Application and verification of ECMWF products 2016

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 short-range and medium-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. Increasing number 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 have become the main products to issue short-range and 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

Objective statistical adaptation is used for 2metre temperature prediction.

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.

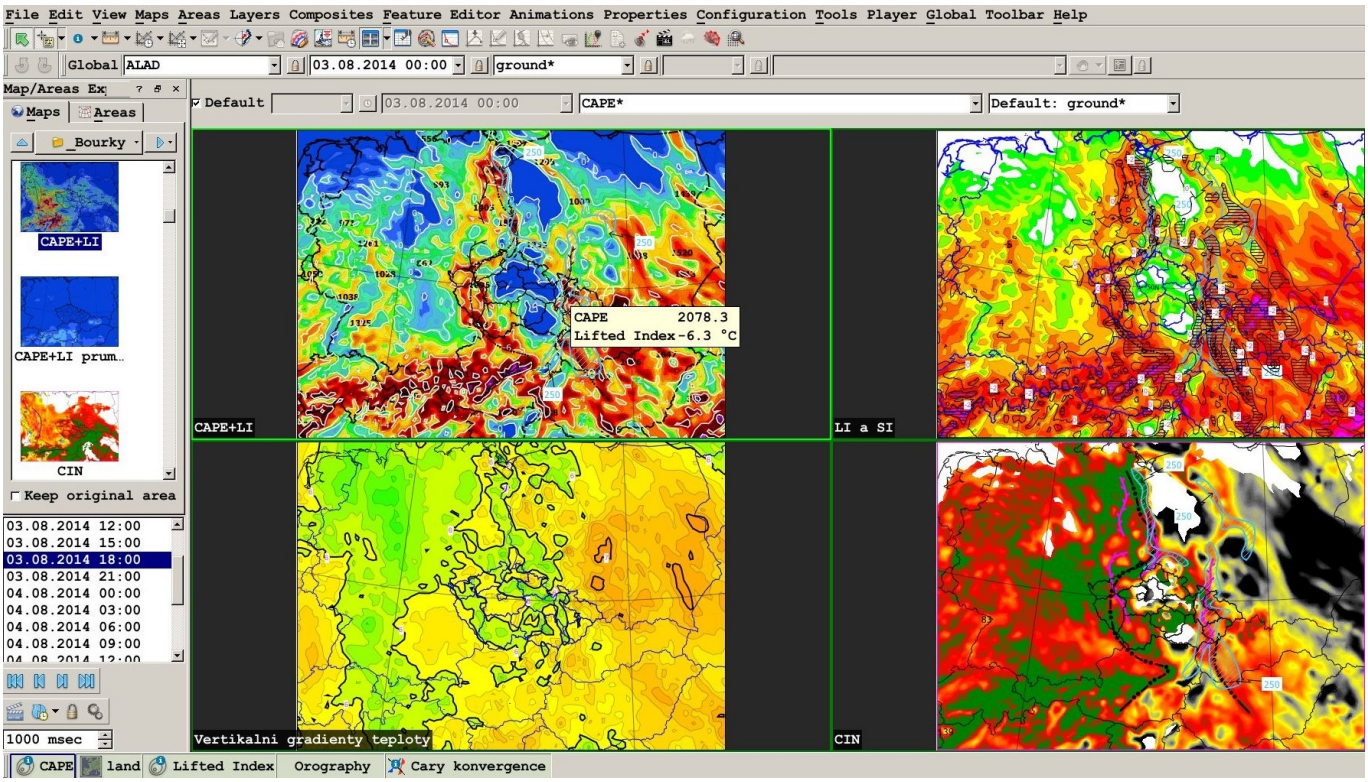
Some of meteorological parameters (pressure, temperature, wind) predicted by ECMWF are used as an automatic input to some our products that are controlled and modified by forecasters.

