Predictability of precipitation with Aemet multimodel SREPS: assessment using HR observations (yavtobos)

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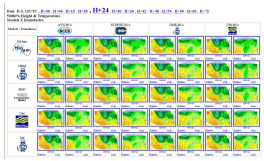
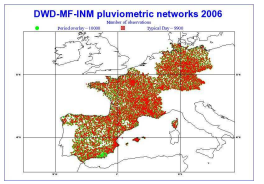
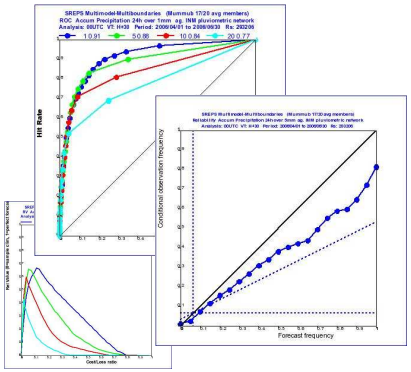
Spanish Meteorological Agency (AEMet)

Outline

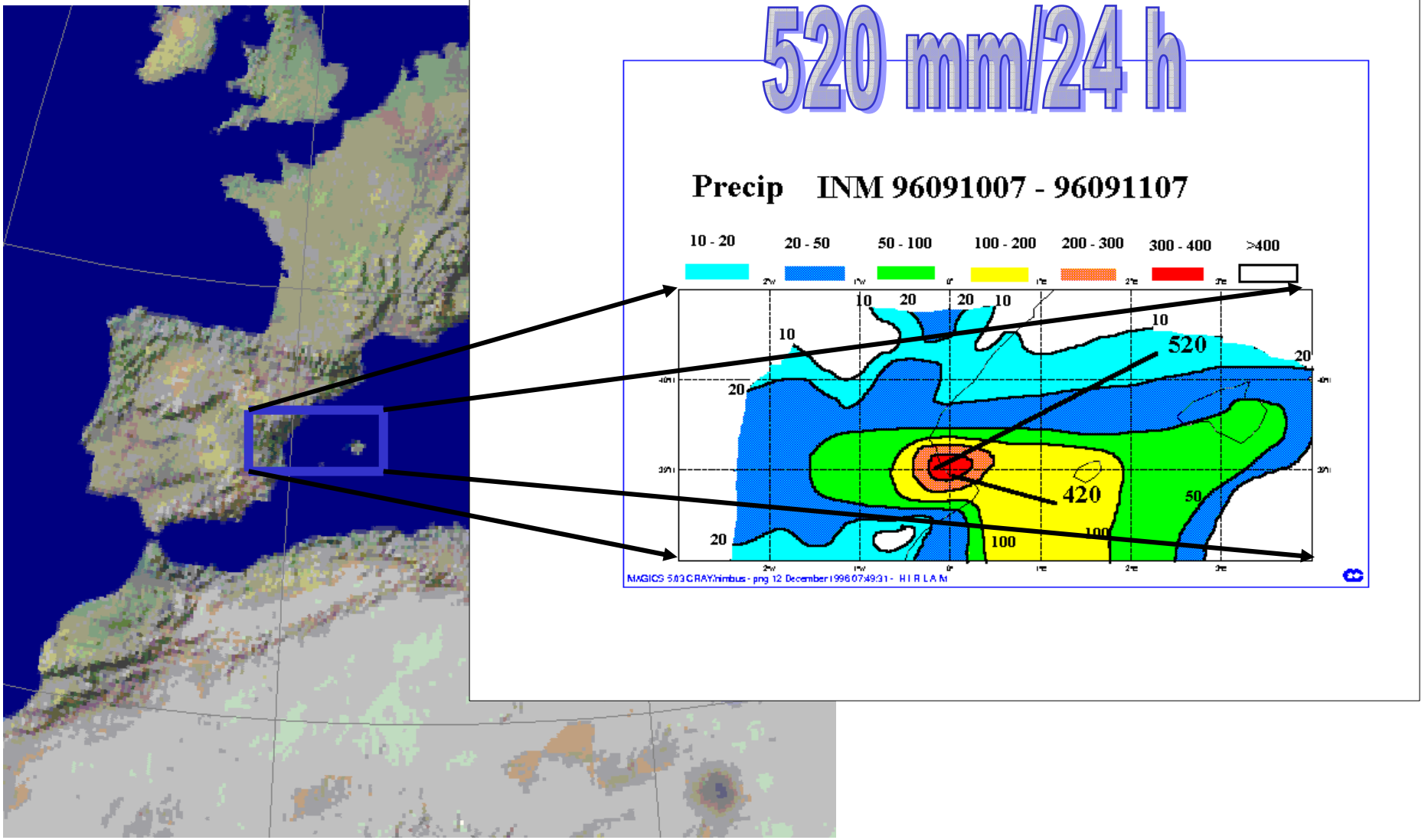
- Why Multimodel SREPS?
- Verification issues
- Performance results
  - Points: Spain & Europe
  - Up-scaled: Europe
- Predictability of pcp
- Concluding remarks



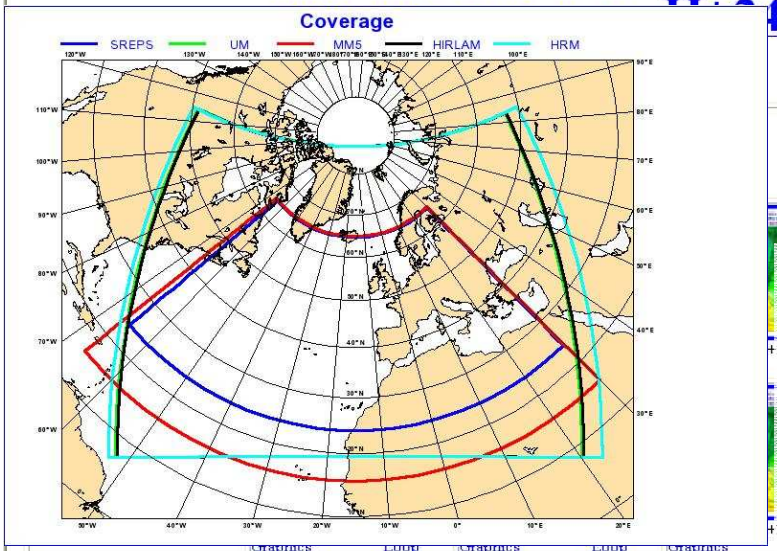


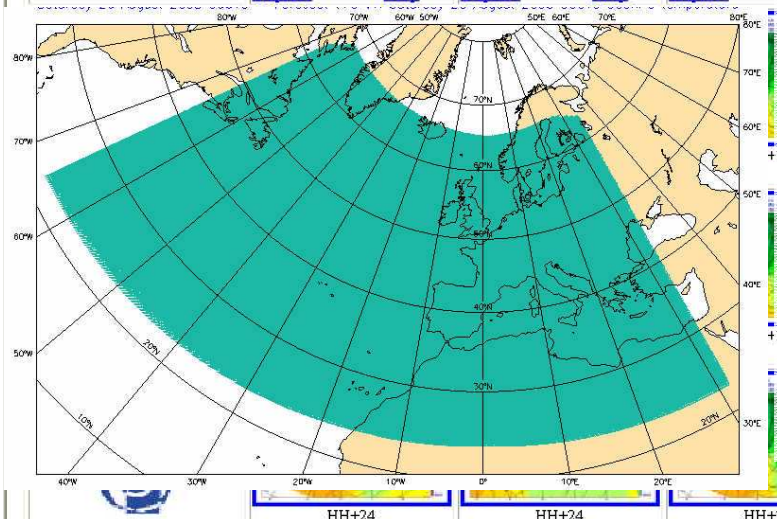


Why an EPS for SR?



