

Application and verification of ECMWF products 2015

RHMS of Serbia

1. Summary of major highlights

ECMWF forecast products became the backbone in operational work during last several years. Starting from ten days deterministic forecast, amount of products in use is growing constantly including EPS, EFI, seasonal forecast etc. Available ECMWF software like MetView and GRIB_API are widely used.

Establishing of South East European Climate Change Centre started during 2008. In order to provide numerical background for monthly forecast for the region, regional Eta model runs with 6 months EPS forecast as boundary conditions, every month. Also, WRF-NMM and NMM-B use ERA fields for case studies and numerical tests for different regions.

Demand for forecast archive and data base appeared during previous years, so RHMSS requested MARS installation. ECMWF experts worked in the cooperation with our staff. Since January 2012 operational NMMB global model products started archiving in MARS RHMSS.

Also, three years ago EcFlow has been installed. There is an ongoing work on migration SMS to Python scripts.

2. Use and application of products

ECMWF products are used for short-range forecast for providing meteorological background for hail suppression activities, specialized service in Ministry of Internal Affairs.

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 verification results compared with ECMWF forecast are presented in chapter 3.1.2.

Some efforts in using ECMWF monthly forecast data as BC for NMM model were made.

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, 2m minimum and maximum daily temperature forecast as well as daily amount of precipitation are used as a background in the severe weather warnings.

Prediction of the heat waves started operationally in August 2008. Maximum temperature predicted in deterministic model run and distributed as BUFR weather parameters is used as a first guess. During winter minimum temperature is used for prediction of the cold waves.

New products in operational use:

- 10 meter wind gust greater than 15m/s (10FGG15)
- 10 meter wind gust greater than 20m/s (10FGG20)
- 10 meter wind gust greater than 25m/s (10FGG25)
- 10 meter Wind speed of at least 10m/s (10SPG10)
- 10 meter Wind speed of at least 15m/s (10SPG15)

- Total precipitation of at least 1 mm (TPG1)
- Total precipitation of at least 5 mm (TPG5)
- Total precipitation of at least 10 mm (TPG10)
- Total precipitation of at least 20 mm (TPG20)

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. Forecast data were taken from 0.25° x 0.25° grid, using grid points closest to chosen synoptic stations. Statistical scores presented here are related to station Beograd - Karadordev park (13274).

MAE and RMSE of 2m minimum (18-06 UTC) and maximum (06-18 UTC) temperature forecast (Fig. 1-2) do not differ significantly compared to the previous year from day D+0 to D+5. These scores for both 2m minimum and maximum temperature are better than during 2013 from day D+6 to D+9.

Scatterplots (Figures 3 and 4) for forecast of 2 meter temperature show that at midday (60h) forecasted temperature generally tends to be a bit higher for temperature between 5°C and 25°C and a bit lower between -5°C and 0°C. There is still an underestimation for midnight (72h) 2 meter temperature.

A slightly overestimation of 10 meter wind forecast can be seen in Fig. 5 and 6, for wind speed lower than 4 m/s and slightly underestimation for wind speed higher than 5 m/s.

Figures 7 and 8 show scores for 2 meter temperature and 10 meter wind speed forecast. Diurnal cycles in forecast errors can be seen, stronger for 2 meter temperature forecast. It can be noticed that all scores from 156 to 240 hour forecast for 2 meter temperature are smaller than last year and all scores for 10 meter wind speed forecast are similar as last year.

Amounts of precipitation smaller than 5mm are overestimated for both 54h and 78h precipitation forecast (Figures 9-10).

3.1.2 ECMWF model output compared to other NWP models

ECMWF model forecast is compared to the regional non hydrostatic NMM model. NMM version 3.0 is running from June 2008 using ECMWF as BC. Horizontal resolution of the model is about 10 km and 00 UTC run is considered.

Comparison of the forecast quality of ECMWF model and NMM model is presented in figs. 11-16. Seasonal averaged values for 2 meter temperature and 10 meter wind speed 60h(midday) and 72h(midnight) forecast and 24 hour precipitation occurrence are taken in consideration.

