Latest Results of the Meteorological Elements Verification over Poland

(Short note)

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1 Introduction

The results of the verification of surface continuous parameters, of 24-h accumulated precipitation and upper-air parameters from January 2006 to December 2006 are presented in this article. We compared the data from SYNOP stations, rain gauges and TEMP stations vs. data from model version 3.5.

Verification of surface parameters using 56 SYNOP stations:

- Monthly verification for the following meteorological elements: 2m temperature, 2m dew point temperature, sea level pressure, 10m wind speed
- Operational verification of selected continuous parameters for chosen synoptic stations

The meteorological variables forecasted by the model were compared with synoptic data from 56 Polish synoptic stations. Mean error (ME) and root mean square error (RMSE) were calculated using the 12 forecast ranges (every 6 hours) for a 72 hour forecast starting at 00 UTC. The error estimators were calculated for all stations and for the whole country.

Verification of the 24-h accumulated precipitation using 308 rain gauges:

- Verification of the 24-hour accumulated precipitation using 7 indices from the contingency table for the 3 forecast ranges (1-day, 2-day, 3-day)
- The following precipitation thresholds were used: 0.5, 1, 2.5, 5, 10, 20, 25, 30 mm. For each threshold we calculated the following indices: FBI, POD, PON, FAR, TSS, HSS, ETS

Verification of upper-air parameters using 3 TEMP stations:

- Operational verification of the selected continuous parameters for Polish sounding stations
- Off-line verification of the selected continuous parameters. The quality of forecasts was verified against measurements of air temperature, relative humidity, air pressure and wind velocity at standard pressure levels conducted at three Polish upper-air stations

Selection and description of cases with poor QPF:

- Selection of single cases with a poor QPF but a reasonably well predicted large-scale flow from all the COSMO model implementations

- Conditional verification with predefined criteria: different vertical stability, stratiform vs. convective (model) precipitation, weather situation, etc.
- Collection of the cases with the largest QPF errors or greatest importance
- Running model reference version (3.19) for the test cases

2 The temperature at 2 m above ground level

A monthly and seasonal variation for the RMSE and ME occurred. The mean error is negative in the winter and positive in the summer. We observed a clear diurnal cycle during the spring (April - June). In the spring and the summer we noticed a large diurnal amplitude of both indices. The biggest amplitude of the ME and RMSE occurred in April and May with maximum value during the day. The smallest value of the ME was in November. See Figures 1 and 2.

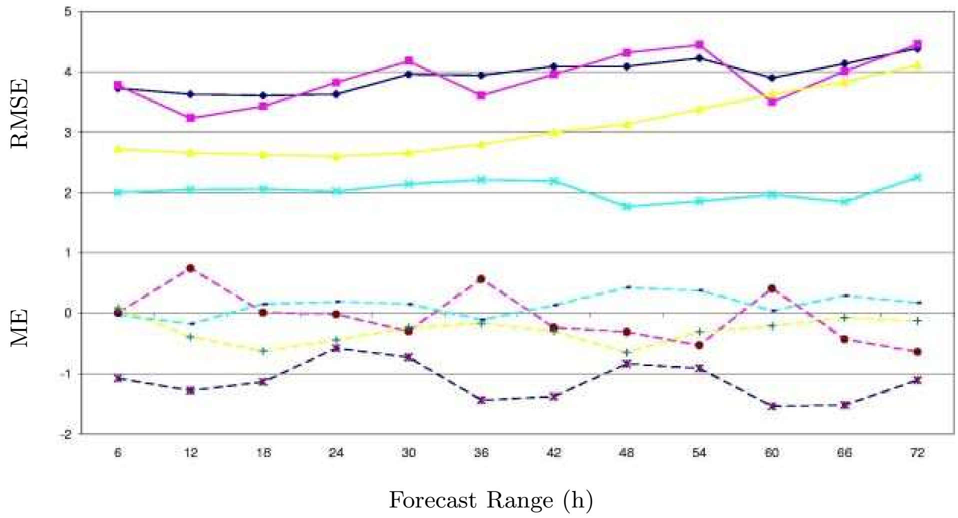


Figure 1: RMSE (full lines) and ME (dashed lines) for Polish SYNOP station measurements (February 2006). Colors are: Temperature, Dew point temperature, Wind, Pressure

