Statement by the UNEP/WMO/ICSU International Conference on

THE ASSESSMENT OF THE ROLE OF CARBON DIOXIDE AND OF OTHER GREENHOUSE GASES IN CLIMATE VARIATIONS AND ASSOCIATED IMPACTS VILLACH, AUSTRIA, 9-15 OCTOBER 1985

A joint UNEP/WMO/ICSU Conference was convened in Villach (Austria) from 9 to 15 October 1985, with scientists from twenty nine developed and developing countries, to assess the role of increased carbon dioxide and other radiatively active constituents of the atmosphere (collectively known as greenhouse gases and aerosols) on climate changes and associated impacts. The other greenhouse gases reinforce and accelerate the impact due to CO_2 alone. As a result of the increasing concentrations of greenhouse gases, it is now believed that in the first half of the next century a rise of global mean temperature could occur which is greater than any in man's history.

The Conference reached the following conclusions and recommendations:

1. Many important economic and social decisions are being made today on long-term projects–major water resource management activities such as irrigation and hydro-power, drought relief, agricultural land use, structural designs and coastal engineering projects, and energy planning–all based on the assumption that past climatic data, without modification, are a reliable guide to the future. This is no longer a good assumption since the increasing concentrations of greenhouse gases are expected to cause a significant warming of the global climate in the next century. It is a matter of urgency to refine estimates of future climate conditions to improve these decisions.
2. Climate change and sea level rises due to greenhouse gases are closely linked with other major environmental issues, such as acid deposition and threats to the Earth's ozone shield, mostly due to changes in the composition of the atmosphere by man's activities. Reduction of coal and oil use and energy conservation undertaken to reduce acid deposition will also reduce emissions of greenhouse gases, a reduction in the release of chloro-fluorocarbons (CFCs) will help protect the ozone layer and will also slow the rate of climate change.
3. While some warming of climate now appears inevitable due to past actions, the rate and degree of future warming could be profoundly affected by governmental policies on energy conservation, use of fossil fuels, and the emission of some greenhouse gases.

These conclusions are based on the following consensus of current basic scientific understanding:

- The amounts of some trace gases in the troposphere, notably carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), ozone (O_3) and chloro- fluorocarbons (CFCs) are increasing. These gases are essentially transparent to incoming short-wave solar radiation but they absorb and emit longwave radiation and are thus able to influence the Earth's climate.
- The role of greenhouse gases other than CO_2 in changing the climate is already about as important as that of CO_2. If present trends continue, the combined concentrations of atmospheric CO_2 and other greenhouse gases would be radiatively equivalent to a doubling of CO_2 from pre-industrial levels possibly as early as the 2030's.
- The most advanced experiments with general circulation models of the climatic system show increases of the global mean equilibrium surface temperature for a doubling of the atmospheric CO_2 concentration, or equivalent, of between 1.5 and 4.5 °C. Because of the complexity of the climatic system and the imperfections of the models, particularly with respect to ocean-atmosphere interactions and clouds, values outside this range cannot be excluded. The realization of such changes will be slowed by the inertia of the oceans, the delay in reaching the mean equilibrium temperatures corresponding to doubled greenhouse gas concentrations is expected to be a matter of decades.
- While other factors such as aerosol concentrations, changes in solar energy input, and changes in vegetation may also influence climate, the green- house gases are likely to be the most important cause of climate change over the next century.
- Regional scale changes in climate have not yet been modelled with confidence, However, regional differences from the global averages show that warming may be greater in high latitudes during late autumn and winter than in the tropics, annual mean runoff may increase in high latitudes, and summer dryness may become more frequent over the continents at middle latitude in the Northern Hemisphere. In tropical regions, temperature increases are expected to be smaller than the average global rise, but the effects on ecosystems and humans could have far reaching consequences. Potential evapotranspiration probably will increase throughout the tropics whereas in moist tropical regions convective rainfall could increase.
- It is estimated on the basis of observed changes since the beginning of this century, that global warming of 1.5 °C to 4.5 °C would lead to a sea-level rise of 20–140 centimeters. A sea-level rise in the upper portion of this range would have major direct effects on coastal areas and estuaries. A significant melting of the West Antarctic ice sheet leading to a much larger rise in sea level, although possible at some future date, is not expected during the next century.

