The impact of using CAPE Singular Vector perturbations in GLAMEPS

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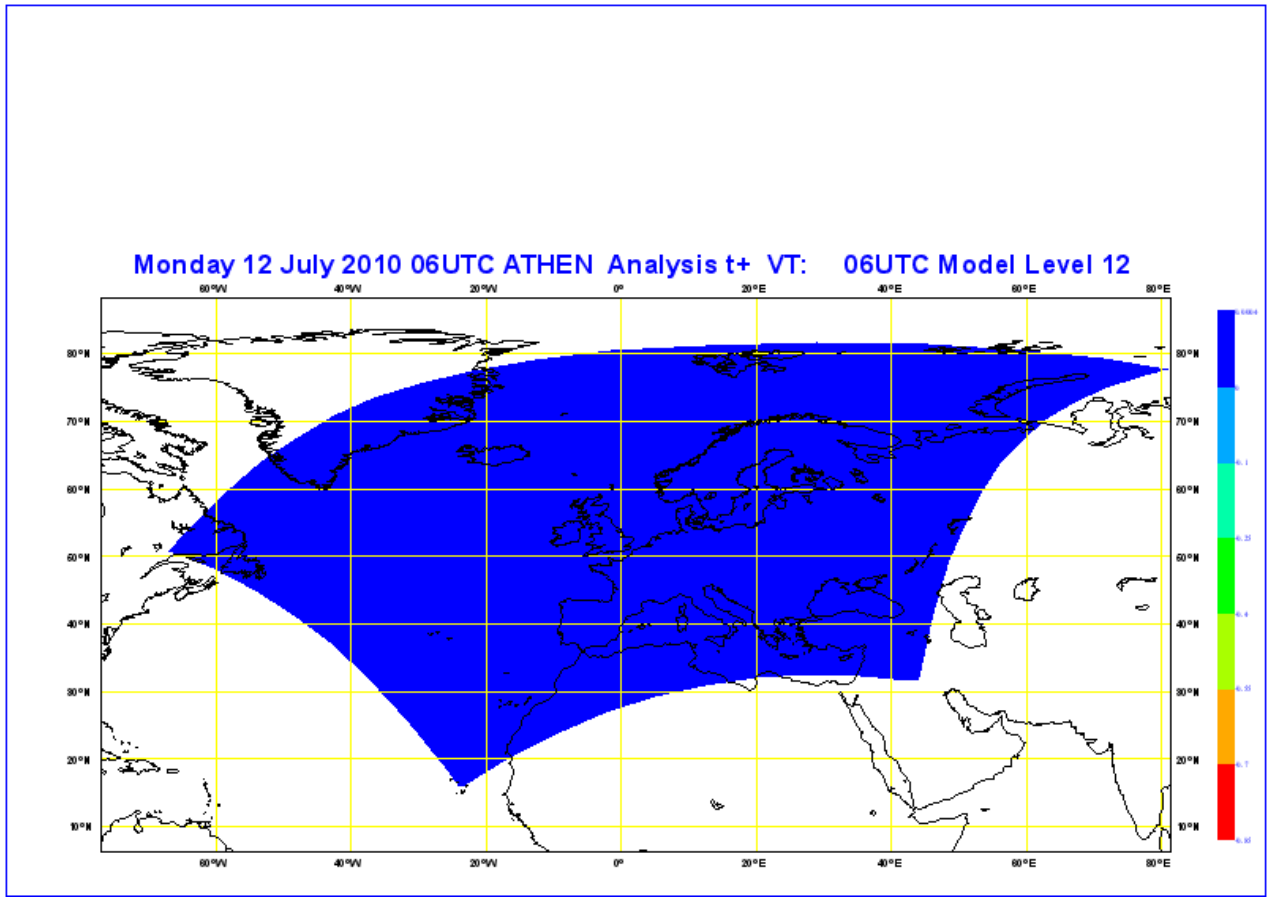
The GLAMEPS configuration

- Hirlam_K mbr000, mbr013 – mbr024 06 / 18
- Hirlam_S mbr000, mbr001 – mbr012 06 / 18
- Aladin mbr000, mbr025 – mbr036 06 / 18
- ECEPS mbr037 – mbr050 00 / 12
- ECDET mbr000 00 / 12

Total number of members: 54

Resolution: 11.1 / 11.8 / 32 km

Glameps area



Set up of experiments

Period: 1 July – 31 August 2010

- Control

- SV experiment: as Control, but:

  Hirlam Kain-Fritsch and *Hirlam Straco* have extra perturbations based on Singular Vectors

Singular vector computations

Analyses of control run were used; interpolation to ~ 48 km res.

Optimisation time: 12 h

CAPE

$$CAPE = g \int_{z_f}^{Z_n} \left(\frac{T_{v,parcel} - T_{v,env}}{T_{v,env}} \right) dz$$

Hirlam_S SV's for Hirlam_S

Hirlam_K SV's for Hirlam_K

#SV's : 14 use linear model of Hirlam

Perturbations for different members

-Gaussian symmetric

-u, v and T

-Perturbations are *added* to ECEPS perturbations

Verification model forecasts

1) 12 h accumulated precipitation
2) 10 m wind
3) 2 m temperature

use synoptic observations in Europe

Spread & verification scores

- Brier score
- Brier skill score
- Roc score / area
- Reliability

Brier (skill) score

$$BS = \frac{1}{N} \cdot \sum_{i=1}^{N} (f_i - o_i)^2$$

2 categories

resolution

$$BS = \frac{1}{N} \sum_{k=1}^{K} n_k (f_k - \bar{o}_k)^2 - \frac{1}{N} \sum_{k=1}^{K} n_k (\bar{o}_k - \bar{o})^2 + \bar{o}(1 - \bar{o})$$

