

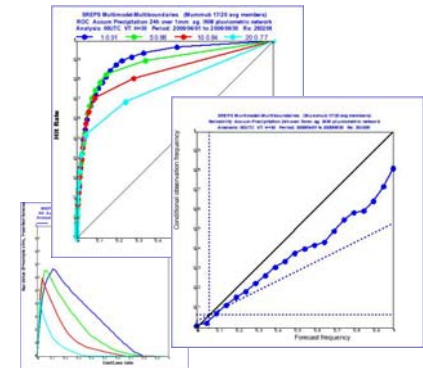
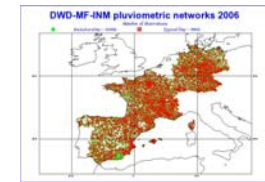
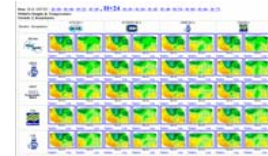
Performance of the INM short-range multi-model ensemble using high resolution precipitation observations

*CARLOS SANTOS, ALFONS CALLADO, JOSE A. GARCIA-MOYA,
DANIEL SANTOS-MUNOZ AND JUAN SIMARRO.*

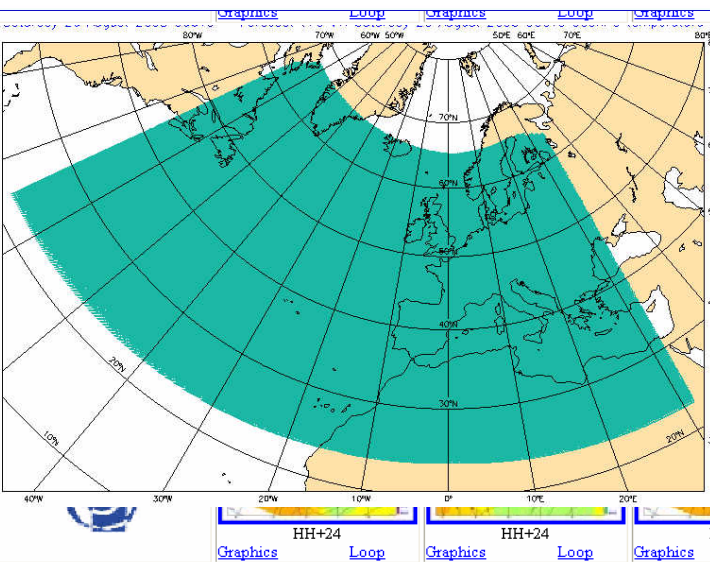
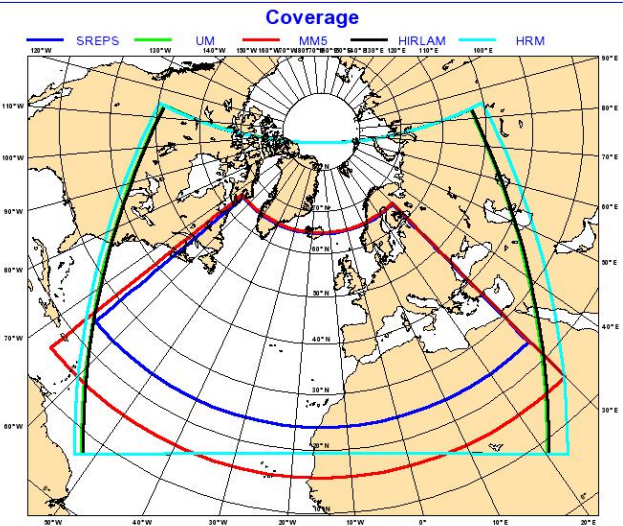
Predictability Group

Spanish Meteorological Institute (INM). 28040 Madrid. Spain

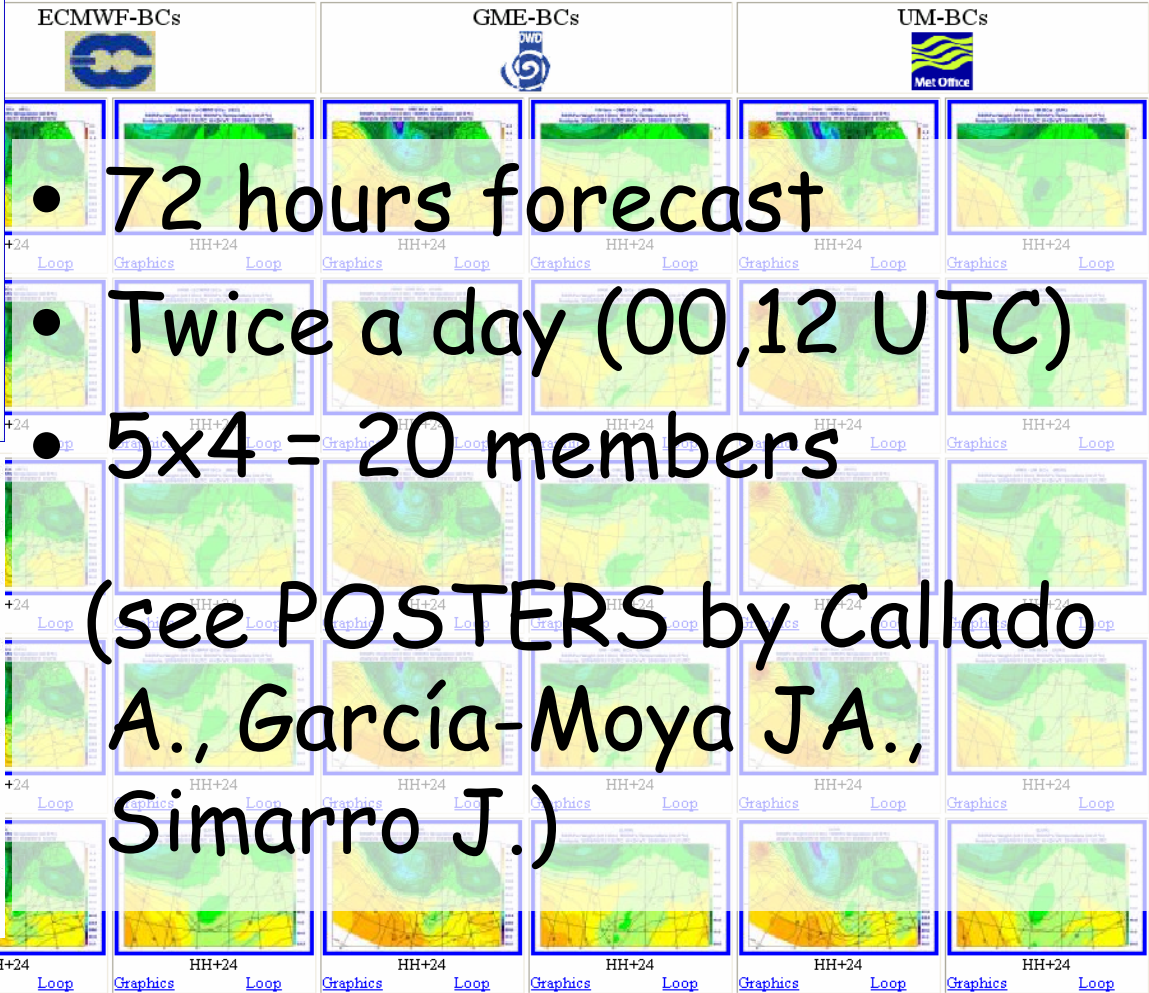
- INM SREPS multimodel
- Verification exercise
- Performance results
 - INM rain gauge network
 - Comparison INM-MF-DWD-Joint
- Concluding remarks



INM SREPS Multimodel



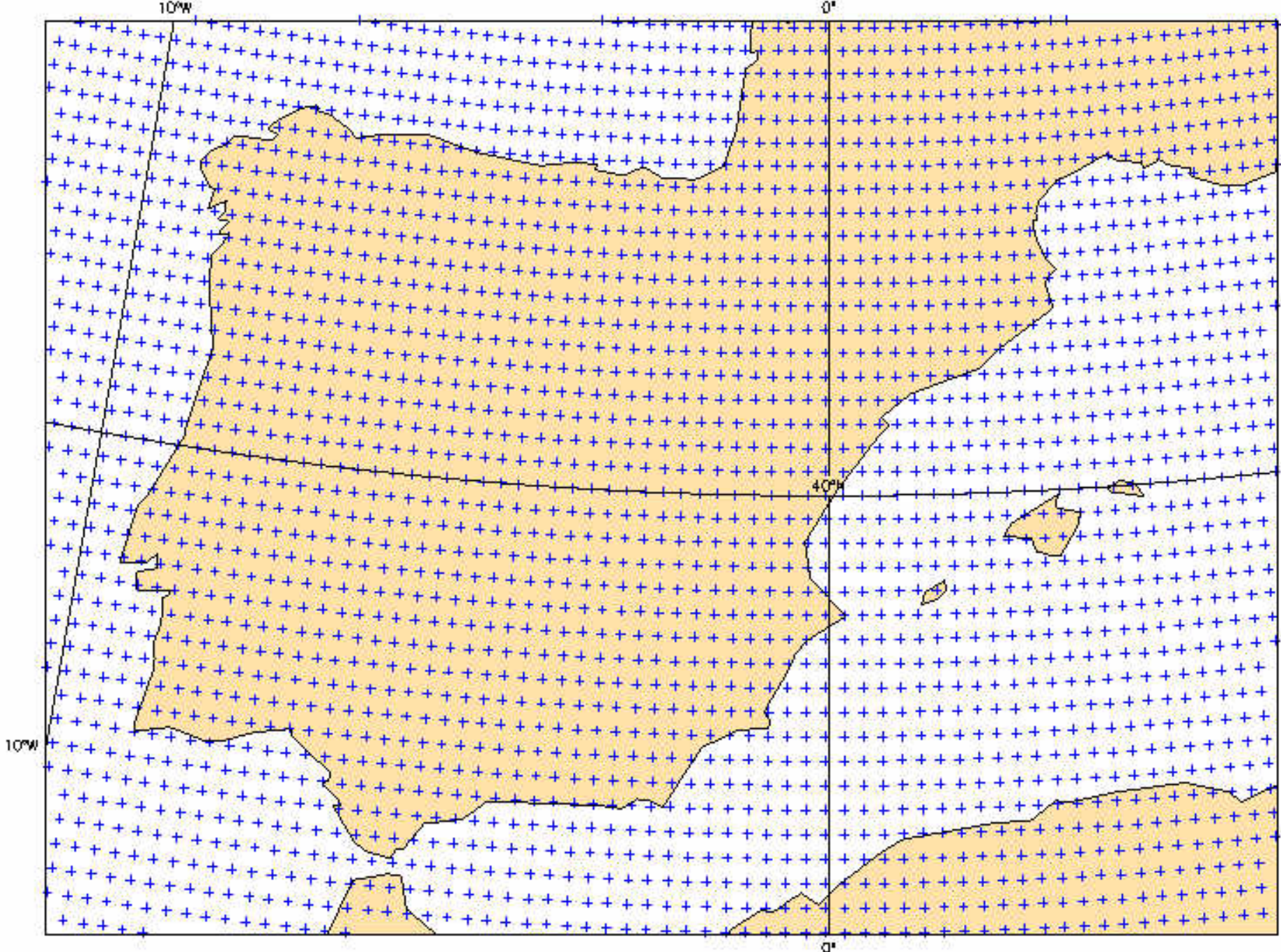
H+30, H+36, H+42, H+48, H+54, H+60, H+66, H+72

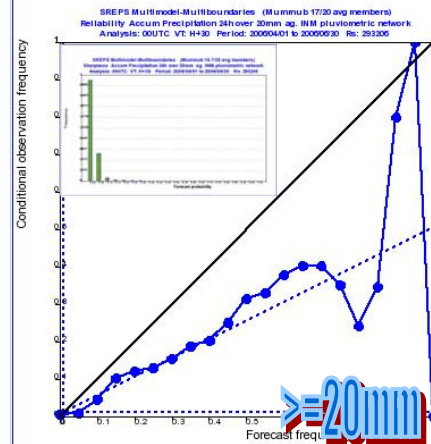
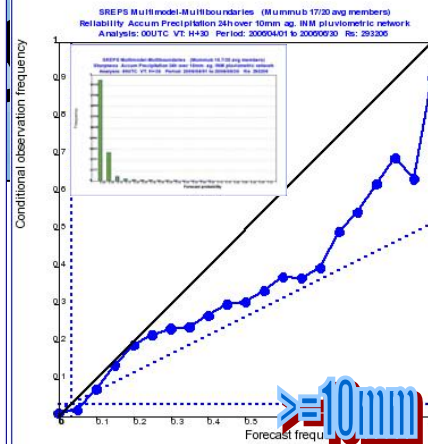
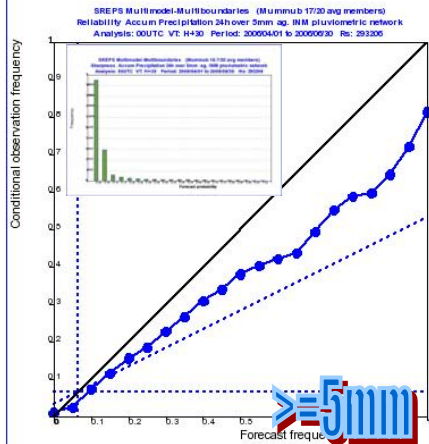
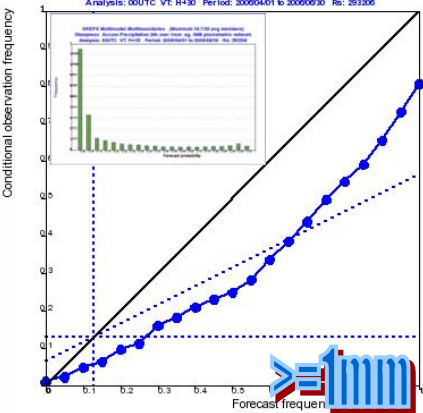


- 72 hours forecast
 - Twice a day (00,12 UTC)
 - $5 \times 4 = 20$ members
- (see POSTERS by Callado A., García-Moya JA., Simarro J.)

