**Grand Limited Area Model Ensemble Prediction System**

GLAMEEPS and HarmonEPS
LAM ensemble prediction systems under development

GLAMEPS is a common project for operational EPS in the short-range in the HIRLAM and ALADIN SRNWP consortia

Inger-Lise Frogner, John Bjørnar Bremnes, ...
HIRLAM contributions to FROST-2014

- GLAMEPS forecasts (FDP)
- HarmonEPS forecasts for Sochi area (RDP)
- Statistical calibration of GLAMEPS forecasts at observational sites in the Sochi area (RDP)
Pre-operational GLAMEPS_v1 for the “synoptic” scales

54 ensemble members
• EC DET (1)
• HirEPS_S (12+1)
• HirEPS_K (12+1)
• AladEPS (13)
• EC EPS (14)

+54h forecast range

06 and 18 UTC (EC 00/12 UTC)

~11 km resolution
• Aladin: 629x529, 11.8km, L37
• Hirlam: 646x492, 0.10°/11.1km, L40

 Runs as Time-Critical Facility at ECMWF
- 6 h CANARI cycle (conventional data only)
- 3D fields updated at 00h and 12h from EPS
- All Alaro members separately
Hirlam component

- Control members have 3D-Var
- Other members only surface assimilation cycle
- Two cloud physics parameterizations
  - HirEPS_S (STRACO)
  - HirEPS_K (Kain-Fritsch/Rasch-Kristjansson)
- Stochastic physics (tendency perturbations) (since 6 February 2013)
- Perturbed surface observations (since 29 January 2013)
GLAMEPS performance for the 4 high-impact weather events
Case of heavy snow
13 January 2013
ECMWF deterministic run, +54 h
12h-accumulated precipitation
Valid 2013-01-13 18 UTC
Examples: ECMWF EPS +54 h and GLAMEPS +48 h
12h-accumulated precipitation
Valid 2013-01-13 18 UTC
Case of torrential rain
24 January 2013
Examples: ECMWF EPS and DET+30 h and GLAMEPS +24 h
24 h accumulated precipitation
Valid 2013-01-24 06 UTC
Case of sudden warming
14-15 February 2013
Examples: ECMWF DET +30/33 h and GLAMEPS +24/27 h

T2m

Valid 20130214 06 / 20130214 09

EC DET

GLAMEPS
Case of heavy rain
12-13 March 2013
Examples: ECMWF EPS + 51 h and GLAMEPS +45 h
24h-accumulated precipitation
Valid 2013-03-13 15 UTC
Verification for the «Sochi area»
Spread/Skill MSLP
December - March
Correction of SST bug

CRPSS (%) - Mean sea level pressure, Sochi2 - Reference forecast: EPS

- 48 stations
- EPS: 06-36
- GLAMEPS: 06-12

+12h

GLAMEPS

EC EPS (ref)

CRPSS (%) - Mean sea level pressure, Sochi2 - Reference forecast: EPS

- 41 stations
- EPS: 06-36
- EPS: 06-24

+12h  +24h

+36h  +48h
Correction of SST bug

+12h

GLAMEPS

EC EPS (ref)

+24h

+36h

+48h
CRPSS 10m wind speed
September 2012 – March 2013

GLAMEPS
EC EPS (ref)

+12h
+24h
+36h
+48h
CRPSS RR24
September 2012 – March 2013

+24

GLAMEPS EC EPS (ref)

+48h
Deliverables of GLAMEPS forecasts

2011
• GLAMEPS semi-operational

2012
• Provide GLAMEPS forecasts routinely
• Forecasts available at ftp-server from September 2012
R&D for further improvements

- Increase the number of Aladin ensemble members at expense of the EC EPS members

- 4 updates per day (lagged ensemble members)

- Include ETKF or EDA in hybrid mode with 3DVar

- Include high-resolution short-range singular vectors for CAPE
HarmonEPS
"HarmonEPS" experiments

- A convection-permitting EPS, sub-European and Sochi-area
- 2.5 km resolution
- +36h forecast range
- Full DA and 6 h cycling for the control
- HarmonEPS to be run every 12 h
- Surface assimilation included for every member.
- 20 members, 10 members with AROME and 10 with ALARO
- Output to be produced every hour
- LBC-data, intend to use increased resolution EC EPS (~16km) with single-step nesting, test also direct nesting from EC EPS at ~32 km
- Simply choose the 20 first members from EC EPS to nest in
- Step-wise develop
  - RUC with DA, and
  - finally hybrid DA and high-resolution observations
<table>
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<tr>
<th>Year</th>
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<td>2011</td>
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* Technical work in setting up Harmonie to run in ensemble mode  
* First test with HarmonEPS for the area of Sochi run successfully |
| 2012 |  
* Run HarmonEPS experiments for the area of Sochi |
| 2013 |  
* Run HarmonEPS for the area of Sochi and provide output |
Statistical calibration of GLAMEPS forecasts
Objectives

Overall
- Calibrated forecasts of main parameters on the model grid
- Synoptic observations as reference data
- No routine calibration yet
- Ongoing experiments with extended logistic regression

FROST-2014
- Probabilistic calibration at stations (annex 1)
  - Extended logistic regression
  - Threshold probabilities, quantiles/ensemble members (?)
- Focus on temperature, precipitation and wind speed
- Higher temporal resolution (hourly)
- Hourly updates of forecasts (?)
  - Main impact expected up to +12 hours ahead
Status

Current status

- Observation files (XML) downloaded for 2012/13 winter
- Code for reading these into R ready
- Archive of GLAMEPS forecasts available

Plans

- Calibration experiments based on winter 2012/13 data (summer 2013)
- Routine generation of calibrated forecasts (latest 1 Dec 2013)
  - Transfer forecast to ftp-server