



## Flash floods in June and July 2009 in the Czech Republic

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Several flash floods occurred in the territory of the Czech Republic during the last decade of June and beginning of July 2009. These events caused vast economic damage and unfortunately there were also 15 fatalities. The complete evaluation of flash floods from the point of view of its meteorological cause, hydrological development and impacts was done under the responsibility of Ministry of Environment of the Czech Republic. Czech Hydrometeorological Institute (CHMI) coordinated this project. The results of the project contain several concrete proposals to reduce the threat of flash floods in the Czech Republic. The proposals were focused on possible future improvements of CHMI forecasting service activities including all other parts of Flood prevention and protection system in the Czech Republic.

The synoptic cause of floods was the extraordinary long (12 days is longest in more than 60 years history) presence of eastern cyclonic situation over the Central Europe bringing warm, moist and unstable air masses from Mediterranean and Black Sea area. Very intensive thunderstorms accompanied by torrential rain occurred almost daily. Storm cells were organized in train effect and crossed repeatedly the same places within several hours. The extremity of the flood events was also influenced by soil saturation due to daily occurrence of rainstorms.

The peak flows exceeded significantly 100-year of recurrence time in many sites. The observed and mainly unobserved catchments were affected. The detailed fields of rainfall amounts were gained from the adjusted meteorological radar observation. All of the available rainfall measurements at the climatological and rain gage stations were used for the adjustment. Hydraulic and rainfall-runoff models were used to evaluate the hydrological response.

It was proved again, that the outputs from currently used meteorological forecasting models are not sufficient for a reliable local forecast of the strong convective storms and their possible consequences – flash floods.

Within the frame of the research project SP/1c4/16/07 „Implementation of new techniques for stream flow forecasting tools“ (project period 2007–2011, funded by Ministry of Environment) a forecasting system for the estimation of runoff response to torrential rainfall has been developed.

CN value automatic update based on antecedent precipitation is used to estimate possible runoff from storm. Ten minutes radar rainfall estimates and COTREC based nowcasting serve as meteorological input. Results of 2009 events hindcast are presented. It proved the underestimation of rainfall by raw radar data and thus the need for real time adjustment of radar estimates based on rain gauge data.

The main output from presented forecasting system is an estimation of flash flood risk. Risk estimation is based on exceeding 3 defined thresholds defined as ratios between the estimated peak flow and theoretical 100-year flood on particular basin.

The procedures mentioned above were being developed during the period 2008–2009. Intensive testing is expected by CHMI forecasting offices during 2010–2011.