



WMO

INTERGOVERNMENTAL PANEL  
ON CLIMATE CHANGE  
(IPCC)



UNEP

**CLIMATE CHANGE AND INTEGRATED ASSESSMENT  
MODELS [IAMs] - BRIDGING THE GAPS**

**Proceedings of the IPCC Asia-Pacific Workshop on Integrated Assessment Models**

United Nations University, Tokyo, Japan, March 10-12, 1997

*This workshop was agreed in advance as part of the IPCC workplan, but this does not imply working group or panel endorsement or approval of the proceedings or any recommendations or conclusions contained herein.*

Supporting material prepared for consideration by the Intergovernmental Panel on Climate Change.  
This supporting material has not been subjected to any formal IPCC review process.

**Climate Change and Integrated Assessment Models [IAMs]  
- Bridging the Gaps**

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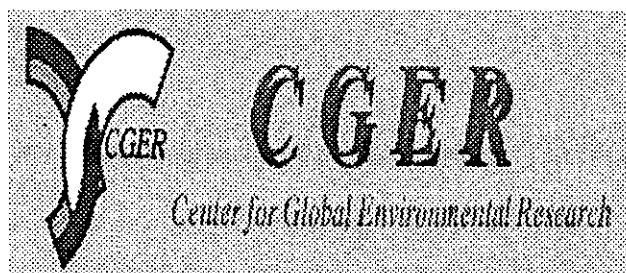
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**INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE**  
World Meteorological Organisation / United Nations Environment Programme



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## Acknowledgments

The successful organisation of the IPCC Asia-Pacific Workshop on Integrated Assessment Models, and the proceedings document resulting from discussion at the Workshop, has been due to the efforts and support of a large number of individuals and organisations. In my capacity as chairman of the Programme and Editorial Committee, it has been very clear how invaluable this support has been towards meeting the objectives of the Workshop. I would therefore like to take this opportunity to express acknowledgment and gratitude for this support, on behalf of everyone involved in both the Workshop, and the production of the proceedings document.

Firstly, the leadership and organisational efficiency exhibited by all the members of the International Organising Committee must be recognised. In particular, the efforts of the two Co-Chairmen, Dr. Hoesung Lee, and Mr. James Bruce, set an inspiring example. Their efforts were an vital factor in the success of the Workshop. I also wish to recognize the essential leadership of Dr. Shuzo Nishioka, without whose organizational and management skills the workshop could not have successfully taken place.

The Domestic Organising Committee also played an essential role in the success of the IPCC Workshop. Professor Amano, Professor Kaya, Professor Fu-Chen Lo, as well as Dr. Nishioka, all provided organisational expertise, guidance and support, which greatly encouraged all the individuals involved with organising the Workshop. Their efforts in providing international participants with support and information will also have been most appreciated.

The support, encouragement, and advice, from the modeling community was an intrinsic element in the successful planning, implementation, and reflection, accompanying the IPCC Workshop. I would like to thank J. Alcamo, H. Dowlatabadi, J. Edmonds, R. Leemans, N. Nakicenovic, M. Schlesinger, R. Richels, J. Sathaye, P. R. Shukla, and J. Weyant, as well as many other individuals who have contributed many ideas. Invaluable advice was obtained at the Snowmass workshop in 1996. Many individuals supplied detailed comments and suggestions, relating to the agenda and structure of the Workshop, in response to a discussion document (Morita, Shukla and Cameron, 1996) circulated to the modeling/policy community comments helped refine the workshop structure, reflected in this proceedings document, and I wish to thank everyone who contributed to this process.

Of course, the Workshop could not have taken place without financial contributions from a number of supportive organisations. I wish here to thank the Government of Japan, the Intergovernmental Panel on Climate Change (IPCC), The Energy Modeling Forum, Environment Canada, and the United Nations University (UNU). All these organisations had the foresight and conviction to support this important Workshop, and, on behalf of all the participants at the Workshop, I commend them for their support and help.

Lastly, but by no means least, I wish to thank all the various individuals at the Workshop secretariat, and the IPCC secretariat, whose tireless endeavors were an intrinsic element in the successful implementation of the Workshop. The efforts of the entire Workshop secretariat ensured that participants at the Workshop had an enjoyable and productive stay in Japan. In particular I would like to thank Mr. Fukuwatari, Dr. Cameron, Mr. Ito, and Ms. Kobayashi, as well as Mr. Natori, Mr. Unisuga, Mr. Kawamata, Mr. Yatsu, and Ms. Suzuki. Similarly, I would like to thank all the individuals who contributed their time and encouragement towards completing the editing and publishing of this proceedings document. In particular, I would like to acknowledge the important contribution of the other members of our editorial team, Dr. Cameron and Mr. Fukuwatari.

I hope that the document will make a positive contribution towards increasing our understanding of environmental issues, and climate change in particular, throughout the Asia-Pacific region. I also hope that it can help increase the application of, and confidence in, Integrated Assessment Models.

Professor Tsuneyuki Morita  
Chairman of the Programme and Editorial Committee

## Foreword

The Intergovernmental Panel on Climate Change (IPCC) was established by the United Nations Environmental Programme (UNEP) and the World Meteorological Organization (WMO) in 1988, to undertake technical-scientific assessments of issues related to climate change. We are currently moving from consideration of the conclusions of the IPCC Second Assessment Report [SAR], published in 1996, to deciding which key themes and policy objectives will influence the structure of the Third Assessment Report [TAR], due to be published in 2001. The Third Conference of the Parties [COP3] will be convened, this December, in Kyoto, Japan.

