

## **Minutes of the meeting on KENDA (also task 1 of COTEKINO PP), Offenbach, 17<sup>th</sup> – 18<sup>th</sup> March 2014**

### **Participants:**

Dmitrii Alferov (RHM), Theresa Bick (Uni Bonn), Dmitri Gayfulin (RHM), Christoph Gebhardt (DWD), Amalia Iriza (NMA), Richard Keane (DWD), Christian Keil (LMU), Heiner Lange (LMU), Daniel Leuenberger (MeteoSwiss), Francesca Marcucci (CNMCA), Chiara Marsigli (ARPA-SIMC), Roland Potthast (DWD), Hendrik Reich (DWD), Christoph Schraff (DWD), Leonard Scheck (LMU).

**Aim:** this is a meeting of the KENDA PP. Since Task 1 of the COTEKINO PP deals with coordination on the use of KENDA for ensemble forecasting and maintaining the link with KENDA development, this meeting is also one realization of this task.

### **Minutes:**

17<sup>th</sup> March 2014.

The meeting started with few presentations, followed by discussion.

Presentations:

- Amalia Iriza: NEFFprove
- Daniel Leuenberger: KENDA at MCH
- Chiara Marsigli: KENDA at ARPA-SIMC
- Hendrik Reich: Tools at DWD to evaluate KENDA experiments
- Theresa Bick: radar assimilation in KENDA

The presentations will be made available on the MCH wiki (<https://wiki.c2sm.ethz.ch/Wiki/ProjKENDApub>).

#### Amalia Iriza's presentation.

The main NEFFprove updates since November are in the INPUT namelist and in the output ASCII file. Up to now the code processes the feed-back files produced by the LETKF (ekf files) but has not been tested on the feed-back files produced by COSMO (fof files). [Action: This test will be done by Daniel, with the help of Amalia.]

At present the scores are computed over the whole period spanned by the files which are read in input. It would be useful to have also the score values for each step, but this can be done by running the code as many times as the steps which are analysed.

The code will become part of the LETKF-3Dvar code, available from the repository.

#### Daniel Leuenberger's presentation.

KENDA has been run over a continuous test period (26.7 - 25.8 2012), 1h update cycle, 40 members, BCs from ECMWF ENS, also deterministic analysis, COSMO version 5.0 in single precision. The single precision assimilation code still has problems, it does not give the same results as the double precision code for the assimilation, the number of observations is different. The results nevertheless can give some hints on the performance of the KENDA system.

Compared with surface observations, the KENDA deterministic analysis is very close to the no-observation experiment, indicating that likely not many observations are actually assimilated -> problem to be investigated. For precipitation, forecasts of the no-obs experiment are better than the nudging (without LHN), probably since TD\_2m is not assimilated in the nudging experiment and the analysis has a dry bias, at least at the surface.

During the discussion it is reminded that obs\_err\_stat is the code (available in the LETKF-3Dvar package) which computed the Desroziers statistics.

#### Hendrik Reich's presentation.

KENDA has been run for one case of June 2011, 40 members, LBC from GME LETKF, including the deterministic run. Four experiments are compared, with all the combination of adap\_R and adap\_rho (T or F), compared with the nudging. Up to now there is no clear evidence of a better performance of the adaptive methods, they should be tuned. The aim is to use LBCs from ICON-LETKF, in order to use BCs as new as possible.

#### Chiara Marsigli's presentation.

KENDA has been run over few case studies (autumn 2012), 3h update cycle, 20 members, BCs from ECMWF ENS, COSMO version 4.26 and 4.29. The difference between using only 10 members in KENDA has been checked against using 20 members, with a far better result for the latter. An OSSE has been implemented, with pseudo-observations from a nature run, which are assimilated in a KENDA cycle. There are still problems in the assimilation, since humidity observations are rejected. The problem is under investigation.

During the discussion it was evidenced the necessity of having a clear picture of the quality checks performed both by COSMO and by KENDA, and the consequences for the observation status.

[Action: Chiara will start preparing such a list, then it will be reviewed by Christoph and Hendrik.]

#### Theresa Bick's presentation.

The assimilation of radar reflectivity has been tested in a real case. An impact has been found only by increasing the observational error w.r.t. the default (from 0.2 to 5 for the wind and from 0.5 to 10 for the reflectivity). A thinning of 5x5 points has been applied. Localisation should be particularly tested. It is discussed how to carry out a "single observation" experiment in the context of radar assimilation (see discussion of the next day).

It is reminded that it was agreed to carry out the further testing on KENDA in a coordinated way between LMU, DWD, MCH and ARPA-ER, using cases falling in the testing period of the Ewelyne Project (August and December 2012). LBCs from IFS ENS are also available (archived by MCH) in the period 25 July 2012 - 25 August 2012.

Roland proposes to set up a public wiki page (with registered access) to collect the description of the experiments ongoing in the different places (also in terms of technical set-up, including version, and report about the results).

It is reminded that a cosmo mailing list has been created for this group cosmo-enda and it should be used for communication within this group.

It is decided to continue the meeting (on specific topics: evaluation and radar) the day after.

18<sup>th</sup> March 2014.