3 The dew point temperature at 2m a.g.l.

The monthly variation of the mean error can be observed. The ME for March is negative at night time and positive during the day. The clear diurnal cycle of the RMSE and ME occurred in the summer. For the first half of the year the RMSE increases with the forecast time. The amplitude of RMSE is small from November to December. See Figures 1 and 2.

4 The wind speed at 10 m a.g.l.

The ME is mostly positive from 0 m/s to 1 m/s. The ME increases during the forecast time. The RMSE is quite similar for every month and different forecast ranges (first day, second day and third day). See Figures 1 and 2.

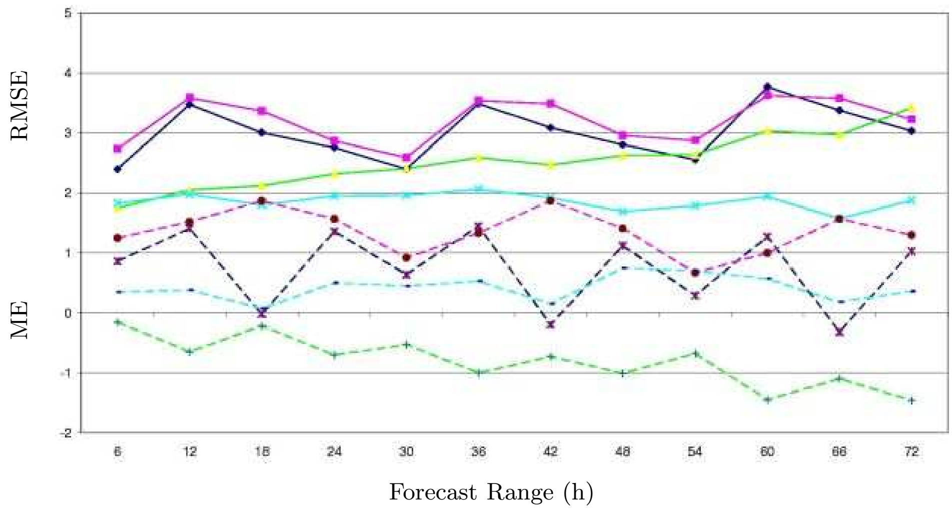


Figure 2: RMSE (full lines) and ME (dashed lines) for Polish SYNOP station measurements (June 2006). Colors are: Temperature, Dew point temperature, Wind, Pressure

4 Sea level pressure.

The RMSE and ME increase with the forecast time. The range of ME is from -1 hPa to +1 hPa. Only in August the ME value is below the above-mentioned range. The RMSE is smaller in the spring and summer and higher in the winter. See Figures 1 and 2.

5 Precipitation.

The model predicts more precipitation than actually occurred. The forecast is better for the first day and for smaller thresholds of precipitation. The best result of the precipitation prediction is in November. See Figures 3-8.

