Application and verification of ECMWF products 2016

Meteorological and Hydrological Service of Croatia – Lovro Kalin and Zoran Vakula

1. Summary of major highlights

At Meteorological and Hydrological Service of Croatia, ECMWF products are considered as the main source in the operational forecast, particularly for the medium- and long-range forecasts. For short range, Aladin model is included also.

Regular verification is still usually done by the point-to-point method, with synop data verified against nearest grid point of the model. The emphasis of the verification is on 2m-temperature and precipitation.

2. Use and application of products

2.1 Post-processing of ECMWF model output

2.1.1 Statistical adaptation

2.1.2 Physical adaptation

ECMWF lateral boundary conditions are used for running a 72hr forecast with ALADIN 8km model. No major change has been detected since last year (for details see 2013 report).

Still, an issue regarding SST has been detected. SST from the coupling files was compared to the values measured on stations and significant differences (up to 10K) were noticed. There are large discrepancies in model SST (from IFS LBCs) and SST from OSTIA in certain regions, suggesting IFS SST is not entirely from OSTIA but modified, at least for the Mediterranean and Adriatic Seas. Therefore, SST is operationally overwritten with the OSTIA analysis (the most recent available).

More on this topic can be found on http://radar.dhz.hr/~tudor/sst/sst_coupl_files2.pdf (courtesy of Martina Tudor).

2.1.3 Derived fields

2.2 Use of ECMWF products

In the operational forecast, ECMWF products are widely used, especially for the medium- and long-range forecasts. For the short range, the emphasis is put to the high resolution model (ALADIN - ALARO). This is particularly valuable for severe weather and warnings. For the long range, ECMWF forecasts are practically the only source; Service's end forecasts are based on ECMWF DMO, although some other sources (UKMO, SEECOF, IRI) are also consulted.

3. Verification of products

3.1 Objective verification

Describe verification activities and show related scores.

3.1.1 Direct ECMWF model output (both HRES and ENS)

In the previous Reports a certain improvement of the skill of 12-hour precipitation forecast has been presented. Latest results confirm that improvement, still with slightly worse results compared to the previous season. While skill (Hansen Kuipers skill score) remained almost the same, bias is slightly negative compared to ideal 1 value in 2014.

