Contributions to the GLAMEPS Project at the Royal Meteorological Institute of Belgium (RMIB)

Introduction

GLAMEPS (Grand Limited Area Model Ensemble Prediction System) is a pre-operational ensemble prediction system for short-range probabilistic forecasts. It is being developed in close collaboration between members of the ALADIN and HIRLAM consortia as a European scale, multi-model EPS at a resolution of about 13 km and with a lead time of 42 hours. At the RMIB the ALADIN group participates actively in the development of the ALADIN EPS (AladEPS) component of GLAMEPS.

In section two we briefly describe how GLAMEPS is currently set up, and in section three we focus on the development of the AladEPS component at the RMIB. Examples of some pre-operational GLAMEPS products are presented in section four. We conclude with a few remarks and, including prospects for future development. A detailed description and evaluation of GLAMEPS can be found in Iversen et al. (2011) (see Reference).

A Brief Description of GLAMEPS

The major objective of GLAMEPS is to build a well-calibrated ensemble for short-range numerical weather prediction across Europe by accounting for both the best set of initial conditions and for model uncertainties. To achieve this four different numerical models are combined.

The first is an ensemble of global forecasts (a control run and 12 perturbed runs). In the experimental runs studied extensively in Iversen et al. (2011), this is EuroTEPS, a version of ECMWF-EPS supplemented with singular vectors targeted specifically at Europe (developed by met.no).

These 12+1 global runs are then used as initial and 3-hourly lateral boundary conditions for three Limited Area Models (LAMs): ALADIN, HIRLAM_S and HIRLAM_K. The latter two are versions of the HIRLAM model with different cloud physics parameterization schemes. Figure 1 shows the domains on which these LAMs are run. They are not identical, because ALADIN and HIRLAM use different projections.

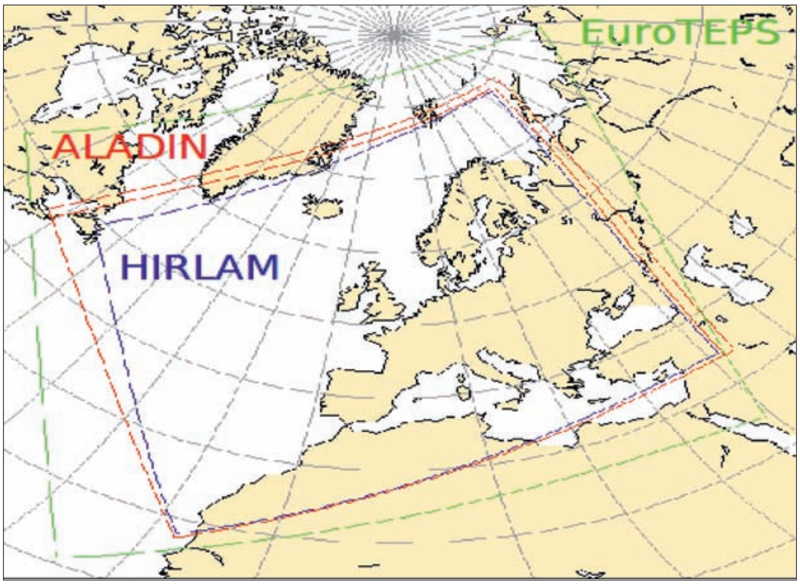

Figure 1

The GLAMEPS model domains currently used. The output of all models is interpolated onto the HIRLAM domain (in blue).

In practice the model data (including the global runs that are at a lower resolution) are all interpolated on a common grid. The horizontal grid resolution is about 13 km. A set of twelve ensemble perturbations are run twice a day (at 00h00 and 12h00 UTC) for each model. Considering perturbed and control forecasts for the four models the GLAMEPS system thus comprises 52 members.

