

Minutes of the meeting of COSMO WG7 (WG on Predictability and Ensemble Methods), St Petersburg, 3rd – 4th September 2018.

3rd September, morning

WG 1 / WG 7 / PP KENDA-O / PP APSU (joint)

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| 09:30 – 9:40 | Chiara Marsigli, Christoph Schraff | Opening |
| 9:40 – 10:10 | Hendrik Reich, Christoph Schraff | Some KENDA aspects at DWD (incl. MEC-based KENDA for ICON-LAM) |
| 10:15 – 10:30 | Marco Arpagaus, Claire Merker, Daniel Leuenberger | KENDA activities at MeteoSwiss |
| 10:35 – 10:55 | Chiara Marsigli | KENDA activities at Arpa SIMC |
| 11:00 – 11:30 | All | COFFEE and REGISTRATION |
| 11:30 – 11:50 | Michael Tsyrlnikov, Elena Astakhova, Dmitry Gayfulin | AMPT: Additive Model-error perturbations scaled by Physical Tendencies |
| 12:00 – 12:30 | Christoph Gebhardt | Stochastic modelling of the model error - Recent developments and open questions |
| 12:40 – 13:00 | All | Discussion |

Participants:

Dmitri Alferov (RHM), Marco Arpagaus (MCH), Elena Astakhova (RHM), Michael Buchhold (DWD), Grzegorz Duniec (IMGW), Christoph Gebhardt (DWD), Ekaterina Machulskaya (DWD), Francesca Marcucci (COMET), Chiara Marsigli (Arpa-SIMC, WG7 coordinator), Andrzej Mazur (IMGW), Tiziana Paccagnella (Arpa-SIMC), Hendrik Reich (DWD), Christoph Schraff (DWD, WG1 coordinator), Michael Tsyrlnikov (RHM), André Walser (MCH).

Minutes:

Pres: Hendrik Reich, Christian Welzbacher, L. Bach, Klaus Stephan, Christoph Schraff, Roland Potthast: “MEC-based KENDA for ICON-LAM”.

Hendrik Reich presents first tests on a simplified version of KENDA (MEC-based setup) for ICON-LAM and compares with COSMO-KENDA-online and COSMO-KENDA-MECbased.

Results are limited to a week period, in which ICON-LAM with KENDA-MECbased shows promising results, outperforming the COSMO implementations (with the exception of RH). The advantage of ICON-LAM in forecast mode is in the longer range, showing mainly the advantage of a better model. (It is underlined that results are for a short period.)

Work on the development of ICON-LAM with KENDA-online is ongoing at DWD, where ICON-LAM uses the observation operators from DACE during the model run.

Pres: Christoph Schraff: “Status Report for KENDA-O + WG1”

Christoph Schraff presents mainly the investigation carried out at DWD about the problem raised by MCH: the nudging analysis apparently has smaller errors than the KENDA analysis, which is in contrast with the results obtained at DWD on the same comparison.

The discrepancy is due to the quality control of the data used for verification, and related to the first-guess check both in the assimilation and verification.

In the KENDA assimilation cycle, fg-check is applied twice: the first time during the COSMO run, and this is the same fg-check as applied in the nudging (which has been developed through the years to take into account the specific errors of the COSMO model, specifically here the inability of COSMO in producing low level temperature inversion), the second time during the LETKF step,

where a different check is applied, with more strict thresholds (3 sigma), with no specific considerations for the model biases.

Therefore both at MCH and DWD in the KENDA assimilation cycle happens that many low-level observations in case of inversion are rejected.

The verification at MCH and DWD is done in two different ways with respect to the quality control of observations used for verification: (i) applying only the COSMO fg-check ('cdfin-based MEC', as at MCH), or (ii) applying both the COSMO and LETKF fg-checks ('ekf-based MEC', as at DWD). It is stressed that the implications are different for verification of analyses compared to verification of forecasts.

