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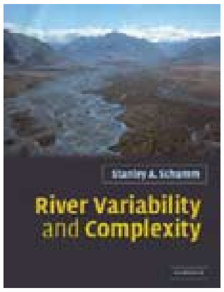

River Variability and Complexity, by S. A. Schumm, 2005, Cambridge University Press, Cambridge, UK, hardcover, 234 p., USD 75.00, ISBN-13: 978-0521846714.

The subject of Schumm's book, *River Variability and Complexity*, is the apparently large alongstream and temporal variability in the geometry of alluvial rivers. According to Schumm, such variability cannot be explained by hydrology or hydraulics, and other controls must be at work. In discussing this subject, Schumm admits up front that there is nothing entirely new in the book.

The book has 220 pages and is organized into 6 parts and 20 chapters. Part I (Background) includes an introductory chapter and chapters on types of rivers and nonregime channels. Chapter 1 introduces the nature of variability of river geometry, the geomorphic context of river channels, and the controls of river geometry. Unfortunately, Figure 1.2, which ostensibly shows the controls on alluvial river geometry, nowhere states that the dominant controls are supply of water and sediment and bank erodibility.

Chapter 2, on types of rivers, refers to the channel pattern (plan geometry) classifications of Brice and Schumm, which use such terms as stable, unstable, bedload, mixed-load, and suspended load streams. Others, however, have shown that these classifications are seriously flawed (Bridge, 2003). Equilibrium (regime, graded) alluvial channel patterns depend mainly on bankfull water and sediment discharge, and bank erodibility, which depend on bank materials, riparian vegetation, and cementation. This dependence should be stated clearly in this chapter, but it is not. Disequilibrium (nonregime) channel patterns also depend on whether the river is degrading, aggrading, or avulsing. In these cases, the bankfull water and sediment discharge are changing in time and space. This is the subject of Chapter 3.

Chapter 3 (Nonregime channels) deals with changing patterns of degrading, aggrading, and avulsing channels, arising from such factors as tectonism, climate and base-level change, and human influences. Throughout the discussion of degradation and aggradation, there is no mention of their basic cause, which is alongstream change in sediment transport rate (i.e., sediment continuity equation). A new word (to me) is introduced on p. 27: *berming*, which means in-channel deposition. This is a great example of the American penchant for using nouns as verbs. Avulsion is discussed in some detail, but there is no inclusion of data from some of the best-known examples of avulsion (e.g., the Rhine-Meuse delta, the Mississippi, and the Kosi River). The discussion of avulsion should also include interavulsion periods and numerical models of avulsion.

Part II (Upstream controls) concerns the effects of upstream changes in water and sediment supply on downstream changes in channel patterns. Chapter 4 (History) is concerned mainly with the effects of Quaternary changes in climate and base level on degradation, aggradation, and channel pattern changes. Climate and base-level controls on river channels are also considered again in chapters 7 and 16. Mississippi channel changes during the Quaternary are discussed, but there is no mention of the complicated degradation-aggradation cycles of rivers flowing across the Gulf coastal plain, which arise from relatively short-term climate changes (e.g., work of Blum). Chapter 5 concerns the effects of regional tectonics and relief on sediment supply, aggradation, degradation, and avulsions. The discussion brings up the intriguing question of whether single earthquakes can cause avulsions or whether ground tilting sets up conditions conducive to later avulsions. The topic of tectonics and avulsions is returned to in chapter 11. Chapter 6 concerns the effect of rock lithology on grain size of sediment supply and hence on channel patterns. Chapter 7 discusses how climate and hydrology influence water supply (discharge) and sediment yield, which are prime controls on river geometry and behavior. This topic was also covered in chapter 4. Chapter 7 includes an extended discussion of the effects of discharge reduction on the Platte River in Nebraska. The final chapter in this part of the book considers the effects of human activities on rivers, specifically dam building, mining, dredging, levee construction, and channelization. Most of this chapter comprises a discussion of the Mississippi River. The effects of humans on rivers are actually discussed in various places throughout this book, and the subject is revisited in Part VI.

