Verification of mesoscale EPS with different resolutions (Sochi experience)

precipitation study

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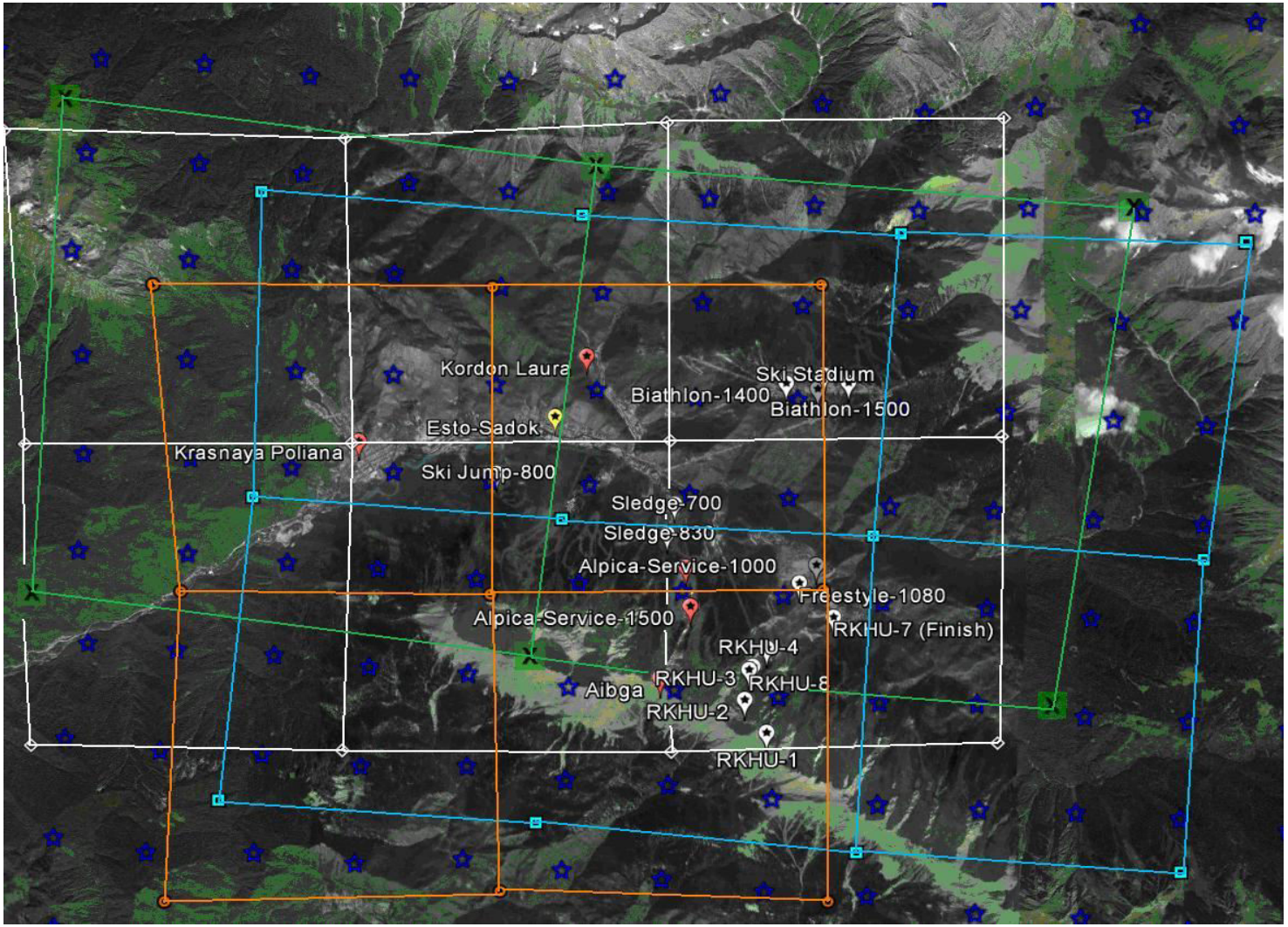
Roshydromet

Stations and models

- Stations (FROST2014 map)
- Models (name, country, grid, members, lead-time):
  - COSMO-S14-EPS, Italy (7 km, 10 mmbs, 72 hrs)
  - GLAMEPS, Norway (11 km, 54 mmbs, 54 hrs)
  - LAEF, Austria (7 km, 17 mmbs, 72 hrs)
  - NMMB-EPS, USA (7 km, 7 mmbs, 72 hrs)
  - COSMO-RU2-EPS, Russia (2.2 km,10 mmbs, 48 hrs)
  - HARMON-EPS, Norway (from 28 Jan 2014),
    (2.5 km, 13 mmbs, 36 hrs)

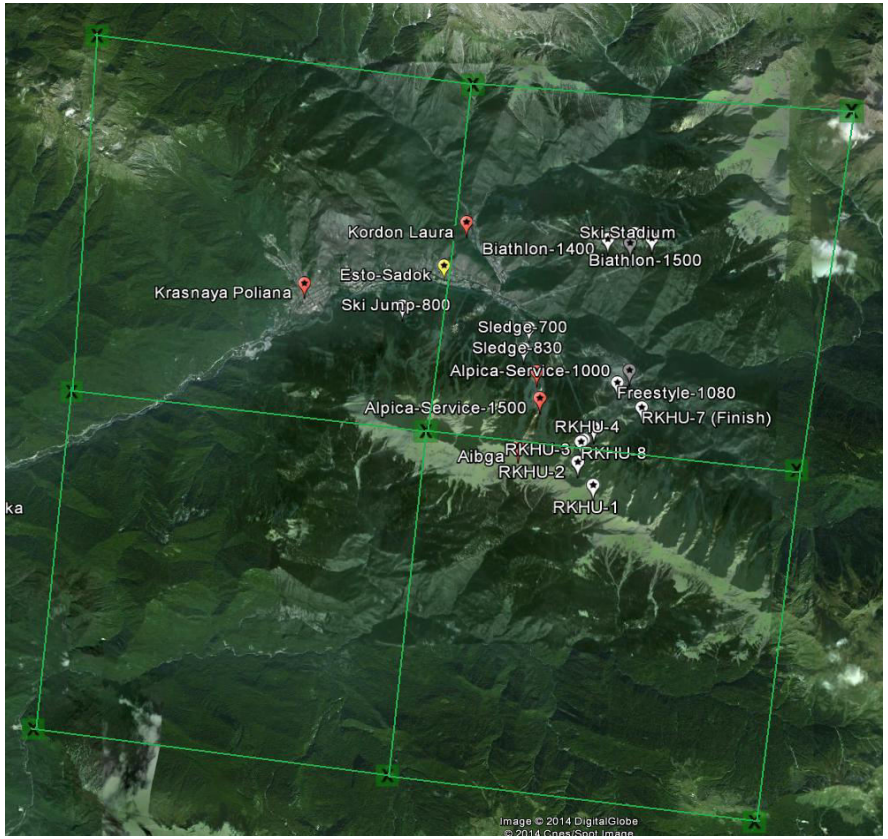
We succeeded in loading only COSMO-S14-EPS, COSMO-RU2-EPS, And GLAMEPS into VERSUS;
for other models difficulties with grib params

Mountain cluster with model nodes

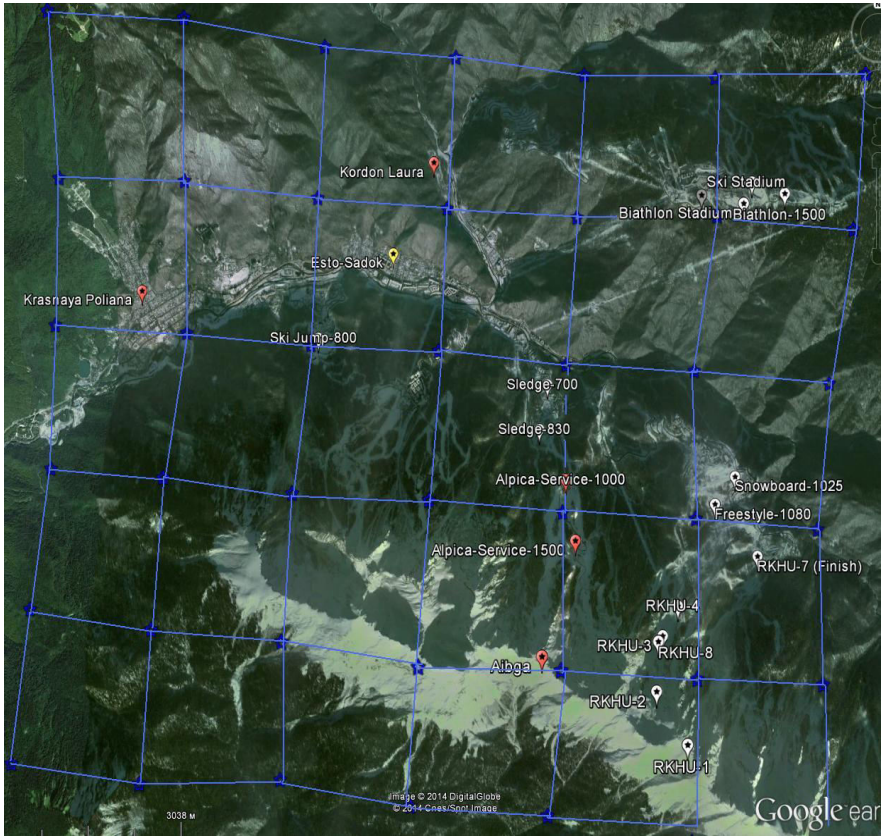


Mountain cluster with model nodes

GLAMEPS – lowest resolution



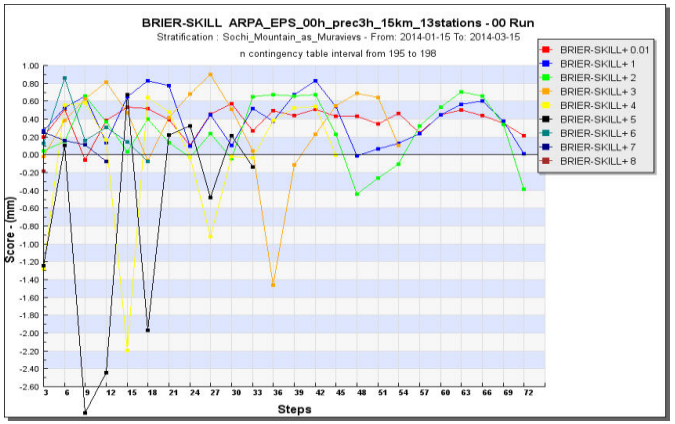
COSMO-RU2-EPS – highest res.

