

This is the final Report of Working Group II of the Intergovernmental Panel on Climate Change, which is sponsored jointly by the World Meteorological Organization and the United Nations Environment Programme. The report considers the potential impacts of climate change. Several hundred working scientists from many countries have participated in the preparation and review of the scientific data. The result is a unique statement on impacts of climate change with a breadth not previously achieved by the international scientific community. The impact assessments cover: agriculture and forestry, natural terrestrial ecosystems, hydrology and water resources, human settlement and socio-economic activities, oceans and coastal zones and the cryosphere. The information presented here is the best available at present. It will inform the necessary scientific, political and economic debates and negotiations that can be expected in the immediate future. Appropriate strategies in response to the issue of climate change can be based on the scientific foundation that the Report provides. The Report is, therefore, an essential reference for all who are concerned with climate change and its consequences.

Climate Change

The IPCC Impacts Assessment

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Edited by

W.J. McG. Tegart, G.W. Sheldon and D.C. Griffiths

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Report prepared for IPCC by Working Group II

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Acknowledgments

This report is a unique example of international cooperation over a wide range of disciplines in a relatively short time frame. While literally hundreds of scientists in a large number of countries have contributed information and peer-reviewed the material, the major task has fallen on the principal authors of the various chapters. The authors are identified at the start of each chapter.

The compilation and editing of the overall report has been carried out by Mr C. Griffiths, Mr G.W. Sheldon and Dr WJ.McG. Tegart from Australia.

We believe that the process of working together to gain a better understanding of the potential of global climate change on regions and nations has been important in building a basis for continuing international cooperation and we wish to offer our sincere thanks to all who have participated.

Professor Yu. A. Izrael (USSR) Chairman

Dr M. Hashimoto (Japan) Co-Vice-Chairman

Dr WJ.McG. Tegart (Australia) Co-Vice-Chairman

Foreword

In making its Impacts Assessment, Working Group II has built on the available country assessments, taking into account significant work undertaken more recently. By its very nature, such work is distributed over many fields. There are many uncertainties in them, and some results have yet to be published. While some countries have produced assessments of the impact of climate change on their economic, industrial and social structure, there has not been a comprehensive assessment on a global scale.

In the preparation of the Assessment, many of the active scientists working in the industrialised countries have been involved. Because of lack of sufficient funding, the contribution from the developing countries has been less than hoped for, and it is clear that much further work needs to be carried out to develop a better framework for economic decisions in a number of countries, notably in Africa and South America. Over 200 contributors are identified in the report, but they have been supported by many others. Because of the diversity of the topics, it has been difficult to carry out a full peer review of the whole report. Chapters have been reviewed by selected organisations, both national and international, and five meetings of lead authors and major contributors, over a period of one and a half years, have helped to shape the final report. An extensive technical review was carried out by the US National Climate Program in early 1990 and helped to ensure a high degree of consensus among authors and reviewers regarding the results presented. Joint Soviet American research in the area of climate change provided a significant input. Thus the Assessment is an authoritative statement of the views of the majority of the international scientific community at this time.

The accompanying Policymakers' Summary, based closely on the conclusions of the Assessment, has been prepared particularly to meet the needs of those without a strong background in science who need a clear statement of the present status of scientific knowledge and the associated uncertainties. It is clear from the report that comprehensive estimates of the physical and biological effects of climate change at the regional level are difficult. Confidence in regional estimates of critical climate factors is low, particularly of precipitation and soil moisture. Much more research is needed to refine the estimates of potential impacts and I urge Governments to continue and increase their support of research on climate change.

It gives me pleasure to acknowledge the contributions of so many, in particular the lead authors, who have given freely of their expertise and time in the preparation of this report. I also acknowledge the contribution of the core team at the State Committee for Hydrometeorology who were responsible for organising meetings in the USSR. Particular acknowledgement is due to Dr Greg Tegart, my Co-Vice Chairman from Australia, who together with Mr Colin Griffiths and Mr Gordon Sheldon were responsible for the compilation and editing of the overall report in Australia. Thanks are also due to Dr M Hashimoto, my other Co-Vice-Chairman from Japan.

I am confident that the assessment and its summary will provide a sound basis for the forthcoming discussions and negotiations on the appropriate strategy and action regarding the issue of climate change which is potentially the greatest global environmental challenge facing humankind.

**Prof Yu A Izrael
Chairman, IPCC Working Group II
Chairman, USSR State Committee for Hydrometeorology
Moscow
October 1990**

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Preface

The Intergovernmental Panel on Climate Change (IPCC) was jointly established by us in 1988. Professor Bert Bolin is the Chairman of the Panel. The Panel's charge was to:

- a. assess the scientific information that is related to the various components of the climate change issue, such as emissions of major greenhouse gases and modification of the Earth's radiation balance resulting therefrom, and that needed to enable the environmental and socio-economic consequences of climate change to be evaluated; and
- b. formulate realistic response strategies for the management of the climate change issue.

The Panel began its task by establishing its Working Groups I, II and III respectively to:

- a. assess available scientific information on climate change;
- b. assess environmental and socio-economic impacts of climate change; and
- c. formulate response strategies.

The panel also established a Special Committee on the Participation of Developing Countries to promote, as quickly as possible, the full participation of developing countries in its activities.

The Panel has completed its First Assessment Report (FAR). The FAR consists of

- * the overview
- * the policymakers summaries of the IPCC Working Groups and Special Committee on the participation of Developing Countries
- * the reports of the IPCC Working Groups

The Overview and the policymakers summaries are to be found in a single volume. The reports of the Working Groups are being published individually.

The present volume is based upon the findings of Working Group II. It should be read in the context of the full IPCC first assessment report.

The Chairman of Working Group II, Professor Yuri Izrael, and his Secretariat, have succeeded in mobilising the co-operation and enthusiasm of hundreds of scientists from all over the world. They have produced a volume of unique breadth, and a Policymakers Summary which translates these complex scientific issues into language understandable to the non-specialist.

We take this opportunity to congratulate and thank the Chairman and his Co-Vice-Chairmen, Dr W J McG Tegart and Dr M Hashimoto, for a job well done.

G O P Obasi
Secretary-General
World Meteorological Organization

M K Tolba
Executive Director
United Nations Environment Programme

