AMSU-B data

To find the best usage of the AMSU-B in the assimilation system, four settings were compared: three runs with full grid using different thinning distances (SFB8: 80 km, SFB6: 60 km and SBF1: 120 km) in the assimilation system, and one run with reduced (3x3 FOV) number of observations (SBX3, thinning distance: 80 km). Using full grid AMSU-B data in 80 km resolution (run SBF8) improved the forecast of all the parameters (see Fig. 4). Nevertheless, we have to mention that SBF8 provides less accurate 6-hour forecasts of temperature than SBF6, SBF1 or SBX3. Comparing the scores of individual daily 6-hour forecasts, it was found that experiments with full grid AMSU-B "failed" to predict (on the 6-hour forecast, valid for 18UTC 18 February 2005) the presence of a low-pressure region over the Southern part of Italy, causing large bias in the forecast of geopotential and temperature (not shown).

48h. Forecast
Relative Humidity
RMSE



4.6.5.

Figure 4. RMSE for relative humidity of individual runs

Comparison of 6-hour cumulative precipitation forecasts

Figure 5. shows the observed and predicted cumulative precipitation for the territory of Hungary. All the runs (with and without AMSU-B data) gave quite good prediction of the rainfalls observed in the Western part of the country. The precipitation patterns in the Eastern part, however, were only predicted by runs that used the AMSU-B data in full grid.

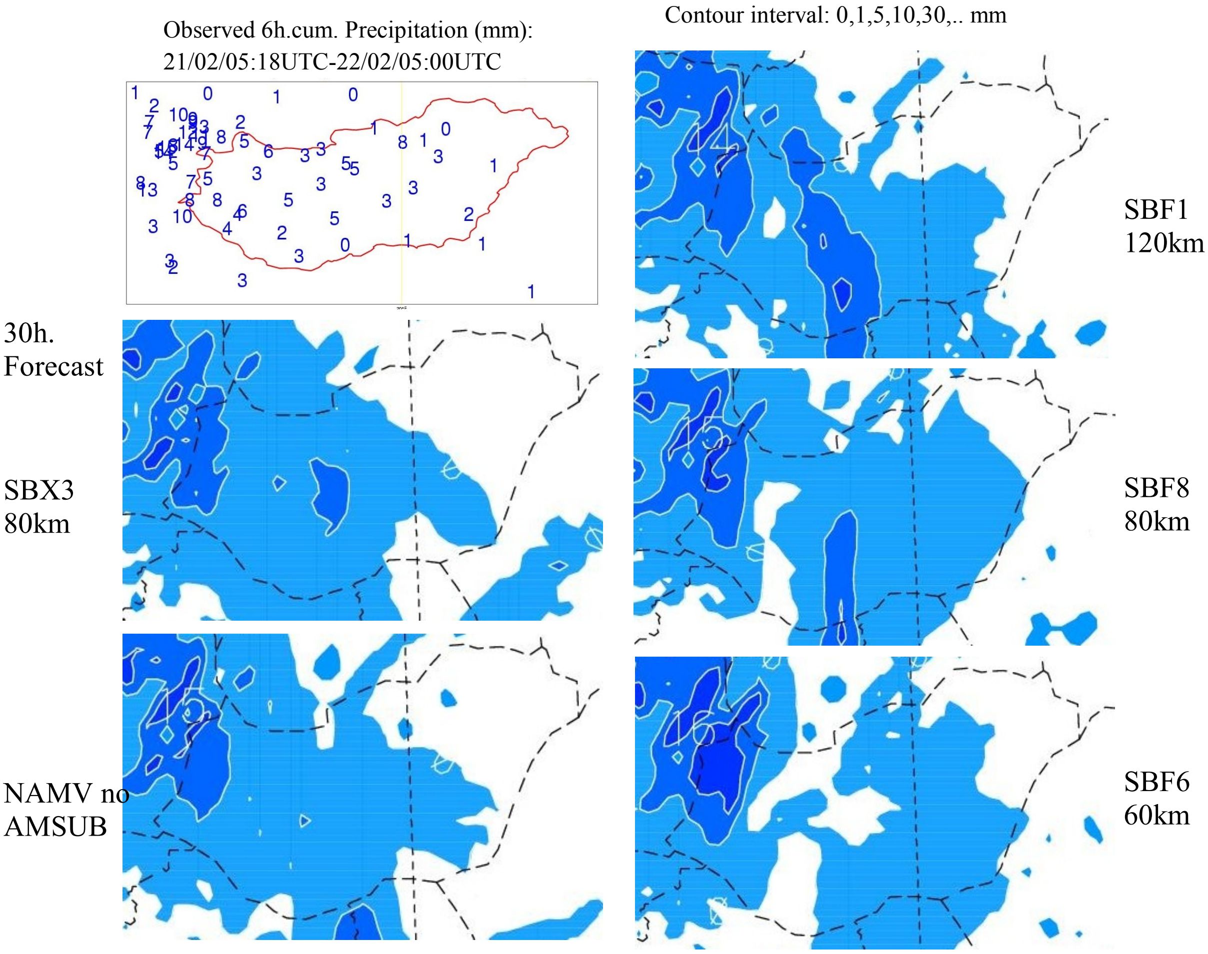


Figure 5. Rainfall observations (top, upper left) compared to the predictions of 6-hour (f30-f24) accumulated precipitation amount valid for 00 UTC 22nd Feb. 2005.

