

Application and verification of ECMWF products 2008

RHMS of Serbia

1. Summary of major highlights

ECMWF products are operationally used in Hydrometeorological Service of Serbia from the beginning of 2003. Deterministic forecast products are received via RMDCN in GRIB and BUFR form for 10 days forecast at different horizontal resolutions and several domains. Products are represented using MetView and are available on local web site. In addition, forecasters consult ECMWF web site, priority for EPS products and monthly forecast. From September 2006 seasonal forecast products are also used.

2. Use and application of products

ECMWF products are used for short-range forecast for providing meteorological background for hail suppression activities, which is specialized part of Hydrometeorological Service of Serbia.

Medium range forecast is mainly based on ECMWF products from deterministic model as well as EPS products available on ECMWF web site.

Hydrometeorological Service of Serbia regularly issues monthly forecast for several places in Serbia. Statistical method by analogy is used together with EPS products from ECMWF.

RHMS of Serbia has continued to use ECMWF's monthly forecasts as well as seasonal forecasts of prediction System 3.

2.1 Post-processing of model output

2.1.1 Statistical adaptation

2.1.2 Physical adaptation

WRF-NMM, a non-hydrostatic limited-area model, has been running operationally since August 2007. Model uses ECMWF boundary conditions for 72 hours ahead. Some preliminary verification results compared with ECMWF forecast are presented in chapter 3.1.2.

2.1.3 Derived fields

2.2 Use of products

Some of ECMWF forecast products, like CAPE and EFI are widely used in every day work. Wind gusts and 2m minimum and maximum daily temperature forecast are especially important for road maintenance requirements.

First steps in using 10 days deterministic forecast of 2m maximum daily temperature for heat wave prediction are made. We are testing several criteria in definition and prediction of heat waves. Plan is to include EPS products in prediction of heat waves and other severe weather events.

3. Verification of products

3.1 Objective verification

3.1.1 Direct ECMWF model output (both deterministic and EPS)

The 00 UTC run of ECMWF deterministic forecast is verified against SYNOP observations. Input forecast values for ECMWF were taken from 0.5°x0.5° grid, using grid points closest to chosen synoptic stations. The verification is carried out for nine synoptic stations (Fig 1.).

Verified parameters are

- 2m minimum temperature (between 18 and 06 UTC).
- 2m maximum temperature (between 06 and 18 UTC).
- daily accumulated amount of precipitation (between 06 and 06 UTC).
- 24h precipitation existence with various thresholds (between 06 and 06 UTC).



Fig.1 Location of synoptic stations used in verification

In general, basic statistical scores (ME, MAE and RMSE) for 2m minimum and maximum temperature forecast do not show significant differences compared to last year.

The benchmark forecast used in mean absolute error skill score calculation is climatology, prepared on a 23-year sample (1983-2005). Daily climate values are obtained averaging values from ±13 day vicinity of the actual day.

Values of skill score (MAE) for 2m minimum and maximum temperature forecast during 2006 and 2007, Beograd-Karadordev park, are presented in Fig. 2. Higher values are reached for maximum temperature. Seasonal variation of the skill score for 2m minimum and maximum temperature forecast is shown in Fig. 3 and Fig. 4. Plots show that minimum temperature skill is highest in the summer and maximum temperature skill was the best during two last winters.