2.1.3. Derived fields

Derived fields are calculated to improve detection and prediction of severe weather, mainly severe thunderstorms with heavy rain, hail and severe wind gusts. They are calculated by weather station Visual Weather (VW) of IBL soft and depicted to tables, maps and diagrams by means of the same weather station.

It is calculated instability of the atmosphere (CAPE, Lifted index, Showalter index, convective inhibition CIN, temperature gradient between 500 and 850 hPa), wind shear between different levels, SWEAT index, jet stream, low-level jet stream, mixing ratio and precipitable water. These parameters are used to improve prediction of thunderstorms and their dangerous events.

Other derived fields like type of precipitation, fogs, rime, ventilaton index are used for prediction another events.



Picture 1 Example of derived fields that are used for thunderstorm event prediction. In summer time forecasters plots convergence and instability lines and instability areas to these maps.

2.2. Use of ECMWF 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 neighboring countries are well applicable also for our service.

3.1 Objective verification

3.1.1 Direct ECMWF model output (both HRES and ENS)

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:

1. average of minimum temperature (2 m above the groud)
2. average of maximum temperature (2 m above the groud)
3. average of sunshine
4. percentage of stations with precipitation (precipitation area)
5. average of precipitation amount
6. percentage of stations with thunderstorms
7. percentage of stations with fogs.

All phenomena are evaluated for both the whole territory of Czech Republic and particular regions of Czech Republic (14 regions) for the 2st day (tomorrow), 3nd day (the day after tomorrow), the 4rd day and the 5th day.

In the year 2011 direct forecasts of weather prediction models were implemented 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 success rate both of forecaster´s predictions and of weather prediction models. Verification of local models is available only for the second day (tomorrow).

Results for the territory of Czech Republic for summer half of the year 2015 (from 1 april to 30 september) are depicted in pictures 1 to 3 and results for winter half of the years 2015/16 (from 1 october 2015 to 31 march 2016) are depicted in pictures 4 to 6. Software that we use evaluates these forecasts not only for Czech Republic, but for particular regions of Czech Republic as well.

