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WORKSHOP ON CLOUD PHYSICS AND CLIMATE

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WORLD CLIMATE PROGRAMME

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ABSTRACT

This paper describes the World Climate Programme (WCP) - its objectives, structure, major activities, accomplishments to date, and projections on where it is going during the next 15 years.

The WCP has three main objectives: 1. To apply existing climate information to benefit a wide variety of human activities, with priority in the areas of food, water and energy, and other areas as resources permit; 2. To improve our knowledge of climate system processes through research to determine the predictability of climate and the extent of man's influence on climate; 3. To monitor and warn governments of the potential economic, social and political impacts of significant climatic variations and changes, both natural and man-made.

The WCP has four components which are the responsibility of the organizations listed: A. World Climate Data Programme (WCDP): WMO B. World Climate Applications Programme (WCAP): WMO C. World Climate Research Programme (WCRP): WMO and ICSU D. World Climate Impact Studies Programme (WCIP): UNEP.

The purpose of the WCDP is to provide timely access to reliable climate data in exchangeable formats, to support the other components.

The purpose of the WCAP is to apply existing climate information with priorities in food, water and energy, and in other areas as resources permit.

The purpose of the WCRP is to determine the predictability of climate and the extent of man's influence on climate.

The purpose of the WCIP is to warn governments of the potential economic, social and political impacts of significant climatic variations or changes, both natural and manmade.

Some tangible results have been achieved toward meeting each of the WCP objectives but there is still much to do. An evaluation of the results achieved so far in each component of the WCP will be given.

Major directions of the WCP over the next 15 years will be indicated.

* The views expressed in this paper are solely those of the author and do not necessarily represent the position of the WMO nor any other organization associated with the WCP.

1. BACKGROUND OF WCP

1.1 As recently as twenty years ago, climatology was regarded as a descriptive science in the backwaters of the atmospheric sciences. Today in 1985, the study of climate is a very active topic in the atmospheric sciences. What are the reasons for this change? Three primary ones are evident:

1. A series of prominent climatic events, which started with the Sahel drought in 1968 and continued throughout the 1970's, brought to the attention of the scientific community and the general public the importance of economic and social impacts of major climatic variations;

2. Concern for the potential effects of increases in carbon dioxide and other greenhouse gases in the atmosphere also received much publicity;

3. The problem of predicting climate came to be regarded by the scientific community as an interesting and feasible challenge which engaged the talents of many prominent scientists.

The modern description of the climate system (Fig. 1) comprised of the atmosphere, ocean, cryosphere (ice fields), and the land surface processes (including biota) was a major step in defining the scientific problem.

1.2 For these reasons and others, the WMO convened a World Climate Conference in 1979 to review the status of climate knowledge and propose a Programme of action. The WMO Congress in 1979 adopted a World Climate Programme (WCP) in conjunction with the United Nations Environment Programme (UNEP), the International Council of Scientific Unions (ICSU), and other international bodies.

2. OBJECTIVES OF WCP

The WCP has three main objectives, as listed in the World Climate Programme Plan:

A. To apply existing climate information to benefit a wide variety of human activities, with priority in the areas of food, water and energy, and other areas as resources permit;

B. To improve our knowledge of climate system processes to determine the predictability of climate and the extent of man's influence on climate;

C. To monitor and warn governments of the potential economic, social and political impacts of significant climatic variations and changes, both natural and man-made.

3. STRUCTURE OF THE WCP

The WCP has four components which are the responsibility of the organizations listed:

A. World Climate Data Programme (WMO);
B. World Climate Applications Programme (WMO);
C. World Climate Research Programme (WMO and ICSU);
D. World Climate Impact Studies Programme (UNEP).

The WMO has the responsibility to co-ordinate the activities of these four components to attempt to achieve the objectives of the WCP.

4. PURPOSE AND MAJOR ACTIVITIES OF WCP COMPONENTS

4.1 The World Climate Data Programme (WCDP)

The purpose of the WCDP is to provide timely access to reliable climate data in exchangeable formats.

The major current activities in the WCDP are:

A. To determine requirements for climate data;
B. To develop a climate data referral system (INFOCLIMA) which will tell users what data now exist, where, the format, and how to obtain them;
C. To assist countries to improve their climate data management systems through a transfer of technology, stressing the user of microcomputer systems (CLICOM);
D. To assist countries and regions to build climate data banks for applications, impact studies and research;
E. To develop a procedure to monitor, diagnose and disseminate information on significant climatic events which may affect mankind's activities, using existing facilities.