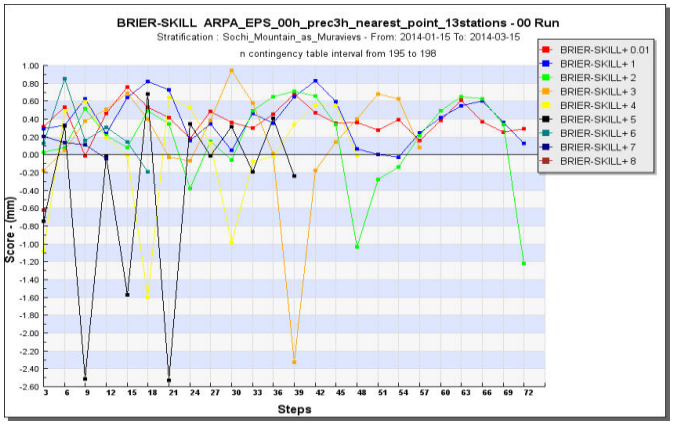


One model grid-point may be the nearest to several stations, even for 2-km resolution ensembles!

BSS of COSMO-S14-EPS 3-h precip for different thresholds, Feb 2014, mountain cluster

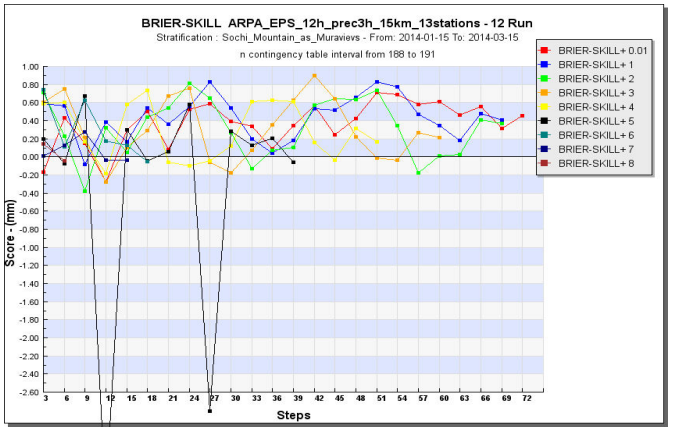
00Z, 15 km

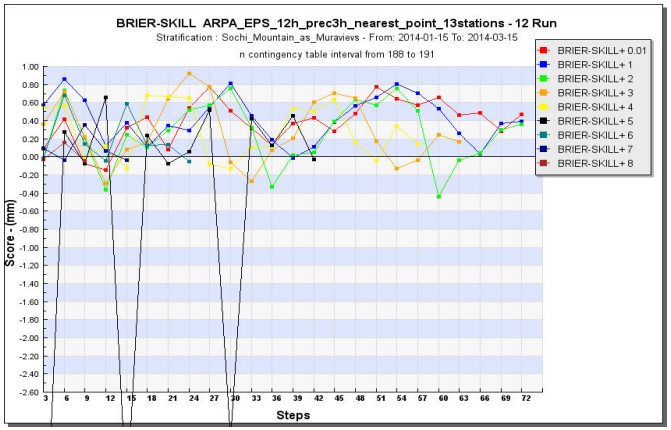




00Z, Nearest point

12Z, 15 km

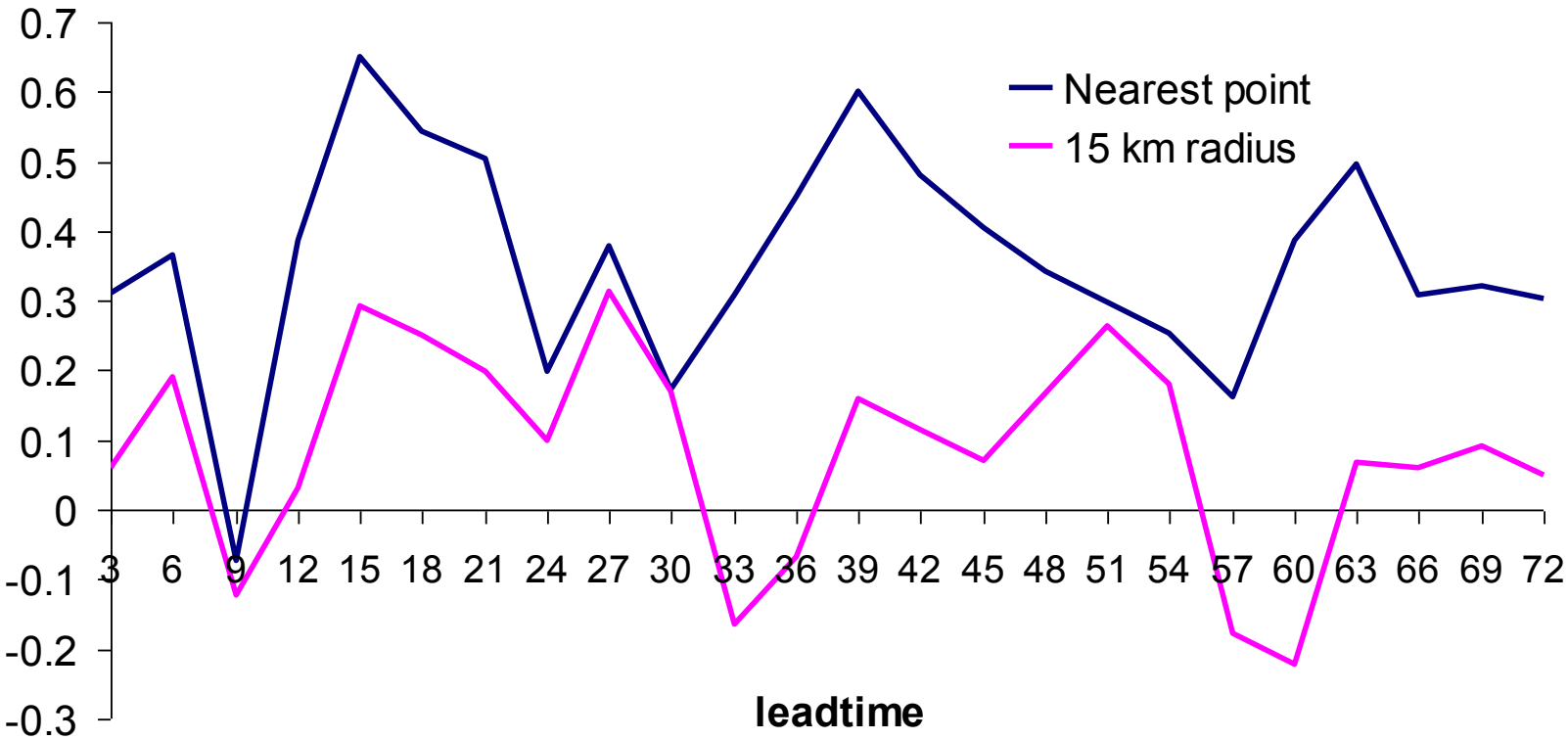




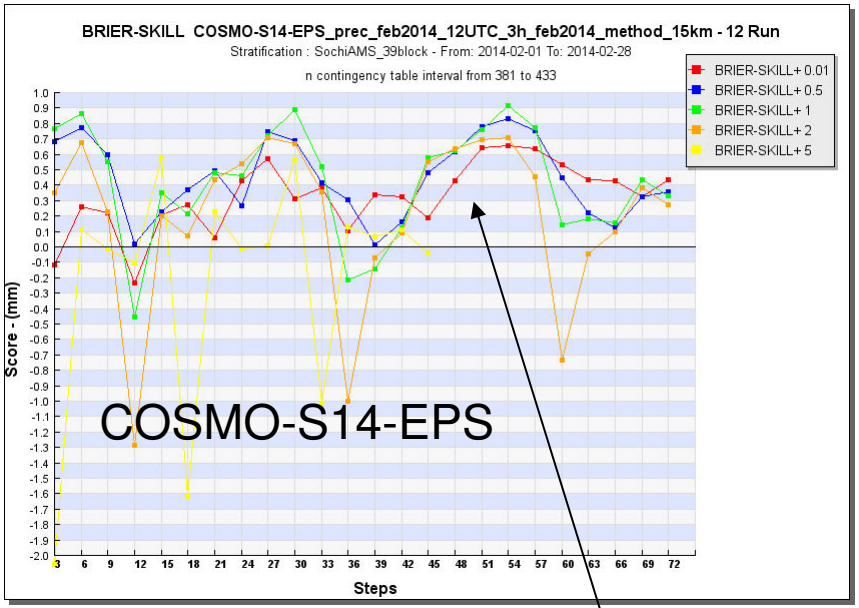
12Z, Nearest point

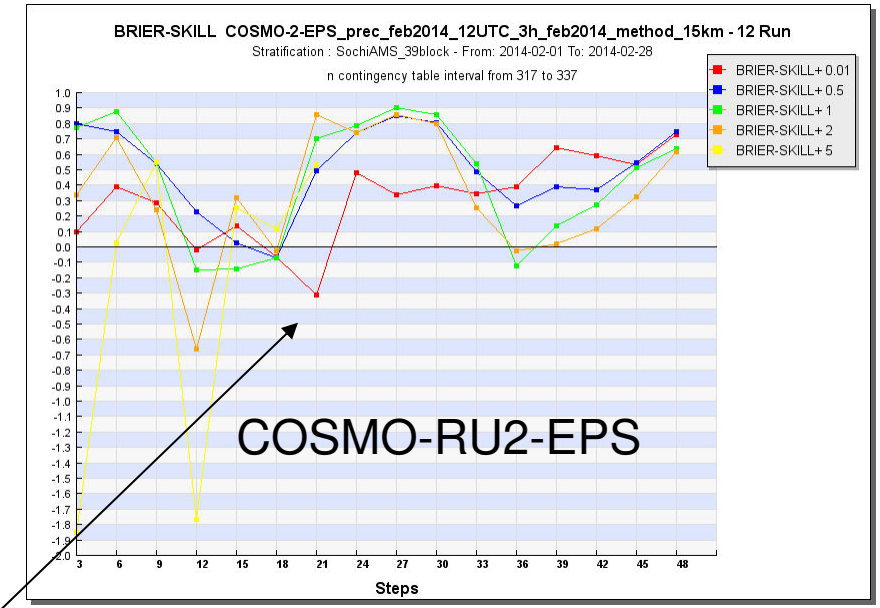
Averaging in such a big radius around the station makes little effect on the scores in the Mountain cluster. New spatial methods for ensembles are needed!

