Grand Limited Area Model Ensemble Prediction System

The prospects of GLAMEPS

Trond Iversen

Core personnel:

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Calibration, presentation, verification:

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ETKF: Å. Johansson, J. Bojarova, N. Gustafsson

SLAF: J. A. Garcia-Moya

Physics perturbations: H. Feddersen, J. Kristiansen

Thanks to ECMWF:
Martin Leutbecher
& Dominique Lucas

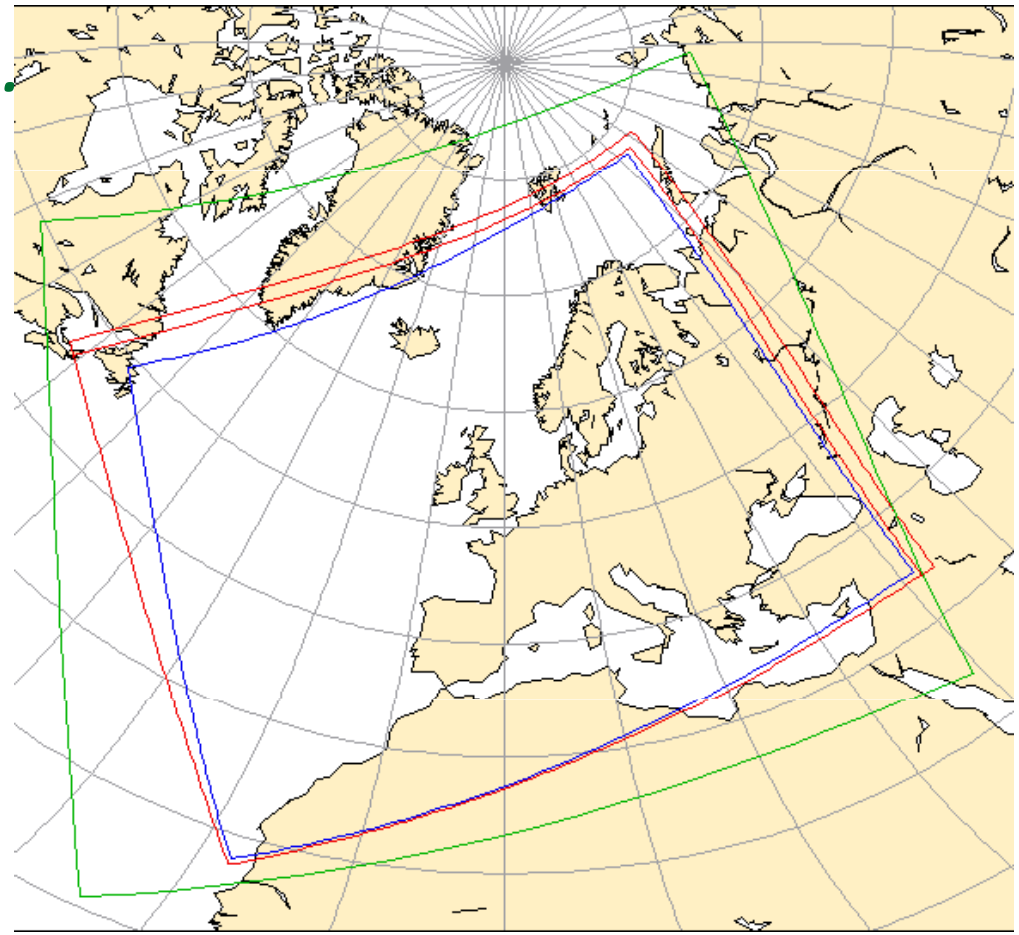
EWGLAM, Exeter, October, 2010

- Some results from GLAMEPS before EPS-upgrade
- *glameps.org* – pre-operational GLAMEPS
- Upgraded EuroTEPS and EuroTEPS-”Super”
- Some further developments
  - ETKF,
    - CAPE SVs, Land-surface multi-analysis, …
- Prospects of cloud-permitting EPS
  - Danish example
  - Norwegian example

Present main candidate for operational GLAMEPS:

52 ensemble members; 13 per model .

EuroTEPS (12 + 1) – or - EC-EPS (12+1)
+ HirEPS_K (12+1) + HirEPS_S (12+1)
+ AladEPS (13) = 52
In reality 51 unique members;
AladEPS_00 is EuroTEPS_00 downscaled



- ***13km grid resolution***

(Aladin 509x416, 12.9km,L37);
(Hirlam 486x378, 0.115deg, L40)
or slightly higher resolution

- ***Forecast range: 42h*** *(54h)*
- ***At 00 and 12 UTC*** *(06 and 18 UTC)*

Experimental operational prod

EuroTEPS_13 Cy35r3 replaced by EC EPS _00-12 Cy36r3

Operational EuroTEPS postponed because of upgrades at ECMWF:

- *T399L62 →T639L62 (36r1)*
- *SVevo →EDA-perturbations (36r2)*
- *new EuroTEPS incl. diabatic SVs is ready, (operational fall 2010)*

Pre-operational test runs since March 2010

Timing results of pre-operational version

- 60 min LAM EPS (serially: AladEPS 40; HirEPS_S 60; HirEPS_K 60)
- 35 Min EC EPS data extraction
- 12 min postPP preparation (Hppv)
- 45 Min postPP production (Hppv)

Overall production time per cycle, ca. **2h 30min**;
obtained by allowing 36 parallel jobs.
With new EuroTEPS: ca. 25 min longer **~ 3h** (needs to be confirmed)

Pre-Operational GLAMEPS

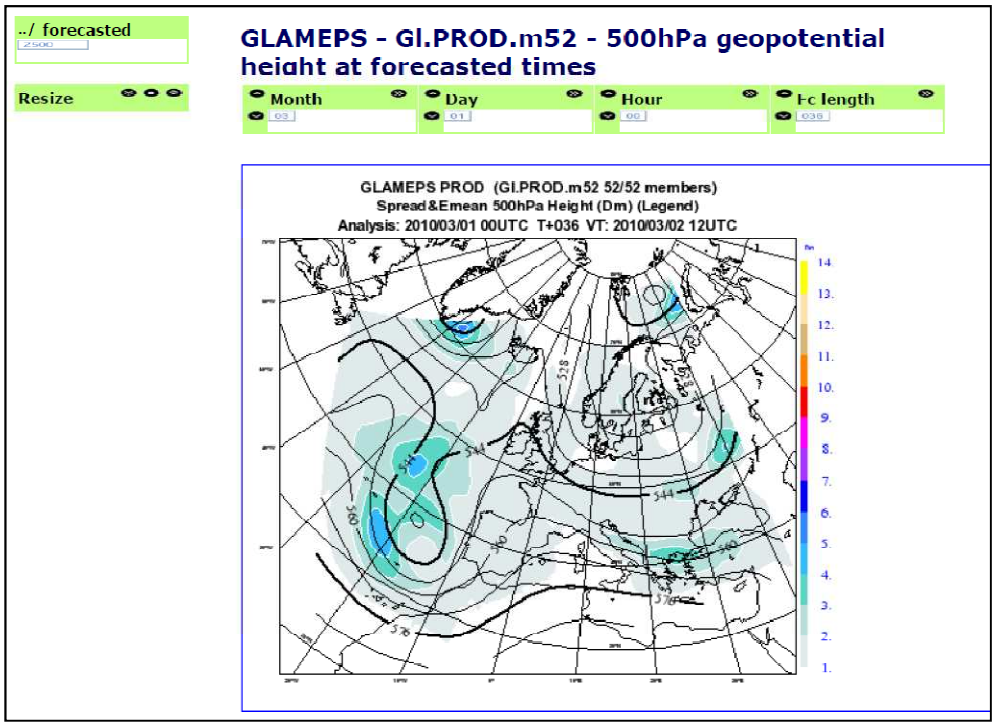
Twice daily GLAMEPS (00, 12) since March 2010

Preliminary product plots available at web-page:

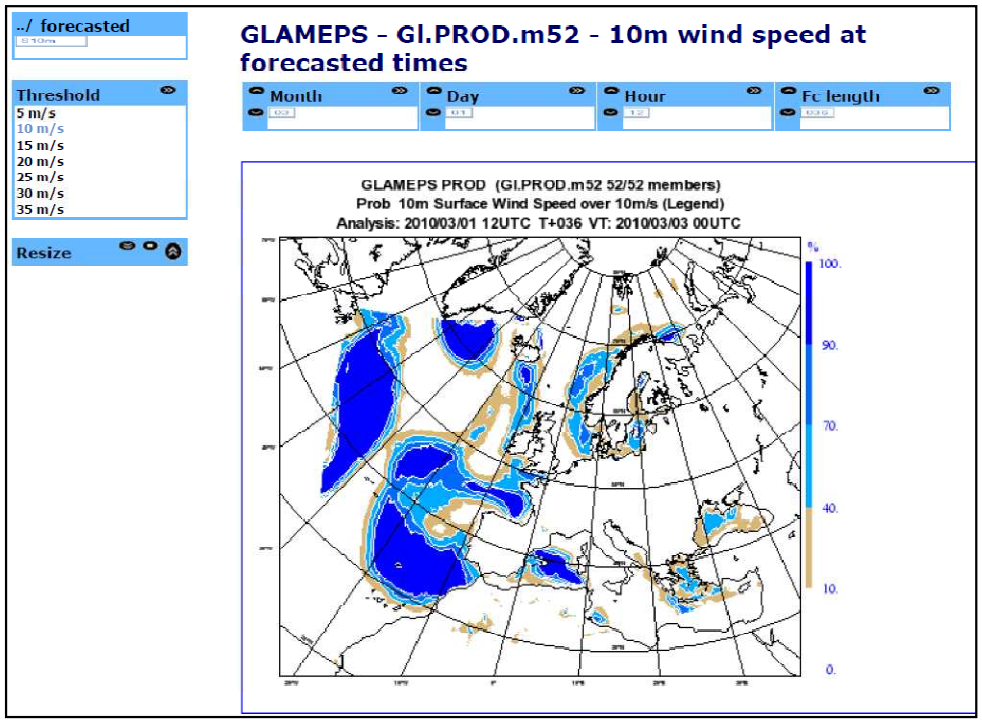
https://glameps.org

For Example:

Z_{500} ensemble mean + RMS spread



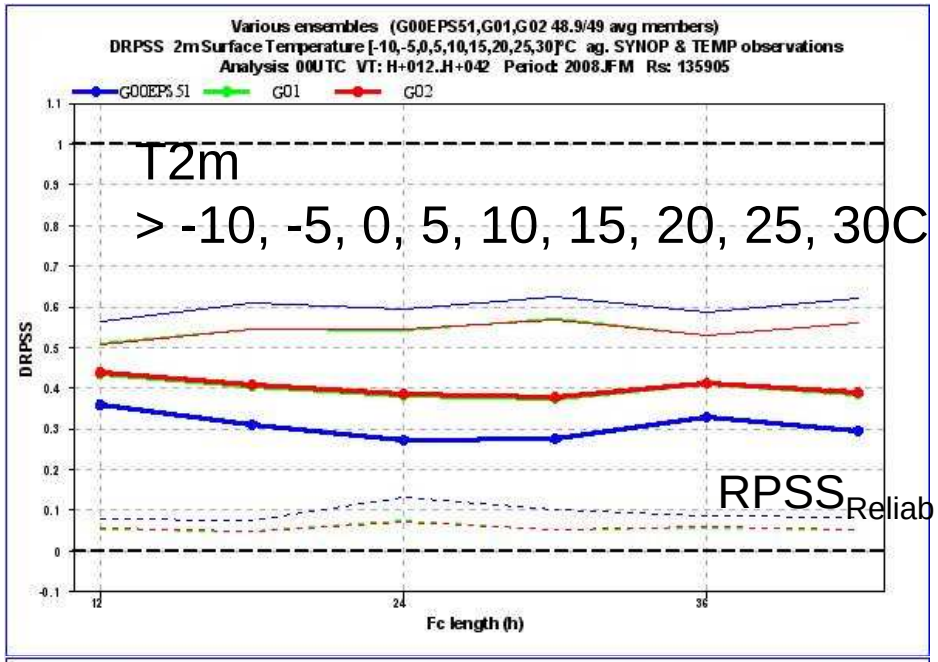
Prob [ff10m > 10m/s]

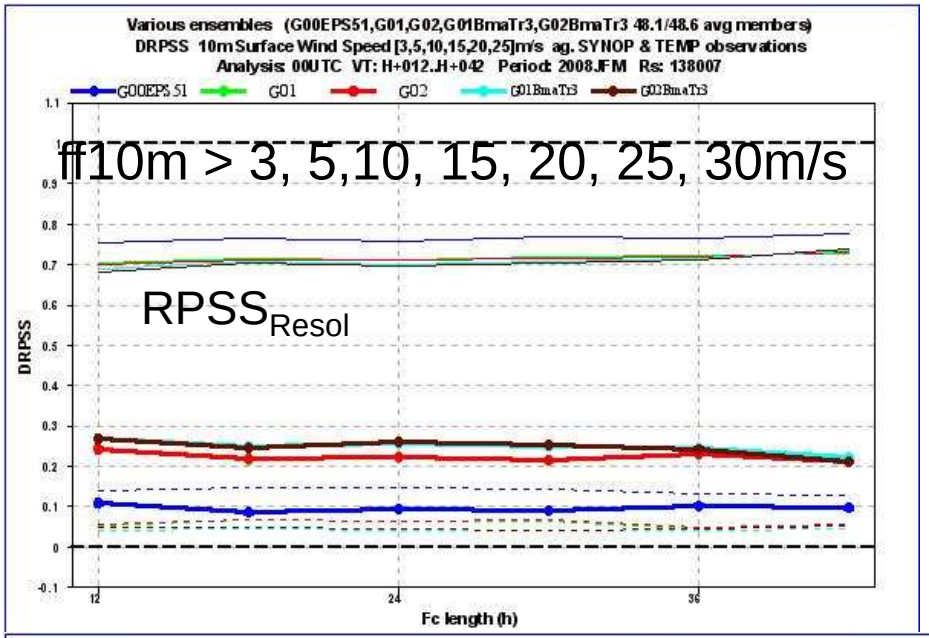


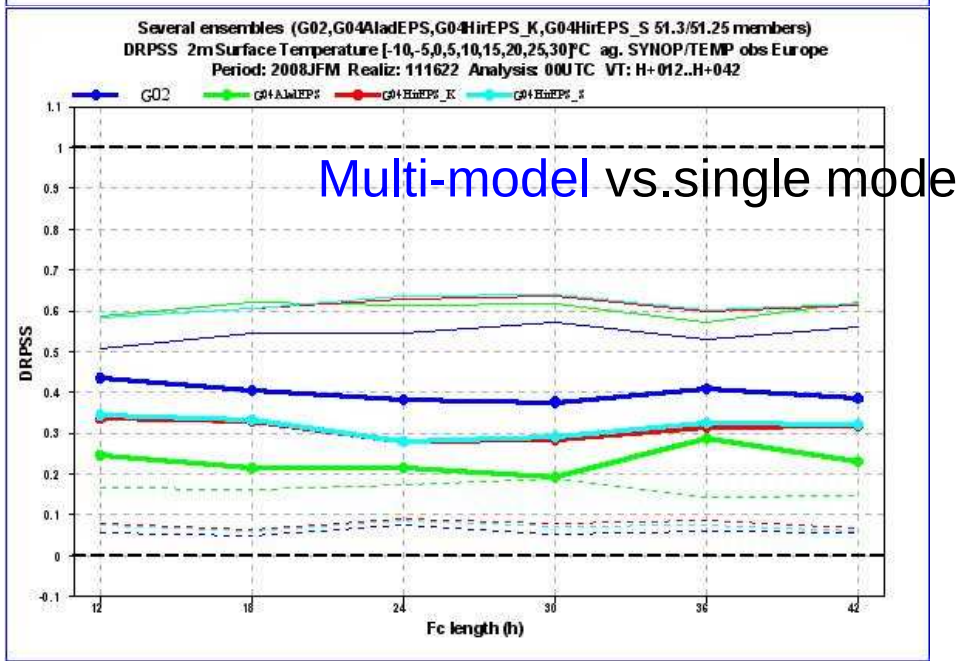
Ranked probability skill score – DRPSS 2008/0117 - 0308 (00, 12)

Using T399L62 EuroTEPS

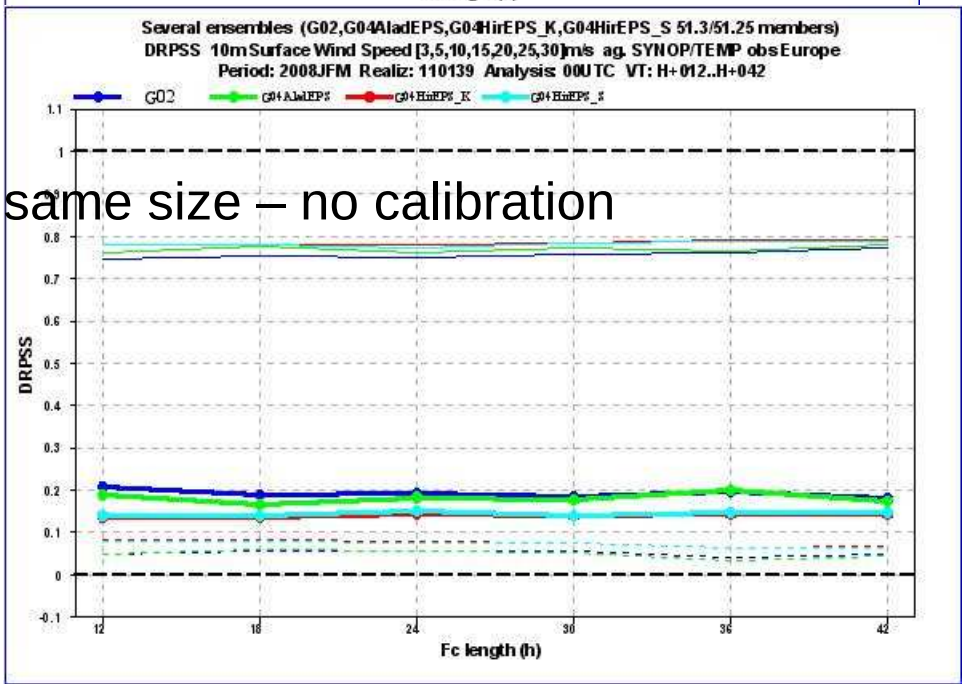
[$DRPSS = 1 - DRPSS_{Reliab} - DRPSS_{Resol}$]







