



**Review of the Australian Bureau of
Meteorology**

**Australian Academy of Technology Sciences and
Engineering**

February 2007

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Submission by the

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Key Points

The key points of the Australian Academy of Technological Sciences and Engineering submission are as follows:

- **The nature and functions of the Bureau of Meteorology should be reviewed and adjusted periodically to accommodate the expanding requirements of a modern society and to the uncertainties in the impacts of climate change and the natural environment.**
- **The Bureau should deliver public-good services in order to help protect life and property from natural hazards and to optimise the benefit to the national economy through the application of meteorological information. These services should be funded from public revenue.**
- **The maintenance and enhancement of the Bureau's infrastructure to monitor and analyse all aspects of climate will be vital for the emerging impacts for climate change on communities and the natural environment.**
- **Australia's location also means that we benefit greatly from the free international exchange of meteorological data under the auspices of the World Meteorological Organization. To maintain our access to such data, it will be necessary for the Bureau to maintain an active role in the relevant international communities**
- **The Bureau's capability should be sustained by ensuring that staff are trained appropriately, by maintaining a strong in-house research capability, and by maintaining effective links with the external scientific community, including the universities and CSIRO in Australia.**

Introduction

The Academy of Technological Sciences and Engineering (ATSE) is pleased to provide comment on the issues raised in the Terms of Reference of the Review of the Australian Bureau of Meteorology.

The Academy was established in 1975 with the mission to promote the application of scientific and engineering knowledge to the future benefit of Australia. The Academy is one of the four learned national Academies, which have complementary roles and work together both nationally and internationally. The Academy has about 750 elected Fellows comprising the leadership of applied science and engineering across the country. The Academy is comprised of experts from a diversity of professions that use meteorological information in decision-making for the

development, operation and sustainability of a wide range of socio-economic services and infrastructure vital to the nation's everyday operation and future prosperity. Thus, the broad scope of the activities of Fellows provides a sound basis for the Academy to comment on the national needs for meteorological services.

The following remarks relate to some of the terms of reference of the review and take into account the specific issues raised in the covering letter. The remarks are preceded by a summary statement of conclusions and recommendations.

Summary

Owing to its geographical isolation and unique climate, Australia has always recognised the need to maintain self-reliance in meteorological services. This need is expected to grow in scale and scope over the 21st century owing to the expanding requirements of a modern society and to the uncertainties in the impacts of climate change on society and the natural environment. Thus the nature and functions of the Bureau of Meteorology should be reviewed and adjusted periodically to accommodate these evolving needs. These functions may evolve towards those of a national environment service.

The fundamental need for a National Meteorological Service is associated with the generation of public-good services, derived from the collection, analysis and interpretation of meteorological observations. The Bureau should deliver these services in order to help protect life and property from natural hazards and to optimise the benefit to the national economy through the application of meteorological information. As public goods, these services should be funded from public revenue. The quality, quantity and scope of these services should be competitive with products available from overseas sources.

The emerging impacts for climate change on communities and the natural environment will place additional pressure on the Bureau in the future to deliver appropriate climate services. The maintenance and enhancement of the Bureau's infrastructure to monitor and analyse all aspects of climate will be vital. The interfaces between meteorology, climate impacts and social response strategies are blurred, and the Bureau will need to play an increasing role in supporting information exchange at these interfaces.

Australia's location also means that we benefit greatly from the free international exchange of meteorological data under the auspices of the World Meteorological Organization. This benefit is especially significant in the exchange of satellite data for monitoring the atmosphere, ocean and land surface. To maintain our access to such data, it will be necessary for the Bureau to maintain an active role in the relevant international communities.

The effectiveness of the Bureau depends upon its scientific capability. This capability should be sustained by ensuring that Bureau staff are trained appropriately, by maintaining a strong in-house research capability, and by maintaining effective links with the external scientific community, including the universities and CSIRO in Australia.

Term of Reference: The general vision for creating a world leading 21st century meteorological organisation

As societies become increasingly averse to risk, they require detailed meteorological information to understand, predict and manage many phenomena associated with natural disasters. It is also found that timely and accurate meteorological information is increasingly

used to optimise the operation and management of many aspects of basic utilities, commerce and industry of a nation. A modern National Meteorological Service needs to be able to deliver the required information to reduce the risk of natural disasters and to optimise the management of the national economy.

With our relative isolation as an island continent in the southern hemisphere and our exposure to a unique and variable climate, Australia has always recognised that it must maintain self-reliance on meteorological information and judgement. The 21st century is imposing new and heightened challenges for National Meteorological Services arising from increasing population density, further land-use change, and climate change. Thus the vision for the future of a national meteorological organisation needs to recognise the changing needs of the nation. Australia's geographical extent also means that the differing regional needs must be accounted for in a national organisation.

While community needs for meteorological data and information grow in quantity, it is also apparent that the scope of the information needs also grows. The strong interactions between the atmosphere, land surface and ocean mean that similar scientific expertise is required to collect and analyse routine operational data in each of these domains. Thus National Meteorological Services are evolving towards national environmental services as routine monitoring and prediction services evolve to encompass oceanic, hydrological and air quality services. The scope of routine monitoring and prediction is expected to continue to increase, and the scale of the infrastructure required to provide the public-good services suggests that a single organisation provides the most efficient and effective means of delivering those services.