Values of ME and MAE show advantage of ECMWF forecast for 2 metre temperature at midday (especially during winters), while NMM 2 meter temperature forecast have better scores at midnight. Better scores can be noticed for ECMWF's 2 meter temperature forecast since winter DJF13 except last winter DJF15 at midnight (Fig. 11-12).

ECMWF is better in 10 meter wind speed forecast for both midday and midnight forecast and during all seasons. Also, significant improvement can be seen in ECMWF's 10 meter wind speed forecast scores during three last years (Fig. 13-14).

Regarding two presented scores, evaluation of precipitation forecast is similar for both models mostly with minimum skill in spring and maximum in autumn. Last two years for ECMWF's forecast minimum was in summer and maximum in winter (Fig. 15-16).

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

4. References to relevant publications

Nurmi, P., 2003: Recommendations on the verification of local weather forecasts, *ECMWF Technical Memorandum No. 430*

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

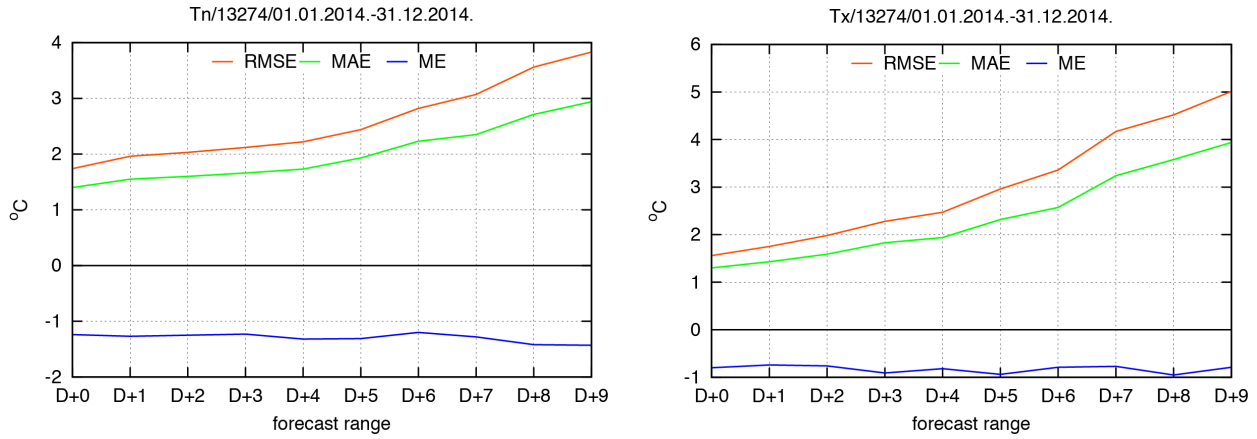


Fig.1–2 ME, MAE and RMSE of ECMWF 2 meter minimum and maximum temperature forecast (D+0 to D+9) as a function of forecast range (Beograd - Karadordev park).

