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Vulnerability of the Someş Mic Meadow in Terms of Hydrological and Hydrographical

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Abstract. Areas of interest are located in the middle of Somes Mic meadow from the Transylvanian Basin. Using rainfall values recorded for the period 2011-2012 at the weather stations in Cluj-Napoca, Salatiu and Apahida could achieve the mean annual precipitation map of Someş Mic floodplain for the section between Cluj-Napoca and Dej. Cluj County has a total surface of 667440 ha from which 10.45% is represented by degraded land. About 15.4% of the total degraded land from Cluj County is affected by excess moisture, which represents 1.60% of the total land of Cluj. Studies with a hydrological, hydrogeological, geotechnical, climatic and demographic character, completed with topographic and geodetic parameters offer concrete data regarding the manifestation of the phenomenon of excess moisture on agricultural land and also make it possible to design, execution and monitoring the behavior of hydrological works. By creating thematic maps using GIS techniques we aimed a better and easier highlighting of the natural factors such as specific flows and precipitations from the studied area and how they influence the land area. Using these newly created maps we can easily identify the areas which are affected the most by heavy rains and floods that cause soil degradation phenomena by excess moisture or hydric erosion.

Keywords: vulnerability, hydrological, hydrographical, meadow, Someş Mic

INTRODUCTION

The rapid progression of urbanization in periurban areas affects the hydrological cycle of periurban rivers. To quantify these changes, distributed hydrological modelling tools able to simulate the hydrology of periurban catchments are being developed. Land cover information is one of the data sources used to define the model mesh and parameters (Xiao *et al.*, 2013).

The spatial pattern of storm runoff volume is of interest in many environmental concerns and storm runoff is an important component in the hydrologic cycle because of its relationship to issues such as flooding and water quality. The isolation of the groundwater component allows the net effect of meteorology to stream flow rate (Ko and Cheng, 2004).

In order to remove excess moisture from the soil and on its surface were performed in Romania many drainage works, which are located mainly in the lowlands, characterized by a historical evolution and a socio-cultural development.

Popescu and Bucur (2004) show that the limits of variation of the three phases of soils in Romania are: the solid 45-60%, 15-35% water and 5-40% air , for the normal development of the crop being required a minimum amount of air in the soil in the range of 10-20% of the apparent volume of the soil.

The purpose of this paper is to highlight the vulnerability of Somes Mic meadow, between Cluj-Napoca and Dej, in terms of hydrological and hydrographical by creating thematic maps regarding the specific flows and their accumulation.

MATERIALS AND METHODS

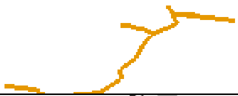
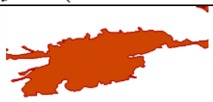
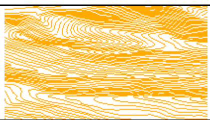
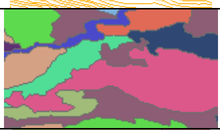
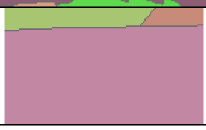
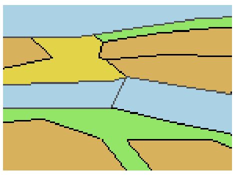
Multivariate spatial statistics techniques can be efficiently applied to generate fine spatial patterns of climate data in presence of an appropriate multivariate spatial structure over ungauged mountainous basins. However, they can become unsuitable when the data available over complex regions are sparse and affected by discordant spatial scales in primary and (colocated)-auxiliary variables. This is the case of actual evapotranspiration (AET). Combining GIS and geoindicators (e.g., topographical and vegetational indices), we proposed an upscaling procedure to overcome this problem, transforming a preliminary-smoothed macro-scale pattern (AET grid-data), into a local-scale pattern (Diodato *et al.*, 2010).

The GIS database was achieved by following the steps: Achieving the primary database by scanning and adding in ArcMap the topographic maps, soil maps and geological maps containing the study area; Georeferencing the spatial support by assigning some points (with known coordinates) to the scanned maps (there are necessary minimum 3 points); Digitization of the spatial support.

