Working Area Predictability

Progress Report

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Period:	2014 (annual report)
Date:	23/02/2015

1 Progress summary

Working group for Predictability faced during the last year (2014) some interesting challenges regarding ALADIN-LAEF system development and maintenance. The effort was focused also towards the application oriented work and the crucial results of R&D have been published.

The important and unavoidable milestone regarding the operational implementation of ALADIN-LAEF system was its migration from the old IBM Power 7 cluster at ECMWF to their new CRAY XC30 supercomputer. ALADIN-LAEF system is running on the new computing facility since the end of September 2014. The peak performance of CRAY XC30 installation is more than twice higher in comparison with the old IBM cluster. Nevertheless, to accommodate the scripts and applications for changed user environment and for completely different batch queueing system was quite challenging task, especially the source code recompilation of necessary model tools was demanding.

Concerning the stochastic model perturbations in ALADIN-LAEF a new approach has been tested successfully. Revized SPPT scheme has been implemented for the soil and surface parameters. In similar earlier experiments within the recent years, the stability of the model has always been questionable. Nevertheless, this time stable ensemble runs were made possible by several changes of the perturbation method. Surface perturbation experiment together with tests of new SPPT scheme for the upper-air fields in AROME-EPS and ALARO-EPS can be considered as a good starting point for further research on this topic for both, convection permitting models and models with parameterized deep convection.

Research on AROME-EPS in 2014 focused on the impact of available LBCs. Experiments were conducted in the framework of the BC Optional Programme with ECMWF by contributors of different consortia (COSMO, HIRLAM, LACE). It was confirmed that the additional coupling using boundary conditions from 06 and 18 UTC runs provided by ECMWF can be beneficial for LAM EPS.

The computation of AROME-EPS is often a matter of available resources. Therefore it is important to know about its benefits compared to EPS systems with lower resolution. A verification study comparing ALADIN-LAEF and AROME-EPS was done for this purpose with special focus on the ensembles' abilities to predict precipitation in mountainous areas and topographically complicated terrain.

The possibilities of ensembles to provide the relevant prediction of severe weather events and automatic warnings are investigated in the framework of a project partially funded by European Commission, PROFORCE. Weather services (ZAMG and OMSZ) tightly work together with civil protection organizations with the aim to build a "seamless" probabilistic forecast chain.

2 Scientific and technical main activities and achievements, major events

S1 Action/Subject/Deliverable: Optimization of ALADIN-LAEF

Description and objectives: This subject summarizes on-going and completed task of ALADIN-LAEF research and development.

Stochastically perturbed physics tendencies of surface fields in ALADIN-LAEF:

Generally, numerical weather prediction is affected by 2 main sources of errors. The first one is the uncertainty of ICs. While the second one concerns the precision of the models themselves. Because the first type of the errors has been already tackled in ALADIN-LAEF system by the ensemble of surface data assimilations and upper-air spectral blending, now rather the model accuracy part was addressed. Next to the successfully used multi-physics approach for handling the model uncertainty, the stochastic physics method targets the model errors at its source by a random disturbance of tendencies computed by the physical parameterizations.

The SPPT (Stochastically Perturbed Parameterization Tendencies) method was implemented in the ALADIN-LAEF to perturb the soil and surface prognostic fields. Mathematically, the j^{th} ensemble member is given by the sum of two contributions. The resolved processes (A) and perturbed tendency of parametrized processes (P’). P’ represents the fluctuation around grid-box averaged physical tendency P and r_j is an uniformly sampled random number for subdomain of size D, constant over time T:

$$\delta e_j/\delta t=A(e_j,t)+P'(e_j,t)=A(e_j,t)+(1+r_j(\lambda,\phi,t)_{D,T})P_j(e_j,t)$$

The random number is defined by Gaussian distribution with zero average and standard deviation σ, using spectral pattern generator with tunable parameters via namelist. For more details see report in References.

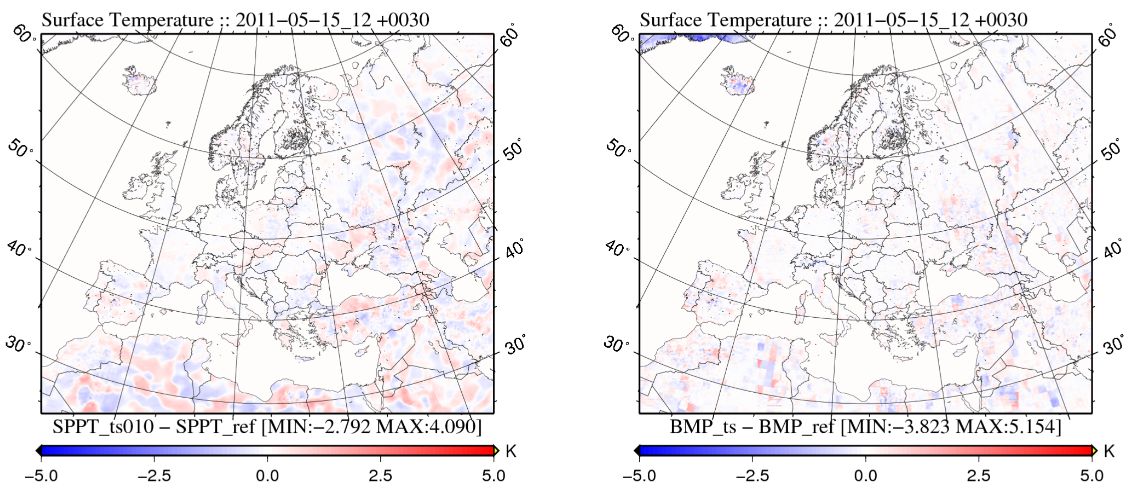
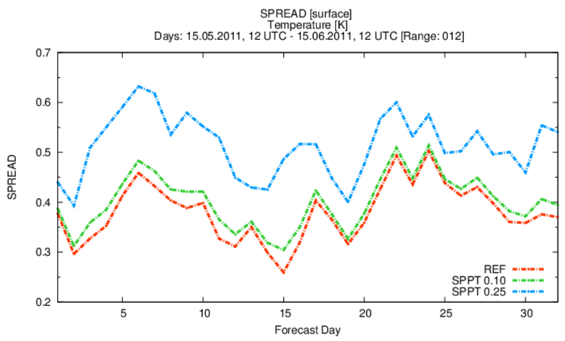


Figure 1: The surface temperature perturbations as obtained by SPPT method (left) and BMP method (right).

Behavior of new revised SPPT scheme has been checked against the former BMP scheme (Buizza, Miller, Palmer, 1999). The main difference between the original BMP scheme and revised SPPT is in the random patterns definition and their generation. While the first one approach divides the whole domain into regular, temporally and spatially constant lat-lon rectangles, the second one generates rather chaotic patterns varying smoothly in space and time. Latter technique is more natural and less dangerous in creation of spurious, non-physical horizontal gradients in the perturbed physics fields (see Figure 1).

