ASSOCIATION OF POLISH HYDROLOGISTS – SHP[1]
UNIVERSITY OF AGRICULTURE IN KRAKOW, POLAND[2]
UNIVERSITY OF ADMINISTRATION IN BIELSKO-BIAŁA, POLAND[3]
INSTITUTE OF TECHNOLOGY AND LIFE SCIENCES– NATIONAL RESEARCH INSTITUTE, POLAND[4]

Influence of land cover data sources on an estimation of runoff according to SCS-CN and modified MSME Model

Wałęga Andrzej[1,2] andrzej.walega@urk.edu.pl , Salata Tomasz[2] tomasz.salata@urk.edu.pl ,
Banasik Kazimierz[1, 4] kazimierz_banasik@sggw.edu.pl and Więzik Beniamin[1,3] bwiezik@interia.pl

OBJECTIVE AND STUDY AREA

The aim of this work was to assess the accuracy of direct runoff depth calculated according to an original *Soil Conservation Service – Curve Number* (SCS-CN) method and MSME method. Moreover, the influence of land cover data base on CN value also was considered.

The research was performed in the Kamienica river, a right tributary of the Dunajec river, south part of Poland. The Kamienica river has a mountain character and its catchment area down to Łabowa gauging station is 64.9 km^2. The length of the main river is 13.4 km, and average slope of the catchment is 0.061 mkm^{-1}. Density of the river network is 1.12 km^{-1}, and mean slope of the watercourse is 1.76%. Total annual precipitation in the catchment is ca. 1000 mm in its highest parts and 750-800 mm in sheltered valleys. The catchment is covered mainly by forests (ca. 76.4%). Arable lands take up ca. 23.2%, and the rest (ca. 0.4%) is an anthropogenic area.

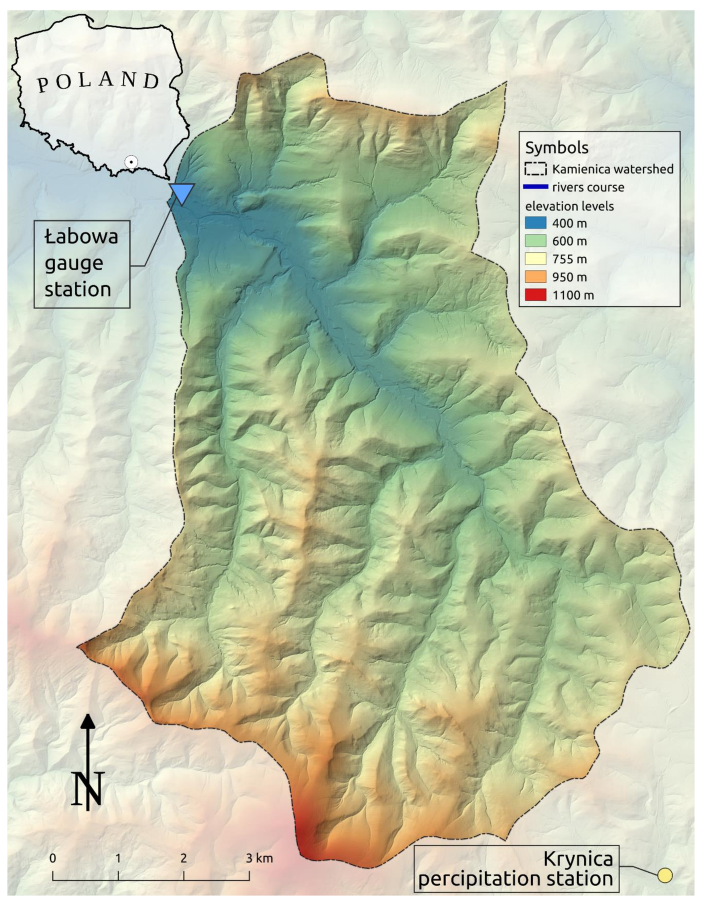

Fig. 1. Location of the analyzed catchment (Walega and Salata 2019)

