Grand Limited Area Model Ensemble Prediction System

GLAMEPS 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
on behalf of the whole GLAMEPS team and HarmonEPS team

Iceland April 2013

Pre-operational GLAMEPS_v1 for the "synoptic" scales:

54 ensemble members:

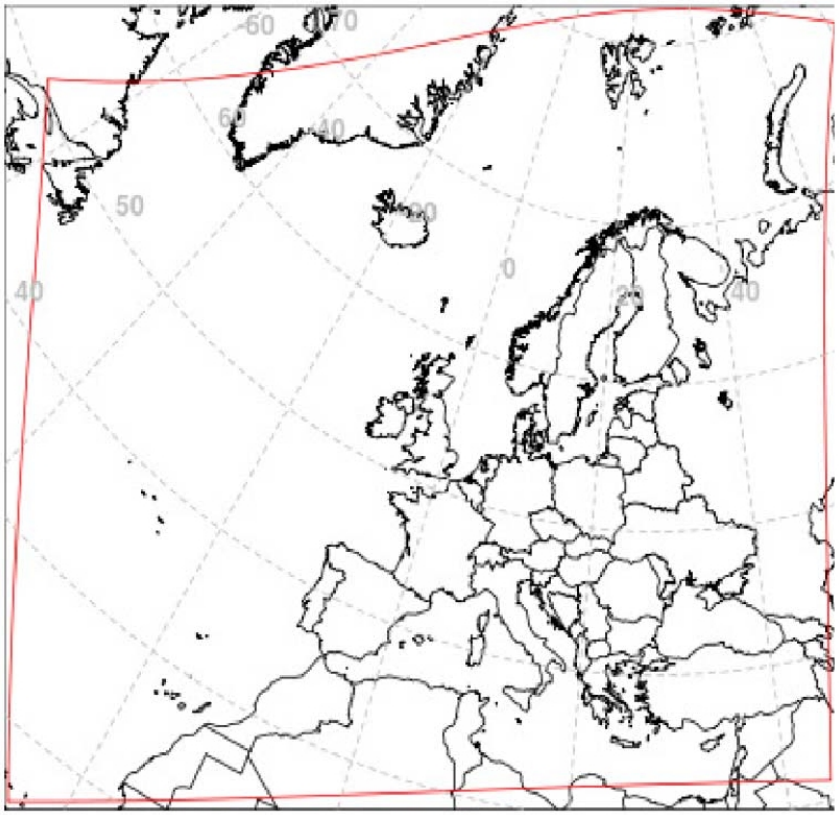
- EC DET (1) +
- HirEPS_S (12+1) +
- HirEPS_K (12+1) +
- AladEPS (13) +
- EC EPS (14) = 54

Forecast range: 54h

- 06 and 18 UTC (EC 00 and 12 UTC)

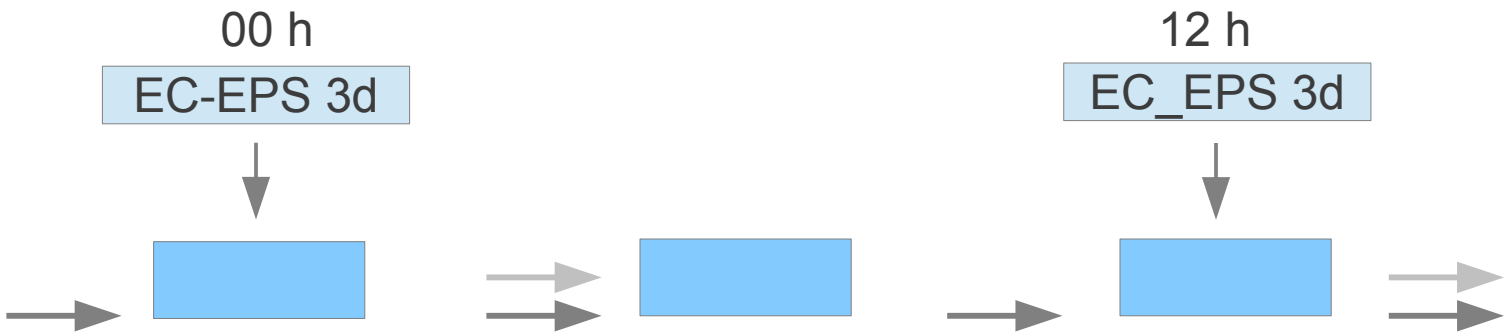
~11 km resolution
Aladin: 629x529, 11.8 km, L37
Hirlam: 646x492, 0.10° (11,1 km), L40

Runs as Time-Critical Facility at ECMWF



Black frame: Aladin domain
Red domain: Hirlam domain and common output domain

Aladin component



- 6 h CANARI cycle (conventional data only)
- 3 d fields updated at 00h and 12h from EPS
- All Alaro members separately

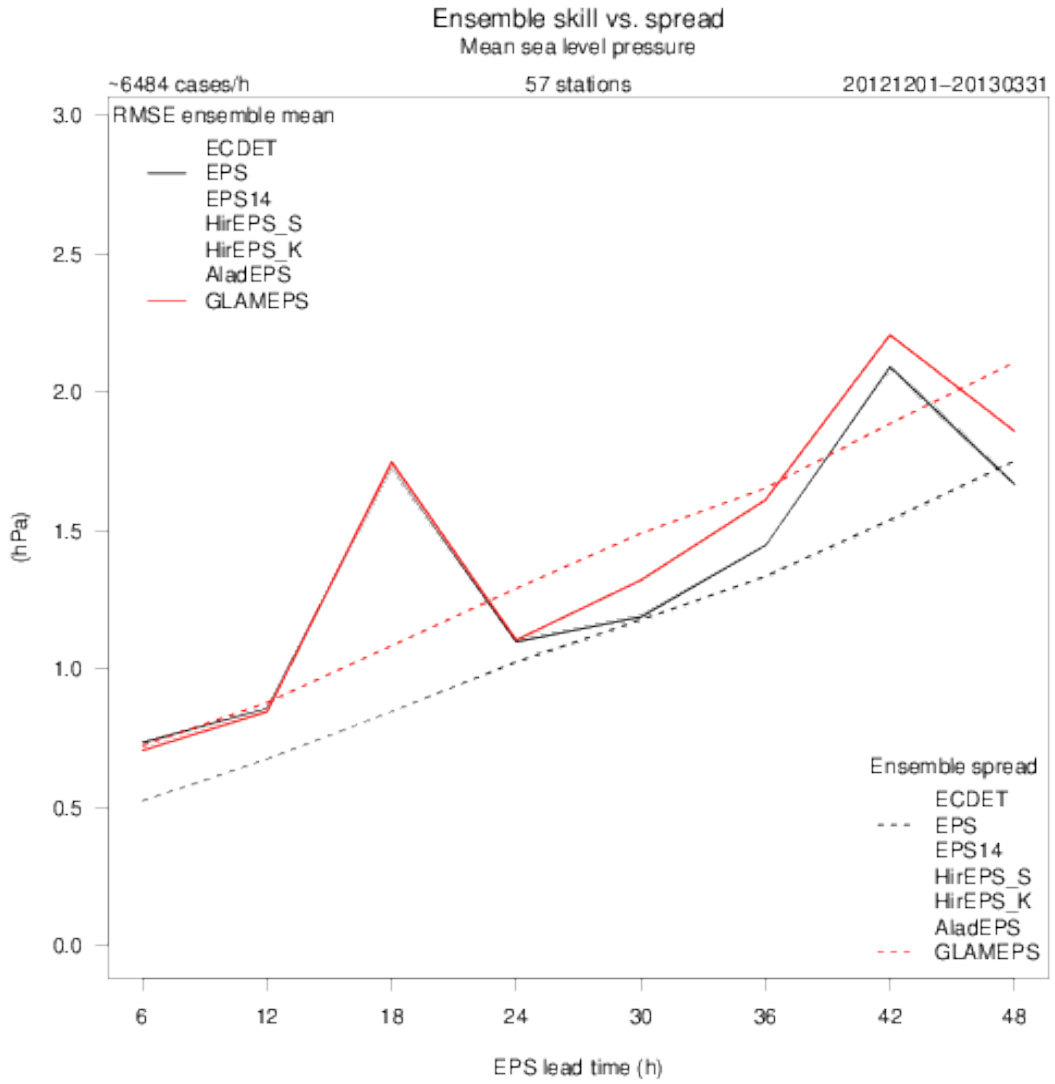
Hirlam component

- Control members have 3d-Var
- Other members only surface assimilation cycle
- Two choices for the cloud physics parameterizarions →
  - HirEPS_S (STRACO)
  - HirEPS_K (Kain-Fritsch/Rasch-Kristjansson)
- Stochastic physics (tendency perturbations) (since 6 February 2013)
- Perturbed surface observations (since 29 January 2013)

