National Institute of Meteorology and Hydrology
Bulgarian Academy of Science

The last flood in Maritsa, Toundja and Arda Basins in Bulgaria

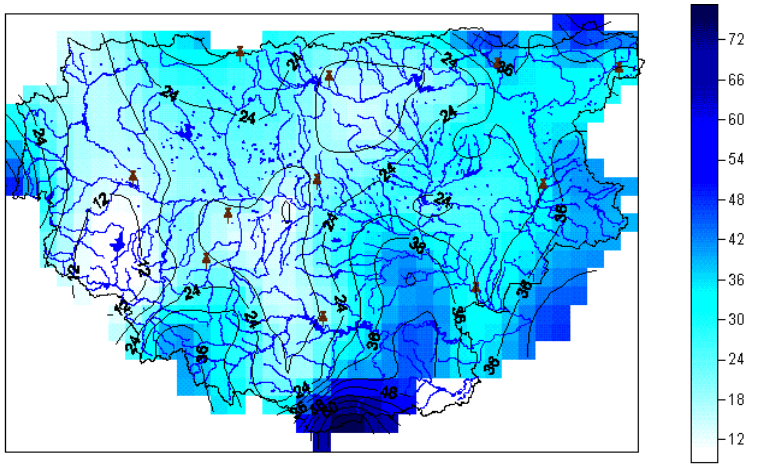
10-20 November 2007

Results of Hydrological Simulation and Forecast

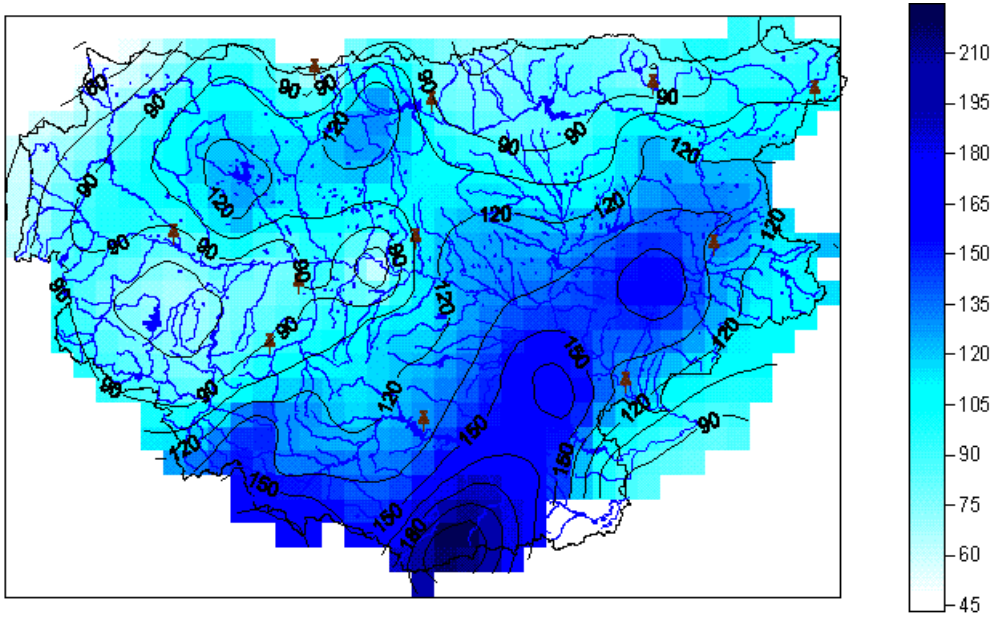
High water level at Svilengrad - the Bulgarian-Turkey-Greece border

Station	Max. daily precipitation in November (1931-1984)	Daily maximum 10-20 November 2007	Return period of the maximum as yearly maximum	Total for 10-20 November 2007
Elhovo	45 mm	41 mm (18)	37%	150
Kardjali	73 mm	66 mm (19)	17%	154.5
Smoljan	88 mm	63 mm (18)	25%	159

The return period of accumulated precipitation, *considered as monthly sum by station*, is about 5-7%. The return period of the precipitation event over a large area - a hydrological statistics question.