Subjective and objective scores evaluated during the use of the AMSU-B in parallel suite

The performance of the main models used by the forecasters are evaluated subjectively everyday. See Tóth (2004) for more details about the subjective verification system at the HMS. It concerns mainly the ECMWF products and three versions of the ALADIN/HU model: 1- the operational one (OPER or HUN2), that actually uses a 3D-Var system assimilating the surface, the radiosonde and the aircraft measurements and the ATOVS AMSU-A radiances to create the initial condition for the forecast model; 2- the one that uses the ARPEGE analysis as initial condition (the so-called dynamical adaptation) and 3- a system that is being tested, which uses the 3D-Var analysis system that also incorporates the full-grid AMSU-B data to create the initial condition (TEST2). Figure 6. shows the subjective scores for the forecasts of precipitation up to 24-hours (the first day and 24-hours cumulated precipitation), where one can see that the dashed line one time below and three times above the solid line. This means one day with worse forecast against three days with improved forecasts of the first two-week of November 2005. Note, that in the subjective verification 10 means perfect and 0 means very bad forecast, and that only a small domain occupying approximately the Hungarian territory and the close surrounding region is evaluated. According to the objective verification, performed for the whole ALADIN/HU domain, a positive impact was observed for the period from 2nd of November to 19th of November 2005 (Fig. 7) when comparing the 24-hour forecast of precipitation with the surface gauges data. Small but significant impact on the analysis and all the forecasts ranges of temperature at 1000 hPa is shown in Figure 8.

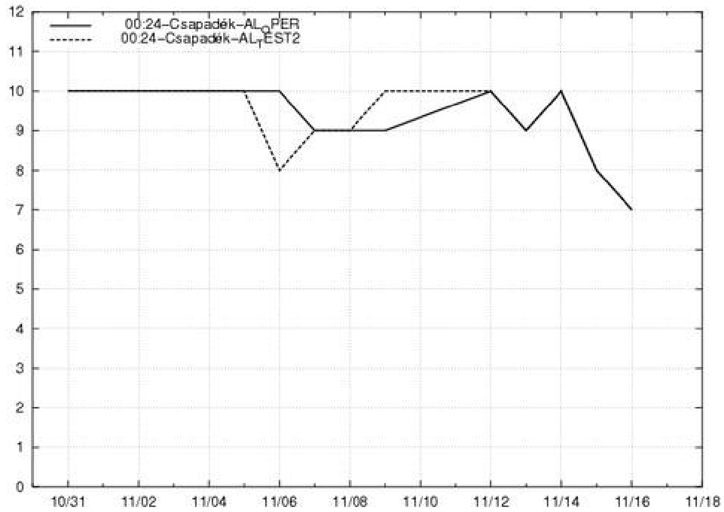


Figure 6. Subjective scores for the 24-hour cumulated precipitation of the run in parallel suite, using AMSU-B data (dashed line), and the operational run (solid line). Comparison valid for the Hungarian territory and the close surrounding regions. Forecast from 00 UTC network

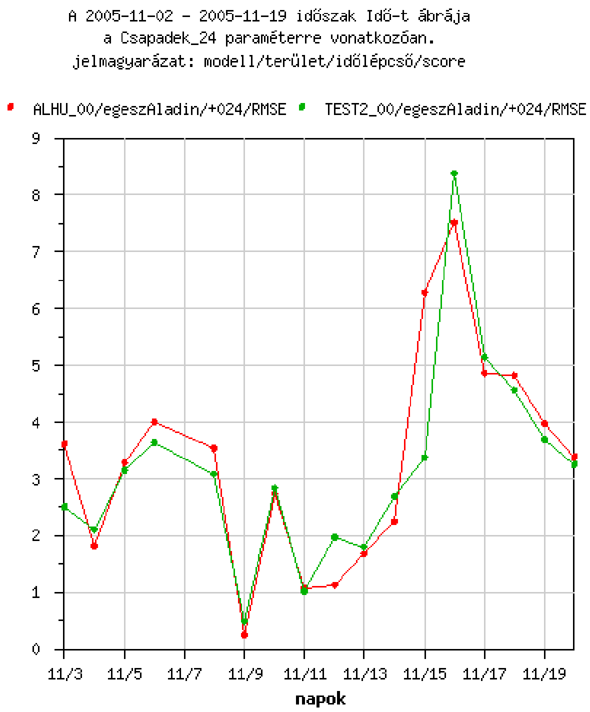


Figure 7. Objective scores for the 24-hour cumulated precipitation of the run in parallel suite, using AMSU-B data (green line), and the operational run (red line). Comparison valid for the whole ALADIN/HU domain. Forecast from 00 UTC network

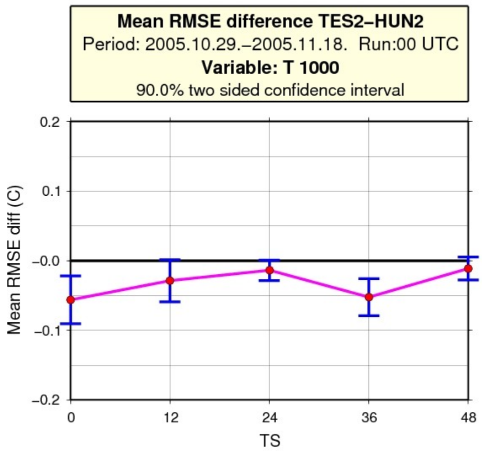


Figure 8. Significance test of the impact of the AMSU-B data on the temperature at 1000 hPa height. A small but significant reduction in RMSE values of the analysis and at all forecast ranges can be observed

4.6.6. Conclusion and future plans

Our experiments showed that the resolution of the input AMSU-B data is important for their better use in a LAM. It is preferable to assimilate the AMSU-B data in full grid.

We found that the "optimal thinning distance" for our system is 80 km.

The impact of the AMSU-B data on the analysis and short-range forecast of temperature, geopotential and wind fields was found to be rather slightly positive than neutral during the testing period. Positive impact on the forecast of relative humidity was observed. The use of the AMSU-B improves the forecast of precipitation. Clear positive impact of the AMSU-B data on the temperature was observed in the lower model levels during their use in the parallel suite.