Verification exercise

- 24h accumulated precipitation forecast 06UTC-06UTC against observed 07UTC-07UTC
 - Checked in HH+30 and HH+54
- ~90 days (Apr1 to Jun30 2006).
- Few different rain gauge networks as references:
 - INM precipitation network (pnw)
 - MeteoFrance pnw
 - DWD pnw
 - Joint pnw
- Verification method
 - Interpolation to observation points
- Verification software
 - ~ ECMWF Metview + Local developments
- Performance scores
 - ECMWF recommendations





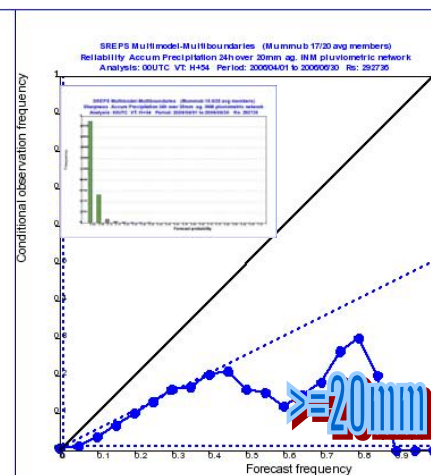
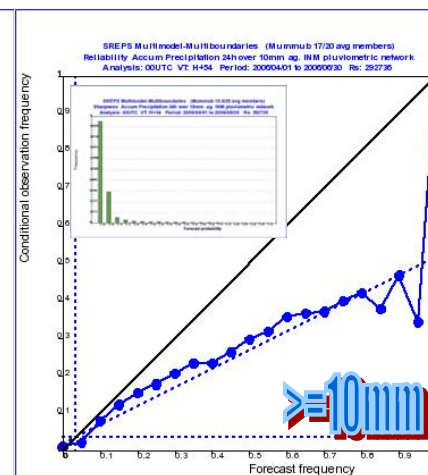
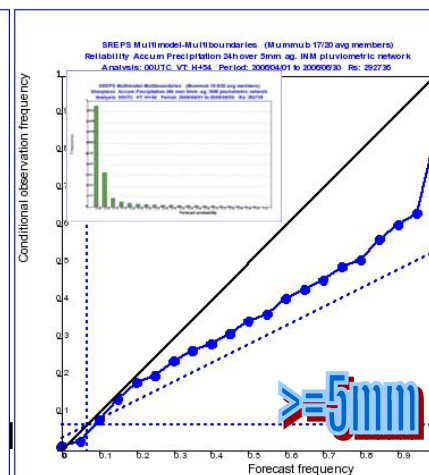
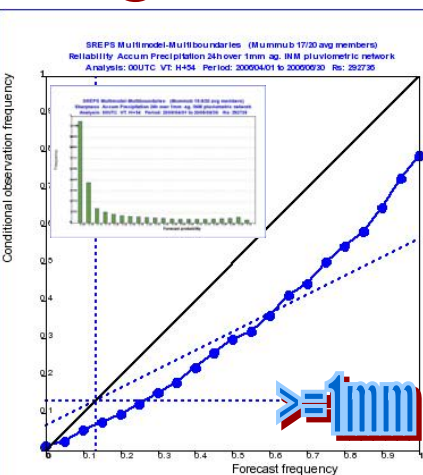
H+30

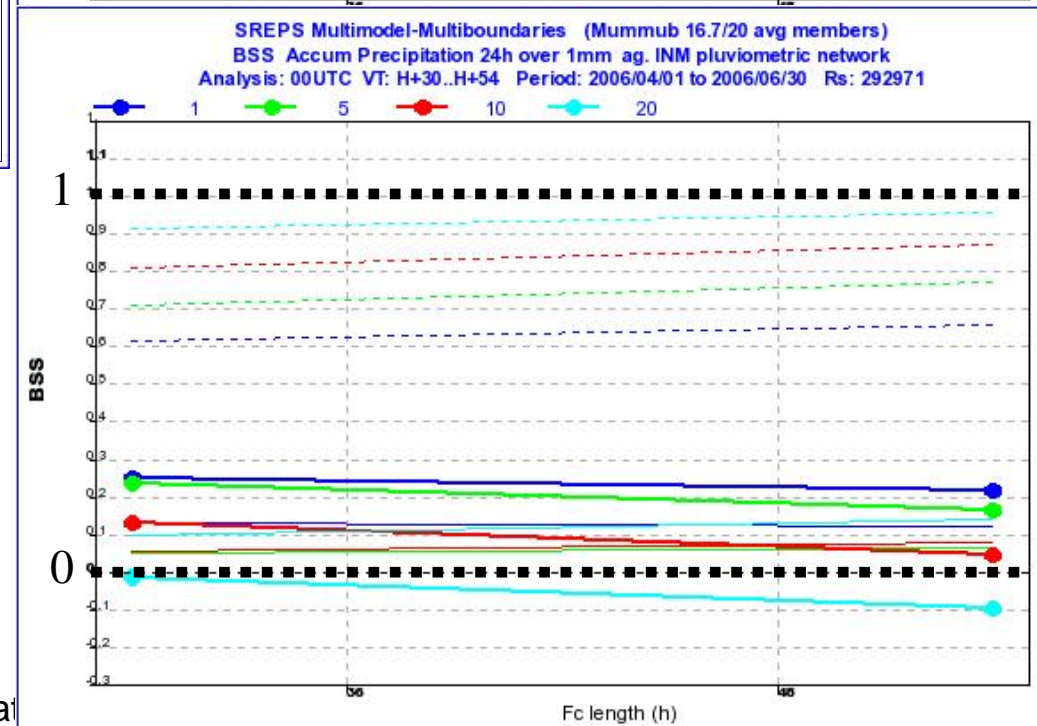
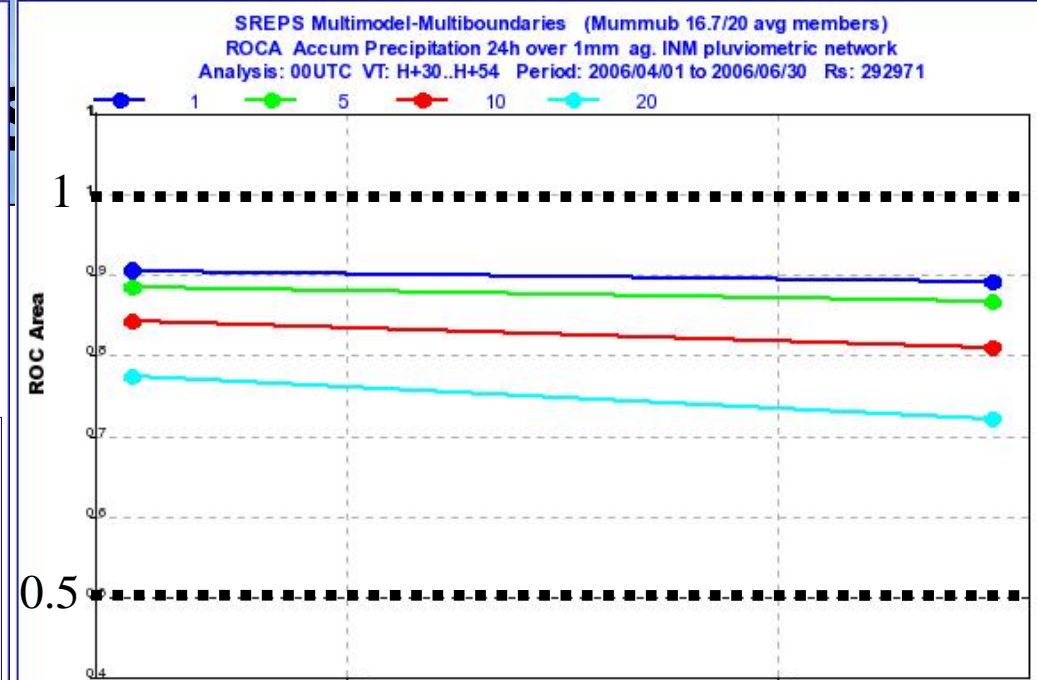
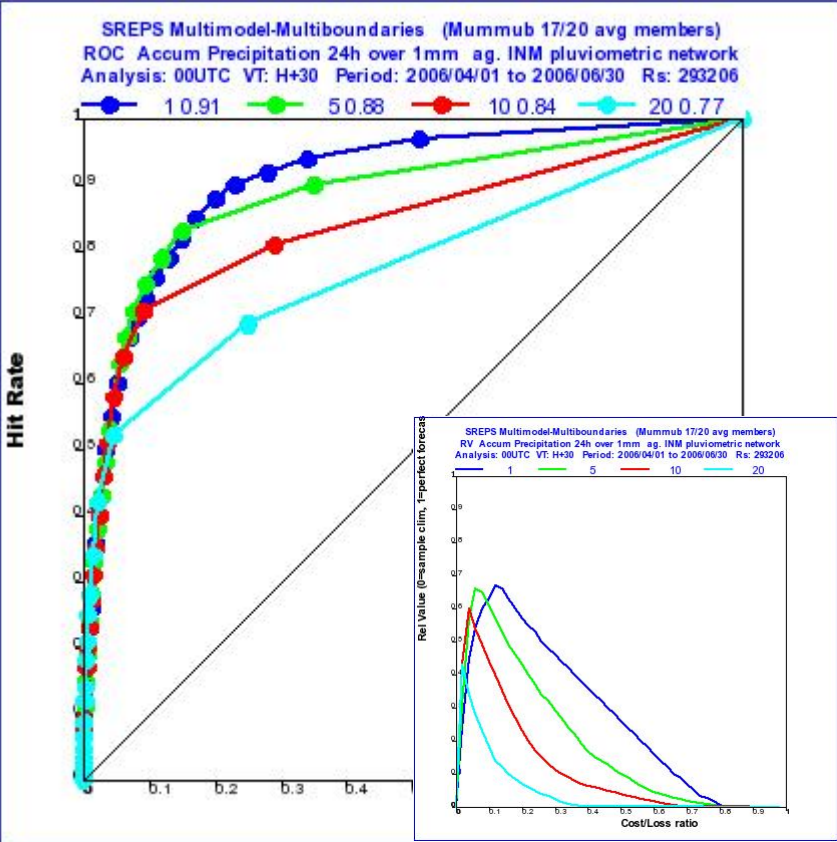
I+NM

H+54

• Good reliability according to

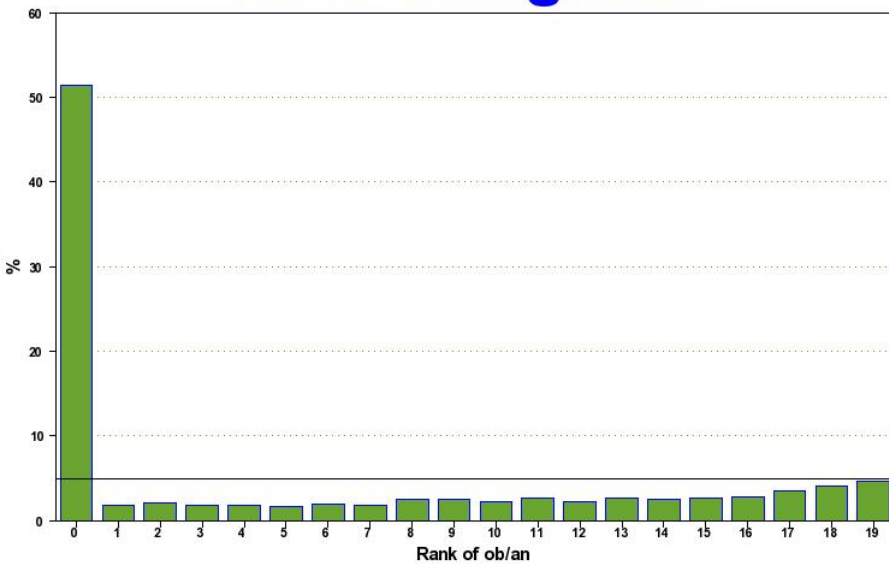
- thresholds (base rate)
- forecast length



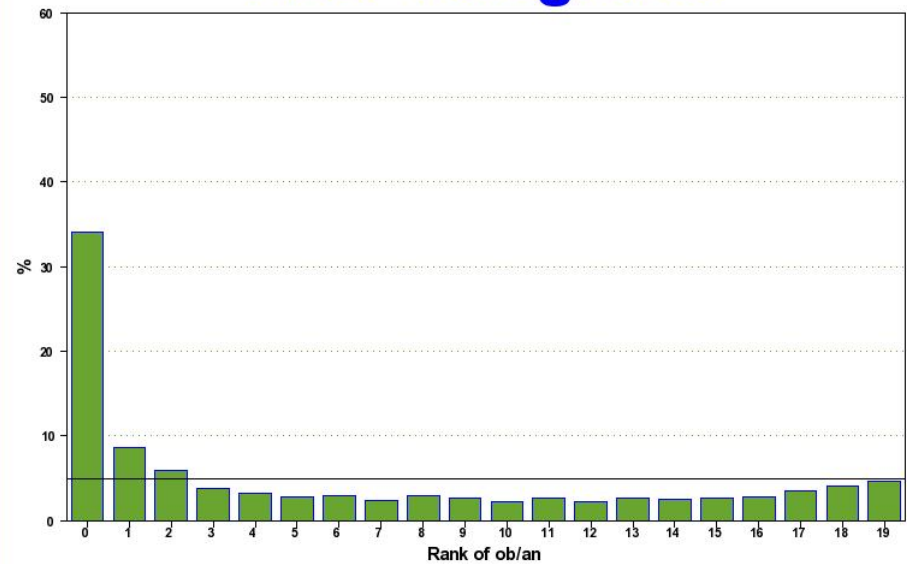


- Good resolution
 - ROC Areas
 - BSSs
- Good RV curves

Raw Talagrand



New Talagrand



- We use a simple algorithm to compute acc pcprank 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 is in 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 pluviometric network 2006