BSS, COSMO-S14-EPS,
3h precip>0.01 mm/3h, whole Sochi region, 00Z
15.01.2014-15.03.2014

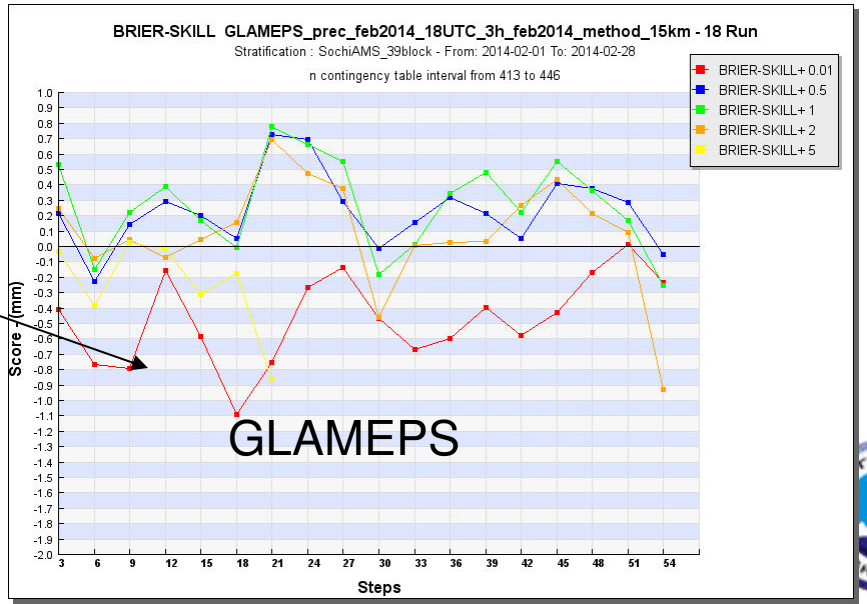


BSS for different 3h precip thresholds (COSMO init.time 12Z, GLAMEPS 18Z), feb 2014

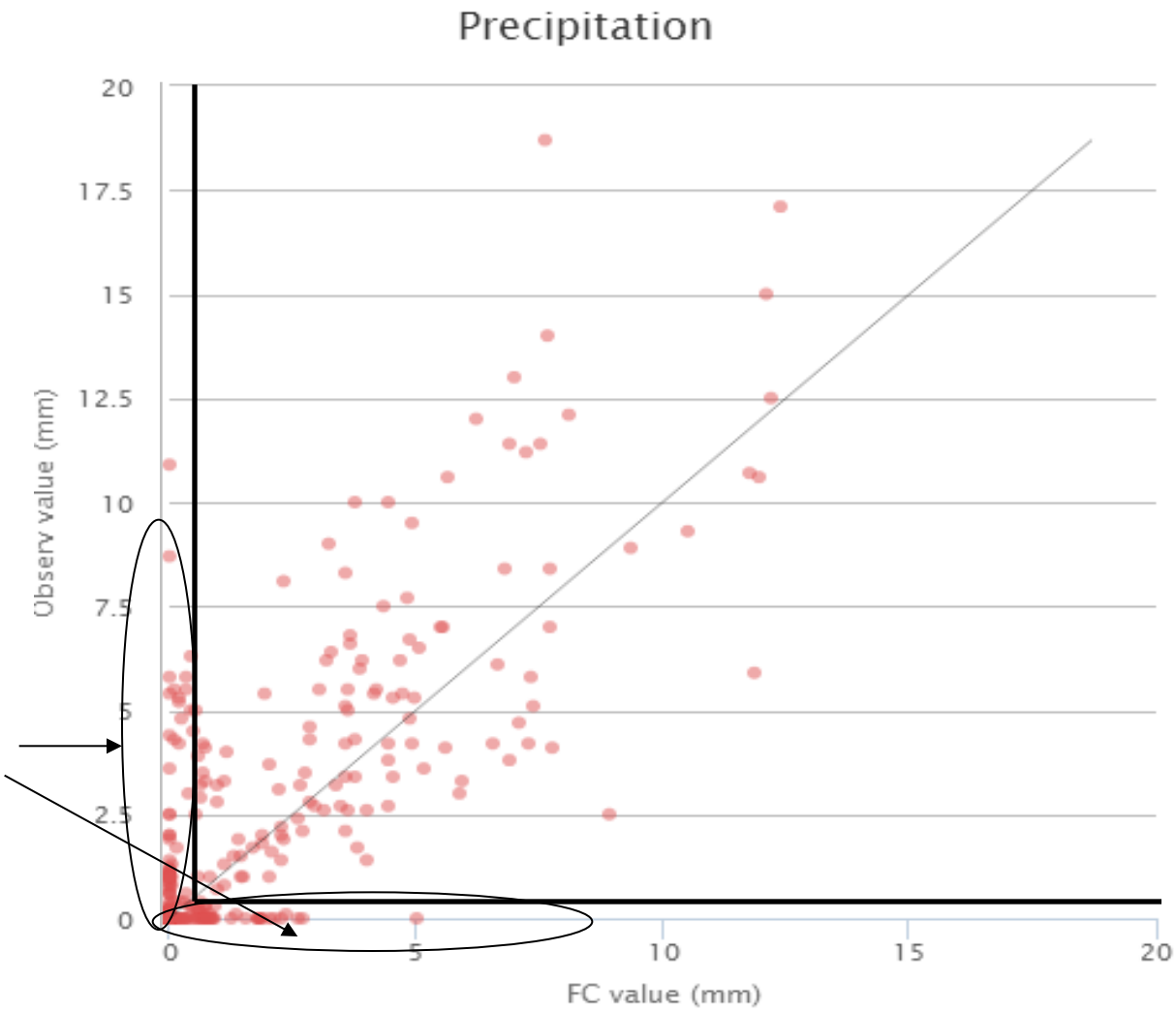




BSS of precipitation occurrence (red) is worse than the BSS of higher precip thresholds up to 5 mm/3h, for GLAMEPS, in particular



Distribution of forecasts and observations (explanation to the previous slide)



Overpopulated stripes along the axes

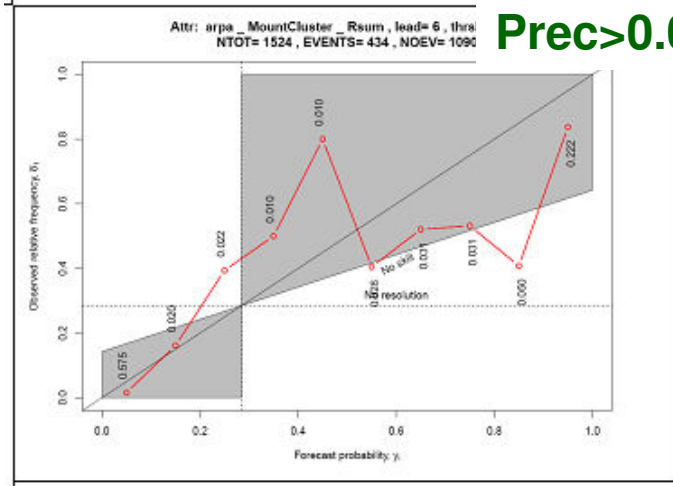
COSMO-S14-EPS
15.01-15.03.2014

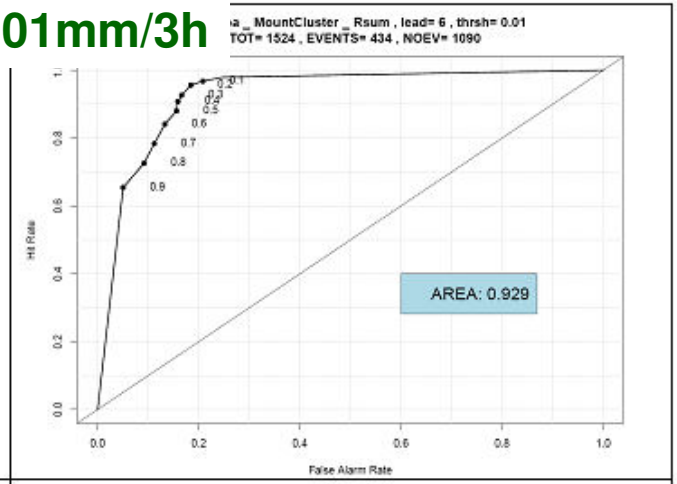
Sample effects evident

ATTR: loss of reliability with threshold.

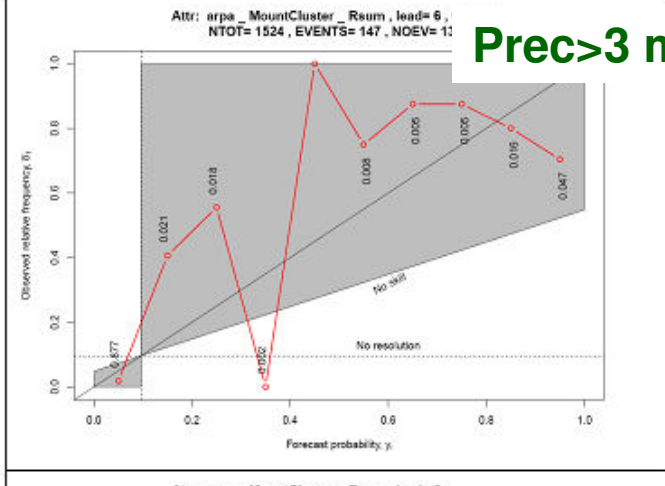
ROC: gradual decrease. No symmetry at higher thresholds.

