GLAMEPS

Grand Limited Area Model Ensemble Prediction System

Towards operational production

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Thanks to ECMWF:
Martin Leutbecher
& Dominique Lucas

EWGLAM, Athens, Ultimo September, 2009

GLAMEPS: Version 1 Operational ideas

- ***An array of Hirlam and Aladin LAM-EPS models coupled to ECMWF EuroTEPS:***
  - ***EuroTEPS*** *- Provides initial and lateral boundary data: ECMWF's EPS extended with higher-resolution, 24h-optimized SVs, European target. +72h, 2x / day.*
  - ***LAM EPS*** *computations can be made*

    in one central place (e.g. ECMWF),

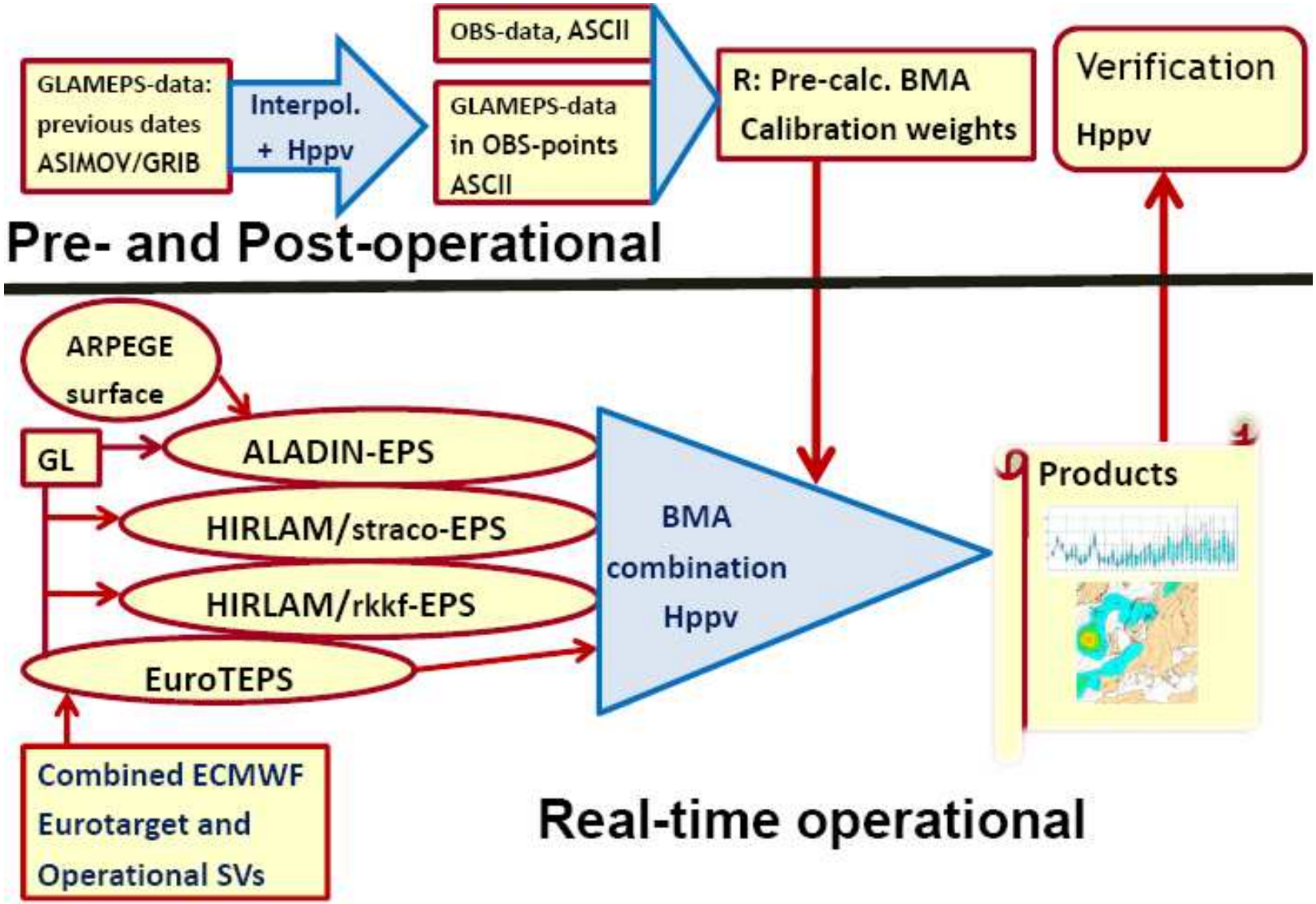
    or partly distributed amongst partners*:*
    - ***HirEPS_K*** *&* ***HirEPS_S:*** *Two HIRLAM versions for two 3DVar-based control forecasts and IC and LBC ensemble perturbations from EuroTEPS,*
    - ***AladEPS****: is a downscaling of EuroTEPS using ALADIN.*
  - ***Calibration (BMA), combination and standard products*** *can be made using R-freeware and Hppv (Aemet)*

- ***Grid resolution*** *Present candidate: ~13km, ~40 levels*
- ***Forecast range*** Present candidate: 42h - daily at 00UT and 12 UT

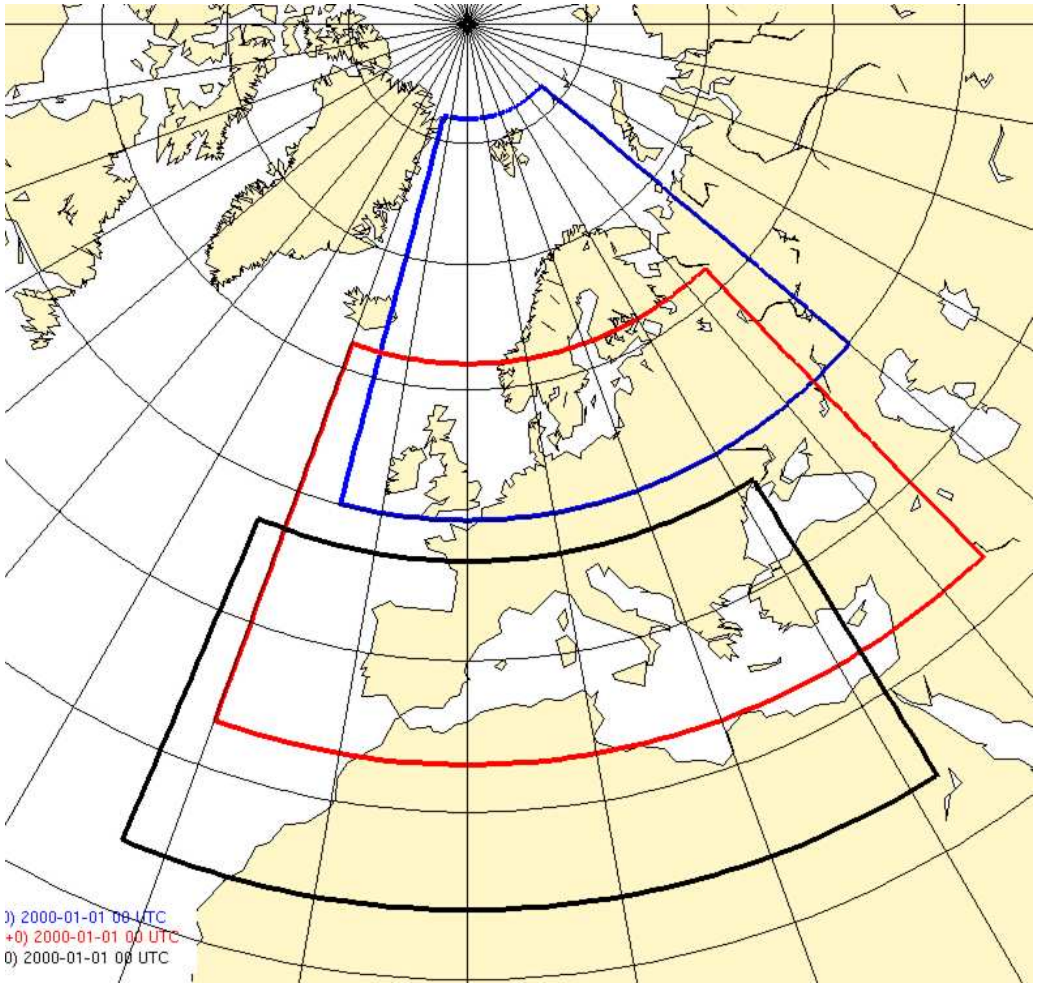
  3-hourly output or finer
- ***A ~common pan-European integration domain***
  - All output interpolated to a common grid in a pan-Europaen area.

GLAMEPS production – flow chart

Launching and monitoring by SMS (Kai Sattler)



EuroTEPS: TARGET AREAS



Target area north
(82N,15W,50N,50E)

Target area central
(62N,20W,33N,44E)

Target area south
(47N,23W,24N,32E)

GLAMEPS_v0: Configuration experiments at ECMWF

- ***All dates run in hindcast mode in a pan-European integration domain***
  7 weeks January-March 2008: *17.01.08 – 05.03.08, 00 and 12 utc*

EXP_0.1 *(6.7 Msbu/yr *)*

- ***44 ensemble members; 11 per model .***

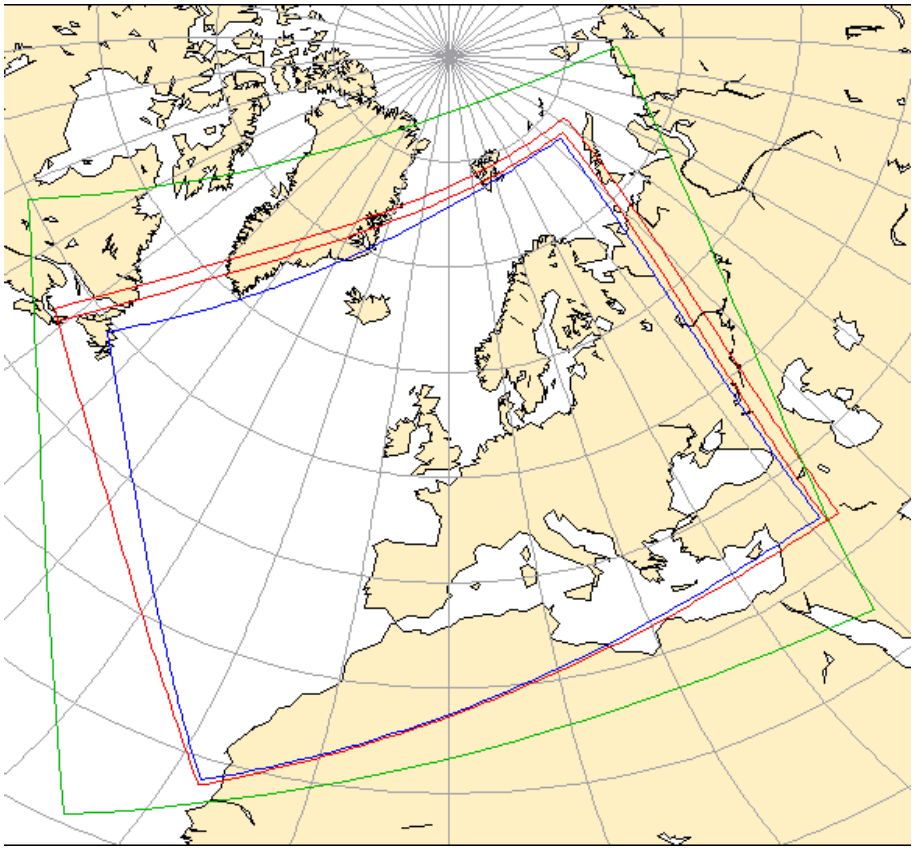
EuroTEPS (10 + 1) + HirEPS_K (10+1)
+ HirEPS_S (10+1) + AladEPS (11) = 44

EXP_0.2 *(7.9 Msbu/yr *)*

- ***52 ensemble members; 13 per model .***

EuroTEPS (12 + 1) + HirEPS_K (12+1)
+ HirEPS_S (12+1) + AladEPS (13) = 52

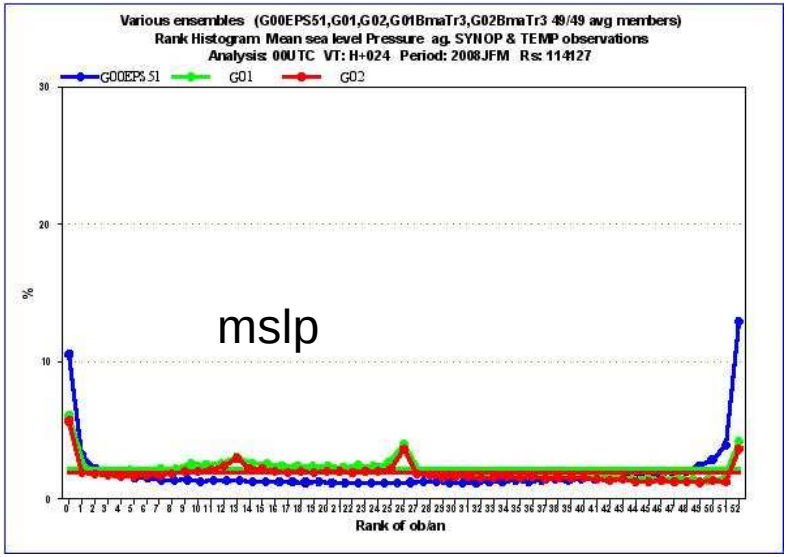
- ***13km grid resolution*** (12.9,L37);(0.115deg,L40)
- ***Forecast range: 42h***

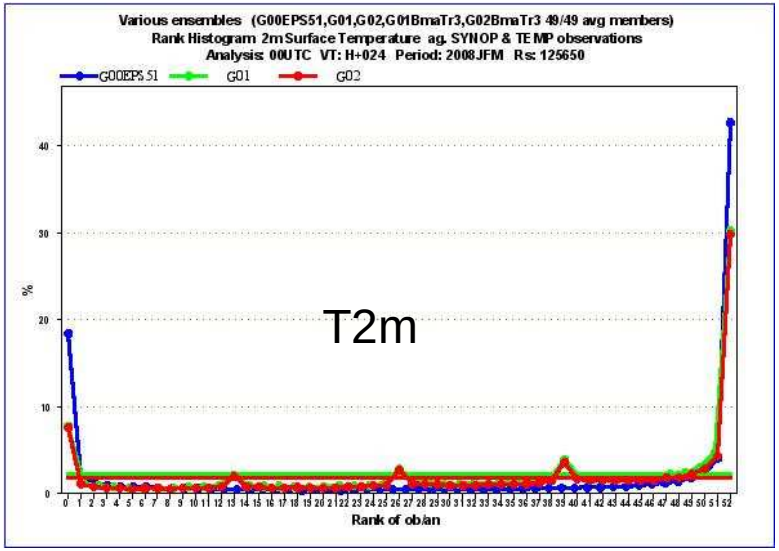


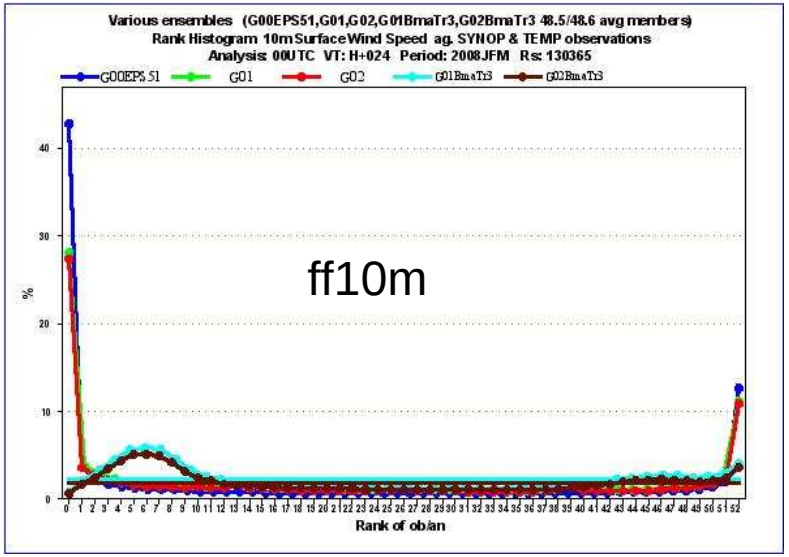
***** *Preliminary estimates to be confirmed*

