Performance of the INM short-range multi-model ensemble using high resolution precipitation observations

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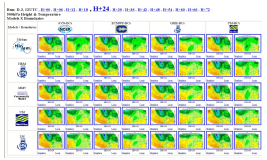
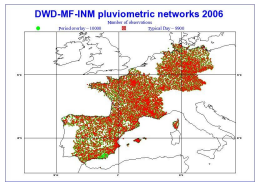
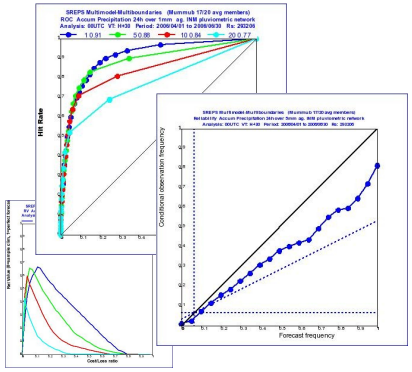
Outline

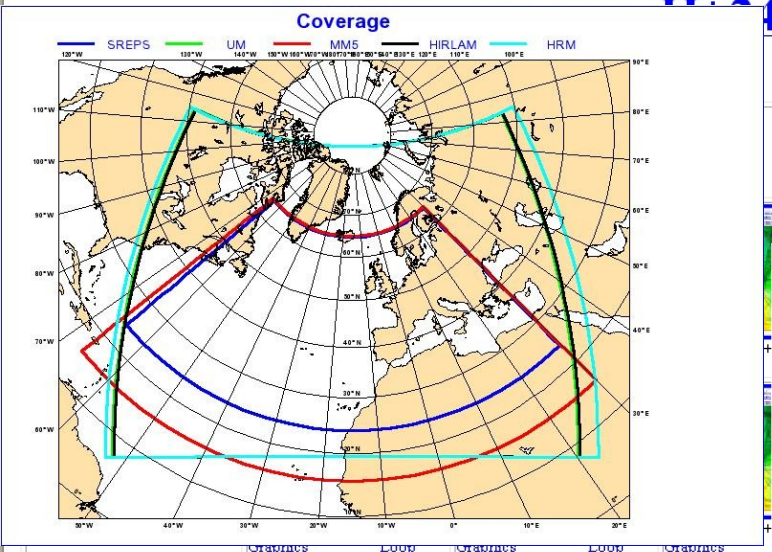
- INM SREPS multimodel
- Verification exercise
- Performance results
  - INM rain gauge network
  - Comparison INM, MF, DWD, UKMO & Europe-Joint
- Concluding remarks

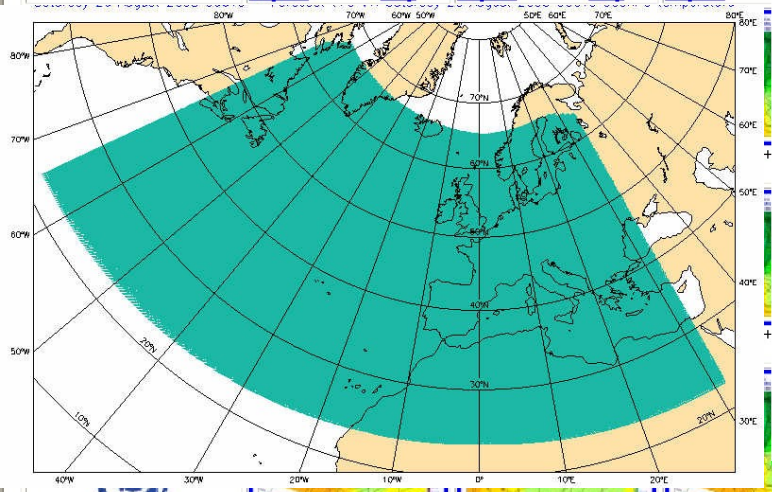






INM SREPS Multimodel





H+30 , H+36 , H+42 , H+48 , H+54 , H+60 , H+66 , H+72

ECMWF-BCs

GME-BCs

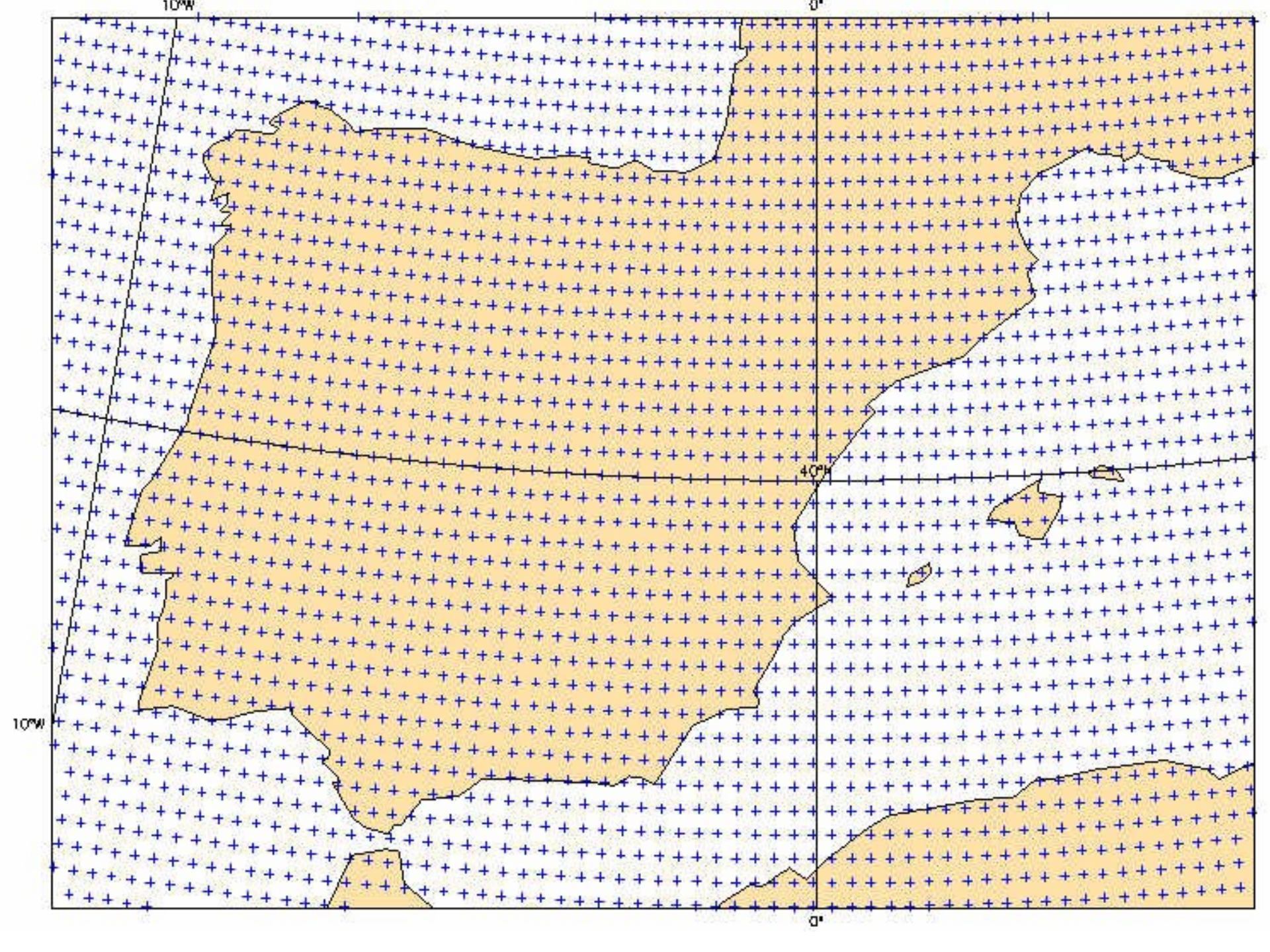
UM-BCs

- 72 hours forecast
- Twice a day (00,12 UTC)
- 5x4 = 20 members
- 0.25º

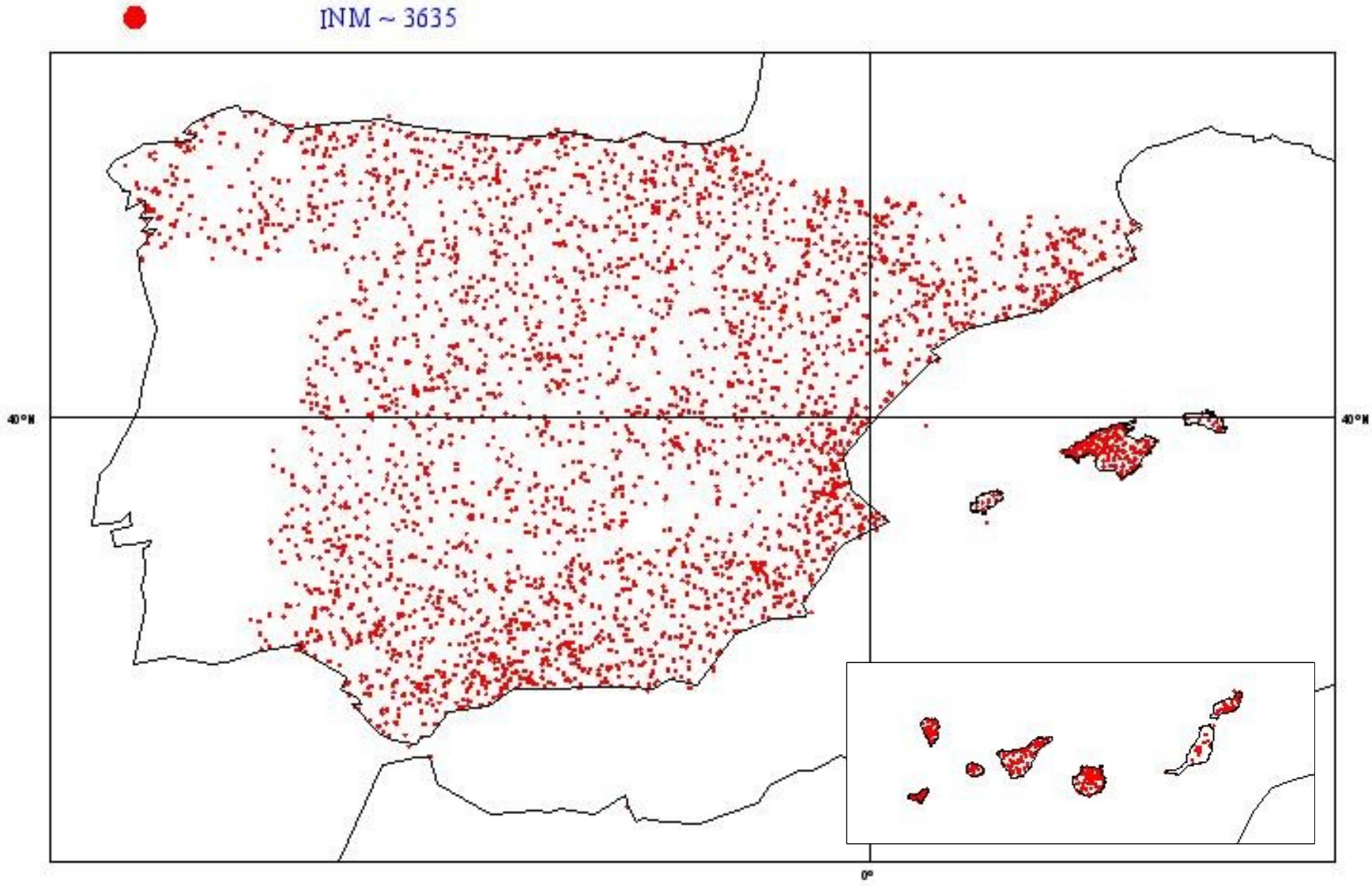
(see POSTERS by Callado A., García-Moya JA., Santos-Muñoz, D. & Simarro J.)

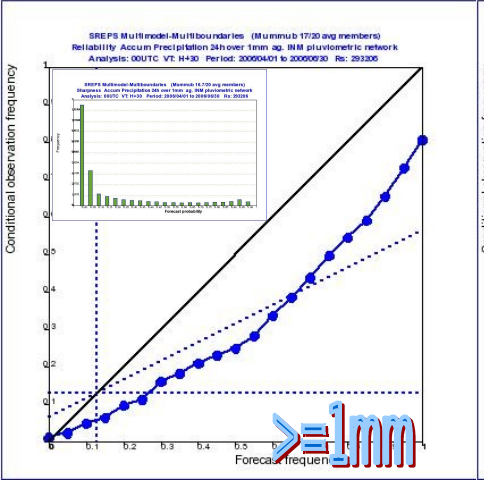
Verification exercise

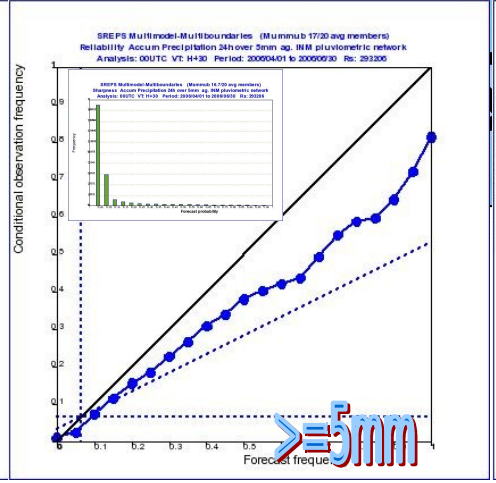
- 24h accumulated precipitation
  - forecast 06UTC-06UTC against observed 07UTC-07UTC
  - Checked in HH+030 and HH+054
- ~90 days (Apr1 to Jun30 2006).
- Few different rain gauge networks as references:
  - INM precipitation network (pnw)
  - MeteoFrance, DWD, UKMO
  - Joint pnw (many countries)
- Verification method
  - Interpolation to observation points
- Verification software
  - ~ ECMWF Metview + Local developments
- Performance scores
  - ECMWF recommendations