The SPPT scheme is applied on the full set of surface prognostic variables (i.e. surface temperature, liquid soil water content, frozen soil water content, snow albedo, snow reservoir water content, snow density, water intercepted by vegetation) and still proved to be stable along 3 months of ensemble integration. However, it must be stressed, that in this experiment only the surface fields were perturbed and not the upper-air ones.

The effectiveness of the concept was tested for two different setups (standard deviation of probability distribution σ=0.1 and σ=0.25) and verified for a 3 months period (mid-May to mid-August 2011). The ALADIN-LAEF system with such perturbed surface has a bigger spread and less outliers than the unperturbed reference and also the BIAS and RMSE scores were slightly enhanced. This is most obvious for temperature (see Figure 2) and humidity, while results are rather neutral for MSLP and wind (not shown). Better results with more sensitivity were achieved for σ=0.25 setup (perturbed tendencies on the level +/-50% of the original values).



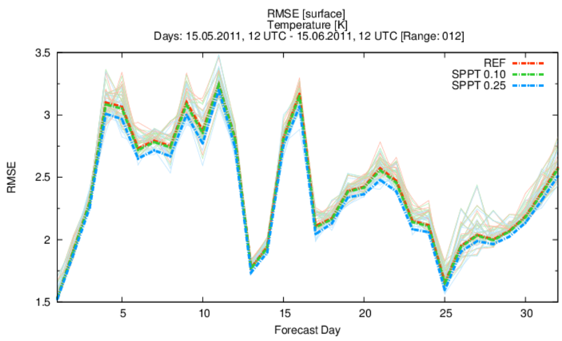


Figure 2: Spread (left) and RMSE (right) for 2m temperature at 12h forecast range for 31 verification days and the reference (red), σ=0.1 (green) and σ=0.25 (blue) experiments.

NCSB versus the ensemble of surface DA:

NCSB (Non Cycling Surface Breeding) technique was the very first method implemented in ALADIN-LAEF system to generate the initial perturbation of surface and soil variables. In principle this approach was introduced for two reasons: a) to simulate the uncertainty of the surface initial conditions and b) to start the integration from the soil and surface fields which are compatible with the ALADIN-LAEF system. Since the ALADIN-LAEF ensemble system is originally coupled with the ECMWF global EPS, the later reasoning was especially important, because the ARPEGE/ALADIN soil/surface treatment is not completely compatible with the IFS one. Such discrepancy was (among the other things) producing unwanted cold bias for the Temperature at 2m.

CANARI (Code d'Analyse Nécessaire à ARPEGE pour ses Rejets et son Initialisation) is standard ARPEGE/ALADIN assimilation tool based on the Optimal Interpolation (OI) method. It was implemented into the ALADIN-LAEF ensemble system in order to perform the surface assimilation along with the surface perturbation. For this purpose, the observations are perturbed randomly using a Gaussian distribution function with zero mean and standard deviation equal to the observation errors. Both NSCB and ensemble CANARI methods are described in the data-flow diagrams (see Figure 3).

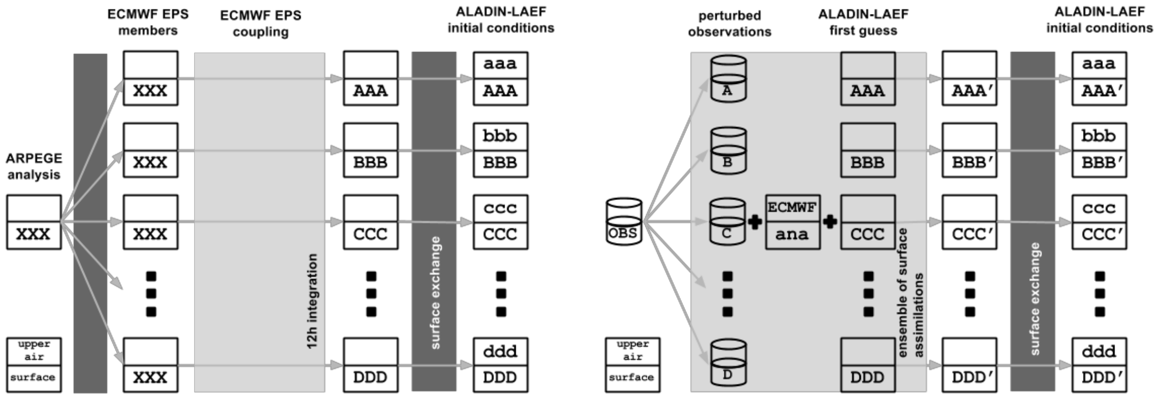


Figure 3: ALADIN-LAEF surface perturbation schemes - NCSB (left) and the ensemble CANARI (right).

Two above experiments were run to study the different approaches for perturbing the surface and soil variables in the ALADIN-LAEF ensemble system. Only the initial surface and soil conditions were modified in otherwise just dynamically adapted global EPS using ALADIN-LAEF model and its domain (no other LAEF enhancements were applied like upperair spectral blending nor multiphysics). Both experiments (NCSB and ensemble CANARI) consisting of 16 ensemble members each were run for the verification period from 15^{th} of May till 15^{th} of July 2011. The systems were integrated up to 54h once per day, for 12 UTC network time. However, to keep the 12h update cycle for the soil initialisation in the assimilation experiment, there was an additional short 12h integration starting at 00 UTC executed as well.

The obtained results have shown clear benefit of the surface perturbation technique by the ensemble of surface Data Assimilations over the former Non Cycling Surface Breeding method. More realistic and spatially homogeneous perturbations are created by the ensemble of surface DA while thanks to the assimilated observations the RMSE of the system is decreased at the same time as well (see Figures 4 and 5).

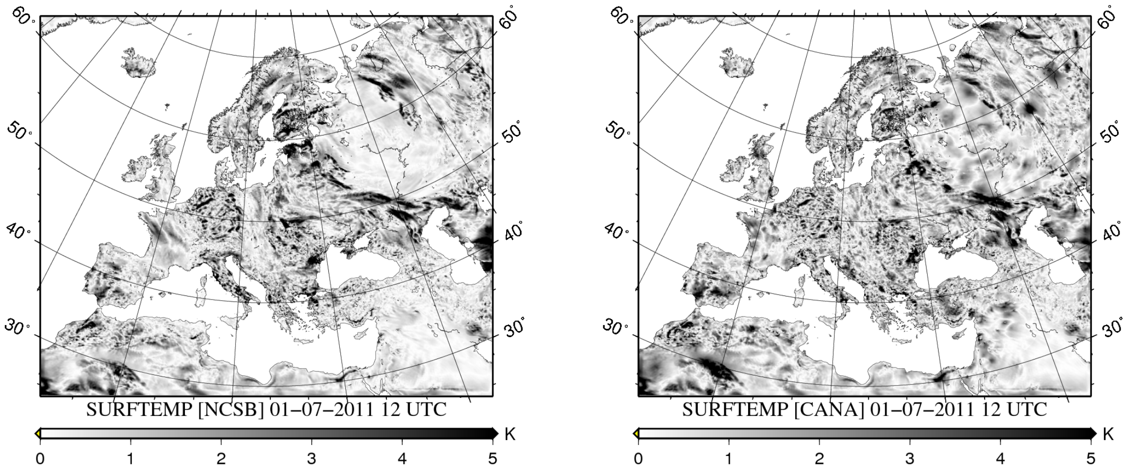


Figure 4: Surface Temperature "perturbation" for experiments NCSB (left) and the ensemble CANARI (right).