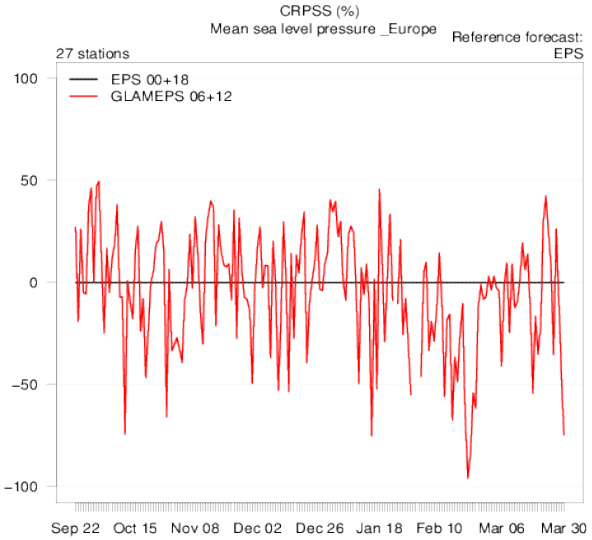
GLAMEPS performance

MSLP

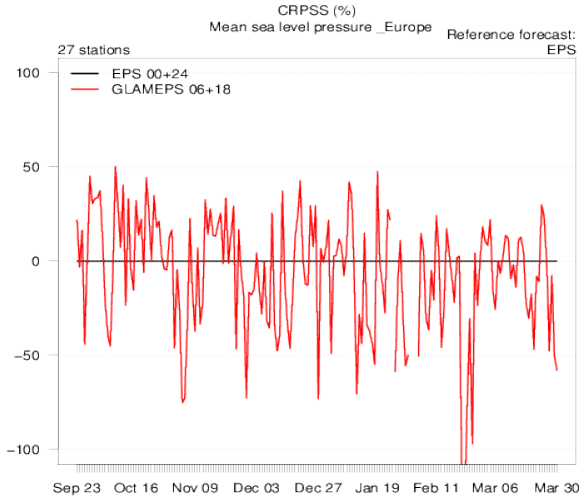
Spread/Skill MSLP
Dec 2012 – March 2013



CRPSS MSLP
20120922-20130331

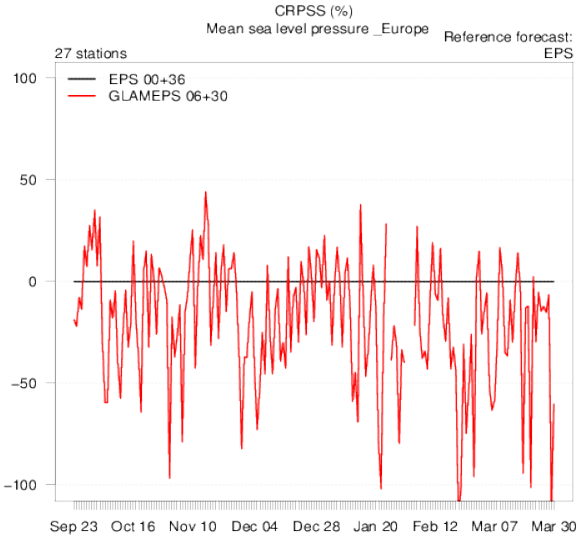


+12h

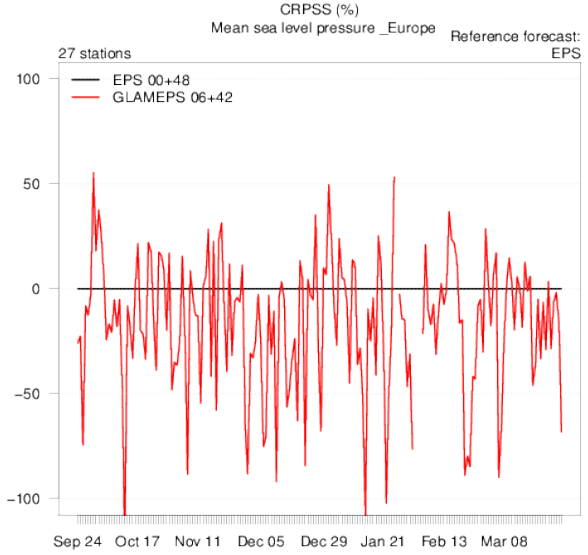


+24h

GLAMEPS
EC EPS (ref)



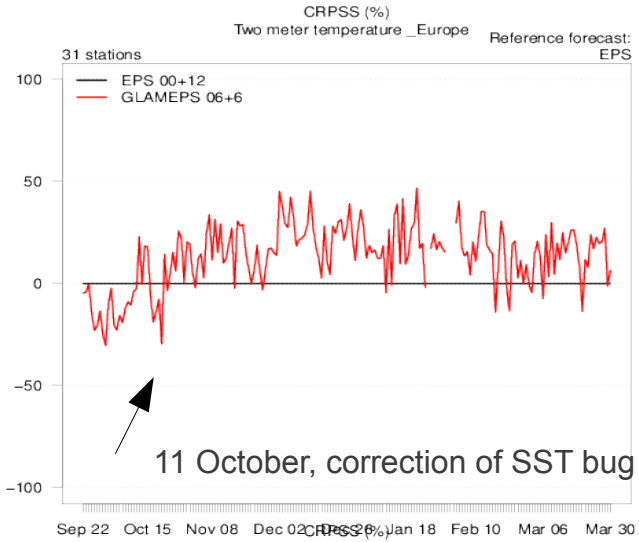
+36h



+48h

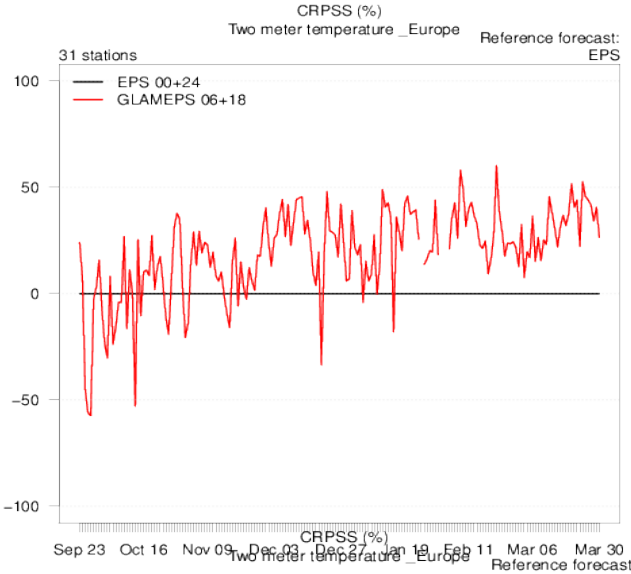
T2m

CRPSS T2m
20120922-20130331

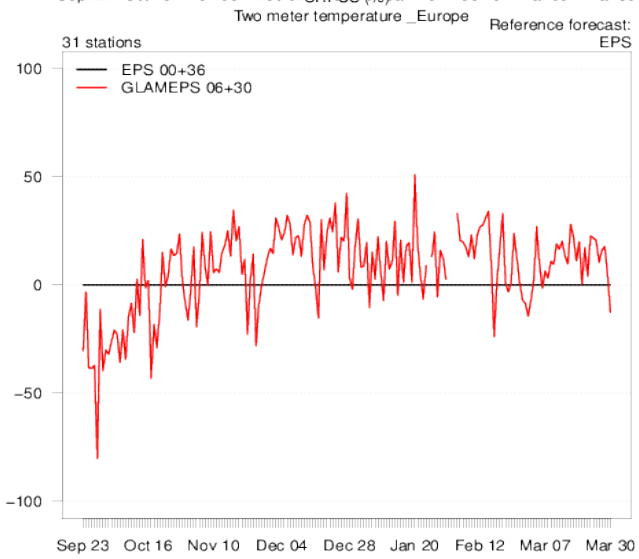


+12h

+24h

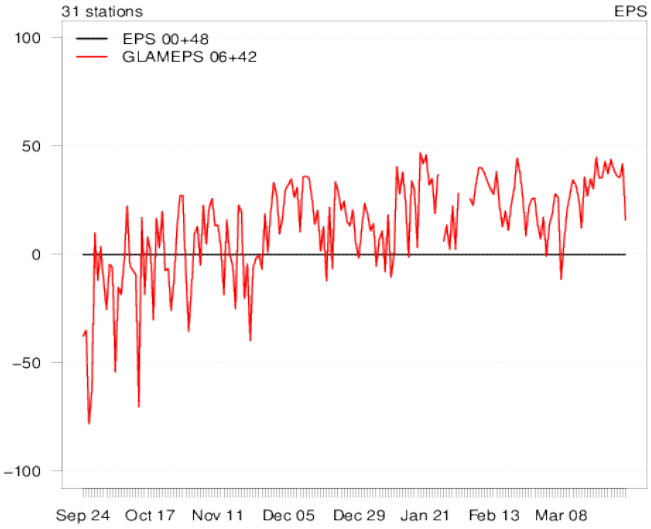


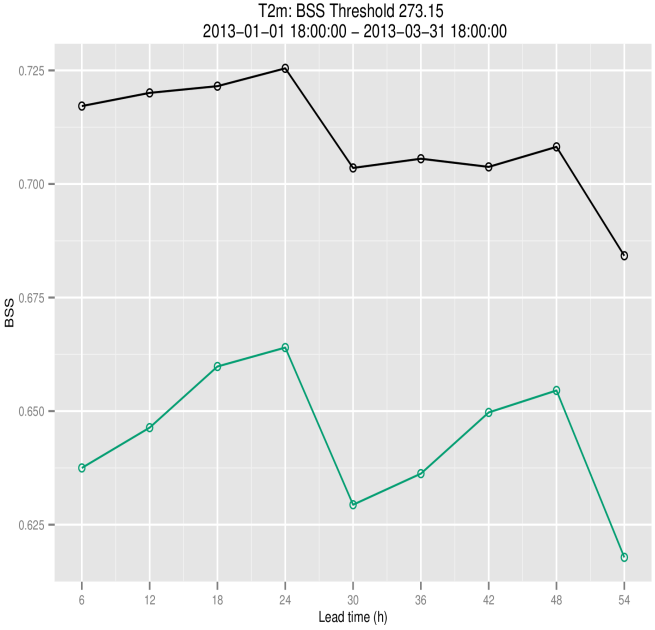
GLAMEPS
EC EPS (ref)



