Application and verification of ECMWF products 2010

National Meteorological Administration

1. Summary of major highlights

Medium range weather forecasts are primarily based on the results of ECMWF and ARPEGE deterministic models. In the short range, ECMWF and ARPGE models results are used in conjunction with those from : ALADIN, ALARO and COSMO_RO. The usage of those models combined with MOS systems continues to lead to a further increase in forecast accuracy. The objective verification of all deterministic models forecasts in use have been continued on all the time ranges. All MOS results and verification results are presented on the specialised web-site. http://neptun.meteoromania.ro (access restricted upon requests)

In 2009 some important steps were performed:

- up-date of all ECMWF_MOS models
- improve the MOS disseminations products based on the forecasters' requests(text format, graphs, grouped stations, etc.)
- daily direct model output verification

2. Use and application of products

2.1 Post-processing of model output

2.1.1 Statistical adaptation

Statistical models MOS are in operational use since 2004. No changes in basic models since that time. Every two years the equations are up-dated. The models provide twice on a day, local forecasts up to 10 days, to 163 meteorological stations for the following main parameters: 2m temperatures, extreme temperatures, 10m wind speed and direction, total cloudiness(3 classes) and total precipitation. The results are plotted in map forms and displayed on the web site. A special selection is made for the end users in text format and also for the forecasters.

In 2008, the PseudoPP statistical model developed in cooperation with Meteo France, was implemented. The parameters are: 6h 2m spot temperatures and extremes temperatures, up to 15 days and up to 32 days. The disseminating formats are: maps, regional graphs, and stations graphs. An example of the recently disseminating format is shows in Fig.1

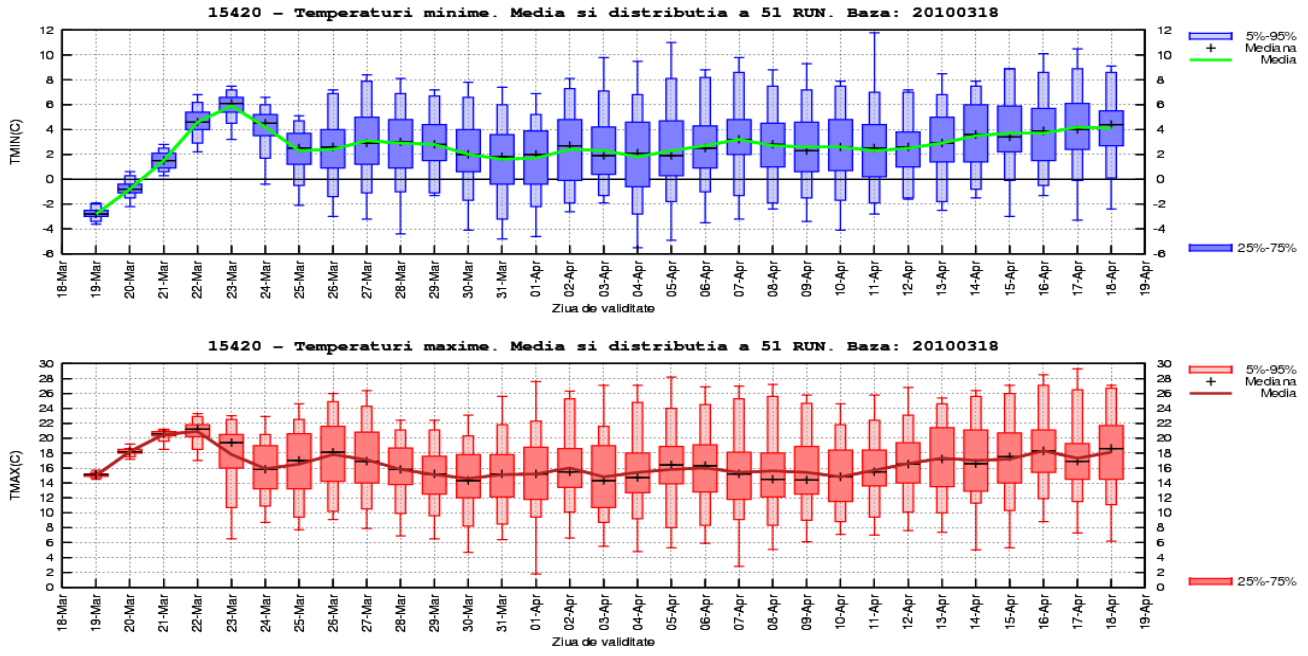

Fig. 1. *Extreme temperatures, at Bucharest Baneasa station. Mean, median and quantile distribution of PseudoPP forecasts up to 32 days.*

2.1.2 Physical adaptation

2.1.3 Derived fields

During the summer the “Humidex” index is computed, using ECMWF 2m temperature and humidity forecasts. During the winter season the “Wind Child” is calculated using 2m temperatures and wind speed forecasted by ECMWF model, twice on a day. The results are displayed in a map format on a web-site. An example of Humidex is presented in Fig. 2