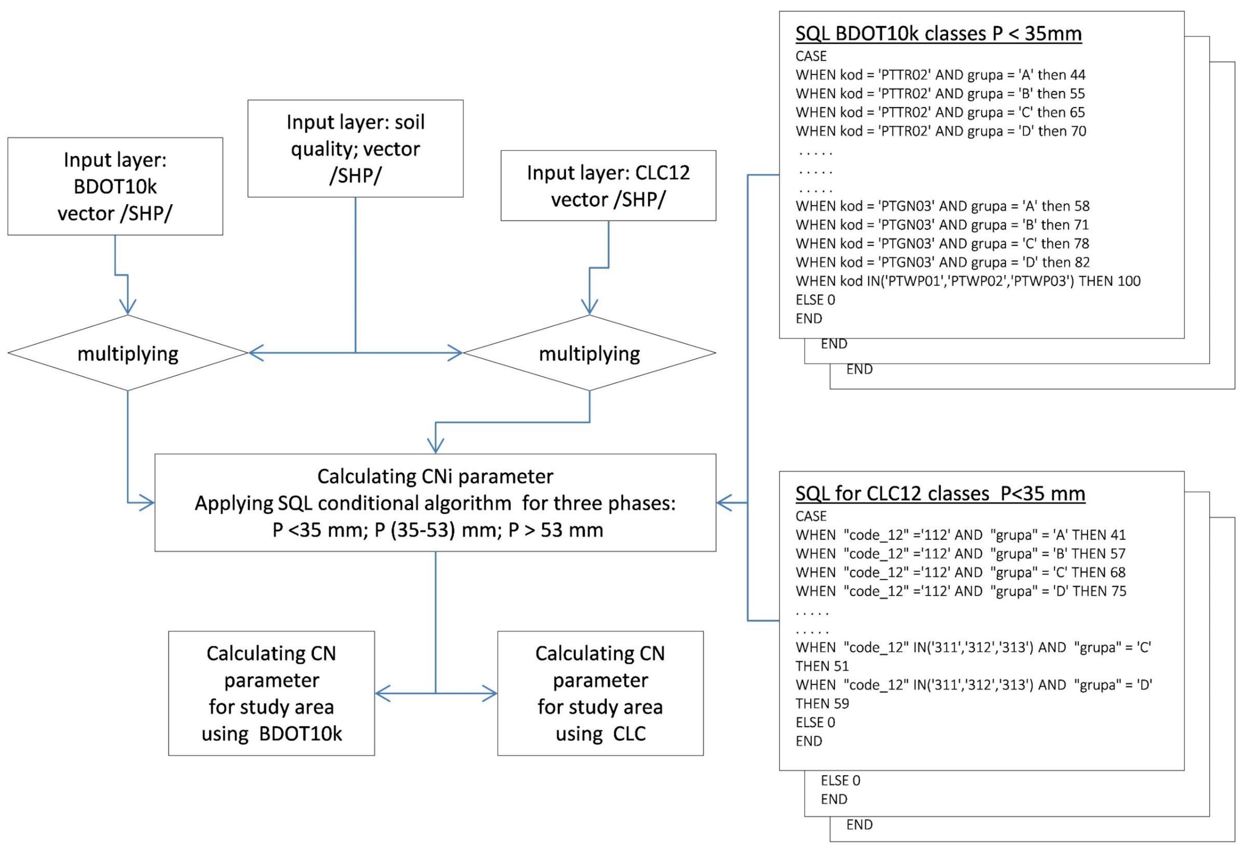

Fig. 2. Method of automatic calculation of CN_{est} parameter using BDOT10k and CLC12 databases

MATERIAL AND METHODS

Rainfall and runoff data for period 1980-2012 were obtained from the Institute of Meteorology and Water Management - National Research Institute. The analysis, which involved 30 rainfall-runoff episodes, showed that direct runoff assessed on the base of original SCS-CN method has not correctly reflected observed values.
In this work two land cover database were tested to assesment of CN parameter: *Database of topographic objects* (BDOT10k) and *Corine Land Cover* (CLC).
Direct Runoff (DRO) was calculated for each event based on original SCS-CN and MSME method.
The quality of models were assesment based on The Nash-Sutcliffe efficiency coefficient (EF), RMSE..

