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GEOMORPHOLOGICAL CLASSIFICATION OF FLUVIAL SYSTEMS FROM G.I.S. TOOLS

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This paper gathers a valid method for the geomorphological classification of fluvial systems, as well as its development with Geographic Information Systems (G.I.S.). The characterization and reach-making of the fluvial network is based on valley geomorphology, streambed slope and channel geomorphology. A process of simplification is necessary to achieve an applicable classification, which is explained with an example (Cabe river, Lugo, Spain). 14 hydromorphological types have been differentiated. There is a clear dominance of alluvial sinuous channels in valleys of moderate confinement and wide valley-floor. The incorporation of G.I.T. (Geographic Information Technologies) tools in fluvial geomorphology has marked a substantial change in the analysis of processes and classifications, as far as its versatility and its possibilities obtaining precise and fast information. Likewise, in the last years the geomorphology begins to settle as the central point of many projects about restoration and comprehension of the natural dynamics of fluvial systems, the reason why is basic to establish guidelines and methodologies that help in this task.

I. INTRODUCTION

Rivers have been traditionally classified and managed based on hydrologic and biological features, leaving channels to background, as much as both its genesis and its dynamics or repercussions as a maintain of the biological components. However, in the last decades the importance of geomorphology as the basis to understand and value natural environments has increased.

The remarkable increment during the past few years of the Geographic Information System (G.I.S.) as an analysis technique has yielded in a new approach and a new methodologic frame in praxis of environmental sciences. Thus, this paper approaches the characterization

of fluvial geomorphology using the calculation power of these tools - sometimes assisted by specific softwares - in order to identify quickly and easily the internally and functionally homogeneous fluvial sections by three geomorphological variables: valley geomorphology, streambed slope and channel geomorphology.

II. METHODOLOGY

The set out methodology constitutes an open protocol of action in which the own investigator settles down the most suitable descriptors for that concrete territory based on other studies and experiences. In the present work it has been carried out a test in the lucense river basin of the Cabe river (733 km^2) on the stream with more than 20 km in length.

The standardization exercise of the network consists of establishing internally and homogeneous hydrogeomorphological sections but different from each other using the previous sectioning work developed from the three geomorphological variables mentioned above. In turn, these variables have been decomposed in six fundamental descriptors and each one of them were also divided in many subtypes.

III. RIVER NETWORK CHARACTERIZATION AND CHANNEL REACHES

3.1. Valley geomorphology

There are three great approaches set out to classify valleys: topographic, physiographic and genetic. Altogether, consist in different and independent ways to proceed, however they are no excluding and integrated one with the other.

Quantitative criterion of topographic perspective is the one that best characterizes valleys, once it makes possible to obtain ecological and geomorphological functional types. Also, entrenchment and the bottom extent of the valley are both extremely important factors for classification by the intense interaction they maintain with the channel.

From the G.I.S. scope, cross-sectional sections were calculated as well as certain parameters of interest using MorfoPerfil-T (*Cartografía GeoAmbiental y Teledetección (CGAT), Departamento de Ingeniería Cartográfica, Geodesia y Fotogrametría de la Universidad Politécnica de Valencia ©* (http://cgat.webs.upv.es).

3.2. Channel slope

The slope variable can be classified in different categories in order to attend the type of information that is needed. We denominated longitudinal slope the one that corresponds to this variation throughout the channel in homogeneous sections, being the one of greatest adaptabiity for geomorphological characterization of fluvial systems.

The slope's channel development was done using G.I.S. with the support of the extension of spatial ecology Hawth's Analysis Tools ® (Dpto. of Biological Sciences of the University of Alberta, Canada).

3.3. Channel geomorphology

The riverbed is the element of most relevance in fluvial hydromorphology works. Study and definition of geomorphological types of channels from the T.I.G. counts on interesting cabinet methodologies with important advantages, once they allow to obtain a plant vision of the channel or determine a global analysis, which not only includes the actual channel but also the environment in which it passes through. This really triggers in a rapid and very effective fluvial classification from a different perspective from the one obtained in field.

Among the mappable elements, sinuosity is one of the most important parameters. Although, it does not depend so much on the photo-interpretation but further on the type of used method.

IV. RESULTS

The methodologic application gives as result a differentiation of 14 hydrogeomorphological classes. It is also observed a clear dominion of winding alluvial channels in moderated entrenchment valleys with a large bottom width. Sinuosity index has similar values in both entrenchment sectors (in many cases derived from sobreimposition processes) and in areas of greater fluvial mobility.

Resulting typology of channels was reduced to two main types: alluvial river and bedrock river. Also, the entire network was considered as an unique channel because of the unrepresentative nature of the other variants.

The exercise of correlation between the dependent variable sinuosity and the independent slope shows low and negative values, except for Cinsa river (r=0,062). The low explanatory load of the slope has led not to consider establishing classes in this river basin.

V. CONCLUSIONS

- The idea of an action protocol instead of a closed and predefined classification supposes to be the investigator —a true knower of the study zone— who determines the suitable parameters for the hydrogeomorphological characterization.
- This type of classification is of extreme interest to understanding of natural systems, as well as of its operation and its value, besides a new instrument to be considered in the plans of territorial management with a remarkable benefit for natural means and the society.
- Slope has not been shown as an explanatory factor of sinuosity nor therefore discriminating factor of the dynamic environments of differentiated processes. Nevertheless, the intensity of this bond is variable according to the number of factors that interact at certain point of the fluvial system, in such a way that the slope itself also can indicate the channel geomorphology in other contexts.
- The transition from one typology to another occurs gradually. However, each sector is quite distinguishable from its surroundings, especially from the channel where the

bedrock rivers are perfectly recognizable. Changes from one valley peculiarity to another is more diffuse and in many cases it is necessary to use quantitative criteria to establish limits. Though, in these zones of typological contact it was not verified a noticeable combination of fluvial styles that could suppose to establish types of transition. A special case that is also present in the study area is the altered channels or sections affected by an impact, which is interpreted as a total or partial loss of the natural geomorphological behaviour.