Overview of operational verification results in Poland

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1 Introduction

A goal of this work is to summarize the main results of operational verification in Poland. The verification results of a few continuous meteorological parameters, as well as 12 and 24h accumulated precipitation are presented in this paper.The fields from COSMO_PL had been verified with 58 Polish SYNOP stations. The model configuration was: 14 km horizontal grid spacing, initial time at 00 UTC, the forecast range 72 h. To verify the diurnal behavior of the model, the couples forecast-observation were stratified according to the hour of the day (3 hourly frequency for continuous parameters) and the season of the year.The verification was performed using a new verification tool - VERSUS. The verification results from June 2008 to May 2009 are shown bellow.

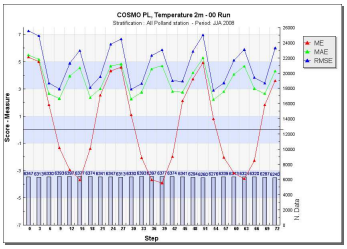
2 The verification method

The mesoscale COSMO_PL had been verified for four seasons for the selected period (JJA, SON, DJF, MAM). The verification was performed for following parameters: temperature at 2m a.g.l, the air pressure at sea level, the wind speed at 10m e.g.l., 12h and 24h accumulated precipitation. For continuous parameters the mean error (ME), the mean absolute error (MAE) and the root mean square error (RMSE) were calculated. For the accumulated precipitation indices FBI, POD, FAR, ETS from contingency table were calculated. For the precipitation verification following thresholds were taken into account: 0.2, 0.4, 0.6, 0.8, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 14, 16, 18, 20 mm.

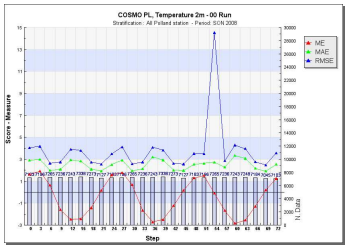
3 Results

3.1 The 2m temperature

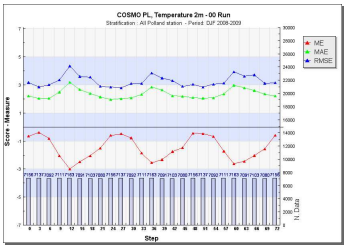
Figures 1-4 present a behavior of 2 m temperature forecast errors for all the set of Polish stations. The diurnal and seasonal cycles were observed. The errors were bigger in summer than in winter time. During half-yearly period from May to August (MAM,JJA) diurnal cycle was marked with large amplitude for ME, MAE, RMSE. The errors reached maximum values around 3UTC and 15 UTC The cold bias was observed during the day and warm bias during the night time. The diurnal amplitude of ME took values in the range (0, -2,5) in DJF. The maximum of errors occurred at midday. The ME was negative for the whole forecast range. ME behavior was quite similar in summer, autumn and spring but the smaller errors were observed in autumn. In SON the maximum values of ME were at 3 UTC and 12 UTC.



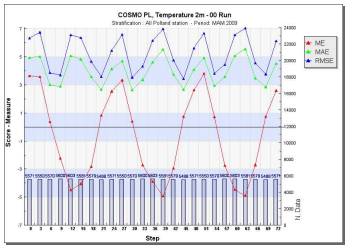
(a) ME, MAE,RMSE, Temperature 2m, JJA 2008, Poland



(b) ME, MAE,RMSE, Temperature 2m, SON 2008, Poland



(c) ME, MAE,RMSE, Temperature 2m, DJF 2008/2009, Poland

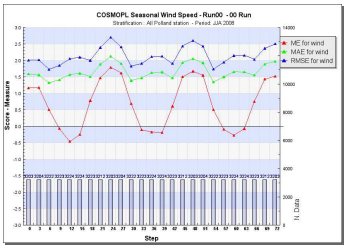


(d) ME, MAE,RMSE, Temperature 2m, MAM 2009, Poland

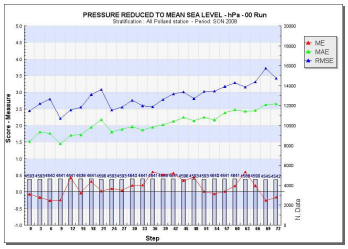
Figure 1: Temperature verification results over Poland