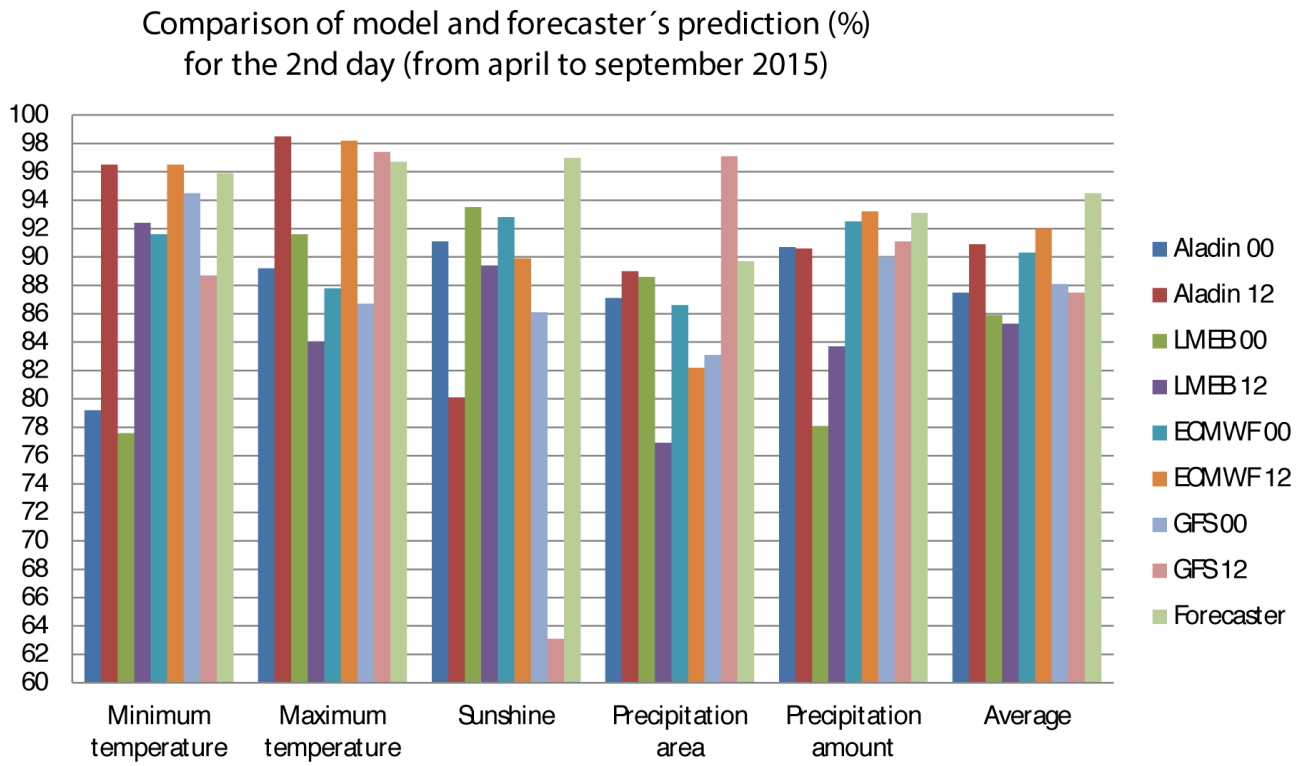


Fig. 1 Comparison of Aladin, LMEB, ECMWF and GFS predictions and forecaster´s predictions for the 2st day (tomorrow) for summer half of a year 2015.

