Atmospheric Science and Public Policy

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From local problems such as urban air pollution to the global threat of human-induced climate change, and from immediate and practical issues such as aviation safety and natural disaster mitigation to fundamental questions of strategy for survival of life on earth beyond the next century, the contribution of atmospheric science is central to many of the great public policy challenges of our time (*1*). Under its more traditional label of "meteorology" (which I equate to atmospheric monitoring, research, and services in their broadest sense and which includes climatology), atmospheric science is well positioned to contribute to the resolution of these issues both within the United Nations system through the activities of the World Meteorological Organization (WMO) and also at the national level through the operation of the National Meteorological Services of the 185 Member states and territories of the WMO. There is ample evidence from all parts of the world of the enormous social, economic, and environmental benefits from the effective application of meteorological science and services to human needs (*2*).

In common with most other areas of science, however, and significantly more so than some, atmospheric science is passing through a period of unprecedented public and political scrutiny within a policy framework which threatens to place at risk many of the achievements and local and global benefits from 20th-century meteorology. The dilemmas facing the atmospheric science community are more deep-seated than the obvious questions associated with maintenance of an inherently cooperative endeavor in a rapidly globalizing economy (*3*) focused on the competitive advantage of nations (*4*). They are intimately linked to the radical changes now transforming international research (*5*) and the challenge that the quickening pace of policy formulation poses to the objectivity of science. Despite the remarkable progress of meteorological science and services under the globally cooperative regime that has operated since World War II and the many benefits to society that have flowed from it, atmospheric science has recently come under immense pressure to provide more definitive answers than the current level of investment can sustain, leading to disturbing crises of integrity within the meteorological community (*6*). It thus behooves us to confront these issues and ensure the protection of those characteristics of atmospheric science that guarantee, or at least support, the integrity and value of its input to sound public policy at both the national and global level.

Data Exchange

The most fundamental tension currently affecting the interface between atmospheric science and public policy relates to the free and unrestricted exchange of meteorological data and information between nations under the regime of international cooperation in meteorology which was put in place more than a century ago through the nongovernmental International Meteorological Organization (IMO) and which is now enshrined in the Convention of the WMO (*7*). It is based on the concept of meteorological data as international public property and meteorological services as public goods (*8, 9*). In close collaboration with the nongovernmental science community through the International Council of Scientific Unions and through globally coordinated observational and service programs such as the World Weather Watch (WWW), the WMO has established an international system of data collection and processing centers that enable the National Meteorological Services of the world to provide the best possible services in support of the safety and general welfare of their national communities with benefit-cost ratios at least of the order of 20 to 1. This system has also provided the essential data foundation for important global environmental research and for a rapidly expanding private-sector industry in the provision of specialized meteorological services in many countries. The free exchange of information and technology between developed and developing countries has played an essential role in the widely recognized success of this system and the recognition of the WMO as a model of international cooperation. It has also established the World Weather Watch as the basic building block, in both a technological and policy sense, for the integrated global environmental observing system needed to support the ambitious goals of sustainable development in the 21st century that are built into the Agenda 21 commitments from the 1992 Rio Earth Summit (*10*).

Ironically, however, just when the basic philosophy and global infrastructure of international meteorology were most needed as the foundation for the fundamentally important systems support for Agenda 21, they began to come under serious threat from other quarters. Under the influence of partial commercialization of the National Meteorological Services of some countries as part of broader government approaches to increased cost recovery and competition in the provision of public services, the pressures for restriction on the free flow of meteorological data and products among countries and between the public and private sectors became intense and, by mid 1995, operational meteorology was on the brink of an international data war (*11*).

Although not everyone was completely satisfied with all aspects of the outcome, the 12th World Meteorological Congress in 1995 achieved the remarkable feat of pulling the international meteorological community back together through its unanimously adopted Resolution 40 on Exchanging Meteorological Data (12), which reaffirms the basic principles of international cooperation in meteorology and sets down a series of guidelines on relationships in commercial meteorological activities.

