Comprehensive study of the calibrated EPS products

István Ihász

Hungarian Meteorological Service

Thanks to

Máté Mile
Zoltán Üveges
&
Gergő Kiss
Mihály Szűcs

Topics

- 15 day VarEPS introduced at the ECMWF
  28 November 2006
- 11 March 2008 Unified VarEPS & Monthly Forecasting System providing reforecast dataset at the ECMWF

- EPS calibration using reforecast dataset at the Hungarian Meteorological Service
- Calibration of the multimodel seasonal forecasts

15 day VarEPS introduced at the ECMWF 28 November 2006

http://www.ecmwf.int/products/changes/vareps/

This new system is characterized by a variable resolution during the forecast period (higher in early forecast range) instead of a constant resolution like EPS.

Thus, the forecast range covered by VarEPS was extended to 15 days with TL399L62 (day 0-10)

and TL255L62 (day 9-15).

see ECMWF Newsletter No. 108 for more detailed information /Buizza et. al., p 14-19/

http://www.ecmwf.int/publications/newsletters/

Unified VarEPS & Monthly Forecasting System providing reforecast dataset at the ECMWF

11 March 2008

http://www.ecmwf.int/products/changes/vareps-monthly/

ECMWF combined its **VA**riable **R**esolution **E**nsemble **P**rediction **S**ystem (VarEPS) and monthly forecasting into a single system. On Thursday of each week, the 00 UTC VarEPS forecast are extended from 15 to 32 days at a resolution of T255 L62 with ocean coupling introduced from day 10.

EPS calibration

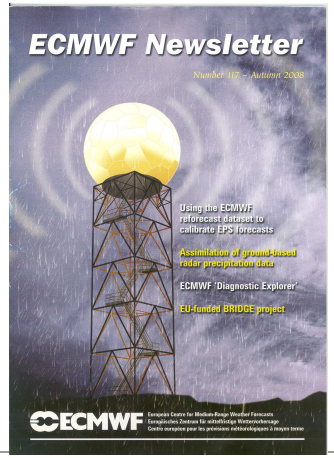
*Hamill, T.M. and J.S. Whitaker, 2*007: Ensemble calibration of 500 hPa geopotential height and 850 hPa and 2-metre temperature using reforecasts. Mon. Wea. Rev., *135*, 3273-3280

*Hamill, T.M., Hagedorm, R. and J.S. Whitaker, 2*007: Probalistic Forecast Calibration: Using ECMWF and GFS Ensemble Reforecasts. Part II: Precipitation. Mon. Wea. Rev., *136*. 2620-2632

Ihász, I., 2007: Experiences using VarEPS products at the Hungarian Meteorological Service: ***Proceedings of the Eleventh ECMWF Workshop on Meteorological Operational Systems***, Reading UK,

Ihász I. *and* ***Mile M.***, 2008: Calibration of ECMWF ensemble precipitation forecasts for hydrological purposes at the Hungarian Meteorological Service. *Proceedings of the XXIV Conference of the Danubian Countries.*

ECMWF Newsletter: 117 Autumn 2008
Hagedorn, R.,2008: Using the ECMWF reforecast dataset to calibrate EPS forecasts
ECMWF Newsletter 117, 8-13
http://www.ecmwf.int/publications/newsletters/



Calibration using reforecast dataset at the HMS

Thanks to Máté Mile and Zoltán Üveges /VarEPS & Monthly/
Gergő Kiss and Mihály Szűcs /seasonal forecasts/

- Questions on generating model climate

- **1. VarEPS & Monthly forecast**
  - ECMWF reforecast dataset last 18 years 1991-2008
  - Calibration method, meteorological parameters
  - Typical model and observation distributions
  - Results, verification, EPS plumes, fields, …

- **2. Seasonal forecast /EUROSIP multimodel EPS**/

Calibration using reforecast dataset:

VarEPS & Monthly forecasts

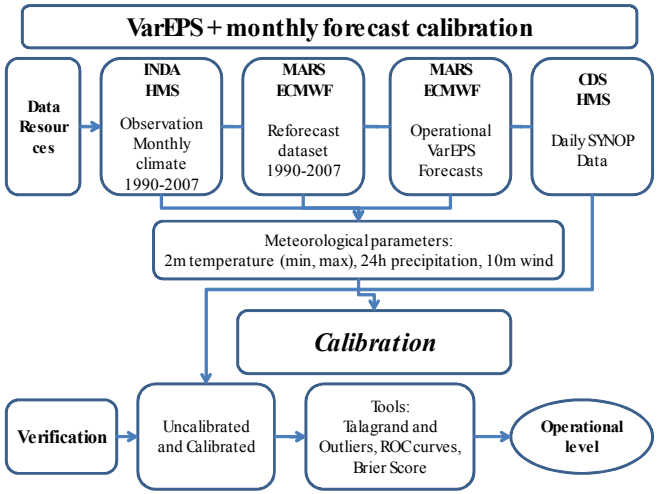
- Questions on generating model climate
  - 1. Simple model statistics
  - 2. Reforecast

- ECMWF reforecast dataset 1991-2008
  - +/- two weeks around current Thursday –
    5 member EPS model run up to 768 h 6 hourly

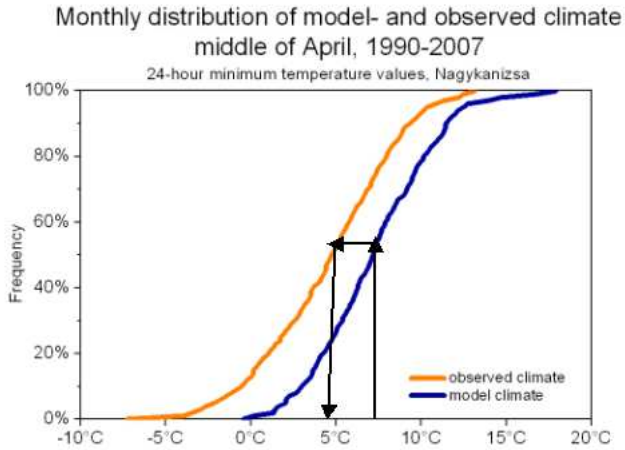
- Calibration method, meteorological parameters
  - 2m temperature at 00, 06, 12, 18 UTC
  - Minimum & maximum temperature
  - Wind speed at 00, 06, 12, 18 UTC
  - 24 h accumulated precipitation

Calibration using reforecast dataset:

VarEPS & Monthly forecasts (cont)