reliability

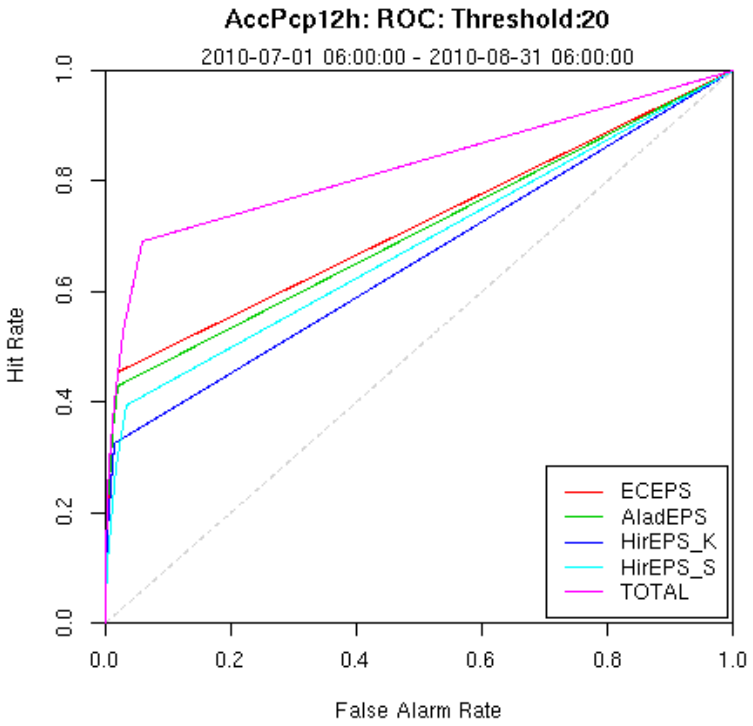
uncertainty

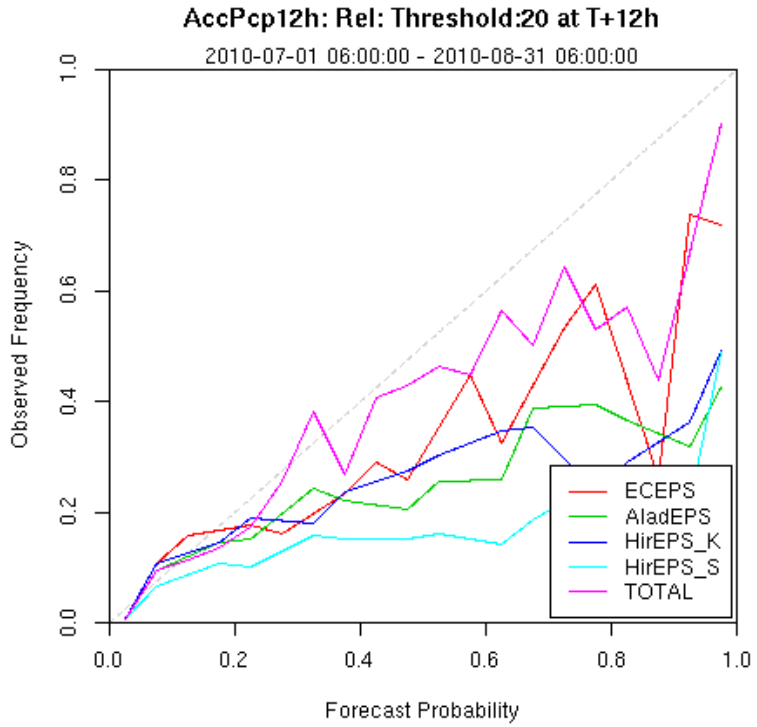
3 component decomposition

$$BSS = 1 - \frac{BS}{BS_{ref}}$$

12 h accumulated precipitation analysis time 6 UTC ROC / reliability score 20 mm

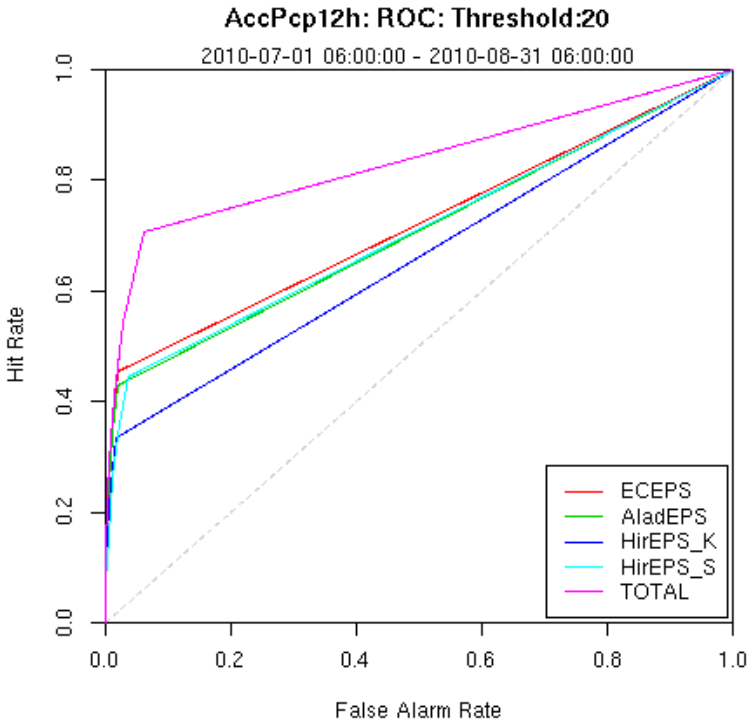
control

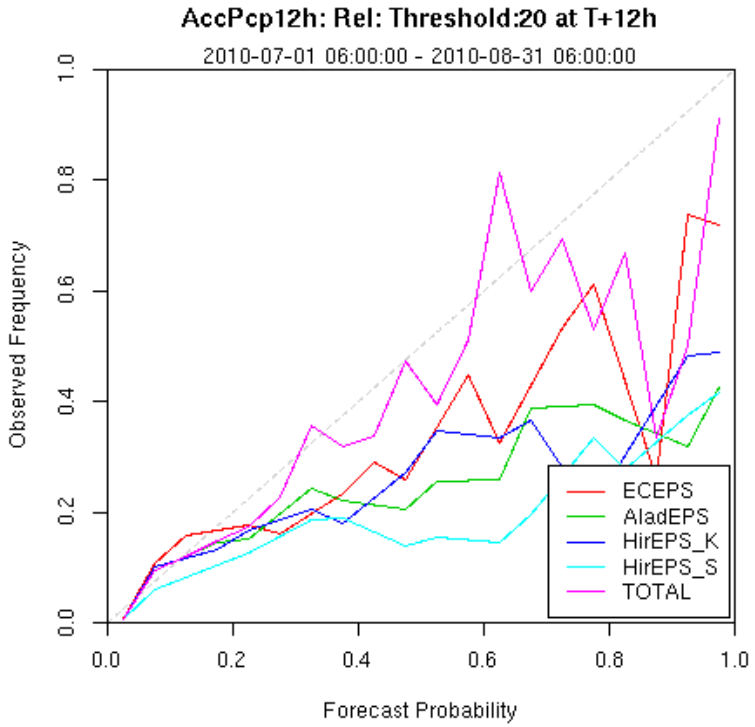




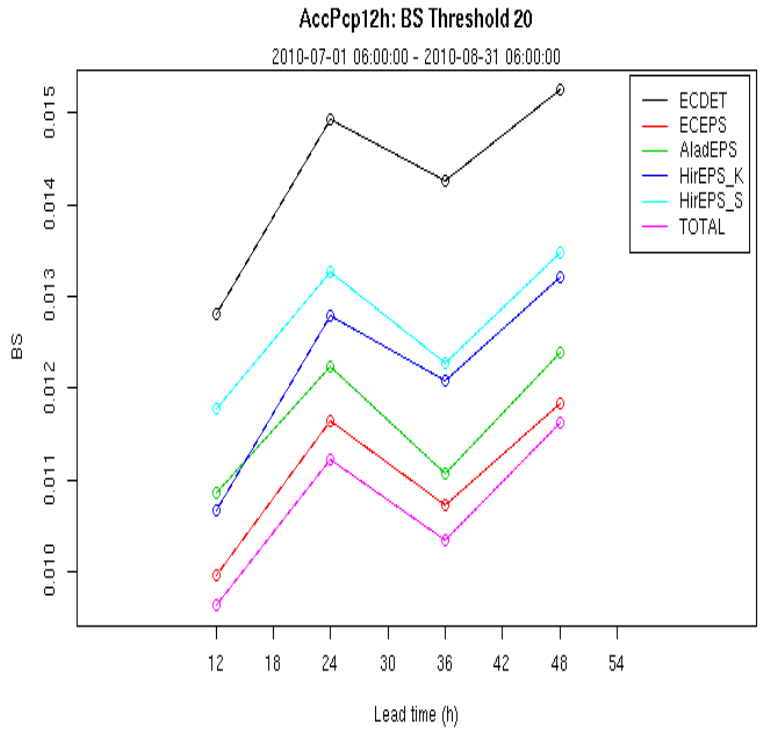
12 h accumulated precipitation analysis time 6 UTC ROC / reliability score 20 mm