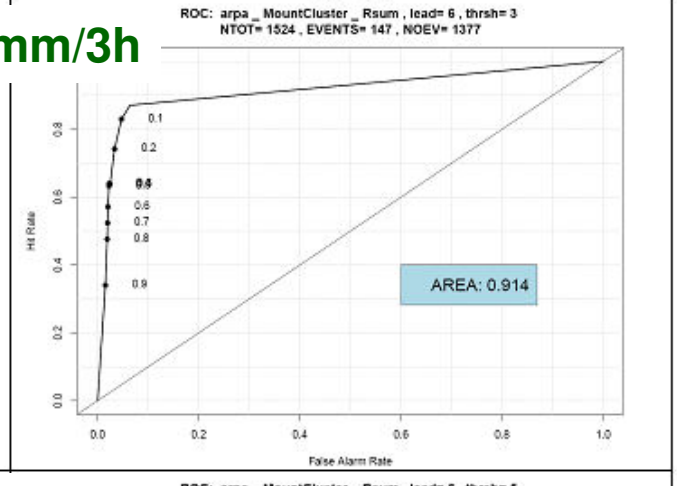
Prec>0.01mm/3h



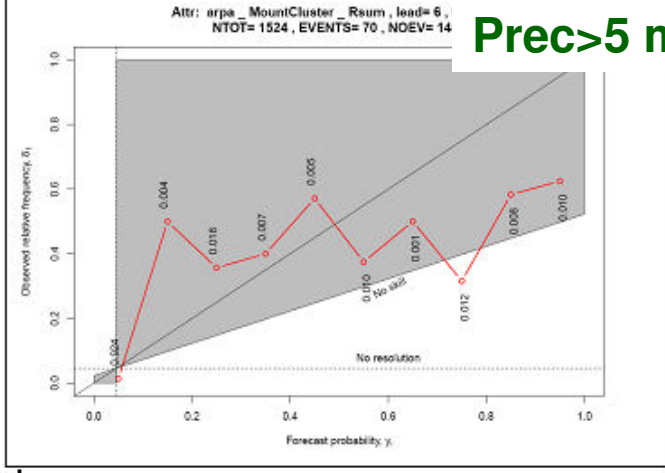


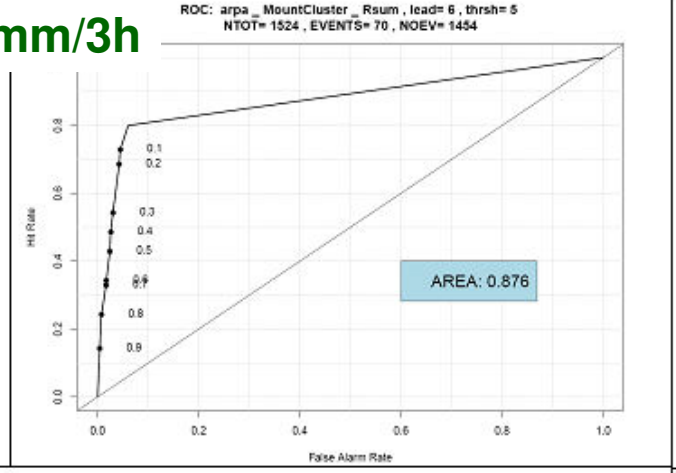
Prec>3 mm/3h





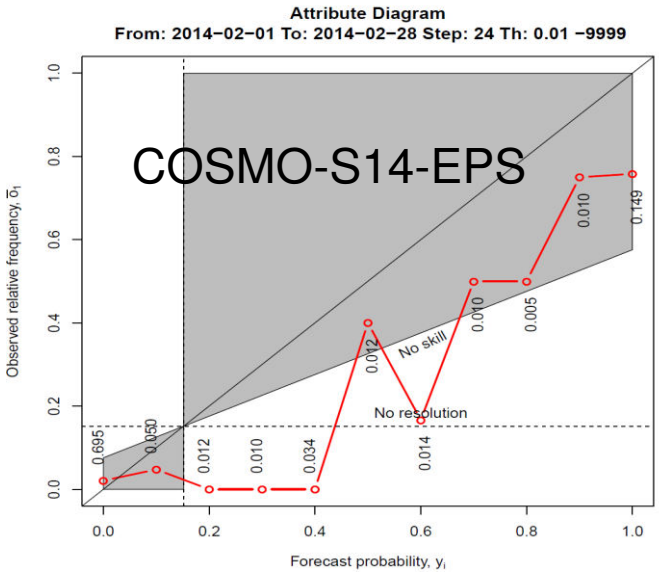
Prec>5 mm/3h

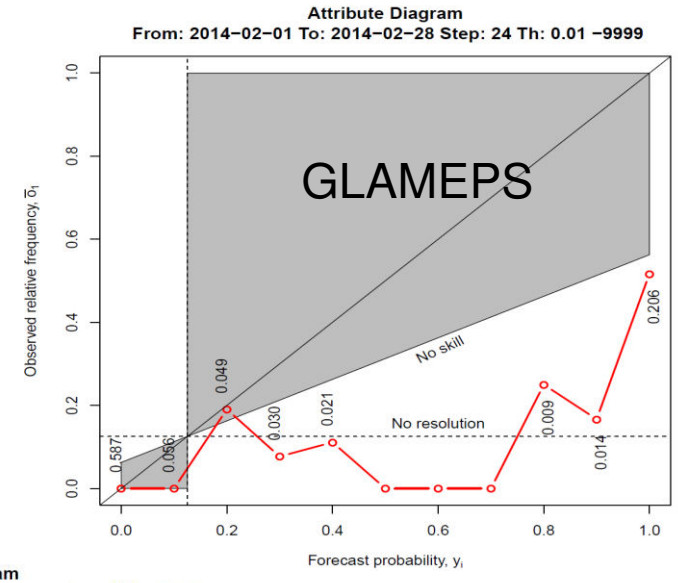


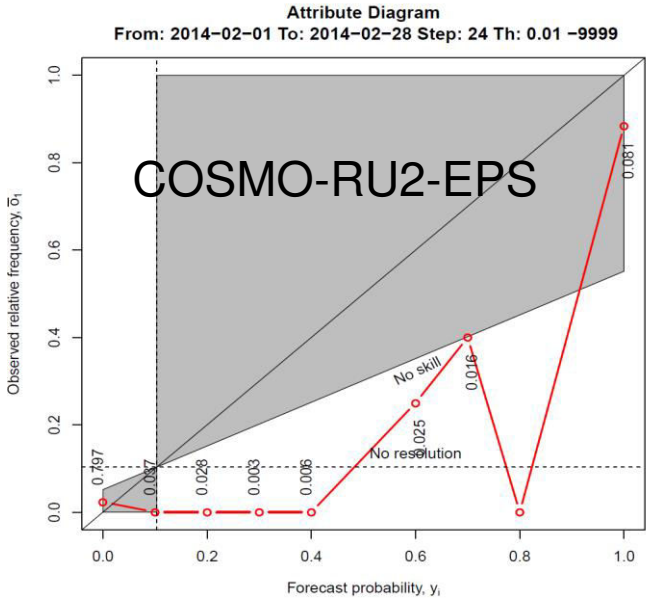


sochi.ru 2014

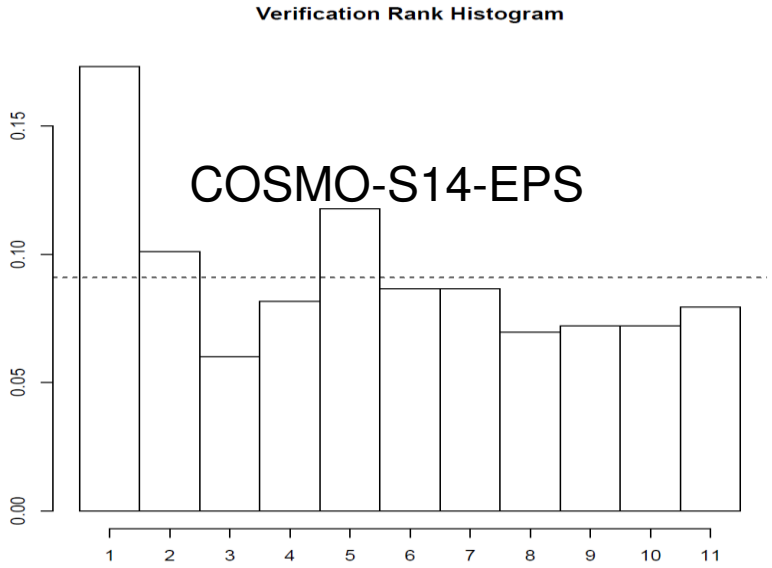
Attribute diagrams, precip>0.01 mm/3h, 24h leadtime, feb 2014