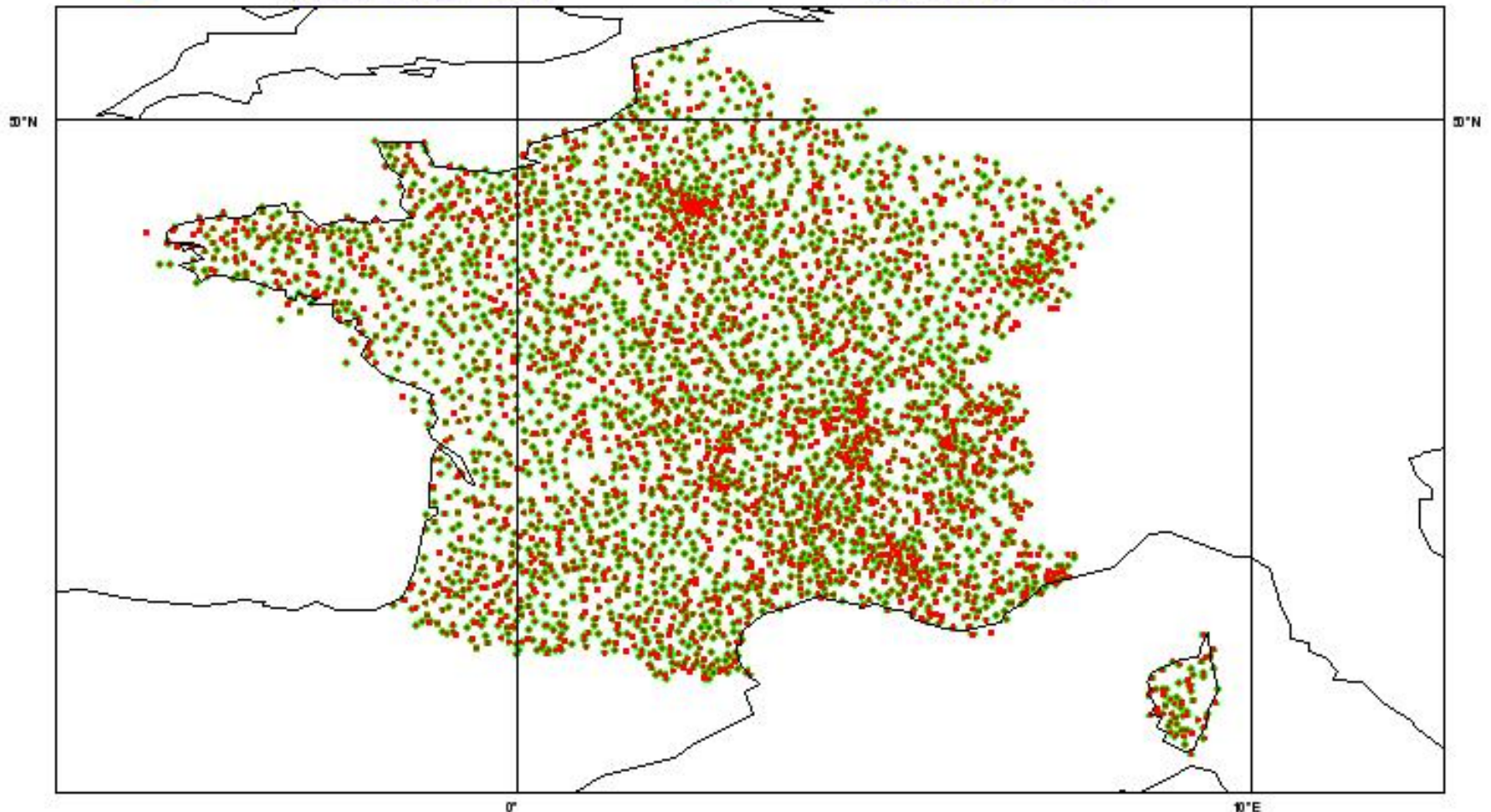
Number of observations



Period overlay ~ 3938



Typical Day ~ 3938



DWD pluviometric network 2006

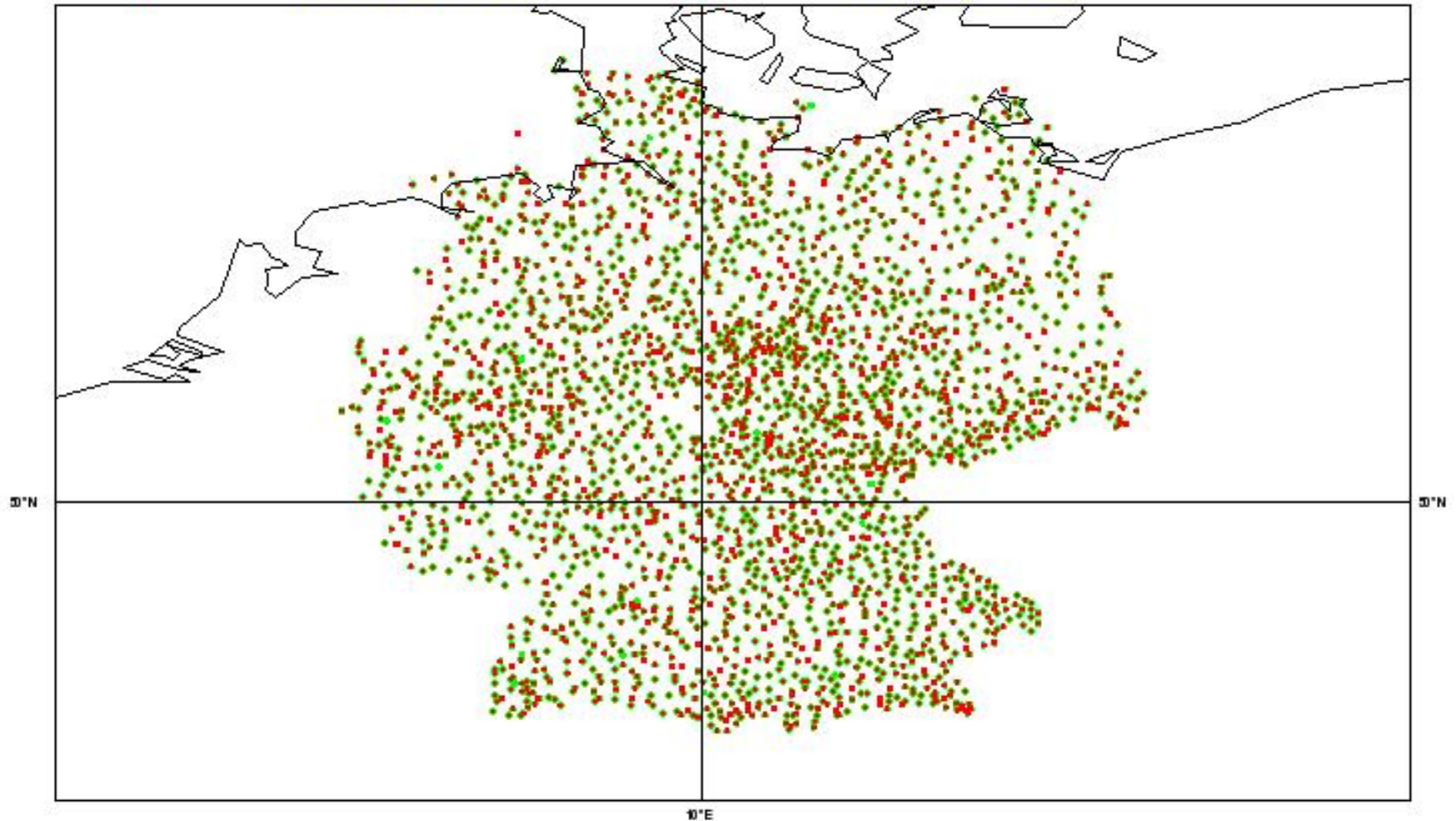
Number of observations

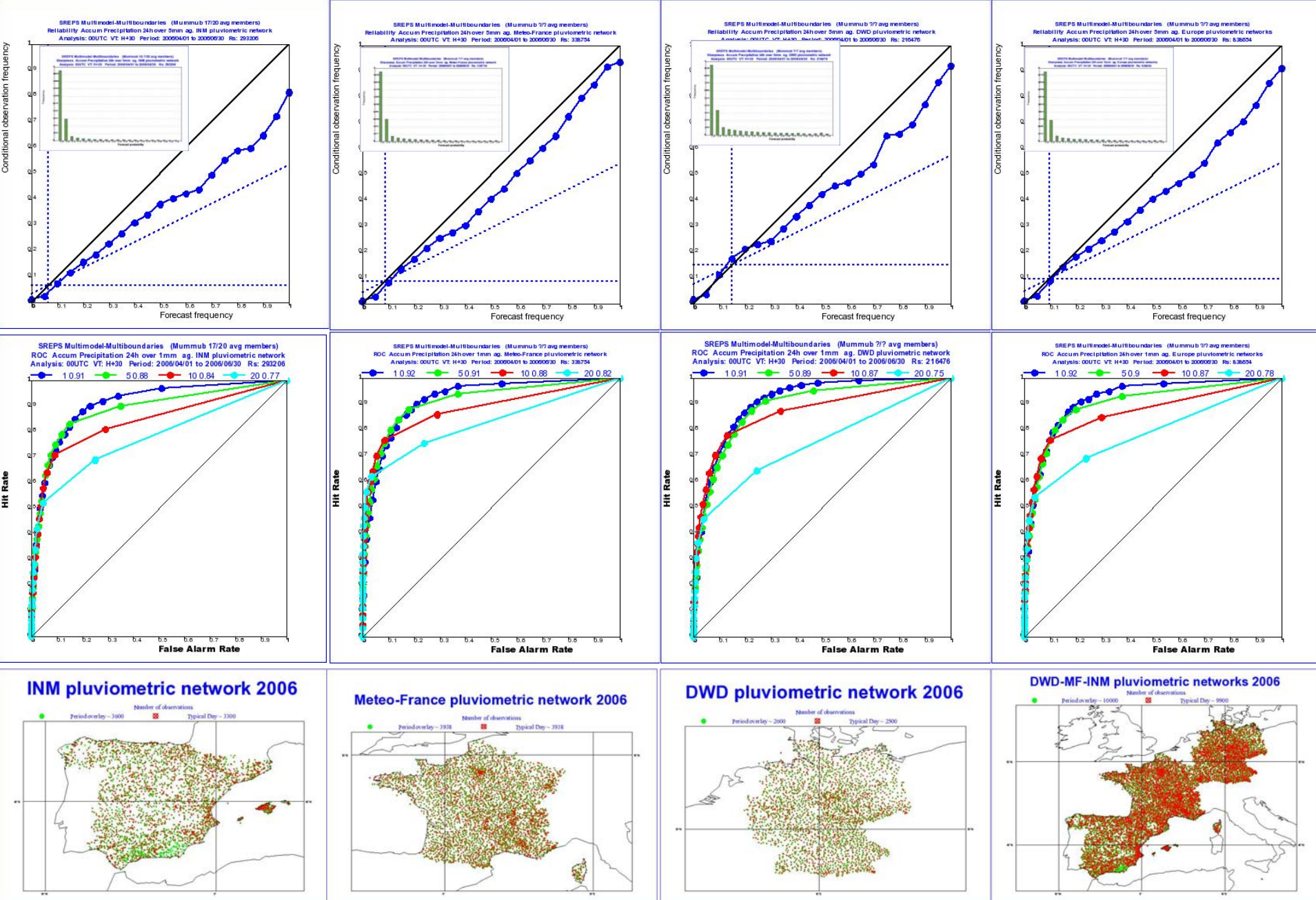


Period overlay ~ 2600



Typical Day ~ 2500





DWD-MF-INM pluviometric networks 2006

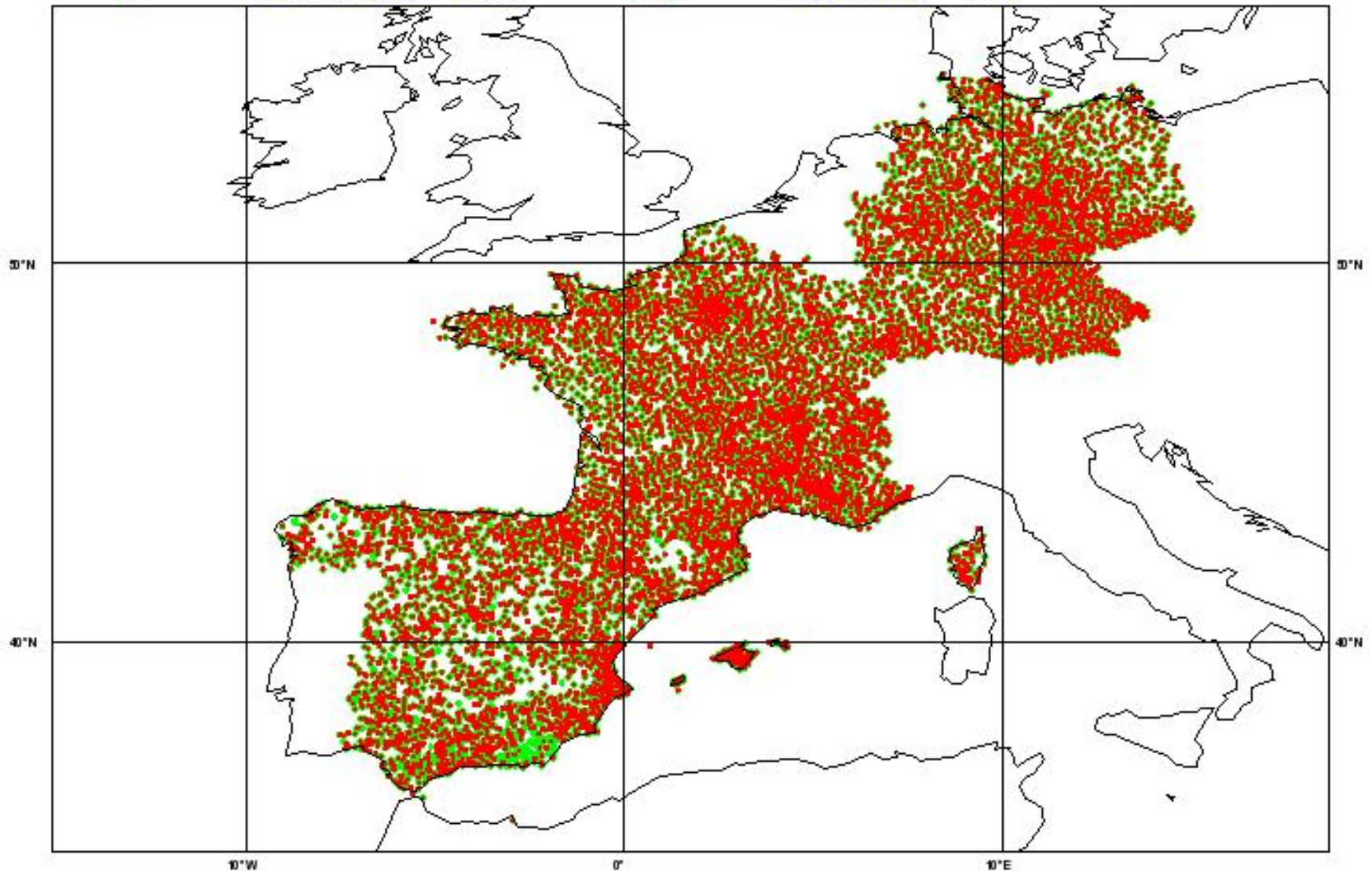
Number of observations

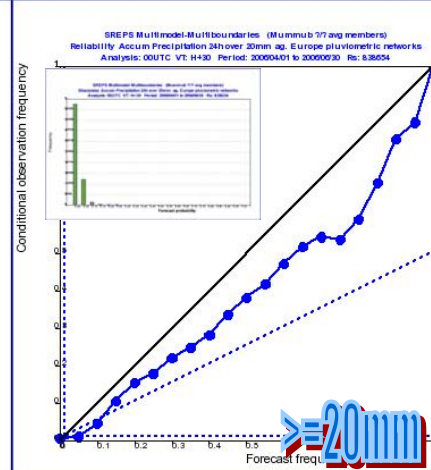
