Experiences using VarEPS products at the Hungarian Meteorological Service

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1 Introduction

ECMWF 15 day Variable Resolution Ensemble Prediction System (VarEPS) products have been operationally available since 28 November 2006. A comprehensive summary on VarEPS is available on web page of the ECMWF: http://www.ecmwf.int/products/changes/vareps/index.html and in some publications, like Buizza et. al (2006). This article summarizes the use and experiences VarEPS, monthly, and seasonal forecast products at the Hungarian Meteorological Service (HMS). Calibration issues of the EPS products using reforecast products are also discussed

2. Use of the ECMWF VarEPS products

At the late spring of 2006 dissemination of EPS products has been extended from 10 days to 15 days. A wide range of the meteorological variables is available for our forecasters and local users. Locally derived extended range EPS meteograms and EPS plumes are available for ten selected Hungarian locations. In 2008 clustering of VarEPS products is planned to be developed for week two. Operational clustering based on early medium range products for Central European domain has been used since 2003. EPS verification is planned to be extended from day 10 to day 15 in 2008. Calibration of the VarEPS products is planned to be operationally used in the first half of 2008 when new reforecast datasets will be operationally available after the introduction of the unified VarEPS and monthly forecasting system.

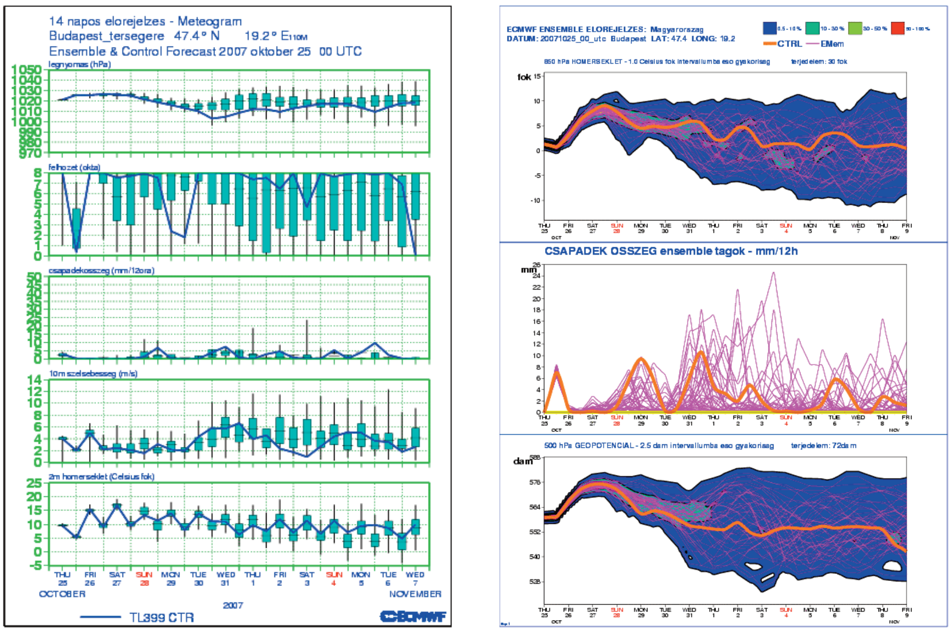

Fig. 1 15 day EPS meteogram for mean sea level pressure, cloudiness, 12 h precipitation, 10 m wind speed and 2m temperature (left). 15 day 'classical EPS plume' containing 850 hPa temperature, 12 h precipitation and 500 hPa geopotential (right).

3 Use of the ECMWF monthly forecast products

ECMWF experimental monthly forecasts became available twice a month in 2002. The monthly forecasting system has been operationally introduced once a week in October 2004. Besides the availability of the monthly forecasts from MARS these products have been available via dissemination since May 2005. At HMS monthly EPS meteogram for ten selected locations and some special locally derived products have been available using bias correction since 2002. Graphical products are available on the intranet. Objective verification scores are annually provided for ECMWF verification book, the so-called Green Book.