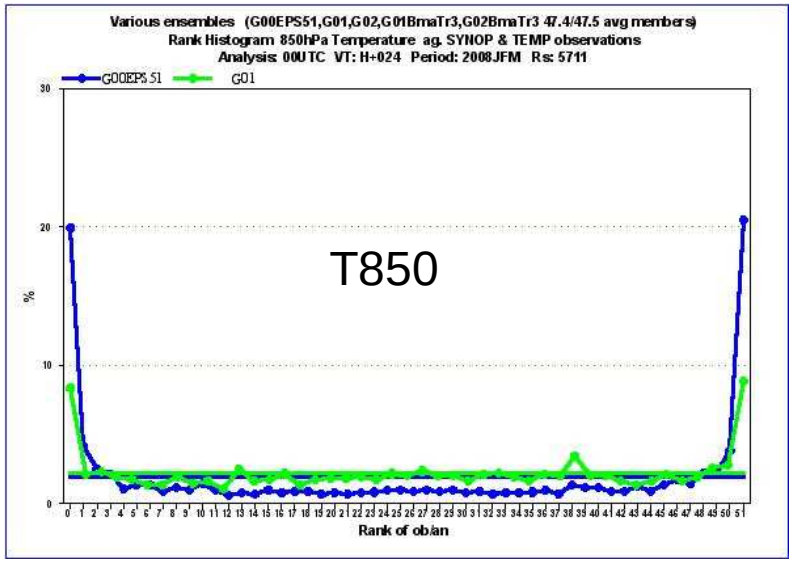
Verification of EXP_0.1 and _0.2 vs. EPS51 20080117 to 20080308 (00 and 12 utc), 7 weeks

Talagrand diagrams (rank histograms) +24h



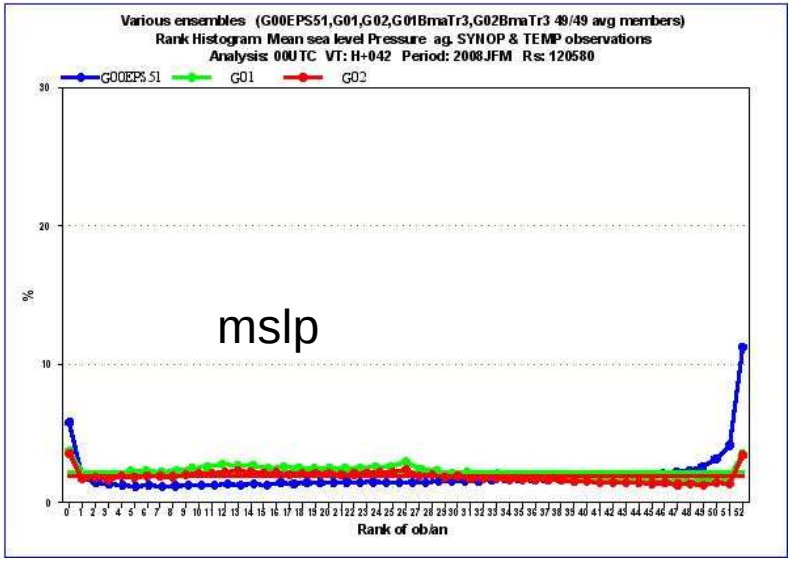


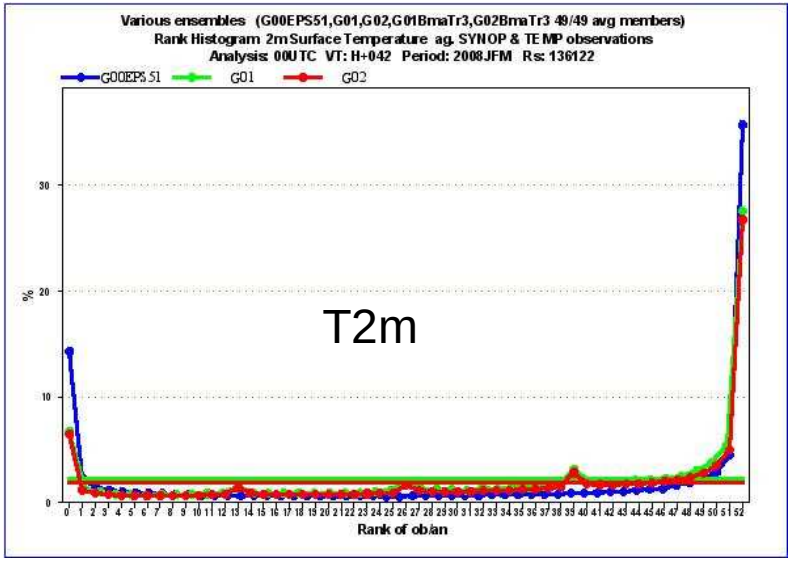


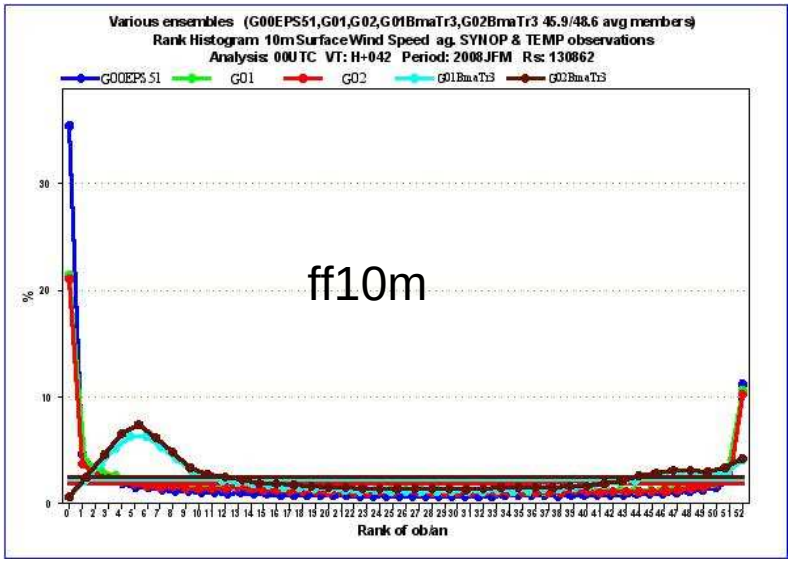


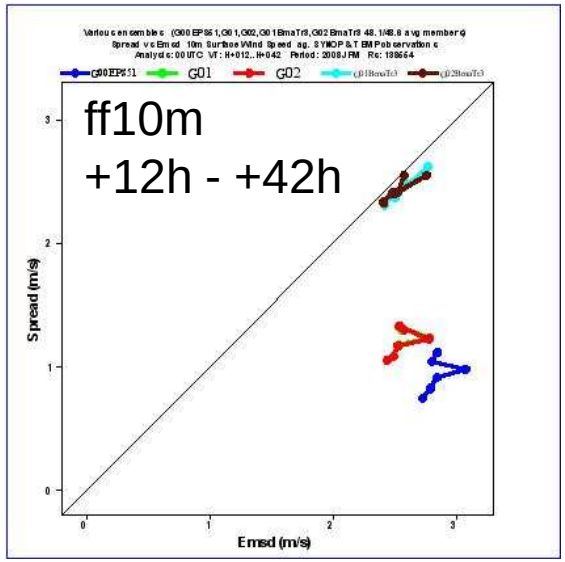
Verification of EXP_0.1 and _0.1 vs. EPS51 20080117 to 20080308 (00 and 12 utc)

Talagrand diagrams (rank histograms) +42h





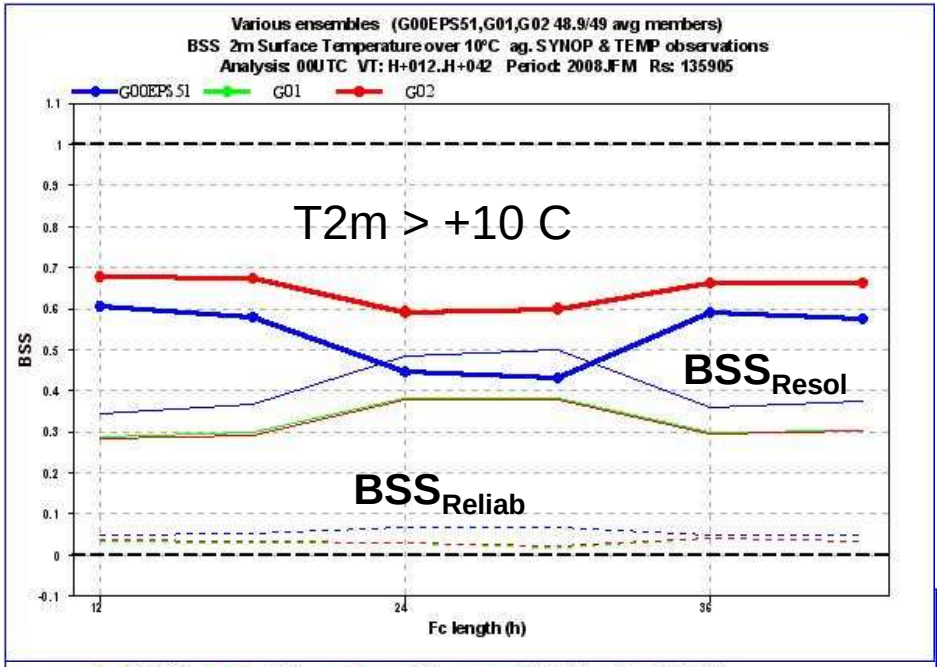


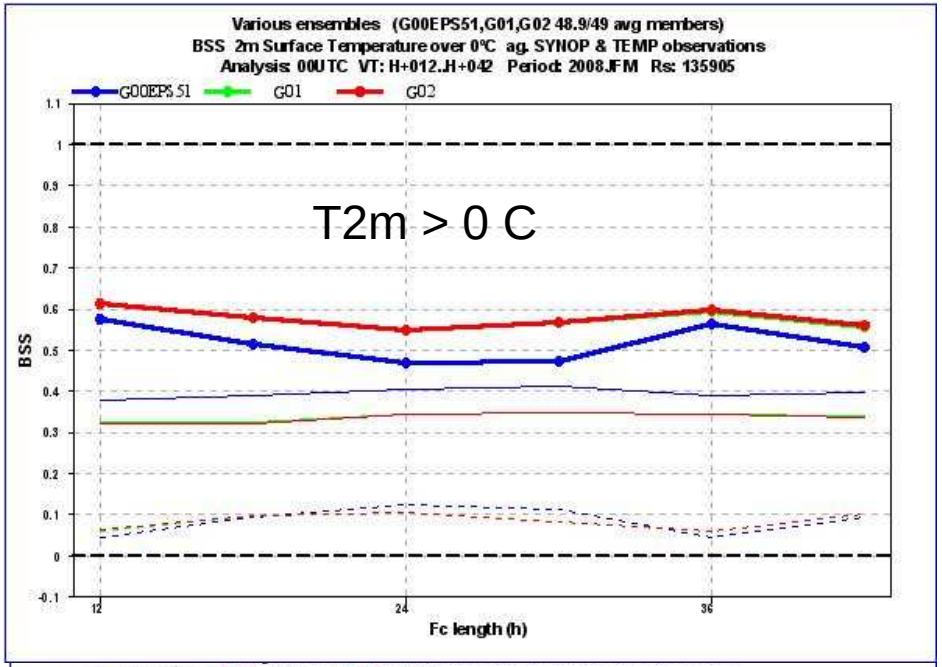


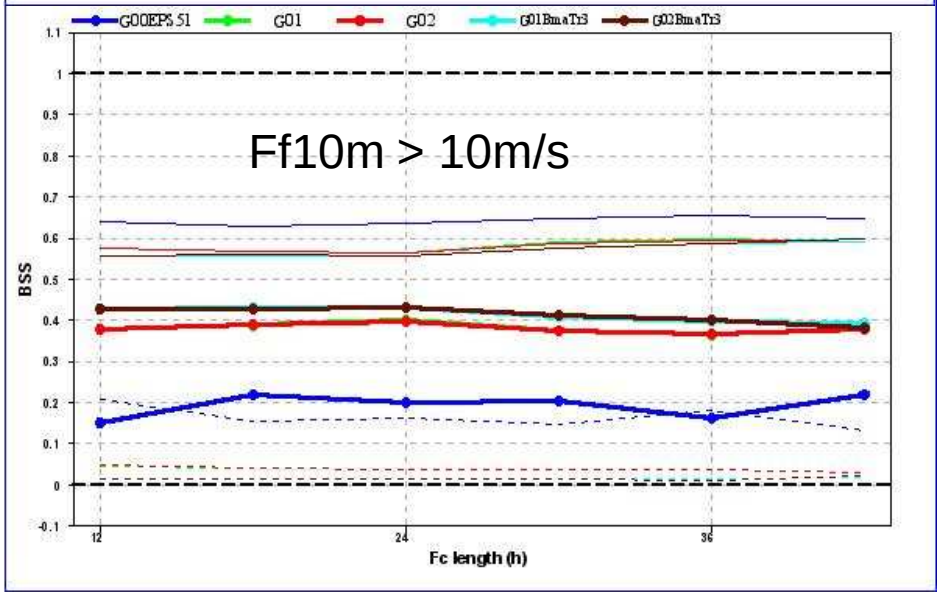
Verification of EXP_0.1 and _0.2 vs. EPS51
20080117 to 20080308 (00 and 12 utc)

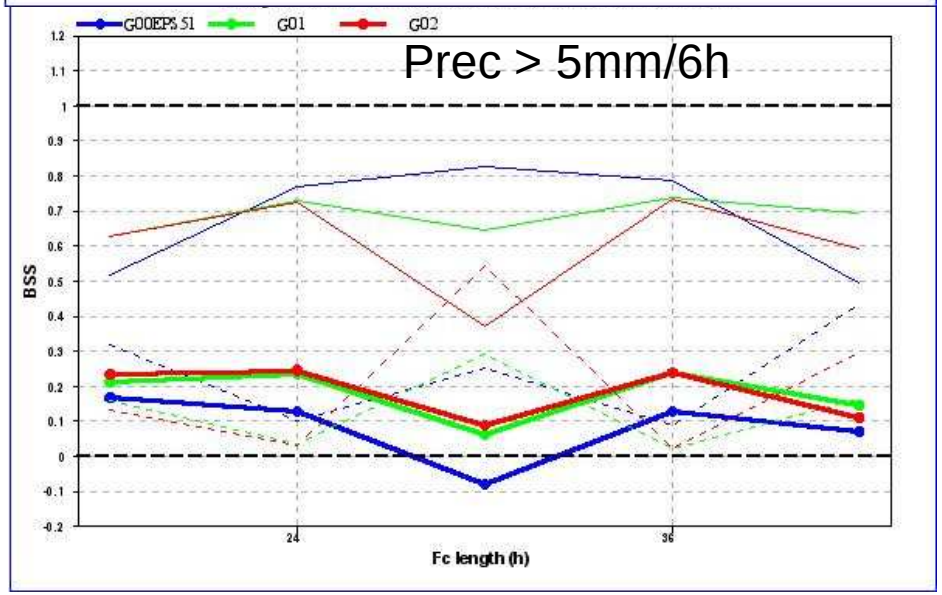
Brier Skill Score

[$BSS = 1 - BSS_{Reliab} - BSS_{Resol}$]



