Application and verification of ECMWF products 2012

Czech Hydrometeorological Institute (CHMI)

1. Summary of major highlights

ECMWF products have been widely used by the Central and Regional Forecasting Offices in Czech Hydrometeorological Institute (CHMI) for medium-range weather forecasts and to some extent also to issue short-range weather forecasts. The clusters, tubes, plumes and EPS-grams are considered in order to evaluate the credibility of the main deterministic forecast as well as to prompt for possible scenarios in situations of low determinism. The Extreme Forecast Index and other probabilistic products have been used especially in severe weather forecasting. ECMWF graphical products are also used by the Weather Service of Army of the Czech Republic.

At the beginning of 2007 CHMI implemented weather station Visual Weather of IBL soft. Many of products of deterministic model and some probabilistic products are visualised on this weather station both at the Central Forecasting Office and at the Regional Forecasting Offices. Using this weather station products of other models including Aladin model (operated in CHMI) and GFS model can be easily displayed and compared to ECMWF model.

ECMWF products has become the main products to issue medium-range weather forecasts for both the whole territory of Czech Republic and particular regions of Czech Republic.

2. Use and application of products

2.1 Post-processing of model output

2.1.1 Statistical adaptation

No statistical adaptation of the ECMWF products is carried out.

2.1.2 Physical adaptation

No limited area modeling using the ECMWF products is carried out operationally, but ECMWF lateral boundary conditions can be used as a back-up for the ALADIN model.

Three-dimensional wind forecasts over the Northern Hemisphere up to +120 hrs are used as the input to the trajectory model used for assessing of risk of distant nuclear or other major accidents.

ECMWF deterministic temperature and precipitation forecast serves as optional input to hydrological model in cases that prolonged lead time is demanded (especially for the purpose of reservoir

management), however it is quite rare practice in Czech Republic.

Some of meteorological parameters (pressure, temperature, wind) predicted by ECMWF are used as an automatic input to some our products that are controlled and modified by forecasters.

2.1.3. Derived fields

No derived fields are calculated out of the ECMWF products.

2.2. Use of products

The final medium-range forecasts produced by forecasters of CHMI are currently used in the general weather forecasting for public and state authorities and in the national Warning and Alert Service. Warning system has become the most important component of our service. Both probabilistic products and the Extreme Forecast Index are used to issue warnings. Ensemble products are considered in order to evaluate the credibility of the main deterministic forecast and to issue weather forecasts more than approximately 5 days in advance.

The seasonal and monthly forecasts are consulted in the long-range forecast process. Currently the results of both deterministic and ensemble forecasts up to 15 days in advance and monthly forecasts are used for identification of the weather type in the analogue-based forecasting method for monthly forecasting.

3. Verification of products

There is currently no objective or systematic subjective verification of ECMWF medium range forecast products carried out. The general scores calculated and published by ECMWF are considered informative. For now we also use verification of ECMWF products from the Green Book. Considering the character of medium-range weather forecasts, the verification scores from neighbouring countries are well applicable also for our service.

3.1 Objective verification

3.1.1 Direct ECMWF model output (both deterministic and EPS)

3.1.2 ECMWF model output compared to other NWP models

Weather forecasts issued by forecasters of CHMI are verified by the same method for many years. It is evaluated success rate of the main meteorological phenomena for the territory of Czech Republic:

average of minimum temperature (2 m above the ground)
average of maximum temperature (2 m above the ground)
average of total cloudiness
percentage of stations with precipitation (precipitation area)
average of precipitation amount
percentage of stations with thunderstorms
percentage of stations with fogs.

All phenomena are evaluated for both the whole territory of Czech Republic and particular regions of Czech Republic for the 1st day (tomorrow), 2nd day (the day after tomorrow), the 3rd day and the 4th day.

At the end of the last year we implemented direct forecasts of numerical models to this verification: local model Aladin (operated in CHMI), local model LMEB (German Weather Service), ECMWF and GFS model (Washington). Outputs based both from 00 UTC and 12 UTC. Excluding of predictions of thunderstorms and fogs.

Thanks to this system it is possible to compare both success rate of forecaster½s predictions and success rate of numerical models. Local models only for the first day (tomorrow). Some results for the period from 1st February 2012 to 30th June 2012 for Czech Republic we can see on the next pictures.