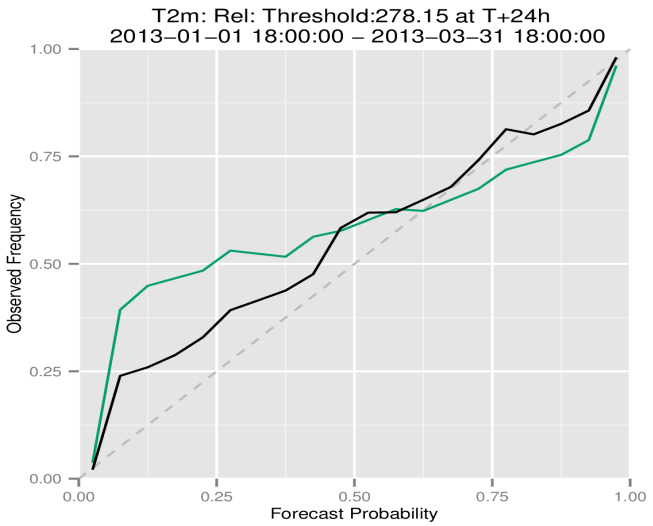
+36h

+48h



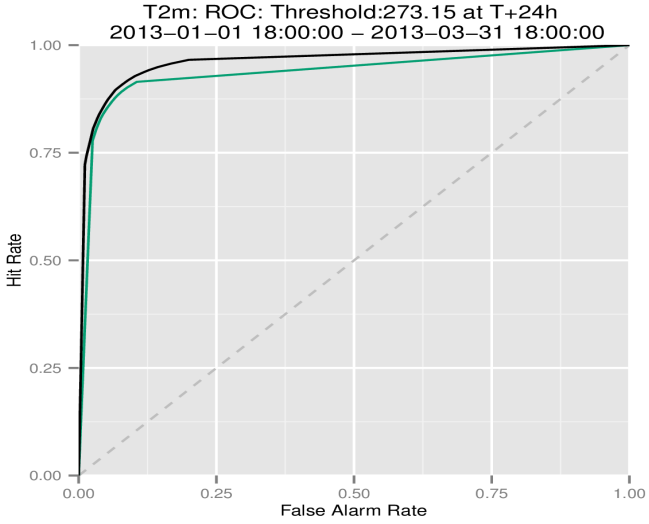


BSS
THR 0

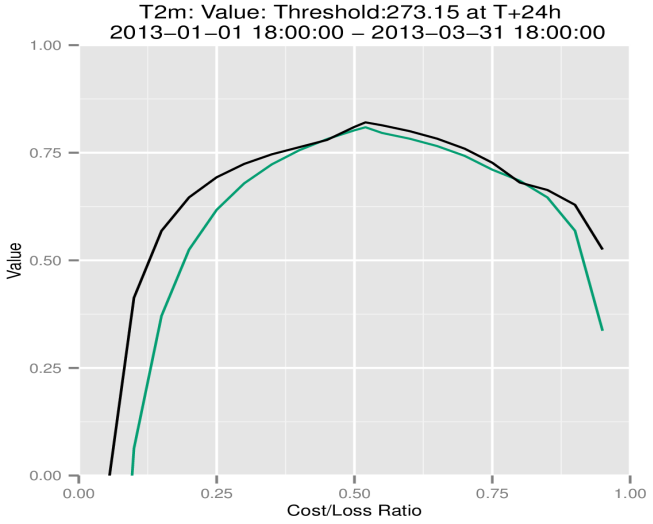


Rel.
THR 5
+24h

GLAMEPS
EC EPS



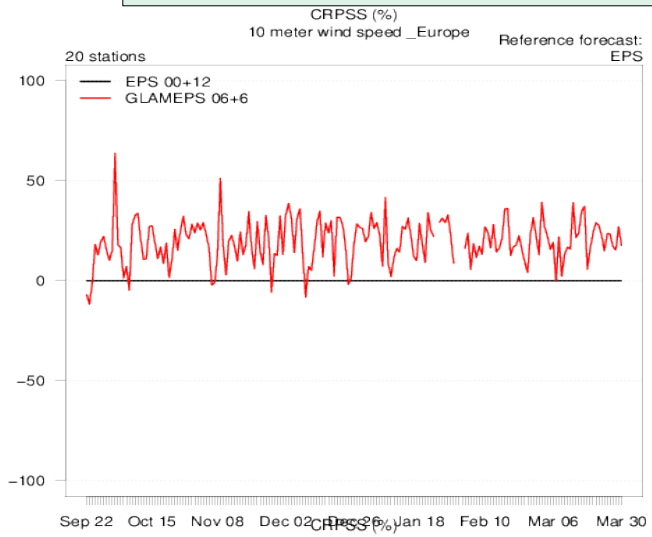
ROC
THR 0
+24h



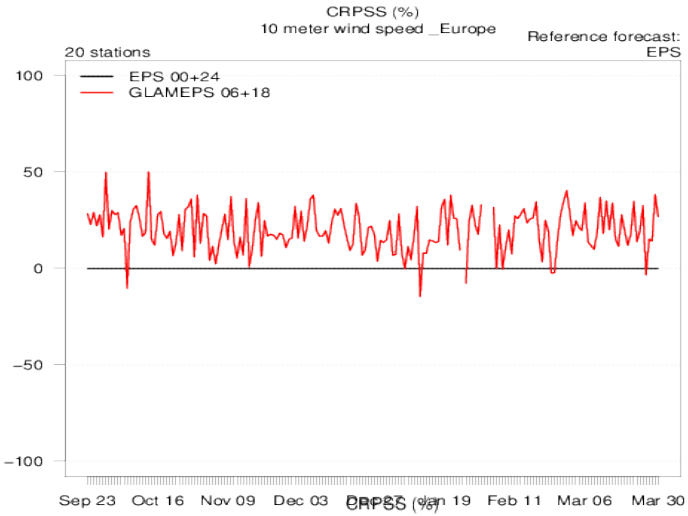
Value
THR 0
+24h

10 m wind speed

CRPSS 10m wind speed 20120922-20130331

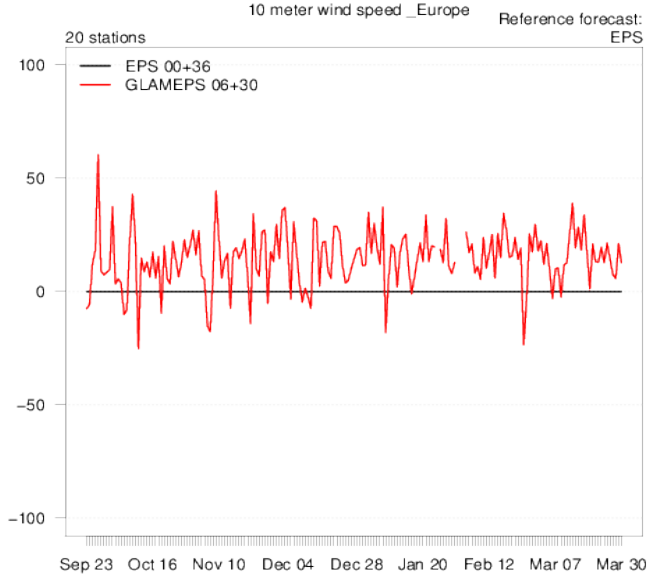


+12h

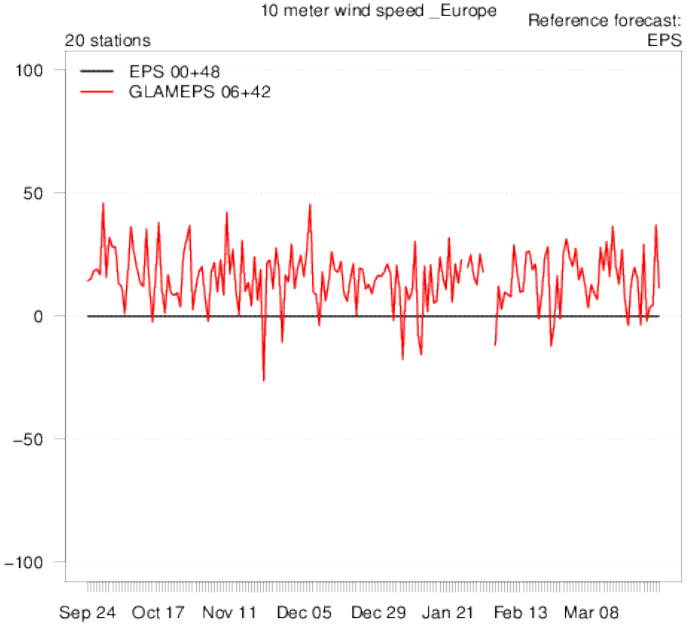


+24h

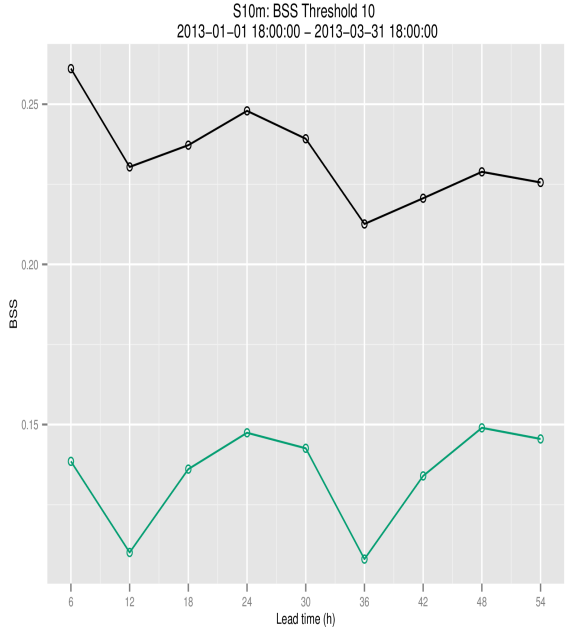
GLAMEPS
EC EPS (ref)