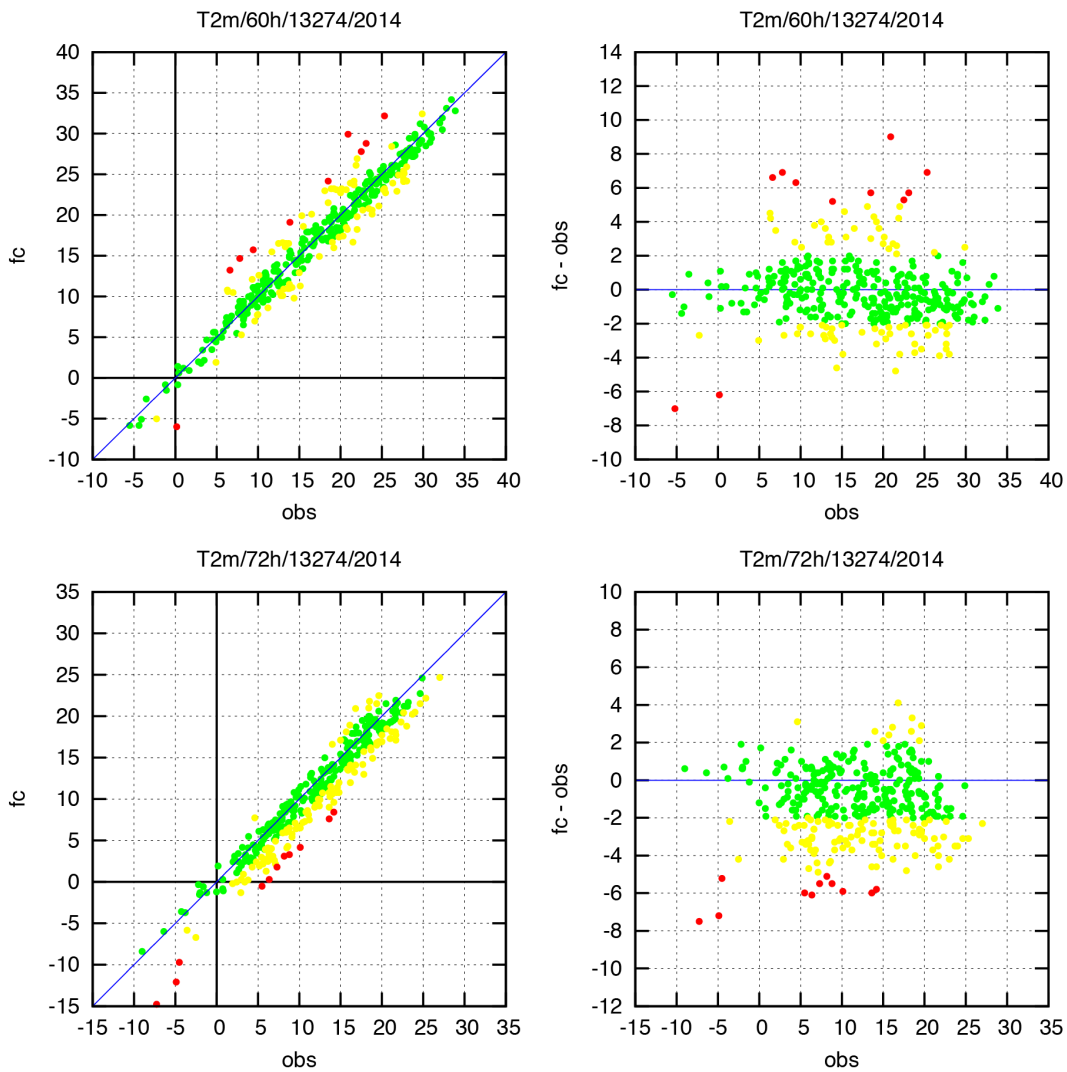


Fig.3–4 Scatterplots and forecast errors vs. observations of one year ECMWF t+60h (midday) and t+72h (midnight) 2 meter temperature forecast for Beograd - Karadordev park (13274).

