Erosion and Sediment Transport Monitoring Programmes in River Basins

Edited by

J. BOGEN
Norwegian Water Resources and Energy Administration, PO Box 5091, Majorstua, N-0301 Oslo, Norway

D. E. WALLING
Department of Geography, University of Exeter, Exeter EX4 4RJ, UK

T. J. DAY
Environment Canada Conservation and Protection, 500 - 269 Main Street, Winnipeg, Manitoba, Canada R3C 1B2

Proceedings of the International Symposium held at Oslo, Norway, 24-28 August 1992. The symposium was jointly organized by the Norwegian Water Resources and Energy Administration and the International Commission on Continental Erosion of the International Association of Hydrological Sciences; and co-sponsored by UNESCO, WMO, the Norwegian Geophysical Union and the Norwegian National Committee for Hydrology.

IAHS Publication No. 210
Preface

The International Symposium on Erosion and Sediment Transport Monitoring Programmes in River Basins was organized by the International Commission on Continental Erosion (ICCE) of IAHS and the Norwegian Water Resources and Energy Administration and co-sponsored by UNESCO, WMO, the Norwegian Geophysical Union and the Norwegian National Committee for Hydrology.

The symposium was held in Oslo, Norway, 24-28 August 1992. The main objective of the symposium was to focus on methodology, on the design and implementation of programmes to monitor the processes of erosion and sediment transport and on the need to obtain consistent information about environment change and the associated problems.

Throughout the last decades there has been an increasing need for integrated programmes to monitor erosion and sediment transport in river basins. Increases in population, urbanization, industrial development and other changes in human activities have caused a multitude of sediment-related problems. In many countries, soil erosion reduces crop yields and is a threat to sustained productivity. Downstream transport of increased sediment loads may cause further problems, including reservoir sedimentation and impairment of irrigation, water supply schemes and aquatic habitat. In some areas sediment-associated nutrients and contaminants also cause serious pollution problems.

On a global scale soil erosion is one of the main environmental issues of our time. If the global climate is subject to changes, monitoring programmes in rivers are required to record possible effects on soil erosion, sediment transport, river morphology and habitat.

Rivers and the contaminants they carry cross political boundaries and may pollute water bodies shared by several nations. There is a growing need for large scale international programmes and better strategies to coordinate and integrate sediment transport monitoring into water quality and hydrological monitoring programmes. New methods and new technology should be developed to meet the need for more detailed and reliable data and information needs pertinent to environmental issues.

The 57 papers included in this volume cover a wide range of topics within the field or erosion and sediment transport. The papers have been grouped under four main themes: Development of measurement techniques; Sampling strategies; Monitoring networks and programmes; and Case studies. Developments and experience in a great variety of environments are reported. It is hoped that these presentations will stimulate discussion and form a basis of increased international cooperation.

Jim Bogen
Norwegian Water Resources and Energy Administration, Oslo, Norway

Des Walling
Department of Geography, University of Exeter, UK

Terry Day
Environment Canada, Winnipeg, Canada
Contents

1 Development of Measurement Techniques

Suspended load and bed load transport in mountain streams determined by different methods W. Bartnik, M. Madeyski & A. Michalik 3

Bed sediment characterization in river engineering problems P. Billi & E. Paris 11

Direct measurement of in-channel abrasion processes P. A. Brewer, G. J. L. Leeks & J. Lewin 21

Measuring changes in micro and macro roughness on mobile gravel beds C. de Jong 31

Using COSSY (CObble Satellite SYstem) for measuring the effects of lift and drag forces P. Ergenzinger & R. Jümpner 41

The impact of particle size controls on stream turbidity measurements; some implications for suspended sediment yield estimation I. D. L. Foster, R. Millington & R. G. Grew 51

Application of sandwave measurements in calculating bed load discharge Huang Jinchi 63