AEMet Multimodel SREPS





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

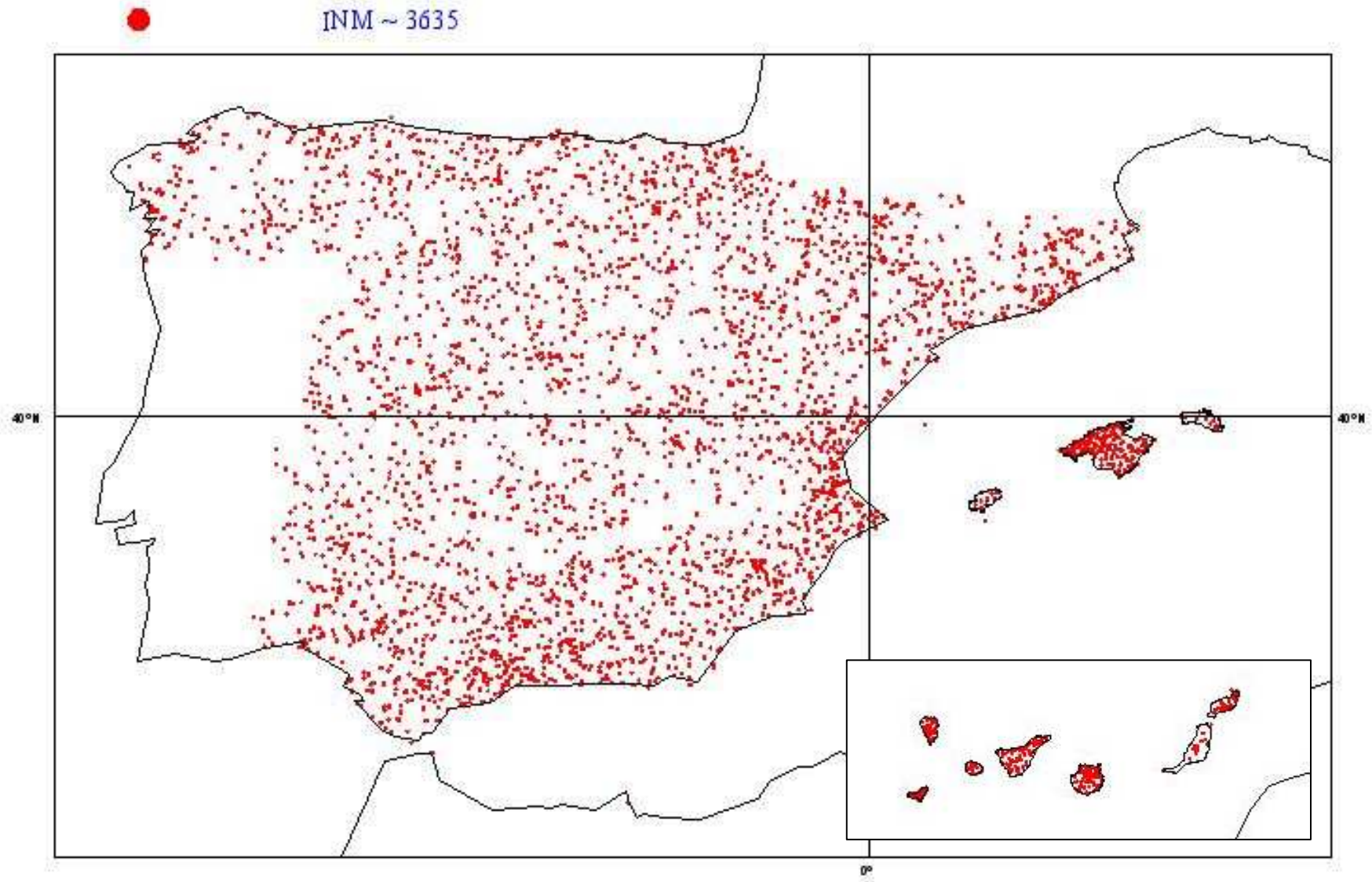
ECMWF-BCs | GME-BCs | UM-BCs

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

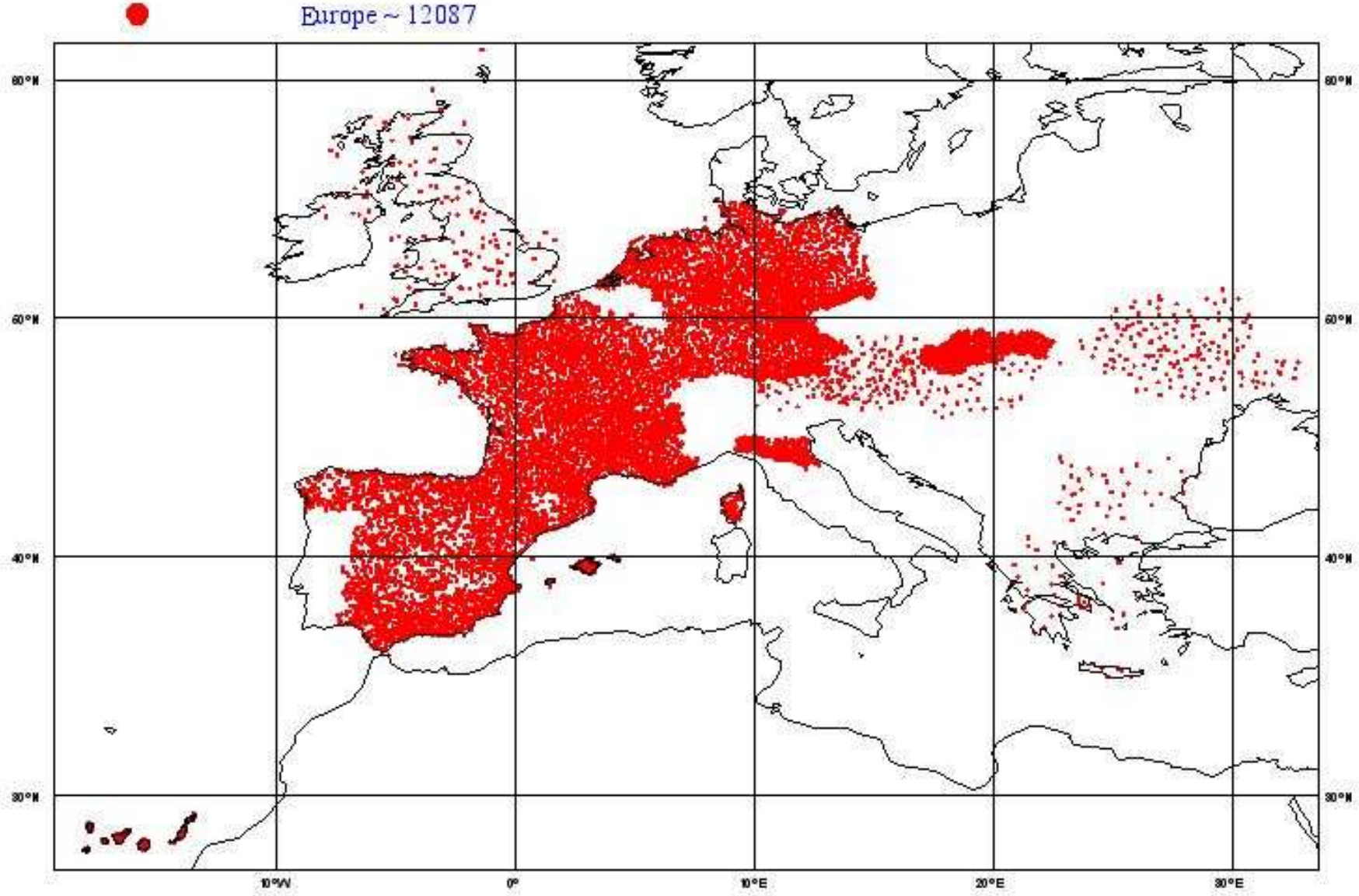
Verification issues

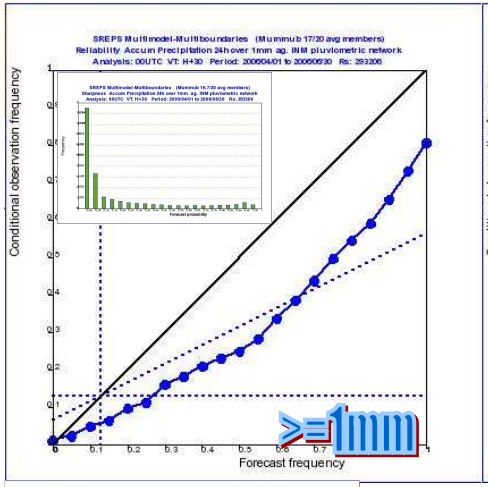
	Standard approach	Improvements & issues
Precipitation	24h accumulated precipitation forecast 06UTC-06UTC ag. observed 07UTC-07UTC HH+030 and HH+054	Extreme events •Definition •Obs. Quality control
Rain gauge networks	Spain Europe	Pooling vs stratification?
Period	~90 days (Apr1 to Jun30 2006).	Pooling vs stratification?
Verification method	Observation points Upscaling	Confidence intervals Feature-oriented
Verification software	ECMWF Metview + Local	
Scoring rules	ECMWF recommendations	New scores