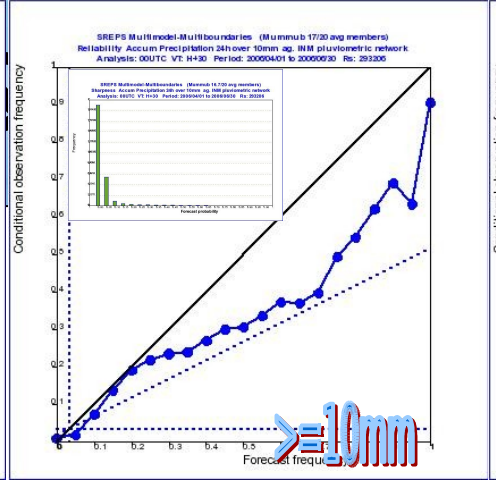

10°W
0°
40°N
10°W
0°

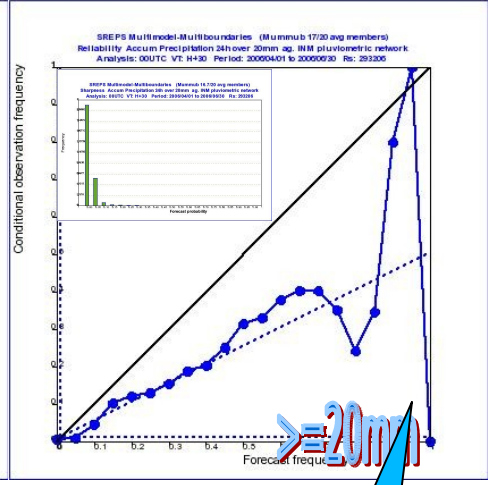
INM pcp network 2006











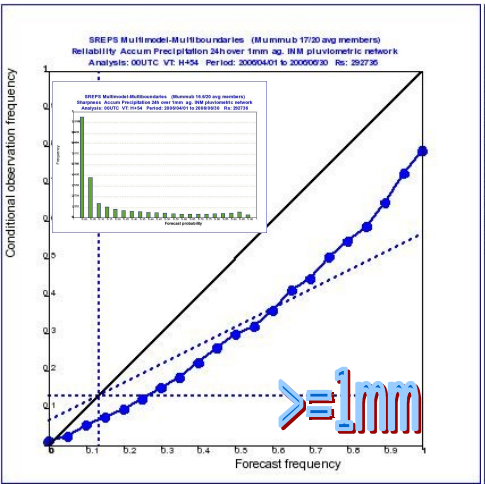
H+30

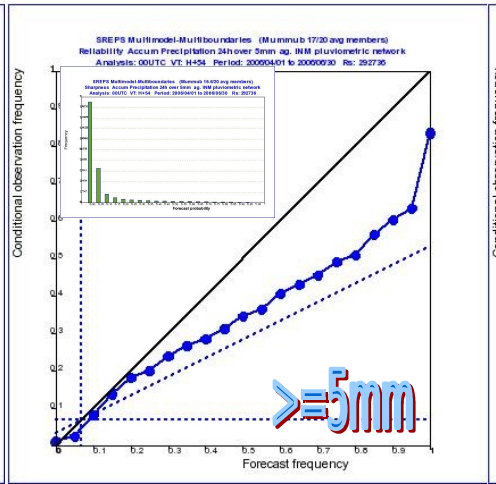
INM

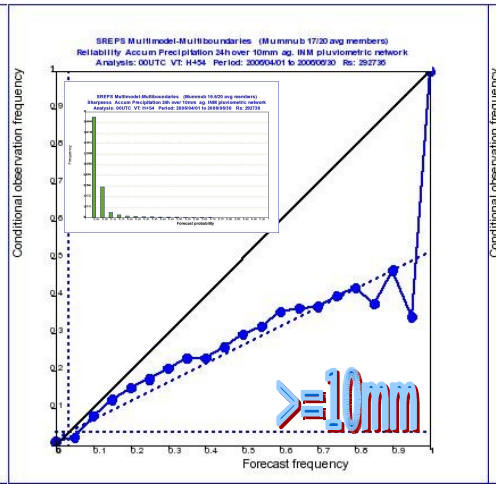
H+54

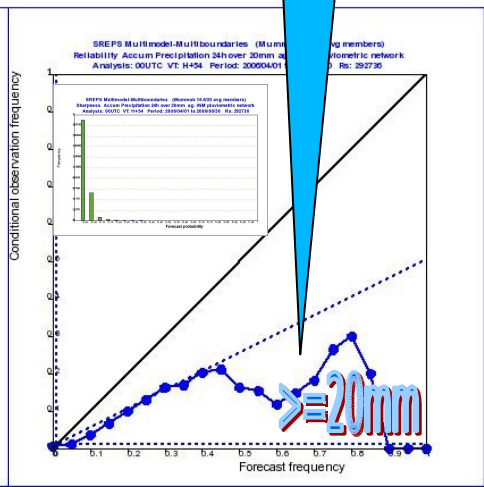
- Good reliability according to
  - thresholds (base rate)
  - forecast length

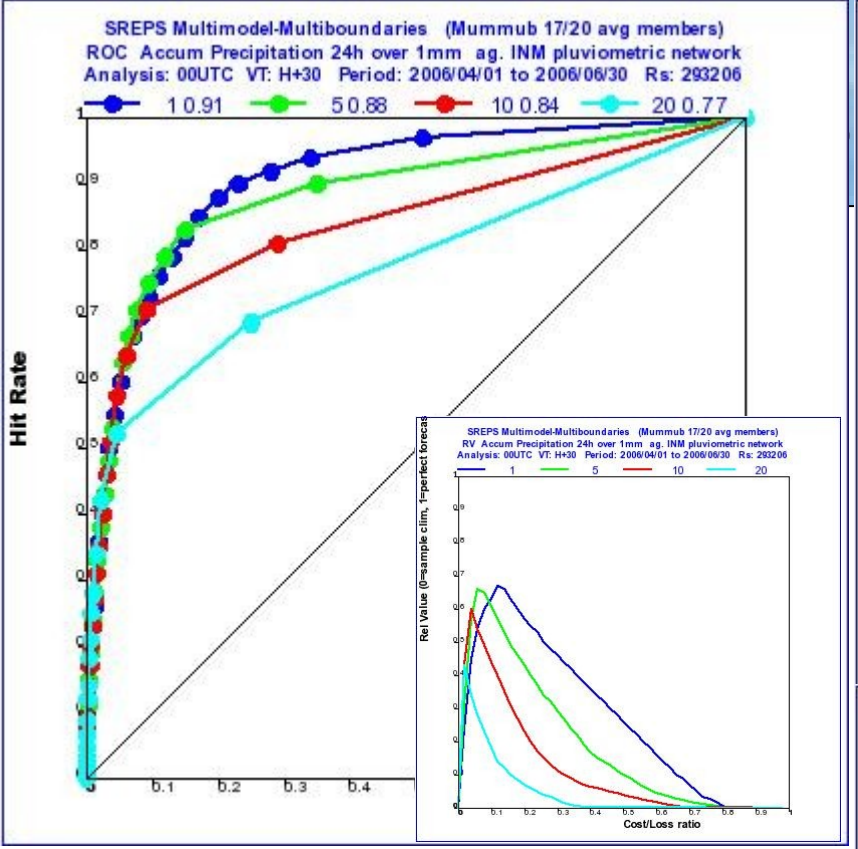
Under-sampling

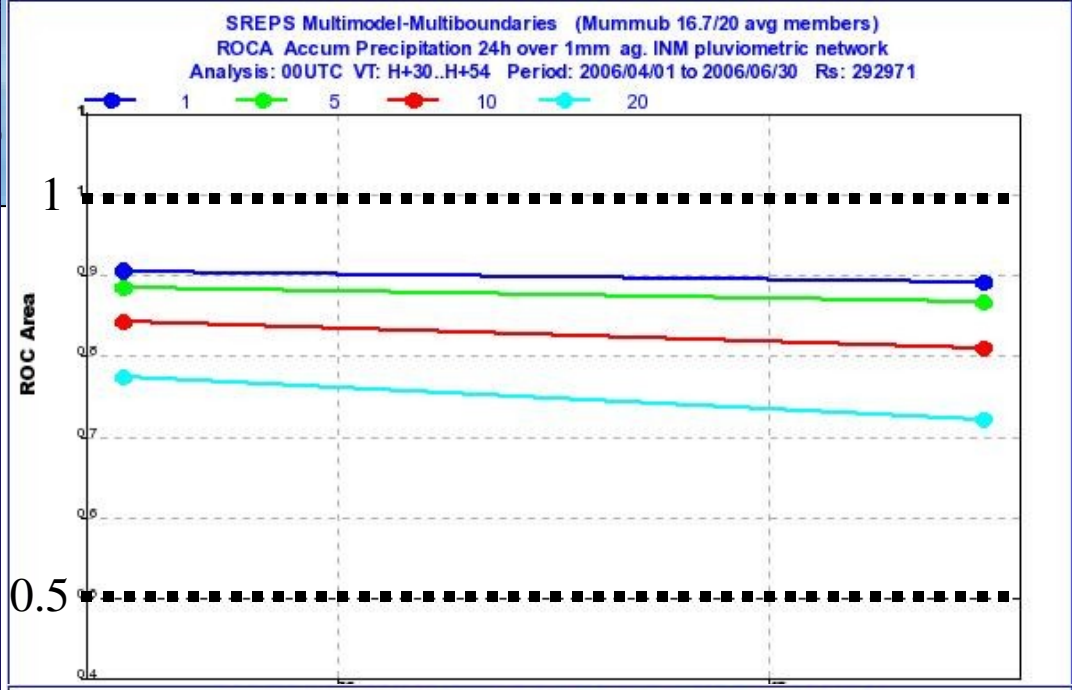


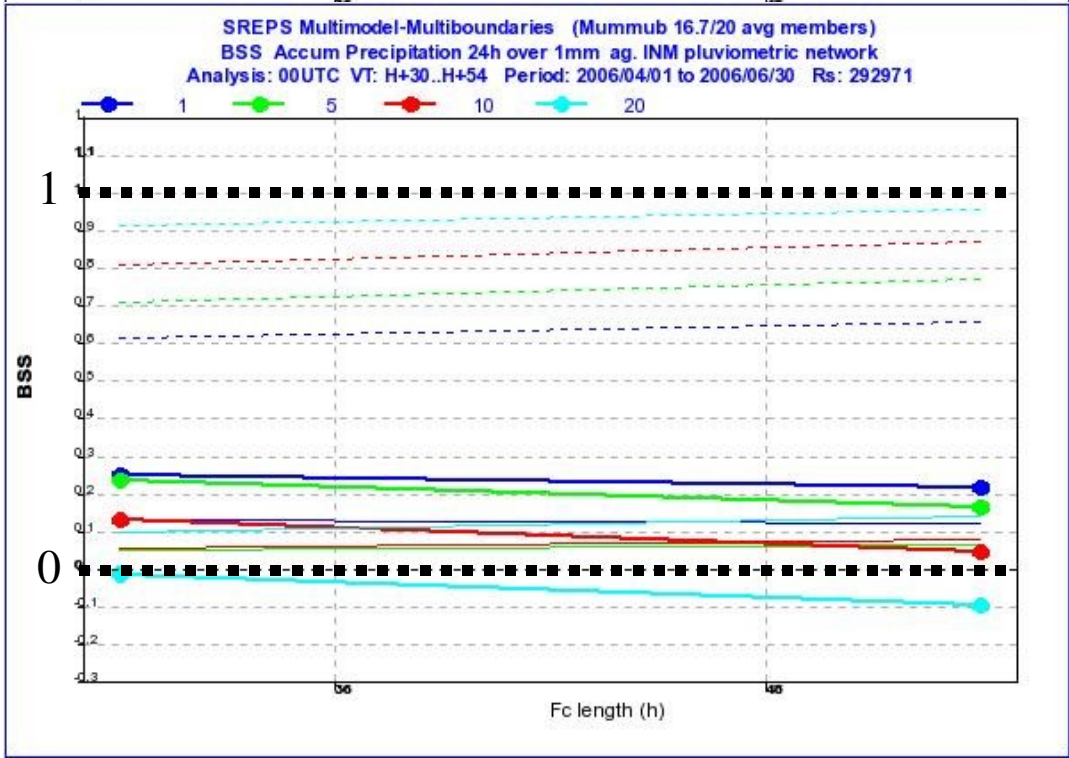




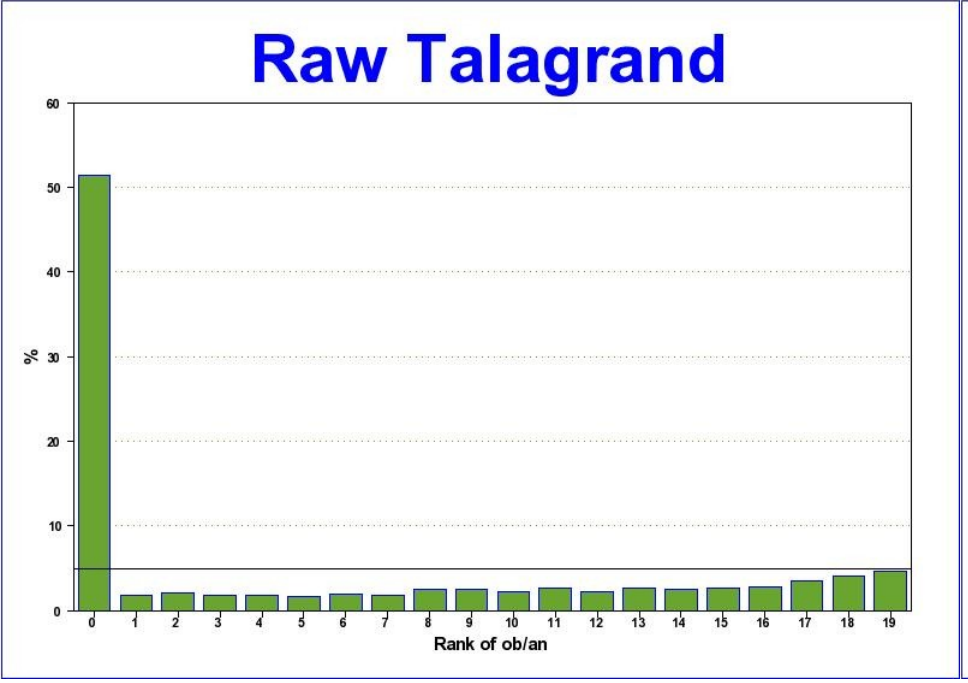


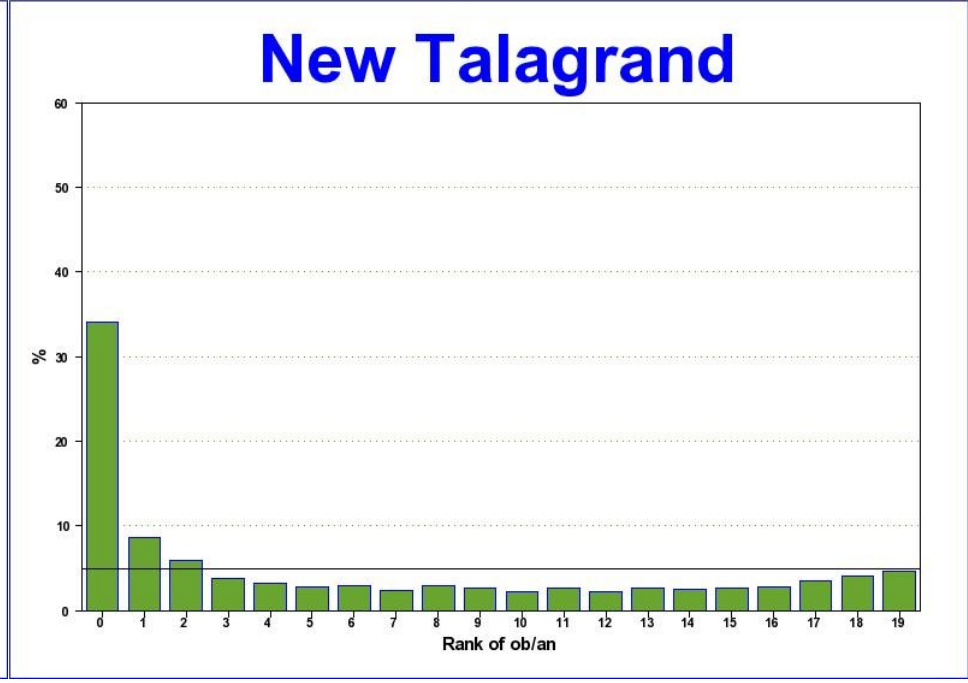






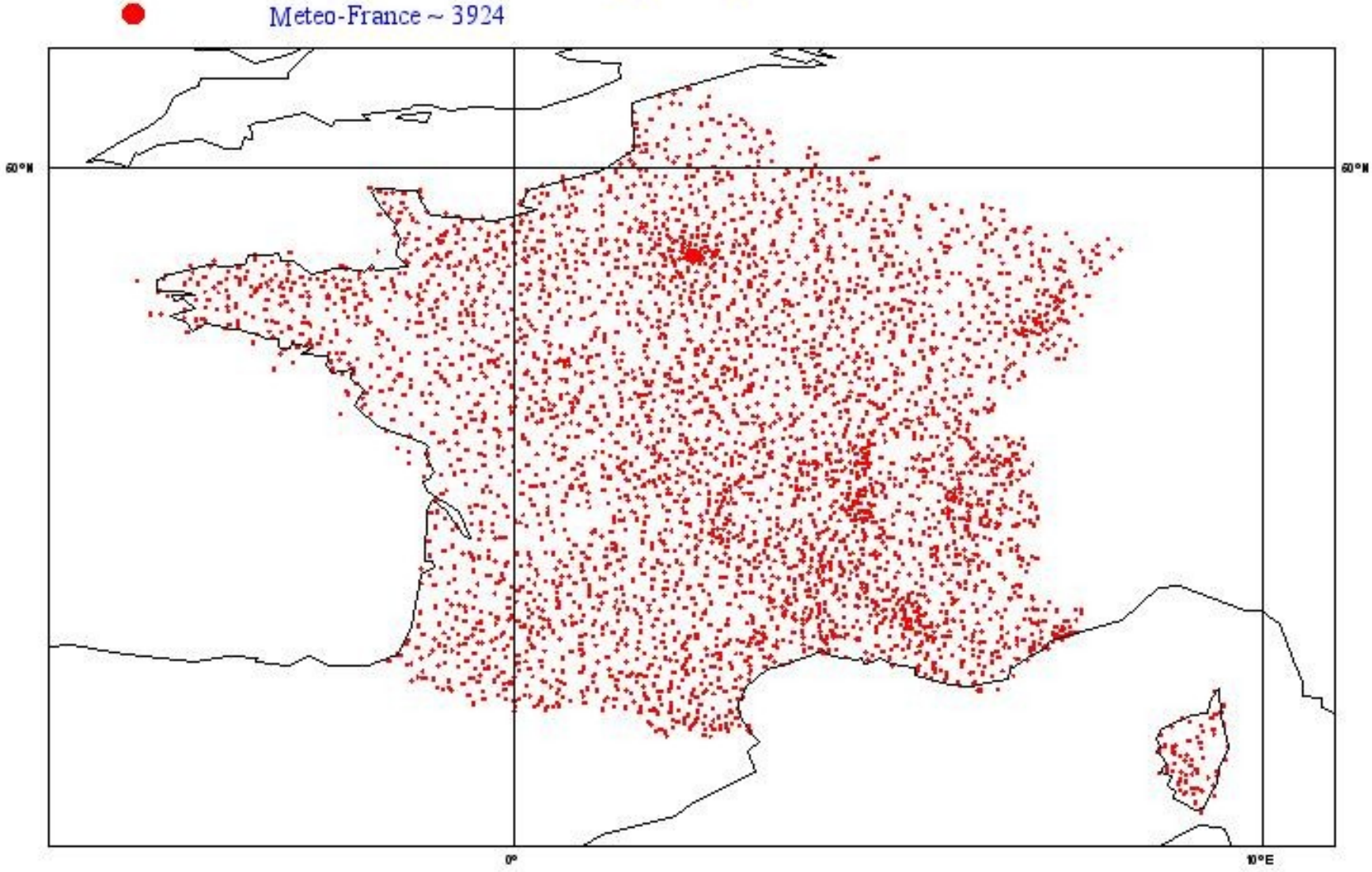
- Good resolution
  - ROC Areas
  - BSSs
- Good RV curves