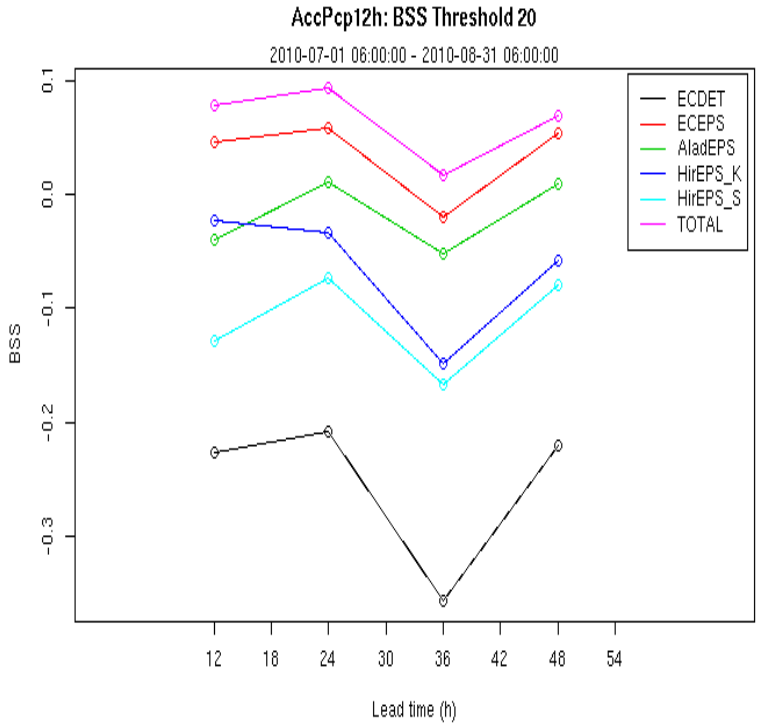
SV



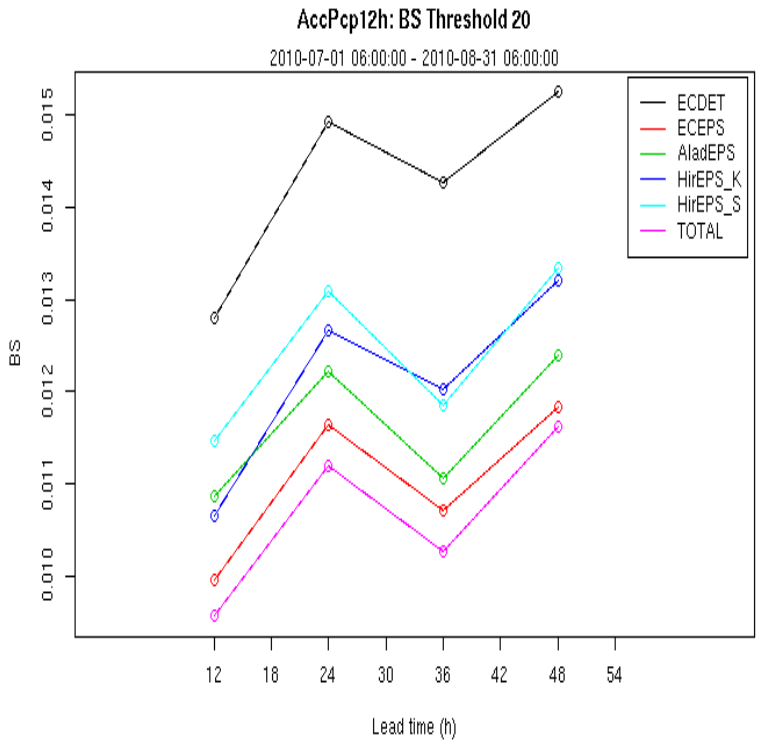


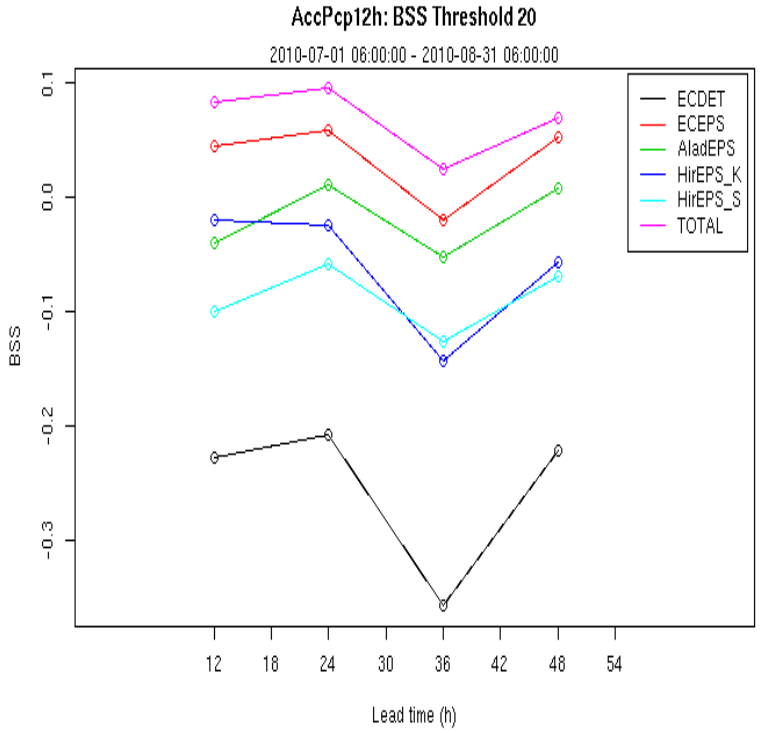
12 h accumulated precipitation analysis time 6 UTC BS / BSS 20 mm control