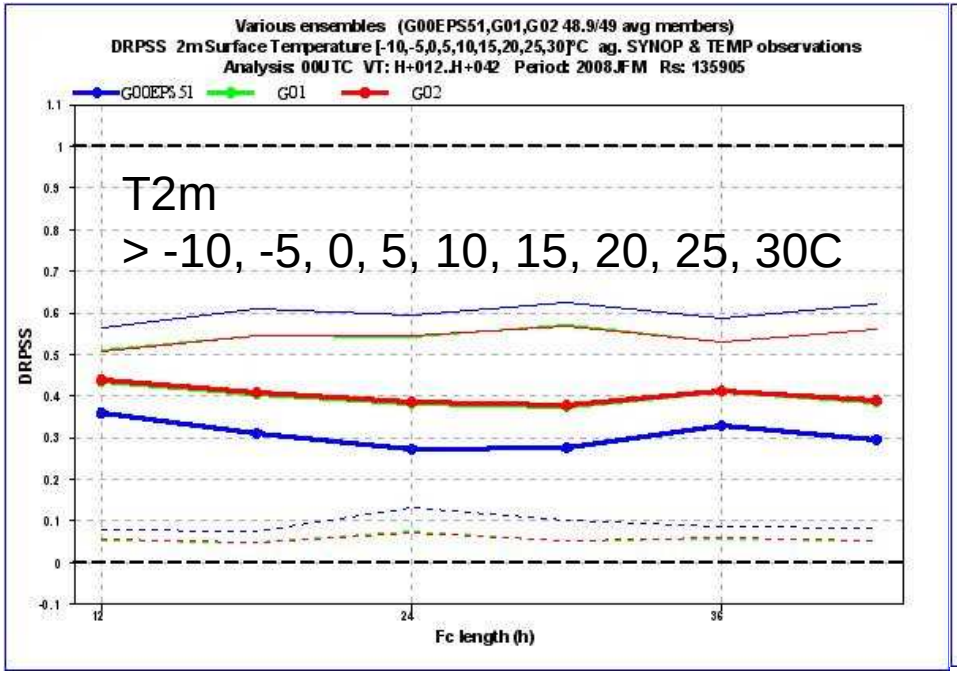


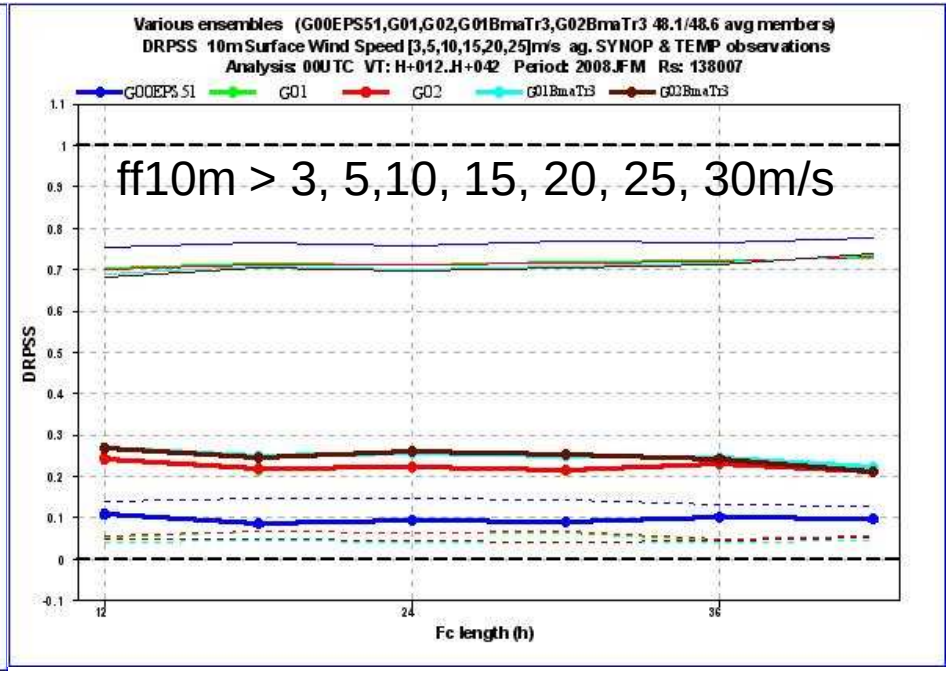




Verification of EXP_0.1 and _0.2 vs. EPS51
20080117 to 20080308 (00 and 12 utc)

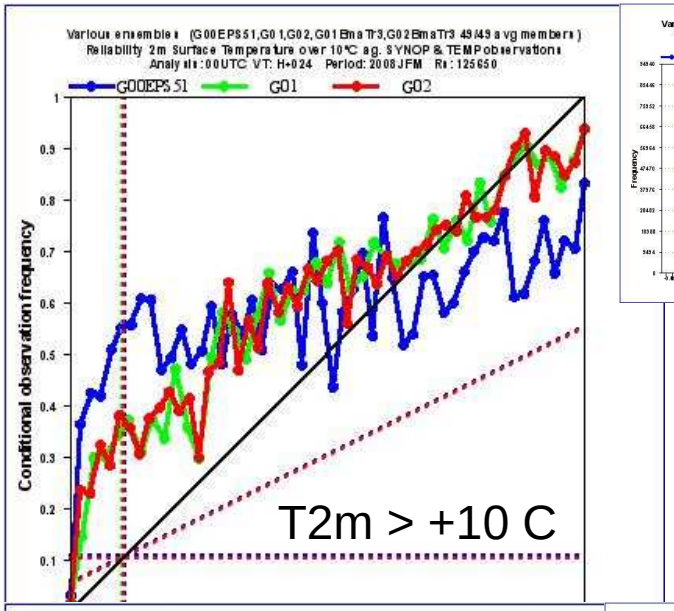
Ranked probability skill score - RPSS

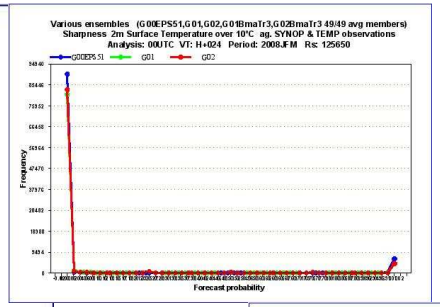


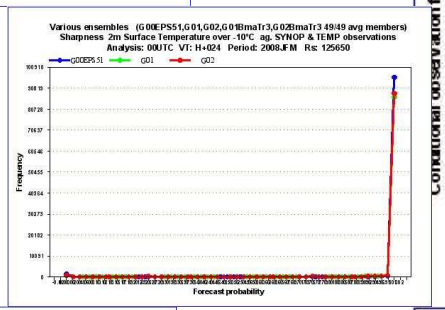


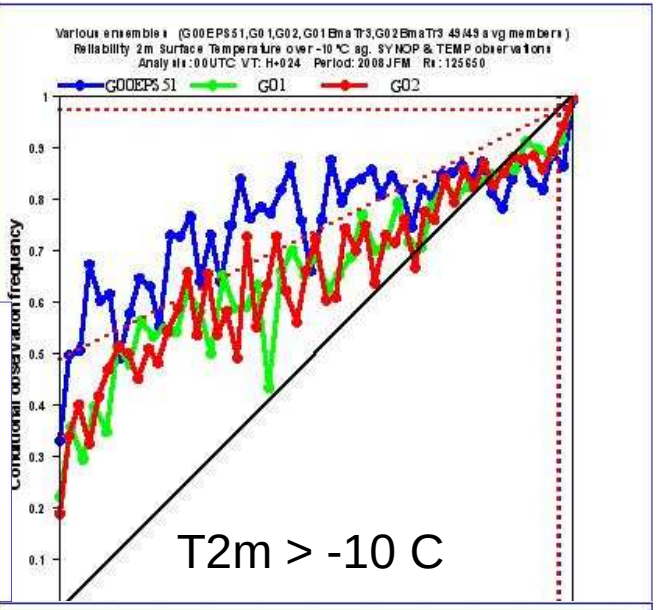
Verification of EXP_0.1 and _0.1 vs. EPS51 20080117 to 20080308 (00 and 12 utc)