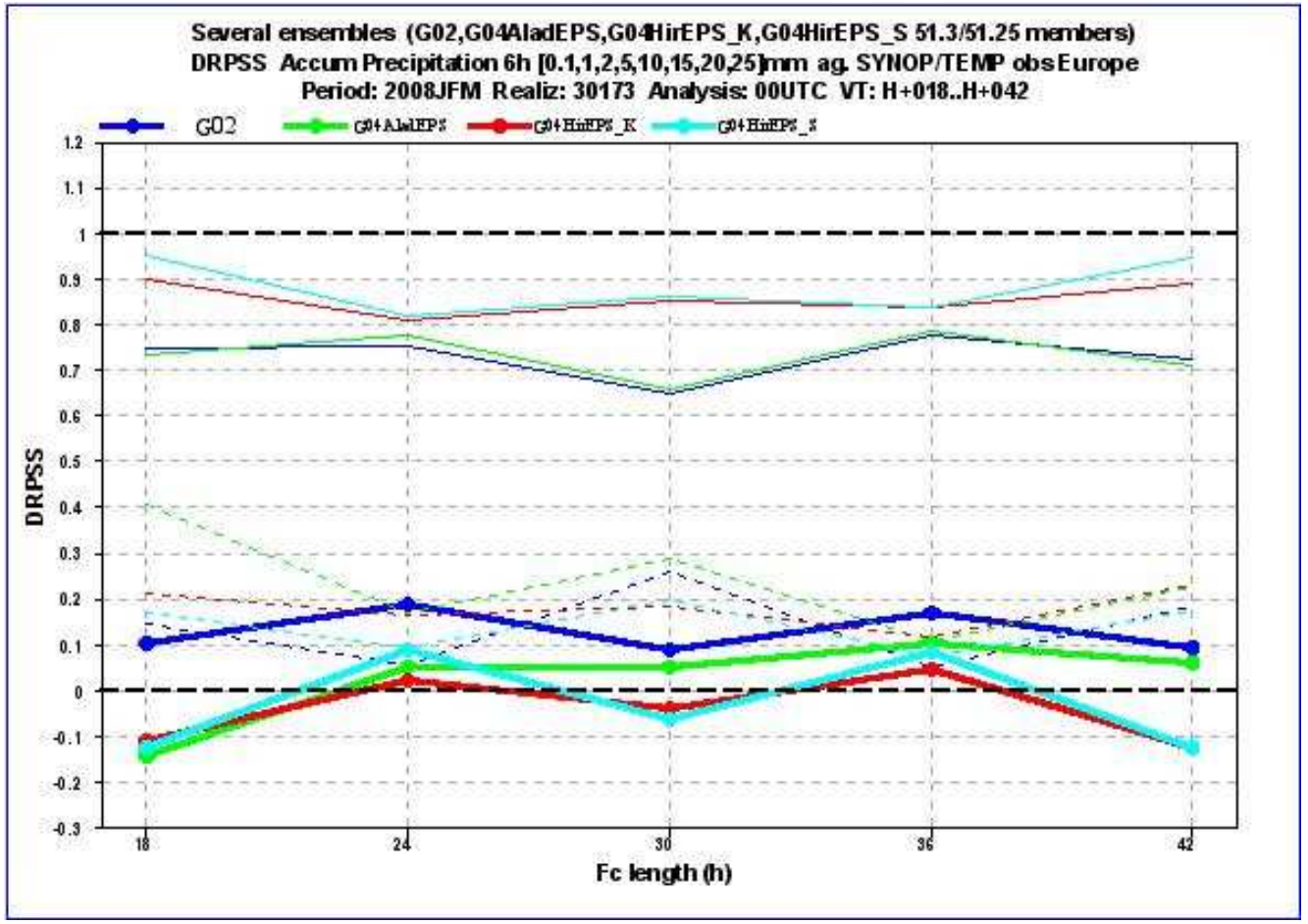
Multi-model vs.single model EPS of same size – no calibration



DRPSS 12-42h, 6h Precip

Multi-model vs.single model EPS of same size – no calibration

Pr6h > 0.1, 1, 2, 5, 10, 15, 20, 25, mm/6h



EuroTEPS with EDA

IFS Cycle 36R3

I-L. Frogner

Ack.: M. Leutbecher

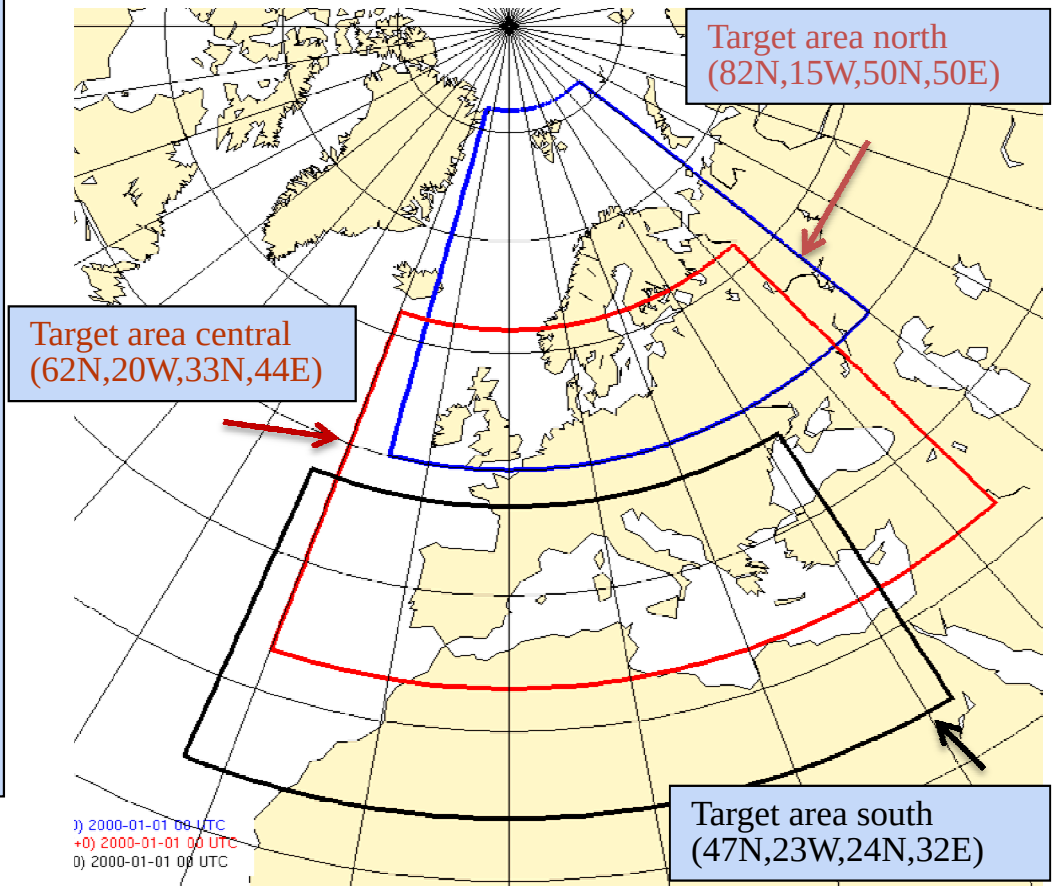
The Targeted Singular vectors (TSVs):

- T159
- 24h optimization time
- diabatic, moist physics in TL & Adj
- orthogonal to the operational SVs

Initial perturbations:

Gaussian sampling of the following SVs :

- 10 TSVs from each of the three European target areas
- 50 SVs from the operational EPS
- Added to the EDA perturbations



Target areas presently used in EuroTEPS

Timing and cost issues, EuroTEPS”super” rough estimates

Timing: almost the same

•When TSVs are computed *after* the NHSVs → about 10 minutes longer computation time.

members run in parallel:
•EuroTEPS 48h for one member, T1279L62 (ensemble run only) ca 40 minutes
•EPS 240h run, for one member, T639L62 (ensemble run only) ca 40 minutes