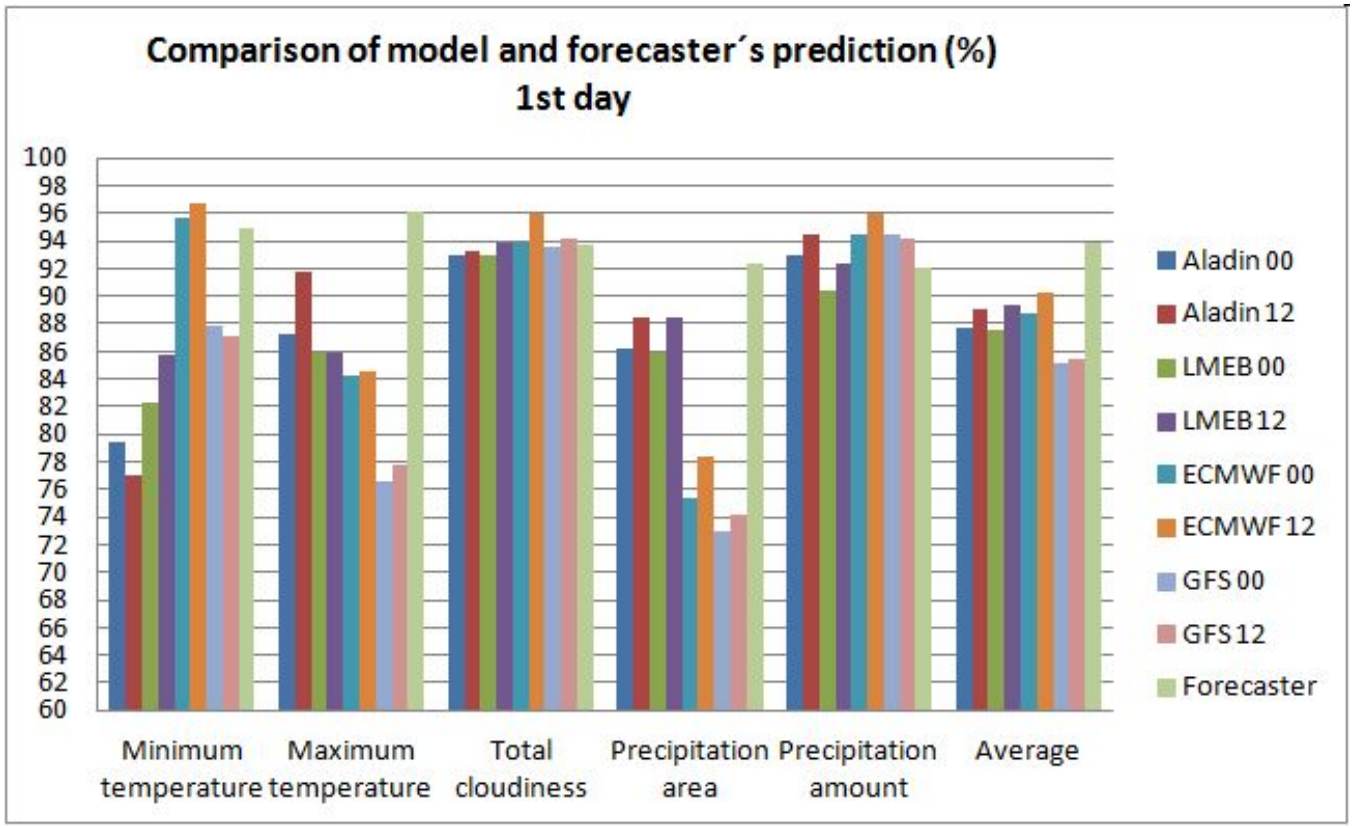

Figure1 Comparison of Aladin, LMEB, ECMWF and GFS predictions and forecaster½s predictions for the 1st day (tomorrow).