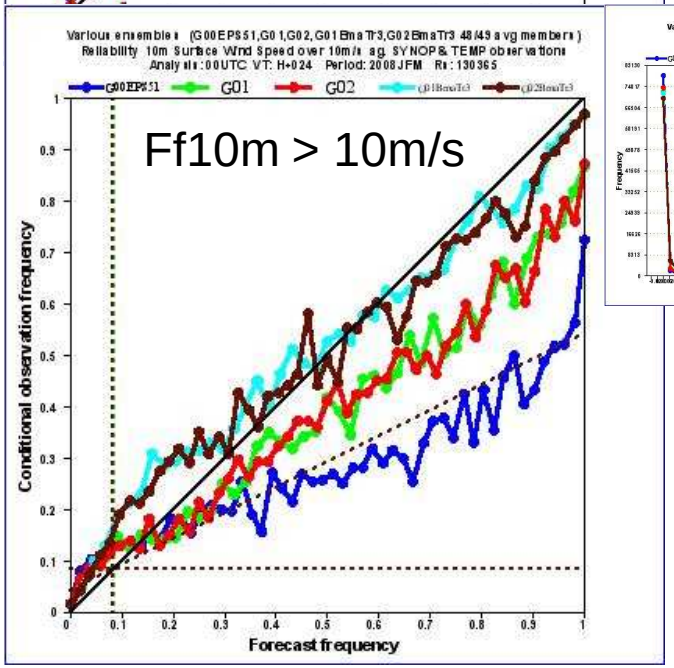
Reliability and Sharpness, +24

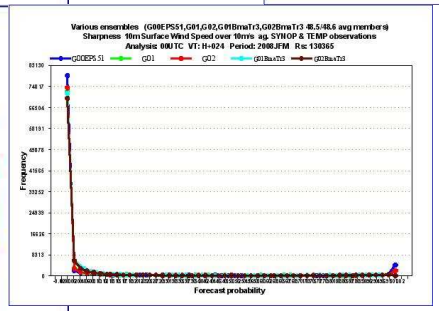


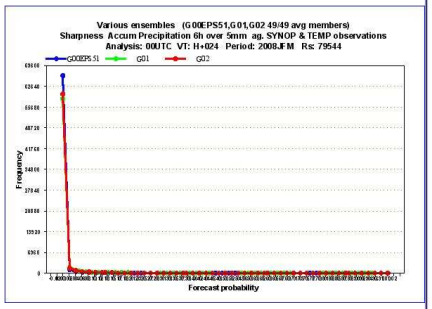


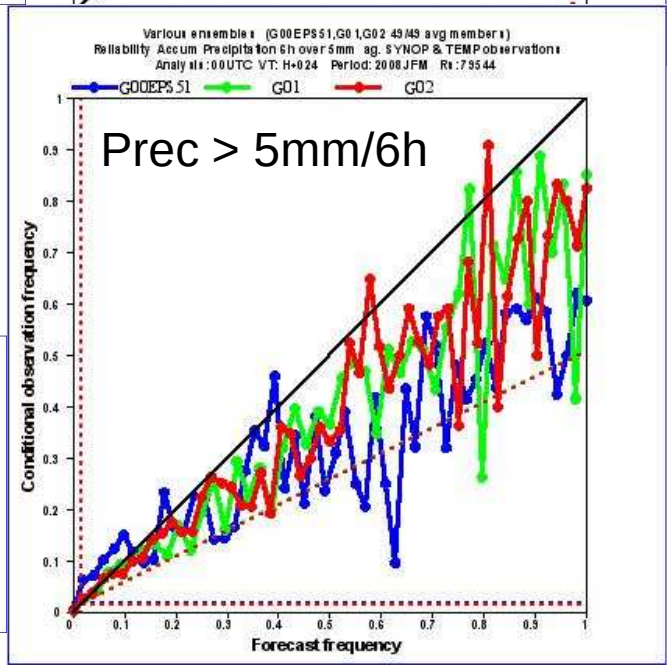




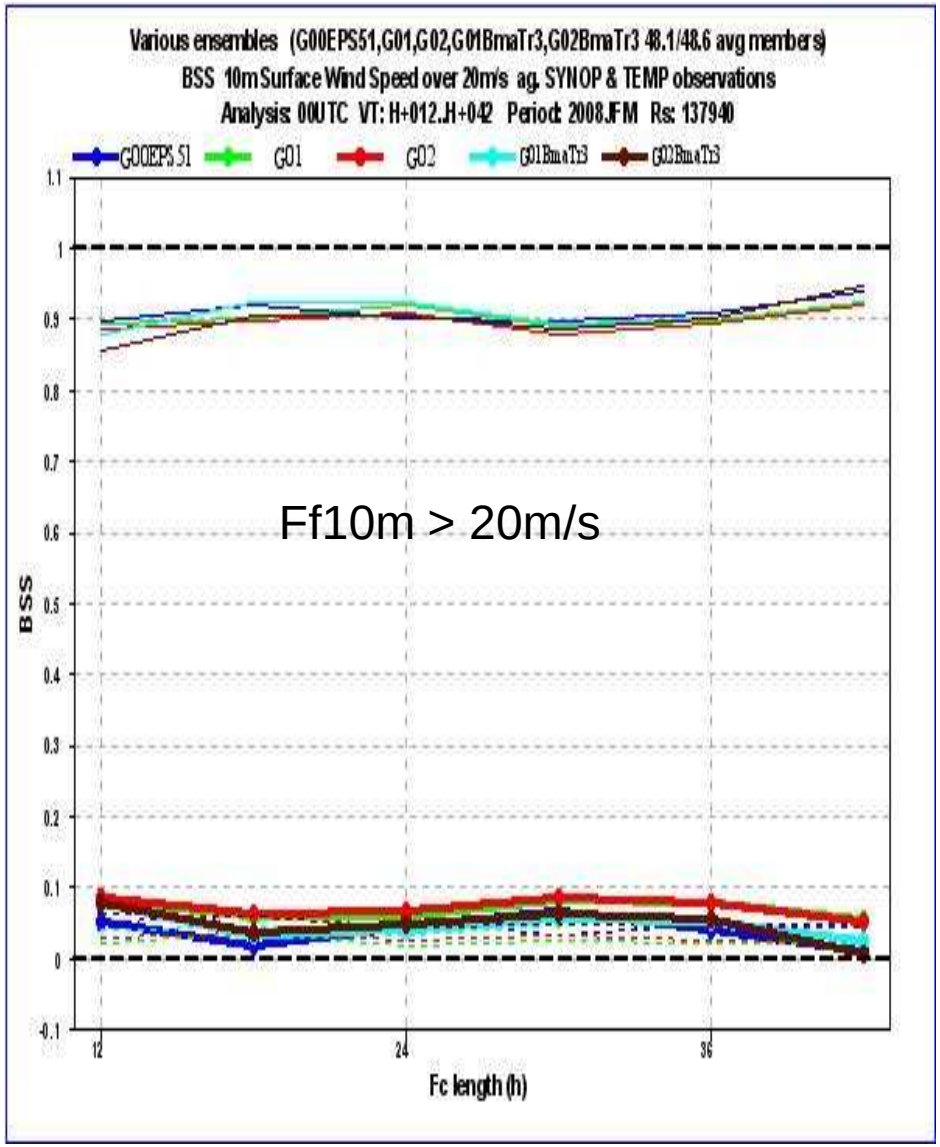


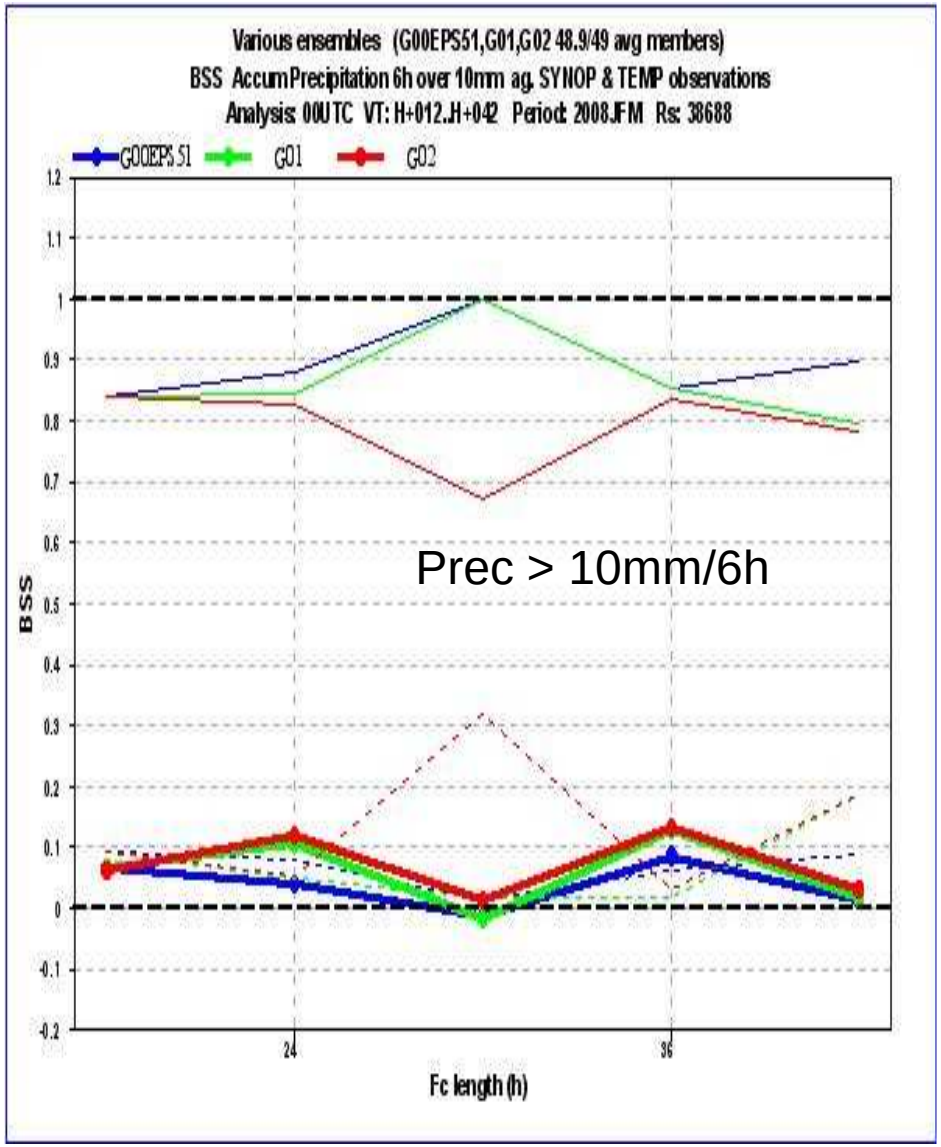


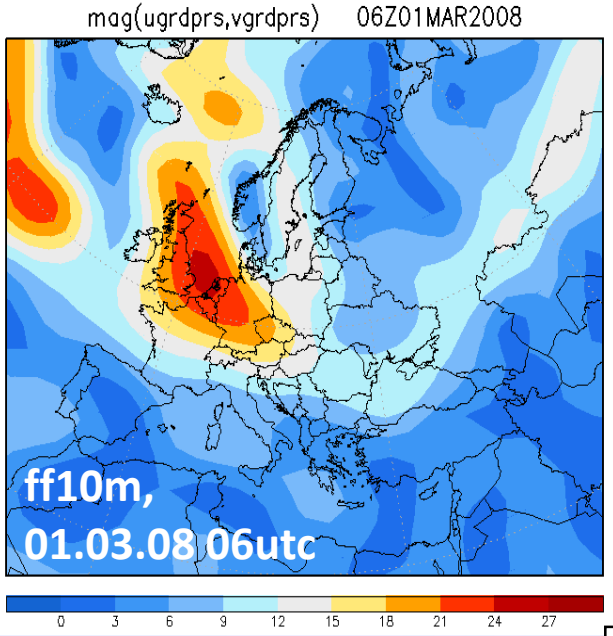


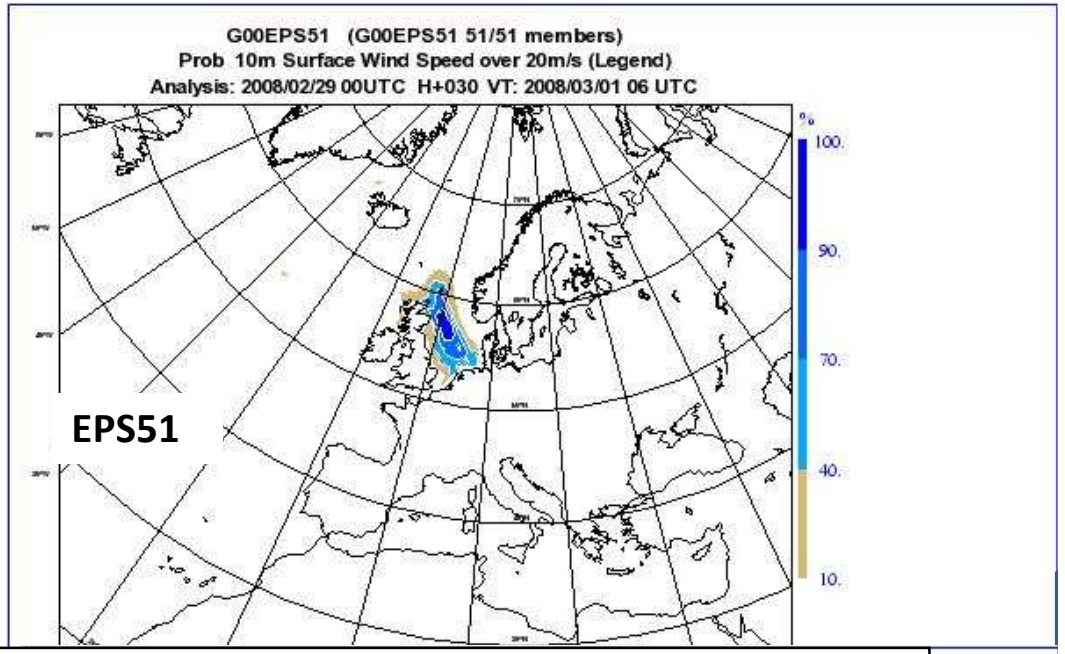


Verification of EXP_0.1 and _0.2 vs. EPS51
20080117 to 20080308 (00 and 12 utc), ***BSS, Rare events***