The AMSU-B data are in operation since the end of January 2006.

The AMSU-B data slightly increased the bias of the relative humidity in the middle troposphere (Fig. 1). One of the important issues in the near future is to update the bias handling procedure in the LAM system. We plan to implement the SEVIRI clear sky radiances in our system.

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4.7. Spaniel O.: Local ALADIN&HIRLAM Operational Suite.

This paper was done, based on the question-form which has been sent to all of the ALADIN and HIRLAM correspondents, with the aim to obtain more detail information about the organization of the local operational suite. The result was also presented during the last ALADIN-HIRLAM workshop in Budapest.

4.7.1. Question-form - Local ALADIN&HIRLAM Scripts, ALADIN&HIRLAM Operation Suite and an Active Standby Operation

This form was compiled as 16 simple questions set into 3 main subjects, with expectable answer as possibility choice.

- Operational environment
- Modularity and flexibility
- Centralize/decentralize hardware
- Queuing system
- Hardware show

- Active standby operation, monitoring and maintenance
- Continual supervision of operational suite
- Method of monitoring
- Communication facility for monitoring

- Active standby operation and monitoring
- Staff
- Cooperation
- LBC data
- Hardware reliability
- Trouble
- Failure

4.7.2. The hardware show

This table shows hardware platform used for model execution, the queuing system and the hardware used for post-processing.

Country	HPCS Platform	Queuing system	Post-processing
Austria	SGI	none	SGI, SUN
Belgium	SGI	PBS Pro	SGI
Bulgaria	Linux PC	none	Linux PC
Croatia	SGI	Open PBS	Linux PC
Czech Republic	NEC	NQS	Linux server
Denmark	NEC/SX6	NQS II	NEC/SX6
Finland	SGI Altix BX2	none	SGI Altix BX2
France	Fujitsu	NQS	Fujitsu, HP
Hungary	IBM	LoadLeveler	IBM
Ireland	IBM RS/6000	LoadLeveler	IBM RS/6000
Morocco	IBM	LoadLeveler	IBM
Netherlands	Sun Fire 15K	none	Sun Fire 15K
Norway	SGI Origin 3800	LSF	Intel Xeon
Poland	SGI	yes	SGI + Linux server
Portugal	DEC	none	DEC
Romania	SUN	none	SUN/DEC
Slovakia	IBM	LoadLeveler WLM, vsrac	IBM/DEC
Slovenia	Linux cluster	FIFO scheduler	Linux cluster
Spain	CRAY X1E	PBS	CRAY X1E
Sweden	Linux Cluster	PBS	Alpha Server 4000
Tunisia	IBM	yes	IBM

4.7.3. Operational environment

This item should answer the question of what is main features of the local operational suite from a programming point of view, generally the operational environment.

• independent scripts and programs executing by system scheduler (cron)	8	3
• the monitor scheduler tool based on a sequential scripts (shell, perl)	1	1
• the monitor scheduler tool based on a modular scripts with checking of dependencies on the independent modules	2	
• the commercial monitor scheduler software (e.g. SMS) covered the scripts	2	2
• the monitor scheduler software written in house based on high-level language	1	

4.7.4. Operational suite

The ALADIN operational suite is generally located on HPCS (or the auxiliary server is used), the system cron is used for submitting a start script through QS if available, the scheduler SMS (Supervisor Monitor Scheduler) and PBS (Portable Batch System) are used and so is a monitoring system based on http. The Nagios can be optionally used as an open source host, service and network monitoring program and the Ganglia as a scalable distributed monitoring system for high-performance computing systems such as clusters and Grids.

4.7.5. Modularity and flexibility

The answer for question how any operational suite is well arranged. It would be useful to know what should be your estimation demand factor for modification of local operational "script"? The task is to make some modification into local operation suite based on upgrading configuration 001 from 48 to 72 hours and to produce a simple graphical output for precipitation. The available time for this task is 6 hours. There is a scale of time tresholds for this task. In fact, the answers are quite optimistic.

• very easy (1-2hours)	5	2
• quite easy (3 hours)	7	4
• difficult (5 hours)	1	
• very difficult (6 hours and more)	1	1
• only after through analysis (1-2 days)		
• practically impossible without rewriting operational suite afresh		

4.7.6. The active standby operation, monitoring and maintenance

Do you use some kind of the active standby operation for the operational suite with periodical procedure of changing the responsible staff?

• yes	6	4
• no	7	3
• yes/no	1	

yes/no - the warning message is sent to person with no obligation to act

4.7.7. The continual supervision of operational suite

- 24x7 (including holidays) 5 5
- 24x5 (only working days)
- 8x5 (only in working time) 8*
- 24x6 1
- no regular operation supervision 2

4.7.8. The method of monitoring

Is there a method of monitoring active or passive mode? An active monitoring means that a status of execution of a suite (or status in case of fault) is sent to the responsible person (SMS, e-mail, notification). A passive monitoring means that the responsible person checks the status of the suite at periodical time.

- active monitoring based on 8 5
  warning message (e.g. SMS, e-mail)
  no active monitoring based on periodic check 4 2
  of operational status
- service mission on the user's 2
- (customer's) demand
  no active monitoring and no periodic check 1
  checking by computer operators 1 2

4.7.9. The communication facility for monitoring

The informants indicated more options in this case, so the simple sum of answers do not tally. The surprise comes from the small number of really mobile communication equipment usie for monitoring. A personal invitation on site is still more popular.