The substantial infrastructure associated with the collection and processing of meteorological and related data needs to be consistent with international standards so that a nation can benefit from the free and open exchange of global data established under the auspices of the World Meteorological Organization. This infrastructure and the basic meteorological products are well-recognised as public goods, which should be delivered to the community through the National Meteorological Service funded from public revenue.

Given Australia's geographical isolation, its meteorological services are very dependent upon data from specialised satellites operated by other countries. In the past, such satellite systems were operated by a relatively small number of countries, and for many years USA and Japan provided the main sources of meteorological data for Australia. However, several middle-level countries are now recognising the benefits of satellite systems focused on their region for national security reasons, including security from natural hazards and security of national communications as well as national defence purposes. Australia's ability to benefit from the satellite systems of other countries at no cost may become more difficult in the future as more countries make direct investments in the technology and become wary of freeloaders.

In addition to the basic public-good meteorological services, specific industries and individuals have needs for focused meteorological services. These services, which may range from detailed analysis of climatological data to site-specific weather forecasts, can be provided as private goods through commercial service providers. These service providers need access to the data held by the National Meteorological Service, desirably for no more than the cost of making them available.

Term of Reference: The impact of the Bureau on the Australian community and the ways in which this impact could be increased and linked transparently to the mechanism by

which funding is allocated

The provision of routine weather warnings and forecasts by the Bureau through the media and the Internet provides a continuing impact on the Australian community. Subjective surveys and statistical analyses show that the accuracy and timeliness of these services are increasing. The scope of the services has also increased, so that UV Indices and seven-day outlooks are now expected by the community. The impact of these basic services has been increased through improved delivery (especially through the Internet), increased accuracy (through continuing research and development), and increased scope. The increasing scope of the basic services is gained through enhanced technical capabilities, greater operational efficiencies, and careful market research to identify community needs.

The community also looks to the Bureau for climate, hydrological and marine services, in addition to the basic weather services. However, the Bureau is not always the most-recognised provider of these services. For example, a range of commercial organisations, government agencies and individuals provide seasonal climate forecasts for Australia, and some of these forecasts are available on the Internet from overseas sources. The Bureau will optimise the benefit to the Australian community by ensuring that it provides the highest-quality national-scale climate products as a benchmark and basic public good.

Term of Reference: The changing needs and expectations of users of climate and weather services in Australia

As noted earlier, the community has an increasing need for meteorological and related services in order to minimise risks and to maximise economic returns. With an essentially urban population, Australia needs weather services that provide timely warnings of natural hazards, such as flooding and hail, at suburban scales. With essentially continuous connection to the Internet through mobile phones and other technologies, communities are likely to expect timely warnings and forecasts of any natural phenomenon that could disrupt commercial or social activities at local scales.

The range of weather forecasts has been gradually increasing as the technological capability of the Bureau's operations has increased, and seven-day outlooks are now of some value. However, many decisions in agriculture and commerce depend upon variations at longer time scales. While there has been some progress with seasonal prediction, based largely on the influence of El Nino on Australian climate, the development of extended-range forecasts (from a week to a month ahead) is awaited by the community, in Australia and around the world.

The community has increasing awareness of the state of the environment, especially associated with air quality as well as water quality and quantity. The recent announcement by the Commonwealth Government of an expanded role of the Bureau to include the collection of water information on a national basis should help Australia move towards a nationally consistent approach to the collection and analysis of water data and information. The effective implementation of this policy will require cooperation with a range of agencies across all jurisdictions. This enhanced role of the Bureau should also provide the opportunity for it to take a lead in developing an internationally consistent approach to hydrological monitoring and analysis. International consistency is required to allow Australia to make comparative assessments of its water resources.

The monitoring of air quality is a responsibility that was devolved to the States in the 1970s,

despite Section 51(viii) of the Australian Constitution empowering the Commonwealth Government with responsibility for meteorological observations. For the last decade all jurisdictions have been labouring to develop a nationally consistent approach to air quality monitoring, but much remains to be done. Moreover, the delivery of air quality forecasts and warnings is evolving towards increasing dependence upon numerical weather prediction models. Such models are also used for strategic planning and air-shed management. There has been some progress with the Bureau cooperating with CSIRO and Environmental Protection Agencies in each jurisdiction to develop the required national capability. The future needs of the Australian community for air quality services may require greater involvement of the Bureau of Meteorology, given its formal role for meteorological monitoring and its technical capability in numerical weather prediction.

Advances in both satellite-based and in situ observing systems has led to a revolution in our capability to monitor and predict the ocean. The strong interactions between the ocean and atmosphere has meant that the Bureau has been involved in this revolution. The new ocean capabilities are being exploited by specific industries (e.g. off-shore exploration), but the development of public-good services could probably be developed further and faster. There would be an overall nation benefit if an appropriate range of public-good ocean and marine services was developed by the Bureau to complement the evolving commercial developments. The reasons for public-good ocean services are analogous to the situation for atmospheric services.

