A submission to the Prime Minister's Science, Engineering and Innovation Council Working Group on Australia's Science and Technology Priorities for Global Engagement

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Introduction

This submission from the Australian Academy of Science to the PMSEIC working group on Australia's science and technology priorities for global engagement comments on:

- the role of the Academy in maintaining formal linkages to global activities;
- the National Committees for Science that underpin those global activities;
- the international networks of Learned Academies;
- the International Science Linkages Programme administered by the Academy on behalf of the Australian Government Department of Education Science and Training (DEST);
- informal networks and international collaborative links;
- formal Australian Government arrangements to promote global engagement in science and technology; and
- US Department of State Embassy Science Fellows Program.

The submission also includes an Appendix with some case studies of Australia's involvement in international scientific activities.

The role of the Australian Academy of Science in international linkages

The Academy of Science is Australia's representative on the International Council for Science (ICSU) and many of its constituent organisations. The Academy has also taken a leading role in Australia in some other international programs, for example the International Geosphere Biosphere Program (IGBP) that is funded with support from the Department of Environment and Heritage.

A significant role for the Academy of Science involves administering of funds on behalf of the Australian government to engage with international scientific organisations with a minimum of bureaucracy and administrative cost for maximum effect. About two thirds of the Academy's DEST grant-in-aid is expended in subscriptions to ICSU and more than thirty international scientific unions and programs. The grant-in-aid also supports Australian voting delegates to attend business meetings of the international unions and meetings of the National

Committees within Australia. At any time, about 300 Australians hold honorary offices in ICSU organisations.

Recently, the Academy of Science undertook an ARC-funded study, *Maximising the benefits of Australia's formal linkages to global scientific activities*, to examine mechanisms to enhance Australian scientific involvement in global scientific programs, including the mechanism of subscriptions to international unions. An analysis of the subscription levels to the major global scientific unions suggested that the Academy is subscribing at appropriate levels to most of these organisations.

The report assembles an inventory of significant global scientific organisations and collaborative opportunities in which Australian scientists and scientific institutions might reasonably be expected to be involved, and maps the extent to which Australia is currently engaged in these programs. The report then outlines the benefits that flow from that engagement. The nature and extent of any gaps between current participation in global scientific programs and potential opportunities are assessed. Mechanisms to enhance Australian scientific involvement in global scientific programs, including the mechanism of subscriptions to international scientific organisations, are also evaluated.

The report finds that Australia is reasonably well-engaged in formal global scientific activities. Approximately 100 major global scientific organisations are identified, along with many more significant activities and organisations under these linkages. Australia has formal ties to variable degrees with almost all of the global scientific organisations in which Australian scientists and scientific institutions might reasonably be expected to participate.

Several clear benefits from Australia's formal engagement with global scientific organisations are identified in the report. For example, from Australia's relatively modest membership contributions, a proportionally high number of scientists are involved in leadership roles in global scientific organisations. Australia's formal engagement has also resulted in a large number of significant international scientific conferences being held in Australia, including the General Assemblies of almost all of the ICSU unions, which attract up to 6000 delegates. Other benefits include the development of formal and informal links with overseas scientists (resulting in increased international collaboration in Australian scientific publications), involvement in cutting-edge international science (particularly science that can only be carried out on a global scale), showcasing of Australian science, leveraging the scientific funding

provided by larger nations, as well as the political influence and capacity building possible in developing countries (particularly in Australia's region).

Although Australia is well-engaged with the main global scientific organisations, this study has identified several strategically important gaps. It is recommended that Australia closes these gaps by becoming a member of the following organisations:

- an Integrated Programme of Biodiversity (DIVERSITAS);
- International Group of Funding Agencies for Global Change Research;
- International Human Dimensions Programme on Global Environmental Change; and
- Integrated Ocean Drilling Program.

Australia should also consider rejoining:

- the Committee on Data for Science and Technology; and
- the Scientific Committee on Problems of the Environment.

These organisations deal with scientific topics of global prominence that cut across national boundaries, and complement the activities of global science organisations to which Australia is already a member. Australia must formally engage with these organisations, and maintain existing arrangements with other globally-relevant scientific organisations, in order to maximise the benefits of Australia's linkages with global scientific activities.