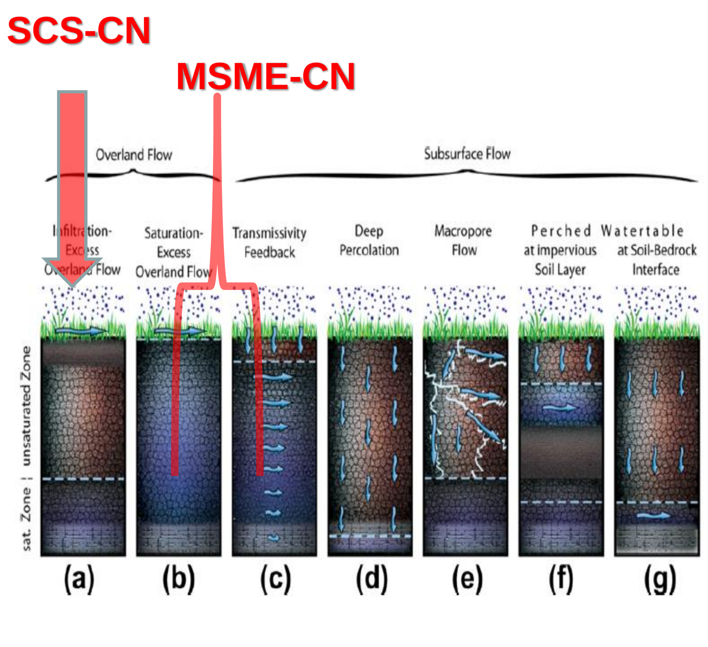

Fig. 3. Types of surface and subsurface runoff processes including in SCS-CN and MSME-CN model

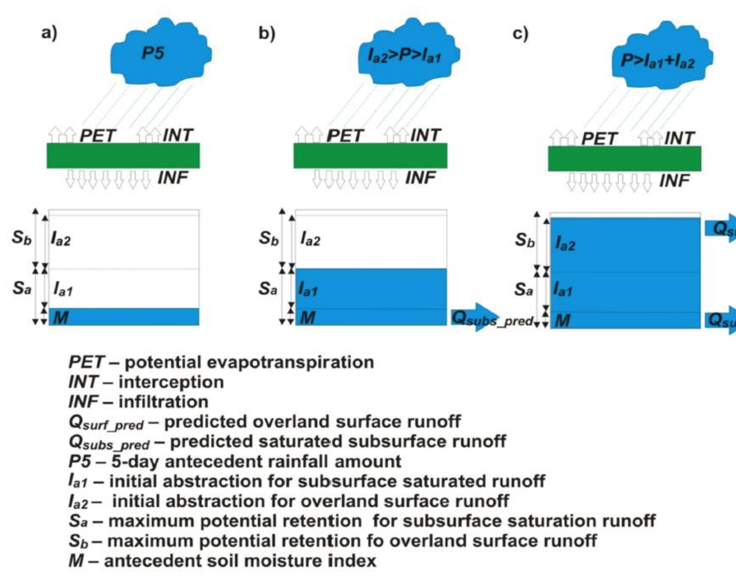

Fig. 4 A conceptual diagram of components of direct runoff formation in the MSME-CN (Amatya et al. 2022)

Table 1. Essential differences between CLC, BDOT10k databases

Parameter	CLC	BDOT10k
Nominal scale	1:100 000	1:10 000
Resolution	nominal 30 x 30 m maximal 20 x 20 m	minimal 5 m maximal 0,1 m
Land cover resolution	nominal 30 x 30 m maximal 20 x 20 m	minimal 5 m nominal 2m
Data format	Source data as raster vector interpolated from raster	vector
Thematic layer	land cover	water network, road network, investment network land cover buildings, constructions and facilities, land use areas protected areas, units of territorial division, other objects.
Land cover classification tree	3 step	3 step
Land cover interpretation methods	photo interpretation	Manual based on orthophotomap in nominal scale 1:1000 (pixel 0.25 x 0.25 m)
Geometry generalization of vector datasets	yes	No
Maintained by	European Union	Polish Government
Actualizations period	Every 6 years	Continuous

