

Global Warming

The Complete Briefing | Fifth Edition

Praise for the Fifth Edition:

‘Still the best undergraduate textbook on climate change. I will definitely be using it on my course.’

Professor Eric M. Kramer, Bard College at Simon’s Rock

‘If you’re looking for an authoritative, comprehensive – and yet highly accessible – treatment of climate change science, impacts, and solutions, look no further than Sir John Houghton’s *Global Warming*. The former co-chair of the Nobel Peace Prize-winning Intergovernmental Panel on Climate Change brings the problem down to Earth, making it both understandable and engaging. As a man of both faith and science, Sir John makes a compelling case that we must act now if we are to preserve Earth’s habitability for future generations.’

Michael Mann,

Distinguished Professor, Pennsylvania State University;
author of *The Hockey Stick and the Climate Wars*

‘... a very important update of a major text, marked particularly by the inclusion of data and illustrations based on the newest IPCC resources. For anyone who needs clear, detailed, well-evidenced information about global warming, this is an outstandingly useful book.’

Dr Peter G. Knight, Head of Geography Programmes, Keele University

‘... an excellent basis for students and non-scientists to understand climate change with its manifold impacts and consequences for humankind and for our common planet. The 5th edition has been updated with important findings of the IPCC’s Fifth Assessment Report and can thus be highly recommended as an up-to-date reference work.’

Professor Ottmar Edenhofer,

Chief Economist of Potsdam Institute for Climate Impact Research;
Co-Chair of Working Group III of the Intergovernmental Panel on Climate Change

‘Like its previous editions, Sir John Houghton has provided an excellent and concise summary of the state of knowledge of global warming at an approachable level of technical detail. I would use this book in either my undergraduate general education course on global warming and society or the graduate survey course on global climate change.’

Dr James L. Kinter, George Mason University

‘The latest edition of Houghton’s *Global Warming: The Complete Briefing* provides a comprehensive, accessible overview of what is surely one of the defining challenges of the 21st century. Houghton’s readable text is grounded in the most definitive science available, but many of the passages speak to the human face of climate change.’

When Houghton discusses the need for action, we can all see the eyes of our children and grandchildren through his prose.'

Professor Christopher Field, Carnegie Institution for Science;
 Co-Chair of Working Group II of the Intergovernmental Panel on Climate Change

'The fifth edition builds on the successful fourth edition. The text starts with an accessible introduction to the scientific processes that control our planet's climate, and builds towards developing technical and political solutions to anthropogenic climate change. Throughout, appealing graphics and visuals keep the reader engaged. ... the section on 'Some global economics' (Chapter 9) is, of all the climate change texts I have used, the best introduction for students to the question of whether mitigation or adaptation is likely to be more expensive in the future.'

Professor Jeffrey A. Cunningham, University of South Florida

From reviews of previous editions

'It is difficult to imagine how Houghton's exposition of this complex body of information might be substantially improved upon ... Seldom has such a complex topic been presented with such remarkable simplicity, directness and crystalline clarity ... Houghton's complete briefing is without doubt the best briefing the concerned citizen could hope to find within the pages of a pocketable book.'

John Perry, *Bulletin of the American Meteorological Society*

'I can recommend [this book] to anyone who wants to get a better perspective on the topic of global warming ... a very readable and comprehensive guide to the changes that are occurring now, and could occur in the future, as a result of human action ... brings the global warming debate right up to date ... Read Houghton's book if you really want to understand both the scientific and political issues involved.'

William Harston, *The Independent*

'... precise account of the science, accompanied by figures, graphs, boxes on specific points, and summaries at the end of each chapter, with questions for students ... ranges beyond the science into the diplomacy, politics, economics and ethics of the problem, which together present a formidable challenge to human understanding and capacity for action.'

Sir Crispin Tickell, *The Times Higher Education Supplement*

'... a widely praised book on global warming and its consequences.'

The Economist

'... very thorough and presents a balanced, impartial picture.'

Jonathan Shanklin, *Journal of the British Astronomical Association*

'I would thoroughly recommend this book to anyone concerned about global warming. It provides an excellent essentially non-technical guide on scientific and political aspects of the subject. It is an essential briefing for students and science teachers.'

Tony Waters, *The Observatory*

‘For the non-technical reader, the best program guide to the political and scientific debate is John Houghton’s book *Global Warming: The Complete Briefing*. With this book in hand you are ready to make sense of the debate and reach your own conclusions.’

Alan Hecht, *Climate Change*

‘This is a remarkable book . . . It is a model of clear exposition and comprehensible writing . . . Quite apart from its value as a background reader for science teachers and students, it would make a splendid basis for a college general course.’