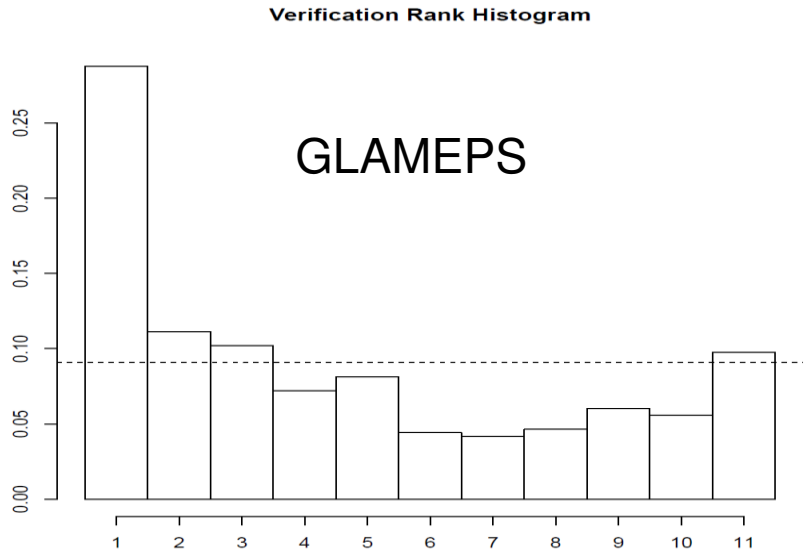




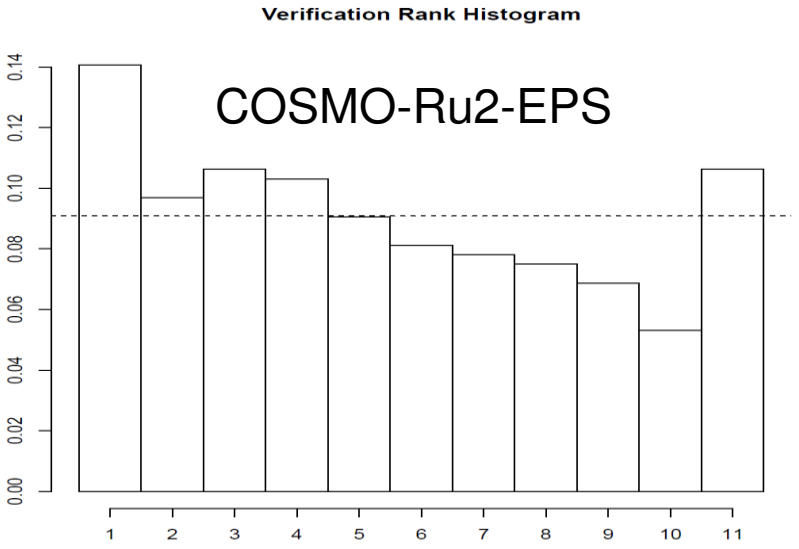


Talagrand diagrams, precip>0.01 mm/3h, 24h leadtime, feb 2014

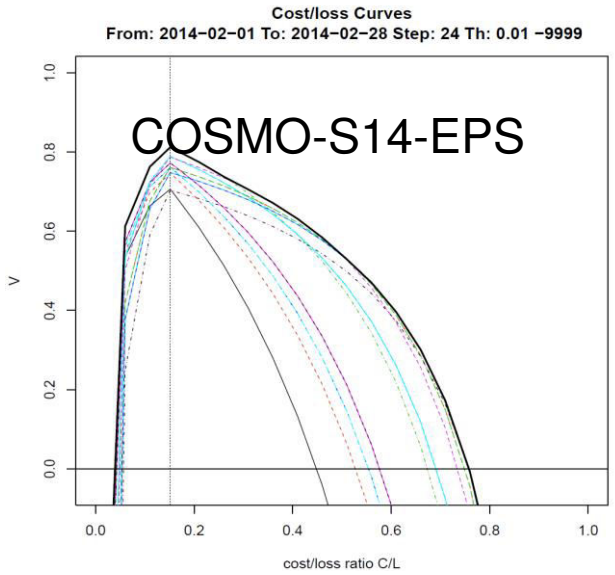


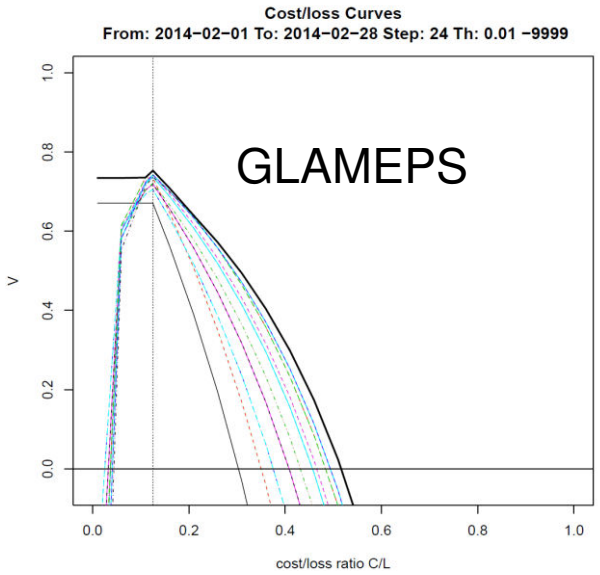


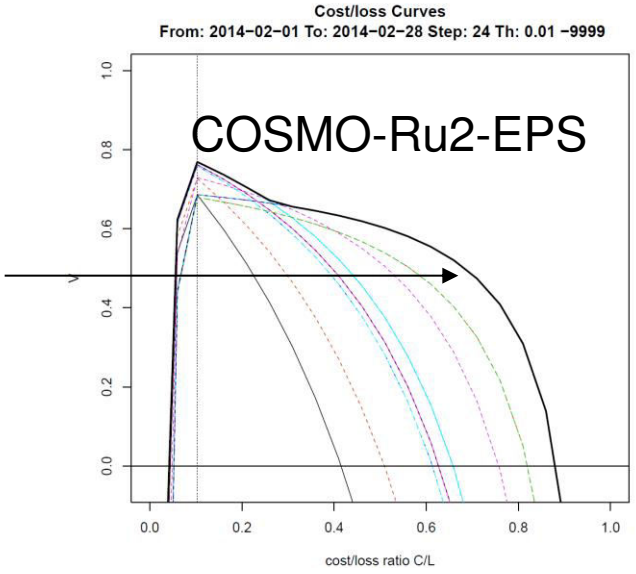
COSMO-Ru2-EPS has the best spread



Economic value, precip>0.01 mm/3h, 24h leadtime. feb 2014





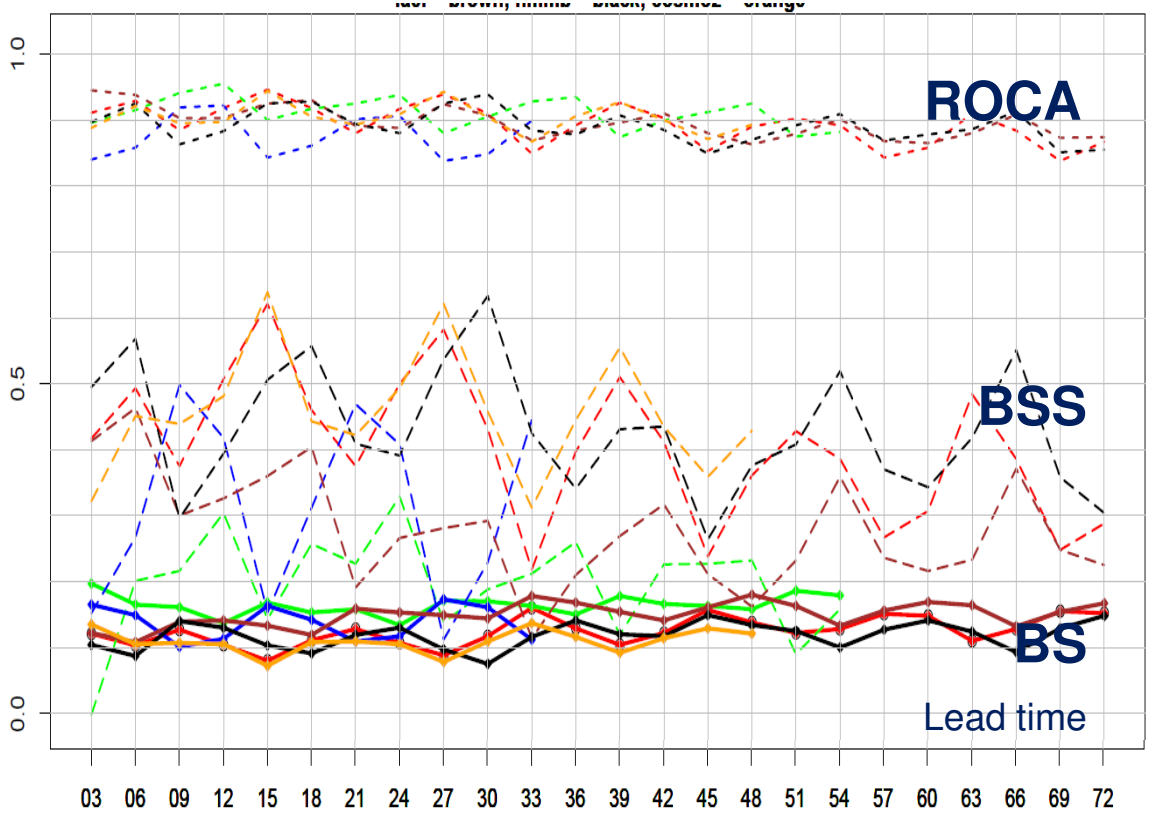


COSMO-Ru2-EPS seems to have the best economic value for users whose loss of precipitation occurrence is comparable with the cost of preventive mesures

ROCA, BSS, and BS for Precip > 0.01 mm/3h, Mountain cluster, all initial times

15.01.2014-15.03.2014

COSMO-S14-EPS – red
COSMO-RU2-EPS – orange
LAEF-EPS – brown
NMMB-EPS – black
HARMON-EPS – blue
GLAMEPS – green

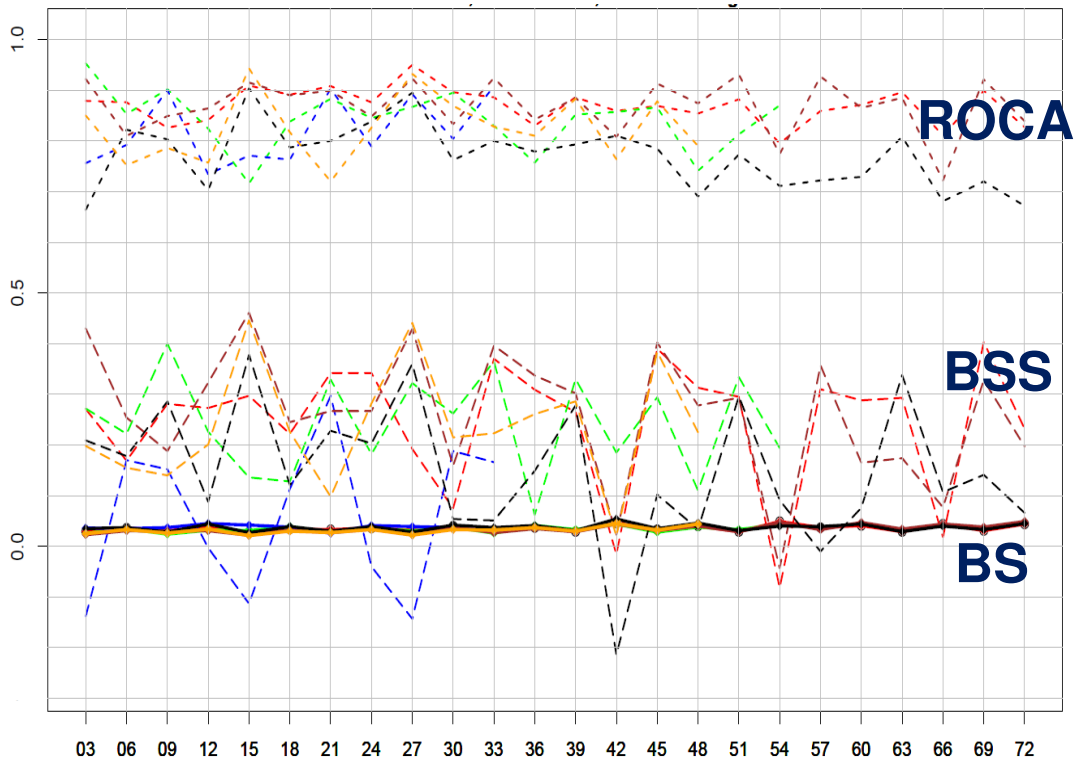


COSMO-S14-EPS, COSMO-RU2-EPS, and NMMB-EPS look most informative. The lowest resolution model GLAMEPS has the lowest skill.

ROCA, BSS, and BS for Precip > 5 mm/3h
Mountain cluster, all initial times

15.01.2014-15.03.2014

COSMO-S14-EPS – red
COSMO-RU2-EPS – orange
LAEF-EPS – brown
NMMB-EPS – black
HARMON-EPS – blue
GLAMEPS – green



For higher Precip threshold (w.r.t. the lower threshold):
- COSMO-S14-EPS, NMMB, and HARMON-EPS become worse.
- In contrast, LAEF and GLAMEPS become better.

EDI, Extremal dependence index

$$EDI = (\log F - \log H) / (\log F + \log H)$$

EDI is especially recommended for low base-rate thresholds, but it will give a good comparative estimate of accuracy for all thresholds ("Suggested methods for the verification of precipitation forecasts against high resolution limited area observations" by the JWGFVR (Laurie Wilson, Beth Ebert et al.)