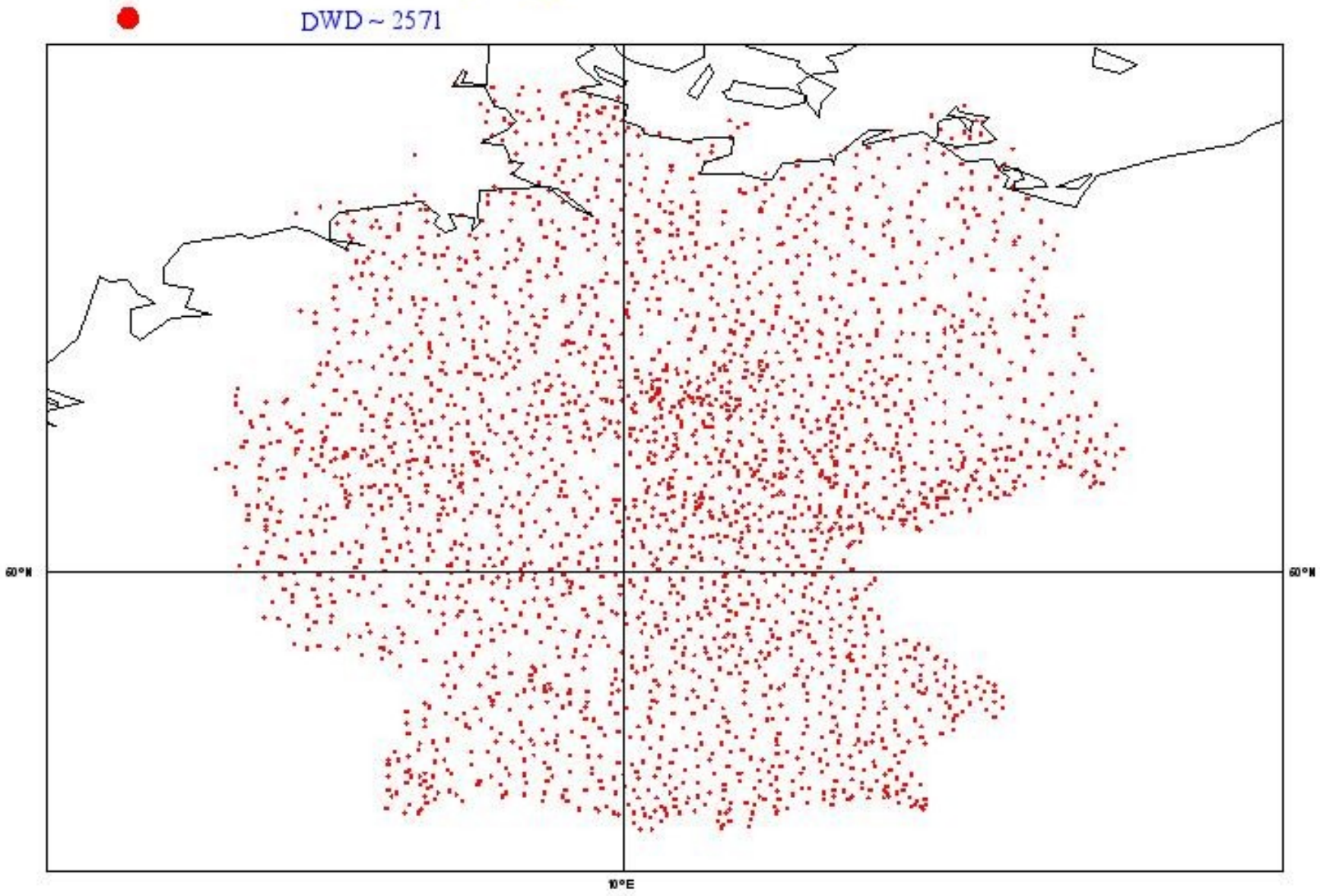


- We use a simple algorithm to compute acc pcp rank histograms avoiding “zero problems”
- Over all those points with obs=0 and M of N fcs=0 the rank of the observation is not really zero (though it seems with some algorithms which plot a spurious overload of “zero ranks”)
- In those cases, a random rank {0..M} can be assigned, which is the same that to add 1/M to all bins in {0,M}. Always under the assumption that the number of realizations is large enough
- With this method more realistic rank histograms can be achieved