10 selected Hungarian stations

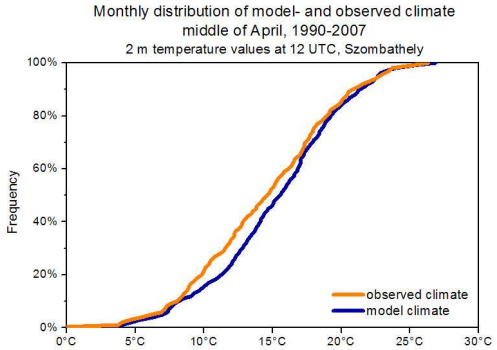


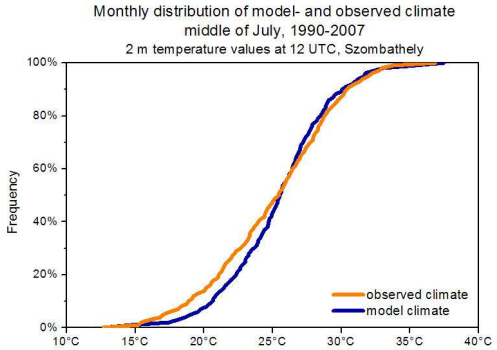
Schematic flow of the calibration

Calibration using reforecast dataset:

VarEPS & Monthly forecasts (cont)

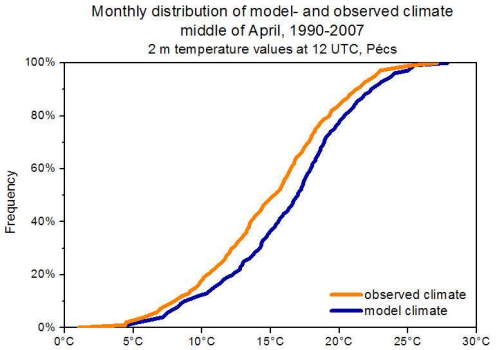
Distributions

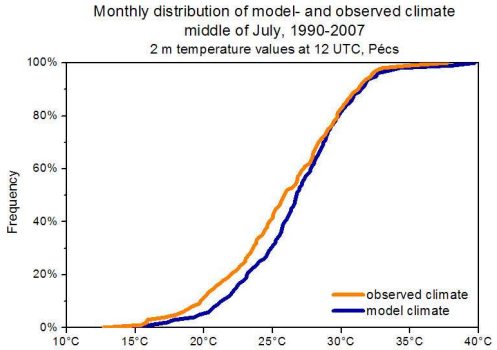




<- April ->

<- July ->





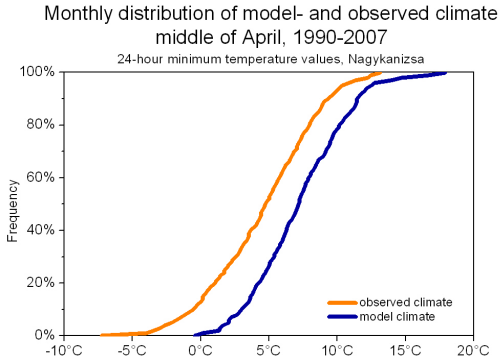
Monthly distribution of 2 m temperature at 12 UTC:

blue - model climate: orange – observed climate:

(Szombathely and Pécs: April /upper row/ and July /lower row/)

Calibration using reforecast dataset:

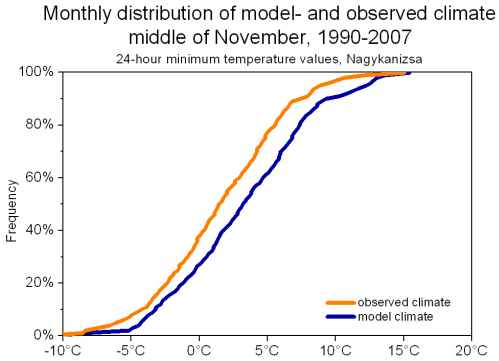
VarEPS & Monthly forecasts (cont)



Distributions

<- April

November ->



Monthly distribution of minimum temperature:

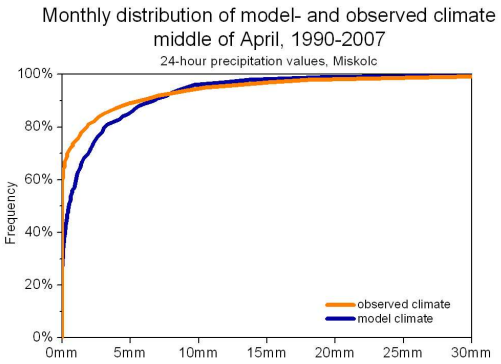
blue - model climate: orange – observed climate:

(Nagykanizsa : April and November)

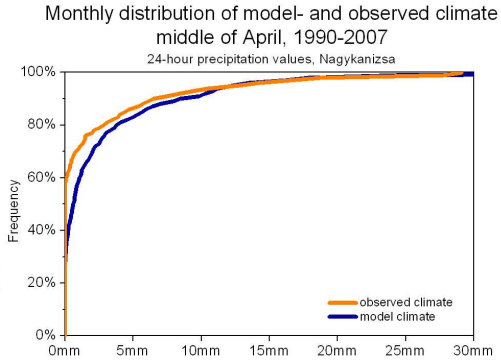
Calibration using reforecast dataset:

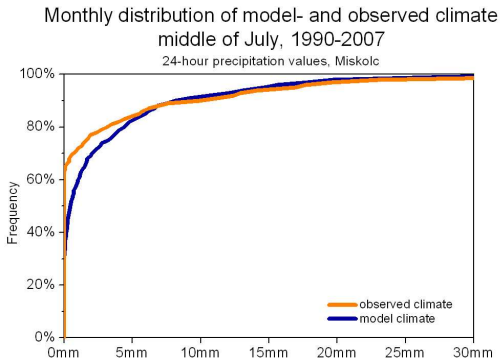
VarEPS & Monthly forecasts (cont)

Distributions

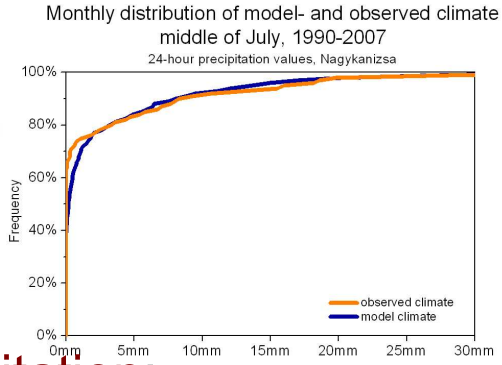


<- April ->





<- July ->



Monthly distribution of daily precipitation:

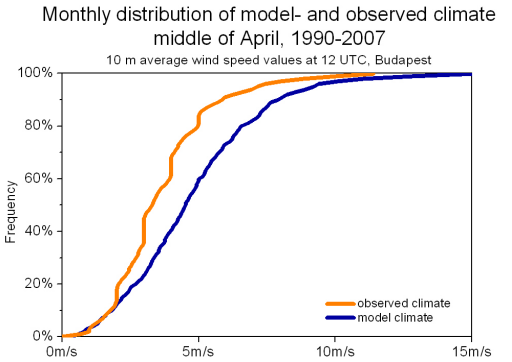
blue - model climate: orange – observed climate:

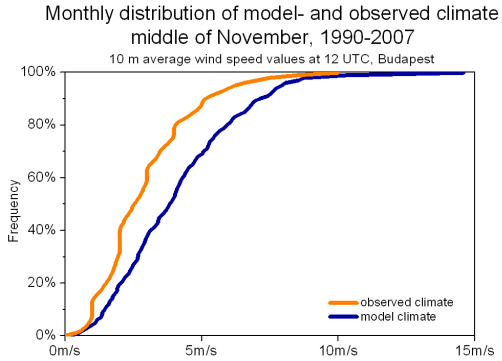
(Miskolc and Nagykanizsa: April /upper row/ and July /lower row/)

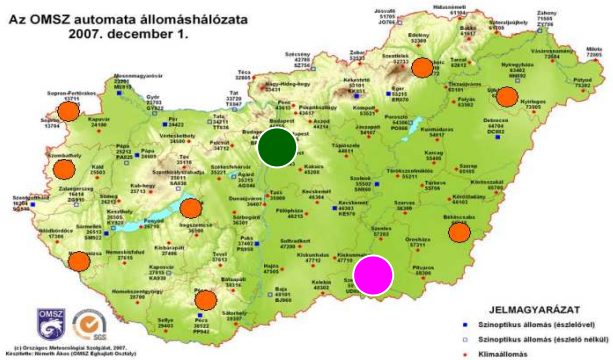
Calibration using reforecast dataset:

VarEPS & Monthly forecasts (cont)

Distributions

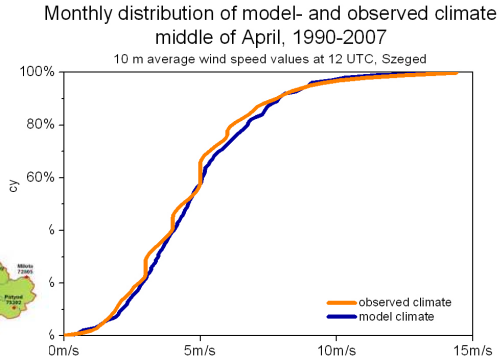


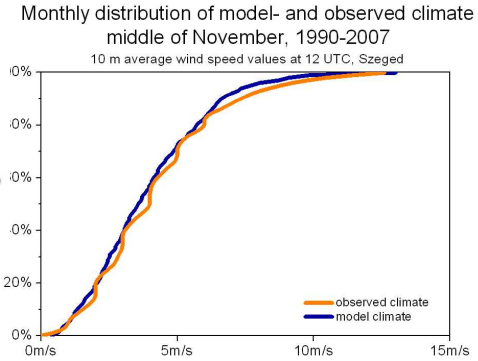




<- April ->

<- November ->





Monthly distribution of 10 m wind speed 12 UTC:

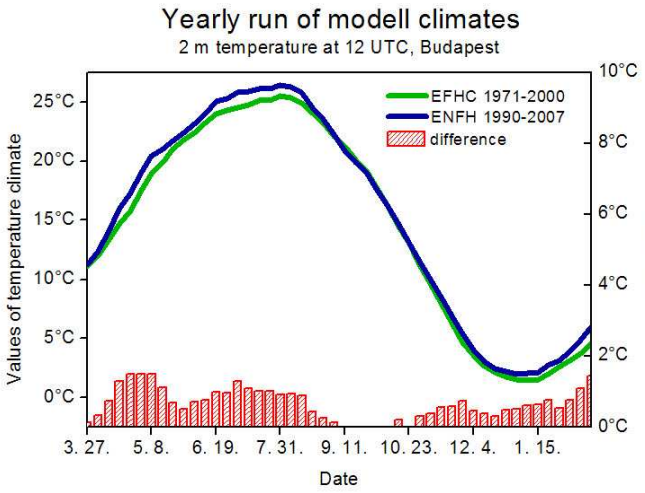
blue - model climate: orange – observed climate:

(Budapest and Szeged : April /upper raw/ and November /lower raw/)

Calibration using reforecast dataset:

VarEPS & Monthly forecasts (cont)

Comparison of two reforecast model climates



Weekly mean values of two model climates

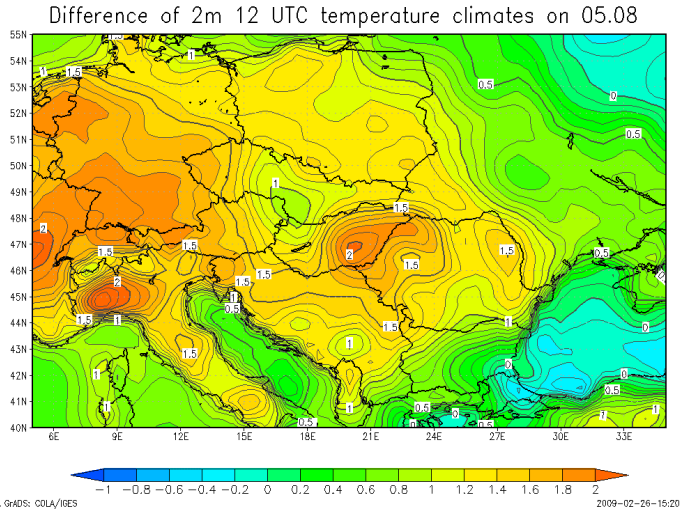
<- for Budapest

(1971-2000 and 1990-2007 intervals).

Difference of two model climates

in the original intervals ->

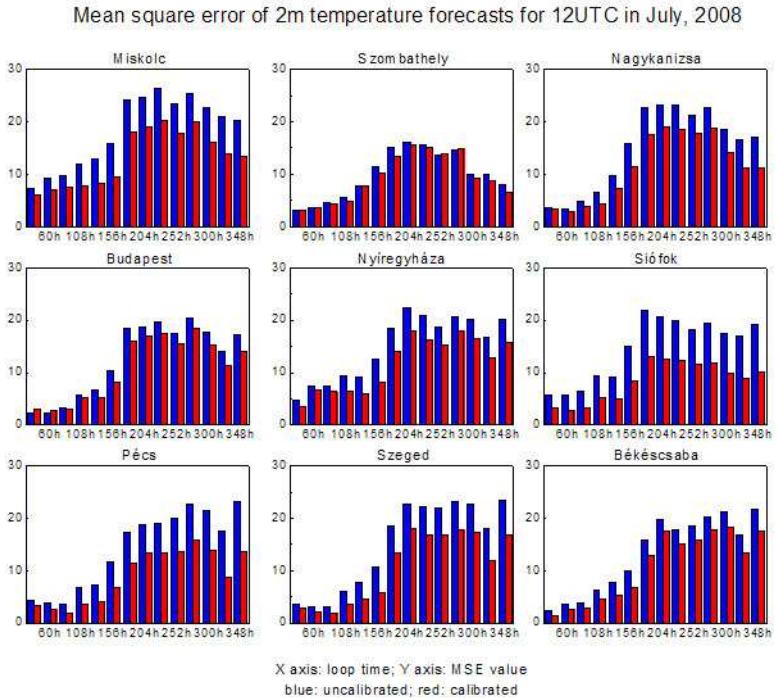
at second week of May



Calibration using reforecast dataset:

VarEPS & Monthly forecasts (cont)

Verification – RMSE of ensemble mean

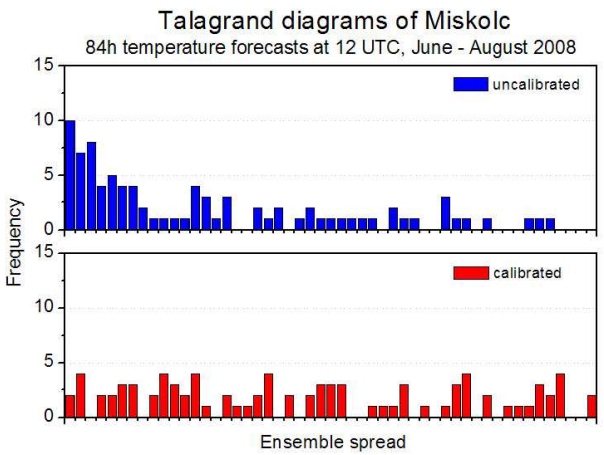


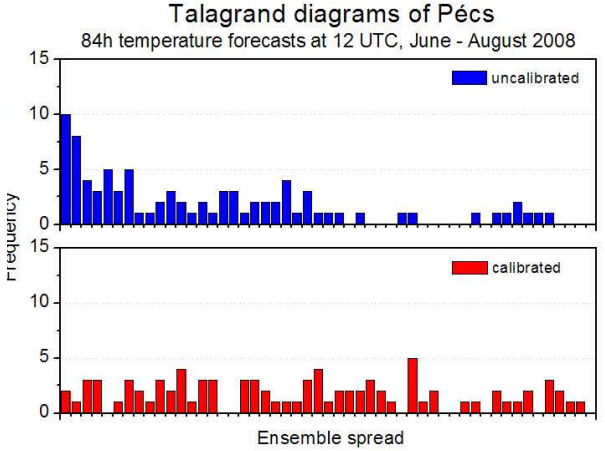
Mean square error of uncalibrated (blue boxes) and calibrated (red boxes) 2m temperature at 12 UTC between +36 and +348 hours with +24 h resolution.

Calibration using reforecast dataset:

VarEPS & Monthly forecasts (cont)

Verification – Talagrand diagram





Talagrand diagrams of uncalibrated (blue boxes) and calibrated (red boxes)

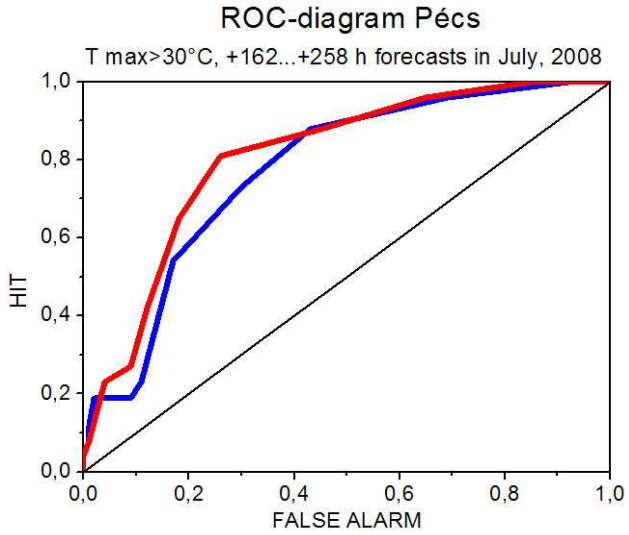
2m temperature at 12 UTC: Miskolc and Pécs (+84 h forecast)

/June – August 2008/

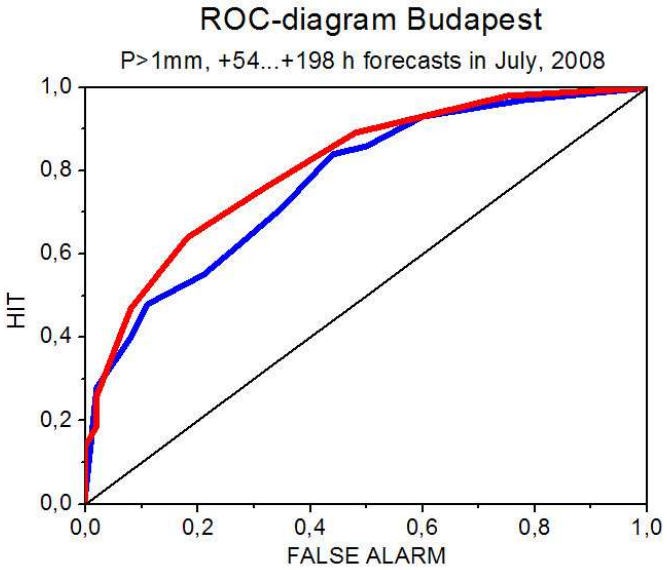
Calibration using reforecast dataset:

VarEPS & Monthly forecasts (cont)

Verification – ROC diagram



uncalibrated (blue line) and calibrated (red line) temperature at 12 UTC when forecast is above 30 degrees Pécs (+162-258 h timestep) July 2008



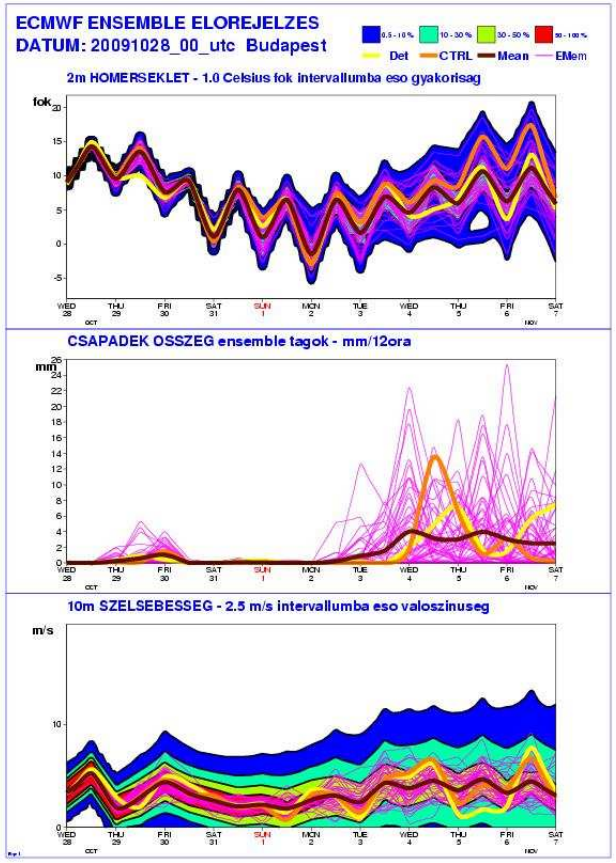
uncalibrated (blue line) and calibrated (red line) 24 h precipitation when forecast is above 1 mm

