

RAINFALL – RUNOFF MODELING OF THE UPPER PARSEŃA RIVER BASIN (WEST POMERANIA, POLAND)

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Rainfall – Runoff models are a powerful tool to understand and to approximate the hydrological responses of a basin. The use of GIS in hydrological modeling allows to analyze a great amount of spatial-related physical data and to account for the spatial variation of model parameters and processes at the detailed resolution (Beven, 2001).

This paper presents the results of a basin scale rainfall-runoff modeling on upper Parsęta river basin using the hydrologic model HEC-HMS and Geographic Information System.

The study area embraces the upper Parsęta catchment. The catchment is situated in the West Pomeranian Lakeland. It covers 74 km². The length of the main river, closed by the hydrometric profile at Storkowo (the location of the Adam Mickiewicz University Geoecological Station) equals 13.26 km. Its mean annual air temperature (1987-2004) equals 7.7°C, while rainfall totals 691.9 mm (Tylkowski, 2005). The catchment is characterized by a groundwater-rain-snow type of alimentation and spring flood season.

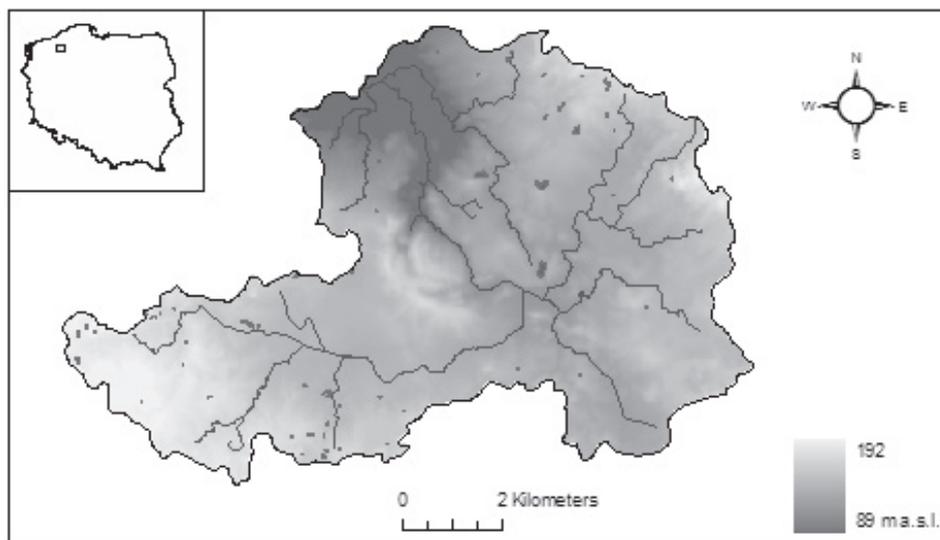


Figure 1. Study area

HEC-HMS model (Hydrologic Engineering Center – Hydrologic Modeling System) has been created and developed in the US Army Corps of Engineers. HEC-HMS is designed to simulate precipitation-runoff of dendritic watershed system (USACE, 2006). It has various methods of simulation. HEC-HMS employs two main model components: a basin model and a meteorological model.

To prepare input data for the basin model the HEC-GeoHMS software together with ArcGIS have been used. Terrain topography, rivers and land use was gathered from a topographic map, while data on land cover and soil – from soil-agricultural map. The generated digital terrain model (DTM) was 10 m resolution. The physical representation of basin and rivers was configured in the basin model. Hydrologic elements were connected in a dendritic network to simulate runoff processes. The basin was divided into 10 sub-basins. Then it was supplemented by following models. Models that compute runoff volume (loss rate): The Curve Number (CN) of the U.S. Dept. of Agriculture, Natural Resources Conservation Service (NRCS) known as SCS CN was used to predict the runoff properties for surface based on the hydrologic soil group and ground cover (US SCS, 1986). One weighted CN for each sub-basin was computed. Models of direct runoff (transform): Transformation of excess precipitation into surface runoff was accomplished using SCS Unit Hydrograph.

The meteorological model in HEC-HMS is used to represent precipitation amount and intensity. Precipitation data from meteorological station at Geoecological Station were used in the study. The measurement period covers 20 hydrological years (1987-2007). Observed stream flow data at hydrometric station were used for calibrating the model. Simulated extreme values of peak flow were analysed and compared to observed runoff series.

The statistical model evaluation results indicated that the model has a relatively high confidence and can give a fair representation of the flow hydrographs.

References

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