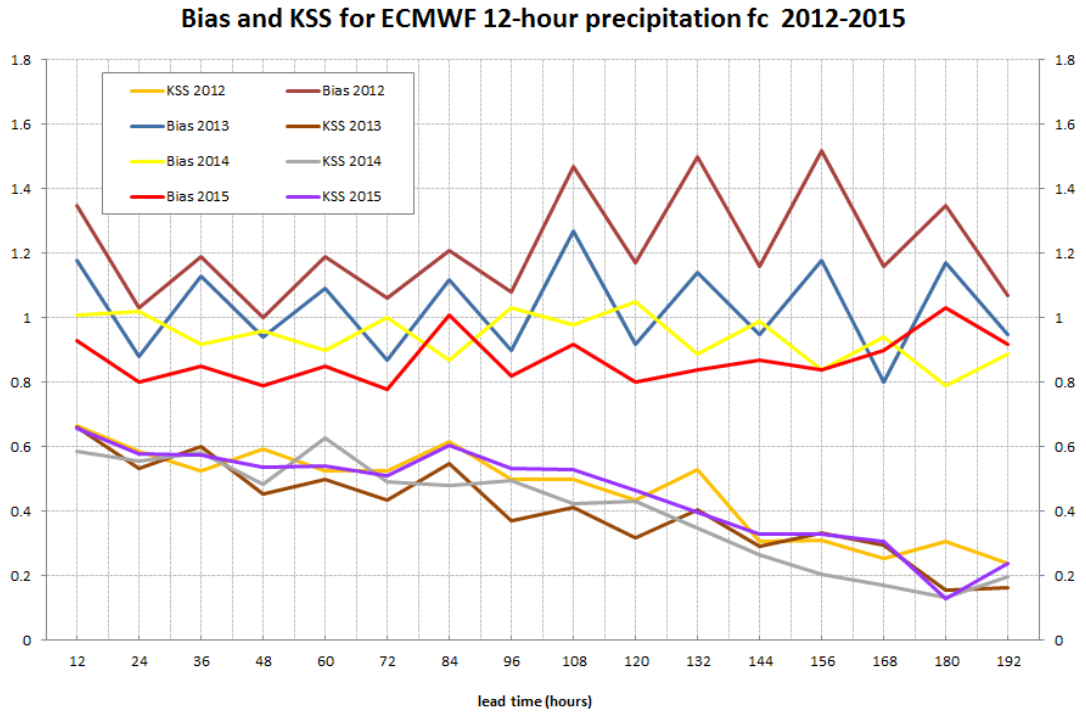

Fig. 1. Verification scores for ECMWF 12-hour precipitation forecast (larger than 0 mm) for station Zagreb Maksimir (14240). Bias and Hansen-Kuipers skill score (KSS) are displayed.

For the 2m-temperature forecast, the extensive verification is provided regularly, with various scores, exhibiting typical features of the forecasting system (see previous reports). Figure 2. presents an example of such verification, with minor degradation of accuracy compared to previous years. However, when expressed in terms of skill, score for year 2015 gives somewhat better results compared to year 2014 (not shown).

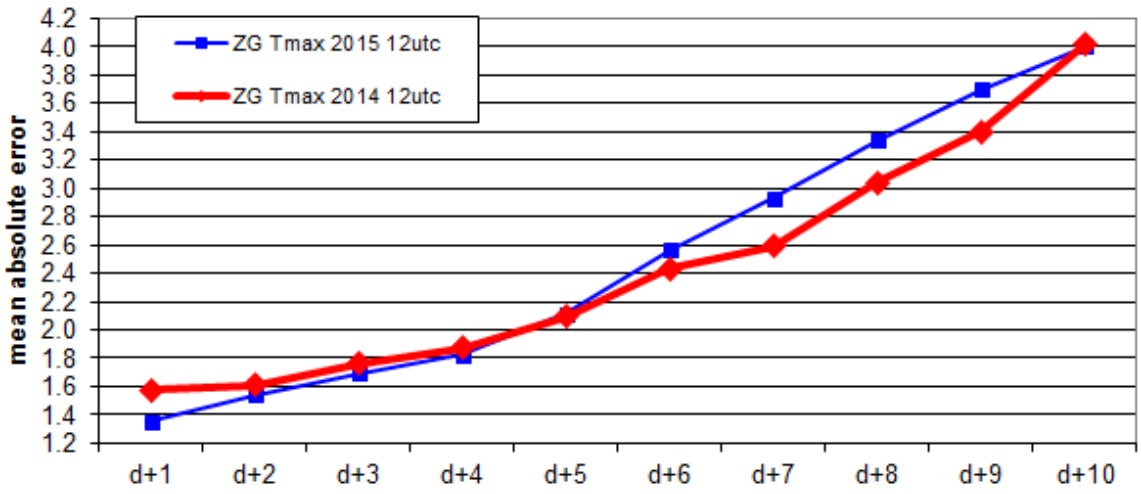

Fig. 2. Mean absolute error for 2m maximum temperature forecast for 2014 and 2015., for station Zagreb Maksimir (14240).

3.1.2 ECMWF model output compared to other NWP models

In the short range, performance of ECMWF model is periodically compared to Aladin (ALARO) Croatia model. Results (not presented in this paper) usually exhibit similar level of skill performed by the two models.

