CLIMATE CHANGE
A Multidisciplinary Approach

*Climate Change: A Multidisciplinary Approach* provides a concise, up-to-date presentation of our current knowledge of climate change and its implications for society.

The book begins by giving a balanced coverage of the physical principles of the global climate, its behaviour on all timescales, and the evidence for and consequences of past change. It then reviews how we measure climate change and the statistical methods for analysing data, before exploring the causes of climate change and how we can model this behaviour. The final sections discuss predictions of future climate change and the economic and political debate surrounding its prevention and mitigation. This comprehensive approach allows a better understanding of the significance of current changes in the context of climate change in the earth’s past, and allows us to assess claims and counterclaims concerning the importance of these changes to human society.

*Climate Change: A Multidisciplinary Approach* is a valuable undergraduate textbook for a wide range of courses which need to consider the impact of a changing climate on the earth and its inhabitants. These subjects include meteorology, oceanography, environmental science, earth science, geography, history, agriculture and social science. It will also appeal to a wider general audience of readers who wish to go beyond the standard ‘coffee table’ book in search of a better understanding of climate change.

After seven years at the UK National Physical Laboratory researching atmospheric physics, Bill Burroughs spent three years as a UK Scientific Attaché in Washington D.C. Between 1974 and 1995, he held a series of senior posts in the UK Departments of Energy and then Health. He is now a professional science writer and has published seven books on various aspects of weather and climate (two as a co-author), and also three books for children on lasers. These books include *Watching the World’s Weather* (1991), *Weather Cycles* (1992), *Does the Weather Really Matter?* (1997) and *The Climate Revealed* (1999), all with Cambridge University Press. He has also written widely on the weather and climate in newspapers and popular magazines.
Climate Change

A MULTIDISCIPLINARY APPROACH

WILLIAM JAMES BURROUGHS
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We are all inclined to take the climate for granted. We are basically acclimatised to the seasonal cycle and most of the variations that occur from day to day and week to week. It is all too easy to forget just how much of this comfort depends on the fact that our buildings, food and energy supplies, health and transport systems and leisure activities are carefully designed to meet the challenges of the local climate. But, when extreme events occur, it becomes acutely apparent how vulnerable much of the infrastructure of society is to climatic fluctuations. Droughts, floods, heatwaves and windstorms (including hurricanes and tornadoes) can all have disastrous consequences.

This sense of independence is often sometimes compounded by our travels. If we jet around the world staying in air-conditioned hotels or indulging in well-equipped holiday facilities, again we can fall into the trap of assuming that we are relatively independent of the weather. If, however, we are stripped of our protective shell and forced to confront the extremes of the tropics, deserts, high mountains and polar wastes, we can become painfully aware of just how forbidding the challenges of many climatic zones are. What is more, for many of the people living in the developing world, where extreme weather events have become a mounting threat to their way of life, these challenges are of vital concern. So, on an increasingly crowded planet it is hardly surprising that the subject of climate change has become a hot topic.

What is surprising is that this interest in climate change is a relatively recent phenomenon. There are two principal reasons for this development. First, it was not until the work of a few dedicated researchers such as Hubert Lamb in England and J. Murray Mitchell in the USA, in the 1950s and 1960s, that the reality of recent climate change became an accepted scientific concept. This type of scholarly work set standards in the examination of various records to establish reliable evidence of climate change. It was also aided by the appreciation that not only was there a lot of information in both
instrumental records and documentary sources, but also in the many other examples of environmental change, including tree rings, ice cores, pollen records and ocean sediments. The use of many of these sources depended in part on the emergence of new technologies that improved the quality of measurements and, hence, enabled more reliable inferences to be drawn about the past.

The second reason for increased interest has been the growing realisation in the last few decades that recent climate change may well be at least partly the result of human activities. If this is indeed the case, it has major implications for economic and social development. This awareness has grown on the back of a greater understanding of the mechanisms driving natural climate fluctuations. It is a measure of these developments that Hubert Lamb’s major two-volume work *Climate: Present, Past and Future*, published in the 1970s, contains very little mention of the El Niño and the Southern Oscillation (ENSO); it was not until the record-breaking event in 1982/3 that the true significance of this natural variation in the climate became apparent. Now it is seen as central to many aspects of interannual climate variability around the world.

