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Towards a sociogeomorphology of rivers

Peter Ashmore

Department of Geography, University of Western Ontario, London, Ontario, Canada N6A5C2

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ABSTRACT

While human impacts on rivers and other landforms have long been a component of geomorphic research, little of this work explicitly includes insights into human agency from social science or recognises that in many cases rivers can be considered to be hybrid co-productions or 'socio-natures'. A socio-geomorphic approach proposed here has parallels with some aspects of sociohydrology and can extend and enrich existing geomorphic explanations of the morphology of, for example, urban rivers by explicitly recognising and working with the co-evolution of the human and natural systems. Examples from recent literature illustrate ways in which these relationships can be understood and analyzed, showing a range of socio-natural influences in particular contexts that have material consequences for river morphology and recognising that events in the system have many forms. The approach recognises the importance of contingency in time and place together with the role and nature of both local and global knowledge. An important element of this approach is that it provides ways for understanding the nature, position and intention of geomorphic and other scientific interventions as part of the system, for example in the case of river restoration. This also leads to the need for reflexivity by geomorphologists and reconsideration of the nature of geomorphological knowledge by those involved in such work and with respect to sociogeomorphology as a whole.

1. Introduction

The central concern of geomorphology is with 'natural' processes and landforms and with enquiry and explanations based almost exclusively in the natural sciences. Most textbooks in geomorphology establish this view at the outset and in some cases it is explicit in the title (e.g. Anderson and Anderson, 2010). In most cases the definitions and the scope of geomorphology contain essentially nothing of the role of socio-political processes as an element of contemporary geomorphology and humans are seen almost always as separate from geomorphic systems and impacting the natural system from the outside (Urban, 2002; Haff, 2003).

The spatial and temporal frames of geomorphology are wide and in many cases this 'entirely natural' framing is appropriate. But even in studying contemporary and local landscapes over relatively short time frames, in which these socio-political processes may be relevant, geomorphologists have tended to seek pristine or wild (natural) landscapes and to privilege those as the primary object of study for the discipline (Urban, 2002) and against which human impact is measured. In fluvial geomorphology, highly modified rivers have generally been either avoided as a subject for study or treated as deviating from natural. In the latter case they are seen as an object for restoration to more 'natural' states and on which to practice and impose engineering geomorphology from a technical point of view.

While the primary focus of geomorphology has been on 'natural' processes and landscapes, this is not to say that geomorphology as a discipline has ignored human effects in the landscape; far from it. Textbooks and research articles often describe human impacts on landforms and landscape processes and the role of geomorphology in documenting, managing and mitigating human impacts and hazards. In this sense human impacts on landscapes and the recognition of human-constructed landforms have long had a place in some accounts of, for example, fluvial geomorphology (Gregory, 2006; James and Marcus, 2006). In this context the detailed development of "anthropogenic geomorphology" as documentation, categorization and systematization of anthropogenic landforms and impacts of a range of human activities is notable (Szabo et al., 2010). This approach fits into the established scope of geomorphic studies of human-induced changes to landforms and processes with the focus on documenting and quantifying direct and indirect effects of human activities. In this account humans are seen as interfering from the outside and disturbing the natural order, human-constructed landforms are artificial, and humans are seen as disturbing and upsetting natural equilibrium, changing boundary conditions, adding 'unnatural variability' and creating harmful effects. Anthropo- geomorphologists then work to measure, document (Graf, 1996) and account for human impact and to conserve, protect and repair landforms from damage (Szabo et al., 2010). There have been several influential and useful analyses of the overall intensity of landform and process modification by human activity illustrating this approach (Hooke, 1994, 1999; Douglas and Lawson, 2001; Haff, 2003, 2010, 2012; Price et al., 2011; Overeem et al., 2013) including analysis

E-mail address: pashmore@uwo.ca.

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of the "anthropic force" (Haff, 2002) in broad framings of landscape dynamics.

An anthropo-geomorphic position in which humans are seen as impacting nature and perturbing natural systems does not allow a complete explanation of the role of humans within these systems, or of the mutual evolution of the 'human' and 'natural' systems, and adheres to a separation of the two. The position is untenable in situations in which the landforms and processes are co-produced by the combined human and 'natural' systems (Urban, 2002). Recognition of this concern is apparent in the oft-repeated calls by geomorphologists to engage more-fully with social sciences to better understand the integration of the physical landscape and the human systems, or to establish a 'cultural' geomorphology (Gregory, 2000, 2006; James and Marcus, 2006; Slaymaker, 2009; NRC, 2010; Harden et al., 2014). This arises in part from explicit concern for landscape sustainability, restoration and conservation and the need for co-development of a science of human-landscape systems (Harden et al., 2014; Wohl et al., 2014). However, there has been little articulation of how this integration might be done and what it would look like as a component of explanations and understanding of landforms and landscapes. Wohl et al. (2014) identify commonalities of conceptualizations among a wide variety of cognate fields that might form a basis for proceeding, which is a useful starting point, but even this kind of integration may be insufficient as an epistemological approach.

