Recent updates of the COSMO-SREPS ensemble system

C. Marsigli[1], F. Gofa[2], P. Louka[2], A. Montani[1], T. Paccagnella[1]

1 ARPA-SIMC, Bologna, Italy
2 HNMS, Athens, Greece

1 Introduction

The perturbations applied to the COSMO-SREPS ensemble have been recently updated, in order to improve the representation of the model error in the ensemble system. The new ensemble configuration is presented in Section 2, where the motivations for this update are also briefly described. In Section 3, a preliminary analysis of the impact of the new perturbations is shown, both in terms of the spread/skill relationship for 2m temperature and in terms of the quality of the different ensemble members.

2 The new COSMO–SREPS configuration

The new ensemble configuration has been selected on the basis of both an extensive testing of new perturbations of the parameters and some physical considerations about the meaning of the parameters, carried out by HNMS. The testing of the new perturbations was performed using the CSPERT suite, a test suite running at ECMWF, using Billing Units from a Special Project (SPITFEAR), where different parameter perturbations are applied. This suite was run over two seasons: autumn (SON) 2007 and summer (JJA) 2008. The quality of the different perturbations was assessed through an objective verification performed both at ARPA-SIMC (over the Alpine area) and at HNMS (over Greece). The outcome of this analysis, together with the aforementioned considerations on the meaning of the parameters, is presented in the SREPS Priority Project Final Report (Marsigli, 2009) and in the CONSENS Quarterly Report March-May 2009 (available on the COSMO web site).

The present COSMO-SREPS configuration is shown in Fig. 1.

member	father	itype_conv	tur_len	pat_len	rlam_heat	rat_sea	crsmin
1	ecmwf	0	150	500	1	20	150
2	ecmwf	1	1000	500	1	20	150
3	ecmwf	0	500	500	0.1	20	200
4	ecmwf	1	500	10000	1	20	150
5	gme	0	500	10000	1	20	150
6	gme	1	500	500	0.1	20	150
7	gme	0	500	500	1	1	200
8	gme	1	500	500	1	1	150
9	avn	0	1000	500	1	20	150
10	avn	1	150	500	1	20	150
11	avn	0	500	500	10	20	150
12	avn	1	500	500	10	20	150
13	ukmo	0	500	500	1	60	150
14	ukmo	1	500	500	1	60	150
15	ukmo	0	500	500	1	20	50
16	ukmo	1	500	500	1	20	50

Figure 1: Scheme describing the new COSMO–SREPS set–up.

The initial and boundary conditions are provided to the ensemble members by the 4 COSMO members of the SREPS system of AEMET (Garcia-Moya et al., 2009), which are 4 runs of COSMO at 25 km horizontal resolution, nested on 4 different global models (IFS, GME, GFS, UM). Then, 16 different set-ups of the physics parameters are applied to the 16 members, irrespective of their driving model. It has to be emphasised that the new suite is no longer symmetric with respect to the perturbations. Hence, for example, the 4 members driven by IFS are now different from the 4 members driven by GME as well as in the physics set-up, while before the same set of 4 physics perturbations was applied to each group of members with the same driving model.

A preliminary analysis of the performance of the new suite over summer 2009 (JJA) is presented in the next section.

3 Preliminary results

An evaluation of the spread/skill relationship of the ensemble in terms of 2m temperature is shown in Fig. 2. The rms error is represented against the rms spread as average values for each class. The classes of spread have been selected in order to be homogenous in terms of class population. The computation is made over the whole domain, for the verification of forecasts at 00 UTC (left panel) and at 12 UTC (right panel).