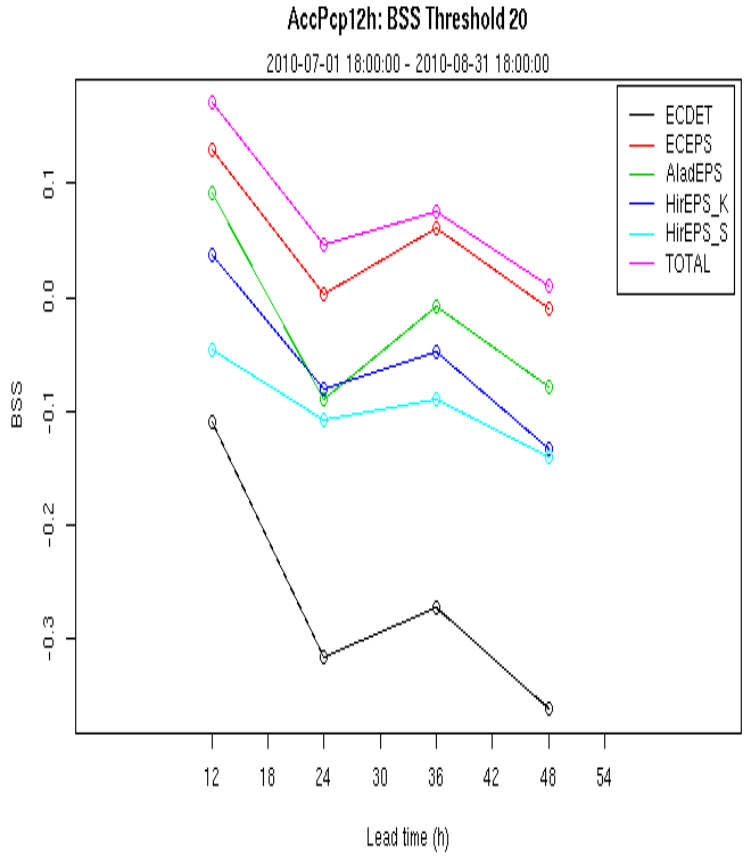


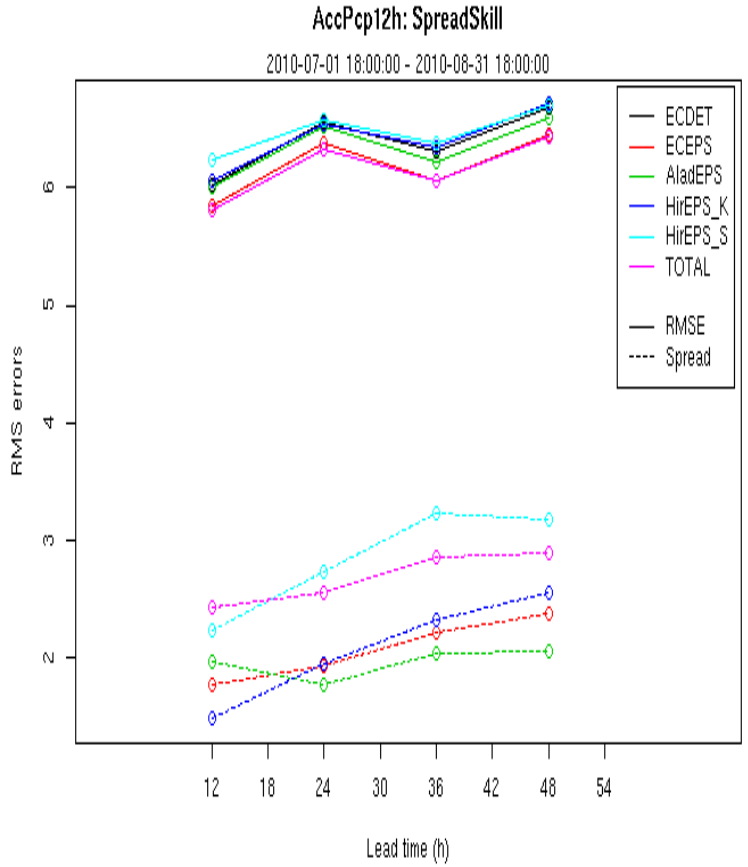
12 h accumulated precipitation analysis time 6 UTC BS / BSS 20 mm SV





12 h accumulated precipitation analysis time 18 UTC BSS and spread 20 mm control





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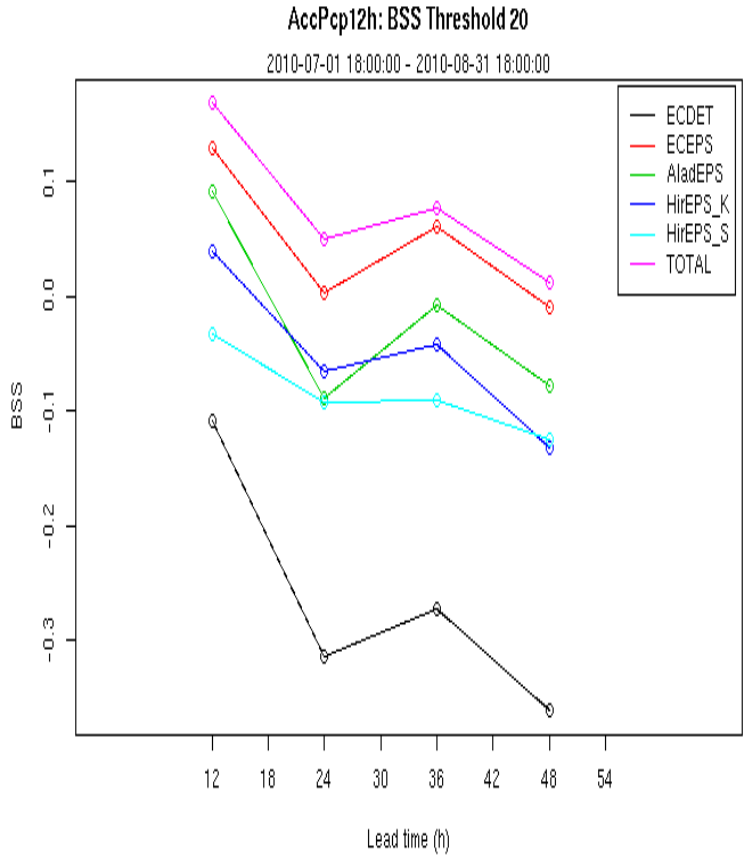
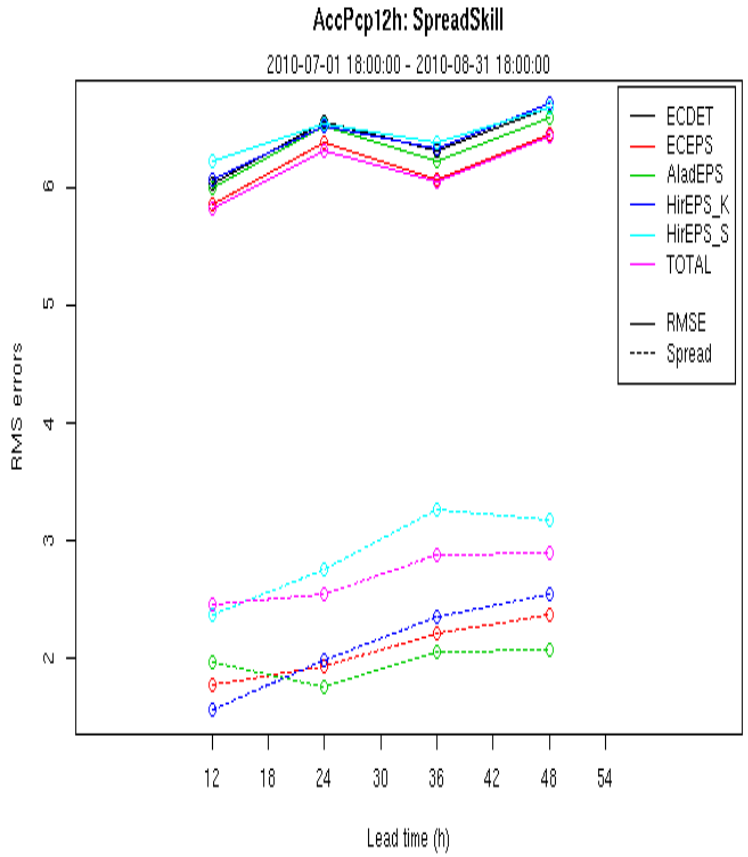
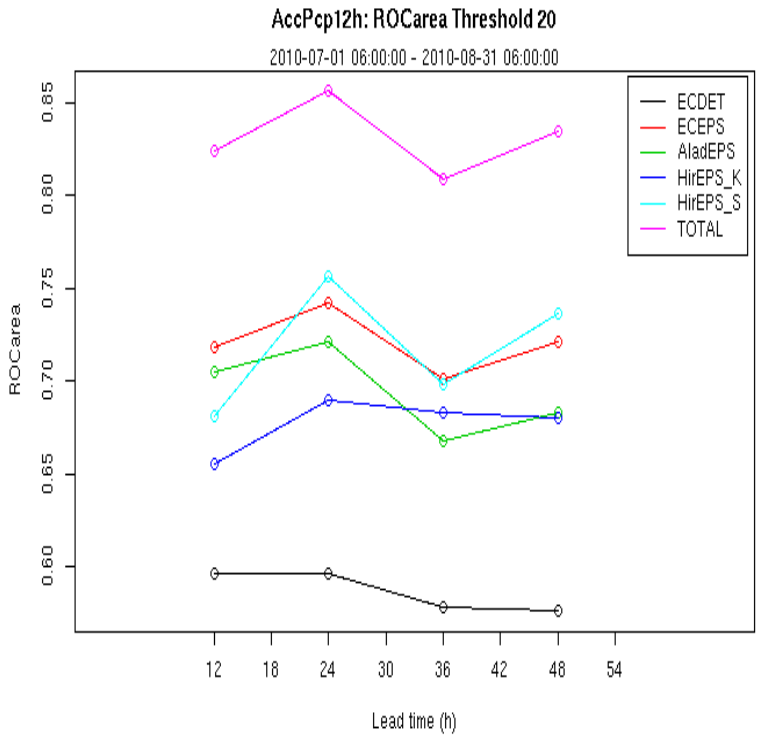