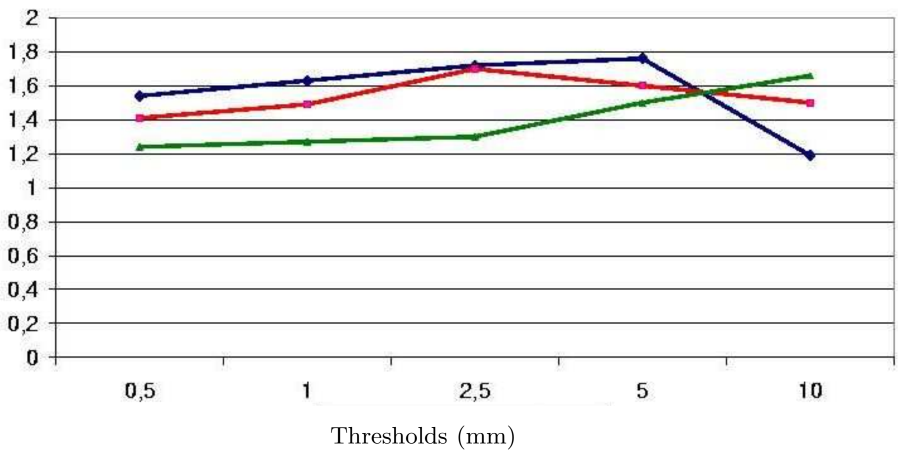
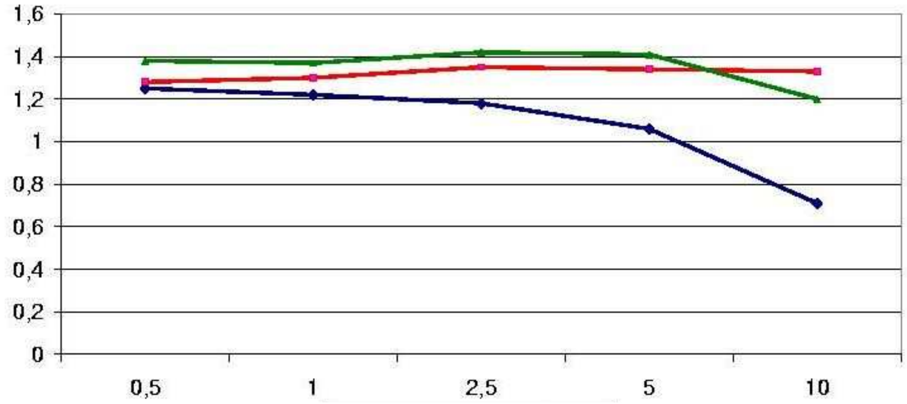
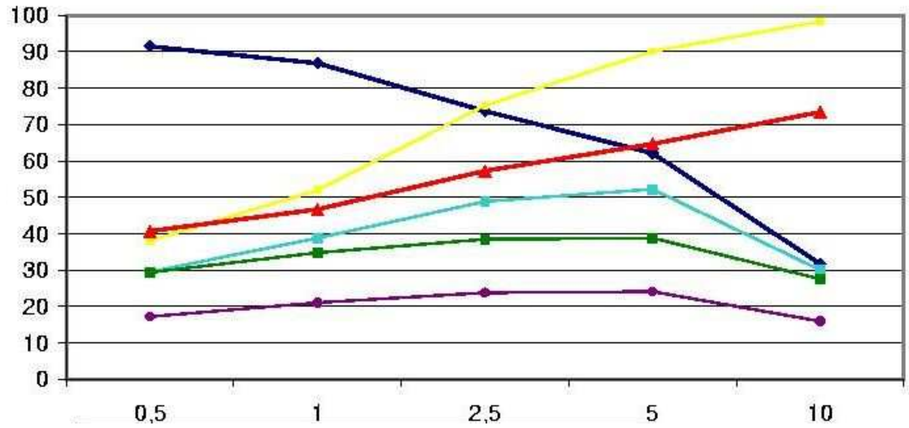


Figure 3: FBI index, precipitation measured with rain gauge network (February 2006). Colors are: day 1, day 2, day 3



