BE PREPARED: CLIMATE CHANGE, SECURITY AND AUSTRALIA'S DEFENCE FORCE

CLIMATECOUNCIL.ORG.AU

Thank you for supporting the Climate Council.

The Climate Council is an independent, crowd-funded organisation providing quality information on climate change to the Australian public.

Published by the Climate Council of Australia Limited

ISBN: 978-0-9944195-2-1 (print)
978-0-9944195-1-4 (web)

—

Image credit: Cover Image: © Commonwealth of Australia 2015, Department of Defence, reproduced with permission. Use of this image does not imply an endorsement from or an association with the Department of Defence.

This report is printed on 100% recycled paper.

facebook.com/climatecouncil
info@climatecouncil.org.au
twitter.com/climatecouncil
climatecouncil.org.au

Preface

The Climate Council is an independent, non-profit organisation funded by donations from the public. Our mission is to provide authoritative expert information to the Australian public on climate change.

The science is in and defence forces are resolute. Climate change will increase sea-level rise, drive up global temperatures and increase the frequency and intensity of extreme weather events. These impacts will limit the availability of food and water, undermine human health and devastate infrastructure and economies. This, in turn, could exacerbate existing tensions, increase societal instability, drive large scale migration and be a trigger for violent conflict. This is why military forces, and the security sector more broadly, are labelling climate change a "threat multiplier". Extreme weather events have direct implications for military preparedness and the ability of the military to sustain itself, whilst greater instability, conflict and climate-induced migration will shape the types of roles and missions that militaries will conduct in the future.

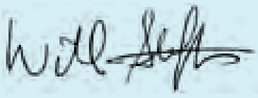
From mainstreaming climate change into national military planning, to appointing senior military authorities to lead on climate change within the defence force, the UK and US governments have directed their militaries to rapidly prepare for climate change and its impacts. Yet Australia continues to lag behind its military allies, taking comparatively little action on climate change and only fleetingly acknowledging climate change in public documents like Australia's Defence White Paper. Outside of defence, there are few academic or scientific publications that unpack the security implications of climate change and what this means for the ADF.

This lack of action and research is particularly troubling as an unprepared and uninformed defence force exposes Australia's soldiers, sailors and airmen, and Australians more broadly, to the considerable strategic risk and uncertainty that climate change brings. This is why the Climate Council has brought together leading climate scientists with renowned defence experts to create an up-to-date and scientifically robust report on climate change, security and what this means for Australia's Defence Force. The links between climate change, food, water, health, migration and conflict are complex and interrelated. This report lays out a simple roadmap to demonstrate some of the connections between these challenges and the significant steps our military allies are taking to be prepared.

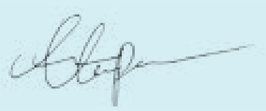
The Climate Council is extremely grateful to our team of reviewers whose comments and suggestions improved the report. The reviewers were: Professor Jon Barnett, Professor Alan Dupont, Captain Leo Goff, USN (Ret.), Dr. Liz Hanna, Rear Admiral Neil Morisetti RN (Ret.) and Rear Admiral David Titley USN (Ret.). This report was also made possible thanks to the efforts of Climate Council staff and research volunteers, Lily Barnett, Max Newman and Zak Baillie.

The authors retain sole responsibility for the content of this report.


Admiral Chris Barrie (Ret.)
Former Chief of the Australian Defence Force

Professor Will Steffen
Climate Councillor
Climate Council

Alix Pearce
Strategic Projects Manager
Climate Council


Major Michael Thomas (Ret.)
Climate Security Specialist

Contents

Key Findings

1

Climate change is a security threat. Climate change poses a significant and growing threat to human and societal well-being, threatening food, water, health and national security.

- **Food security.** The 2008 food crisis increased the number of undernourished people worldwide by 75 million. The cost of wheat increased by 127%, rice by 170% and maize by 300%. By increasing the frequency and severity of droughts in important food producing regions, climate change was a key factor in the crisis.
- **Water security.** Climate change will significantly affect the accessibility and availability of freshwater resources. Rising sea-levels can result in saltwater intrusion of coastal acquifers, while rainfall patterns are changing worldwide.
- **Extreme weather.** Climate change is increasing the frequency and severity of many extreme weather events. These events affect individuals and societies through the displacement of people, damage to critical infrastructure, and damage to health and livelihoods.

2

Global military forces are labelling climate change a "threat multiplier".

- The impacts of climate change can exacerbate other stresses, like poverty, economic shocks and unstable institutions, to make crises worse. For instance, increasing extreme weather events can reduce the availability of food. Extreme weather and water scarcity contributed to soaring food prices, which saw food riots erupt across Africa and the Middle East in 2008. Rising food prices in 2011 have also been identified as one of the factors that destabilised the Middle East, leading, for example, to the "Arab Spring".
- Climate change can worsen tensions and increase the risk of conflict between states as sea-level rises, coastlines retreat and the eventual submergence of small low-lying islands affect maritime boundaries and exclusive economic zones where natural resources are located.
- Leading international organisations and defence forces around the world, from the Pentagon to NATO member states and now the G7, have all identified climate change as a significant threat to national security.

3

Climate change puts the Australian Defence Force under pressure.

- Australia and the Asia-Pacific region are vulnerable to climate change with over half of the world's natural disasters occurring in the Asia-Pacific region last year. The ADF will increasingly be called upon to deliver humanitarian assistance in response to extreme weather and its impacts both at home and overseas. In serious cases the ADF may need to coordinate with other countries to provide assistance.
- Extreme weather could also affect the ADF's readiness and capability by disabling critical military and civilian infrastructure at times when rapid mobilisation is needed. Defence property (military bases) are also at risk from sea-level rise and extreme weather.
- Rising temperatures and more frequent and intense heatwaves will have implications for the health of Australia's military personnel when undertaking training and conducting military exercises.

4

The UK and US militaries are rapidly preparing for climate change while Australia lags behind.

- Governments in the UK and US have taken significant legislative and strategic steps to ensure that climate change is integrated into defence planning. The US has mandated that their military forces address the risks of climate change as a routine part of all mission planning.
- In Australia, comparatively less action is being taken by the Government to ensure the Australian Defence Force is prepared for the security risks posed by climate change.
- Increasingly, Australia is out of step with its allies in preparing for climate change, exposing Australian soldiers, sailors and airforce personnel, as well as Australia more broadly, to the considerable strategic risk and uncertainty climate change brings.

5

Strong action to reduce greenhouse gas emissions is critical for limiting the security implications of a changing climate.

- Global emissions must start tracking downward this decade if there is to be a chance of keeping the warming of the planet to below 2°C, and limiting the severity of climate change and its implications for security.
- We must adapt to the inevitable changes that are already occurring while working hard to minimise the long-term changes, some of which could be massive, abrupt and disruptive.

Introduction

There is now a vast body of scientific evidence that climate change is having ever more negative impacts on human society and the environment (IPCC 2013; 2014). Climate change is increasing the frequency and severity of many extreme weather events in Australia and around the globe. While there has been considerable focus on how these changes are affecting our natural environment, water, economy, agriculture and health, much less attention has been focused on the ways in which climate change can act as a threat multiplier, with significant national and regional security implications.

Analysis shows that climate change is already contributing to increases in the forced migration of people within and between nations, as well as playing a role in heightening social and political tensions, flowing onto conflict and violence. Analyses of recent global crises, such as the 2008 food crises demonstrate how climate change interacts with other, multiple stresses to make crises worse - climate change is a threat multiplier, exacerbating threats from other causes.

Leading security institutions and defence forces around the world, from the Pentagon to the UK military, have identified climate change as a significant threat to national security that requires immediate action by governments and military institutions alike. President Obama stated in a 2015 address to the US coastguard, *'climate change constitutes a serious threat to global security, an immediate risk to our national security... and make no mistake, it will impact how our military defends our country'.* The security implications of climate change have been considered by the United Nations Security Council (UNSC) and General Assembly, assessed by the Intergovernmental Panel on Climate Change (IPCC), and identified as a security concern by the North Atlantic Treaty Organisation (NATO) and The Group of 7 (G7) member nations.

Security sector experts identify climate change as a significant risk in three ways. Firstly, climate change can influence a country's security environment by exacerbating economic and political problems within and between countries. Secondly, it can alter the types of roles and missions militaries need to undertake. For example, increases in the frequency and intensity of extreme weather events and the resulting destruction will place more pressure on militaries to provide disaster relief and humanitarian assistance. Finally, climate change can limit military readiness and burden the military before it moves into action. Military preparedness may be eroded through the impact that climate change is likely to have on Defence infrastructure through sea-level rise, extreme heat, storm surges and drought.

Australia's key strategic military allies, the United States and the United Kingdom, have taken significant steps to identify and respond to climate change and its impacts. US legislation requires the US military to assess the risks of climate change for current and future missions, and the UK Ministry of Defence appointed a Climate and Energy Security Envoy in 2009 to act as the nation's 'voice on climate security.'

