A change in climate for the Australian Defence Force

by Anthony Bergin and Jacob Townsend

Climate change is a major issue facing both Australia and the world. It’s now a central topic of media and political debate. In May this year, the Chief of Defence Force, Air Chief Marshal Angus Houston, noted that the Australian Defence Force (ADF) faced security challenges that it had not previously considered, naming climate change as one such challenge.

On 17 April 2007, at the behest of the UK Chair, the UN Security Council debated the issue, while the US Congress is set to task the CIA and the Pentagon with preparing intelligence estimates on climate change. In Australia, two-thirds of respondents to a 2006 Lowy Institute poll believed that immediate action should be taken on global warming even at significant cost. At the 2007 Australian Davos Connection’s Future Summit, assembling 400 future Australian leaders, climate change dominated proceedings. The Office of National Assessments, which provides assessments on international strategic developments to the Prime Minister and the National Security Committee of Cabinet, has completed five reports on climate change.

Why should the ADF be concerned about climate change? One reason is that climate change has global, regional and national implications that may affect what the ADF does, potentially re-balancing its mix of missions or creating new mission types.

A second reason is that climate change may affect how the ADF operates, particularly with regard to energy use. When considering responses, it is useful to distinguish between mitigation, such as by reducing greenhouse gas emissions, and adaptation, such as designing equipment to operate in more variable environmental conditions. Many ADF responses will build on a range of trends that are already developing, motivated by concerns for energy security and cost-effectiveness. Climate change is likely to intensify these trends and raise their political profile.

There is a growing body of work on the general strategic challenges of climate change, but almost no analysis on the practical implications for the military. This paper therefore looks out over the next two to three decades and examines the implications of climate change for the ADF. The ADF would benefit from being pro-active rather than reactive to climate change. While many of the potential consequences of climate change are some years away, the ADF will need to adapt to the future security environment and operational conditions. The ADF will also play a part in mitigating climate change, by minimising the impact of its activities and driving technological change.

This paper suggests that the ADF should be thinking more about the long term effects of climate change and recommends that...
the Defence Department establish a section to examine the range of strategic, force structure, capability and energy efficiency challenges and opportunities presented to the ADF by climate change. The next Defence White Paper should examine the full implications of climate change for the ADF.

**Threats**

The Asia–Pacific region is home to extremes in economies and population densities, with troubled island nations and diverse climates. It is difficult to be precise about the scale and location of climate change impacts, although there is a growing scientific consensus on general trends and probabilities. Developments in Asia and the South Pacific are of key strategic importance to Australia and these areas will be amongst the worst affected both directly and indirectly by climate change.

One direct effect is more extreme weather. Cyclonic intensity is likely to increase, as could frequency. Many more people will be exposed to flooding. Australia was fortunate last year that Cyclone Larry made landfall where it did, less than 100 km south of Cairns. It still required a significant ADF response. A Category 4 cyclone such as Larry hitting Cairns or the Gold Coast would require a large-scale evacuation and recovery effort, which would almost certainly involve the ADF. For comparison, Cyclone Tracy was a Category 4 when it hit Darwin in 1974, a town of 48,000 people with far less valuable infrastructure than present-day Cairns or Gold Coast. It required the evacuation of 35,000 people, killed 71, and caused $837 million in damage.

Perversely, along with cyclones, fire risk may also rise and droughts are likely to become more frequent. More extreme weather may damage electricity transmission infrastructure and raise the risk to offshore installations. Heavier storms may degrade communication and transportation infrastructure and storm surges may become worse. Water shortages may become more frequent and severe.

Another direct effect will be sea level rise. When sea level rises, so does the likelihood of flooding. Perhaps the most ominous numbers come from Bangladesh, a low-lying nation of 150 million people with the majority living along its 580 km of coastline. It will likely compete with South Pacific atolls for the fastest production of climate refugees. Mass movements of people may require more ADF border protection activities.

Indirectly, climate change could act as a threat multiplier for instability in our neighbourhood, particularly by intensifying resource conflict within and between states and by inducing migration. Many countries already struggle to cope with natural disasters. Food production patterns could change because of higher temperatures and more variable rainfall. Some areas will struggle to grow current food staples, such as rice. Climate change may increase the geographic range of vector-borne diseases such as malaria, dengue, Ross River virus and yellow fever, while increasing the risk of water-borne disease. It will also increase pressure on water supplies in most regions of Asia.