- Based on analyses of observational data, the estimated increase in global mean temperature during the last one hundred years of between 0.3 and 0.7 °C is consistent with the projected temperature increase attributable to the observed increase in CO_2 and other greenhouse gases, although it cannot be ascribed in a scientifically rigorous manner to these factors alone.
- Based on evidence of effects of past climatic changes, there is little doubt that a future change in climate of the order of magnitude obtained from climate models for a doubling of the atmospheric CO_2 concentration would have profound effects on global ecosystems, agriculture, water re- sources and sea ice.

RECOMMENDED ACTIONS

1. Governments and regional inter-governmental organizations should take into account the results of this assessment (Villach 1985) in their policies on social and economic development, environmental programmes, and control of emissions of radiatively active gases.
2. Public information efforts should be increased by international agencies and governments on the issues of greenhouse gases, climate change and sea level, including wide distribution of the documents of this conference (WMO, 1986).
3. Major uncertainties remain in predictions of changes in global and regional precipitation and temperature patterns. Ecosystem responses are also imperfectly known. Nevertheless, the understanding of the greenhouse question is sufficiently developed that scientists and policy-makers should begin an active collaboration to explore the effectiveness of alternative policies and adjustments. Efforts should be made to design methods necessary for such collaboration.

    i. Governments and funding agencies should increase research support and focus efforts on crucial unsolved problems related to greenhouse gases and climate change. Priority should be given to national scientific programme initiatives such as (a) the World Climate Research Programme (WMO-ICSU), (b) present and proposed efforts on biogeochemical cycling and tropospheric chemistry in the framework of the Global Change Programme proposed by ICSU, (c) National Climatic Research Programmes. Special emphasis should be placed on improved modelling of the ocean, cloud-radiation interactions, and land surface processes.
    ii. Support for the analysis of policy and economic options should be increased by governments and funding agencies. In these assessments the widest possible range of social responses aimed at preventing or adapting to climate change

should be identified, analyzed and evaluated. These assessments should be initiated immediately and should employ a variety of available methods. Some of these analyses should be undertaken in a regional contest to link available knowledge with economic decision-making and to characterize regional vulnerability and adaptability to climate change. Candidate regions may include the Amazon Basin, the Indian subcontinent, Europe and Arctic, the Zambezi Basin, and the North American Great Lakes.

4. Governments and funding institutions should strongly support the following:

    i. Long-term monitoring and interpretation with state-of-the-art models of:

        a. radiatively important atmospheric constituents in addition to CO_2, including aerosols,
        b. solar irradiance, and
        c. sea lever.

    ii. Study and interpretation of the past history of climate and environment, specia1ly regarding interactions among the atmosphere, oceans and ecosystems.

    iii. Studies of the effects of atmospheric compostion and of changing climate and climatic extremes on sub-tropical and tropical ecosystems, boreal forests, and on water regimes.

    iv. Investigations of the sensitivity of the global agricultural resource base with respect to:

        a. direct effects of increases in atmospheric CO_2 and other greenhouse gases,
        b. effects of changes in climate, and
        c. probable combinations of these.

    v. Evaluation of social and economic impacts of sea-level rises.

    vi. Analysis of policy-making procedures under the kinds of risks implied by a significant greenhouse warming.

5. UNEP, WMO and ICSU should establish a small task force on green- house gases, or take other measures, to:

i. Help ensure that appropriate agencies and bodies follow up the recommendations of Villach 1985.
ii. Ensure periodic assessments are undertaken of the state of scientific understanding and its practical implications.
iii. Provide advice on further mechanisms and actions required at the national or international levels.
iv. Encourge research in developing countries to improve energy efficiency and conservation.
v. Initiate; if deemed necessary, consideration of a global convention.

REFERENCE

World Meteorological Organisation (WMO) (1986) *Report of the International Conference on the assessment of the role of carbon dioxide and of other greenhouse gases in climate variations and associated impacts,* Villach, Austria, 9-15 October 1985, WMO No.661.