Andrew Bishop, Association for Science Education

‘This very readable and informative book is valuable for anyone wanting a broad overview of what we know about climate change, its potential impacts on society and the natural world, and what could be done to mitigate or adapt to global warming. To this end, discussion questions are included at the end of each chapter. The paperback edition is an especially good value . . . Houghton’s compact book is an accessible, well-researched, and broadly based introduction to the immensely complicated global warming problem.’

Professor Dennis L. Hartmann,
Department of Atmospheric Sciences, University of Washington

‘. . . a useful book for students and laymen to understand some of the complexities of the global warming issue. Questions and essay topics at the end of each chapter provide useful follow-up work and the range of material provided under one cover is impressive. At a student-friendly price, this is a book to buy for yourself and not rely on the library copy.’

Allen Perry, *Holocene*

‘This book is one of the best I have encountered, that deal with climate change and some of its anthropogenic causes. Well written, well organised, richly illustrated and referenced, it should be required reading for anybody concerned with the fate of our planet.’

Elmar R. Reiter, *Meteorology and Atmospheric Physics*

‘Sir John Houghton is one of the few people who can legitimately use the phrase ‘the complete briefing’ as a subtitle for a book on global warming . . . Sir John has done us all a great favour in presenting such a wealth of material so clearly and accessibly and in drawing attention to the ethical underpinnings of our interpretation of this area of environmental science.’

Progress in Physical Geography

‘. . . this complete briefing on global warming is remarkably factual and inclusive. Houghton’s concern about planet Earth and its people blends well with his hopes for global cooperation in concert with the spirit of the Intergovernmental Panel on Climate Change.’

Choice

‘. . . this book is the most comprehensive guide available. Ignore it at your peril.’

The Canadian Field-Naturalist

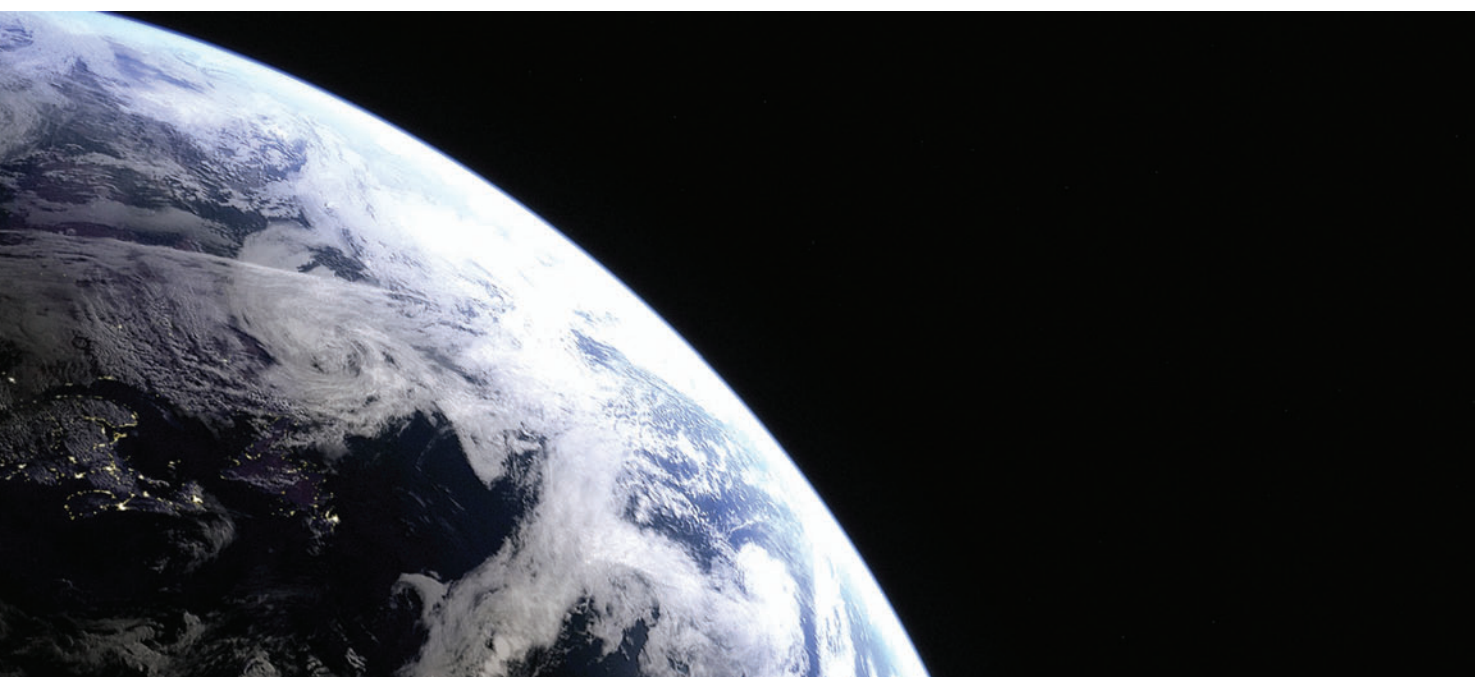
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To my grandchildren,
Daniel, Hannah, Esther, Max,
Jonathan, Jemima and Sam
and their generation