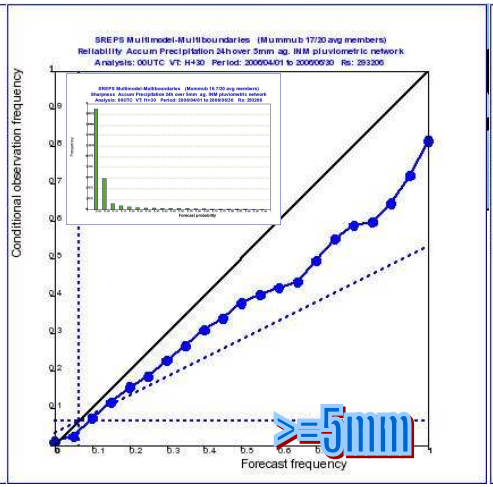
INM pcp network 2006

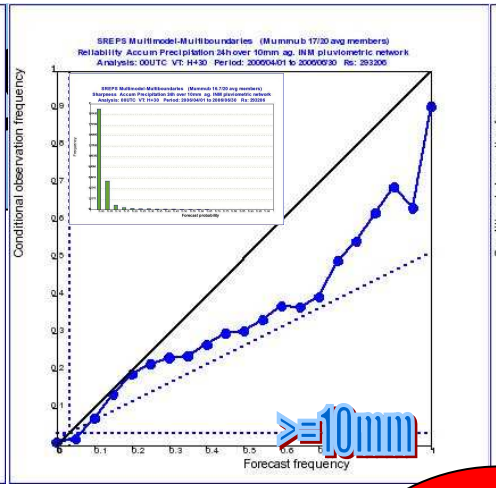


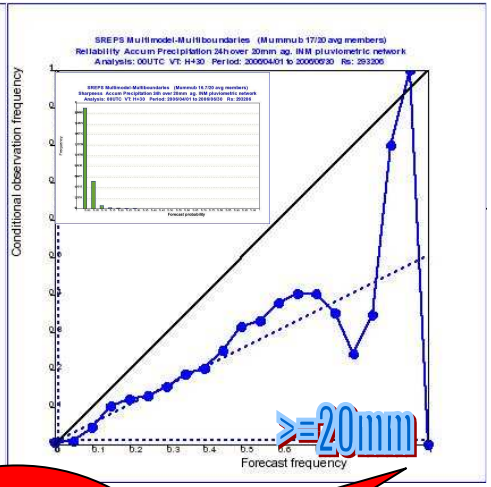
Europe pcp networks 2006

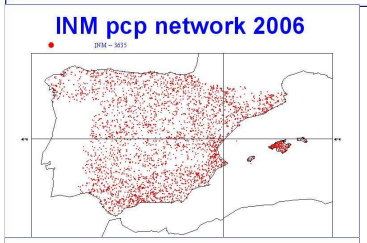


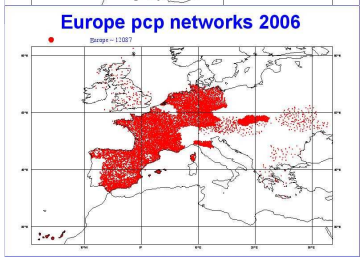








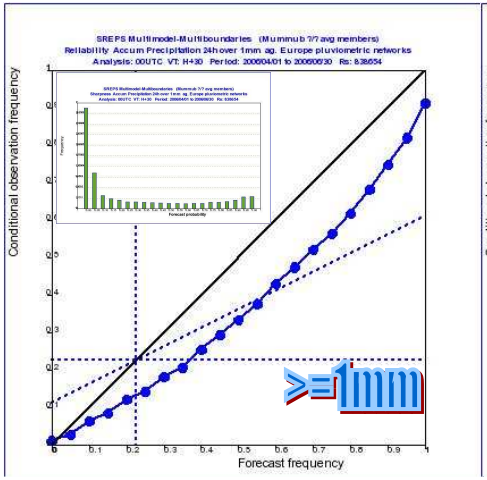


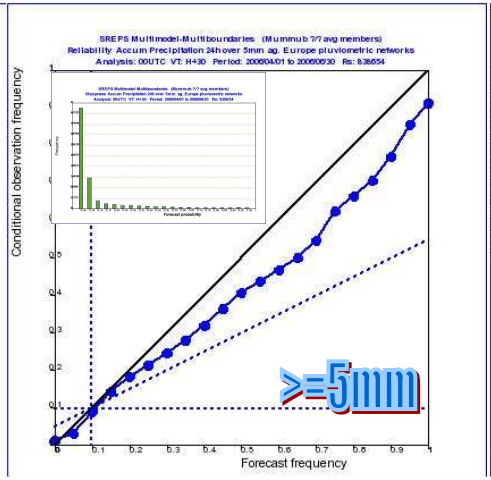


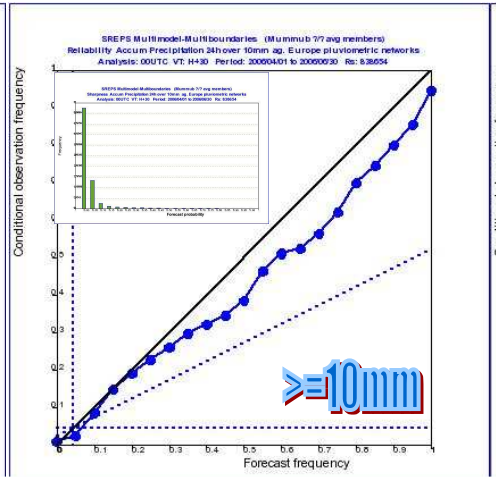
- Reliability

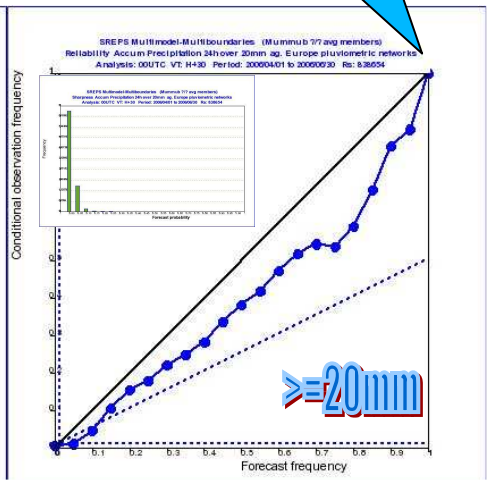
Under-sampling

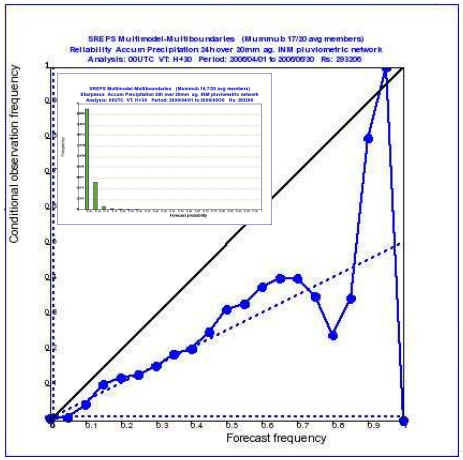
OK