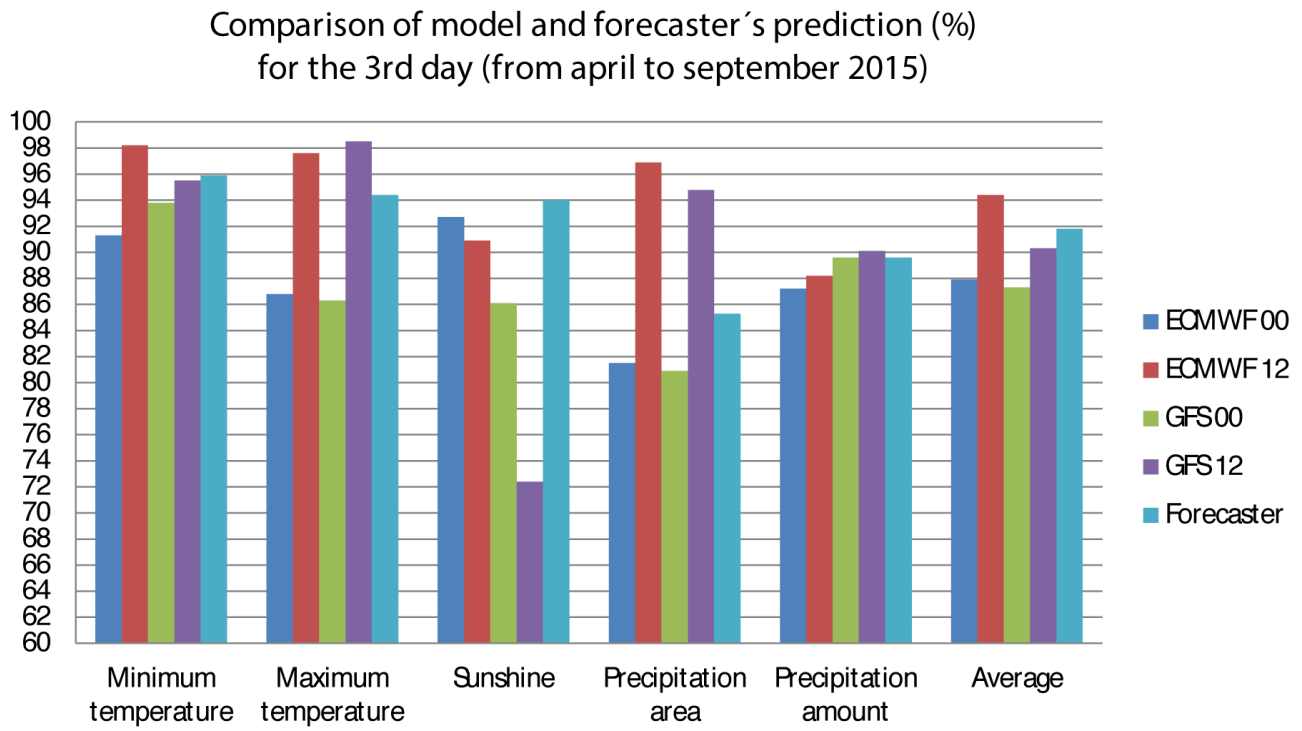


Fig. 2 Comparison of ECMWF and GFS predictions and forecaster´s prediction for the 3rd day (the day after tomorrow) for summer half of a year 2015.

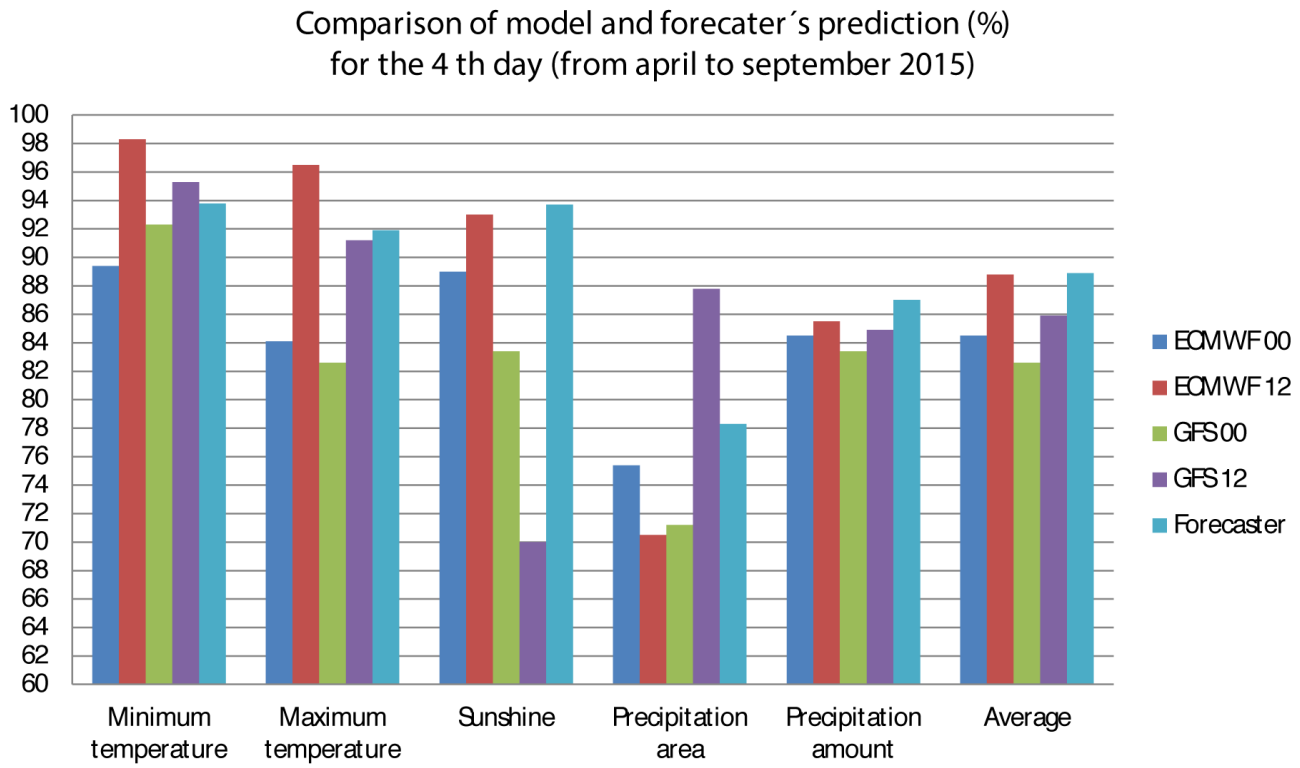


Fig. 3 Comparison of ECMWF and GFS predictions and forecaster´s prediction for the 4th day for summer half of a year 2015.

