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 2017…………………………………………………..……

Project Title: Multiphysics and stochastic perturbations for high-resolution LAMEPS……………………………..……

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Computer Project Account: SPBETERM……………………………………..……

Principal Investigator(s): Piet Termonia……………………………………..……

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Affiliation: Royal Meteorological Institute, Belgium…………..……

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

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Start date of the project: 1/1/2015…………………………………………..……

Expected end date: 31/12/2017…………………………………..……

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)	130000	9765	130000	3882 (28/06/2017)
Data storage capacity	(Gbytes)	800	8.9	800	8.9 (28/06/2017)

Summary of project objectives
(10 lines max)

This project aims to study the sensitivities of convection-permitting (EPS) systems to various aspects:

- use of different physics configurations (e.g. in turbulence, deep convection, microphysics)
- stochastic perturbations (e.g. SPPT)
- influence of surface error/uncertainty (e.g. on triggering of deep convection)
- influence of initial and lateral boundary conditions

As in the predecessor project SPFRCOUP, the intention of this project is to allow scientists from selected (Cooperating and Non-Member) States access to resources on the HPCF to (1) develop and maintain a unified software environment for experimentation and preparing boundary conditions, and (2) perform boundary condition file preparation at ECMWF before sending it to their own sites for running the LAM(EPS)s.

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Summary of problems encountered (if any)
(20 lines max)

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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

RMI-Belgium activities

We continued to investigate forecast results of the RMI-EPS system, which consists of 10+1 ALARO members and 10+1 AROME members, both at 2.5km horizontal resolution (with SURFEX), using the ECMWF-EPS for initial perturbations (IC) and lateral boundary conditions (LBC). This is meant to be a prototype convection-permitting EPS system for Belgium. Hereafter, we refer to the ECMWF-EPS system as ECEPS.

Last year, a preliminary statistical verification over 15 forecasts around several thunderstorm episodes in August 2015 was done, with encouraging results. For convenience of the reader, we summarise the results here again. Figure 1 shows RMSE and ensemble spread for 6h accumulated precipitation, with scores being averages over 10 standard WMO weather stations spread over the whole of Belgium. The RMSE of RMI-EPS is comparable with those of GLAMEPS and ECEPS, while the ensemble spread is clearly larger and closer to the RMSE.
For 2-meter temperature, results are shown in figure 2. Here, the RMSE is somewhat smaller than GLAMEPS and ECEPS in the first 24h, and somewhat larger thereafter. The ensemble spread on the other hand is clearly worse than GLAMEPS, but still much better than ECEPS. The larger and better ensemble spread for 2-meter temperature in GLAMEPS is likely due to the addition of more perturbations in the surface, which is something that can still be improved greatly in the current (prototype) version of RMI-EPS.

This year we analysed the results for a 3 week period in winter (19 February 2016 until 11 March 2016). It confirmed the good results for precipitation, as shown in figure 3. The RMSE of RMI-EPS is similar to that of GLAMEPS and ECEPS, and comes with an improved ensemble spread. It is clearly larger and closer to the RMSE than the ensemble spread of ECEPS, and similar or slightly better than the ensemble spread of GLAMEPS. The good results are likely due to the multi-model approach, with ALARO and AROME being good complements to each other (with one still having an explicit parameterization for convection, and the other assuming it will get resolved by the dynamics).

For 2-meter temperature in winter, results are not so good, as shown in figure 4. Here we see that RMI-EPS has clearly the worst RMSE, and as in the summer the ensemble spread is also clearly less good than GLAMEPS, and only slightly better than ECEPS. As mentioned before, the ensemble spread can likely be improved by introducing more surface perturbations. This will be investigated in the near future. The high RMSE on the other hand, seems to be in large part due to a bias in winter that was not present in summer, see figures 5 and 6. We discovered later that there were some problems with the sea temperature in the IC's due to a bug, which is now corrected. Probably this caused a large part of the bias, but it still remains to be seen whether it solves the bias problem completely. Possibly there are also some issues with the continuous cycling used in the surface data assimilation, or with the interaction between the SURFEX surface scheme and the ALARO and AROME physics. This will be investigated further.

