Report on stay at ZAMG

18/10 – 12/11/2010, Vienna, Austria

Continued work on new ALADIN-LAEF domain definition and X-pattern testing

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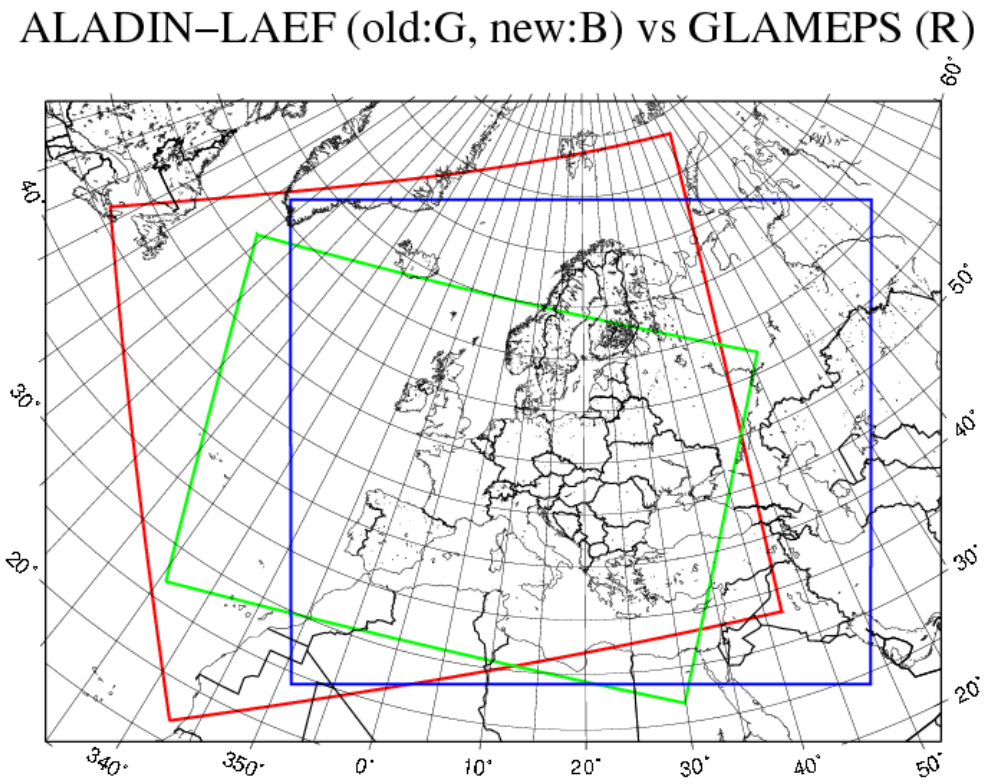
Foreword:

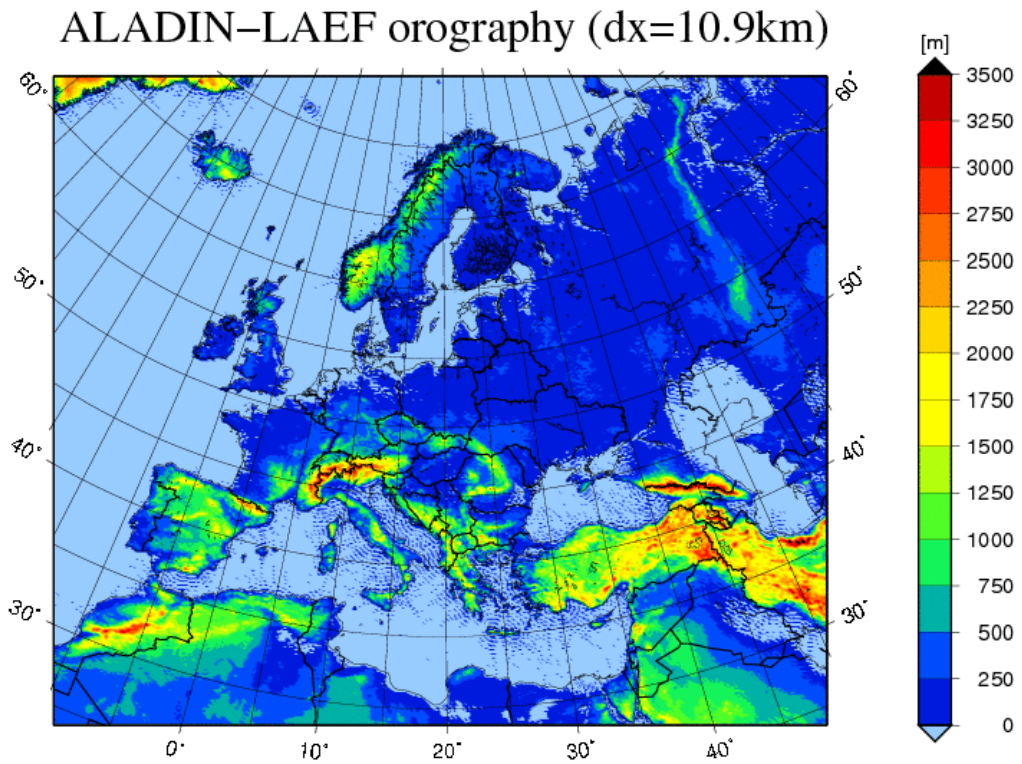
The main aim of this stay was redefinition of new ALADIN-LAEF domain in order to fulfil requirements of all the partners (especially Turkey) and to perform a full ALADIN-LAEF suite test on NEC HPC at ZAMG. In parallel, our concentration was focused on the upgrade of used model executables and corresponding configuration namelists. We wanted to verify as well, whether recently reported X-pattern problem is present in the ALADIN-LAEF initial fields, since the buggy code was proved to be related to the ee927 configuration mostly used within DFI spectral blending. Up to now it was believed, that a hot-fix for this problem would be to switch off the packing procedure used in ee927 configuration by setting NVGRIB=0 in NAMFA namelist. Unfortunately, for the cycle cy32t1 we can say, that even with NVGRIB=0 in corresponding DFI blending steps, there is still that problem although much less pronounced. This logically leads us to the question, whether the fixed version of the code (cy36t1 with at least bf5) can solve fully the X-pattern problem or not. If NVGRIB=0 case can be still somehow contaminated, the bug-fix related to that part of the code, which is at such condition skipped, need not to be fully solving the problem. Our suspicion turned to be true, however up to now we are not able point out the exact source of the pattern. Using cy36t1_bf6 the output fields from DFI blending procedure seems to be pattern-free on the first sight, but after making the difference between NVGRIB=2 and NVGRIB=0 experiments, the X-pattern is surprisingly (but clearly) there. Where is the source of the first contamination in the ALADIN-LAEF initial conditions? Has the fixed code still some deficiency? These are the questions which should be further investigated.

I. New domain:

The need of more grid points in Turkey's surround and also the aspiration for the participation on the XXII Olympic Winter Games in Sochi 2014 with the ALADIN-LAEF ensemble forecast, the new bigger domain (600x500 points for C+I+E) of higher spatial resolution (10.9 km) was redefined. New Lambert conic conformal projection with the reference and central point latitudes and longitudes equal to each other was defined. A comparison of the operational ALADIN-LAEF, GLAMEPS and new ALADIN-LAEF domain borders is shown on the following picture (Fig.01). New domain model topography is shown on Fig.02.



::Fig.01 Domain boundaries of the operational ALADIN-LAEF (green), new redefined ALADIN-LAEF (blue) and GLAMEPS (red).



::Fig.02 New ALADIN-LAEF domain and model topography at 10.9 km spatial resolution.

New ALADIN-LAEF domain (re)definition:

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&NAML
   NROTEQ     =  -1 ,
   REF%LON    =  19.5 ,
   REF%LAT    =  52. ,
   CENTER%LON =  19.5 ,
   CENTER%LAT =  52. ,
   SW%LON     =  -8.841841320309186 ,
   SW%LAT     =  24.023981523201257 ,
   NE%LON     =  86.48989491532193 ,
   NE%LAT     =  61.51661572413199 ,
   ERPK       =  0.788010753606722 ,
   PDL%ONX    =  10900. ,
   PDL%ONY    =  10900. ,
   KGIVO      =  0 ,
   KSOTRP     =  0 ,
   NDLUN      =  1 ,
   NDLUX      =  573 ,
   NDGUN      =  1 ,
   NDGUX      =  480 ,
   NDLON      =  600 ,
   NDGL       =  500 ,
   NMSMAX     =  199 ,
   NSMAX      =  166 ,
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II. Testing:

a) Problem with in-line fullpos

We have observed some strange behaviour of configuration e001 with switched on in-line fullpos, were always an abort was called in STEPO with the message: "FPCORPHY: CANNOT FIND LAND-SEA MASK", even if the land/sea mask (SURFIND.TERREMER) was present in the initial file and recognized by the model. This was not the case, when in-line fullpos was deactivated via namelist (LFPOS=.F.), which turned our attention to the in-line fullpos. The same crash was observed with model versions cy32t1 and cy35t1. Finally, applying some old (and nearly forgotten) hints from Ryad, we have learned that everything works properly if SURFTEMPERATURE (CFPPHY) is added among the list of post-processed fields (even if we don't need it :). Fullpos is sometimes full of surprises.

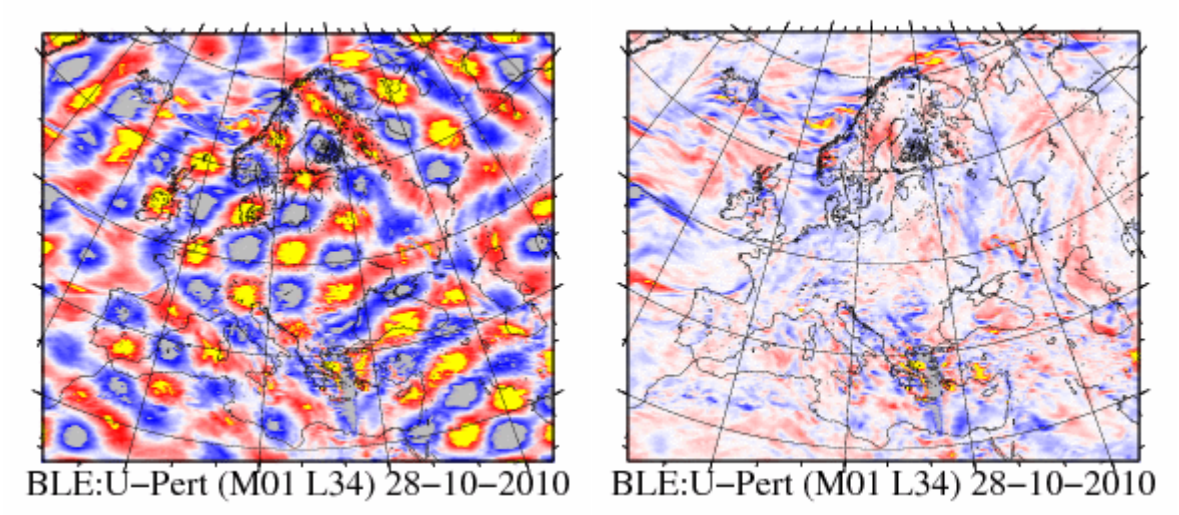
b) X-pattern problem

It was confirmed by our experiments that so called X-pattern reported on March 2010 can be present randomly in some isolated vertical levels also in the ALADIN-LAEF initial perturbations (see Fig.03). This bug comes from the configuration ee927 and is related to the GRIB packing procedure. It is caused by wrongly pre-computed optimal Laplacian power, while problem itself lies in used packing error criterion where original spectral coefficient and the approximate one are compared (for more details please see report on RC LACE forum "X-pattern produced by configuration ee927" by J. Mašek).

Since this long-time sleeping bug in the code was uncovered and fixed only recently in newer version of the model (cy36t1_bf5), we have switched off GRIB packing in corresponding ee927 blending steps in ALADIN-LAEF operational suite running at ECMWF on HPCF in order to avoid presence of the X-pattern problem. (This easy trick was firstly noticed by R. Brožkova and proposed to be used as a temporary solution of the problem.)