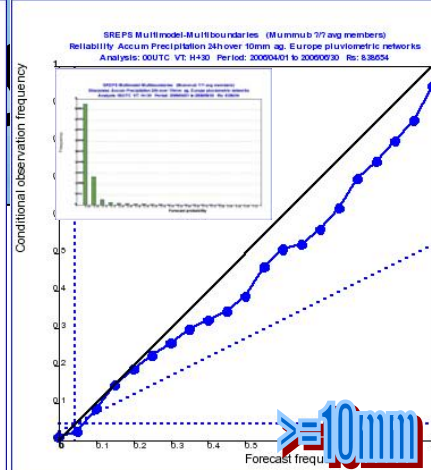
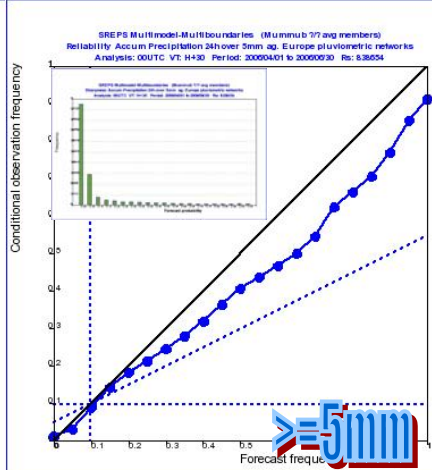
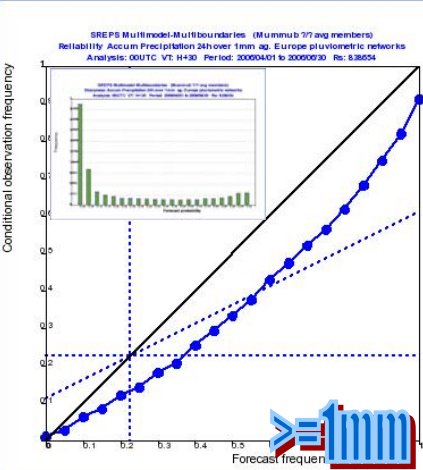


Period overlay ~ 10000



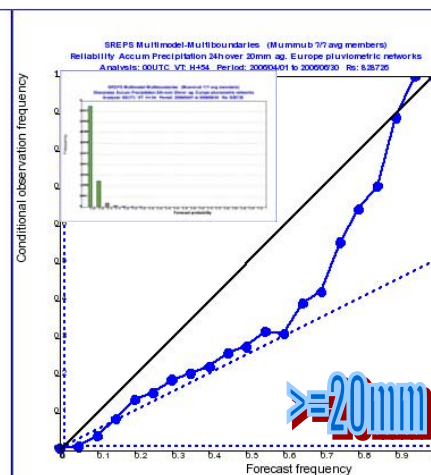
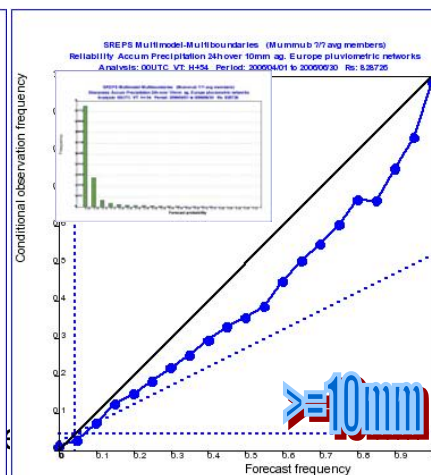
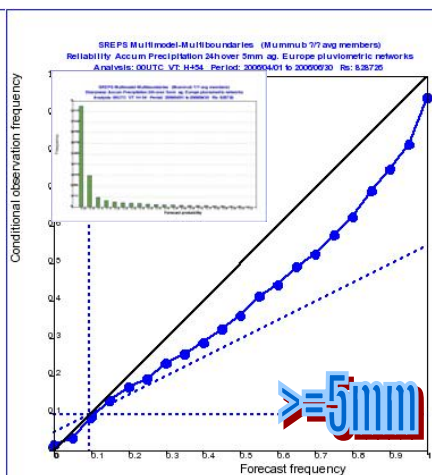
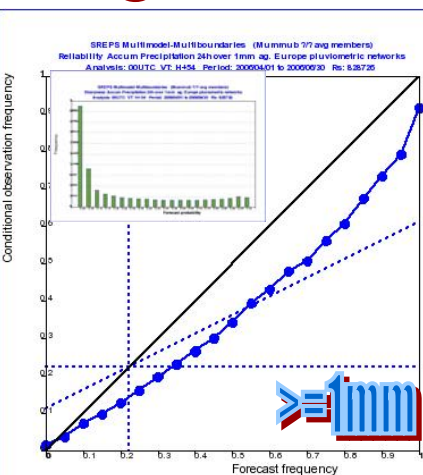
Typical Day ~ 9900

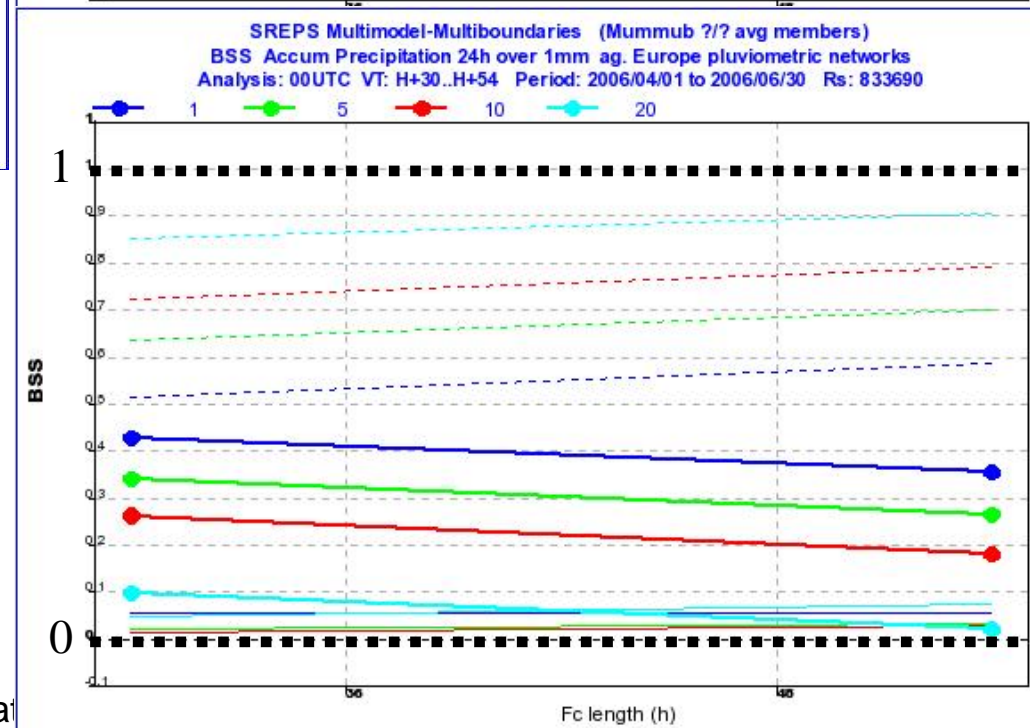
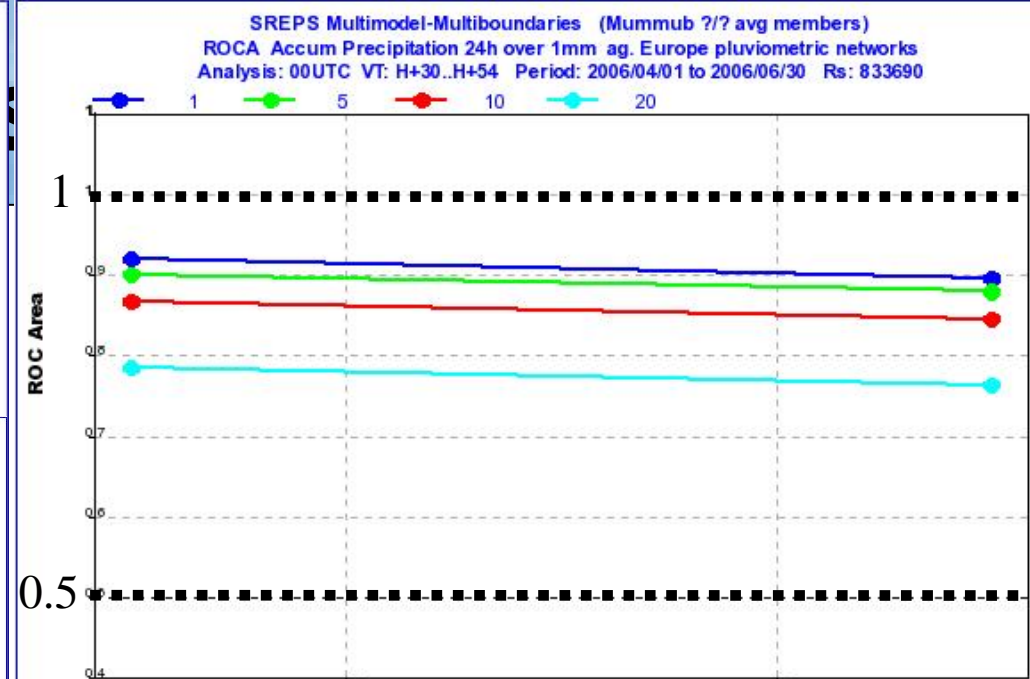
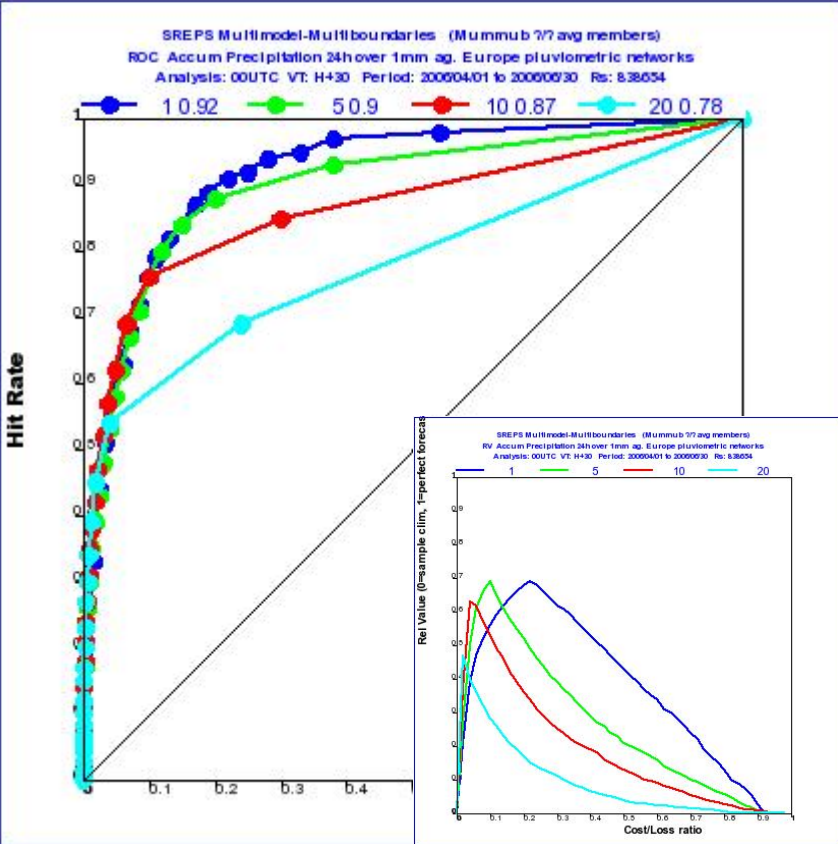