4.2 The World Climate Applications Programme (WCAP)

The purpose of the WCAP is to apply existing climate information with priorities in food, water and energy, and in other areas as resources permit.

The major current activities in the WCAP are:

A. To strengthen national capabilities to apply climate information;
B. To make available existing basic knowledge on the climate of a region in a way to permit ready application to a variety of problems;
C. Promote access to operational techniques which have been used, through the Climate Applications Referral System (CARS);
D. Support the development of new climate application methods.

4.3 The World Climate Research Programme (WCRP)

The purpose of the WCRP is to determine the predictability of climate and the extent of man's influence on climate.

The major current activities of the WCRP are grouped into three streams:

A. Physical basis for long-range weather prediction on time scales of one month to a season. The primary physical processes under study are cloud-radiation interactions and the transfers of heat, momentum and water vapour into the atmospheric boundary layer from both land and ocean surfaces.

B. Interannual climate variations on time scales of one to three or four years. The primary physical process under study is the effect of variations of sea surface temperatures in the tropical oceans on global atmospheric circulations. This is being done under the TOGA programme, which stands for Tropical Ocean Global Atmosphere. Monsoon circulations are also being studied in this research stream. (The processes in stream A are included here).

C. Decadal climate changes up to about 100 years. The two primary physical processes on this time scale are the coupled ocean-atmosphere circulations (through WOCE, which stands for World Ocean Circulation Experiment) and the effects of increased carbon dioxide and other radiatively active gases on the climate system. (The processes in streams A and B are included here).

It is recognized that climatic changes on much longer time scales are also important in understanding the climate system but, given very limited resources, it has been decided to concentrate on those time scales of most immediate importance to mankind. Active research on the longer timescales is being carried on in many countries outside of the WCRP. In a more general sense, it is clear that many climate activities are underway throughout the world which are not explicitly included in the WCP but which contribute toward achieving its objectives.

4.4 The World Climate Impact Studies Programme (WCIP)

The purpose of the WCIP is to warn governments of the potential economic, social and political impacts of significant climatic variations or changes, both natural and manmade.

The major current activities of the WCIP are:

A. To improve the methodology of doing climate impact assessments, a new science essentially spawned by the WCP;
B. To determine the potential economic, social and political impacts of man-induced climatic changes, with a strong emphasis on the effects of increasing CO_2 and other radiatively active gases;
C. To determine the impacts on national food systems of climate variations and changes, with special emphasis on the effects of droughts.

Other activities in the WCIP include climate impacts on human health, water management and energy.

5. HOW IS THE WCP DOING?

5.1 Overall, some tangible results have been achieved toward meeting the WCP objectives but much still needs to be done to achieve the objectives. An evaluation of the results achieved so far in each component of the WCP is given below.

5.2 In the Data component the requirements have been reasonably well defined at this time but, as climate research uncovers new questions and as applications and impact studies develop new capabilities, the data requirements will change so this is a continuing process. The climate data referral system (INFOCLIMA) is coming along quite well, with the first issue due in 1986 and updates every two years. The CLICOM project has generated much interest especially in the developing countries and early versions of

CLICOM systems have been placed in a few countries, but we are still determining the general specifications for readily available microcomputer hardware and the software for climate data processing, which should be available by early 1986. Meetings on regional data banks have been held in West Africa, Southern/Eastern Africa, South East Asia and Latin America, but only in South East Asia has an effective regional climate data base been developed so far. The Climate System Monitoring (CSM) bulletin (which reports significant climatic events produced by ongoing activities) was initiated in 1984, with six-monthly issues to date (Jan. 1985) and an annual (1984) issue to be published soon. The CSM bulletin has generated much interest and several countries have offered products from their on-going activities. Overall in the Data programme, a good start has been made in each of the areas noted but much remains to be done in this immense task.