Despite some steps already being taken by the Australian Defence Force (ADF), such as launching the Global Change and Energy Sustainability Initiative in 2011, there has been very limited public acknowledgement

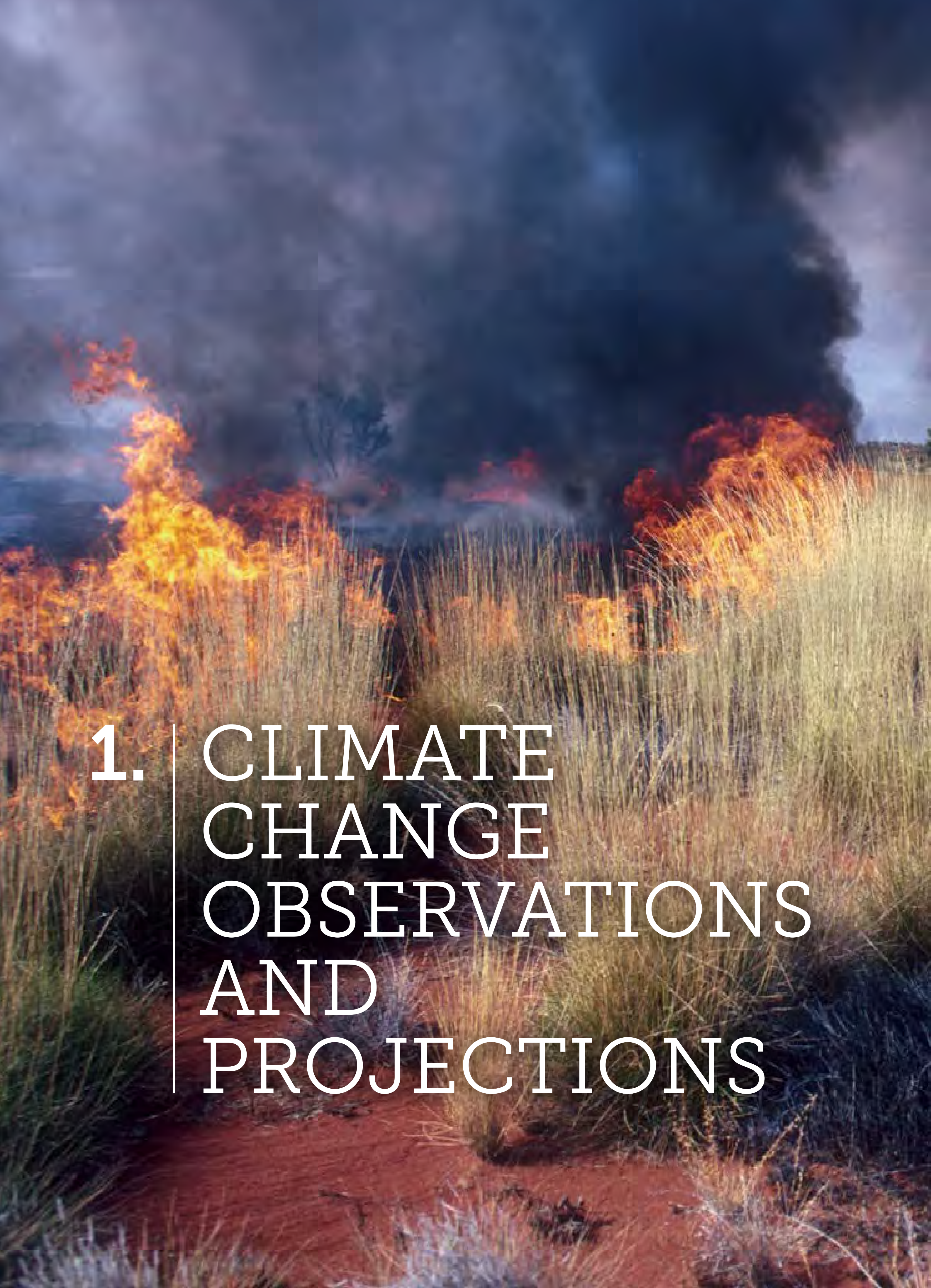
Climate change is one of the largest long-term, global challenges humans have ever faced in the history of civilisation. The implications for the security sector and defence forces are formidable.

of climate change by senior military leaders and only very brief acknowledgement of its security implications in Defence strategy documents. Overall, comparatively little action is being taken to ensure the ADF is prepared for the risks posed by climate change. This is particularly concerning because Australia and the Asia-Pacific are on the frontline of climate change and its impacts. Increasingly this is leaving the ADF out of step with its allies, and exposing Australia's soldiers, sailors and airforce personnel, and the broader public, to the considerable strategic risk and uncertainty that climate change brings.

This report outlines the most up-to-date climate observations and projections, both globally and for Australia, before describing how climate change poses significant risks for human and societal well-being by changing the availability of food and water, and through the increase in frequency, intensity and severity of extreme weather events, all of which have implications for human health. It considers how these risks to human and societal well-being can worsen existing threats, by increasing the forced migration of people and exacerbating conflict. It then provides an overview of the implications of climate change for the ADF. This report concludes by comparing the response of the Australian military with that of the US and UK.

Ultimately, climate change represents a potentially catastrophic shift in the planetary life support system that has supported human existence and development since modern humans evolved some 200,000 to 250,000 years ago. Climate change is far more than just an environmental issue; it fundamentally changes our relationship with food and water, which is essential for our well-being and for the viability of nearly all other forms of life. We have collectively built and optimised all of human civilisation for the relatively stable climate that has existed for thousands of years, starting at the end of the last ice age. That climate is now changing rapidly. We must adapt to the inevitable changes that are already occurring while working hard to minimise the long-term change, some of which could be massive, abrupt and disruptive to a planet currently carrying over 7.3 billion people, all of whom want, expect, and have a right to a decent and safe standard of living. We will need to meet the challenge of climate change in a context of existing regional, political and ethnic tensions, an ever-increasingly globalised society, and one that is becoming more interconnected by the month. Climate change is one of the largest long-term, global challenges humans have ever faced in the history of civilisation. The implications for the security sector and defence forces are formidable.

Whilst defence forces can prepare for the potentially catastrophic risks posed by climate change, they cannot solve the problem alone. As a nation we must join the global effort to substantially reduce carbon emissions by rapidly replacing fossil fuels with renewable energy sources, and eliminating emissions elsewhere in the economy. If we are to reduce risks to our security, we must limit the impacts of climate change.



1. CLIMATE CHANGE OBSERVATIONS AND PROJECTIONS

1.1. Introduction

Human activities, primarily the emission of greenhouse gases from the burning of coal, oil and gas, are driving many changes to the climate system. Observed changes in climate around the globe, including in Australia and the Asia-Pacific region, include a clear warming trend, rising sea-levels and an increase in the frequency and severity of many extreme weather events.

The burning of coal, oil and gas, are driving many changes to the climate system.

Figure 1: Human activities, primarily the emission of greenhouse gases, are driving many changes to the climate system.

1.2. Observed Changes in Global Climate

The Earth has been experiencing a pronounced warming trend since the mid-20th century, with 2014 the warmest year ever since global records of surface temperature began in 1880. The world's ten warmest years on record have occurred since 1998. 2014 was the 38th year in a row with above-average temperatures and the July 2014 to June 2015 period has been the warmest 12-month period in the 136-year period of temperature records (NASA 2015; NOAA 2015a; NOAA 2015b).

The world's ten warmest years on record have occurred since 1998.

Figure 2: A floodway shimmers in the heat in Ashburton, Western Australia.