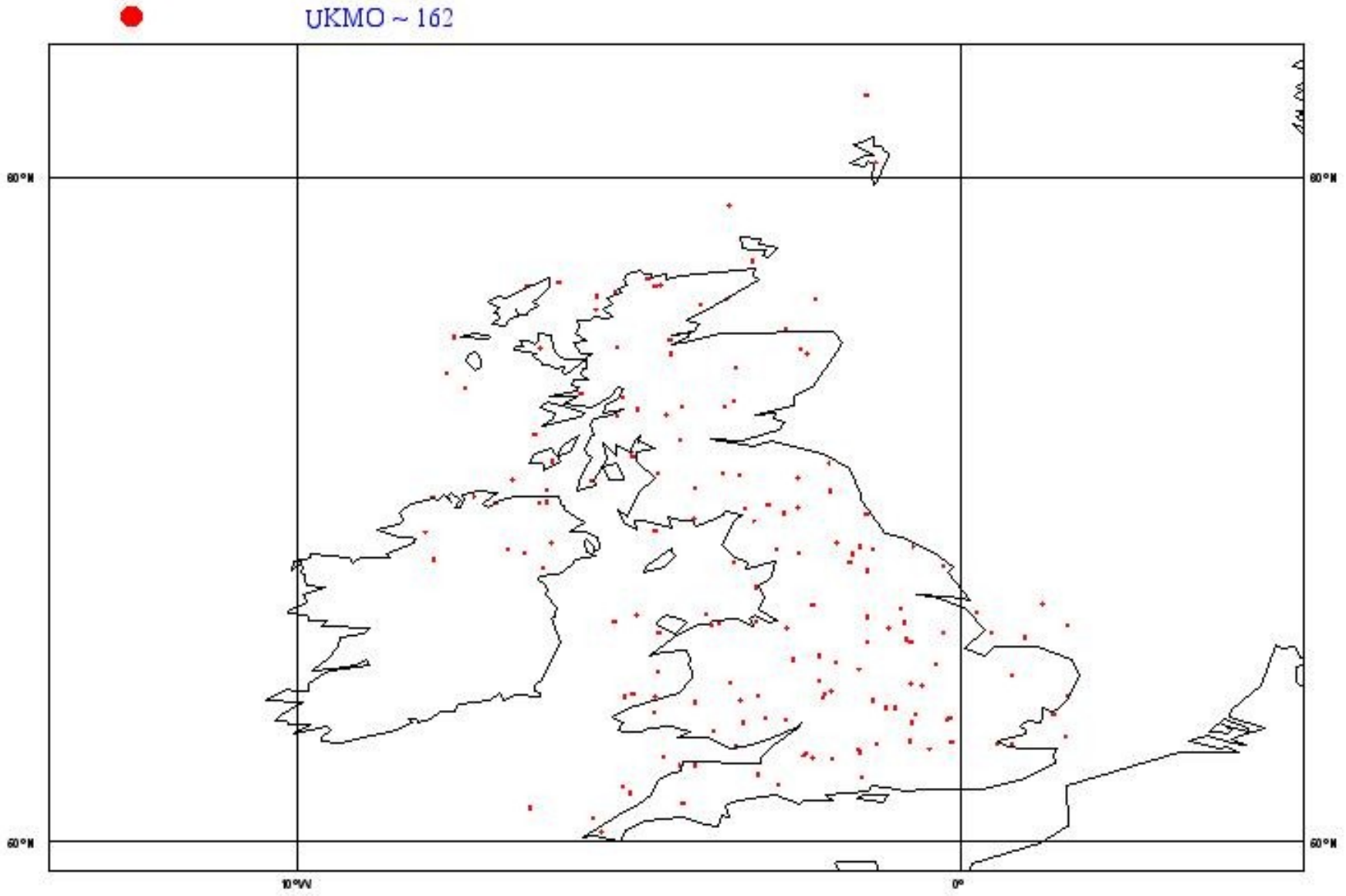
Meteo-France pcp network 2006

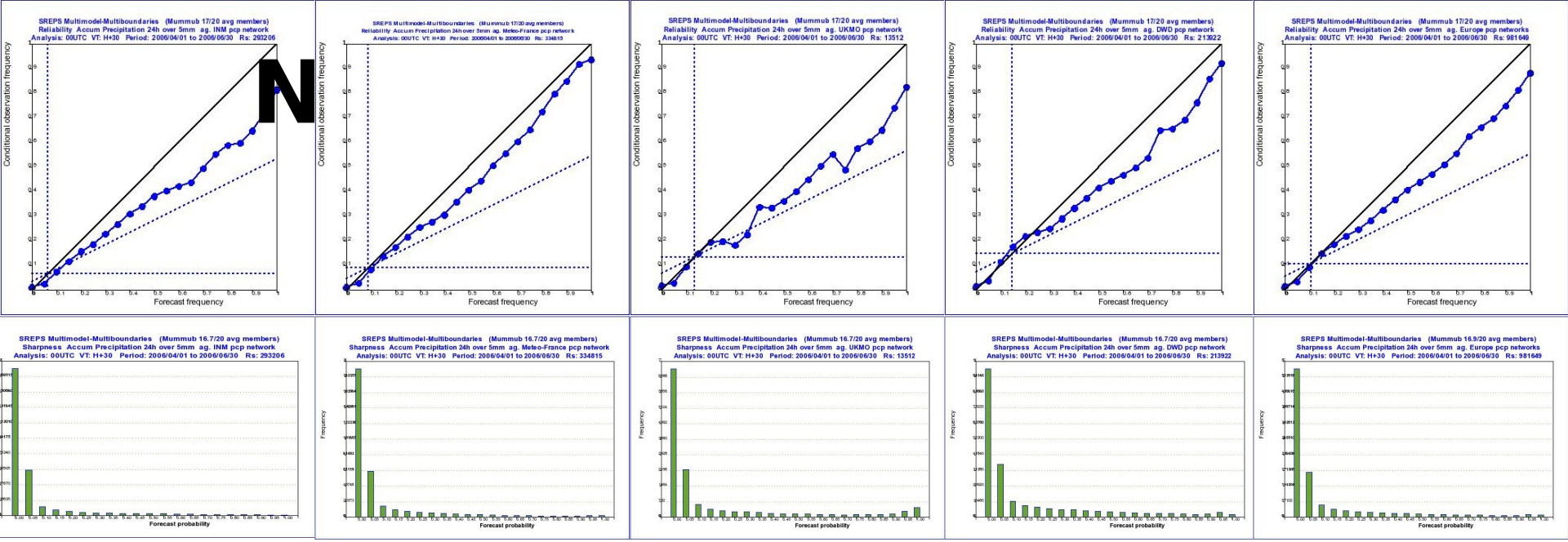


DWD pcp network 2006



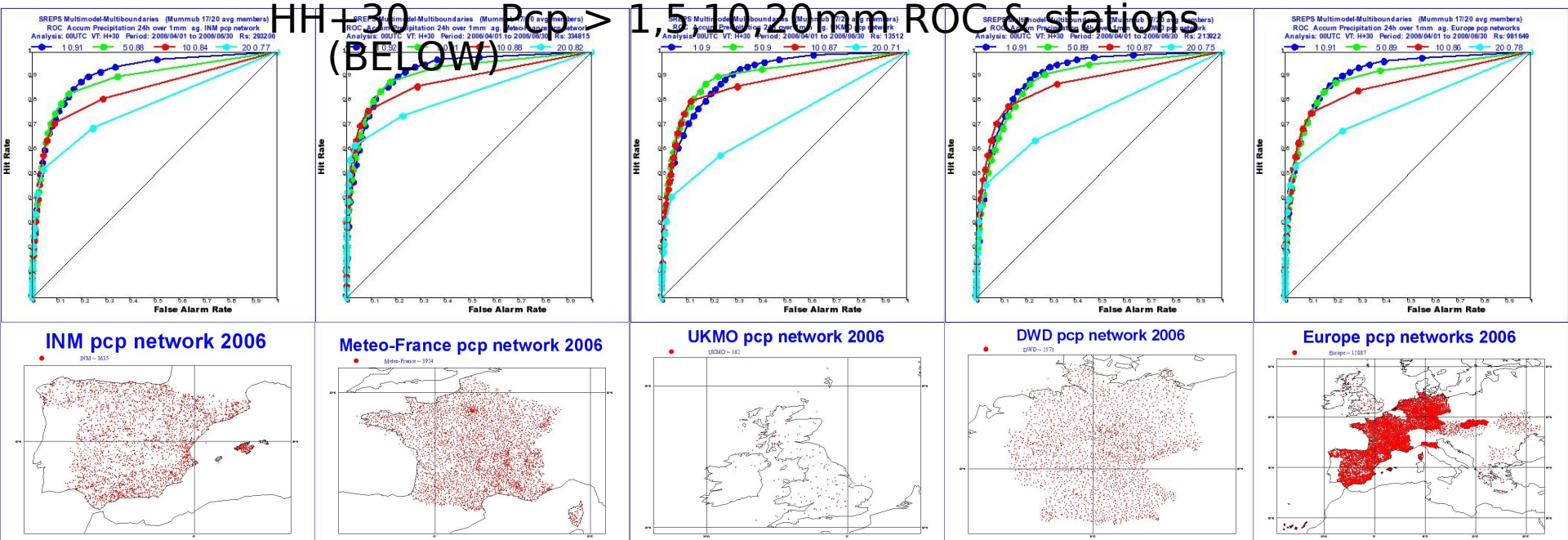
UKMO pcp network 2006



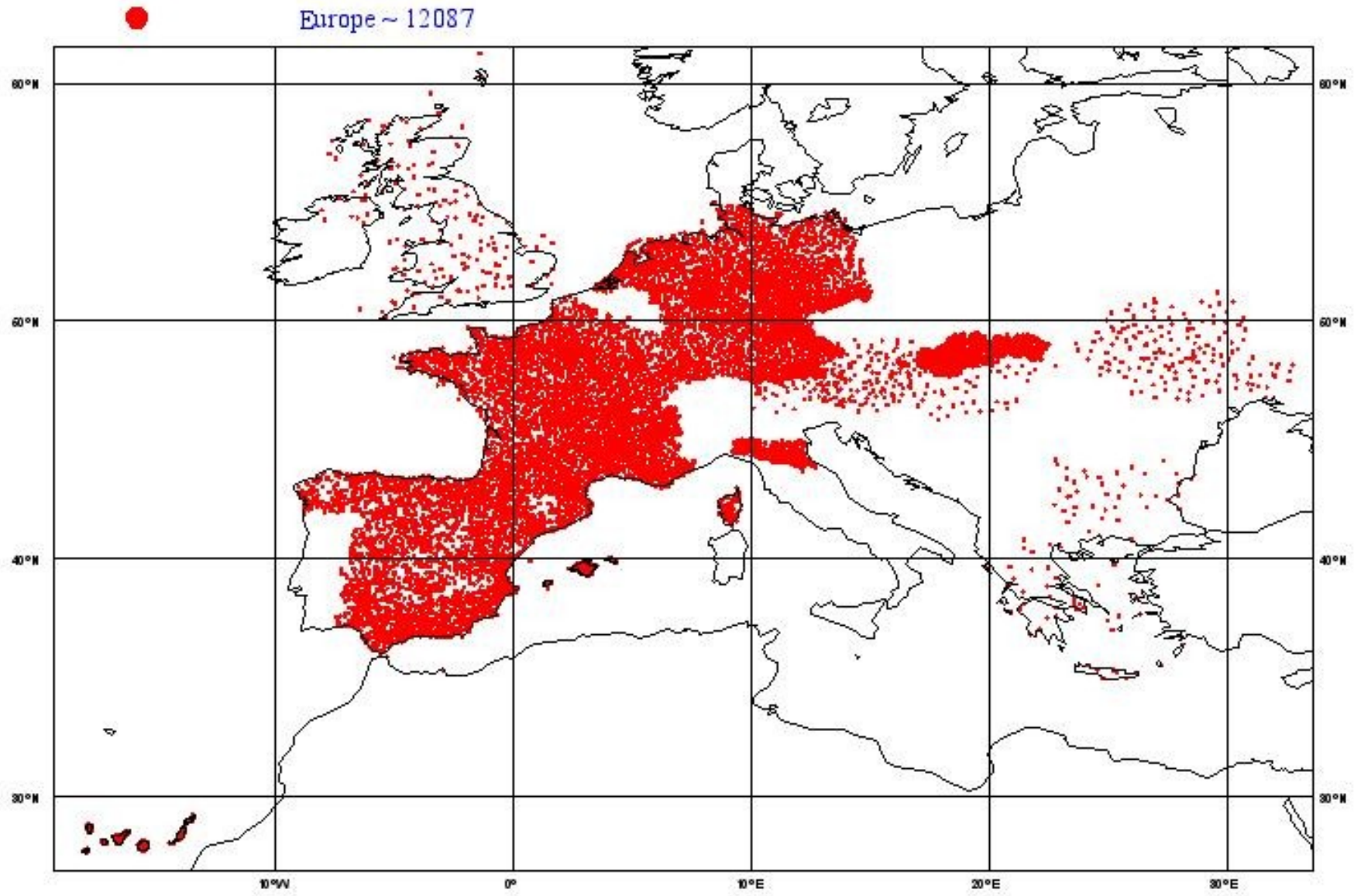


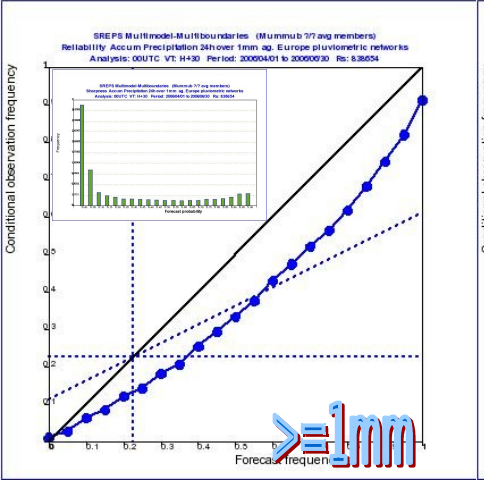
HH+30 Pcp > 5mm reliability & sharpness (ABOVE)

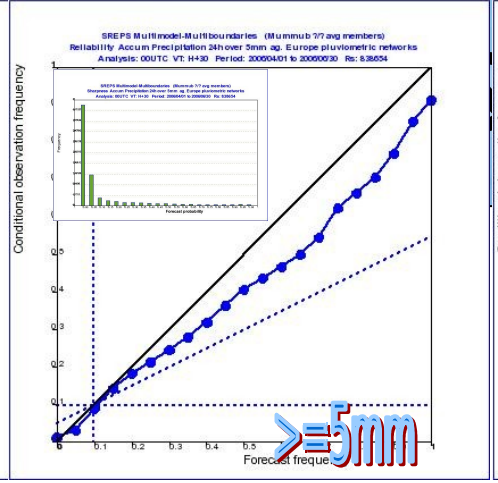
HH+30 Pcp > 1,5,10,20mm ROC & stations (BELOW)

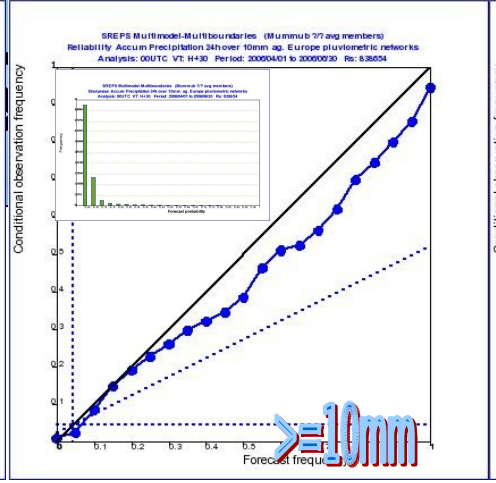


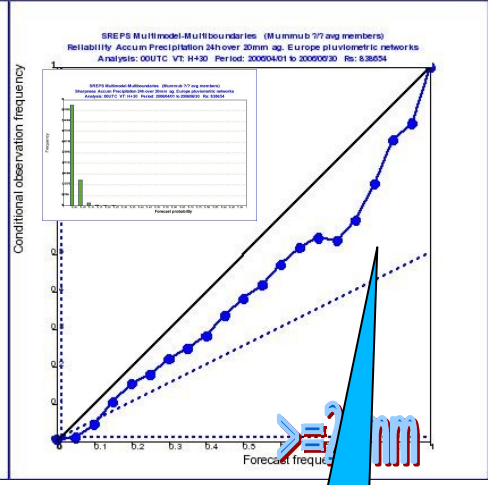
Europe pcp networks 2006







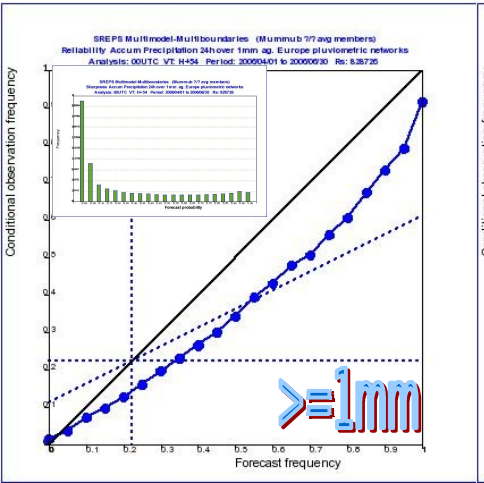


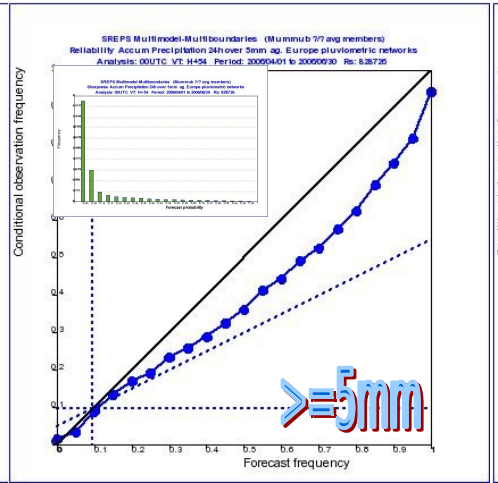


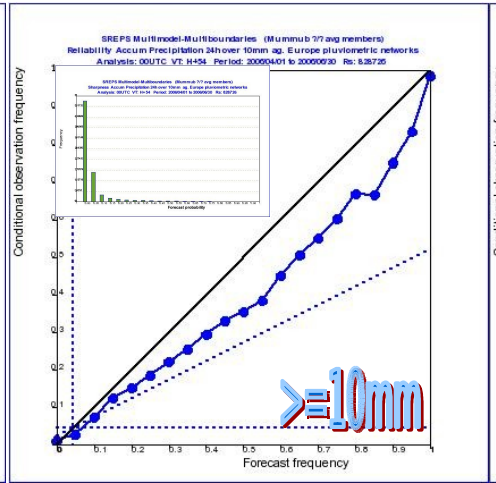
H+30 Joint H+54

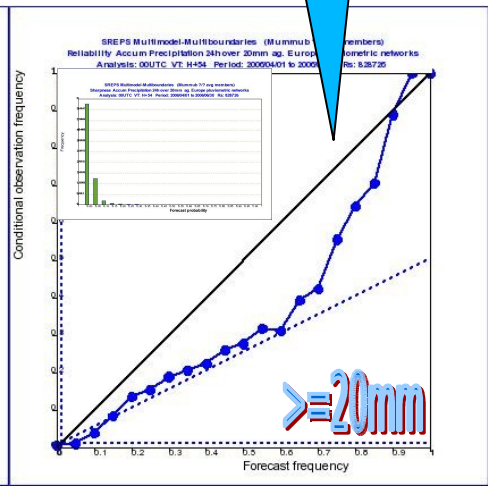
- Good reliability according to
  - thresholds (base rate)
  - forecast length

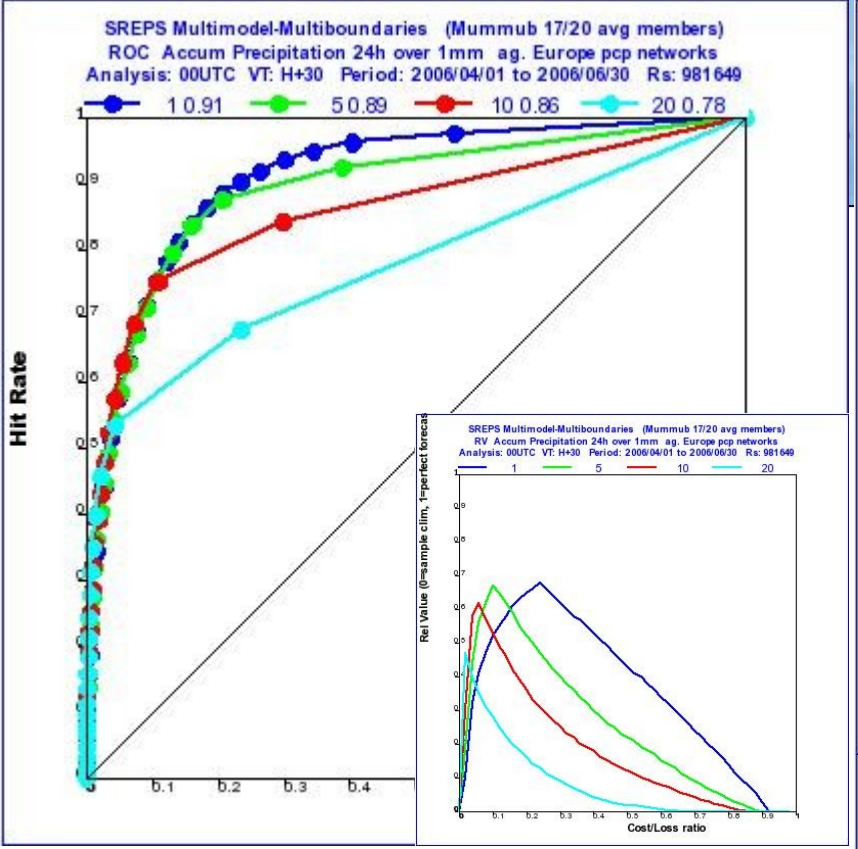
No Under-sampling

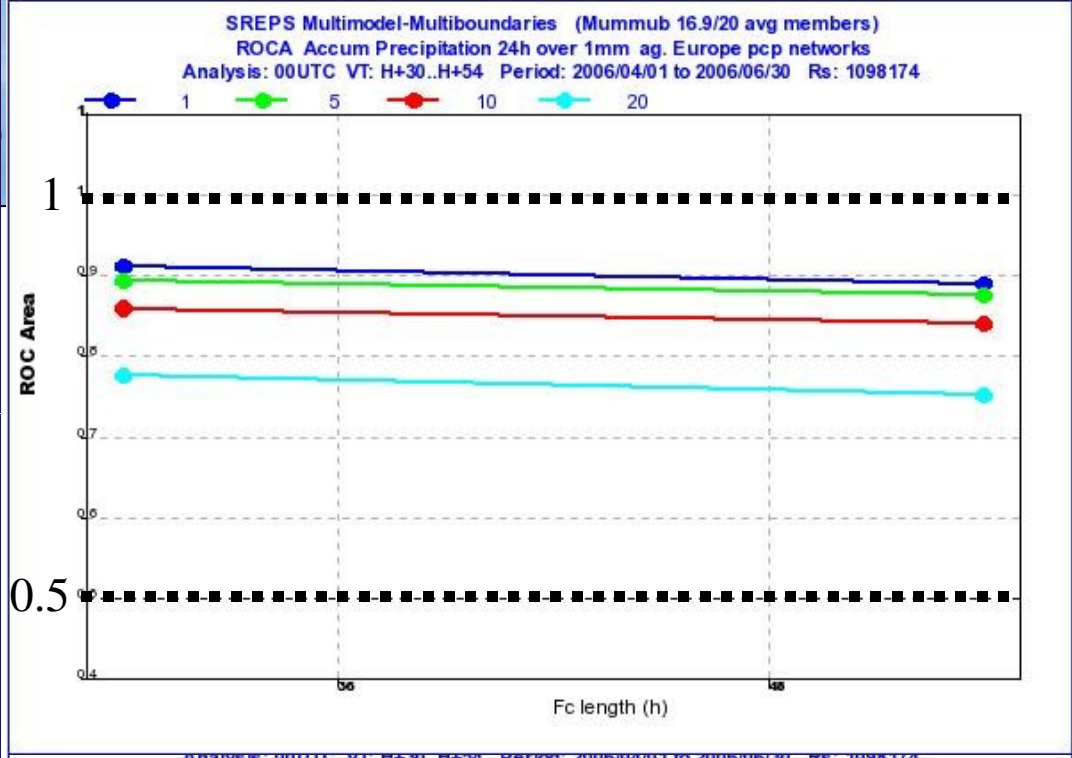


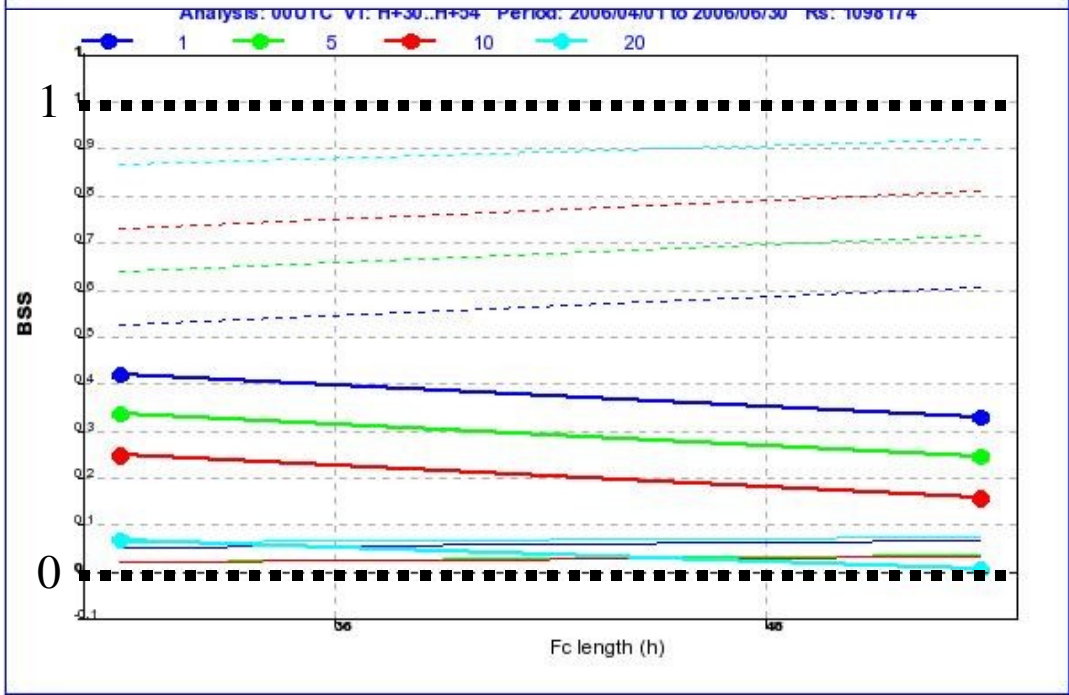












- Good resolution
  - ROC Areas
  - BSSs
- Good RV curves

Conclusions & near future

- According to this exercise, the performance of the INM short-range multi-model ensemble 24h accumulated precipitation forecasts using high resolution pcp observations is very good
  - INM, MF, DWD, UKMO & Europe-Joint pnw show high performance (reliability & resolution), independently on the different frequency of occurrence (base rate) on each network and threshold, thus overcoming different skill difficulties

