Foreword

A student once asked me after a lecture on climate change impacts to hydrology, 'Sir, What is the problem with increasing temperatures due to global warming. Can't we buy a bigger air conditioner and get back to normal?' The student was correct—one can engineer the effect of temperature rise unless it gets out of hand. The bigger problem is that temperature rise comes with change in rainfall, its intermittency, its distribution in space and in time, and the nature of its extremes that cause floods on one end and droughts on the other. Any change in rainfall will require re-engineering the planet, something that may not even be possible if the change gets too big.

This book by Prof. Srinivasa Raju and Prof. Nagesh Kumar is, to my knowledge, one of the first text-cum-reference books to assess and redesign water resources systems due to our changing climate. It will fill a timely gap to knowledge, given climate change is no longer a topic of debate, but one which countries around the world are learning to adapt to. Part of this adaption requires assessing change to risk for existing water resources infrastructure, put in place to allow us to live in places where water is too much or too little. Part of this adaption is also finding ways of designing new infrastructure that will be needed to combat the new water scarcity or excess a warmer climate will bring. The book draws heavily on the excellent work reported in several PhDs supervized by the authors and their colleagues, along with the considerable literature that has been published on this topic worldwide. The book is meant for those familiar with the principles of water resources systems, their design, management and operation, and for those wishing to learn on how they should be redesigned to cope with the challenges ahead.

The book starts with an explanation of what causes warming, why it is anthropogenic, what changes occur, why they are significant and irrefutable, and what are the implications to hydrology and the design and operation of water resources systems. It then shifts to how one can model future change, the challenges this entails, how climate models should be selected and uncertainty quantified, and how this uncertainty may be reduced through clever combination strategies. Following this, a comprehensive assessment of downscaling approaches is presented, which is needed due to the coarse resolution of climate models. This is followed by chapters detailing the statistical techniques used in assessing model simulations, the hydrologic models needed to simulate changes in flow, and soil moisture from the changed rainfall and evapotranspiration conditions of the future, as well as a number of carefully selected case studies that articulate the range of problems the techniques presented can be used for.

I was especially pleased to see a set of questions at the end of each chapter, providing lecturers examples of questions that could be posed to students, giving an opportunity to assess for themselves what they have learnt and what remains. It is these questions that push students and the rest of us to devise solutions to what is turning out to be one of the biggest challenges humanity has faced till date. Many of these numerical questions enable better understanding of the theory clearly and systematically. While the climate has been changing since eternity, human-induced change is real and significant, with the bigger changes yet unseen and requiring careful assessment and planning. I feel this book is a step in the right direction, as it will provide the knowledge needed to re-engineer the planet and ensure our water resources systems continue to provide the security we have come to expect over the years.

My congratulations to both authors on this excellent accomplishment, and I hope this book forces its readers to ponder not only on the science behind climate change but also the engineering that is required to combat its effects on our way of life and existence.

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