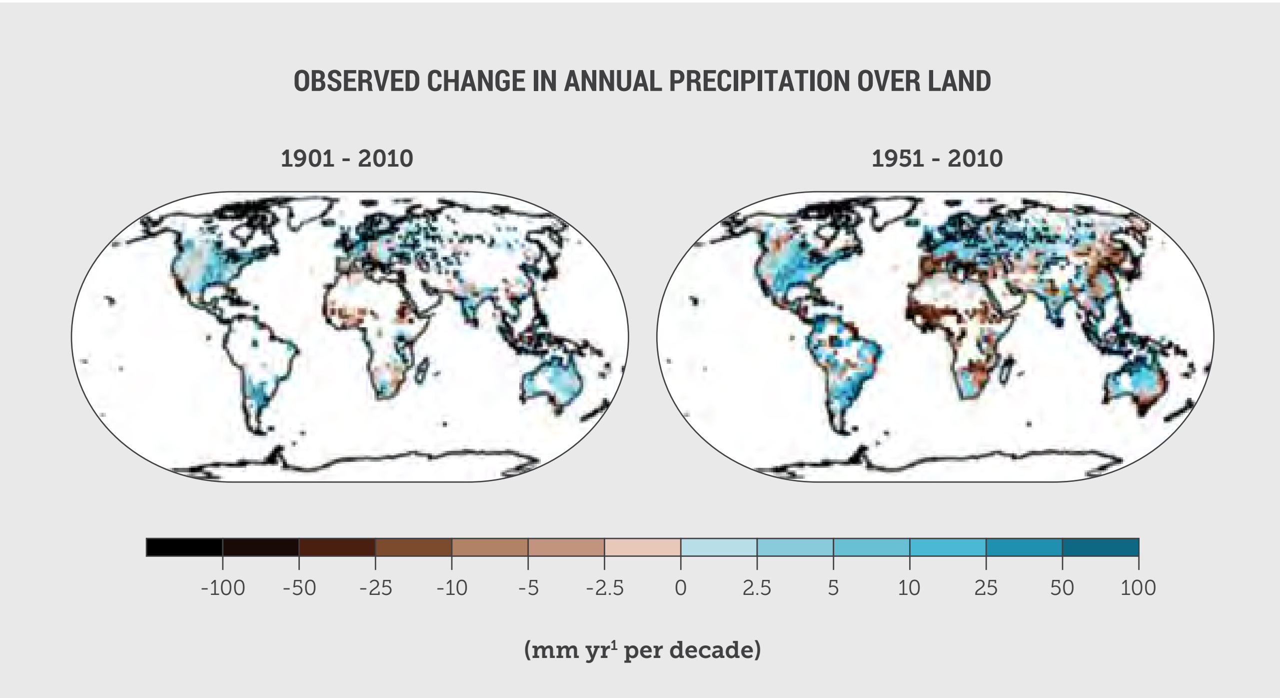


Figure 3: Maps of observed precipitation change, 1901-2010 and 1951-2010. **Source:** IPCC 2013.

Global precipitation patterns are also changing (Figure 3), with some areas receiving more rain, some areas less and the timing of rainfall changing in many regions. A significant increase in precipitation has been observed over the northern mid-latitudes since 1901, and especially since 1951.

Furthermore, it is likely that there are more land regions where the frequency of heavy precipitation events has increased than where it has decreased. The frequency and intensity of drought has likely increased in the Mediterranean and West Africa (IPCC 2013).

Figure 4: Arid soils in Mauritania, Africa. The frequency and intensity of drought has likely increased in the Mediterranean and West Africa.

Figure 5: Melt water from Columbia Glacier in Alaska.

Sea-level is rising due to (i) expansion from increasing ocean heat content and (ii) the addition of more water to the ocean from the melting of ice and discharge from land-based ice sheets and glaciers going into the ocean (see, for example, Figure 5). Over the period from 1901 to 2010, global average sea-level rose by 0.19 m (19 cm) (IPCC 2013). Sea-level rise exacerbates the extent and frequency of coastal flooding by allowing storm surges to ride on higher seas, causing more damage to infrastructure and property along the coast when storms occur. The frequency of coastal flooding events approximately trebles for every 10 cm of sea-level rise (Hunter 2012).

Many changes in extreme weather events have been observed since about 1950 on a global scale and climate-related disasters now account for over 80 percent of all disaster events globally (UNISDR 2015). It is likely that the frequency of heatwaves has increased in large parts of Europe and Asia. In Australia, there is strong evidence that climate change has increased the frequency, intensity and duration of heatwaves (Section 1.4). As noted previously, changes in both heavy precipitation events and drought have been observed at the regional level. It is virtually certain that intense tropical cyclone activity has increased in the North Atlantic region since 1970 (IPCC 2013). It is very likely that uptake of atmospheric CO_2 by the ocean has resulted in the gradual acidification of the ocean.

It is now beyond doubt that human activities, largely the combustion of fossil fuels like coal, oil and gas, are driving the many changes in the climate system that have been observed since the mid-20th century. Our capacity to understand and model the nature and magnitude of the human influence on climate continues to become more sophisticated and reliable (IPCC 2013), providing better estimates of the risks that climate change presents for security.

Sea-level rise exacerbates the extent and frequency of coastal flooding.

1.3. Observed Changes in Climate in the Asia-Pacific Region

Across most of Asia, average annual temperature has increased over the past century and the frequency of heatwaves has increased since the middle of the 20th century. For example, across Southeast Asia temperature has been rising by 0.14-0.20°C per decade since the 1960s (Hijioka et al 2014). The warming trend and increase in heat extremes is also evident in the Pacific. For example, in the western tropical Pacific, a region that stretches from Papua New Guinea (PNG) to the Cook Islands, the frequency of hot days and nights has more than tripled since 1951 (BoM and CSIRO 2014).

Regional increases in sea-level vary around the globe, and large portions of Asia and the Pacific have experienced increases in sea-level that have been much higher than the global average. For example, in the past 20 years, sea-level in the Southeast Asian region has risen at double the global average (Strassburg et al 2015). In the Sea of Japan, rates of sea-level rise (5.4 ± 0.3 mm yr $^{-1}$) were also nearly double the global average between 1993-2001 (Hijioka et al 2014).

Sea-level in Southeast Asia has risen at double the global average.

Figure 6: Cyclone Pam hits Vanuatu in 2015. storm surges are now riding on higher seas, increasing the extent and severity of flooding damage from cyclones.

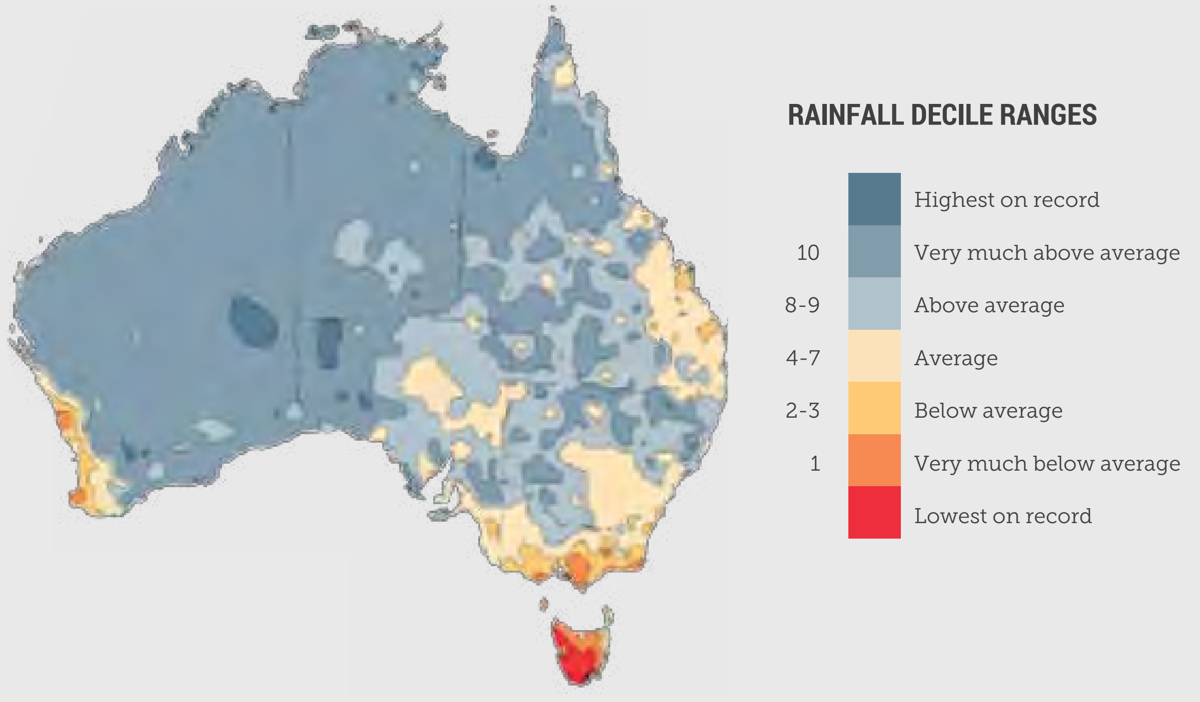
1.4. Observed Changes in Climate in Australia

Hot days have doubled in Australia in the last 50 years while heatwaves have become hotter, last longer and occur more often (CSIRO and BoM 2012; Climate Council 2013). Average surface temperature over the Australian continent has increased by 0.9°C since 1910 (CSIRO and BoM 2015), with 2013 the hottest year on record (BoM 2014). In general, warming has been stronger over inland areas than coastal regions (BoM 2014).

Climate change has increased the intensity, frequency and duration of heatwaves in Australia. For example, the number of heatwave days in Perth has almost doubled since 1950, heatwaves are starting 19 days earlier in Sydney and in Adelaide the average intensity of a heatwave has increased by 2.5°C (Perkins and Alexander 2013). During the summer of 2012/2013 the country experienced its hottest day, hottest week, and hottest month on record (BoM 2013).