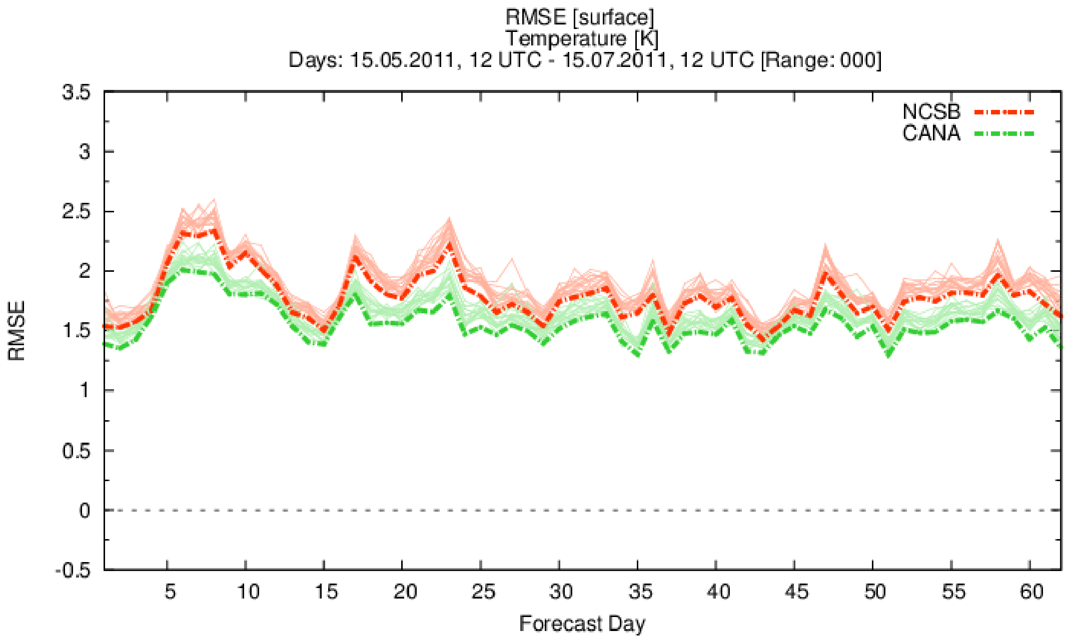


Figure 5: RMSE of ensemble mean and the individual members for 2m temperature at initial time by the experiment days for both NSCB (red) and the ensemble CANARI (green) perturbation methods.

Efforts: 6 PM (2.5 LACE stay)

Contributors: Martin Belluš (SHMU, LACE stay), Florian Meier (ZAMG), Yong Wang (ZAMG)

Documentation: Stay reports of Martin Belluš, paper for publication in scientific journal in preparation

Status: Ongoing

S2 Action/Subject/Deliverable: Migration of ALADIN-LAEF to CRAY

Description and objectives: In accordance with planned computing facility upgrade at ECMWF the operational suite of ALADIN-LAEF and its R&D counterpart had to be migrated from former IBM cluster (c2a/c2b) to the new HPC system based on CRAY machine (cca/ccb). The SMS application, which is used to schedule operational ALADIN-LAEF tasks, is still available also one the new system. Therefore the suite data flow did not need to be changed. However, the compilation of executables was more challenging. There are 3 compilers available on CRAY (cray, intel and gnu). While majority of LAEF content could be compiled with the intel compiler, the assimilation tools like BATOR, CANARI, SHUFFLE, etc. worked correctly only with the cray compiler.

The service of IBM c2a cluster definitely ended on 30th of September 2014. Initial problems sometimes occur with the job-scheduler on new cca cluster, which partially causes longer queuing times. Also the job tuning for ideal performance under the new environment is still ongoing.

Technical details of ALADIN-LAEF operational version running on CRAY at ECMWF:

- 10.9 km horizontal resolution and 45 vertical levels
- 00 and 12 UTC runs up to +72h
- 16 perturbed members + 1 unperturbed control run
- lagged (by 12h) ECMWF-EPS coupling (first 16 ECMWF-EPS members are used)
- multi-physics (16 different combinations of parameterization schemes and their tunings for micro-physics, deep/shallow convection, radiation and turbulence)
- ensemble of surface data assimilations by CANARI with perturbed T2m and RH2m observations for the soil and surface IC perturbations
- upper-air spectral blending by digital filter technique to combine ECMWF-EPS perturbations with ALADIN-LAEF breeding vector for IC perturbations on model levels
- Grib files are available from approx. 03:30 UTC and 15:30 UTC

Efforts: 3 person months

Contributors: Florian Weidle (ZAMG)

Documentation: LAEF flow charts

Status: Finished with some ongoing maintenance tasks

S3 Action/Subject/Deliverable: AROME-EPS

Description and objectives: Research and development of high-resolution ALARO-EPS and AROME-EPS including the seamless ensemble cascade system developed within the European project PROFORCE.

Comparison of AROME-EPS versus ALADIN-LAEF for precipitation:

AROME-EPS was evaluated versus ALADIN-LAEF for a 3-months test period from mid-May to mid-August 2011, i.e. for an entire convective season. The AROME-EPS forecast were run every day from 00 UTC for a range of 30h. For the test runs, initial and lateral boundary conditions were both derived from ALADIN-LAEF forecasts, which were initiated at the same time. No data assimilation nor physics perturbations were applied. Hence, the aim of the study was to evaluate whether the dynamical downscaling of ALADIN-LAEF via high-resolution AROME model can improve the quality of the forecasts.

Details of AROME-EPS set-up:

- 2.5 km horizontal resolution / 60 vertical levels / 60s time step
- 432 x 320 grid points
- 16 ensemble members
- coupled to ALADIN-LAEF (no time lag)
- 3h coupling frequency

The forecasts of the 3 months were evaluated using surface observations (Figure 6, left), gridded INCA analyses for the surface parameters and also the ECMWF analyses for the upper-air levels. For the observation-based and upper-air verification the LAEF Verification Package was used. The evaluation was enhanced by spatial verification techniques like SAL (Wernli et al., 2008) and Fraction Skill Score (Roberts and Lean, 2008) using an R-based verification package. Several meteorological parameters were considered (temperature, wind, MSLP, relative humidity) but the main focus was on the precipitation forecasts validation. For the latter purpose the INCA domain was divided into seven sub-domains (Figure 6, right) to investigate the forecast characteristics in mountainous terrain and flat land. Each day of the 3-months period was assigned to one of the classes: ‘strong forcing’, ‘weak forcing’ or ‘dry’.