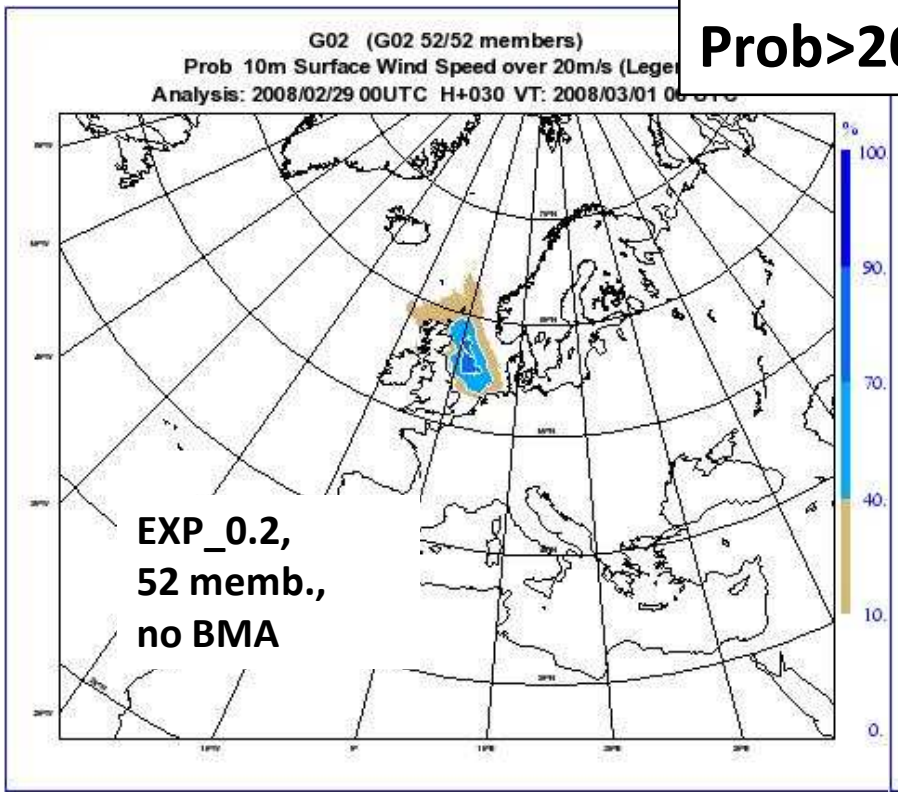


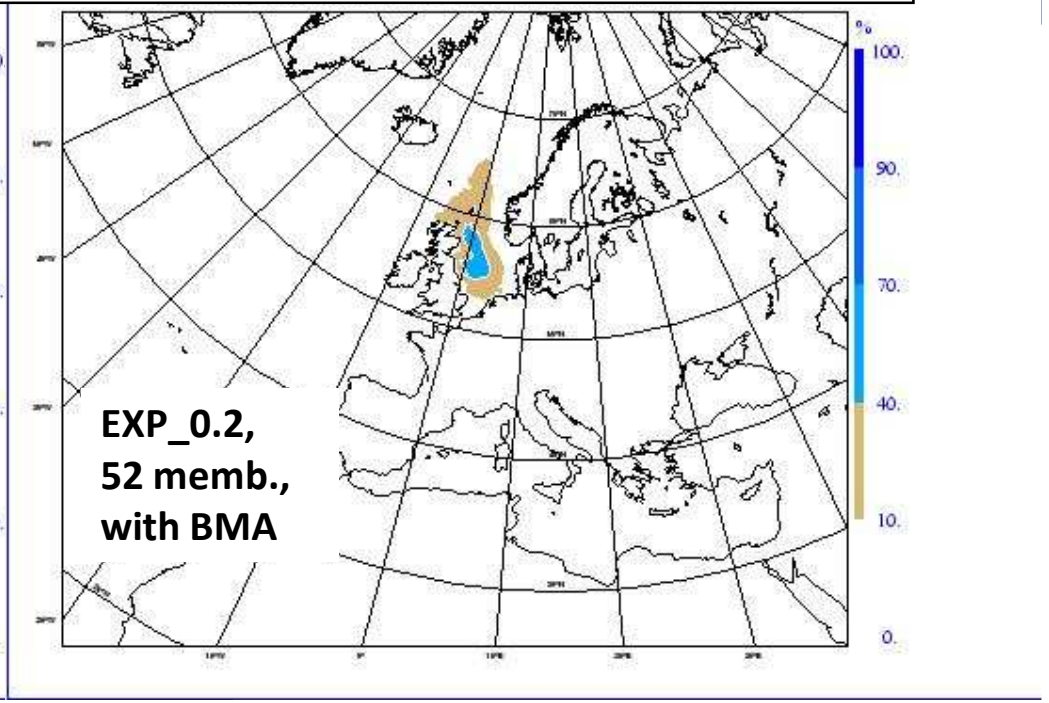


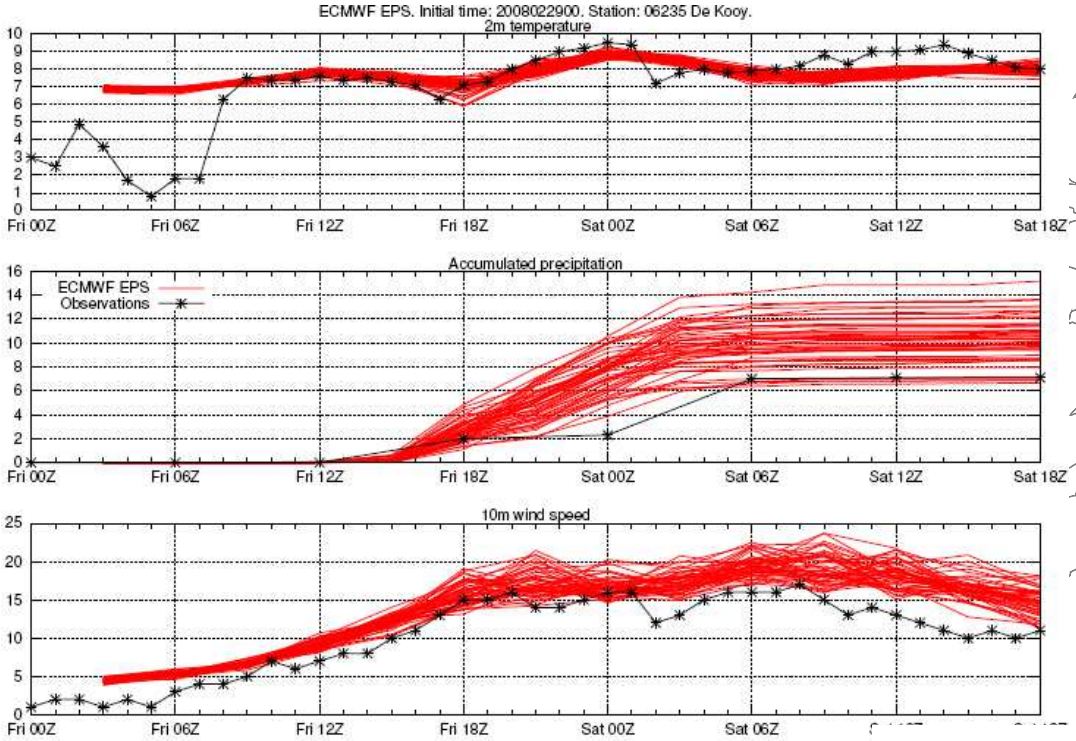


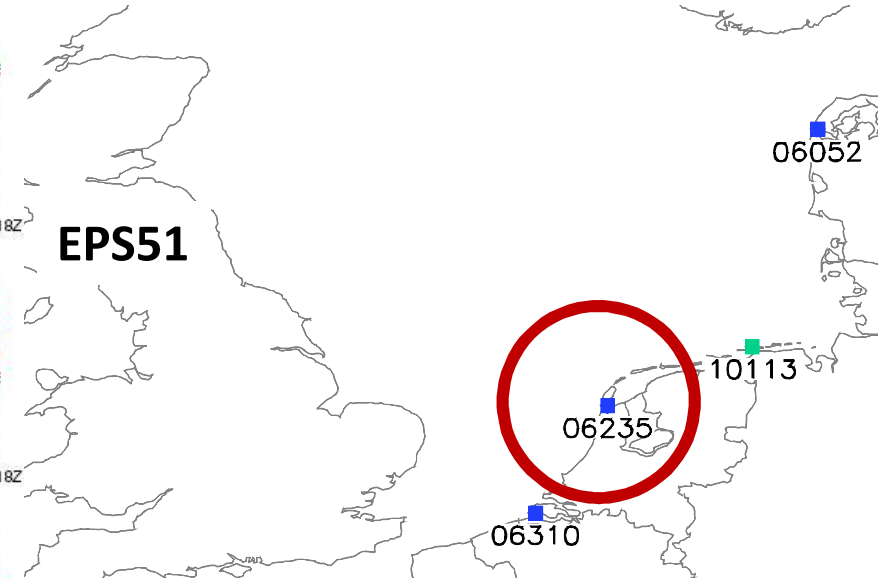


Prob>20m/s, 29.02.08 00utc + 30h



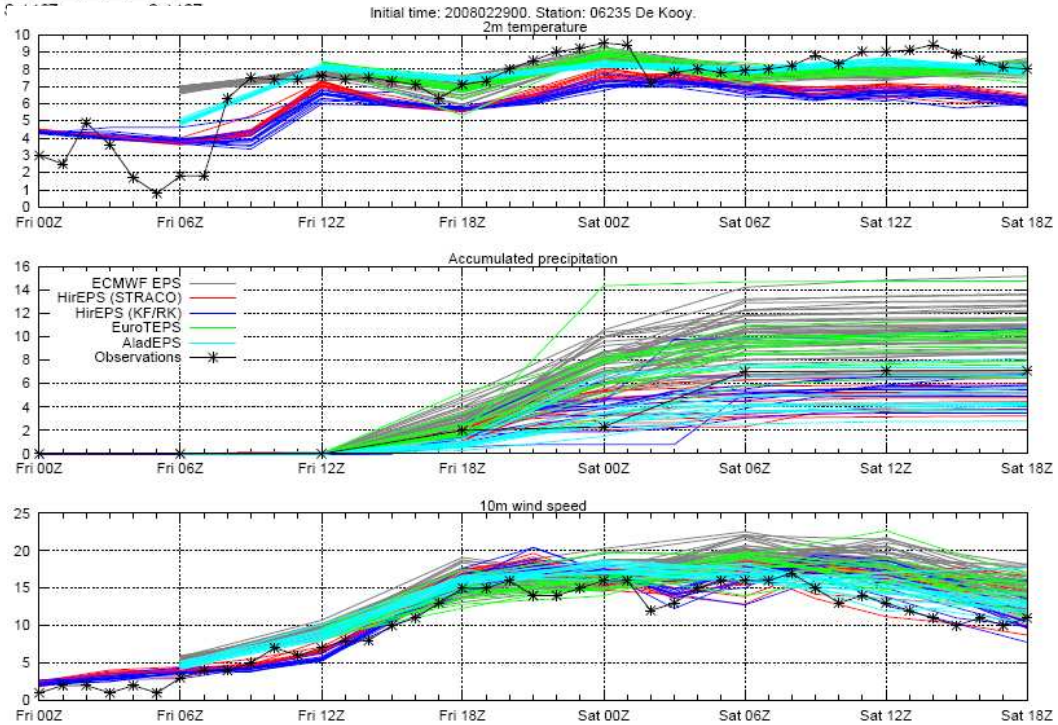






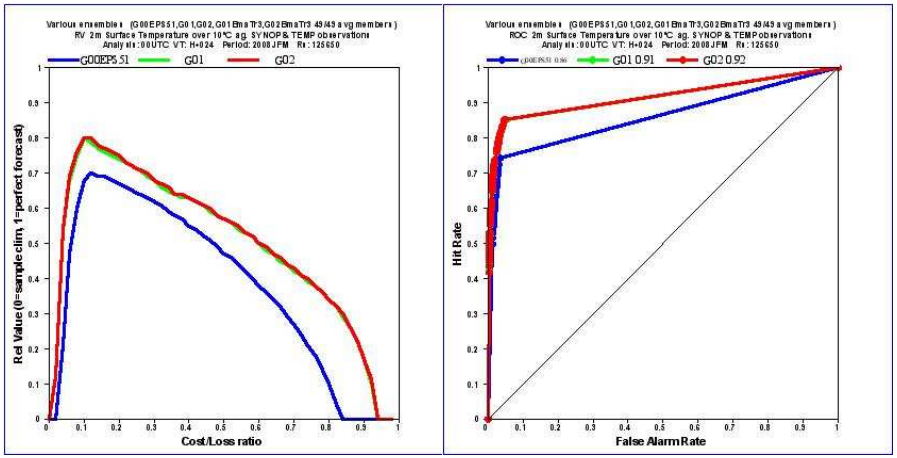
29.02.08 00utc + 0h-42h

EXP_0.2, 52 memb., no BMA

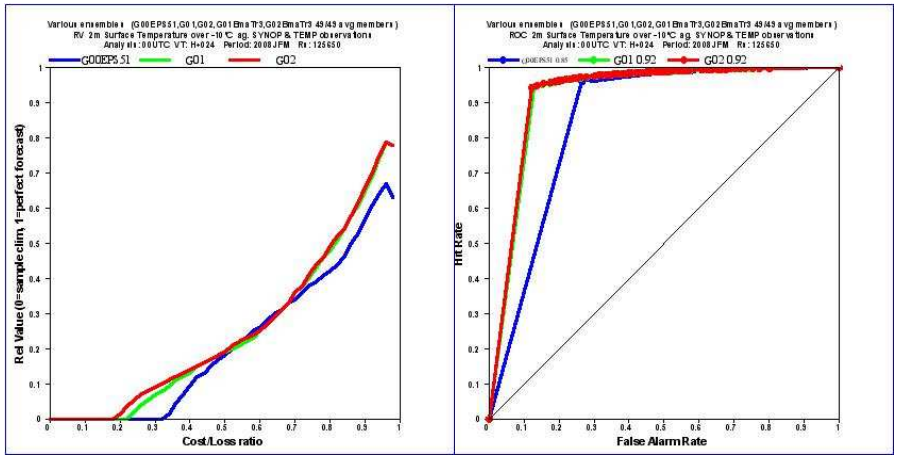


Verification of EXP_0.1 and _0.1 vs. EPS51
20080117 to 20080308 (00 and 12 utc)

Value and ROC, +24

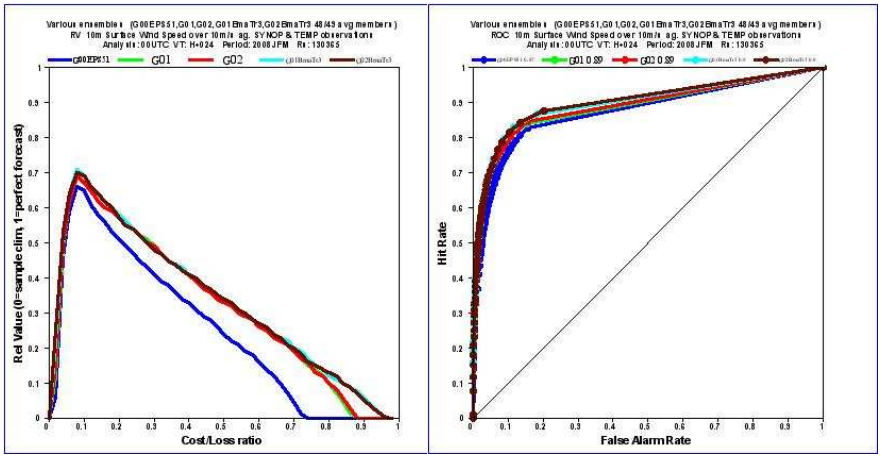


T2m > +10 C

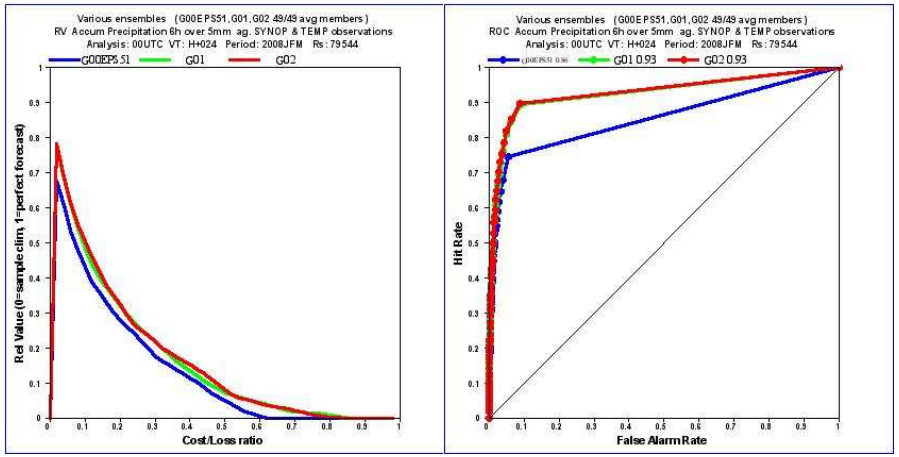


T2m > -10 C

Ff10m > 10m/s

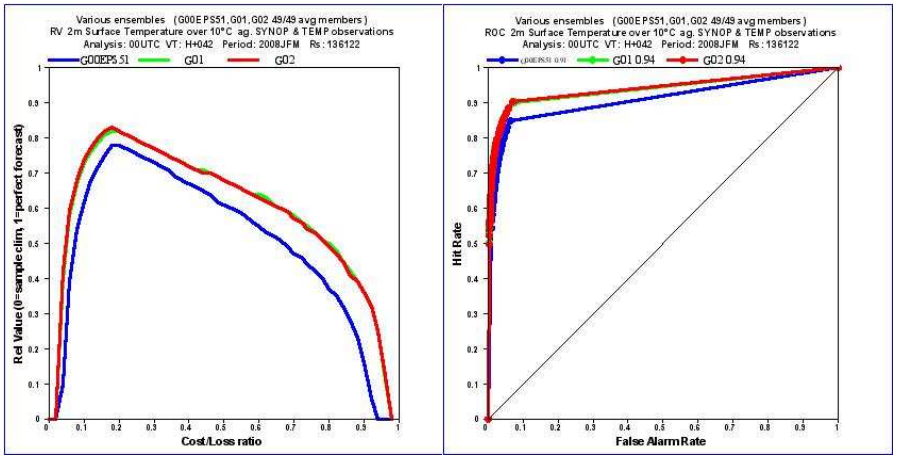


Prec > 5mm/6h

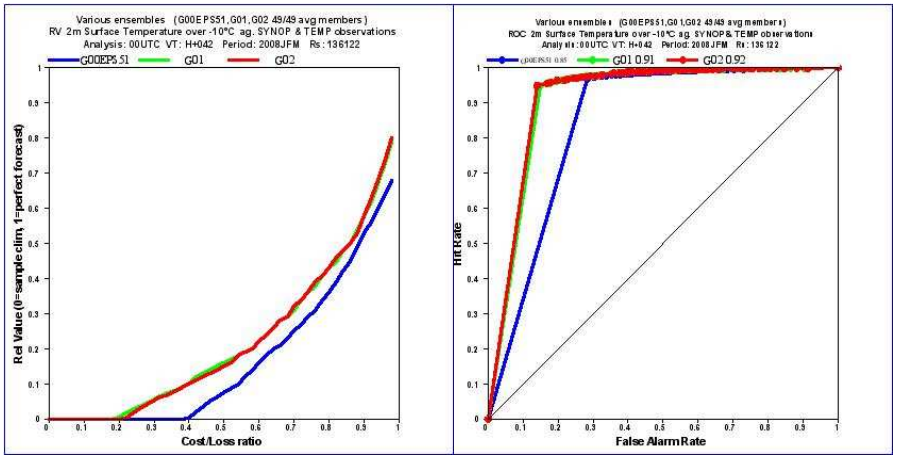


Verification of EXP_0.1 and _0.1 vs. EPS51
20080117 to 20080308 (00 and 12 utc)

Value and ROC, +42

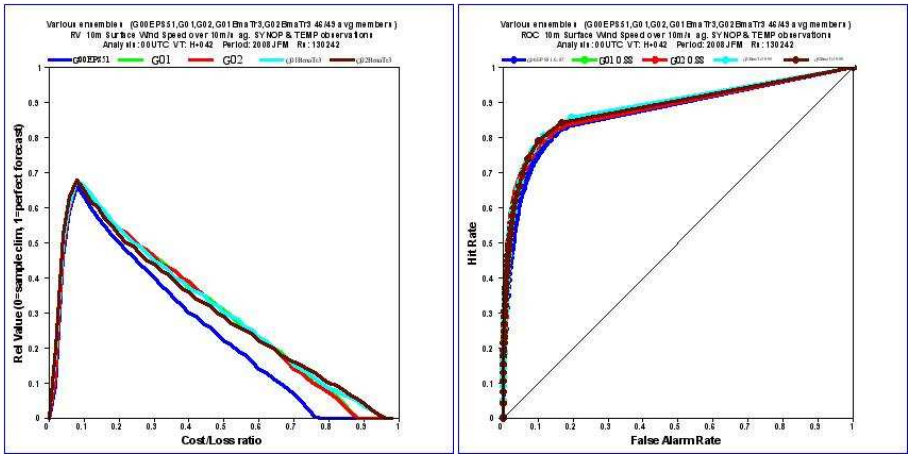


T2m > +10 C



T2m > -10 C

Ff10m > 10m/s



Prec > 5mm/6h

Missing obs

Conclusion and status

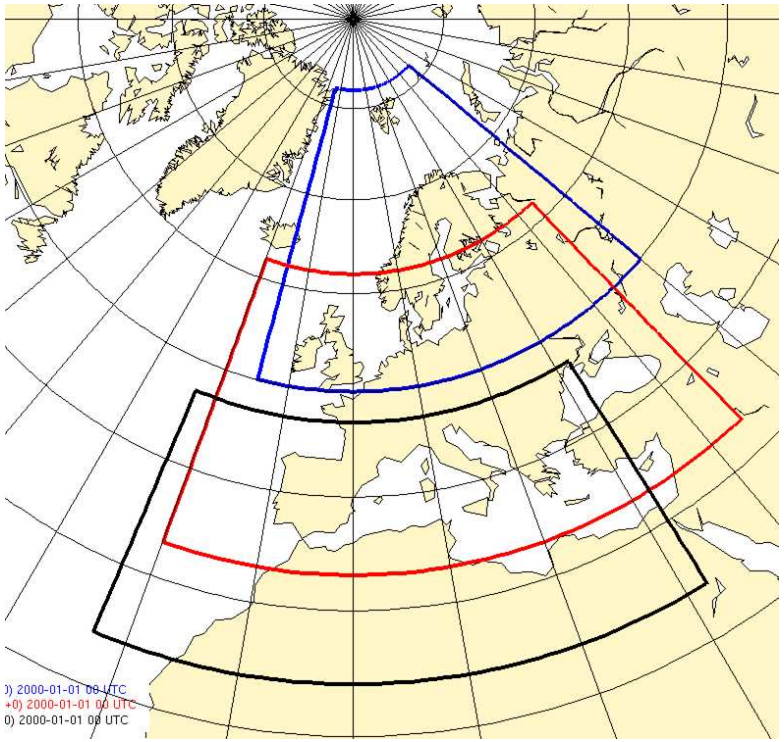
Important breakthrough for GLAMEPS

- All model components work technically
- GLAMEPS show convincingly better results than ECMWF EPS51 up to +42h
- It is difficult to distinguish GLAMEPS 44 members from 52 members
  - Indications for rare / extreme events
- SMS-script for entire GLAMEPS production is developed (Kai Sattler)

NEXT:

- Study of the relative contributions to GLAMEPS quality is underway:
  - EXP 0.3: EuroTEPS vs. Selected members of ECMWF EPS,
  - EXP 0.4: multi modeling vs. single (or fewer) models
- Develop LAM-specific ensemble perturbations for the first 12-24h with emphasis on initial state errors and meso-scale structures
  - ETKF
  - LAM SVs with CAPE inner product
- Operationalization, first at ECMWF:
  - EuroTEPS
  - GLAMEPS_v1

Operational EuroTEPS: available to all…?