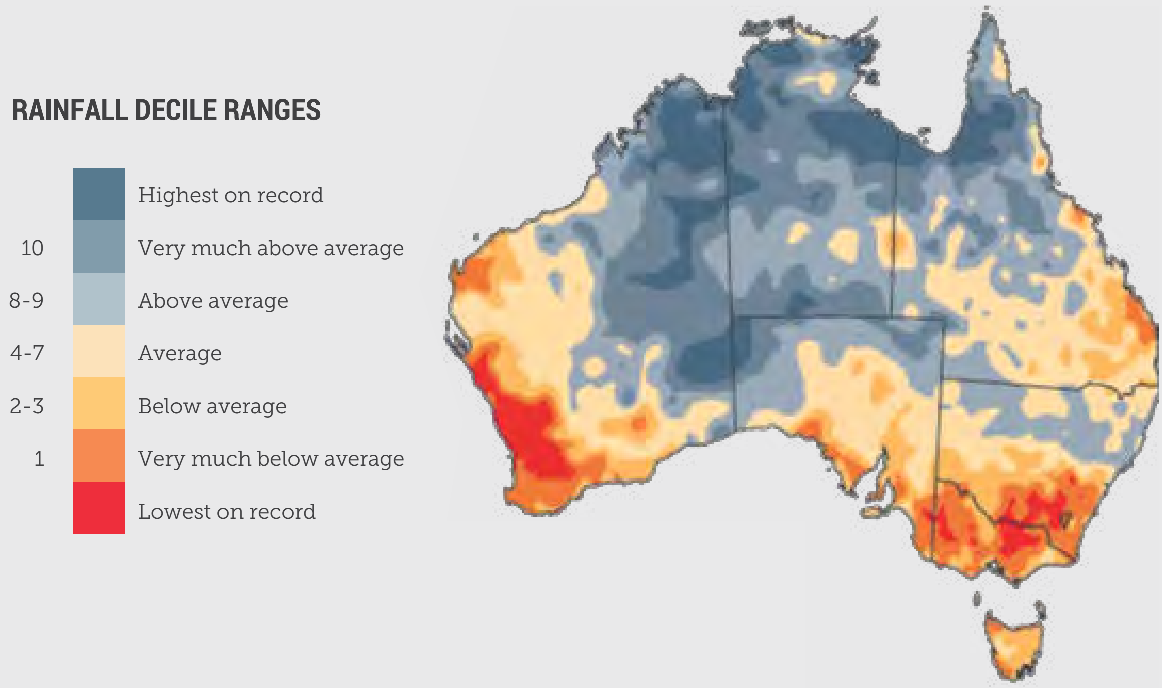
Over the past several decades there have been significant changes in regional and seasonal distribution of rainfall across the continent (CSIRO and BoM 2015; Figures 7a and 7b). Warm season (October to April) rainfall has increased across northern and central Australia since the 1970s, with rainfall very much above average over the 1997-2013 period. Cool season (May to September) rainfall trends show marked decreases in in the southwest and the southeast of the continent, the season in which these regions normally receive most rainfall (CSIRO and BoM 2015).

Climate change has increased the intensity, frequency and duration of heatwaves across Australia.



(a) Australian rainfall Oct – Apr, 1997 – 2013.

Figure 7a: Rainfall deciles for October to April (the Northern wet season) 1997 to 2013, relative to the reference period 1900-2013, based on AWAP data. **Source:** BoM 2014a, cited in CSIRO and BoM 2015.



(b) Australian rainfall Apr – Sep, 1997 – 2013.

Figure 7b: Rainfall deciles for April to September (Southern wet season) 1997-2013, relative to the reference period 1900-2013, based on AWAP data. **Source:** BoM 2014a.

High bushfire danger weather has increased in southeast Australia over the past 30 years.

High bushfire danger weather (see, for example, Figure 8) has increased over the past 30 years in southwest and southeast Australia with the increasingly hot, dry conditions (Clarke et al 2013).

The rate of sea-level rise around Australia has recently increased: on average, sea level rose 2.1 mm per year in the 1966-2009 period and 3.1 mm per year in the 1993-2009 period, close to the global average (White et al 2014). Australia is highly vulnerable to coastal flooding because most of the nation's cities, towns and critical infrastructure are located along the coast, and over half of the Australian coastline is vulnerable to erosion. At Fremantle and Sydney, where sufficiently long records are available, flooding events have increased three-fold over the 20th century (Church et al 2006).

Figure 8: Bushfire smoke hangs over the city of Sydney, during bushfires in 2013.

1.5. Climate Projections for the Asia-Pacific Region

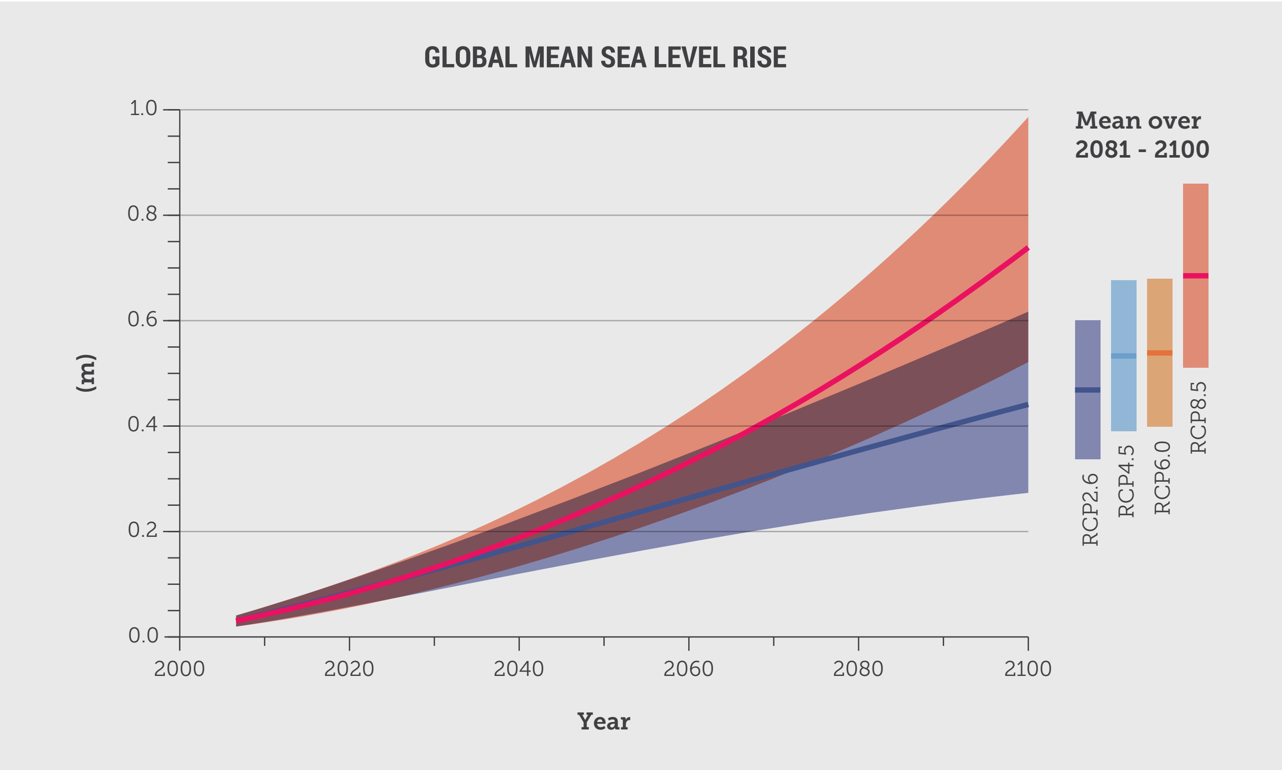
As part of the global trend, average temperatures across the Asia-Pacific region will continue to increase, with projected warming by 2030 likely to be around 0.5-1.0°C compared to a late 20th century baseline (BoM and CSIRO 2014). It is very likely that throughout the 21st century all land areas of Asia will experience continued warming, with temperatures increasing by up to 4°C or more above the late 20th century baseline (up to 4.6°C or more compared to a pre-industrial baseline) under a high emissions scenario (Hijioka et al 2014; IPCC 2013). Increases in hot days and heatwaves are virtually certain by the end of the century (IPCC 2013).

Projections of change in rainfall, sleet and snow show some general patterns of change, but are more uncertain compared to those for temperature (IPCC 2013). In general, mid-latitude and tropical areas in the Asia-Pacific that currently have dry climates will likely experience a decrease in precipitation while those that are wet will experience an increase. The area encompassed by monsoon systems will likely increase, monsoon precipitation is likely to intensify, and monsoon seasons are likely to lengthen. In general, extreme precipitation events will likely become more intense and frequent by the end of the century (IPCC 2013), and heavy precipitation associated with monsoons and with tropical cyclones is likely to increase in East, South and Southeast Asia throughout the 21st century (Hijoka et al 2014).