National committees

The Academy supports 20 National Committees for science. These foster a designated branch of natural or applied science in Australia and serve as an effective link between Australian scientists and overseas scientists within a particular discipline, as well as advising the Council of the Academy of Science on relevant matters. National Committees are frequently called on for advice on science policy matters, on proposals for Academy sponsorship of scientific conferences, and on proposals for grants from special purpose funds.

National Committees prepare documents on the state and outlook of their respective disciplines. For instance, the National Committee for Astronomy recently launched a decadal

review of Australian astronomy and astrophysics, while the National Committee for Mathematical Sciences is undertaking a national strategic review of mathematical sciences. These reviews follow a *National Strategic Plan for the Geosciences*, October 2003, prepared by the National Committee for Earth Sciences.

National Committees maintain active links with relevant scientific societies and international organisations, the latter of critical import for a small and isolated nation that produces from 2 to 3 per cent of the world's scientific papers. The National Committees are assisted in their meetings and other activities by the Academy of Science's secretariat, and the Academy hosts a biennial meeting of Chairs of National Committees in Canberra, to encourage best practice by sharing ideas for the efficient and effective operation of the Committees.

An important responsibility of National Committees is to bid for, and host, international congresses of ICSU unions in Australia. To date, fifteen international congresses associated with ICSU unions have been held in Australia. Recent congresses held in Australia include the:

- 41st General Assembly of the International Union of Pure and Applied Chemistry, Brisbane, 2001;
- 25th General Assembly of the International Astronomical Union, Sydney, 2003;
- Joint International Association of Geodesy /the International Association for the Physical Sciences of the Ocean /the International Association for Biological Oceanography, Cairns, 2005;
- XXIX meeting of the Scientific Committee on Antarctic Research, Hobart, July 2006; and
- the International Geographical Union Regional Conference, Brisbane, July 2006.

Plans are to host a number of international congresses in future years, including:

- XVII International Union for Quaternary Research Congress, Cairns, July 2007;
- 18th International Botanical Congress, Melbourne, July 2011; and
- 34th International Geological Congress, Brisbane, August 2012.

The Academy of Science encourages National Committees to organise international congresses in Australia, not only for national economic benefit, but to showcase Australian

science and to provide opportunities for younger Australian scientists to be exposed to cutting-edge science and scientists.

Inter-Academy Panel on International Issues (IAP)

The primary goal of IAP is to help member academies, numbering 93, to work together to provide advice on scientific aspects of critical global issues. It is particularly interested in helping younger and smaller academies to achieve these goals. The Academy of Science has been a member of IAP since its inception in 1993 and was a member of the IAP Executive from 2001 to 2003. The IAP has released statements on scientific capacity building, science education, science and the media, access to scientific information and mother and child health. The Academy of Science has provided input to IAP on Australian science education for the IAP portal, and into a statement calling on the United Nations to ban human reproductive cloning, but not the use of cloning techniques for approved research in cell biology.

Federation of Asian Scientific Academies and Societies (FASAS)

FASAS was established in 1984 to promote greater awareness of the roles of science and technology in nation building and regional development. The Academy of Science is one of 15 member academies and has been a member since 1995. The FASAS secretariat is based in Kuala Lumpur.

The Australian Academy of Science hosted the 2005 meeting of the FASAS executive in Canberra on 7–9 September; and in September 2006 the President of the Academy attended the annual meeting of the FASAS executive in Singapore. This network of academies can be mobilised quickly to share information, in the case of extreme events, such as SARS and the Indian Ocean tsunami, and in the case of future threats such as pandemic influenza. FASAS further provides a platform for scientific academies in Asia to collaborate in scholarly endeavours.

International Science Linkages Programme (ISL)

The Australian Academy operates an international scientific collaborations program to improve Australian access to global science and technology in North America, Europe and northeast Asia. This scheme is funded under DEST's ISL Programme as announced in the *Backing Australia's Ability: The Australian Government's Innovation Report 2005–06,* that will continue to be funded until at least 2010–2011.