Operational at ECMWF hopefully from February 2010.
NB: Paid by national SBU quota.

Costs

Preliminary estimates

Present (Cy35r3): ca. 2.7 Msbu/year
(2x/day, 21 members, +72h, T399L62)

In November: → Cy36r1 (T639L62)
Multiply by a factor ca. 5

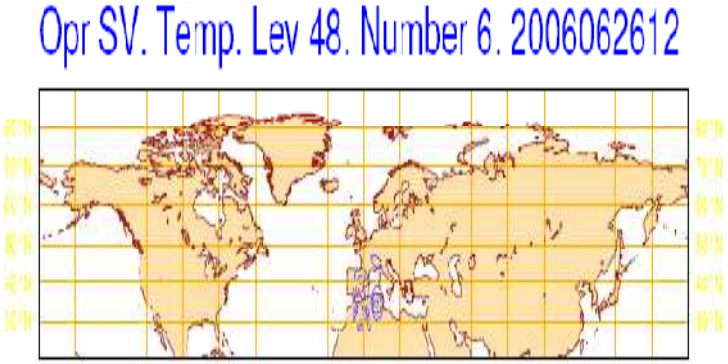
In February; Evolved SVs replaced by EnsDA.
No extra costs for EuroTEPS

Later in 2010 → T639L92: 50% increase:

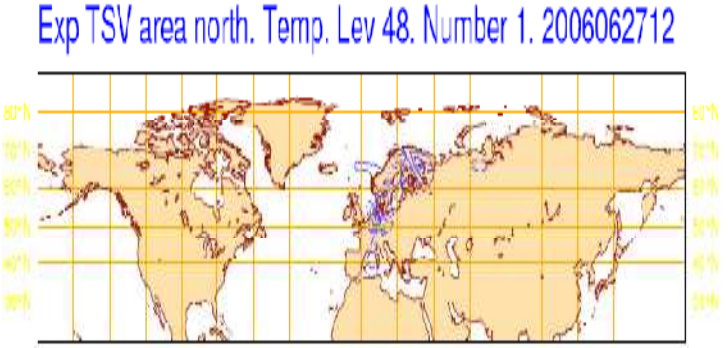
- EuroTEPS_21: 16.9 Msby/year (+72h)
- EuroTEPS_13: 10.7 Msbu/year (+72h)
  8.9 Msbu/year (+60h)

EuroTEPS SVs:

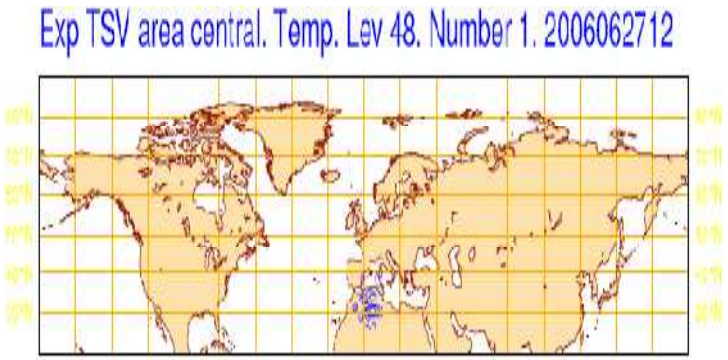
NH SVs 48h and TSVs 24h, target time: 2006/06/28 12utc. T ~850 hPa



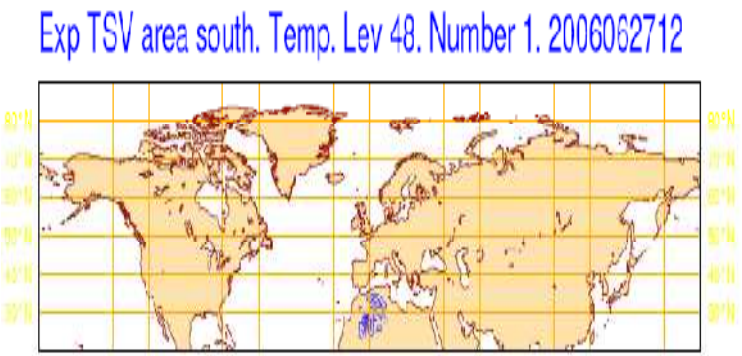
NHSV_6



TSV-north_1



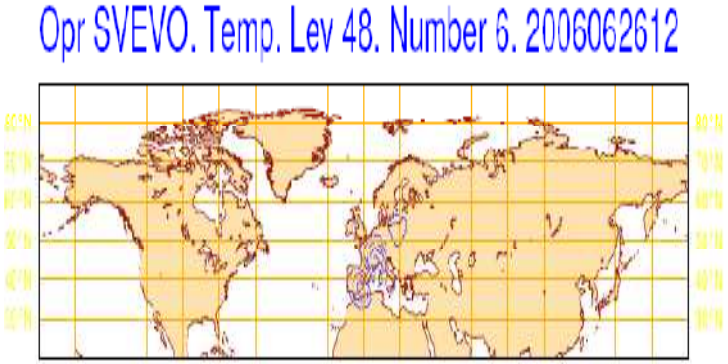
TSV-central_1



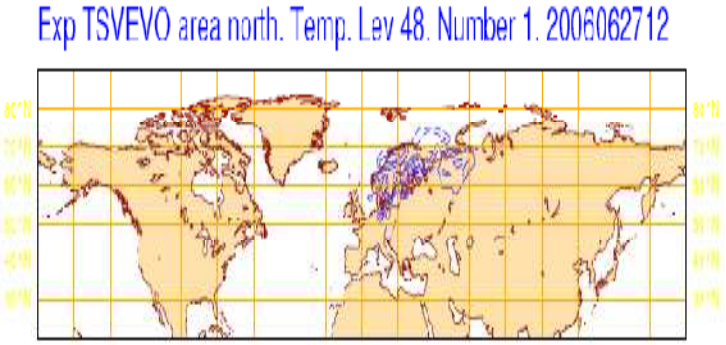
TSV-south_1

EuroTEPS SVs:

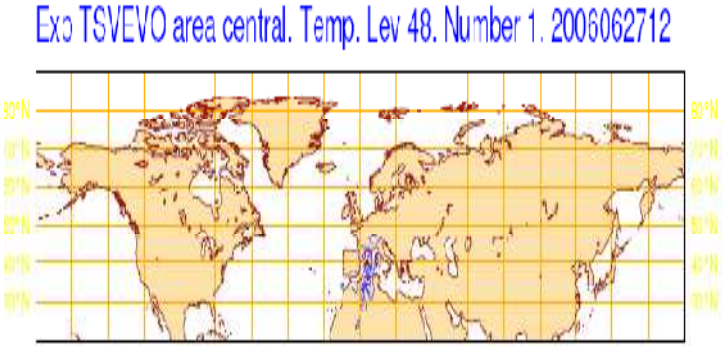
NH SVs 48h and TSVs 24h, target time: 2006/06/28 12utc. T ~850 hPa; Evolved



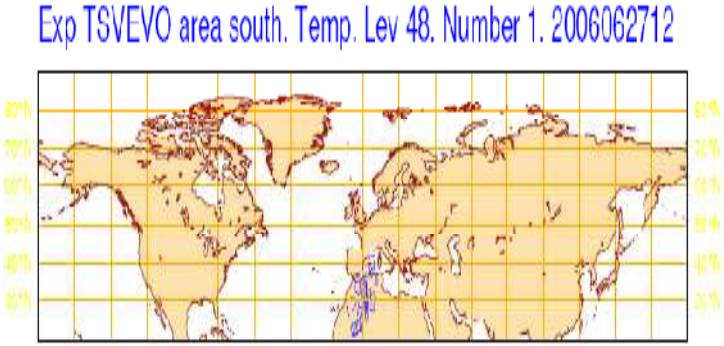
NHSV_6



TSV-north_1

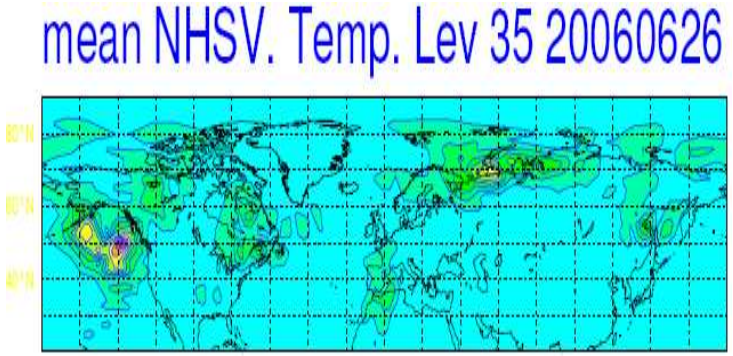


TSV-central_1

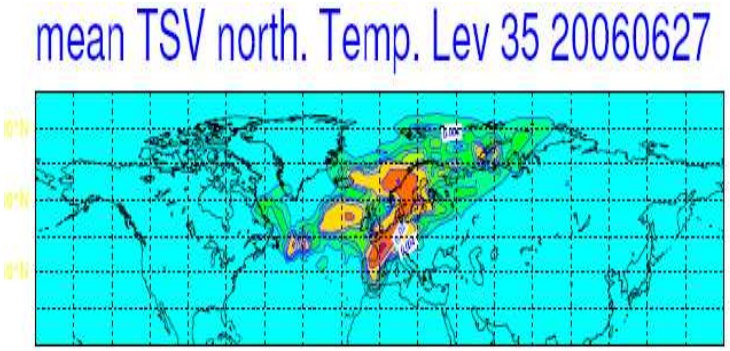


TSV-south_1

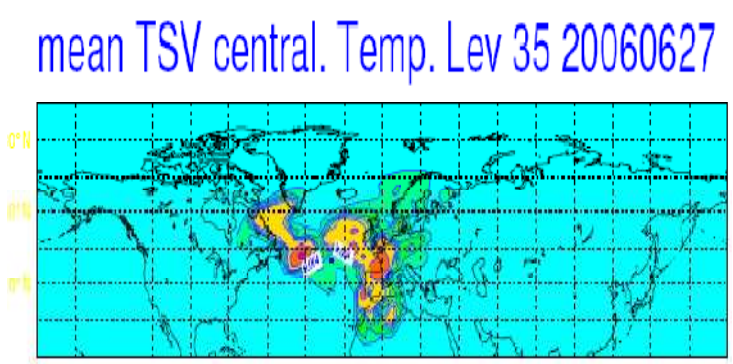
NH SVs 48h and TSVs 24h, target time: 2006/06/28 12utc. T ~850 hPa



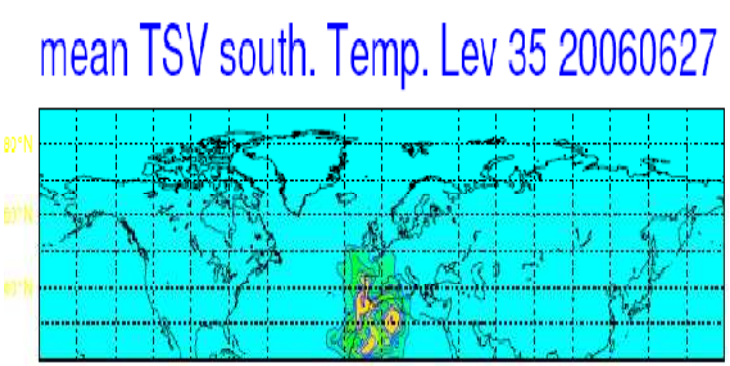
NHSV_1-10



TSV-north_1-10

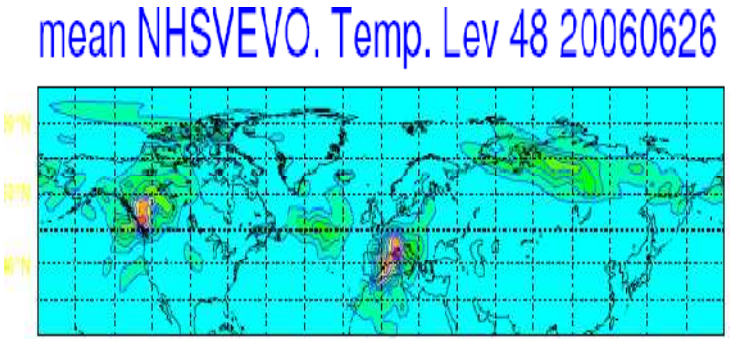


TSV-central_1-10

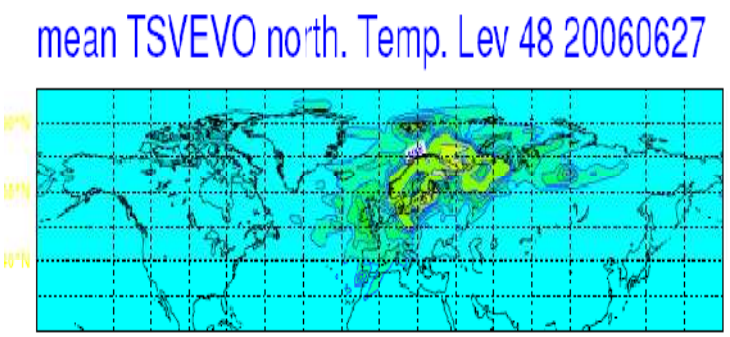


TSV-south_1-10

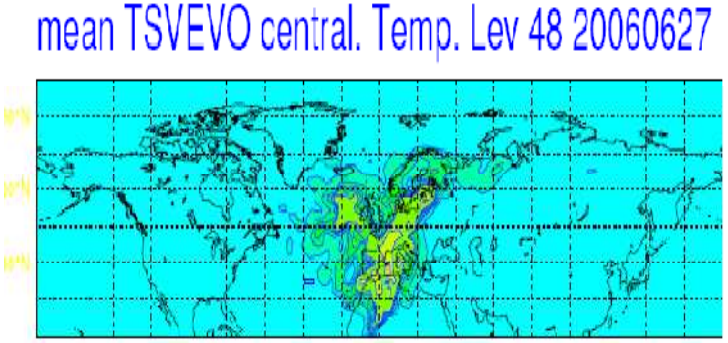
NH SVs 48h and TSVs 24h, target time: 2006/06/28 12utc. T ~850 hPa, Evolved