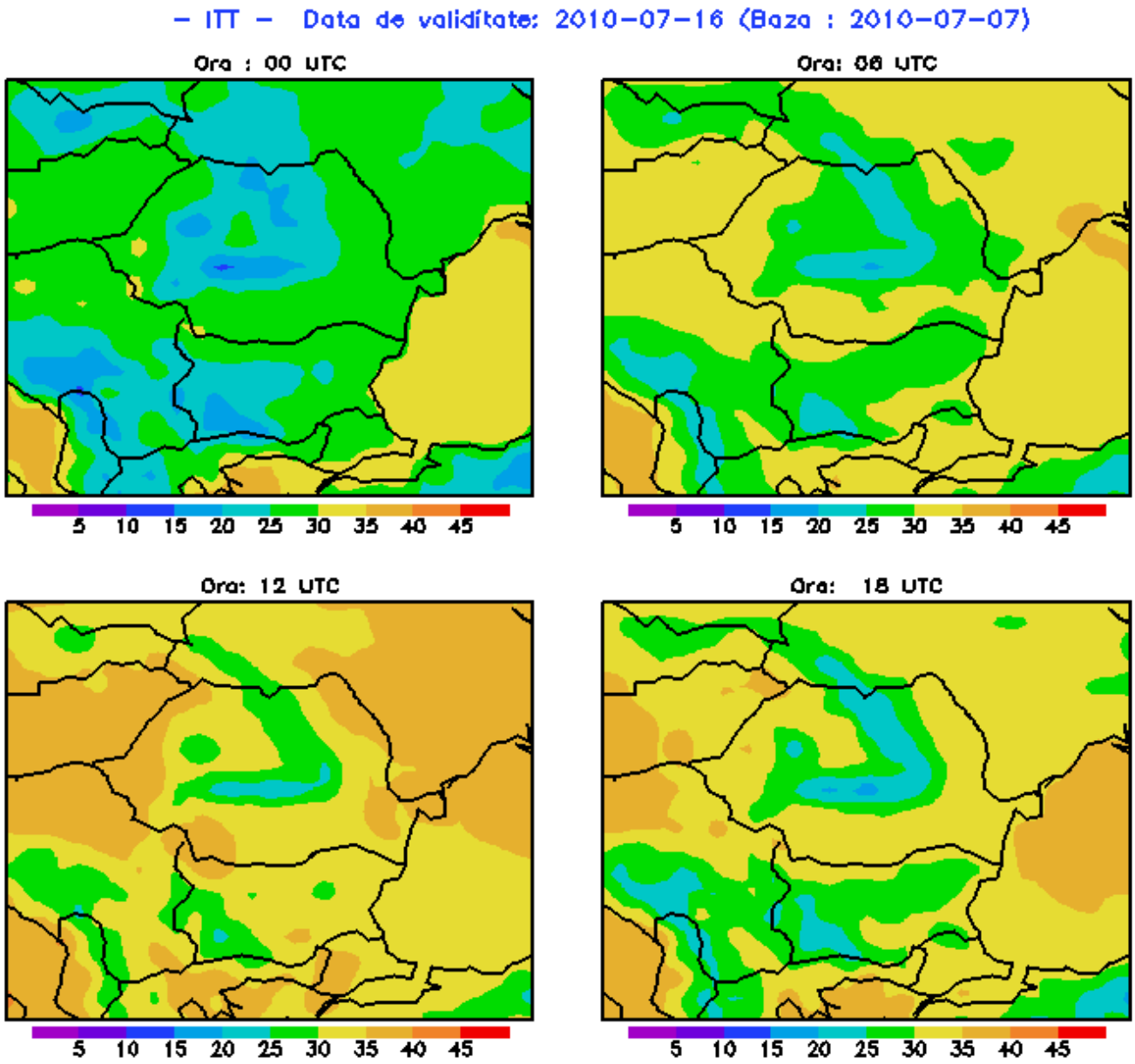

Fig. 2 *Humidex computed using ECMWF direct model fields*

2.2 Use of products

The ECMWF products continued to form the basis of short and medium range forecasts, for public, customers and state authorities, and in the national warning system. The deterministic IFS model outputs, received twice per day via RMDCN, are processed (splitting and adding headers) for telecommunication purposes and routed towards the visualisation systems (NEX-REAP) of National Meteorological Forecasting Centre and of the Regional Meteorological Centres, where graphical products are automatically generated. On the other hand, a large number of new graphical products, generated through METVIEW are available on a dedicate Intranet site.

3. Verification of products

3.1 Objective verification

3.1.1 Direct ECMWF model output (both deterministic and EPS)

The objective verification has been performed by the VERMOD - an unitary system for objective verification of all models used operationally by NMA: ECMWF, ARPEGE, ALADIN, HRM, COSMO.ro 00 and 12 hours runs of the models were verified, monthly, against all Romanian SYNOP observations. The verifications were performed for the following variables: 2m temperatures, 10m wind speed, direction and components, total cloudiness and 6, 12 and 24 hours total precipitation amount. A wide range of statistical verification measures are computed and the results are disseminated via dedicated *statistical an verification* web-site. The results are averaged over different selections of stations.

In 2009 a new procedure was developed in order to perform daily verification of all models used in NMA. The parameters are : 2m temperature, total cloudiness, msl pressure, wind speed and 24 total precipitation.

The results are displayed in map and graph forms, on the friendly web-page. The user can choose the parameters, the station of interest and can easily see the performance of one model on the specific day and the comparison between the models over the regions. The graph and map formats for 2m temperature, wind speed, total cloudiness and msl pressure are the same(see examples below).

