LACE
nwp central europe

Working Area Predictability

Work Plan

Prepared by:	Martin Belluš
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Introduction and background

The regional ensemble forecasting system ALADIN-LAEF provides the probabilistic forecasts for the LACE partners operationally on daily bases. Many changes and upgrades within the last few years took place in order to make the system more reliable and accurate. In 2016 we have technically upgraded ALADIN-LAEF to new computational domain with 5 km horizontal resolution and 60 vertical levels. We have updated its components to CY40T1 with the use of ALARO-1 physics and changed the grid type finally to linear. However, the first ALADIN-LAEF results on high resolution were not quite satisfactory. After some investigation a rather unexpected bug in the quadratic coupling procedure in CY40T1 was discovered. It is very likely, that the nature of this bug could have been responsible for the bad statistical scores in our experiments. Therefore, new ALADIN-LAEF configuration needs to be tested again with the bug-fixed code.

Goals

The newly implemented methodology for handling IC perturbation for the upper-air fields (BlendVar) has to be carefully tested before entering the operations. The upper-air data assimilation (3DVar) is very sensitive to chosen observations. Their quality and reliability has to be checked regularly, which is going to be even more complicated task within the operational EPS framework. Also the perturbation to the observations needs to be implemented and tested, not to mention the different possibilities for a computation of background error statistics. Therefore, it is in consideration to split the operational implementation of new ALADIN-LAEF into two steps. The first (relatively fast) phase would be just the upgrade of current configuration to the higher resolution with the inclusion of surface SPPT and new ALARO-1 multiphysics. In the second phase later on, new BlendVar with the perturbed observations can be reliably implemented.

The simulation of model uncertainty by the multiphysics is never-ending story because of continuously evolving model and maybe even more sophisticated stochastic physics, like randomly perturbed physics parameters (a stochastic perturbation at the process level), could be considered as well. The work will definitely continue also on the development of new stochastic pattern generator suitable for LAM EPS, and that's going to be on both regional and convection-permitting "fronts".

Research and development in the field of convection-permitting ensembles remain still as a second main topic, although due to the limited computing resources it is hard to expect fully operational implementations within the near future in any of the LACE countries. However, the progress in this area is more and more pronounced. One of the possibilities how to cope with the current situation is to use the deterministic AROME runs (e.g. RUC) to construct the lagged ensembles.

Main R&D activities

1 Action/Subject: **Optimization of ALADIN-LAEF**

Description and objectives: ALADIN-LAEF upgrades and related R&D

❏ Continue with testing the ALARO-1 physics and its different tunings. Use of the most suitable set of 4 different configurations (at maximum) with altered settings for microphysics, turbulence and deep convection and construct a 16-member ensemble out of their combinations. Ensure model stability.

❏ Supplement reduced multi-physics with the stochastically perturbed physics tendencies (using newly developed and implemented random pattern generator) for the upper-air and surface prognostic variables.

❏ Perform detailed scientific validations and tunings of the 3DVar within ALADIN-LAEF framework.

❏ Investigate different approaches for the creation of background model statistics (B-matrix) in the EPS framework, e.g. flow-dependent B-matrix can be recomputed regularly every couple of weeks with very little costs. Test its impact on ALADIN-LAEF performance.

❏ Suggest the assimilation strategy. In the context of newly implemented BlendVar, there are several possibilities how to create an assimilation loop in ALADIN-LAEF. The easiest option, from the technical as well as from the cost point of view, is to stick with the current operational configuration, i.e. no separate assimilation cycle (where the assimilation guess is taken directly from the previous production run). More sophisticated approach (but also with the additional cost) involves a separate assimilation cycle, but with the advantage to wait for the real-time boundary conditions. Therefore, more accurate assimilation guess would be created. Except the necessary additional model integrations, there will be also more complicated data flow in the operational production line. The decisions must be taken prior to the implementation.

❏ Implement the perturbation of the observations for the usage within 3DVar (BlendVar) and evaluate its impact on the ALADIN-LAEF forecast.

❏ Experiment with the 5 km ALADIN-LAEF version and all of its components, eventually start with its operational implementation. It has to be decided whether to do everything in one go or per-partes (e.g. to start firstly with the upgrade of computational domain and just afterwards follow with the addition of new components like BlendVar).

❏ Test the benefits of ensemble calibration and post processing of high resolution ALADIN-LAEF wind forecast.

Proposed contributors & Estimated efforts: Florian Weidle, Yong Wang, Christoph Wittmann (all ZAMG), Martin Belluš, Martin Dian (both SHMU), Simona Taşcu (NMA), Iris Odak Plenković (DHMZ) - 13 PM (including 5.5 PM LACE stays at ZAMG)

Planned time-frame and deliverable: Ongoing. State-of-the-art ensemble system capable to deliver operational probabilistic forecasts, the evaluation results, stay reports.

Planned stays:
1. Martin Belluš (4+4 weeks) ...preferably in May and October/November, 2017
2. Simona Taşcu (6 weeks) ...preferably summer + autumn/winter
3. Martin Dian (4 weeks) ...preferably in March~April, 2017
4. Iris Odak Plenković (4 weeks) ...preferably in November~December, 2017

2 Action/Subject: ALADIN-LAEF maintenance

Description and objectives: Maintain and monitor the operational suite of ALADIN-LAEF running on Cray HPCF at ECMWF.

