Application and verification of ECMWF products 2012

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1. Summary of major highlights

At Meteorological and Hydrological Service of Croatia, medium- and long-range forecasts are dominantly based on ECMWF products. For short range, Aladin model is very important also.

Regular verification is 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.

For the medium range, recent verification results of the precipitation forecast exhibit certain increase of the skill. Particularly due to more frequent seasons of extreme weather, demand for monthly and seasonal forecasts is constantly increasing.

2. Use and application of products

Include medium-range deterministic and ensemble forecasts, monthly forecast, seasonal forecast

2.1 Post-processing of model output

2.1.1 Statistical adaptation

2.1.2 Physical adaptation

For the approximate period of 2012, ECMWF boundary conditions (starting with 18UTC run + 6 hours forecast) have been used to perform a parallel run of Aladin (ALARO) Croatia model, with 8 km horizontal resolution. Obtained skill exhibits no significant difference compared to operational Aladin (boundary conditions by ARPEGE model).

2.1.3 Derived fields

Including post-processing of EPS output e.g. clustering, probabilities

2.2 Use of products

For the operational purpose, ECMWF products are widely used, particularly for medium and long range forecasts. For the short range, they are used along with the high resolution model (ALADIN - ALARO). This is particularly valuable for severe weather and warnings. Furthermore, significance of ensemble approach is constantly increasing, particularly for the long range, where the ECMWF forecasts are practically the only source (Service's forecasts based on ECMWF DMO).

3. Verification of products

3.1 Objective verification

3.1.1 Direct ECMWF model output (both deterministic and EPS)

No significant verification has been carried out for ensemble forecasts.

So far the verification of all meteorological forecasts has been performed with synop data, usually against nearest grid point. Parameters mostly verified are 2m-temperature and precipitation.

In the recent years, verification results for the medium range have not been presented extensively in this paper, since no significant change has been observed. However, this year we present some results that point to a possible significant improvement of the medium-range forecast performance. Figure 1. presents some verification scores (Wilks, 2011) for the 12-hour precipitation forecast, with respect to lead time. A clear improvement for year 2012 can be observed. It can be associated with the implementation of IFS cycle 38r1, which introduced a series of improvements that are expected to influence model performance (http://www.ecmwf.int/products/changes/ifs_cycle_38r1/).
For the more reliable proof of this connection in our case, a more comprehensive study needs to be carried out.

Furthermore, results exhibit several other known features, such as overestimation of the precipitation, and significant daily variation (before noon and afternoon) of bias and skill scores.

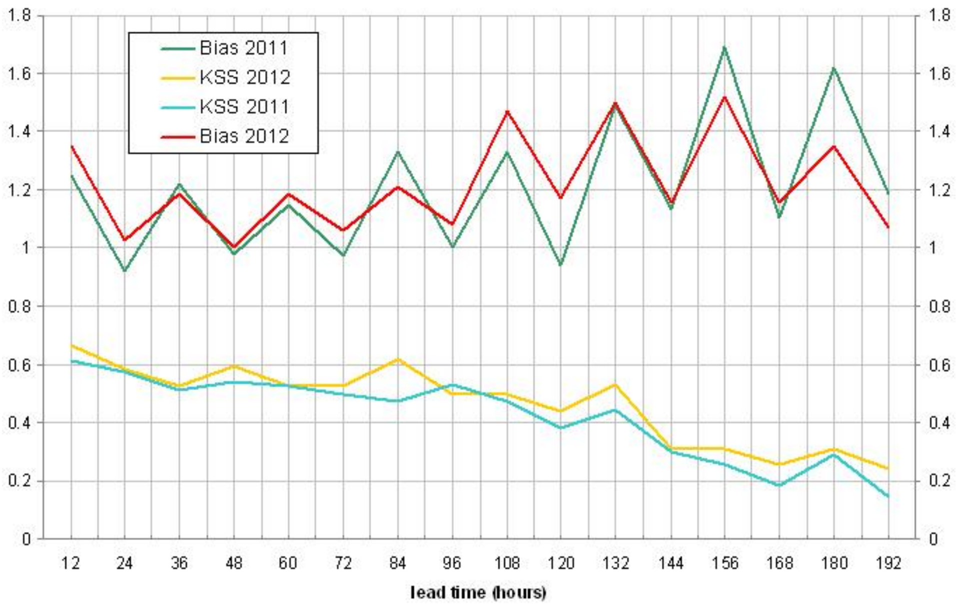

Figure 1. Verification scores for ECMWF 12-hour precipitation forecast (larger than 0 mm) for station Zagreb Maksimir (14240). Bias and Hansen-Kuipers skill score are displayed.