3.2 The sea level pressure

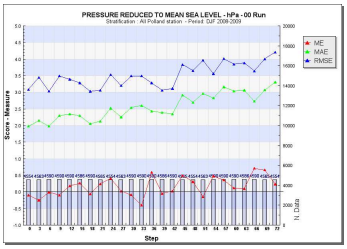
Figures 5-8 show ME, MAE, RMSE for the pressure reduced to mean sea level. For all the seasons we observed clear increasing tendency of RMSE and MAE with the forecast step. No clear tendency of ME was noticed. The errors (RMSE, MAE) were smaller in the summer than in the winter. ME error was near zero (-0.5 0.5) in the autumn and winter. The amplitude of ME was bigger in the spring and summer and took the range (-1.0-1.0).



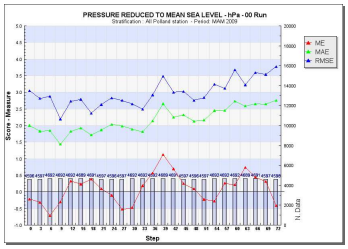
(a) ME, MAE,RMSE, Sea level pressure, JJA 2008, Poland



(b) ME, MAE,RMSE, Sea level pressure, SON 2008, Poland



(c) ME, MAE,RMSE, Sea level pressure, DJF 2008/2009 Poland

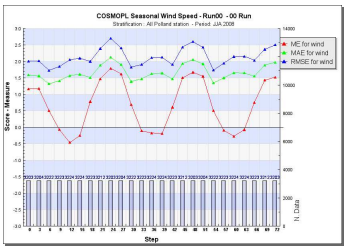


(d) ME, MAE,RMSE, Sea level pressure, MAM 2009, Poland

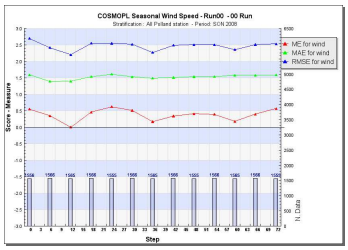
Figure 2: SLP verification results over Poland

3.3 The wind speed 10m above ground level

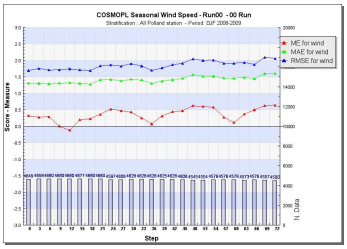
The verification results of the wind speed 10m above ground level are presented in figures 9-12. Very explicit seasonal runs of errors with a division for two half-yearly period were noticed. For the first period, summer 2008 and spring 2009, we observed explicit diurnal cycle of all errors (RMSE, MAE, ME) with maximum at midnight. ME was above zero during the night and below zero during the day. For the second period, September 2008-February 2009, the amplitude of errors was small. Despite of the small amplitude of ME clear diurnal cycle was observed.



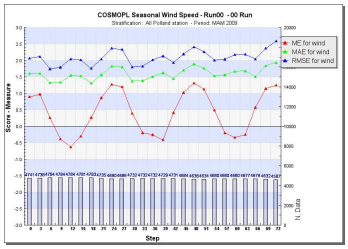
(a) ME, MAE,RMSE, Wind speed 10m, JJA 2008, Poland