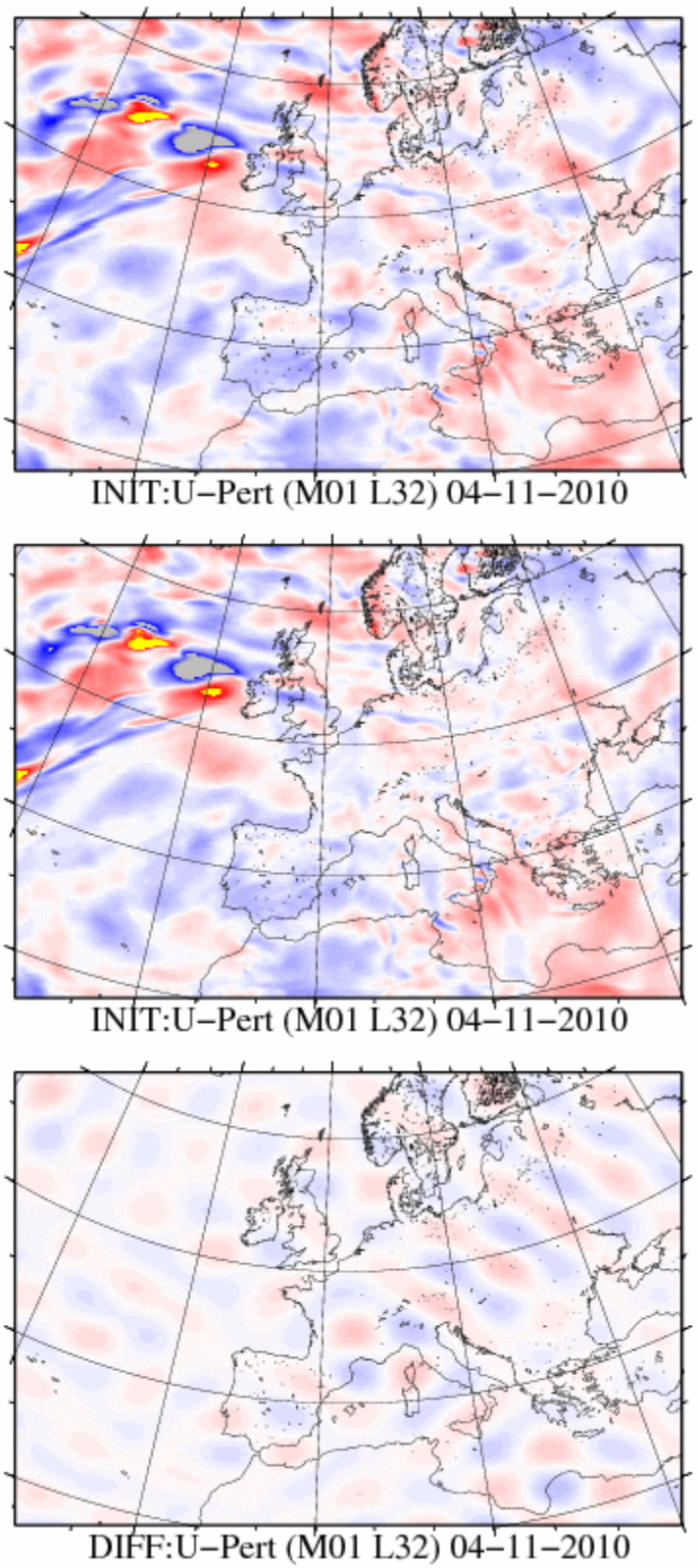
The only side effect (purely technical) of that change to the operational configuration of

ALADIN-LAEF are the bigger intermediate files within blending procedure. Those are all temporary files. Blend utility used in the last step of blending procedure ignores input packing and uses its own default packing for the output fields. It means that the upper-air spectral fields have the same volume as before. Nevertheless, the size of final perturbed initial conditions was increased due to some unpacked surface fields which are now copied to the INIT file from ARPGEGE analysis during the blending process but are not replaced by the externally perturbed surface fields afterwards (only some surface fields are perturbed in the ALADIN-LAEF system). The bigger surface fields for OZONE, ALBEDO, AEROSOLS, etc. are causing the increase of volume of the INIT files from 33 to 49 MB (for current operational domain).



::Fig.03 Initial-time perturbation of U-wind component spoiled by strong X-pattern effect (left) and the same field after switching off GRIB packing in corresponding ee927 steps within blending procedure (right). (Experimental run using cy32t1 for ee927 configuration.)

