Verification of LM-COSMO Model in Poland with SYNOP and Rain Gauge Data

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1 Introduction

In our article we presented the results of the verification of LM-COSMO model for Poland during 2004. For the calculations we interpolated the gridded forecast values on the station points where observations are available. The interpolation of forecast values on the station points was performed by averaging the values on the four nearest grid points. For this purpose we used the bilinear interpolation. We compared data from the model starting at 00 UTC with data 56 Polish SYNOP stations (Fig. 1).

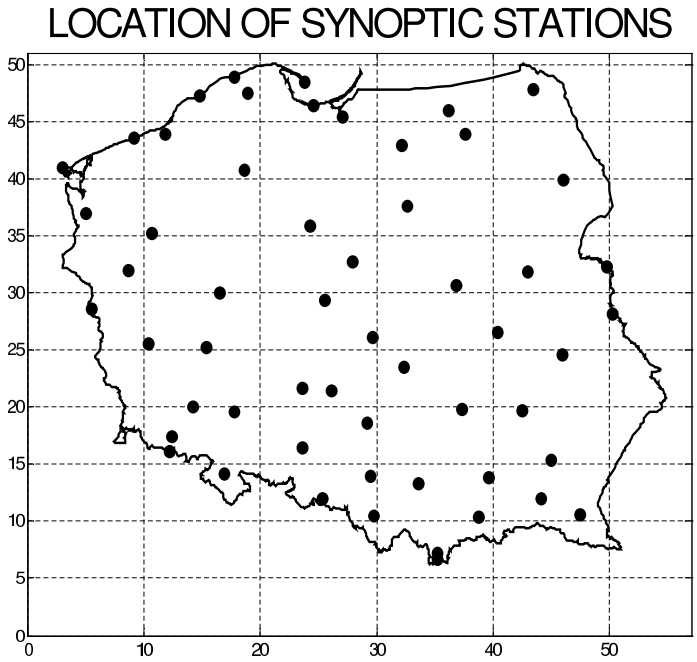

Figure 1: Location of synoptic stations

We used the following meteorological parameters for verification:

- Temperature at 2 m above ground level
- Dew point temperature at 2 m a.g.l
- Air pressure at sea level
- Wind speed at 10 m a.g.l

For comparison we used mean error (ME), root mean square error (RMSE) and correlation coefficient at six hour intervals from the range 6h - 72h. We calculated the errors for all the separate stations and they proved different in each station. We have also mountainous

stations (in the south of Poland) and coastal ones (in the north). We finally calculated the monthly mean errors in Poland (mean of all stations). We also made verification for the 24h precipitation amount (from 6h - 6h next day). We compared the precipitation data from the model started at 00 UTC with data from 308 rain gauges (Fig. 2). We calculated some verification indices from the contingency table for the different precipitation thresholds.

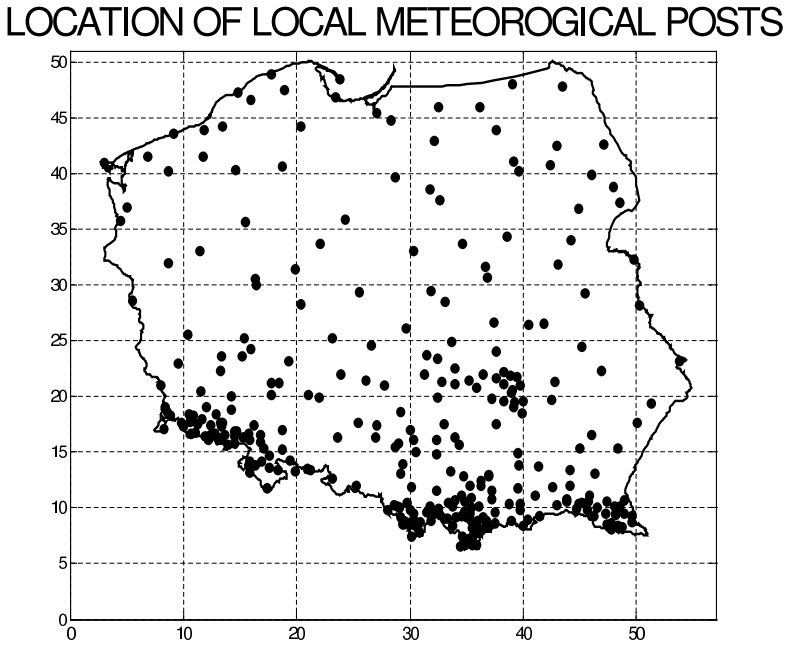

Figure 2: Location of local meteorological posts

2 Results

2.1 Comparison with SYNOP station.

Figures 3-10 show monthly the verification results during 2004.