(b) ME, MAE,RMSE, Wind speed 10m, SON 2008, Poland



(c) ME, MAE,RMSE, Wind speed 10m , DJF 2008/2009, Poland

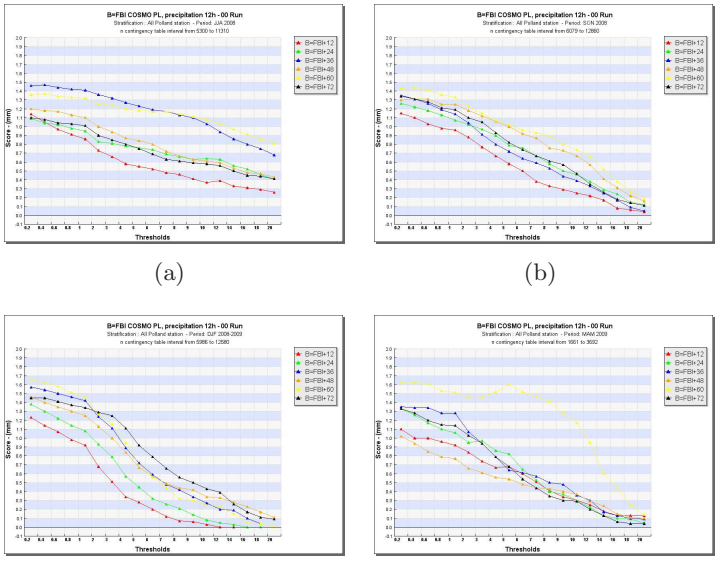


(d) ME, MAE,RMSE, Wind speed 10m, MAM 2009, Poland

Figure 3: 10m wind speed verification results over Poland

3.4 12h and 24h accumulation precipitations

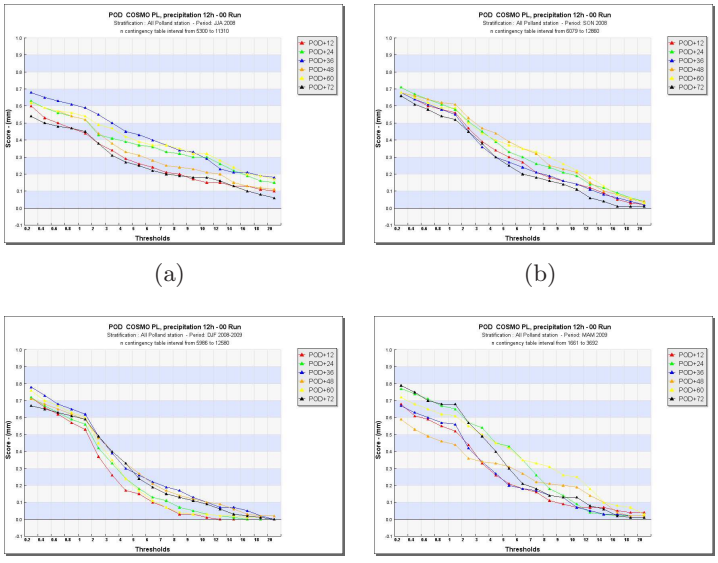
Figures 13-28 show verification of 12h accumulated precipitations and figures 29-44 show 24 h accumulated onces. For both precipitation sums an overestimation was noticed for small thresholds (0-2.0 mm) and underestimation for higher thresholds. FBI plots decreased rapidly for higher thresholds. The results of FBI were better for JJA and MAM. Also POD diminution with the precipitation thresholds was observed. The curve broke down rapidly around the threshold of 2 mm. FAR increased monotonous with precipitation thresholds. The results were better for the first day of forecast. ETS score was quite low for the all seasons and the precipitation sums. Almost no skill level was noticed. For all indices the results of verification were better for 24h accumulated precipitation than for 12h accumulated precipitation.



(a) (b)

(c) (d)

Figure 4: FBI , 12h accumulated precipitation, June 2008-May 2009, Poland



(a) (b)

(c) (d)