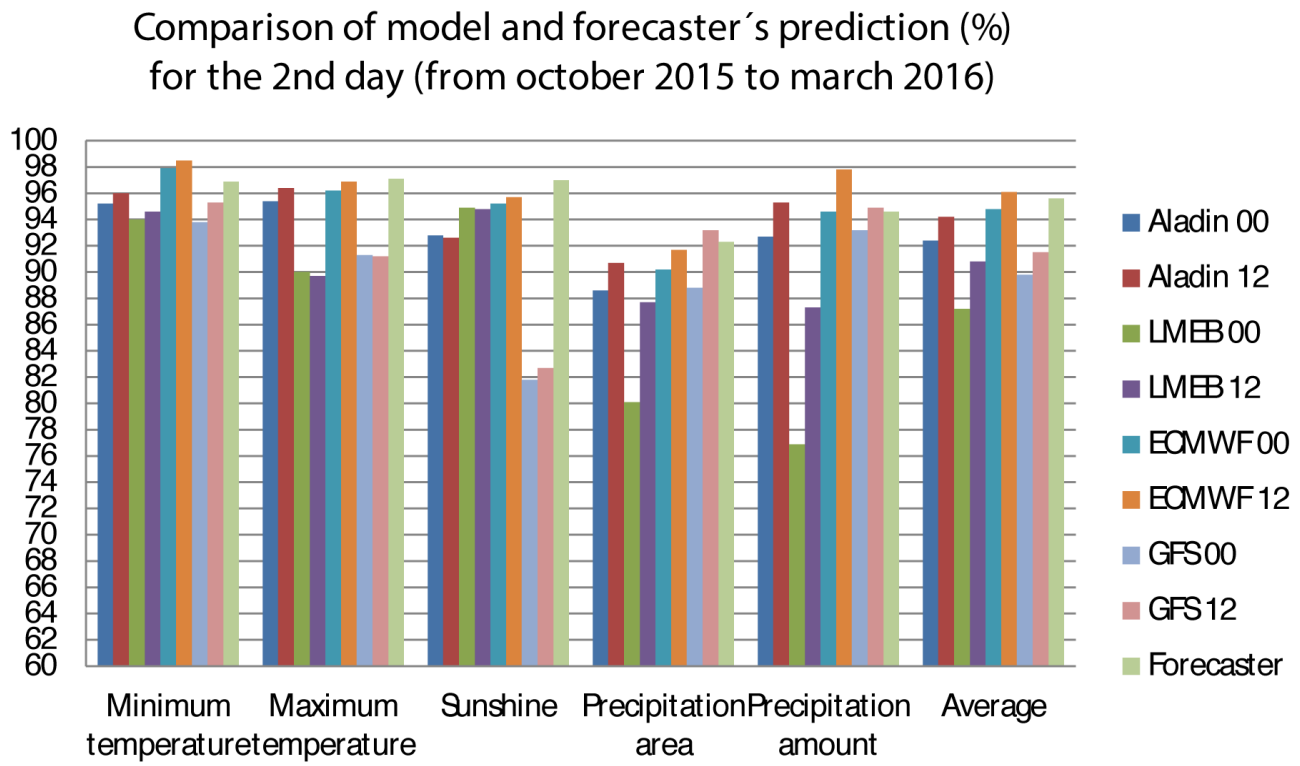


Fig. 4 Comparison of Aladin, LMEB, ECMWF and GFS predictions and forecaster´s predictions for the 2st day (tomorrow) for winter period 2015/16.