By the end of the 21st century global average sea-level will likely have risen by 0.4-1.0 m (Figure 9), but possibly more if there is significant loss of ice from the West Antarctic ice sheet (IPCC 2013).

Extreme precipitation events could become more intense by 2100.

Figure 9: Projections of global mean sea-level rise over the 21st century relative to 1986-2005 obtained from the combination of the CMIP5 ensemble with process-based models, for RCP2.6 (low emission scenario) and RCP8.5 (high emission scenario). The assessed likely range is shown as a shaded band. The assessed likely ranges for the mean over the period 2081-2100 for all RCP scenarios are given as coloured vertical bars, with the corresponding median values given as a horizontal line. **Source:** IPCC 2013.



In the Pacific, small islands states such as Kiribati, where most of the islands are less than 2 m above sea-level, will experience an average sea-level rise of 7-17 cm by 2030 and 38-87 cm by 2090 under a high emissions scenario (BoM and CSIRO 2014; Wyett 2014) increasing the risk of flooding over many areas. Through this century, tropical small island states will also be affected by the projected increase in the heavy rainfall and maximum wind speed of cyclones (IPCC 2013), coupled with higher coastal water levels from sea-level rise (IPCC 2012; Hijioka et al 2014).

Figure 10: Children in the ocean in Vanuatu. In the Pacific, small islands will experience sea-level rise of 7-17 cm by 2030.

1.6. Climate Projections for Australia

As greenhouse gas concentrations continue to rise, what is now considered unusually hot weather across Australia will become commonplace (IPCC 2012; Climate Council 2014a). By 2030 the annual average temperature is projected to be 0.6-1.3°C above the 1986-2005 baseline (1.2-1.9 °C above pre-industrial levels) (CSIRO and BoM 2015), and by the end of the century, annual average temperature is projected to increase by 2.8 to 5.1°C above the baseline (3.4-5.7°C above pre-industrial levels) if emissions continue on their current trajectory (IPCC 2013).

If global emissions are not significantly reduced, heatwaves will continue to increase in intensity, severity and frequency. In the southeast and southwest of Australia, it is very likely that fire seasons will become longer with an even larger number of days of extreme fire danger (Clarke et al 2011; 2012).

Cool-season rainfall is projected to decrease across southern Australia, but rainfall changes across the rest of the country are more uncertain. Extreme rainfall events are projected to become more intense. Time in drought (see, for example, Figure 11) is projected to increase in southern Australia, with a greater frequency of severe droughts. It is likely that evapotranspiration rates will also rise through this century, which will likely exacerbate the frequency and severity of periodic droughts (CSIRO and BoM 2015). The projected sea-level rise around Australia over the rest of this century is similar to the global projection.

Without strong action heatwaves and fire danger weather are expected to worsen.

Figure 11: Lake Hume in drought, Victoria.

1.7. Tipping Points

Military forces and the security sector more broadly, have identified climate change as a high-risk phenomenon (Chapter 4) and hence must prepare for all eventualities, including crossing climate tipping points.

Perhaps the most dangerous aspect of a rapidly changing climate system is the risk of crossing large-scale thresholds (Lenton et al 2008; Richardson et al 2011; National Research Council 2013; Figure 14), which could not only cause severe, direct consequences for human well-being, but also drive strong reinforcing feedbacks in the climate system that further accelerate climate change itself. Prominent amongst these tipping points is the potentially rapid loss of ice from the polar ice sheets leading to greater sea-level rise, and consequent coastal flooding (IPCC 2013). The West Antarctic ice sheet is perhaps the most vulnerable because it is grounded below sea-level. In a short period of time (a few decades), warming ocean water could detach much of the ice sheet from the shallow sea floor on which it is grounded, leading to rapid sea-level rise. The IPCC has warned that a high emissions scenario could trigger this effect, causing sea-level rise to surpass the uppermost current projections by tens of centimetres (IPCC 2013).

The Greenland ice sheet (Figure 12) may also reach a tipping point this century, potentially within the next few decades. The IPCC has assessed that a tipping point, beyond which most or all of the ice sheet will eventually be lost, lies somewhere between a 1°C and 4°C temperature rise above pre-industrial levels (Church et al 2013). Once the tipping point is crossed, the Earth will experience sea-level rise of up to 7 metres, although it will take several centuries at least for this to unfold.

Tipping points are thresholds that, if crossed, could have severe consequences for our well-being.

Figure 12: A NASA image of the Greenland ice sheet and surface melt runoff during summer. The tipping point for the eventual loss of the Greenland ice sheet lies somewhere between a 1 and 4°C temperature rise above pre-industrial levels.

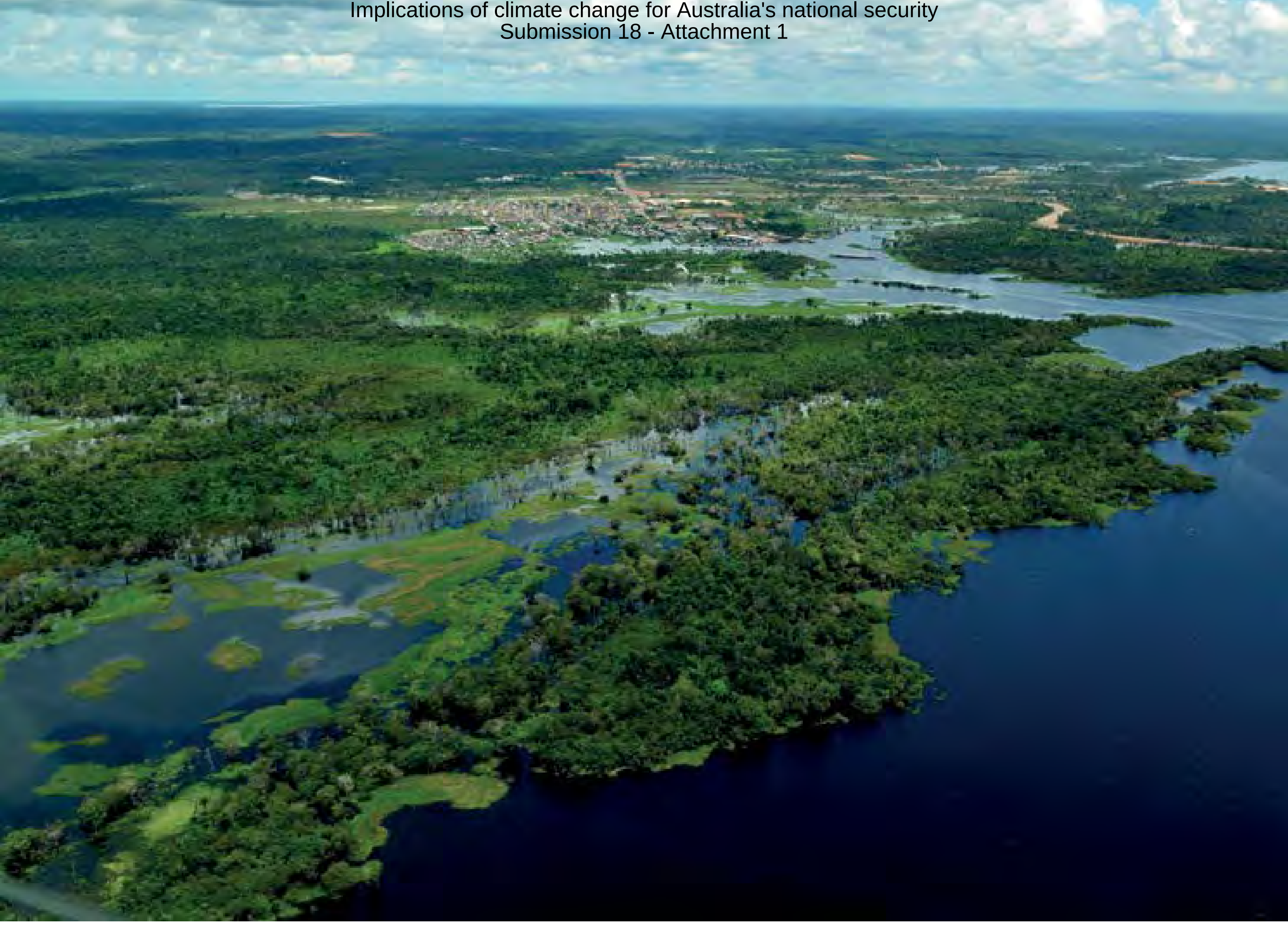


Figure 13: Aerial view of the Amazon rainforest. Tipping points in the coming decades include the partial conversion of the Amazon rainforest to grassland or a savanna.