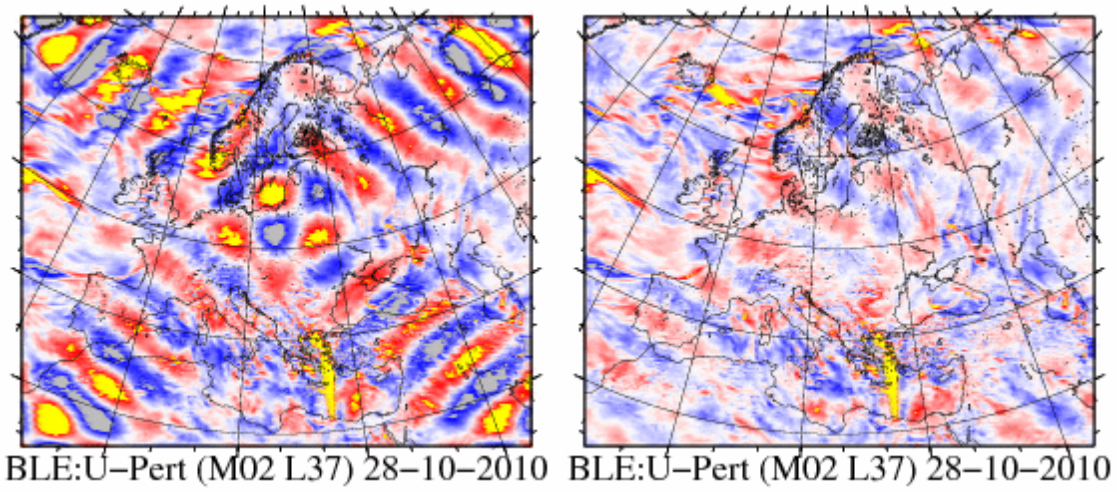
Even if the X-pattern was present in the initial conditions almost on daily bases, it was fortunately most often too weak and only on isolated vertical model levels. This leaves us hoping for that it was hardly spotted in the regular LAEF outputs at the surface fields. On the following maps (Fig.04) there is shown the initial-time perturbation of U-wind component taken from the operational ALADIN-LAEF forecast from 04.11.2010 00 UTC before and after applying hot-fix (NVGRIB=0). Now looking only on the perturbations itself, one can hardly see any distortion of the fields. But when the difference between “packed” and “unpacked” fields is plotted, the presence of X-pattern in INIT file is obvious. (This test of course says nothing about the source of the contamination. It can be in either of the files, eventually in both. But after deeper look it seems, that at least the file with packed spectral fields possesses the “well-known” structure.)



::Fig.04 Contaminated initial-time perturbation at 32nd model level (up), the same but with NVGRIB=0 (middle) and their difference where a weak X-pattern presence is clearly detected. The surrounding model levels were not affected at all (differences are either "zero" or at the level of homogenous noise). (Operational run using cy32t1 for ee927 configuration.)

Even if the X-pattern problem seemed to be cured by the setting of NVGRIB=0 via namelist, it was highly recommended to upgrade model version to cy36t1bf5 at least for the blending application, where bugged ee927 configuration is responsible for the errors. (So far the problem was always revealed only if such model configuration is used for increasing the spectral resolution of the files, which is the case in spectral DFI blending procedure.)

Unfortunately, during further tests with cycle cy32t1 we have observed some weak X-pattern effect even for NVGRIB=0 setting (Fig.05). This is of course something completely new and surprising (since in that case the bugged routines are not even activated in the code!). That was surely good reason for the verification whether bug-fixed code in the cycle cy36t1 (related only to the routines active under NVGRIB not zero) can reproduce it or not.



::Fig.05 Initial-time U-wind component perturbation with NVGRIB=2 (left) and NVGRIB=0 (right). Much weaker but however still obvious X-pattern can be seen also for NVGRIB=0 case. (Experimental run using cy32t1 for ee927 configuration.)

Furthermore, the recent experiments using cycle cy36t1_bf6 (i.e. the code with fixed packing errors) surprisingly have shown the presence of contamination as well! Although, the individual perturbed fields (both for NVGRIB=2 and NVGRIB=0 settings) seems to be already X-pattern free, their difference proves the opposite (Fig.06).