The IPCC organized three working groups to conduct the required scientific and technical assessments. Working Group III was charged with assessing the literature on cross-cutting issues of the social and economic aspects of climate change. Working Group III was also asked to assess the existing greenhouse gas emissions scenarios. The Second Assessment Report volume focusing on the economic and social dimensions of climate change, contained an assessment on integrated assessment modeling work, prepared by a Working Group III writing team.

However, despite the obvious potential of Integrated Assessment Models [IAMs] as a valuable assessment tool and aid to policy decisions, there was considerable reluctance to include some of the preliminary findings of IAMs in the summary for policy makers. The existing IAMs required greater input from a wider base of scientific approaches, being highly economically orientated. They also needed to reflect more accurately the experiences and realities found in developing countries.

As such, they act as a symbol for one of the key tasks facing the IPCC during the transition phase between the second and third assessment report: namely the need to integrate the conclusions from the various Working Groups within the IPCC into a cohesive body of knowledge which can aid policy making; and also to ensure that the experiences and insights of developing nations, and the regional perspective, are more accurately and thoroughly represented in the future.

The IPCC Asia-Pacific Workshop was approved specifically to help address these dual objectives. Firstly, to present a forum in which the developing nations of the Asia-Pacific region can communicate directly with modelers, most of whom come from developed nations. And secondly, to provide a setting in which policy makers and experts from a variety of fields can communicate directly with modelers. The workshop therefore represents an invaluable first step towards making IAMs an accepted technique for inclusion in the Third Assessment Report, as well as building research contacts and networks throughout the increasingly vital Asia-Pacific region.

Dr. Hoesung S. Lee (Chairman of the International Organising Committee)

### *for the International Organising Committee*

Prof. A. Amano	Mr. J. P. Bruce (Co-chairman)	Dr. Z. Fengqi
Dr. L. G. Meira Filho	Mr. H. Hamanaka	Sir J. T. Houghton
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Prof. H.J. Schellnhuber	Dr. N. Sundararaman	Prof. H. Uzawa
Dr. R. T. Watson	Prof. J. Weyant	Dr. M.C. Zinyowera

July 1997

## Preface

This volume constitutes the proceedings of the IPCC Asia-Pacific Workshop on Integrated Assessment Models [IAMs], held on 10th-12th of March, 1997 at the United Nations University, Tokyo, Japan.

Integrated Assessment Models [IAMs] have been recognized by the IPCC as having great potential in becoming an effective communication tool between north and south, and between scientists and policy-makers, on the implications of international and domestic policies related to climate change.

However, the IPCC advised against prematurely applying IAMs to actual policy proposals because of limitations in existing IAMs scientific underpinnings and, most crucially, the omission of considerations of the specific factors relating to the socioeconomic dynamics of developing countries. These concerns have been reflected in the experiences of researchers from developing countries in Asia and elsewhere, who have argued that existing IAMs are not fully representative of their situation.

There was therefore an urgent need to discuss the aims and development of IAMs and, as a result, the IPCC agreed to host a Workshop, focusing on the Asia-Pacific region, to address these areas. The Workshop was hosted by the Japanese government, in collaboration with the United Nations University in Tokyo. The Workshop had three main objectives:

- Its first objective was to review results of the Integrated Assessment Models which emerged after the 1995 IPCC Second Assessment Report, thus providing a vital source of information on the State of the Art of Integrated Assessment Modeling during the run-up to the Third Conference of the Parties [COP3], to be held in Kyoto, Japan, in December 1997.
- The second objective was to input to the current IPCC work of preparing for Third Assessment Report, and develop concrete goals and objectives as to how Integrated Assessment Models [IAMs] can further this end.
- The third objective of the Workshop was to expand joint activities on the transfer and use of IAMs in developing countries, especially in the Asia-Pacific region, whilst also enhancing communication between Integrated Assessment researchers, experts, and policy-makers. A special session held on the final day of the Workshop was devoted to discussion on the development of research networks in the Asia-Pacific region.

This document, containing the proceedings of the workshop, illustrates the great advances made in meeting these objectives, and the potential for much invaluable collaborative research throughout the Asia-Pacific region. As such, it represents an important contribution towards addressing global, and regional, issues associated with climate change. The contributions made in all the presentations, and by participants from the audience, enabled the workshop to open vital channels of communications between individuals from different disciplines and regions. We hope that this communications can lead to further advances in the future.

Prof. Yoichi Kaya (Chairman of the Domestic Organising Committee)

*for the Domestic Organising Committee*

Prof. A. Amano

Prof. F. Lo

Prof. Y. Kaya (Chairman)

Dr. S. Nishioka

July 1997

### **Editorial Note**

At the workshop, each session consisted of paper presentations, thematic discussion presentations, and open audience discussions. In this proceedings document, the open audience discussions have been summarized by rapporteurs.

These proceedings contain some differences from the Workshop itself, in terms of both the presentations listed in Appendix A (the Workshop Agenda) and the overviews of the respective sessions described in the rapporteurs' reports. These differences result from the fact that not all the discussants and keynote speakers were able to submit papers for inclusion in these proceedings. It was decided not to edit the rapporteurs' summary reports, which include descriptions of some of these omitted papers, so as to ensure that all comments and questions from workshop participants are fully represented in this document. Whilst some of these comments and queries focused on papers that have not been included in this final document, they also raised general questions relating to IAMs, and the topics covered in the respective sessions.

In each workshop a chairperson facilitated debate and discussion. Chairpersons were provided with an opportunity to comment on the session which they had chaired, and the rapporteurs' summary reports. Where chairpersons wished to express further opinions, they are included in these proceedings at the end of each session.