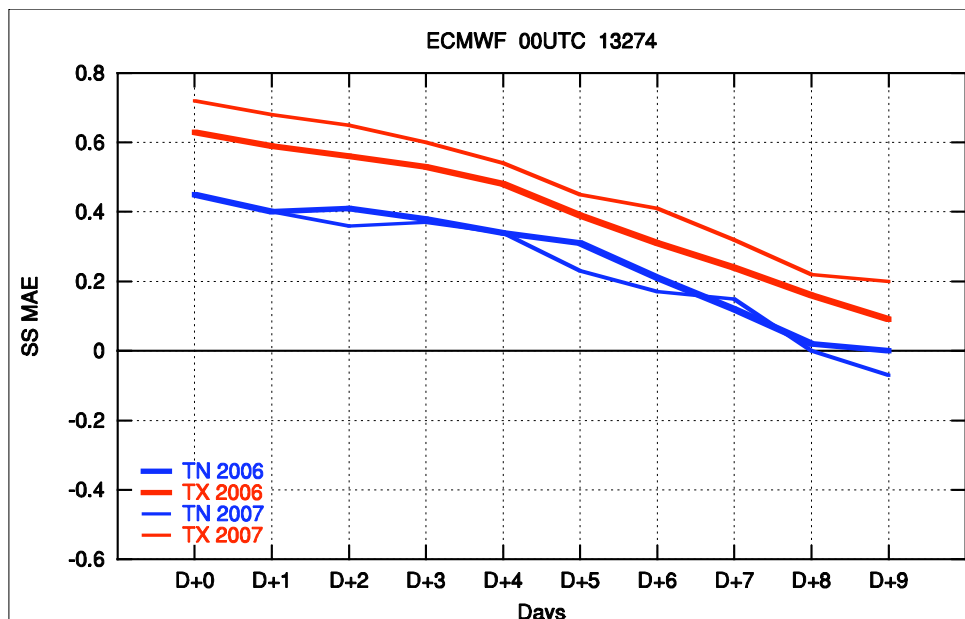


Fig.2 The mean absolute error skill score for 2m minimum and maximum temperature forecast for Beograd.

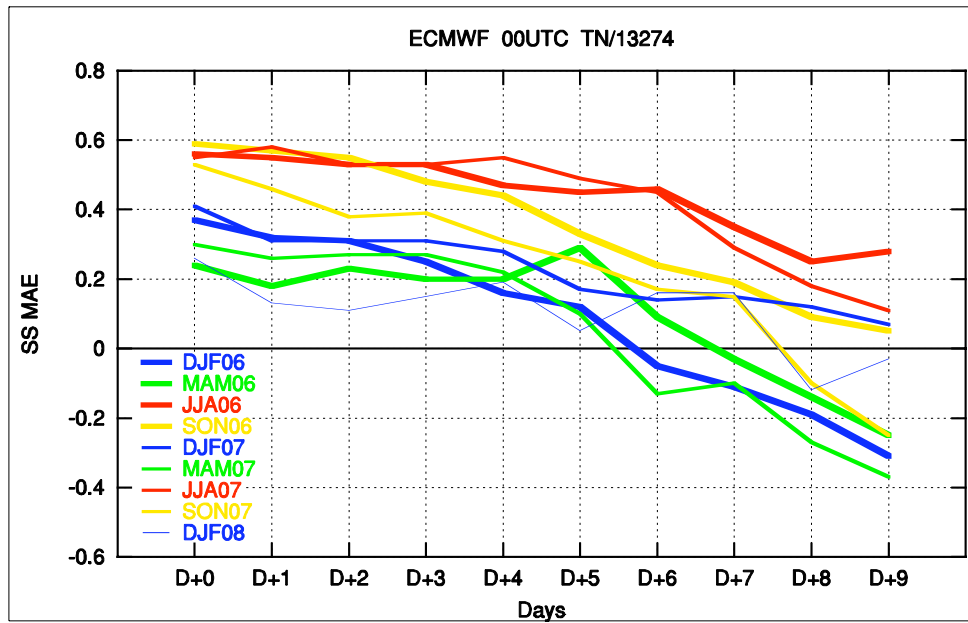


Fig.3 The mean absolute error skill score for 2m minimum temperature forecast for Beograd.