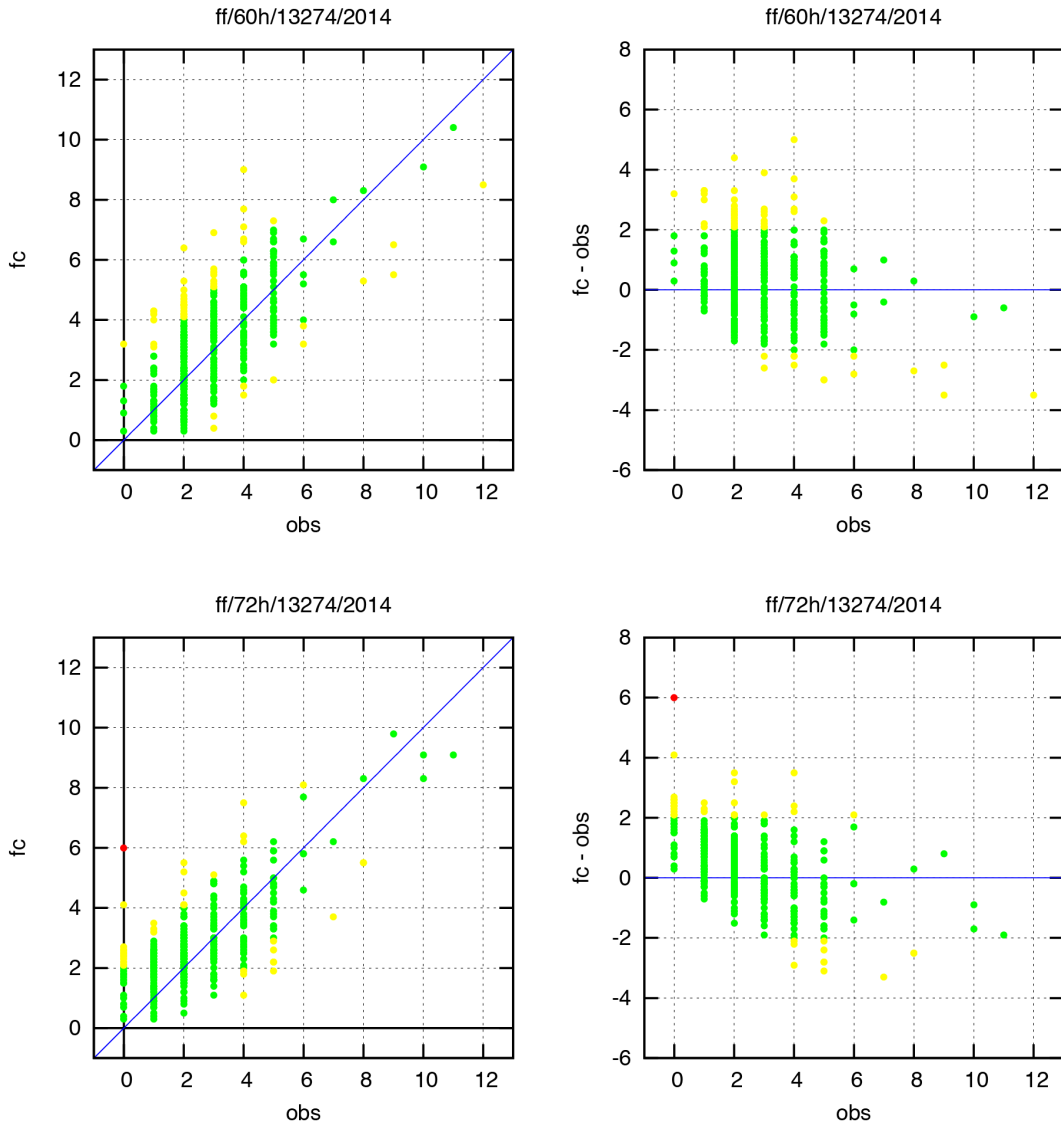


Fig.5-6 Scatterplots and forecast errors vs. observations of one year ECMWF t+60h (midday) and t+72h (midnight) 10 meter wind speed forecast for Beograd - Karadordev park (13274).