RESULTS and CONCLUSIONS

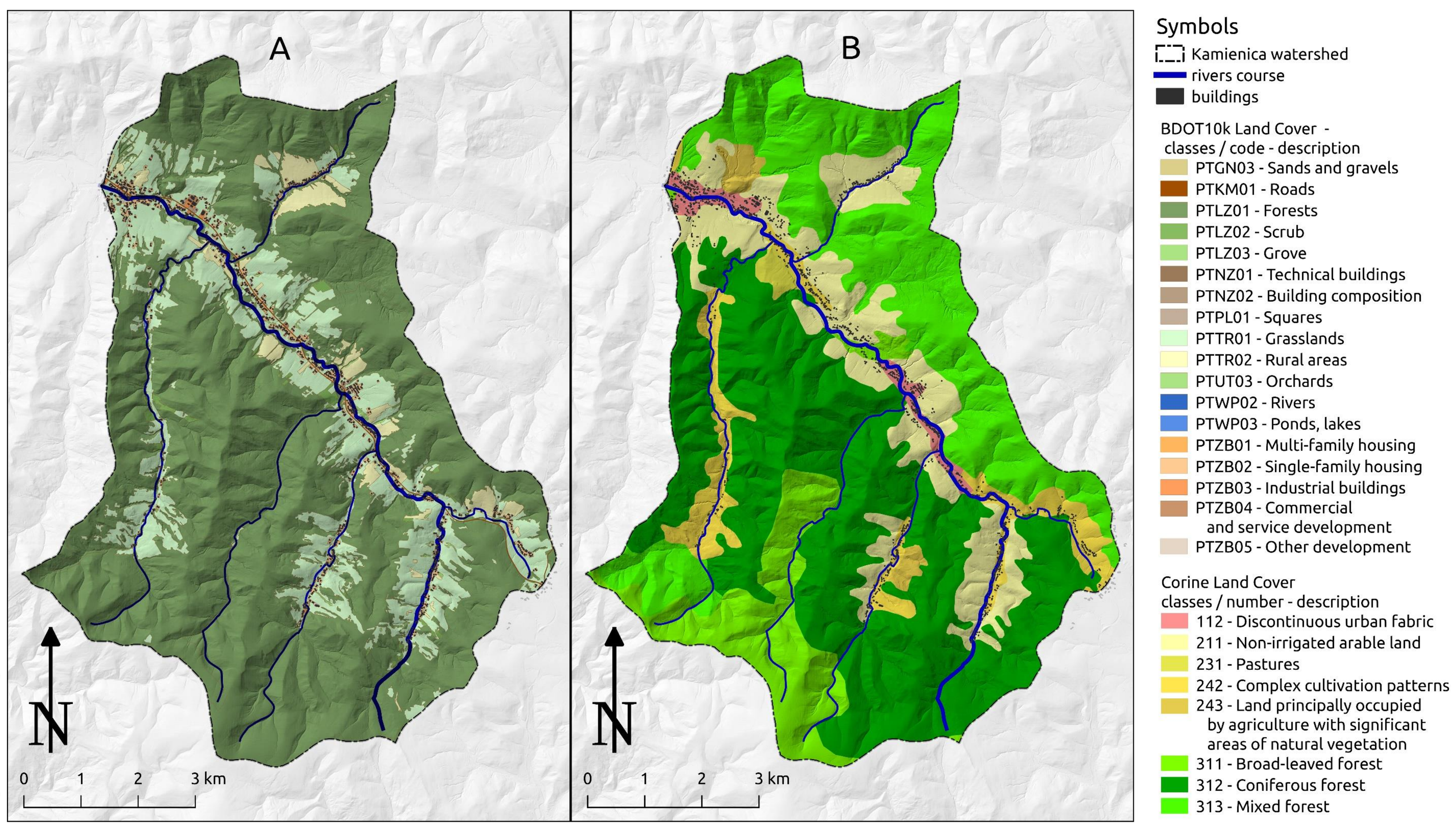

Fig. 5. Visualization of the BDOT10Kk and CLC12 databases against a numerical land model.