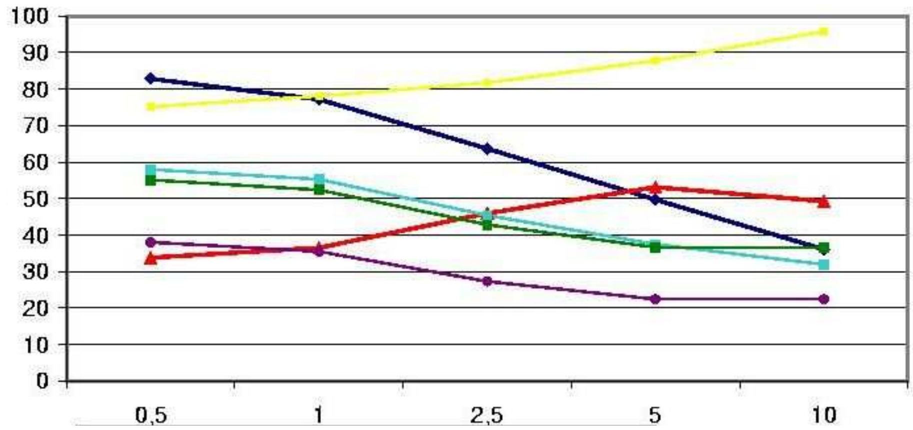
Thresholds (mm)

Figure 4: FBI index, precipitation measured with rain gauge network (June 2006). Colors are: day 1, day 2, day 3



Thresholds (mm)

Figure 5: Indices for 24h precipitation, first day of forecast (February 2006). Colors are: POD, PON, FAR, TSS, HSS, ETS



Thresholds (mm)

Figure 6: Indices for 24h precipitation, first day of forecast (June 2006). Colors are: POD, PON, FAR, TSS, HSS, ETS

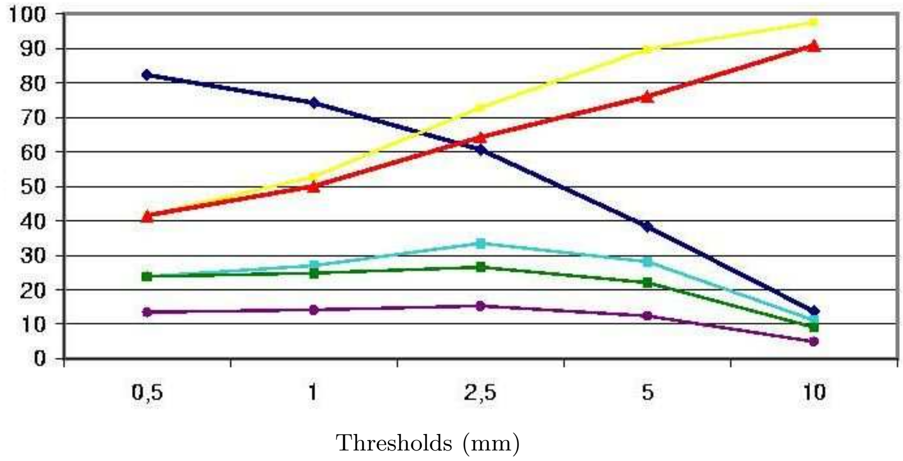


Figure 7: Indices for 24h precipitation, second day of forecast (February 2006). Colors are: POD, PON, FAR, TSS, HSS, ETS

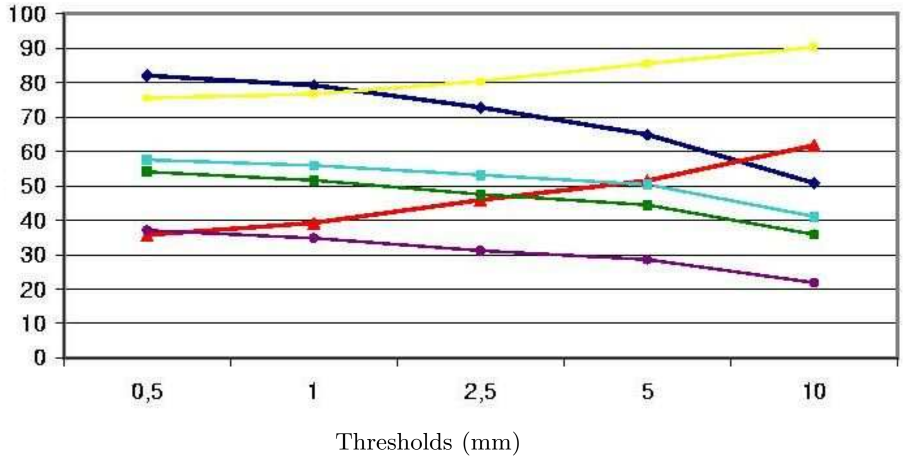


Figure 8: Indices for 24h precipitation, second day of forecast (June 2006). Colors are: POD, PON, FAR, TSS, HSS, ETS