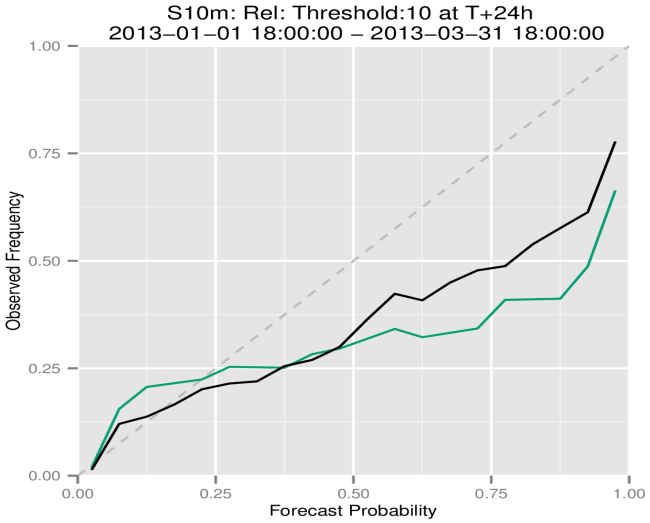
+36h



+48h

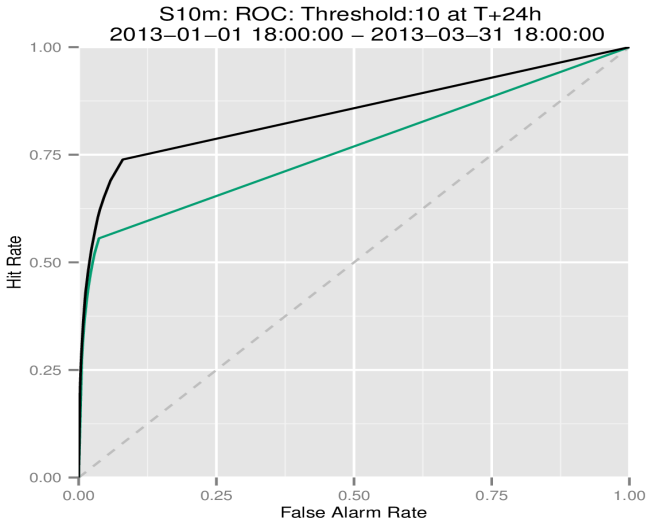


BSS
THR 10

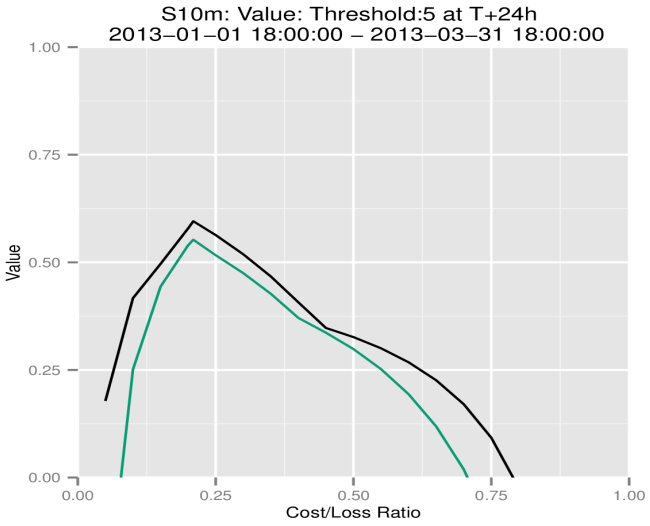


Rel.
THR 10
+24h

GLAMEPS
EC EPS



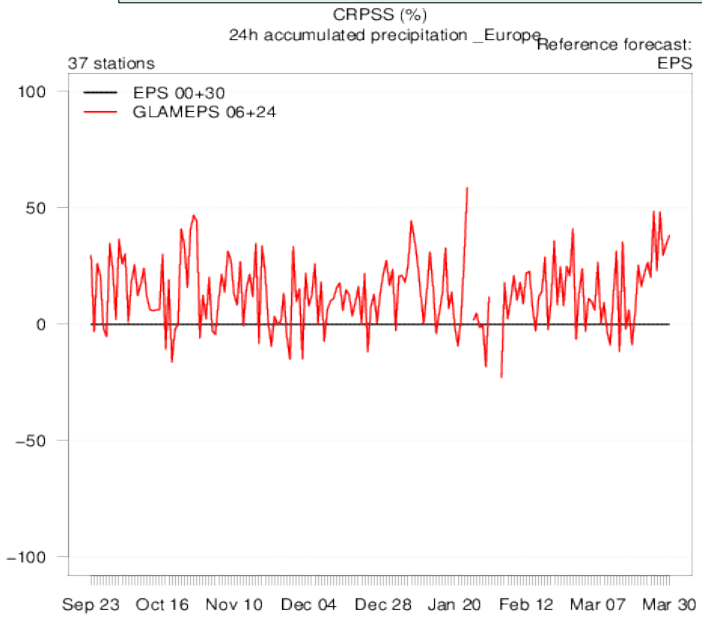
ROC
THR 10
+24h



Value
THR 5
+24h

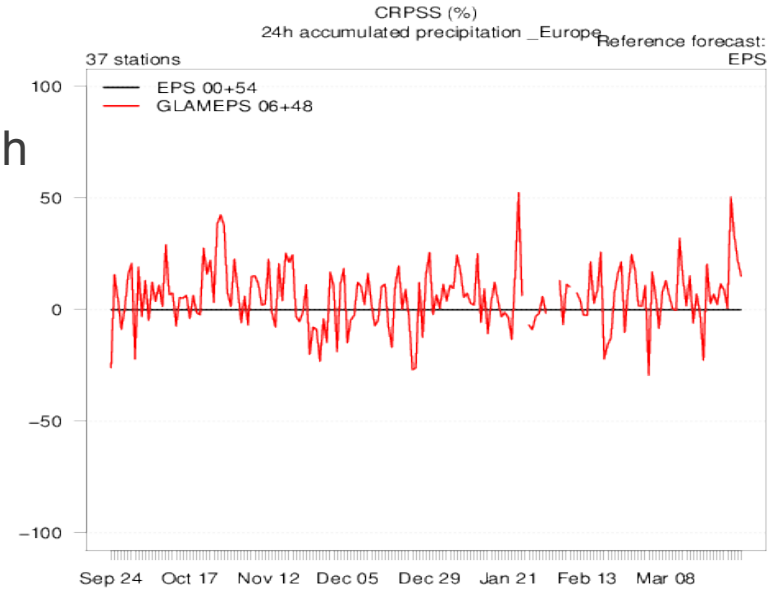
12 h accumulated precipitation

CRPSS 24h acc precipitation 20120922-20130331



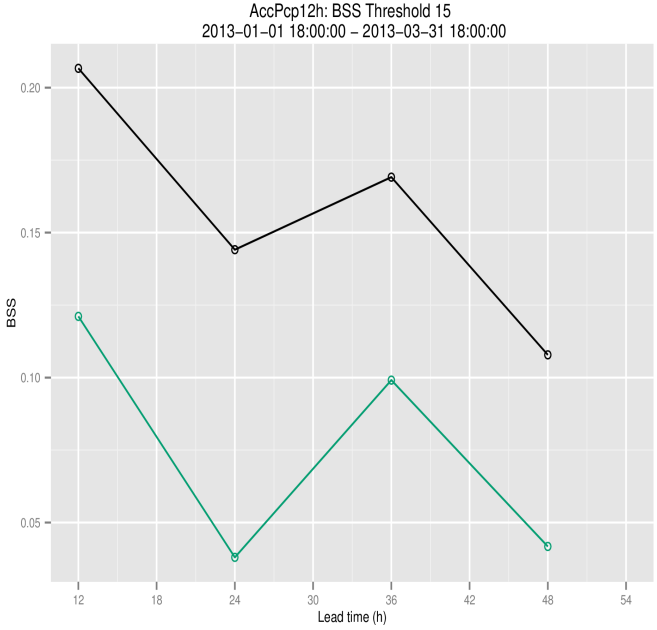
+24h

+48h

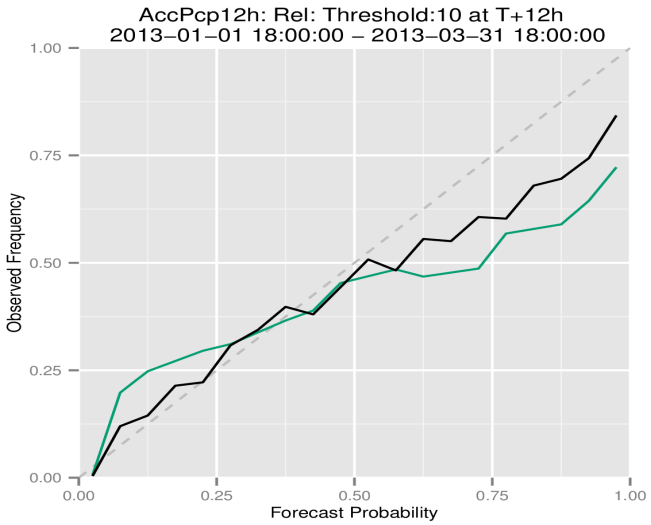


GLAMEPS

EC EPS (ref)

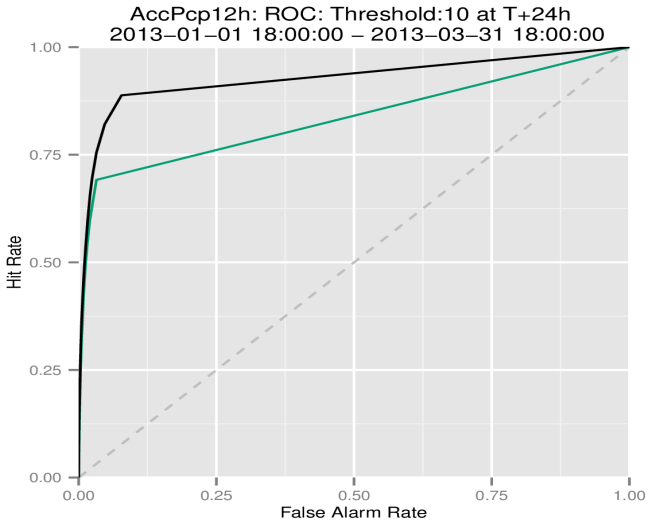


