

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 2015.....

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	0 (30/06/2015)
Data storage capacity	(Gbytes)			800	26 (30/06/2015)

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

Sensitivities of convection-permitting systems will be investigated by studying several recent thunderstorm cases with various model set-ups. In particular two notable thunderstorm cases that occurred over Belgium, namely the Pukkelpop thunderstorm of Thursday 18 August 2011, and the Pentecost storms of 7 to 9 June 2014 will be used. The RMI-Belgium has already studied these cases with their operational LAM model, and has recently started experiments with the convection-permitting ensemble system HarmonEPS. Also the Polish IMGW (Institute of Meteorology and Water Management) has started investigating these cases with the ALARO-1 limited area model in cooperation with Belgium. Some more details about these activities are given below in the sections ‘RMI-Belgium activities’ and ‘IMGW-Poland activities’.

Since full ECMWF-EPS data is not archived in Mars, we decided to use the ECMWF-EPS dissemination (ECDISS) files that the GLAMEPS system uses operationally to create boundary files for the convection-permitting LAMEPS, since these dissemination files have been archived by the GLAMEPS system for the past two years. Some work is still required to set up the necessary scripts at ecgate and cca, for making boundary files appropriate for ALARO using the ECDISS files. Bogdan Bochenek and Malgorzata Szczech-Gajewska from IMGW will be working on this during a stay in Belgium from 29 June to 17 July, in the framework of the ALADIN program. For this reason no SBUs of the project have been used yet. They will be used in the second half of the year, once the scripts are ready, for the creation of boundaries. Depending on how many SBUs are then still left, some small experiments could then be done on SPBETERM as well. Most experiments will be done locally however, or on other SBU accounts, since extensive testing with a full-fledged convection-permitting LAM-EPS requires much more SBUs than are available in the SPBETERM project.

RMI-Belgium activities

The Pentecost storms were a series of thunderstorms and hail events during the Pentecost weekend of 2014 (Saturday 7 June until Monday 9 June), which caused several hundred million euros of damage. For our studies of convection-permitting model sensitivities, the hail event of Saturday 7 June, seems particularly interesting, as it was relatively small scale (see radar images in figure 1), and was completely missed by most of our operational runs. It was also a high profile event, as it occurred live on TV, during a football match of our national team in Brussels (Belgium – Tunisia), which had to be stopped for 40 minutes due to the heavy hail.

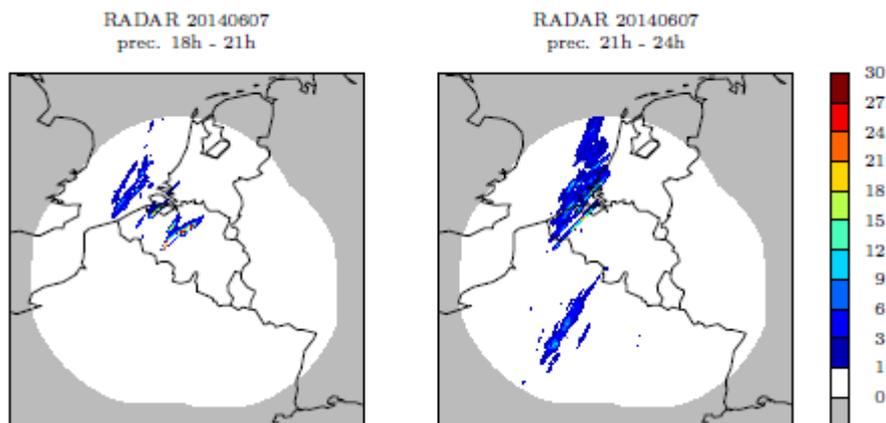


Figure 1: Radar images of 7 June 2014 between 18h and 24h UTC. On the left, a heavy hail event over Brussels.

Most of our operational models did not predict this event. In the 00h UTC run of 7 June, neither GLAMEPS, the ECMWF models (deterministic and EPS), or our operational LAM model (4km ALARO coupled to ARPEGE) showed any convective activity (see figure 2). The 12h UTC run, did predict some convective precipitation (see figure 3), but timing, position and shape differ from what was observed (respectively later, more eastwards, and more large scale). Moreover, this run was only available around 17h UTC, so only 1 to 2 hours before the event happened.