(i) With cdfin-based MEC, part of the observations used in the verification have been assimilated in one experiment (nudging) but not in the other (KENDA), and related to verification of analyses, the verification result may become and (for the period considered) in fact is (in first order) unfair and misleading with regard to the analysis quality. With ekf-based MEC, the comparison is less unfair because after all it only uses data that have been used to produce the analyses of both experiments. However, even ekf-based MEC is (in second order) unfair, because quite a few (subjectively evaluated) correct observations are omitted in the verification. This makes the verification blind to those conditions where these correct observations are typically rejected.

(ii) This latter effect can also impair the ekf-based MEC verification of forecasts. For the verification of forecasts, the cdfin-based verification is more appropriate. However, this statement holds only for the situation that the (current implementation of the) LETKF fg-check rejects too many data which is (to our knowledge) only the case in the presence of strong systematic model errors.

Pres: Daniel Leuenberger, Claire Merker, Marco Arpagaus, Alexander Haefele, and Giovanni Martucci: "KENDA activities at MeteoSwiss"

Marco Arpagaus presents the MCH work.

At MCH first tests of KENDA assimilation with COSMO in Single Precision have been made. This requires some bug fixes in COSMO, otherwise the assimilation cycle cannot work. Results in terms of performance are promising but not shown.

Work has been made on testing the Additive Covariance Inflation in KENDA, based on the ICON covariance matrix provided by DWD. Impact on the forecasts is positive for temperature but not for relative humidity. The improvement is only in winter. MCH plans to implement it in the operational suite to improve the winter performance.

Pres: Virginia Poli, Thomas Gastaldo, Chiara Marsigli, Pier Paolo Alberoni, Tiziana Paccagnella: "Data assimilation of radar reflectivity volumes in a LETKF scheme".

Chiara Marsigli presented the tests ongoing at Arpa-SIMC on the assimilation with KENDA of the volumes of radar reflectivity of the Italian radar network. Different set-up of the assimilation cycle have been tested: with convective observations + Latent Heat Nudging, with conventional observations + 3d reflectivities with fixed observational error and with conventional observations + 3d reflectivities with observational error different for each radar. Forecasts at 2.2 km initialised with the 3 different analyses show that the LHN gives a better performance in the first hour, while assimilation of reflectivities has a better impact in the few successive hours, in both configurations. The evaluation should be repeated on longer periods, characterised by different weather situations. The PhD student, Thomas Gastaldo, has spent a period at Environment Canada, working with P. Houtekamer on investigating the unbalance problem in short assimilation cycles. He will apply the same methodologies at Arpa, testing sub-hourly assimilation cycles.

Pres: Michael Tsyrlunikov, Elena Astakhova, Dmitry Gayfulin: "AMPT: Additive Model-error perturbations scaled by Physical Tendencies".

Michael Tsyrlnikov presents the new method for model perturbation which is under development at RHM. The method is called AMPT (Additive Model-error perturbations scaled by Physical Tendencies) and it is an additive model error term, independently applied to the model variables (temperature, wind, specific humidity; also q_c and q_i where they are not zero). It uses the Random Patter Generator for the spatial and temporal correlation of the perturbations and the magnitude of the perturbation is proportional to the domain-average physical tendency. The plan is to create a hybrid model perturbation by blending AMPT and SPPT. First results are promising.

Pres: Martin Sprengel, Tobias Heppelmann, Ekaterina Machulskaya, Christoph Gebhardt: “Stochastic modelling of the model error - Recent developments and open questions”.

Christoph Gebhardt presents the developments on the scheme for a model of the model error developed by E. Machulskaya. Work is focussing on the estimate of the parameters of the model, for which different approaches can be followed. In particular, is it better to use successive runs or runs and analyses to estimate to model error tendency? In the discussion followed to the presentation it is also raised the point if really the proportionality of scales is needed in the model error. Does the model error really behave this way? It appears clear that our knowledge of the model error is still not good. The parallel development taking place at DWD and RHM is beneficial for both groups and for COSMO in general (coordinated at COSMO level in Task 1 of the APSU PP).