6 Verification of upper - air parameters

Errors (especially RMSE) increase with forecast time. That is clearly seen mainly for wind velocity and air temperature, still, relative error (i.e. ratio error to value) for these two parameters is actually very low. Comparing sequential years, improved parametrisation results in enhancement of quality of forecasts. See Figures 9-12.

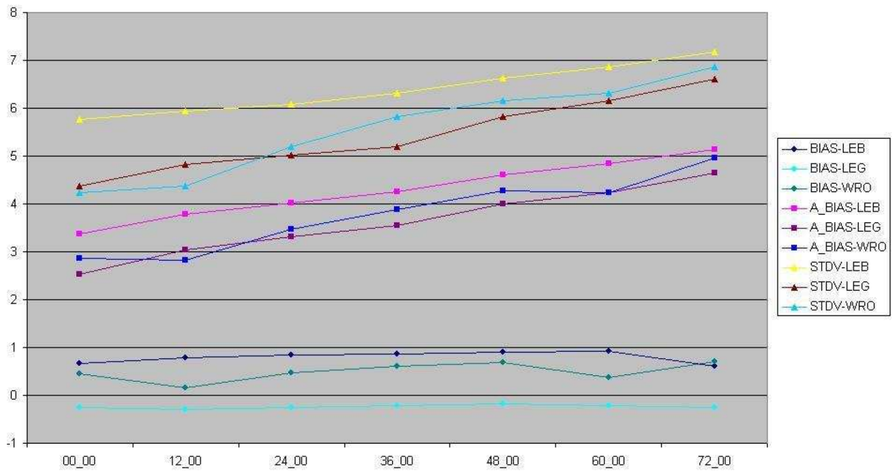


Figure 9: Bias, absolute bias and standard deviation of wind velocity at pressure levels, Polish upper-air stations, vs. forecast hours (January 2005 - June 2006).

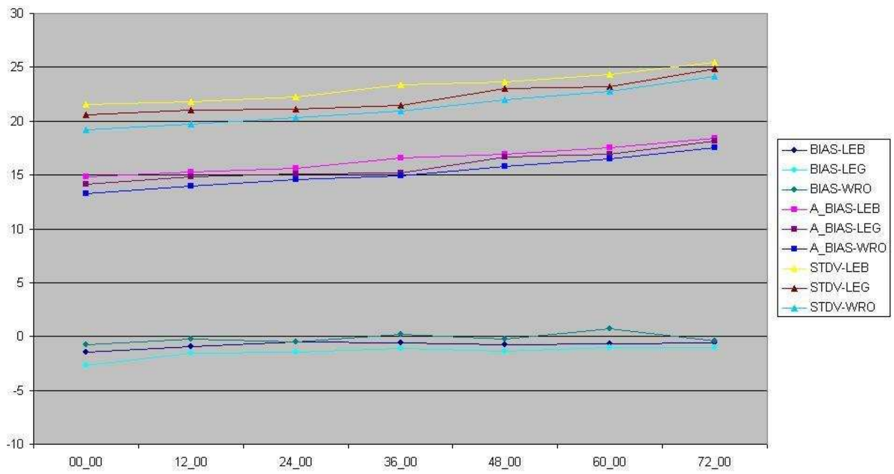


Figure 10: Bias, absolute bias and standard deviation of relative humidity at pressure levels, Polish upper-air stations, vs. forecast hours (January 2005 - June 2006).