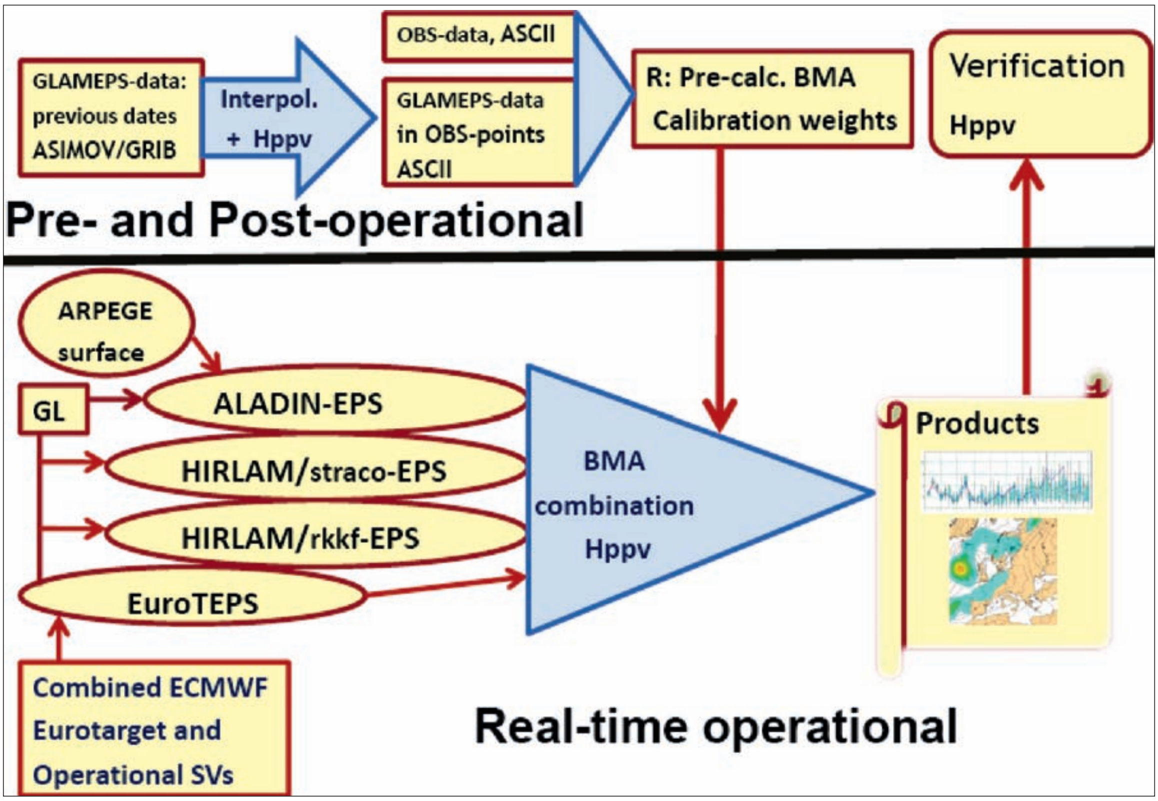

Figure 2

A flow chart of GLAMEPS (courtesy Kai Sattler, DMI)
The four models used in GLAMEPS are represented by the red ellipses. The blue triangle represents the combination of all outputs (possibly with a Bayesian Model Average (BMA)) from which graphical products are issued.

A flow chart of the GLAMEPS setup is given in Figure 2. It also includes some additional components that are not discussed explicitly in this article, such as the interpolation tool GL (developed by the HIRLAM community) and the Hppv package (developed at the Spanish meteorological service) used for processing data and forecasts and for producing graphics of probabilistic forecasts.

In the GLAMEPS experiments it was shown that the EuroTEPS targeted EPS improved the spread of the ensemble over Europe. However, these experiments were run before recent improvements in the ECMWF-EPS, such as the introduction of Ensemble Data Assimilation (EDA). An upgraded EuroTEPS is being tested. Presently, the two daily runs of GLAMEPS are coupled to members of the operational ECMWF-EPS. We are still evaluating further the use of EuroTEPS using EPS.

Some Particular Issues with ALADIN

Currently, the ALADIN component is run as a downscaling of the global runs; it does not include data assimilation. However some surface fields (in particular soil moisture) issued from EuroTEPS or ECMWF-EPS are unsuitable for ALADIN because the ECMWF H-Tessel surface parametrization scheme is not fully compatible with the ISBA scheme used by ALADIN (ISBA: Interaction Soil-Biosphere-Atmosphere). So the surface fields for ALADIN are presently taken from the global analysis of the Arpège model run by Météo-France.