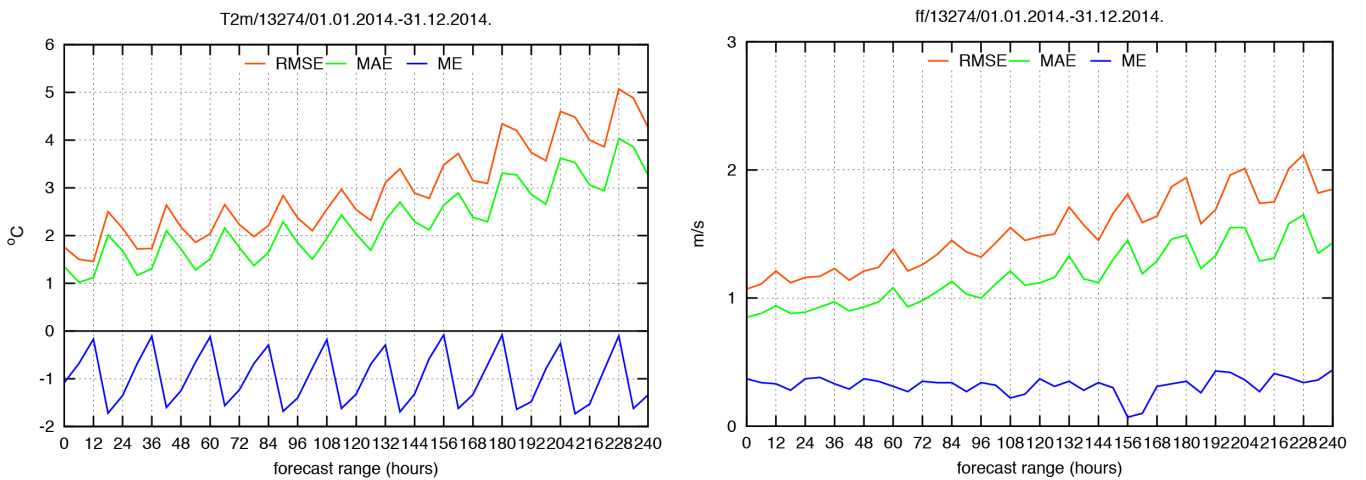


Fig.7-8 ME, MAE and RMSE of ECMWF 2 meter temperature and 10 meter wind speed forecast as a function of forecast range (Beograd - Karadordev park).