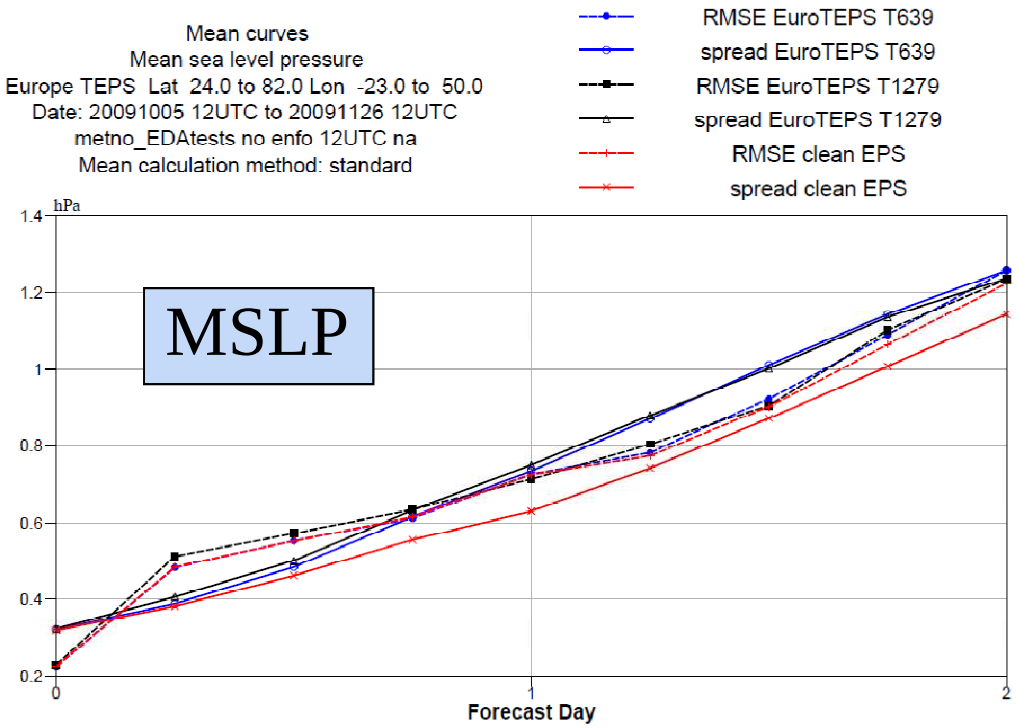
SBU

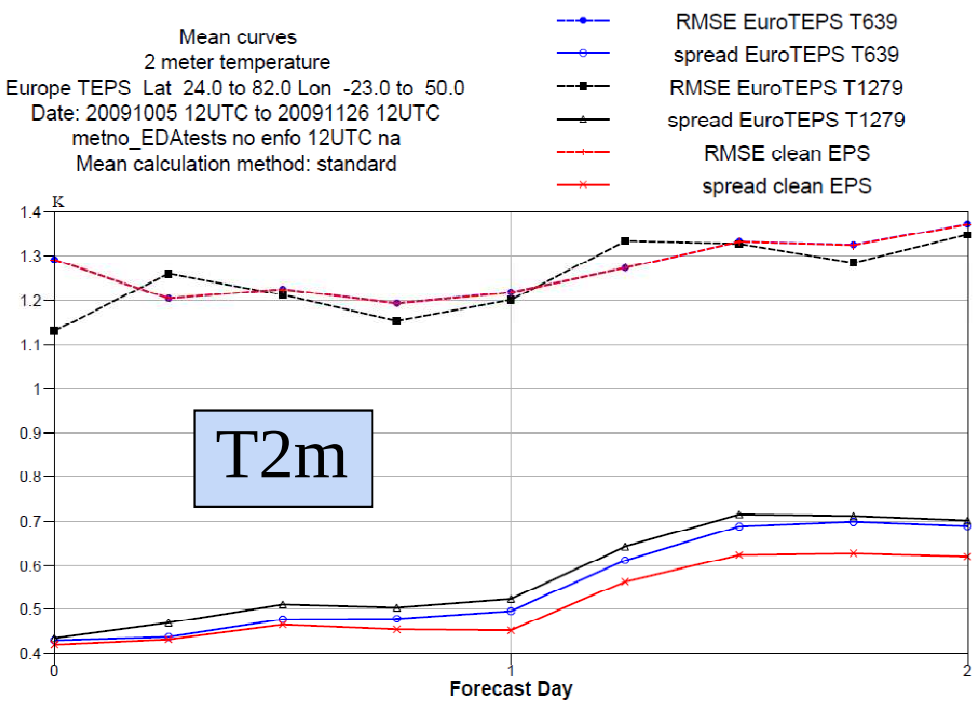
48h, 12+1 member EuroTEPS”super”: 40% of the SBUs used by 240h EPS with resolution T639L62

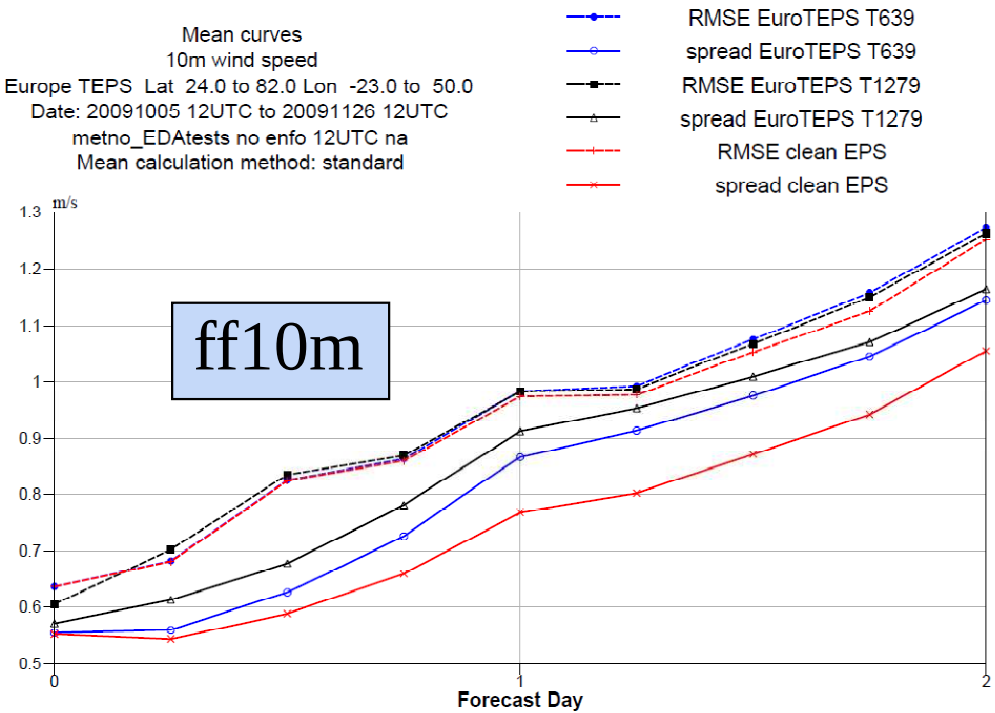
⇒EuroTEPS”super”, 06 and 18 UTC: 37200SBU * 2 * 365 = **27 mill SBU**

AMPLITUDE TUNING
EuroTEPS resolution T1279L62 (“super”) and T639L62 (standard)

- Different amplitudes can be assigned to the different sets of SVs,
- So far, the best spread/skill relationship obtained with:
  - **75 % reduction of EPSGAMMA for NHSV => EPSGAMMA=0.002**
  - **EPSGAMMA for TSV = 0.008**
- EuroTEPS and EuroTEPS”super” compared to an EPS with same ensemble size: 12+1, +48h