4 Use of the ECMWF seasonal forecasts

ECMWF experimental seasonal forecasting system /System-1/ was introduced 1998. The new version, System-2 was introduced in January 2003, seasonal forecast became a part of the dissemination in July 2004. The recent operational version, System-3 has been used since March 2007. At HMS seasonal EPS meteogram for ten selected locations and some special locally derived products have been available using bias correction since 2003. Graphical products are available on intranet. Objective verification scores are annually provided for the Green Book.

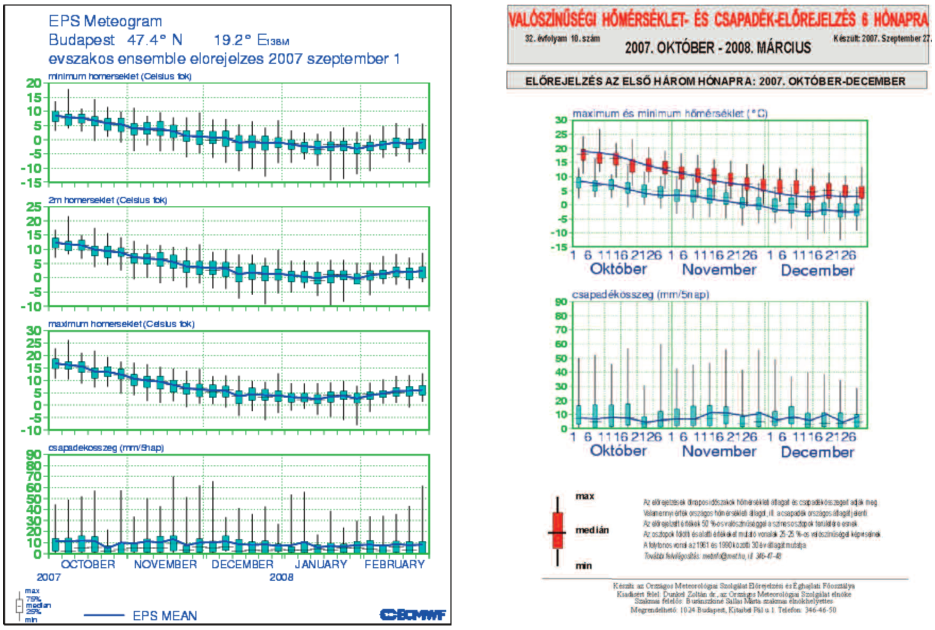

Fig. 2 seasonal forecast EPS meteograms for five months (left) and three months (right).