Of particular concern is the potential for climate change to induce fish stock migration and other changes in marine biosystems. Island nation economies that rely on marine resources would be adversely affected if those resources migrated beyond their maritime jurisdiction. Southward migration of some fish stocks appears to be occurring already,
with fishing fleets following. There is likely to be increased illegal fishing in Australian waters as climate change exacerbates the impacts of over-fishing in regional fisheries. Protecting our marine resources might require more ADF enforcement efforts, regardless of the quality of domestic management of Australia’s fisheries and marine industries.

In responding to the direct and indirect effects of climate change, it’s unlikely that the ADF would be deployed to pressure another state to change its carbon emissions policies. It may, however, find itself on more missions that blend disaster relief, development assistance and state-building. Planning for these issues will require a whole-of-government approach to security in an increasingly complex physical and political environment. Decisions on who is responsible for planning and executing responses will reinforce the need for high-level and operational coordination and cooperation between the ADF, other government agencies and non-government organisations, both at home and abroad.

Finally, nuclear industries in the Asia–Pacific are likely to expand, as states take a fresh look at the potential of nuclear power to mitigate climate change. Along with the possible creation of special police units and the use of private security firms, the ADF may also be required to secure any nuclear enrichment, supply and power generation facilities we might develop here. Additionally, ADF counter-proliferation missions, such as those under the Proliferation Security Initiative, may become more frequent.

**Equipment and force structure**

The geographical and military environments in which the ADF will find itself will be affected by climate change, possibly involving large population movements, scarcity of basic commodities and failing infrastructure. A changing balance of threats and missions may raise new questions about equipment and force structure.

Even though climate change impacts may not be evident for many years, the time horizon is very similar to that of major procurement decisions. The recently approved Air Warfare Destroyer project grew out of the 2000 Defence White Paper, with the ships scheduled for service until the early 2040s. Australia first decided to buy F-111 aircraft in 1965. They were delivered in 1973 and are due to retire in 2010. Climatologists and Defence capability planners work on parallel timelines. Any environmental changes identified by climatologists are likely to affect operating conditions for ADF equipment.

To carry out relief missions at short notice brought about by extreme weather patterns, the ability to move and land large volumes of supplies is crucial. The impact of climate change on coastal zones could affect the use and availability of amphibious landing sites. Navy may require more shallow draft ships capable of landing in disaster-stricken areas and heavy lift helicopters for ship-to-shore transport. The use of hovercraft may become more attractive.

If climate-induced disaster relief missions were to become more frequent and/or demanding, there will be a growing need for military equipment relevant to these activities or civil equipment that is moved by the ADF. Important areas are construction, sanitation, fuel transportation, pharmaceutical supplies, power generation and non-lethal weapons. The ADF’s capability for logistics and communication in the absence of infrastructure makes it an important addition to emergency services. Many ADF assets have the flexibility, versatility and endurance for various non-combat tasks, such as when CH-47 Chinook helicopters were used to turn the power on after Cyclone Larry, manoeuvring electricity poles into position. The ADF, in cooperation with other
government departments, may procure more disaster-specific or dual-use equipment.

Air surveillance assets may need to be worked even harder, or supplemented further by civilian contractors, to monitor our offshore zones. Increasing interest in Antarctica’s role in and impact from climate change may also see more calls on ADF assets to contribute to Antarctic logistics and for the ADF to operate dedicated multi-role vessels in the Southern Ocean. Airlift capacity, such as from the C-17 Globemaster and C-130 Hercules, will be crucial for reaching crisis zones quickly, as will a replacement for the medium-lift and operational flexibility of the Caribou.

For the Navy, there has already been some strain evident from higher tempo patrolling. Sub-optimal deployment of assets has been necessary, such as the use of minehunters on surveillance and interdiction duties in the Timor Sea. Climate change has the potential to ratchet up further the intensity of border protection activities and hasten the trend to multi-crewing to keep ships at sea for longer periods. Many of the problems caused by climate change will require rapid responses and deployments and suggest the need for ship designs with greater role adaptability for the crew and hull. Consideration may need to be given to the replacement of a number of minor war vessel types with a class of multi-role vessels. These might incorporate drop-in modular attachments to support role-specific activities such as patrol and interdiction, minehunting or hydrographic surveying. Greater sea-keeping ability may become more important in procurement decisions in order to cope with higher sea-states.

