Application and verification of ECMWF products 2014

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 have 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

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, ventilation index are used for prediction another events.

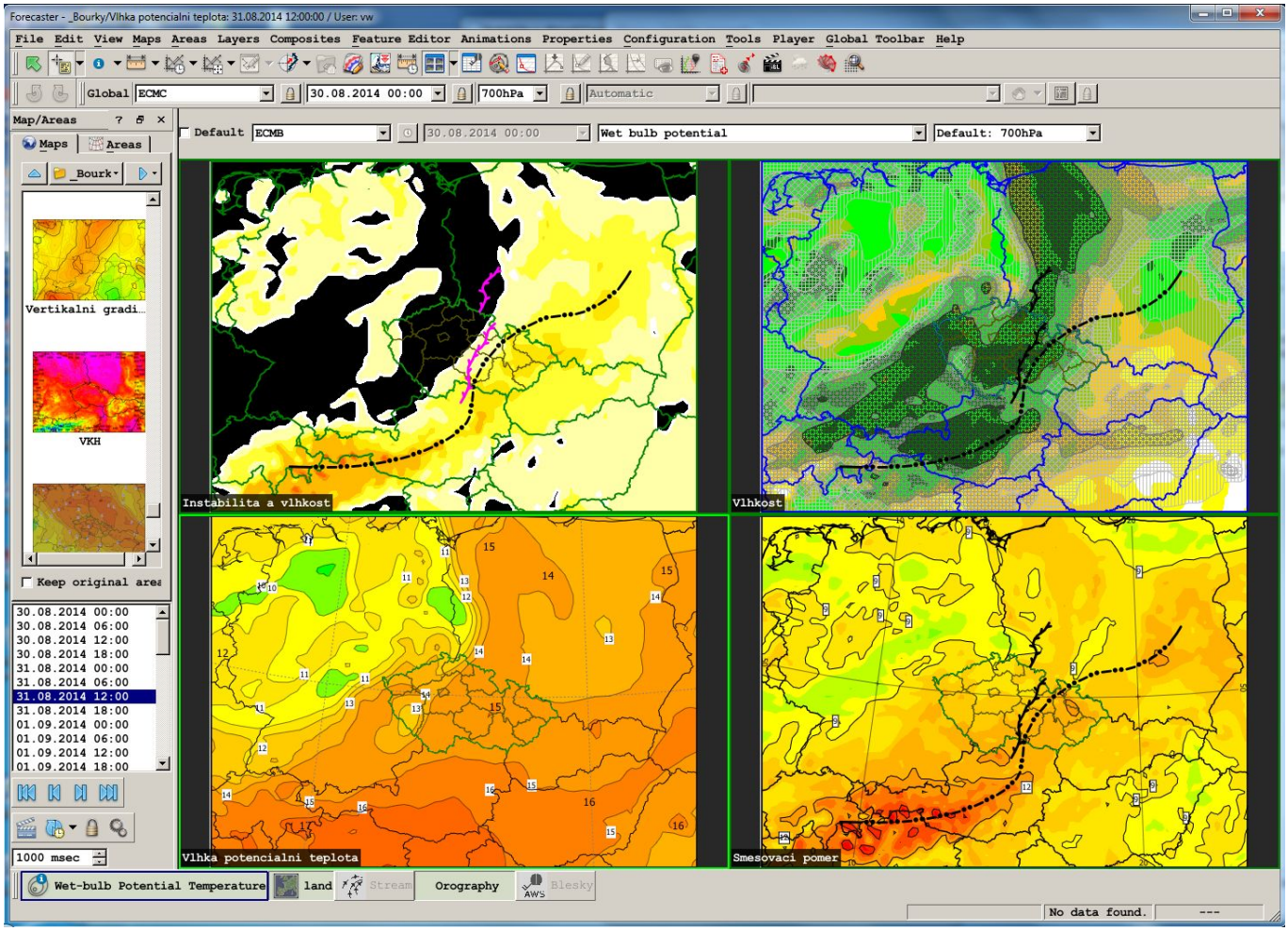

Figure 1 Example of derived fields that are used for thunderstorm events prediction. To these maps forecasters plots convergence and instability lines and instability areas.

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 neighboring 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

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.

In early summer 2013 Czech Republic was affected by three flood events. Detailed evaluation of these flood events, including functioning of warning service of CHMI and proposals of preventive measures was done during 2nd half of 2013 within governmental project Evaluation of floods in June 2013.

Contribution "**Quantitative Precipitation Forecast (QPF) by the IFS model during the flood episodes in June 2013 – discussion of some result**" was prepared for ECMWF. The main conclusions of this contribution:

Extreme precipitation event of June 1 – June 3 2013 in Czech Republic was quite a difficult one to forecast, regarding both the spatial distribution and amplitude. Besides the high amplitudes in mountain regions, there was a narrow belt of extreme precipitation across the country. The belt was a result of a chain-like effect existing for 20 hours about. It was likely out of the hope to capture this belt structure for lower resolution models like IFS. The underestimation of precipitation amounts is also understandable (all models underestimated mainly the lowland amounts), but we should have a critical remark to the westerly shift of the core of the precipitation activity also for short forecast ranges. The second discussed event of June 23 – June 26 2013 was forecast better, with a useful warning of 3 days ahead. There a critical remark could be addressed to the forecast for 25 June, namely due to a too late decay of the activity and oscillating solution, as demonstrated by frequency bias and fractions skill scores.

Experience and conclusions from evaluation of flood situations in Czech Republic during several last years

PROBLEMS WITH MODEL OUTPUTS

Processes that significantly affect precipitation regime:

- strong convergence at lower levels,
- significant wind shear between levels determining precipitation processes,
- wind speed and direction to the orographic obstacles
- development of convection (thunderstorm) processes, train effect
  - Total precipitation is product of combination of large-scale precipitation and precipitation associated with storm activity.
  - In many cases, global models are not able to correctly interpret these processes.
  - Despite better results of quantitative precipitation forecast from regional models, it is evident that in the atmosphere are still processes that cause intense rainfall and none of these models can not accurately describe them.

CONCLUSIONS

- Generally probabilistic (ensemble based) outputs of numerical models could be very beneficial for forecasters in many synoptic situations, especially EFI, but:

In case of high rainfall

- EPS probability is less useable

In case of mountainous regions with expected high rainfall/wind gusts

- •EPS probability is unsatisfactory, especially in potential flood synoptic situation (up to now CHMI has been very sceptical)

- Better results have multimodel outputs as:
- Probability over the threshold
- Max. value of models

CHALLENGES FOR CHMI FOR THE NEXT YEAR(S)

- Due to the fact that the new version of Visual Weather can work with EPS data, these data from ECMWF begin to download and process them.
- Then create sufficiently long series of such data (one year?) and find a method (BIAS correction) for their subsequent operational use.
- For this purpose a new development department at Central Forecasting Office was created on 1st July 2014.
- Extend the outputs of the model Aladin to 72 hours, and its outputs use for multimodel processing.
- Extend the outputs of the model Aladin up to 5 days using ECMWF lateral boundary conditions as a back-up for the Aladin model (only for one run from 00 UTC). These outputs also use for multimodel processing.
- Start preparing 3-5 day probabilistic forecasts (for MeteoAlarm) – using EPS or/and multimodel outputs.

4. References to relevant publications