To ensure continuity in the overall proceedings document, and thus to facilitate ease of reading of the completed document, it was necessary to apply some editorial discretion to the format and style of submitted papers. In particular, the differences in computing systems used to produce submitted work, and the wide variety of format and style in tables, diagrams and figures, made some changes necessary. However some variations will be noted in the proceedings document. Where spelling differences result from regional preferences, the spelling terminology used in submitted papers has been left intact. As a result, there are differences between papers in the spelling of some words. Similarly, some flexibility was shown with respect to authors' preferences for presentation style and for references formatting. There are also minor differences in the presentation of rapporteurs' summary reports, resulting from the fact that the style of these reports was left to the discretion of the individual rapporteurs.

For ease of presentation in some sections of these proceedings (for example, in the Table of Contents) only one name is attributed to a paper, even if the paper had more than one author. In such cases, the name of the co-author who presented the paper at the Workshop is given. The names of *all* contributing authors are listed at the start of individual papers in the proceedings.

The editorial team wishes to acknowledge the vital contribution of audience participants who offered questions and comments. Wherever possible, the names of these participants have been included in the rapporteurs' summary reports. Several people gave presentations covering topics which were not directly related to their current research interests and experiences. This approach enhanced the overall scope of debate in the Workshop. The extra effort put in by these individuals was most appreciated, as was the endeavours and accuracy of the session rapporteurs.

Dr. Owen K. Cameron

*for the Editorial Team*

Dr. O. K. Cameron

Mr. K. Fukuwatari

Prof. T. Morita

July 1997

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## **Opening Session**

## **Welcome address**

**By Prof. Hleitor Gurgulino de Souza**  
**Rector, United Nations University**

Excellencies,  
Distinguished Participants,  
Ladies and Gentlemen,

It is a great honour and privilege for me to welcome you this morning to the IPCC Asia-Pacific Workshop on Integrated Assessment Models, jointly organized by the IPCC, the Government of Japan and the United Nations University.

Firstly, I would like to express my sincere gratitude to the distinguished participants from around the world for having accepted our invitation to attend this conference, as well as to the many concerned members of the audience who have come to this very important event. In particular, my heartfelt thanks go to Professor Yoichi Kaya and members of the local committee for their efforts.

This event is the first of three the next two being the Tokyo Modeling Forum and the IPCC Lead Author Meeting also being hosted later this week by the UNU. In parallel to these workshops, we are also hosting the second phase of our multilateral diplomacy workshop (the first UNU Multilateral Diplomacy Workshop was held last November). The attending diplomats and government officials will also be observers in this IPCC workshop, giving an opportunity to assess the uses of scientific knowledge for addressing international environmental issues. The IPCC Asia-Pacific Workshop is notable, as it is the first IPCC meeting on Integrated Assessment Modeling. It also marks the first time that integrated assessment modelers have been brought together with representatives and experts from developing countries. We have great hopes that the scientists from developed countries and those from developing countries, working together on this stream of research, can bridge the gaps of knowledge in this critical area.

This bridging function between developed and developing countries is one of the main missions of the UNU. The UNU was chartered to devote its research and training capacity to "pressing global problems of human survival, development and welfare" - problems that will also affect the future of the global system and coming generations of people. A major challenge is that of environmentally sustainable development. This has been one of the primary concerns of UNU since its foundation over 20 years ago. Many of you may know that the work of the UNU is carried out through a network of research and training centres and programmes. These include our first such centre UNU/WIDER in Finland as well as UNU/INTECH in the Netherlands, UNU/INRA in Ghana and Zambia, UNU/IIST in Macau, UNU/BIOLAC in Venezuela, UNU/ILA in Jordan, our new International Network on Water, Environment and Health (UNU/INWEH) in Canada, and the newest research and training center of the UNU system: the Institute of Advanced Studies here in Tokyo that is organizing today's events. Each of these centres and programmes, in addition to the academic programmes coordinated from our UNU Headquarters, works with numerous scholars and institutions in many different countries. In these academic programmes we have focused our attention on key environmental and development problems. Since the Earth Summit in Rio de Janeiro in 1992, we have consolidated these efforts in new directions with our own Agenda 21 programme.

Modeling has been an important tool for human society to study pressing global issues. Since 1991, the UNU has played a role in facilitating this process. We have organized a series of

conferences and workshops on Global Change and Modeling focusing on, amongst other areas, arms reduction, economic development, and the sustainable future of the global system. Given our history and goals, the UNU is very pleased indeed to be a hosting partner in these IPCC events.

Since the dawn of the industrial age, the peoples of the Earth have become influential forces on nature through their use of natural resources. The balance of natural systems has been affected, in many cases irreversibly. Now many of our activities have come back to haunt us, in the form of environmental problems around the world. While many of these problems have been local or regional, climate change in particular has both global and local dimensions. In addition, climate change occurs over the long-term and is highly complex in nature.

Climate change has been an important scientific issue for decades. Through our use of fossil fuels and other human activities, we have emitted a tremendous amount of greenhouse gases, and this use will continue to escalate over a large part of the next century. A considerable body of scientific evidence has been accumulating on the effects of these activities on the climate. As a result of this knowledge, the international community, and in particular the developed countries, has seen the importance of seeking international consensus and action. This was reflected in the formation of the IPCC, an important organization in humanity's effort to understand the consequences of its actions on the climate system.

In its Second Assessment Report, the IPCC concluded, amongst other things, that atmospheric greenhouse gas concentrations are continuing to increase, and that climate models project that the global mean surface temperature will increase by approximately two degrees centigrade by the year twenty-one hundred. This rise in the global surface temperature has been projected to lead to a rise in sea level, changes in water resource distribution and agricultural productivity, and to affect human health through the spread of diseases such as malaria. And yet, these physical models still have much uncertainty in them.