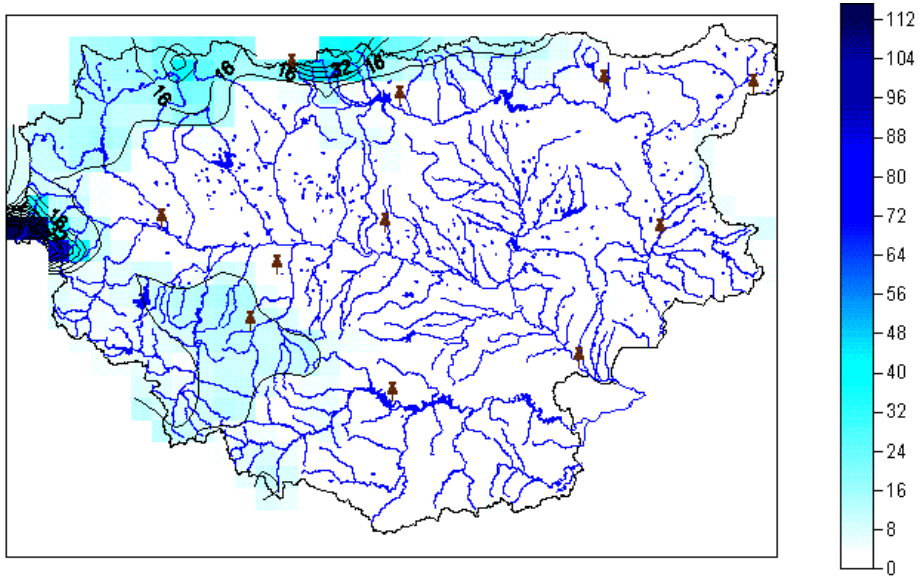
Precipitation total 10-13 November 2007



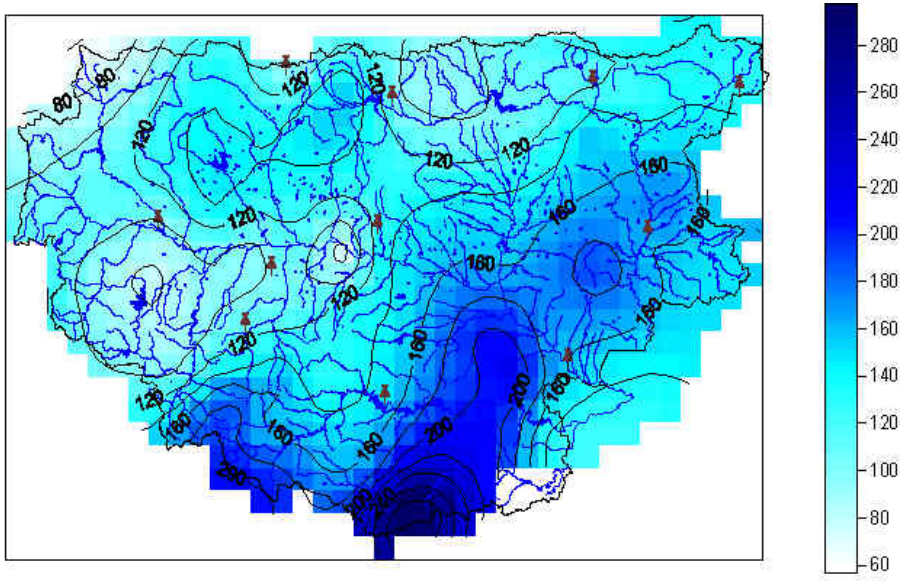
Precipitation total 15-20 November 2007

Modeling results – Water Budget Components

