



Forecast verification at the Croatian Meteorological and Hydrological Service

Lovro Kalin¹, Zoran Vakula¹ and Josip Juras²

¹Meteorological and Hydrological Service, Zagreb, Croatia kalin@cirus.dhz.hr, vakula@cirus.dhz.hr

²Department of Geophysics, University of Zagreb, Croatia juras@irb.hr

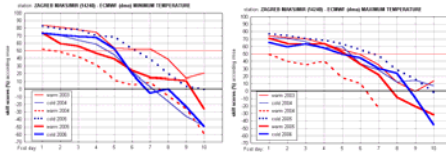


Abstract

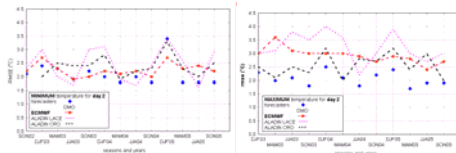
Verification developed at the Croatian Meteorological and Hydrological service is mostly done on a point-to-point basis (synop data against nearest grid point). A variety of scores is computed, particularly for temperature, precipitation and wind. Croatian versions of ALADIN model (00 UTC run) and ECMWF 12 UTC run.

Temperature

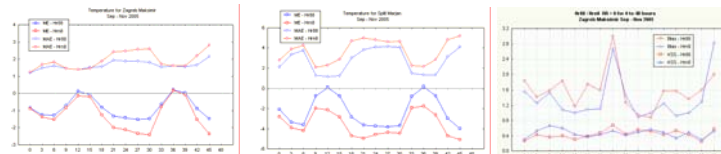
Direct model output temperature (DMO) from ECMWF and Aladin, and subjective forecast are verified against synop data.



Deterioration of temperature forecast (ECMWF), approaching zero skill between day 7 and day 10. Samples are divided in warmer and colder season, in order to resolve better skill in colder period, especially for minimum temperature forecast.



Temperature forecasts show significant seasonal variation, with better skill in warmer part of the year, and worse in winter - particularly for minimum temperature - when stable inversion situations are not well matched.

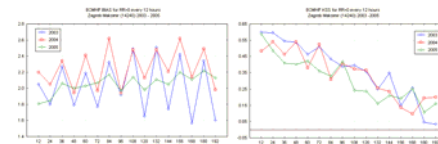


In autumn 2005, a new version of Aladin model is introduced to the operational forecast. During 3 months of trial period both models were run - and more intensive verification was made - to give some feed back to the modeling people.

Although a sample can be regarded as not sufficiently large, a significant improvement can be noticed. Bias is reduced, although there is still a significant daily variation - particularly for the consistently underestimated temperature for marine stations (upper middle). Precipitation for the new model is slightly less overbiased, with no significant improvement in skill (upper right).

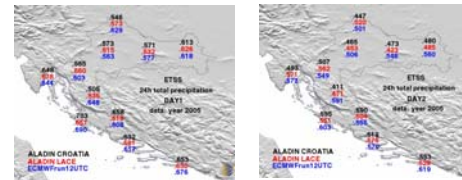
Precipitation

Verification of precipitation is done on a point basis against nearest grid point. A variety of scores is calculated: bias, Equitable Threat Skill Score (ETSS), Hansen-Kuipers skill score (KSS), Heidke skill score (HSS) etc.



Comparison of bias for last 3 years (upper left) shows a significant improvement in reducing daily variation - for the year 2005 (green line)

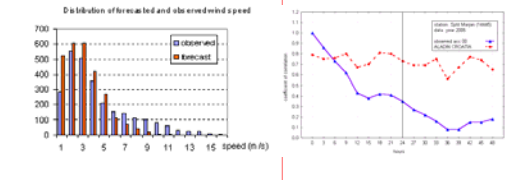
Upper right figure displays deterioration of skill (Hansen - Kuipers skill score) in time - with some potential improvement when approaching the end of the forecasted period.



Comparison of ECMWF against two Aladin versions shows slight advantage for ECMWF (ETSS for 24-hour precipitation for day 2, with thresholds 0.1, 1 and 5 mm).

Wind

An emphasis is put on the verification of Aladin wind forecasts, widely used in the operational duty, and most appreciated even in episodes with strong bura gusts.



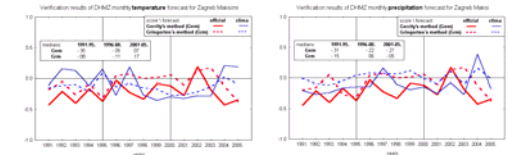
Distribution of forecasted wind speed (upper left) is narrower than observed, and shifted to the lower speeds, with overestimation for lower speed frequencies, and underestimation for higher speed frequencies - most common feature for all models.

Correlation analysis (upper right) gave surprisingly good - even excellent results - with very slight decrease of skill through whole forecasting period.

Monthly forecast

Based on medium range, monthly and seasonal WCMWF forecast - and combined with statistical method of analogy - a monthly forecast is issued twice a month for 5 Croatian regions - forecasting temperature and precipitation anomaly.

Verification, done by two different methods show some skill and improvement in time - particularly when ECMWF forecasts were introduced and implemented: deterministic in year 1995, EPS in 2000 and eventually seasonal forecasts.

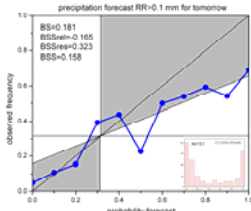


References

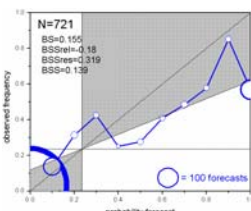
Jolliffe, I.T. and D.B. Stephenson, 2003. Forecast Verification: A Practitioner's Guide in Atmospheric Sciences (Wiley)
Gerrity J. P., 1992: A note on Gandin and Murphy's equitable skill score. *Mon. Wea. Rev.*, **120**, 2709-2712
Nurmi, P., 2003: *Recommendations on the verification of local weather forecasts*, ECMWF Technical Memorandum No. 430, December 2003, 19 pp.
Wilks, D. S., 1995., *Statistical Methods in the Atmospheric Sciences*. Academic Press, London, 464 pp.

Probability forecasts

Every day head forecaster issues probabilistic forecast for precipitation for the city of Zagreb. Forecasts cover present and the following day - for 4 classes with thresholds 0.1, 1 and 5 mm. Brier score is calculated and decomposed in reliability and resolution term, and displayed in reliability diagrams (below)

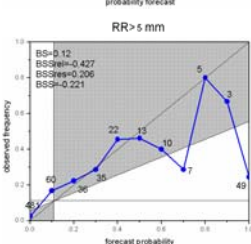


Reliability diagrams for 24-hour precipitation forecast - larger than 0.1, 1 and 5 mm. Each diagram is made in a different fashion, in order to demonstrate and inquire ability of observer to recognize distribution of forecast probabilities.



Brier skill score - as expected - is decreasing for larger thresholds.

For probability forecasts larger than climatology, there is a significant overestimation - particularly for 100% forecast.



As usual, forecast are too sharp ("overconfident"), resulting with high resolution term, but at the same time decreasing reliability of the sistem.

Q: Which plot do you find most effective?