The 2m temperature

The bias is bigger and positive (0-2) during spring and summer, while lower and negative (0-1) during winter (Fig. 3). We observed large diurnal amplitude in spring (April, May) and a little smaller in summer (June, July, August) with maximum of ME at 12 UTC (and 24 UTC) and minimum at 18 UTC (and 6 UTC). In the remaining months (autumn and winter) daily cycle is not well reproduced.

For RMSE error (Fig. 4) we observed explicit diurnal run for months from April to August with maximum of error at 12 UTC and minimum at 6 UTC.

The 2m dew point temperature

The dew point temperature is overpredicted for all months and the daily cycle is observed (especially in summer) with maximum at day time and minimum at night time (Fig. 5).

The RMSE reaches a maximum at 12 UTC and minimum at 6 UTC (Fig. 6). The errors are larger in summer than in winter. From October to December the daily cycle is not well observed.

Pressure sea level

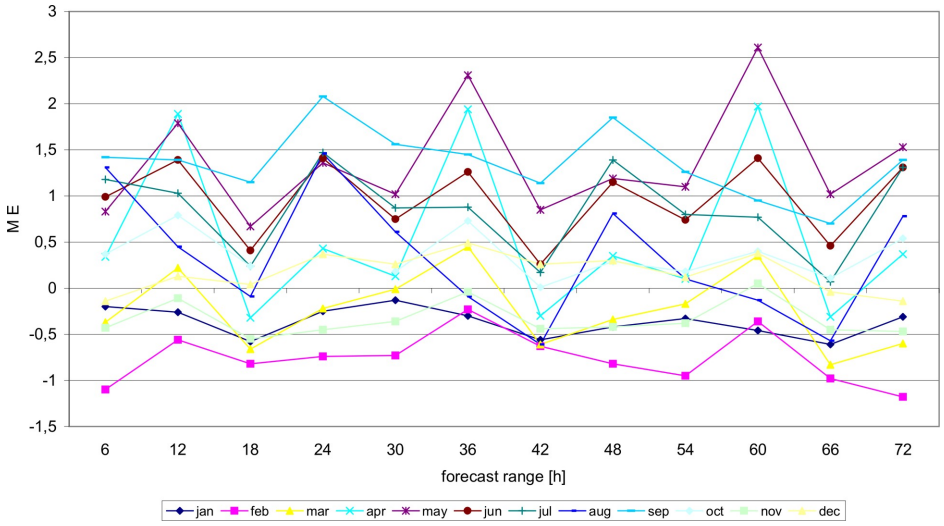

Figure 3: Mean error, Temperature 2m [C], Poland, 2004

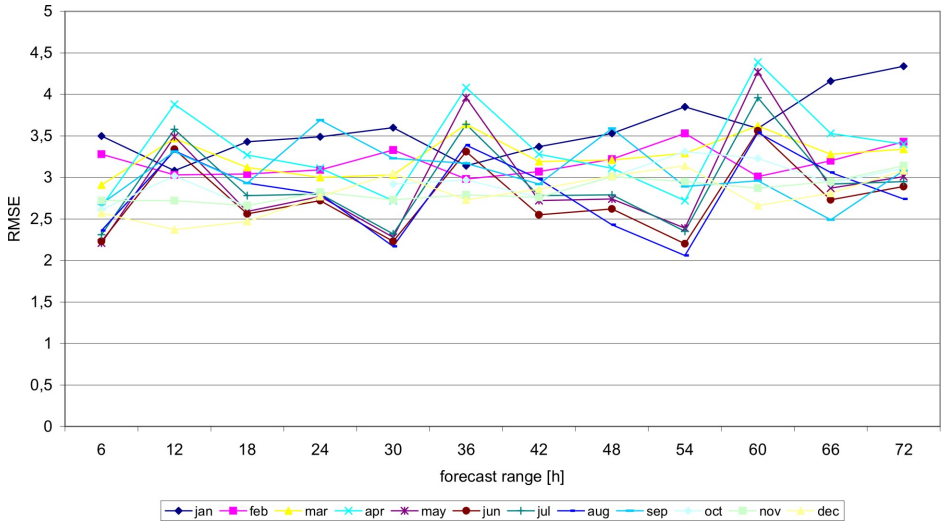

Figure 4: RMSE, Temperature 2m [C], Poland, 2004

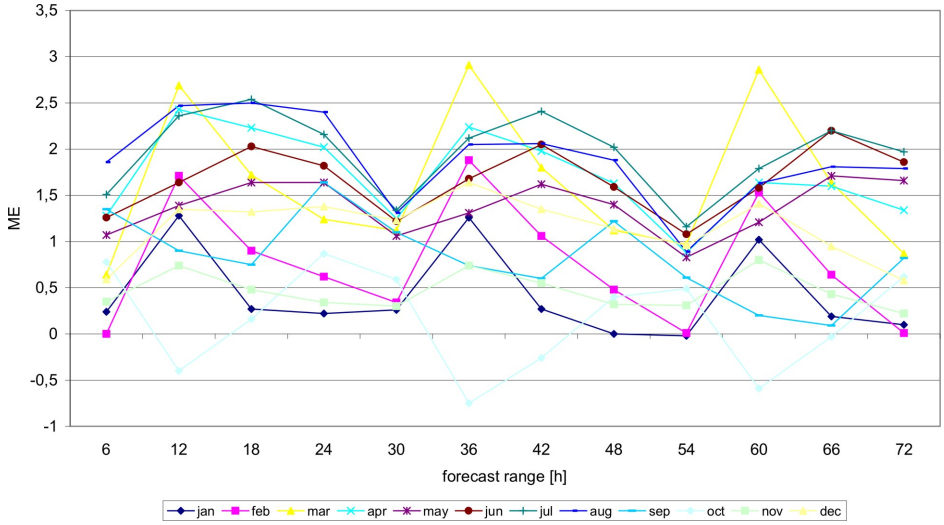

Figure 5: Mean error, Dew point 2m [C], Poland, 2004

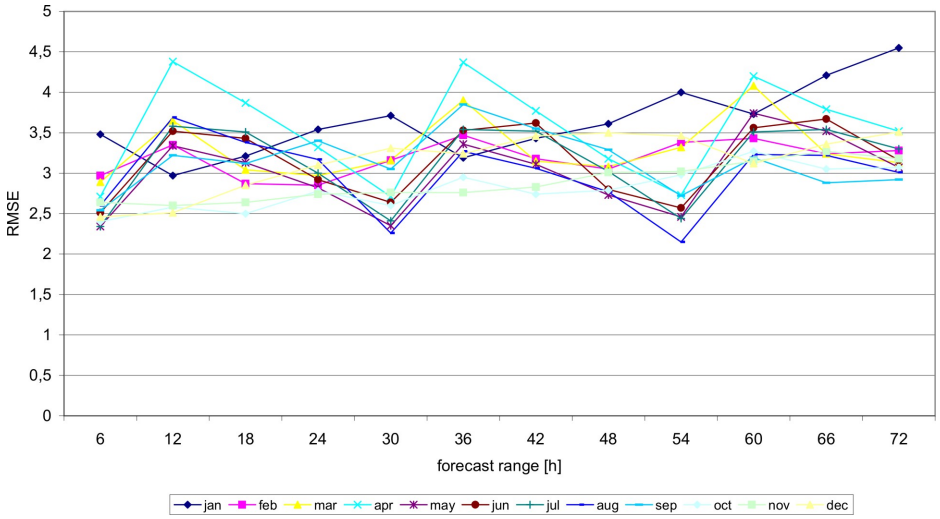

Figure 6: RMSE, Dew point 2m [C], Poland, 2004

The sea level pressure is underestimated for winter and summer (Fig. 7).