Storm surges and cyclones often compromise the information contained in printed hydrographic charts. Where they occur around ports, ship traffic is reduced or halted until new surveys are completed, with particularly adverse consequences on small Pacific economies. More frequent or intense weather events may place further demands on the Navy’s hydrographic efforts at home and abroad.

The ADF also has the potential to help in the science of climate change. It often operates in areas that would otherwise go unvisited. For example, the Navy shares some oceanographic data with CSIRO. Strengthening these arrangements across the Services and improving the capacity of ADF assets for environmental data-gathering would be useful for climate monitoring.

Extreme weather events have always impacted upon the conduct of military operations. Climate change will place a greater premium on the ADF having good predictive data on temperature rises and sea level rises in areas where the ADF expect to undertake operations. Striving for better weather prediction may lead to growth in ADF meteorological capabilities.

Environmental costs may be given more emphasis during design, procurement and operation, potentially complicating decisions. Basing and maintenance costs would rise if ADF equipment is used and stored in different or more variable environments, as well as posing operational challenges. For example, dusty conditions significantly increase turbine maintenance requirements, affecting their use and life.

The temperature a piece of equipment is designed for at the start of its in-service life will not be the temperature it operates in at later years. The ADF may need to map predictions of temperature change against some of its equipment programs in order to determine the extent to which platforms might experience temperature rises during service and what impacts this might generate. Designers will need to factor in the likely temperature increase in their investment proposals. Even small
temperature rises can have a significant impact on the performance of certain military systems.

Responding to climate change may see Defence implement force structure decisions that produce benefits in terms of cost, capability and environmental footprint. Fuel conservation has for a long time been a concern for the ADF. Carrying bulk fuel is expensive and slows operational tempo, while emissions are vulnerable to detection. Climate change will add to these operational incentives to adopt technology that offers improvements in these areas.

In particular, climate change is encouraging energy research and this may enhance military capabilities. Alternative energy sources such as solar and wind power and low-emission fuels may become more important for military bases and on some ADF operations, and indeed could deliver cheaper energy once initial sunk costs are recouped. Military research has often driven technological advances and it is likely that ADF efforts in these areas will see it become part of the solution to climate change.

For example, the US Department of Defense Advanced Research Projects Agency is funding the development of jet biofuels. Hybrid technologies could be investigated to see if they might be used in non-combat and/or selected combat assets. The CSIRO, Defence Science and Technology Organisation and the Defence Materiel Organisation might join together to investigate the current state of play and emerging developments in alternative fuels for military applications.

Adopting fuel cell technology and high-efficiency, portable solar and wind power generators would provide dual spin-off benefits by increasing autonomy during missions in austere environments and reducing the vulnerability of lines of supply. For example, the US has chosen to use solar power for some air conditioning in Iraq in order to improve logistical security, with the added benefit of reducing emissions.

Environmental concerns now have minimal influence in ADF procurement decisions. ‘Green procurement’ might be one approach that Defence could use in purchasing office equipment and other non-combat goods and services such as cars and buses. Most ADF vehicles, planes and ships are exempted from emissions standards, although the three services try and regularly do meet these standards where they don’t impact on performance. Defence exemptions may come under pressure over the next 20-30 years. In particular, the issue of emissions at high altitude may present a challenge, since there is concern that they contribute disproportionately to the greenhouse effect. Military aviation generated 22% of the government’s greenhouse gas emissions in 2004-05.

Energy efficiency

The effects of ADF activities on the climate will increasingly be counted as a cost of doing business. The ADF, like other agencies, may need to adapt to more intrusive energy accounting and a requirement to provide carbon offsets in order to minimise the environmental impact of activities, although climate accounting constraints would probably be relaxed by government according to the imperative of the mission. Transparency in ADF reporting would need to be carefully balanced against the risks of publicly disclosing ADF capacity to store and distribute different fuel types.

In 2004-05, the Australian Government reported using 8,150 terajoules (TJ), of which the Department of Defence used 45%. ADF operations, however, are excluded from this figure. At 13,038TJ, ADF operations used more than 1.5 times the energy of the rest of the government. In other words, the Department...
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of Defence, including ADF operations, used 3.6 times more energy than all other agencies combined. This is a drop in the ocean of Australia’s economy, less than 1% of the energy New South Wales consumed in the same period. However, as efficiency concerns grow nationwide, the government will want to be seen as a standard-setter—and Defence is its biggest challenge.