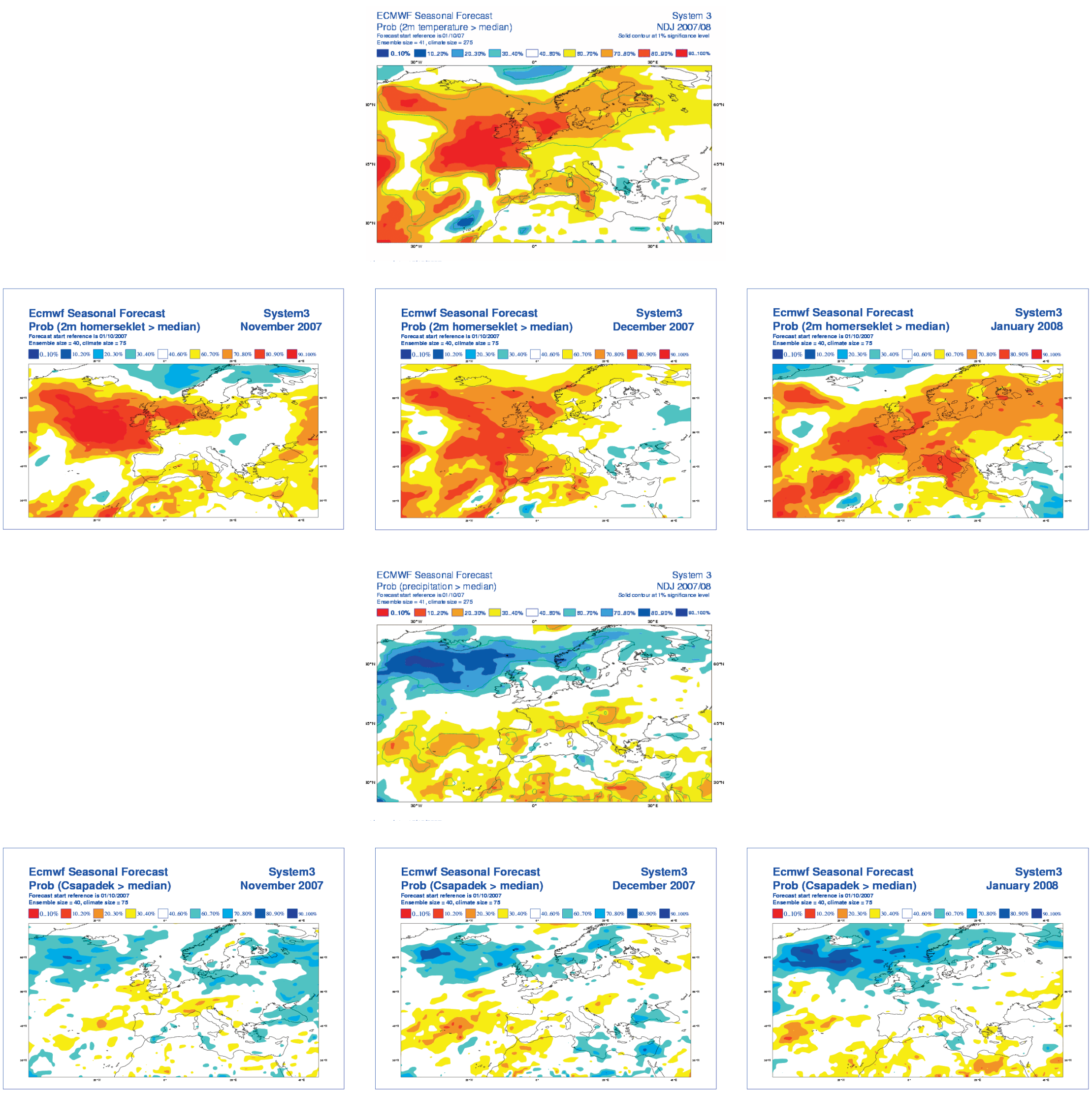

Fig. 3 seasonal forecast probality fields based on forecast 15 October 2007
first raw: three month average probability /November - January / second raw: monthly probability for 2m temperature
third raw: three month average probability /November - January / fourth raw: monthly probability precipitation

5 Calibration using reforecast dataset

For avoiding some errors of numerical weather prediction models, calibration can improve the weather forecacts. Wide range of calibration methods are used and can be selected. ECMWF plans to operationally provide 5 member EPS reforecast dataset for 18 years up to 32 forecasting days once a week. Since February 2006 some kind of reforecast dataset has been operationally available up to +48 h based on control model reruns for 30 years. Our aim was to develop a calibration program package using reforecast information. In the future this method can be used operationally when ECMWF VarEPS&monthly reforecasts will be available. During calibration current EPS distribution, reforecast and observed climatological distribution are used as it shown on fig. 4. Calibration has been done for the following parameters: 2m temperature at 00 and 12 UTC, minimum and maximum temperature, 24 h precipitation, wind speed at 00 and 12 UTC for ten selected hungarian stations (fig. 5) for the period of March 2006 and September 2007. Difference between EPS and observed climate is quite changeable depending on meteorological variable, season and geographical locations (fig. 6 and 7). Verification has been done for the same meteorological variables, fig. 8 shows Talagrand diagram for different lead times (48, 96 and 144 h) for 2m temperature.

