

SPECIAL PROJECT PROGRESS REPORT

All the following mandatory information needs to be provided. The length should *reflect the complexity and duration* of the project.

Reporting year 2021

Project Title: Improving the Convection-permitting ensemble configuration over Italy

Computer Project Account: spitconv

Principal Investigator(s): Chiara Marsigli

Affiliation: Arpae

Name of ECMWF scientist(s) collaborating to the project (if applicable)

...

Start date of the project: June 2021

Expected end date: December 2023

Computer resources allocated/used for the current year and the previous one (if applicable)
Please answer for all project resources

		Previous year		Current year	
		Allocated	Used	Allocated	Used
High Performance Computing Facility	(units)	9,600,000	6,941,164.90	9,600,000	4,823,784
Data storage capacity	(Gbytes)	1000	1000	1000	500

Summary of project objectives (10 lines max)

The aim of the project in the first year was to prove a possible beneficial effect of introducing model perturbations to the COSMO-2I-EPS ensemble run by Arpae on the CINECA HPC, and to show the benefit of using BCs from IFS ENS.

Two simple perturbation strategies have been selected: the Perturbed Parameters (PP, Marsigli et al., 2009 and 2013), also operational in COSMO-LEPS, and the Stochastic Perturbation of Physical Tendencies (SPPT, Buizza et al., 1999), developed at ECMWF and currently operational in the COSMO model at MeteoSwiss.

Summary of problems encountered (10 lines max)

The runs with a combination of PP and SPPT lead often to model failures, therefore it was needed to restart several times the sms suite performing the runs. At the end of the year, on the 24th of December, all the jobs were stopped on the machine, therefore the sms suite was also stopped and it was not possible to complete the runs scheduled for the period (due to holiday).

Summary of plans for the continuation of the project (10 lines max)

The model perturbations will be introduced in the operational suite. The direct nesting into IFS ENS members did not cause any problem, no further tests will be conducted with COSMO. The migration from COSMO to ICON at Arpae is proceeding faster than expected, therefore no further tests with COSMO-based ensemble will be performed. In the second year, first tests with the new model (ICON) will be performed, by testing the ensemble configuration and the impact of model perturbation in ICON at high-resolution.

List of publications/reports from the project with complete references

No publications are issued at the moment, a Master Thesis is in preparation, based on the results obtained thanks to this project.

Summary of results

If submitted **during the first project year**, please summarise the results achieved during the period from the project start to June of the current year. A few paragraphs might be sufficient. If submitted **during the second project year**, this summary should be more detailed and cover the period from the project start. The length, at most 8 pages, should reflect the complexity of the project. Alternatively, it could be replaced by a short summary plus an existing scientific report on the project attached to this document. If submitted **during the third project year**, please summarise the results achieved during the period from July of the previous year to June of the current year. A few paragraphs might be sufficient.

Four configurations of an ensemble similar to COSMO-2I-EPS (but without data assimilation) were run for two selected periods, in order to test the model perturbation methodology:

- control run (no perturbations)
- PP, with parameter perturbation
- SPPT, with SPPT
- PP+SPPT, with a combination of parameter perturbation and SPPT

The ensembles have 10 members, IC and BC from the first 10 IFS members, and the forecast range is 24 hours.

The two selected periods were 1-31 July 2021 and 1-15 November 2021.

All the outputs are stored at `ec:/mce/cosmo_2i_eps/suEPS`, in the directories noPP, PP, SPPT and PP-SPPT.

Verification has been performed for some meteorological variables.

For July 2021, for precipitation accumulated over 3h, a set of standard probabilistic scores have been computed (Brier Skill Score, ROC area, reliability diagram). Results show that model perturbations generally improve the ensemble scores. PP only tends to improve both BSS and ROC but only slightly, while SPPT only shows a more marked improvement in terms of ROC area.