Another comparison of forecasts/models is delivered in real time, with daily visualisation of different forecasts compared to observations. An example of 2m maximum temperature forecast is displayed in Figure 3. Both models had substantial problems in catching daily maxima, by episodes of either severe overestimation or underestimation. This is a feature well known in typical winter stable situations. As the consequence, duty forecasters (blue line) also struggled to stay in the acceptable threshold of 2°C error.

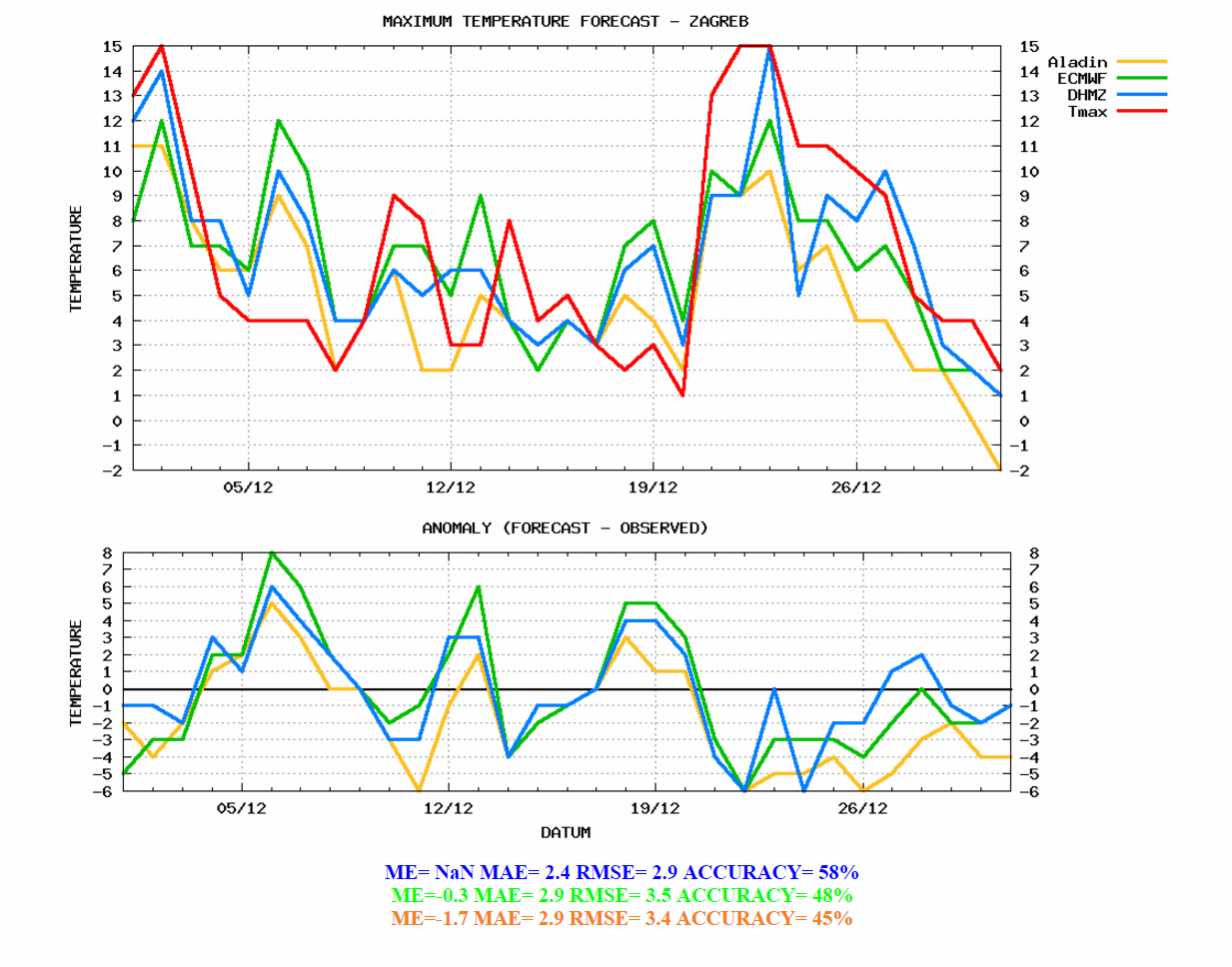

Fig. 3. Maximum 2m-temperature forecast (for the following day) for station Zagreb Maksimir (14240) in December 2015. Aladin (yellow line), ECMWF (green line), forecaster's prediction (blue line) and observed temperature (red line) are displayed. Anomalies are displayed in the lower panel Mean error (ME), mean absolute error (MAE) and root mean square error (RMSE) are calculated. Accuracy is defined as the percentage of forecasts with error smaller than 2 degrees.

3.1.3 Post-processed products