Budapest (+54-198 h timestep)

Calibration using reforecast dataset:

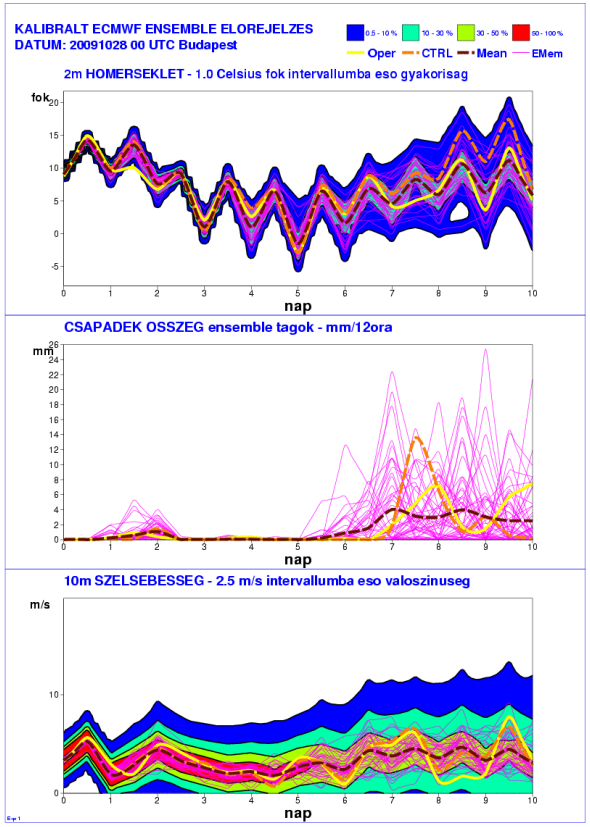
VarEPS & Monthly forecasts (cont)

Operational application – EPS plumes



00 UtC 28 October 2009

-->



Calibration using reforecast dataset:

VarEPS & Monthly forecasts (cont)