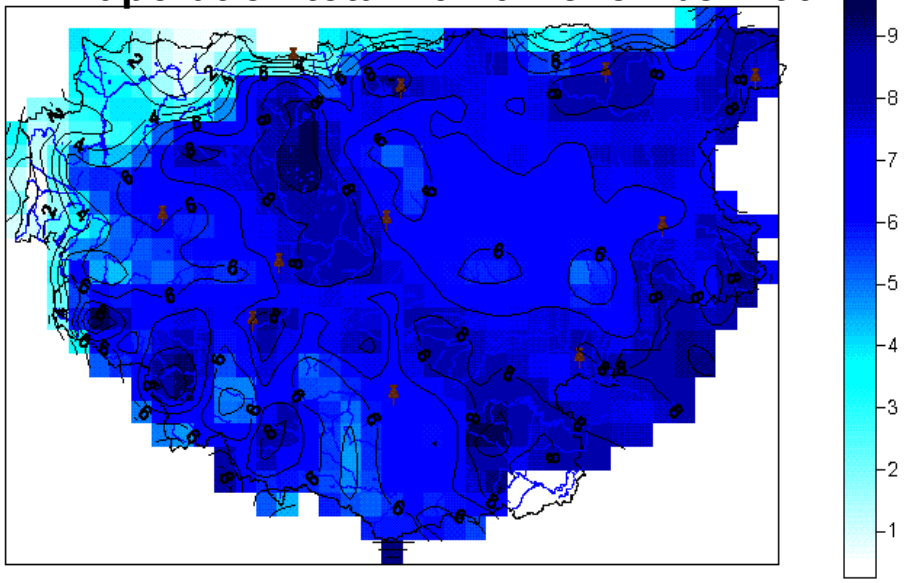
Snow accumulation - 20 November 2007



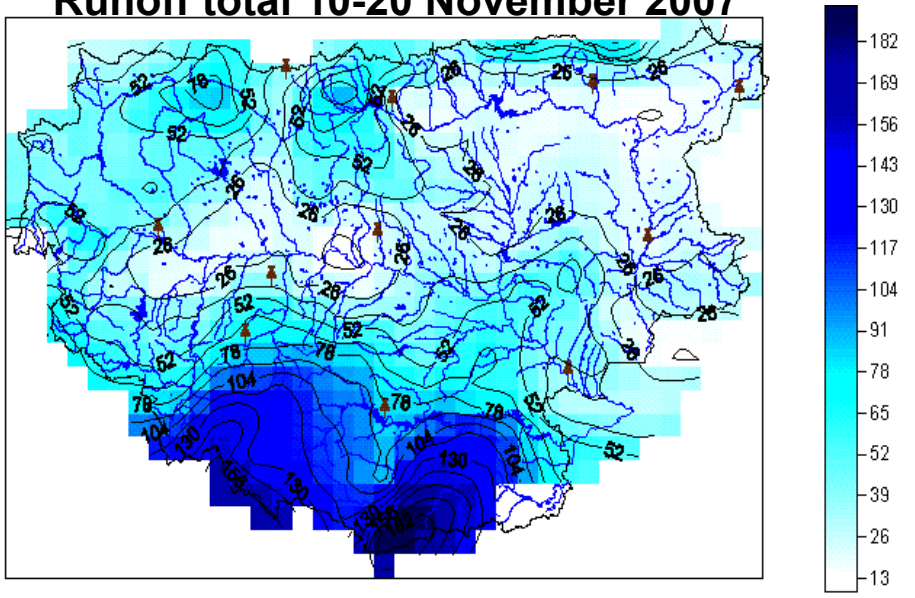
Precipitation total 10-20 November 2007



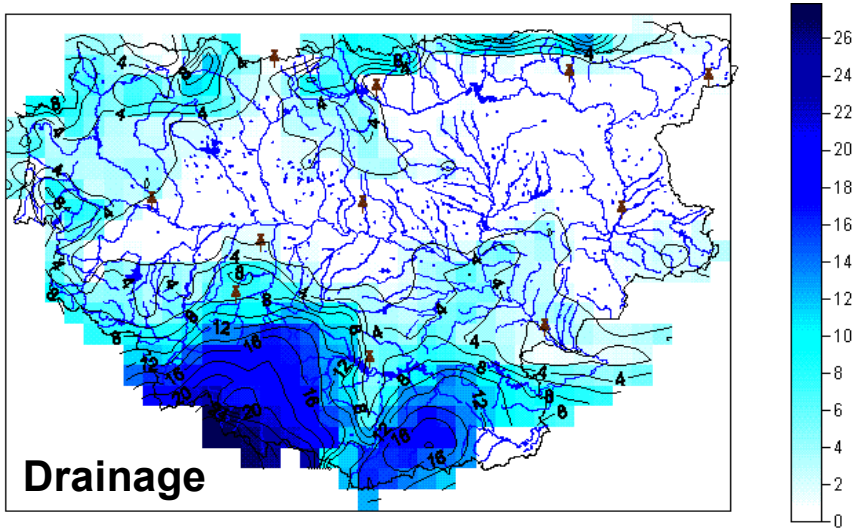
Evaporation total 10-20 November 2007