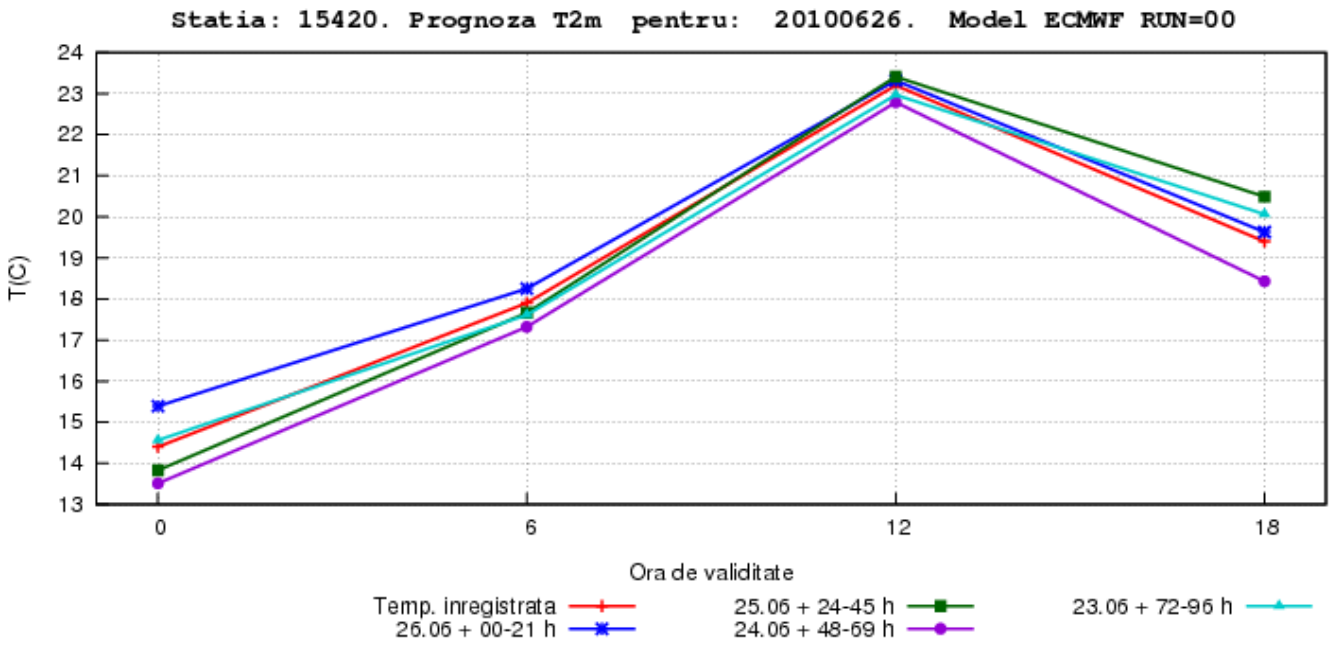

Fig. 3. *Example of daily verification graphs: Forecasts with different time lags against observation(red line) for 15420 – Bucharest Baneasa stations.*

The 24 hours accumulated amount of precipitation are verified against SYNOP observations and recently over all precipitation information: synoptic stations, rain gauges, hydrological stations, more 1600 points over the country.

The results are displayed in terms of daily errors, see Fig. 5 as example.