H+30
Joint
H+54

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





- 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 & joint pnw show high performance (reliability & resolution), independently on the different frequency of occurrence (base rate) on each network, thus overcoming different skill difficulties
- Future plans to improve acc pcp SREPS forecasts
 - Increase model resolution of individual members (currently $\sim 0.25^\circ \times 40$)
 - Promising **BMA** on acc pcp (see Santos, D. presentation)
- Future improvements on the **verification method**
 - **Fuzzy verification methods** (shown in this workshop Casati, Ebert) might show a more realistic information about performance (e.g. better representativeness of actual pcp)
 - Focus on **Proper skill scores** (Broecker), **bootstrap** (Wilson)

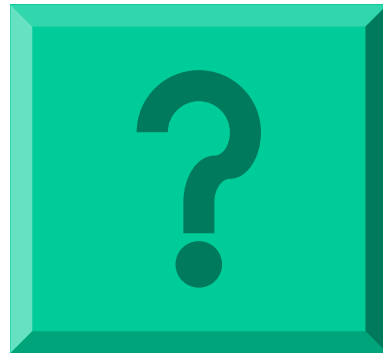
Aknowledgements

- Eugenia Kalnay (Univ. Of Maryland),
- Ken Mylne, Jorge Bornemann (MetOffice)
- Detlev Majewski, Michael Gertz (DWD)
- Metview Team, Martin Leutbecher (ECMWF)
- Chiara Marsigli, Ulrich Schättler (COSMO)
- Olivier Talagrand (LMD)

- We also like to thank DWD and MeteoFrance to make their climate network precipitation observations available to us for verification

- This project is partially supported by the Spanish Ministry of Education under research projects **CGL2004-04095/CLI** and **CGL2005-05681**

Any questions?



`csantos@inm.es`

(Bonus slides)

- **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

- [Jolliffe, I. T., Stephenson, D.B., 2003](#): Forecast Verification: A Practitioner's Guide in Atmospheric Science, *John Wiley and Sons, Chichester*
- Verification of ECMWF products in Member States and Co-operating States, Report 2005. *ECMWF, A1-A15.*
- Hou D., Kalnay E., & Droegemeier, K.K., 2001: Objective Verification of the SAMEX'98 Ensemble Forecasts. *M.W.R.*, 129, 73-91.
- Buizza, R., A. Hollingsworth, F. Lalaurette, and A. Ghelli, 1999: Probabilistic predictions of precipitation using the ECMWF Ensemble Prediction System. *ECMWF*
- Stensrud D. J., H. E. Brooks, J. Du, M. S. Tracton, and E. Rogers, 1999: Using Ensembles for Short-Range Forecasting, *M.W.R.*, 127, 433-446
- Arribas A., Robertson K.B., & Mylne, K.R., 2005: Test of Poor Man's Ensemble Prediction System. *M.W.R.*, 133, 1825-1839

- 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

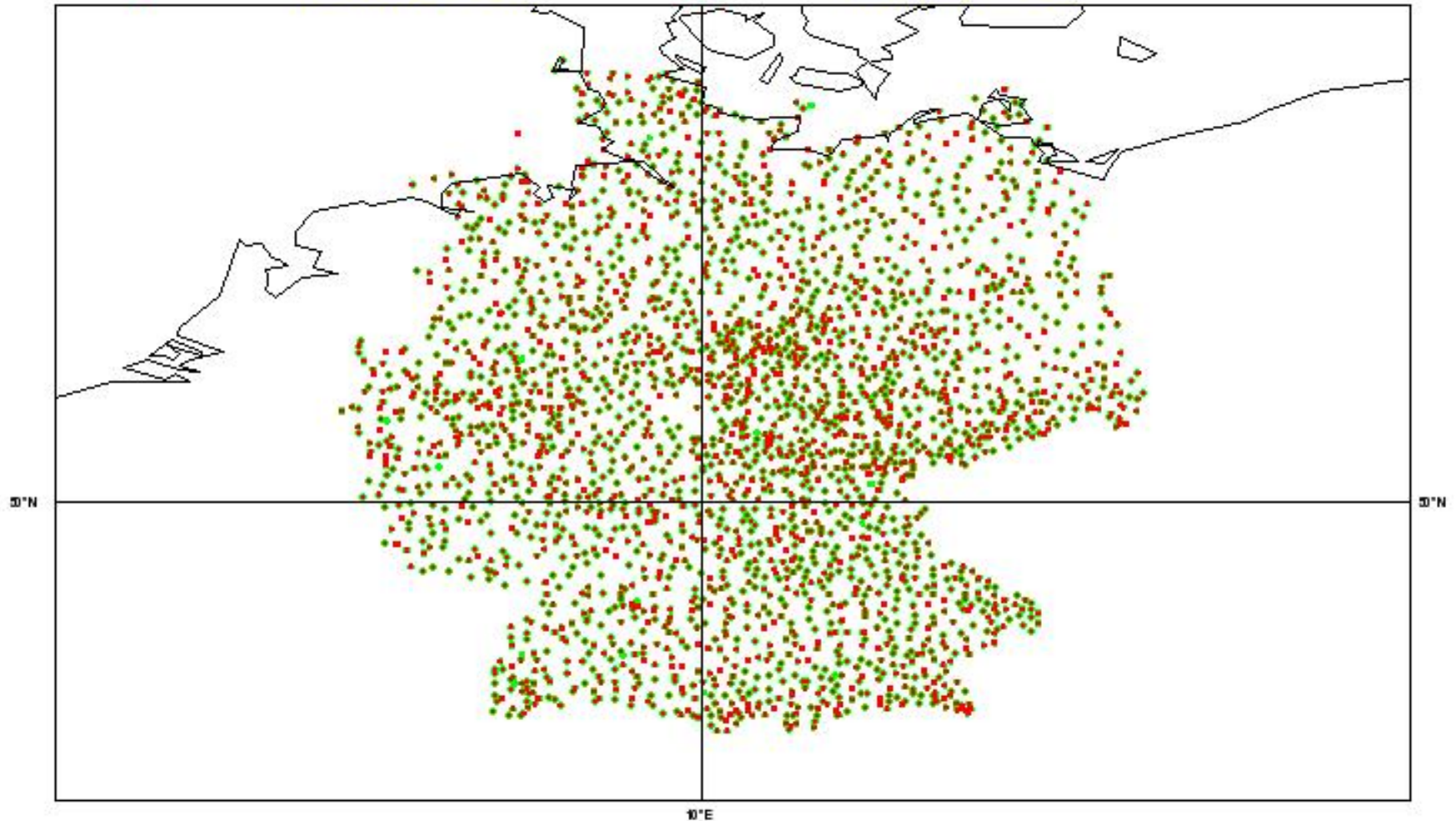
Number of observations

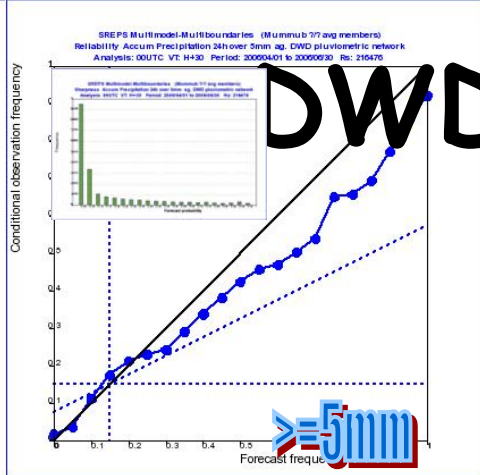
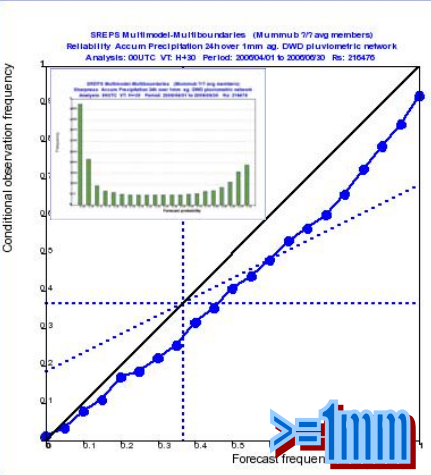


Period overlay ~ 2600

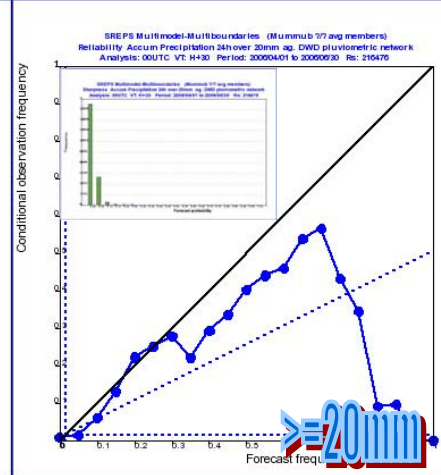
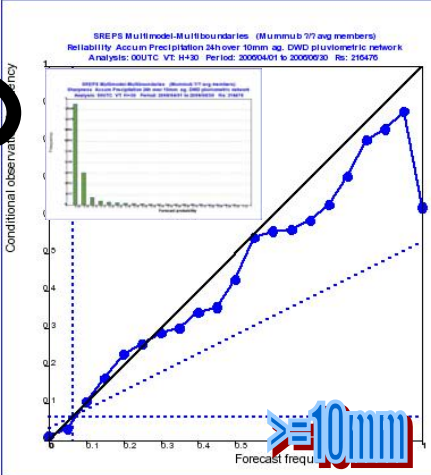


Typical Day ~ 2500





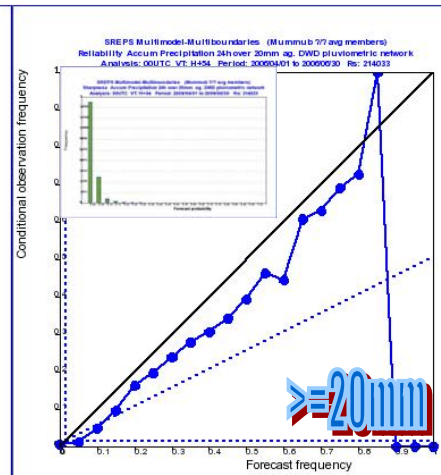
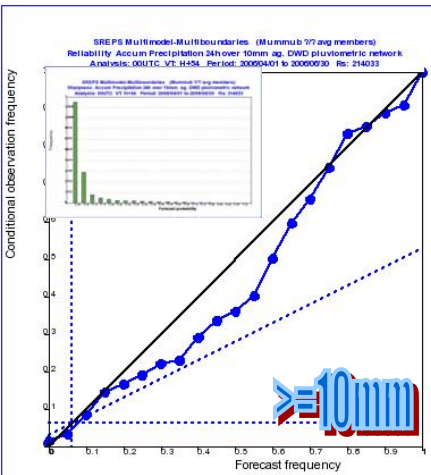
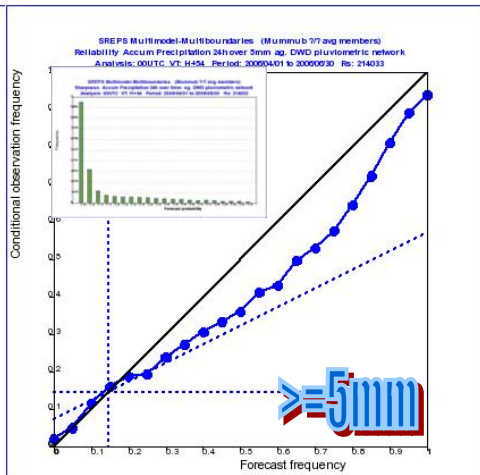
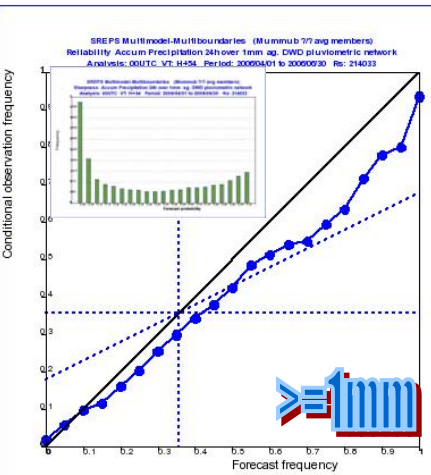
DWD