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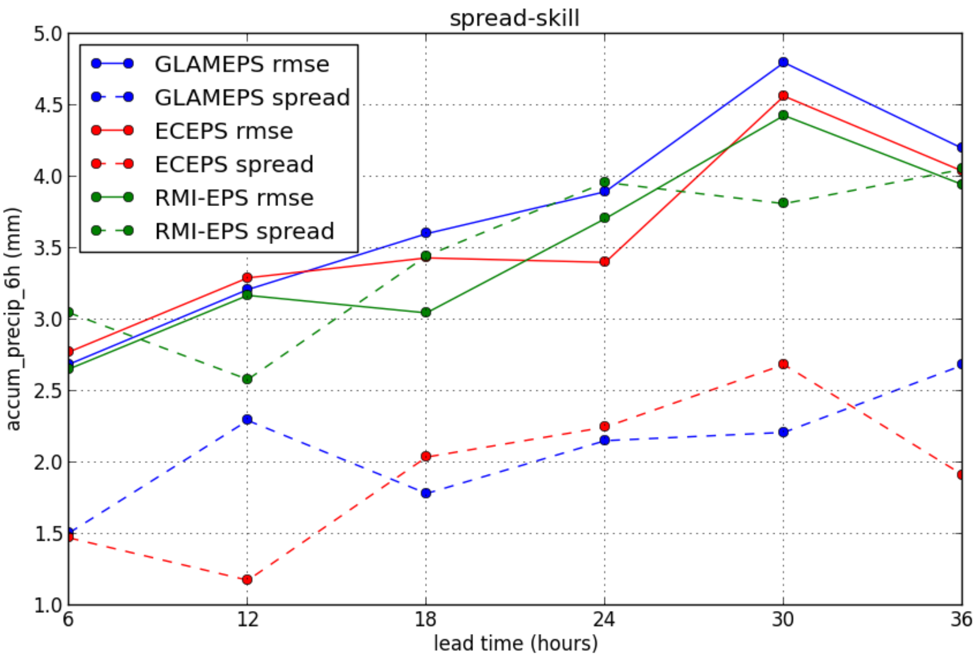

Figure1: RMSE and spread for 6h accumulated precipitation: thunderstorm cases of August 2015 (averages over 10 standard stations in Belgium). Comparison of RMI-EPS with GLAMEPS and ECEPS.

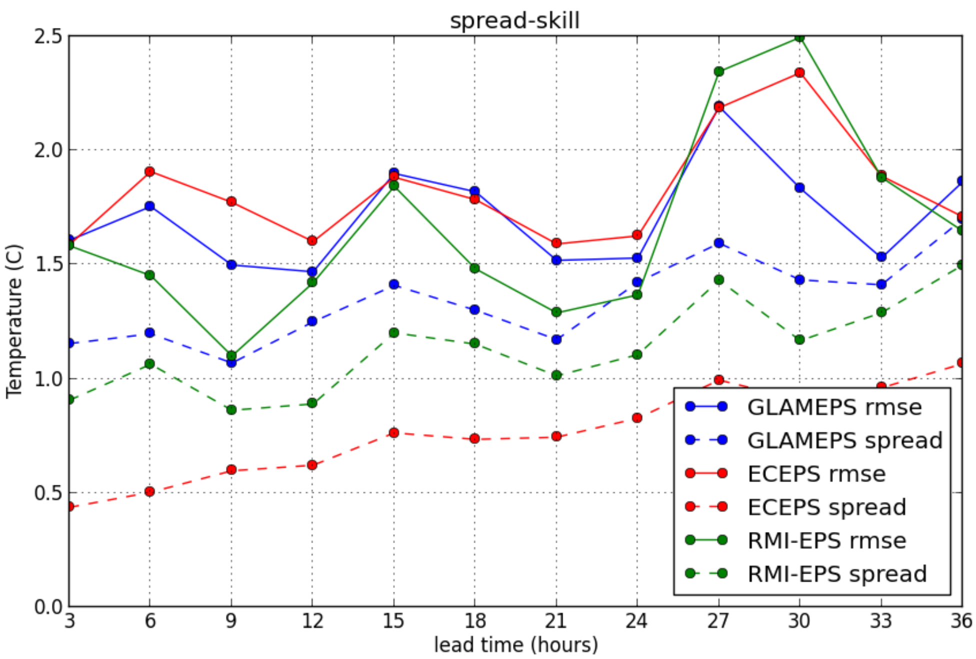

Figure 2: RMSE and spread for 2-meter temperature: thunderstorm cases of August 2015 (averages over 10 standard stations in Belgium). Comparison of RMI-EPS with GLAMEPS and ECEPS.