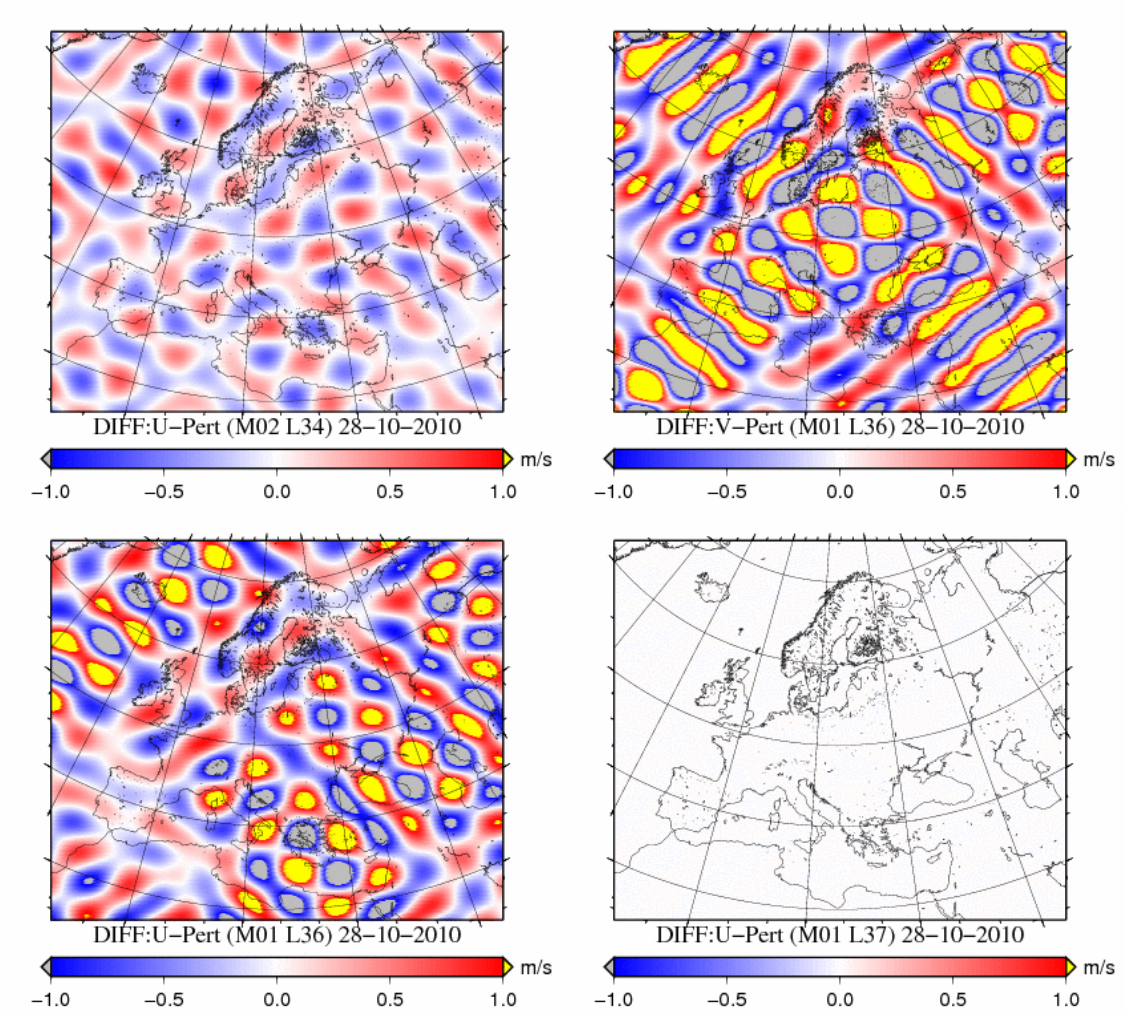
This method is indeed good for identification of the problem, but unfortunately we can't say which branch is contaminated. Making the differences between ee927 temporary PX-files (always unpacked spectral fields) and PF-files (packed spectral fields in the result if NVGRIB=2) for each of the questionable blending procedure steps could be of some help.

Here is the recapitulation of status quo of the X-pattern investigation using cycle cy36t1_bf6:

1. Laplacian powers for each of the fields in the input and intermediate files are either: zero, one or two, never higher. Which is perfectly OK, since this was the indication of some possible problems if the powers would be higher.