- phone (voice)-interactive comm. with technical
  and forecaster staff 4 5
- phone line (modem)-interactive access 4 3
- mobile phone (voice)-interactive
  communication with technical and forecaster staff 6 3
- notebook (with GPRS/EDGE modem) 2
- PocketPC, smart phone (with GPRS/EDGE modem) 2
- personal intervention on site 9 1

4.7.10. The Active standby operation and monitoring

The monitoring based on willingness is more or less equal to official one.

- spontaneous with exclusion of profit 5 3
- officially as office of profit 5 2

- officially with compensation in time
- a special service contract arrangement

□+ depending on the weather situation

4.7.11. The NWP staff

There is an overview from NWP staff responsible for operational suite ordered by the number of people in active standby operation. The statistic is not very precise because there is probably a mix of available people during working time and responsible people for current time.

during working time	(out of working time)
1	(0)
1	(0)
1	(0)
2	(0)
2	(0 to 2)
1	(1)
1	(1 IT operator)
1	(1 IT operator)
1 to 5	(1)
1	(1)
2	(2)
2	(2)
2	(2)
2+1	(1)
2-3	(1-2)
3	(1)
8	(1 person in periodical shift)
4	(1)
5-6	(1-2)
2+1+1	(2+1+1)
4+4	(4+4)

4.7.12. The cooperation

The cooperation with another technical section (department) in the field of maintenance and supervising system.

The mostly cooperation between application, system environment and communication channel is used.

• only NWP	3	
• NWP + LAN/WAN maintenance	2	
• NWP + LAN/WAN maintenance + system administrator	7	6
• NWP + outsourcing + system administrator	2	1
• NWP + LAN/WAN maintenance + outsourcing		
• NWP + outsourcing		

4.7.13. The LBC data

The fetching of LBC is done mainly through Internet. Very often, both connection are used simultaneously by means of intelligent fetching procedure for elimination Internet prime time effect (ALADIN case).

	the main connection		the backup	
• Internet	9	2	3	2
• RETIM	0		4	
• RMDCN	2	5	3	2
• local data	1		1	
• leased line to TLS	1		0	
• Messir-Comm	1	1		
• no backup	x		2	3

Internet&RMDCN	simultaneously
Internet&Messir-Comm	
Internet&RETIM	
Internet&Internet (another provider)	
RMDCN (ISDN)	on demand

There is a table for error rate for transfer LBC data via Internet and RETIM in SHMI suite during the last 10 months (terms for the false event are "no data" or "delay more than 2 hours") . The total error rate means that data are missing from the both sources all at once. As you can see (e.g. for 06:00 run) the error rate is quite high for both sources (8,7 and 6,3), but thanks to backup and "small probability of event at same time" the total error rate is quite acceptable (1,5). This is only an example which shows that backup is really needful.

	Internet	RETIM	total error rate
00:00	2,3%	3,3%	0%
06:00	8,7%	6,3%	1,5%
12:00	1,7%	4,0%	0,7%
18:00	4,8%	7,1%	0,8%

4.7.14. Hardware reliability

A maintenance agreement for the High Performance Computing System.

• yes	11	7
• no	3	0

4.7.15. The trouble

The “bottle neck” for the local operational suite.

- 24,7% 15,1% receiving LBC data
- 17,4% 32,0% operational system, parallel environment, queuing system
- 14,7% 21,7% hardware
- 13,0% 7,5% model execution
- 12,1% 9,5% archiving
- 10,4% 4,7% dissemination of products to the customers and the end users
- 7,7% 9,5% post-processing

4.7.16. The failure

How many failures do you have during one month?

The question is divided into 3 parts; the first one, is done by severity level, the second one, by intervention time and the last one, by source of problem.

The lesser failure is defined as a delay of less than 2 hours or an error in some low priority post-processing. The severe failure is defined as a necessity of intervention by operational staff. The fatal failure is simply no result due to missing LBC or power supply. The number of events depends on intervention assessments and consequences. This is the reason for 2 categories of answers; the second one reflects higher risk assessment in case of no intervention for minor event.

In case of two daily runs (00:00 and 12:00 UTC), the operational suite usually runs after working time when, more often than not, minor events are likely to occur, due to lack of human risk assessment.

Generally, the initialization of the operational suite is connected with troubles concerning customization and functionality of queuing system and parallel environment. Finally, the users is able to find the right path through this environment, the problem should sprinng up again, in case of upgrade and modification of local operational suite.

• minor (delay less than 2 hours)	1 – 4	(10 - 30)	1 - 2
• severe (intervention of operational staff)	0 – 2	(10)	0 - 1
• fatal (no result)		1 – 5/year	1 – 2/year

(missing of LBCs or power supply)

• during working time	35%
• after working time	65%

(operational suite is usually running after working time very often the minor failure becomes severe after working time)

• hardware failures	15%
• software failures	85%

(the most of the errors are usually due to software failures and queuing system, the hardware problem is rare)

4.7.17. Conclusion (ALADIN)

What is the portrait of common ALADIN operational suite at the present time?

- The powerful computer (auxiliary server – historical, technical, safety reason)
- The LBC are getting through Internet with a backup connection
- The operation is based on script(s) initiated by system cron through a queuing system
- Scheduling by a batch system (SMS, PBS, in house soft)
- Monitoring based on web GUI with warning option
- A NWP team take care about operational suite (optionally or officially)
- The monitoring remote access is done from various palette of communication devices, the personal intervention on site is often used
- The cooperation with the LAN and system administrator support is preferable
- The reliability of hardware is warranted by maintenance agreement
- The fetching of LBC, customization and using a given queuing system and parallel environment are sources of the most frequent troubles

4.7.18. Conclusion (HIRLAM)

What is the portrait of common HIRLAM operational suite at the present time?