Part III (Fixed local controls) is concerned with the effects on rivers of bedrock (Chapter 9), tributaries (Chapter 10), tectonic features (Chapter 11), and valley morphology (Chapter 12). As this book is mainly about alluvial rivers, chapter 9 is somewhat out of place. This chapter, however, also contains an extended discussion of the effects of clay plugs on Mississippi river meandering. Chapter 10 contains various examples of how sediment introduced by tributaries affects channel geometry downstream of the confluence. Chapter 11 shows how local tectonics affect channel gradients and thereby aggradation, degradation, channel patterns, and avulsion. Valley morphology is clearly influenced by bedrock, tributaries, and local tectonics. Chapter 12, however, is reserved for the special case of valley long profile variations resulting from local deposition. In arid and semiarid regions, such long-profile variations give rise to discontinuous gullies.

Part IV (Variable local controls) is about floods (Chapter 13), riparian vegetation (Chapter 14), and such so-called accidents (Chapter 15) as logjams and landslides. It should be stated in chapter 13 that equilibrium channel geometry is normally controlled by bankfull floods (the so-called channel forming discharge), but it is not. Extreme floods can of course cause large changes in equilibrium channel geometry, but subsequent, more common floods tend to reverse these nonequilibrium changes. It is generally accepted that riparian vegetation slows down the rate of bank erosion and channel widening, but whether or not vegetation greatly influences channel pattern remains a controversial topic. It should be pointed out that all types of channel pattern can be formed in the laboratory with absolutely no vegetation present. This important topic is not addressed in the book. Log jams, ice jams, landslides, and lava flows are important because they can induce local flooding, aggradation, degradation, channel widening, cut offs, and avulsion.

Part V (Downstream controls) concerns river slope changes due to base-level change (Chapter 16) or changes in channel length (Chapter 17) due to cut-offs, avulsion, or channelization. Such changes in gradient can cause aggradation, degradation, and changes in channel pattern and roughness.

Part VI (Rivers and humans) is a return to the familiar theme in this book of the effects of humans on rivers and vice versa. In chapter 18 (Applications), Schumm gives some advice on river management: (1) gain a broad perspective by examining the river upstream and downstream of the reach of interest; (2) be aware of the sensitivity of the river to a change in a controlling variable; and (3) use multiple working hypotheses in problem solving. In chapter 19 (Some unintended consequences), Schumm gives four examples of the effects of humans on rivers. Two examples concern the effects of bed armoring following dam construction, another is about deposition upstream of dams, and yet other is about the effects of removing gravel from a river bed. All these examples point to the ignorance of engineers about river processes. In chapter 20 (River impact on ancient civilizations: A hypothesis), Schumm puts forward the hypothesis that differences among the ancient civilizations along the Nile, Tigris-Euphrates, and Indus are dependent on the character of these great rivers. The hypothesis is speculative, however, and this topic is off the main point of the book.

There is a lot of information in this book, much of it in the form of examples from modern rivers. Inevitably, there is much more information from rivers in the United States than rivers worldwide. The information is mostly qualitative and in places almost anecdotal. There is very little quantitative analysis. Schumm makes a convincing case that river geometry can be quite variable for a range of different causes. I think the case may be somewhat overstated, however. Certainly, human activities have had a big impact on river geometry and behavior. Many natural rivers are not particularly variable, and their geometry can be explained readily as a function of water and sediment supply during seasonal floods. As might be expected, there are many references to the extensive body of work by Schumm and his colleagues. Unfortunately, many other important references are omitted. The reference to Schumm and Galay (1994) is not in the reference list. The quality of the layout and figures is good. Despite some shortcomings in the content and organization of this book, Schumm still has worthwhile things to tell us about rivers, and this book is definitely worth reading.

References

Bridge, J.S., 2003, Rivers and floodplains: Blackwell, Oxford, UK, 512 p.

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