

Contents

Preface	xi
List of contributors	xiii
1 Introduction: river confluences, tributaries and the fluvial network	1
<i>Stephen P. Rice, Bruce L. Rhoads and André G. Roy</i>	
Introduction	1
Key aims of the book	4
Sections of the book	4
References	5
I RIVER CHANNEL CONFLUENCES	11
2 Introduction to Part I: river channel confluences	13
<i>André G. Roy</i>	
Introduction	13
Individual chapters	15
Reference	16
3 Modelling hydraulics and sediment transport at river confluences	17
<i>Pascale M. Biron and Stuart N. Lane</i>	
Introduction	17
Hydraulics	18
Bedload, suspended and solute transport	29
Conclusion	37
Acknowledgments	38
References	38
4 Sediment transport, bed morphology and the sedimentology of river channel confluences	45
<i>James L. Best and Bruce L. Rhoads</i>	
Context	45
Bed morphology	46

Sediment transport	56
Sedimentology	60
Conclusions	66
Acknowledgements	67
References	68
5 Large river channel confluences	73
<i>Daniel R. Parsons, James L. Best, Stuart N. Lane, Ray A. Kostachuk, Richard J. Hardy, Oscar Orfeo, Mario L. Amsler and Ricardo N. Szupiany</i>	
Introduction	73
Bed morphology	75
Flow structure at large river channel confluences	80
Flow mixing at large river confluences	85
Conclusions	87
Acknowledgements	88
References	88
6 Management of confluences	93
<i>Robert Ettema</i>	
Introduction	93
Unruly confluences	95
Management approaches	103
Managing confluences for sediment transport	104
Managing confluences for ice passage	111
Summary	116
References	116
7 Unconfined confluences in braided rivers	119
<i>Peter Ashmore and J. Tobi Gardner</i>	
Introduction	119
General characteristics and significance of confluences in braided channels	121
Confluence scour depth	125
Confluence kinetics and bar formation	128
Confluence spacing and the length-scale of braided morphology	130
Sediment transport and sediment budgets	132
Sediment sorting and alluvial deposits	135
Prospect	139
Acknowledgements	142
References	143
II TRIBUTARY–MAIN-STEM INTERACTIONS	149
8 Introduction to Part II: tributary–main-stem interactions	151
<i>Stephen P. Rice</i>	
Introduction	151
Individual chapters	153
References	155

CONTENTS

vii

9	Spatial identification of tributary impacts in river networks	159
	<i>Christian E. Torgersen, Robert E. Gresswell, Douglas S. Bateman and Kelly M. Burnett</i>	
	Introduction	159
	Data and measurement	160
	Analytical tools	167
	Future developments and challenges	175
	Acknowledgements	176
	References	176
10	Effects of tributaries on main-channel geomorphology	183
	<i>Rob Ferguson and Trevor Hoey</i>	
	Introduction	183
	Conceptual considerations	185
	Empirical evidence	187
	Theoretical models: (1) Regime analysis of confluences	191
	Theoretical models: (2) Numerical experiments with adjustable grain-size distributions	198
	Discussion	201
	Acknowledgments	206
	References	206
11	The ecological importance of tributaries and confluences	209
	<i>Stephen P. Rice, Peter Kiffney, Correigh Greene and George R. Pess</i>	
	Introduction	209
	Tributaries, confluences and river ecology	210
	Tributaries, ecosystem functions and river management	215
	Constraints on understanding and progress	217
	A case study	218
	Conclusion	235
	Acknowledgments	237
	References	237
12	Tributaries and the management of main-stem geomorphology	243
	<i>Frédéric Liébault, Hervé Piégay, Philippe Frey and Norbert Landon</i>	
	Introduction	243
	Conceptual framework for assessing the geomorphological impact of tributaries	245
	Managing the geomorphological impact of tributaries	251
	Conclusion	266
	Acknowledgments	267
	References	267
13	Confluence environments at the scale of river networks	271
	<i>Lee Benda</i>	
	Introduction	271
	River network structure and confluence environments	272

Symmetry ratios and confluence environments	273
Basin shape, network patterns and confluence environments	280
Local network geometry	284
Drainage and confluence density	284
River network scaling properties of confluence environments	285
The law of stream sizes and the spatial scale of morphological diversity related to confluences	289
Longitudinal extent and size of confluence environments	290
Stochastic watershed processes	291
The role of hierarchical branching networks	292
Discussion	295
River networks, resource management and river restoration	296
Acknowledgements	297
References	297
III CHANNEL NETWORKS	301
14 Introduction to Part III: channel networks	303
<i>Bruce L. Rhoads</i>	
Introduction	303
Individual chapters	304
References	305
15 Hydrologic dispersion in fluvial networks	307
<i>Patricia M. Saco and Praveen Kumar</i>	
Hydrologic dispersion effects on runoff response	307
Runoff response as travel-time distributions: the GIUH	309
Geomorphologic dispersion in stream networks	314
Non-linear effects and the use of hydraulic geometry relations	316
Kinematic dispersion in stream networks	318
The effect of scale and rainfall intensity on the dispersive mechanisms	320
Hillslope Dispersive effects	324
Kinematic dispersion effects using the meta-channel approach	329
Summary and future research directions	331
Acknowledgments	333
References	333
16 Sediment delivery: new approaches to modelling an old problem	337
<i>Hua Lu and Keith Richards</i>	
Introduction	337
The concept of sediment delivery	340
Difficulties in measuring and estimating sediment yield and SDR	341
Links between hydrology and sediment production and yield	347
Physical inferences of sediment delivery based on a simple lumped model	352
Practical large-scale application using a distributed model	358
Conclusions	361

CONTENTS

ix

Acknowledgements	362
References	362
17 Numerical predictions of the sensitivity of grain size and channel slope to an increase in precipitation	367
<i>Nicole M. Gasparini, Rafael L. Bras and Gregory E. Tucker</i>	
Introduction	367
Landscape-evolution models	370
Example simulation of network evolution	376
Discussion	386
Conclusions	388
Acknowledgements	389
References	389
18 Solute transport along stream and river networks	395
<i>Michael N. Gooseff, Kenneth E. Bencala and Steven M. Wondzell</i>	
Introduction	395
Review of current knowledge	396
Linking transport processes with the fluvial geomorphic template	404
Forward-looking perspective	410
Acknowledgements	413
References	413
19 Fluvial valley networks on Mars	419
<i>Rossman P. Irwin III, Alan D. Howard and Robert A. Craddock</i>	
Introduction	419
Early observations	421
Distribution, age, origin and morphology of valley networks	422
Morphometry	432
Alluvial deposits	436
Hydrology	438
Summary	442
Acknowledgements	442
References	442
Subject Index	453
Place Index	457