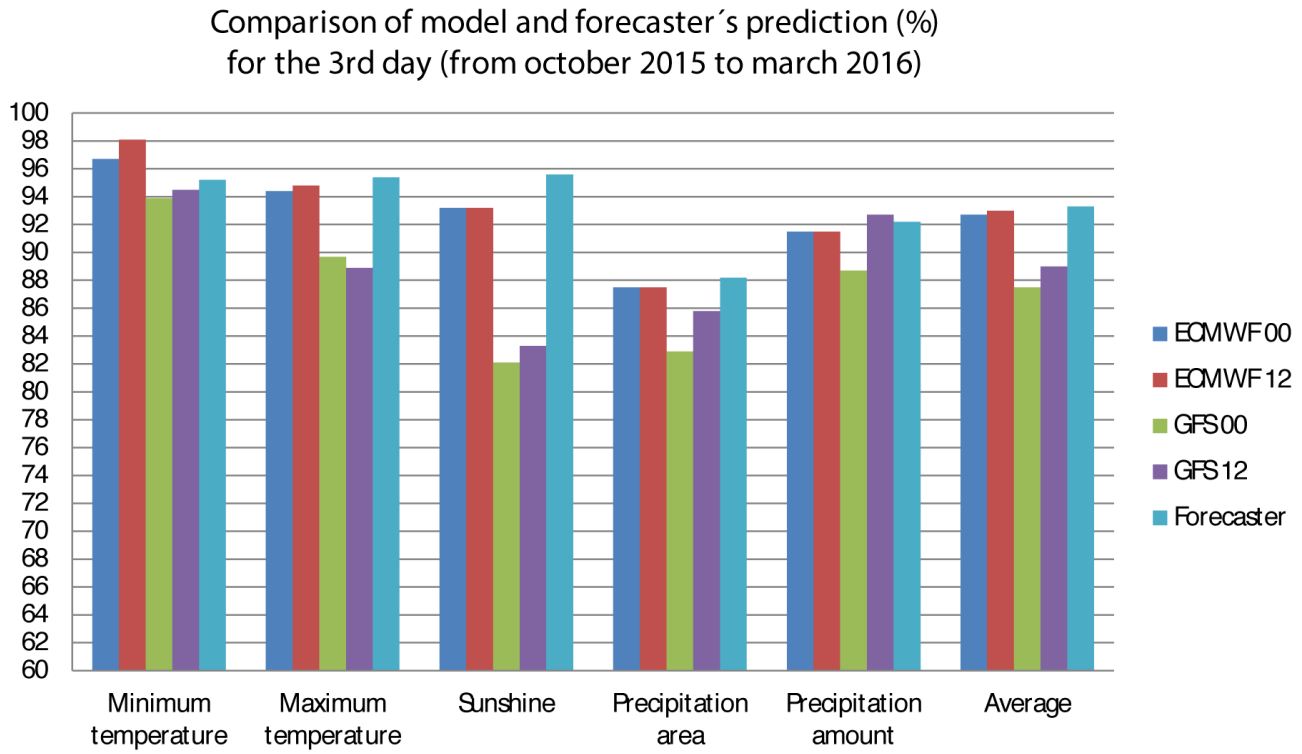


Fig. 5 Comparison of ECMWF and GFS predictions and forecaster´s prediction for the 3th day for winter period 2015/16.