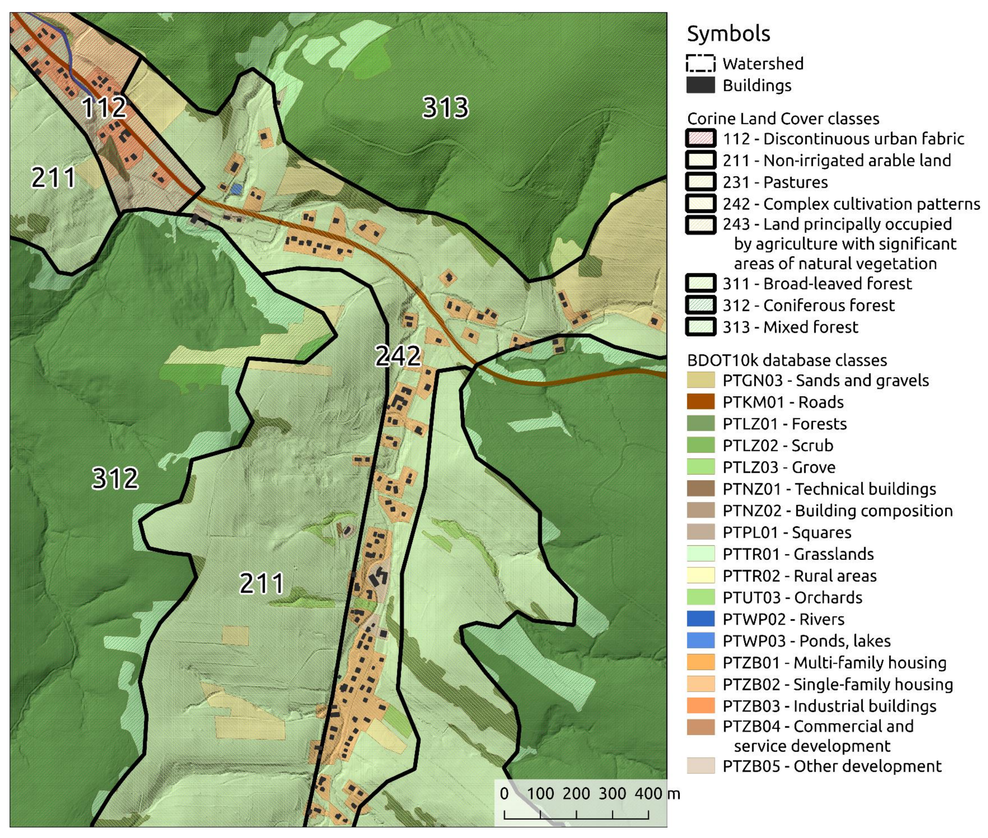

Fig. 6. An example of misinterpretation of CLC12 for small and scattered objects.

Table 2. Quality assessment of the analyzed methods

Land cover database	MSME-CN		SCS-CN	
	RMSE [mm]	EF [-]	RMSE [mm]	EF [-]
CLC	8.95	0.79	19.47	0.49
BDOT10k	9.58	0.76	21.67	0.37