BSS
THR 15

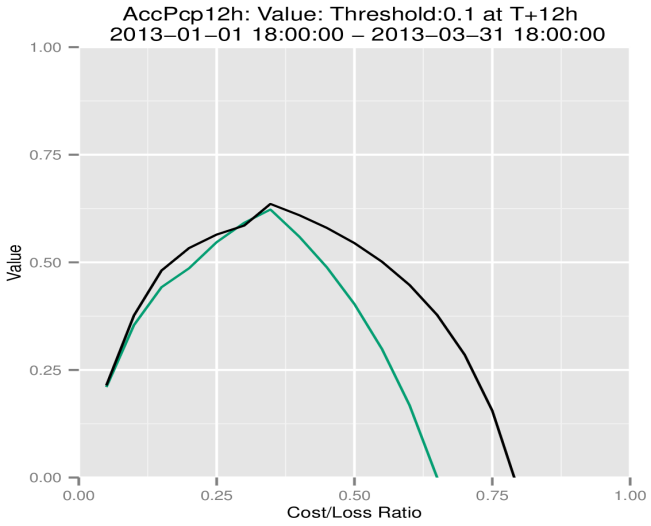


Rel.
THR 10
+12h

GLAMEPS
EC EPS



ROC
THR 10
+24h



Value
THR 0.1
+12h

R&D for further improvements include:

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

- GLAMEPS 4 times per day (lagged ensembles). Increased resolution (~8 km)

- Include ETKF or EDA in hybrid mode with 3DVar – see the presentation from Åke on ETKF

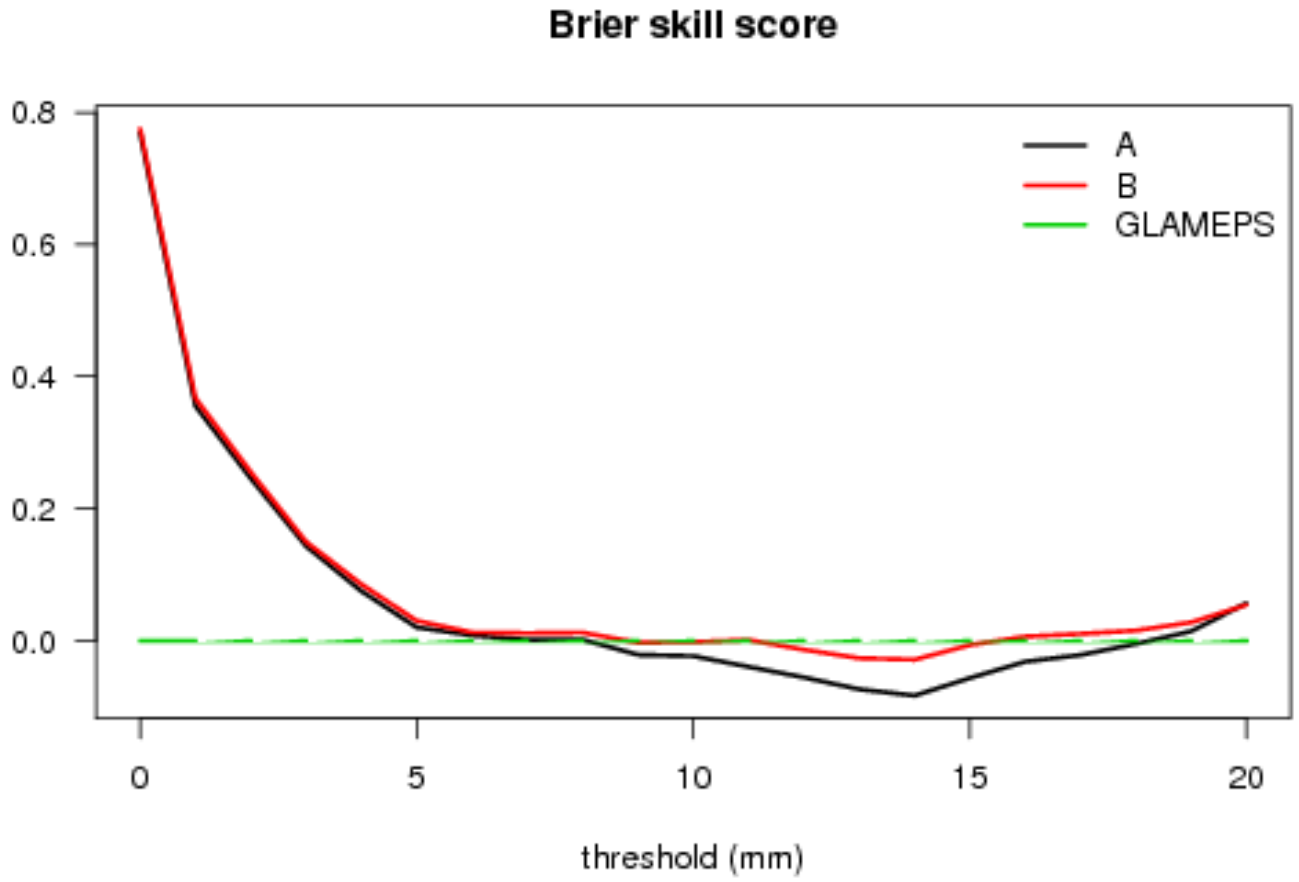
- Include high-resolution, short-range, singular vectors for CAPE – see the presentation from Sibbo