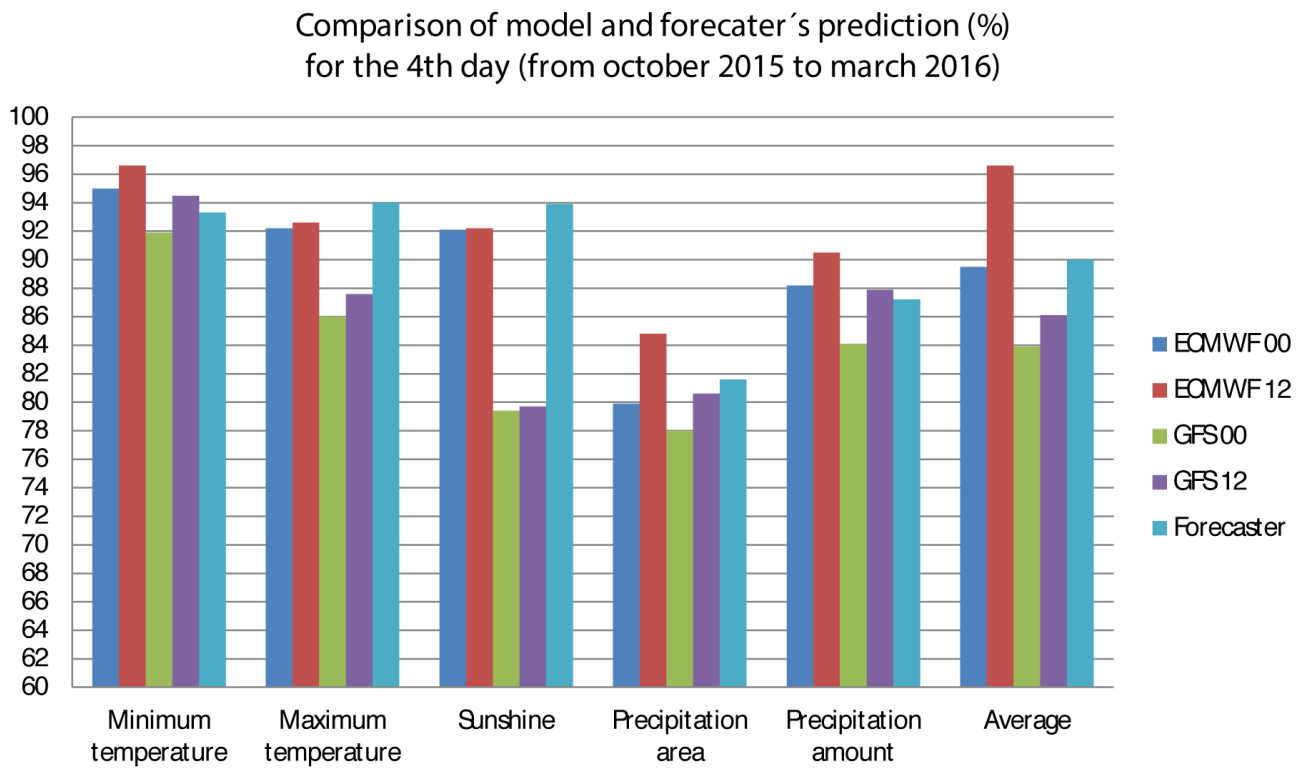


Fig. 6 Comparison of ECMWF and GFS predictions and forecaster´s prediction for the 4th day for winter period 2015/16.

Conclusions:

a) Generally success rate is decreasing with length of forecasting period. For the same day runs from 12 UTC are usually a bit more successful than runs from 00 UTC because they are 12 hrs newest. Forecaster´s prediction is based on models from 00 UTC (and study of synoptic situation, experience etc.).

b) Generally good results of ECMWF outputs also in comparison to local models.

c) Good prediction of sunshine of ECMWF (unlike GFS)

d) Better results of all models in winter than in summer in short-range (2nd day). Results in medium-range are similar.

e) Generally poor prediction of precipitation area at all models (problem of low precipitation).

f) Success rate of forecaster´s prediction is usually better or comparable to models predictions for all meteorological phenomena (forecaster experience, knowledge of the territory…).

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 Case studies

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

4 Feedback on ECMWF "forecast user" initiatives

We use the page "Known IFS forecasting issues", it is useful to be aware of them. Of course some of described issues are common not only to ECMWF model, but also to other numerical weather prediction models. We are interested mainly in precipitation forecasts issues and danger weather issues in general.

Severe weather catalogue is not used often but in some cases it is very useful.

5. References to relevant publications