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Preface

Global Warming is a topic that increasingly occupies the attention of the world. Is it really happening? If so, how much of it is due to human activities? How far will it be possible to adapt to changes of climate? What action to combat it can or should we take? How much will it cost? Or is it already too late for useful action? This book sets out to provide answers to all these questions by providing the best and latest information available.

I was privileged to chair or co-chair the Scientific Assessments for the Intergovernmental Panel on Climate Change (IPCC) from its inception in 1988 until 2002. During this period the IPCC published three major comprehensive reports – in 1990, 1995 and 2001 – that have influenced and informed those involved in climate change research and those concerned with the impacts of climate change. In 2007, a fourth assessment report was produced, and in 2014 the fifth assessment report was published. It is the extensive new material in this latest report that has provided the basis for the substantial revision necessary to update this fifth edition.

The IPCC reports have been widely recognised as the most authoritative and comprehensive assessments on a complex scientific subject ever produced by the world's scientific community. On the completion of the first assessment in 1990, I was asked to present it to Prime Minister Margaret Thatcher's cabinet – the first time an overhead projector had been used in the Cabinet Room in Number 10 Downing Street. In 2005, the work of the IPCC was cited in a joint statement urging action on climate change presented to the G8 meeting in that year by the Academies of Science of all G8 countries plus China, India and Brazil. The world's top scientists could not have provided stronger approval of the IPCC's work. An even wider endorsement came in 2007 when the IPCC was awarded a Nobel Peace Prize.

Many books have been published on global warming. My choice of material has been much influenced by the many lectures I have given in recent years to professional, student and general audiences.

The strengths of this book are that it is:

- **up-to-date with the latest reliable, accurate and understandable information** about all aspects of the global warming problem for students, professionals and interested or concerned citizens.
- **accessible** to both scientists and non-scientists. Although there are many numbers in the book – I believe quantification to be essential – there are no mathematical equations. Some important technical material is included in boxes.
- **comprehensive**, as it moves through the basic science of global warming, impacts on human communities and ecosystems, economic, technological and ethical considerations and policy options for action both national and international.

- appropriate as a **general text for students**, from high-school level up to university graduate. Questions and problems for students to consider and to test their understanding of the material are included in each chapter.
- Its **simple and effective visual presentation of the vast quantities of data** available on climate change ensures that readers can see how conclusions are made, without being overwhelmed. Illustrations are available online.

Over the 25 years since the inception of the IPCC, our understanding of climate change has much increased and significant changes in climate due to human activities have been experienced. Further, studies of the feedbacks that determine the climate response have shown an increasing likelihood of enhanced response, so leading over these years to greater concern about the future impact of climate change on both human populations and ecosystems. Can much be done to alleviate the impact or mitigate future climate change? Later chapters of the book address this question and demonstrate that the technology is largely available to support urgent and affordable action. They also point to the many other benefits that will accrue to all sectors of society as the necessary action is taken. However, what seems lacking as yet is the will to take that action with sufficient urgency and commitment.

As I complete this revised edition I want to express my gratitude, first to those who inspired me and helped with the preparation of the earlier editions, with many of whom I was also involved in the work of the IPCC or of the Hadley Centre. I also acknowledge those who have assisted with the material for this edition or who have read and helpfully commented on my drafts, in particular, Averil Macdonald, Myles Allen, Kathy Maskell, Stephen Belcher, Jason Lowe, David Parker, Peter Stott, Rachel McCarthy, Fraser Lott, Michael Sanderson, Nicola Golding, Fiona O'Connor, Fiona Carroll, Richard Betts, Philip Bett, Mick Carter, Ben Booth, and Sue Whitehouse. My thanks are also due to Catherine Flack, Matt Lloyd, Anna-Marie Lovett and Jo Endell-Cooper of Cambridge University Press for their competence and courtesy as they steered the book through its gestation and production.

Finally, I owe an especial debt to my wife, Sheila, who gave me strong encouragement to write the book in the first place, and who has continued her encouragement and support through the long hours of its production.