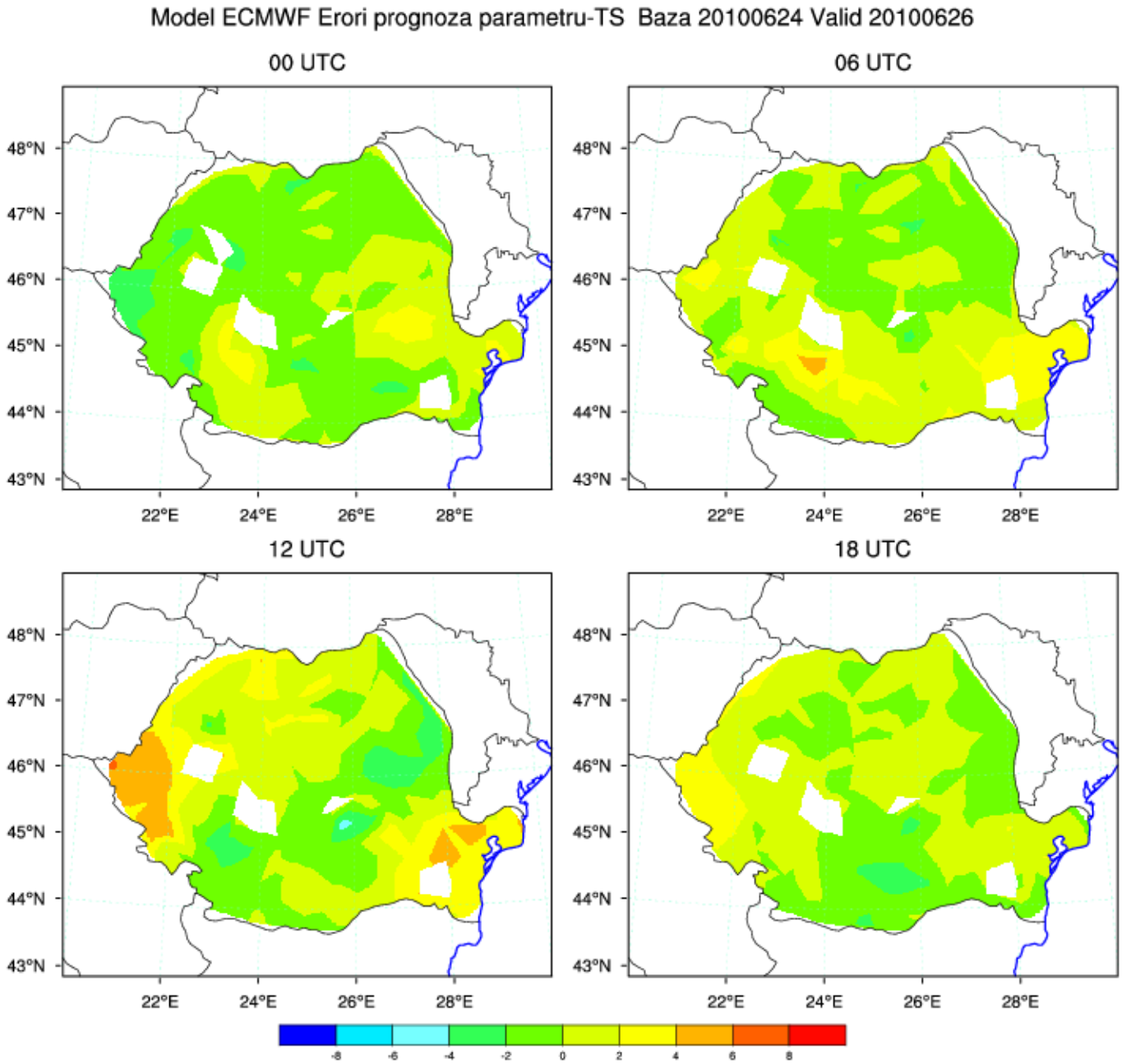

Fig. 4. *Example of daily verification maps: Forecasts errors with different time lags, against observation*

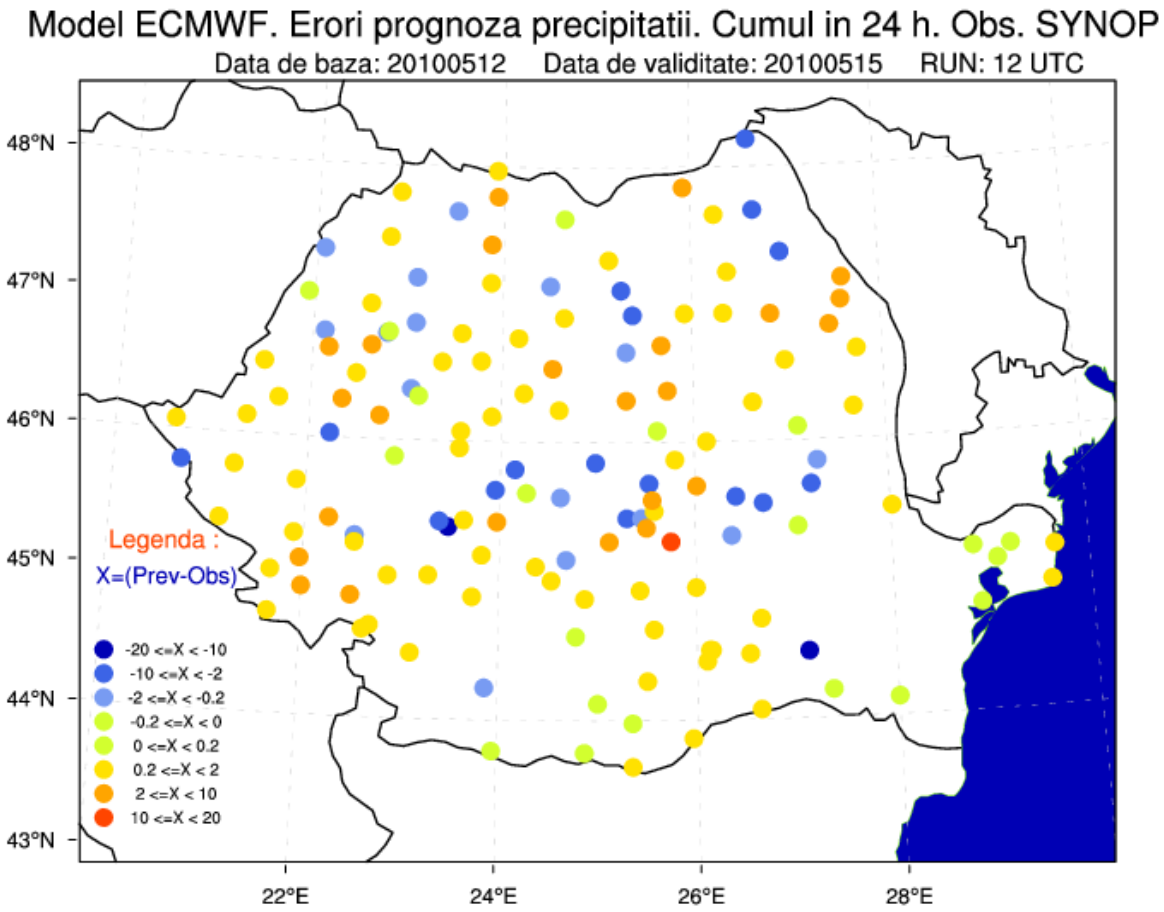

Fig. 5. *Example of daily 24 h errors precipitations map.*

3.1.2 ECMWF model output compared to other NWP models

Comparison of performance of ECMWF model to other NWP models used by NMA are performed monthly, for the most important surface weather parameters: 2m temperature, 10m wind speed, total cloudiness, mslp pressure and 24 h total amount of precipitation. Graphs of the main verification scores are available on the web-site and also an overview of the performances of the models for all year . Examples of graphs are presented in the Fig. 6 – 8.