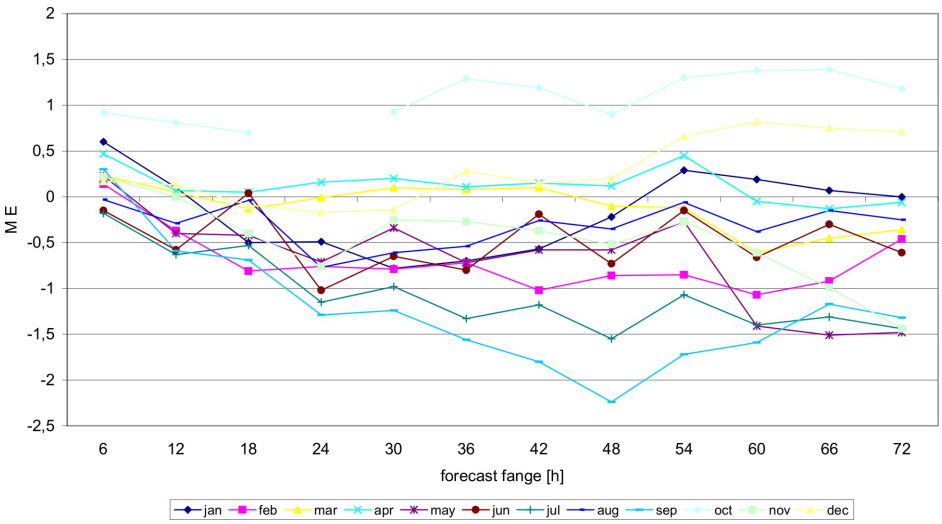

Figure 7: Mean error, Pressure [hPa] Poland, 2004

In spring the ME was about zero. The RMSE error increased with forecast range and it was smaller for summer than for winter (Fig. 8).

10 m wind speed

The wind speed is overpredicted with minimum of error at 18 UTC (Fig. 9).

The ME for wind speed is from 0 to 1 m/s. In RMSE error for daily amplitude with forecast range was very little and also the difference of RMSE among several months was small (Fig. 10).

The previous pictures show the mean errors from all stations, and the next three figures (11-13) represented the distribution of errors for one month (March 2004) for a 36h forecast, for each of 53 SYNOP stations (without the three high mountainous stations). The error was different and depended on the location of the stations.

ME for temperature, wind speed and sea level pressure was different and sometimes they were below zero and sometimes above zero level (Fig. 11), but the dew point temperature