Everything depends on the given situation. It can be either without any dramatic changes or with some crucial updates in the operational configuration of ALADIN-LAEF system. At this moment it is not clear whether and to what content the new components of ALADIN-LAEF will be operationally implemented, and also how quickly it will be.

Proposed contributors & Estimated efforts: Florian Weidle (ZAMG) - 1 PM (or much more in case of the upgrade of our system!)

Planned time-frame and deliverable: Ongoing. Stable ALADIN-LAEF operational suite and reliable delivery of the probabilistic forecast products (GRIB files, plots) to the LACE partners.

3 Action/Subject: Development of AROME-EPS

Description and objectives: Development of convection-permitting ensemble system based on non-hydrostatic AROME model. The aim would be to probabilistically forecast high-impact weather on local spatial scales and with short life-cycle. Activities are planned at ZAMG and OMSZ:

❏ Develop and implement new random number generator suitable for LAM EPS environment.

❏ Continue work on stochastic perturbation of physics tendencies as a tool to simulate the model uncertainty, with the usage of improved random number generator. Test and evaluate the different options of model perturbation.

❏ Test some other possibilities to enhance ensemble spread and improve system reliability for high-impact weather, e.g. the stochastic perturbation at the process level (a targeted perturbation of given parameters contributing to the precipitation processes, strong winds, etc.).

❏ Perform the "cheap" parallel experiments with lagged convection-permitting ensemble system formed by several deterministic AROME runs (RUC).

❏ Answer the question, whether the convection-permitting EPS are capable of providing better precipitation and temperature forecasts already at this stage of their evolution in comparison with the regional ensembles running on coarser resolutions in hydrostatic regime.

Proposed contributors & Estimated efforts: Mihály Szűcs, Panna Sepsi (both OMSZ), Clemens Wastl, Christoph Wittmann (both ZAMG) - 10 PM (including 1.5 PM LACE stay at ZAMG)

Planned time-frame and deliverable: Ongoing. Reports on the experiments, exchange of the technical expertise.

Planned stays:
1. Mihály Szűcs (6 weeks) ...preferably in September~November, 2017

4 Action/Subject: Verification

Description and objectives: Further development of the verification tools for both ALADIN-LAEF and AROME-EPS forecasts.

Proposed contributors & Estimated efforts: Simona Taşcu (NMA), Martin Belluš (SHMU) - 1 PM

Planned time-frame and deliverable: Ongoing. Enhanced verification tools.

5 Action/Subject: Contributions to international projects, collaboration

Description and objectives:

❏ Contributions to PHASE II of the SRNWP-EPS activities. The second phase of the project will continue to the end of 2017, focusing on the development of new probabilistic methodologies to predict severe weather conditions like thunderstorms and fog and studying the underlying sensitivity of the models to soil conditions and the boundary layer.

❏ Closer collaboration with HIRLAM group and the exchange of know-how related to their HarmonEPS and our ALADIN-LAEF systems, especially the expertise on a) initial conditions perturbation generation (EDA and 3D-Var, LETKF) and b) model uncertainty simulation (SPPT, multi-physics using ALARO-1 package with the different tunings).

❏ Contributions to the other workshops and meetings.

Proposed contributors & Estimated efforts: Florian Weidle, Yong Wang (both ZAMG), Mihály Szűcs (OMSZ), Martin Belluš (SHMU) - 2 PM

Planned time-frame and deliverable: Ongoing. Presentations at the workshops, reports.

6 Action/Subject: Publications

Description and objectives: Publication of the scientific results achieved within the project. The scientific achievements of the project will be presented at the international workshops and published in the scientific journals.

Proposed contributors & Estimated efforts: Florian Weidle, Yong Wang, Christoph Wittmann, Clemens Wastl (all ZAMG), Martin Belluš (SHMU), Simona Taşcu (NMA), Mihály Szűcs (OMSZ) - 6 PM

Planned time-frame and deliverable: Ongoing. Reviewed papers and the workshop contributions.

Summary of resources [PM]

Subject	Manpower	LACE	ALADIN	Other
S1: Optimization of LAEF	12+1	4.5+1		
S2: LAEF maintenance	1			
S3: AROME-EPS	10	1.5		
S4: EPS - Verification	1			
S5: Collaboration	2			
S6: Publications	6			
Total:	32+1	6+1	0	0

Meetings and events (2017)

❏ 28th LSC Meeting, 13-14 March, Payerbach, Austria

❏ Joint 27th ALADIN Workshop & HIRLAM All Staff Meeting 2017, 3-7 April 2017, Helsinki, Finland

❏ 29th LSC Meeting, 21-22 September 2017, Slovenia

❏ 39th EWGLAM and 24th SRNWP meetings, 2-5 October 2017, Reading, UK

❏ 2nd SRNWP-EPS II Workshop, 24-26 October, Madrid, Spain

❏ Other international EPS related conferences or workshops