The ADF will always be a significant user of energy. It’s the nature of the business and it’s doubtful that the ADF will ever be a carbon-neutral organisation. Nevertheless, growing political and economic pressure on government agencies to implement energy efficiency measures will see Defence devote greater attention to reducing its greenhouse gas emissions. Defence’s environmental impact is biggest in ADF operations and although this may theoretically offer the best potential for energy reduction, it’s hard to imagine a government cancelling an operation because of its carbon footprint. Delivering optimal combat power will remain the central concern in procurement and deployment.

The greatest opportunities for efficiency gains will be in non-operational energy consumption. Defence could seek to reduce its carbon footprint by, for example, increased use of alternative fuels such as ethanol or LPG for non-mission critical equipment that is never going to be deployed to a combat zone (see also below). Military facilities might reduce greenhouse gas emissions through ‘green’ building design that improves heating, ventilation, air-conditioning, lighting, hot water and thermal performance.

The ADF already justifiably wins accolades for its care of the environment. To maintain this record as the issue of climate change becomes more salient, Defence might demonstrate its credentials by radically reducing its greenhouse gas emissions and achieving exemplary best practice standards. Substantially minimising the use of fossil fuels will be a long-term and significant challenge. However, especially if it overlaps with energy security concerns, climate change may increase incentives to move towards low-carbon energy. Defence’s market power will help to drive down the costs of environmentally-friendly technology. It could also use this power to spread best practice to the many private contractors for whom Defence is an important customer. The ADF will improve its reputation as the climate change issue develops by advertising its willingness to respond to environmental challenges.

Personnel and training

Climate change could alter the environments in which military personnel are deployed. Shifts in weather patterns as a result of climate change may mean that conditions become hotter, drier, wetter or dustier — and perhaps change more rapidly. The ADF may need to adapt to health impacts. A changing geographic distribution of diseases, such as malaria or Ross River fever, could have implications for deployed military personnel. The ADF may face a shrinking recruitment pool due to an expected increase in the prevalence of respiratory problems caused by more airborne dust and infections from poorer-quality drinking water. Recruitment standards may need to be changed to keep numbers up.

Winning water resources for military operations is as old as warfare itself, but water shortages in the future could have greater impacts on endurance in ADF training and operations. In some areas ADF trainers may need to plan for and accommodate more frequent heatwaves. An increased likelihood of conducting disaster relief operations may well drive changes in preparedness towards emphasis on
humanitarian missions in training programs. This may heighten problems in training people to operate equally effectively between combat and humanitarian paradigms. The Army’s concept document, *Adaptive Campaigning*, is an example of ADF efforts to respond to this trend.

Any commensurate increases in mission tempo arising from climate change impacts may see more frequent use of the reserves for domestic relief operations. This could spur reserve recruitment from areas most prone to disasters, in an effort to incorporate invaluable local knowledge. Reserves may also be used more frequently overseas, to ease the burden on the regular force and where a reservist has particularly relevant skills. Any increased role for the ADF in domestic disaster response would probably be assisted by closer cooperation and integration with standing volunteer services, including in training.

The possibility of more humanitarian taskings for the ADF may have implications for recruitment and retention. Responding to natural hazards caused by climate change and fighting the second order effects of climate change in failing states might be seen as positive recruiting messages. Though they’re not the classical images of defence force valour, they could well attract the more vocationally inclined ‘Generation Ys’ and beyond.

While the ADF has a very good environmental record, the government may place a greater regulatory burden on ADF training operations to reduce energy use and emissions. Defence already applies simulator training extensively as a means to optimise training using a minimum of resources. This trend could accelerate. Energy use and emission restrictions may encourage even greater use of simulation in preference to ‘live’ training, with possible ramifications for ADF operational performance.

Climate change may have both positive and negative impacts on ADF land holdings. On the plus side, some training areas (TAs) and bases provide valuable biodiversity habitat and water supply catchment areas, which will be increasingly valued by society as the climate changes. A good example is Shoalwater Bay, a biologically diverse TA covering 400,000 hectares. On the negative side, climate change could reduce the resilience of TAs to training impacts, increase fire susceptibility and induce more storm damage. This might lead to larger management costs. If the tropical climate moves south and rainfall patterns change, the ADF may need to establish new TAs. In the worst case, from an ADF perspective, there could be pressure to cease using some TAs because of their potentially greater value as biodiversity refuges or water supply catchments.