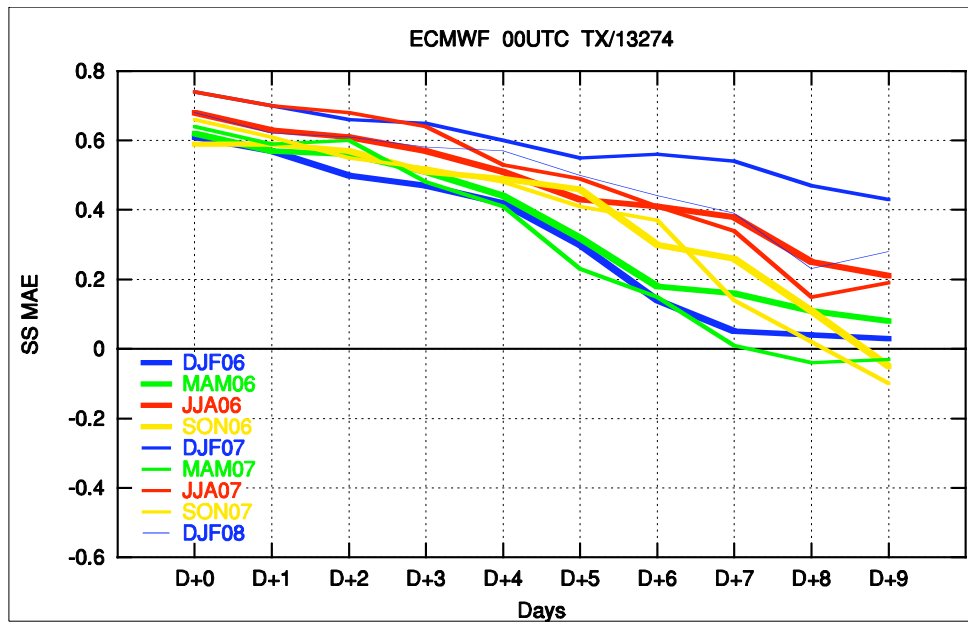


Fig.4 The mean absolute error skill score for 2m maximum temperature forecast for Beograd.

Precipitation forecast is verified as categorical (precipitation existence) and continuous (daily accumulated) variable. According to verification results averaged over nine stations, larger amounts of 24h precipitation are underestimated and smaller amounts are overestimated. Precipitation forecast is unbiased for threshold close to 2mm/24h (Fig. 5, a) and b)). Heidke Skill Score approaches zero skill after approximately 8 days for threshold of 20mm/24h (Fig 5, c) and d)).