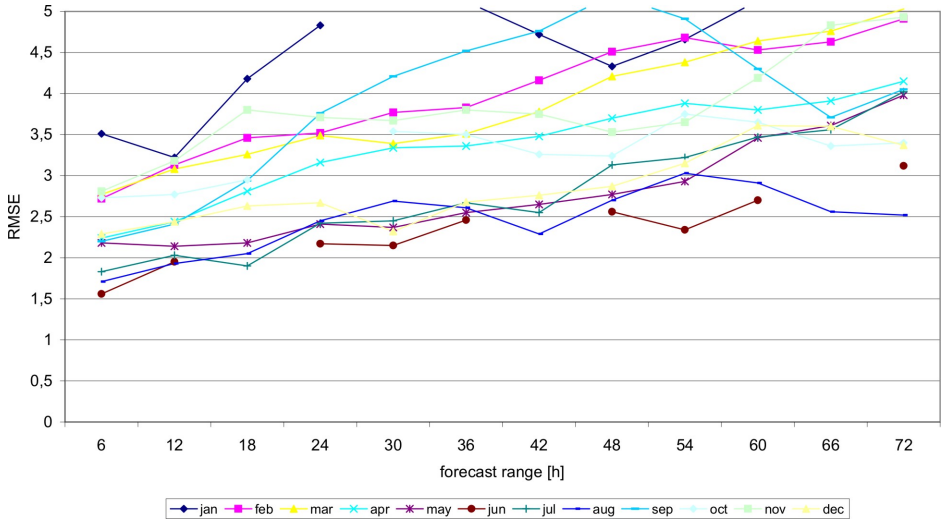

Figure 8: RMSE, Pressure [hPa] Poland, 2004

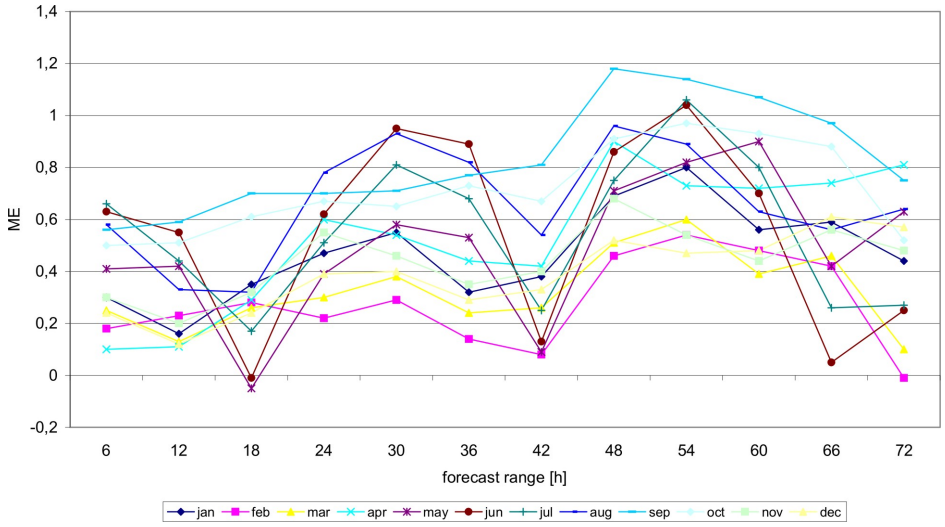

Figure 9: Mean error, Wind speed [m/s], Poland, 2004

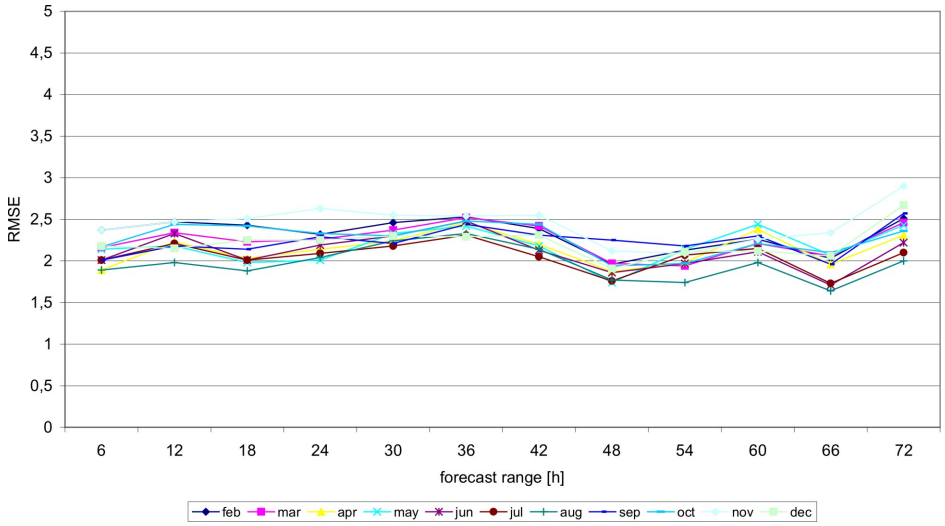

Figure 10: RMSE, Wind speed [m/s], Poland, 2004

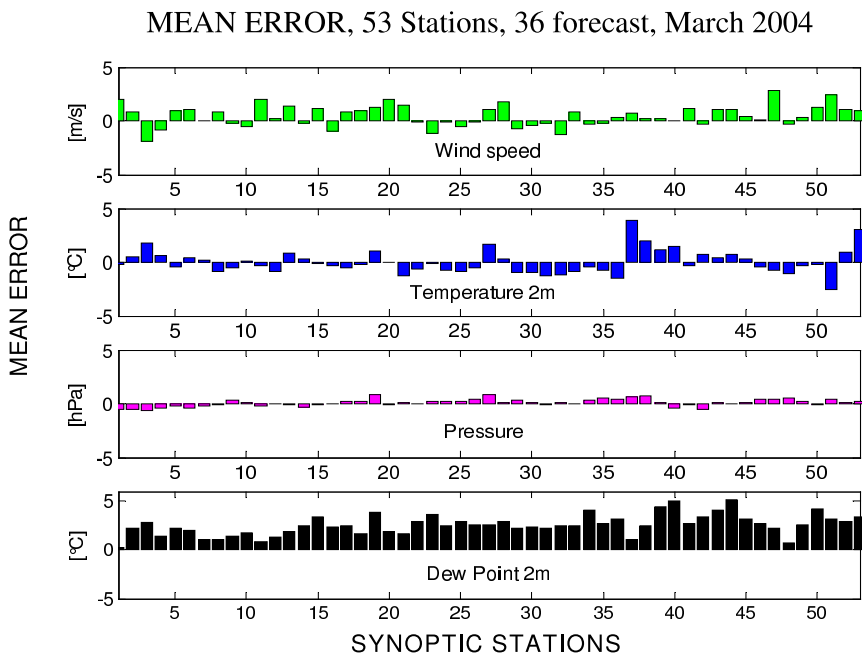

Figure 11: Mean error,53 stations, 36h forecast, March 2004

this month was overpredicted for all stations. In Fig. 12 we show RMSE for individual stations for the same month.