Scientific knowledge plays an increasingly important part in policy decision-making.

Scientists have the important responsibility of reporting their results to the international community. Specifically, the reports of the IPCC will have important consequences for the Third Conference of the Parties to be held in Kyoto this December. Given this role, scientists such as yourselves must have the foresight to recognize how your actions can dictate the course of events and, in particular, how your recommendations can affect societies and individual communities within them.

The Asia-Pacific region now has the fastest growing economies in the world, and as such is becoming an important contributor to climate change. As a result of its focus on the Asia-Pacific region, this workshop provides an important test of how well the needs of a rapidly growing region can be incorporated into analyses and solutions. Any solutions to the climate change problem will have to address the needs and concerns of the people in the region, in particular the many who have been left behind in the wake of progress.

Many of these points have been addressed in the academic literature. Some have also made their way into integrated assessment models. However, we must never lose sight of the importance of understanding the limitations of science. In particular the way in which human activities are represented in social science, or in the mathematical formulae of models, is still very much bound by limited perspectives.

One major issue is the perceived fairness of the analysis and the proposed solutions. Thus, in addressing the contributions of various countries to the climate change problem, historical emissions from the highly industrialized countries must be taken into account, and the limited means and needs of developing countries must also be addressed. Until that happens, no global solution will be valid, or will be taken seriously. Furthermore, the sharing of economic and technological resources is paramount. Integrated assessment is one resource that is used for common decision-making and, therefore, it should reflect the concerns of the many whose futures it encompasses. It is important that these shared international resources be used within a multilateral framework, and that they take into account the major issues dividing the North and South.

I also wish to stress how important it is for learning to occur in both directions.

Scientists, diplomats, and other concerned people from developing countries, that are present in this audience, should benefit from learning about the scientific knowledge and processes discussed by the scientists from developed countries.

I think it is highly significant that both diplomats and scientists are gathered here today. Both pursue the same objectives of sustainable development and preservation of the environment, and both must effectively work together in order to reach these objectives which are vital for our common survival. I hope that this workshop will also provide opportunities for building bridges between scholars and decision-makers. I call upon both groups to fully exploit this opportunity.

I believe that this workshop will shed substantial new light on the effects on the earth's living processes, and that it will provide people with hope for a sustainable future.

I look forward to your deliberations and the outcomes from this important conference.

Thank you.

## **Welcome address**

**Mr. Tsuneo Suzuki**

Parliamentary Vice-Minister,  
Environment Agency of Japan,  
Government of Japan.

Good morning ladies and gentlemen. As has been introduced, my name is Tsuneo Suzuki, Parliamentary Vice Minister of the Environment Agency. I would like to extend my wholehearted welcome to all of you, especially to those of you who have flown from abroad. I have been looking forward to seeing you here. Today, Michiko Ishii, Director General of our Agency, was supposed to come here and see you, but she has been prevented from attending the workshop. Unfortunately she must participate in an important Diet session to introduce the next year's fiscal budget, and thus she was not able to come here.

As a Diet member of the House of Representatives, from Yokohama District, I would like to make a few remarks in her place. First of all, I would like to express my deepest gratitude to all participants for their attendance at this workshop and for their excellent initiative in tackling global warming. My special thanks also go to the organizers of this workshop, the United Nations University, as well as the Chairman of the Workshop. Needless to say, the issue of protecting the global environment has become increasingly important in recent years.

We have called upon many Japanese participants and speakers to take part in this workshop, and they have accepted our invitation quite eagerly. Especially focused on the prevention of global warming, the COP3 conference is to be held in Kyoto in December this year and, as you know, the other conference, protocols, and international frameworks, regarding the prevention of global warming for the year 2000 and onwards, are expected to be adopted. For our part as a host country we are determined to play an active role in the conference, so that we can successfully secure international commitment that is both effective in preserving the environment and at the same time is highly implementable.

We all know that the IPCC, ever since it was set up in 1988, has been involved in a variety of activities including publication of two assessment reports, and collection, evaluation and provision of the latest scientific findings. The IPCC has been the driving force behind international efforts to curb global warming. One culmination of such efforts has been adoption of the United Nations Framework Convention on Climate Change. The Japanese government intends to continue to embrace IPCC's activities seriously, and provide experts and inputs to IPCC whenever and wherever they are necessary (in compiling reports or in compiling research results). Almost all the world's leading researchers, working on integrated assessment models, are taking part in this workshop.

I believe it is of great significance that they will engage in an exchange of information and views on the latest developments in this field. I am also told that a large number of researchers here are from within the Asia Pacific region. I believe that the Asia Pacific region holds an important key to the solution of the issue of global warming, taking the view that it will probably continue to undergo rapid economic growth and generate even larger loads on the environment toward the future. I also hope that this workshop will help the Asia-Pacific nations to promote extensive understanding and international cooperation with each other. I have high expectations that the fruits of the workshop will be conducive for the IPCC to compile its third assessment report, accomplishing the objectives of the UNFCCC and developing future countermeasures against global warming.

Ladies and gentlemen, spring has come to Japan. I hope you will enjoy your stay here. Have a stroll in the parks. There are some cherries which will start to bloom in a few days, in fact some are already in bloom. As Dr. De Souza has said, the people gathered here are the challengers for protecting the global environment. They are up against the challenge to protect the environment. The cherry blossoms, I believe will give you great encouragement, and inspiration to those people who will be taking on this challenge. I sincerely hope that this workshop will play a significant role and contribution to protecting the global environment. Thank you for your attention.