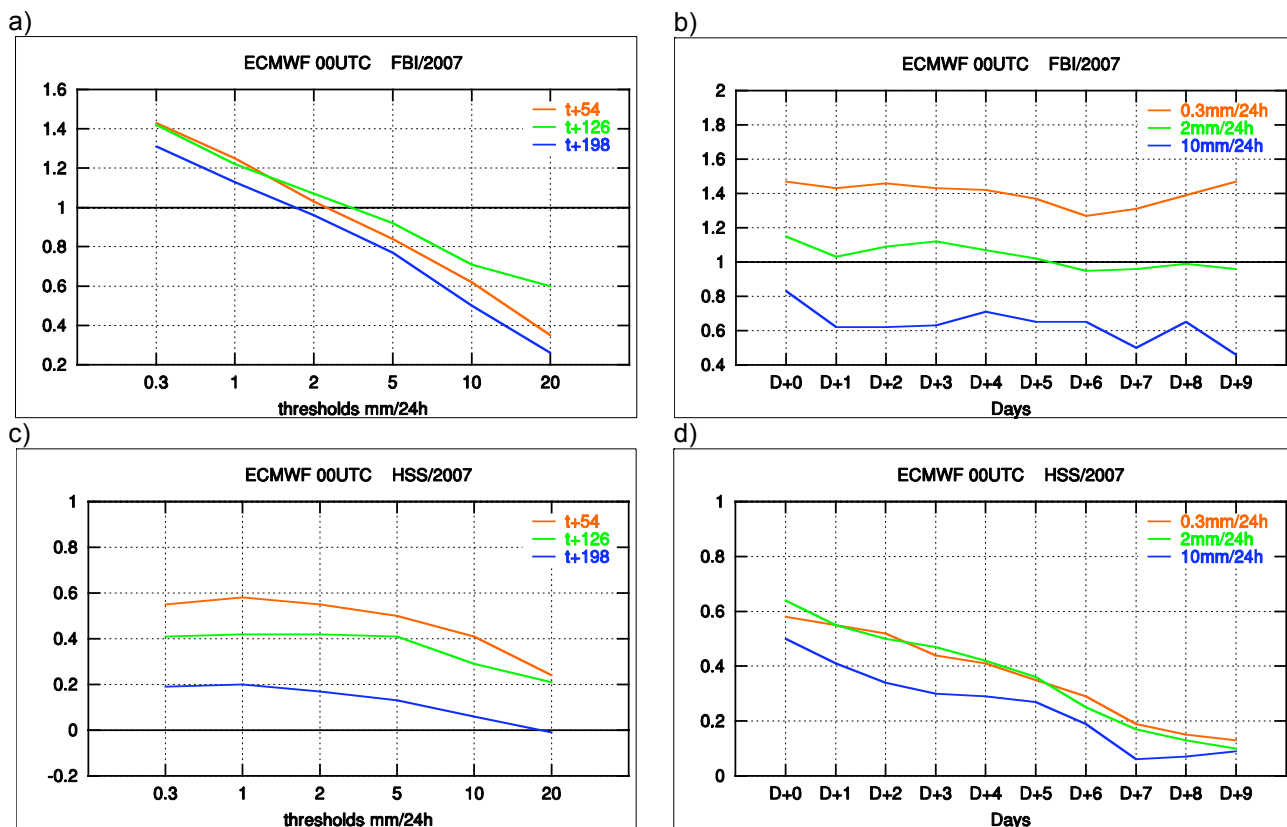
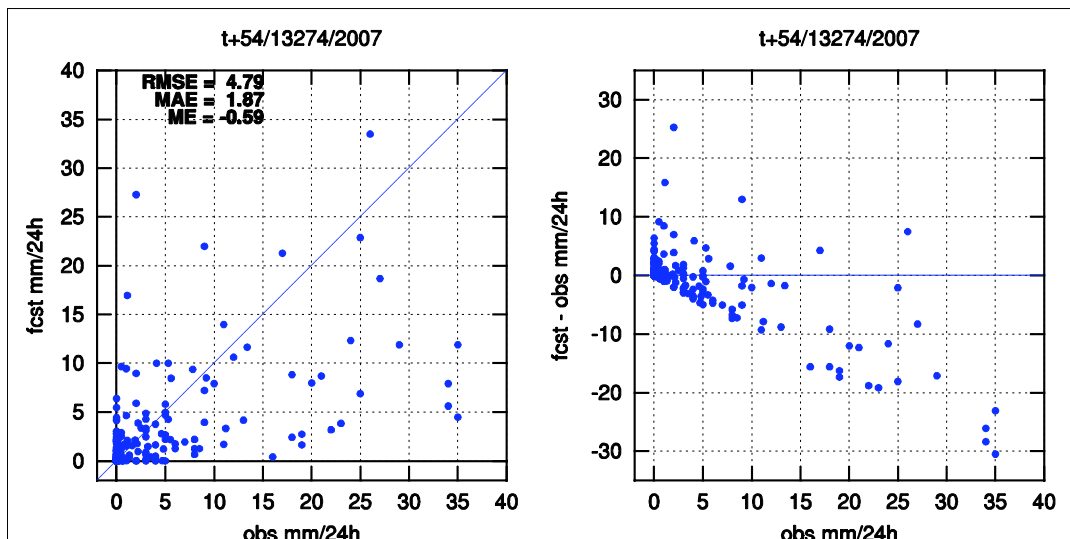


