

## Seeing the Forest for the Trees

For centuries, people have understood that forests, and our utilization of them, influence the climate. With modern environmental concerns, there is now scientific, governmental, and popular interest in planting trees for climate protection. This book examines the historical origins of the idea that forests influence climate, the bitter controversy that ended the science, and its modern rebirth. Spanning the 1500s to the present, it provides a broad perspective across the physical and biological sciences, as well as the humanities, to explain the many ways forests influence climate. It describes their use in climate-smart forestry and as a natural climate solution and demonstrates that in the forest–climate question, human and sylvan fates are linked. Accessibly written with minimal mathematics, it is ideal for students in environmental and related sciences, as well as for anyone with an interest in understanding the environmental workings of forests and their interactions with climate.

**Gordon Bonan** is senior scientist at the National Center for Atmospheric Research. He is the author of *Ecological Climatology* (Cambridge University Press, 2015), *Climate Change and Terrestrial Ecosystem Modeling* (Cambridge University Press, 2019), and numerous publications on terrestrial ecosystems and climate. He is a Fellow of the American Geophysical Union, the American Meteorological Society, and the Ecological Society of America.

‘Gordon Bonan is one of the world’s leading experts on the carbon, water and energy dynamics of forests, and their influence on the Earth system. In *Seeing the Forests for the Trees*, he combines that scientific expertise with a deep understanding of how forests have influenced art and literature, as well as patterns of human settlement and land use. Bonan’s understanding of the history of the forest-climate controversy (do forests affect climate, and for good or ill?) is encyclopedic, and in the first part of this book he tells the story in wonderful detail. This is followed by a clear and engaging description of how that controversy has been resolved through modern research, and an accessible telling of how forests actually function, from microclimates to the global carbon cycle. Case studies of climate sensitive regions and the potential for climate-smart forests bring the knowledge presented throughout the book to bear on important questions we face about conserving and managing these magnificent ecosystems.’

*John Aber, University Professor emeritus at the University of New Hampshire and author of Less Heat More Light: A Guided Tour of Weather, Climate and Climate Change*

‘This is the third book in Gordon Bonan’s exceptional series focussing on ecology and terrestrial ecosystems. It is the most accessible for a broader audience and will excite and intrigue readers from earth systems, ecology, environmental science and elsewhere. Even the expert will find a depth of history, and explanations of how our science fragmented and was renewed to become part of the solution to climate change.’

*Andy Pitman, University of New South Wales*

‘Another must have book by Professor Gordon Bonan! Bonan takes a thoughtful, detailed and novel approach from both a historical and interdisciplinary scientific lens to examine how forests influence climate. This book will appeal to a range of audiences from detailed practitioners within the field to an interested undergrad!’

*Christiane Runyan, Johns Hopkins University*

# Seeing the Forest for the Trees

## Forests, Climate Change, and Our Future

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**Gordon Bonan**

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To old friends not forgotten and new friends found

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## Preface

The origins of this book lie in two separate events; little did I know the profound influence they would have on my scientific journey. In 1997, I published a study of the effects of deforestation on the climate of the United States. Many other studies had examined the climate effects of tropical deforestation, but temperate forests, many of which had been cleared over the past several centuries, were largely unstudied. That paper opened up to me a vast literature of historical writings on forests and climate change. What I had thought was a novel analysis of the climate influences of forests was instead but another paper in a centuries-long topic of study. I am indebted to the many historians of science who have written on this subject. Their works provided access to the rich primary literature of a controversy forgotten by modern-day climate scientists, but which profoundly shaped our study of nature. I am indebted, too, to the many organizations that digitized and made accessible the trove of books, papers, and documents from long ago, and also to the interlibrary loan department at the National Center for Atmospheric Research for assistance in finding the more obscure works.

At the same time, I had begun to consider how to convey the interdisciplinary aspect of the science – part ecology, part atmospheric science. The second pivotal event, then, was the publication of *Ecological Climatology: Concepts and Applications* (1st ed., 2002). *Ecological Climatology* describes why terrestrial ecosystems are an essential component of climate science; explains the physical, chemical, and biological processes by which ecosystems affect climate; and discusses the commonality between climate science and ecology. A subsequent book, *Climate Change and Terrestrial Ecosystem Modeling* (2019), describes how to mathematically represent terrestrial ecosystems in numerical models of climate. Both books are rich in complexity and nuances and both delve deeply into the details of the science and the models.

*Seeing the Forest for the Trees: Forests, Climate Change, and Our Future* is a companion to those two works. Matt Lloyd at Cambridge University Press, who has supported my books over the years and shepherded them into production, and I had been discussing for some time the need for a primer to complement the other books. *Seeing the Forest for the Trees* is that primer, told in the context of forests and climate. In this, I am indebted also to Sarah Lambert of Cambridge University Press for her patience with the project. *Seeing the Forest for the Trees* combines the historical controversy over forests and climate change, spanning several centuries of debate, with our modern understanding of climate science. There is growing scientific and public interest in the use of forests to mitigate anthropogenic climate change – a nature-based solution to solve a human-made problem. The notion of preserving forests or planting trees to improve climate is not new. It is an age-old idea, reborn with new concern about climate change. The subject brings together concepts of climate science, ecology, human impacts on climate, and more broadly our relationship with forests. There is also a need to consider forests beyond the lens of science; to consider them not just as a public utility that provides climate services but also from a humanities vantage point. The rationalism of science must be balanced with the romanticism of forests. This book tells the story of forests and climate change from multiple points of view, interwoven with

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central tenets of forest ecology and climate science and with an understanding of past controversies. Complexity is reduced and the science is distilled down to its essence so that the larger message of forest influences on climate emerges while also broadening our perception of forests and the natural world. The book allows us to see the forest for the trees.