The objectives of the Academy's program of international scientific and technological collaborations are to improve Australian access to science and technology and to increase awareness of Australian research. The Academy's program gives Australian researchers the opportunity to collaborate with foreign colleagues, to widen research perspectives and experience, to exchange ideas, to be recognised in the international arena, to gain information and knowledge of techniques that will stimulate and advance Australian research, and to be involved in large international projects. The Academy's international programs are structured into four sections: short-term visits to Europe, North America and Asia, and long-term postdoctoral fellowships. The programs support collaborative research between professional Australian scientists and technologists and their colleagues in Europe, Korea, China, Japan, Taiwan, USA, Canada and Mexico. The Academy also administers postdoctoral fellowships with Japan and Korea. The programs provide funds for living and travelling costs.

Bilateral activities provide opportunities for Academy officials and government officials to meet with high-level international researchers and research funding agencies, to discuss international science and technology policy and practices, and to promote Australian research and technology. They also help to promote and strengthen long-term relationships and increase Australia's presence and influence at the international level. Meetings between Academy representatives and their international counterparts provide an opportunity to discuss the operation of a particular program and make necessary modifications to ensure a program is meeting its objectives. A large portion of the Academy's bilateral activities is funded under DEST's International Science and Technology Networks, a component of the ISL Programme.

The Sir Mark Oliphant International Frontiers of Science and Technology Conferences

The Australian Academy of Science and the Australian Academy of Technological Sciences and Engineering jointly administer the Sir Mark Oliphant International Frontiers of Science and Technology Conference scheme which supports two prestigious international conferences in the emerging sciences each year.

Informal networks and international collaborative links

In terms of subject matter for investigation, all portions of the Earth are of equal importance to understanding the integrated functioning of the earth's biophysical system under human pressure. In terms of source of ideas and collaborative links, the more scientifically advanced a nation, then the greater the opportunities they provide for helping to build mutual capacity.

The Institute of Scientific Information (ISI) in Philadelphia maintains an electronic data-base, the *Web of Science*, which lists scientific publications according to authors, title, journal, date of publication and addresses of authors. In order to record the extent of collaboration between Australian participants in the Australian Academy of Science International Programmes and colleagues in the host country, the ISI electronic data-base can be searched for jointly authored scientific papers. For example, in a recent study it was found that scientific papers by participants in the Australian Academy of Science Programme that were jointly authored with an international collaborator were cited in the international literature more than twice as often as Australian papers with national coauthors.

Considerable linkages exist outside formal arrangements and agreements. A study by Butler (2004) examined 12,212 publications (from 1996 to 2000) arising from ARC-funded projects and fellowships.[1] Of these publications, 37% had a joint authorship reflecting international collaboration. Collaboration in western Europe accounted for 49% of the publications, the USA for 34%, followed by Japan (8%), Canada (7%) and New Zealand (3%). China and India accounted for 5% and 1 % of the publication links respectively. Butler (2003) also examined international collaborations arising from National Health and Medical Research Council supported publications (from 1996 to 2000), where joint authorship with an overseas

[1] Linda Butler, February 2004. (Research Evaluation and Policy Project, Research School of Social Sciences, The Australian National University for the Australian Government, Australian Research Council). ARC–supported research: the impact of journal publication output 1996–2000. p14

collaborator accounted for 34% of the publications.[2]Collaborations in western Europe accounted for 53% of publications, the USA for 45%, followed by Japan (7%), Canada (6%) and New Zealand (4%).

Formal Australian government arrangements to promote global engagement in science and technology

There is a perception among Australian scientists that Australia does not use science as a foreign policy tool as effectively as do some other countries. The Australian Centre for International Agricultural Research (ACIAR) (with a budget for 2006–07 of $50.3 million) is an Australian Government statutory authority that operates within the portfolio of Foreign Affairs and Trade (DFAT), as does the Australian Agency for International Development (AusAID) (with a budget for 2006–07 of $2.946 billion, including debt relief). These two agencies contribute to global engagement in science and technology in certain high priority developing countries. This scientific contribution is through sustainable development in the case of ACIAR and by addressing the threat of pandemics such as avian influenza and communicable diseases in the case of AusAID. However, the mainstream scientific collaborations between Australians and their counterparts in Europe and North America seem to go largely unnoticed by DFAT and its missions overseas.