Global commitment to follow up the unanimous adoption of Resolution 40 through rigorous adherence to both its letter and its spirit stands now as the greatest test ever faced by the international meteorological community. The prospects of success depend heavily on all the key stakeholders—governments, the private sector, the nongovernmental scientific community, and the National Meteorological Services themselves—becoming sufficiently aware of the issues at stake to recognize the overwhelming benefits for all concerned from the international cooperation that has served the world so well for so long. It will, however, require that governments, in particular, understand that every nation, even the poorest, has a small but essential contribution to make through funding the basic infrastructure of its National Meteorological Service as its share of the globally cooperative effort; and, even more importantly, that governments recognize the uniquely successful regime of international cooperation in meteorology as a distinct and vitally

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important framework of interaction among nations alongside those which operate in fields such as intellectual property, communications, trade, diplomacy, and defense.

Climate Change

If the continued exchange of basic data is the most fundamental internal policy issue facing the atmospheric science community, there is little doubt that the most demanding challenge from the external community has been, and will continue to be, to advise policymakers and governments on the threat of global warming and other long-term changes of climate as a result of the build-up of atmospheric concentrations of greenhouse gases due to human activities.

After grappling with the greenhouse issue within the atmospheric science community for almost a decade, there was a certain inevitability in the establishment of the Intergovernmental Panel on Climate Change (IPCC) as a joint mechanism of WMO and the United Nations Environment Programme (UNEP) in 1988. If, as was increasingly being suggested in the popular media, the greenhouse threat posed the need for a globally coordinated mitigation strategy which could impact adversely and differentially on national economies, it followed that some special mechanism was needed for providing an assessment of current knowledge that would both command respect within the scientific community and also serve to bridge the communication gulf between the science and policy communities. My recollection of the defining moment was the impassioned plea by the Principal Delegate of Botswana to the 1987 Tenth World Meteorological Congress that WMO establish some mechanism that would assist her, and others in similar positions to hers, to advise their governments on the genuineness or otherwise of the threat of global warming. On the basis of this intervention and drawing on earlier WMO experience with the Intergovernmental Panel for the First GARP Global Experiment, as well as a range of proposals put forward by various delegations, the concept of operation of the IPCC took shape (*13*).

Irrespective of the outcome from the forthcoming third session of the Conference of the Parties to the Framework Convention on Climate Change in Kyoto in December 1997, the IPCC's First and Second Assessment Reports must be judged as an outstanding achievement in objective scientific assessment and science-policy dialogue. Five decisions taken very early in the IPCC process were of critical importance, namely to: (i) invite UNEP to cosponsor the new body so as to achieve political/environmental as well as scientific and technical ownership of its work within the UN system; (ii) combine in one mechanism governmental representation and the primacy of individual scientific expertise; (iii) draw in the active research community through multi-author publication of the underlying scientific assessment material; (iv) insist that the IPCC must remain a scientific and technical assessment, rather than a policy formulation, mechanism; and (v) take special measures to involve experts from the developing countries in the assessment process.

The preparation of the First Assessment Report (*14*) and its use in framing the declaration of the Second World Climate Conference (*15*) and providing the scientific underpinning for the negotiation of the Framework Convention on Climate Change, endowed the IPCC with an international visibility and status which, in many ways, soon overshadowed that of its parent organizations. The February 1990 Edinburgh meeting of IPCC Working Group I lead authors, which produced the Summary for Policymakers and effectively endorsed the chapters of the underlying report, was, in many respects, the highpoint in the preparation of the First Assessment Report and left little to be criticized in terms of the integrity of science under pressure (*16*). Whether what eventually came out of the Sundsvall session of the IPCC in August 1990 had any real bearing on the international decision that there would be a Convention, or whether the political processes had already by then run well ahead of the science, remains, however, in my view, a matter for debate.