<u>Operational application</u> – calibrated fields

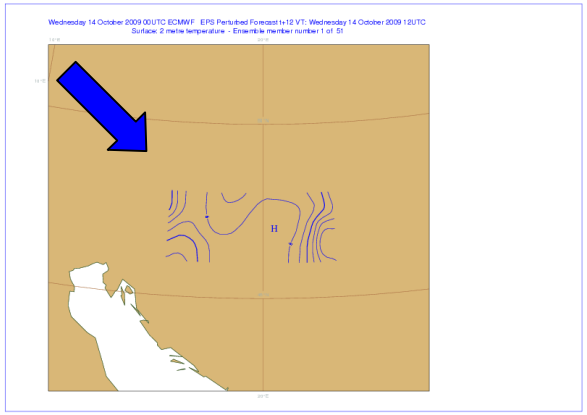
NW corner 49N 16E ,SE corner 46N , 23E

*0.5*0.5 degrees grid*

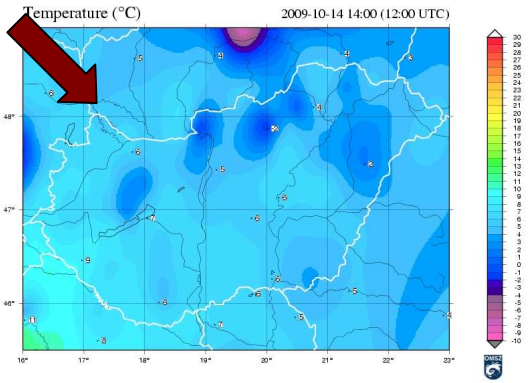
based on 70 stations

->

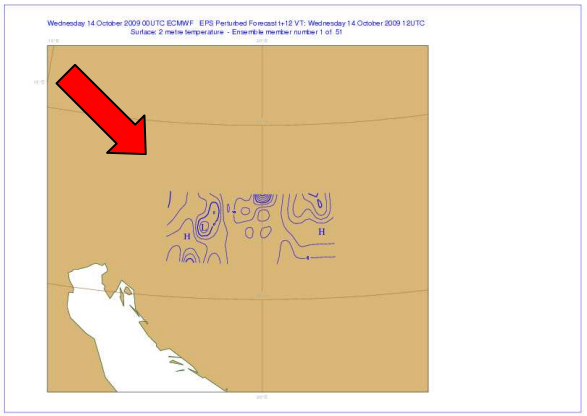
Uncalibrated



Observation



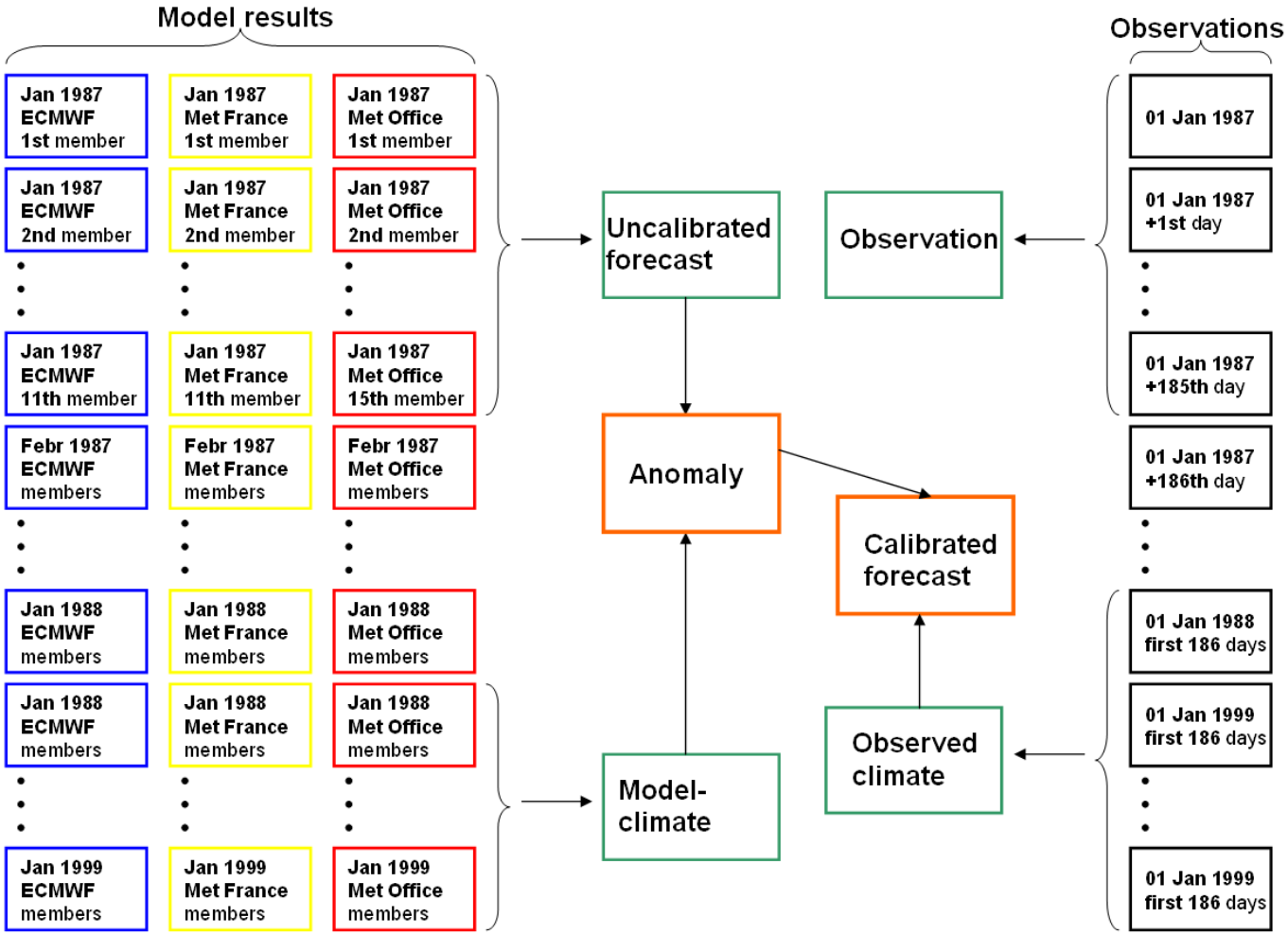
Calibrated



2m temperature: 00 UTC +12 h 14 October 2009 (EPS member Nr. 1)

Calibration using reforecast dataset:

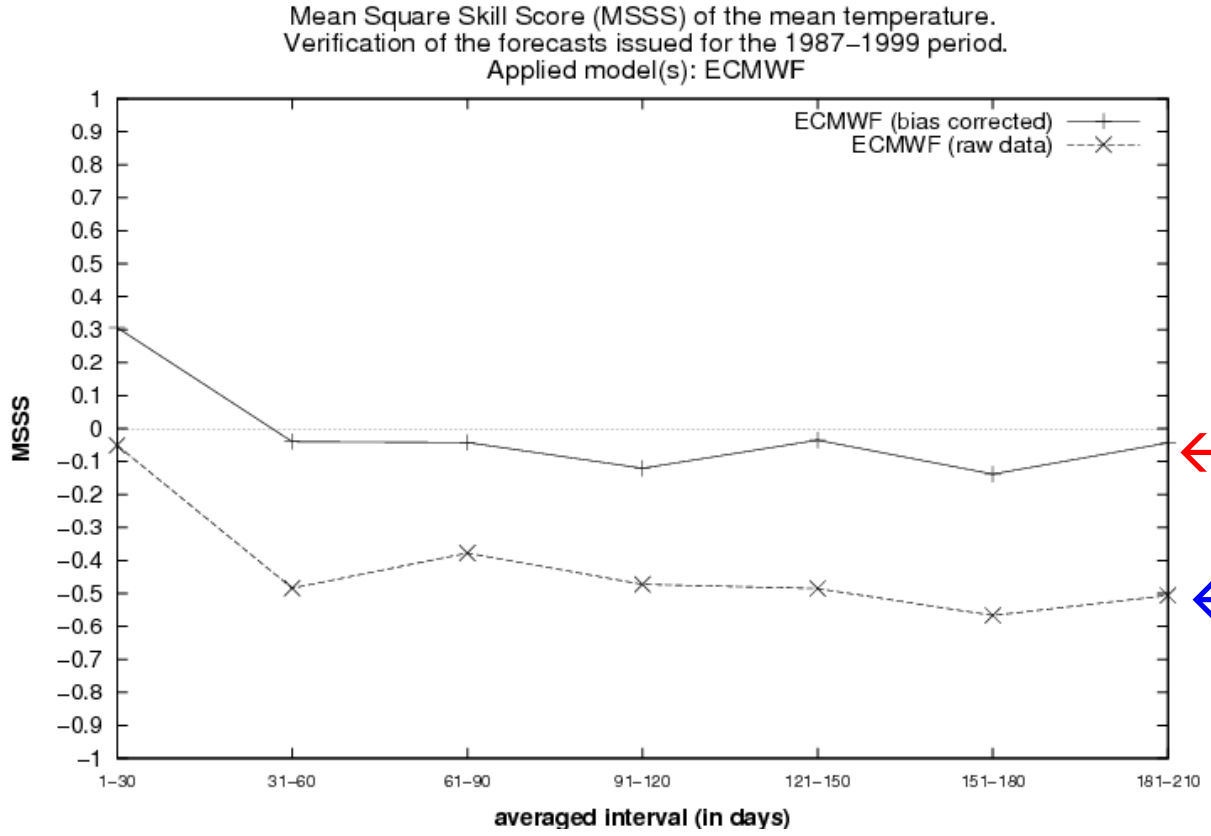
ECMWF & EUROSIP multimodel seasonal forecasts



Calibration using reforecast dataset:

ECMWF & EUROSIP multimodel seasonal forecasts

http://www.ecmwf.int/products/forecasts/d/charts/seasonal/forecast
http://www.ecmwf.int/products/forecasts/seasonal/documentation/eurosip