2. The differences between given fields in PF-file and corresponding PX-file for each of the ee927 blending steps have shown only some homogenous noise or Gibbs waves but nothing related to the misterious X-pattern.

3. Despite of **1** and **2**, there is at least for the wind components a distinct X-pattern materialized in the difference between NVGRIB=2 and NVGRIB=0 experiments (Fig.06). This is of course something very strange, contradicting and needs to be further investigated (which was unfortunately behind the scope of present stay).



::Fig.06 Difference between the two runs (NVGRIB=2 minus NVGRIB=0) for the wind components perturbation and some model levels. While for the first three maps the difference between "packed" and "unpacked" fields is obviously spoiled by the X-pattern, the last map shows how the difference should be if there is no contamination (it is just the next model level for the same case!). (Experimental run using cy36t1_bf6 for ee927 configuration and DFI.)

c) FA-file headers

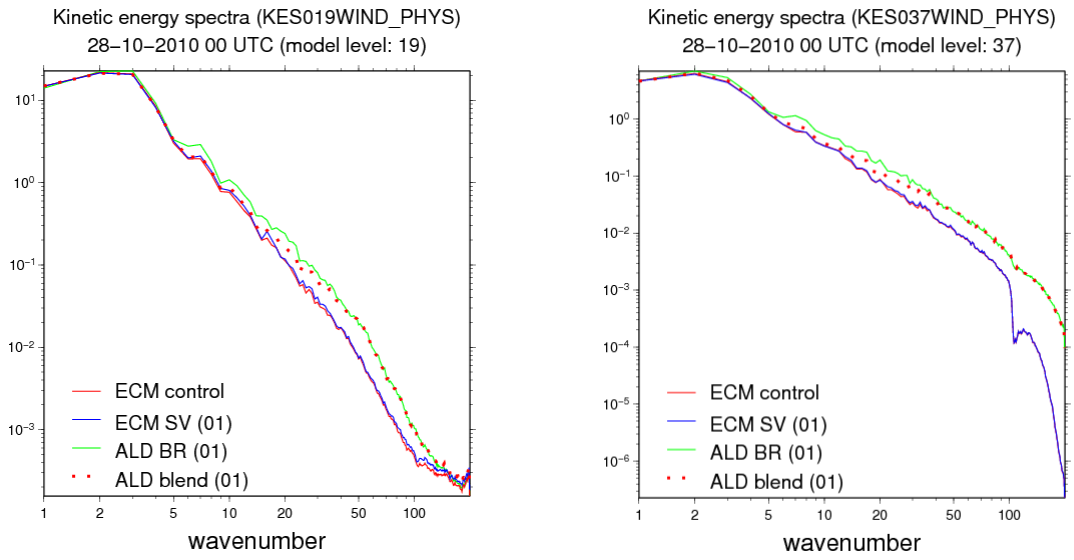
To avoid known problems (in "esetup_trans" routine) related to the usage of input files with the new FA-file headers during breeding procedure, the bug-fix introduced last time was now applied for the new version of the Fortran programs containing vertically variable scaling factor. Bug-fixed source codes working with both (new and old EGGX) types of the FA-file headers can be found on frontend under directory: ~bellus/src_breeding

Warning: The output from breeding procedure will have the same file header as the third input file (i.e. the control analysis), since the final perturbed and rescaled 3D fields are just replacing the original 3D fields in that input-output file. After the conversion of ECMWF

GRIB files (taken from MARS database) into FA-files via configuration 901, the parameter NCADFORM=-1 must be set in the namelist of configuration e927 to obtain files with EGGX new style format headers. Initially the default value (NCADFORM=0) was used in our former experiments with ALADIN-LAEF on original domain and the same "strategy" for BC is still used in the operational ALADIN-LAEF suite at ECMWF. This is particularly important, since new ALADIN blend utility works correctly only with the new FA-file headers.

d) Kinetic energy spectra

On the following charts one can see the kinetic energy spectra of the two input files (ECMWF EPS member and corresponding ALADIN breeding member) and the result of their combination after the upper-air spectral blending procedure. It is valid for the new ALADIN-LAEF domain with recent model version and new namelists. This is always a good indication, whether blending procedure works as supposed.



::Fig.07 Kinetic energy spectra for 19th (left) and 37th (right) model levels.