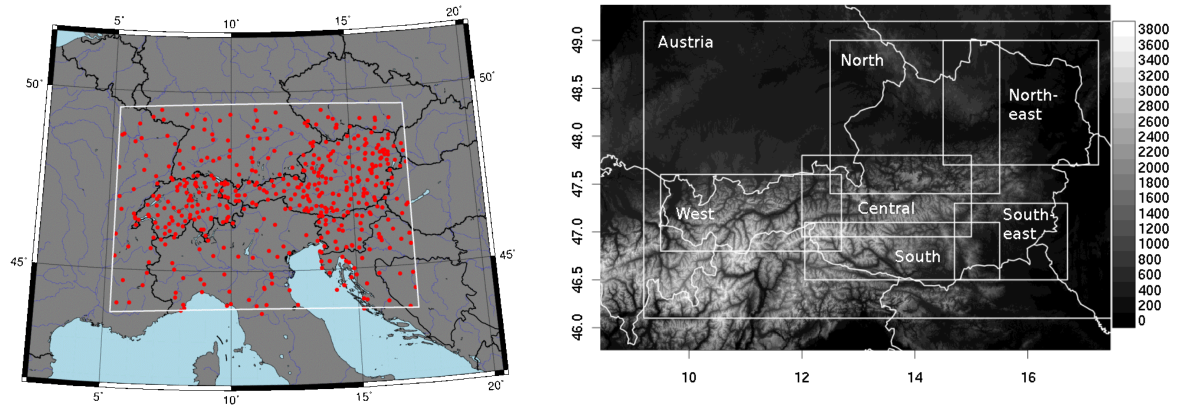


Figure 6: AROME-EPS domain and surface observations (left), INCA domain with sub-domains used for the evaluation (right)

The evaluation of surface parameters showed a clear improvement regarding the MSLP verification scores for AROME-EPS in comparison to the ALADIN-LAEF. However, for the other surface parameters and upper-air levels the results are more ambivalent.

Concerning the precipitation, it is obvious that the daily variability of precipitation is simulated differently by the models (see Figure 7). AROME-EPS tends to overestimate the daily maximum of 3h precipitation by 20%-50%. ALADIN-LAEF better captures the amount of the maximum but the timing is too early (3h time shift).

The Brier Score (Brier, 1950) shows the performance of the ensembles to simulate a suitable PDF of the precipitation fields. For the threshold of 0.1 mm (i.e. threshold for 'rain' or 'no rain') AROME-EPS provides significantly better values of the Brier score than ALADIN-LAEF around noon (see Figure 8).

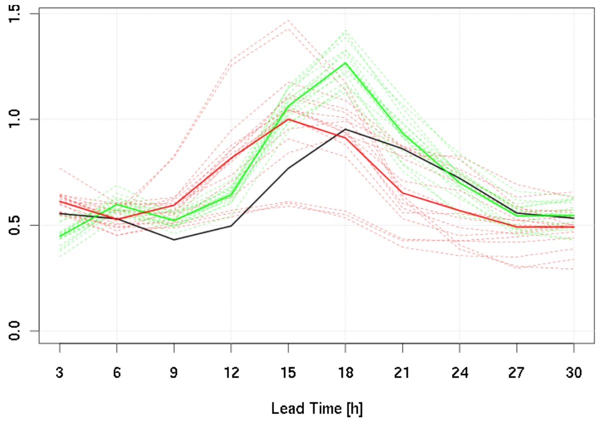


Figure 7: Areal mean precipitation in region 'Austria' for AROME-EPS (green), ALADIN-LAEF (red) and INCA (black) on days with strong synoptic forcing.

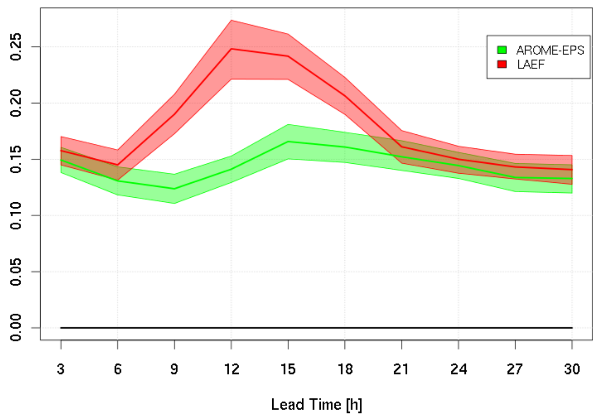


Figure 8: Brier Score with confidence intervals in region 'Austria' for AROME-EPS (green) and ALADIN-LAEF (red) on days with strong synoptic forcing.

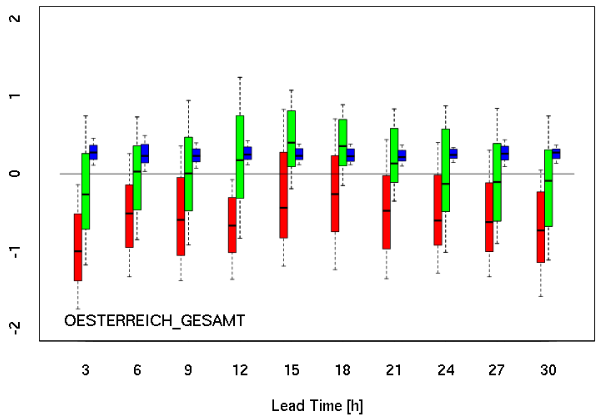


Figure 9: Structure (red), Amplitude (green) and Location (blue) scores for AROME-EPS in the region 'Austria' on days with strong synoptic forcing. Result of ensemble median.

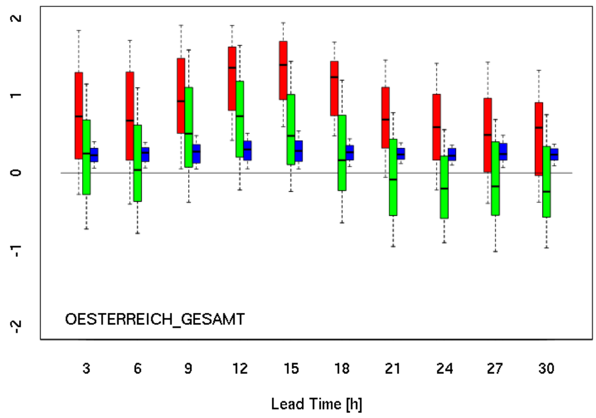


Figure 10: Structure (red), Amplitude (green) and Location (blue) scores for ALADIN-LAEF in the region 'Austria' on days with strong synoptic forcing. Result of ensemble median.

The S-A-L score in Figures 9 and 10 provide information about the abilities of the ensembles to predict the structure, amplitude and location of the precipitation events. The most obvious difference between AROME-EPS and ALADIN-LAEF is the negative and positive sign of the structure component (red). This is mainly due to the resolution and means that AROME-EPS predicts too small and too peaked precipitation objects while ALADIN-LAEF too large and flat ones. The amplitude component indicates at which time of the day the ensemble is overestimating or underestimating the mean areal precipitation amount. Concerning the location of the precipitation events (blue), both ensembles show equally good results.