3rd September, afternoon
WG 7 / PP APSU

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| 14:30 – 15:00 | Andrea Montani | COSMO-LEPS updates: 5 km tests and development of "Civil Protection oriented" products. |
| 15:00 – 15:30 | André Walser | COSMO-E updates |
| 15:30 – 16:00 | Andrzej Mazur | Preliminary activities in PP APSU |
| 16:00 – 16:30 | All | COFFEE and REGISTRATION |
| 16:30 – 17:00 | Chiara Marsigli | COSMO-2I-EPS: verification for thunderstorms |
| 17:00 – 17:30 | All | PP APSU: next steps |
| 17:30 – 18:30 | All | Some discussion items: - Transition to ICON-LAM for ensembles - Ensemble Workshop in Madrid - preparation of PP SPRED Technical Report |

Participants:

Dmitri Alferov (RHM), Elena Astakhova (RHM), Michael Buchhold (DWD), Grzegorz Duniec (IMGW), Christoph Gebhardt (DWD), Chiara Marsigli (Arpae-SIMC, WG7 coordinator), Andrzej Mazur (IMGW), Andrea Montani (Arpae-SIMC), André Walser (MCH).

Minutes:

Pres: Andrea Montani: “COSMO-LEPS updates”.

Andrea Montani presents the last COSMO-LEPS scores, showing that last winter the ensemble had a little worsening of the performance. André Walser confirmed that this happened also for IFS scores, therefore likely last winter was characterised by low predictability.

Test of COSMO-LEPS with 5 km horizontal resolution was performed, showing higher scores with respect to the operational (7km) version in terms of 2m temperature and precipitation. It is observed a decrease of the spread, which may be due to the fact that in the 5km suite parameter perturbations are not applied. Nevertheless, due to the usually low impact of the parameter perturbation, this spread decrease needs further investigation.

New COSMO-LEPS products for the assistance to civil protection activities have been developed.

In the discussion it is reminded that from COSMO version 5.05 the SPPT perturbation (not operational yet in COSMO-LEPS) should work also in Single Precision.

André Walser suggests to explore also an increase of the vertical resolution of COSMO-LEPS, which is still running with 40 levels.

Pres: André Walser: “COSMO-E update”

André Walser presents the status of COSMO-E, which operational configuration have not changed since last year. The member selection of S. Westerhuis is still in e-suite. Verification shows that COSMO-E is more skilful than IFS ENS, particularly in the shorter forecast range. It was also verified that the ensemble is still underdispersive in 2m T and Td, therefore it was tested the addition of observational error (following Saetra et al, 2004) in the spread/skill computation, but with unsatisfactory results. Summarising the results obtained in the SPRED PP, AW underlined that with SPPT the spread is increased, but mainly in summer, while in winter is not enough. On top, they tested the BLPERT approach (by Craig and Kober) and they experienced problems in summer, when the perturbation has a disruptive effect on the convection.

For the APSU PP MCH has planned to test 2 different approaches for model perturbations (not included in the project plan until now): iSPPT (an SPPT with different perturbations for the tendencies from different physics parametrisations) and a model perturbation based on analysis increments, which uses the analysis increments of the assimilation cycles (here KENDA) as estimate of the model error.

The plan of applying a scaling to the IC perturbations has been abandoned, because it has been decided to implement instead in KENDA the additive covariance inflation (see the morning presentation).

Finally, plans have been presented, indicating that in 2020 a merge of COSMO-1 and COSMO-E should be reached (ModInterim internal project). As for the transition to ICON-LAM, in 2020 a project will start, with the aim of operational use of ICON-LAM by 2022.

Pres: Andrzej Mazur, Grzegorz Duniec, Wittek Interewicz: “Introductory activities in PP APSU at IMWM and results of ANN post-processing of EPS forecasts”.

Andrzej Mazur presents results from their ensemble (TLE-MVE), where different perturbations are combined. In the operational run c_soil is perturbed, in test mode also the soil surface temperature and eff_coeff are perturbed.

Lately they implemented a method to produce probabilistic prediction of flashrate, based on the proportionality to the updraft. Prediction of visibility has also been implemented. A fog stability index (FSI) has also been applied, and the output verified against observations at the Polish synop stations. As for thunderstorms, an approach based on instability indices has been implemented, and verification against lightning has been performed. These activities have been presented also in the joint meeting with WG5 and WG4 of the Tuesday afternoon.