While the First Assessment Report was generally seen as a very successful experiment in taking stock of the state of knowledge of a complex scientific issue and presenting it in a form that would provide a useful foundation for the negotiation of the Convention, the IPCC's Second Assessment Report was destined to be subject to much more critical scrutiny of both its content and the process through which it was produced. This proved to be the case, with considerable controversy surrounding the final stages of the preparation of the Report. In taking stock of the Second Assessment a year or so after its completion, a number of observations may be offered as follows: 1) The Report's use of a definition of climate change that was different from that in the Convention has not contributed to the overall clarity of dialogue between the scientific and policy communities. 2) Although the integrity of the process survived rather well, the inherent tension of being both scientific and intergovernmental became more evident in the preparation of the Second Assessment Report than in the First. 3) Although lobby group pressures on delegations and individual scientists were extreme, it is debatable whether they had any net effect on the final content of the Report. 4) The pressure for consensus was intense, leading, some have argued, to apparently authoritative statements in the Report in cases where many in the scientific community would have preferred to conclude that no consensus exists. 5) The time demands on lead authors and reviewers and the tension between the proponents of concurrent and sequential review left some of the participants feeling exhausted and frustrated that a better job could not be done.

While these and other criticisms of the IPCC process probably have some validity, they should not detract from the overall achievement of the IPCC in the effective use of science in policy formulation on issues of enormous significance to the future of humanity. Undoubtedly the most significant controversy surrounding the Second Assessment Report has been that which erupted in the United States, in particular, over allegations of politically motivated rewriting of Chapter 8 (Detection of Climate Change and Attribution of Causes) of the Working Group I Report (*17*). Without going into the details of the controversy, I believe it is fair to say that, while there was some unavoidable informality in the IPCC procedures relating to Chapter 8—before, at, and after the November 1995 Working Group I session in Madrid—there was no conspiracy involved and the suggestions of "scientific cleansing" were unfounded. There was some inevitable naïvety on the part of some of the scientists who found themselves thrust into the politically charged environment at Madrid, a certain amount of passion on both sides of the scientific debate, and an understandable sense of urgency on the part of those who were committed to getting the Report approved and published in an appropriate up-to-date form, but there was no conspiracy.

Coordination Within the Earth Sciences

The need for an integrated and effective approach to natural disaster reduction, protection of the ozone layer, sustainable use of the world's water resources, response to climate variability and change, and the many other major issues of public policy to which the fluid Earth sciences are of central importance, has increased the awareness among the meteorological, oceanographic, and hydrological communities of the need for much stronger linkages among the disciplines and between the governmental and

nongovernmental scientific communities within these disciplines. This has become manifest in the burgeoning use of concepts such as earth system science (*18*) and integrated global observing strategy (*19*). It has also emerged prominently in the planning documents of the WMO (*20*) and the thinking of the group of eminent persons recently assembled by the Secretary General of WMO to look into the more effective application of the geosciences to improved understanding of the major issues affecting human survival, health, and socioeconomic well-being, as well as the ecosystems on which humanity depends (*21*).

These are important developments and it behooves governments and the international scientific community to study them closely and respond decisively. I believe that, if the atmospheric sciences are to maintain and enhance their outstanding record of contribution to human safety and welfare and to the formulation of sound public policy at local, national and global level, some important commitments must be entered into by governments, international agencies, and the scientific community. 1) The essential basic meteorological infrastructure of individual countries needs to be maintained and strengthened and the public interest role of National Meteorological Services needs to be enhanced. 2) The regime of international cooperation under the World Meteorological Organization needs to be reinforced, and the convention of free and unrestricted exchange of basic meteorological and related environmental data and products needs to be preserved. 3) Strengthened cooperation is needed among the geosciences of meteorology, oceanography, and hydrology; among the international agencies that foster them; and between the governmental and nongovernmental scientific communities that they embrace. 4) A coordinated international framework is needed for implementing and operating an integrated global observing system built on the World Weather Watch and the Global Climate, Ocean and Terrestrial Observing Systems. 5) A long-term investment is required in atmospheric and related earth system research in academic and governmental research institutions and especially in their contribution to the implementation of the jointly sponsored international research programs on weather, climate and global change. 6) Stronger support is needed from developed countries for the essential data collection, processing and service provision infrastructure of the National Meteorological Services of the developing countries.

The international scene on science-policy interaction in meteorology is evolving rapidly, particularly on issues that relate to global environmental change (*22*). The challenges are enormous and the opportunities for sustained contribution to human welfare and environmental sustainability in the 21st century are great.

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