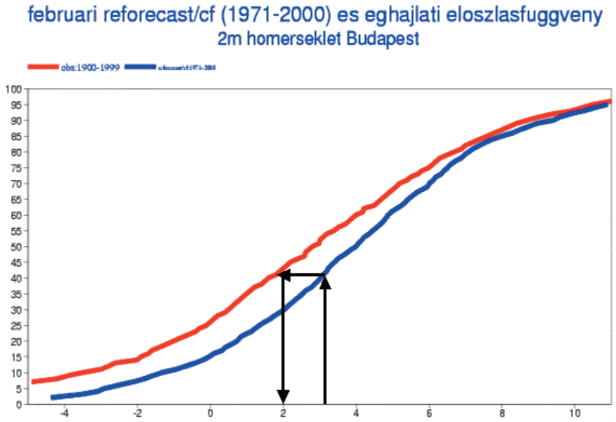

Fig 4 Schematic method of the calibration

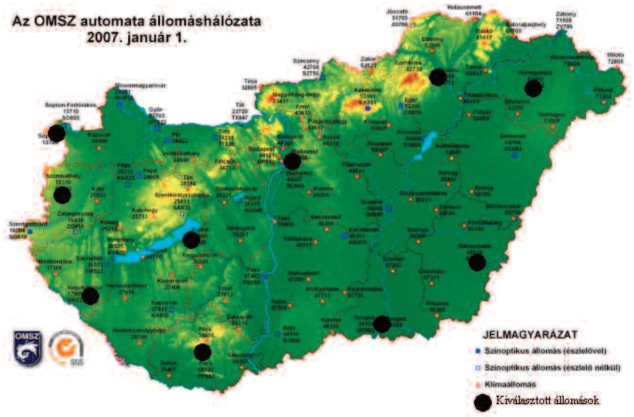

Fig 5 Selected hungarian SYNOP stations used for calibration

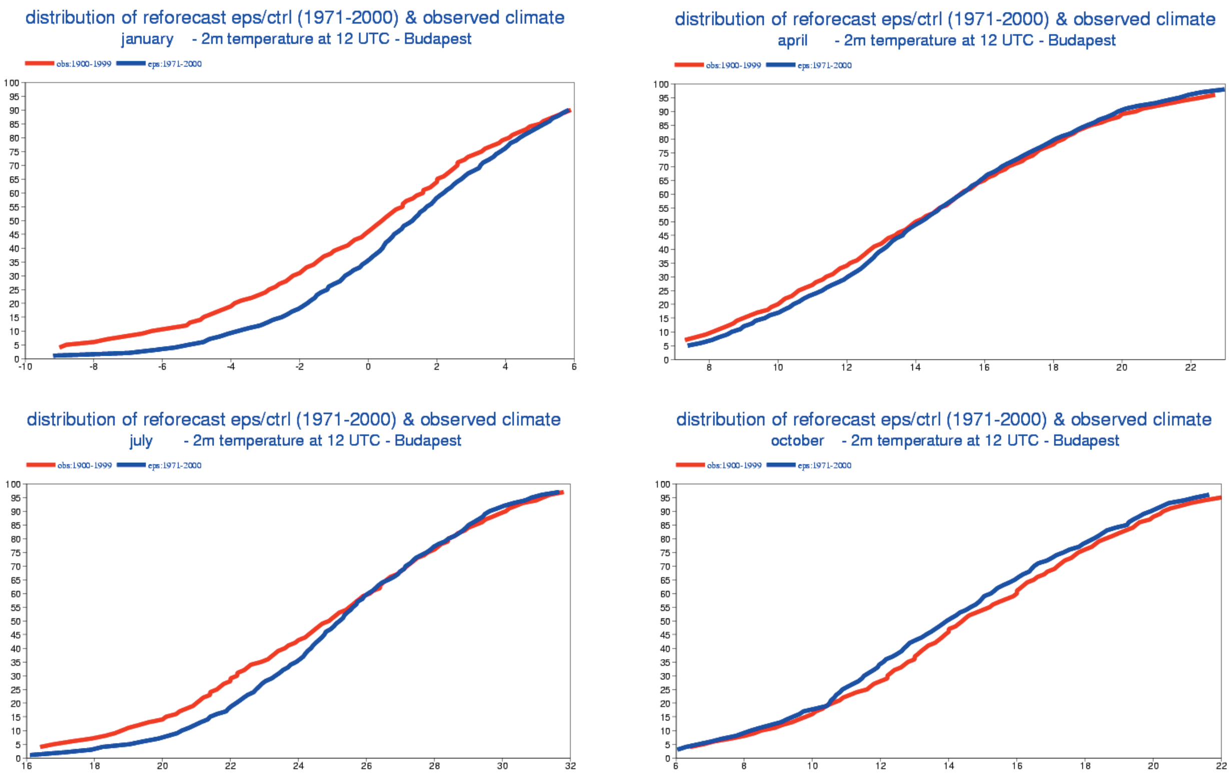

Fig. 6 EPS model and observed climate distribution for 2m temperature for Budapest for January, April, July and October