- Cooperation with LAEF

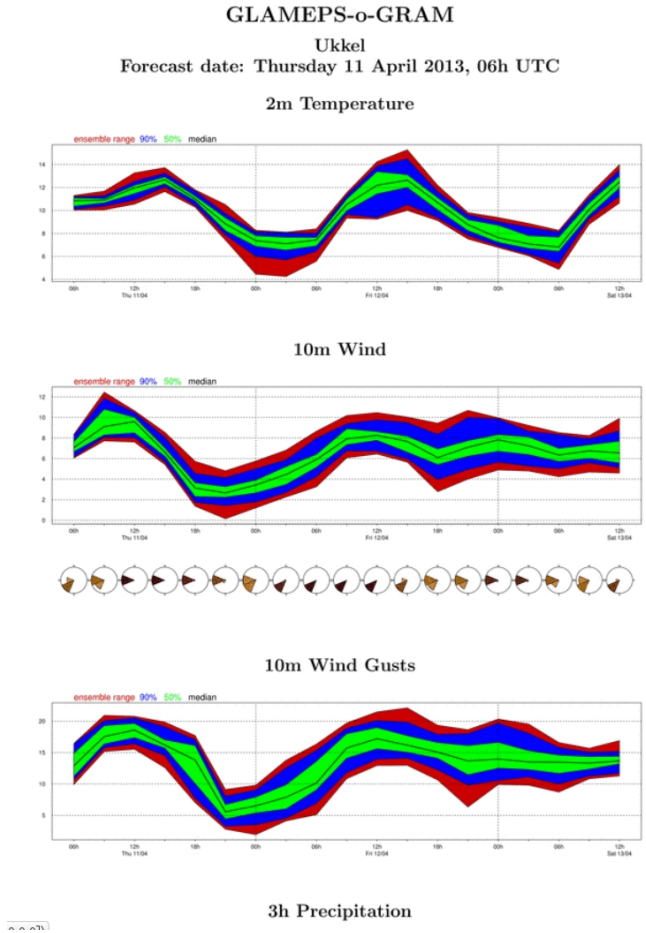
- Verification (HARP)

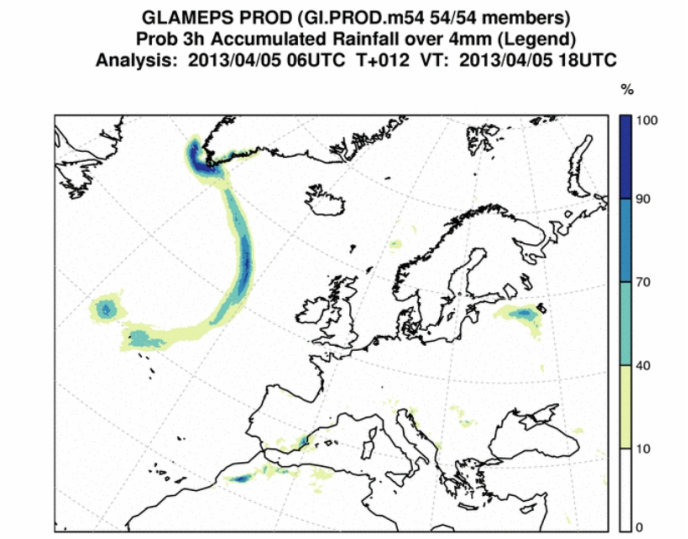
- Statistical post-processing for bias- and variance-corrections and multi-model combination (ELR)

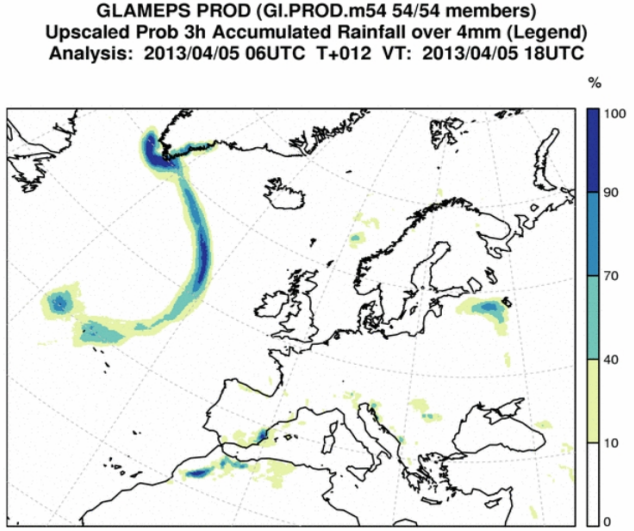
Example of BSS for calibrated GLAMEPS
6h precipitation, +42h



New products at glameps.org





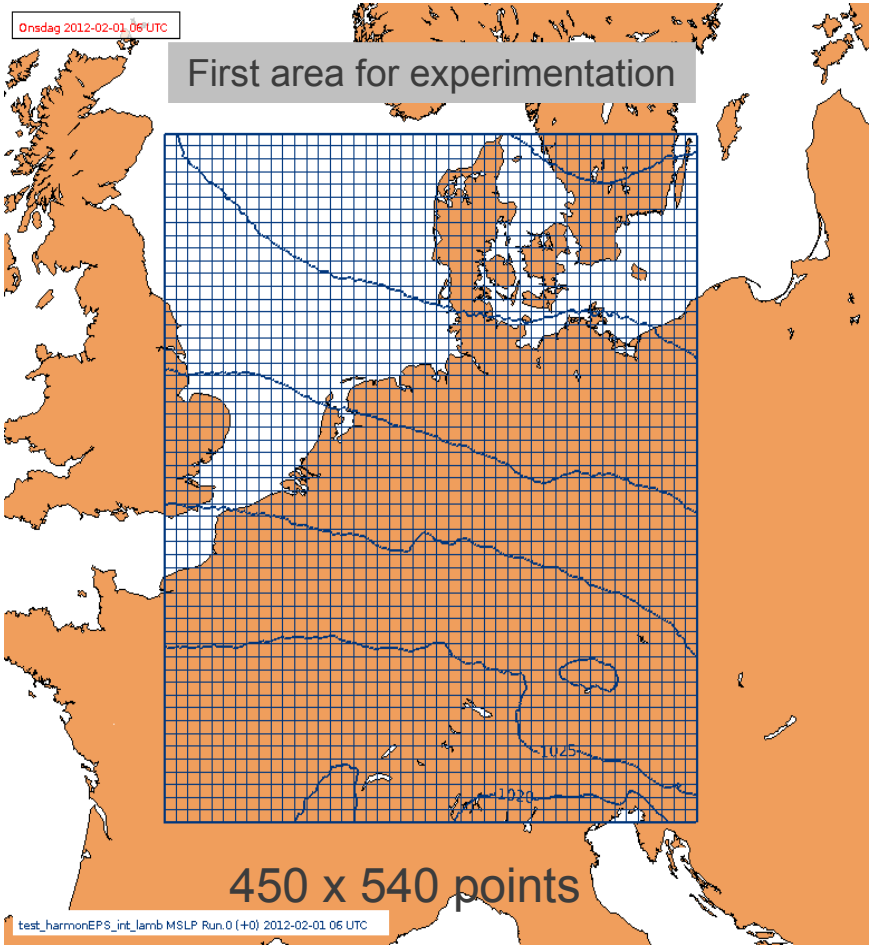


A second output stream from GLAMEPS

Paramater	GRIB number	Level Type	Level	Unit
Surface Pressure	1	105	0	Pa
Height Pressure Level	6	100	1000	m^2/s^2
Height Pressure Level	6	100	700	m^2/s^2
Temperature Pressure Level	11	100	1000	K
Temperature Pressure Level	11	100	700	K
U-wind Pressure Level	33	100	1000	m/s
V-wind Pressure Level	34	100	1000	m/s
U-wind Pressure Level	33	100	700	m/s
V-wind Pressure Level	34	100	700	m/s
Relative Humidity Pressure Level	52	100	1000	0..1
Relative Humidity Pressure Level	52	100	925	0..1
Relative Humidity Pressure Level	52	100	850	0..1
Relative Humidity Pressure Level	52	100	700	0..1
Relative Humidity Pressure Level	52	100	500	0..1
Large Scale Precipitation	62	105	0	kg/m^2
Convecitve Scale Precipitation	63	105	0	kg/m^2
Low Cloud Cover	73	105	0	0..1
Medium Cloud Cover	74	105	0	0..1
High Cloud Cover	75	105	0	0..1

HarmonEPS

- Intention is to provide to the member weather services a prototype probabilistic forecast system on non-hydrostatic, convection-permitting scales
  - Not pan-European
- To enable reliable predictions of probabilities for high-impact weather events which are confined in space and time by:
  - Meso-scale dynamical structures
  - Orographic and other fine-scaled surface forcing



HarmonEPS: set-up first experiments

- A convection-permitting EPS, ~2.5 km, sub-European and Sochi-area
- 2.5 km resolution
- +36 h lead time.
- 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 . -> continue the multi-model approach

- Step-wise develop
  - RUC with DA, and
  - finally hybrid DA and high-resolution observations
  - Size of area needed? How many members? Grid resolution?