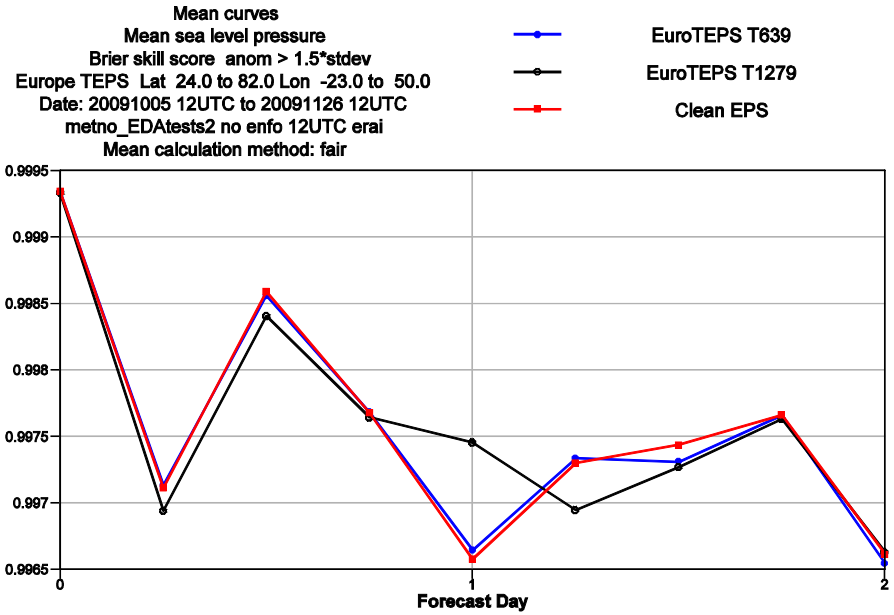




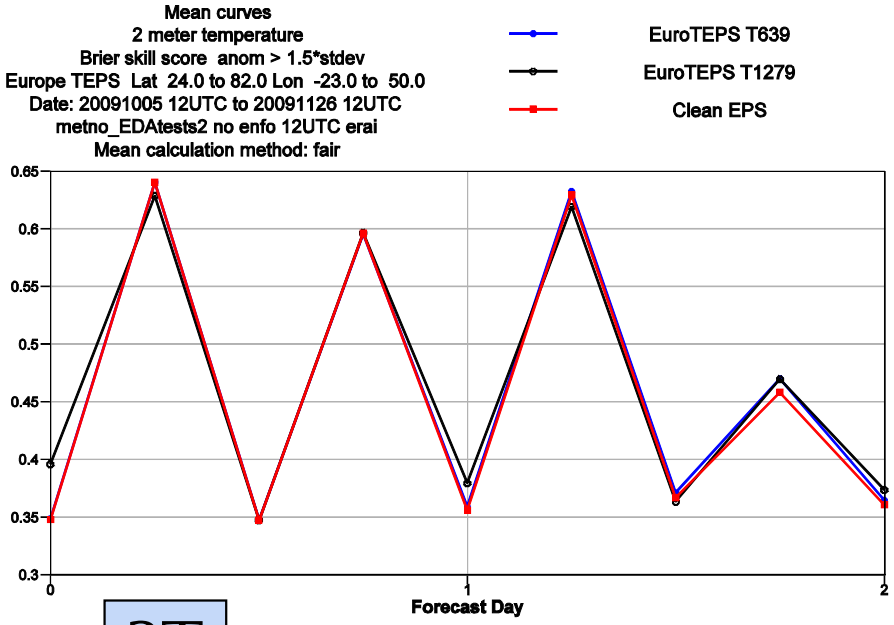


Examples of verification from 14 days in 2009

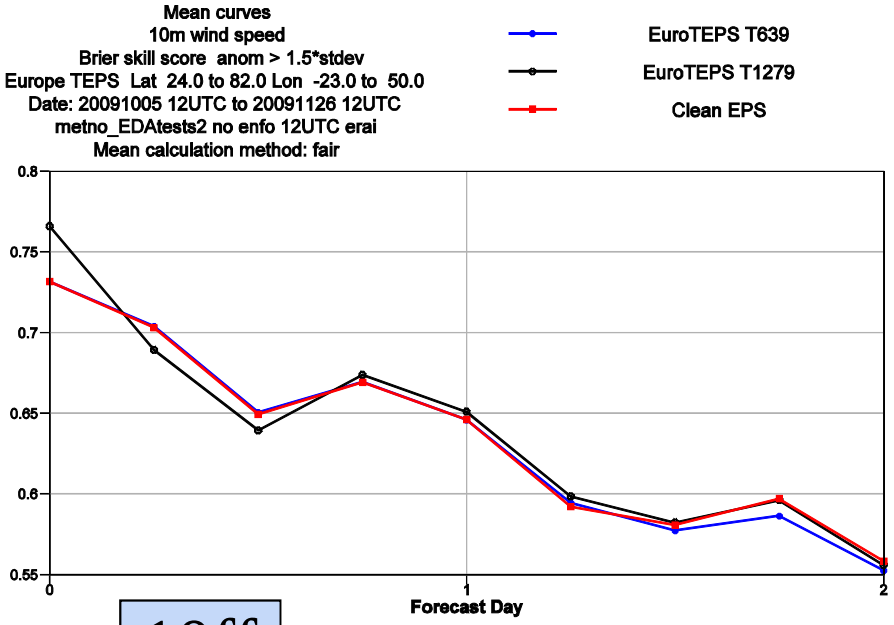
BSS
Thr: > 1.5s



MSLP



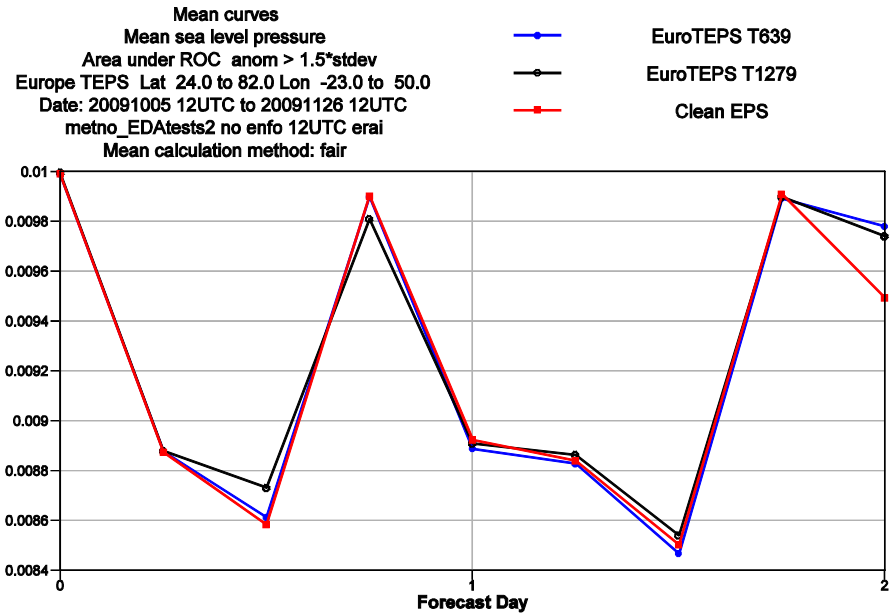
2T



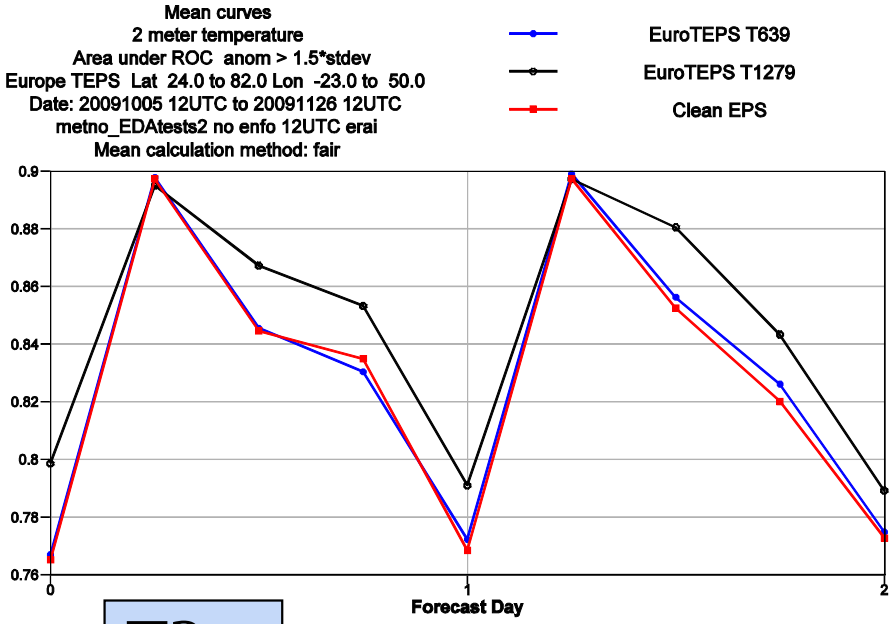
10ff

Examples of verification from 14 days in 2009

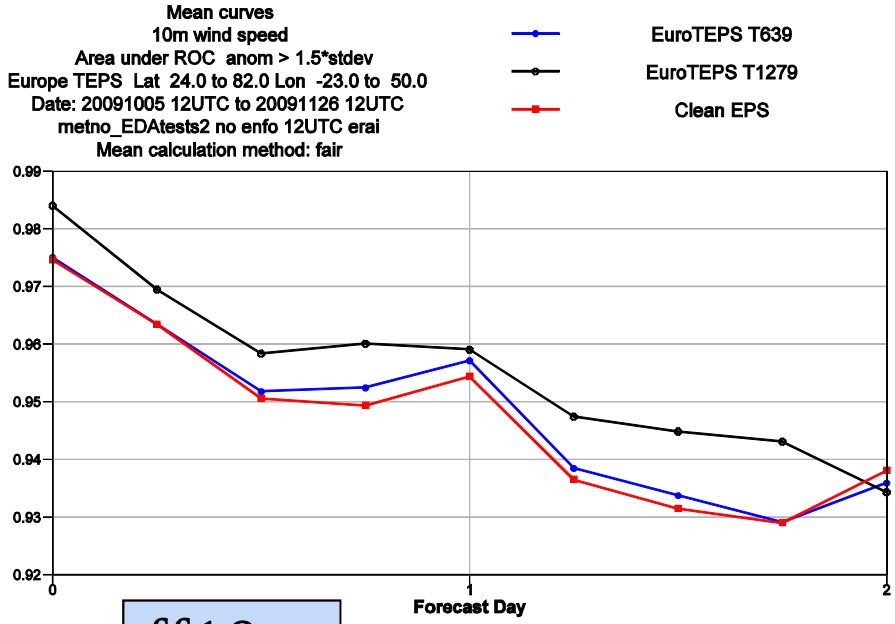
Area ROC
Thr: > 1.5s



MSLP



T2m



ff10m

ETKF, Åke Johansson

Control vs ETKF-Pert vs EuroTEPS-Pert

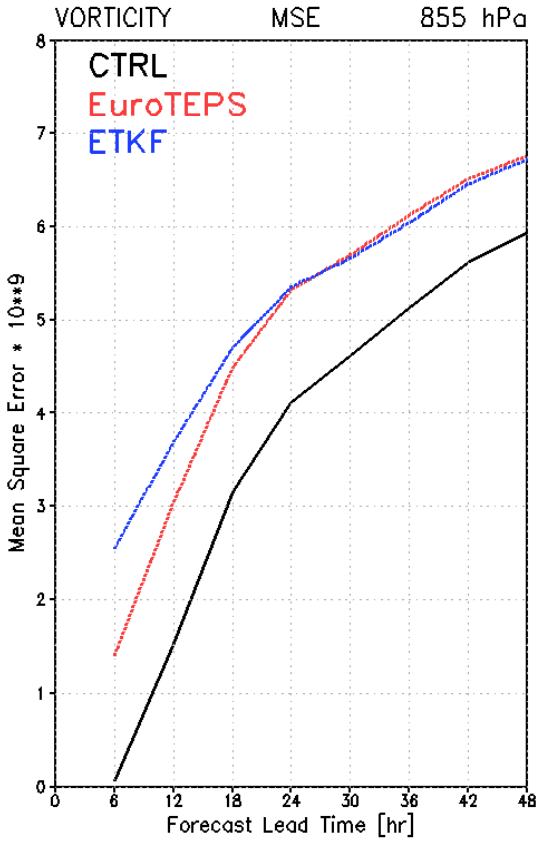
MSE of Vorticity at different levels

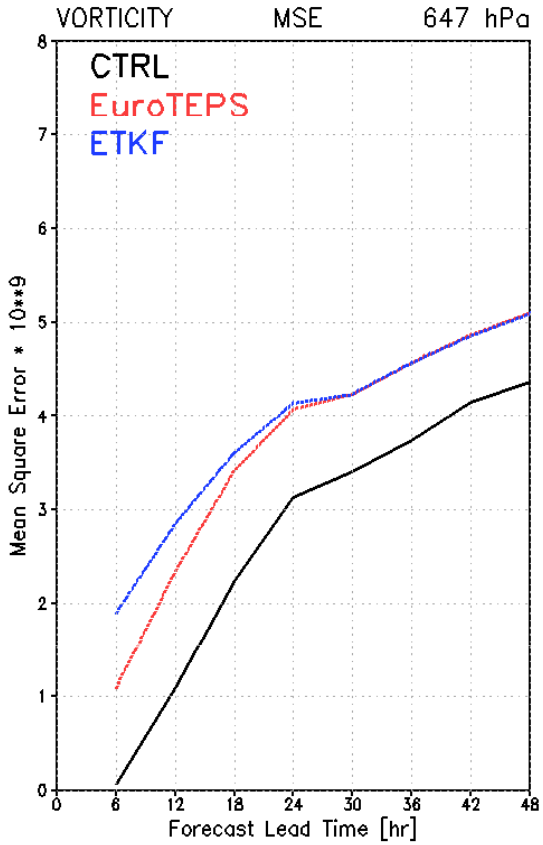
- Diagnostics for 25 JAN-5 FEB 2008
- GLAMEPS_V1: 0.115 X 0.115 , L40
- 12 Members