For the temperature forecast, a real time daily verification has been established, with visualisation of different forecasts compared to observations. An example of maximum temperature forecast in July (for the following day) is given in Figure 2. A relatively good skill of both models can be noticed, particularly for the extreme hot spell at the end of the month. Still, for ECMWF, a general slight underestimation of the temperature (ME) is still exhibited.

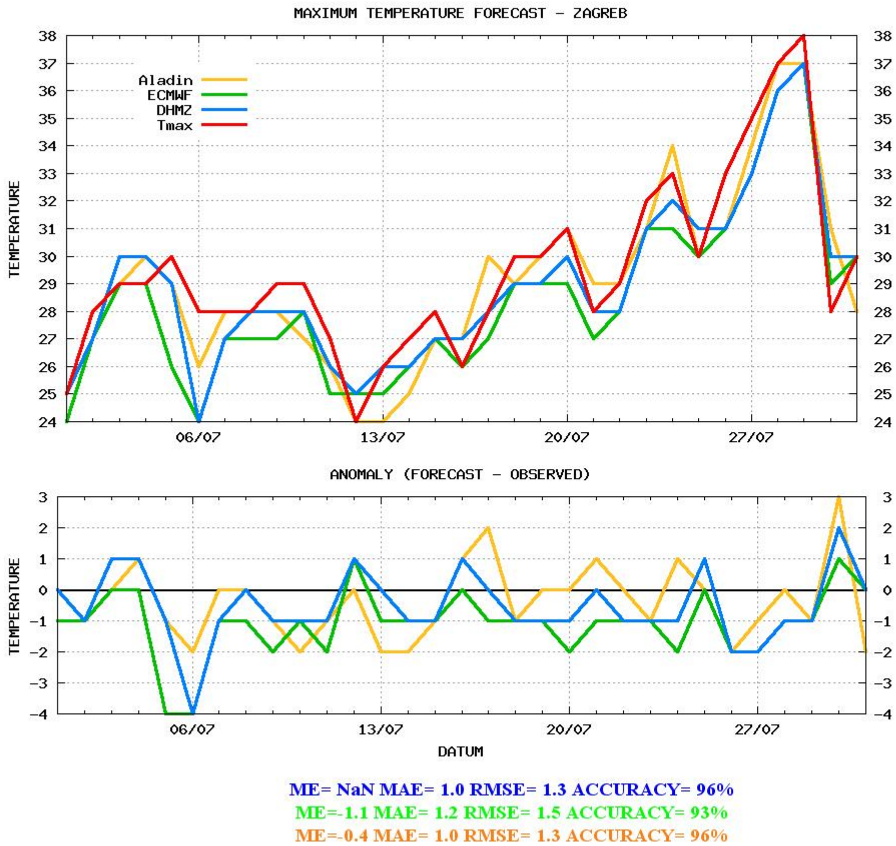

Figure 2. Maximum 2m-temperature forecast (for the following day) for station Zagreb Maksimir (14240) in July 2012. Aladin (yellow line), ECMWF (green line), forecaster's prediction (blue line) and observed temperature (red line) are displayed. Mean error (ME), mean absolute error (MAE) and root mean square error (RMSE) are calculated. Accuracy is defined as the percentage of forecasts with error smaller than 2 degrees.

In the recent years, there is a growing demand for long range forecasts, particularly due to frequent periods and seasons characterized by climatological extremes. At our Service, monthly and seasonal end-forecasts are issued regularly. They are based almost exclusively on ECMWF forecast, with direct model output prediction followed by a short explanation by the forecaster.