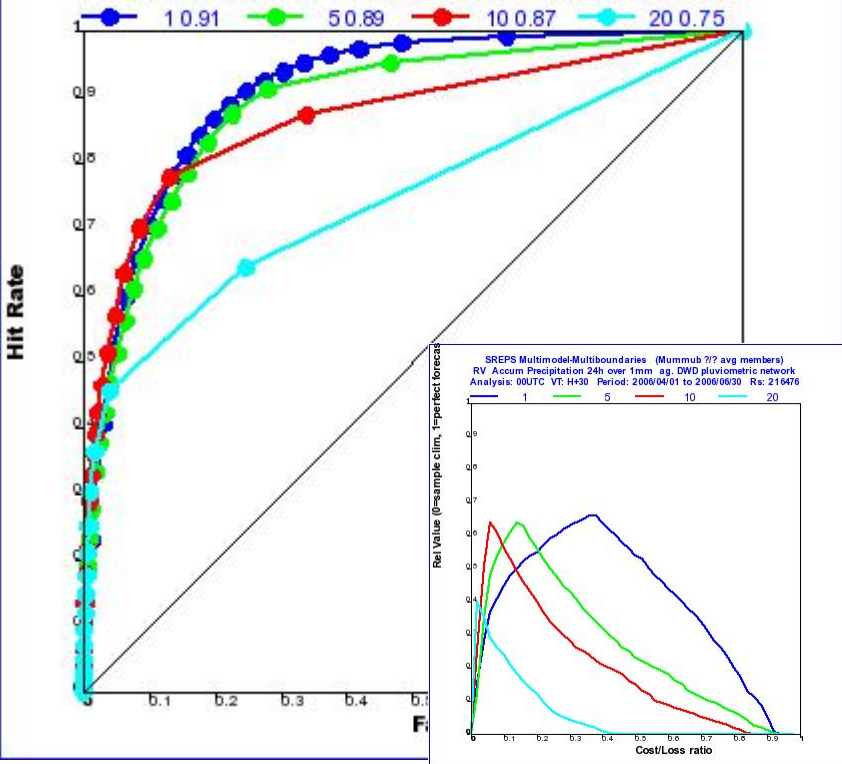
H+30

DWD

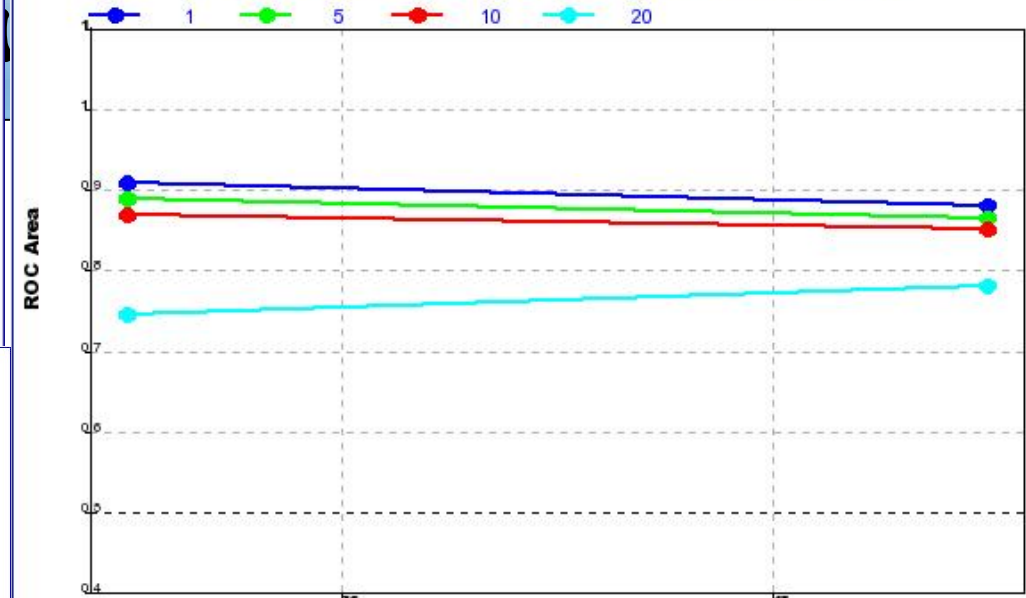
H+54



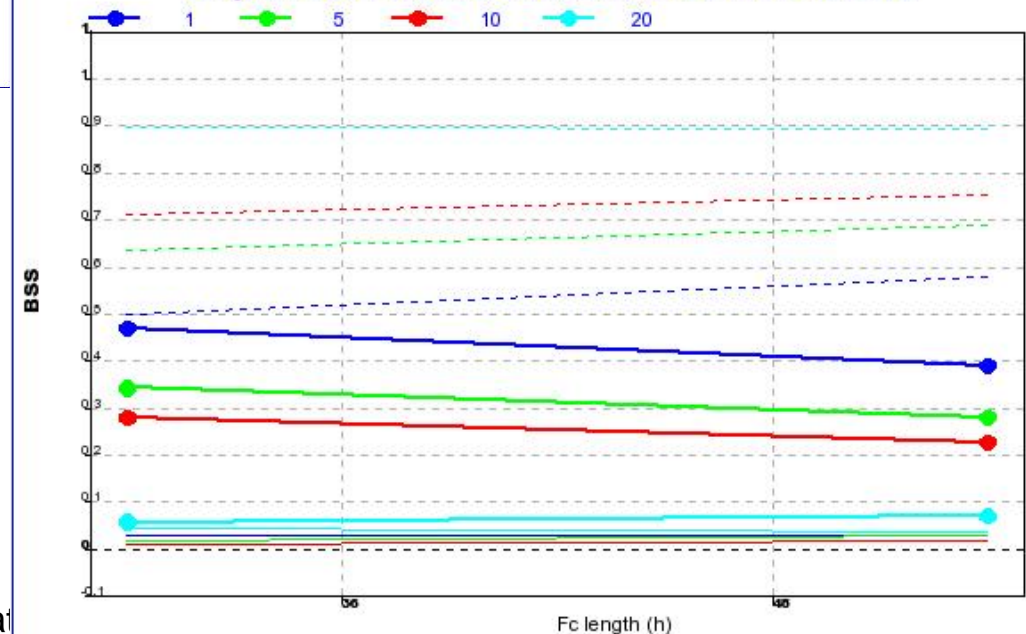
SREPS Multimodel-Multiboundaries (Mummub ??? avg members)
 ROC Accum Precipitation 24h over 1mm ag. DWD pluviometric network
 Analysis: 00UTC VT: H+30 Period: 2006/04/01 to 2006/06/30 Rs: 216476



SREPS Multimodel-Multiboundaries (Mummub ??? avg members)
 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



SREPS Multimodel-Multiboundaries (Mummub ??? avg members)
 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



- DWD

Meteo-France pluviometric network 2006

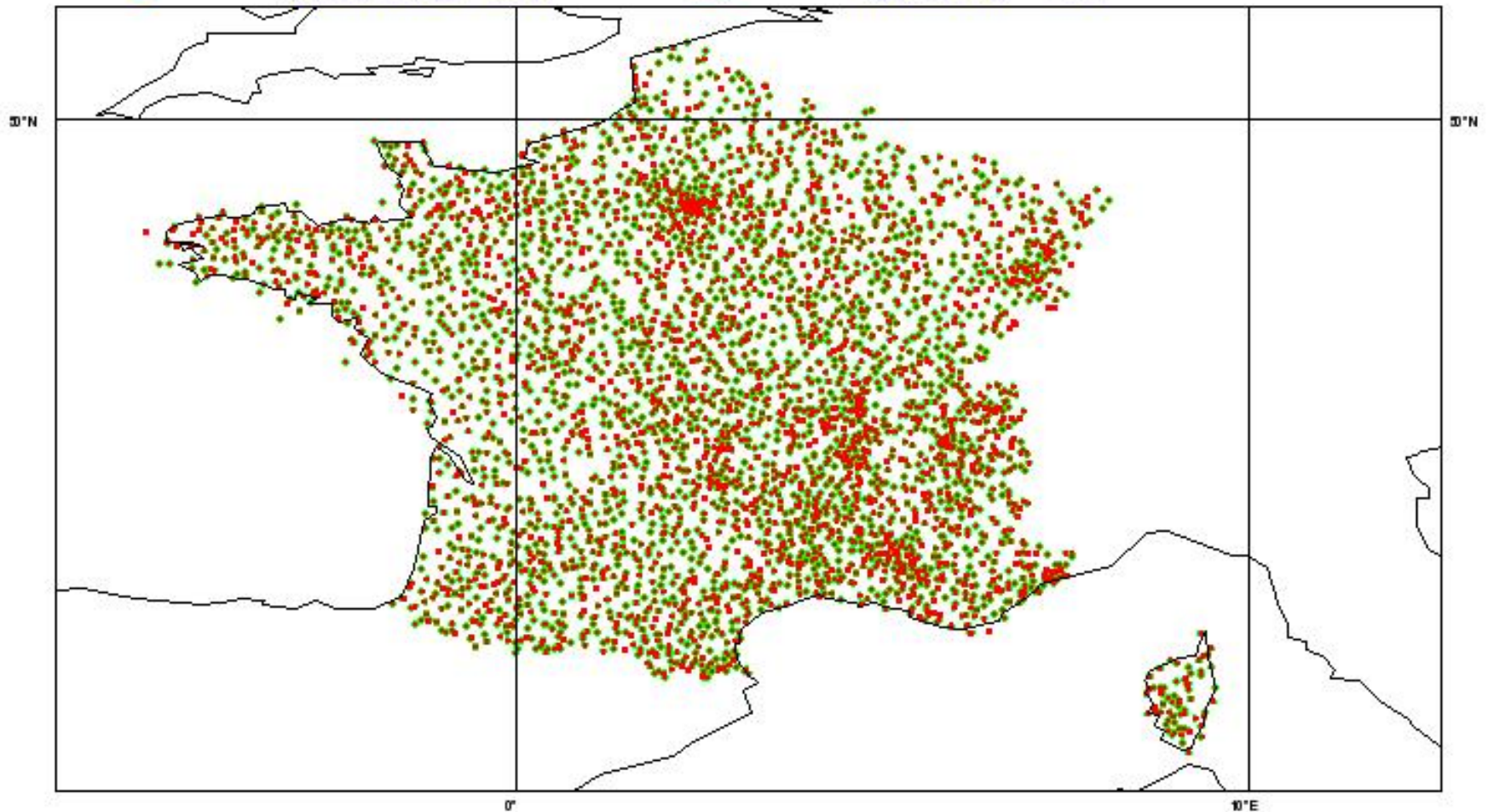
Number of observations

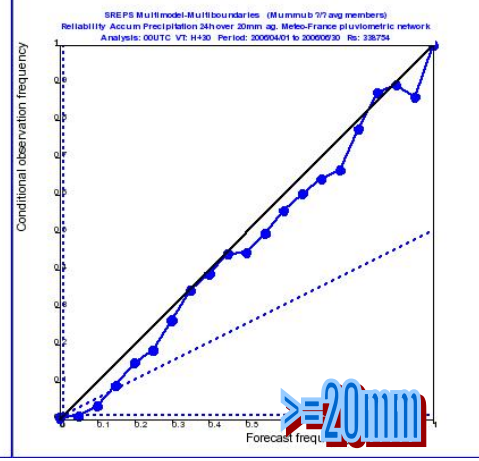
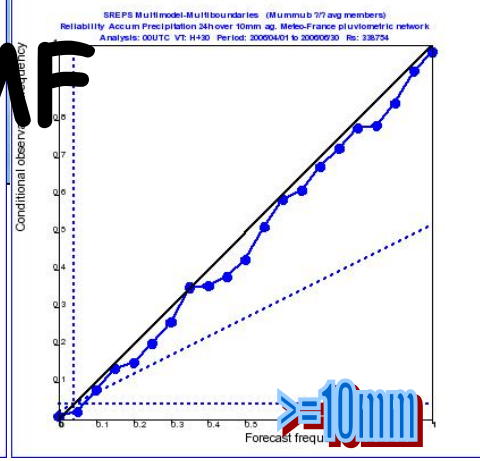
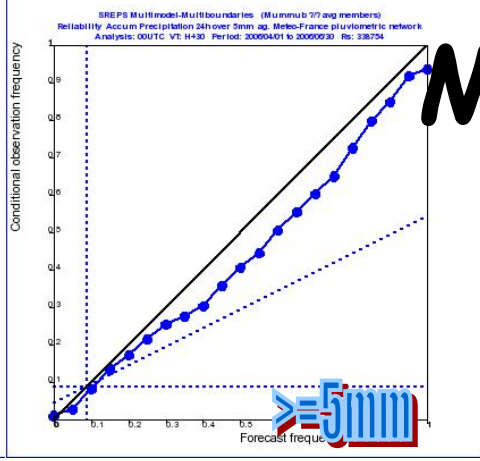
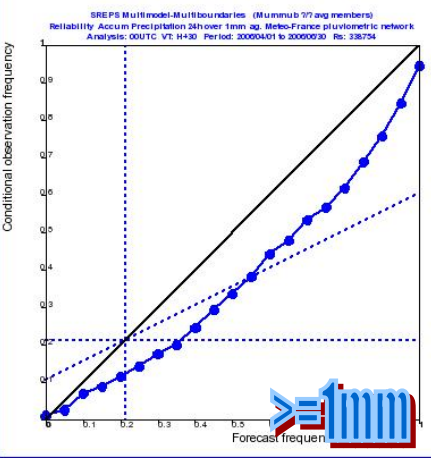