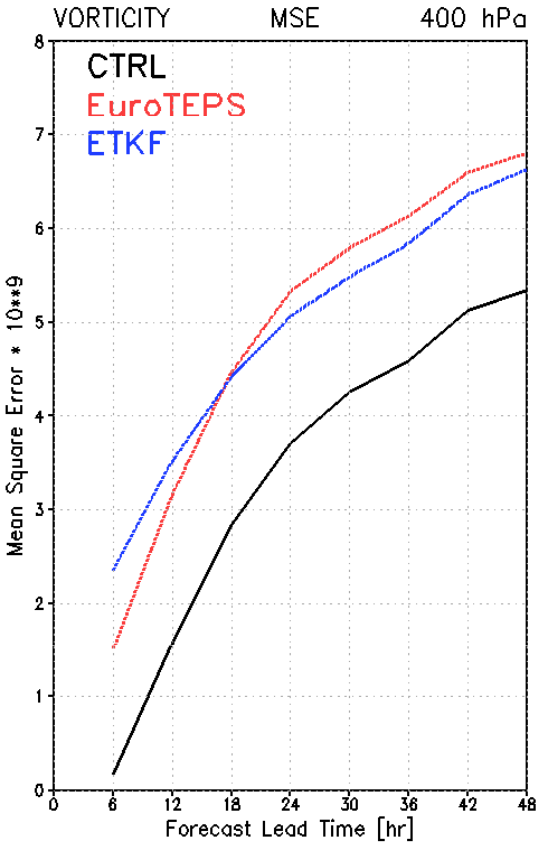
Experiment called EuroTEPS:
100 % EuroTEPS on the lateral and upper boundaries
100 % EuroTEPS in the interior

Experiment called ETKF:
100 % EuroTEPS on the lateral and upper boundaries
80% ETKF and 20% EuroTEPS in the interior

MSE


VORTICITY MSE 855 hPa
CTRL
EuroTEPS
ETKF
Mean Square Error * 10**9
Forecast Lead Time [hr]
0 6 12 18 24 30 36 42 48
0 1 2 3 4 5 6 7 8

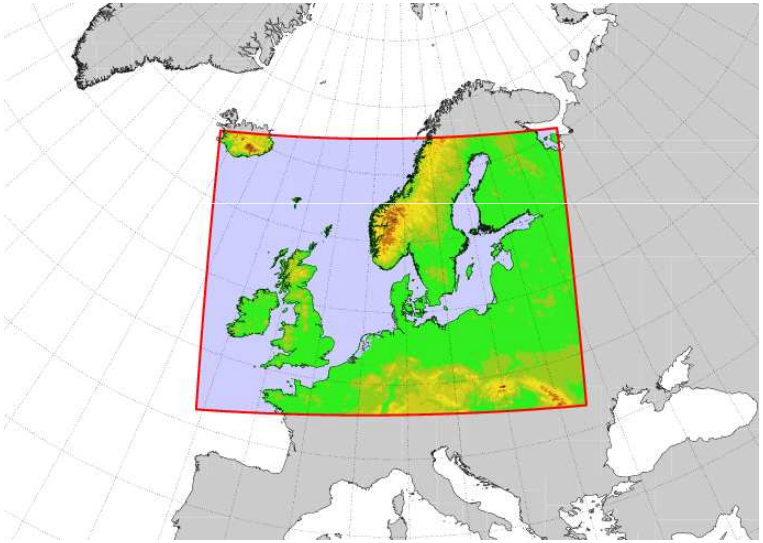

VORTICITY MSE 647 hPa
CTRL
EuroTEPS
ETKF
Mean Square Error * 10**9
Forecast Lead Time [hr]
0 6 12 18 24 30 36 42 48
0 1 2 3 4 5 6 7 8


VORTICITY MSE 400 hPa
CTRL
EuroTEPS
ETKF
Mean Square Error * 10**9
Forecast Lead Time [hr]
0 6 12 18 24 30 36 42 48
0 1 2 3 4 5 6 7 8

12 UTC + Xh

DMI-EPS configuration (experimental)

H. Feddersen, K. Sattler



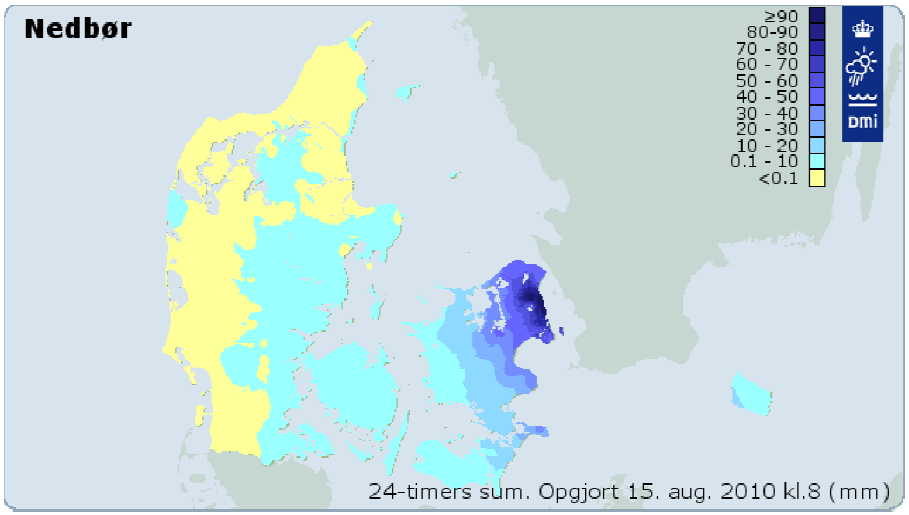
- HIRLAM 0.05° horizontal resolution
- 40 levels
- Forecast length=36hr
- 25 members
- Analysis for control run
- Runs 4 times daily

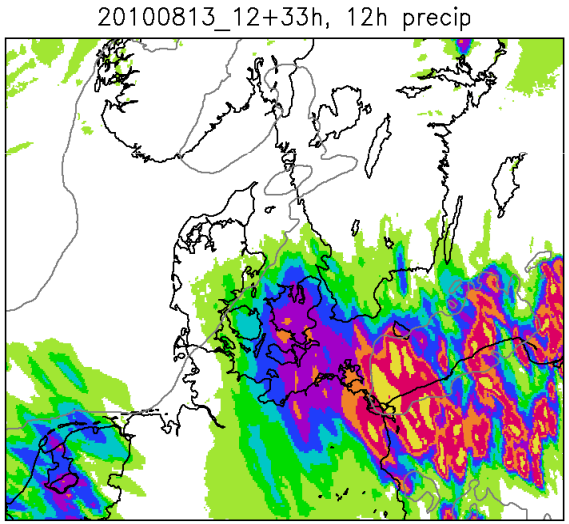
- SLAF initial conditions: $IC=AN\pm\alpha_n[FC_{n\ hr\ old}(n\ hr)-AN]$, n=0,6,12
- Lateral boundary conditions: Like initial conditions
- Model perturbations
  - Convection/condensation: STRACO or KF/RK
  - Stochastic physics: yes or no
  - Land surface: ISBA or ISBA+HIRLAM ”Newsnow”

Copenhagen rain event on 14 Aug 2010

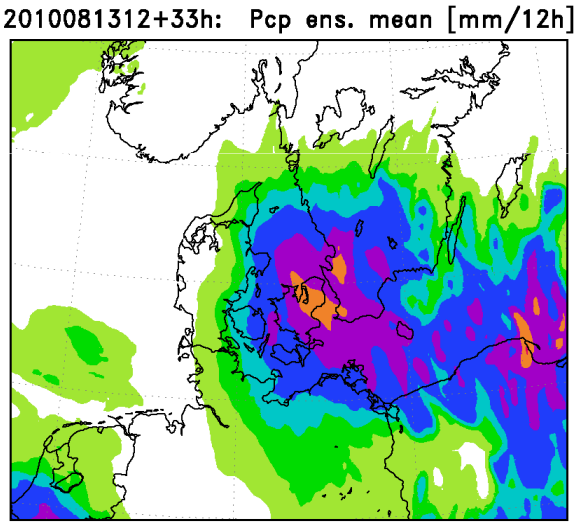
DMI

Lyngbyvej





DMI's operational HIRLAM

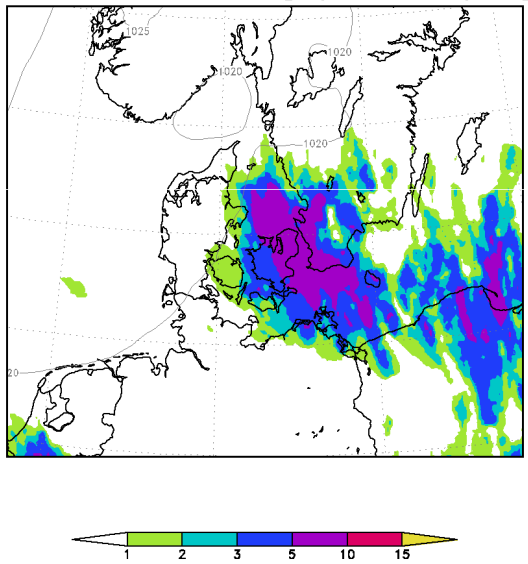


DMI-EPS ensemble mean

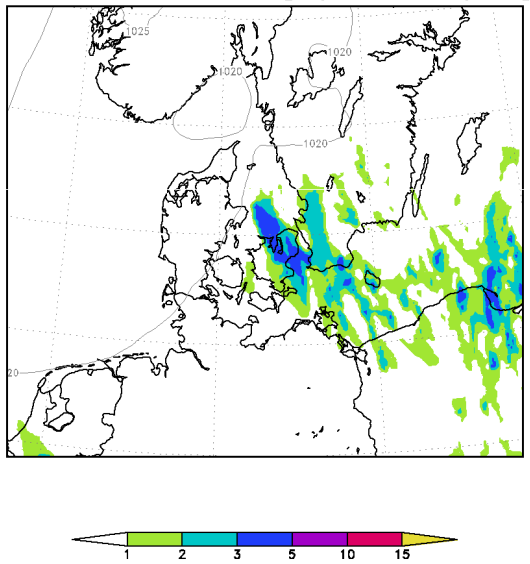
DMI-EPS ”probability maps”