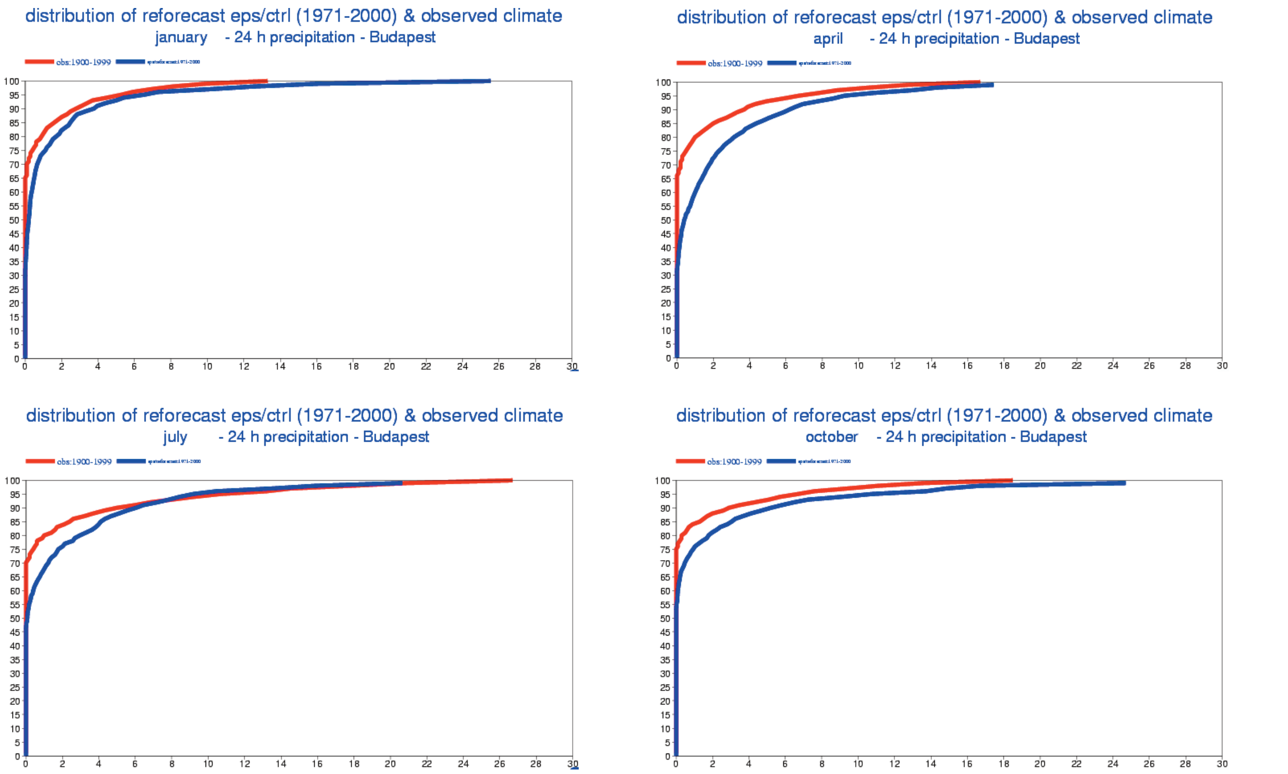

Fig. 7 EPS reforecast model and observed climate distribution for daily precipitation for Budapest for January, April, July and October