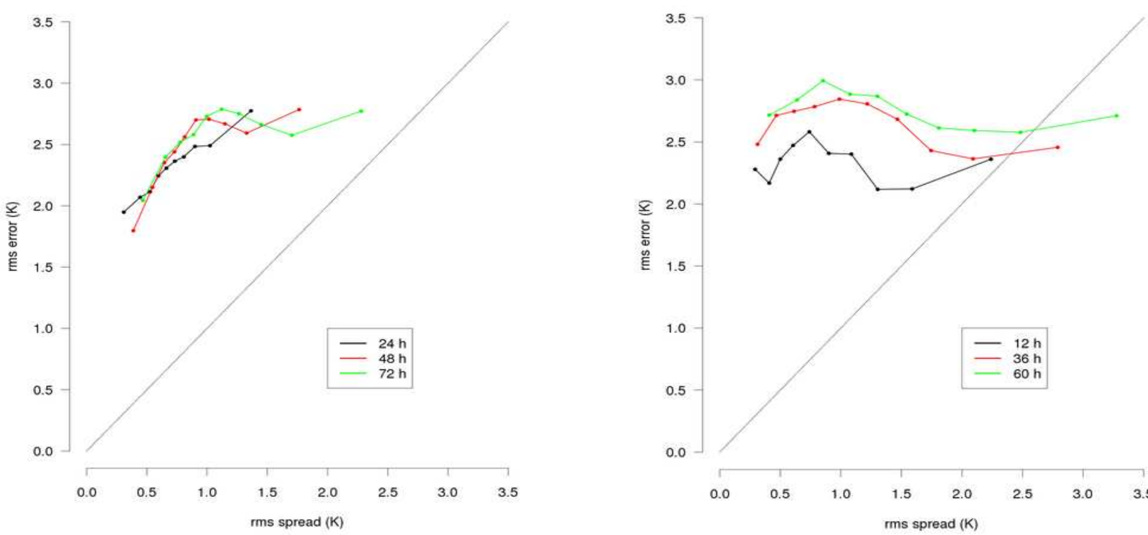

Figure 2: Spread/error relationship of COSMO-SREPS in terms of 2m temperature for the verification of forecasts at 00 UTC (left panel) and at 12 UTC (right panel). The black line is for the first forecast range, the red line for the second and the green line for the third.

While at 00 UTC there is a good relationship between spread and error, though with a strong underdispersion, at 12 UTC the spread does not provide valuable information about the forecast error. This can be due to the dependence of the model bias on the time of the day. As discussed in previous analyses (Marsigli, 2009), it is believed that the bias of the COSMO model in 2m temperature affects this result, by inflating the error to an amount which cannot be represented by the spread.

In order to ensure that the model perturbations applied in the new COSMO-SREPS suite are not producing a general worsening of the forecasts, an evaluation of the performance of the forecasts issued by the 16 members was also carried out. Up to now, this has been done in terms of 2m temperature only over the Alpine area and in term of the continuous parameters (T, U and Td) over Greece. Precipitation has not yet been considered mainly due to the fact that, during the summer season, precipitation over the two areas was not strong enough, but it will be considered for the next season.

In Fig. 3, the BIAS and Mean Absolute Error of the 16 forecasts in terms of 2m temperature are shown, as a function of the forecast range. The scores are computed for the summer season (JJA 2009), over the alpine domain, using data from the SYNOP stations. The same analysis has also been done over Greece, using data from SYNOP stations as well (not shown). The 16 lines are plotted with the same grey colour, except for the lines representing the score of the members where the tur_len parameter is perturbed.

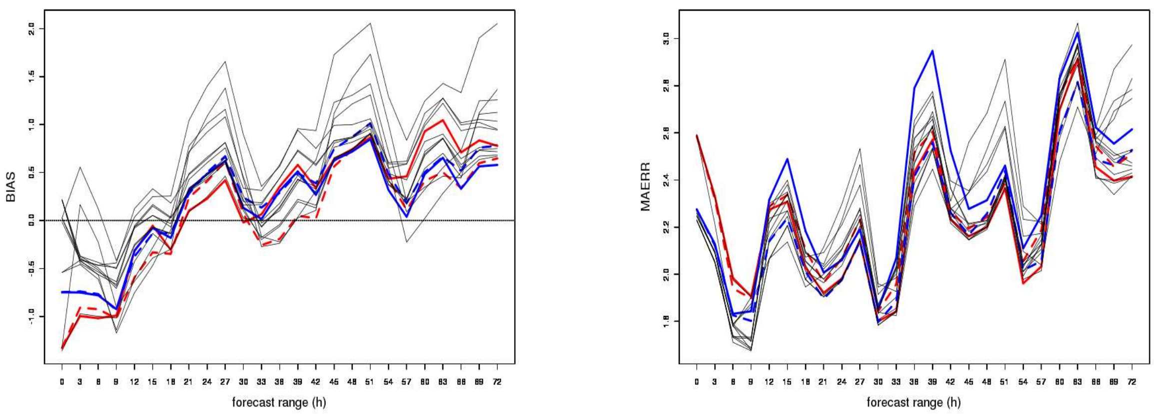

Figure 3: BIAS and Mean Absolute Error of the 16 forecasts in terms of 2m temperature over the alpine area, as a function of the forecast range. The coloured lines represent the score of the members where the tur_len parameter is perturbed.