LACE EPS for civil protection (PROFORCE):

PROFORCE is a project co-financed by the European Commission. Its main aim is to build up a 'seemless' ensemble-based forecasting system for the purpose of forecasting extreme weather events. Seemless means, that the forecasts of different ensembles, from medium-range (ECMWF) to short-range (ALADIN/ALARO-EPS, AROME-EPS, Ens-INCA) are concluded to one prediction system. The project started in December 2013 and lasts until November 2015.

There are four project partners, two from each of the participating countries Austria and Hungary: The Hungarian and Austrian met-services (OMSZ and ZAMG) as well as two civil protection organizations from Hungarian Somogy-county (DMDSC, Disaster Management Directorate of Somogy County, south of Lake Balaton) and Lower Austria (NOEL-CP, Niederösterreichische Landesregierung – Civil Protection).

A big part of the manpower is dedicated to the identification of requirements for the use of weather forecasts in civil protection agencies and of the potentials which adapted probabilistic forecasts can have for the severe weather events in Austria and Hungary.

Training sessions of meteo-services together with civil protection organizations are therefore an important part in the work flow of the PROFORCE project.

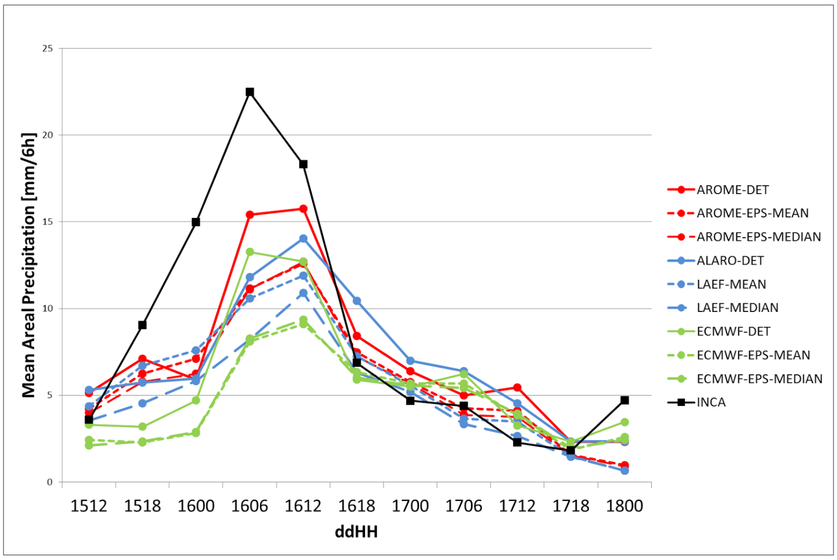


Figure 11: Sequence of 6-hourly mean areal precipitation for the region with largest precipitation amounts during storm 'Yvette' (parts of lower and upper Austria). The black line shows the INCA observations. Solid red, blue and green lines the precipitation amounts of the deterministic forecasts of AROME-AUSTRIA, ALARO-AUSTRIA and ECMWF, respectlively. Dashed lines denote the simulated precipitation amount of the ensemble means and medians for AROME-EPS, ALADIN-LAEF and ECMWF-EPS.

The status and progress of the probabilistic forecast systems is demonstrated by means of selected case studies. Storm 'Yvette' of May 2014 was selected as a test case. Few impressions provided by ZAMG and OMSZ project teams are summarized in below.

Figure 11 shows the sequence of 6-hourly mean areal precipitation amounts during storm 'Yvette' from May 15 2014, 12 UTC until May 18 2014, 00 UTC. The diagram involves the models of the ensemble-forecast chain which are provided for PROFORCE by ZAMG (except the ensemble-INCA) as well as their deterministic counterparts.

The selected area (marked by a red rectangle in Figures 12-14) covers the mountainous parts of lower and upper Austria. It is obvious that the precipitation was underestimated by all models. However, AROME-EPS (and AROME for the deterministic models) showed best performance in capturing the precipitation sums during the most intense phase of the storm. AROME-EPS was also used for downscaling of ALADIN-LAEF, but without data assimilation. The precipitation amounts (24h accumulated) can be seen on the Figures 12-14 and are numerically compared to each-other in Table 1. The areas of highest precipitation intensity are nicely described by both ALADIN-LAEF and AROME-EPS. However the precipitation amounts are better described by AROME-EPS.

An example of probabilistic wind gust for the different thresholds forecasted by ECMWF-EPS and ALARO-EPS can be seen on Figure 15.

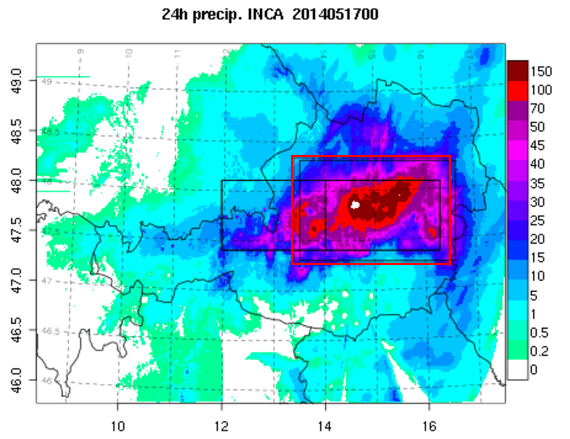


Figure 12: 24h precipitation amounts observed by INCA (sum of hourly analyses) for the period 2014051600 - 2014051700.

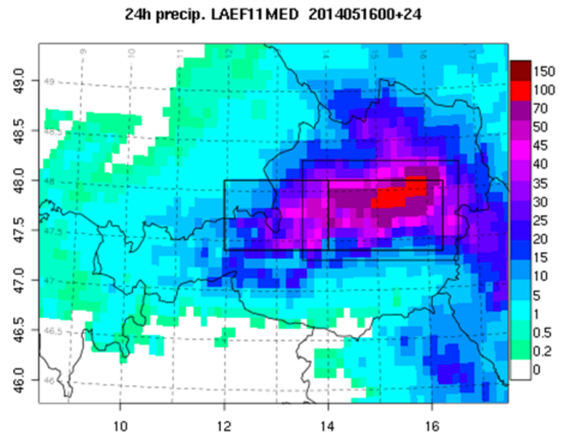


Figure 13: 24h precipitation amounts for 2014051600 -2014051700 provided by ALADIN-LAEF median (forecast range +24h).