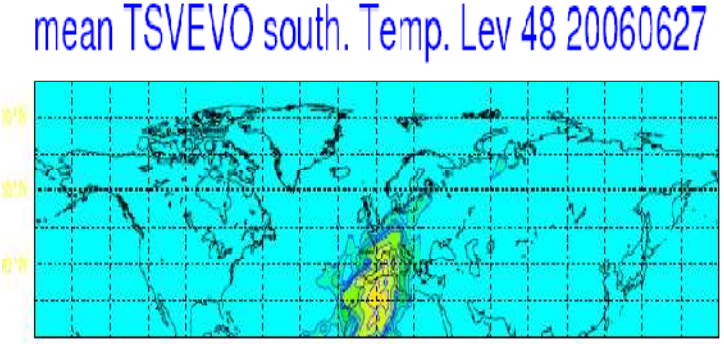
NHSV_1-10



TSV-north_1-10



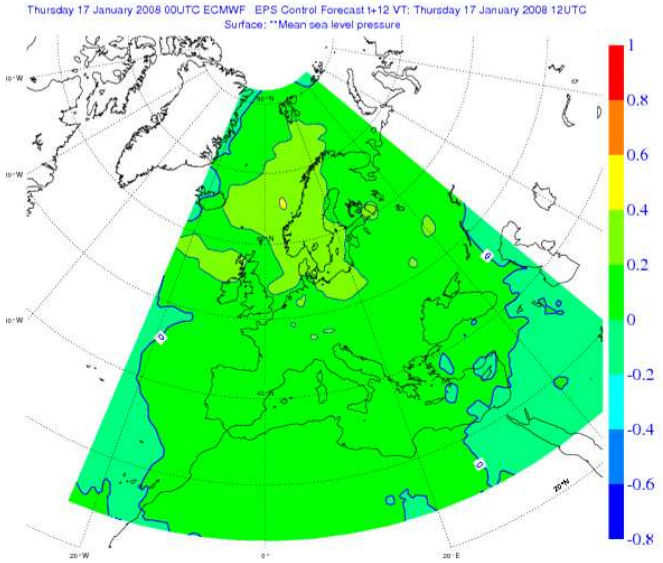
TSV-central_1-10



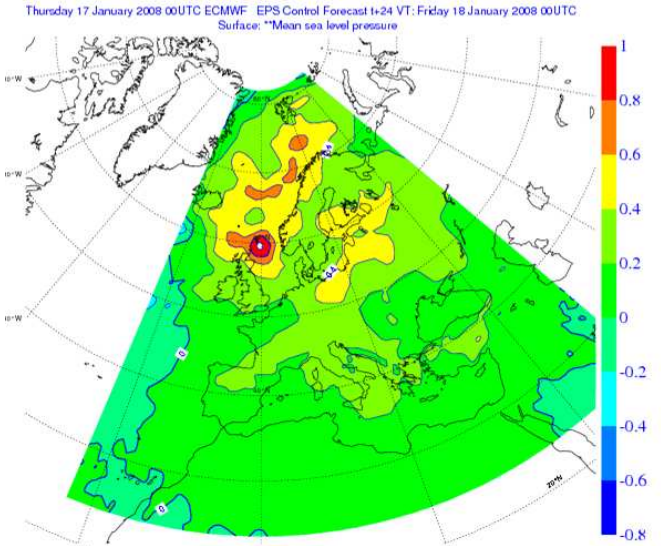
TSV-south_1-10

Difference in spread between EuroTEPS and EPS (21 winter cases)