Other tipping points that could potentially be crossed over in the coming decades include the partial conversion of the Amazon rainforest to a savanna or grassland (Cook and Vizy 2008; Richardson et al 2011), and the large-scale emission of carbon dioxide (CO_2) and methane from thawing permafrost (Ciais et al 2013). Each of these examples would cause further disruptions to the climate system, with knock-on effects for human societies. Potential emissions of CO_2 and methane from melting permafrost in the northern high latitudes (e.g., Siberia, Alaska), which would accelerate climate change, are assessed to be in the range of 50 to 250 billion tonnes of carbon over the 21st century under the highest emissions scenario (Ciais et al 2013). By comparison, current human emissions of carbon averaged about 10 billion tonnes per year over the most recent decade (Le Quéré et al 2014).

If the threshold for loss of the Greenland ice sheet is crossed, sea-level could rise by up to 7 metres.

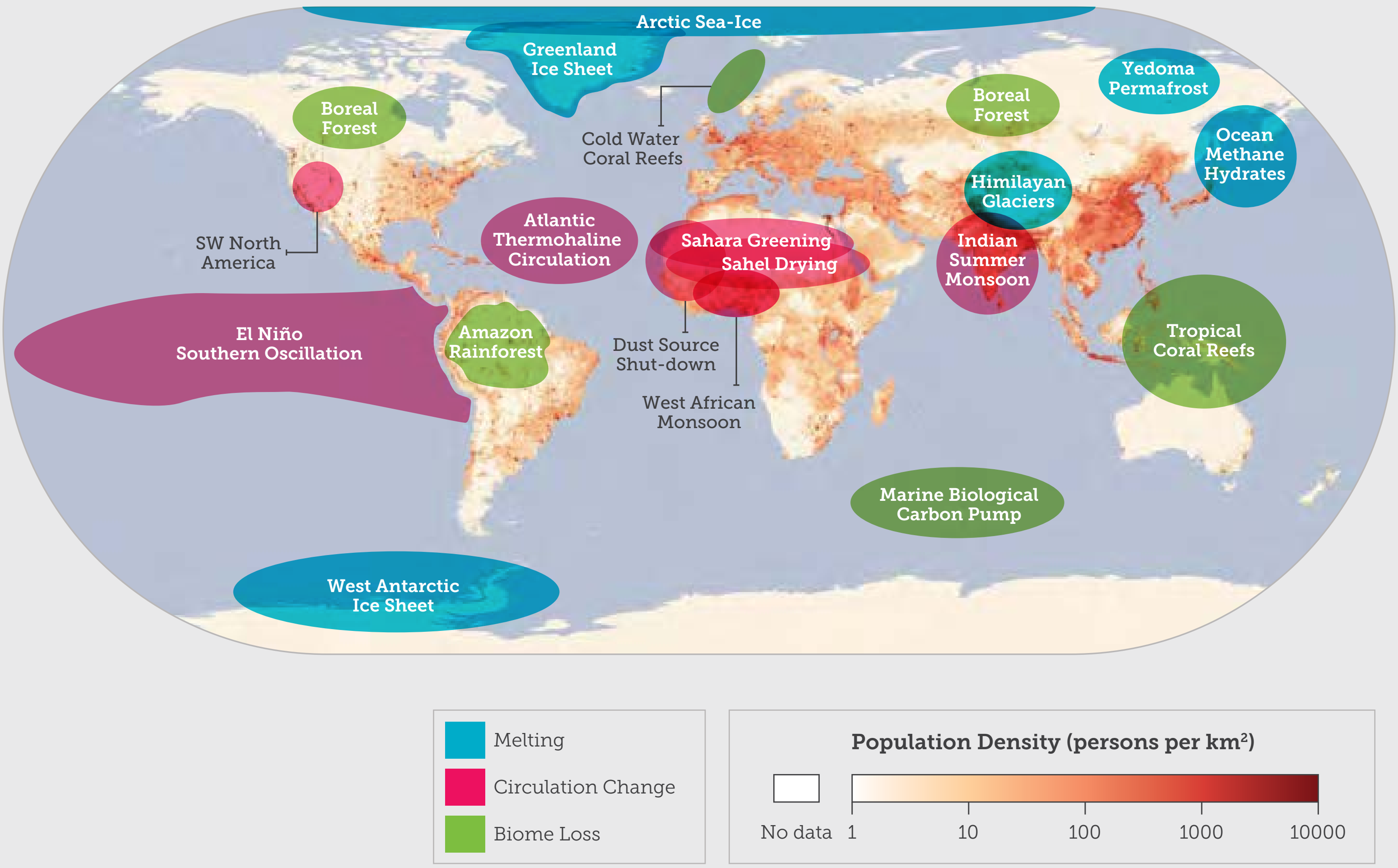


Figure 14: Map of where potential climate tipping points may occur around the world, overlain with global population density. Red indicates major changes in atmospheric and oceanic circulation; blue indicates the melting of ice sheets, glaciers and sea ice, and the thawing of frozen soils and sediments; and green indicates the loss of large terrestrial and marine biomes. As the map indicates, significant tipping points could occur in densely populated regions across the globe – *adapted from Lenton et al 2008 based on Chapter 7 of Richardson et al 2011.*

2. CLIMATE RISKS FOR HUMAN AND SOCIETAL WELL-BEING

It is clear that climate change is increasing sea-level, driving up global temperatures and increasing the frequency and intensity of many extreme weather events (Chapter 1). This poses significant risks for human and societal well-being, as climate change will affect the availability of food and water and undermine human health. Extreme weather events, scarcity of food and water and health risks are all factors that can exacerbate conflict and societal instability. They also play a role in forcing people to migrate within and between nations, which can contribute to further tensions. This is why the security sector is increasingly labelling climate change a “threat multiplier”, with significant security implications. The focus of this chapter is on the impacts of climate change for food and water availability as well as for human health. These impacts are already being felt around the world. In this section we draw on a range of international examples of these impacts, with a focus on the Asia-Pacific region and Australia.

2.1. Climate Change and Food Scarcity

Climate change threatens the accessibility and quality of food in a variety of ways, as illustrated by declines in crop yields, damage to fisheries and degradation of agricultural land. It can also affect the affordability of food, as demonstrated by food prices during the Millennium Drought in Australia and rising food prices in the Middle East. Climate change clearly interacts with a variety of stresses to undermine food security, as exemplified during the 2008 food crisis that erupted in food riots in Africa and the Middle East.

The multiple components of a food system required to support a healthy lifestyle have been collectively termed "food security". This term is defined by the United Nations Food and Agriculture Organization (FAO) at the World Food Summit in 1996 as:

'when all people at all times have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life' (FAO 1996).

There is enough food produced per capita to feed the world's population, but 870 million people were hungry from 2010-2012, with most of the undernourished living in developing countries (Porter et al 2014; Figure 15). By 2050, the world's population is projected to reach more than 9 billion (UN 2013). At the same time, the per capita wealth in many developing countries is increasing, leading to growing demand for protein-rich diets. Collectively, these trends are expected to increase the global demand for food by 70 to 100 percent by the middle of the century (FAO 2009; Godfray et al 2010; Alexandratos and Bruinsma 2012). Climate change has the potential to increasingly undermine the accessibility, affordability and quality of food, and thus be an additional stressor on food security.

Figure 15: A woman holds a malnourished child, waiting for medical assistance in Somalia. 870 million people were hungry from 2010-2012.

Climate change is damaging coral reefs that are relied upon for food by 500 million people.

Without adaptation, local temperature increases of about 1°C above pre-industrial levels are projected to reduce yields of staple cereals such as wheat and rice in both tropical and temperate regions, although individual locations may benefit (Porter et al 2014). Future projections indicate that irrigated wheat yields in developing countries could decline 13 percent and irrigated rice by 15 percent by 2050 (Thornton and Cramer 2012). Whilst such declines in yields in some parts of the world may benefit other regions (for example, lower wheat yields overseas may mean higher profitability for Australian exporters) changes in trade balances may have important flow-on impacts for domestic food availability and prices.

Inundation of coastal areas due to sea-level rise will also have significant implications for food accessibility in low-lying nations where agricultural land is concentrated along the coast. For example, seven percent of Vietnam's agricultural land may be submerged with a 1 m rise in ssea-level (Dasgupta et al 2009). Coral reef ecosystems serve as another clear example of how climate can affect food accessibility. Reef ecosystems provide food and other resources to over 500 million people and account for roughly a quarter of total fish caught in Asia annually (Hoegh-Guldberg et al 2007; Porter et al 2014). It is estimated that an additional 156,000 km^2 of coral reef will need to be exploited to sustain population growth by 2050 (Hoegh-Guldberg et al 2007). Unfortunately, many factors, including rising ocean temperatures, increasing acidification and overfishing, are immediately threatening 75 percent of the world's coral reefs. Declines in coral reefs (see, for example, Figure 16) leads to an inevitable decline in the abundance of fish, affecting the communities that depend on this resource (Porter et al 2014).