NOTES:
- Pictures will refer to thresholds 0.01 and 3, and the last threshold at which the 50% probability EDI curve remains not interrupted in the 0-36h interval

COSMO-S14-EPS

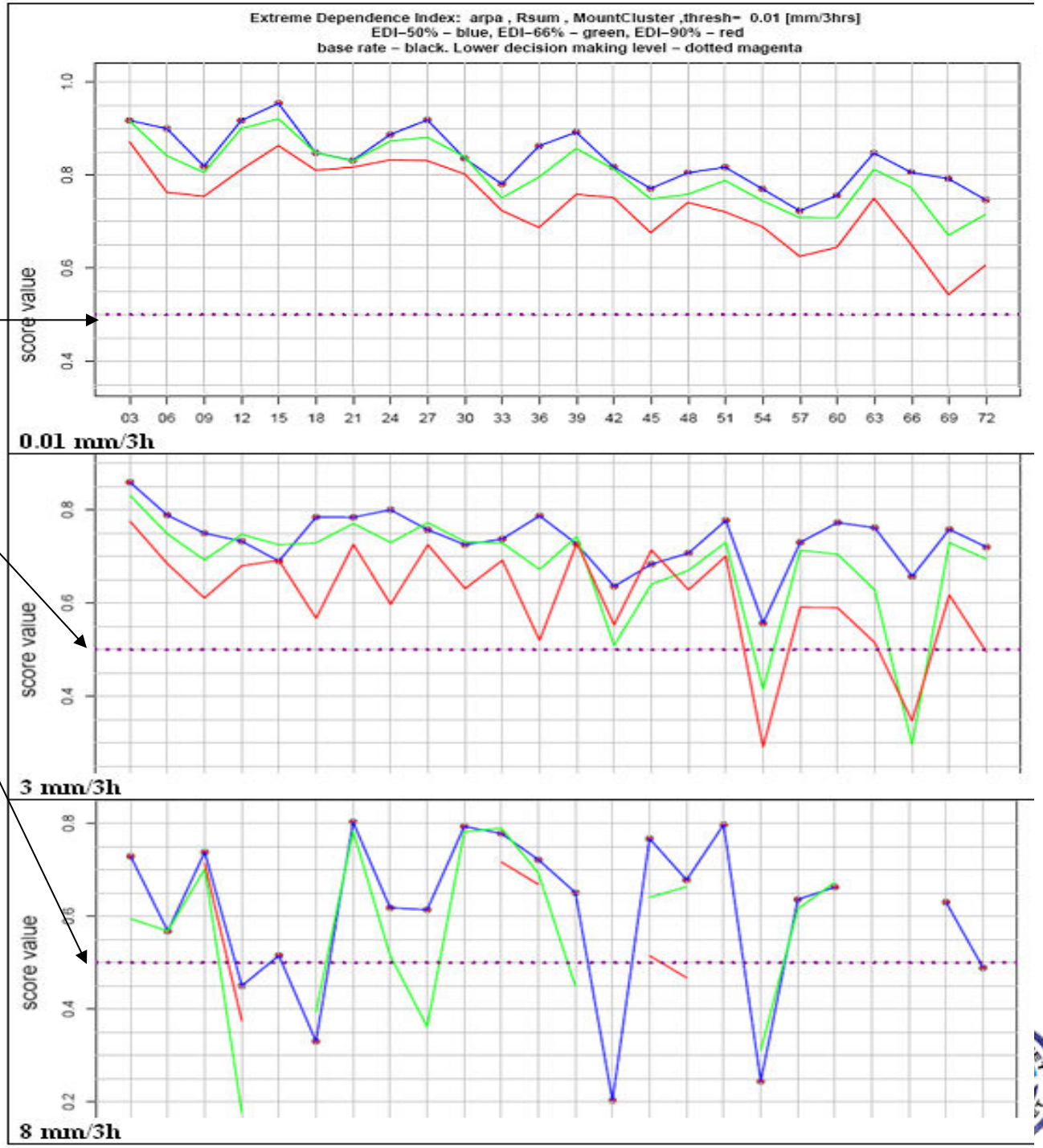
Last threshold: 8 mm/3h

Lower decision-making level

Blue: EDI for 50% probability threshold

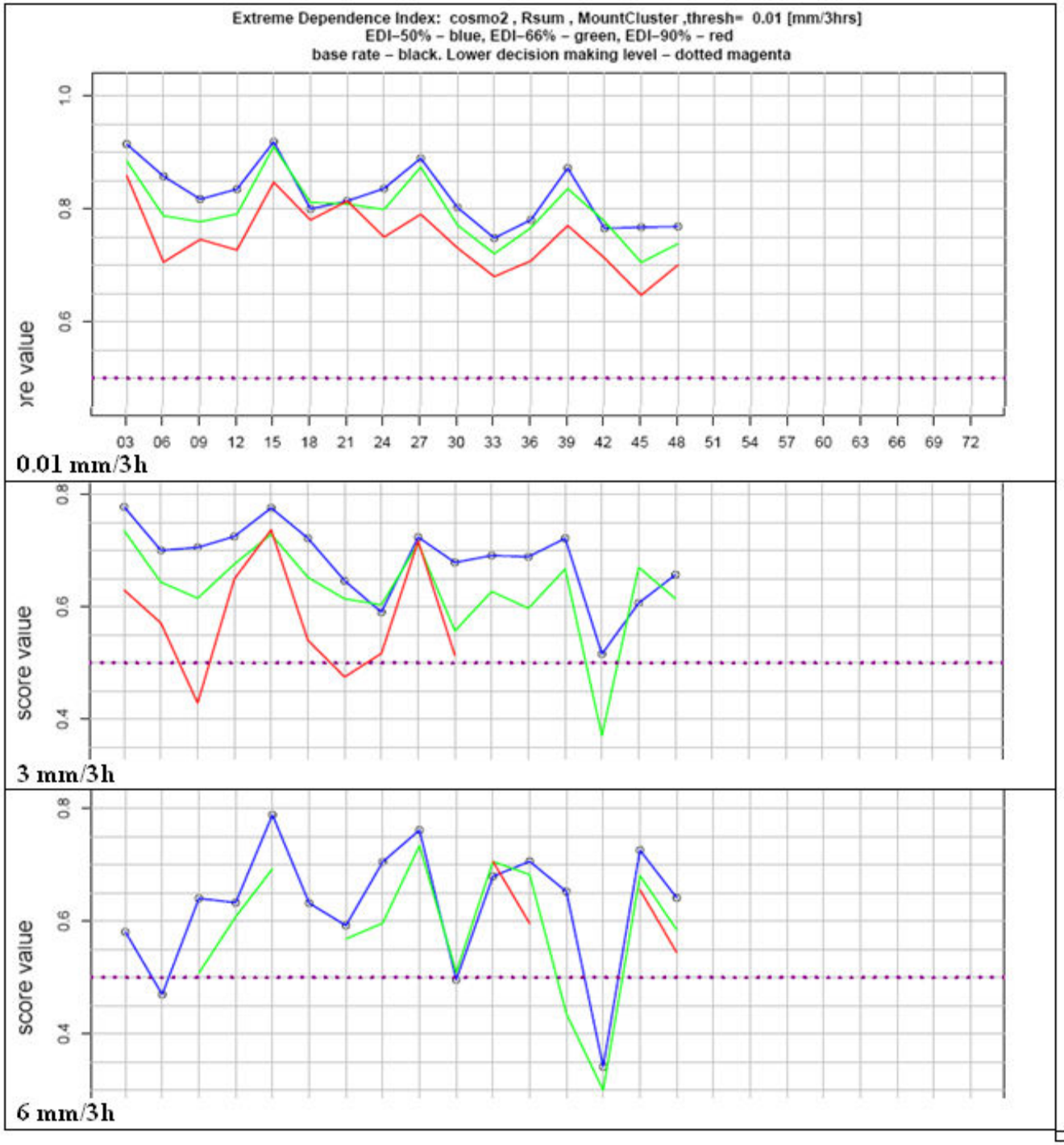
Green: for 66%

Red: for 90%



COSMO-RU2-EPS

Last threshold: 6 mm/3h



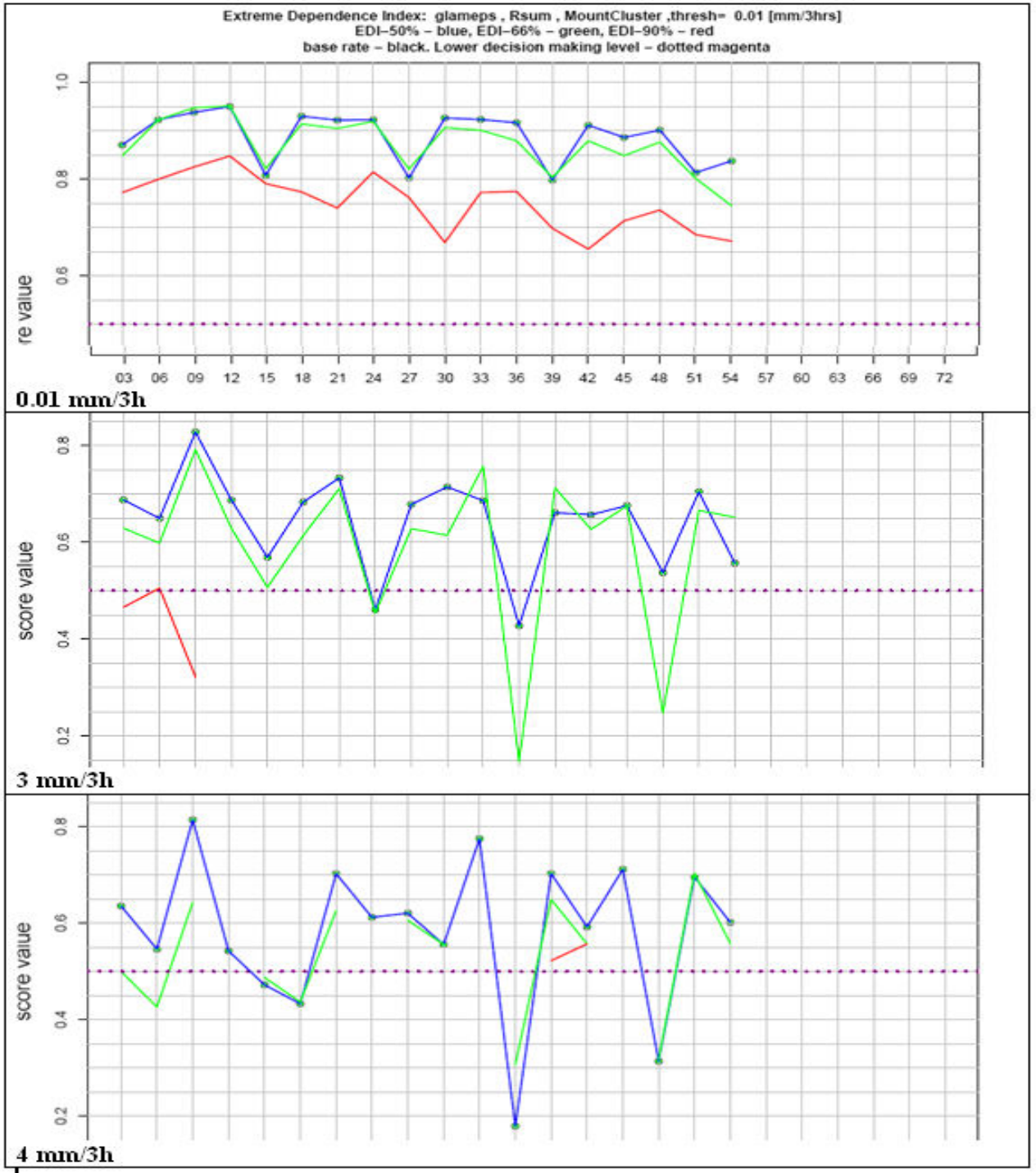
Blue: EDI for 50% probability threshold