Term of Reference: The service model of the Bureau of Meteorology in relation to resources and assess the risks arising for key stakeholders such as defence, aviation, public safety and well-being, Australian government agencies, industry and the private sector

The structure of the Bureau of Meteorology reflects the federal nature of Australia. National consistency is maintained by having clear national authority for the development of basic infrastructure and expertise. However, most services are delivered at the local level and so a strong presence in major urban areas is important in ensuring that services are responsive to local needs.

The role of the Bureau itself in interacting with the various sectors of Australian government and industry is expected to evolve with management fashions. However, the enduring requirement of a national meteorological agency is that it provides nationally-consistent public-good services to the whole community. Those services need to include areas such as aviation where safety and national well-being depend upon international consistency, authority and standards. The issuing of warnings of natural hazards should also be a clear public-good service, for reasons of national safety and well-being.

The Bureau's public-good services are delivered to the community as its basic meteorological products. The basic products evolve in accuracy, scope and delivery mechanism as scientific capability and technological development increase. The Internet is becoming a primary source of public-good meteorological information, with the services being delivered from many places around the world. It is important that the Bureau ensures that its basic products are at least comparable in quality and scope with those available from other sources.

The effectiveness of a National Meteorological Service depends upon its scientific capability, both in its ability to carry out its service functions and in its credibility with its stakeholders at

national and international levels. The Bureau has recognised the importance of scientific capability by ensuring that all its staff are trained appropriately for their functions, by maintaining a strong in-house research capability, and by maintaining effective links with the external scientific community in Australia and overseas. To fulfil its role, the in-house research needs to maintain a balance of strategic and applied research serving the broad needs of a National Meteorological Service, and not just the needs of external agencies that will fund specific research projects.

The small population of Australia means that the total meteorological community in the Bureau, other government agencies and the universities is not large by any standard. It is therefore vital for the health of the science in Australia that the Bureau maintains effective ties with the universities in research and training, recognising their complementary roles. The relationship between the Bureau and CSIRO is currently developing under a joint venture, which could lead to more effective cooperation between these government agencies. However, history has demonstrated that it is vital for the Bureau to maintain direct links between its research and operational units.

Term of Reference: The capacity of the Bureau to contribute to monitoring of and preparation for climate change and related weather events

By definition, climate change is a global phenomenon and so Australia has to cope with both national and international issues. Monitoring climate change is perhaps the most difficult monitoring problem for National Meteorological Services because the associated signal tends to be masked by the natural variability of the climate system. Thus, the systems need to be of high quality and precision, and they should also be distributed at sufficient spatial density to detect variations of regional relevance. The scope of measurements needs to include variables that are particularly important to Australia, such as soil moisture, but that may be difficult to measure accurately. Moreover the systems need to be integrated with the systems of other countries, conforming to international standards and with data being freely exchanged. Thus, the Bureau needs to at least maintain its current infrastructure for monitoring climate and to maintain its involvement in the international processes, especially the Global Climate Observing System (GCOS), aimed at optimising the overall global systems. The relative isolation of Australia and its dependence upon the systems of other countries are substantial reasons for such international involvement.

Associated with the collection of observations is the analysis of those data to assess the state of our climate and to estimate future climate. The Bureau has a significant capability in climate analysis and it continues to enhance its links with other agencies so that meteorological information is provided effectively to other agencies and the general community. The uncertainties associated with the potential impact of climate change on national infrastructure are driving the need for 100-year projections of variables such as the frequency of tropical cyclones, sea level rise and local flooding, and the Bureau will need to support efforts to make those projections. Indeed the interfaces between meteorology, climate impacts and social response strategies are blurred, and it is likely that the Bureau's role at these interfaces will increase, as the need for meteorological expertise is recognised. As noted earlier, the growing community need for routine environmental data and information (extending beyond pure meteorology) may lead to the establishment of a national environment service, based on the functions and expertise of the Bureau. The Bureau's longstanding and substantial contribution to the assessments of the Intergovernmental Panel on Climate Change (IPCC) demonstrates its technical capabilities in climate science.

The development of the numerical models used for the simulation and prediction of future climates is now a major undertaking. Over the last forty years, climate modelling has evolved from the work of an individual scientist, to the work of a team of scientists and technical support staff and now to the work of an organisation of specialised teams. To provide the required concentration of expertise the Bureau is collaborating with CSIRO and the universities to develop the Australian Community Climate and Earth System Simulator (ACCESS). This important initiative will need sustained and substantial support to ensure that the output is more than the sum of the parts. In particular, the computing infrastructure required to support a world-class effort is very substantial. The required infrastructure and expertise may be best established under a focused national environmental computing facility (based on the existing joint Bureau-CSIRO facility) involving the Bureau, CSIRO and the Australian Partnership for Advanced Computing (APAC).

In summary, it is clear that Australia with its relative isolation and highly variable climate is very dependent upon the functions of the Bureau of Meteorology for the well-being of its citizens and for the economic development of its industry and commerce. The range and quality of the associated meteorological services are expected to evolve as the technological capability of the Bureau and the needs of the community expand.