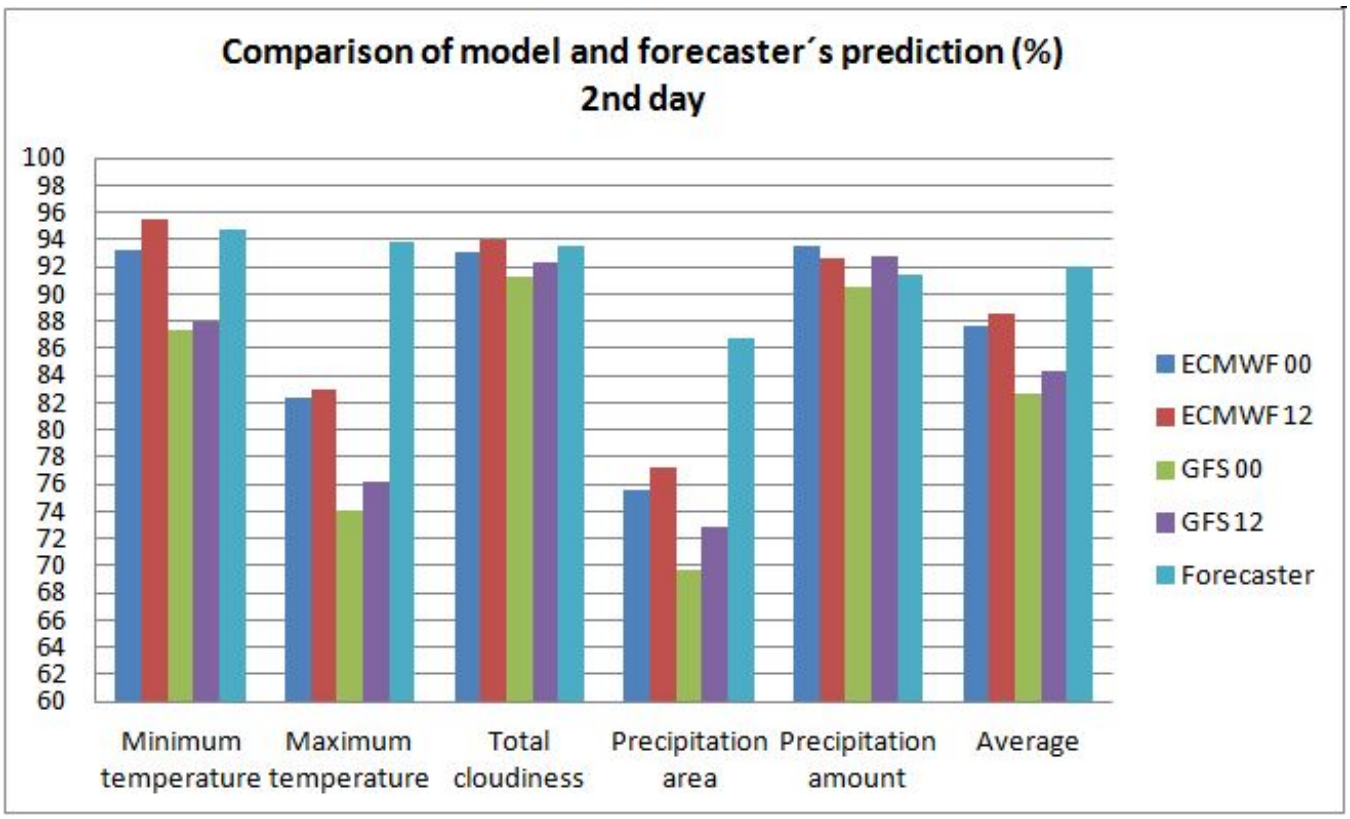

Figure2 Comparison of ECMWF and GFS predictions and forecaster½s prediction for the 2nd day (the day after tomorrow).