## **Opening address**

**Prof. Bert Bolin**

Chairman of the IPCC

I am very happy to be here on this occasion, to greet you on behalf of the IPCC. I wish also to express my thanks for what you have done here in Japan to get this Workshop under way, as well as to those that in other ways have supported this workshop--Canadian and US institutions in particular.

Integrated assessment modelling is most important. This can best be demonstrated by me being sceptical about its usefulness at present, but indeed being positive about its potential possibilities. The reason is simply that you can easily misinform if not being careful about the assumptions that always will be required, but on the other hand contribute substantially if you have proceeded thoughtfully. At this stage integrated assessments should still primarily be viewed as a research tool, but of course we wish to see it play a role in the political debate in the future. Let us therefore view the development of integrated models as a process which has begun by bringing together models for the different parts of the total system in, order to learn more about the interactions between these different parts.

But we have a long way to go. We will never be able to build a complete model and include everything in trying to describe the climate system and the way it is changing. We are dealing with a very complex system that includes the natural processes that creates the climate, the social and economic features of the society that we have built ourselves, and the political processes that govern it.

A number of key questions must be addressed. Since we will never be able to include more than the most important processes, that may be of importance, and since we shall never have data that describe all that is going on, the concept of simplification and what it brings with in terms of uncertainty, becomes very important. How can one account for the total range of uncertainty? It is all too easy to say: the outcome of an analysis will be so uncertain that we cannot draw any conclusions. Then we have of course achieved nothing. We rather must try to find out: what can we say in spite of all uncertainties? This is a difficult question and there are no obvious answers at the outset of an analysis. Politically, it is important to find answers to a question such as 'how to deal with developed and developing countries on an equal footing', although we know that very large differences exist. 'How to account for cultural differences between people? - they cannot easily be expressed in terms of numbers, nevertheless they are important. And 'how to use integrated models so that the need for national actions will be viewed both in a national and an international perspective'. It is natural that countries first will ask: 'how will changes impact my country?'

Many of these questions raise issues of a political nature. However, these cannot be answered without a well documented scientific basis. One may ask if some questions can be answered in terms of probabilities. It would then, of course, be important to recognise that the use of probabilities brings up the issue of how people conceive of probabilities.

What then are the issues at stake in the political negotiation? It should first be observed that the conclusion by the IPCC, in its Second Assessment Report, that 'the balance of evidence suggests a discernible human influence on the global climate', has had a significant impact on how the climate change issue is being conceived. There is, however, still some hesitation because it has not been possible to relate conclusively damages from recent droughts, floods,



storm, etc., to the emissions of greenhouse gases and the global warming trend that has been observed during the last half century. It is important that the scientific community addresses this issue carefully during the years to come. In other words: 'how can we estimate more accurately and conclusively the sensitivity of the climate system to increasing radiative forcing due to the emissions of greenhouse gases?'; or: 'how serious is global warming to the human society that has developed during the last century?' Can integrated modelling contribute in the analysis of this issue?

Article 2 of the Climate Convention envisages stabilization of greenhouse gas concentrations in the atmosphere, but does not prescribe any particular concentration levels for the different greenhouse gases. Indeed here I foresee an important role for integrated models, when they are judged to be trustworthy. They might help in deciding, if actions are required, what to do, how quickly to do it, and how to choose the most economically advantageous way that is least disturbing to society.

There is still a gap between what integrated models can tell today and what might ultimately be possible to achieve. I am happy to be here and have the opportunity to find out where we are in the process of developing integrated models. I have been given 5 minutes also at the end of the workshop. I will be back then and tell you what I have learned. Until then I am going to enjoy myself by listening to you.

## **Opening address**

**Prof. James Bruce**

IPCCWG3 Co-chair,  
Co-Chairman of the IPCC Asia-Pacific Workshop on Integrated Assessment Models

It is great to see so many familiar faces and dear colleagues present here this morning. I am just going to say a few words about the origin of this workshop, and the effort to bring all countries into the integrated assessment modeling club. And my colleague Dr. Lee will say more about the specific objectives of the workshop from an IPCC perspective. In preparing the Second Assessment Report, Working Group III, part way through our work, decided to organise a special writing team on integrated assessment modeling. This team was ably convened by John Weyant, who I am pleased to see with us, and many of the distinguished members of that team are here as speakers at this important workshop.

A very excellent assessment of integrated assessment modeling work was prepared by this writing team and this appears in the economic and social dimensions volume of the Second Assessment Report. However, when we came to the final plenary sessions of the working group, with more than 100 country representatives taking part, there was considerable reluctance to adopt much material drawn from the integrated assessment chapter, into the summary for policy makers. It became obvious in the course of discussions of the *government representatives that there was not yet great enough confidence that the models reasonably represented economies and social and physical natures of all countries, especially of developing countries.*

Thus there was considerable reluctance to include some of the preliminary findings of integrated assessment models in the summary for policy makers. At the same time, almost all of us in Working Group 3 could see that this is a potentially very powerful tool and a key to aid decision making. It is also a means of clarifying relationships and the consequences of various policy options. Thus we could see the great potential value of integrated assessment models for IPCC's upcoming Third Assessment Report. At the same time, it was obvious that to be the kind of valuable instrument internationally that we hoped for, many more countries would have to develop a capability in integrated assessment modeling, in order to understand and interpret the model results in their national decisions. In addition, the existing group of modelers recognized the need for greater input from economists and other scientists from developing countries, to help ensure that the assumptions and model parameters reflect the situation in developing parts of the world as well as in developed countries. As an initial step, to move us to a position where integrated assessment models will become an accepted technique in the Third Assessment Report, the Government of Japan kindly offered to host this important workshop for Asian-Pacific countries. IPCC is encouraging other workshops in other regions and a training programme for developing countries under the START and Inter-American Institute programmes. For this workshop we hope that all will gain greater understanding of the strengths and the problems associated with integrated assessment models, and that the workshop will pave the way to effective capacity building in many countries.