5.3 In the Applications component, much effort has gone into strengthening the capabilities of national services to perform effective climate applications. This has been done through expert missions, roving seminars on specific topics like wind or rain erosion, workshops, conferences, sponsoring university-level education, and publishing practical manuals on climate applications. The first three parts of the climate applications referral system - CARS-Food, -Solar Energy, -Wind Energy - have been published and more will be done in the next few years. The definition of requirements for climate applications and the definition of exactly how climate is related to specific application areas is proceeding slowly. Support is being given to develop new climate application techniques within the resources available. The WCAP has published a useful pamphlet on urban climate for the general public and recently held an international conference on this topic in Mexico City. Thus, a few results have in fact been achieved in the WCAP. But if we ask in how many cases have climate applications really made a significant difference in helping to increase crop production, conserve water or energy,

or in the design of cities or other human activities, then the answer must be very, very few. This response includes the developed as well as the developing countries. Much remains to be done.

5.4 In the Research component, a complete WCRP Plan was published in September 1984. The International Satellite Cloud Climatology Project (ISCCP) is underway and is proceeding very well, but it still has not received data from the Indian satellite. TOGA started officially in January 1985, but a complete implementation schedule remains to be completed. For the remainder of the planned WCRP activities, the WMO/ICSU Joint Scientific Committee (JSC) did in late February/early March 1985 develop the first draft of an implementation programme for the next 10 years or so, specifying who will do what in specified time-frames. So we now have a climate research plan, with a few activities beginning, and a draft implementation schedule. Given the complexity of the climate system, it very likely will be many years before we can expect a significantly improved understanding of the climate system which may allow credible climate predictions.

5.5 In the Impact Studies programme, the objectives have been narrowed to match the resources available and some few results have been achieved in this new science. A state-of-the-art volume on the methodology of climate impact assessments has been published in 1985. A project is underway to develop methodologies to determine climatic impacts in the cold climate margins and the dry margins; this work too is scheduled to be completed in 1985. A project to determine climate impacts on the national food system in India is underway but for many reasons few significant results have emerged so far. Thus, while there has been much improvement in defining a realistic programme for WCIP and several projects have been initiated, we must admit that so far not much real progress has been made toward achieving the third objective in the WCP - to warn of economic, social and political impacts of climatic events. This is understandable because the science of climate impact assessments is still very new.

5.6 This evaluation may seem to present a bleak picture of very little real progress in the WCP. On the contrary, tangible results have been achieved in every component. But, in comparison to the overall task, we have just begun to scratch the surface.

5.7 Why has progress been so slow? Many reasons exist of course, but in my opinion the main ones are:

A. The objectives of the WCP are very wide-ranging but the resources to do this job are quite small. Compare, for example, the much narrower focus of GARP Objective No. 1 which had far greater resources than the WCP. As a result, progress will be slow;

B. Research is being attempted into an extremely complex physical system, which we understand much better than we did 25 years ago, but it still presents many formidable problems including ocean-atmosphere interactions which we are just beginning to probe. Many basic processes in the ocean are still very poorly understood, let alone their interactions with the atmosphere. Add in the interactions with land surface processes and we have a highly complex physical-biological climate system which will take many years to unravel;

C. Applications are most needed in the developing countries which unfortunately have the least capabilities and the least funds to achieve effective results. Even in developed countries not much effort has been put into effective climate applications;

D. Climate impact studies are a brand new science which is even more complex than the physical-biological science on the climate system, because it includes human activities and responses. If one considers that not much capability exists now to make credible predictions in the overall fields of economics, sociology or politics then it is no wonder that progress is slow

in trying to achieve a capability to make credible predictions of the impacts of climate variations or changes. But the stakes are so high in this critical task that we must continue to try to achieve the objective.

6. WHERE IS THE WCP GOING IN THE NEXT DECADE?

6.1 Given that the organizations responsible for the WCP remain committed to its objectives and that much remains to be accomplished, it is not surprising that I believe that efforts will continue along the main lines already initiated in the WCP. I doubt that the next decade or so will see major breakthroughs in achieving any of the three main objectives. Rather, it will be hard, slow progress toward the solution of some difficult problems, with some useful results being achieved in the next decade and a half.

6.2 In general terms, I expect that the following will happen before the year 2000:

A. A very large increase in climate activities;
B. A very large increase in the ability to process, store and retrieve climate data (micros and video discs);
C. A large increase in climate applications;
D. A modest increase in knowledge of the climate system;
E. A modest increase in the capability to predict climate variations over short and medium terms;
F. A small increase in capability to predict decadal and longer term climate changes;
G. A small increase in ability to make credible impact assessments.

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