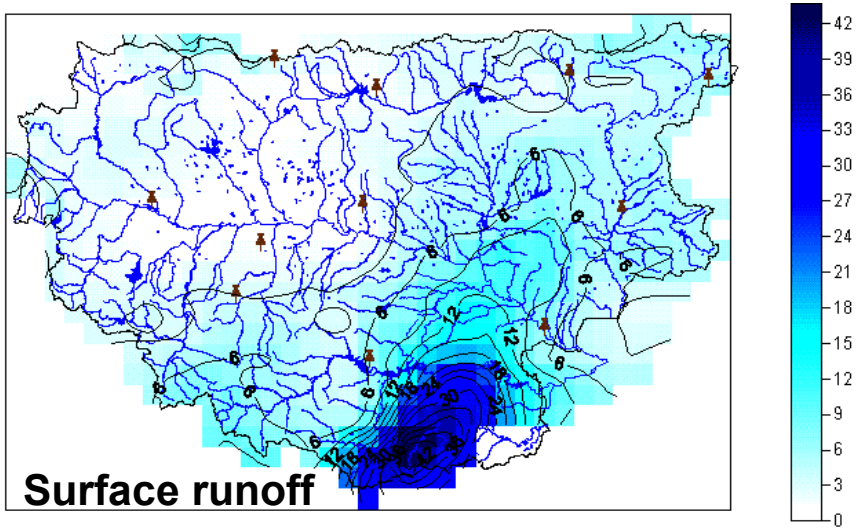


Runoff total 10-20 November 2007

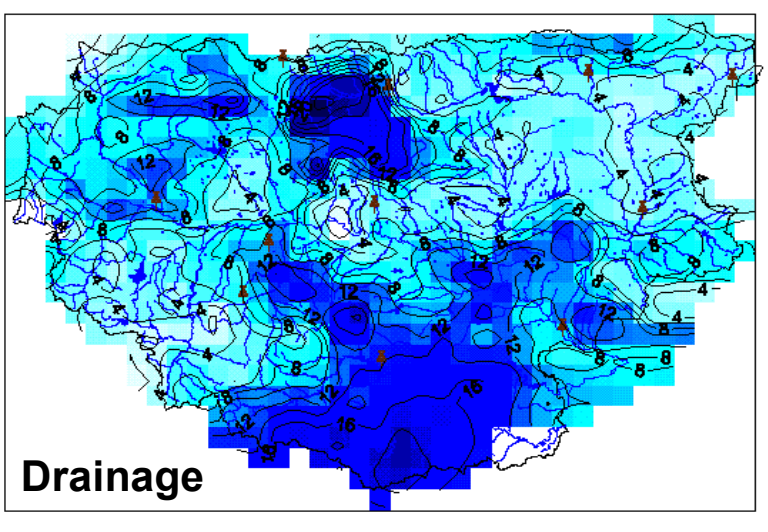


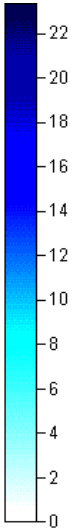
Runoff partitioning for 17 November