Green: for 66%

Red: for 90%

GLAMEPS

Last threshold: 4 mm/3h



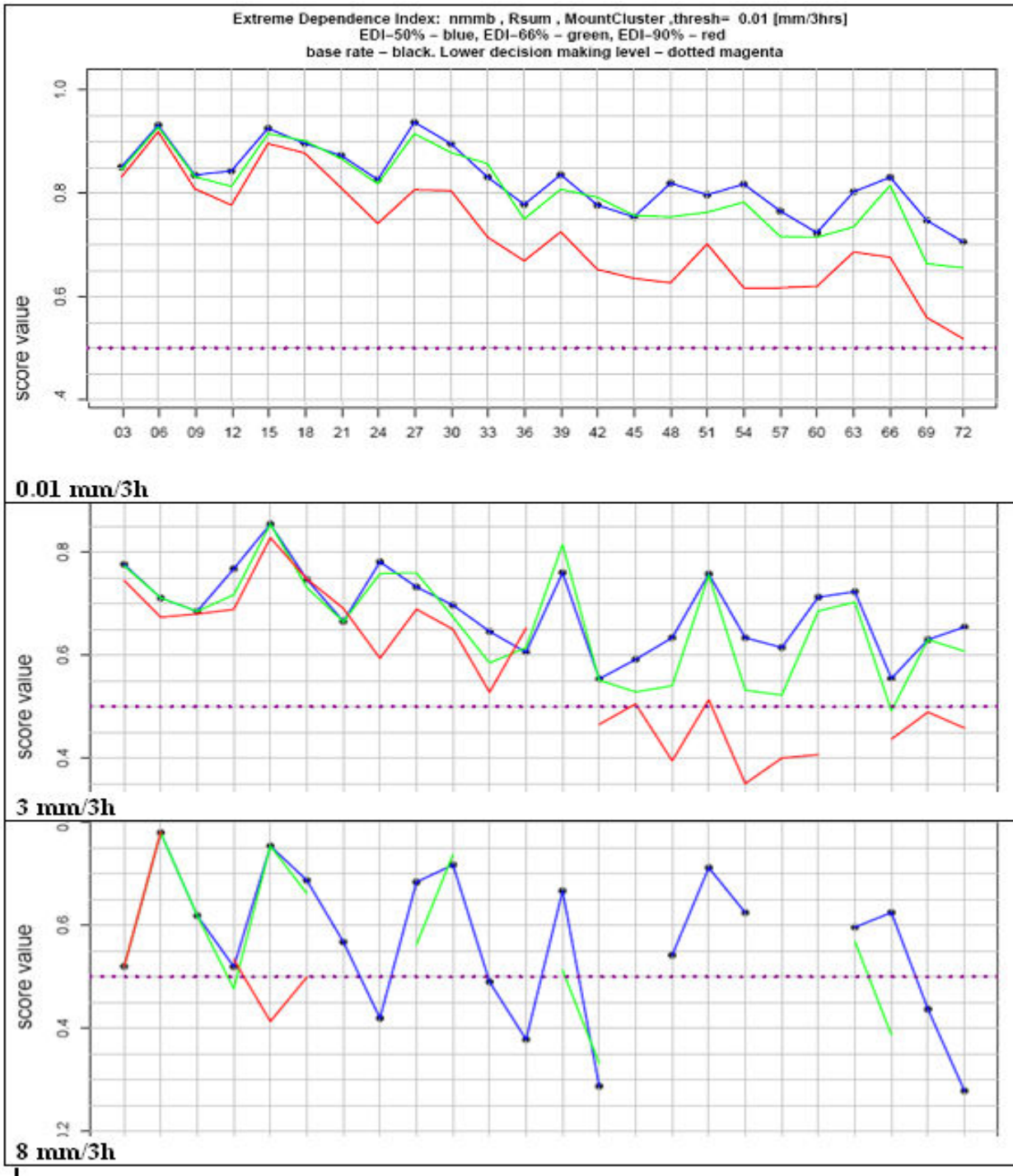
Blue: EDI for 50% probability threshold

Green: for 66%

Red: for 90%

Nmmb

Last threshold: 8 mm/3h



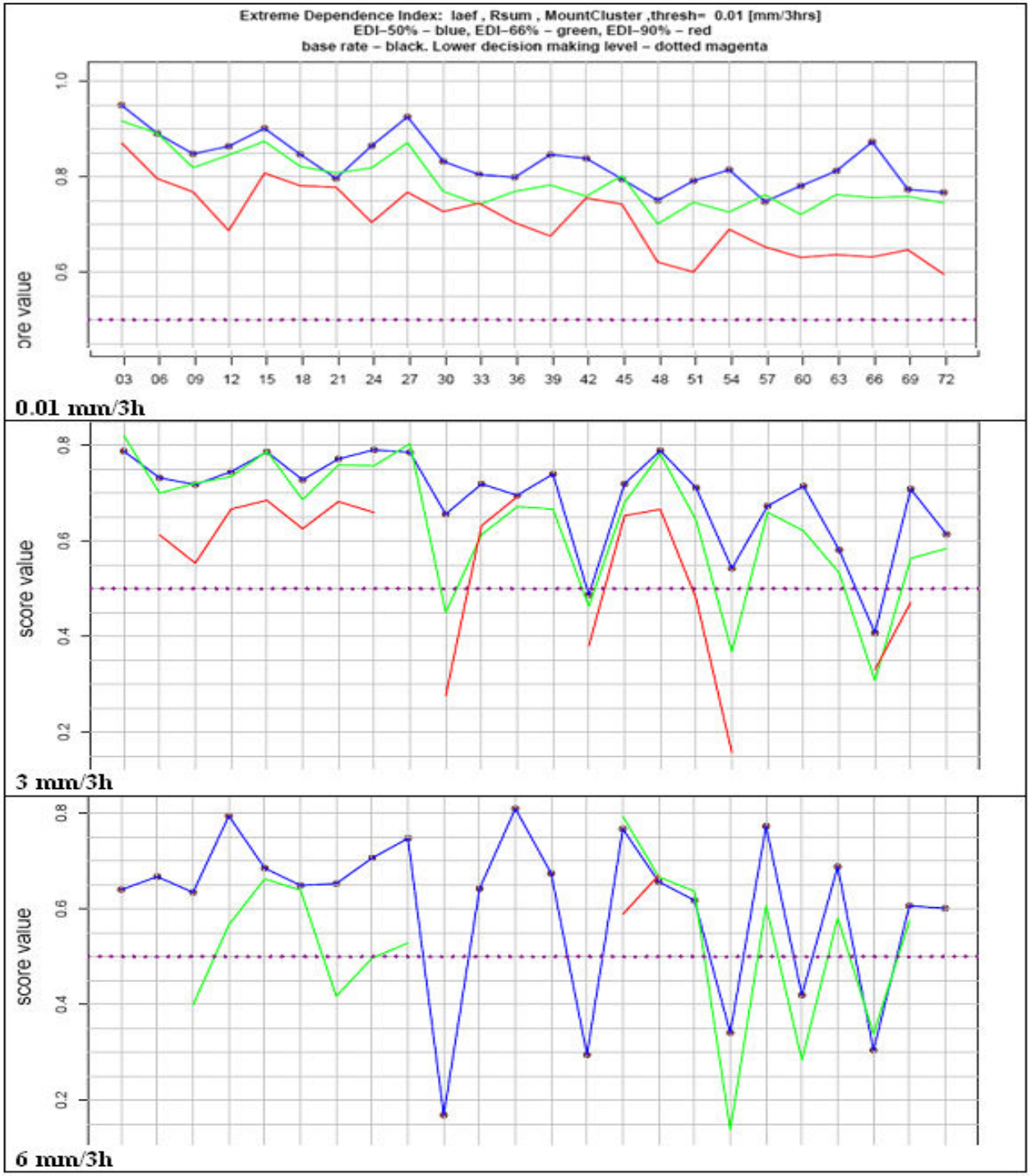
Blue: EDI for 50% probability threshold

Green: for 66%

Red: for 90%

Laef

Last threshold: 6 mm/3h



Blue: EDI for 50% probability threshold

Green: for 66%

Red: for 90%

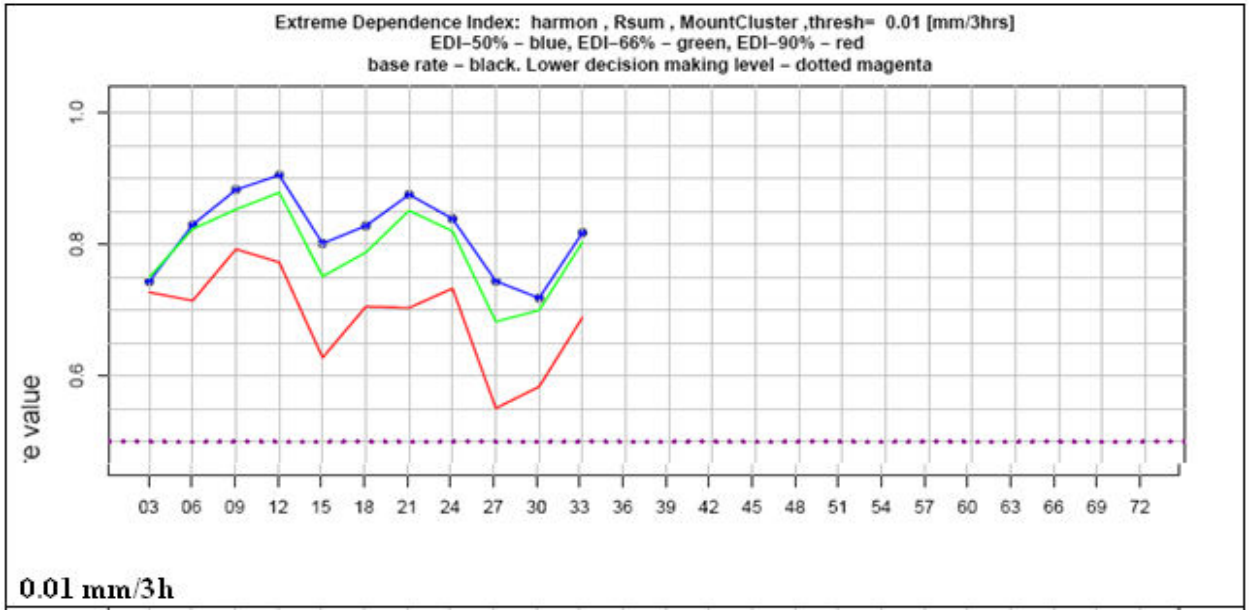
Harmon-EPS (fewer cases!)