The other essential component of climate studies has been the explosive growth of computer technology. This has led to many advances, of which perhaps the most important is the development of computer models that are capable of simulating many features of the global climate. The power of these models is such that it is now possible to explore various aspects of climate change that may result from natural causes, or as a result of human activities. What is more, in recent years a growing confidence has emerged that we may now be capable of predicting just what future changes may occur if human activities continue unabated. These predictions paint a worrying picture of our vulnerability to future changes.

This combination of the growing importance of climate change in our lives and our increasing ability to both unravel past variations and predict future developments make this an ideal time to take stock of all aspects of the subject. This is best done by exploring the subject in the round. It requires us to examine a whole range of disciplines. It starts with what the science of meteorology tells us about the climate of the Earth, and leads into the evidence of past changes and their consequences. It needs to assess the reliability of various measurement sciences and how they tease out the subtle details of changes on every timescale – from the recent past to the depths of geological time – and how statistics are used to extract the maximum amount of useful information from records. Armed with these insights it is possible to study the implications of these changes in history, economics, agriculture and other social and political areas, and to consider how predictions of future changes may impact on society.

Add to all this the intricate detective work that weaves together all the clues as to how and why the climate changes to form a coherent picture, and you have the ingredients for an intriguing story. Moreover, when it comes to
assessing the impact of changes, from mass extinctions (e.g. the Death of the Dinosaurs) to the part played by human activities in global warming, the plot thickens. So, only by looking at all aspects of climate change can we form a balanced judgement about the relevance to widely debated contemporary environmental, economic and social issues. My objective in this book is to help you, the reader, to come to this balanced judgement.

William J. Burroughs
ACKNOWLEDGEMENTS

As this book draws on lengthy personal involvement in climate matters, it is difficult to identify all the people who have helped me to form a view on the many facets of climate, how it has changed and its impact on all our lives. Among the meteorological community I would like to thank: Chris Pollard, David Parker, Tony Slingo, John Mitchell, Bruce Callendar, David Griggs, Jack Hopkins and Alan Thorpe at the UK Meteorological Office; David Anderson, Tim Palmer, Tony Hollingsworth, Peter Jannsen, Anders Peerson and Austen Woods, at the European Center for Medium Range Weather Forecasting; Grant Bigg, Keith Briffa, Tom Holt, Mike Hulme and Phil Jones at the University of East Anglia; David Cotton at the University of Southampton; John Harries and Joanna Haigh at Imperial College; David Blackman at the Proudman Oceanographic Laboratory; Chris Mutlow at the Rutherford Appleton Laboratory; Niel Lonie at the University of Dundee; Dominic Reeve at Sir William Halcrow and Partners Ltd; Christopher Landsea at NOAA Hurricane Research Division, Miami; David Robinson at Rutgers University; Tom Karl at NOAA Climate Data Center; John Christy at the University of Alabama; and Jan Lindstrom at the University of Helsinki. Thanks are also due to Franz Fliri and Norman Lynagh for helpful discussions, and the provision of data and other material, which in one way or another was essential for completion of the book. In addition, I am grateful to Richard Alley, Roger Barry, Per Gloersen, Michael Hambrey, Michael Mann, Martin Parry, Julia Slingo, Jon Snow, and Kevin Trenberth for helpful advice on climate matters.

I also wish to acknowledge the importance of two vital sources of information and inspiration for producing this book. First, there is the groundbreaking work of the late Hubert Lamb, and in particular his major two-volume opus Climatic: Present, Past and Future, which was published in the 1970s and provides an ideal guide of what any book on climate change should address. Secondly, there is the work of the Intergovernmental Panel on Climate Change (IPCC), which has, since its establishment in 1988,
ACKNOWLEDGEMENTS

produced a series of publications that represent a massive resource and by far the most comprehensive assessment of climate issues available at present. It is no accident that this book relies so heavily on this source for so many of its illustrations. Finally, I am deeply indebted to my wife, who, as always, helped and supported me throughout the lengthy gestation of this book.
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