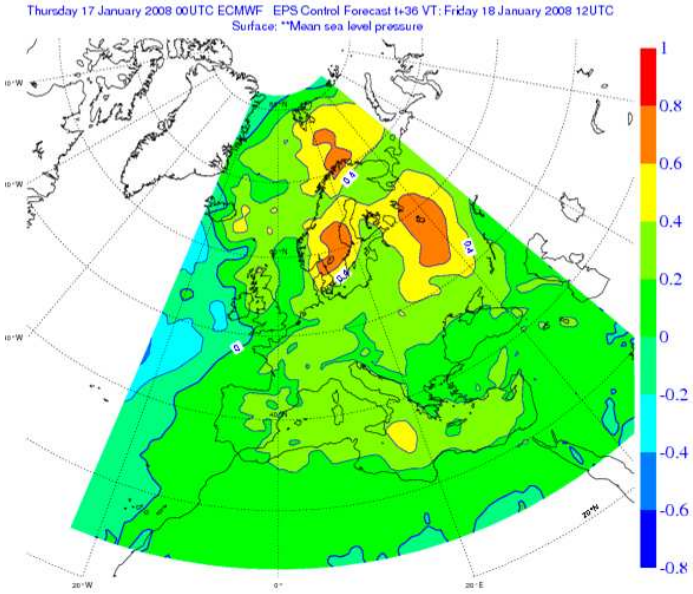
+12



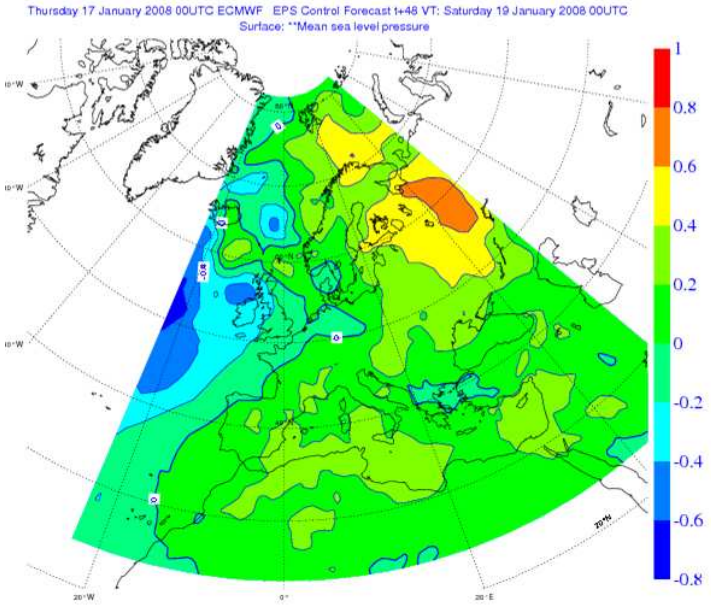
+24



+36

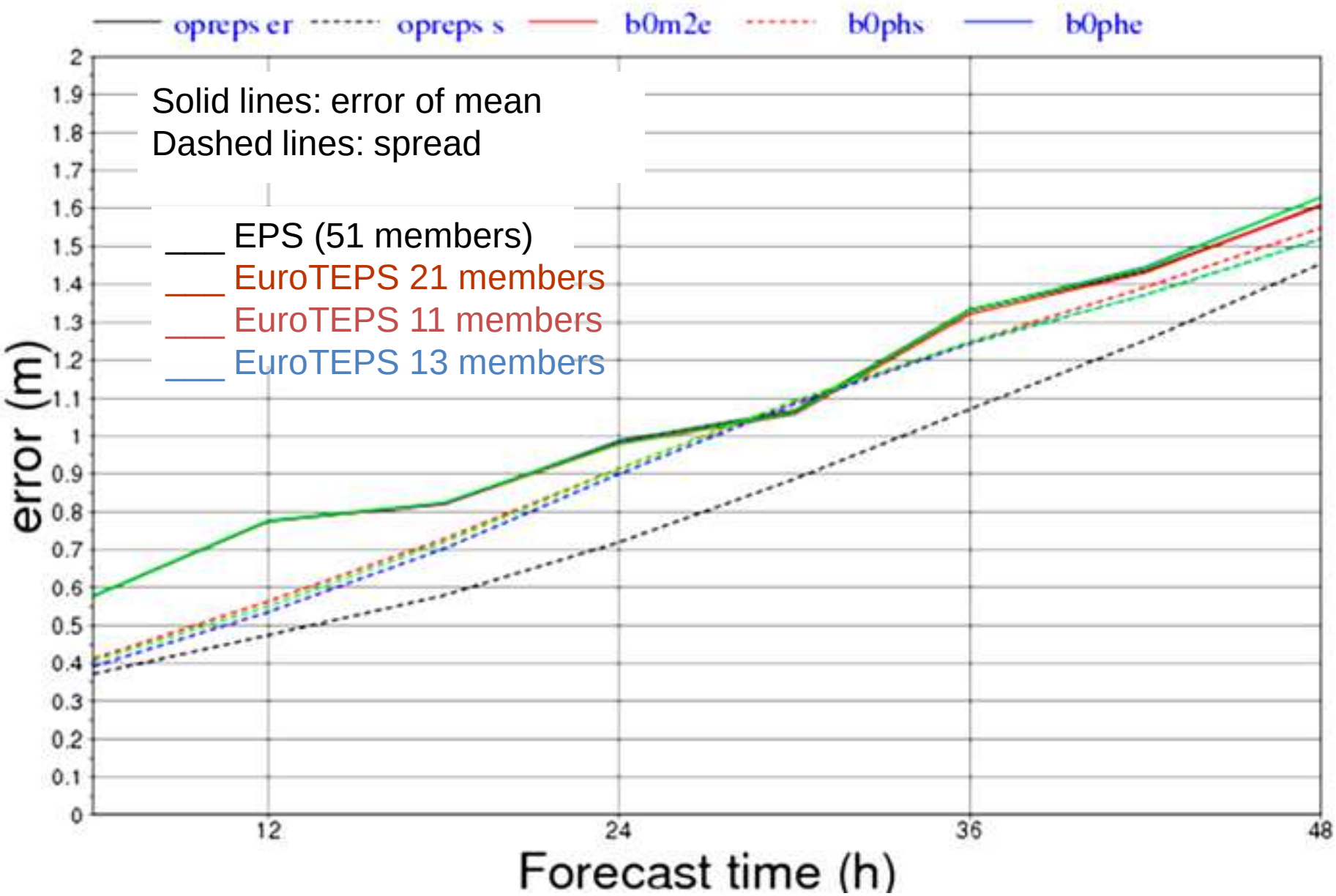


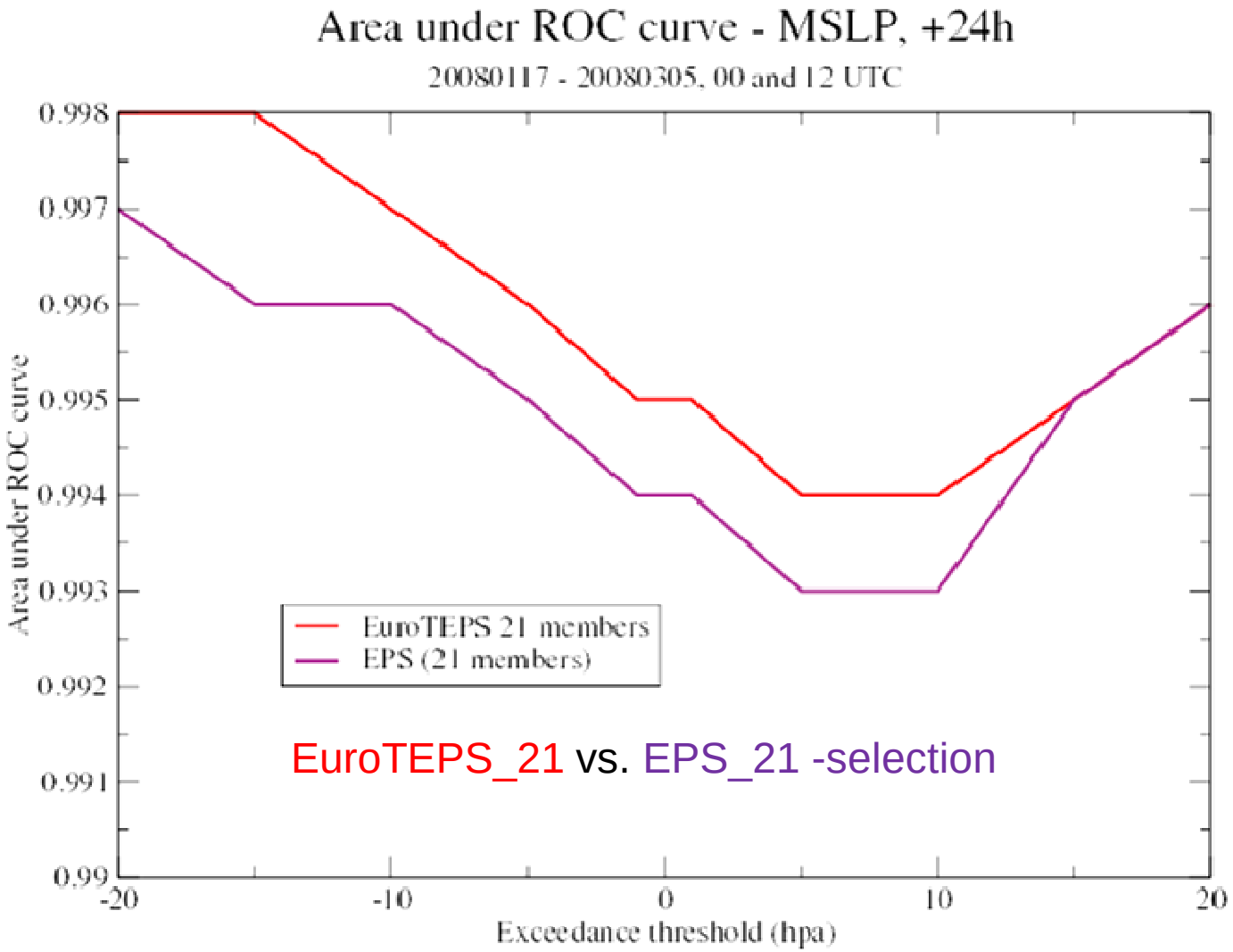
+48

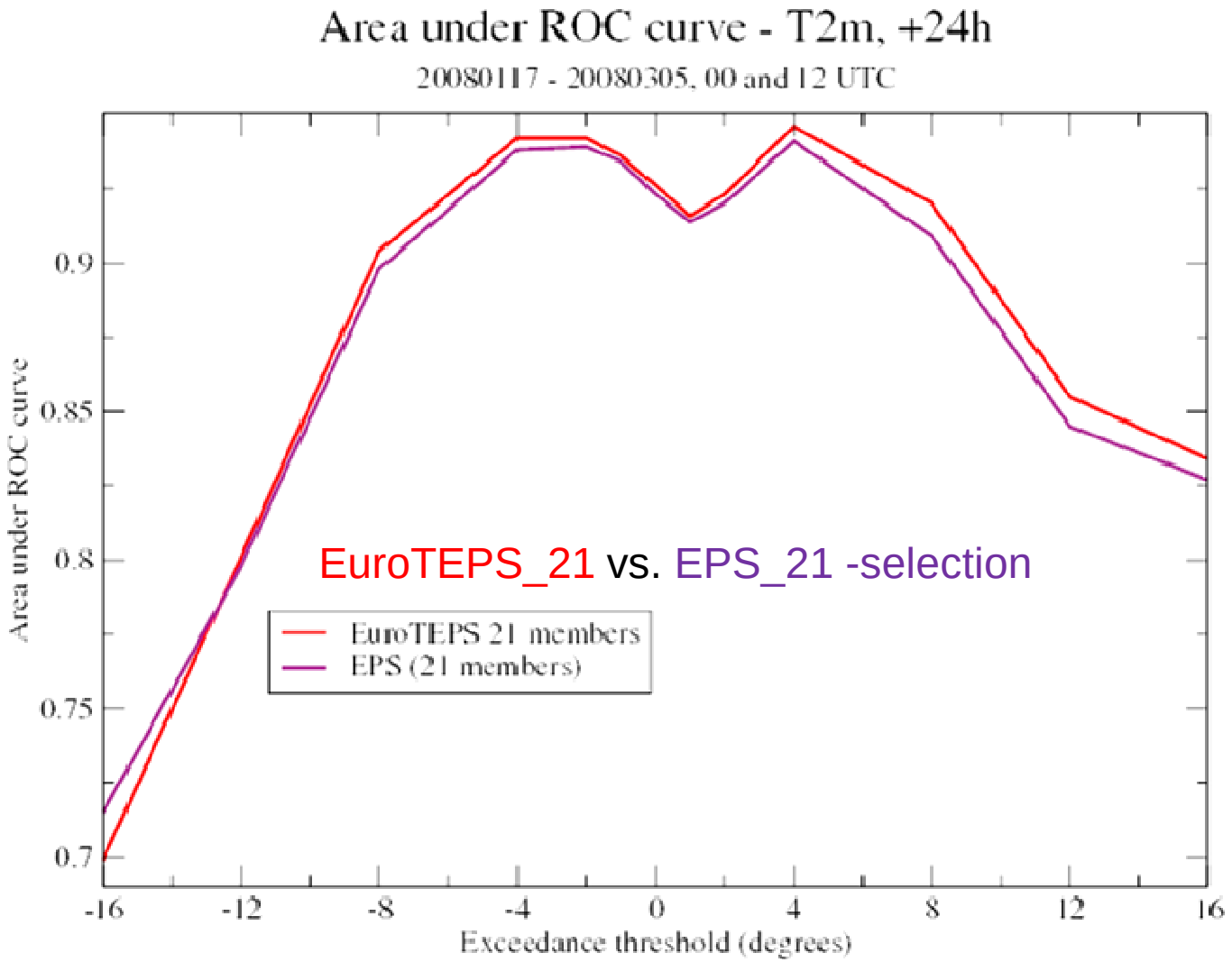


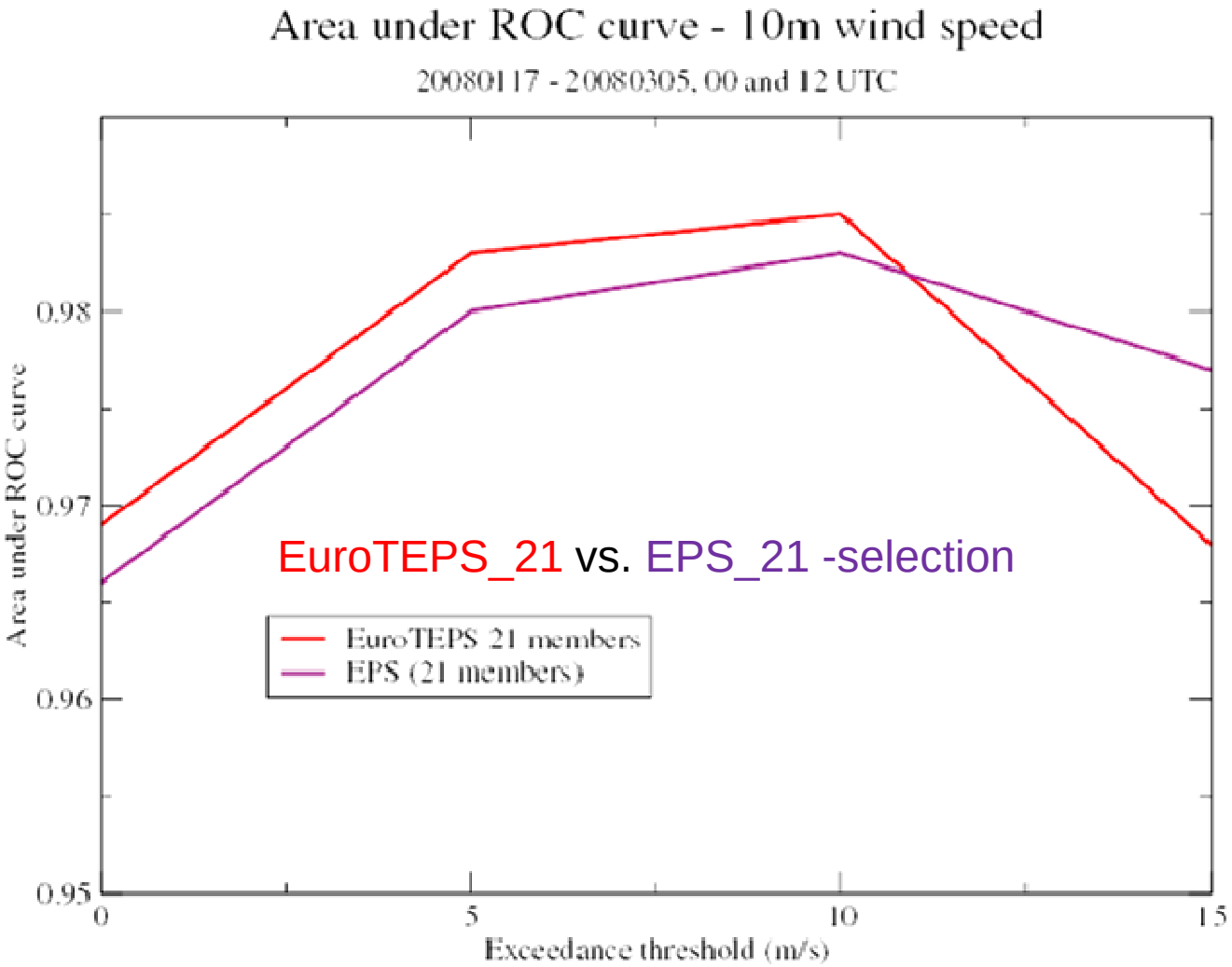
MSLP

Spread-Skill MSLP 21 cases winter 2008



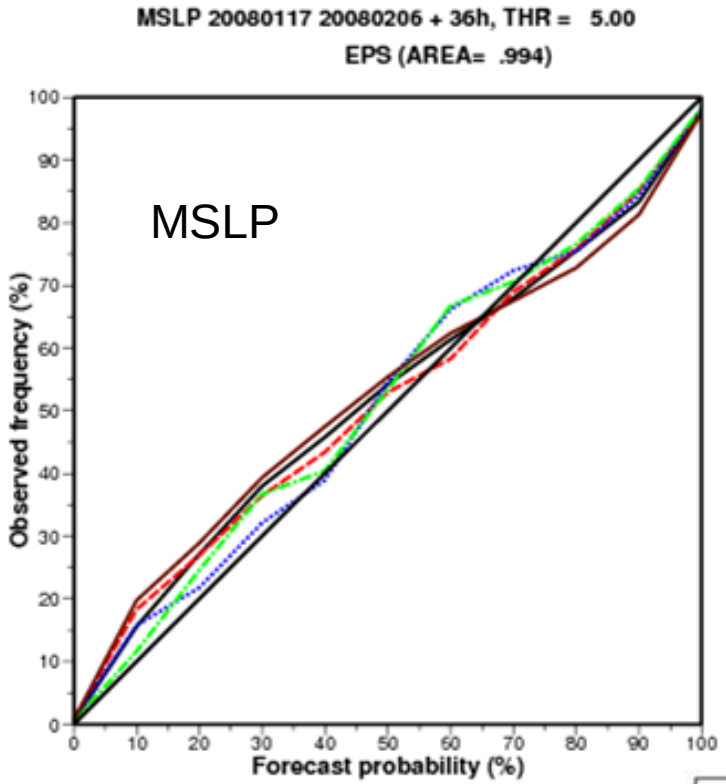

Area under ROC curve - MSLP, +24h
20080117 - 20080305, 00 and 12 UTC
Area under ROC curve
0.998
0.997
0.996
0.995
0.994
0.993
0.992
0.991
0.99
-20
-10
0
10
20
Exceedance threshold (hpa)
EuroTEPS 21 members
EPS (21 members)
EuroTEPS_21 vs. EPS_21 -selection

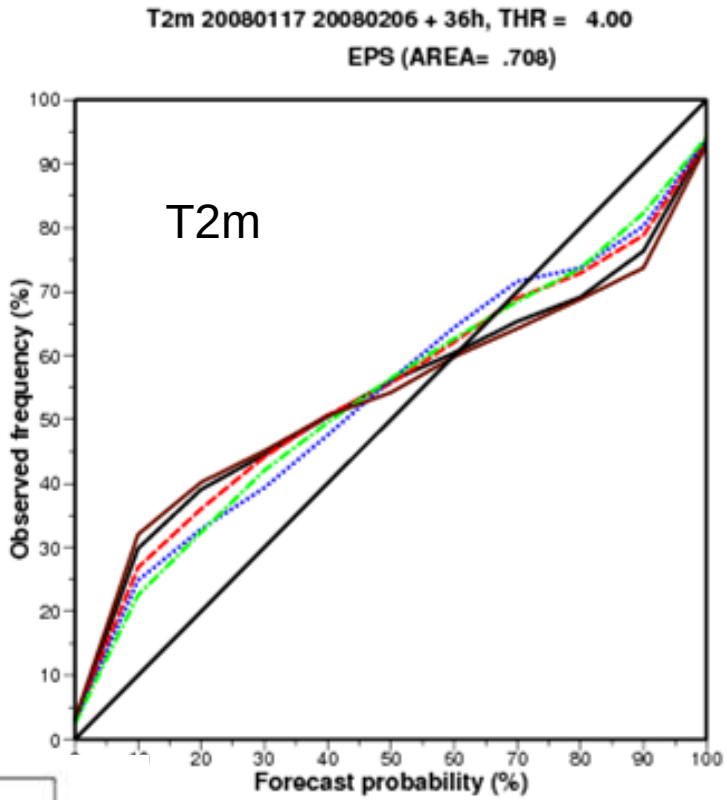

Area under ROC curve - T2m, +24h
20080117 - 20080305, 00 and 12 UTC
Area under ROC curve
0.9
0.85
0.8
0.75
0.7
-16
-12
-8
-4
0
4
8
12
16
Exceedance threshold (degrees)
EuroTEPS_21 vs. EPS_21 -selection
EuroTEPS 21 members
EPS (21 members)

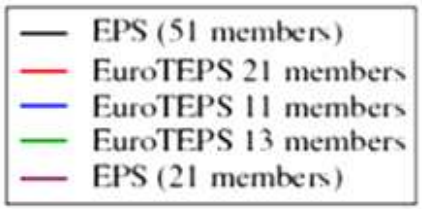

Area under ROC curve - 10m wind speed
20080117 - 20080305, 00 and 12 UTC
Area under ROC curve
0.98
0.97
0.96
0.95
0
5
10
15
Exceedance threshold (m/s)
EuroTEPS_21 vs. EPS_21 -selection
EuroTEPS 21 members
EPS (21 members)

Reliability diagram

EuroTEPS_21/13/11 vs. EPS_21 –selection/EPS_51



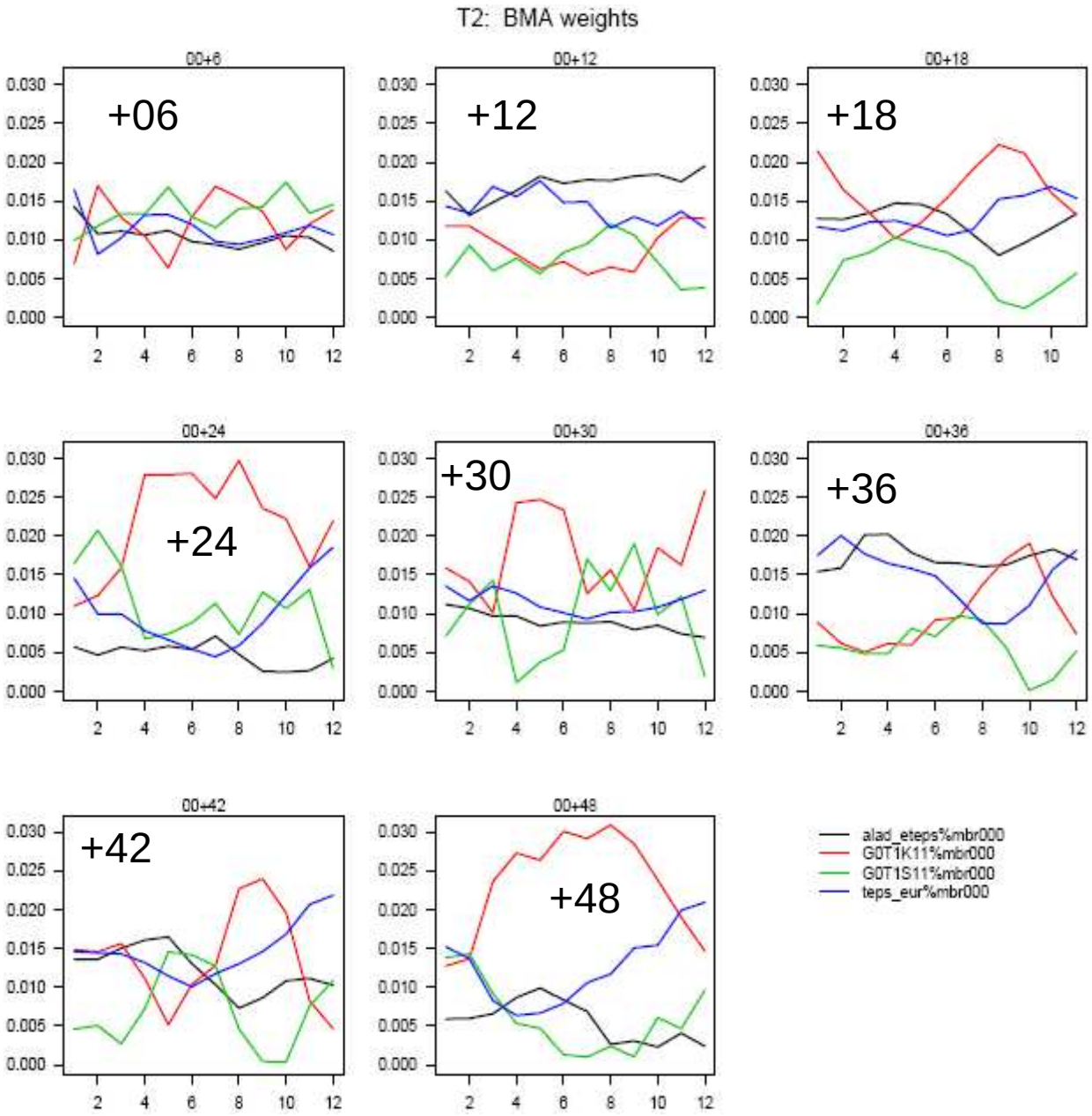





Thank You!

Extra Slides

BMA-Weights, EXP_0, August 2007



BMA Weights, T2m:

Day2 = 18. Aug.

Day8 = 25. Aug. 2007

3-day learning period

____ ALADIN_EPS (NEW)

____ HIRLAM_EPS_K

____ HIRLAM_EPS_S

____ EuroTEPS