- The powerful computer (auxiliary server used for post-processing in two cases)
- The LBC are getting through RMDCN with a Internet backup
- The operation is based on script(s) initiated by system cron through a queuing system
- A NWP team take care about operational suite (cooperation with IT)
- The monitoring remote access is done by internet connection or based on phone (voice) call
- The cooperation with the LAN and system administrator support is preferable
- The reliability of hardware is warranted by maintenance agreement
- The customization and using a given queuing system and parallel environment are sources of the most frequent troubles

4.8. Spiridonov V., S. Somot and M. Déqué: ALADIN-Climate: from the origins to present date.

4.8.1. Introduction

The story of ALADIN-Climate is of course much shorter than that of its NWP counterpart. It started about 10 years ago, when Janiskowa proved that a one month long simulation of ALADIN without any assimilation in the domain was possible. The model, driven by 6-hourly ARPEGE analyses at its lateral boundaries did not diverge numerically and provided acceptable meteorological situations. A few years later, three Czech institutes (CHMI, CUNI and CAS) launched a common project on climate simulation. The idea was to use ARPEGE-Climate as a driving model for IPCC climate scenarios, and possibly introduce parameterizations from the climate model better suited for this exercise: radiation code including explicitly greenhouse gases and aerosols, cloud scheme without empirical moisture profile and deep soil scheme without relaxation. The role of CNRM was to provide lateral conditions from his own scenario simulations, and routines from ARPEGE-Climate.

Once the PRUDENCE European project was finished, the partners prepared the GENIE proposal, which was later included in ENSEMBLES. The aim of this project was to go from the 50 km horizontal resolution of PRUDENCE to 20 km or even 10 km. Up to this date, the CNRM based his regional climate simulations on a variable resolution of ARPEGE (Déqué and Piedelievre, 1995). In climate simulation over Europe, it is important that the stretching factor is not greater than 3, otherwise the low resolution over the far Atlantic produces a too south storm track. As a consequence, 20 km resolution is very expensive (3 months to produce 10 years on ECMWF computer) and 10 km resolution impossible with present hardware. Therefore, CNRM decided, in order to continue participating in the European climate modelling group, to have a more active role in the design of an ALADIN-Climate model. In 2003, this was made possible, as version 4 of ARPEGE-Climate, based on cycle 24 of ARPEGE-IFS, is ALADIN compatible.

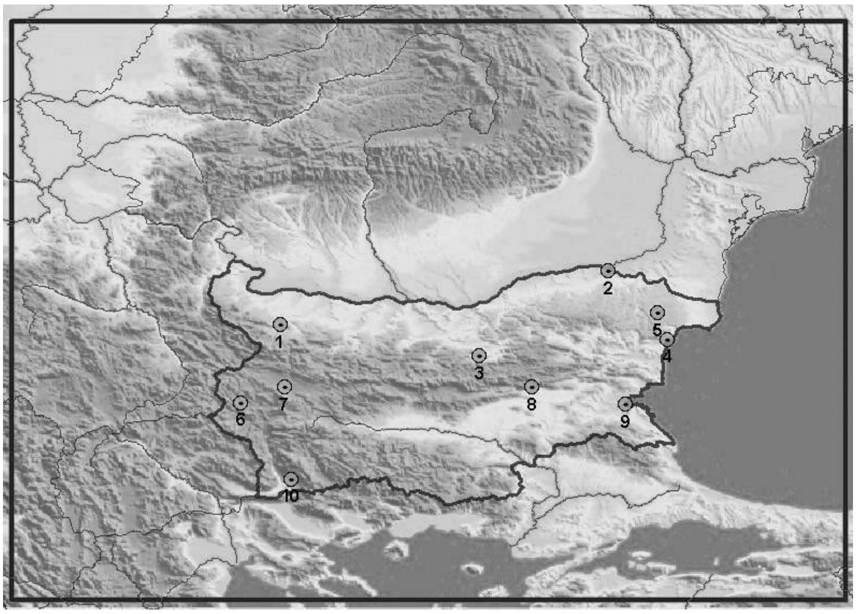
4.8.2. The ENSEMBLES project

There is an additional reason for the development of ALADIN-Climate at CNRM. A variable resolution model cannot be driven at its boundaries by observations. In ENSEMBLES, each regional model should be weighted, according to its realism to reproduce present mean climate and present climate fluctuations. This weighting will be based on an ERA40-driven simulation of each participating model. Météo-France and CUNI-CHMI are participants in this project. Météo-France will use a version directly derived from ARPEGE-Climate 4, whereas CUNI-CHMI will develop an original version based on a more recent cycle of ARPEGE-IFS. Both groups will run two 40-year runs at 50 km and 25 km resolution on a wide domain covering Europe from Greenland coast to Nile mouth. Then Météo-France is committed to provide a 100 year simulation of the 1950-2050 period driven by a GCM involved in IPCC scenarios. It is highly probable that the GCM will be ARPEGE-Climate and the scenario A1B. The geometry of ALADIN in this exercise will be the 25 km resolution over the wide European domain.