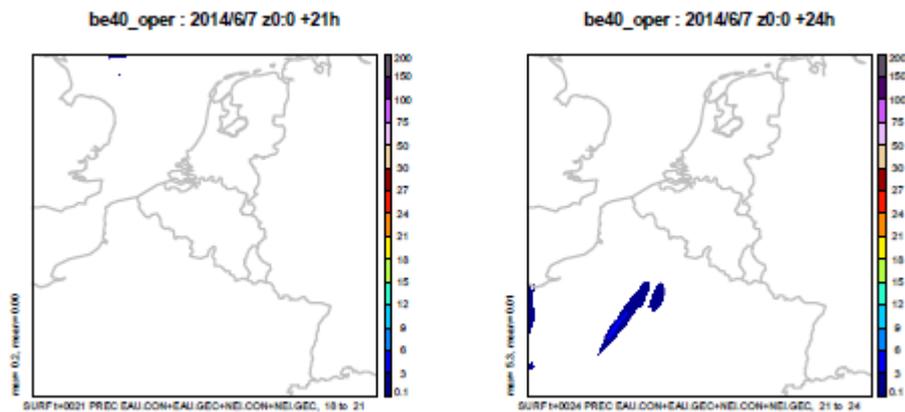


Figure 2: Operational Belgian LAM (4km ALARO coupled to ARPEGE). Forecast of 7 June 2014, 00h UTC. Accumulated 3-hourly precipitation for lead times +21h (left) and +24h (right).

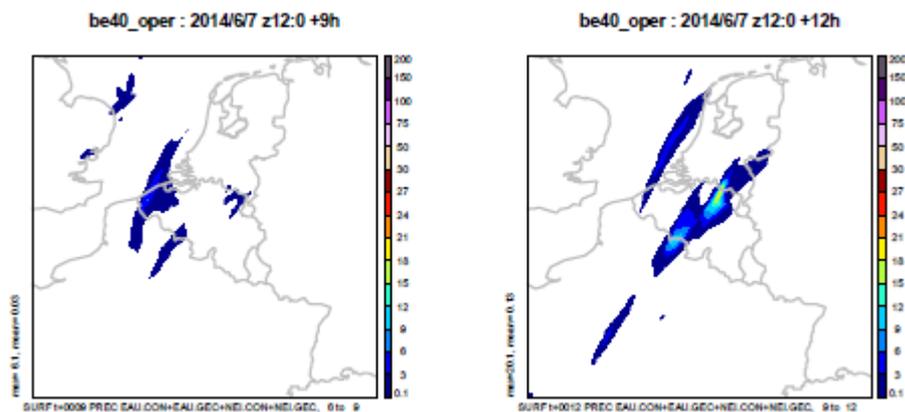


Figure 3: Operational Belgian LAM (4km ALARO coupled to ARPEGE). Forecast of 7 June 2014, 12h UTC. Accumulated 3-hourly precipitation for lead times +9h (left) and +12h (right).

The same event was studied using the convection-permitting HarmonEPS system. This allowed us to test the influence of the physics (ALARO and AROME), coupling (ECMWF vs ARPEGE), data assimilation (upper-air 3DVar) and domain size. Experiments consisted of coupling one AROME member and one ALARO member (both with horizontal resolution of 2.5km) to the deterministic ECMWF model. Coupling to ECMWF-EPS and multiple ALARO/AROME members will be investigated in the future. Tests were done on ecgate/cca but using a different SBU account (bedb). The results can be summarized as follows:

- The hail event of Saturday evening (June 07, between 18h and 21h UTC), occurring over Brussels also does not show up in the HarmonEPS experiments of 2014060612 and 2014060700, neither in the ALARO or

the AROME member (see figure 4). Hence, coupling to ECMWF does not improve the prediction in this case.

- It seems 3DVAR has little influence on the forecasts of the thunderstorms, particularly precipitation does not change much when running without upper-air data assimilation.
- The location of the precipitation is better in the run over the larger domain (NETHERLANDS) compared to the smaller standard domain (HarmEPS_1). In all runs, there seems to be only one system arriving in Belgium around 9 June 00 UTC, instead of the two systems on the radar image (one near the coast, and one going over Wallonia). The runs only seem to have one system, corresponding with the Wallonia system, but the location (Wallonia) is only more or less correct for the run over the larger domain.
- First impression is that ALARO generally gives too little precipitation in convective situations, while on the other hand AROME can sometimes be too active. However, a more detailed study still has to be done, and some careful tuning of the Harmonie members is probably advisable.