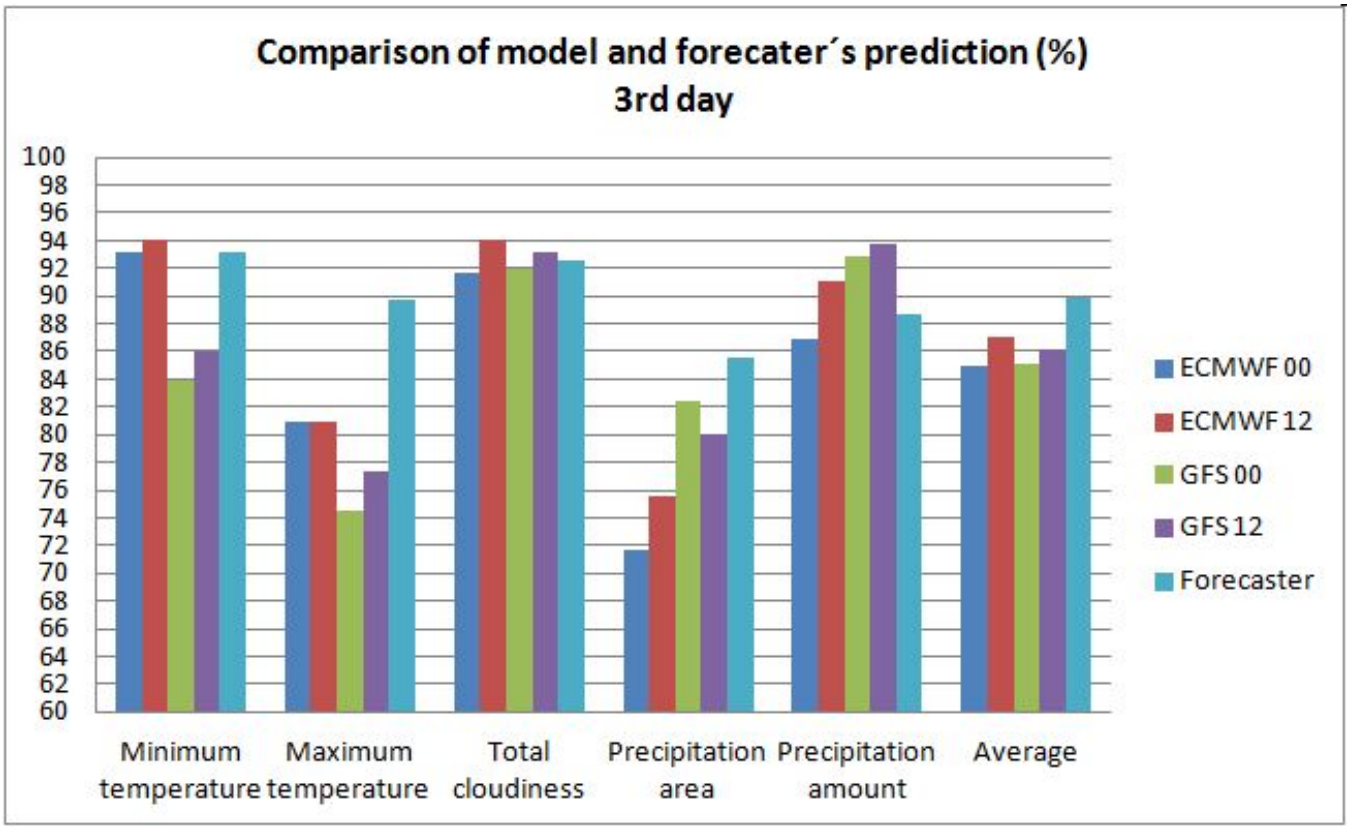

Figure 3 Comparison of ECMWF and GFS predictions and forecaster½s prediction for the 3rd day.