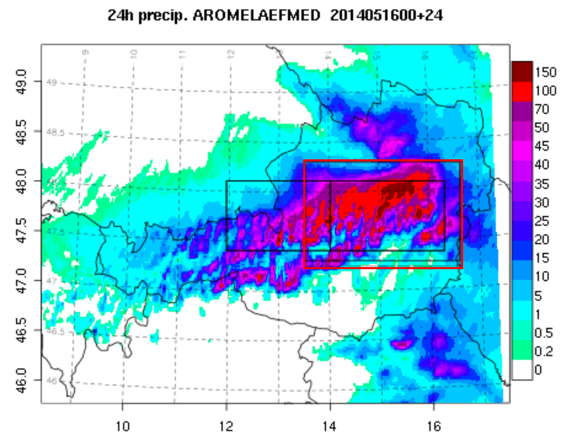


Figure 14: 24h precipitation amounts for 2014051600 -2014051700 provided by AROME-EPS median (forecast range +24h).

Model	Mean precipitation
INCA	53 mm
AROME-LAEF-Median	45 mm
ALADIN-LAEF-Median	38 mm
ECMWF-Median	30 mm
AROME-LAEF-Mean	46 mm
ALADIN-LAEF-Mean	44 mm
ECMWF-Mean	30 mm

Table 1: Comparison of 24h precipitation amounts predicted by the involved ensemble systems (EPS median and mean) and the "truth" represented by INCA analysis.

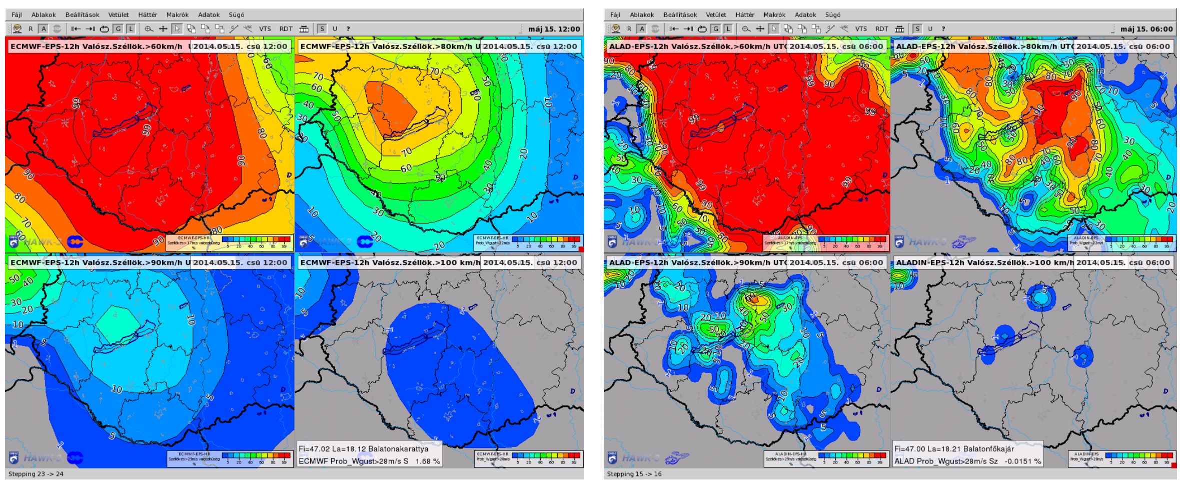


Figure 15: Probabilistic wind gust by ECMWF-EPS (left) and ALARO-EPS (right) for gust > 60km/h (upper left), > 80km/h (upper right), >90km/h (lower left) and > 100km/h (lower right).

Stochastically Perturbed Parameterized Tendencies in ALARO and AROME:

Revised SPPT scheme was implemented and used for the upper-air physics tendencies perturbation in ALARO-EPS and AROME-EPS experiments. It must be stressed, that the tapering function was not touched, i.e. the random perturbations were tending to zero near the model top as well as near the surface, while the surface was not perturbed at all (to the contrary of the similar experiments with ALADIN-LAEF).

The experiments involve 2 times 1-month long ensemble runs with SPPT activated during the model integration. In spite of bigger value for the standard deviation which bounds the random numbers to the interval +/-1 (i.e. perturbed tendencies could have reached at most twice the original unperturbed values), the impact of the perturbation scheme was rather small. Hence, the idea for future experiments would be to combine SPPT with EDA, when SPPT is active also in the assimilation cycle.

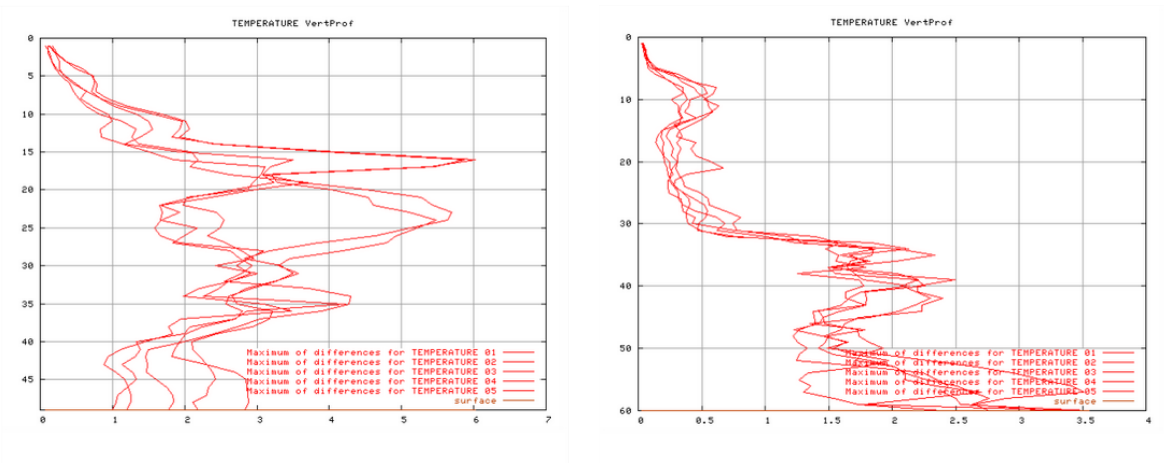


Figure 16: Vertical profile of maximum perturbations in ALARO (left) and AROME (right) for temperature at +3hours

The example of vertical structure of the maximum temperature perturbations in both ALARO and AROME ensemble systems is shown on Figure 16. More details can be found in the Mihály's report published on RC LACE webpage.

Efforts: 13 PM (1 LACE stay)

Contributors (only NWP): Theresa Schellander-Gorgas, Yong Wang, Clemens Wastl, Christoph Wittmann (ZAMG), Mihály Szűcs (OMSZ, LACE stay), André Simon, Gergely Bölöni (OMSZ)

Documentation: PROFORCE documentation and web page, project reports, paper for publication in scientific journal in preparation, stay report of Mihály Szűcs

Status: Ongoing

S4 Action/Subject/Deliverable: EPS - Verification

Description and objectives: A forecast verification tool is very important in order to establish the quality of weather forecast systems (deterministic or probabilistic) over time, the final goal being to improve the forecasts in the future. The huge amount of data, from one or more ensemble systems, requires an appropriate, optimized and flexible verification tool which is essential to assess and manipulate these data.

Efforts: 2 PM (0.5 LACE stay)

Contributors: Theresa Schellander-Gorgas (ZAMG), Simona Tașcu (NMA, LACE stay)

Documentation: Stay report (not yet available)

Status: Ongoing

S5 Action/Subject/Deliverable: Collaborations

Description and objectives: Activities merging different areas, collaboration with other consortia, applications.

