BOOK REVIEW

Title: Regional Hydrological Response to Climate Change

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This book addresses the effects of global climate change, particularly global warming induced by greenhouse gas emissions, on hydrological budgets at the regional scale. As noted in its preface, the book consists peer-reviewed papers delivered at scientific meetings held by the International Geographical Union Working Group on Regional Hydrological Response to Climate Change and Global Warming, supplemented with some additional chapters that round out coverage of the topic. The editors hope that this book will serve as "not only a record of current achievements, but also a stimulus to further hydrological research as the detail and spatial resolution of Global Climate Models improves".

Three broad questions came naturally to mind when I first picked up this book. I'll structure my review around these questions.

1. *Is the state of the science advanced enough to merit documentation in book form?*

Our ability to predict regional climate change is, of course, extremely limited. General circulation model (GCM) simulations, while useful for understanding climate dynamics, the nature of ocean-atmosphere and land-atmosphere interaction, and general climate sensitivities, may be of little use in providing predictions of precipitation change at the regional scale, a critical need for the analysis of basin-scale hydrological response to a warmed climate. This is because the precipitation estimates generated in simulations of current climate and (presumably) an anthropogenically modified climate are often poor at this scale, due in large part to their dependence on simple parameterizations of complex atmospheric processes. The resulting estimate of precipitation change, a *difference* between two poorly estimated quantities, can thus be especially poor. Alternative approaches to predicting cli-

matic changes, such as the study of historical climate analogues, are limited by a paucity of relevant data and the perhaps unique signature imposed by humans on the climate system.

Put bluntly, the current state of the science does not allow accurate estimates of regional hydrological response to global warming. Most of the contributors to this book seem cognizant of this, though some nevertheless engage in extensive speculation based in part on GCM scenarios. Many employ a range of GCM-derived climate change scenarios to produce a plausible range of impacts on water resources in specific regions. Few of these papers, however, fully address the additional uncertainties associated with the hydrological models they use in conjuction with the GCM-derived forcing. Fewer still address the critical impact of precipitation variability on water resources, perhaps because GCM predictions of changes in variability are even more tenuous. All said, the uncertainty of regional prediction fundamentally limits the value of this book.

Several contributors correctly emphasize that the value of their work lies not so much in the listed quantitative predictions but in the demonstration of methodology, the idea being that this methodology will be available to take advantage of improved GCM predictions as they become available. One methodology discussed, for example, is the development of relationships between precipitation and large-scale climatic indices that GCMs may have better luck predicting. Though they do not represent a comprehensive survey of the literature, I did find many of the methodology discussions intriguing.

2. *For how long can the book's information be considered timely?*

This is also a critical issue. Judging from reference lists and other clues, many of the chapters were written a few years before the book was published. The years since have seen

a new IPCC report and significant advances in climate modeling, hydrological modeling, atmospheric model nesting, and data downscaling, and research into these topics is still continuing at a rapid pace. A good portion of the material discussed in the book is, as a result, dated.

Some of the material, however, remains timely. For example, in order to put potential climate change in context, several chapters provide overviews of regional climate (e.g., in China, Argentina, Ireland, and Japan) and its variability over the last several decades, overviews that remain valid and valuable today. Background material on issues related to regional climate change and the nature of prediction strategies is also still relevant. Nevertheless, before applying any of the book's results or methodology to their own studies, readers are strongly advised to examine the more recent literature first.

3. *Do the chapters, which are mostly contributed and thus generally reflect the authors' individual research projects, fit together into a cohesive whole, or does the book come across as a disjointed collection of papers?*

The editors have done much to tie all of the papers together. The papers are distributed into several sections ("Sensitivity of the Global Hydrosphere", "Regional Implications of Global Warming", "Precipitation Change and Variability", "Impacts on Snow, Ice, and Meltwaters", and "The Water Balance and Changing Regional Resources"), and each of these sections begins with summary pages that highlight important points from the papers therein. Introduction and conclusions sections try to arrange these points into a cohesive framework.

Still, a certain disjointedness does come across. The discussion of regional climate change

is not geographically comprehensive; several papers, for example, address climate variability and change in China, whereas coverage of other areas (e.g., Africa) is very limited. A few of the chapters in the later sections don't address climate change implications until the final paragraphs, and only in a way that seems forced, as if such mention were needed to justify the paper's appearance in the volume. The book's back cover implies that its component chapters show a "considerable unananimity" in general conclusions regarding climatic impact prediction. This is a bit misleading, since the conclusions listed at the end of the book are not obviously supported by many of the chapters, which, again, focus on individual research projects and often offer results with limited direct bearing on climate change and its impacts. While a book consisting of a multitude of contributed papers does have its advantages — most importantly, the reader can get a glimpse of a wide range of research into the subject matter, from a number of international authors — a single set of authors would perhaps have been more successful in weaving together a cohesive book with clearly supported general conclusions.

On a less important note, typographical errors in the book are common, a figure (11.4) is replaced by a duplicate of another, and two pieces of text are missing (pp. 378, 410). An errata page does provide one of those pieces.

To summarize: I found the background material on regional climatology to be valuable and the methodologies presented to be of interest. The value of the book is significantly diminished, however, by the dated nature of some of the material and by large uncertainties in the predictions of regional precipitation change. The book would have been improved by a much more extensive documentation of the uncertainty associated with each step of the

prediction process.

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