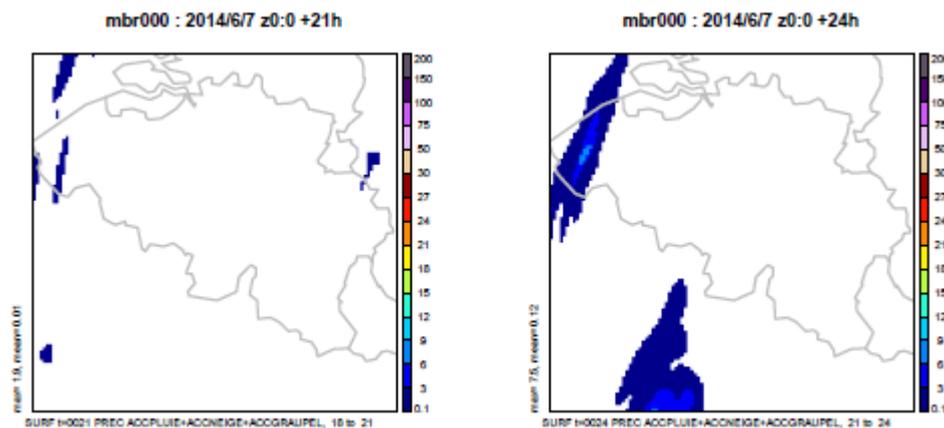


Figure 4: AROME member of HarmonEPS (coupled to deterministic ECMWF). Forecast of 7 June 2014, run of 00h UTC. Accumulated 3-hourly precipitation for lead time +21h (left) and +24h (right).

IMGW-Poland activities

Recently we started running ALARO-1 operationally. This new version of ALARO contains major developments in turbulence, radiation and deep convection, making it better adapted for running at high resolutions down to 1km. Since the results in the previous section all apply to the older ALARO-0 version, we restudied the Pentecost storm with ALARO-1. The first experiments were done by running over the HarmonEPS domain (with 65 vertical levels, and 2.5km horizontal resolution as in the HarmonEPS runs done by Belgium), coupling with ARPEGE (as is done operationally). Additionally, an ensemble was created with the SLAF (Scaled Lagged Average Forecast) method. Consistent with Belgian results, the 00h UTC runs of 7 June 2014 showed very little precipitation over Belgium, but convective activity was seen in the 12h UTC runs (see figure 5). Interestingly, a few SLAF members predicted more than 30mm of precipitation, much more than the ALARO-0 (be40_oper) runs, and closer to what was observed (see figure 6). The predicted structure of the precipitation field is however much broader than observed.