12 h accumulated precipitation ROC area control 20 mm

06



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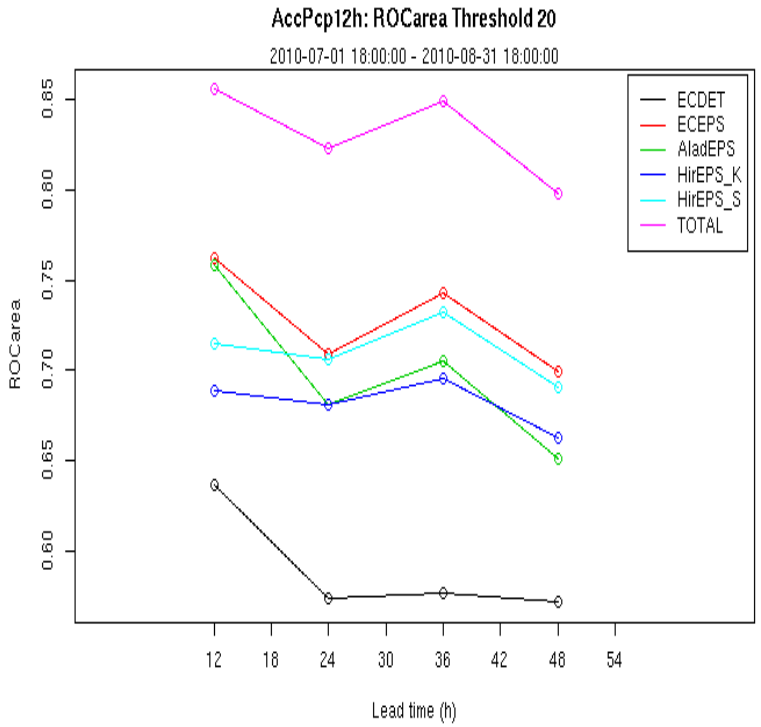

12 h accumulated precipitation ROC area SV 20 mm

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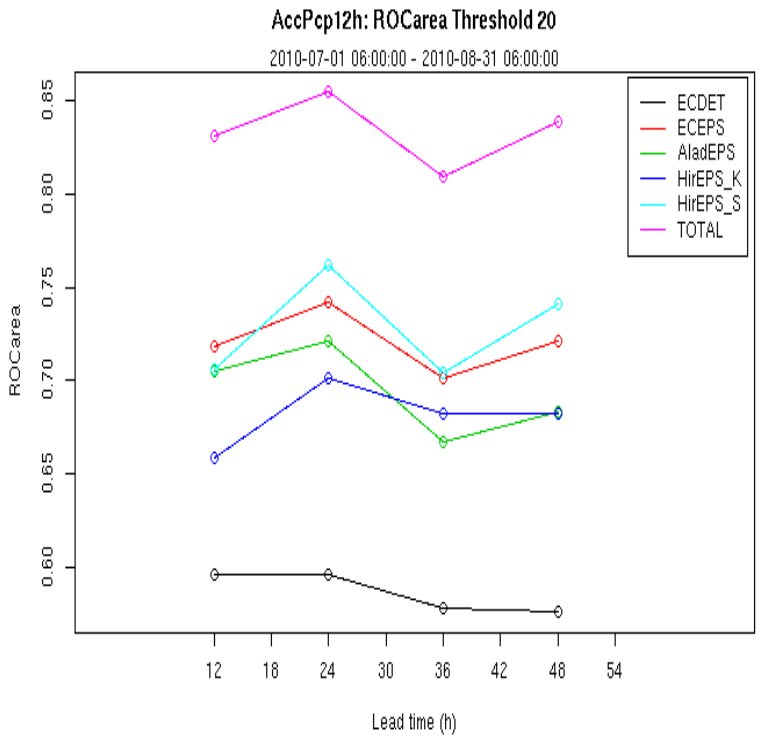