Studies have been carried out to produce monthly/seasonal ensemble forecast of Standardized Precipitation Index. Results are very promising (described in last year's Report), but the SPI forecast is still not fully operational.

3.1.4 End products delivered to users

Long range forecast are also monitored with special attention, since the Service's monthly and seasonal end product forecast are based on ECMWF-DMO, visualized and interpreted. Classical scores are regularly calculated, for monthly forecast exhibiting decrease of the skill with time, with marginal skill for the week 3 and 4. However, another approach provides better results, when comparing number of successful and unsuccessful forecast of positive/negative temperature/precipitation anomalies (Figure 4). Similar approach is applied for seasonal forecasts (Figure 5).

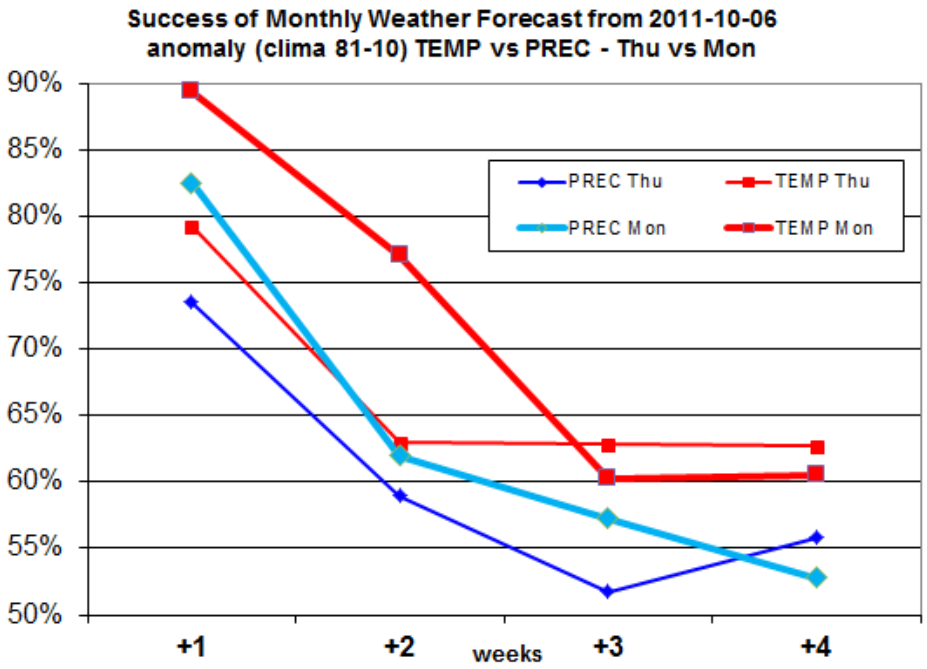

Fig. 4 Number of successful/unsuccessful forecasts of weakly temperature and precipitation anomaly (Monthly forecast system), for station Zagreb Maksimir (14240)

