Morphological approach of braided rivers quality. A case study in Romania

Approche morphologique de la qualité des rivières tressées. Étude de cas en Roumanie

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RÉSUMÉ

Ce travail a développé une méthode pour l'évaluation de la qualité morphologique des rivières en Roumanie, basée sur la simplification de l'Index de Qualité Morphologique. Elle a pris en compte dix-sept indicateurs montrant les modifications du chenal fluvial, l'artificialité et la fonctionnalité. Ils ont été calculés et comparés pour 1900 (sur des Cartes d'État Majeur) et 2005 (sur des photos aériennes) par le biais de techniques SIG. Des scores ont été attribués en fonction du degré de changement de chaque indicateur. La méthode a été appliquée sur l'ensemble du secteur tressé de la rivière Prahova (76 km). Ce secteur a subi des modifications morphologiques (de la rétraction de la bande active à la métamorphose fluviale) probablement dues à des interventions anthropiques importantes (comme la construction de barrages et le développement de l'infrastructure de transport). Le score final du changement indique une qualité morphologique moyenne de ce secteur tressé. Appliquée sur de longs secteurs, cette méthodologie sert à des comparaisons régionales entre l'état actuel de l'activité de tressage de plusieurs cours d'eau.

ABSTRACT

This paper proposed a method for the assessment of morphological quality of rivers in Romania, based on the simplification of Morphological Quality Index. It took into account seventeen indicators for channel adjustments, artificiality and functionality. They were calculated and compared for 1900 (on Military Survey Maps) and 2005 (on aerial photos) in GIS environment. Scores were attributed based on the level of change of every indicator. The method was applied on the entire braided sector of Prahova River (76 km). This sector suffered morphological adjustments (from retraction of braided channel to fluvial metamorphosis) probably due to important human interventions (like dams' construction and transportation infrastructure development). The final score of change indicate a moderate morphological quality of this braided sector. Applied on long sectors, the method serves for regional comparison purposes between current status of braiding activity of several rivers.

KEYWORDS

Braided river, GIS, Morphological Quality Index, Morphological adjustments, Prahova River.

1. INTRODUCTION

Morphological conditions analysis is one of the demands of Water Framework Directive (EC, 2000). They are compared to reference conditions in order to establish their current status/quality. A method of assessing morphological adjustments of river channels for comparison purposes is the one of Rinaldi et al. (2013), consisting in Morphological Quality Index (MQI) calculation.

This study aimed at developing a method for the assessment of morphological quality of rivers from Romania. The method is applied on the braided sector of Prahova River; it corresponded to the Subcapathians and the related piedmont and had 76 km in length (in 1900).

2. METHODOLOGY

The proposed method was adapted from MQI. We analysed indicators of channel adjustments, functionality and artificiality. Than we detected modifications and attributed scores function of the degree of change. Finally, we calculated the score of change from the maximum possible score. The analysis is based essentially on cartographic analysis in GIS environment.

Table 1. Methodology of the study. [1]Score calculated for every indicator; [2]Calculated for both river banks; [3]Width of the erodible corridor equal to the width of river channel on both banks; [4]Not calculated for reaches with flood plains largely opened.

Indicator	Classes of change	Score	Data used		
			Document	Data	Scale
Channel pattern	No change	0	Military Survey Maps	1900	1/20,000
	To a similar pattern	3			
	To a different pattern	6			
Width of braided channel	<15%	0			
	15-35%	3			
	>35%	6			
Area of in-stream vegetated bars	<15%	0	Aerial photos	2005	1/5,000
	15-35%	3			
	>35%	6			
Catchment area upstream reservoir dams	0	0	Aerial photos	2005	1/5,000
	0-33%	3			
	>33%	6			
Number of local bridges, weirs and low-head dams[1]	0	0			
	< 1/1 km	3			
	> 1/1 km	6			
Length of levees, embankments, rectification, revetments, forest[1, 2]	< 10%	0			
	10-50%	3			
	> 50%	6			
Local sediment mining activity (in-stream, from the floodplain)	Absent	0			
	Moderate	3			
	Intense	6			
Length of a potentially erodible corridor, with no human interventions[2, 3]	>66%	0			
	33-66%	3			
	<33%	6			
Length of banks covered by grass[2]	>90%	0			
	10-90%	3			
	<10%	6			
Connectivity between hillslopes/terraces and river corridor[2, 4]	>90%	0			
	33-90%	3			
	<33%	6			
Erosion/accumulation processes	Presence	0			
	Absence	6			