Turbidimeter measurements in a tropical river, Costa Rica M. B. Jansson 71

Recording bedload discharge in a semiarid channel, Nahal Yatir, Israel Jonathan B. Laronne, Ian Reid, Yitshak Yitshak & Lynne E. Frostick 79

Determining event bedload volumes for evaluation of potential degradation sites due to gravel extraction, N.S.W., Australia Jonathan B. Laronne, David N. Outhet, Joel L. Duckham & Tony J. McCabe 87

River bank erosion events on the Upper Severn detected by the photo-electronic erosion pin (PEEP) system D. M. Lawler & G. J. L. Leeks 95

A study of field methods for measuring sediment discharge K. Miyamoto, J. Kurihara, T. Sawada & Y. Itakura 107

Quantification of soil detachment by raindrop impact: performance of classical formulae of kinetic energy in Mediterranean storms D. Sempere Torres, C. Salles, J. D. Creutin & G. Delrieu 115

Tracing the source of recent sediment using environmental magnetism and radionuclides in the karst of the Jenolan Caves, Australia R. K. Stanton, A. S. Murray & J. M. Olley 125

A new acoustic sensor for sediment discharge measurement S. Taniguchi, Y. Itakura, K. Miyamoto & J. Kurihara 135
Contents

The use of caesium-137 measurements in soil erosion surveys
D. E. Walling & T. A. Quine

Use of radiometric fingerprints to derive information on suspended sediment sources D. E. Walling & J. C. Woodward

Separate in-situ entrapment of sand and silt in river systems J. V. Witter & G. W. A. M. Waajen

Measuring techniques of bed load in the Yangtze River Xiang Zhian & Zhou Gangyan

2 Sampling Strategies

Monitoring grain size of suspended sediments in rivers J. Bogen

Reliability and representativeness of a suspended sediment concentration monitoring programme for a remote alpine proglacial river A. M. Garnell, M. J. Clark, C. T. Hill & J. Greenhalgh

Monitoring sediment load from erosion events Bent Hasholt

The use of automatically collected point samples to estimate suspended sediment and associated trace element concentrations for determining annual mass transport A. J. Horowitz, K. A. Elrick, P. B. Von Guerard, N. O. Young, G. R. Buell & T. L. Miller

Calculating the suspended sediment load of the Dez River A. Jahani

Towards the design of a strategy for sampling suspended sediments in small headwater catchments R. C. Johnson

Temporal variability of suspended sediment flux from a subarctic glacial river, southern Iceland D. M. Lawler, M. Dolan, H. Tomasson & S. Zophoniasson

Stream suspended sediment transport monitoring – why, how and what is being measured? L. J. Olive & W. A. Reiger

Critical reflections on long term sediment monitoring programmes demonstrated on the Austrian Danube W. Summer, É. Klaghofer, I. Abi-Zeid & J. P. Villeneuve

A sampling strategy for an investigation on particle associated contaminants Wolfram Symader

Monitoring of suspended sediment concentration in discharge from regulated lakes in glacial deposits E. Tesaker & T. E. Dahl

Some sampling considerations in the design of effective strategies for monitoring sediment-associated transport D. E. Walling, B. W. Webb & J. C. Woodward

A comparison of methods used to measure suspended sediment in Canada’s federal monitoring programs T. R. Yuzyk, Wm. D. Gummer & L. M. Churchland
## 3 Monitoring Networks and Programmes