- Future plans to improve acc pcp INM-SREPS forecasts
  - Increase model resolution of individual members (currently ~ 0.25ºx40)
  - Promising BMA on acc pcp (see Santos-Muñoz, D. poster)

- Future improvements on the verification method
  - Fuzzy verification methods (Casati, Ebert) might show a more realistic information about performance (e.g. better representativeness of actual pcp)
  - Focus on Proper skill scores, bootstrap

Aknowledgements

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- Chiara Marsigli, Ulrich Schättler (COSMO)
- Olivier Talagrand (LMD)

- We also like to thank many Met. Services for making their climate network precipitation observations available to us for verification (some of them not yet included): Arpa-Sim (Italy), DWD (Germany), EARS (Slovenia), HNMS (Greece), HMS (Hungary), KNMI (Netherlands), Lombardia (Italy), Météo-France (France), NIMH (Bulgaria), NMAP (Romania), SHMU (Slovakia), UKMO (UK), ZAMG (Austria).

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Thank you

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Extras

(Bonus slides)

Team

- **José A. García-Moya**.
- **Carlos Santos** (Hirlam, verification & graphics, web server).
- **Daniel Santos** (MM5, Bayesian Model Average).
- **Alfons Callado** (UM & grib software).
- **Juan Simarro** (HRM, LM and Vertical interpolation software).

References

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- Arribas A., Robertson K.B., & Mylne, K.R., 2005: Test of Poor Man's Ensemble Prediction System. *M.W.R.,* 133, 1825-1839

Links

- WWRP/WGNE Joint Working Group on Verification, Forecast Verification - Issues, Methods and FAQ

http://www.bom.gov.au/bmrc/wefor/staff/eee/verif/verif_web_page.html

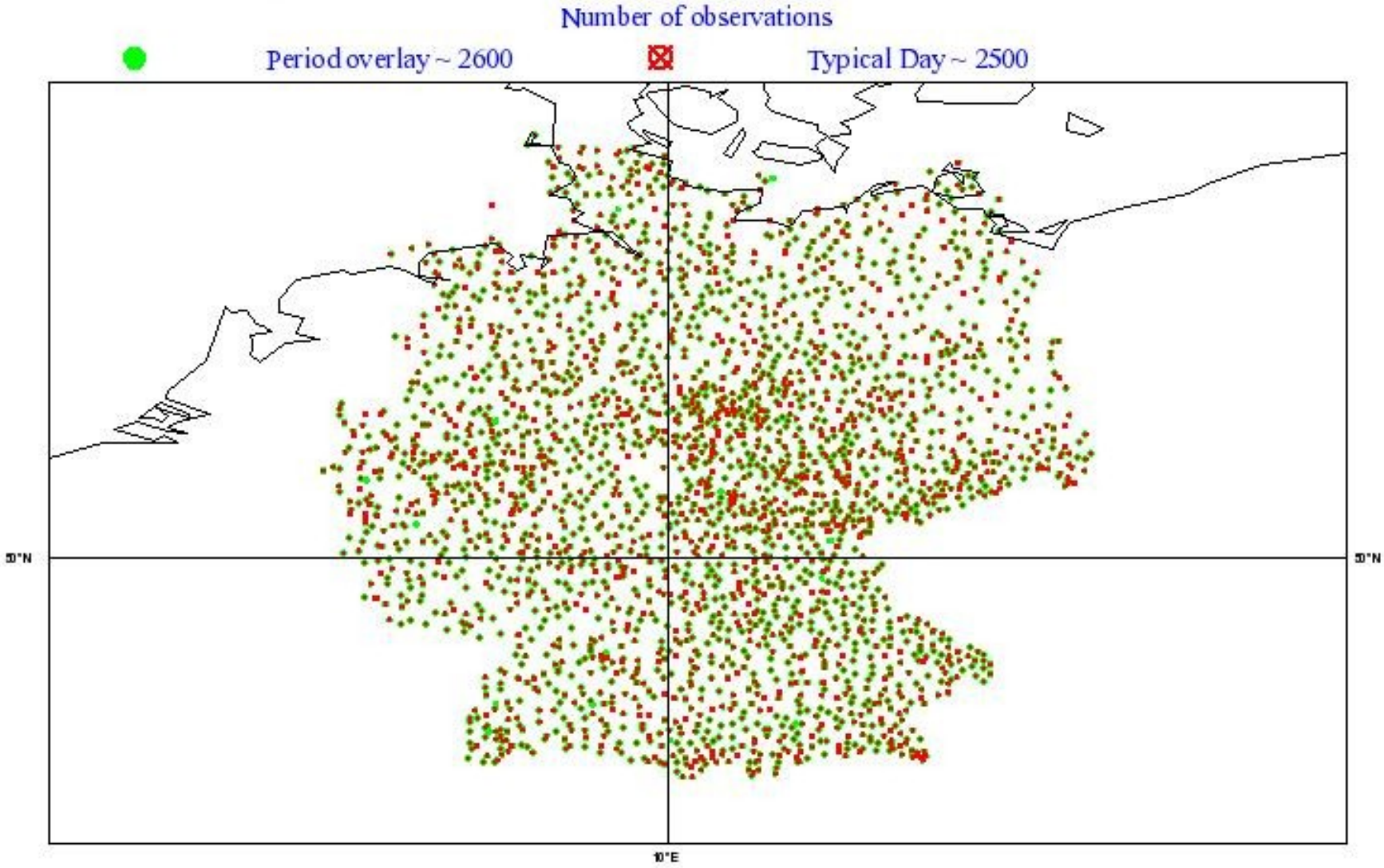
- VERIFICATION SYSTEMS FOR LONG-RANGE FORECASTS NEW, Standard Verification System (SVS) for Long-range Forecasts (LRF)

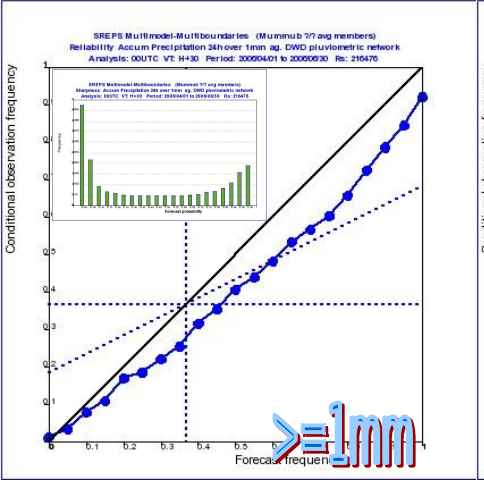
http://www.wmo.ch/web/www/DPS/verification_systems.html

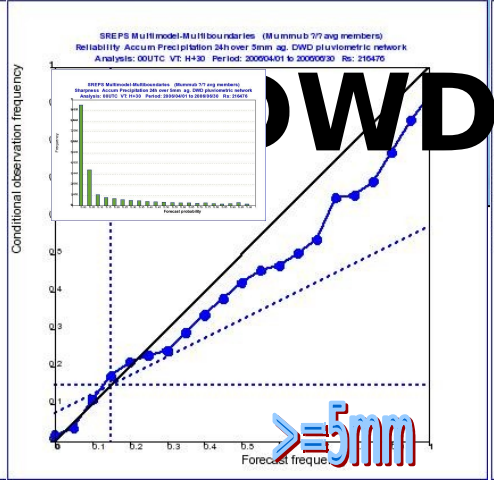
- ECMWF EPS Verification

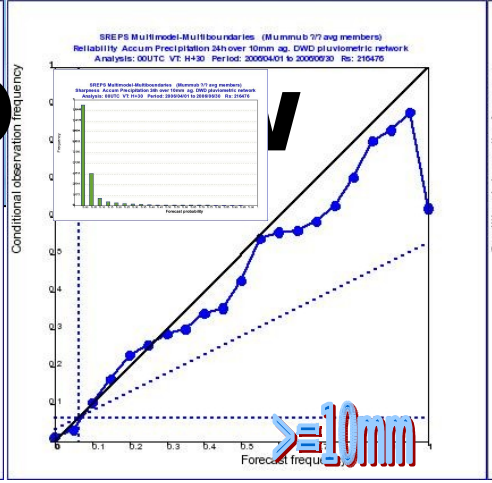
http://www.ecmwf.int/products/forecasts/d/charts/medium/verification/

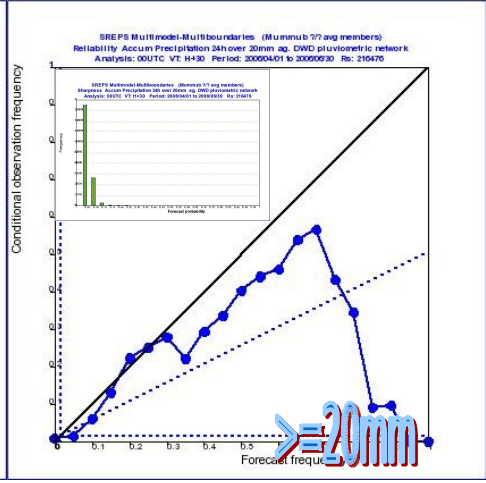
DWD pluviometric network 2006




SREPS Multimodel-Multiboundaries (Mummub '7/7 avg members)
Reliability Accum Precipitation 24h over 1mm ag. DWD pluviometric network
Analysis: 00UTC VT: H+30 Period: 2006/04/01 to 2006/06/30 Rs: 216476
Conditional observation frequency
Forecast frequency
>=1mm


SREPS Multimodel-Multiboundaries (Mummub '7/7 avg members)
Reliability Accum Precipitation 24h over 5mm ag. DWD pluviometric network
Analysis: 00UTC VT: H+30 Period: 2006/04/01 to 2006/06/30 Rs: 216476
Conditional observation frequency
Forecast frequency
>=5mm

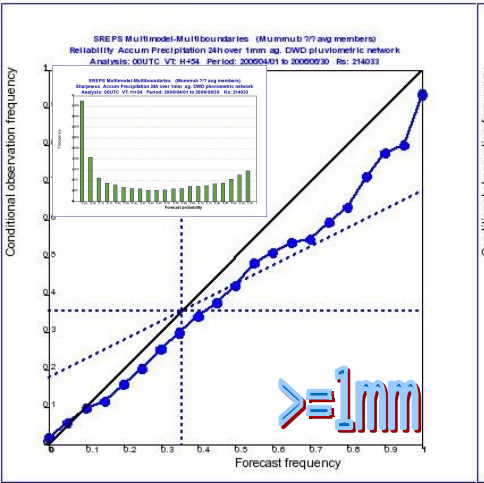

SREPS Multimodel-Multiboundaries (Mummub '7/7 avg members)
Reliability Accum Precipitation 24h over 10mm ag. DWD pluviometric network
Analysis: 00UTC VT: H+30 Period: 2006/04/01 to 2006/06/30 Rs: 216476
Conditional observation frequency
Forecast frequency
>=10mm


SREPS Multimodel-Multiboundaries (Mummub '7/7 avg members)
Reliability Accum Precipitation 24h over 20mm ag. DWD pluviometric network
Analysis: 00UTC VT: H+30 Period: 2006/04/01 to 2006/06/30 Rs: 216476
Conditional observation frequency
Forecast frequency
>=20mm

H+30

DWD

H+54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Reliability Accum Precipitation 24h over 1mm ag. DWD pluviometric network
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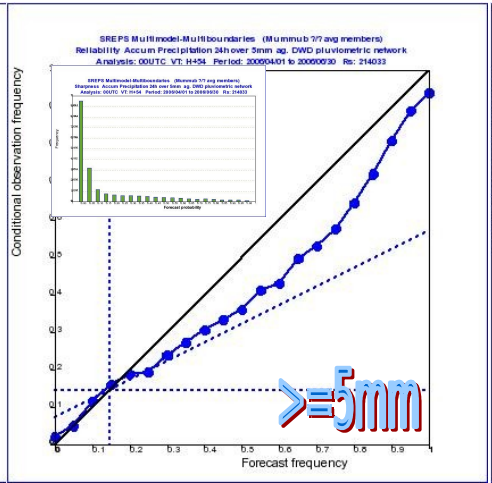
Conditional observation frequency
Forecast frequency
>=1mm


SREPS Multimodel-Multiboundaries (Mummub '7/7 avg members)
Reliability Accum Precipitation 24h over 5mm ag. DWD pluviometric network
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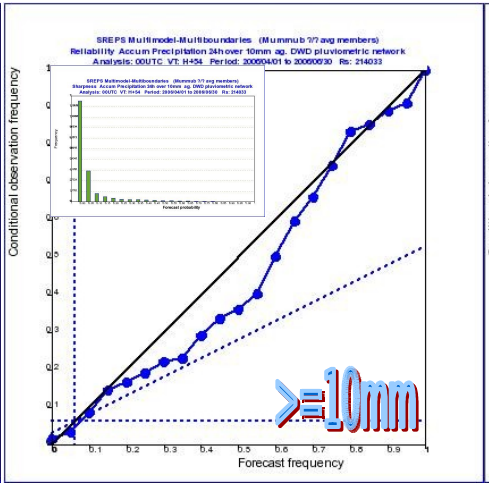
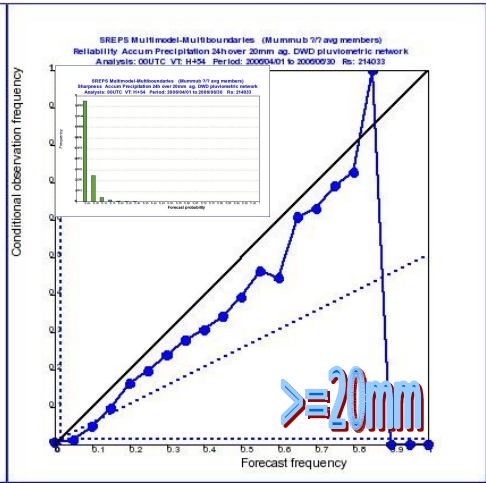
Conditional observation frequency
Forecast frequency
>=5mm


