The COSMO_LM_PL Precipitation Forecasts are Verified on Daily Rainfall Data Averaged over Selected River Basisn

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The COSMO model forecasts are used in Warsaw Operational Hydrology System to run HBV hydrological model every day giving discharge forecasts for 20 river basins. These are tributaries of main Polish River – Vistula, in the lowland part of Poland. As an input to the hydrological model daily rainfall forecasts and mean daily air temperature are needed. The assumed lead-time is equal 3 days. In this study the rainfall forecast errors have been estimated over chosen 7 river basins (Fig.1) for the 8-months period starting from Jan 2003.

Results of analysis are presented in the Table 1 and Figures 2 - 4. The mean square errors (MSE) and efficiency coefficient (E) were calculated. The index E is considered as a comparison of forecast errors to the errors of "no forecast case" (for details see Mierkiewicz at al., COSMO Newsletter No 3, 2003 p.120). Thus, if the model produces errors equal or greater than inertial forecast it means that the model does not contribute any information gain. The value E *ge* 1.0 disqualifies the model, the value E between 0.8 and 1.0 presents an index of little progress produced by model, and E $<$ 0.8 can be considered as an index of fair model performance.

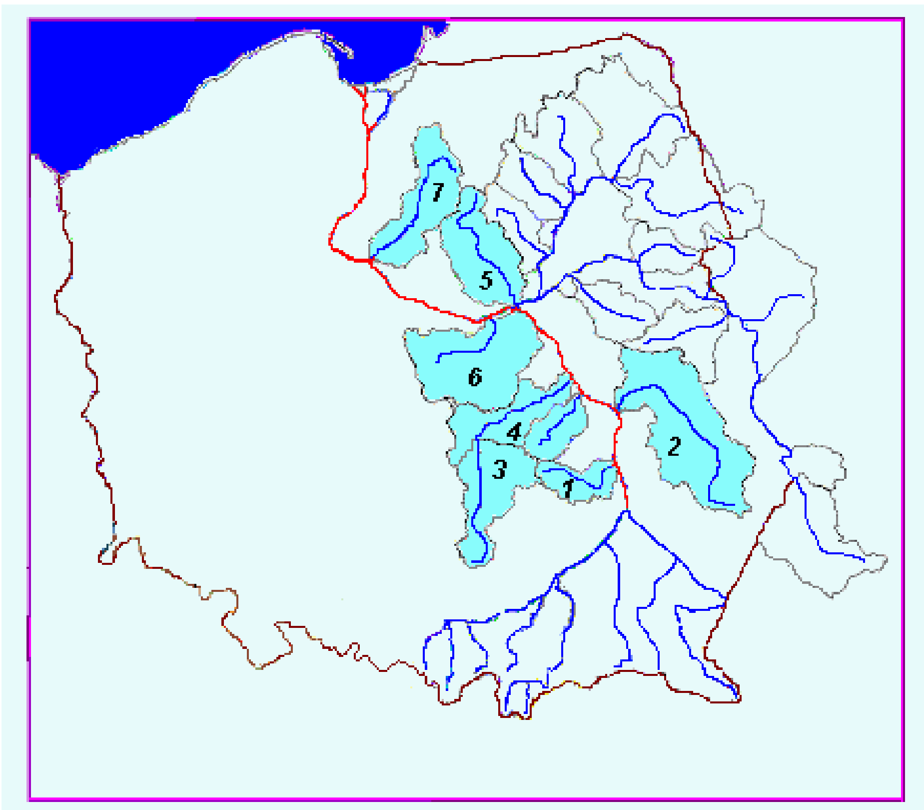

Figure 1: Tributaries of the Vistula River. The COSMO_LM model forecasts for river basins No 1-7.

Table 1: Results of operational run of the COSMO_LM model Errors of rainfall forecasts for the network of 14x14 and 7x7 km (MSE: mean square error, E: efficiency coefficient.

No	River basin	Area (km^2)	COSMO_LM model forecasts of rainfall							
			1-day ahead				2-days ahead		3-days ahead	
			LM-14km		LM-7km		LM-14km		LM-14km	
			MSE	E	MSE	E	MSE	E	MSE	E
1	Kamienna	2007.9	3.15	**0.93**	2.91	**0.71**	4.22	**0.98**	3.82	**1.02**
2	Wieprz	10415.2	3.80	**1.39**	3.29	**1.27**	2.88	**0.94**	3.12	**0.98**
3	Pilica_1	3908.6	3.86	**0.72**	4.45	**0.74**	3.62	**0.71**	4.37	**0.79**
4	Pilica_2	5364.4	2.85	**0.62**	2.65	**0.56**	4.01	**0.85**	3.46	**0.77**
5	Wkra	5322.1	3.71	**0.91**	3.86	**0.98**	3.74	**0.84**	3.84	**0.88**
6	Bzura	7787.5	3.02	**0.70**	2.77	**0.62**	3.29	**0.72**	3.36	**0.78**
7	Drweca	5343.5	3.54	**0.73**	3.62	**0.79**	3.69	**0.70**	4.96	**0.93**

Table 2: Number of observational stations vs. number of model grid nodes taken into account for calculating average daily mean.