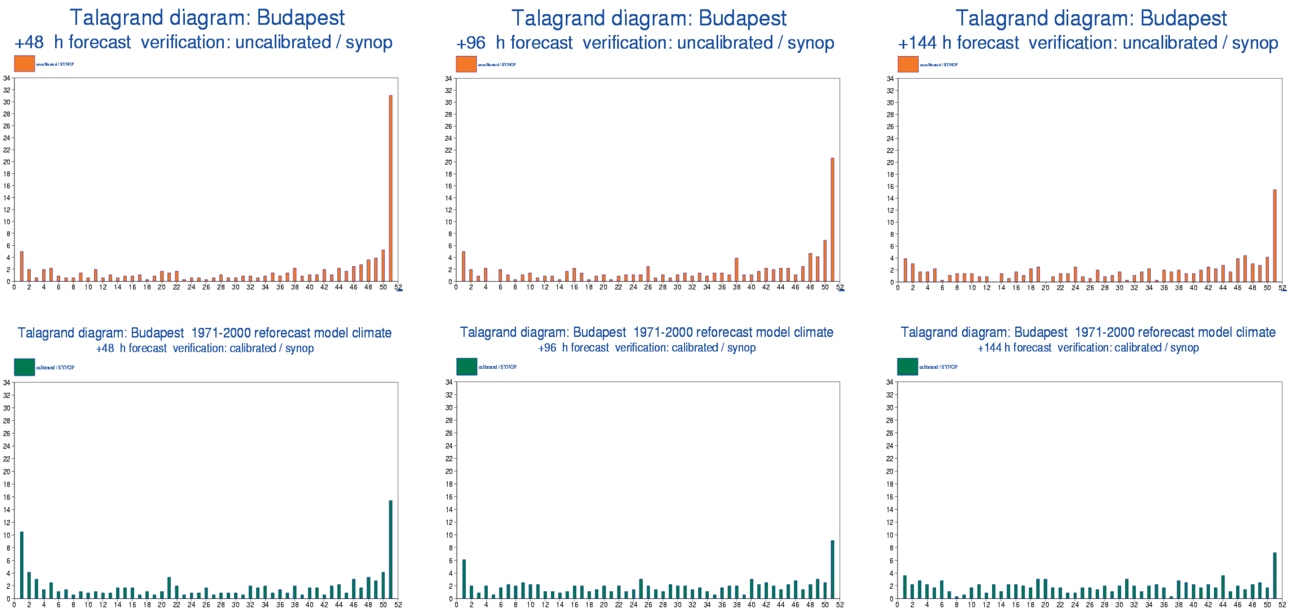

Fig. 8 Talagrand diagram for 2m temperature for raw EPS forecasts /first raw/ and calibrated EPS forecasts /second raw/

6 Visualization

The operative meteorological visualization tool at HMS is currently the HAWK-2 system, that was created and developed between 2000 and 2006. The development of a new meteorological workstation, HAWK-3 was started in 2004, reached testing phase in 2007, and is expected to enter operative service in 2009 (fig. 9-12).

HAWK-3 is written in C++ using the Qt development toolkit, and various third party libraries, such as the ECMWF GRIB API, and NetCDF. It is engineered to run on a Linux platform, but is expected to be functional on Windows as well.

Currently available HAWK-3 features

- Mapped visualization of radar, satellite, SYNOP, grid data (analysis, deterministic & ensemble forecasts)
- Various input data formats (NetCDF, GRIB, Bitmap)
- Controllable settings (colour settings, time-range, value scan)
- Efficient graphical user interface
- Product generation mode
- Various map projections
- Support for optimal resolution geographical objects
- Multi window system
- Saving and restoring products and program states as macros
- Multiple language support
- Users (with customizable settings)
- Animation, zoom, exporting, printing of images or series of images
- Basic numerical operations on grid data, interpolation, gradient, on-demand composite creation for radar (multiple stations) and satellite (multiple channels) images