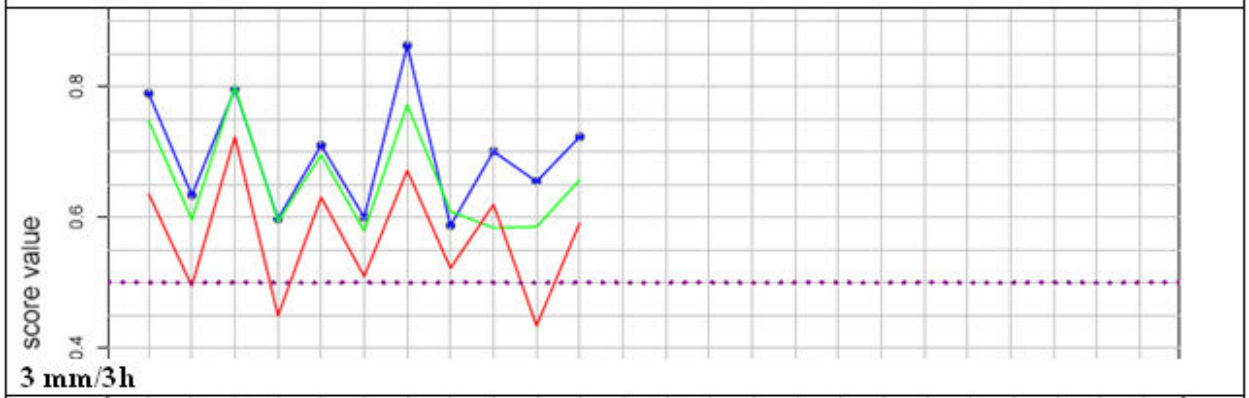
Last threshold: 6 mm/3h

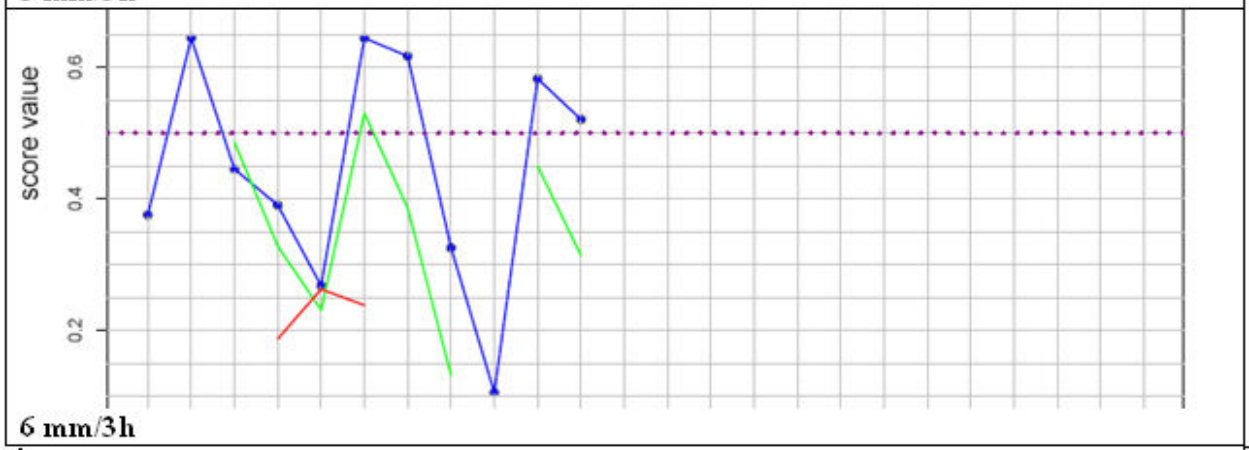
Blue: EDI for 50% probability threshold

Green: for 66%

Red: for 90%







Conclusions, EDI

Extremal Dependence Index, EDI, can be used for decision making, especially for rare events when other scores, such as PSS, approach zero. Constructing EDI for different probability decision levels (50, 66, and 90%) showed that the participated EPSs demonstrate skill up to the following precipitation thresholds:

COSMO-S14-EPS and NMMB-EPS – informative up to 8mm/3h;

COSMO-RU2-EPS, Harmon-EPS, ALADIN LAEF - informative up to 6mm/3h;

GLAMEPS – informative up to 4mm/3h.

General conclusions

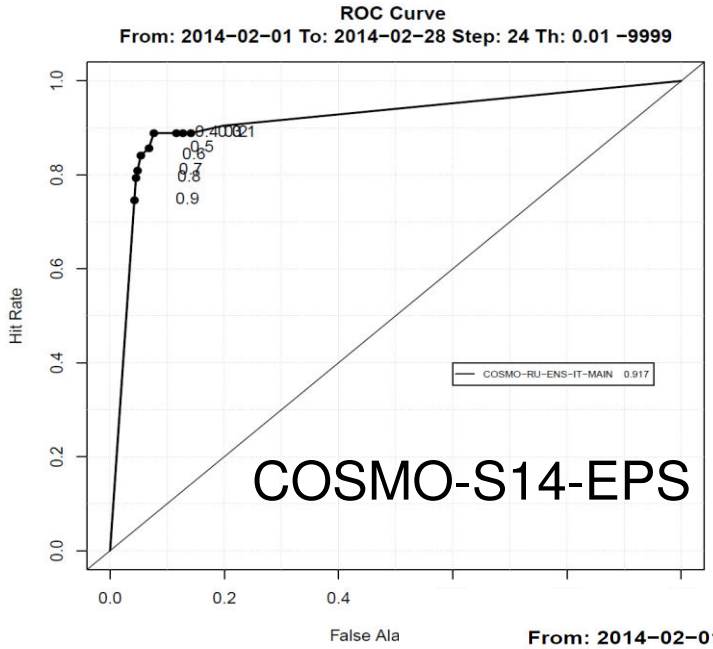
- The choice of a representative model point for each station is a problem
- Sample effect is evident for all models, especially for higher thresholds of variables.
- It is therefore unlikely to label a definite model “the best ensemble producing system”, but still some conclusions can be drawn

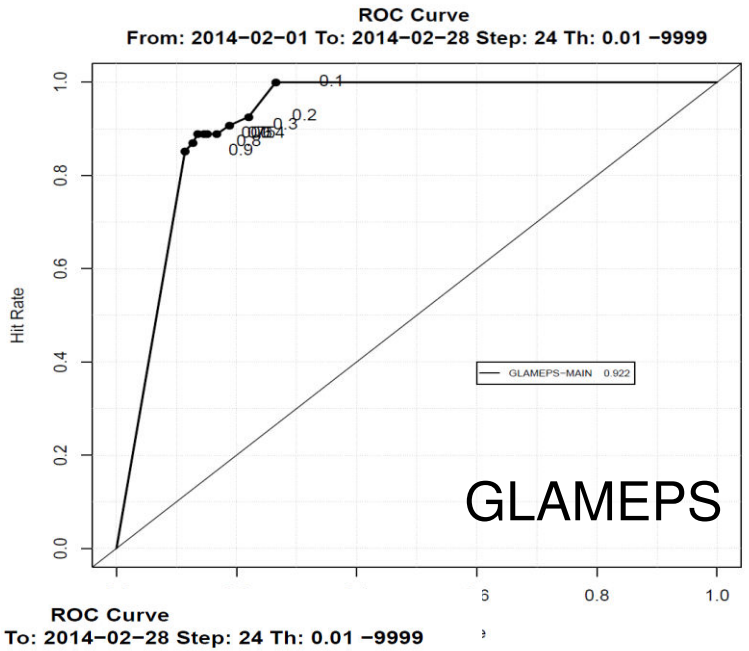
Conclusions, precipitation

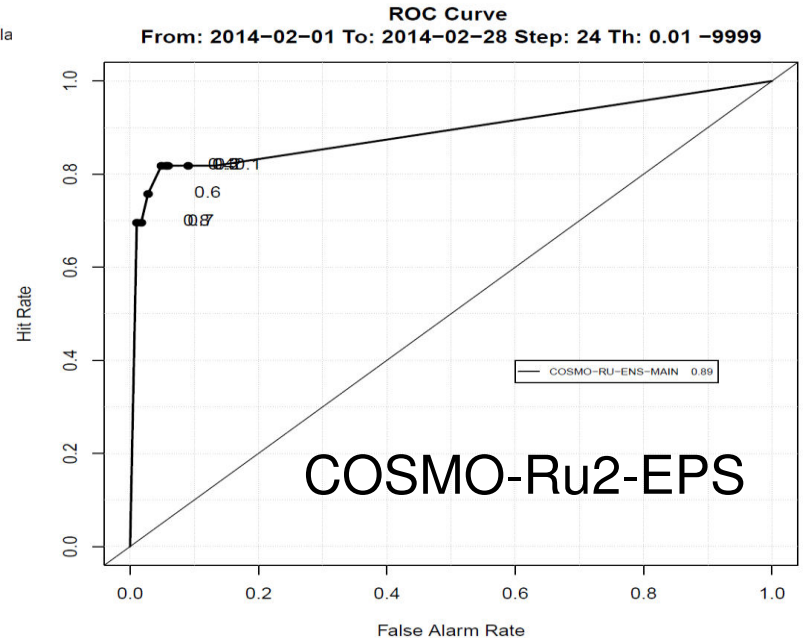
- For precipitation occurrence, the skill of COSMO-S14-EPS, COSMO-RU2-EPS, and NMMB-EPS is the highest (as assessed by ROCA, BS, BSS). The lowest-resolution model GLAMEPS has the lowest skill
- COSMO-RU2-EPS and LAEF are the best models for more intense precipitation forecasts
- The forecast skill of precipitation occurrence is worse that that of higher thresholds up to ~5mm/3h

Thank you for your attention!

ROC-curves (precip>0.01 mm/3h, 24h leadtime)







- - The base rate has the following approximate values:
- P(0.01mm/3h)=0.3; P(1mm/3h)=0.2; P(2mm/3h)=0.15; P(3mm/3h)=0.1; P(4mm/3h)=0.055;P(5mm/3h)=0.05