3. RESULTS

Prahova River channel adjusted between 1900 and 2005. Channel pattern changed to a single channel on about 25 km (both upstream and downstream river reach). Channel width diminished by more about 68% (Figure 1A) and some alluvial bars were covered by shrubs or forest.

This may be related to various human interventions. Four dams regroup more than 80% of braided sector's catchment. Bridges and weirs have a density of almost 0.25/km. Embankments and revetments cover together 14% of river banks. Last kilometres of the braided reach are lined by riparian forest, corresponding to 33% of reach's length.

Therefore, the erodible corridor correspond to 86% of sector's length; but only 57% of the erodible corridor are covered by grass. We estimate that the major part of the river reach is disconnected from the hillslopes (or fluvial terraces) due to other various human activities. Meanwhile, the erosion/deposition processes are still active in the braided channel.

The braided sector of Prahova River has a final score of change of 41.1%. Therefore we consider that it has a moderate morphological quality (Figure 1B).

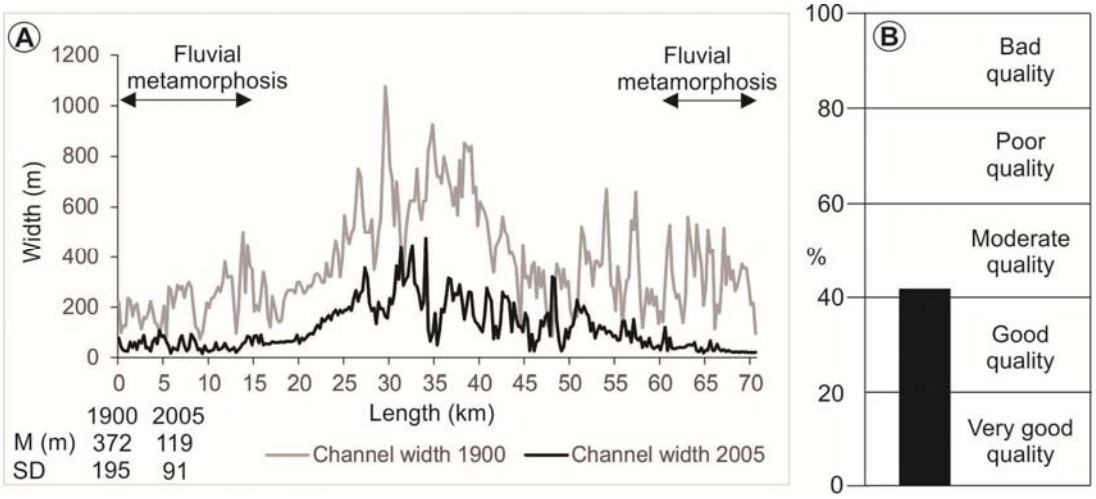

Figure 1. Morphological features of braided sector of Prahova River. A) Variations of channel width (M: mean; SD: standard deviation). B) Morphological quality.

4. DISCUSSION AND CONCLUSION

This paper showed a successful use of a similar MQI protocol in order to evaluate a braided river. Despite drastic morphological adjustments of river channel, fluvial processes seem to be active, but probably less intense. Major interventions took place on the bottom of the valley, disconnecting the river from the hillslopes, mainly because of dams and the presence of roads, railroads and even some settlements.

Compared to MQI, the analysed indicators were simplified due to the available data. The scale used is less detailed, because the method was applied on a sector instead of a reach.

This application of MQI on a long river sector may be used especially for comparisons between braided rivers. For example, Prahova River braided sector has a better quality then reaches of other rivers from Eastern Carpathians (Rădoane et al., 2013).

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