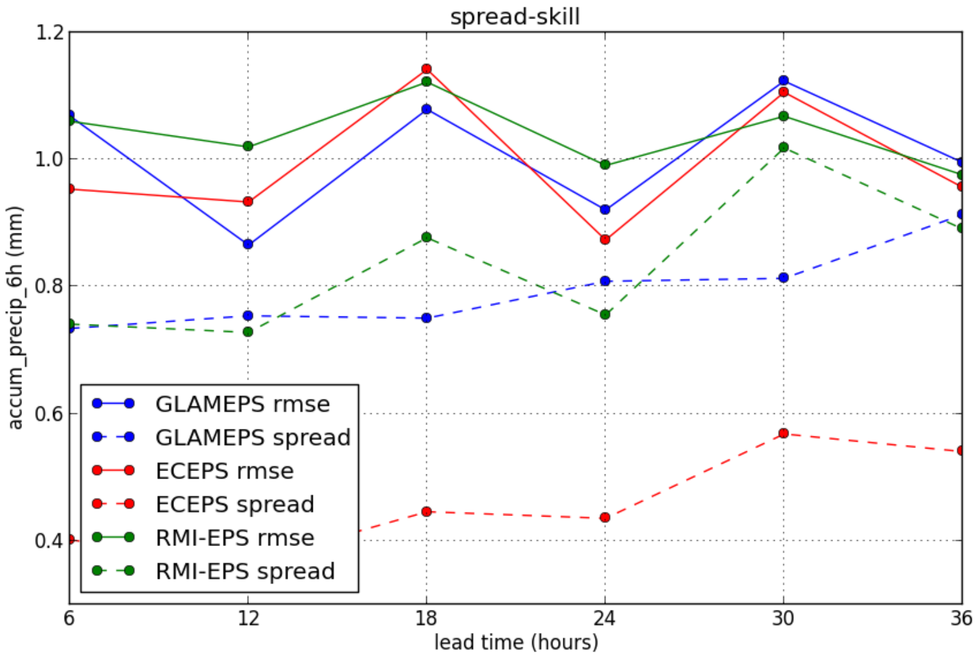

Figure 3: RMSE and spread for 6h accumulated precipitation: 3 weeks in February-March 2016 (averages over 10 standard stations in Belgium). Comparison of RMI-EPS with GLAMEPS and ECEPS.

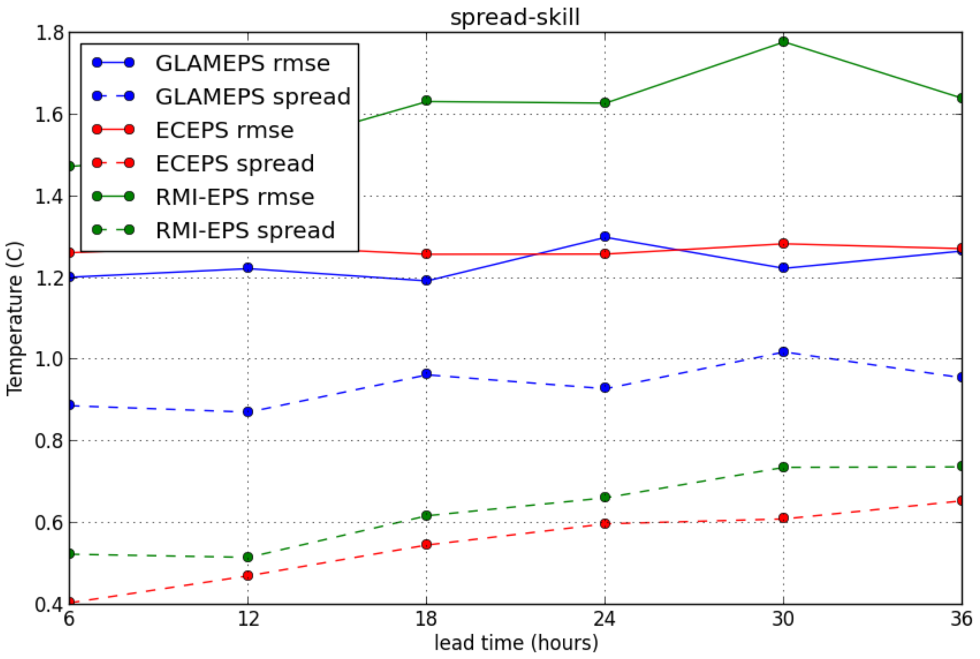

Figure 4: RMSE and spread for 2-meter temperature: 3 weeks in February-March 2016 (averages over 10 standard stations in Belgium). Comparison of RMI-EPS with GLAMEPS and ECEPS.

