CLIMATE CHANGE 2001: THE SCIENTIFIC BASIS

Climate Change 2001: The Scientific Basis is the most comprehensive and up-to-date scientific assessment of past, present and future climate change. The report:

- · Analyses an enormous body of observations of all parts of the climate system.
- Catalogues increasing concentrations of atmospheric greenhouse gases.
- Assesses our understanding of the processes and feedbacks which govern the climate system.
- Projects scenarios of future climate change using a wide range of models of future emissions of greenhouse gases and aerosols.
- Makes a detailed study of whether a human influence on climate can be identified.
- Suggests gaps in information and understanding that remain in our knowledge of climate change and how these might be addressed.

Simply put, this latest assessment of the IPCC will again form the standard scientific reference for all those concerned with climate change and its consequences, including students and researchers in environmental science, meteorology, climatology, biology, ecology and atmospheric chemistry, and policymakers in governments and industry worldwide.

J.T. Houghton is Co-Chair of Working Group I, IPCC.

Y. Ding is Co-Chair of Working Group I, IPCC.

- M. Noguer is the Deputy Head of the Technical Support Unit, Working Group I, IPCC.
- P.J. van der Linden is the Project Administrator, Technical Support Unit, Working Group I, IPCC.
- X. Dai is a Visiting Scientist, Technical Support Unit, Working Group I, IPCC.
- K. Maskell is a Climate Scientist, Technical Support Unit, Working Group I, IPCC.
- C.A. Johnson is a Climate Scientist, Technical Support Unit, Working Group I, IPCC.

D.J. Griggs is the Head of the Technical Support Unit, Working Group I, IPCC.

Climate Change 2001: The Scientific Basis

Edited by

J.T. Houghton

Y. Ding Co-Chair of Working Group I, IPCC

Co-Chair of Working Group I, IPCC

M. Noguer

Deputy Head of Technical Support Unit, Working Group I, IPCC Project Administrator, Technical Support Unit, Working Group I, IPCC

P.J. van der Linden

D.J. Griggs

Head of Technical Support Unit, Working Group I, IPCC

X. Dai

Visiting Scientist, Technical Support Unit, Working Group I, IPCC

K. Maskell

Climate Scientist, Technical Support Unit, Working Group I, IPCC

C.A. Johnson

Climate Scientist, Technical Support Unit, Working Group I, IPCC

Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change

Published for the Intergovernmental Panel on Climate Change



PUBLISHED BY THE PRESS SYNDICATE OF THE UNIVERSITY OF CAMBRIDGE The Pitt Building, Trumpington Street, Cambridge, United Kingdom

CAMBRIDGE UNIVERSITY PRESS The Edinburgh Building, Cambridge CB2 2RU, UK 40 West 20th Street, New York, NY 10011–4211, USA 10 Stamford Road, Oakleigh, Melbourne 3166, Australia Ruiz de Alarcón 13, 28014 Madrid, Spain Dock House, The Waterfront, Cape Town 8001, South Africa

http://www.cambridge.org

© Intergovernmental Panel on Climate Change 2001

This book is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of the Intergovernmental Panel on Climate Change.

First published 2001

Printed in USA at the University Press, New York

A catalogue record for this book is available from the British Library

Library of Congress cataloguing in publication data available

ISBN 0521 80767 0 hardback ISBN 0521 01495 6 paperback

When citing chapters or the Technical Summary from this report, please use the authors in the order given on the chapter frontpage, for example, Chapter 2 is referenced as:

Folland, C.K., T.R. Karl, J.R. Christy, R.A. Clarke, G.V. Gruza, J. Jouzel, M.E. Mann, J. Oerlemans, M.J. Salinger and S.-W. Wang, 2001: Observed Climate Variability and Change. In: *Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change* [Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 881pp.

Reference to the whole report is:

IPCC, 2001: *Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change* [Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 881pp.

Cover photo © Science Photo Library

Contents

Foreword			vii
Preface			ix
Summary for Policymakers			1
Technical Summary			21
1	The Clima	te System: an Overview	85
2	Observed (Climate Variability and Change	99
3	The Carbon Cycle and Atmospheric Carbon Dioxide		183
4	Atmospheric Chemistry and Greenhouse Gases		239
5	Aerosols, their Direct and Indirect Effects		289
6	Radiative Forcing of Climate Change		349
7	Physical Climate Processes and Feedbacks		417
8	Model Evaluation		471
9	Projections of Future Climate Change		525
10	Regional C	Climate Information – Evaluation and Projections	583
11	Changes in Sea Level		639
12	Detection of Climate Change and Attribution of Causes		695
13	Climate Scenario Development		739
14	Advancing	Our Understanding	769
Ap	pendix I	Glossary	787
Ap	pendix II	SRES Tables	799
Ap	pendix III	Contributors to the IPCC WGI Third Assessment Report	827
Ap	pendix IV	Reviewers of the IPCC WGI Third Assessment Report	845
Appendix V		Acronyms and Abbreviations	861
Appendix VI		Units	869
Ap	pendix VII	Some Chemical Symbols used in this Report	871
Ap	pendix VIII	Index	873