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Quantifying the performance of automated GIS-based geomorphological approaches for riparian zone delineation using digital elevation models

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Abstract. Riparian zone delineation is a central issue for managing rivers and adjacent areas; however, criteria used to delineate them are still under debate. The area inundated by a 50-yr flood has been indicated as an optimal hydrological descriptor for riparian areas. This detailed hydrological information is usually only available for populated areas at risk of flooding. In this work we created several floodplain surfaces by means of two different GIS-based geomorphological approaches using digital elevation models (DEMs), in an attempt to find hydrologically meaningful potential riparian zones for river networks at the river basin scale. Objective quantification of the performance of the two geomorphologic models is provided by analysing coinciding and exceeding areas with respect to the 50-yr flood surface in different river geomorphological types.

1 Introduction

Riparian areas are involved in different geomorphological, hydrological and ecological processes (Tabacchi et al., 1998; Naiman et al., 2005), reducing flood risk and improving the availability and quality of water (Staats and Holtzman, 2002; Hruby, 2009). Despite this, riparian zones are commonly under high pressure due to human activities and land-use transformation (for a review see Poff et al., 2011). The maintenance of riparian functions and values is of key importance and requires planning at catchment scale and to locate the optimal zones to conserve or restore riparian buffer strips. Additionally, the definition of riparian zone extent is an unavoidable issue when managing river corridors. There exist several different approaches to delineate riparian areas (e.g. McGlynn and Seibert, 2003; Dodov and Foufoula-Georgiou, 2006; Nardi et al., 2006), but the development of a standard geomorphologic method for preliminary floodplain mapping is still an open research topic.

The delineation of riparian zones is highly dependant on what is understood as "riparian". Existing definitions are quite heterogeneous with respect to the zones encompassed by this term. While most authors use definitions matching with river banks and floodplains, others also include river channels (Naiman et al., 1993; USDA FS, 1994) or extend these zones to the slopes adjacent to floodplains (Ilhardt et al., 2000; Verry et al., 2004). By focusing on land adjacent to watercourses, there is agreement about the following riparian zone characteristics: (i) they are transitional zones between aquatic and terrestrial ecosystems (Gregory et al., 1991; NRC, 2002); (ii) their soil and vegetation characteristics are strongly influenced by free or unbound water in the soil that comes from elevated water tables and flooding by high waters (USDA NRCS, 1991; Naiman et al., 1993; USDA FS, 1994); (iii) they present gradients of environmental factors, ecological processes and biota (Gregory et al., 1991; NRC, 2002). Hence, the spatial and temporal distribution of vegetation in riparian areas is heavily influenced by flood regime (Gregory et al., 1991; Merrit et al., 2009; Naura