Figure 16: Bleached coral. Rising ocean temperatures and increasing acidification are damaging coral reefs.

Figure 17: Women in Mauritania inspect their failed crops, in the wake of low rainfall.

Extreme climate events can also affect the affordability of food.

Climate change is also affecting the distribution and availability of pelagic fish, which occupy the surface waters in tropical and temperate zones (Hobday et al 2009). For example, in the tropical Pacific pelagic fish such as tuna are a vital source of food, as they are essential for livelihoods, food and economic security and make up the majority of fish harvested in the region (Ganachaud et al 2013). However, the warming of the ocean's surface is altering the migration patterns of these fish, as seen with tuna stocks in the tropical Pacific that are already shifting eastwards in response to warming ocean temperatures (Hobday et al 2015). The redistribution of fish, such as tuna, across the tropic and sub-tropics will lead to overall declines in productivity throughout the region (Ganachaud et al 2013).

Climate change can also affect food quality. Increased atmospheric CO_2 reduces the protein and mineral content of plants, affecting their nutritional quality (Taub et al 2008; Porter et al 2014). Reduced protein content in wheat, in particular, has important implications for flour and bread quality (Fernando et al 2015).

Extreme climate events can also affect the affordability of food. During the Millennium Drought in Australia, food prices during the 2005-2007 period increased at twice the rate of the Consumer Price Index (CPI) with fresh fruit and vegetables the worst hit, increasing 43 percent and 33 percent respectively (Quiggan 2007). Between 2006 and mid-2008, the average global price of food nearly doubled (FAO 2008). Similar price jumps were recorded in 2011. Some studies have implicated rising food prices as one of the factors that destabilised the Middle East, leading, for example, to the "Arab Spring" and also contributing to the conflict in Syria (Slaughter et al 2013). Of course, many other non-climatic factors are also likely to have contributed to these price rises (Adger et al 2014).

Soaring food prices disproportionally affect poor consumers, as higher prices mean more people with low to medium-incomes cannot afford to purchase enough, if any, food. Since June 2010, the number of people living in extreme poverty in low and middle-income countries has increased by approximately 44 million, due to food price increases (Porter et al 2014). Limits to the availability, accessibility and quality of food also have significant implications for health (Section 2.5).

An example of how climate change can affect food availability and demand can be seen during the 2008 food and energy crisis (Figure 18). The food crisis of 2008 caused the number of undernourished people around the world to increase from 848 million to 923 million (von Braun 2008). Over the three years running up to the crisis food prices had increased by 83 percent, while global grain stocks were at their lowest level since 1982 (Mittal 2009). Food riots erupted across Africa and the Middle East in 2008 as prices for basic food soared. The cost of wheat increased by 127 percent, rice by 170 percent and maize by 300 percent (Mittal 2009; McMichael 2009).

Several long-term trends contributed to the 2008 crisis:

(i) Steadily diminishing availability of new, high-quality agricultural land (Lambin et al 2013);

(ii) Slowing crop yield increases in response to agricultural intensification in many parts of the world (Fuglie 2010);

(iii) Increasing frequency and severity of extreme weather events such as drought (Lobell and Field 2007) driven by climate change;

(iv) Rising demand for food globally.

This combination of stresses overloaded the global food system's coping capacity. In addition to this, rising oil prices in the 2000s drove up food prices with the increasing cost of food production and also encouraged some farmers to switch production to biofuels as a substitute for fossil-based transport fuels. Because cropland can now be used for either feedstock for biofuels or for food production, the global food and energy systems became closely interconnected (Homer-Dixon et al 2015). Climate change exacerbated the 2008 food crisis. Climate change was not the "cause" of the 2008 food crisis but it acted as another stressor on a complex, highly interlinked food system that was already reaching the limits of its coping capacity, with obvious consequences for security.

An independent taskforce comprised of experts from the UK and USA has recently found that climate change is increasing the risk that a significant 'weather-related shock' will hit global food production, destabilising global grain markets and affecting the well-being of individuals and societies in vulnerable countries. Preliminary analysis of limited existing data has led the taskforce to suggest that the risk of a 1-in-100 year production shock event from extreme weather could increase to a 1-in-30 year risk or more in the next few decades (Bailey et al 2015).

The 2008 global food crisis was exacerbated by climate change.

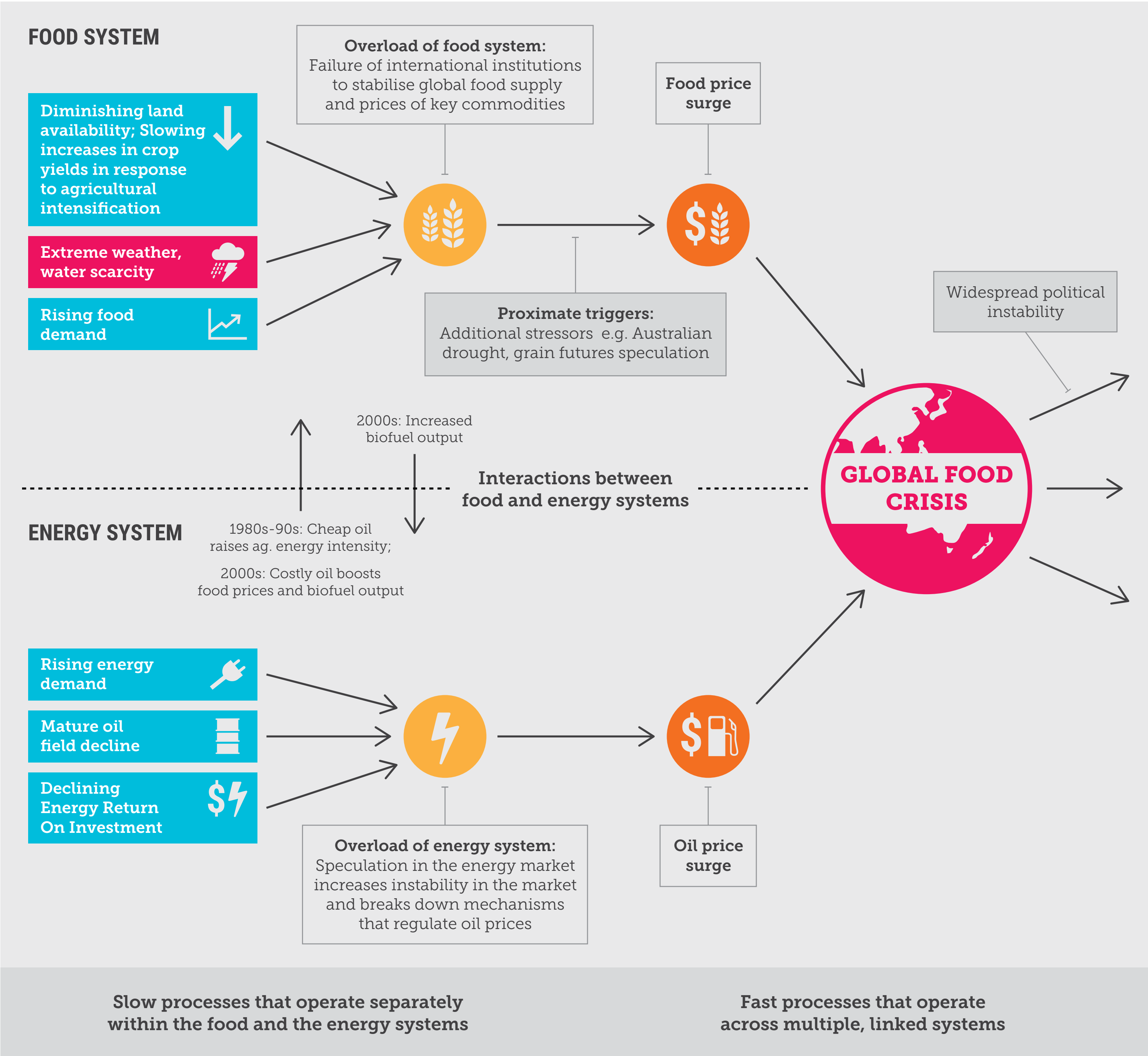


Figure 18: The 2008 food-energy crisis. **Source:** Adapted from Homer-Dixon et al 2015.

2.2. Climate Change and Water Availability

Climate change affects the accessibility and availability of freshwater resources in a variety of ways. Saltwater intrudes into coastal aquifers, variable precipitation can reduce access to reliable surface water, and changes in the timing and rate of glacier melt makes water flows less reliable. Shifts in the regularity of monsoon systems and increases in the intensity and severity of drought also threaten water availability in many regions around the world. Importantly, food and water security are closely interconnected and climate change is increasingly placing both under significant pressure.