After completion of digitization and eliminate all errors that have occurred, the following layers corresponding to primary database (Tab. 1). These layers will form the basis of the study area based on them being constituted other derived layers.

Tab. 1

Layers for primary database

	Layer name	Layer type	Representation mode	Format	Attribute
	Railway	line	vector	.shp	Type Length
	Road network	line	vector	.shp	Type Indicative Length
	Settlement	polygon	vector	.shp	Name Surface
	Hydrography	line	vector	.shp	Name Length Code Altitude
	Leveling curves	line	vector	.shp	Altitude
	Land use	polygon	vector	.shp	Use type Surface
	Soils	polygon	vector	.shp	Genetic type of soil Permeability
	Geological structure	polygon	vector	.shp	Type Structure

RESULTS AND DISCUSSIONS

In order to obtain the accumulation flow map (Fig. 1) was used: the elevation model which affects the flows through altitude; the flow direction in order to identify the primary and secondary collectors. In the upstream the Somes Mic flow is lower (less tributaries with lower flows) than the downstream, before the confluence, where the contribution of the flow received from the upstream and the higher number of tributaries from both the left and right of the river lead to much higher flow rates.

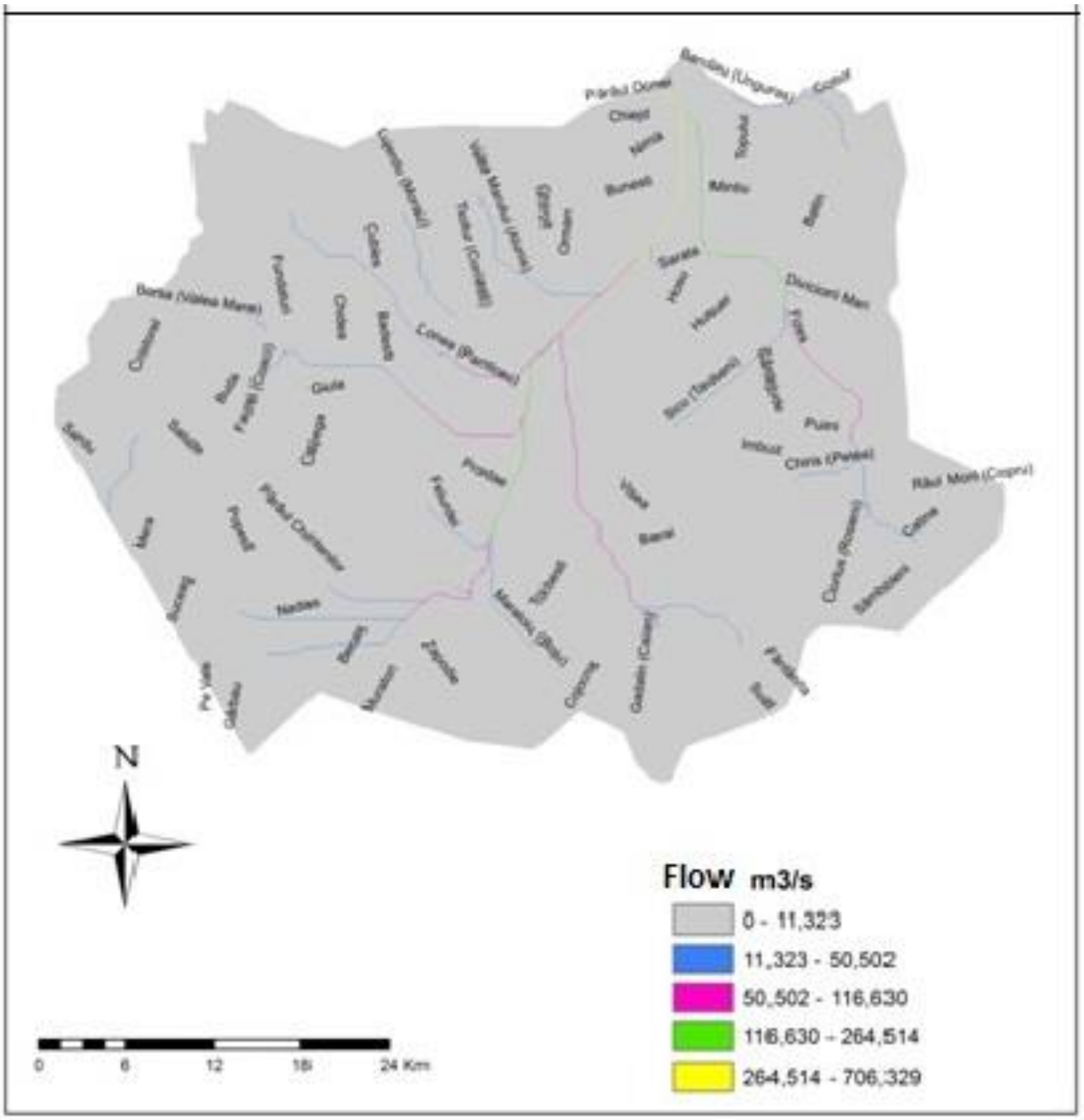


Fig. 1. Flow accumulation map for Someșul Mic between Cluj-Napoca and Dej

Maximum, minimum and average flows measured on the watercourse of Somes Mic for the Bonţida and Jucu area are shown in Fig. 3 and Fig.4. for the years of study 2011 and 2012.

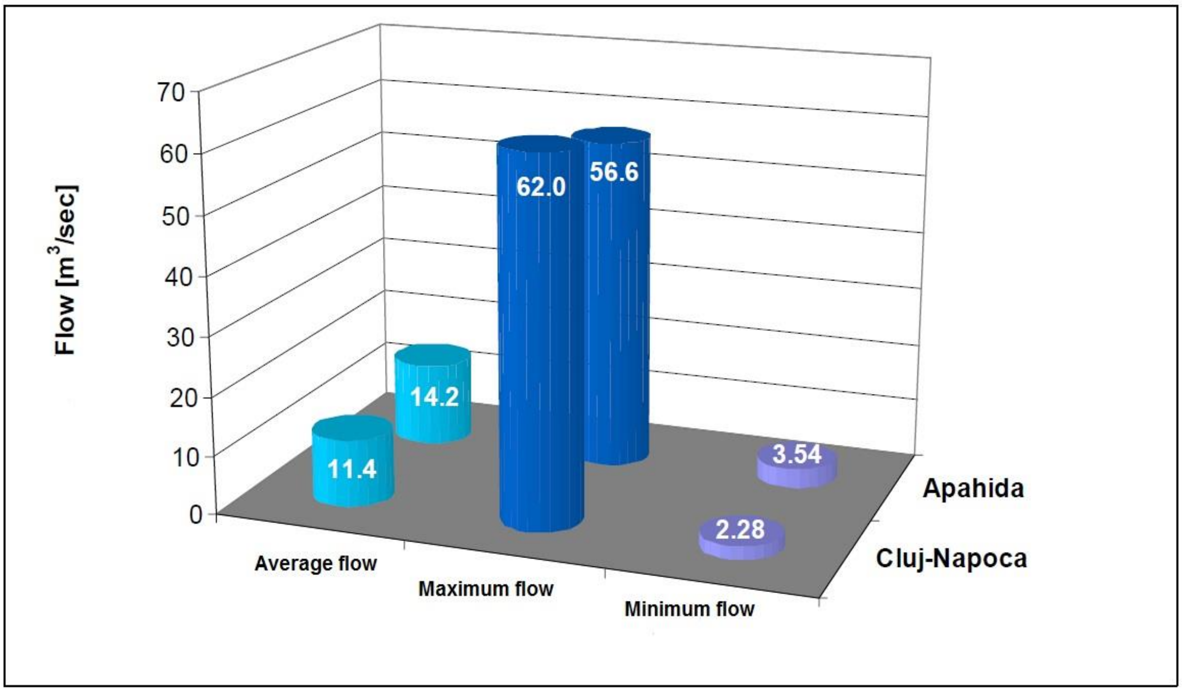


Fig. 2. Maximum, average and minimum values of the flow recorded in 2011, for Someșul Mic, Cluj-Napoca – Dej area