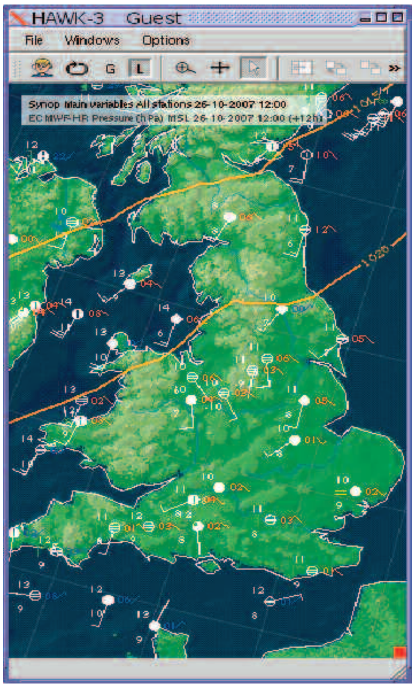

Fig.9 SYNOP obs. Pres fcst

Short and medium term development goals

- Other datatypes (TEMP, AMDAR, windprofiler, lightning, MSG-SAF products, trajectory, frontlines, pictures)
- Additional visualization modes (vertical profile, cross section, meteogram)
- Additional input data formats (e.g. FA, HDF, BUFR)
- Postscript printing
- Grid & frontline editing
- Ergonomic development & optimization
- Commercialization

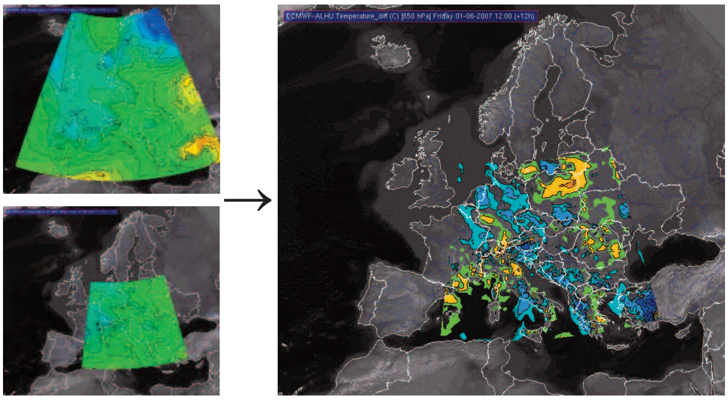

Fig. 10 Difference of ALADIN and ECMWF

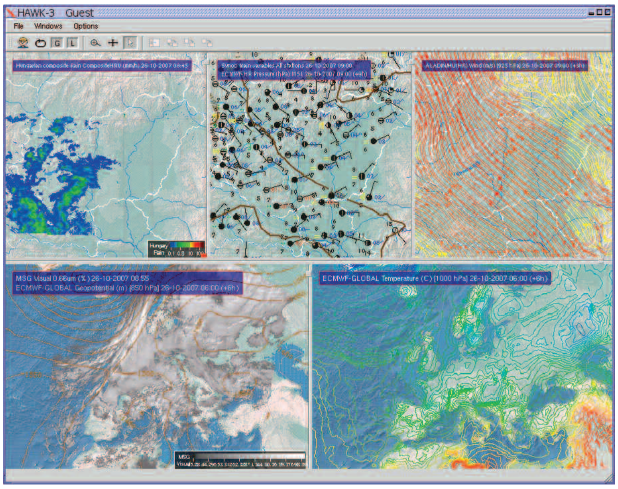

Fig. 11 Snapshot of the application

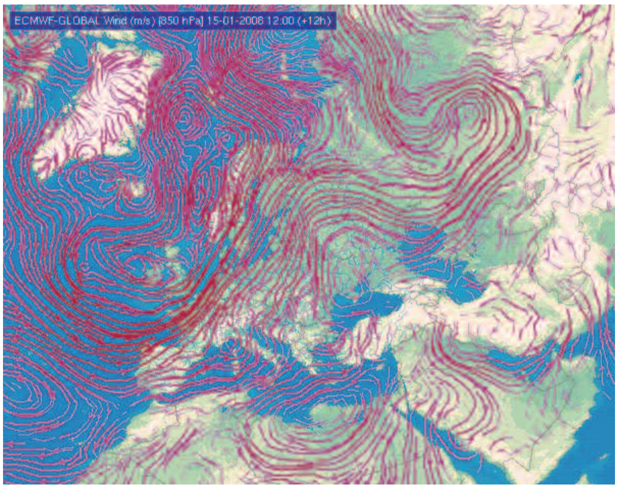

Fig. 12 Emphasised streamlines

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