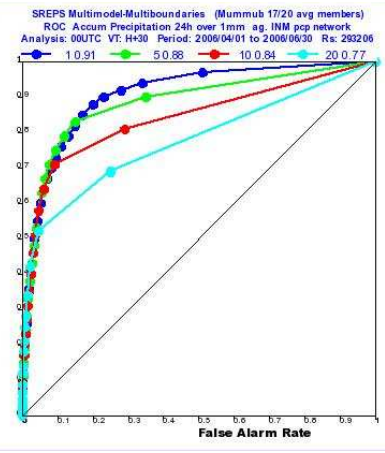


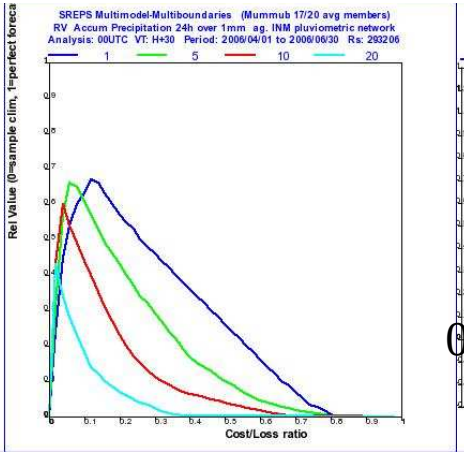


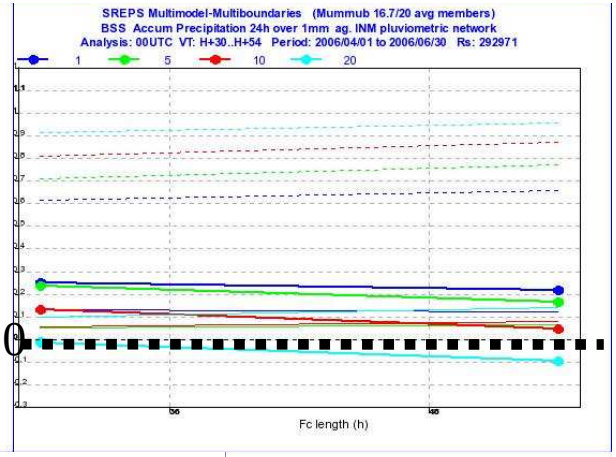












Reliability

Pcp>20mm

T+30

ROC

Pcp>1,5,10,20mm

T+30

RV

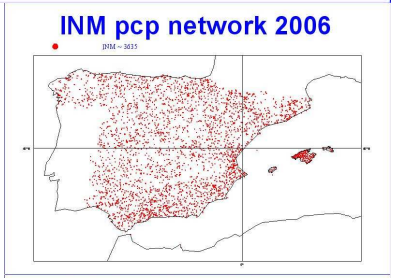
Pcp>1,5,10,20mm

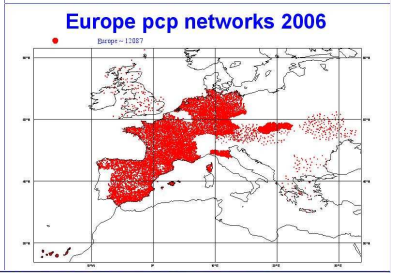
T+30

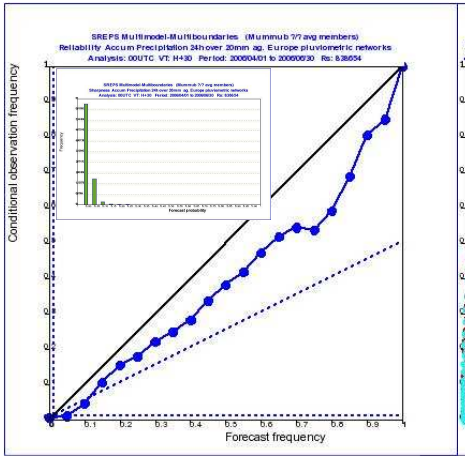
BSS

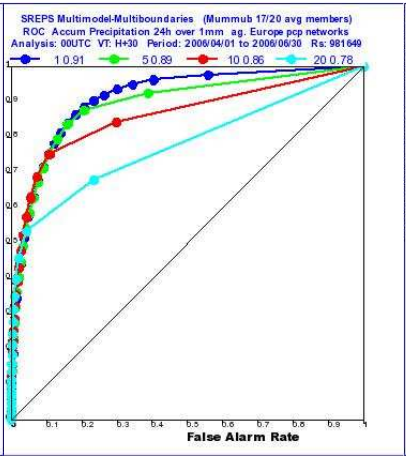
Pcp>5mm

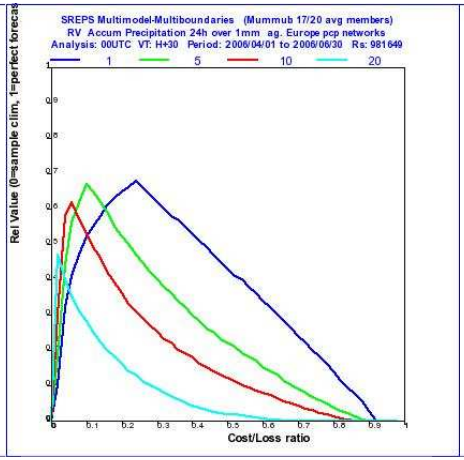
T+30,54

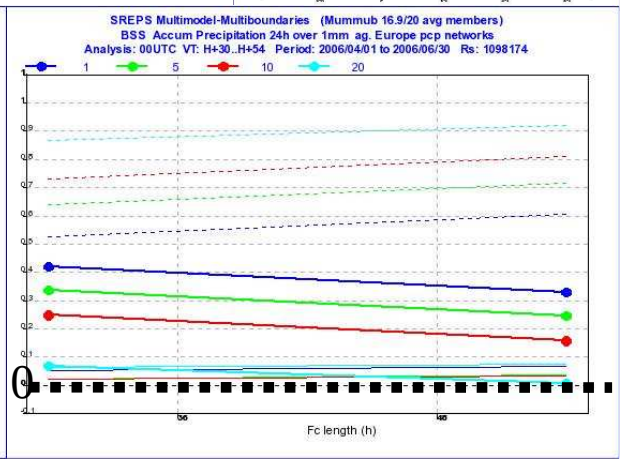