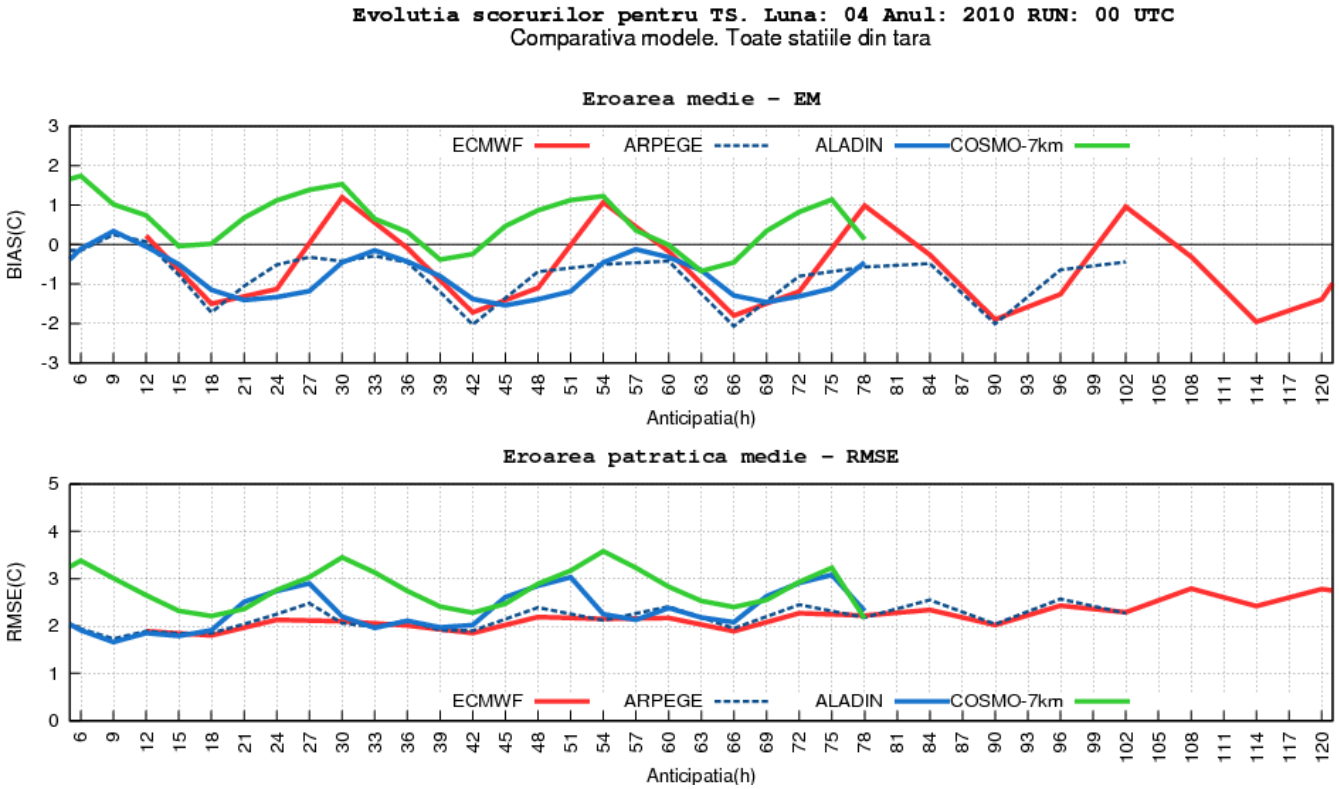

Fig 6. **2m Temperature**. *BIAS and RMSE scores distributions using all meteorological stations. Month of April, 2010.*