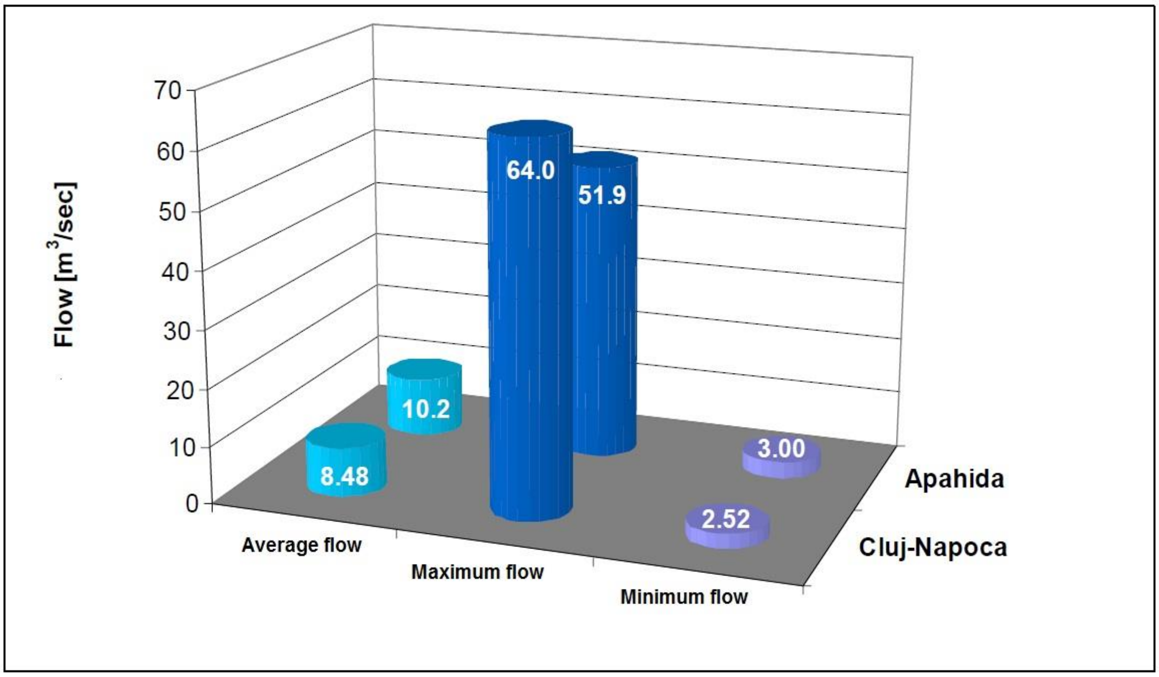


Fig. 3. Maximum, average and minimum values of the flow recorded in 2012, on Someșul Mic, Cluj-Napoca – Dej area

Somes Mic is characterized by lower annual maximum flow to 43 m^3 / s in the village Jucu, who afterwards after Bontida higher values (Fig. 4).

The map presenting the maximum flow for Jucu and Bonţida highlights the high intake of left tributary especially after Bontida. Regarding the right tributaries, flows have maximum values recorded by 43 m^3 / s (Fig. 4) .