HarmonEPS: Uncertainty strategies

Initial condition perturbations:

- Perturbations from EC EPS
- Humidity perturbations: humidity in SVs, use of MSG cloud mask
- Later ETKF/LETKF/EDA

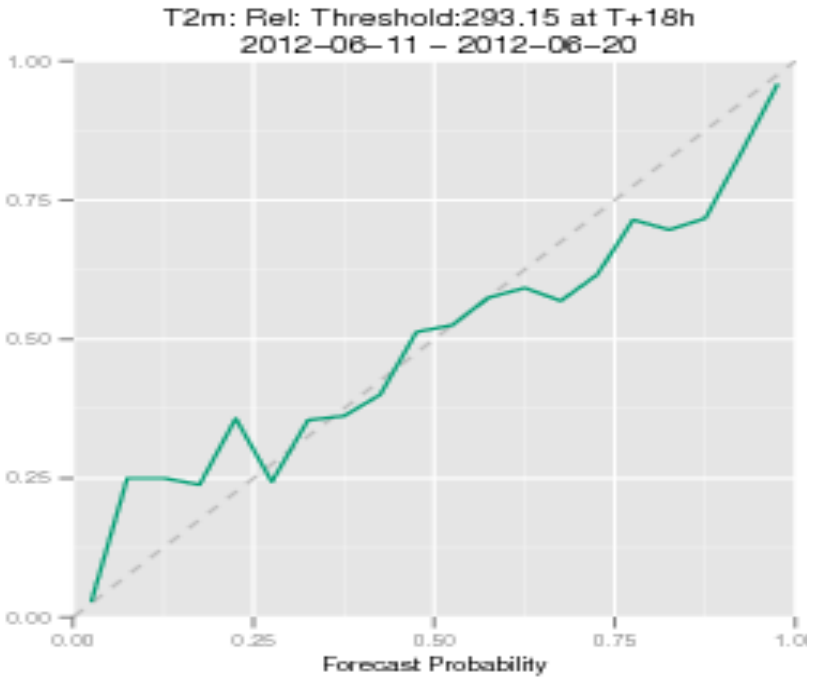
Lateral boundary perturbations:

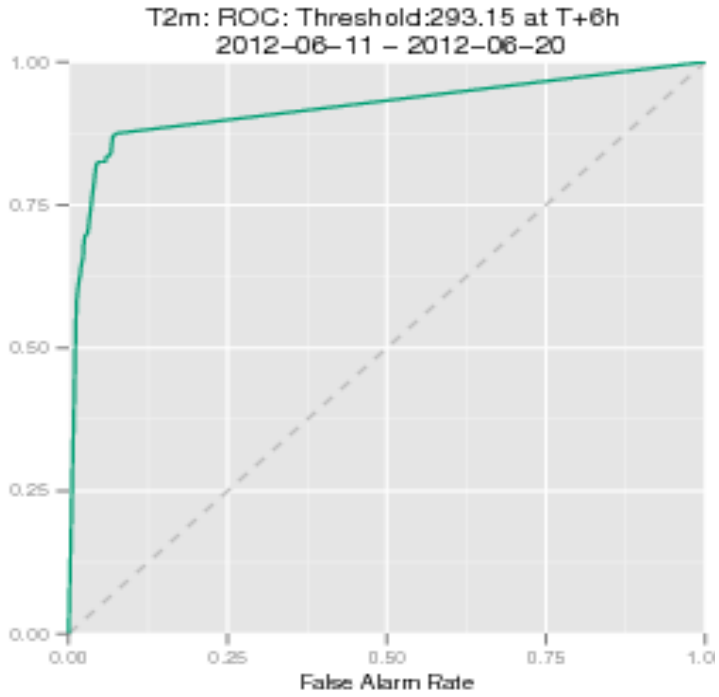
- Test EPS (T639) vs EPS (T1279)
- Difference between deterministic runs / SLAF

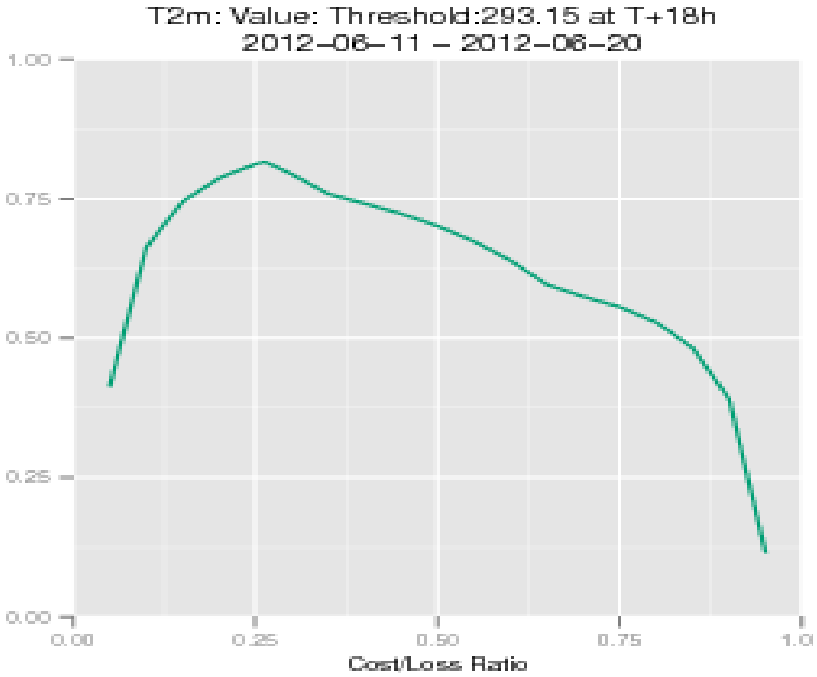
Model error

- Multi-model
- SPPT
- physics parameter perturbations
- Introduce "stochastic physics" on process level, rather than multiplying the total physical tendencies
- Use Cellular Automata (CA)

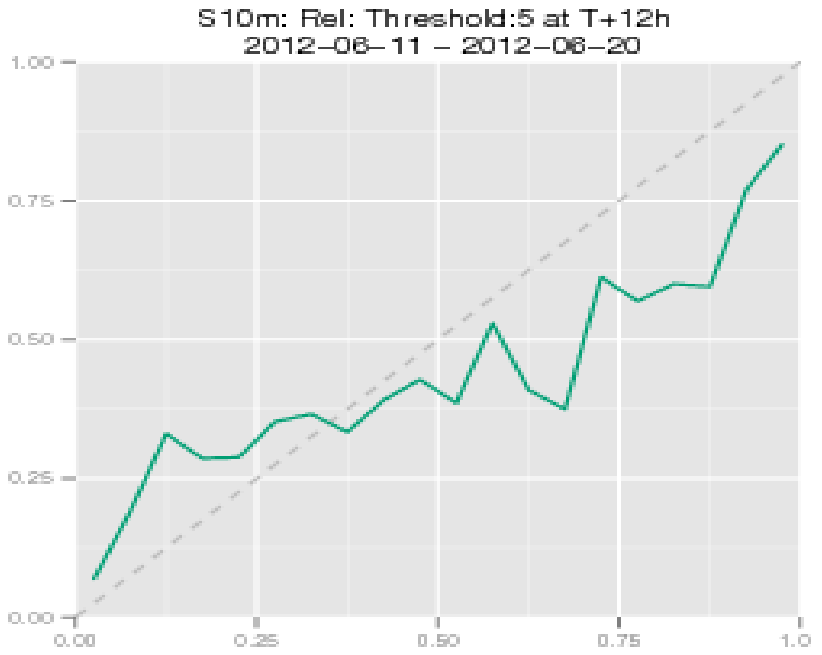
Examples of verification
T2m
10 days in June 2012