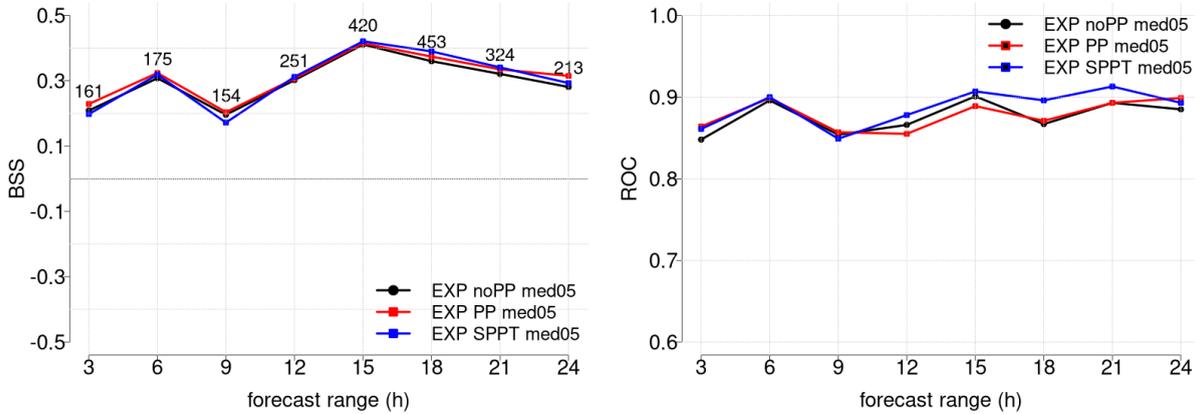


Figure 1. Example of scores relative to accumulated precipitation over 3 hours, against data from rain gauges. Verification is performed in terms of average values over boxes of 0.5 x 0.5 deg, for the 1mm threshold. Brier Skill Score (BSS) to the left and Area under the ROC Curve (ROC) to the right.

In terms of 2m temperature and dew-point temperature, and of 10m wind, the spread/skill relation of the ensembles have been computed, comparing the standard deviation of the ensemble with the rmse of the ensemble mean. With the PP perturbation, a small but consistent increase of spread is observed, with a slight reduction of the rmse. Applying SPPT only, the spread is greatly increased, but it is observed also a small increase of the rms error of the 2mT.

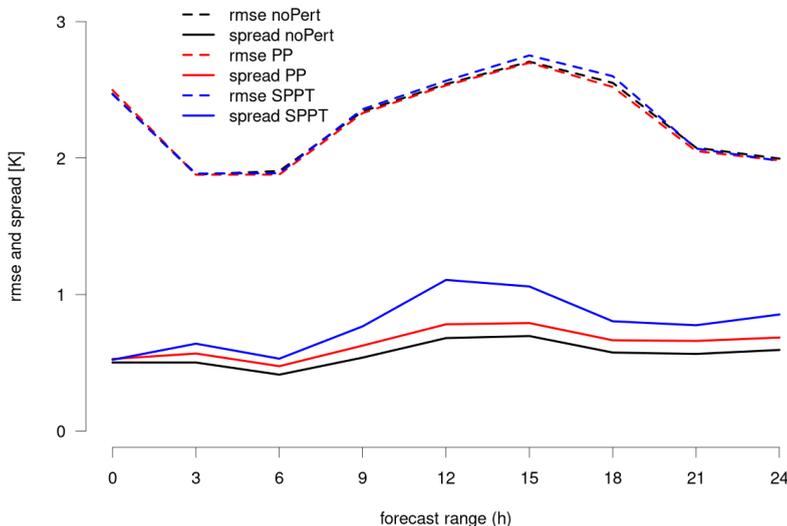


Figure 2. Example of spread-skill relation for 2m temperature.

The scores for the November period do not show a significantly different behaviour, the impact of model perturbations being less than in July.

We do not observe any problem in the first hours of the runs due to the direct nesting of the 2.2 km COSMO into the IFS ENS members.