ECMWF BC Optional Programme:

In the framework of the ECMWF BC-project the expert team of C-SRNWP for EPS presented key requirements for providing boundary conditions for limited area convection-permitting ensembles to the TAC (December, 2013, see LACE report of 03/2014). It was decided to enhance the experiment with LBCs for convection-permitting EPS by providing two additional ensemble runs at 06 and 18 UTC with resolution T639 (current resolution of ECMWF-EPS). The additional LBCs were used to answer a number of questions concerning the added value of having 4 ECMWF ensemble runs per day instead of 2 (e.g. in terms of spread/error relation).

The additional LBCs were provided for the test period of 10-31 May 2013 with 20+1 members and every 3 hours for the range of 0 to 144h. The test runs were carried out by Met.no (HIRLAM, HarmonEPS), MeteoSwiss (COSMO, COSMO-E) and the Hungarian Met Service for LACE (AROME-EPS).

The LACE test runs were performed for 10+1 members for 36h forecast range and a domain covering the Carpathian Basin. Two experiments were compared: One run was initiated at 00 UTC coupled to 18 UTC ECMWF-EPS LBCs, the other one was initiated at 06 UTC with LBCs of the 00 UTC ECMWF-EPS run. Both experiments used ensemble data assimilation with perturbed conventional observations and atmospheric motion vectors.

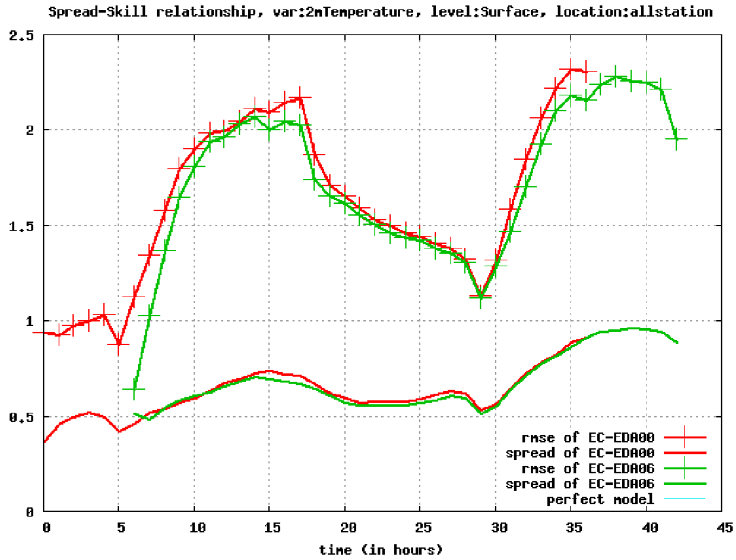


Figure 17: Spread (solid) and RMSE (solid with crosses) of 2 different configurations of AROME-EPS for 2m temperature.

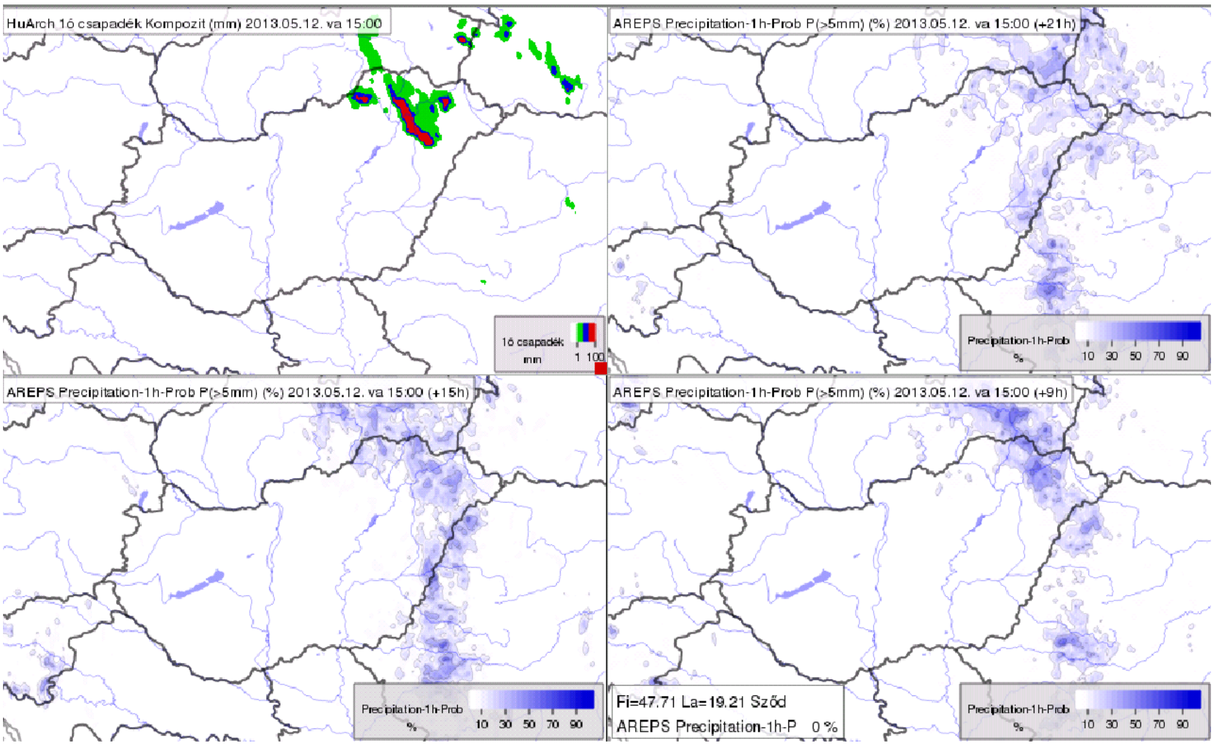


Figure 18: Radar observations (upper row, left picture) of the 1h precipitation sum (1-5 mm - green, 5-10 mm - blue, over 10 mm - red) and 1h precipitation probabilities with 5 mm threshold of AROME-EPS runs for 12 May 2013 15UTC, started on 11 May 2013 18UTC run (+21h forecast, up and right), on 12 May 2013 00UTC run (+15h forecast, down and left) and on 12 May 2013 06UTC run (+9h forecast, down and right).

The results show that coupling with LBCs from the additional ECMWF-EPS runs can bring an added value in daily forecasting. As expected the spread-RMSE relation is slightly better (smaller RMSE, spread rather similar) for the forecast with the shorter lead time when compared for the same time of day (see Figure 17 for 2m temperature). Despite of this, the difference is small for many parameters. For precipitation, however, 06 UTC forecasts are necessary to precisely predict afternoon convection, but they are available too late (around 12 UTC). 00 UTC runs much better meet the needs of forecasters and also have good quality, while the forecast range of the 18 UTC run of the previous day is already too long. In other words: The forecasts with shorter lead times provide sharper forecasts and are therefore more valuable in decision making. This is demonstrated on Figure 18 by three probabilistic forecasts valid for the same time and date (15 UTC, 12 May 2013) based on the different forecast lead times.