(no. of ens.members predicting prec>P mm/12h)

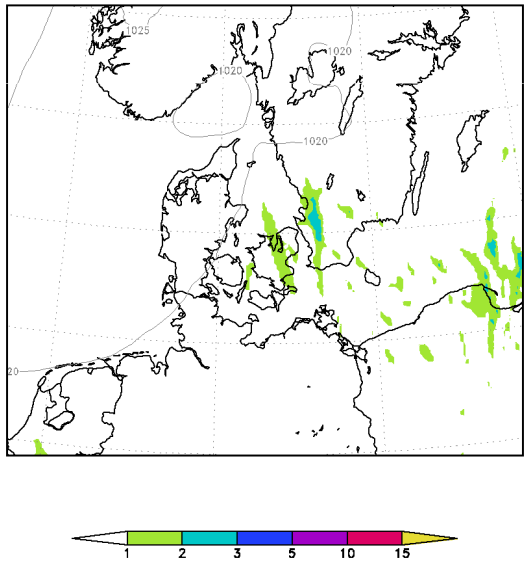
2010081312+33h: mbrs[Pcp > 10. mm/12h]



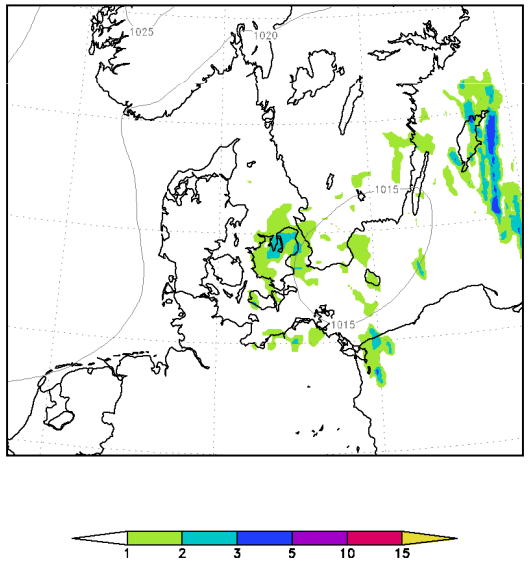
2010081312+33h: mbrs[Pcp > 25. mm/12h]



2010081312+33h: mbrs[Pcp > 50. mm/12h]



2010081412+12h: mbrs[Pcp > 50. mm/12h]

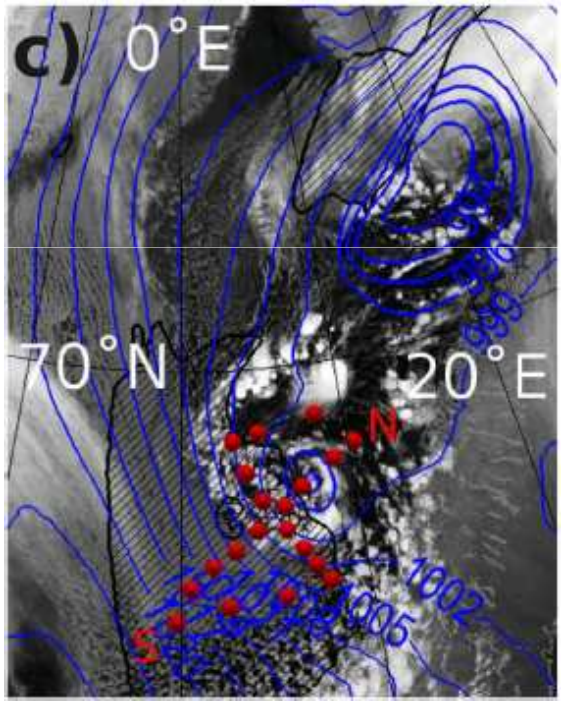


High-resolution ensemble prediction of a polar low development

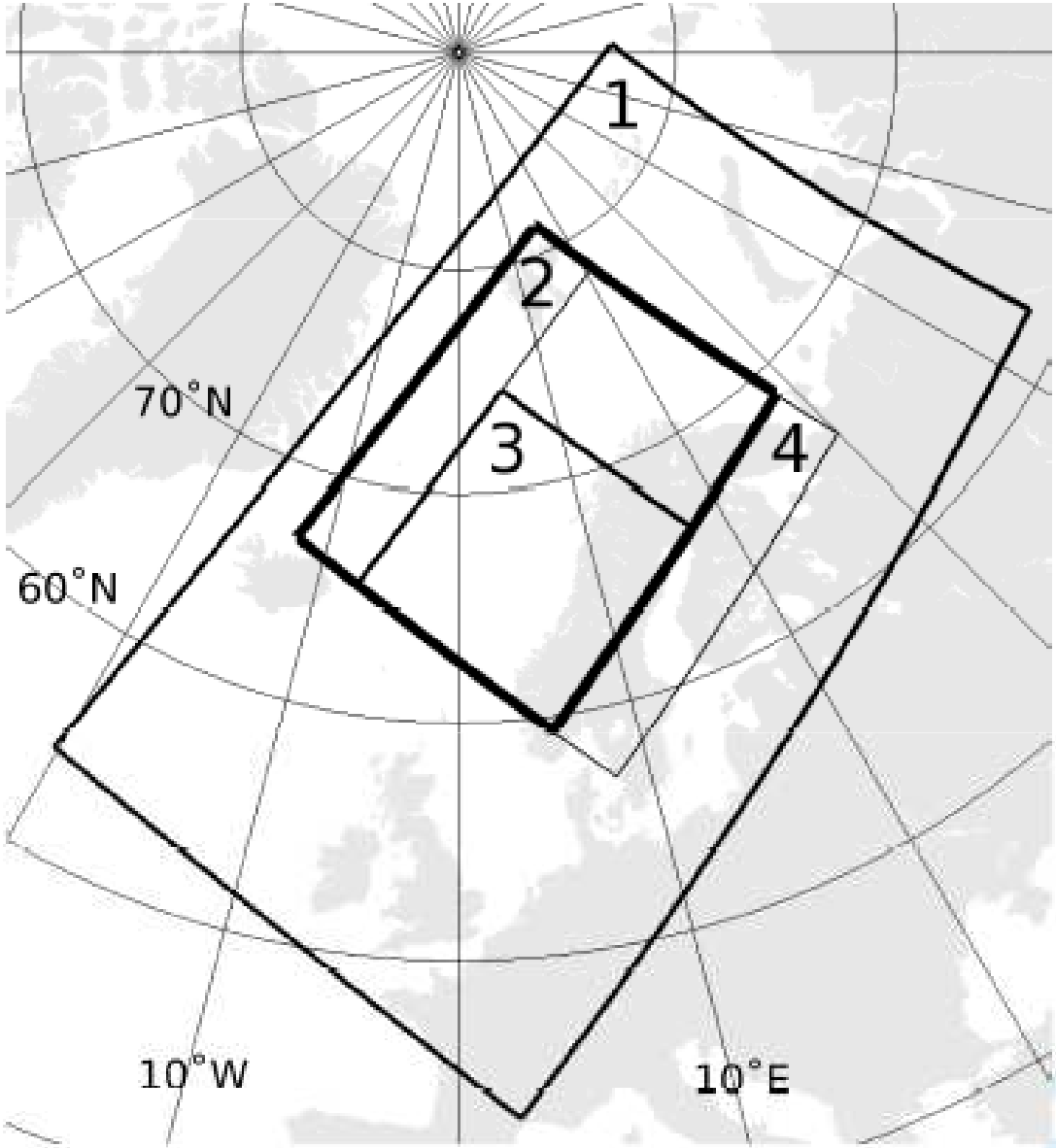
By Jørn Kristiansen[1*], Silje Lund Sørland[1], Trond Iversen[1,2], Dag Bjørge[1] and Morten Ødegaard Køltzow[1], [1]*Norwegian Meteorological Institute (met.no), Oslo, Norway;*