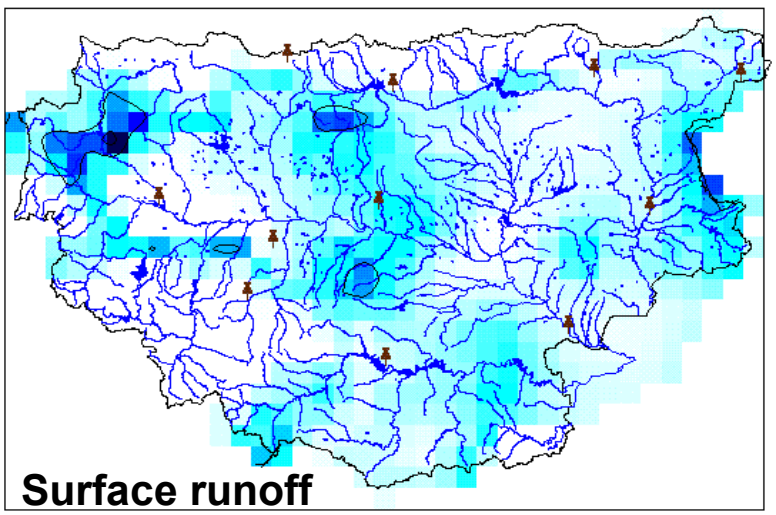


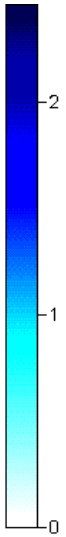


Runoff partitioning for 20 November

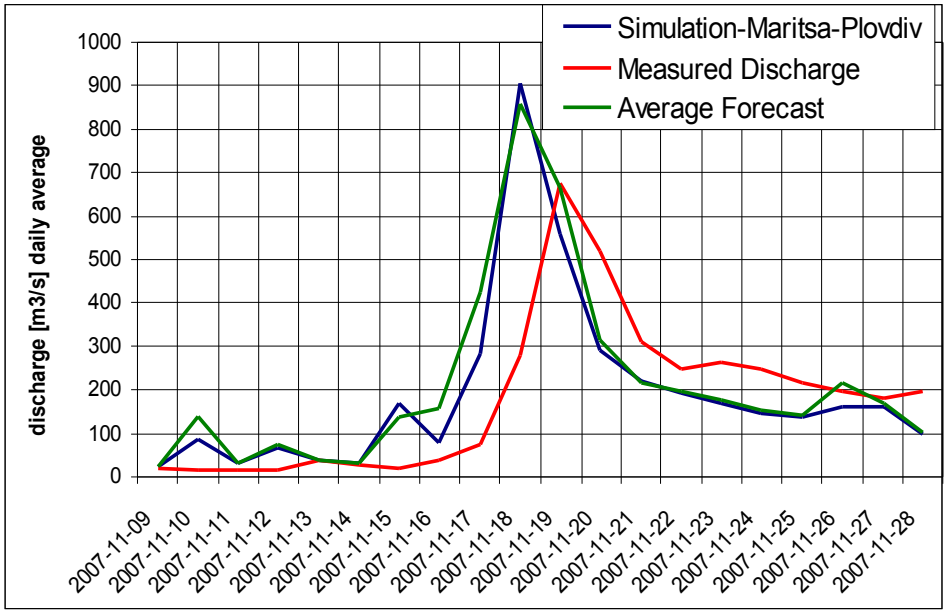


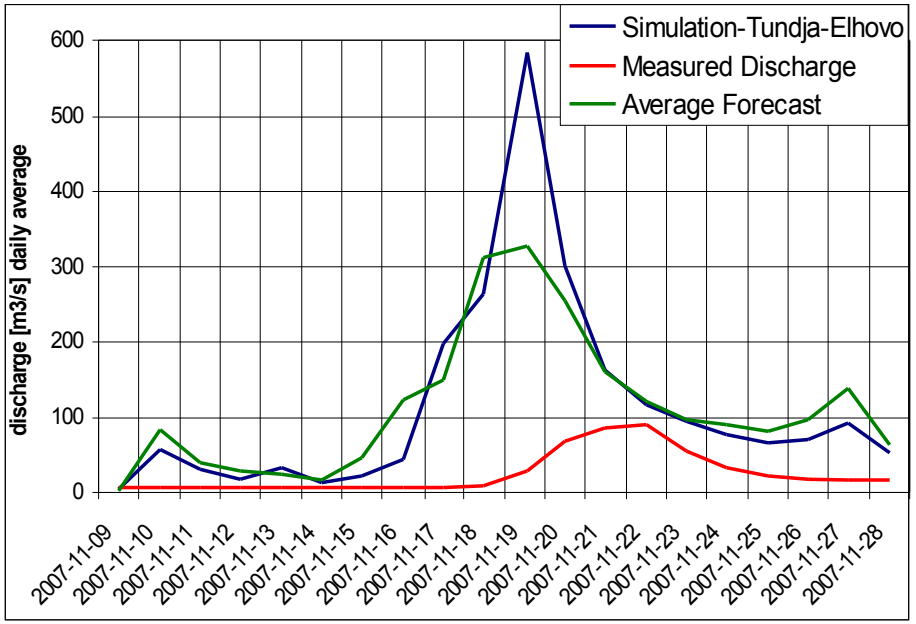


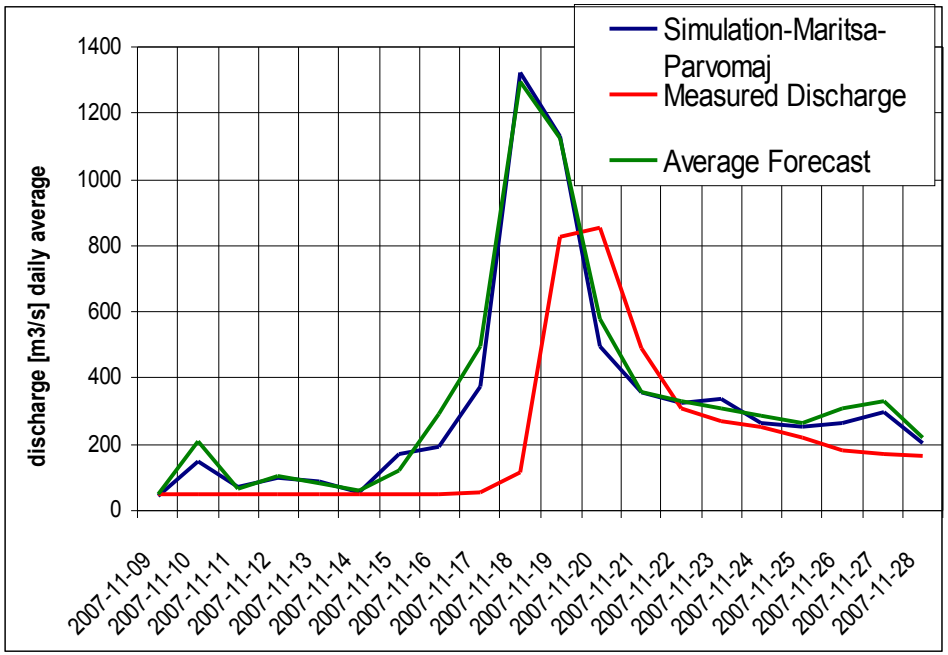