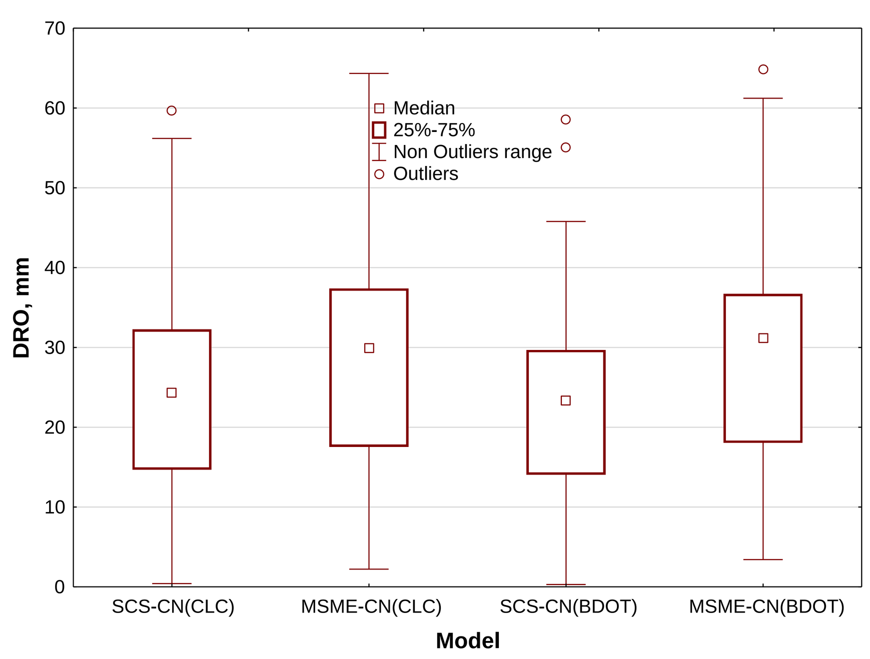

Fig. 7. Comparison of DRO from analyzed models

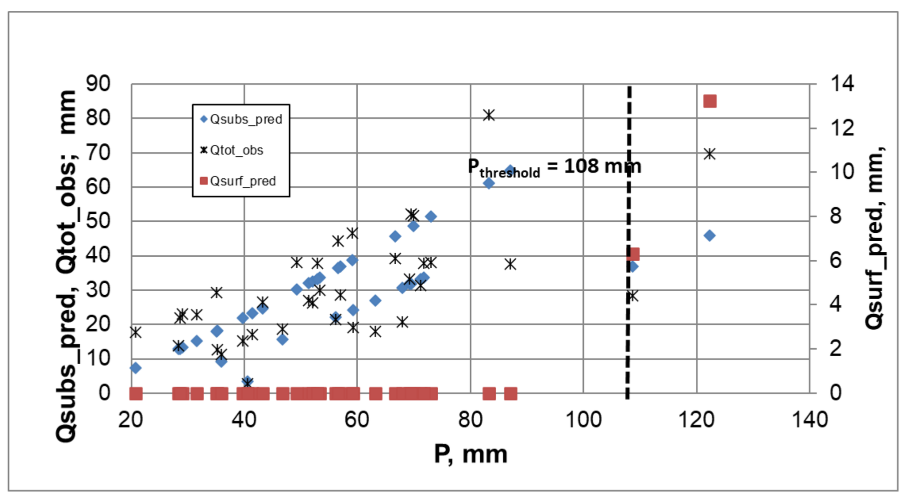

Fig. 8. Relationships between measured event total rainfall (P) and observed direct runoff, predicted saturated subsurface runoff, predicted overland surface runoff for the CN assesed based on BDOT10k

The BDOT10k was proven to be a considerably more precise land cover database that enabled more accurate interpretation in subcatchments, where more commercial land use is observed.

The study demonstrated that the accuracy of direct runoff calculation with MSME method is higher than the original SCS-CN method.

Moreover, the MSME model can divide runoff on subsurface (dominated by runoff in natural catchments) and surface (occurring after heavy rainstorm).

REFERENCES

Wałęga A., Salata T. 2019. Influence of land cover data sources on estimation of direct runoff according to SCS-CN and modified SME methods. Catena 172, 232-242
D.M. Amatya, A. Walega, T.J. Callahan, A. Morrison, V. Vulava, D.R. Hitchcock, T.M. Williams, T. Epps, Storm event analysis of four forested catchments on the Atlantic coastal plain using a modified SCS-CN rainfall-runoff model, Journal of Hydrology, 608, 2022,127772, https://doi.org/10.1016/j.jhydrol.2022.127772.

The 28th IUGG GENERAL ASSEMBLY, BERLIN, 11 - 20 July 2023