[2]*Department of Geosciences, University of Oslo, Norway*

Valid time: 1200 UTC 4 March 2008

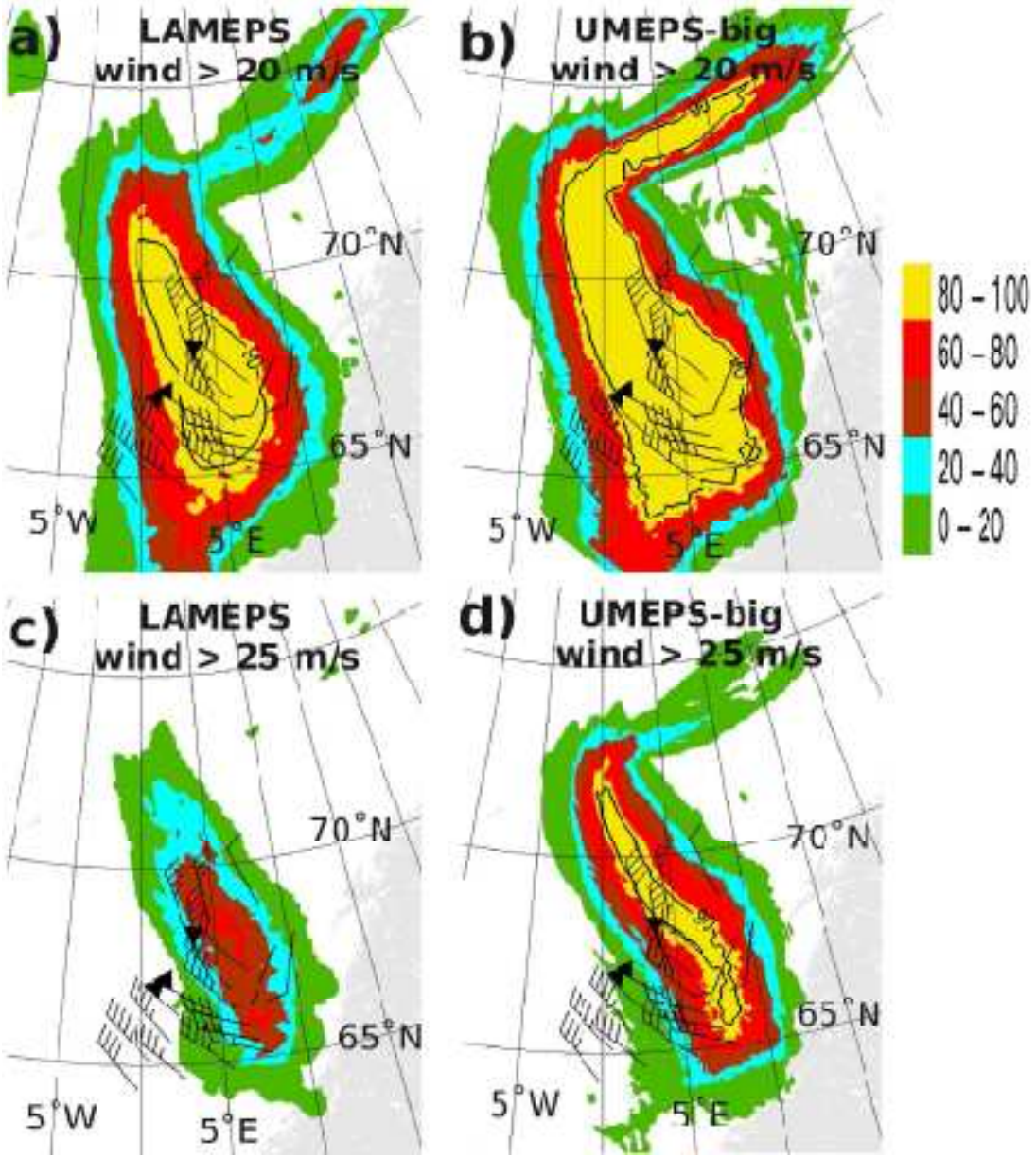


Model domains



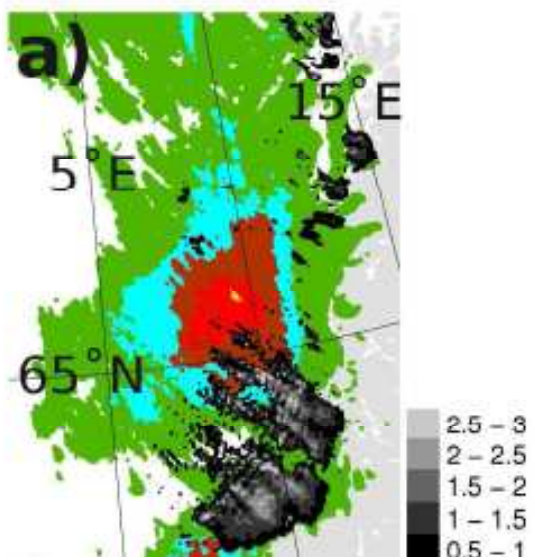
1 LAMEPS (12 km grid spacing)
2 UMEPS-big
3 UMEPS-small
4 UMEPS-bigII

Probability for severe winds 12 UTC 4 March (T+42)

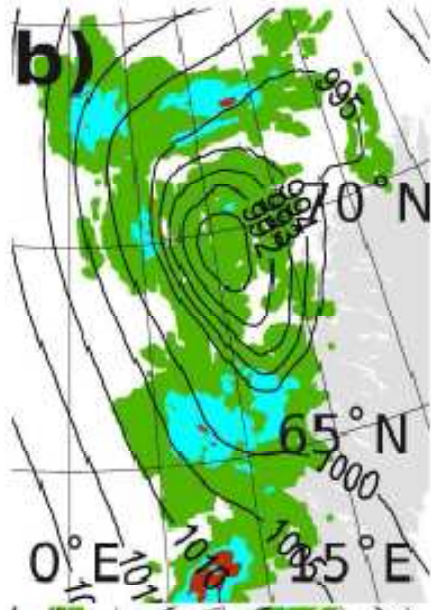


Probability for precipitation

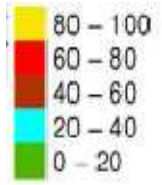
2.5 mm/3h; 0900-1200 UTC 4 March (T+39->T+42)

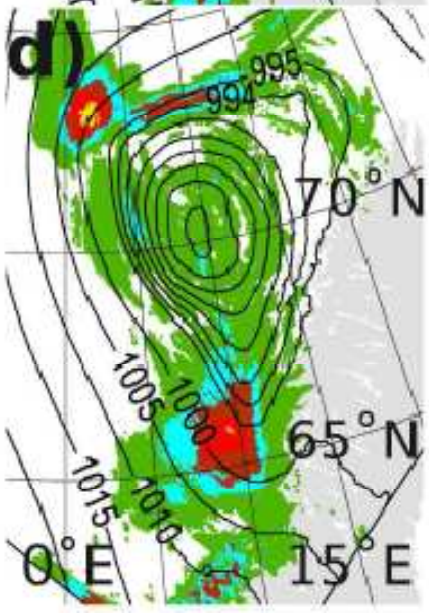


UMEPS-big (colour) Radar observations (grey)



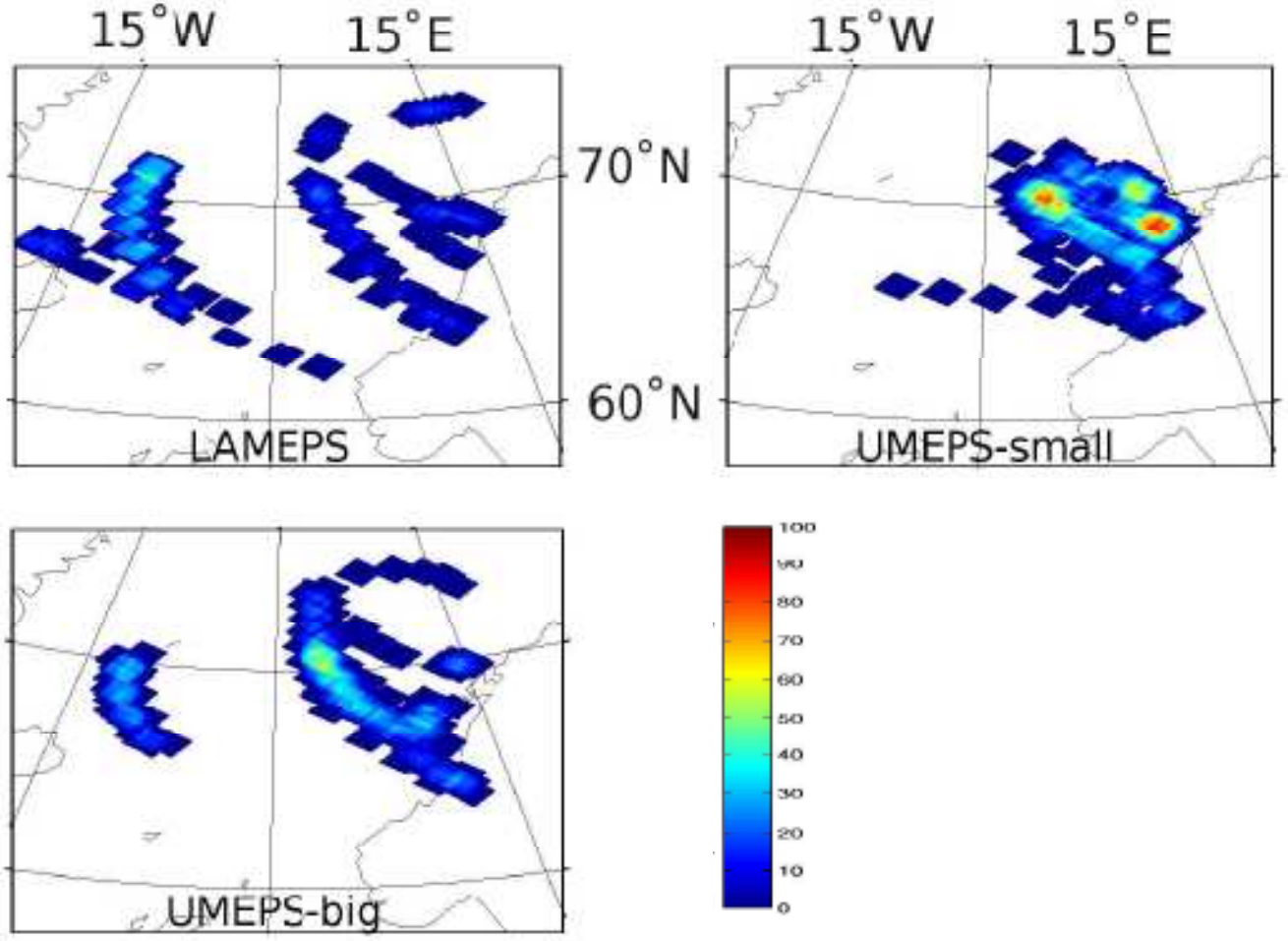
LAMEPS





UMEPS-big

Strike Probability Maps




Thank You!

Summary on GLAMEPS

- GLAMEPS_v1 is running operationally at ECMWF
- Multi-model better than single model EPS
  - Exceptions exist: systematic un-even model quality
- Replacing EuroTEPS with EPS-selection degrades – but only slightly
  - However, EuroTEPS is not fully exploited so far
  - With EPS, resources could be spent on something else
- Ongoing development:
  - Upgrading EuroTEPS
  - Multiple surface analysis in ALADIN
  - ETKF in HIRLAM
  - HIRLAM SVs (CAPE)
  - Further work on BMA (or other calibration methods)
  - Operational verification