Preface

This book contains 28 papers that resulted from the IAHS Symposium entitled: *Erosion Prediction in Ungauged Basins (PUB): Integrating Methods and Techniques* The symposium was part of the XXIII General Assembly of the International Union of Geodesy and Geophysics, and took place 8–9 July 2003, in Sapporo, Japan. The objective of the two-day symposium was to review recent progress in the development of methods for predicting erosion in ungauged basins. In many parts of the world, erosion rates and sediment yields are not, or only poorly, monitored. This problem is particularly evident in developing countries, where this information is most urgently required. In addition, a lack of historical and current information in many basins prevents the evaluation and prediction of changes in process rates in the future.

The symposium was convened as a contribution to the Predictions in Ungauged Basins (PUB) initiative of IAHS. The goal of PUB is the prediction of flow, sediment and water quality variables at multiple scales. In PUB, prediction is not based on the availability of measured data. The absence of data precludes tuning or calibrating predictive models, and PUB hence requires the development of new predictive approaches based on a deep understanding of hydrological functioning at multiple space–time scales. The symposium brought together scientists from around the world, who have used different approaches to address the sediment-related aspects of the PUB problem.

During the symposium, the presenters described a wide variety of approaches to predicting erosion in ungauged basins. In this book, the papers are arranged into four sections that each emphasize a particular approach. The first two sections are comprised of papers that emphasize field studies. The first of these is entitled *Field-based Studies—Current Conditions*, and the three papers in this section focus on the estimation of current process rates. In the second section, *Field-based Studies—Historical Perspectives*, five papers describe studies aimed at evaluating erosion rates in the recent past to provide a long-term point of view.

From the papers in the first two sections of the book, the following general themes become apparent:

(a) Isotopes such as Cs-137 and Pb-210 can play an important role in the reconstruction of the erosional record, as they allow dating of sediment and, in the case of caesium, can be used to trace topsoil as it moves through the drainage basin.

(b) Reconnaissance studies using these tracers are a useful tool to establish preliminary sediment budgets in regions where sediment data are scarce or absent. If necessary, this approach can then be used to decide where more detailed monitoring will be most effective.

(c) Studying the sediment deposited in valleys and in reservoirs and lakes is an important tool for estimating sediment yields in areas where the monitoring network is sparse or absent, and for extending the process record to the past.

Combining such studies with contemporary process observations can be very effective for estimating how erosion rates and sediment yields have responded to changes in land use, climate, and other controlling factors.

(d) There is a need for techniques that can be used to determine the individual contributions of multiple sources to the sediment mix accumulated in reservoirs and lakes.

Many of the papers presented at the symposium featured models, ranging from regression models to physically-based, distributed models. The book's third section, *Empirical and Physically-Based Models*, contains eight papers that describe various models of erosion at a variety of scales, ranging from a single plot to part of a continent. The modelling approach is further expanded in the fourth section, *Integrating Models, GIS, and Remote Sensing*, which is comprised of twelve papers that address the use of GIS and remote sensing to parameterize erosional models at the drainage basin scale.

The following modelling-related themes emerge from these papers:

(a) The use of a GIS for processing spatial information on elevation, surface material characteristics, climate, vegetation, land-use and other variables data is a well-established approach when modelling erosion in large drainage basins.

(b) Dividing a drainage basin into sections that are homogeneous in terms of erosional response is an effective and practical method for handling the spatial variation in the controlling factors. Such homogeneous sections have been called "erosion response units" (ERUs, see Märker & Sidorchuk, *this volume*), and are analogous to the hydrological response units (HRUs) that are widely used in flood modelling. Much research, however, needs to be carried out to investigate topics such as the optimal size of ERUs in relation to the drainage area, and the impact of variability within the ERU on erosion rates and sediment yield.

(c) Global data sets such as GTOPO30 are a readily available source of the elevation data required for modelling sediment transport in the drainage basins of large rivers such as the Indus and the Yellow River.

(d) The Universal Soil Loss Equation (USLE), or variations thereof, is frequently used as the basis of models of erosion and sediment yield in drainage basins at a variety of scales, even though in essence the USLE is a plot-scale model developed for application in the United States of America. However, it must be emphasized that this is a case of misapplication rather than a fault inherent in the model.

(e) The previous issue highlights the need to develop innovative approaches and concepts for modelling erosion and sediment transport in drainage basins, especially in larger-scale basins where sediment storage within the valleys and the channel network, rather than erosion on the slope surfaces, becomes the dominant control of sediment transport. Thus, sediment routing and delivery ratios dominate the erosional response at the drainage basin scale.

(f) There is a need to devise methods to quantify the uncertainty of modelling results, which for sediment yields and erosion rates can be substantial because of uncertainties in the parameterization, and because of uncertainties in the erosional response of the basin.

One of the outcomes of the symposium is that it is clear that predicting sediment yields and erosion rates in ungauged basins is a problem that is much more difficult than predicting the flow of water. Considerable effort will be required to advance our understanding of how drainage basin characteristics and basin hydrology affect the supply and transport of sediment at the drainage basin scale. This effort will require the coordination of modelling and fieldwork in basins specifically selected for this purpose in the future.

Symposium HS01 was convened jointly by the IAHS International Commissions on Continental Erosion (ICCE), Remote Sensing (ICRS), and the other commissions. The editors would like to thank the authors for the high standard of their contributions, and the reviewers for their prompt and insightful comments. Finally, many thanks are due to Cate Gardner and Penny Farnell for their efforts in preparing the final version of this book.

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