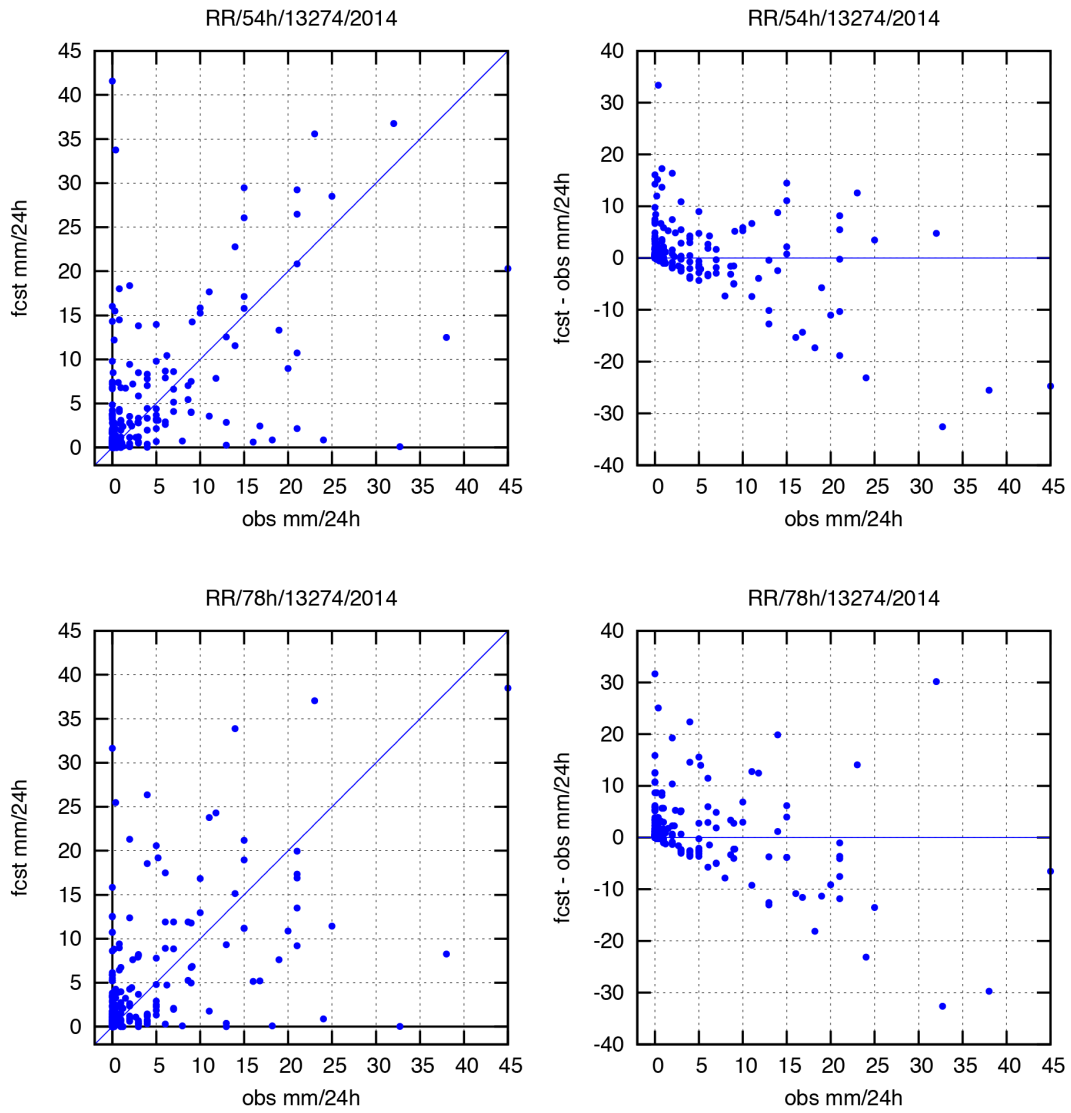


Fig.9-10 Scatterplots and forecast errors vs. observations of one year ECMWF 54h and 78h 24h precipitation forecast for Beograd – Karadordev park (13274).

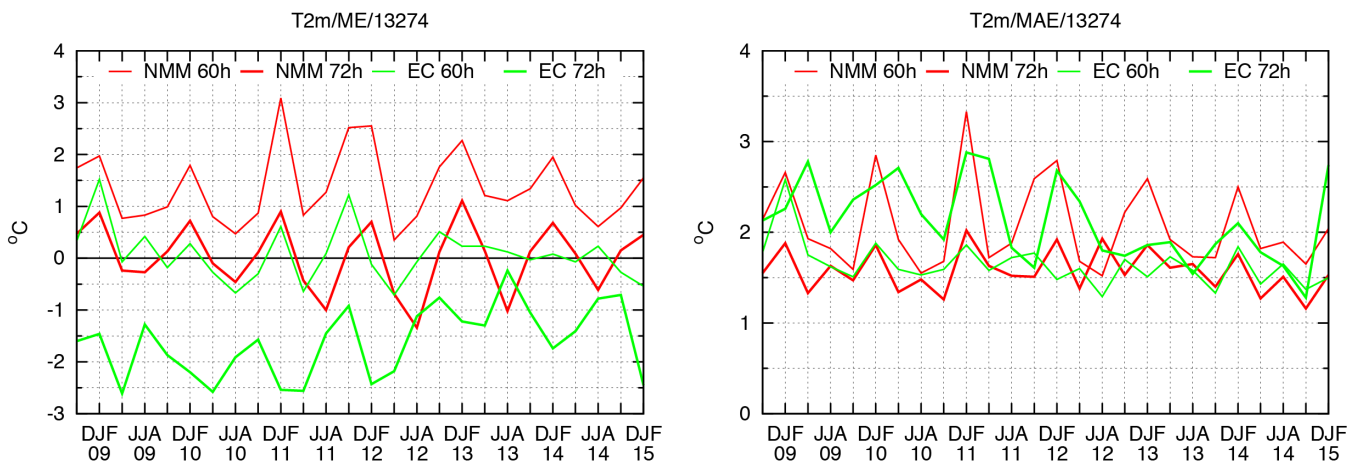


Fig.11-12 ME and MAE of ECMWF midday and midnight (60h, 72h) 2 meter temperature forecast for seasons SON08 to DJF15. Comparison to WRF-NMM forecast (Beograd – Karadordev park).