The main feature associated with seasonal forecasts is the lack of the signal. Figure 3 presents the comparison of temperature anomaly forecasts compared to the observed data. It can be noted that the predicted variability is significantly smaller than the observed one, because the predicted values (usually between 0 and 1degrees Celsius) are one order of magnitude smaller than the corresponding observations (2-5 degrees Celsius). This feature - along with ensemble mean/median concept - leads to the inability to predict anomalies posititoned on the tails of climatological distribution. So, instead of ensemble mean/median (currently in use at our Service), a probabilistic approach would be recommended, calculating probabilities for defined events, using quantiles (terciles) etc.

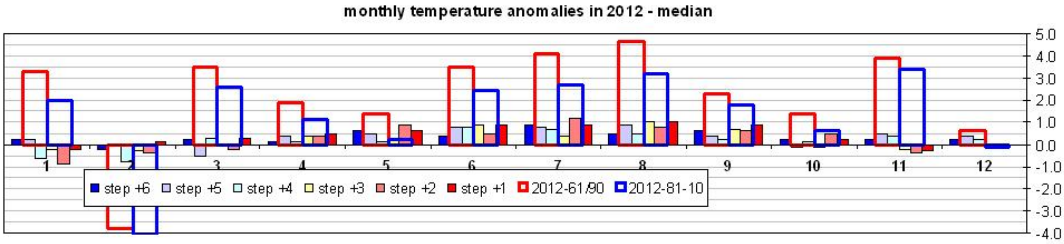

Figure 3. Forecasts of mean monthly temperature anomalies for station Zagreb Maksimir (14240), for different lead times (from month+1 to month+6), compared to the observed ones. Anomalies are calculated with respect to two different climatological reference periods: 1961-1990 (red boxes) and 1980-2010 (blue boxes).

However, an ability to resolve potentially warm and cold months/seasons is accomplished (Figure 4). Such high skill is however partly compromised because of the significant majority of warm months/seasons that occurs in recent years.

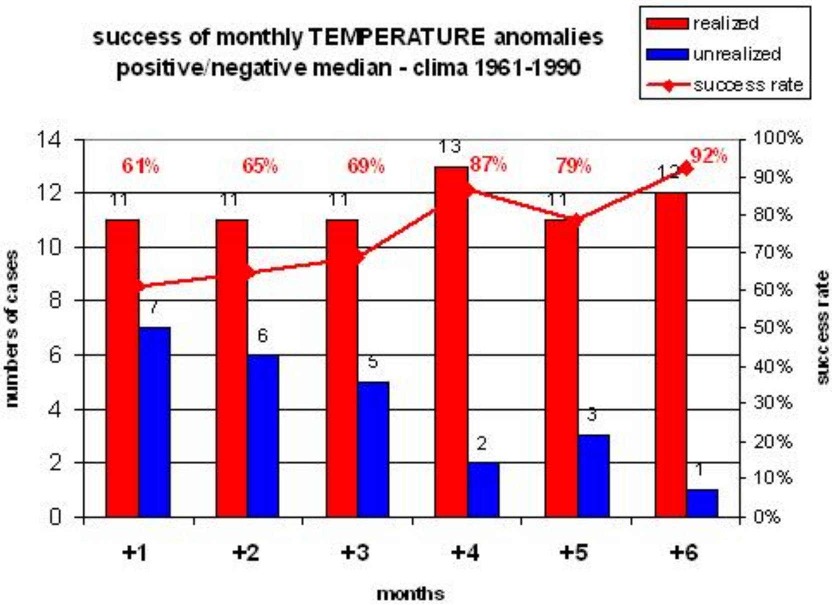

Figure 4. Number of successful (red bars) and unsuccessful (blue bars) forecasts of positive/negative monthly anomaly prediction, for different lead times (station Zagreb Maksimir).

3.1.2 ECMWF model output compared to other NWP models

For 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 two models.

3.1.3 Post-processed products

3.1.4 End products delivered to users

3.2 Subjective verification

Subjective verification of ECMWF forecasts is done only occasionally, usually through individual studies, but no systematic verification has been carried out. For some general subjective remarks see previous reports.

4. References to relevant publications

Wilks, D.S., 2011: Statistical methods in the atmospheric sciences. Third edition. Academic Press, London