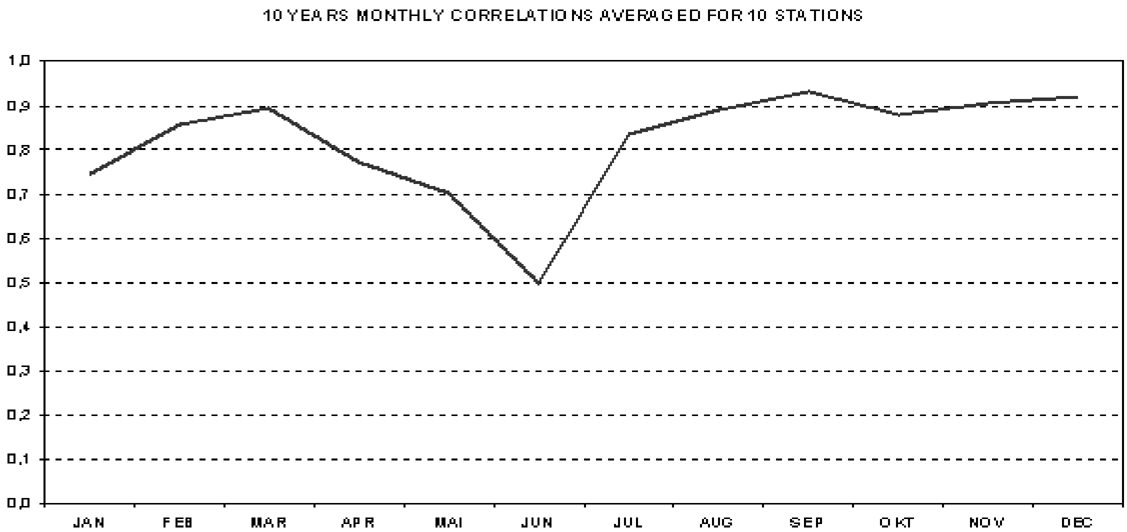
4.8.3. Application to the Bulgarian domain

Downscaling of a global model with a certain LAM needs some preliminary experiments. That is necessary for evaluation of the method feasibility. The ERA40 data was used as boundary conditions during the integration of ALADIN-Climate in the period 1990-1999. The model resolution was 12 km. The observations were taken from synoptic stations, representative for different micro-climatic regions in Bulgaria. The domain and stations are shown bellow.

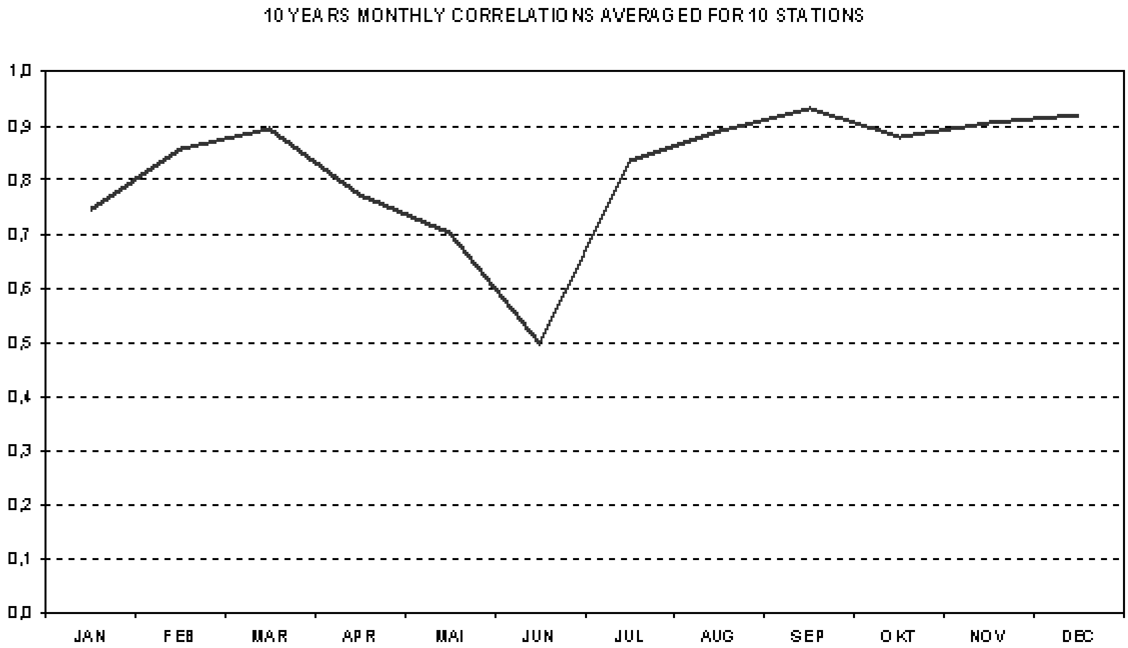
DOMAIN AND LOCATION OF THE SYNOPTIC STATION



The following example of model results and observed monthly mean temperatures shows smoother variability of the model comparing with observation. Similar behavior was recognized for all stations.



Averaged for all 10 stations correlation coefficient varies with months. May and June are the most problematic in this experiment.



Finally we can conclude that the 'jump' up to 10 times' finer resolution (~120 km for ERA40 data and 12 km for the model) is possible. Downscaling over small domain gives reasonable and more detail temperature field even with big increasing of resolution.

4.8.4. Bilateral cooperation

ALADIN has been from the beginning subject to bilateral research projects. At present, two project concern ALADIN-Climate. A project started two years ago between France and Bulgaria. The theme is the design of small size high resolution domains with the ARPEGE-Climate physics. Indeed, contrary to the NWP physics, the parameterizations of the climate version are developed at 250 km resolution, and tested up to 50 km resolution in the stretched geometry. On the other hand, they have proved to be robust in multi-year integrations. The climate group of CNRM is indebted to NIHM for his contribution in the formation of climate modellers to the tips and tricks of ALADIN. A second project between France and Romania will start in 2006 and concerns the introduction of spectral nudging in ALADIN-Climate. Indeed, running a LAM in multiyear simulation is a challenge to numerics, as the solution imposed at the lateral boundaries is not a natural solution of the system of equations. The two ways to circumvent this flaw is either to use a small domain, so that the LAM is enough constrained, or to add a constraint on the large waves inside the domain to maintain the consistency between the centre and the boundaries.