Finally, results from the calibration of the ensemble outputs with the ANN (neural network) method have been presented, showing an improvement with respect to uncalibrated output.

Pres: Chiara Marsigli, Maria Stefania Tesini, Davide Cesari, Andrea Montani, Tiziana Paccagnella: “Prediction of thunderstorms with COSMO-2I-EPS”.

Chiara Marsigli presents an evaluation of the COSMO-2I-EPS ensemble for a period of 2 weeks in which several thunderstorms occurred over Italy. Verification shows a positive impact of the KENDA initial conditions in the first 6 hours of the run, even if generally scores are low. The issue of how to verify thunderstorms events has been discussed, by considering also the value of a SAL approach and by mentioning the possible use of lightning data in combination with radar data.

Finally, the discussion takes place.

AW raises the problem of the estimate of the observational error in the spread/skill relation. The method proposed by Saetra et al is too simple and the error estimated is too small. We need to estimate this error and this activity should be carried out in collaboration with WG1.

It is also repeated that in the spread/skill relation computed for the 2m T the problem of the model bias is affecting the estimate of the relationship and that we could reconsider to use analysis instead of observations for the computation of the error.

About the APSU PP, an update of the project plan is needed. They will address Task 1 (different model perturbation methods will be tested at MCH and RHM), Task 5 (remove the FTEs tentatively planned by MCH) and Task 6. About Task 6, more detailed planning of the transition to ICON-LAM in ensemble mode has been made in some centres, and the plan will be updated accordingly.

Finally, the Final Report of the SPRED PP is in preparation, aiming at having the correspondent Technical Report by the end of 2018. CM will soon circulate a draft asking for contributions.

4th September, afternoon

PT CIAO / WG7

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| 14:30 – 14:50 | Andrea Montani | Intro + activity at Arpa-SIMC |
| 14:50 – 15:00 | Edoardo Bucchignani | Activity at CIRA |
| 15:00 – 15:15 | Valeria Garbero, Massimo Milelli | Activity at Arpa-Piedmont |
| 15:15 – 15:30 | Marco Alemanno | Activity at COMET |
| 15:30 – 16:00 | All | Discussion and future plans |

WG7 / WG5 /WG4 (joint) on High Impact Weather verification

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|---------------|----------------------------|--|
| 17:00 – 17:30 | All | Discussion and presentation of ideas Connection with PP-ASPU Connection with JWGFVR and HIW New PP on High Impact Weather |
| 17:30 – 17:45 | Andrzej Mazur, IMGW-PIB | IMGW-PIB experiences and results of operational forecasts of fog/VR/thunderstorms |
| 18:00 – 18:30 | All | Discussion – future actions |

Flora Gofa has manifested the intention of starting a PP within WG5 about high impact weather verification, in cooperation with WG4 and WG7 (with regards to ensemble aspects).

Chiara Marsigli has illustrated the discussion which took place at the last webconference of the Evaluation Task Team (lead by Beth Ebert) of the HIW Project, the WMO Project on High Impact Weather, which serves as a collector / observer /coordinator of the activities on-going related to the topic of the high impact weather. While the verification of high impact weather is a topic of high interest, there are neither methods already established, nor many activities on the subject. The TT has manifested interest for the work which will be initiated in COSMO and they would like to follow the developments. On the other hand, for COSMO it is useful to keep informed about the other activities going-on in the framework of HIW and this link will be kept in the PP.

After the presentation of Andrzej and a short presentation of Chiara (see presentations of Monday afternoon), Flora has outlined a draft of the Priority Project. This could include the following Tasks:

- a) Overview of forecast methods, representation and user-oriented products linked to HIW verification
- b) Overview of appropriate verification measures
- c) Study the Extreme Value Theory (EVT) approach
- d) Spatial verification applications on HIW deterministic and EPS forecasts
- e) Verification of Warnings
- f) Reforecasts as a tool to diagnose model bias and to statistically correct weather forecasts by developing improved user specific products for HIW.