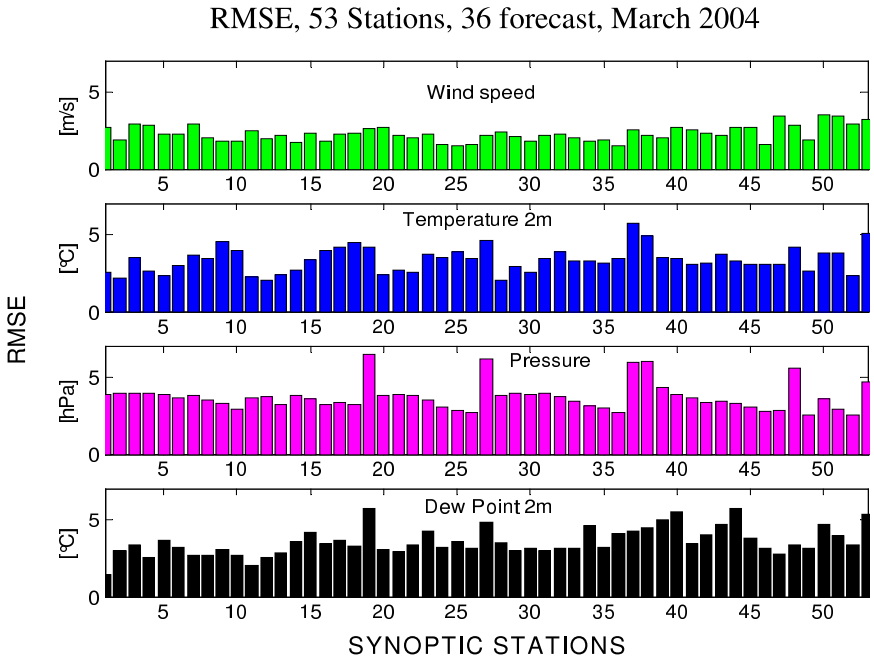

Figure 12: RMSE, 53 stations, 36h forecast, March 2004

2.2 Comparison with rain gauges

For precipitation we calculated indices from the contingency table for the 24 h accumulated forecast data and data from 308 stations (rain gauges). For verification of precipitation thresholds 0.5, 1,2.5,5,10,20,25,30 mm were used. For each threshold the following scores were calculated (the same are used at DWD): FBI (Frequency bias), POD (Probability of

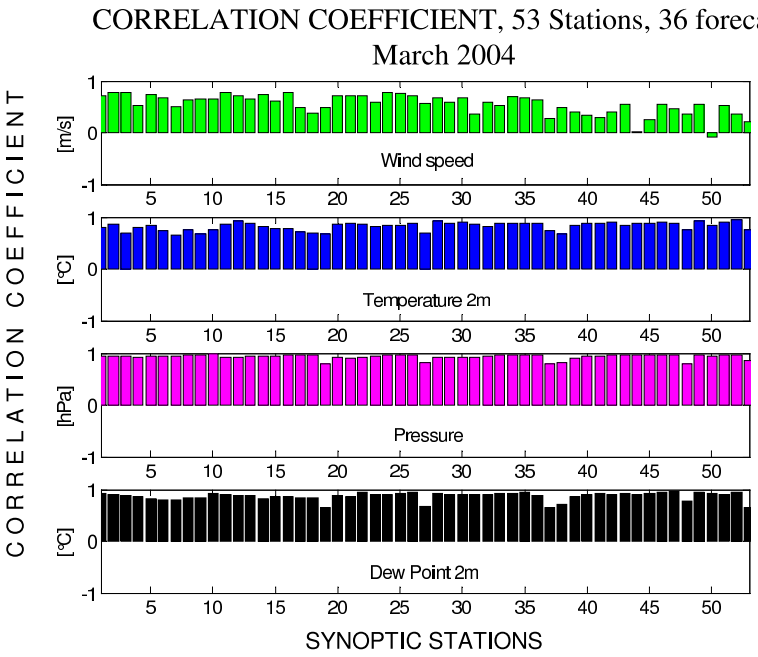

Figure 13: Correlation coefficient, 53 stations, 36h forecast, March 2004

detection of event), PON (Probability of detection of non-event) FAR (False alarm rate), TSS (True skill statistics), HSS (Heidke skill score), ETS (Equitable skill score).