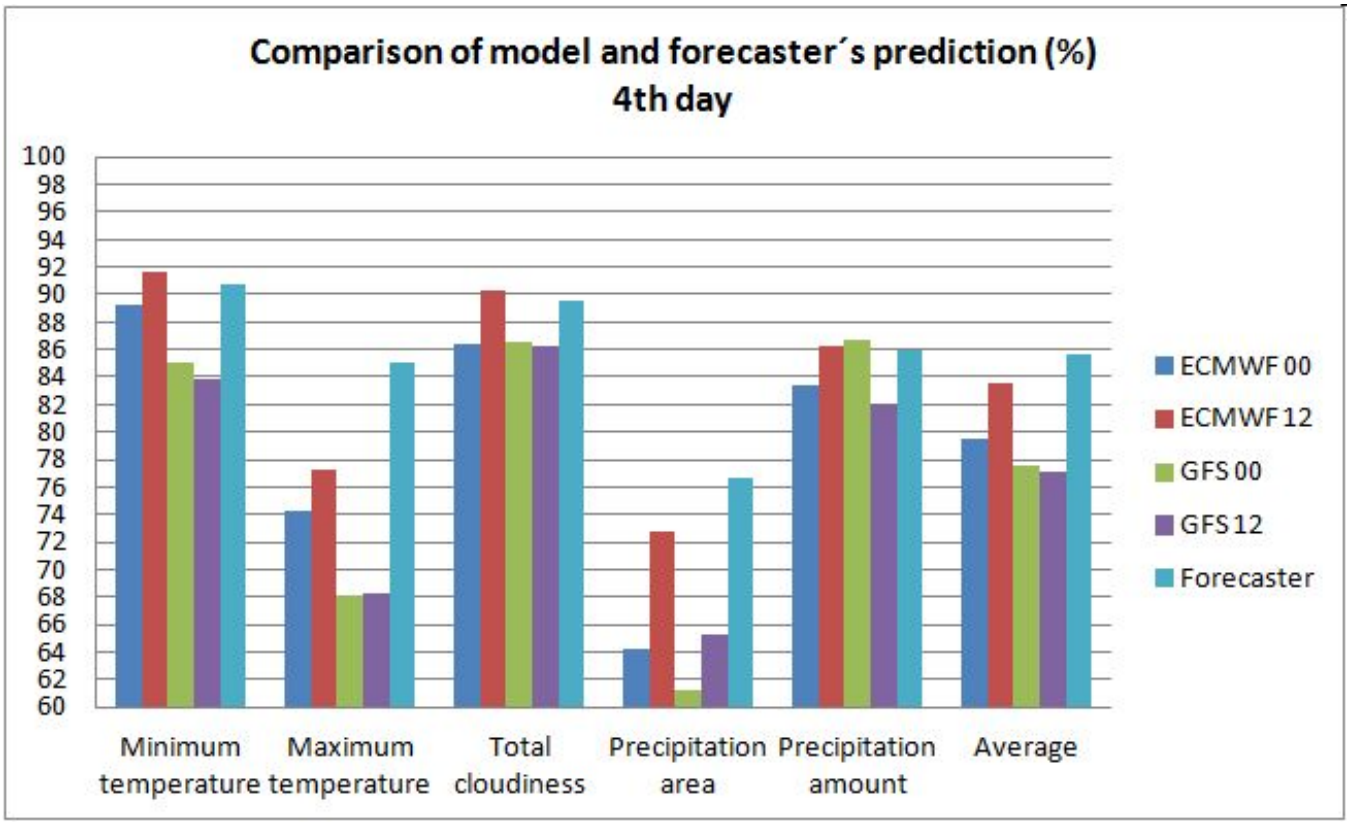

Figure 4 Comparison of ECMWF and GFS predictions and forecaster½s prediction for the 4th day.