Navy training may also be affected, because most exercises have a sea-state above which they are forbidden. If climate change leads to more rough sea days, quite likely on our west coast, the Navy may find its training flexibility restricted and guidelines may need to be recalibrated.

**Budgeting and coordination**

The economic impact of climate change is uncertain and potentially huge. Money spent on combating climate change might be diverted from the Defence budget. If as a result of climate change the ADF were to conduct more humanitarian operations, this too will have an impact on Defence resources.

Depending on the economic impacts of climate change, new reporting requirements may become mandatory. In the UK, for example, legislation under consideration proposes that an independent panel set five-year national carbon budgets that would bind the government. The high profile of carbon budget figures would likely increase
the pressure on government departments to account for and limit drawdown of their carbon allocation.

Even if Australia does not adopt such an approach, the use of carbon offsets and the creation of a national emissions trading system seems likely. ADF operations are energy-intensive and by their nature are risky to curtail through discretionary choice. As such, this places a limit on how far Defence can reduce its carbon footprint. If the government makes a serious effort to be carbon-neutral, a whole-of-government approach may require the negotiation of substantial offsets with the ADF, particularly since the emissions impact of an operation would be unlikely to prevent it from going ahead. On the positive side, Defence may be able to earn substantial amounts helping to mitigate climate change, using the millions of acres of land that it owns for carbon offsets.

Climate change may require large budgetary decisions relating to designing, protecting and improving military infrastructure. Defence may need to assess the vulnerability of coastal installations to degradation from extreme weather events and sea-level rise. In this, Defence may be able to learn from the insurance industry, which has already begun to factor climate change into the nature of insurance risks.

The Navy would need closer liaison with port operators, as it operates mainly in commercial ports. Use and maintenance may be affected by sea-level rises and storm surges, particularly in Queensland and Darwin. Ships may find it more difficult to access dry docks because of sea-state and higher wave action.

Water shortages are already affecting marginal activities at ADF bases and creating challenges for some Defence industry contractors. These pressures are likely to intensify, encouraging stronger restrictions at bases and re-fitting to make them more self-sustaining. Some ADF quarters are already being fitted with grey water recycling systems and complying with local water conservation measures, but the full range of rainwater, grey water recycling and best-practice efficiency fittings in defence installations are far from universal. Furthermore, water shortages may impact on power generation in some areas and affect ADF facilities, a situation that could be mitigated by substantial solar hot water heating investment across Defence’s infrastructure portfolio.

Any program to improve the efficiency of bases will confront the problem that many of them are old. (Defence also holds more than 15,000 houses.) Minor adjustments or re-fits may help, but substantial efficiency gains may require wholesale removal or reconstruction. The cost of replacing such assets would be huge. Even so, Defence’s purchasing power will assist in driving down market costs for environmental compliance and retro-fits. The ADF may still find itself under more political pressure here as base modernisation is sometimes viewed as expensive featherbedding by the Services.

Next steps

For the ADF, the rapid response that disasters demand may require bigger surge capacity, a larger logistics capability and maintaining higher states of readiness. Additional resources would be needed, while extreme weather will add complexity to military missions and maintenance schedules. What are now considered disruptions—for example, the delay to re-fitting HMAS Betano due to shortages of material caused by Cyclone Larry—may become more common. In decisions on where to base assets, this may suggest that Defence look again at the trade-off between weather risk and proximity to areas of operation.

Current trends towards partnerships and standing orders with private contractors
and NGOs might grow. This may mean a greater need for ADF peacetime training with these groups, as well as an extension of any emissions accounting regime to cover ADF contractors. More regular ADF involvement in domestic disaster response may require new budget-sharing arrangements with the states. Internationally, agreements with regional governments and with international non-government organisations may need to be upgraded in order to facilitate rapid responses and preparatory cooperative training.

Preparedness priorities for war-fighting, peacekeeping, disaster relief and border protection missions could adjust as a result of climate change. ADF capabilities may increasingly be called upon to support AusAID, regional organisations, the UN and state governments. Climate change will see ADF assets increasingly being used with other Australian government departments and agencies—a multi-agency approach. There is also scope for greater ADF international cooperation in these endeavours.

All of this is not to suggest that climate change will make the ADF a predominantly humanitarian crisis response organisation. Climate change will add to the probability of conflict over resources. Conventional threats and less predictable security outcomes in our region will mean that the need for ADF combat capability is not likely to fade in the future because of climate change.