The effect of these perturbations is generally reasonable, but the run driven by NCEP with the small tur_len value shows high MAE values during daytime. This feature, which also appears in the verification carried out over Greece, will be monitored in the future, in an attempt to establish if it is statistically persistent over a longer period.

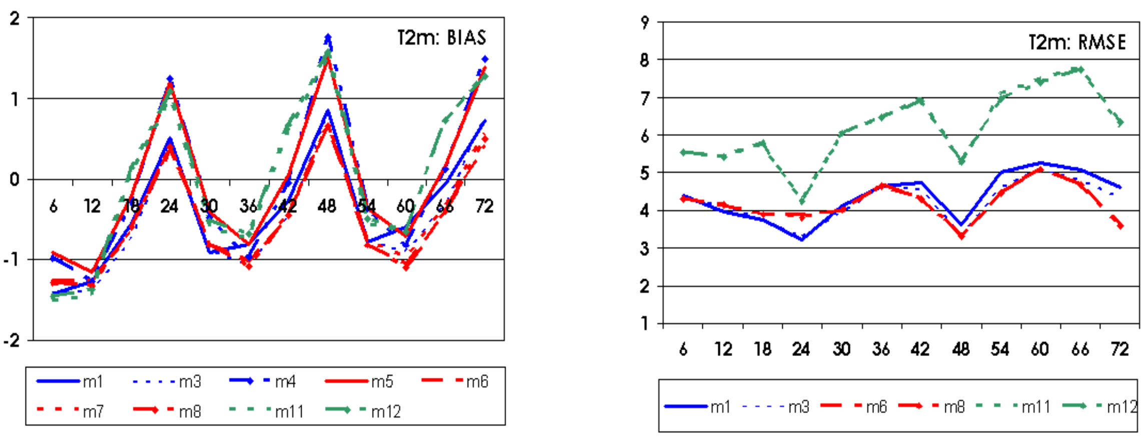

Figure 4: BIAS and Root Mean Square Error of the 16 forecasts in terms of 2m temperature over Greece, as a function of the forecast range. The green lines are for the members where rlam_heat is increased to 10.

Another parameter which deserves attention in the future is rlam_heat. In Fig. 4, the BIAS and RMSE values for some members of COSMO-SREPS are plotted, for the 2m temperature forecasts verified over Greece. The most striking feature is that the members represented by the green lines (m11 and m12) show a large value of RMSE. These two members are those where the rlam_heat parameter was increased to the value of 10. This feature was not evident in the verification carried out over the alpine area (not shown). Hence, this parameter will also be monitored in the future, in order to determine wether this perturbation should be retained or rejected.

4 Summary and Outlook

A preliminary analysis of the new configuration of the COSMO–SREPS ensemble system has been carried out. Before drawing any conclusions on the impact of the new parameters, it is necessary to complete the analysis. The spread/error relationship will also be computed for other meteorological variables (temperature at 850 hPa, mean sea level pressure, precipitation). Furthermore, the bias and error of the different ensemble members will be calculated for another season, focussing on precipitation. Up to now some parameters have been identified as important to be monitored. Finally, new parameters are already under testing in the experimental CSPERT suite, including parameters of the microphysical scheme. Since it is believed that perturbing the physics parameters alone it is not sufficient to have a proper representation of the model error, the perturbation of some soil fields will also be included, starting from soil moisture. This work is being carried out at HNMS.

References

[1] Garcia-Moya, J.A., A. Callado, C. Santos, D. Santos-Munoz and J. Simarro, 2009: Predictability of Short-range Forecasting: A Muli-Model Approach. *Nota Tcnica 1 del Servicio de Predicibilidad y Predicciones Extendidas* (NT SPPE-1), pp. **30**.

[2] Marsigli, C., A. Montani and T. Paccagnella, 2009: COSMO Priority Project "Short Range Ensemble Prediction System" (SREPS): Final Report. *COSMO Technical Report No. 13*, pp.**33**.