SREPS Multimodel-Multiboundaries (Mummub '7/7 avg members)
Reliability Accum Precipitation 24h over 10mm ag. DWD pluviometric network
Analysis: 00UTC VT: H+54 Period: 2006/04/01 to 2006/06/30 Rs: 214033
Conditional observation frequency
Forecast frequency
>=10mm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Reliability Accum Precipitation 24h over 20mm ag. DWD pluviometric network
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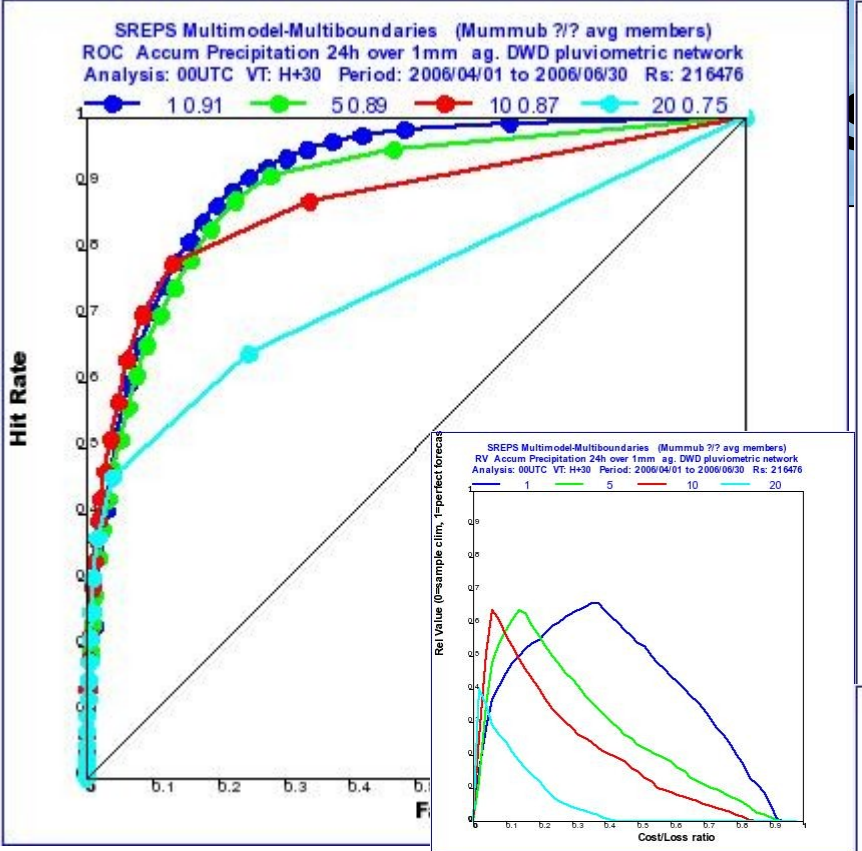
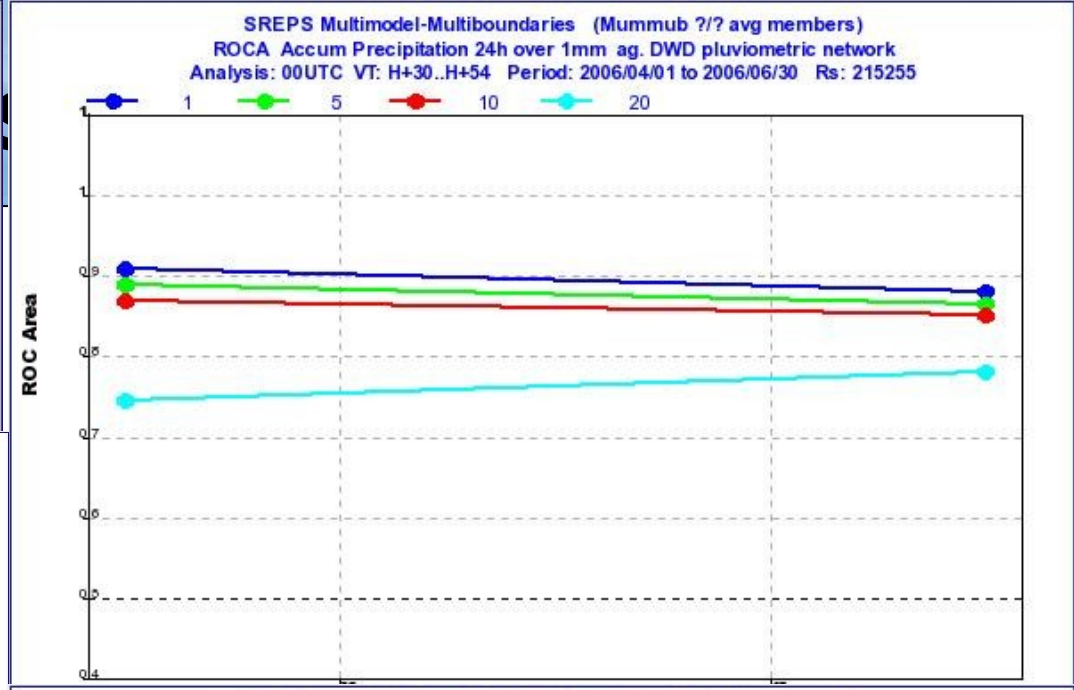
Conditional observation frequency
Forecast frequency
>=20mm


SREPS Multimodel-Multiboundaries (Mummub ?/? avg members)
ROC Accum Precipitation 24h over 1mm ag. DWD pluviometric network
Analysis: 00UTC VT: H+30 Period: 2006/04/01 to 2006/06/30 Rs: 216476
1 0.91
5 0.89
10 0.87
20 0.75
Hit Rate

SREPS Multimodel-Multiboundaries (Mummub ?/? avg members)
RV Accum Precipitation 24h over 1mm ag. DWD pluviometric network
Analysis: 00UTC VT: H+30 Period: 2006/04/01 to 2006/06/30 Rs: 216476
1
5
10
20
Rel Value (0=sample clim, 1=perfect forecast)
Cost/Loss ratio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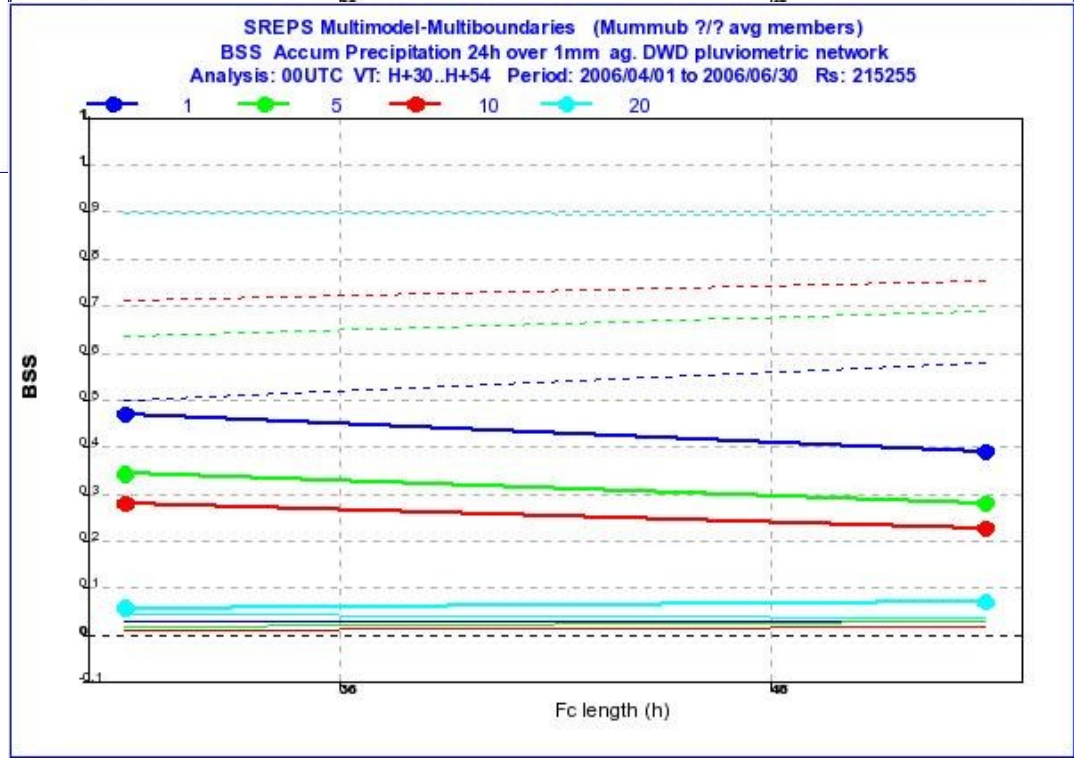
ROCA Accum Precipitation 24h over 1mm ag. DWD pluviometric network
Analysis: 00UTC VT: H+30..H+54 Period: 2006/04/01 to 2006/06/30 Rs: 215255
1
5
10
20
ROC Area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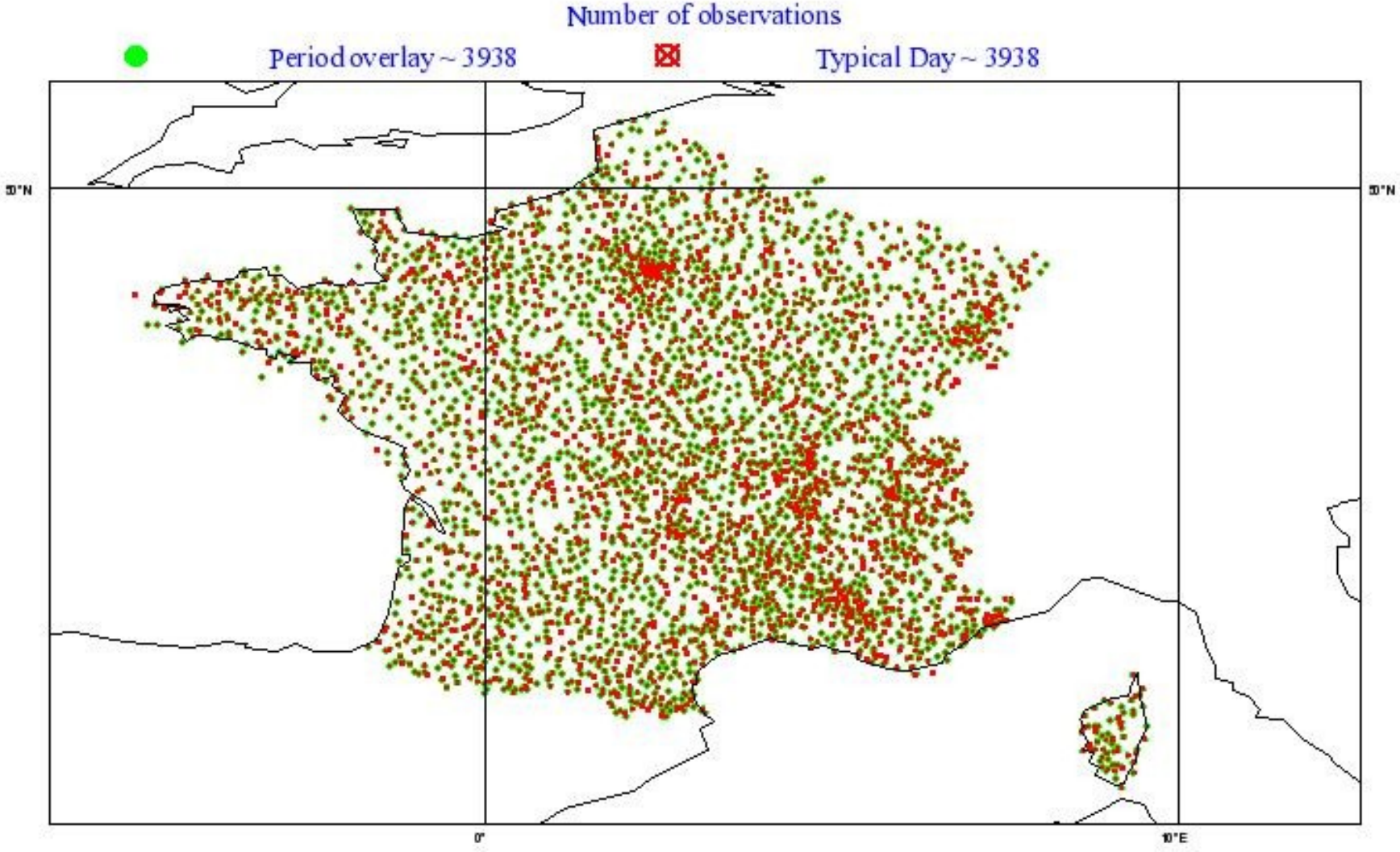
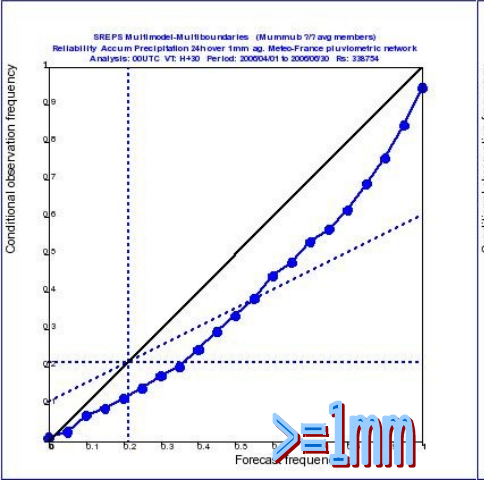
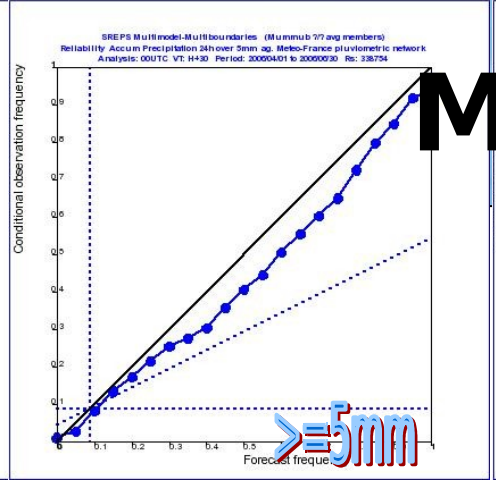
BSS Accum Precipitation 24h over 1mm ag. DWD pluviometric network
Analysis: 00UTC VT: H+30..H+54 Period: 2006/04/01 to 2006/06/30 Rs: 215255
1
5
10
20
BSS
Fc length (h)

- DWD

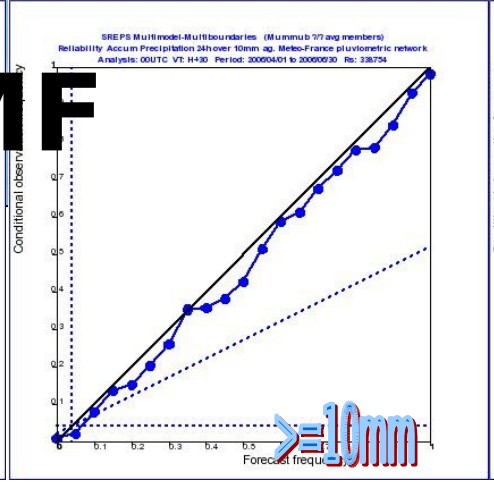
Meteo-France pluviometric network 2006




SREPS Multimodel-Multiboundaries (Mummub '07 avg members)
Reliability Accum Precipitation 24h over 1mm ag. Meteo-France pluviometric network
Analysis: 00UTC VT: H+30 Period: 20060401 to 20060930 Rs: 338754
Conditional observation frequency
Forecast frequency
>=1mm


SREPS Multimodel-Multiboundaries (Mummub '07 avg members)
Reliability Accum Precipitation 24h over 5mm ag. Meteo-France pluviometric network
Analysis: 00UTC VT: H+30 Period: 20060401 to 20060930 Rs: 338754
Conditional observation frequency
Forecast frequency
>=5mm