Importantly, the Australian Academy of Science has observed a reduction in the members of scientific counsellors based in Australia's overseas missions, and where these counsellors are in place, the emphasis in their portfolios seems to have shifted from science and technology to recruitment of international students to Australian schools and universities. The Academy of Science suggests that the PMSEIC working party might examine ways in which some other countries integrate science into the foreign policy process. One example from the US is summarised here.

[2] Linda Butler, October 2003 (Research Evaluation and Policy Project, Research School of Social Sciences, The Australian National University project for the Australian Government, National Health and Medical Research Centre) NHMRC – supported research: the impact of journal publication output 1996–2000. p13

US Department of State Embassy Science Fellows Program

In May 2000 the US Department of State made public a new policy mandate to strengthen the State Department's capacity to integrate science, technology and health factors into a broader spectrum of the foreign policy process. This initiative was stimulated by a 1999 report by the National Research Council and National Academies of Science, which concluded that 13 of 16 US international affairs strategic goals encompass science, technology and health issues, and that the State Department must become better prepared to address these factors.

A major objective in this effort was the creation of active, long-term partnerships with the science and technology community in government, academia and the private sector. The Embassy Science Fellows program is a successful example of just such a partnership, a joint venture initially between the State Department and premier US Government technical agencies. The Embassy Science Fellows Program provides a valuable mechanism through which the Department of the State can work with other agencies of the US Government to assist them in advancing national research and development priorities through international collaboration and explore the degree to which new broad-scope umbrella science and technology agreements can provide a venue for the types of relationships, which will benefit the US Government technical agencies.

The program builds upon the complementary strengths and needs of the partner organisations. The Embassy Science Fellows Program meets the objectives of all partner agencies in allowing posts to acquire high-level scientific advisory capacity to address science and technology issues important to their missions, while simultaneously providing agency staff an opportunity for valuable international experience, training and networking.

North Atlantic Treaty Organisation (NATO) Science, Technology and Research Network

In order to foster resource sharing, the NATO Research Technology Agency recently finished the initial development of its science, technology and research network, STARNET, a collection of scientific data sources freely available on the Internet (//starnet.rta.nato.int). The purpose of this network is to facilitate access to the non-classified scientific information

already existing in many different countries. The STARNET virtual library focuses on seven different topic areas or ‘nodes’. They are the:

- Aerospace and Aerospace-Related Research Information Node;
- Defense Against Terrorism Node;
- Environmental and Biological Sciences Node; Information Science Node;
- Land-Based Operations Node;
- Naval, Marine and Sea-based Operations Node; and the
- Research Planning Node.

NATO is currently seeking feedback on STARNET as well as suggestions for additional resources to include in the network.

Appendix 1

Australia's international role in climate change science

In the area of Climate Change Science, Australian scientists currently have extensive interactions internationally through intergovernmental bodies such as Intergovernmental Panel on Climate Change (IPCC) and Intergovernmental Ocean Commission (IOC) as well as the international science research agencies such as World Climate Research Programme and International Geosphere-Biosphere Programme (IGPP) and the experimental programs that these science bodies spawn (eg. WOCE, CLIVAR) and international science bodies, such as Scientific Committee on Oceanic Research. Australia is developing new partnerships in this area of science with a new US meteorological partnership.[3]

It is only natural that one day, Australia should be recognised as the world leader in predictions of-, and in recommending adaptation to-, climate change on all manner of sectors in the economies of countries in the southern hemisphere. This requires a very strong commitment to the physical and biological sciences that are involved in the coupled ice-ocean-atmosphere system, as well as a much expanded effort in links between this fundamental science activity with the effects on the various communities (eg. environment, farming, electricity generation, insurance). These must be two-way links as for example, a change in land use affects the evolving climate. Australia, as the only developed economy in the southern hemisphere, and located in a convenient location to observe the Southern Ocean, should be in the box seat to become the provider of climate knowledge and climate solutions to all nations in our hemisphere. I am yet to see or hear the 'political' will among the agencies to take on this challenge. This area of science certainly ranks as an emerging area, and will become increasingly more important to the economy. It has a natural link in to the energy sector, as the science here feeds back in providing the urgency (or not) for adopting new and different energy options (eg. electricity from nuclear energy). It also has a natural link to water supply issues for cities and farms, including the farms that might 'grow' ethanol for our cars. So these considerations are deeply embedded in Priority Areas.