Period overlay ~ 3938



Typical Day ~ 3938



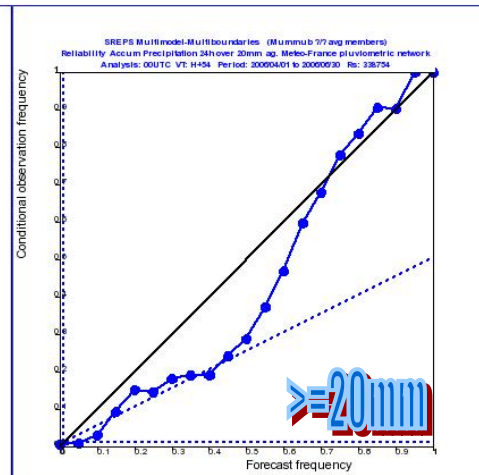
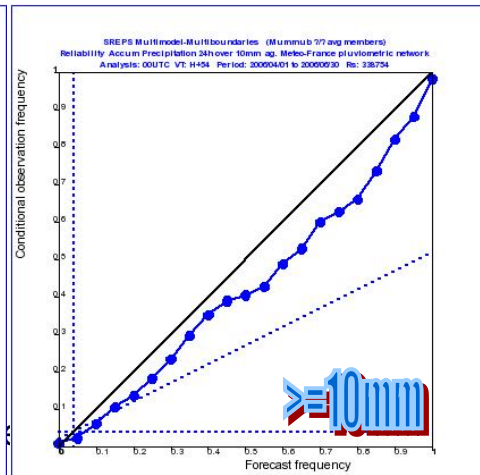
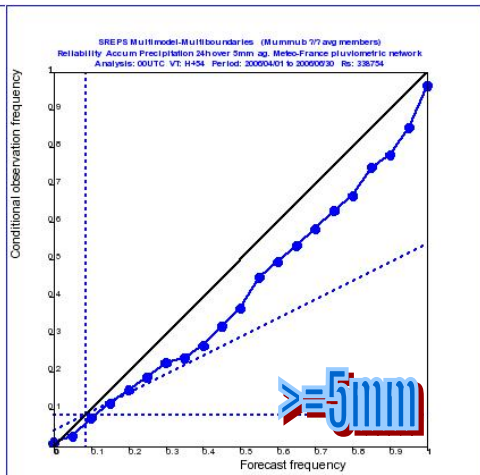
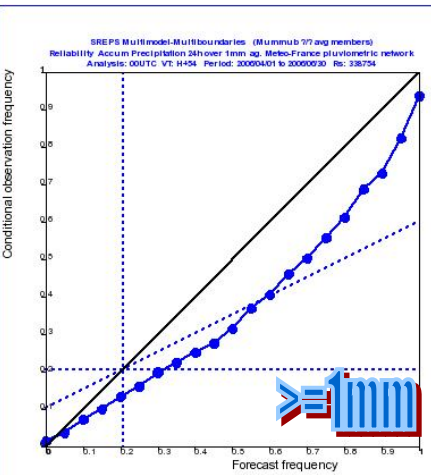


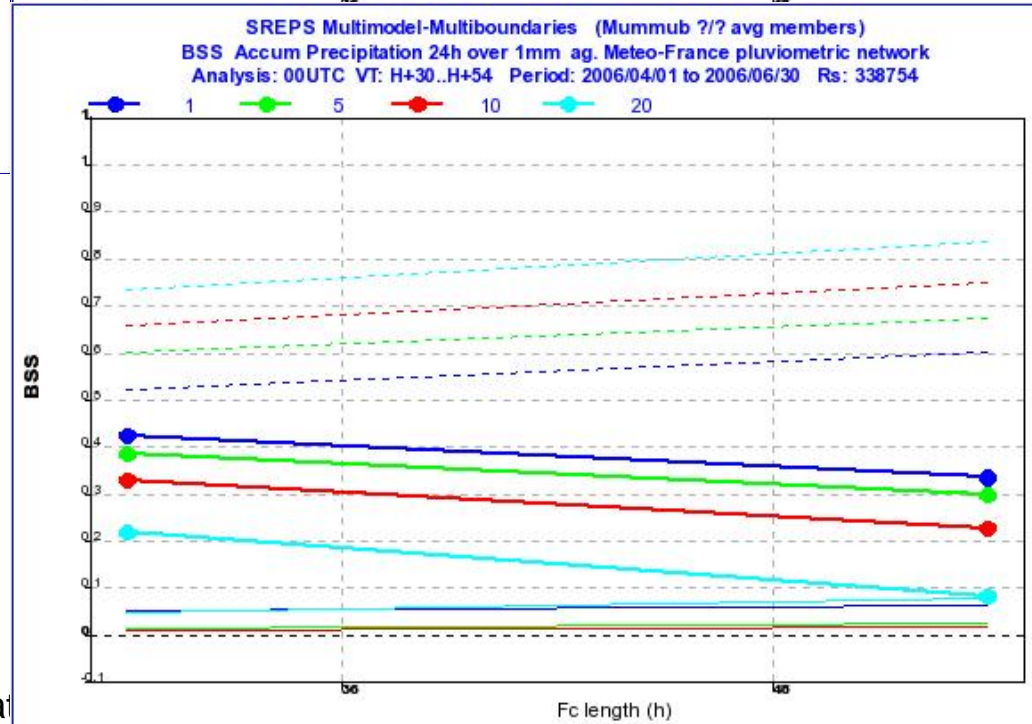
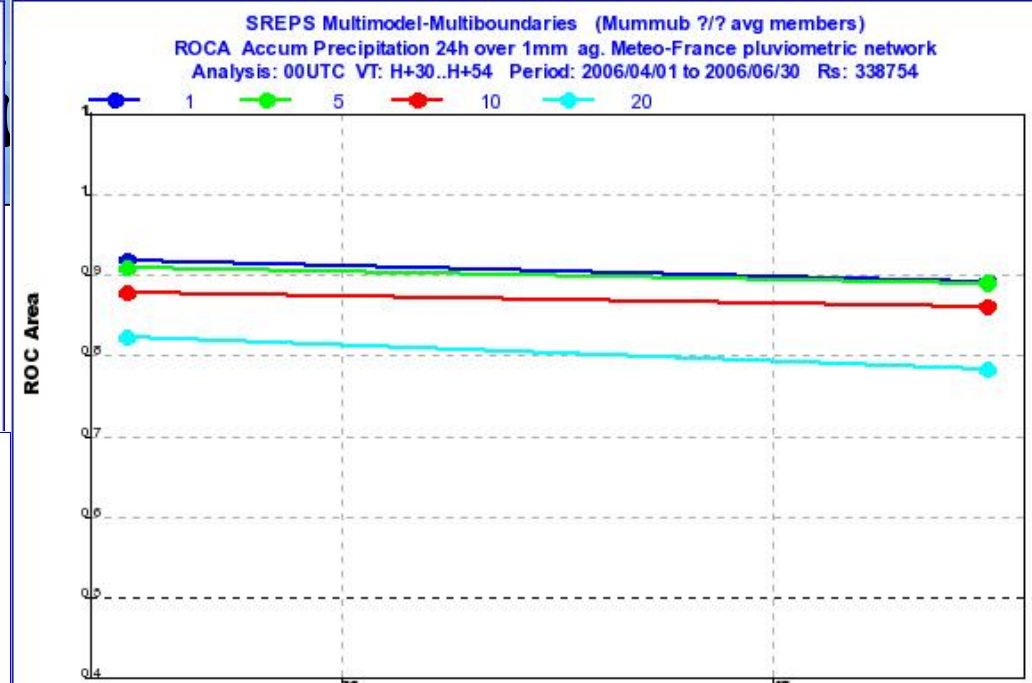
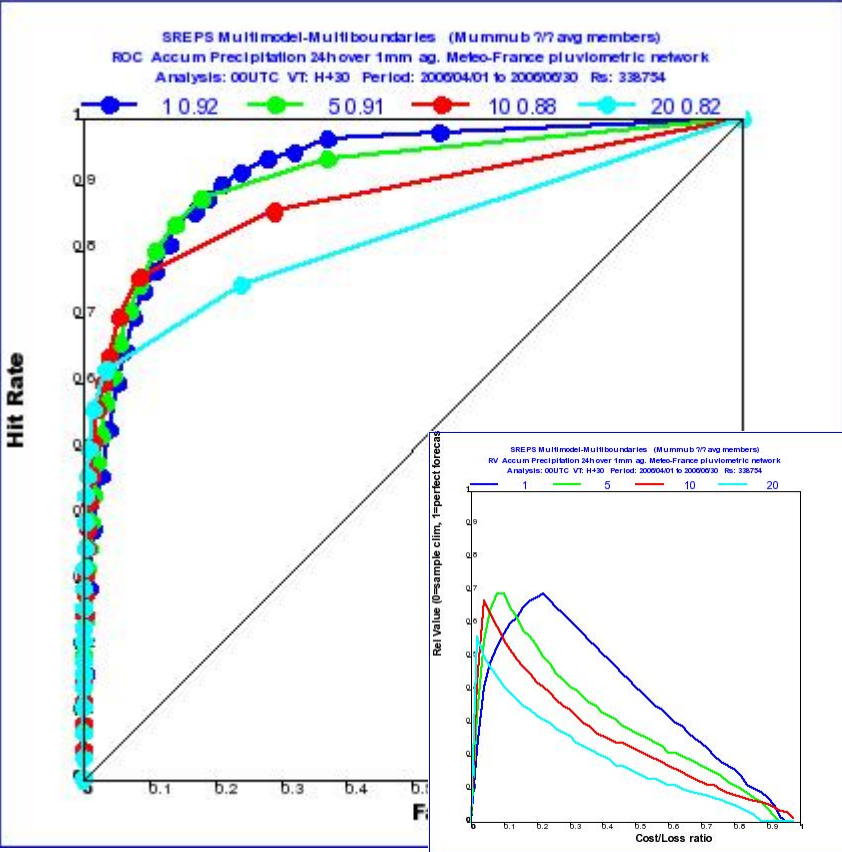
MF