MF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Reliability Accum Precipitation 24h over 10mm ag. Meteo-France pluviometric network
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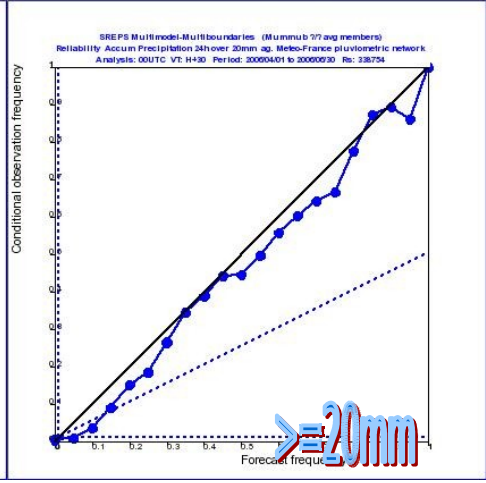
Conditional observation frequency
Forecast frequency
>=10mm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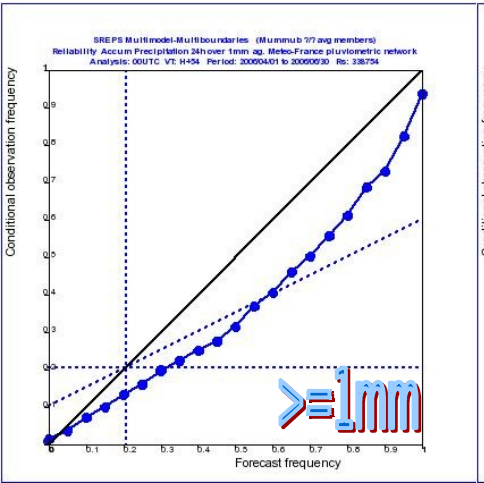
Conditional observation frequency
Forecast frequency
>=20mm

H+30

MF

H+54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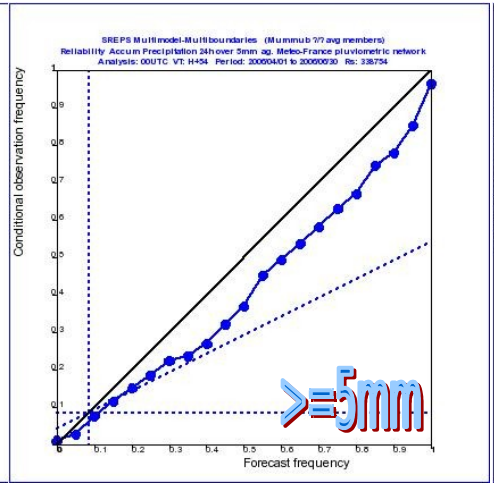
Analysis: 00UTC VT: H+54 Period: 20060401 to 20060930 Rs: 338754
Conditional observation frequency
Forecast frequency
>=1mm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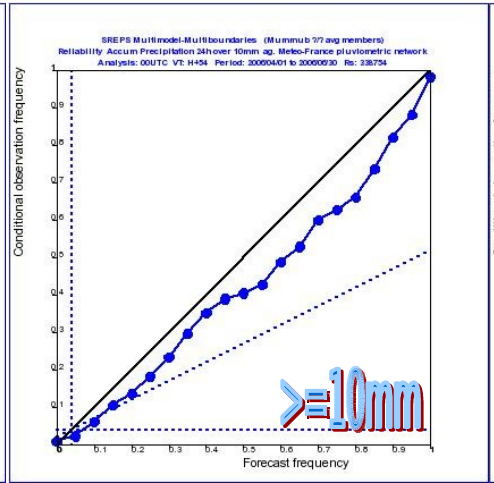
Reliability Accum Precipitation 24h over 5mm ag. Meteo-France pluviometric network
Analysis: 00UTC VT: H+54 Period: 20060401 to 20060930 Rs: 338754
Conditional observation frequency
Forecast frequency
>=5mm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Reliability Accum Precipitation 24h over 10mm ag. Meteo-France pluviometric network
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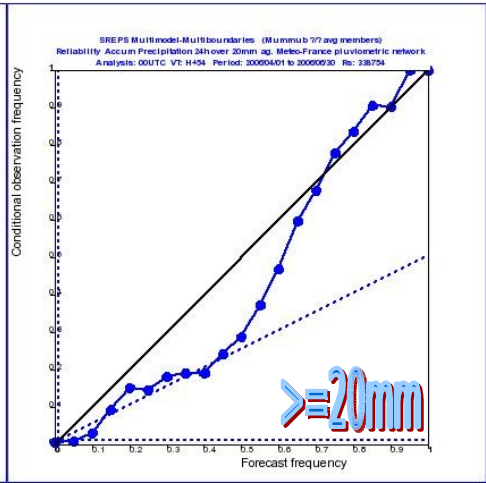
Conditional observation frequency
Forecast frequency
>=10mm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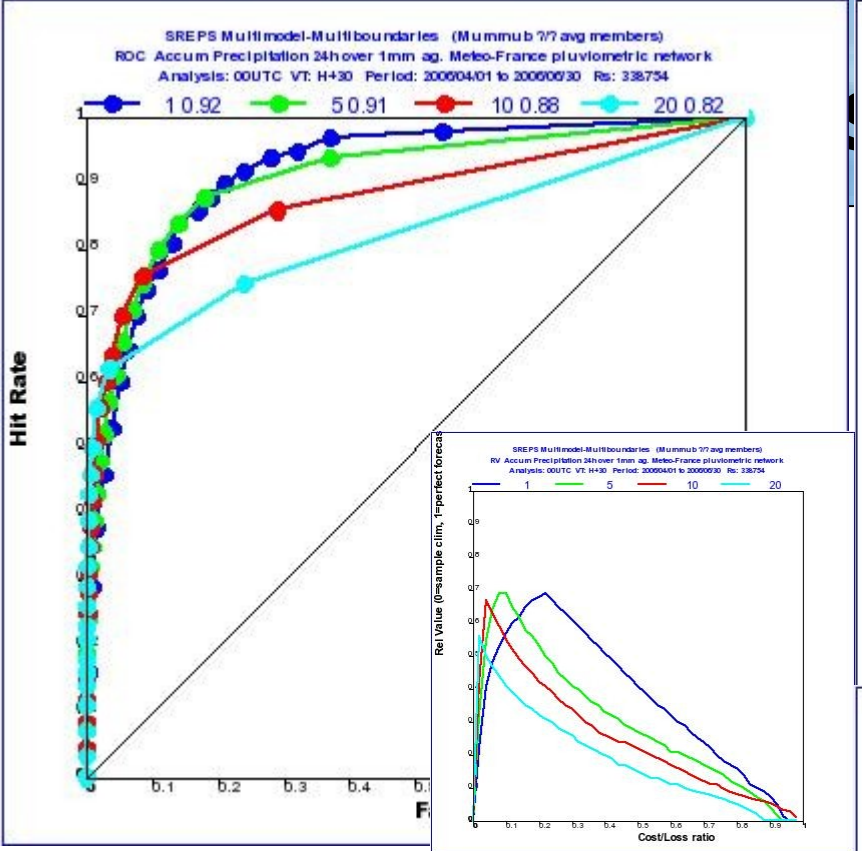
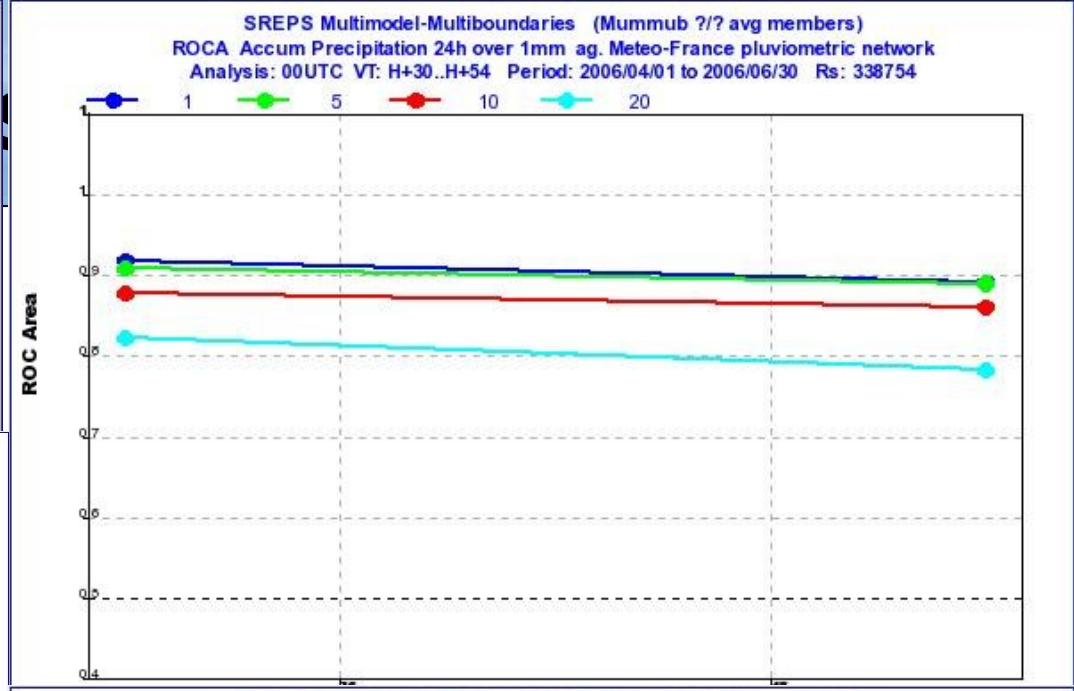
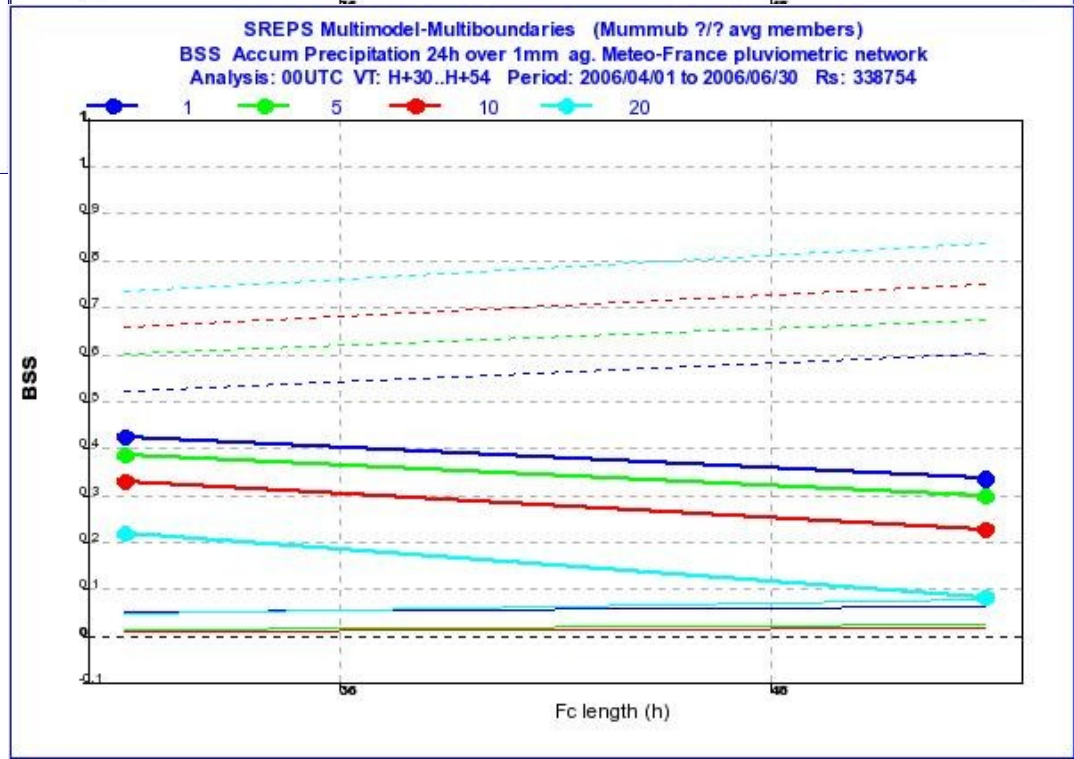
Reliability Accum Precipitation 24h over 20mm ag. Meteo-France pluviometric network
Analysis: 00UTC VT: H+54 Period: 20060401 to 20060930 Rs: 338754
Conditional observation frequency
Forecast frequency
>=20mm