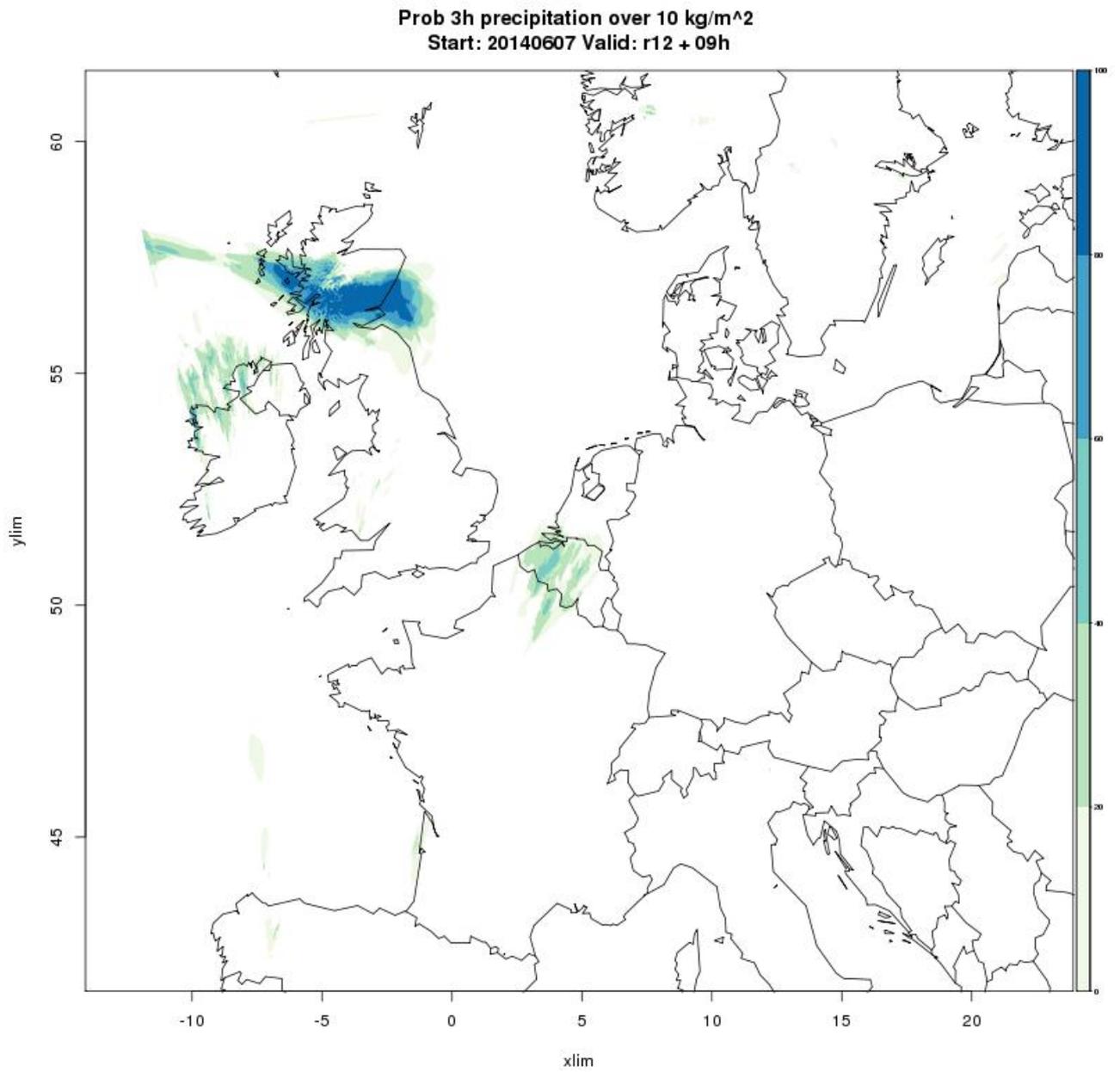


Figure 5: ALARO-1 coupled to ARPEGE (with SLAF). Probability of 3-hourly accumulated precipitation over 10 mm. Forecast of 7 June 2014, 12h UTC run, lead time +9h.

2014060718 - 2014060721 UTC
3h precipitation

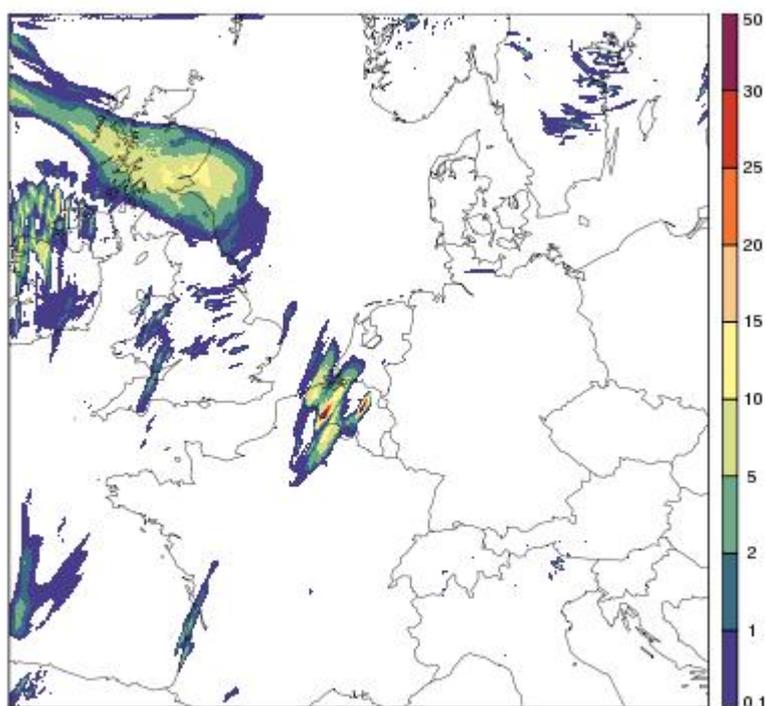


Figure 6: SLAF member of ALARO-1 coupled to ARPEGE. Accumulated 3-hourly precipitation. Forecast of 7 June 2014, 12h UTC, lead time +9h.

Next, we plan to test coupling to ECMWF (deterministic + SLAF) and to ECMWF-EPS. Scripts to generate ECMWF-EPS boundaries will be set up at ecgate/cca in the second half of the year.

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)

In the next 6 months, the necessary scripts will be written to generate boundaries at cca, using the ECDISS files of GLAMEPS. The SBUs of this project (SPBETERM) will then be used to generate boundaries for LAM-EPS experiments:

- Coupling ALARO-1 to ECMWF (deterministic with SLAF) and to ECMWF-EPS
- HarmonEPS experiments with archived ECMWF-EPS boundaries
- Perturbing physics in ALARO

Several thunderstorm case studies will be studied, possibly combined with statistical verification over longer time periods.

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