H+30

MF

H+54





- MeteoFrance

DWD-MF-INM pluviometric networks 2006

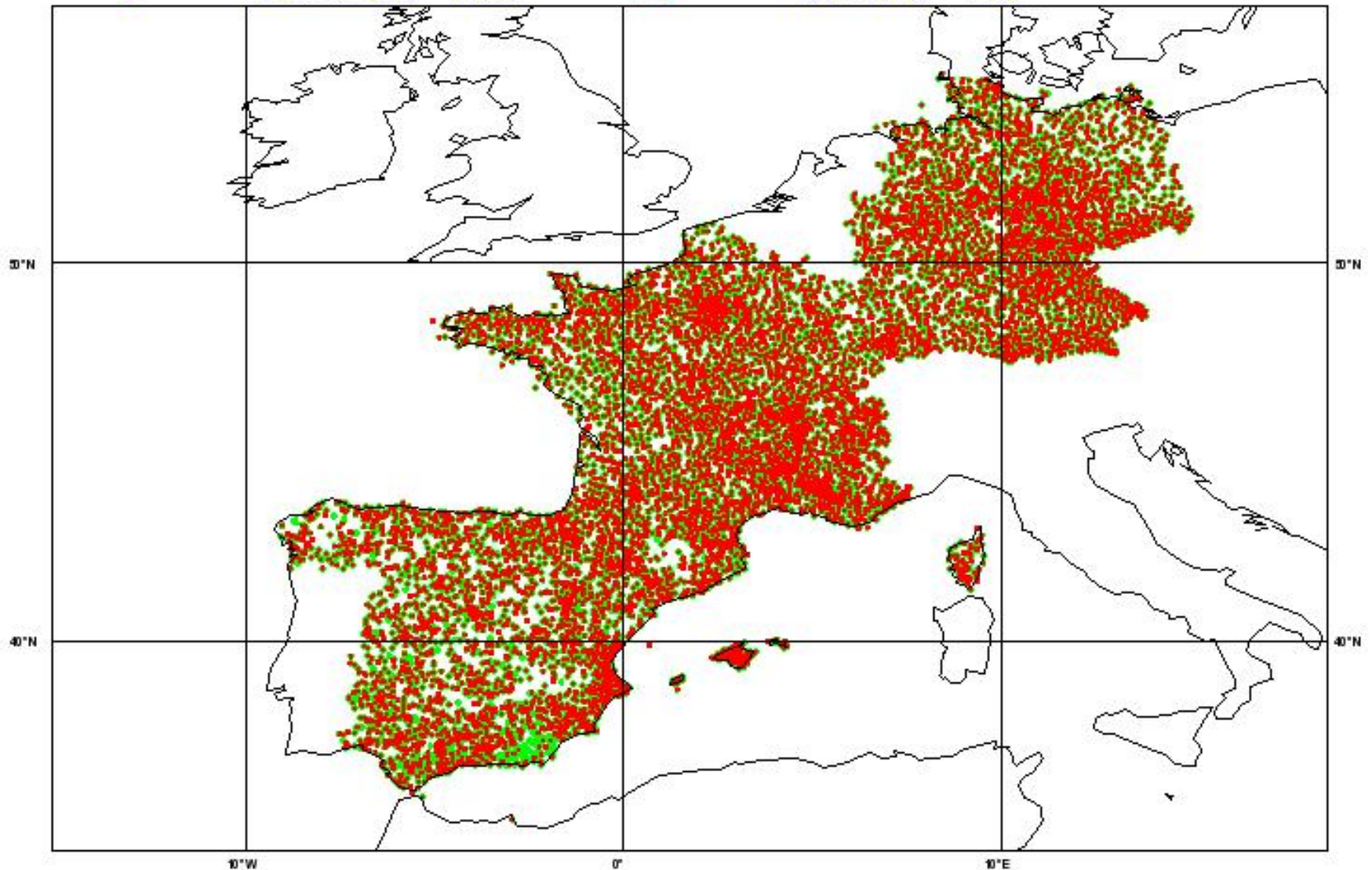
Number of observations

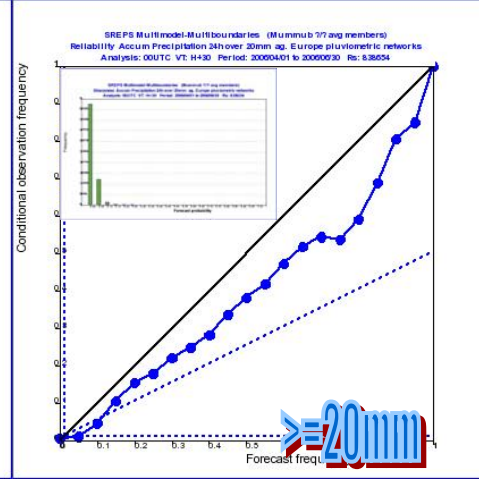
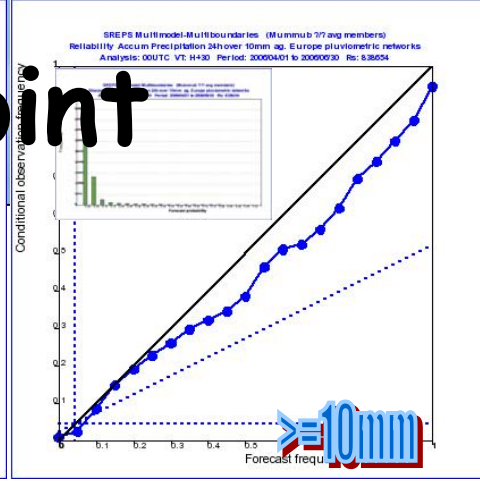
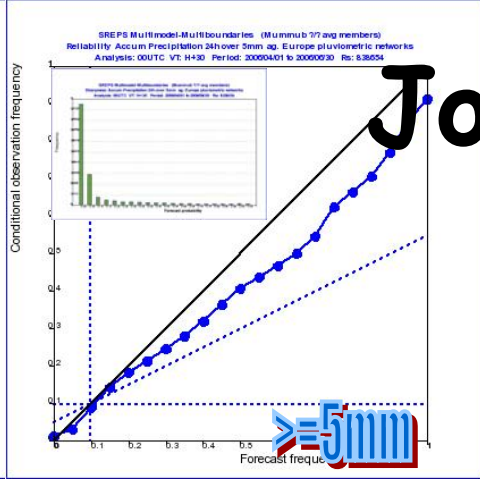
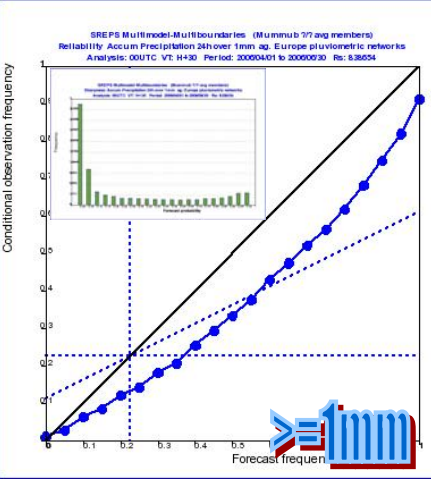


Period overlay ~ 10000



Typical Day ~ 9900



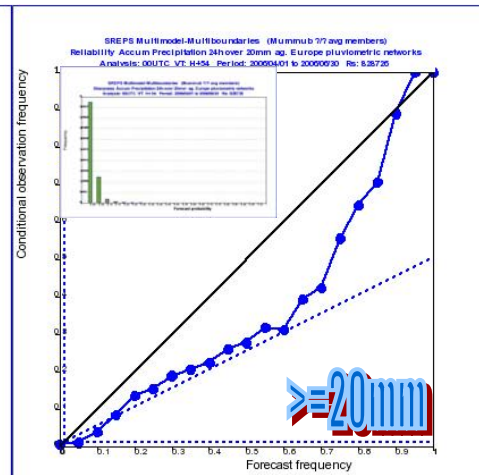
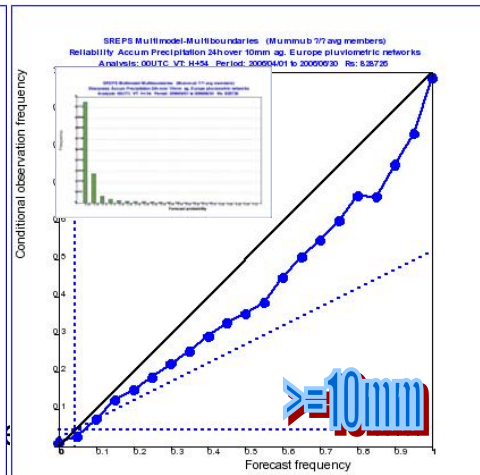
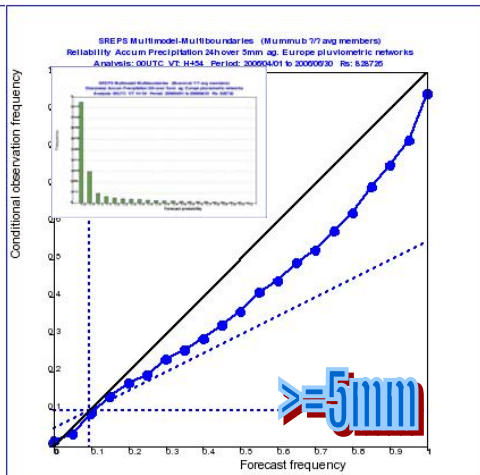
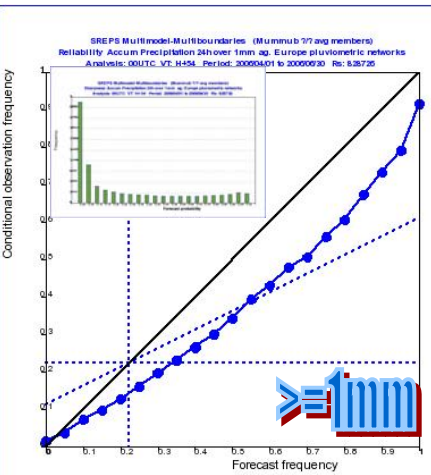


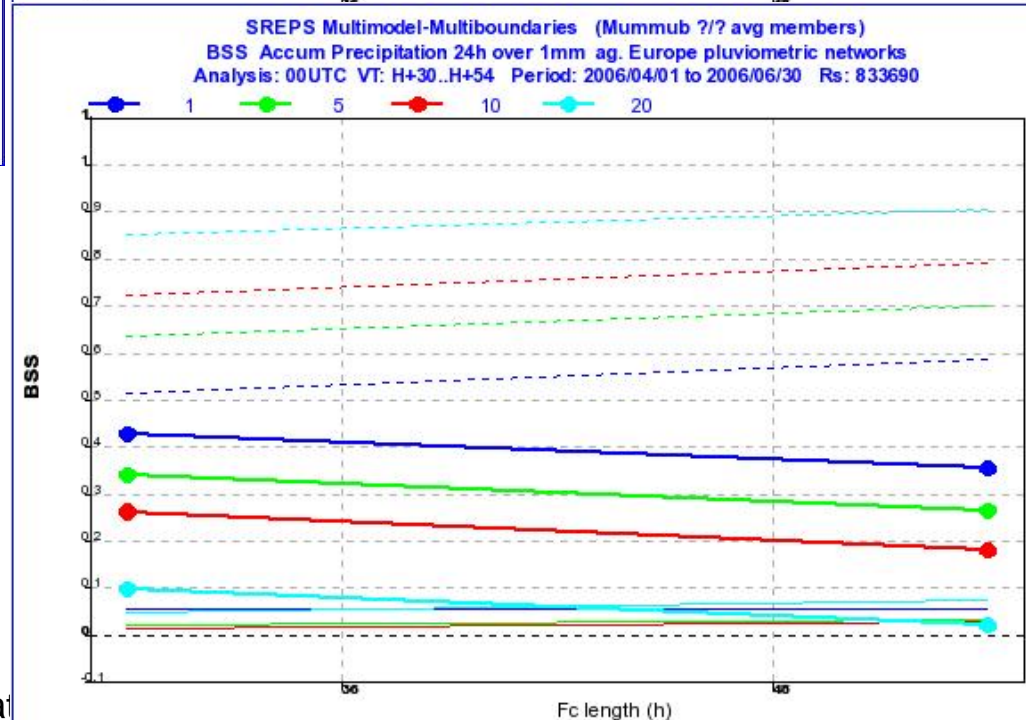
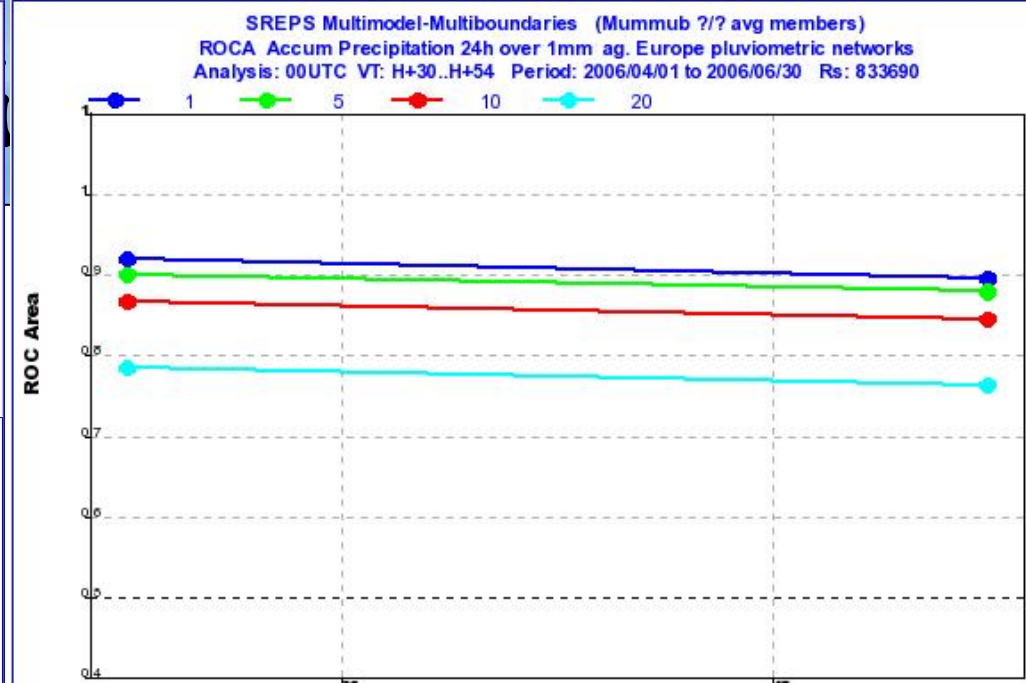
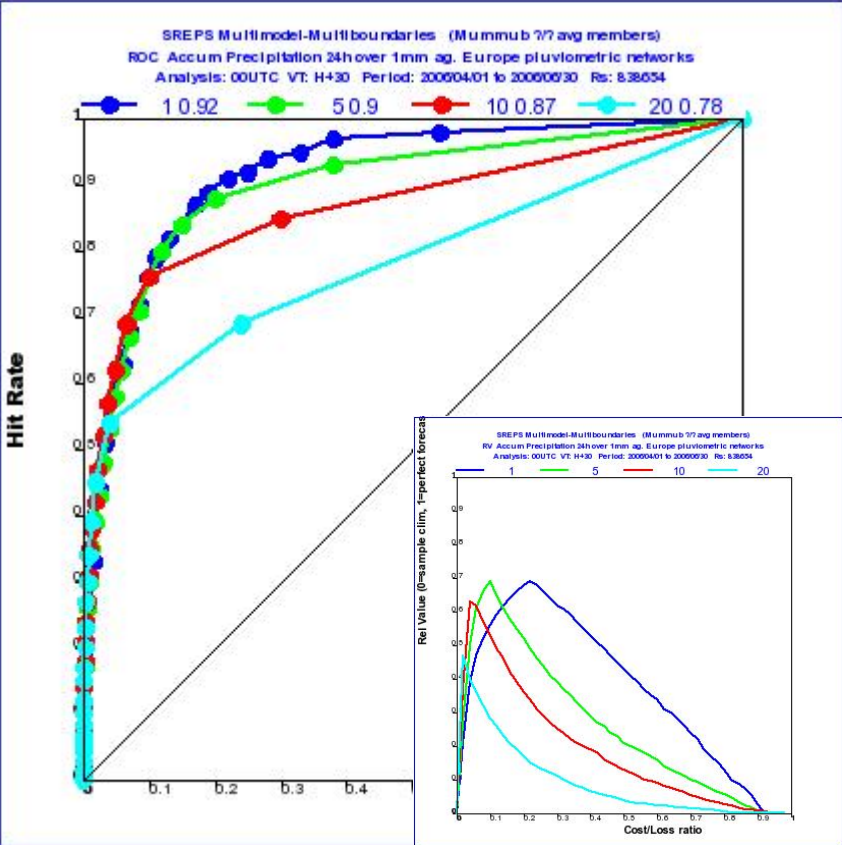
Joint

H+30

Joint

H+54





- 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 approach 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