In terms of contemporary environmental geography and related fields, many landforms in 'human impacted' and 'restored' landscapes can be seen as hybrid manifestations (co-productions) of nature-culture (socio-natures) while at the same time raising the question of whether there is a prior or separate "nature" (Eden et al., 2000; Urban, 2002; Castree, 2005; Bakker, 2009; Linton, 2010; Hartmann, 2011; Bouleau, 2013; Di Balldassarre et al., 2013). Adopting a position of hybrid socio-natures of landforms would enable geomorphologists to engage in a more complete explanation of human-impacted and human created landforms bringing the field closer to understanding the why of 'human impact' (Urban, 2002) and a refined ability to model these processes and landscapes at the level of human agency and intention (Ertsen et al., 2014) within a more complete explanatory and predictive framework.

The main goal in this paper is to present examples and show the benefits of taking this position. My use of "socio-geomorphic" is intended to make a distinction from anthropo-geomorphology. Although others (e.g. James and Marcus, 2006) have proposed that anthropo-geomorphology might explicitly include elements of socio-cultural analysis, I use the term here to argue for a distinctive mode of enquiry that explicitly approaches rivers as socio-natures and adopts some of the methods and philosophies related to that idea. My use of the term sociogeomorphology is partly connected with recent developments in socio-hydrology (Hartmann, 2011; Sivapalan et al., 2011; Di Baldassarre et al., 2013; Ertsen et al., 2014; Lane, 2014). However, some distinctly different approaches have already emerged in that field (Lane, 2014). One is of socio-hydrology as a "quantitative science of people and water, with the ambition to make predictions of water cycle dynamics" with humans as a social force acting on water flows (Sivapalan et al., 2011). This is more analogous to what I have identified as anthropo-geomorphology and it differs substantially from critical and radical conceptions of the water cycle (Linton, 2010; Budds et al., 2014; Linton and Budds, 2014) and socio-hydrology that recognises constructivist accounts of hydrological science (and of science in general) and the ways in which hydrologists' interventions affect outcomes (Lane, 2014) with a goal to explicitly understand human-water systems (Di Baldasarre et al., 2013). This is exemplified by the concept of the hydrosocial cycle in which water circulation is seen as a hybrid biophysical and socio-political set of processes, explicitly contrasting with the asocial and apolitical conception of the hydrological cycle (Budds et al., 2014). Thus this approach to sociohydrology looks at the material flows of water along with the social and political practices, discourses and power relations as an integral part of water flows such that water and society make and remake each other (Linton and Budds, 2014).

My proposition for sociogeomorphology is that geomorphological understanding and explanation can usefully be broadened in some circumstances by adopting the concept of co-production and of socio-natural systems of landforms, although the exact form of analysis will depend on evolving philosophical positions and directions of development of the idea. This 'more social', approach also recognises alternative ways of framing environmental research and the nature of human agency, and that processes are context-specific with the implication that contingent understanding and explanation are the goals of enquiry rather than generalised quantitative predictions of system dynamics (Budds et al., 2014). It may also connect to more radical framings of geomorphology such as the "ethno-geomorphology" recently proposed by Wilcock et al. (2013). I also propose that this sociogeomorphic approach can be developed within geomorphology and need not necessarily involve inter-disciplinary studies and collaborations with, for example, social science (and see Lane, 2014 on this point).

Here I introduce elements of this 'more social' approach in the case of river morphology and ways in which explanations of river morphology can be expanded through a more critical view (Lave et al., 2014; Tadaki et al., 2014a) of rivers as co-productions of socio-geomorphic processes (Bouleau, 2013). I do so by first presenting a case of urban river morphology illustrating ways in which 'physical only', anthropo-geomorphic analysis limits understanding of morphological changes. I then move to broaden the discussion using examples from other rivers and aspects of fluvial geomorphology in which analysis of the social aspects of the system lead to expanded understanding. This points the way to future development of the socio-nature of rivers. These examples identify ways in which institutional power, nation-building, political history and ideas, cultural norms and perceptions, socio-natural contingencies, environmental activism, scientific constructs and ambitions, international scientific projects, and the nature of, and motivation for, geomorphic intervention, as well as fluvial processes, can all be seen to play a role in 'explaining' river morphology.

The consequences of this change in perspective include: a move to more place-based, contingent and historical understandings of rivers; the questioning of the role and goal of global-knowledges and predictive explanations; the development of knew paradigmatic questions and propositions; and the recognition that geomorphologists are actors in the socio-geomorphic system whose conceptions and actions are valid and necessary subjects of enquiry.

2. A case in urban river morphology

There has been substantial geomorphic analysis of the possible effects of urban development on river morphology (Chin, 2006; Chin et al., 2013). Analyses focus on changes of river morphology as a consequence of the 'impact' of urbanization, primarily through documented or assumed changes in stream-flow hydrology and sediment delivery. There has been very little generalization from this assemblage of studies for a variety of reasons (Chin, 2006; James and Marcus, 2006). But even if that generalization were accomplished it is questionable whether a complete understanding of urban river morphology can be achieved by this 'physical only' account that views hydrological change as simply being imposed on the system by some set of urbanization processes, the analysis of which is beyond the norms of geomorphic research.

Highland Creek watershed in the City of Toronto has an area of about 100 km^2 draining directly into Lake Ontario (Toronto Region Conservation Authority (TRCA), 1999; Vocal-Ferencevic and Ashmore, 2012). Extensive forest clearance for agriculture occurred in the 18th and 19th centuries as a consequence of European settlement. The dominant agricultural land use was supplanted by urban development between the early 1950s and the 1980s. Greater than 85% of the watershed area is now urban land use (much of the remainder is riparian parkland along the main river valleys) and 53% has impervious surfaces