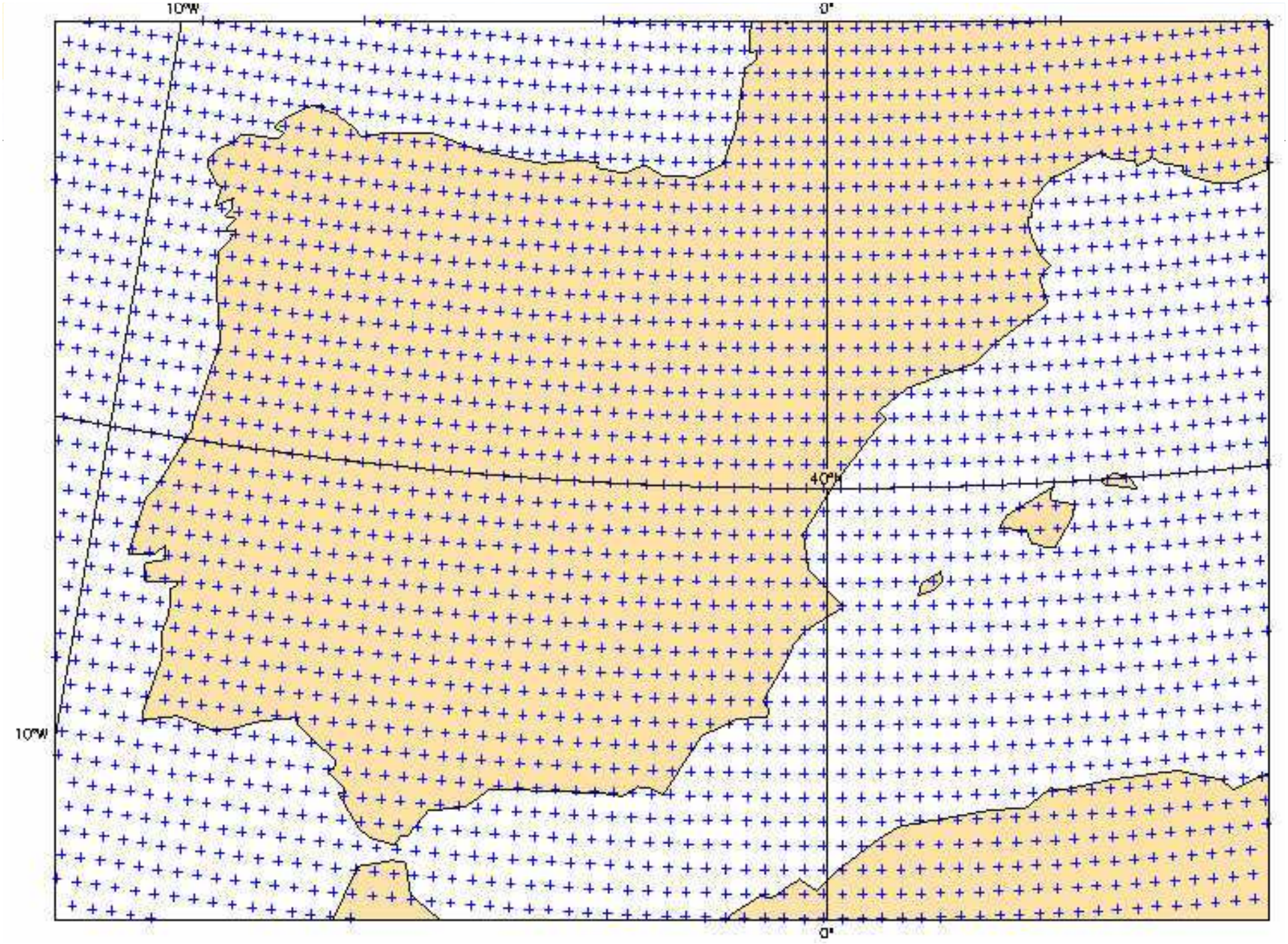








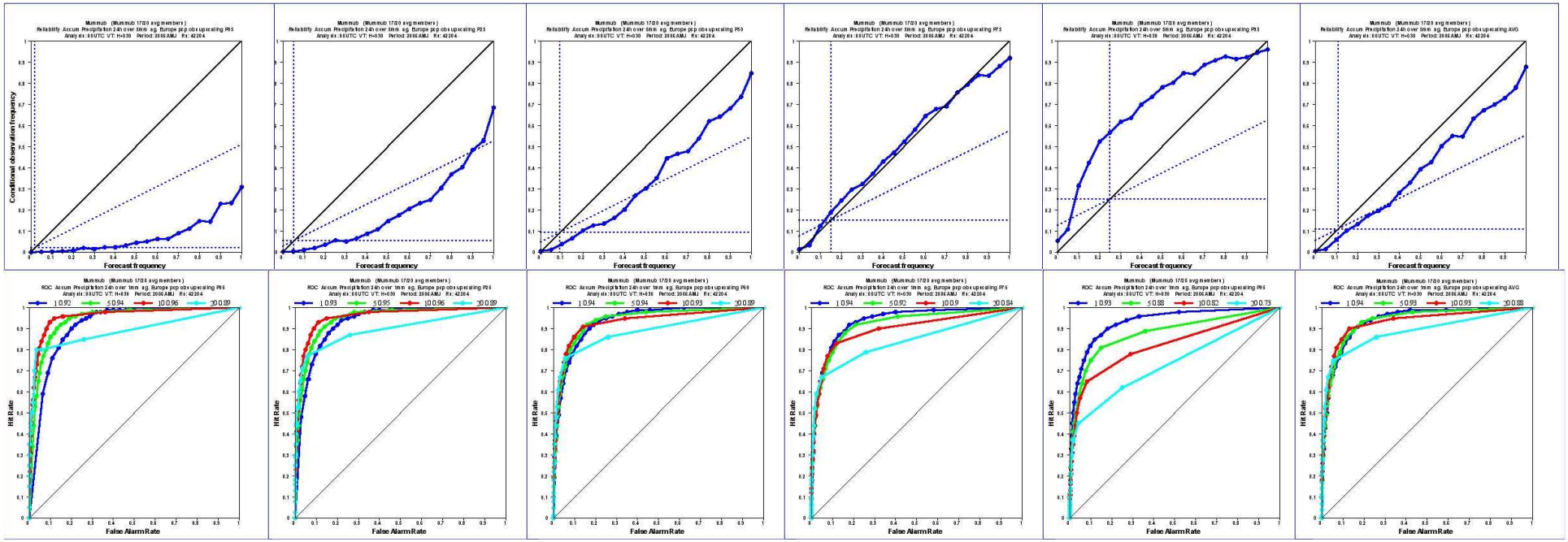



10°W
0°
40°N
10°W
0°

Up-scaled HR observations

- What is the truth? (yesterday talks)
- Verification on points: Independency of realizations?
- Up-scaling Europe HR data: a first simple approach

p_{05} p_{25} p_{50} p_{75} p_{95} avg



Extreme events

- EPSs give explicit, quantitative and detailed information about uncertainty. They provide predictability information, and can especially help forecast extreme events.