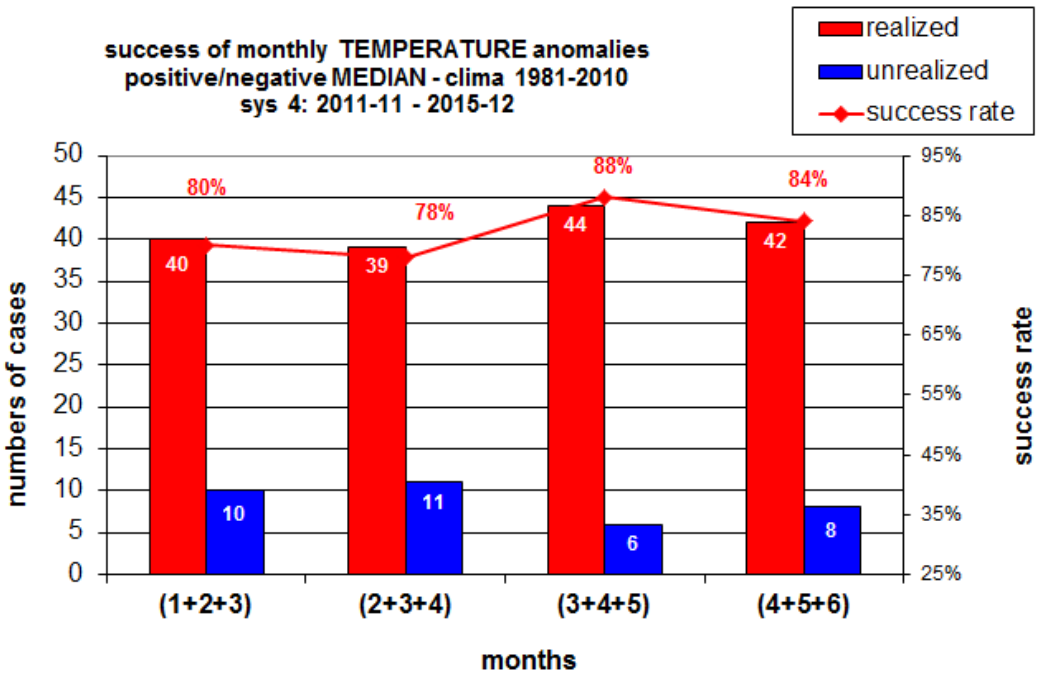

Fig. 5. Percentage of successful forecasts of positive/negative 3-monthly temperature anomaly, for different lead times (station Zagreb Maksimir). ECMWF seasonal forecast is compared to 'layman' forecast which persistently forecasts positive anomaly.

3.2 Subjective verification

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

Major subjective comments refer to: improved wind forecast, jumpiness of the model (even for ensembles in the medium range) and excessive precipitation amounts at the end of the forecast range. Other remarks are related to some typical problems such as behaviour of 2m-temperature in situations with snow cover, inversions etc. Peculiar forecast values of CAPE over sea are also reported.

A survey regarding new visibility product was proposed to the forecasters in the Service's Maritime Branch (and even in the Air Traffic Weather Service), but unfortunately with no success, since most of the forecasters reported they still don't use the product intensively, while some expressed some subjective criticism of the product accuracy (particularly in fog and rain situations).

3.2.2 Case studies

One of the most significant severe events in the last season was the freezing rain that occurred on Jan 5th 2016. This is so far the only such case since ECMWF precipitation type product started. Possibility of severe event was detected in ECMWF forecast even in the medium range (5 days in advance), and was consistent as the target was approaching. This all resulted in very good Service's early announcement (red warning) and final forecasts of the freezing rain, that covered most of the Croatian inland. Fortunately, no significant damage or casualties have been reported. Such forecasts are considered with great attention, since the notorious freezing rain event in 2014 in Slovenia, Croatia and Hungary.

The 2016 case will be submitted in detail to the Severe Event Catalogue.

4. Feedback on ECMWF "forecast user" initiatives

These initiatives are most welcome and highly appreciated by the forecasters. Unfortunately, no joint conclusion regarding their features has been produced.

5. References to relevant publications