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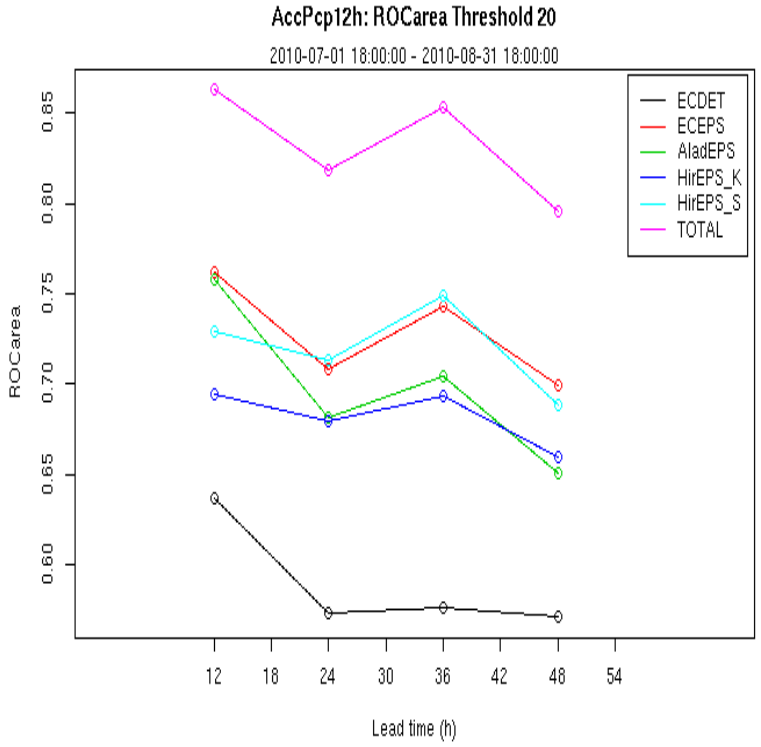

12 h accumulated precipitation ROC area control 10 mm

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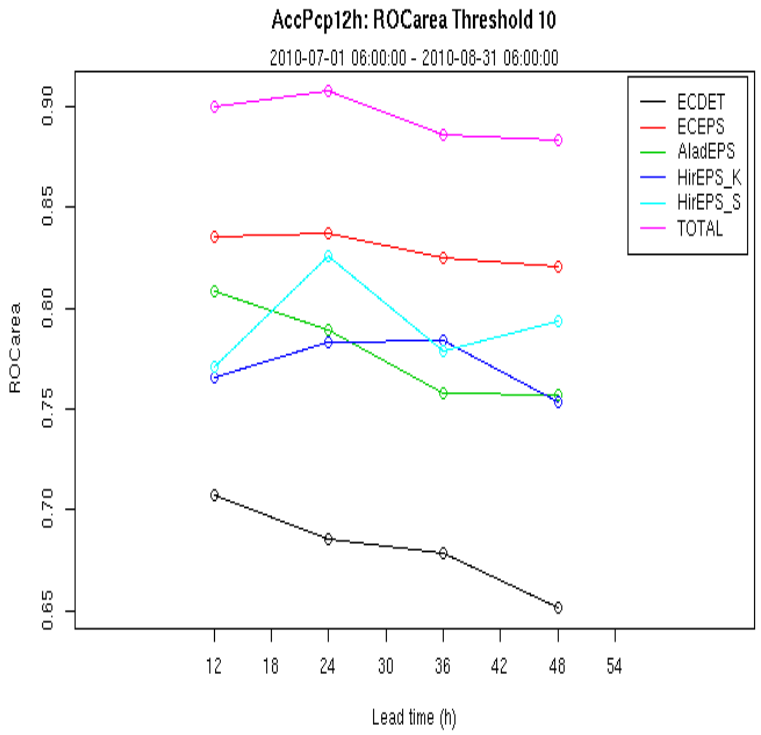

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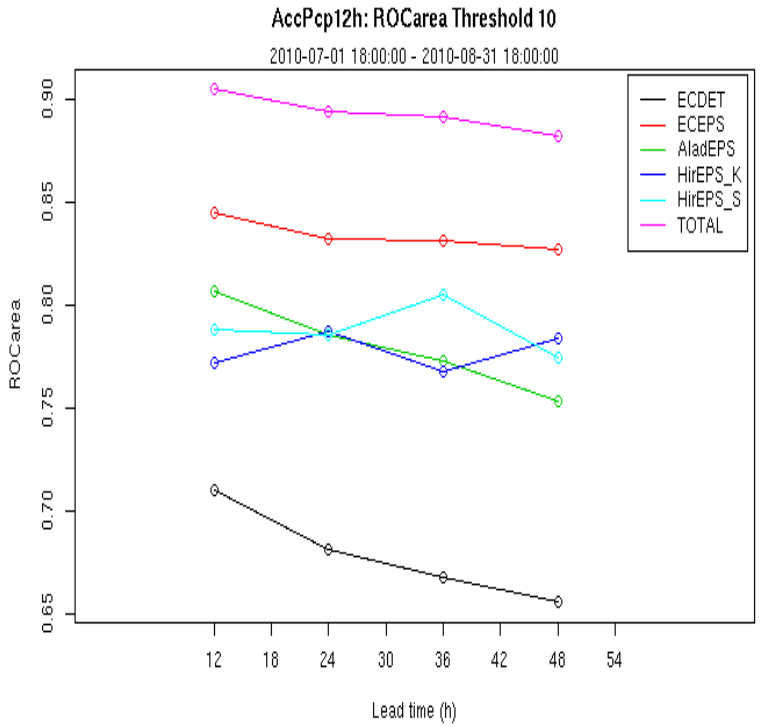

12 h accumulated precipitation ROC area SV 10 mm

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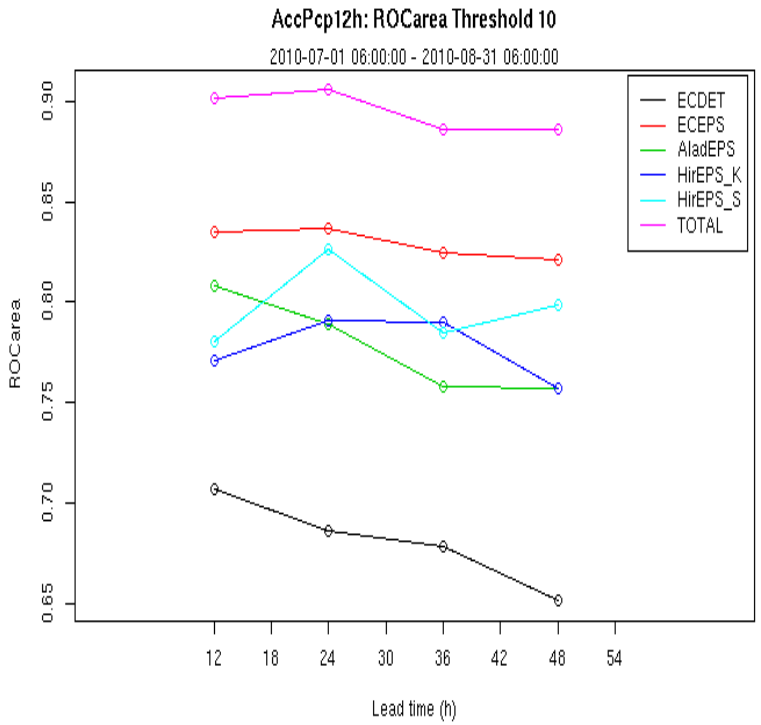