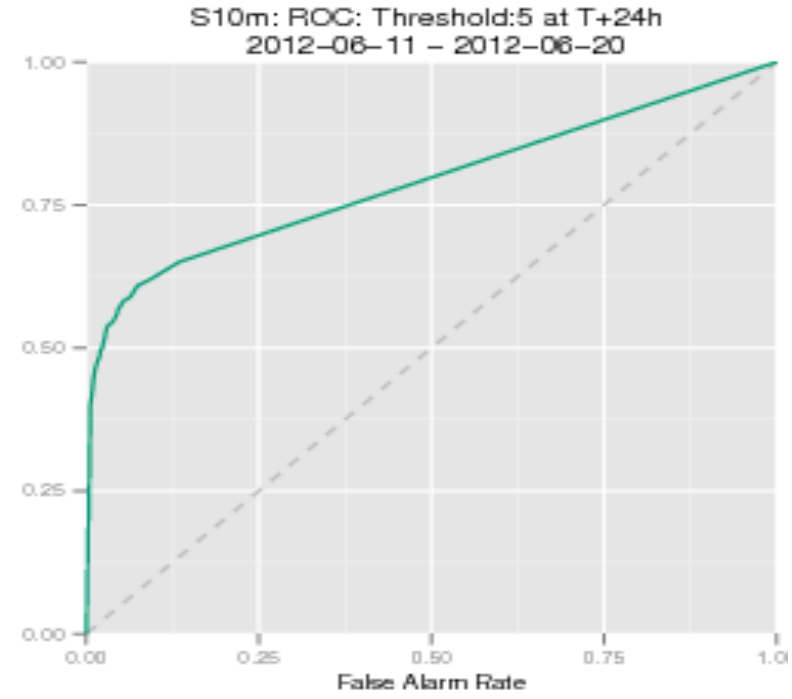


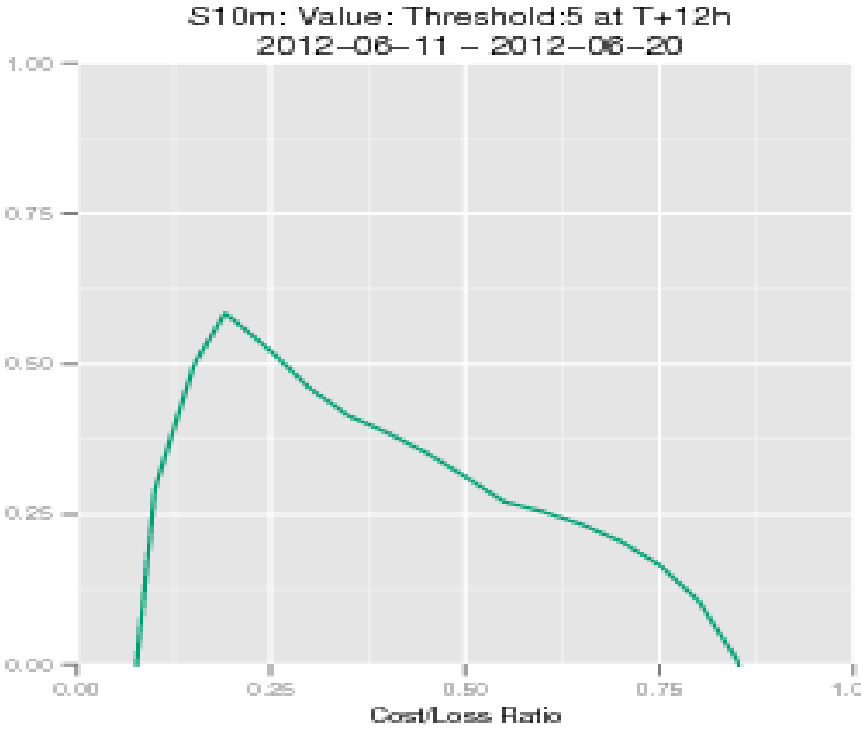




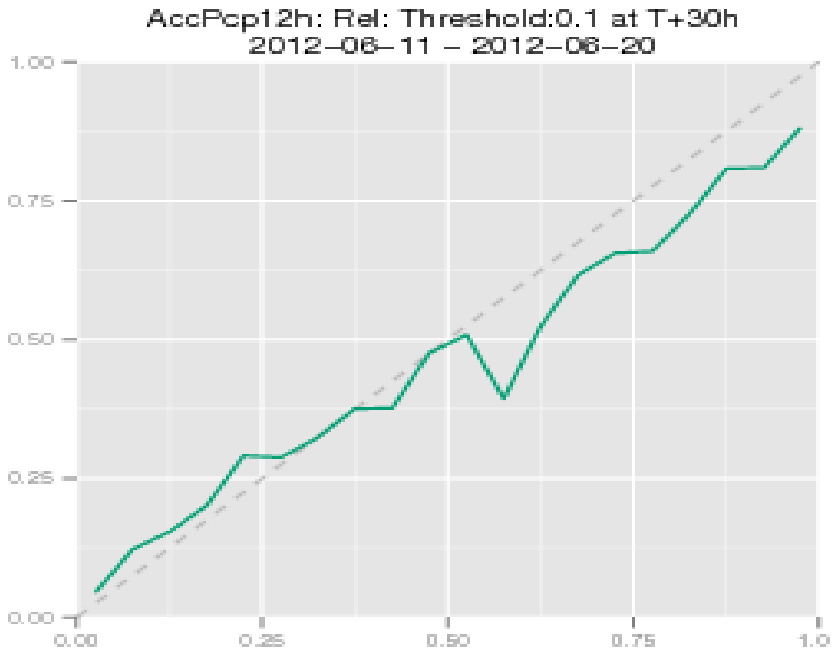
Examples of
verification
10m wind speed
10 days in June 2012

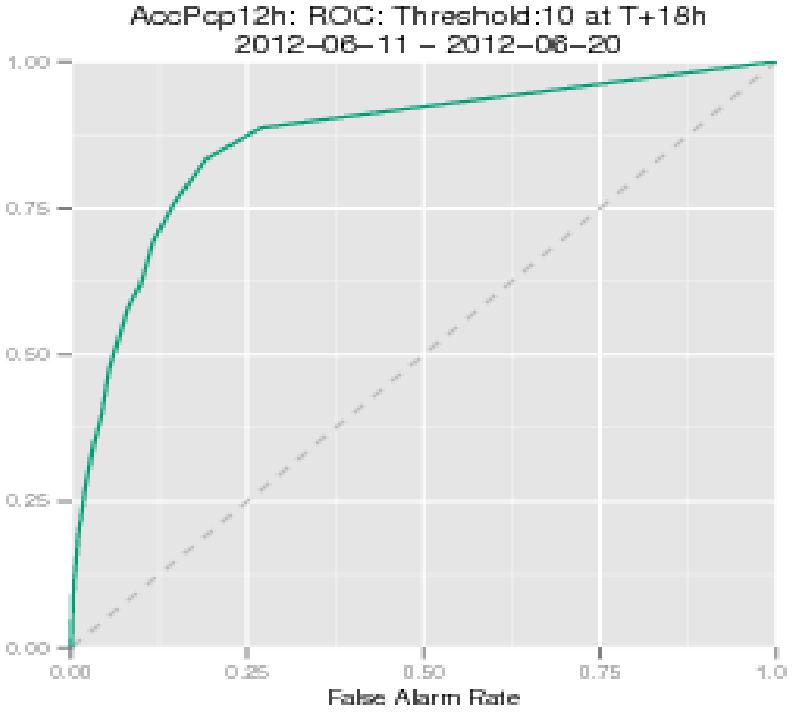


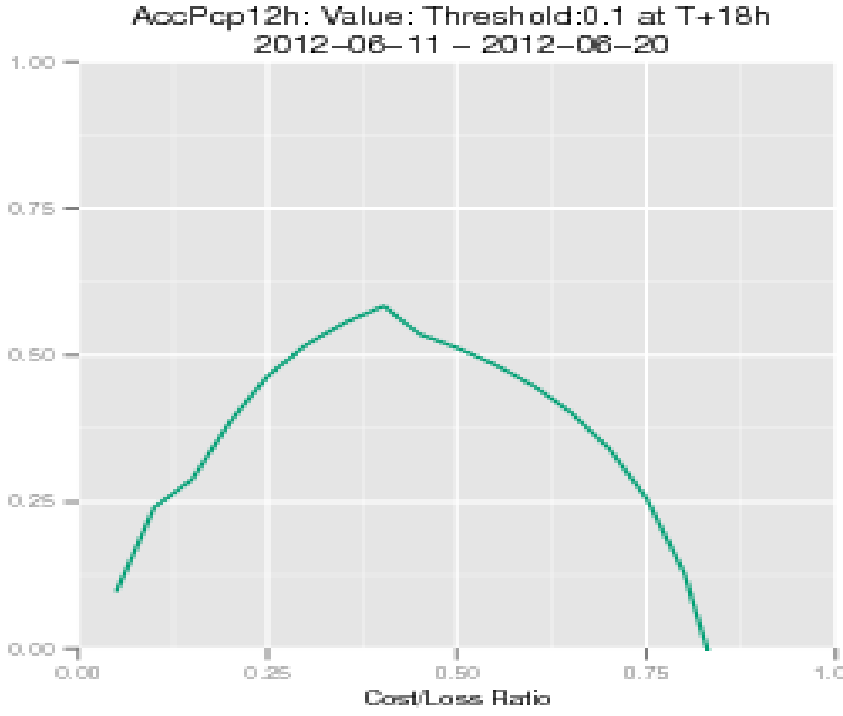




Examples of verification
12 h acc precip
10 days in June 2012







HIRLAM contribution to FROST

Meeting in St. Petersburg last week.

2011:
•GLAMEPS semi operational (FDP). Technical work in setting up Harmonie to run in ensemble mode. First test with HarmonEPS for the area of Sochi run successfully (RDP)

2012:
•Providing GLAMEPS results routinely (FDP) – Delivery of GLAMEPS to FROST from September 2012.
•Run HarmonEPS experiments for the area of Sochi.
•Calibration of EPS forecasts (RDP).

2013:
•Run HarmonEPS for the area of Sochi and provide output
•Calibrated forecasts for venues

Thank you