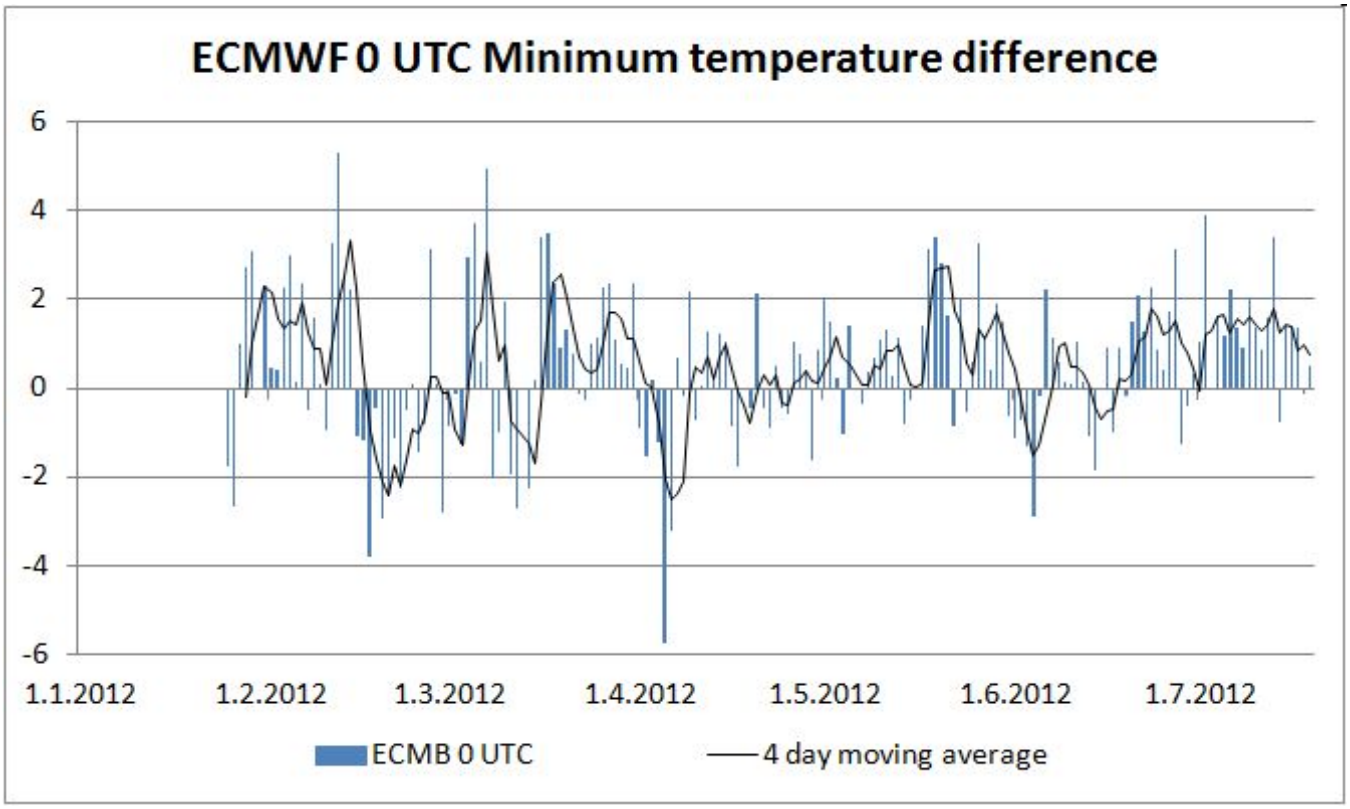

Figure 5 Time course and 4 day moving average of minimum temperature differences at íC of ECMWF prediction for the 4th day.

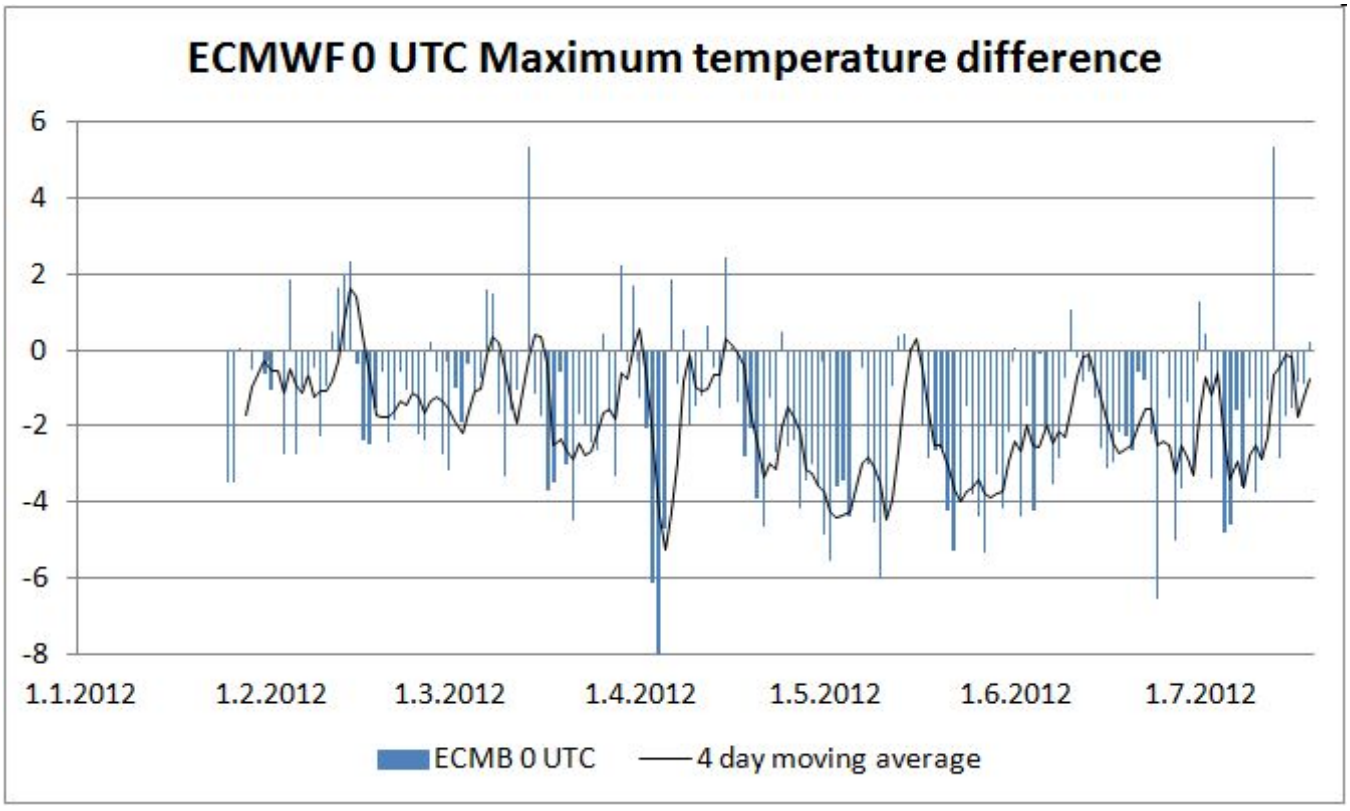

Figure 6 Time course and 4 day moving average of maximum temperature differences at íC of ECMWF prediction for the 4th day.