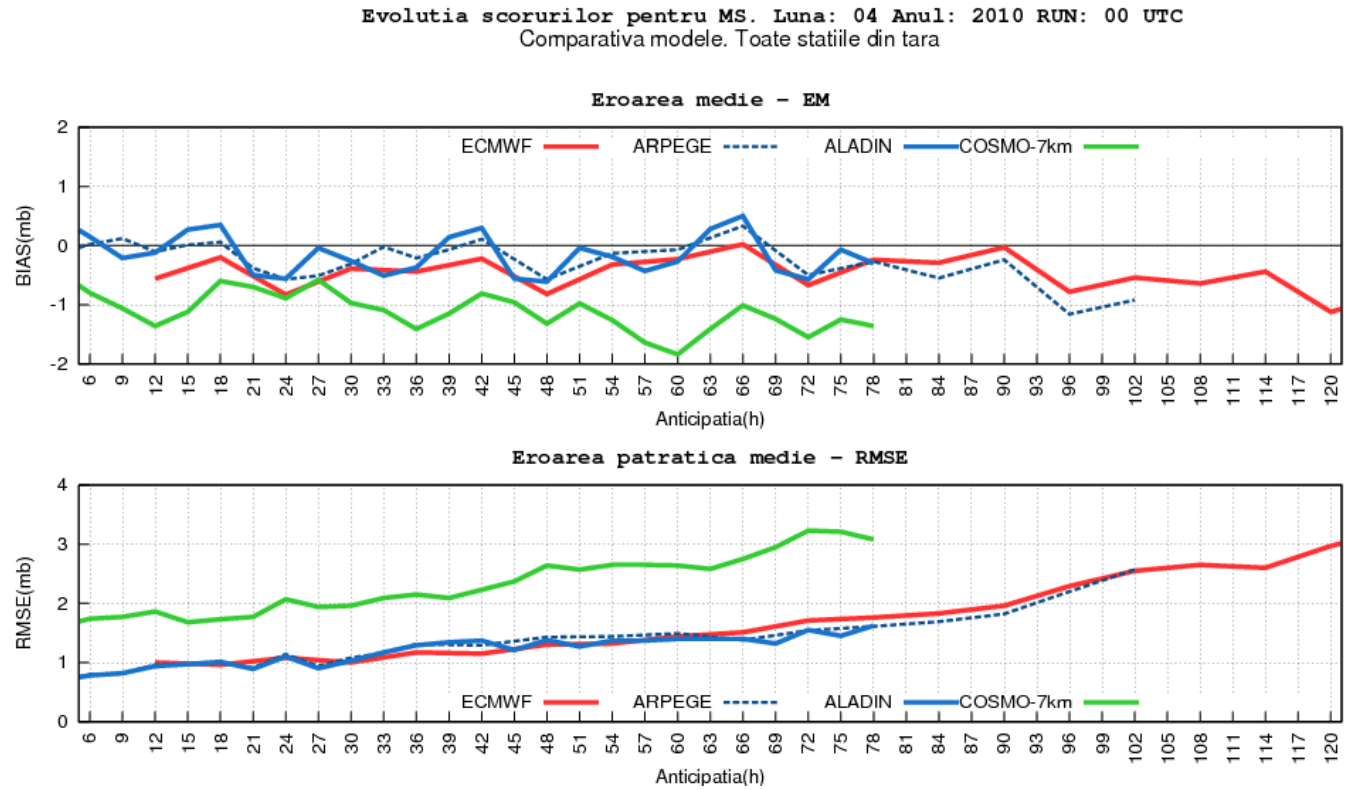

Fig. 7 **MSLP.** *BIAS and RMSE scores distributions using all meteorological stations. Month of April, 2010.*

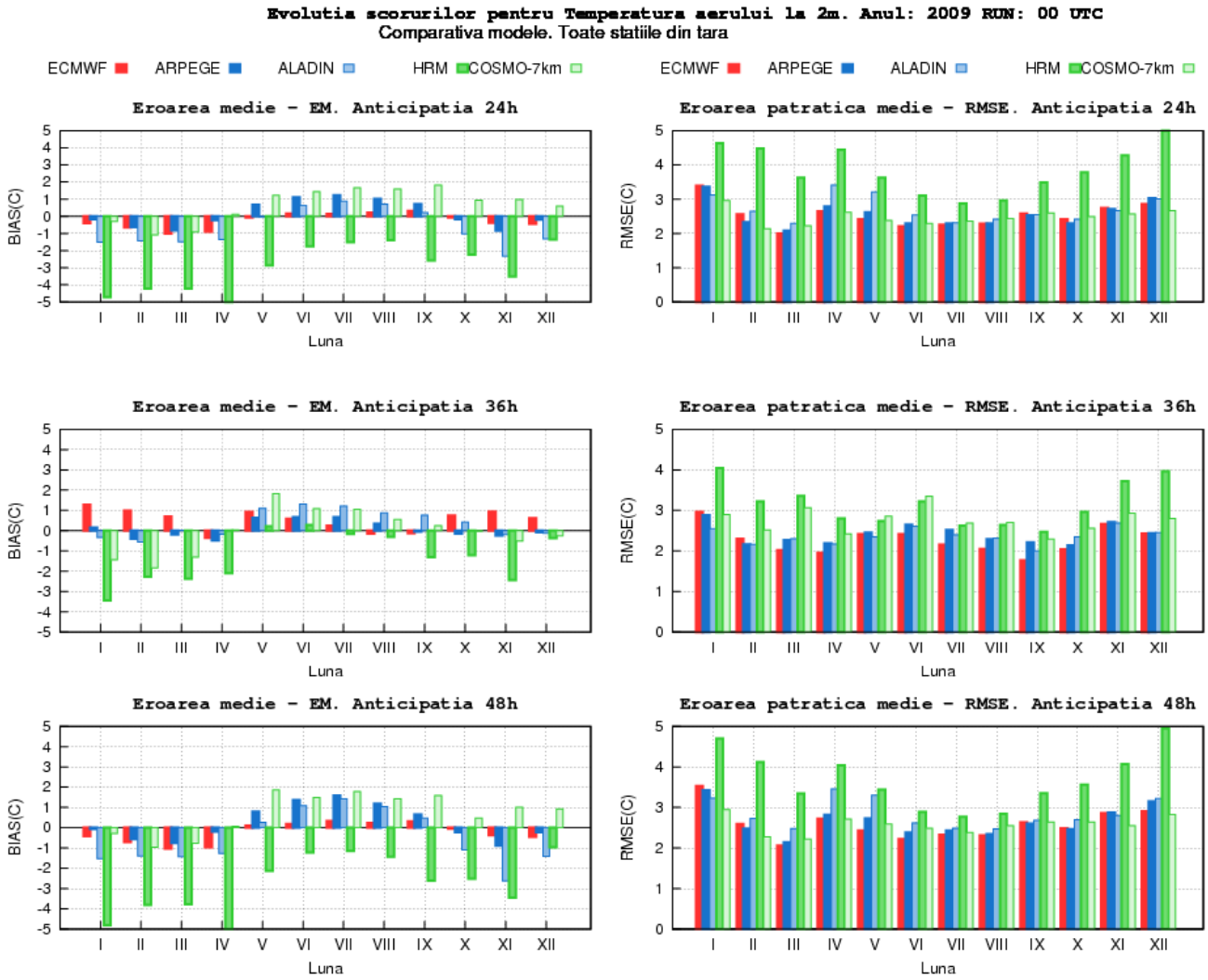

Fig 8. **2m Temperature**. *Monthly averaged BIAS and RMSE scores distributions using all meteorological stations. Year – 2009*