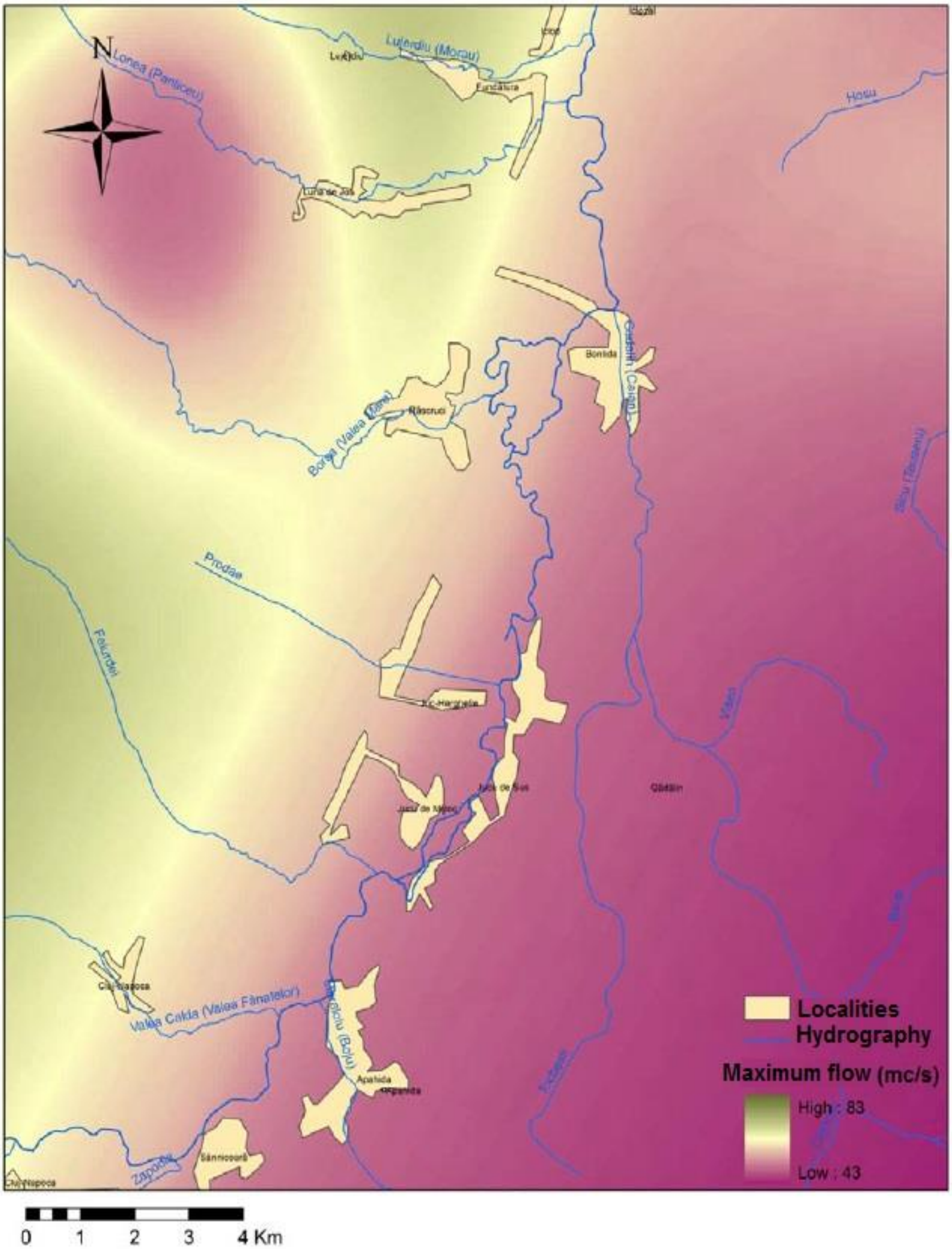


Fig. 4. Map with maximum flow recorded in 2011-2012 on Someșul Mic, Cluj-Napoca – Dej area

Minimum flows around 4.78 m^3 / s are recorded in the tributaries left their values gradually decreasing to the right of the valley Somes Mic (Fig. 5).