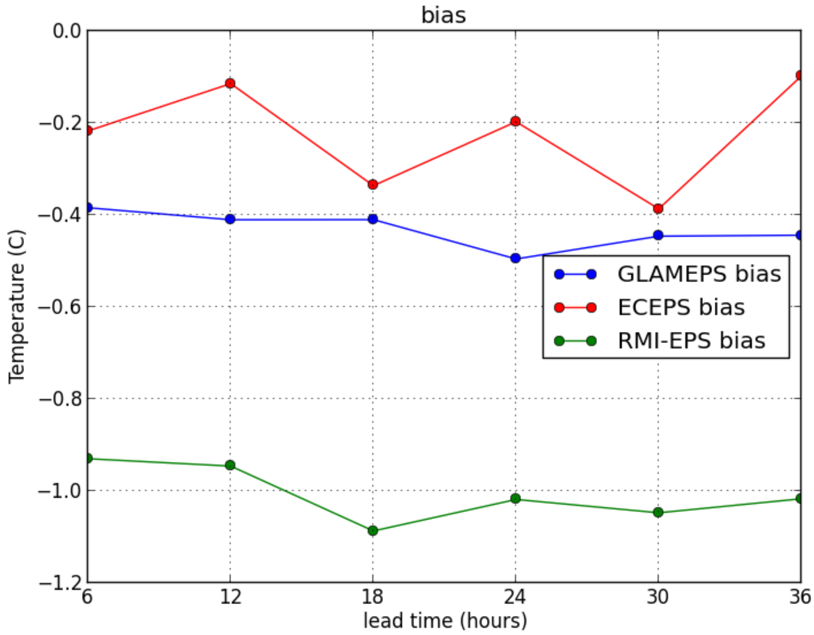

Figure 5: Bias for 2-meter temperature: 3 weeks in February-March 2016 (averages over 10 standard stations in Belgium). Comparison of RMI-EPS with GLAMEPS and ECEPS.

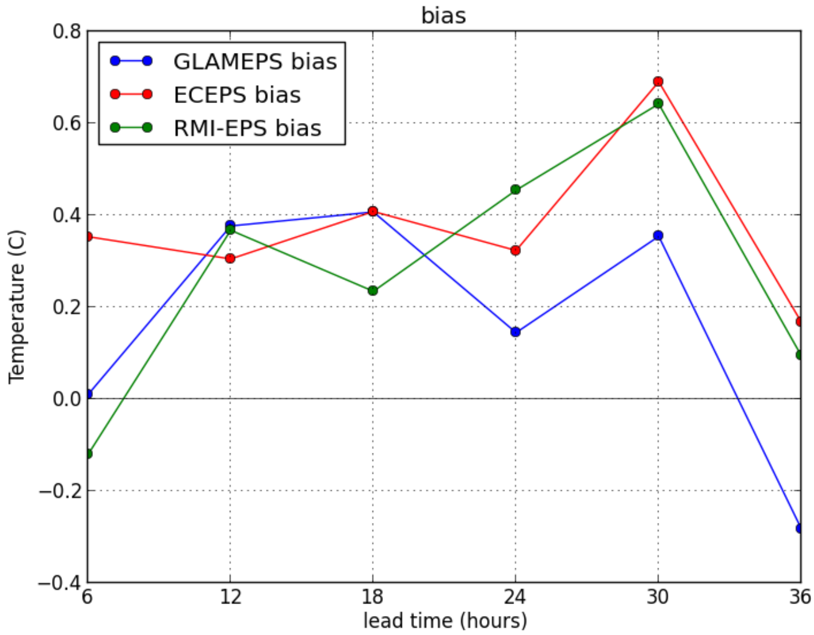

Figure 6: Bias for 2-meter temperature: thunderstorm cases of August 2015 (averages over 10 standard stations in Belgium). Comparison of RMI-EPS with GLAMEPS and ECEPS.

List of publications/reports from the project with complete references

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Summary of plans for the continuation of the project

(10 lines max)

The SBUs of this project (SPBETERM) will be used to generate boundaries for convection-permitting LAM-EPS experiments, e.g.:

- Coupling ALARO-1 to ECMWF (deterministic) and to ECMWF-EPS
- Perturbing physics in ALARO
- Surface perturbations

Several on-going thunderstorm case studies will be continued, and combined with statistical verification over longer time periods.

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