With the careful thought and planning of the workshop organizers, the excellent arrangements provided by United Nations University and the Government of Japan, and the absolutely stellar lineup of speakers, I am sure that this workshop will succeed in meeting these goals. Our deepest thanks to the Government of Japan, the UNU, and the organizers for making this possible. Thank you.

## Introduction of the Workshop

Dr. Hoesung Lee

IPCCWG3 Co-chair,  
Chairman of the International Organizing Committee and  
Co-Chairman of the IPCC Asia-Pacific Workshop on Integrated Assessment Models

I am delighted to be able to address this opening session of the IPCC Asia-Pacific Workshop on Integrated Assessment Models. I would like to take this opportunity, on behalf of the International Organizing Committee of the Workshop and IPCC Bureau, to express our appreciation to our hosts, the United Nations University and the Japanese Government, for their gracious support, without which this important workshop could not have proceeded.

This Workshop represents an important milestone for the Asia-Pacific region, an area for which climate change has profound economic and environmental implications. Moreover, no strategy to address the challenges of global warming can succeed without involving the Asian countries. Asia contains over half the world's population, and great regional environmental diversity. Population increases are likely to place increasing stresses on the region's environment. The regional economies have experienced rapid recent increases in growth, and currently contribute around one quarter of the global total of CO<sub>2</sub>. This estimate is likely to increase to half the global total in the future. The discussion and ideas generated at this Workshop are therefore of great importance.

We are currently in a transition phase, moving forward from the conclusions of the IPCC Second Assessment Report, published in 1996, to selecting which key themes and policy objectives will influence the structure of the Third Assessment Report. Given the increasing political and public attention on climate change issues, this report is likely to be a crucial document.

During this transition process, I believe attention should focus on two key elements: *integration*, and *developing countries*. It is vital that we integrate the conclusions, drawn up by the various Working Groups of the IPCC, into a body of policy guidelines which can facilitate the policy-making process. Moreover, the developing nations must increasingly be involved in all aspects of the research, integration, and policy processes. And we must also integrate the interests of various stakeholders whom these conclusions shall affect.

In its efforts to address the need for an integrated set of policy guidelines, the IPCC has already recognized the invaluable role of Integrated Assessment Models [IAMs]. Integrated assessment functions as a convenient forum for combining knowledge from a wide range of disciplines and perspectives, to provide a unified set of recommendations. Integrated Assessment Models use computer programs to facilitate this process, utilizing mathematical representations of information from the various contributing disciplines to facilitate consistency amongst the various components of the model. IAMs can be divided into two broad classes: *policy optimization models* and *policy evaluation models*. In the case of global climate change, these two classes combine to address three goals:

- coordinated exploration of possible future trajectories of human and natural systems,
- development of insights into key questions of policy formation,
- prioritization of research needs in order to enhance our ability to identify robust policy options.

However, serious gaps exist between contemporary IAM models, and the experiences and expectations of developing countries. Debate has centered on whether IAMs adequately represent the social and economic circumstances of developing countries, and also on the ability of IAMs to represent regional variations. In considering adaptations measures, it is necessary to investigate how realistically IAMs estimate climate change impacts on developing countries; whether it is possible to apply the same policy instruments to both developing and developed countries; and the extent that existing IAMs can be applied to both developed and developing nations.

This Workshop therefore has three specific objectives. First, the workshop will review recent IAM studies, disseminating knowledge on the state of the art of these important analytical tools, and reaching conclusions on their strengths and weaknesses. This process will greatly facilitate the second aim of the conference, enhancing communication with developing countries, to help bridge the aforementioned gaps. The Workshop will allow participants from these countries to express their opinions directly to modeling experts, thus enhancing mutual understanding. This exchange of views underpins the third aim of the Workshop, which is to lay the foundations for an increase in dialogue, and an expansion of joint research activities, within the Asia-Pacific region. Currently, several programs do exist, representing important regional environmental initiatives. However these initiatives need to be extended to incorporate more countries.

The IPCC Asia-Pacific Workshop also opens a new chapter on the IPCC tasks. It is the first IPCC conference solely to consider Integrated Assessment Models. Moreover, the consensus to hold the conference in Asia illustrated an increasing awareness of the vital role the countries in the region must play in addressing environmental and economic concerns.

Following today's introductory session, the workshop will focus on the state of the art of computer models related to climate change, and then review recent trends in Integrated Assessment Modeling. After these two sessions have set a theoretical background for discussion, the next four sessions will then consider the specific questions relating to gaps between IAMs and the developing countries.

During the presentations and discussions focusing on these gaps, we will have an opportunity to consider the way forward, how best to plan our future research in terms of both theoretical approach and practical implementation. Most of the leading modelers in this field of research are here in Tokyo this week. This Workshop therefore provides us with a precious opportunity to increase the applicability of research conclusions, from IAMs, to both developing and developed nations; and for the many participants to set in place contacts and ideas which can greatly increase future collaborative research within the Asia-Pacific region. I am confident that the Workshop can meet these aims.

In closing, I would like to take this opportunity to convey my sincere gratitude to speakers, moderators, discussants, and participants, whose active involvement will make this workshop an extremely valuable event for IPCC activities. I am also confident that this workshop will represent a major contribution to climate change policy throughout the Asia-Pacific region.

Finally, I would like to convey my deep appreciation for the work of the Local Organizing Committee, chaired by Professor Kaya, the IPCC Workshop secretariat, organized at the National Institute for Environmental Studies, and the United Nations University.