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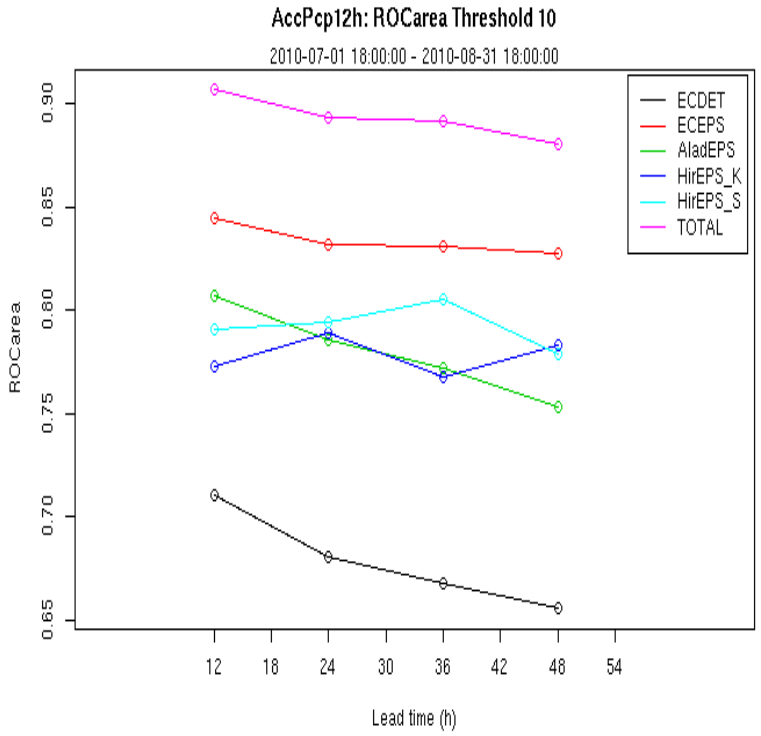
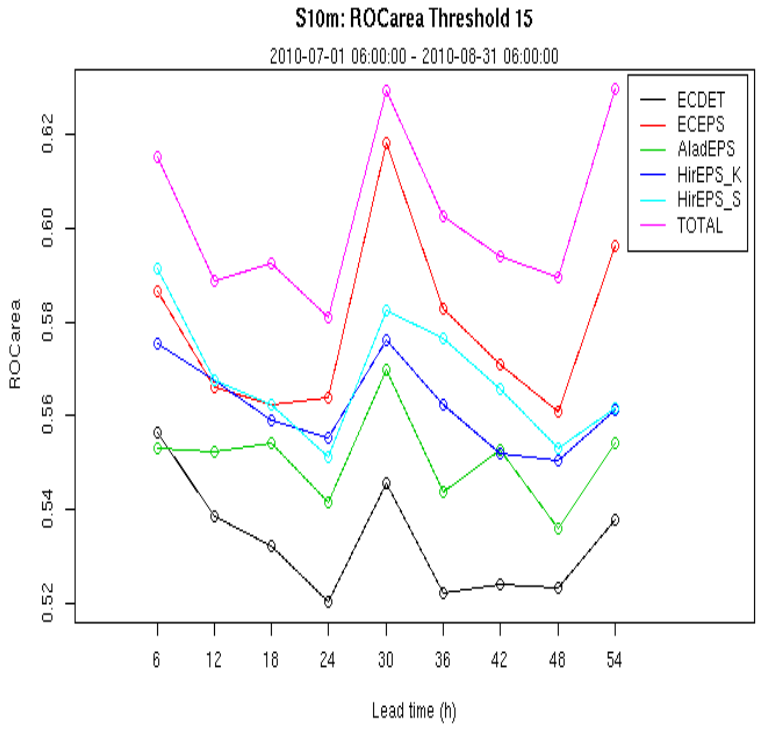


ROC area 10 m wind 15m/s
control

06



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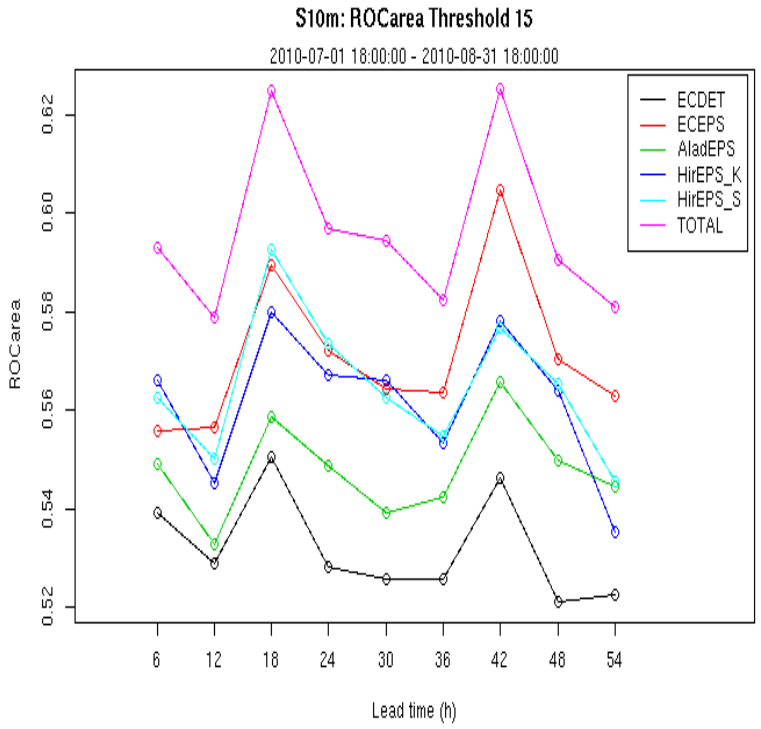
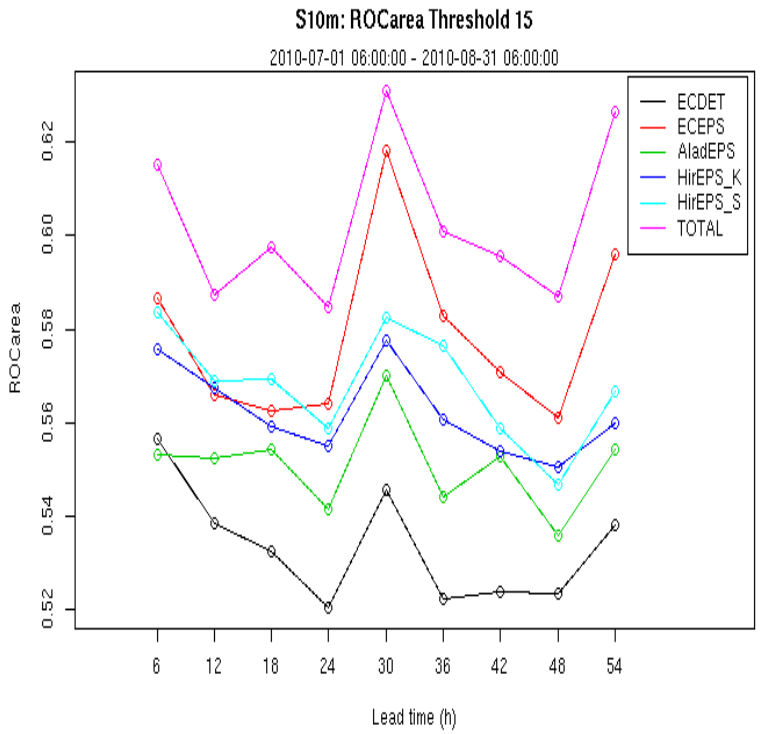