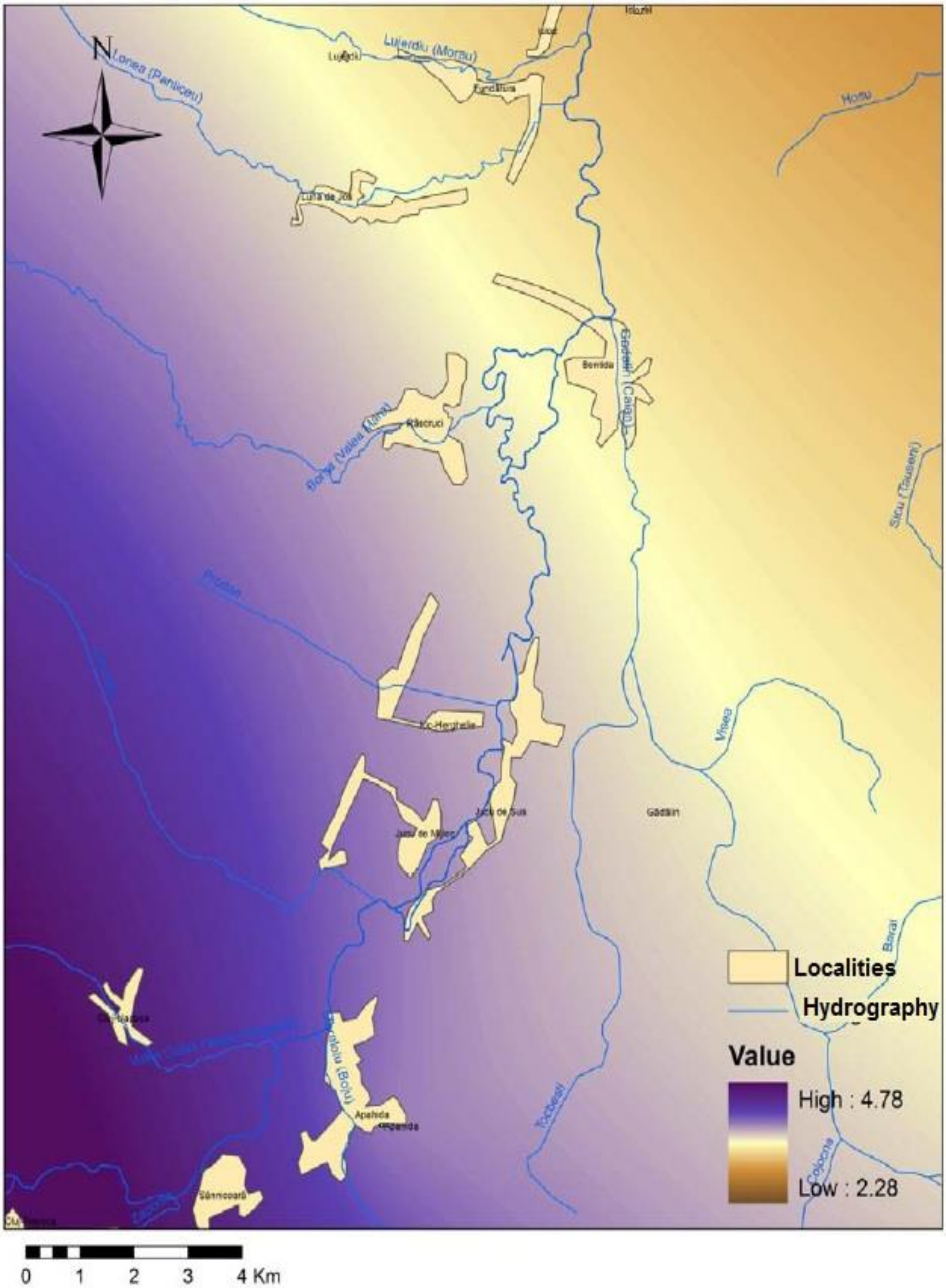


Fig. 5. Map with minimum flow recorded in 2011-2012 on Someșul Mic, Cluj-Napoca – Dej area

Average flow values for Jucu - Bonţida area between 10 and 17 m^3 / s, with low values on the left tributary and tend to 17 m^3 / s tributaries gradually on the right (Fig. 6).