We are currently experimenting with replacing this Arpège surface analysis by a surface assimilation run within the GLAMEPS suite. This will also offer the possibility of perturbing the surface fields thus increasing the spread of the AladEPS.

Other ongoing work at RMIB includes new routines for production of graphical products, GRIB data and verification tools. In the future we also hope to investigate running a limited number of extra ALADIN members coupled not to ECMWF-EPS but to the Météo France global ensemble system PEARP.

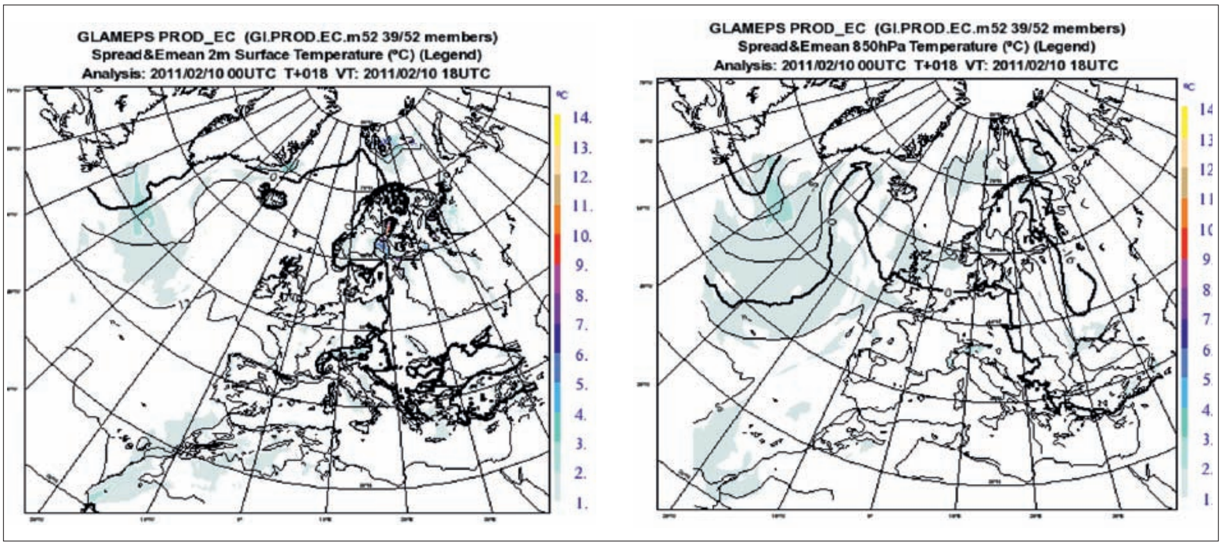

Figure 3

GLAMEPS Mean (continuous black curves) and standard deviation fields (coloured areas described by the legend on the right-hand side of the graphs); the upper chart displays a 2m Temperature forecast over Europe at +18 hours lead time for the run of the 10th of February 2011 at 00h00 UTC and the lower chart displays the T850 forecast for the same date and the same area and lead time.

Examples and Comments on Pre-Operational GLAMEPS Results

GLAMEPS products are issued twice a day to show the dispersion of forecasts every 3 hours up to 42 hours.

Mean and standard deviation fields are displayed for a few parameters: MSLP, 2m T (also TMAX and TMIN at 2m) and upper-air fields T850 and Z500. An example of two of these fields is presented in Figure 3.

Probability charts for several parameters and thresholds are produced: charts for 1-hour or 3-hours accumulated precipitation (rain/snow), 10 metre gusts and (mean) wind speed, and upper-air parameters like 925hPa wind speed. An example probability chart is shown in Figure 4.