ECMWF

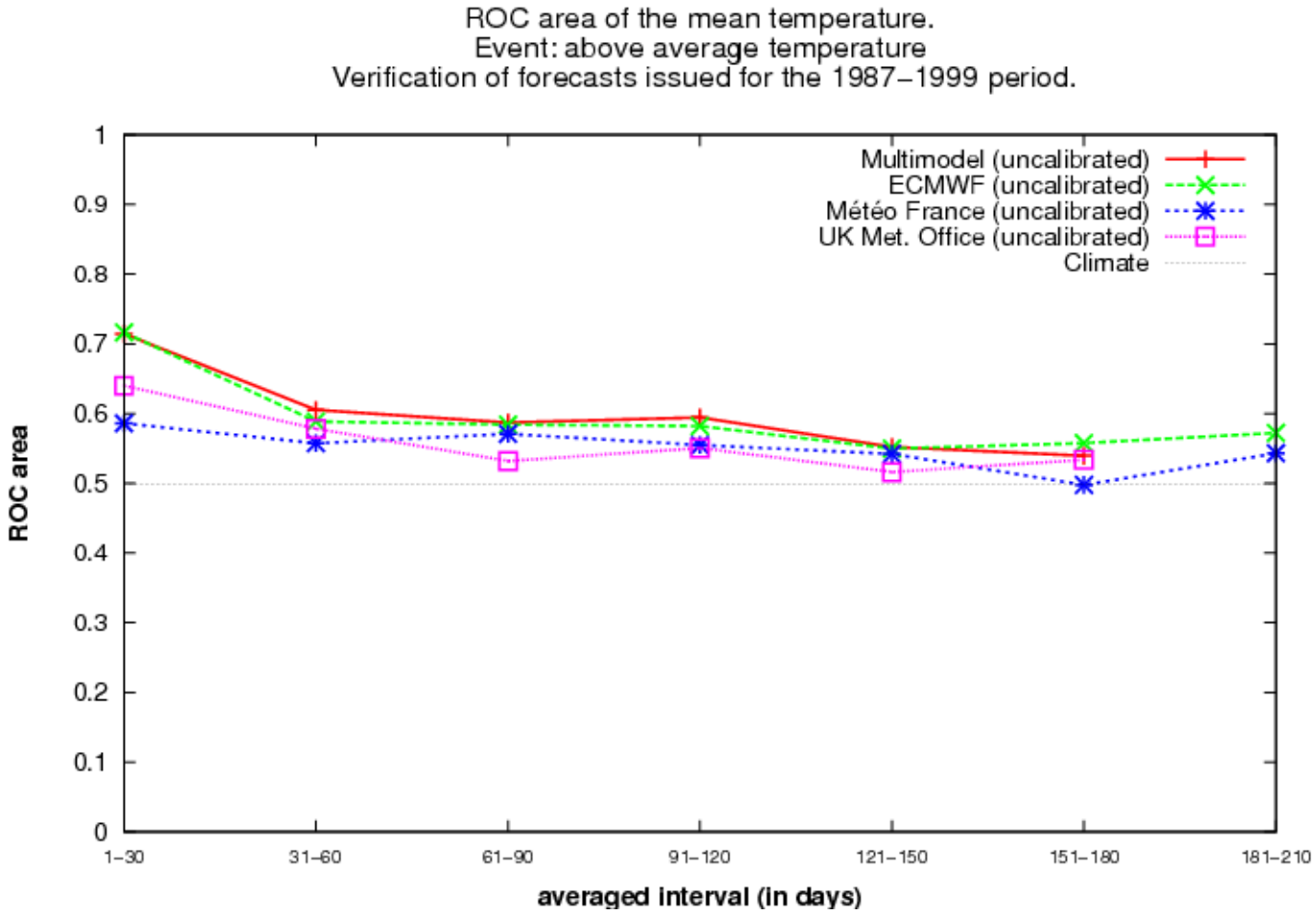
Simple bias correction

← bias corrected forecast

← raw forecast

Calibration using reforecast dataset:

EUROSIP multimodel seasonal forecasts



ROC area:

Event above

Average temperature

1987-1999

Uncalibrated:

ECMWF

Meteo France

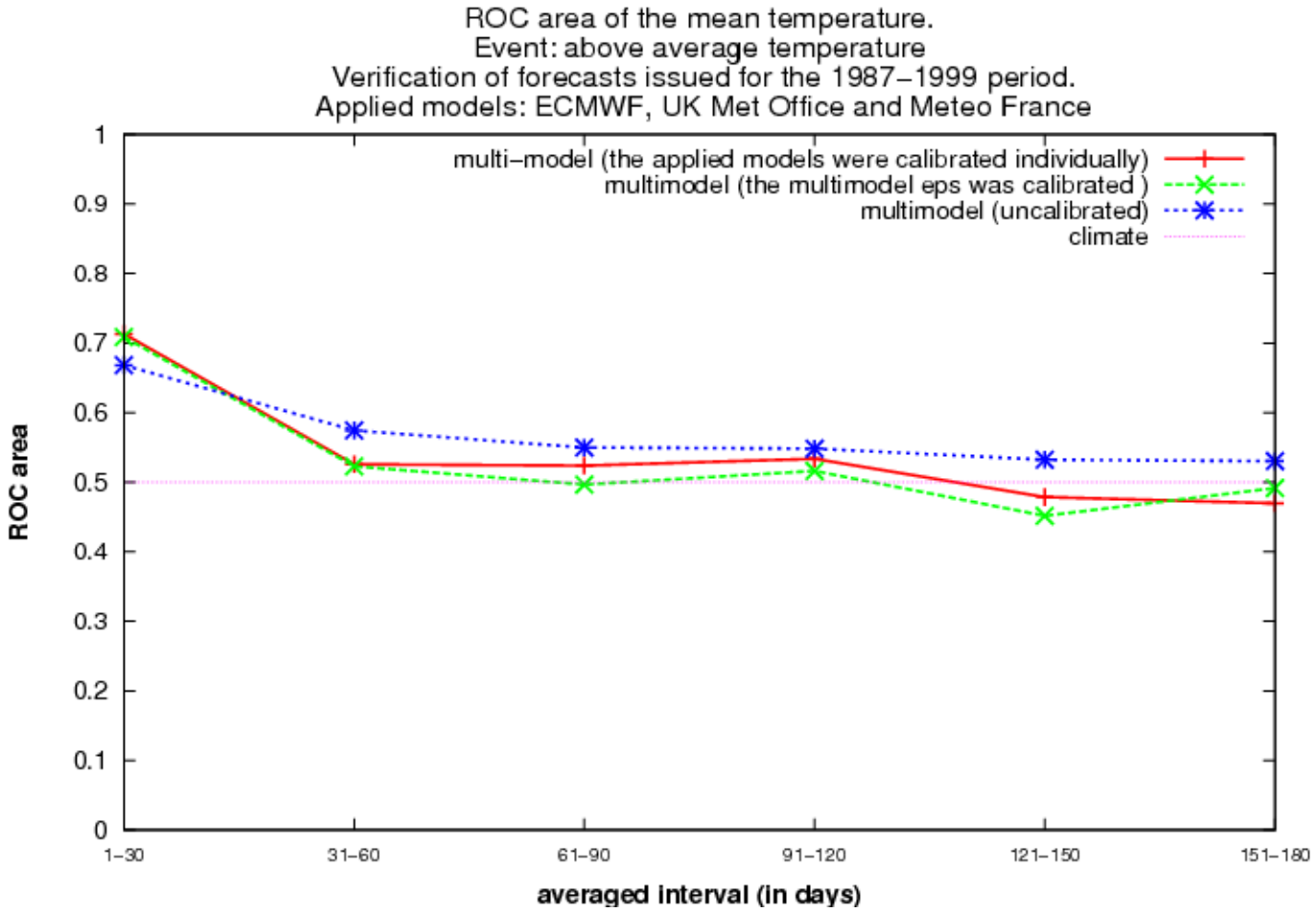
UK Met. Office

Multimodel

Climate

Calibration using reforecast dataset:

EUROSIP multimodel seasonal forecasts



ROC area:

Event above

Average temperature

1987-1999

Uncalibrated

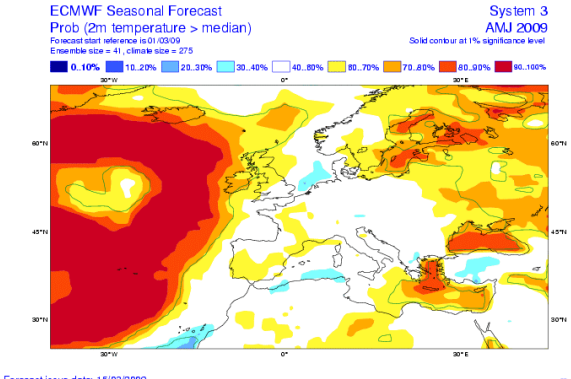
Calibrated (individually)

Calibrated (together)

Climate

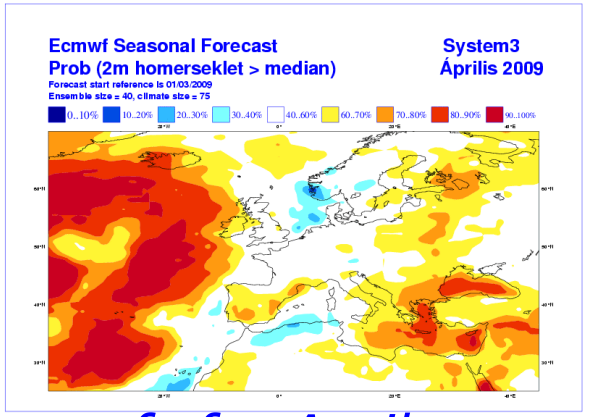
Calibration using reforecast dataset:

ECMWF seasonal forecasts

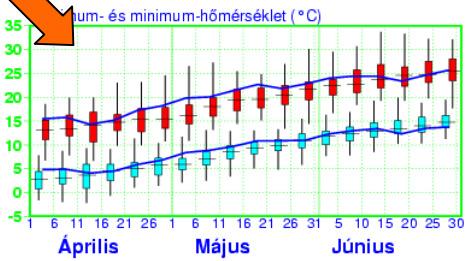


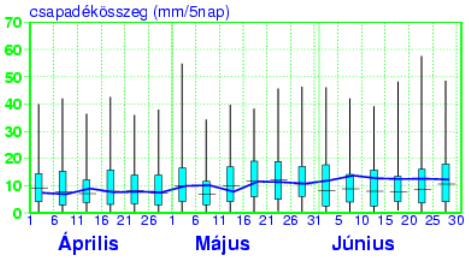
fc for April – June

Case study:
15 March 2009



fc for April

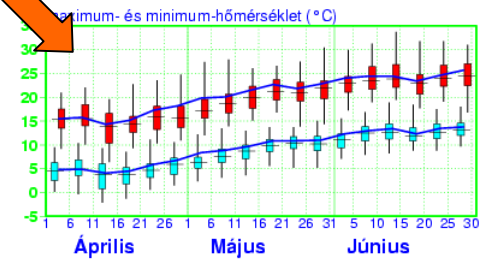


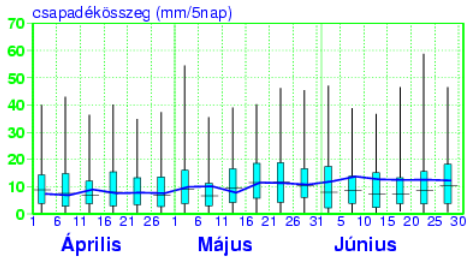
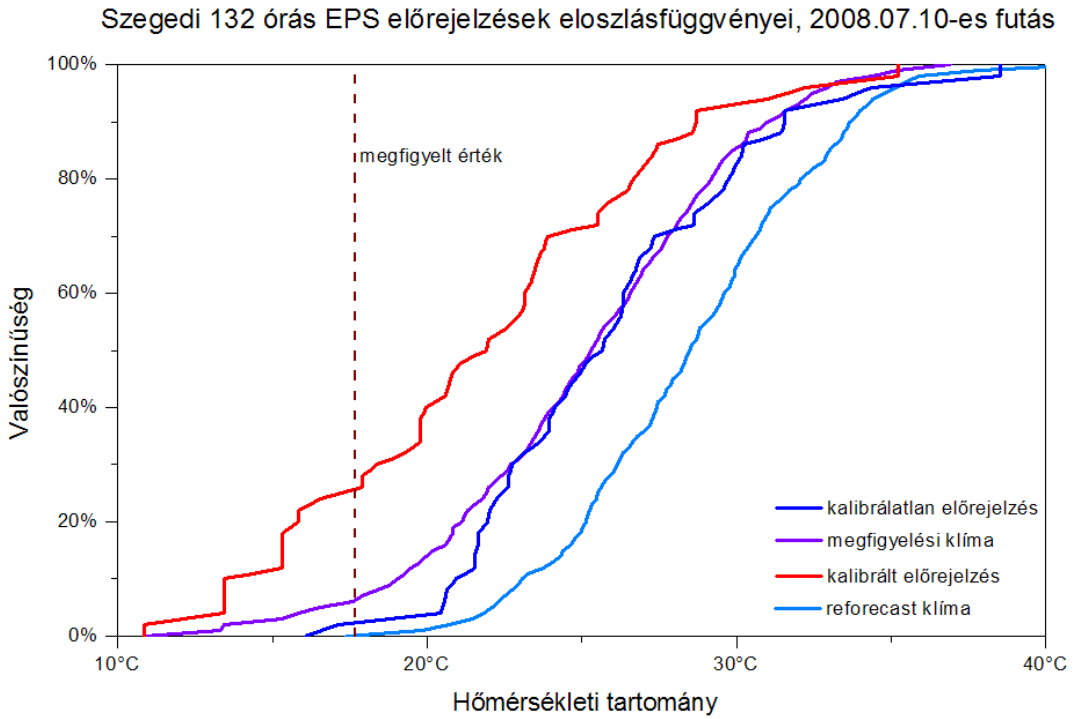


<- uncalibrated

calibrated ->

EPS meteogram





Thanks a lot for your attention