
Preface

Climate change has been emerging as one of the major challenges in the global scenario. Changes in climate may lead to adverse negative impacts on both natural and human systems. Continued emissions of greenhouse gases would further amplify the existing risks and create new complications for people and ecosystems. To analyze the possible impacts of climate change on a river basin, it is required to predict the future climate changes. This ultimately will help in planning and management of water resources in the basin. Effective decision-making to throttle climate change and its risks can be addressed by broad range of analytical and mathematical approaches by predicting the changes. General Circulation/Global Climate Models (GCMs) are one of the most credible tools presently available for modeling climate change. However, accuracy of GCMs, which generally run at coarse grid resolution, decreases with increasingly finer spatial and temporal scales, rendering them unable to represent sub-grid scale features. In other words, GCMs are not able to effectively model sub-grid scale processes which are of prime interest to hydrologists and water resources planners. Downscaling is one of the approaches where GCM outputs are interpolated to the scale of hydrological modeling or local scale requirement.

Over the years, various experts across the world have brought out a number of books on the above subject. Most of the books published so far are rather theoretically based with limited number of examples and case studies. The present book is an amalgamation of available resources and divided into various chapters and information about the chapters are as follows: Chap. 1 provides introduction to climate change and variability, climate feedback, forcing mechanism, atmospheric chemistry, palaeo records, monsoon variability, Holocene, IPCC scenarios, teleconnections, impact of climate change, and organization and utilization of the book. The chapter concludes with revision questions and exercise problems, advanced review questions, references, and suggested further reading. This sort of exercises is provided to all the chapters in the book with exception of Chap. 6 in which case studies are presented. Chapter 2 describes GCMs and their choice, performance indicators for evaluating GCMs, weight estimation, multicriterion decision-making techniques in deterministic and fuzzy scenario, Spearman rank correlation

coefficient, and group decision-making. Ensembling methodology of GCMs is also discussed. Chapter 3 describes downscaling techniques. Detailed discussion is presented on statistical downscaling techniques such as multiple regression, artificial neural networks, Statistical Downscaling Model (SDSM), change factor technique, and support vector machine. Brief discussion on nested bias correction is also made. Chapter 4 presents data compression techniques, namely, cluster and fuzzy cluster analysis, Kohonen neural networks, and principal component analysis. Trend detection techniques and optimization techniques, namely, linear and non-linear programming and genetic algorithms, are also discussed. Chapter 5 describes hydrological models, SWMM, HEC-HMS, SWAT, and other modeling techniques. Chapter 6 presents various real-world global case studies in AR3 and AR5 perspective that are related to the theories and techniques explained in the earlier chapters. Even though AR3 is relatively older than AR5, case studies are presented to understand the impact of climate change with temperature anomaly equivalent visualization paths, namely, SRES or RCPs.

Appendix A covers procedures for acquiring data from various sources. Appendices B and C provide representative list of journals and books related to climate. Index is also provided for efficient retrieval of topics.

PowerPoint presentations of selected topics are also provided as an additional study material. Interested individuals can contact publishers for PowerPoint presentations.

The present book can help undergraduate as well as postgraduate programs in the field of hydrology, climate change, and allied fields and can be referred as a text book. It can also be used as a reference book or as supplementary study material for researchers working in this upcoming field. The case studies, PowerPoint presentations, extensive references, limited but informative and illustrative problems, and software information render this book as a valuable source of information for researchers, experts, professionals, teachers, and others who are interested in the field of climate, hydrology, and allied fields.

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The concerned experts and researchers have generously given permission to utilize their study material. We have included in this book some portions of our own publications and publications of other researchers published in various journals (after obtaining copyright permissions) by giving due reference to the journals at the appropriate places. We sincerely thank the publishers of these journals such as Springer, Elsevier, IWA ASCE, Copernicus, De Gruyter, Inter-Research Science Center (Germany), and Prentice Hall of India for giving us specific permissions to reuse the material. Acknowledgements are also due to Dr. A. Anandhi, Dr. Sonali P., and Dr. T.V. Reshmi Devi, Prof. Ajit Pratap Singh, and Ms. Gayam Akshara for permitting us to utilize material from their works. Special Acknowledgements to Ms. V. Swathi for providing numerical problems in the chapter, hydrological modeling.

Even though efforts were made to quote all the sources in the form of acknowledgements or references, a few may have been missed inadvertently. We sincerely apologize for any such inconvenience caused and assure that these will be duly incorporated in the next edition on noticing the same.

Every effort is made to eliminate typographical calculation and methodological errors but still, some may have been left out. We request the readers to bring it to our notice to rectify them in the next edition. The software information provided does not necessarily indicate that the authors are encouraging to use only those particular software. Similar softwares may also be available which may perform as efficiently as those mentioned or even better. Critical suggestions are welcome for improvement of the contents.

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Komaragiri Srinivasa Raju
Dasika Nagesh Kumar

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Srinivasa Raju, K.; Nagesh Kumar, D.

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