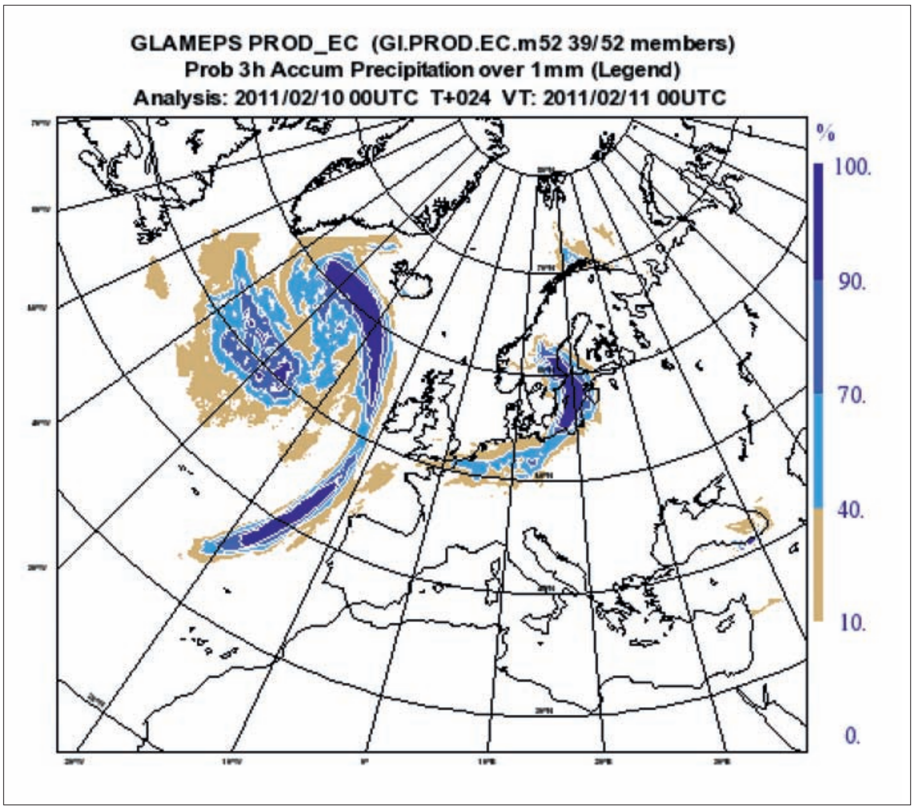

Figure 4

probability chart for 3-hours accumulated precipitation forecasts over 1 mm in the GLAMEPS domain for the same date and lead time as in Figure 3. The coloured areas again represent the forecast probabilities describe in the legend on the right-hand side of the graph.

In Iversen et al. (2011) it is shown that the multi-model setup and the higher resolution of GLAMEPS significantly improve the resolution and reliability of the ensemble compared to ECMWF-EPS. The use of Bayesian Model Averaging (BMA) for calibration is also shown to be beneficial, but it is not used in the current pre-operational system and further research is needed to make the calibration dependent on geographical location.

Concluding Remarks

GLAMEPS is due to become operational in 2011. Some changes that are currently being developed are:

- A slightly enlarged domain
- Dissemination of results in graphical or binary form (GRIB2 or GRIB-api)
- Extension of lead-time up to 54 hours

In a pre-operational phase, access to the experimental GLAMEPS products has been restricted to just a few users, and the feedback of forecasters at the RMIB is needed.

An important issue is the way that the ensemble forecasts will be communicated to forecasters. Maps of probability forecasts (as shown above in Figure 4) are only one way of visualizing forecasts. Other treatments and presentations may be equally important to the forecaster community so as to use the GLAMEPS output in the best way. One additional possibility to facilitate the interpretation of probability forecasts would be to associate probability forecasts to a selection of more probable weather phenomena retrieved from conceptual models.

Jean **Neméghaire** and Alex **Deckmyn**
RMIB – Belgium

Reference

Trond Iversen, Alex Deckmyn, Carlos Santos, Kai Sattler, John Bjørnar Bremnes, Henrik Feddersen & Inger-Lise Frogner, Evaluation of "GLAMEPS" - a proposed multi-model EPS for short-range forecasting, Tellus A (2011) to appear.