Because of demands on ADF resources for maritime border security, maritime enforcement and disaster relief, climate change may give greater currency to arguments in support of a coastguard and re-vamped civilian disaster agencies. On the other hand, it may have the opposite impact, with more frequent disasters creating more violent chaos and the need for greater military integration and presence within humanitarian operations. At the very least, this will create challenges for government to delineate between when ADF capabilities are to be used and when they are not. Even if emergency services become better-resourced, more professional and deployable, however, the ADF is likely to continue to provide the high-end capabilities.

Most climate change issues are national issues requiring a national response, which will cut across many Defence activities. An efficient adaptation for Defence may be to mainstream the issue of climate change so it becomes part of the standard Defence risk matrix. An enhanced ADF capability in strategic analysis of climate change as a threat to Australia’s security interests would be useful. Consideration should be given to the creation of a small section within Defence to analyse the impacts of climate change on the ADF. It could ensure that climate change is fully reflected in all Defence decision making. The section might prepare a long-term strategy for developing ADF responses to climate change, based on an analysis of the political, strategic, financial and capability risks and opportunities that climate change presents to ADF business.

Both major parties have now committed themselves to issuing a new Defence White Paper. The next White Paper should comprehensively consider the impact of climate change on the ADF. Climate change is shaping up as the global issue of the century. It’s fast becoming one of the most important political issues in Australia. Many argue it’s already making the world more dangerous. The ADF will feel the effects. It’s time for Defence to invest more heavily in understanding and planning for them. The biggest challenge will be changing Defence behaviour and systems without reducing ADF operational capability.
Endnotes

1 Speech to RUSI Conference, 16 May 2007. Also, the UK’s Chief of Defence Staff recently suggested in a speech 25 June 2007 that climate change is such a threat to global security that military planners must build it into their calculations. Available at http://www.mod.uk/Defenceinternet/AboutDefence/People/Speeches/ChiefStaff/ClimateChangePoliticsVsEconomics.htm


5 If average temperatures rise by 2-3 degrees, CSIRO predicts that cyclonic maximum wind speeds will increase by 5–10% and precipitation rates by 20–30%. See B.L. Preston and R.N. Jones, 2005. Climate Change Impacts on Australia and the Benefits of Early Action to Reduce Global Greenhouse Gas Emissions, CSIRO.

6 CSIRO expects a doubling of the number of people exposed to flooding if average temperatures rise by 1-2 degrees, which is likely on present projections. See B.L. Preston and R.N. Jones, 2005. Climate Change Impacts on Australia and the Benefits of Early Action to Reduce Global Greenhouse Gas Emissions, CSIRO. The Intergovernmental Panel on Climate Change anticipates that human and societal development on Australian coasts will exacerbate risks from sea-level rise and from expected increases in the severity and frequency of storms and coastal flooding. See Climate Change 2007: Climate Change Impacts, Adaptation and Vulnerability, Summary for Policymakers.


8 CSIRO is predicting an increase of up to 70% in the frequency of days with very high and extreme forest fire danger index ratings by 2050. See K. Hennessy et al., 2005. Climate Change Impacts on Fire-Weather in South-East Australia, CSIRO and the Bureau of Meteorology. CSIRO also projects a 70% increase in droughts in New South Wales, even if average temperatures rise by less than one degree. See B.L. Preston and R.N. Jones, 2005. Climate Change Impacts on Australia and the Benefits of Early Action to Reduce Global Greenhouse Gas Emissions, CSIRO.


12 See for example Joan H. Bryan, Desmond H. Foley and Robert W. Sutherst, 1996. ‘Malaria Transmission and Climate Change in Australia,’ Medical Journal of Australia, 164, pp.345-347. In countries such as Australia, it is likely that effective public health interventions will minimise the impact of more permissive environments for diseases such as malaria. Countries that already struggle to control these illnesses will probably find it even more difficult.

13 For example, ocean acidification, which is already occurring, could have devastating effects on marine biodiversity and food chains, crippling the economic potential of the oceans. See Richard A. Feely, Christopher L. Sabine, Victoria J. Fabry, 2006. Carbon Dioxide and our Ocean Legacy, Pacific Marine Environmental Laboratory.


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19 The Navy’s ability to distil its own water at sea and re-supply small communities is very relevant to this challenge.

20 Concern for managing heat exhaustion during training has already been raised in the ADF as a result of the death of a soldier in the Northern Territory in 2004.


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