SPECIAL PROJECT PROGRESS REPORT

Progress Reports should be 2 to 10 pages in length, depending on importance of the project. All the following mandatory information needs to be provided.

Reporting year	2016-2017
Project Title:	Boundary layer model errors in the AROME ensemble prediction system
Computer Project Account:	spfrbout
Principal Investigator(s):	Francois Bouttier
Affiliation:	CNRM, Meteo-France
Name of ECMWF scientist(s) collaborating to the project (if applicable)	n/a
Start date of the project:	January 2015
Expected end date:	December 2017

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)	7 MSBU	6.1 MSBU	7 MSBU	3.6 in June
Data storage capacity	(Gbytes)	5	4	5	4

Summary of project objectives

(10 lines max)

The objective is to research new parametrisations for the representation of low-level model error in ensemble prediction. The main intention is to test several strategies for stochastically perturbing parameters in the Bougeault-Lacarrere TKE-based vertical mixing scheme.

Summary of problems encountered (if any)

(20 lines max)

n/a

Summary of results of the current year (from July of previous year to June of current year)

This section should comprise 1 to 8 pages and can be replaced by a short summary plus an existing scientific report on the project

Most of the work has been performed by the Hungarian Met Service (Mihaly Szucs in particular), as registered to this project.

Tests started during the previous year have been continued in order to consolidate the results. It was found that the current SPPT scheme (using Météo-France operational settings) was activating the clipping of tendencies at many points, suggesting that SPPT had too much spread. A reduction of SPPT tendency spread by a factor 5 was tested, which reduced ensemble spread at the expense of a degradation of the spread/skill relationship. It has been concluded that SPPT with the MF settings is rather unrealistic in terms of physical tendencies, but its benefits (in terms of improving the reliability of spread) outweigh this problem in the current system.

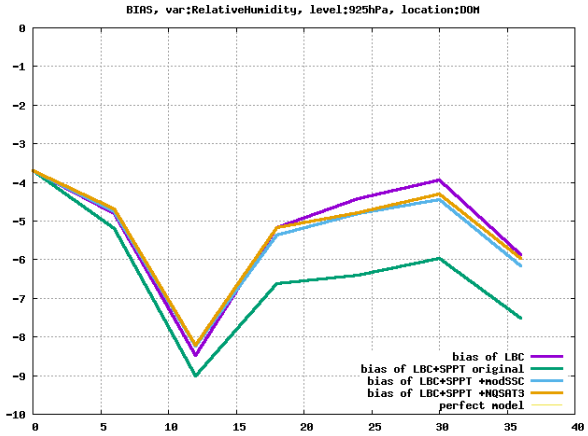
Some possible improvements to SPPT have been designed and tested by M. Szucs, notably a 'multivariate elliptical' system by which a fraction of the SPPT perturbations is allowed to be different between the perturbed tendencies (U,V,T,q). In the ECMWF and operational MF setting, all these variables use the same perturbations. The multivariate elliptical system is found to improve the ensemble spread/skill relationship in the boundary layer, at the expense of creating biases at upper levels. Nevertheless this is regarded as a promising option.

Operational experience with the default SPPT settings at MF have revealed that SPPT can sometimes crash the model in severely convective situations. This is linked to instabilities in the planetary boundary layer (although SPPT is not directly acting at the lowest model levels). As a quick fix, the reductions to the SPPT perturbation amplitude have been successfully tested, and then activated in the operational system.

A prominent weakness of SPPT in Arome is that it tends to reduce tropospheric humidity, which causes dry biases with respect to observed screen-level humidity and precipitation. (This problem has been reported in other systems such as IFS-ENS). Changes to the treatment of humidity in SPPT have been tested in the hope of alleviating this problem. The NQSAT_SDT supersaturation check option was originally developed at ECMWF, but not used in Arome for two reasons: (1) there already is a built-in supersaturation check in the Arome physics, which is believed to already play this role, and (2) the NQSAT_SDT code is designed for the IFS treatment of saturation, which is slightly different from Arome. Nevertheless, tests of several supersaturation treatments for Arome involving the NQSAT_SDT code have shown a successful reduction of the dry SPPT bias (available experiments are too short to conclude on the impact on the overall probabilistic performance of the modified ensemble). Clearly, this is not a long-term solution because it is slightly inconsistent with rest of the Arome model setup, but the results show that there is some potential to reduce the dry SPPT bias by a more careful treatment of humidity.

Example result : (average over 10 runs) the green curve is the setup with the original SPPT, and it has the largest dry bias.

This work is continuing.



List of publications/reports from the project with complete references

not available in this particular year.

Summary of plans for the continuation of the project

(10 lines max)

The potential of the elliptic SPPT scheme will be further investigated by focusing more on the PBL response. It will be complemented by stochastic perturbations to parameters of the turbulence scheme, and specific perturbations of the low-level humidity field.