Figure 5: POD, 12h accumulated precipitation, June 2008-May 2009, Poland

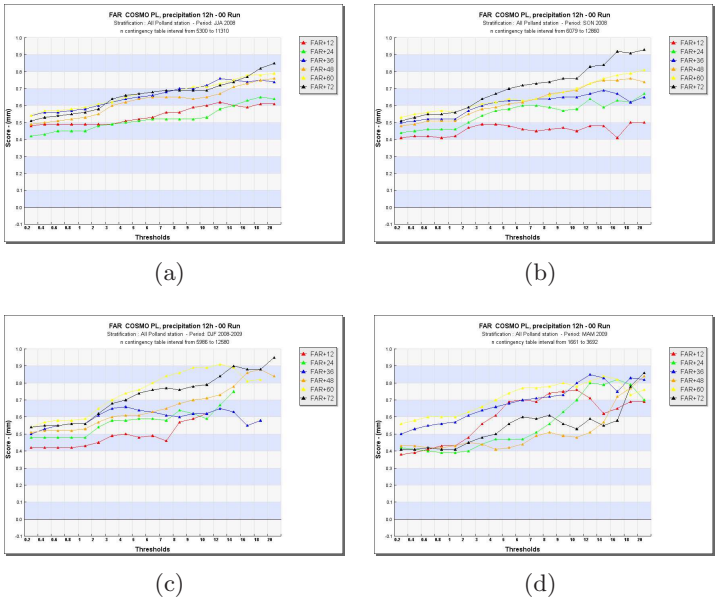


Figure 6: FAR, 12h accumulated precipitation, June 2008-May 2009, Poland

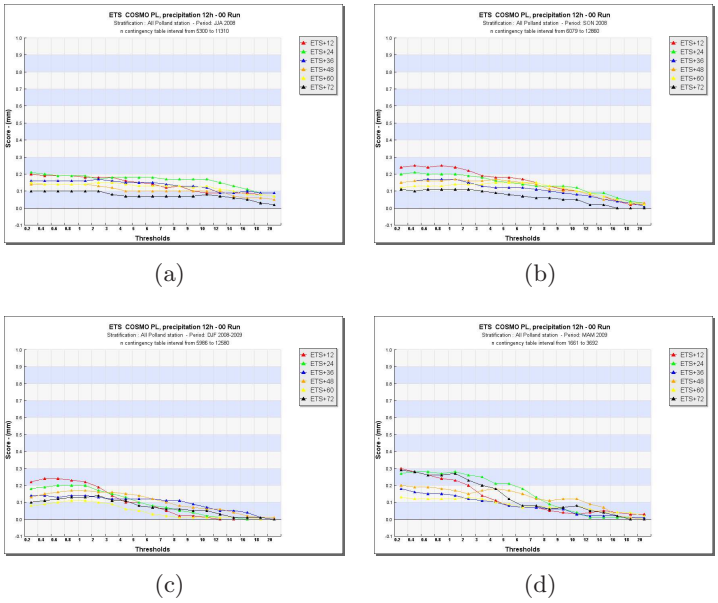
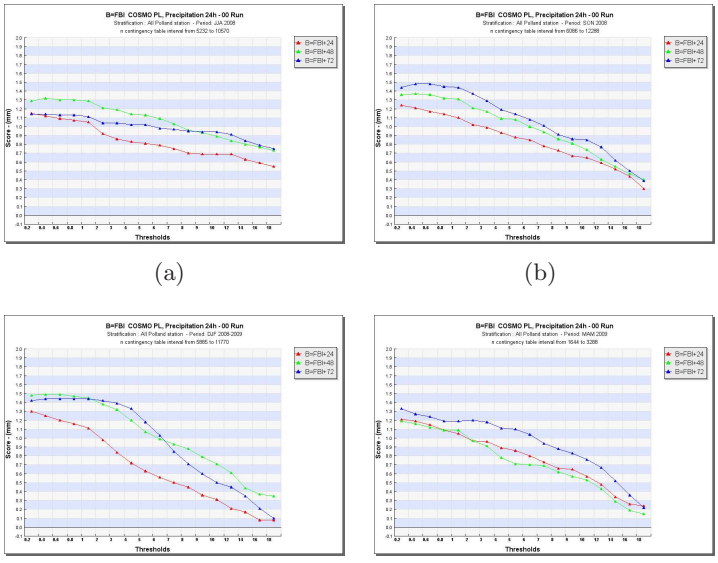


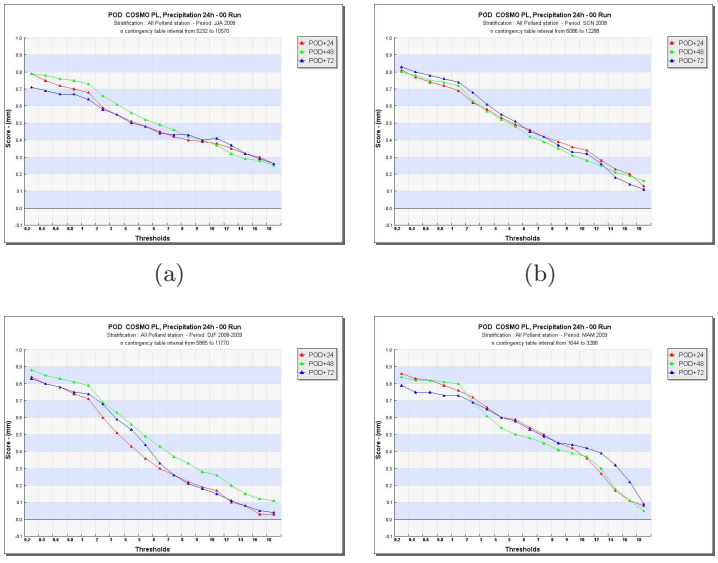
Figure 7: ETS, 12h accumulated precipitation, June 2008-May 2009, Poland