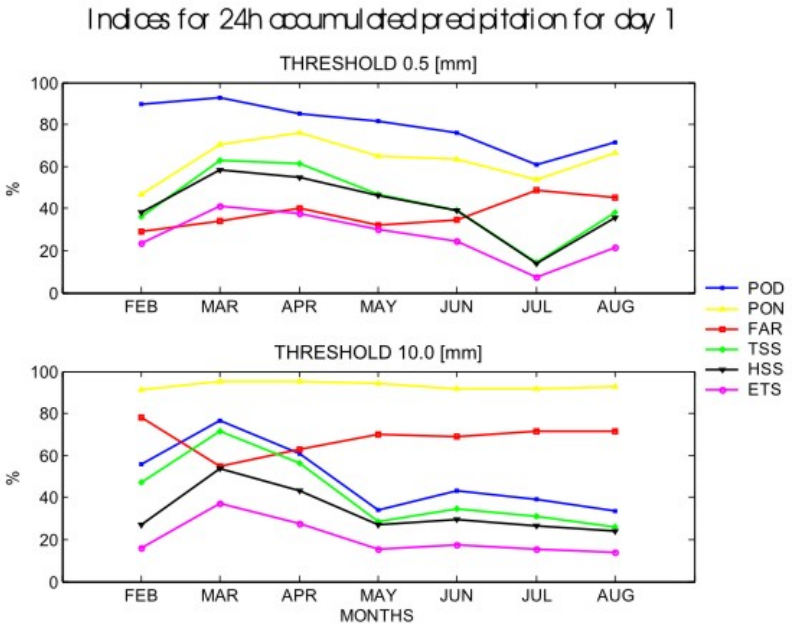

Figure 14: Indices for 24h accumulated precipitation for day 1

At Fig. 14 we show those indices for two thresholds 0.5 and 10 mm from February to August for the first day forecast. We have chosen March to present the indices for all thresholds for three days of forecast range (Fig. 15).

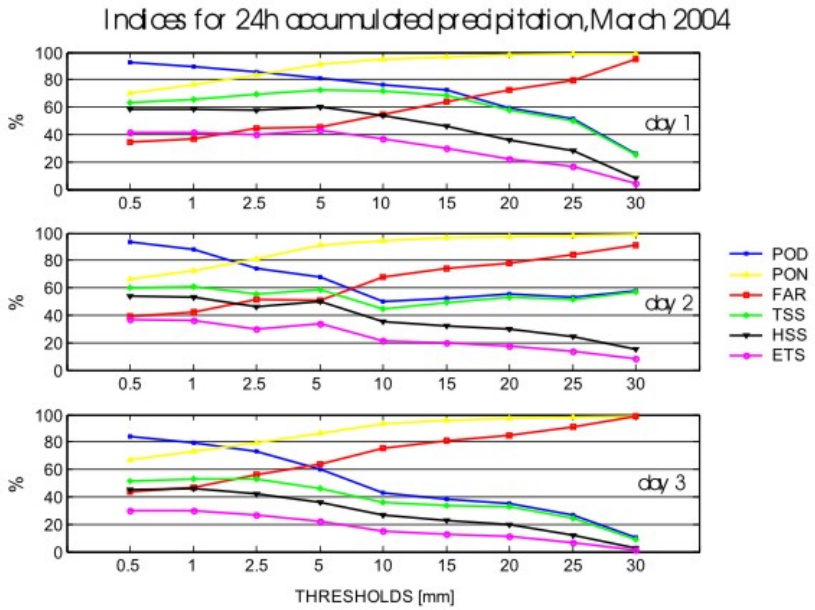

Figure 15: Indices for 24h accumulated precipitation, March 2004

3 Conclusions

1. We observed the diurnal and monthly cycle of RMSE of the 2m temperature and the 2m dew point temperature.

2. RMSE increased during the forecast, especially for the sea level pressure.

3. The distribution of RMSE for the wind speed was quite smooth with minimum values occurring at night (similar in every month).

4. ME is positive for the wind speed and the 2m dew point temperature, about zero or negative for the sea level pressure and changes a sign for temperature (negative in winter and positive in summer).

5. Precipitation amounts seem to be overestimated by the model.