ROC area 10 m wind 15m/s

SV

06



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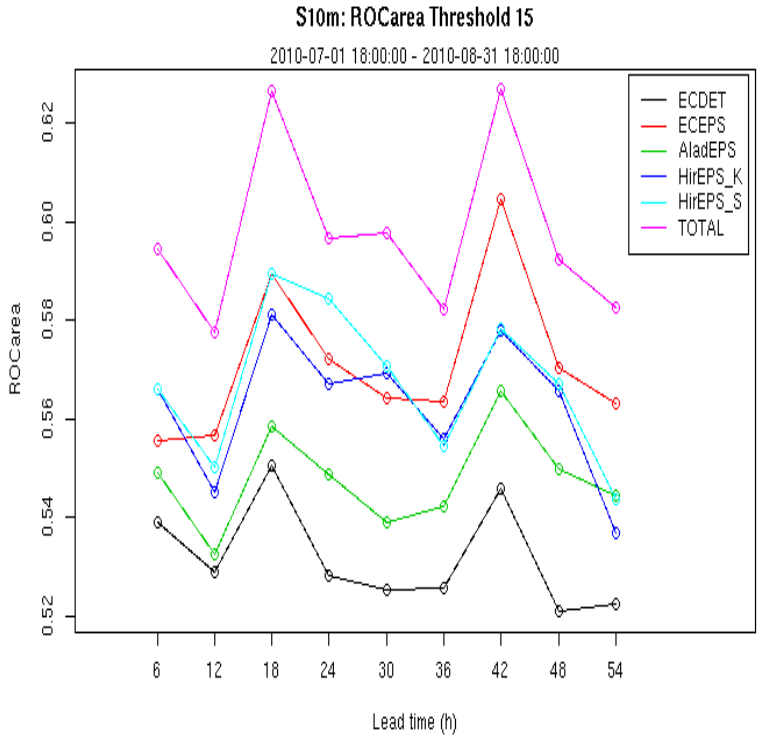
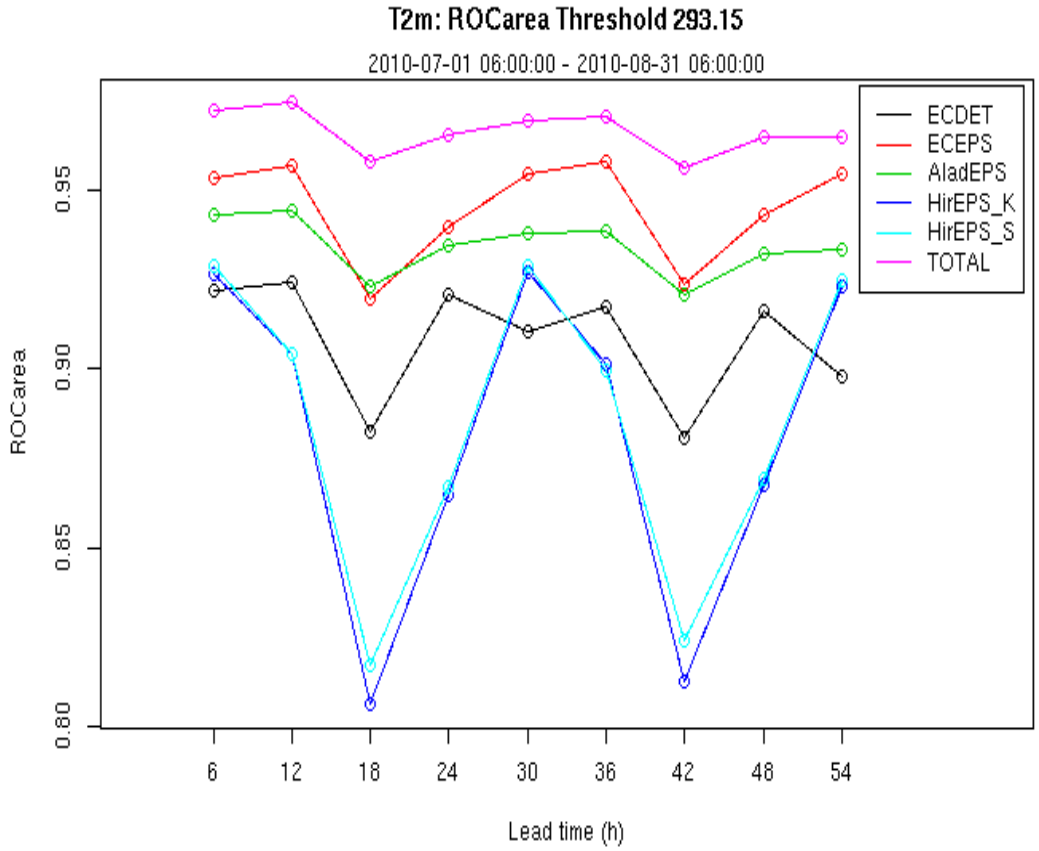


T 2m Roc area 20 C 06



Conclusions (1)

1) Different model qualities in the control run

- 12 h prec: Hirlam-S exhibits the largest spread, but the worst verification scores for BS and BSS

ROC area: Hirlam-S better than Hirlam-K and better than Aladin

- EC model has often best verification scores
- whole ensemble considerably better than the best model

Conclusions (2)

2) Impact CAPE SV's in Glameps

a) 12 h accumulated precipitation

- only significant impact *(positive)* for higher thresholds
- increased spread in Hirlam models
- larger impact *(positive)* for shorter lead times
- better ROC curves for Hirlam (K and S) and total ensemble

Conclusions (3)

- better reliability, (*but only for whole ensemble)*

- better ROC areas, (*primarily for the shorter lead times)* *~ 2%*

- improved Brier and Brier Skill Scores

(shown for + 12h forecasts)

Conclusions (4)

b) Impact on 10 m wind

Hirlam is sensitive to CAPE SV's

(impact on quality ensemble is unclear for 06 UTC, slightly positive for 18 UTC)

c) Impact on 2m T

Hardly any influence (but quality already quite good for 20 C threshold)

General conclusion:

Use of CAPE Singular Vectors in Hirlam:

Clear (modest) positive impact on precipitation for shorter lead times with higher thresholds

Outlook

- Further analysis verification results
- Calibration
- Hirlam SV computations operational?

Thanks to:

Alex Deckmyn

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