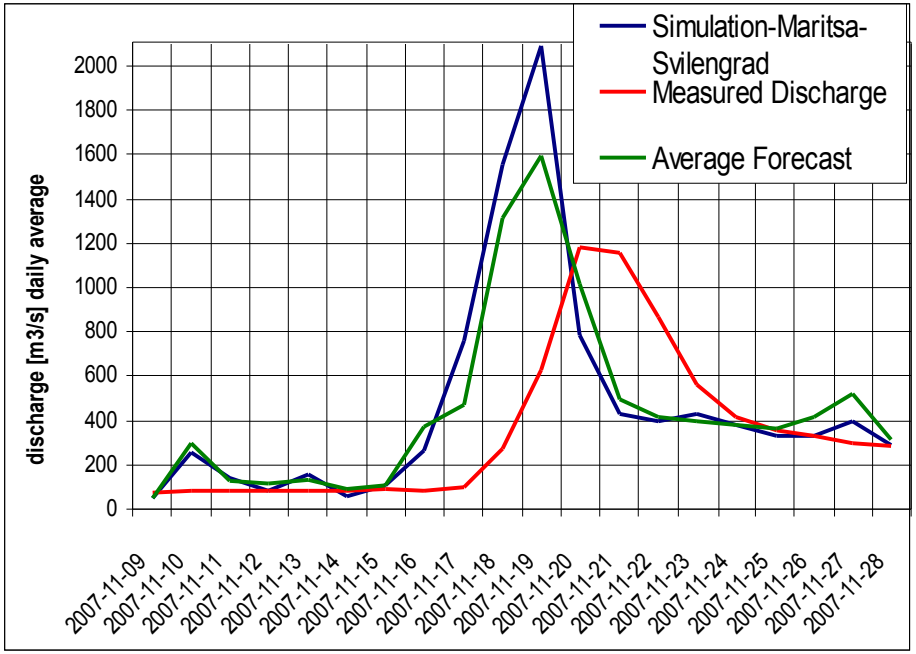


Daily averaged discharge series – measured, simulated with measured precipitation and forecasted with use of forecasted precipitation – four *anthropized* basins.