No	River Basin	Area (km^2)	Number of observational stations	Number of grid nodes of LM 14	Number of grid nodes of LM 7
1	Kamienna	2007.9	9	9	41
2	Wieprz	10415.2	5	53	214
3	Pilica_1	3908.6	9	20	83
4	Pilica_2	5364.4	8	11	39
5	Wkra	5322.1	4	28	109
6	Bzura	7787.5	6	39	162
7	Drweca	5343.5	4	28	108

Conclusions

The analyse of table and graphs shows that:

- The probability distribution of observed precipitation is similar to the distribution of errors of forecasted precipitation (QPF) - that means, the range of QPF errors is comparable to the range of observed precipitation (especially for two and three days lead-time).
- Generally, the QPF for one day ahead contributes some information about future precipitation.
- There are not essential differences between QPF errors for 14x14 km and 7x7 km networks of the LM_DWD model.

Final Remarks

As seen from Table 1 obtained results are not quite coherent concerning the two obvious facts (expectations): 1) For such long time series the LM_07 model results should be obviously better (not worse) then LM_14 – what is violated for 3 (nearly 50%) basins: Pilica_1 No3, Wkra No5, Drweca No7, and the 2) The (un)efficiency coefficient E should increase with the lead-forecast time. This is true only for Kamienna (No 1) and Bzura (No 6). For other basins this rule is violated. The best results are for Pilica_2, the worse – quite not understandable for Wieprz (No 2). One of possible explanations is that number of stations relevant to each of basins was not adequate enough for given simple averaging procedure. Beneath, in the Table 2 are gathered numbers that show the irregularity of station redistribution between basins.

When the same evaluation calculus be repeated on simulated hydrographs – what is presumed in near future – that will eventually clarify revealed ambiguities.

Fig. 2. The Pilica_1 River basin - rainfall forecasts from COSMO_LM model (14x14km network)
Observed precipitation (Pobs) and 1-day (W1), 2-days (W2) and 3-days (W3) ahead forecast errors
Period: 1.01. - 8.09.2003

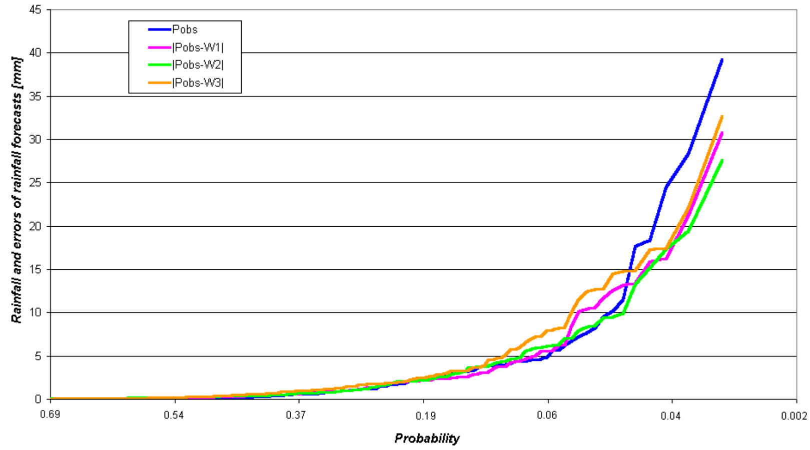

Fig. 3. The Pilica_1 River basin - rainfall forecasts from COSMO_LM model (7x7km network)
Observed precipitation (Pobs) and 1-day (W1) ahead forecast errors
Period: 1.01. - 8.09.2003

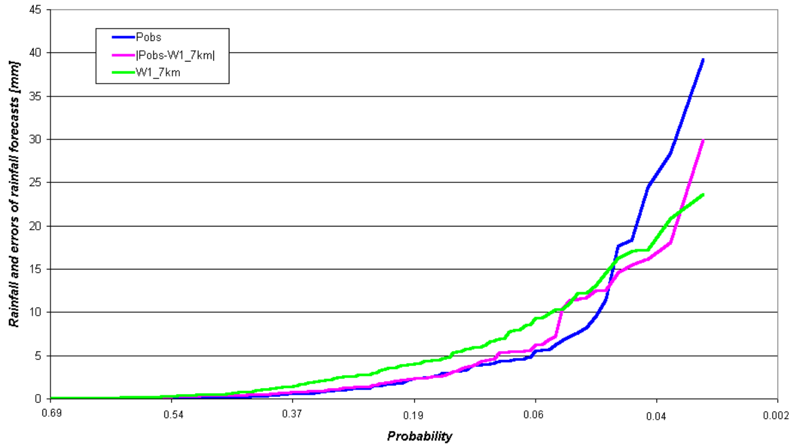

Fig. 4. The Wieprz River basin - rainfall forecasts from COSMO_LM model (14x14km network)
Observed precipitation (Pobs) and 1-day (W1), 2-days (W2) and 3-days (W3) ahead forecast errors
Period: 1.01. - 8.09.2003