(a) (b)

(c) (d)

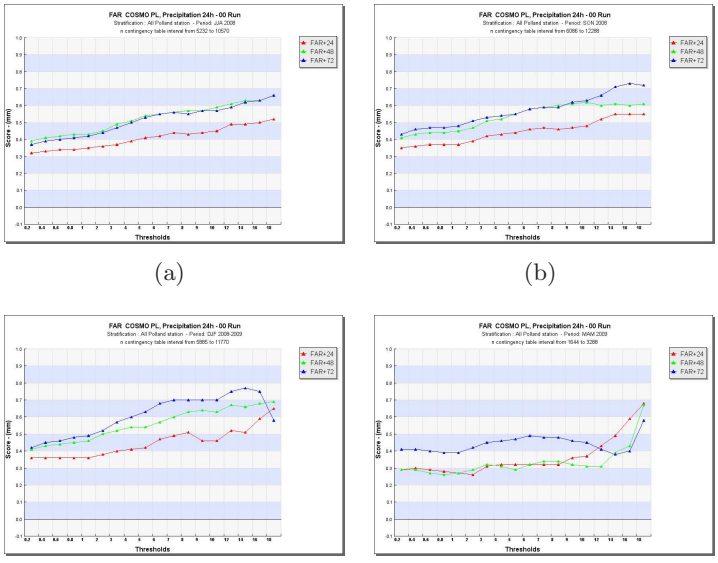
Figure 8: FBI, 24h accumulated precipitation, June 2008-May 2009, Poland



(a) (b)

(c) (d)

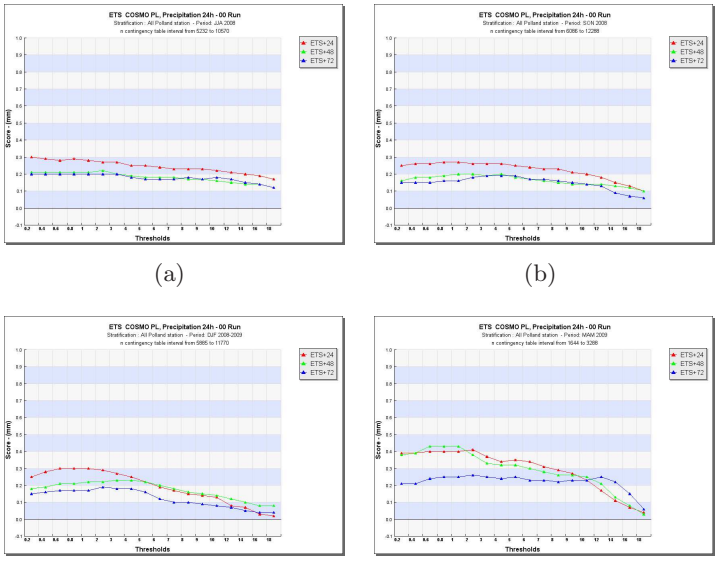
Figure 9: POD, 24h accumulated precipitation, June 2008-May 2009, Poland



(a) (b)

(c) (d)

Figure 10: FAR, 24h accumulated precipitation, June 2008-May 2009, Poland



(a) (b)

(c) (d)

Figure 11: ETS, 24h accumulated precipitation, June 2008-May 2009, Poland

4 Conclusions

Operational verification results using a new verification tool VERSUS was presented in this paper. Diurnal, seasonal and half-yearly period cycles of the errors were observed for the 2 m temperature and the wind speed. The model seems to underestimate 2m temperature for the winter time. For remaining seasons the temperature is underestimated during the day and overestimated during the night. For all seasons the wind speed is always overestimated during the day. MAE and RMSE of sea level pressure increase with the forecast time. The model underestimates the precipitation for higher thresholds. The verification results were obtained better for 24 h accumulated precipitation.

References

[1] I.T.Jolliffe, D.B.Stephenson, 2003. Forecast Verification, A Practitioners Guide in Atmospheric Science, *WILEY* D.S. Wilks, 1995. Statistical Methods in the Atmospheric Science *Academic Press*

[2] Zepeda-Arce, J, E. Foufoula-Georgiou, and K. Droegemeier, 2000. Space-time rainfall organization and its role in validating quantitative precipitation forecasts, *J. Geophysical Research*, 105(D8), **10**,129-**10**,146.