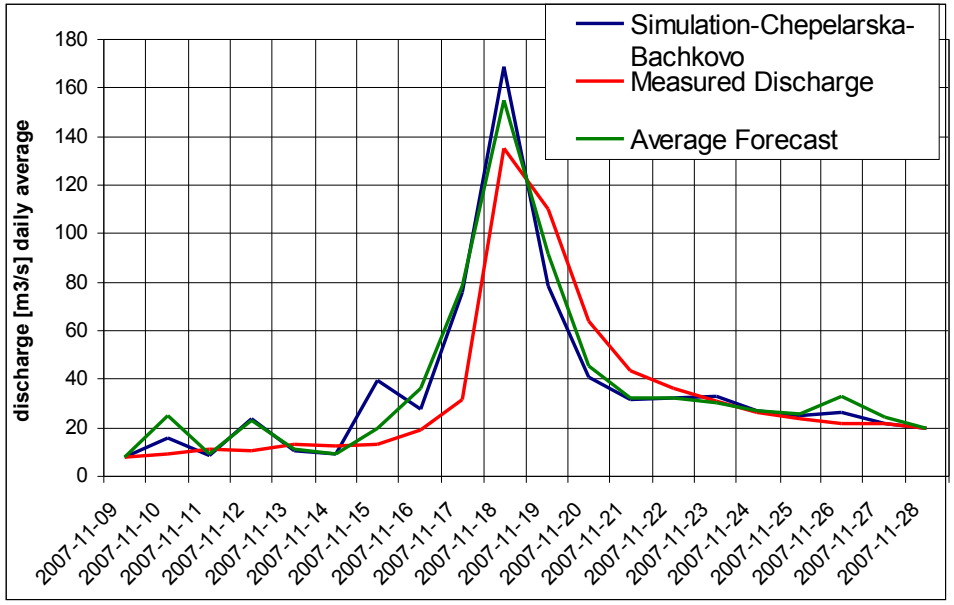


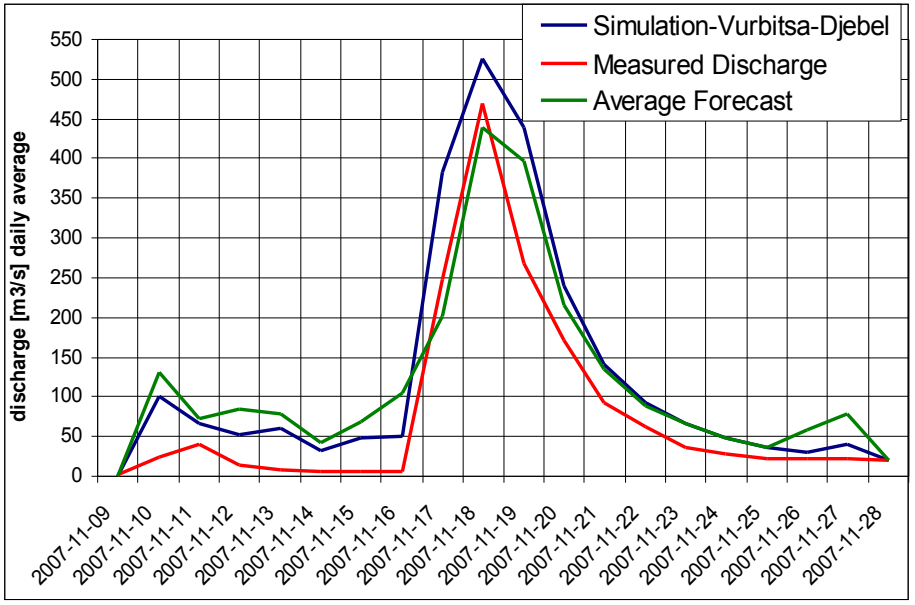




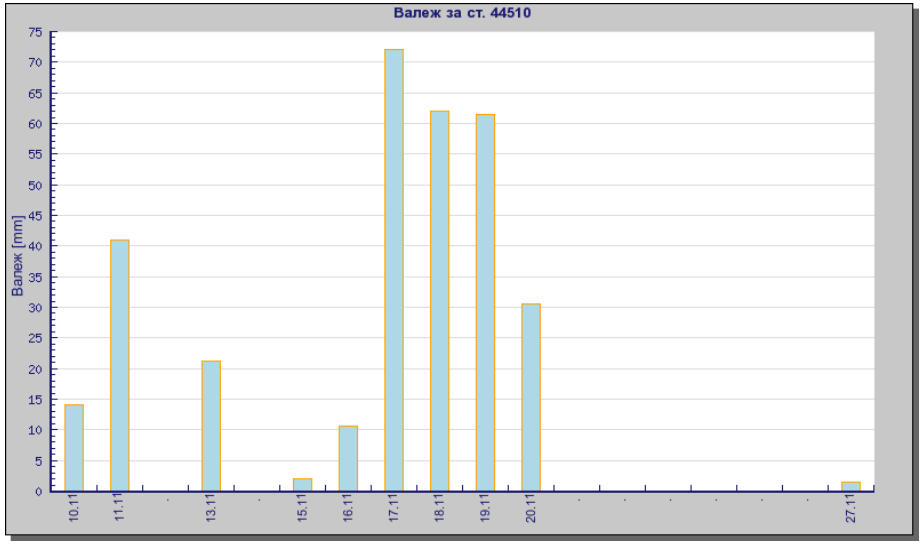


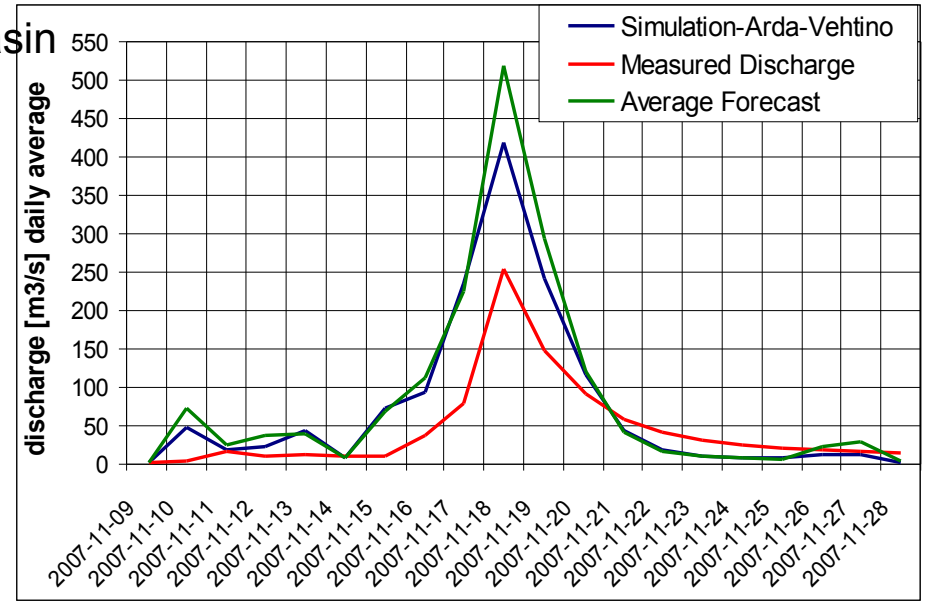
Daily averaged discharge series – measured, simulated with measured precipitation and forecasted with use of forecasted precipitation – *not anthropized* basins.





Precipitation daily series for Kirkovo – Vurbitsa basin





Results validation using data from automatic stations and actual rating curves

River-Station	Basin area [km2]	measured volume 17-28 XI [m3E6]	average measured runoff height [mm]	average simulated runoff height	simulation error % / R2 coefficient	average forecasted runoff height	forecast error % & R2
Arda-Vehtino	839	69	83	116	40/0.87	134	62/0.89
Vurbitsa-Djebel	1144	127	111	156	41/0.95	135	22/0.87
Chepelarska-Bachkovo	794	49	62	63	3/0.78	65	5/0.83
Tundja-Elhovo	5549	39	7	32	363/0.10	29	321/0.12
Maritsa-Plovdiv	8077	295	37	36	-2/0.36	39	7/0.39
Maritsa-Parvomaj	13399	337	25	36	44/0.26	38	51/0.27
Maritsa-Svilengrad	21379	557	26	33	27/0.12	31	19/0.24

The validation consists:

2. To compare the simulated and forecasted runoff height for the period to the measured runoff height. The result is an error estimate in percents.
3. To compare the daily water discharge series of the simulated and forecasted river flow to the measured one. The result is a correlation coefficient.

The correlation of measured against simulated and forecasted daily discharge is good for the *not-anthropized* drainage basins – Arda, Vurbitsa and Chepelarska, however the simulations and the forecast generally overestimate the runoff height (Chepelarska is an exception). This is a *calibration problem of the model* itself. The precipitation forecast is proved to be enough reliable, especially for long-lasting and large area precipitation events.

Conclusion:

C. A precisely calibrated hydrological model could produce high quality simulations with use of dense enough precipitation measurement network.
D. It is possible to produce hydrological forecasts of reliable quality for the river flow up-to 3 days ahead with use of Aladin precipitations.
E. Downstream large dams or reservoirs with big retention capacity the results are highly influenced from the dam operation. Therefore data from the dam operation are necessary to be included in the simulation/forecasting procedure in order to achieve a reasonable forecast quality.