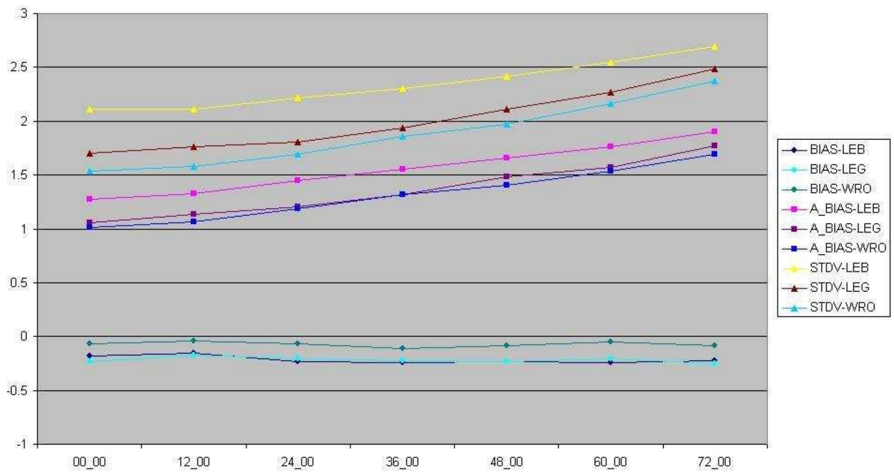


Figure 11: Bias, absolute bias and standard deviation of temperature at pressure levels, Polish upper-air stations, vs. forecast hours (January 2005 - June 2006).

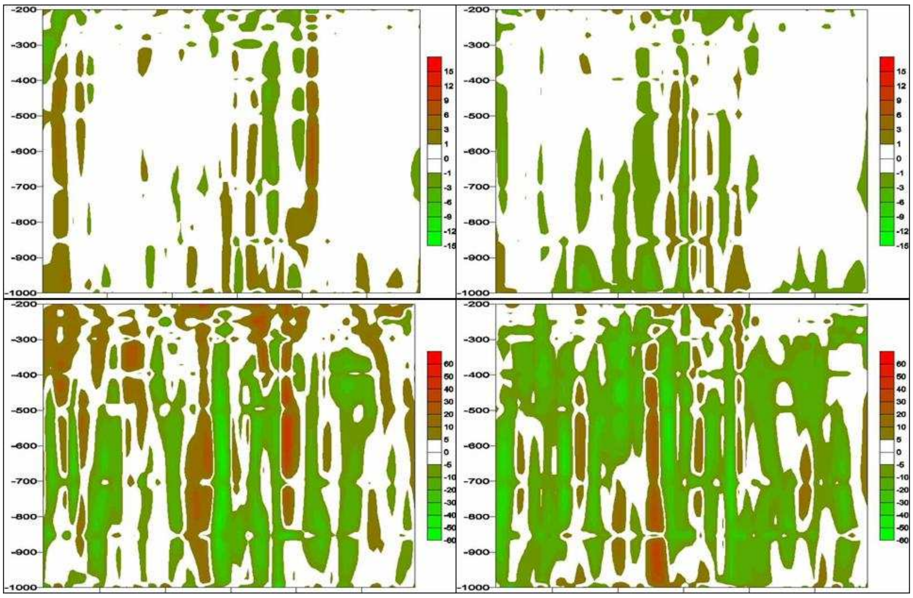


Figure 12: Mean error of air temperature (upper charts) and relative humidity (lower charts) at standard pressure levels for model run at 00 UTC (left charts) and at 12 UTC (right charts), (Leba station, 2005-2006).

7 Case study of QPF.

To choose test cases being dominated by stratiform or convective precipitation we used every day model results (3h forecast and accumulated 24 h), surface data from 56 SYNOP stations and 308 rain gauge stations and radar network. We received reference version of the model 3.19 with grid scale 7 km. This version was used for sensitivity studies by changing the initial condition, numerics, and physical parametrisations. Following example demonstrates model's behaviour in selected meteorological situation(s) and presents the results of precipitation forecast derived from two different runs of the operational version and reference version of the model. As an example we show here the results for 24-hours accumulated precipitation, 4 May 2005. See Figures 13-16.