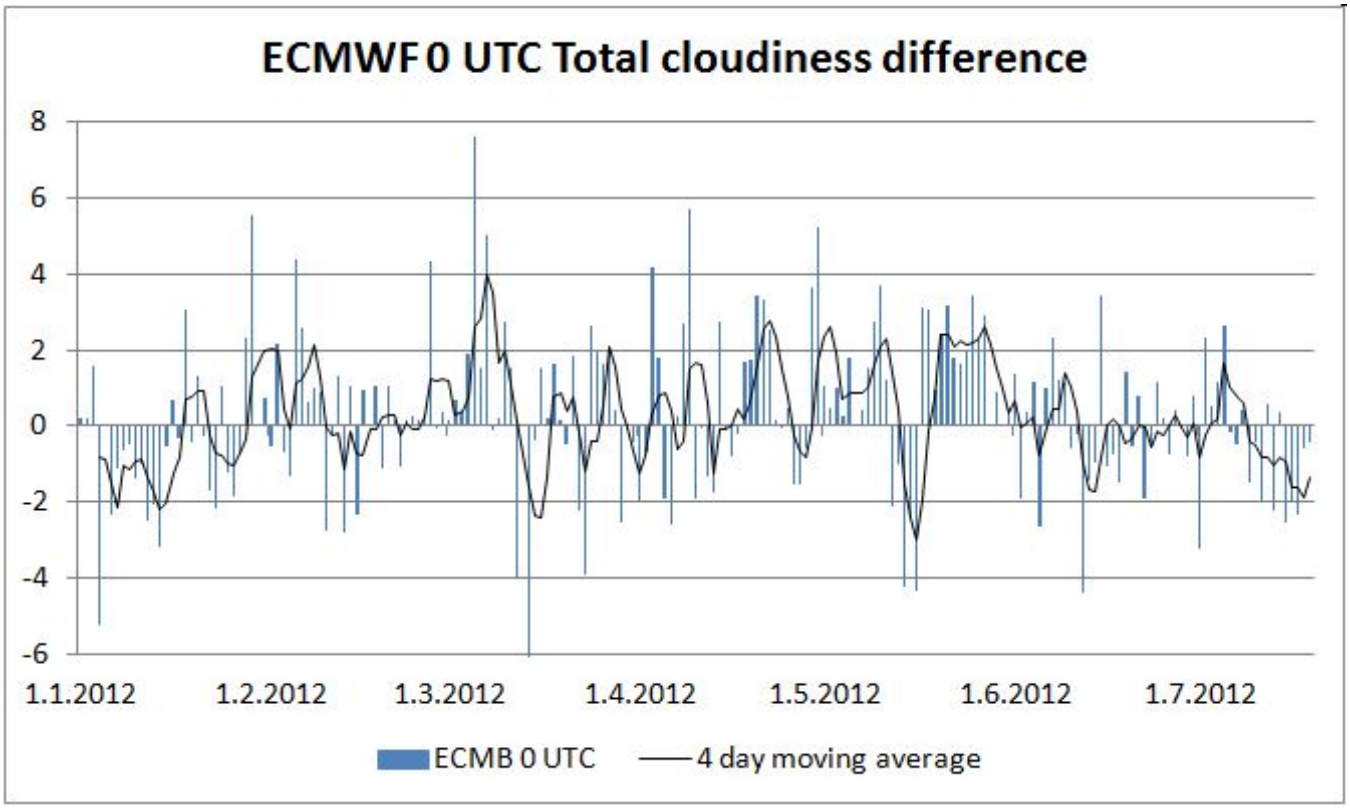

Figure 7 Time course and 4 day moving average of total cloudiness differences at tenth of cloud cover of ECMWF prediction for the 4th day.

