A Submission to the
Review of the National Innovation System
Department of Innovation, Industry, Science and Research
Canberra

24 April 2008

Contact: Professor Kurt Lambeck FAA
President
Australian Academy of Science
GPO Box 783
Canberra ACT 2601
Tel: (02) 6201 9400
Fax: (02) 6201 9494
Email: es@science.org.au

Climate Change Knowledge Production, Application and Dissemination:-
Addressing the major barriers to innovation

Climate change poses a severe threat to Australia because it directly or indirectly affects every component of our natural and human environments and the economy, from iconic flora and fauna to human health to production and key export industries. Our region is susceptible to impacts on water availability and quality, food security and infrastructure. In a globalized world, climate change impacts occurring anywhere in the world could trigger structural adjustment throughout the global economy, with influences in Australia on productivity, trade, and capital flows.

Climate science has provided the evidence that observed changes in global climate over the past 100 years are indeed predominantly and increasingly attributable to human activities. Following community acknowledgement that climate change over recent decades is real and largely human-induced, we are now faced with urgent scientific challenges for innovative support of finding ways to adapt to the unavoidable further warming already committed by past emissions and additional warming from continuing emissions. This includes increasing the detail of climate change prediction for local adaptation, determining the effects of mitigation policies, and warning of the potential and risk of catastrophic changes ("tipping points"). Such science, while internationally linked, must be done in Australia to address the unique systems and processes of our land and to focus on local regions and issues. The gathering pace of observed climate change, and of international protocols to address it, sets the urgency of keeping pace in global climate change science.

To meet the grand challenge posed by climate change we require a comprehensive and highly integrated climate science effort, in which natural scientists collaborate in a whole-of-system approach. At present, our research efforts across the many relevant facets of earth system science are seriously under-resourced compared to what is needed to meet this urgent national challenge. Research groups remain poorly integrated, despite recent moves to consolidate efforts.

To answer pressing climate-change threats to economic and ecological sustainability, and to national security, road blocks to progress need to be removed in the following three areas.

1. Infrastructure.

(a) Coordinated continuous observations – *in situ* and via satellite - over long time periods are needed to track changes to the global and Australian environments and interpret causes of change. Given the past decline in observational infrastructure administered by the Bureau of Meteorology, this now requires an increase in investment. Only Australians will monitor Australian climate change and its impacts in detail.

(b) A greatly expanded Australian supercomputing ability is urgently needed for modeling our changing climate and its impacts at resolutions high enough for the needs of adaptive innovations. Australia maintains the last climate system modeling effort in the Southern Hemisphere, but our computational resources are at least an order of magnitude less than other modeling centres internationally. To be effective, the supercomputing infrastructure must be accessible to the entire research community.

(c) Innovation in research relies on major experimental infrastructure such as research ships, flux towers, and Free Air CO_2 Enrichment facilities. These investments in our competitiveness need to be adequately resourced on a continuing basis so that they can be maintained and kept technically up to date over decades.

2. Human resources.

(a) We have seen a dramatic increase during 2007 in demand by government and industry for climate knowledge support. The demand, particularly concerning changes in climate variability and extremes, will grow with continuing climate change over decades. More research personnel are needed to develop models and theory, to interpret observations, data time-series and experiments, and to work with industry and decision makers to interpret results correctly. At present the number of graduates beginning Ph.D. studies in earth system science is inadequate for both present and future demand. It is vital that the universities build and adequately support undergraduate and postgraduate programs, and enhance institutional cooperation.

(b) Administrative, legal and research classification framework problems, deriving from distinctions between traditional academic disciplines and historic roles of institutions, are impeding earth system research. The ACCESS modelling activity within the new Centre for Australian Weather and Climate Research (CAWCR) is an encouraging start showing how institutions (CSIRO & BOM) can link their research effort to eliminate duplication.

3. Information management.

Massive bodies of observational data and model output results are generated in this field. Ready access by diverse investigators for analysis, synthesis and interpretation requires a national data management system. A growing commitment beyond the current NCRIS process is required to ensure data access, consistent data use protocols, data security, and continuity of data through time across changing instrumentation, definitions, computer-models and data storage devices. As with routine environmental monitoring, the information management systems need to be sustained for many decades, well beyond the life cycles of individual researchers or of governments.

A balanced expansion

Perhaps we could have been forgiven in the 20th century for treating climate change as merely a future inconvenience to the global community. We now know that further climate change is as serious a threat to human well-beings as any we have faced. Earth system science has recognized the grand challenge of providing reliable, salient and timely knowledge of the climate system integrated in a whole-of-earth system understanding.

Reducing the barriers to innovation in climate change science capability is achievable only with commitment to the three key deficiencies discussed above, to integrated engagement of the whole pertinent research community, and commitment of resources by government. Major environmental problems afflicting Australia had their genesis many decades ago. The natural timescales of the phenomena involved greatly exceed the longevity of governments, grant programs, departments, even institutions. Relevant infrastructure, research programs and data management need continuity of commitment. Ways need to be found, within the independent peer review process, to ensure the most efficient long term commitment of research personnel to these activities.

The scale of the problem is enormous, and the challenging nature of the research tasks needed to foster innovative adaptation demands that the scope of these research activities ramp up over a very few years to be several times their current magnitude. The needs are now obvious and the required expansion is urgent. It is in Australia's interests to be a world leader in understanding the trajectory and effects of human-induced climate change. It is realistic to aim to be the source of information for Southern Hemisphere nations. Australia's national heritage, prosperity and security will not be assured unless we grasp this challenge urgently.

Four early steps in such a balanced expansion are:

- government to commit to a major upgrade of Australian large scale national computing infrastructure at least to current international standard for earth system simulation,
- the Australian Research Council to establish an Earth Systems Science panel for evaluation of highly multidisciplinary earth system proposals, with an associated increase in real funding. Large projects of longer duration (5 years) should be encouraged
- establishment of a working group structure for developing a comprehensive, coherent and enduring environmental data management system in the context of international earth system data management
- renewed commitment to the maintenance of existing climate monitoring networks and new investment in observational infrastructure underpinning earth system science

Australian National Committee for Earth System Science. April 2008.