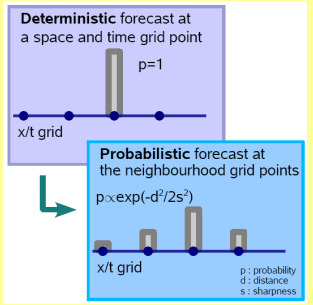
- BUT So far, no mature objective methods to verify extreme events only, or isolated case studies.

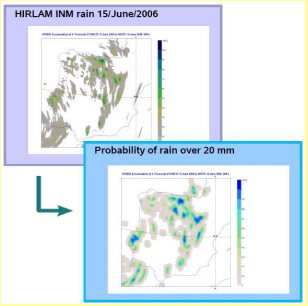
- Following Group of experts in verification methods for extreme events
  - Confidence intervals on scores
  - New scores not sensitive to vanishing sample rates (very rare events) e.g. EDS
  - Feature-oriented, fuzzy verification methods (Ebert, Casati) might show a more realistic information about performance (by better representation of actual pcp), e.g. SAL decomposition

Predictability of pcp

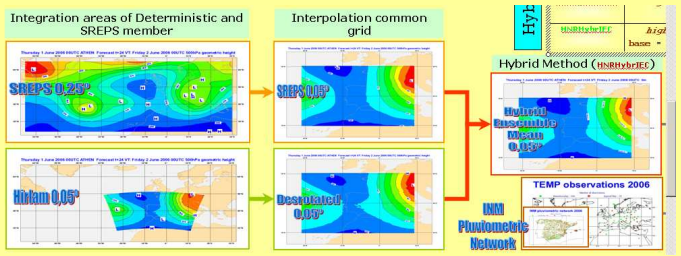
Tested methods for probabilistic pcp forecasts:

- Diffusive methods (Theis)



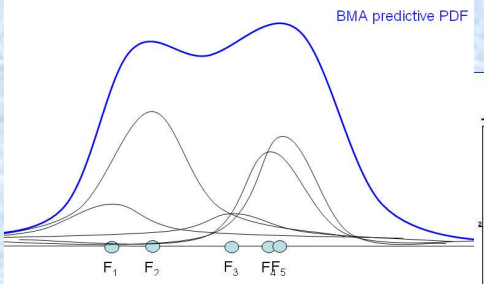


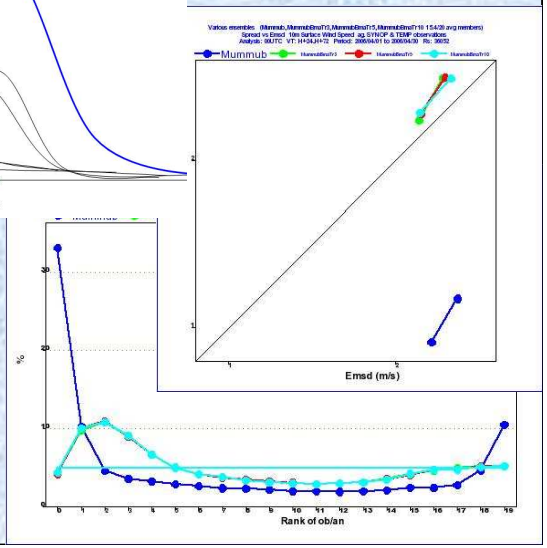
- Hybrid ensembles (Jun Du)



Near future improvements on Aemet SREPS pcp forecasts:

- Non gaussian BMA (gaussian succesful for 10m wind speed)





Conclusions & [near] future

- High performance of the AEMet short-range multi-model ensemble 24h probabilistic precipitation forecasts using HR pcp observations
  - On points: good reliability & resolution, independently on the different frequency of occurrence (base rate) on each network and threshold, thus overcoming different skill difficulties
  - Up-scaling: first simple approach, promising
- Future improvements on verification methods
  - 1 year verification up-scaling HR pcp observations
  - Following Group of experts in extreme verification methods
- Future plans to improve SREPS pcp forecasts
  - Promising non-gaussian BMA on acc pcp
  - Increase model resolution of individual members (currently ~ 0.25ºL40)

Aknowledgements

- Eugenia Kalnay (Univ. Of Maryland),
- Ken Mylne, Jorge Bornemann (MetOffice)
- Detlev Majewski, Michael Gertz, Michael Denhard (DWD)
- Metview Team, Martin Leutbecher (ECMWF)
- 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).

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

Thank you

Any HR pcp datasets are welcome!!!

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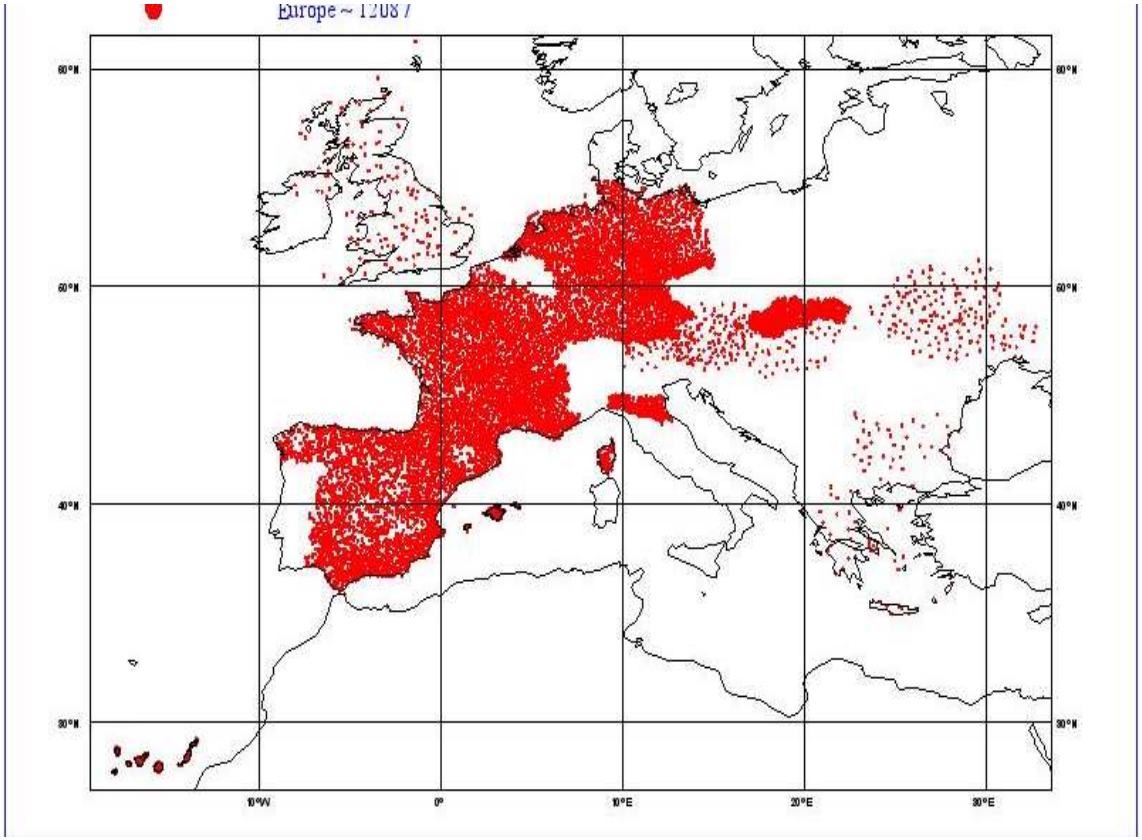