Efforts: 2 PM

Contributors: Mihály Szűcs (OMSZ)

Documentation: Report of SRNWP-EPS team for TAC subgroup meeting

Status: Finished

S6 Action/Subject/Deliverable: **Publication of scientific results**

Description and objectives: The scientific achievements of the LACE EPS R&D activities are presented at international workshops and published in scientific journals. In the following an overview is provided of published journal papers and documents in preparation.

Published:

- Wang, Y., M. Belluš, J.-F. Geleyn, X. Ma, W. Tian, F. Weidle, 2014: A new method for generating initial condition perturbations in regional ensemble prediction system: blending**.** Monthly Weather Review, 142, 2043-2059 doi: http://dx.doi.org/10.1175/MWR-D-12-00354.1

Submitted:

- Szintai B., Szűcs M., Randriamampianina R., Kullmann L., 2014: Application of the AROME non-hydrostatic model at the Hungarian Meteorological Service: physical parameterizations and ensemble forecasting. Submitted to Időjárás.

In preparation:

- Smet, G., Y. Wang, F. Weidle, 2013: Comparison of ECMWF and NCEP coupling for the ALADIN-LAEF LAM-EPS – in preparation for Wea. Forecasting (ALADIN flat rate stay of Geert Smet, 2013). To be completed.
- Schellander-Gorgas, T., A. Kann, F. Meier, Y. Wang, F. Weidle, C. Wittmann, 2014: On the forecast skills of a convection permitting ensemble – in preparation for Wea. Forecasting

- Paper of comparison between NCSB and CSB – in preparation for Wea. Forecasting.
- Belluš, M., F. Meier, 2014: Paper of Ensemble-CANARI vers. NCSB – in preparation for Mon. Wea. Rev. or Quart. J.
- Paper dealing with different approaches to LBC interpolation (spatio-temp. consistency) - in preparation for Mon. Wea. Rev. or Quart. J.
- Paper of LAEF performance in B08RDP – in preparation for MAP.
- Taşcu, S., Y. Wang, C. Wittmann, F. Weidle, 2014: Forecast skill of regional ensemble system comparing to the higher resolution deterministic model - in preparation for Mon. Wea. Rev. or Quart. J.

Efforts: 4 person months

Contributors: Yong Wang, Florian Weidle, Christoph Wittmann (ZAMG), Geert Smet (KMI, Belgium, ALADIN flat-rate stay), Martin Belluš (SHMU), Simona Taşcu (NMA), Balázs Szintai, Mihaly Szűcs, Roger Randriamampianina, Kullmann L. (OMSZ)

Documentation: Reviewed papers, see above

Status: Ongoing

3 List of actions, deliverables including status

S1 Subject: Optimization of ALADIN-LAEF

Deliverables: Report on SPPT for soil and surface fields on RC LACE web page, paper in preparation for publication in Mon. Wea. Rev. or Quart. J.

Status: Ongoing

S2 Subject: Migration of ALADIN-LAEF to CRAY

Deliverables: ALADIN-LAEF migrated from IBM to CRAY computer at ECMWF

Status: Finished with some ongoing maintenance tasks

S3 Subject: AROME-EPS

Deliverables: Project documentation and web page, paper for publication in scientific journal in preparation, stay report on RC LACE web page

Status: Ongoing

S4 Subject: EPS - Verification

Deliverables: Stay report (not yet available)

Status: Ongoing

S5 Subject: Collaborations

Deliverables: Report of SRNWP-EPS team for TAC subgroup meeting

Status: Finished

S6 Subject: Publication of scientific results

Deliverables: See publication list

Status: Ongoing

4 Documents and publications

Peer reviewed:

- Wang, Y., M. Belluš, J.-F. Geleyn, X. Ma, W. Tian, F. Weidle, 2014: A new method for generating initial condition perturbations in regional ensemble prediction system: blending. Monthly Weather Review, 142, 2043-2059 doi: http://dx.doi.org/10.1175/MWR-D-12-00354.1

Stay reports:

- Martin Belluš, 2014: Stochastically perturbed physics tendencies of surface fields in ALADIN-LAEF, Report on stay at ZAMG, 12/05 - 20/06/2014, Vienna, Austria

- Mihály Szűcs, 2014: Stochastically Perturbed Parameterized Tendencies in ALARO and AROME , Report on stay at ZAMG, 06/10 - 31/10/2014, Vienna, Austria

- Martin Belluš, 2014: Non Cycling Surface Breeding versus the ensemble of surface Data Assimilations by CANARI in ALADIN-LAEF system (preparation of the publication) , Report on stay at ZAMG, 03/11 - 28/11/2014, Vienna, Austria

5 Activities of management, coordination and communication

- 24th ALADIN Workshop & HIRLAM All Staff Meeting 2014, 7-11 April 2014, Bucharest, Romania (presentation Theresa Schellander-Gorgas).

- SRNWP-EPS activity: Meeting of WG-leaders in Bologna for preparation of requirements for Phase II, July 1 2014 (participation of Theresa Schellander-Gorgas via Webex).
- TAC subgroup meeting for ECMWF BC Optional Programme in Reading, 3 September 2014 (contribution and participation of Mihály Szűcs).
- ALADIN Forecasters meeting in Ankara, Turkey, 10-11 September 2014 (presentation Florian Weidle).
- 36th EWGLAM and 21st SRNWP meetings, Offenbach, Germany, 29th September to 2nd October 2014 (presentation Theresa Schellander-Gorgas).

6 Summary of resources/means

Subject/Action/deliverable	Resource		LACE		ALADIN	
	planned	realized	planned	realized	planned	realized
S1: Optimization of LAEF	9	6	4.5	2.5	1	0
S2: Migration of LAEF to Cray	3	3				
S3: Arome-EPS (incl. PROFORCE)	13	13	1	1		
S4: EPS – Verification	2	2		0.5		
S5: Collaborations	2	2				
S6: Publications	3	4		1.5		
Total:	32	30	5.5	5.5	1	0

Problems and opportunities

During 2014 some of the plans for Predictability group had to be changed slightly. Firstly the ALADIN-LAEF maintenance was very time consuming, and secondly some stays were delayed or planned tasks has started a bit later for various reasons. This shows again the importance of having the appropriate manpower for EPS R&D.

The fact that the biggest progress in e.g. LAEF development is usually made during LACE stays proves that the collaboration, exchange of knowledge and particularly the undisturbed, concentrated work on concrete tasks are highly valuable commodities.

It is in the nature of ensemble forecasting issue that the expertise of different modeling areas is necessary to create a well-balanced and reliable ensemble system. Especially the collaboration between the areas of Physics, Predictability and Data Assimilation was strengthened during the last year and shall be continued. This is seen as a very positive evolution, which will be indeed beneficial for each of the areas.

Used References

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