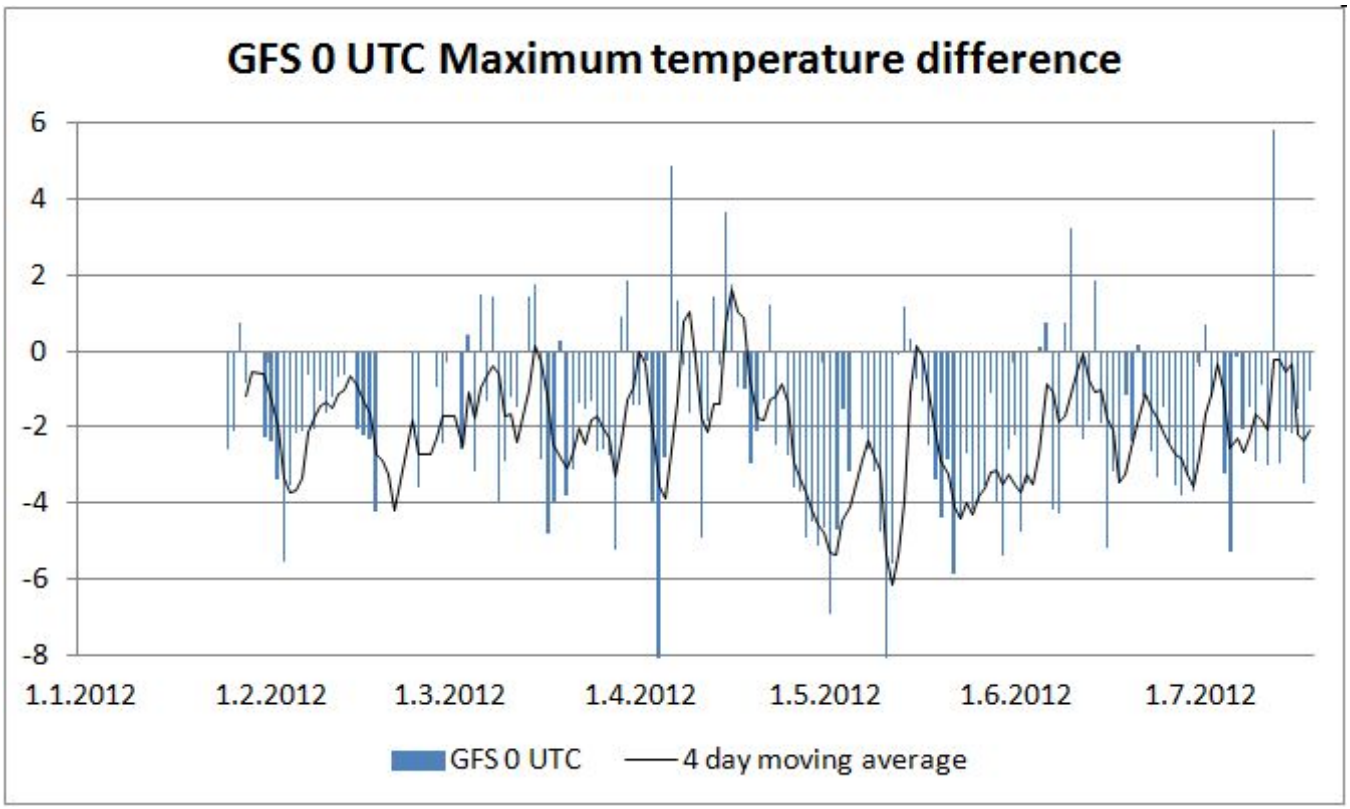

Figure 8 Time course and 4 day moving average of maximum temperature differences at íC of GFS (Washington) prediction for the 4th day.

3. Conclusions:

a) Generally success rate is decreasing with length of forecasting period. For the same day runs from 12 UTC are a bit more successful than runs from 00 UTC because they are 12 hrs newest.

b) Quite low success rate of maximum temperature of ECMWF and especially GFS. They are usually underestimated by both models (it is showed on Fig. 6 for ECMWF and Fig. 8 for GFS).

c) Quite low success rate of precipitation area. Local models were more successful (for tomorrow) mainly due to more detailed orography.

d) Success rate of forecaster½s prediction is better or comparable to models predictions for all meteorological phenomena (forecaster experience, knowledge of the territory…)

e) When we compare time courses and 4 day moving averages of meteorological elements from ECMWF (Fig.5 to Fig. 7) with the same ones from different models (example on Fig 8 for GFS maximum differences) we can see that different models behave in a similar way at the same meteorological situation.

3.1.3 Post-processed products

3.1.4 End products delivered to users

3.2 Subjective verification

3.2.1 Subjective scores (including evaluation of confidence indices when available)

3.2.2 Synoptic studies

The seasonal and monthly forecast products are considered as having some informative value. However, the frequency of "no signal" of these forecasts is considered still too high.

4. References to relevant publications