Extras

(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

- 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

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/

Introduction

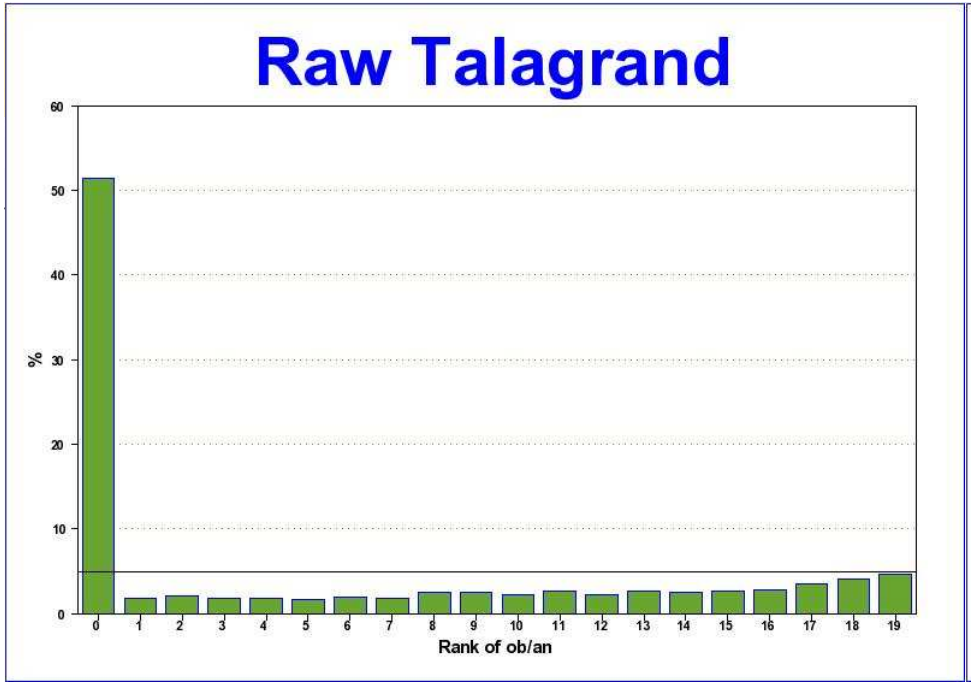
- Predictability is flow dependent
- Extreme weather events have a low predictability, uncertainties can grow critically even in the Short Range (less than 72 hours),
- Convection is highly non-linear and it shows a chaotic behaviour.
- Then a probabilistic apprach may help to improve the prediction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

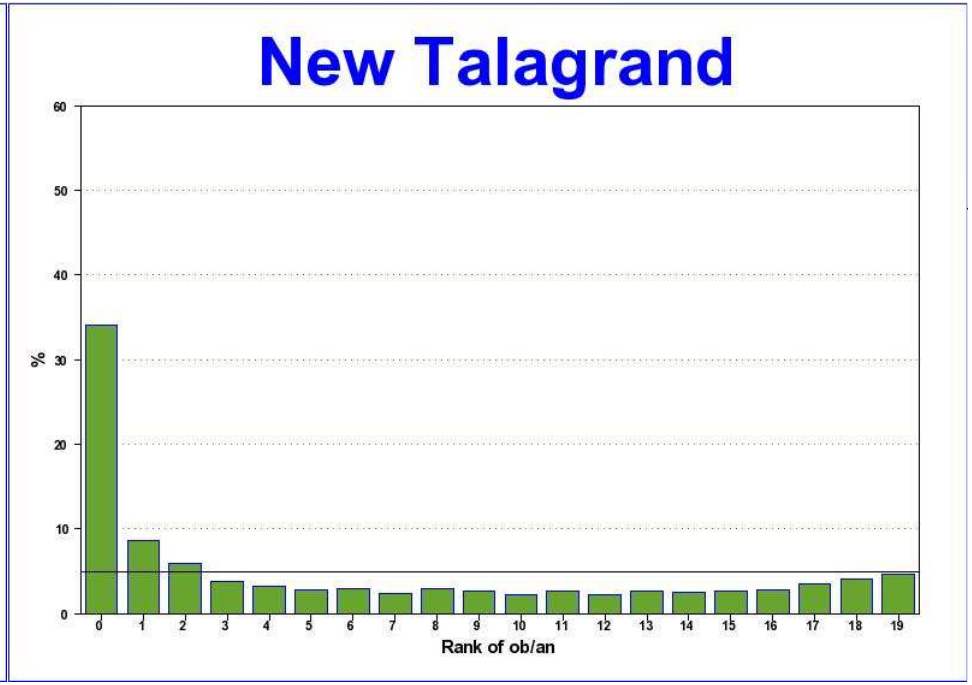
Ensemble for short range

- 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.

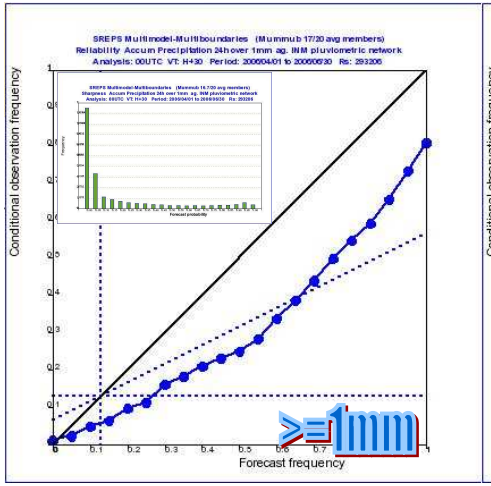
Meteorological Framework

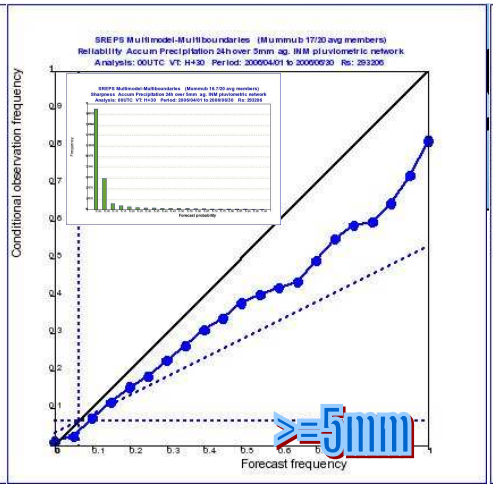
- Main Weather Forecast issues are related with Short-Range extreme events.
- Convective precipitation is the most dangerous weather event in Spain.
- Western Mediterranean is a close sea rounded by high mountains, in autumn sea is warmer than air.
- Several cases of more than 200 mm/few hours every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

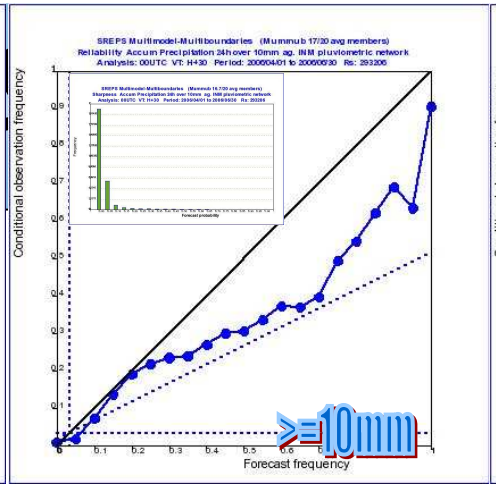


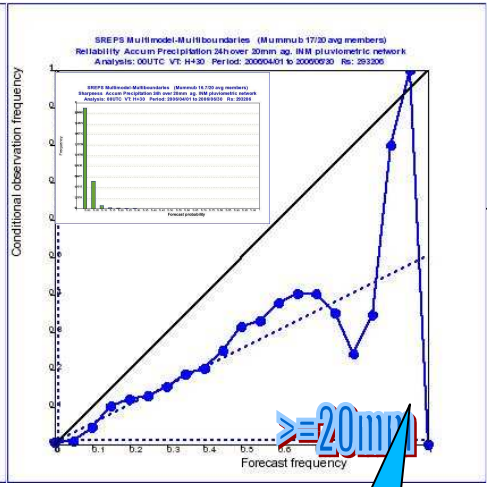


- We use a simple algorithm to compute acc pcp rank histograms avoiding "zero problems"
- Over all those points with obs=0 and M of N fcs=0 the rank of the observation is not really zero (though it seems with some algorithms which plot a spurious overload of "zero ranks")
- In those cases, a random rank {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