4.8.5. Perspective: the CECILIA project

In December 2004, a meeting organized in Prague by Halenka in the framework of the MAGMA Centre of Excellence resulted in the creation of an informal group including modellers from Czech Republic, Bulgaria, Romania, Hungary, Austria, Italy (ICTP), Denmark (DMI) and France (Météo-France). A response to an European-Commission call for proposal was coordinated by Halenka in October 2004 with the acronym CECILIA. At time of writing, CECILIA has passed the first step of the review process, but we don't know whether CECILIA is definitely accepted. In any case, a community on climate modeling of eastern and central Europe is born. In this project, complimentary to ENSEMBLES, country-wide domains of ALADIN and RegCM will be prepared at 10 km resolution. Thirty-year simulations (1961-1990, 2021-2050 and 2071-2100) driven by 50 km-resolution versions of ARPEGE-Climate (global variable resolution) and RegCM (wide ENSEMBLES domain over Europe) will be carried out. As a validation, an ERA40-driven simulation will also be performed. The project also includes statistical downscaling, extreme events analysis, and impacts on air quality and forestry.

4.8.6. Perspective: a coupled model for the Mediterranean Sea

The Mediterranean climate and the Mediterranean Sea should be studied with regional ocean-atmosphere coupled models (Somot, 2005). Indeed high resolution and air-sea coupling are often essential in Mediterranean climate processes (cyclogenesis, open-sea deep convection, …). ALADIN-Climate (resolution of 20 km) associated with a Mediterranean version of the ocean model OPA (10 km) and forced by ERA40 (or by a climate model) lateral boundary conditions will be a well dedicated Atmosphere-Ocean Regional Climate Model (AORCM) to study Mediterranean climate. This regional coupling will be tested in the framework of the French ANR-CICLE project in the next three years. Regional process studies as well as interannual and climate change studies will be completed in comparing the regional coupled approach to the more classical forced approach.

References:

Déqué M, Piedelievre JP (1995) High-Resolution climate simulation over Europe. Clim Dyn 11:321-339

Somot (2005) Modélisation climatique du bassin méditerranéen : variabilité et scénarios de changement climatique. PhD thesis. Univ. Paul Sabatier, Toulouse, 333 pp. (in French).

4.9. Vasiliu S.: An evaluation of the 3D-FGAT scheme for the ALADIN/Hungary model.

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An intermediate step from the 3D-Var to the 4D-Var data assimilation scheme is the so-called three-dimensional First Guess at the Appropriate Time (3D-FGAT). In the 3D-Var system, the observations are collected within an observations window (± 1.5 or ± 3 hours around the analysis time, called cut-off) and assumed to be valid at the analysis time. The innovations (observations - background) are computed using a short-range forecast valid at the analysis time. As the name indicates, in the 3D-FGAT scheme, the observations are taken into account at their accurate time and compared with the first guess at the appropriate time. The assimilation window is divided into **n** observation windows (generally each one of 1 hour) and for each observation window, the differences between the observations and the forecast states, valid at the observation time, are computed. The innovations are assumed to be constant in time and remain stationary within the observation window. Excepting the evaluation of the innovations, 3D-FGAT follows the same algorithm as 3D-Var. The 3D-FGAT scheme for the ALADIN model estimates the 3D-FGAT analysis at the beginning of the assimilation (when the first-guess is valid) and not at the middle of the assimilation window (as for the 3D-Var scheme). Thus, even if the same observations are used along the assimilation window (of 6 hours) the 3D-FGAT analysis is valid with 3h before the one evaluated by the 3d-Var scheme.

The experiments have been performed using the cycle 28t3 of the ALADIN/Hungary model (with 12 km horizontal resolution), taking into account the observations available at the Hungarian Meteorological Service (SYNOP, TEMP, SATOB, WIND PROFILE, AIREP, satellite radiance).

At the beginning single observation experiments were carried out, using only one observation of the temperature field. It was shown the isotropic shape of the temperature increment (both for the surface observation and for the 500 mb measurement), which confirmed that the 3D-FGAT scheme is applied correctly.

The second set of experiments consists in performing an assimilation cycle during 11.05.2005 – 21.05.2005. The results of the 48h integration of the model, using as initial condition the 3d-Var analysis, respectively the 51h integration (due to the 3h difference between the valid time of the analyses), with 3D-FGAT analysis as initial condition, were compared both with the observations (from the surface) and with the ARPEGE analyses (based on the VERAL procedure). The verification scores did not show an improvement in the first 12h forecasts, when the 3D-FGAT scheme was used. Afterwards, the scores become neutral. An explanation of this poor evolution can be that for the same moment of time, as example for 00 UTC, the 3d-Var analysis and 3h forecast obtained with the 3D-FGAT scheme were compared with observations. It is known already from the 3d-Var experiments, that the analysis of the model is improved, but after 6h integration, the improvement is decreased significantly.

In these conditions, the third set of experiments was performed, similar with the previous one (and carried out in the same period), but for which the assimilation window was decreased till ±1.5 hours around the analysis time. Thus, the results of the 48h integration of the model (using the 3d-Var and 3D-FGAT analyses as initial conditions) were evaluated at the same moment of time. A significant improvement (comparing the two assimilation cycles with the 3D-FGAT scheme) was noticed when the assimilation window was reduced.

A case study (with significant amount of precipitation measured over Hungary) was investigated. The forecasts have shown the main features of the precipitation field.

These experiments represent a first evaluation of the 3D-FGAT scheme for the ALADIN/Hungary model. Further it follows to increase the observation number during the assimilation cycle, and other case studies to be carried out for establishing the performance of this assimilation scheme. More details about the experiments and the results will be available in the RC LACE Internal Report.

4.10. Wong Y. and A. Kann: ALADIN Limited Area Ensemble Forecasting (LAEF).

KANN.pdf

5. ALADIN PhD Studies

5.1. Radi Ajjaji: Incrementality deficiency in ARPEGE 4d-var assimilation scheme

On temporary (?) leave from Maroc-Météo.