<table>
<thead>
<tr>
<th>Title</th>
<th>Author(s)</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erosion and sediment transport in South America. Monitoring programmes and strategies</td>
<td>G. Arduino</td>
<td>301</td>
</tr>
<tr>
<td>River morphology, sediments and fish habitats</td>
<td>Kevin Bellamy, John T. Beebe, Houston C. Saunderson &amp; Jack Imhof</td>
<td>309</td>
</tr>
<tr>
<td>Environmental studies in Western Europe using overbank sediment</td>
<td>J. Bogen, B. Bolviken &amp; R. T. Ottesen</td>
<td>317</td>
</tr>
<tr>
<td>Problems of monitoring erosion and sediment yields in southern Africa</td>
<td>Q. K. Chakela</td>
<td>327</td>
</tr>
<tr>
<td>Network evaluation and planning: Canada’s sediment monitoring program</td>
<td>T. J. Day</td>
<td>337</td>
</tr>
<tr>
<td>Planning sediment monitoring programs using a watershed model</td>
<td>W. T. Dickinson, R. P. Rudra, D. N. Sharma &amp; S. M. Ahmed</td>
<td>343</td>
</tr>
<tr>
<td>Refining a tributary monitoring program for the Great Lakes basin</td>
<td>I. G. Droppo, E. D. Ongley &amp; J. Marsalek</td>
<td>353</td>
</tr>
<tr>
<td>River reach characterization: a survey strategy for river regime and environmental monitoring and analysis</td>
<td>Henry R. Hudson</td>
<td>363</td>
</tr>
<tr>
<td>The design and operation of sediment transport measurement programmes in river basins: the Chinese experience</td>
<td>Long Yuqian</td>
<td>373</td>
</tr>
<tr>
<td>Environmental quality: changing times for sediment programs</td>
<td>E. D. Ongley</td>
<td>379</td>
</tr>
<tr>
<td>A sediment monitoring program for North America</td>
<td>W. R. Osterkamp, T. J. Day &amp; R. S. Parker</td>
<td>391</td>
</tr>
<tr>
<td>The Vigil Network — long-term monitoring to assess landscape changes</td>
<td>W. R. Osterkamp &amp; W. W. Emmett</td>
<td>397</td>
</tr>
<tr>
<td>Multipurpose studies of erosion and sedimentation in the Upper Ob basin</td>
<td>B. F. Snishchenko</td>
<td>405</td>
</tr>
<tr>
<td>The Swedish network of sediment transport</td>
<td>G. Wennerberg &amp; M. Brandt</td>
<td>413</td>
</tr>
</tbody>
</table>

## 4 Case Studies

<table>
<thead>
<tr>
<th>Title</th>
<th>Author(s)</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment delivery in large prairie river basins, western Canada</td>
<td>Peter Ashmore</td>
<td>423</td>
</tr>
<tr>
<td>Hydrological and sediment dynamics network design in a Mediterranean mountainous area subject to gully erosion</td>
<td>J. C. Balasch, X. Castelltort, P. Llorens &amp; F. Gallart</td>
<td>433</td>
</tr>
<tr>
<td>Assessment of catchment erosion in the southern Pennines, United Kingdom, using reservoir sedimentation monitoring</td>
<td>D. P. Butcher, J. C. Labadz, A. W. R. Potter &amp; P. White</td>
<td>443</td>
</tr>
</tbody>
</table>
Contents

Spatial and temporal variations in erosion and sediment yield
I. A. Campbell  
455

Assessment of the impact of farmland erosion on sediment quality: the
Saskatchewan River basin, western Canada M. A. Carson &
H. R. Hudson  
467

Suspended sediment dynamics of a riverine lake of the St. Lawrence
River, Canada D. H. De Boer & C. Lemieux  
473

A programme of monitoring sediment transport in north central Luzon,
the Philippines A. Dickinson & P. Bolton  
483

Channel erosion and erosion monitoring along the Rhine River
B. Dräge, H. Engel & E. Gölz  
493

Monitoring radionuclide and suspended-sediment transport in the Little
Colorado River basin, Arizona and New Mexico, USA
John R. Gray & Gregory G. Fisk  
505

Erosion and sediment transport in Papua New Guinea. Network design
and monitoring. Case study: Ok Tedi Coppermine A. Markham &
K. Repp  
517

The new sediment yield map for southern Africa A. Rooseboom &
H. H. Lotriet  
527