## **What does the IPCC expect of IAMs?**

**Dr. R. Moss**

**Director, Technical Support Unit, IPCC WG II**

### **I. Introduction**

Dr. Robert Watson, Chair-elect of the IPCC, is unable to attend this week's workshop due to illness. He has asked me to convey his regrets for not being able to be here, and to cover in this presentation a number of points related to the plans for the IPCC's Third Assessment Report (TAR), the potential uses of integrated assessment models in the TAR, and issues which will need to be addressed in both application and development of integrated assessment models.

### **II. Substantive orientation of the Third Assessment Report**

Plans for the TAR are being developed in an open and consultative fashion. Dr. Watson has prepared a white paper describing the options for the report, and has circulated this white paper several times to members of the academic community, government officials, and stakeholder groups. The white paper has been discussed at several IPCC Bureau meetings, and will continue to be circulated and revised until September 1997, when, we hope, plans for the report will be approved by the 13th IPCC Plenary session, in the Maldives.

The TAR is expected to be completed in early 2001. It will build on the strengths of the large and highly-regarded set of assessments completed under the chairmanship of Professor Bert Bolin. It will maintain the strongest attributes of these previous assessments. It will be comprehensive and will cover the complete range of scientific, technical, economic, and social issues deemed important by both the scientific/technical and policy communities. It also will include the full range of credible viewpoints in the scientific and technical literature, identifying and characterizing uncertainties. As previous IPCC assessments have done, the TAR will provide information that is important for policymakers. Given the current and likely future focus of debate and negotiations under the UN Framework Convention on Climate Change (FCCC), the TAR will focus on scientific, technical, and economic issues relevant to the interpretation of Article 2 of the Convention, and other issues identified as being important by the FCCC and its subsidiary bodies (SBI and SBSTA). It will primarily assess information generated since the Second Assessment Report (SAR) and subsequent special reports, and will summarize the state of knowledge covered in previous IPCC reports.

Plans for the TAR correct several weaknesses of the SAR that have been pointed out by reviewers. These limitations in the structure of the SAR included:

- an artificial separation of the "social and economic sciences" from the "natural and technological sciences" in Working Groups II and III;
- an under-emphasis on the regional aspects of climate change;
- the lack of an integrated cross-sectoral analysis of the impacts of climate change;
- the failure to provide an integrated assessment of the energy sector (within and between the energy supply and energy demand sectors), or to assess the applicability of technologies and policies in different regions.

The proposed new structure for the TAR will facilitate the following changes:

- Working Groups II and III will be reorganized, with the new Working Group II covering impacts and adaptation, including the social and economic aspects, and the new Working Group III covering greenhouse gas mitigation options (technologies and policies), including the economic and social aspects.
- some elements of the two ecological chapters in Working Group I (Chapters 9 and 10) will be moved to the beginning of the new Working Group II, providing the intellectual basis for the ecological aspects of the impacts assessments.
- more emphasis will be placed on regional analysis (e.g., Africa, Latin America, Small Island States), augmenting the global sectoral approach of the SAR.
- the energy supply and energy demand sectors will be assessed in a more integrated manner (within and between the energy supply and demand sectors), and there will be greater emphasis on analyzing the technical, economic, and market potential for mitigation (as was done in the Technical Paper on Technologies, Policies, and Measures).

Thus, the proposed structure of the TAR and the scope of the Working Groups are as follows:

Synthesis Report	<i>Synthesis</i> and integration of working group material
Working Group I	<i>The Climate System:</i> Sources and sinks of greenhouse gases and aerosols; observed changes in atmospheric composition, climate variables, cryosphere, and sea level; climate variability; physical and biogeochemical processes; evaluation of models; model simulations of past and current regional and global climate; model simulations of future regional and global changes in atmospheric composition, radiative forcing, climate, cryosphere, and sea level; evaluation of approaches for developing regional climate information.
Working Group II	<i>Regional sectoral and cross-sectoral impacts of, and adaptation strategies to, climate change, including the social dimensions (e.g., equity) and economic costs and benefits:</i> Response of terrestrial and marine ecological and hydrological processes to changes in climatic conditions and atmospheric composition, e.g., increased carbon dioxide concentrations; human health mechanisms; methods for assessing impacts and adaptation options for ecological systems, human health, and socio-economic sectors; regional evaluations of the sectoral and cross-sectoral impacts of climate change, including the social dimensions and economic costs and benefits; regional sectoral and cross-sectoral adaptation strategies (technological, institutional, and policy aspects) in the context of meeting human needs; and global sectoral assessments (e.g., movements in ecosystem boundaries, and changes in agricultural and fisheries productivity at the global level).
Working Group III	<i>Mitigation of climate change, including the social aspects and economic costs and benefits, and methodological aspects of cross-cutting issues:</i> Methodological issues associated with mitigation, equity, discount rates, decision-making frameworks, uncertainties, and integrated assessment modeling; evaluation of the technical, economic, and market potential of energy supply and demand and land-use technologies; geo-engineering; regional assessments of the mitigation

potential of different technologies, including the social dimensions and economic costs and benefits; global assessment of energy-related and land-related mitigation options, including “distributional” costs for different stabilization levels and different emissions profiles; and evaluation of policy options (including carbon and energy taxes, subsidy elimination, internalization of local and regional environmental externalities, and joint implementation).

Each of the working group reports will include a summary for policymakers (5-10 pages), a technical summary (25-50 pages), and a series of chapters (each with a 1-2 page executive summary). The detailed chapter outlines will be developed by the lead authors, working with the respective Bureaus of the working groups, once the general orientation for the working groups is finalized by the IPCC Plenary.