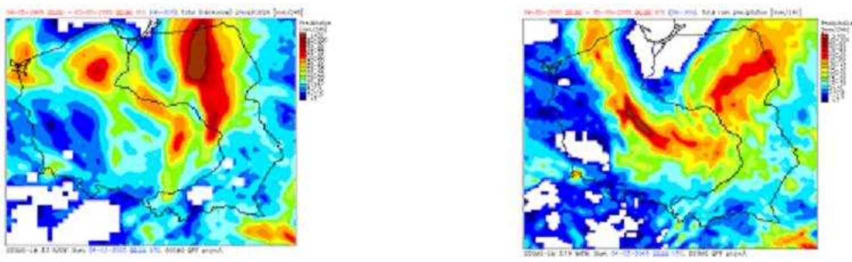


Figure 13: Total precipitation (left: COSMO model v. 3.05, right: COSMO model v. 3.19).

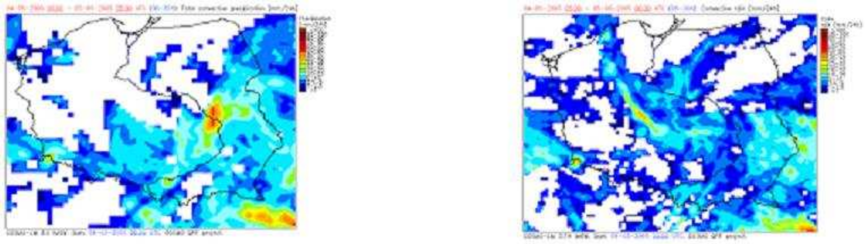


Figure 14: Convective precipitation (left: COSMO model v. 3.05, right: COSMO model v. 3.19).

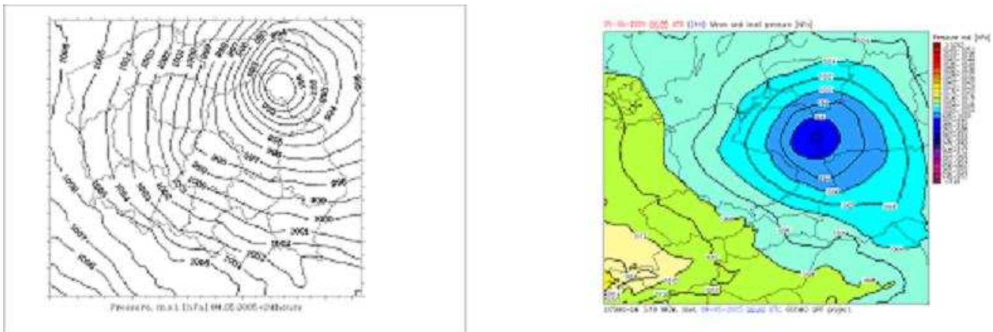


Figure 15: Pressure chart (left: COSMO model v. 3.05, right: COSMO model v. 3.19).

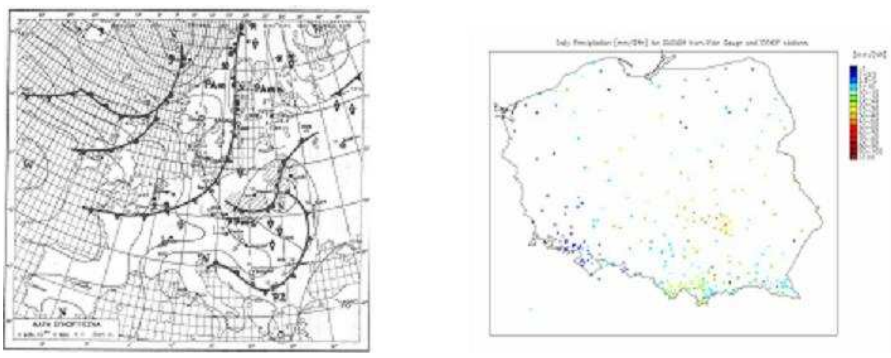


Figure 16: Synoptic chart and precipitation measured at Polish stations network.