[3] Hunt, G. Media Release GH060/06: Historic Australia – US meteorological partnership signed today. 25 March 2006. Available at: www.deh.gov.au/minister/ps/2006/psmr25mar06.html

Positive developments are:

- National Collaborative Research Infrastructure Strategy (NCRIS) funding of $53m over 5 years for marine observations, mainly in the coastal region;
- The appointment of three Federation Fellows in this area of work (Amanda Lynch, Monash University; Matthew England, University of New South Wales; and David Karoly, University of Melbourne);
- The initiation of Australian Community Climate and Earth Systems between CSIRO, the Bureau of Meteorology (BOM) (and some small university involvement) to reduce duplication between the agencies and to develop a more comprehensive climate model; and
- an ARC coordination grant administered by Professor Andy Pitman at Macquarie University that facilitates collaboration between research at the universities and at CSIRO and the BOM.

However, these four positive developments are not sufficient to ensure that Australia appears on the world map as the world leader in southern hemisphere climate change (in say four years).

Submitted by Dr Trevor McDougall, Chief Research Scientist CSIRO Marine and Atmospheric Research

Case Study: *Climate Activities in Australia Report*

Every two years the Australian Academy of Science together with the BOM and Australian Greenhouse Office (AGO) produces the *Climate Activities in Australia Report.* Although the title of this publication suggests a domestic focus, about half the content is devoted to Australia's engagement in international climate activities.

Information for the Report is provided by The Australian Academy of Science's National Committee on Climate and Global Change; The BOM's National Climate Centre; the AGO; the Australian Joint Working Group for Global Climate Observing System/ Global Ocean Observing System/ Global Terrestrial Observing System; Australian delegations to sessions of the IPCC and its Working Groups.

The proud tradition of the Australian Academy of Science in international networks and enhancing the competitiveness of Australia's science and technology since its formation in 1954 is outlined in a report compiled by Dr Fiona Wood and Dr Keith Boardman (1999), *International Networks and the Competitiveness of Australia's Science and Technology*. Since this report, international collaboration in science and technology research has grown considerably.

On a practical level, many of the scientific challenges facing modern nations, such as climate change and security, are global rather than national and need to be tackled collaboratively. While professional specialisation is becoming increasingly narrow, many of the practical applications of science cut across numerous disciplinary boundaries, making collaboration essential.

Recent studies of international scientific cooperation find that more than half of these links are researcher-to-researcher collaboration.[4] Other commonly funded activities include access to large, overseas research facilities; government-to-government arrangements such as treaties and memorandums of understanding; fellowships, exchanges and awards; and organisation-to-organisation agreements.

Australia's international role in Earth system science

In Earth systems science, Australian punches well above its funding-weight internationally. That the Global Carbon Project is headquartered in Australia is testimony to its high international status and places the nation in a good position to capitalise on that status. Australia's high profile in the International Polar Year is also testimony to such high status in cryosphere research. Australia's position as an advanced country in the southern hemisphere, places it in a strong position to continue building its existing strengths in southern hemisphere climate, ocean and polar studies.

The domain of Earth systems science is an inherently international activity that covers interactions between a wide spectrum of natural and human induced phenomena that influence the evolution of the Earth as a suitable habitat for sustainable civilised human

[4] The Allen Consulting Group (2003) A Study of International Science and Technology Policies and Programs, Canberra.

existence. This covers atmospheric and climate, the geosphere, the biosphere (including agriculture and forestry), the cryosphere and the hydrosphere.