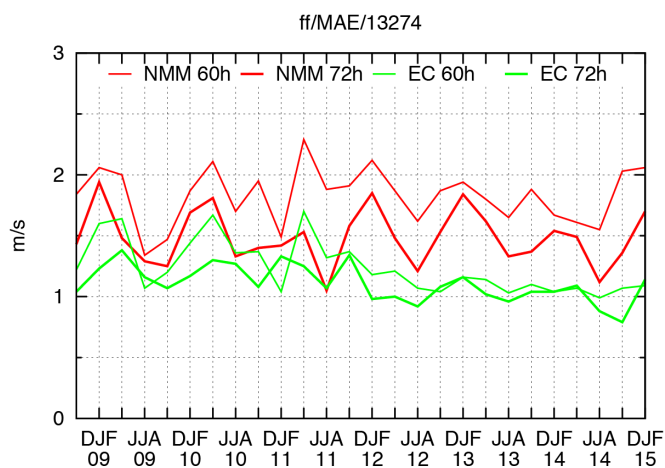
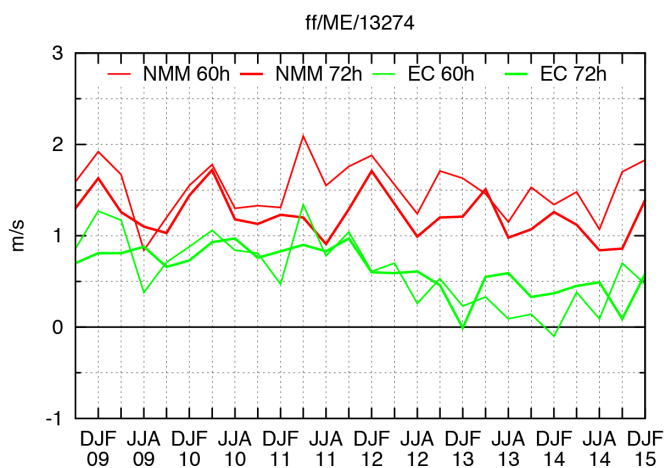


Fig.13-14 ME and MAE of ECMWF midday and midnight (60h, 72h) 10 meter wind speed forecast for seasons SON08 to DJF15. Comparison to WRF-NMM forecast (Beograd - Karadordev park).

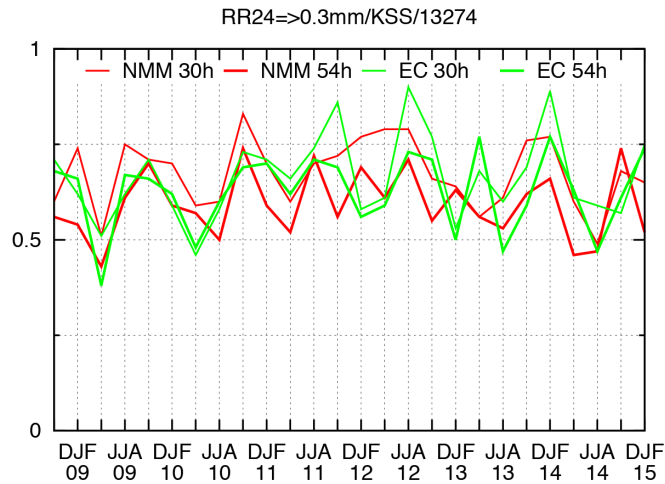
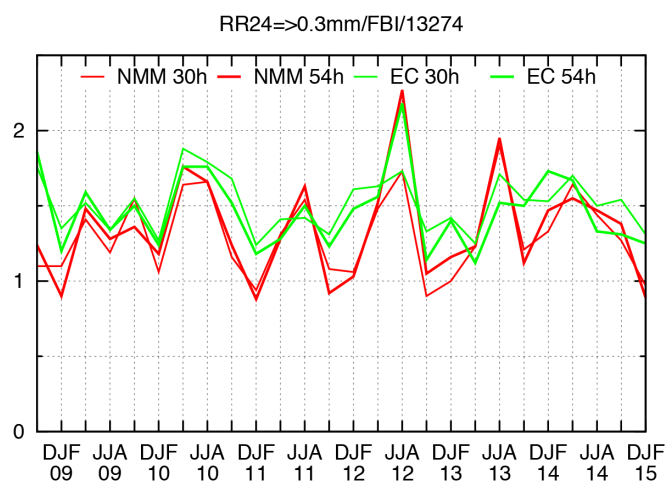


Fig.15-16 FBI and KSS of ECMWF 24h precipitation forecast (30h, 54h) for seasons SON08 to DJF15. Threshold is 0.3mm/24h. Comparison to WRF-NMM forecast (Beograd - Karadordev park).