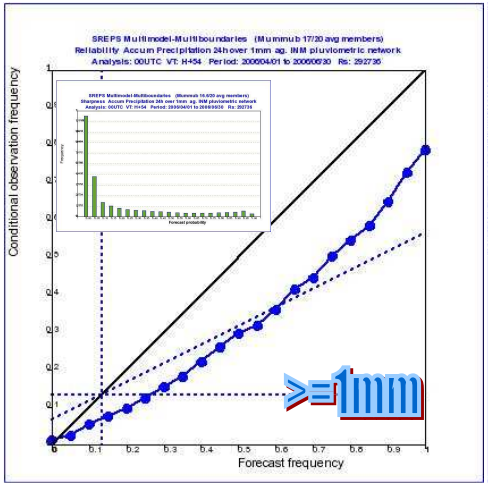
H+30

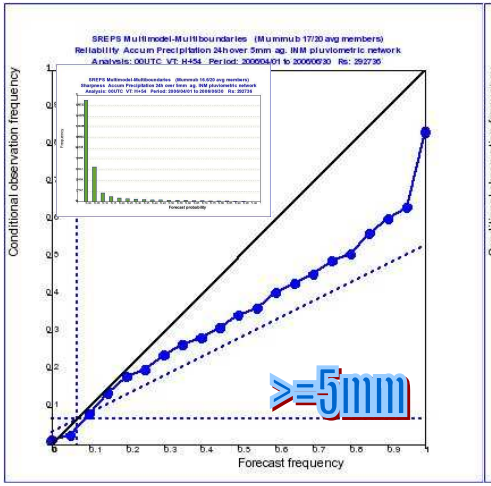
Spain

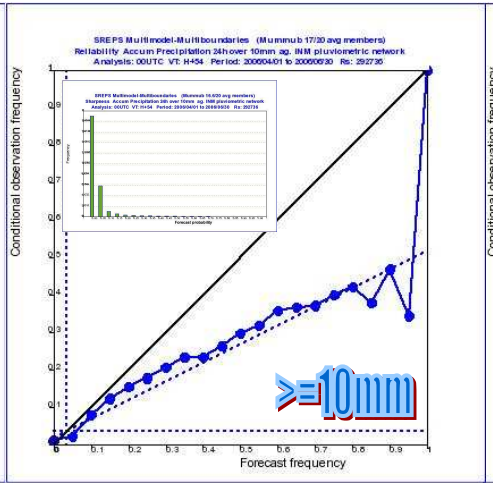
H+54

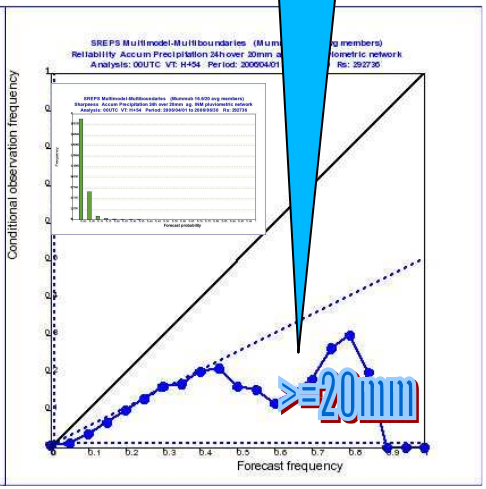
- Good reliability according to
  - thresholds (base rate)
  - forecast length

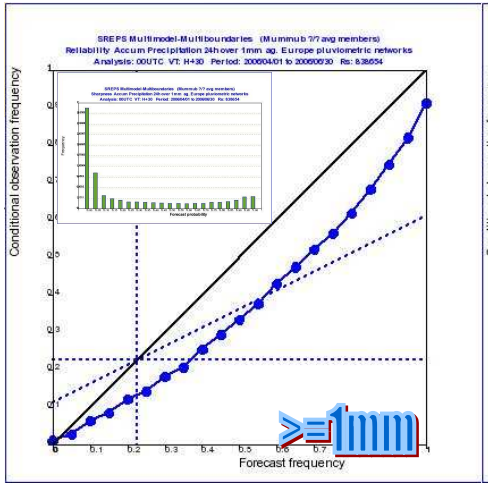
Under-sampling

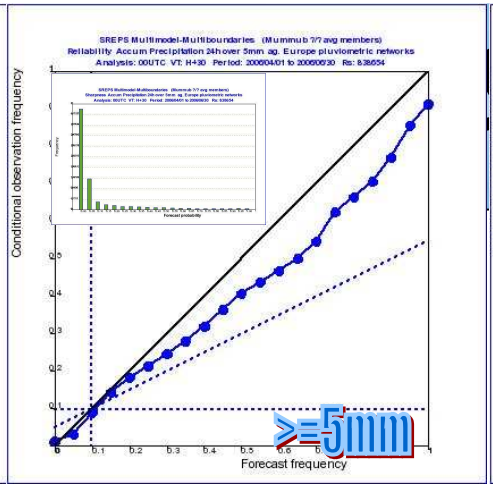


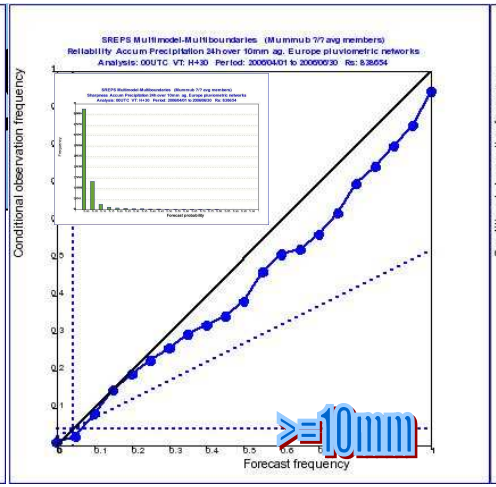


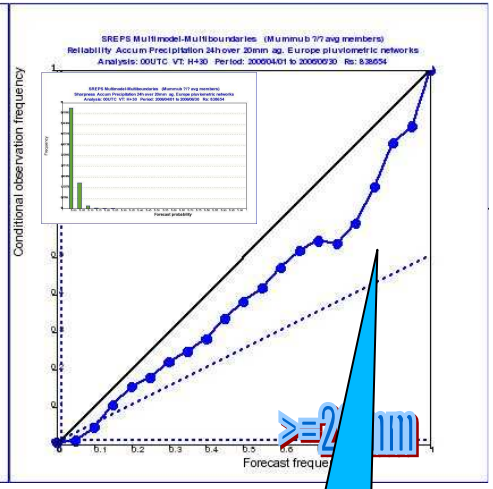












H+30

Europe

H+54

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

No Under-sampling