Internationally, the domain is covered by the Earth Systems Science Partnership (ESSP), between the World Climate Research Program (WCRP), the IGBP, the DIVERSITAS and the International Human Dimensions Programme on Global Environmental Change (IHDP). All these four components have active Australian participation. The ESSP has launched four global-scale collaborative and internationally integrated joint projects, namely:

- the Global Water System Project ;
- the Global Carbon Project (GCP);
- Global Environmental Change and Food Systems ; and
- Global Change and Human Health.

All four of these areas have Australian involvement or potential involvement. In particular the GCP is co-convened by Australians and has its headquarters hosted in CSIRO in Canberra.

In addition, the four older programs that comprise ESSP (WCRP, IGBP, DIVERSITAS and IHDP) each have their own research projects (like Climate Variability and Predictability Project); World Ocean Circulation Experiment; Land-Use and Land-Cover Change; Global Ocean Ecosystem Dynamics; Analysis, Integration and Modelling of the Earth System and many more. There is much more that could be added to this description from a variety of earth systems science perspectives. It would be a daunting task to find out and catalogue all the Australian links into this large number of activities. There are many. Australia is strongly linked internationally in all areas of Earth systems science.

However, the very nature of these international programs and projects is that they form a basis for a network of communication, subject matter intelligence, and integrative planning, rather than for research funding which depends on activity within participating nations. They are critical for Australian scientists to be up at the forefront of global thinking and advances in the subject domain, but not a source of funding to capitalise on that intelligence and awareness through Australian research and development.

Submitted by Dr Roger M. Gifford, Chair, National Committee for Earth Systems Science

National Committee for Space Science

Space science is both an existing and an emerging area of strength for Australia in science and technology. Australia's space science community contains world leaders in several areas of space science, including solar and interplanetary physics, cosmo-chemistry and associated dating of the solar system, coupling of Earth's magnetosphere to the ionosphere and atmosphere, remote sensing from space the Earth's atmosphere and surface, space weather, and astrobiology. Expertise exists in instrumentation design and building, observation, data analysis, and theoretical modelling. Existing overseas scientific collaborations are on a research group basis at present for science (including the TIGER radar in the international Super-Darn network and the Japanese Hayabusa, Europe's ACES, and NASA's to-be-launched STEREO space missions), while the Australian Government IPS Radio and Space Services is a World Data Centre and provider of Australian space weather data globally. While Australia's space science is already a strong area of research, it is also an emerging area of strength: the community is currently developing a Decadal Plan in order to maximise such potential in the nation's science and technology portfolio. This is foreseen to involve research projects with clear national benefit that are strongly engaged with international programs in space science.

Australian industry is successful globally in areas ranging from defence materials to communications and from building small satellites and components to insurance. Developing Australian space science to its full potential would have significant industry and economic benefits, as well as national and public good benefits. This would be associated with reduction of risk to the nation's defence and communications. The former include a larger, more scientifically literate workforce and population, increased national pride and positive recognition of Australian intellectual achievements overseas, development of space hardware, software, and mission capability, and better, more flexible provision of space weather and remote sensing data and communications.

Australia is an attractive partner because it:

- has a unique global footprint that is vital for studying space science from a global perspective, laying claim to approximately one quarter of the southern hemisphere from the south pole to the equator;

- is part of Asia (though also a western country), and with associated political benefits on both accounts;
- has scientific and technical expertise in several desired areas of space science (see above); and
- is politically and financially stable, thereby being a good risk to fulfil commitments.

The nations and regions that have the most to offer Australia are those with well developed space science capabilities and programs (including the USA, EU, Japan, Canada and Scandinavia). Countries also include those whose capabilities and programs are still emerging with great potential in the international arena (China, India, and Taiwan). The former group are attractive because they organise excellent, well-funded space missions and can invite Australians with the specific desired expertise immediate entrance; then only local funding and resources must be provided. The latter community (and Japan) are attractive because they are developing their programs from a relatively low level, and so are more reliant on our expertise. They are also located in Asia–Oceania, with major political benefits to them and us. At present the Australian space science community is engaged with both groups and this is expected to continue under the Decadal Plan. A possible collaboration with China, to link a proposed Australian space weather network to the just-funded Chinese Meridian project, would provide the first pole-to-pole, global scale space weather network and enable unique space science to be done.