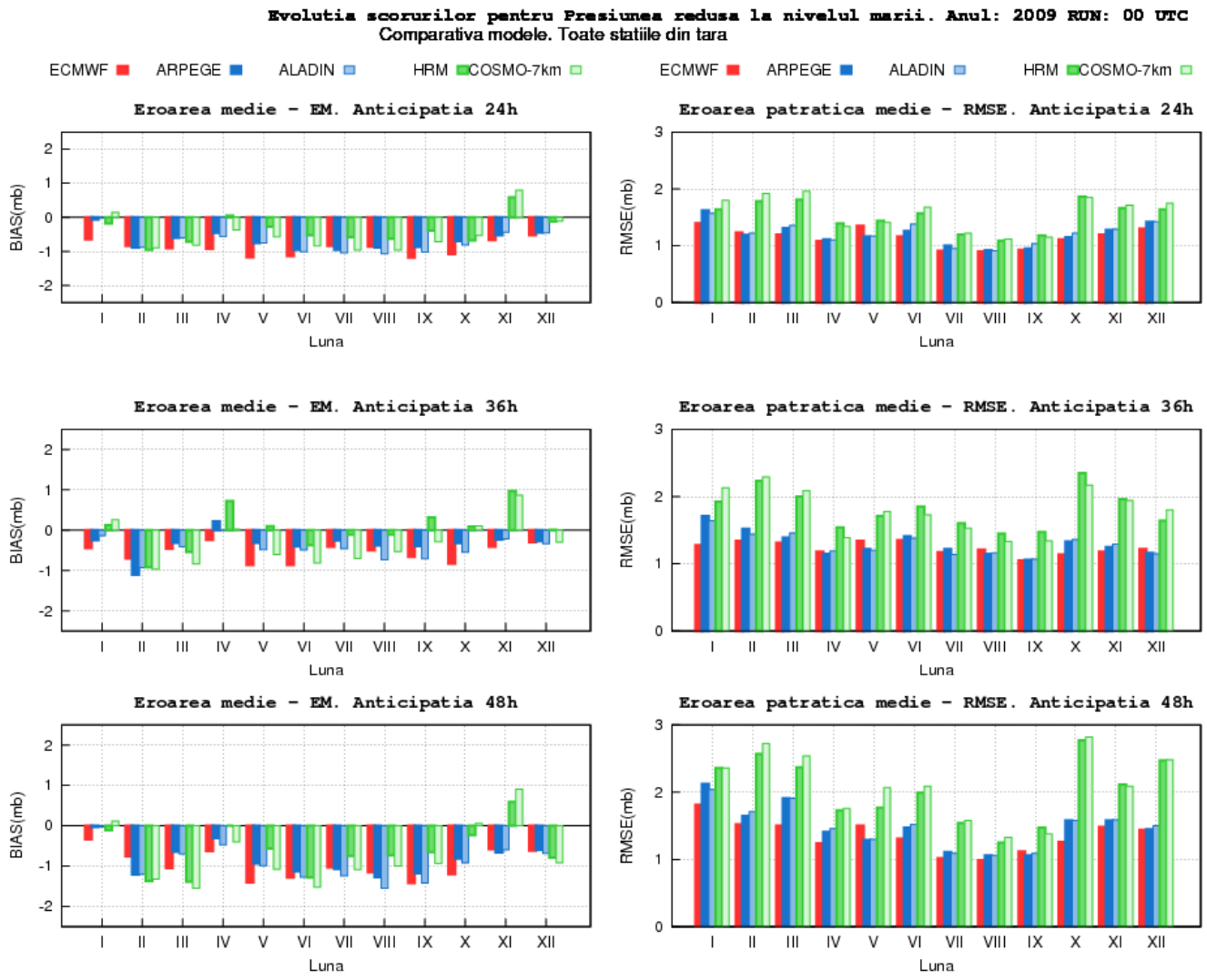

Fig 9. ***MSLP.*** *Monthly averaged BIAS and RMSE scores distributions using all meteorological stations.*

Year – 2009

3.1.3 Post-processed products

All MOS forecasts are verified monthly, since 2004, and the results are displayed on the web site.

A comparison between MOS and meteorologist forecasts, for extremes temperatures is performed since 2002. We can see the improvement for all MOS systems , over the years Fig 10 and Fig. 11.