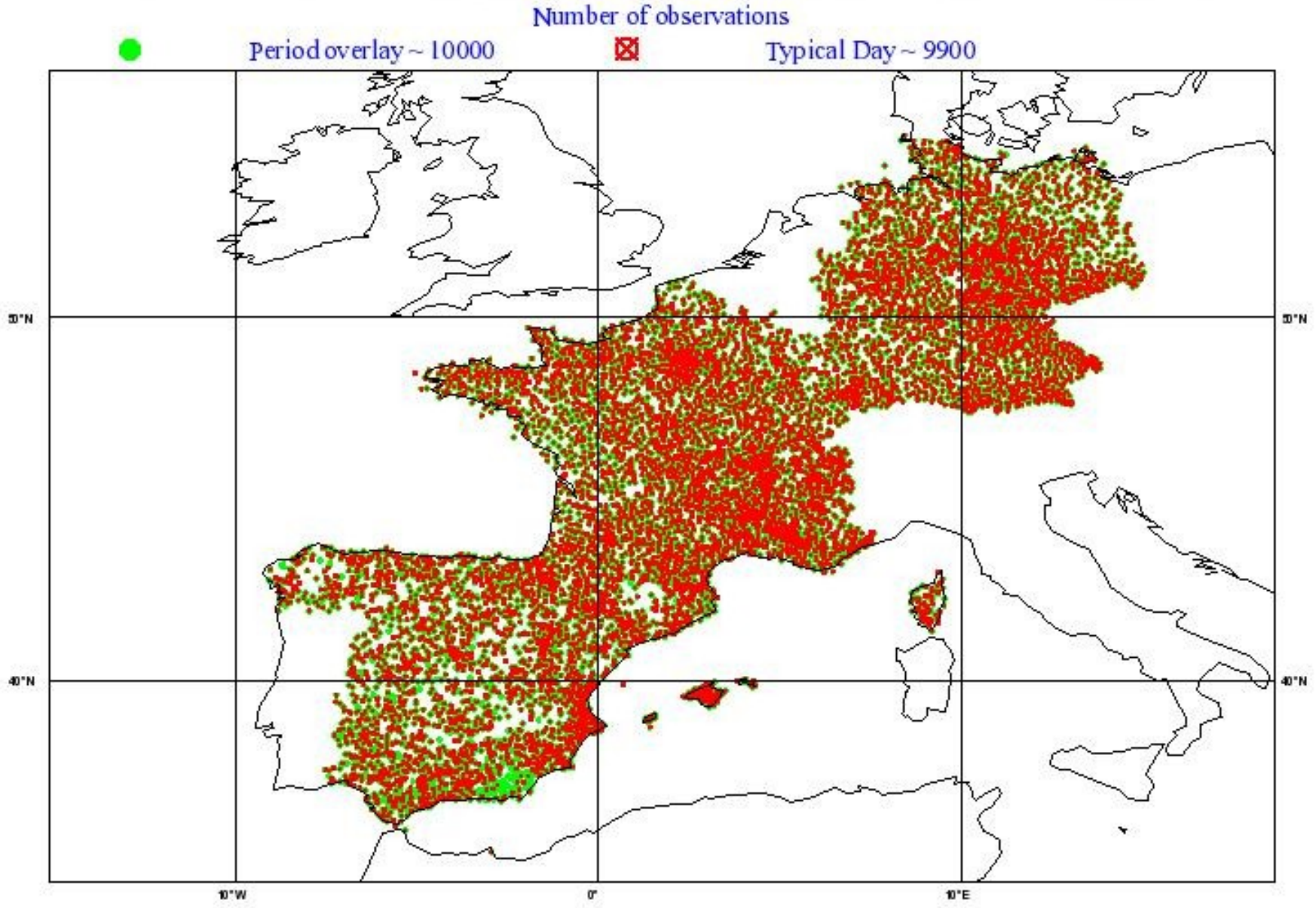




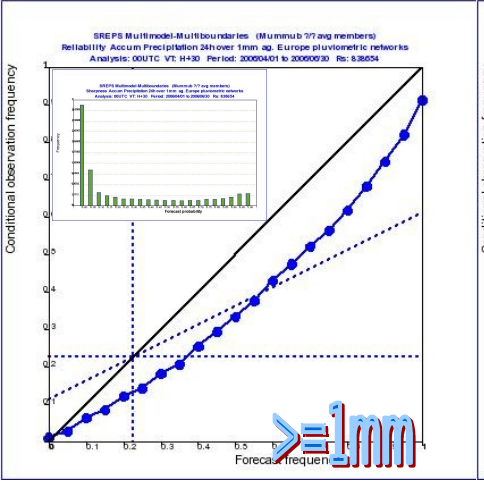


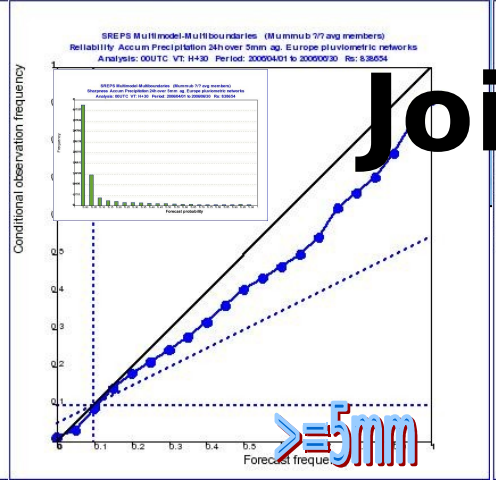
- MeteoFrance

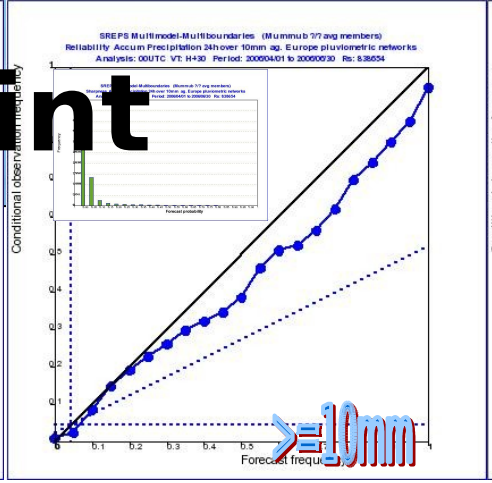
DWD-MF-INM pluviometric networks 2006

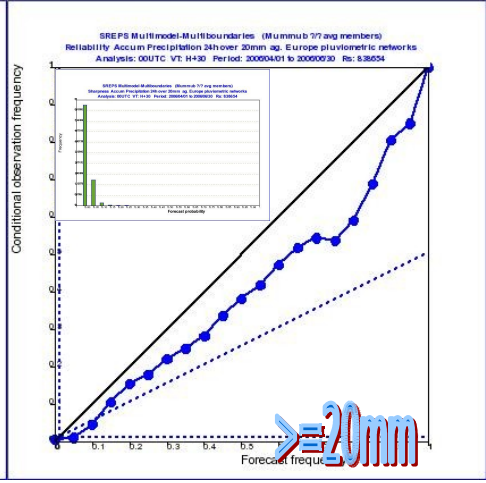


Joint





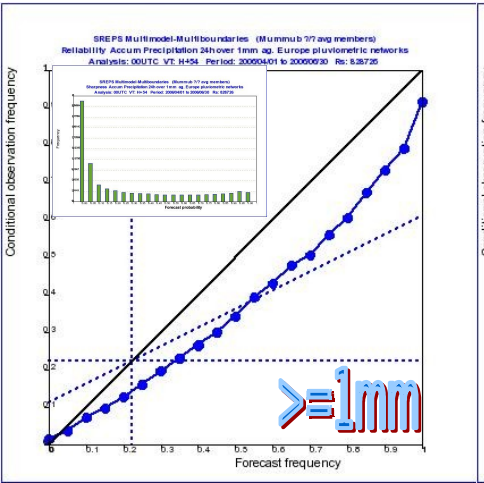


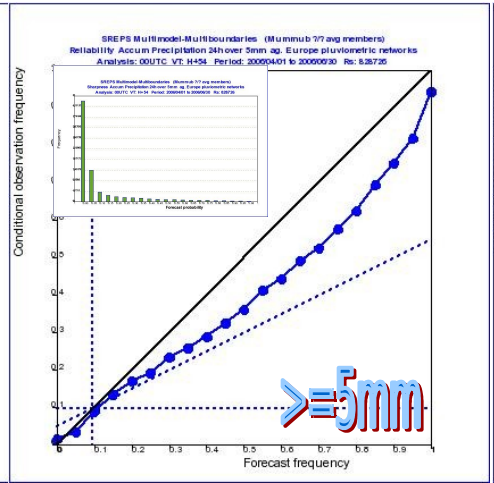


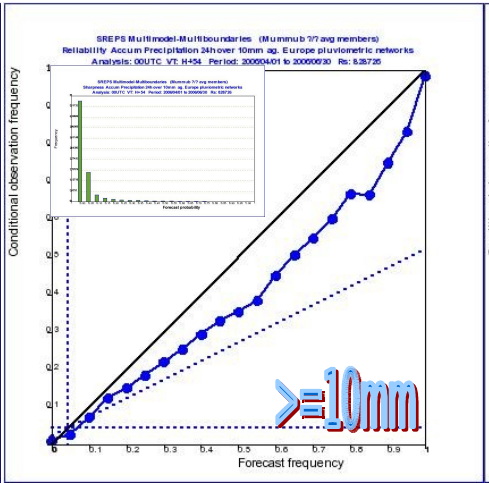
H+30

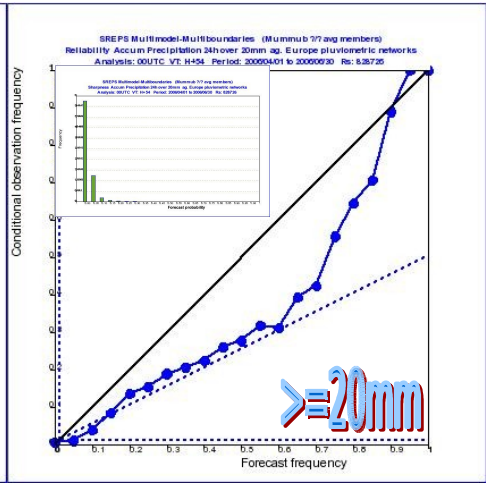
Joint

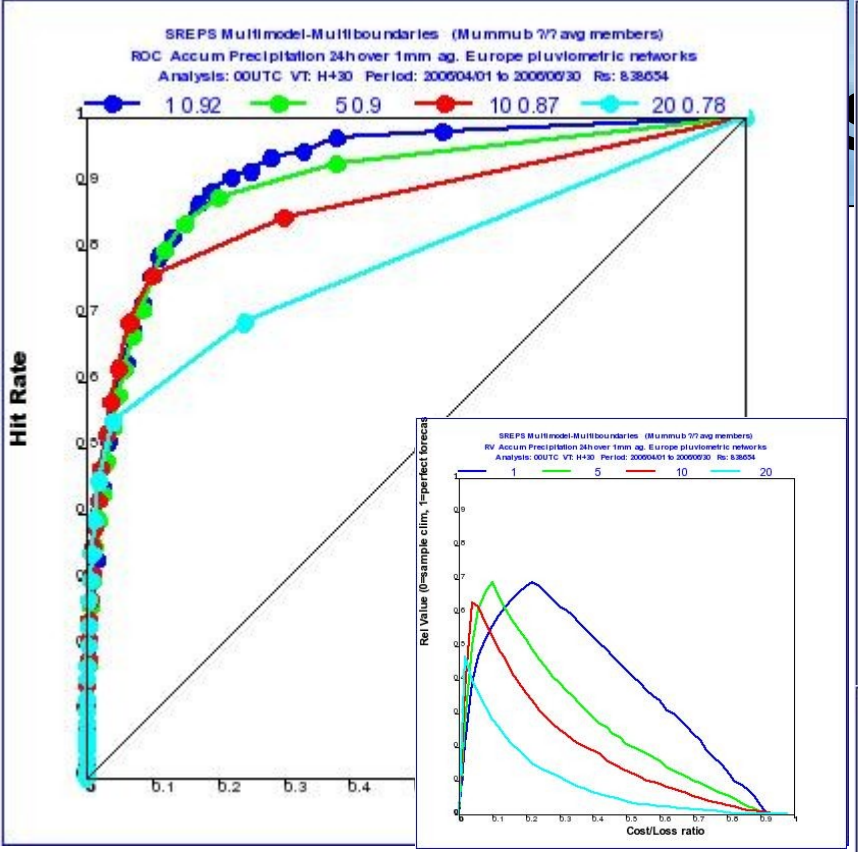
H+54

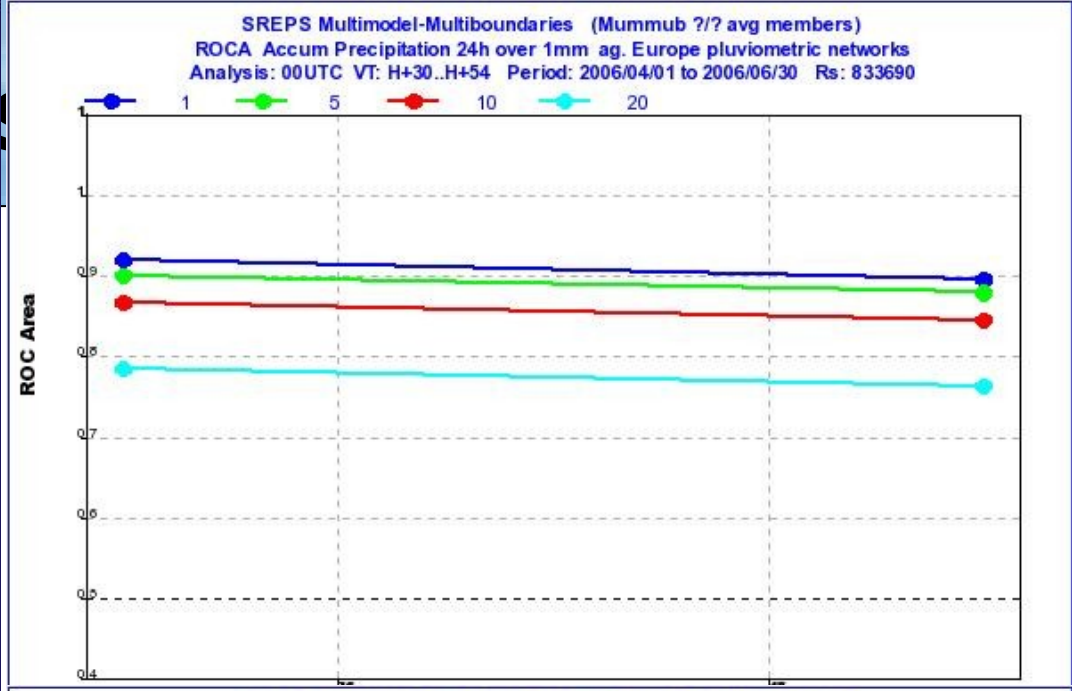


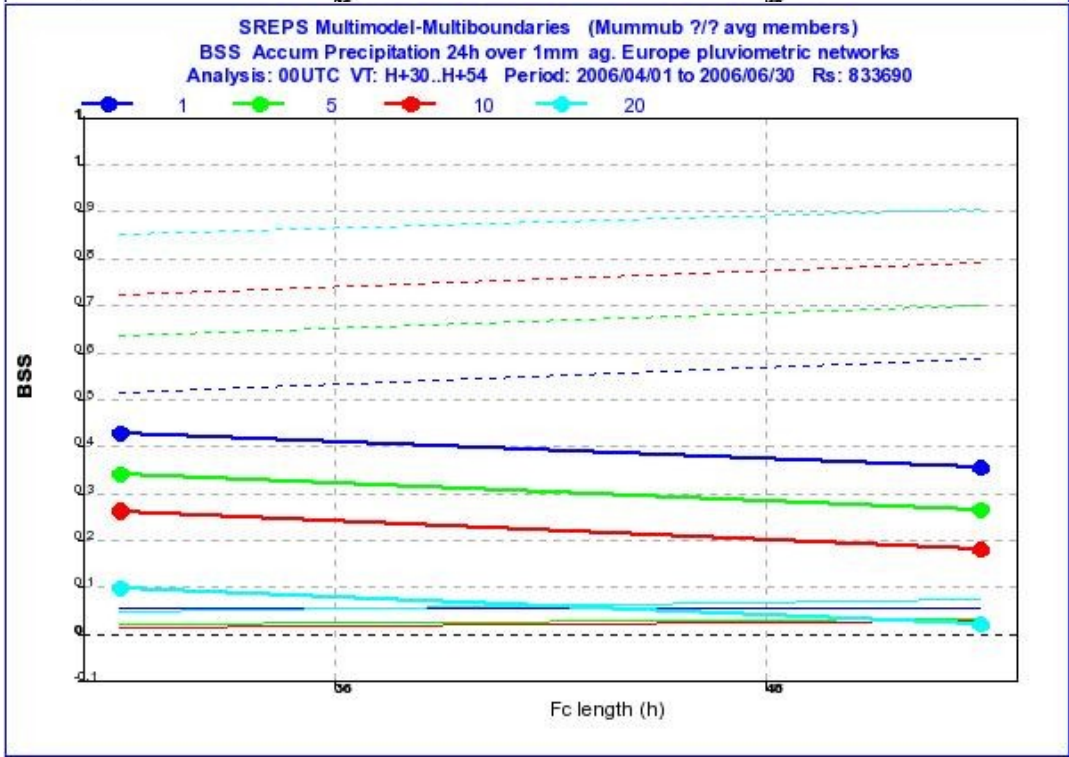







SREPS Multimodel-Multiboundaries (Mummub ?/? avg members)
ROC Accum Precipitation 24h over 1mm ag. Europe pluviometric networks
Analysis: 00UTC VT: H+30 Period: 2006/04/01 to 2006/06/30 Rs: 838654
1 0.92
5 0.9
10 0.87
20 0.78
Hit Rate
Rel Value (0=sample clim, 1=perfect forecas
Cost/Loss ratio


SREPS Multimodel-Multiboundaries (Mummub ?/? avg members)
ROCA Accum Precipitation 24h over 1mm ag. Europe pluviometric networks
Analysis: 00UTC VT: H+30..H+54 Period: 2006/04/01 to 2006/06/30 Rs: 833690
1
5
10
20
ROC Area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BSS Accum Precipitation 24h over 1mm ag. Europe pluviometric networks
Analysis: 00UTC VT: H+30..H+54 Period: 2006/04/01 to 2006/06/30 Rs: 833690
1
5
10
20
BSS
Fc length (h)

- Joint

Introduction

- Predictability is flow dependent
- Extreme weather events have a low predictability, uncertainties can grow critically even in the Short Range (less than 72 hours),
- Convection is highly non-linear and it shows a chaotic behaviour.
- Then a probabilistic apprach may help to improve the prediction of such phenomena.

Ensemble for short range

- Surface parameters are the most important ones for weather forecast.
- Forecast of extreme events (convective precip, gales,...) is probabilistic.
- Short Range Ensemble prediction can help to forecast these events.
- Forecast risk (Palmer, ECMWF Seminar 2002) is the goal for both Medium- and, also, Short-Range Prediction.

Meteorological Framework

- Main Weather Forecast issues are related with Short-Range extreme events.
- Convective precipitation is the most dangerous weather event in Spain.
- Western Mediterranean is a close sea rounded by high mountains, in autumn sea is warmer than air.
- Several cases of more than 200 mm/few hours every year. Some fast cyclogenesis like “tropical cyclones”.

Ensemble for short range