The greatest impediments that the Australian space science community faces are the lack of an internationally recognised office for Australian space science that can handle approaches from, and research contracts with, foreign space programs. There is also the lack of official approval and funding for a national program of space research, and the lack of adequate single-proposal funding sources over the relatively long (greater than 5 year) periods for many space projects.

Submitted by Professor Iver Cairns, Chair, National Committee for Space Science

Australia's international role in mathematical sciences

The Australian Mathematical Sciences Institute (AMSI) is the body, which coordinates many research activities within Australia and between Australia and international research centres.

So a brief submission from the Director of AMSI, Professor Phil Broadbridge, was requested. MASCOS is the ARC Centre of Excellence for Mathematics and Statistics of Complex Systems. ICE-EM is the International Centre of Excellence for Education in Mathematics. There are strong links between these three organisations.

AMSI has:

- signed a trilateral agreement of cooperation with MASCOS and the Canadian network, Mathematics for Information Technology and Complex Systems (MITACS);
- become a member of Pacific Rim Mathematical Association(PRIMA); and
- agreed to make a formal collaborative arrangement with Atlantic Association for Research in Mathematical Sciences.

Canada is a welcome collaborator in mathematical sciences, since they have strong government science funding programs and they are experienced in long-distance access-grid collaborations, e.g. coast-to-coast at the national level. In April 2007, AMSI, MASCOS, MITACS and ICE-EM will be jointly hosting a workshop at the Gold Coast on energy demands and pricing. The Canadian government has a new $US7million funding program for networking with international research institutes. MITACS will be submitting a proposal for a funded international network that includes AMSI. We are guaranteeing a financial contribution towards the project but of course it is an order of magnitude lower than the Canadian contribution.

Membership of PRIMA gives us contacts to other Pacific Rim countries besides countries like Canada. So far we haven't made much use of it except to offer free accommodation to PRIMA students attending our summer school and to offer support to Australian students attending overseas PRIMA events.

MATHEON of Germany has been working with MASCOS on logistics OR at seaports. The Australia–Germany connection may be important as we are trying to negotiate a large contract job with the coal industry.

Submitted by Professor Phil Broadbridge, Director of AMSI

Generally, Australian mathematicians and statisticians have strong links to the Asian area, as well as Europe, the US and Canada. These countries include Taiwan, Korea, Singapore, Hong

Kong and of course, China. China is investing huge amounts in science in general and the mathematical sciences in particular. A number of mathematical sciences research institutes have been set up in China to attract the outstanding Chinese diaspora in the US and Europe to return for long or short visits, or more permanently.

Australian mathematical sciences is well served by AMSI, but currently, funding is provided by subscription by hard pressed mathematics and statistics departments around the country, since the Victorian Government Science, Technology and Innovation funding has now run out. So this is the major impediment to fostering international collaboration at the level of large scale research programs.

Traditionally Australia has been strong in mathematical modelling in areas like meteorology, fluid mechanics and continuum mechanics, partial differential equations and numerical analysis, optimisation and various areas of statistics, such as biostatistics, stochastic processes, epidemiology. Some of these areas are no longer as vibrant (see the forthcoming National Review of Mathematical Sciences), due to an average decline of around one third in staff numbers in mathematics and statistics departments in the last decade.

Optimisation and logistics, in the mining, transport and retail areas, is an important area with growth opportunities. Similarly bioinformatics, biostatistics and mathematical biology are key areas internationally with applications of statistical and optimisation methods to many parts of medicine, as diverse as radiation oncology to hospital procedures. Contacts with international research centres are crucial to the mathematical sciences remaining competitive in Australia.

Canada has a network of four major research centres in mathematical sciences and there are numerous such centres in the US and Europe. New Zealand has a National Mathematical Sciences Research centre, as has Singapore. A network of centres is being built up in China. Collaboration between such centres is very important, as new interdisciplinary areas of science and technology require rapid input from the mathematical sciences.

Submitted by Professor J. H. Rubinstein, Chair National Committee for the Mathematical Sciences