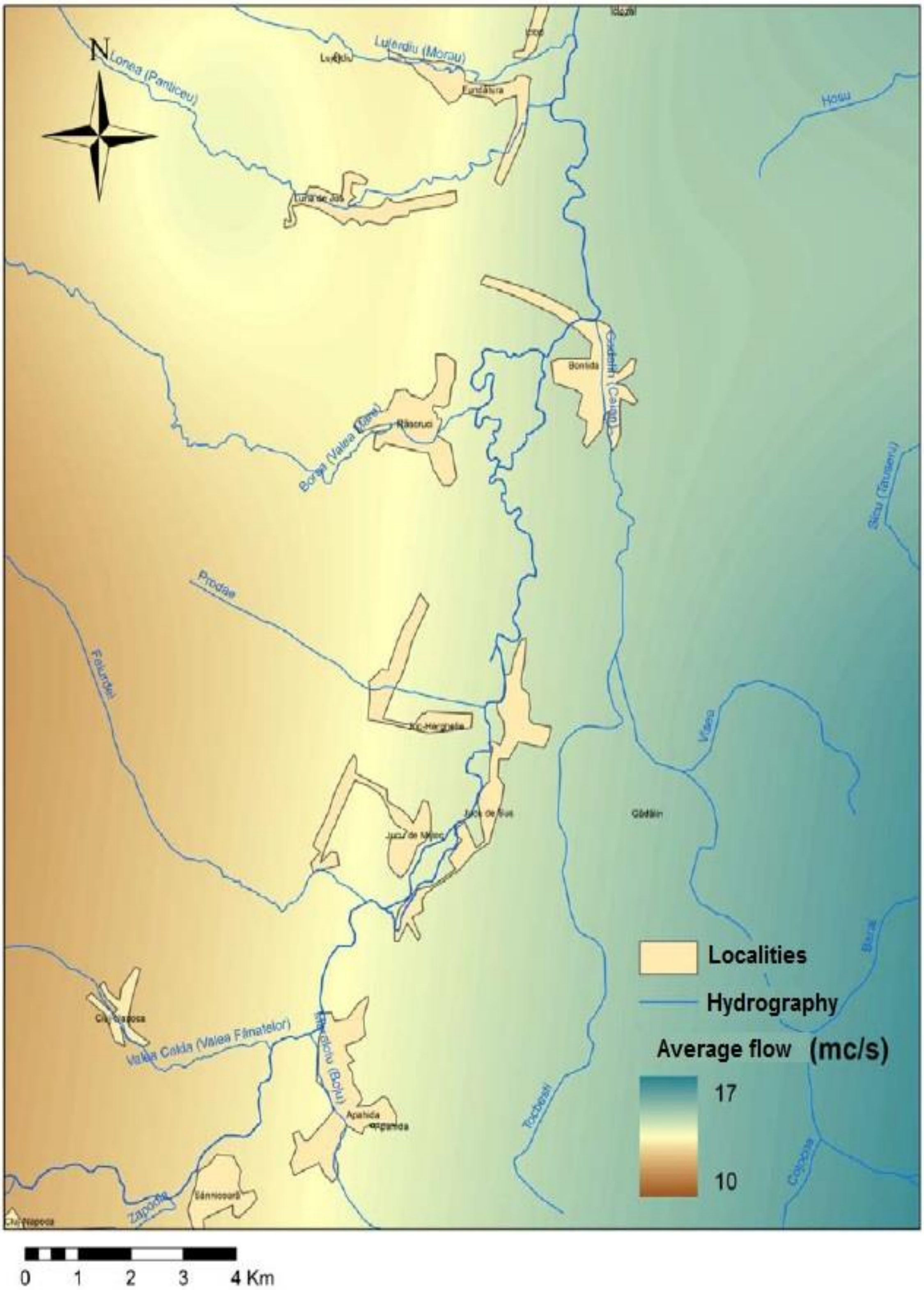


Fig. 6. Map with average flow recorded in 2011-2012 on Someșul Mic, Cluj-Napoca – Dej area

CONCLUSION

The results obtained by this thematic interdisciplinary study aims to highlight the issues of combating and preventing degradation processes of floodplain in agricultural ecosystems from Someşul Mic meadow, Cluj-Napoca - Dej area, using thematic maps which present the distribution of flows in the studied area.

Knowledge of these flows is important in order to intervene with future hydroameliorative works like drainages (vertical drainage, mole drainage, combined drainage), dams and irrigation systems which are required for a modern and competitive agriculture.

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