#### KENDA evaluation.

The meeting starts by going through the list of diagnostics for KENDA evaluation prepared during the meeting of KENDA-COTEKINO held in Sibiu. The list is here reported, taken from the minutes of the meeting, available in the COSMO web (COTEKINO pages):

1. Maps of spread at different vertical levels (including the bottom one and one at the top of the PBL), for all the prognostic variables (always include humidity)
2. Skill evaluation: should be done against observations at observation locations, for all types of observations. Feed-back files can be used for this evaluation.

3. Evaluation of ensemble mean against observations (bias, rmse), in terms of background fields, for all types of observations. (by CNMCA)
4. Check the spread/skill relation of the LETKF ensemble at the end of each cycle (e.g. 6h), considering also the observation error. (by CNMCA) This is done stratified by level, over the whole evaluation period.
5. Sanity check (to check is the filter is working properly): check obs-ana
6. For ensemble forecasting, spread/skill relation should be checked also for the forecasting ensemble
7. Compute the difference analysis-first guess as fields, all variables (always humidity)
8. Spectra of fields and perturbations

Discussion on each point took place:

As for point 1, it is stressed that levels and variables should be defined. [When and how to do it?]

As for point 2, 3, 4, 6, NEFFprove is now being made available for this purpose. Further development of the code are discussed in order to meet the needs of the evaluators. At present the code computes the scores for the ensemble mean, for the deterministic run, for all the members and also for the whole ensemble (all the members together using probabilistic scores).

- a. It is underlined the need of making the code able also to compute the scores on the member of the forecast ensemble (not in the kenda assimilation cycle), for being able to perform the evaluation in upper air also for the forecast ensemble initialized from kenda analyses. In order to obtain this, the forecast ensemble outputs should be put in the same format of the da ensemble (feed-back files in netcdf). This is being done at DWD by Andreas. Furthermore, Amalia should introduce in the code the possibility of performing verification for different forecast ranges, which is not there yet.
- b. It is stressed the importance, for this evaluation, of producing scores of the vertical profiles of the standard variables for different lead times (from +6 up to +24h), as shown yesterday in Hendrik's presentation.
- c. It is also specified that this verification strategy is meant for research and development purposes, in the framework of DA development and evaluation. It is also underlined that this approach has not been designed for precipitation, which evaluation bears some specificities. It is not discussed if and how to extend the code to include also precipitation evaluation.
- d. Scores should be looked at with different time steps for different variables (even hourly), therefore the code should be flexible about this.
- e. [Action: Amalia will provide the current NEFFprove version (tested only on ekf files) to be included in the LETKF package, in the repository. Then the development will continue within the svn environment.]
- f. Computation of spread should be included in NEFFprove (already planned). For comparing spread and skill, the observational error should also be taken into account. It is suggested to compare (obs\_err + spread) against RMSE, as it is already done at CNCMA.

As for point 7, this is easily done with different programs.

As for point 8, the code for computing spectra used at ARPA-SIMC will be made available as soon as possible.

As for point 5, it reminded the availability of the diag files for checking the use of observations, the localization radius, ... . In order to improve this facility, it was suggested to extend the diag file, by producing the output separately for each observation type. [Action: Hendrik will take care of this.]

The main tool for the sanity check is the Desroziers statistics, performed by the obs\_err\_stat code.

Note that the computation of obs-fg and obs-ana is performed in observation space. Therefore these

values are different on each point on a similar computation made on the output grib files, in model space.

A note on the implementation: KENDA is implemented in BACY at DWD, under their operational scripting environment at CSCS at MCH, under sms at ECMWF at ARPA-SIMC.

Radar.

The single observation experiment has been discussed. It was concluded that it is advisable to carry out an experiment which is not really “single observation” but “single cell”. How to perform this is practice has also been discussed. Daniel suggested to use ncdump-ngen. The first permits to transform the netcdf observation file in ASCII format. Then the ASCII file can be modified in order to obtain the single observation. Finally the ASCII file can be re-coded in netcdf COSMO format with ngen. This should be tested. It could also be useful for the OSSE.

Thinning or super-obbing should also be applied, before using the data. The fof file contains the data already processed.

It is suggested to test various update rates and various localization radii. In order to assimilate radar together with other observation types it is meant to use the multi-step analysis, which should be tested.

A discussion took place on the no-reflectivity datum (which should be coded differently than the missing datum). A threshold should be defined, to select which reflectivity corresponds to no-reflectivity (e.g. 10 dBz). This threshold could depend on the radar and this issue should be addressed with radar scientists. Then, the value in reflectivity which should be assigned to the no-reflectivity signal should also be selected, in order to avoid to discriminate between several no-reflectivity values in the assimilation.

### **Actions.**

- Who is writing the documentation for KENDA?
- Test about the use of NEFFprove with COSMO fof files will be done by Daniel, with the help of Amalia.
- Chiara will start preparing a summary of the quality checks performed by COSMO and KENDA, then it will be reviewed by Christoph and Hendrik.
- Hendrik will improve the diag files by distinguishing for observation type
- Amalia will provide a version of the code ready to be put in the repository, before making further development
- Roland will take care of providing a wiki page for collecting detailed information about the experiments.
- Chiara will provide the spectra code.