5.2. Margarida Belo-Pereira: Estimation and study of forecast error covariances using an ensemble method in a global NWP model

Defence spring 2006.

5.3. Karim Bergaoui: Further improvement of a simplified 2d variational soil water analysis

Operational duties at home.

5.4. Vincent Guidard: Evaluation of assimilation cycles in a mesoscale limited area model

The PhD manuscript is near completion.

5.5. Raluca Radu : Extensive study of the coupling problem for a high-resolution limited-area model

5.6. André Simon: Study of the relationship between turbulent fluxes in deeply stable PBL situations and cyclogenetic activity

Latest steps here too, with a defence latest in spring 2006.

5.7. Simona Stefanescu : The modelling of the forecast error covariances for a 3D-Var data assimilation in an atmospheric limited-area model

5.8. Malgorzata SZCZECH-GAJEWSKA : Use of IASI/AIRS observations over land.

Back at work after maternity leave.

5.9. Steluta Vasiliu: Scientific strategy for the implementation of a 3D-Var data assimilation scheme for a double-nested limited-area model.

The three reports necessary for defending my Ph.D thesis have been written and presented at the Faculty of Physics, University of Bucharest. Their titles are:

a) “Theoretical considerations about some data assimilation algorithms for the mesoscale numerical weather predictions models”;

b) “Implications of the three-dimensional data assimilation scheme on the results of the spectral mesoscale numerical weather prediction model ALADIN”;

“Considerations about the use of the explicit blending method with the three-dimensional data assimilation scheme for ALADIN model”.

5.10. Jozef VIivoda : Application of the predictor-corrector method to non-hydrostatic dynamics.

5.11. Fabrice Voitus : A survey on well-posed and transparent lateral boundary conditions (LBCs) in spectral limited-area models.

6. PUBLICATIONS

6.1. Berre L., S. E. Stefanescu and M. Belo Pereira, 2006: The representation of the analysis in three error simulation techniques.

Tellus 58A, pp. 196-209. http://www.blackwellpublishing.com/

6.2. Bouttier, F., G. Hello, Y. Seity and S. Malardel, 2006: Progress of the AROME mesoscale NWP project.

CAS/JSC WGNE "Blue Book" annual report "Research Activities in Atmospheric and Ocean Modelling", Ed. J. Côté.

6.3. Chapnik B., G. Desroziers, F. Rabier and O. Talagrand: Diagnosis and tuning of observational error in a quasi-operational data assimilation setting.

Quart. Jour. Roy. Meteor. Soc. N° 615 January 2006 Part B. Volume: 132 Number: 615 Page: pp. 543- 565. http://www.royalmetsoc.org/

6.4. Desroziers G., L. Berre, B. Chapnik and P. Poli: 2006: Diagnosis of error statistics in observation space.

CAS/JSC WGNE "Blue Book" annual report "Research Activities in Atmospheric and Ocean Modelling", Ed. J. Côté.

6.5. Gérard L., J-M. Piriou and J-F. Geleyn: 2006: Advances in the integration of deep convection and microphysics for the meso-scale.

CAS/JSC WGNE "Blue Book" annual report "Research Activities in Atmospheric and Ocean Modelling", Ed. J. Côté.

6.6. Hua, Z., F. Rabier, M. Sczech-Gajewska, N. Fourrié and T. Auligné, 2006: Impact study on the assimilation of the AIRS radiances over land.

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Abstract:

In this paper, the three-dimensional variational (3D-Var) data assimilation scheme for the ALADIN/Hungary model is described and its performance is evaluated by comparing the resulting forecast scores with those from the reference model running in dynamical adaptation. Experiments with different assimilation strategies have been studied, in order to establish the general framework for further research. The verification scores show a better short-range performance of the 3D-Var system. More results are presented for two individual synoptic cases, corresponding to interesting meteorological situations. One was selected based on the poor performance of the reference model, where the model using the 3D-Var scheme is found to perform better. The other was an example, when the operational model did well, and it was shown that the 3D-Var scheme is able to keep the good performance of the reference model.

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'Modelling the Arctic Boundary Layer: An Evaluation of Six Arcmip Regional-Scale Models using Data from the Sheba Project' *pp. 337-381(45) Boundary-Layer Meteorology, Volume 117, Number 2, November 2005, pp. 337-381(45)*

Abstract:

A primary climate change signal in the central Arctic is the melting of sea ice. This is dependent on the interplay between the atmosphere and the sea ice, which is critically dependent on the exchange of momentum, heat and moisture at the surface. In assessing the realism of climate change scenarios it is vital to know the quality by which these exchanges are modelled in climate simulations. Six state-of-the-art regional-climate models are run for one year in the western Arctic, on a common domain that encompasses the Surface Heat Budget of the Arctic Ocean (SHEBA) experiment ice-drift track. Surface variables, surface fluxes and the vertical structure of the lower troposphere are evaluated using data from the SHEBA experiment. All the models are driven by the same lateral boundary conditions, sea-ice fraction and sea and sea-ice surface temperatures. Surface pressure, near-surface air temperature, specific humidity and wind speed agree well with observations, with a falling degree of accuracy in that order. Wind speeds have systematic biases in some models, by as much as a few metres per second. The surface radiation fluxes are also surprisingly accurate, given the complexity of the problem. The turbulent momentum flux is acceptable, on average, in most models, but the turbulent heat fluxes are, however, mostly unreliable. Their correlation with observed fluxes is, in principle, insignificant, and they accumulate over a year to values an order of magnitude larger than observed. Typical instantaneous errors are easily of the same order of magnitude as the observed net atmospheric heat flux. In the light of the sensitivity of the atmosphere–ice interaction to errors in these fluxes, the ice-melt in climate change scenarios must be viewed with considerable caution.