### **III. Potential Uses of Integrated Assessment Models**

As the above description of plans for the TAR indicates, there will be an increased emphasis on regionalization and integration in the next IPCC assessment. This is in response to the policy community's need for this sort of information; it is possible because of advances in the research literature. One of the areas of greatest advance in recent years has been in the area of integrated assessment models (IAMs). Models included under the heading of IAMs are very diverse, covering both linked systems of process models for subcomponents of the climate system (e.g., carbon cycle, atmospheric chemistry, ocean, terrestrial biosphere, economic systems) and a variety of “reduced form” models which summarize information contained in the more extensive and computationally intensive process models. The more economically and globally orientated of these IAMs seek to give information on the cost effectiveness or efficiency of mitigation options, as well as on possible “emission pathways” which can be taken to attain any given atmospheric stabilization goal. One of the common characteristics of full-scale IAMs is that they go from “end to end” of the climate-change issue, linking human activities, emissions, atmospheric composition, climate and sea-level changes, and impacts on ecosystems and human activities. This characteristic makes them potentially very useful to the TAR and its proposed synthesis of information related to Article 2 of the UNFCCC.

Due to the diversity of models and approaches, it is not possible to detail all of the uses to which IAMs could potentially be put in the TAR. It is possible, however, to speculate on uses within individual chapters (where one would wish to assess the feedbacks and relationships among various subcomponents of the climate-change issue), as well as in the synthesis report, where the emphasis will ultimately be on understanding the potential implications of different policy options on the climate system, on impacts, and on the economy. Indeed, I hope to learn more about ways of using IAMs and about their potential relevance for the TAR over the course of this workshop. I am quite sure that Dr. Watson would welcome suggestions or input from the workshop on this issue. However, perhaps I can point to several issues where it seems that IAMs would be very useful. These include:

- Emissions scenarios: calculation of potential scenarios of emissions based on demographic, economic, technological, and land-use assumptions;
- Interaction of regional and global impacts for key commodities or sectors: implications for global markets (e.g., trade flows, prices) of regional changes in, for example, agriculture and forestry production; global market implications for regional-level economic gains/losses;

- The implications of current policies to limit greenhouse gas concentrations (i.e., those agreed at COP-3, if any);
- The implications of additional policies to limit greenhouse gas concentrations aimed at Article 2 of the FCCC (i.e., stabilization of concentrations);
- Distributional/equity issues associated with various policy alternatives, such as the effect of Annex I obligations on non-Annex I countries; and
- The environmental and economic implications of adaptive strategies.

It is important to point out that this speculative list of topics, to be addressed with the assistance of IAMs, is not intended to be exhaustive, simply a set of illustrative issues. It is equally important to point out that these issues will not be addressed using IAMs alone. A variety of information, including information from full-scale models as well as from non-quantitative frameworks, will also be used in the TAR to address these and similar issues.

#### **IV. Issues to Address in Development and Application of Integrated Assessment Models**

The issues of how much and in what ways to use IAMs in the TAR are controversial. Thus, I think it is extremely useful that the Government of Japan and the United Nations University are sponsoring this workshop. In addition to providing an opportunity to review the results of IAMs which have emerged after the 1995 IPCC Second Assessment Report, the workshop will enhance communication between researchers, experts, and policy makers regarding IAMs and their potential uses.

Three cautions that need to be heeded in using IAMs in the TAR, or in any policy-relevant assessment, are:

- IAMs are still in their early stages of development, and there are many gaps directly related to the kinds of questions that policy makers ask. These gaps will have to be filled before IAMs become credible, widely-accepted tools to be used directly in policy making.
- IAMs are highly aggregated and economically oriented, for the most part the product of North American and European thinking. Some researchers and policymakers (particularly from developing countries) perceive that IAMs are biased and that the best interests of developing countries may be hurt by use of the models in policy settings. I personally do not share this perspective, but it is clear that workshops such as these are needed to address this issue, either to expose the weaknesses of the models or to familiarize developing country researchers and policymakers with them, or both.
- Economically-oriented IAMs are perceived by many as stressing economic efficiency as the dominant evaluative criteria, for example in their optimization of emissions trajectories based on least-cost mitigation costs rather than on other criteria, such as minimization of damages, or distributional criteria (e.g., fair distribution of costs and benefits among North and South, or across generations). I do not see these as "either-or" issues, but rather as a question of how one applies or interprets the results. As with the previous issue, however, dialogue in settings such as this is important for evaluating the biases of the models and for making potential users of the results more aware of both their strengths and their limitations.

In addition to the above cautions, it is clear that IAMs will need to undergo further development to increase their utility in assessments such as the TAR, and thus their ultimate utility to policymakers. Among the needed developments that occur to me are:

- Improving the representation of damages and impacts in IAMs, going beyond the simple link between dollar-estimates of aggregate damages and climate variables such as mean



temperature change; including adaptive responses; and characterizing the interactions of impacts in different sectors;

- Improving the representation and treatment of regions within IAMs, by developing regional and national sub-models, and by involving more modelers from within developing and transition-economy countries; and
- Improving the treatment and analysis of uncertainty in IAMs.

I look forward to learning more about the current state of the art in these models, and about what the modeling community believes are the most needed developments.

## **V. Conclusion**

In conclusion, IAMs have tremendous potential for illuminating a number of the critical issues that will be assessed in the IPCC TAR. The IPCC looks forward to working with both the research community and the policy community in defining how the models can be used, and in developing a joint understanding regarding how their results should be interpreted. I thank the organizers for sponsoring this workshop, which provides a very useful first step in this dialogue.