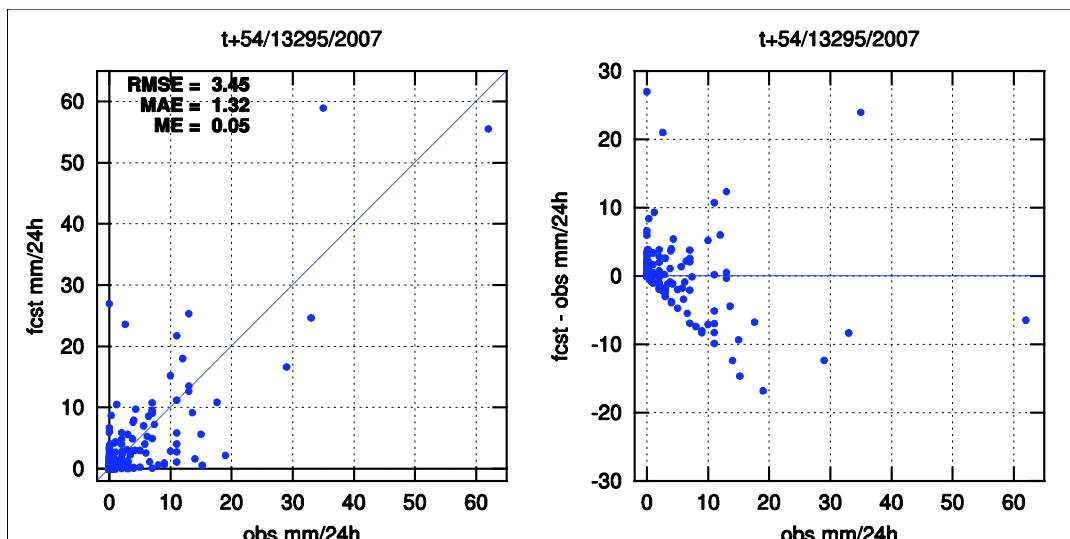
Fig.5 Verification of 24h precipitation existence forecast averaged over nine stations: FBI (a) and b)) and HSS (c) and d)) for different thresholds and forecast ranges.

Examples of 24h accumulated precipitation forecast verification for three locations are presented in Figure 6 (a, b) and c)). Underestimation of larger amounts of precipitation can be obtained in scatterplots and forecast errors versus observations plots.

a)



b)



c)

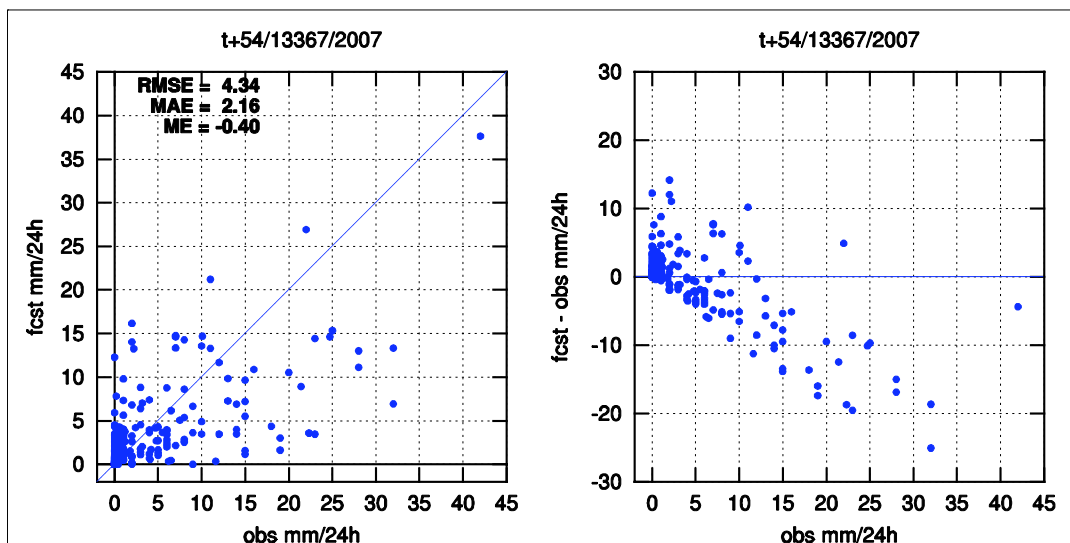


Fig.6 Scatterplots, forecast errors versus observations and statistical scores for the 24h accumulated precipitation forecast for a) Beograd (13274), b) Negotin (13295) and c) Zlatibor (13367).

3.1.2 ECMWF model output compared to other NWP models

Comparison of ECMWF model and WRF-NMM model has been made only for 2m minimum and maximum temperature forecast during winter 2007/2008. 00 UTC runs were considered. The verification results are presented in Figure 7.