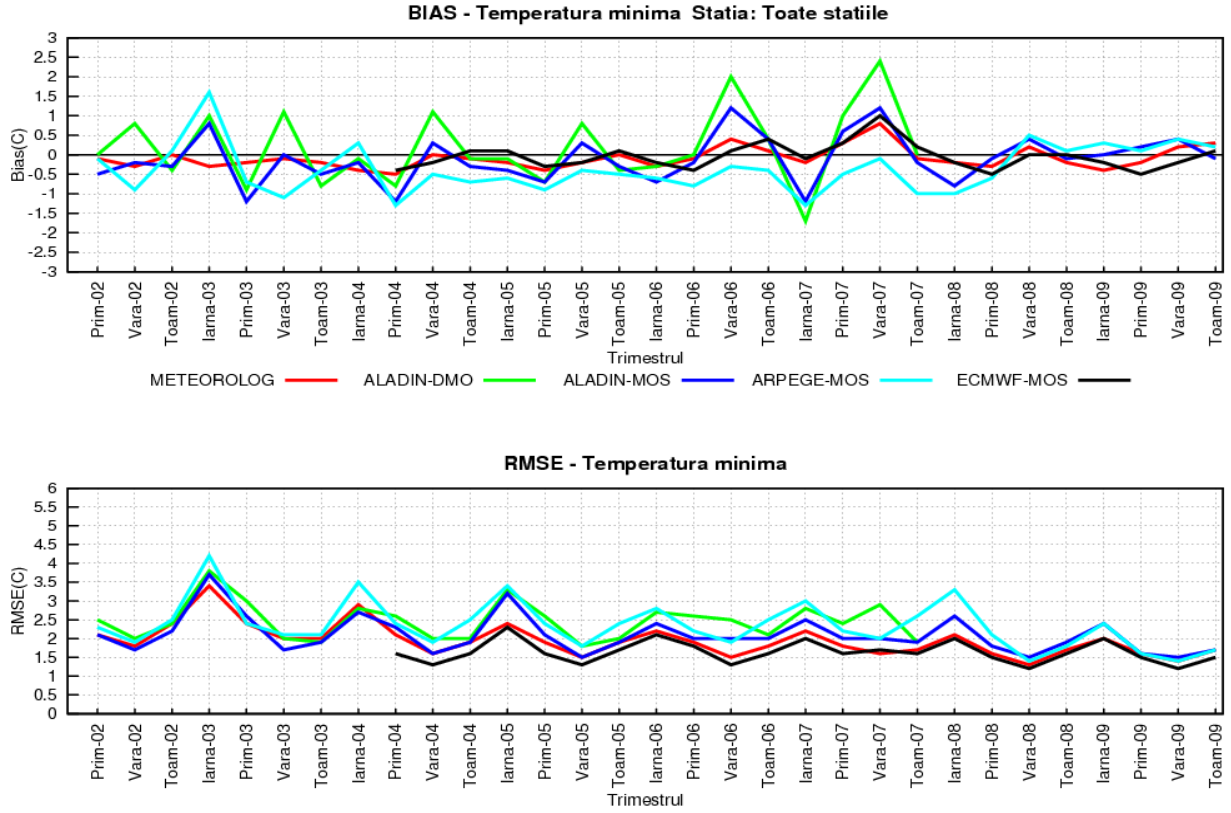

Fig. 10. *MOS_ECMWF, MOS_ALADIN and MOS_ARPEGE , compared with "subjective"-METEOROLOG forecasts – **minimum temperature.** Average over 21 meteorological stations*

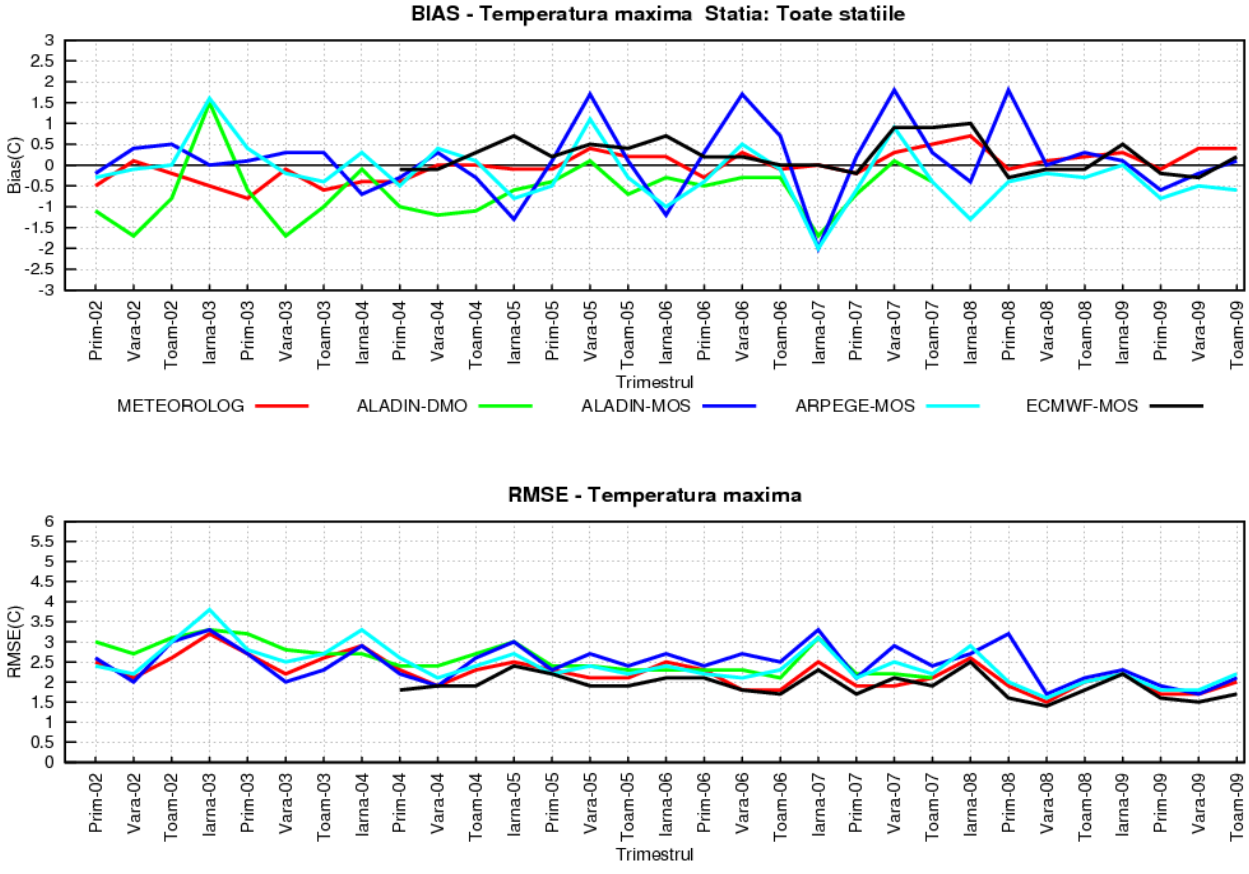

Fig. 11. *MOS_ECMWF, MOS_ALADIN and MOS_ARPEGE , compared with "subjective"-METEOROLOG forecasts – **maximum temperature**. Average over 21 meteorological stations*

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