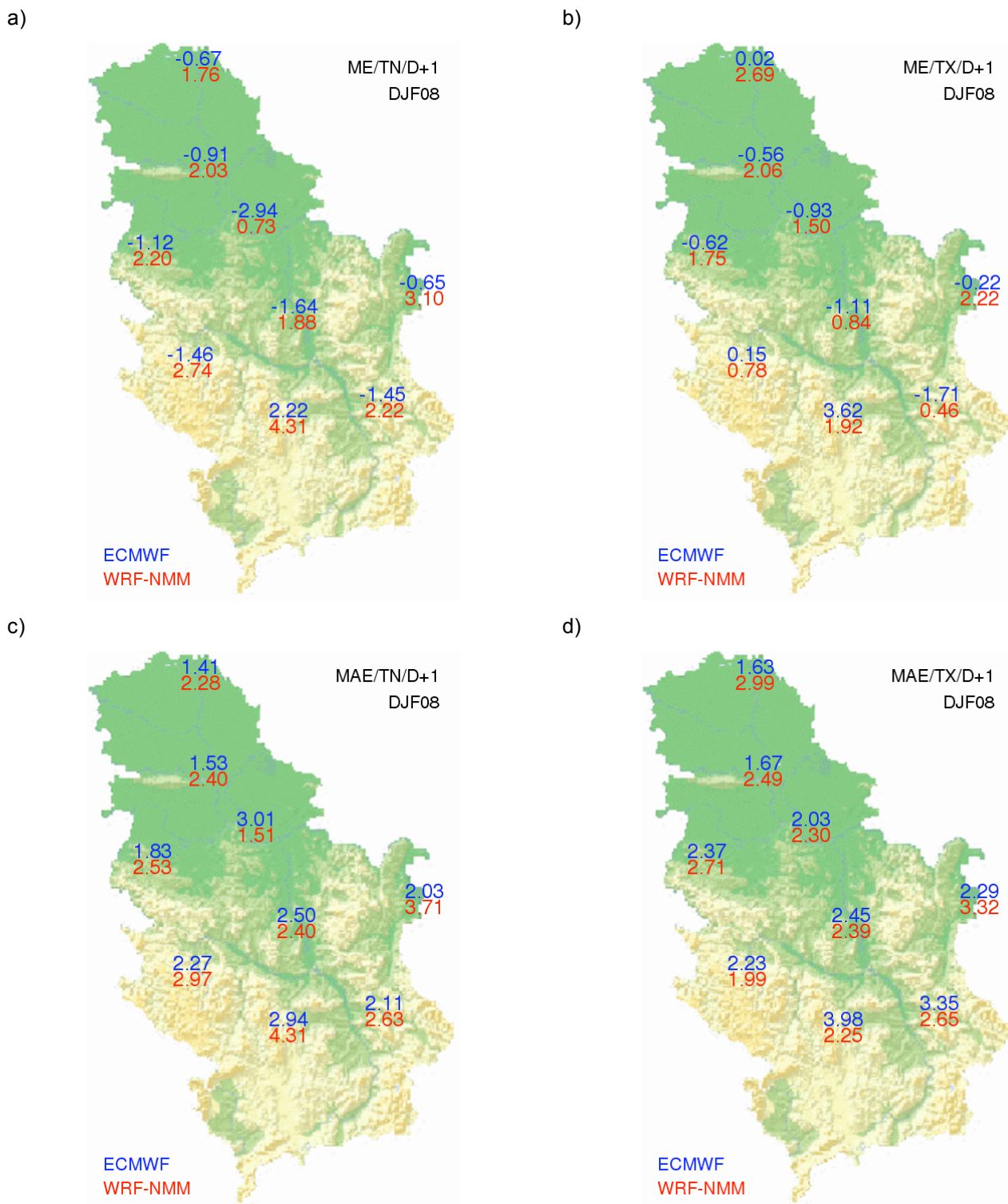


Fig.7 Mean error and mean absolute error of 2m minimum and maximum temperature forecast during winter 2007/2008.

For most of locations ECMWF model forecast underestimates while NMM overestimates values of 2m minimum and maximum temperature during last winter. Exceptions are mountain regions in southwest and south part of the country. Results that are more representative will be available after at least one-year forecast data verification.

3.1.3 Post-processed products

3.1.4 End products delivered to users

3.2 Subjective verification

There is no subjective verification.

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

3.2.2 Synoptic studies

4. References to relevant publications

<http://www.ecmwf.int/products/greenbook>

Annual Report on application and verification of ECMWF products in Member and Co-operating States