Population growth, increasing consumption rates, economic development, urbanisation and changes in land use are already decreasing water supply and increasing water demand. Approximately 80 percent of the global population is exposed to some degree of water insecurity (Jimenez et al 2014). Climate change will put further pressure on water security by affecting the accessibility and availability of freshwater resources (IPCC 2014).

Up to 98 percent of the earth's available freshwater is made up of groundwater (water stored below ground in porous soils and aquifers) and for many developing nations and remote communities groundwater is the only reliable source of water available (National Water Commission 2012). Climate change affects groundwater in a variety of ways. For example, saltwater intrusion of coastal aquifers is driven primarily by over-abstraction and rising sea levels, a phenomenon that is already being observed in Kenya (Okello et al 2015). In the case of the Shela aquifer (located on Kenya's southeast coast) the combination of a rapidly increasing population and rising sea level is projected to completely deplete this water resource by 2033 (Okello et al 2015).

Climate change is also reducing the supply of reliable surface water in some regions, due in part to an increased variability of precipitation. In southern Australia, for example, cool season (May to September) rainfall is projected to decline by as much as 44 percent by 2090, leading to reduced water supplies, an impact further exacerbated by rising temperatures (BoM and CSIRO 2015; Chapter 1).

Climate change will affect the accessibility and availability of freshwater resources.

Figure 19: Gokyo Peak in the Khumbu region of the Nepal Himalayas. The Himalayan glaciers are losing ice as the planet warms, with risks for future streamflows.

Climate change is driving water insecurity in South Asia.

Changes in the climate system at the regional level can play important roles as risk multipliers in food-water systems. Two of these changes lie in the Asian region and have important implications for security in Australia's part of the world.

The regularity of precipitation provided by the South Asian monsoon system and the timing and rate of glacier melt in the Himalaya provides a large, reliable water supply for the regions surrounding the mountains, such as India, Pakistan and Bangladesh. But the Himalayan glaciers, like most around the world, are losing ice as the planet warms, creating substantial risks for future streamflows (IPCC 2014). As this process continues through this century, water flows are likely to become less reliable, their timing will be less matched to agricultural seasons, and glacial lakes high in the mountains may be overwhelmed by increases in meltwater, threatening catastrophic flooding downstream (IPCC 2013; Cisneros 2014). These changes to water flows have implications for the agricultural capacity of the region, as well as fresh water availability.

The regularity of the South Asian monsoon system is also now at risk from a number of factors, including both climate change and regional air pollution. The summer monsoon season brings torrential rainfall, which nations throughout Southeast Asia depend on for agricultural production, hydroelectric power and to replenish wells and aquifers for the rest of the year. A major concern for the monsoon season is the large emission of aerosol particles (air pollution) over the Indian subcontinent. Large concentrations of aerosols in the atmosphere cool the surface temperature over the subcontinent, thereby decreasing the temperature difference between land and the Indian Ocean; this temperature difference is the driver of the monsoon. Large aerosol concentrations, coupled with a rapidly warming Indian Ocean, are thereby increasing the risk that the monsoon system will weaken or even flip to a much drier state (Zickfeld et al 2005), disrupting agriculture across India and its neighbouring countries. The present concentration of aerosols, mostly due to the use of wood in cooking and the burning of fossil fuels for energy and transport, can reduce incoming sunlight by 10-15 percent, putting the monsoon system at significant risk of failure (Ramanathan et al 2005).

Climate change is also projected to alter the frequency and intensity of droughts (Figure 20), although the impacts will vary depending on region. Droughts, both meteorological (less rainfall) and agricultural (drier soil) are projected to increase in length and severity in some regions due to both reduced rainfall and increased evaporation driven by a warming climate (IPCC 2013). For example, climate change is exacerbating drought conditions in southwest and southeast Australia (CSIRO and BoM 2015). The projected increase in duration and intensity of droughts in southeast Queensland will increase the length of time it takes to refill key water storages in the region (CSIRO and BoM 2015). Water scarcity will be further compounded as climate change will likely reduce raw water quality. For example, increases in water temperature can increase the intensity of algal blooms, some of which produce toxins that can damage the health of humans, domestic animals and livestock (Jimenez 2014; NSW Government 2015).

Figure 20: Cracked earth in Rajasthan, India. There is a risk that the monsoon season will flip to a much drier state, disrupting agriculture in India.

Food and water security are also closely interconnected (see, for example, Figure 21). Agriculture already accounts for the extraction of about 65 percent of China's freshwater resources (World Bank 2015). The IPCC projects that, depending on the scenario and climate model, there will be insufficient water for agriculture in parts of China as early as the 2020s, particularly as the demand for water for non-agricultural uses grows (Xiong et al 2010; Hijioka et al 2014).

With the global population continuing to increase, the effects of climate change are worsening the stresses placed upon the world's water stocks. Whilst better water management strategies can help alleviate water scarcity issues, widescale changes in the hydrologic cycle will be difficult, if not impossible, to adapt to (Hijioka et al 2014), contributing to instability, conflict and climate-induced migration within and between nations (Section 3.2).

The effects of climate change are worsening the stresses placed upon the world's water stocks.

Figure 21: Oxen working in a rice paddy. Food and water security are closely interconnected.

2.3. Climate Change and Extreme Weather Events

Climate change can also directly undermine the well-being of individuals and societies due to the increasing frequency, intensity, and severity of many extreme weather events. This increase in extreme events, coupled with issues such as population growth, patterns of economic development, land-use change, resource degradation, urbanisation and ineffective disaster management practices, is increasing the number of individuals and communities affected by extreme events such as bushfires, cyclones, flooding, droughts and extreme heat.

In what can now be considered a 'typical year', total global natural disasters in 2011 killed around 31,000 people, injured a further 245 million and resulted in economic losses of approximately US$ 366 billion (Guha-Sapir 2012). Of particular importance for regional security is that the majority of the damage caused by natural disasters consistently occurs in the Asia-Pacific (see, for example, Figure 22). In 2014 over half of the world's 226 natural disasters occurred in this region (UN 2014).

Climate change is increasing the frequency, intensity, and severity of many extreme weather events.

Figure 22: This photo, taken a month on from Cyclone Pam, shows a village in Tuvalu damaged and flooded.

Climate change-related disasters affect the well-being of individuals and societies through the large scale displacement of people, loss of livelihoods and destruction of food supplies, damage to critical infrastructure, such as water and power infrastructure, and through increases in physical and mental illness. Increasingly, climate change related disasters also necessitate the deployment of military forces to provide security, restore order and to provide Humanitarian Assistance and Disaster Relief (HADR).

Over half the world's natural disasters in 2014 happened in the Asia-Pacific.

2.4. Climate Change, Sea-level Rise and Coastal Flooding

Sea-level rise has significant implications for individual and societal well-being. Over half of the urban population in Asia lives in low-lying coastal zones and flood plains that are most at risk from coastal flooding, and thus are particularly vulnerable to sea-level rise (Hijioka et al 2014).

By the year 2100, without adaptation, millions of people will be adversely affected by coastal flooding, with the majority of those affected in East, Southeast and South Asia (Wong et al 2014). Large populations living in low-lying Asian mega-deltas, such as the Mekong Delta, are affected by flooding due to coastal recession and land subsidence, now being exacerbated by rising sea level. A study of 33 deltas around the world found that 85 percent of the deltas have experienced severe flooding in the past 10 years, temporarily submerging 260,000 km^2 of land (Syvitski et al 2009; Hijioka et al 2014).

Sea-level rise is also one of the most significant challenges currently facing low-lying islands and atolls in the Pacific (see, for example, Figure 23), as rising sea-level increases severe flooding and erosion risks, as well as degrading fresh groundwater resources (Nurse et al 2014). In some parts of the tropical western Pacific, rates of sea-level rise of approximately 12 mm yr^{-1}, about four times the global average, have been reported between 1993 and 2009 (Cazenave and Remy 2011).

Figure 23: Residents of the low-lying Pacific island of Kiribati use coral rocks to build temporary walls in an attempt to break the swell of increasingly large king tides.

Much of the Asia-Pacific region is vulnerable to climate change.

Figure 24: The main square of Nui island, Tuvalu, still under water over a month after Cyclone Pam hit.

Rising sea-level has already exacerbated the damage caused by cyclones in Asia and the Pacific, as storm surges are now riding on higher seas, increasing the extent and severity of flooding damage from cyclones and storms surges. For example, Cyclone Pam, which affected 22 Pacific islands in March 2015, caused severe storm surges which inundated homes across several atolls in Tuvalu and up to 70 percent of the population in Vanuatu were displaced (ABC 2015a; ABC 2015b; Australian Red Cross 2015; Climate Council 2015; UN News Centre 2015). Sea-level rise also poses severe risks for Australia. A rise of approximately 1.1 m puts more than $226 billion (2008$) in commercial, industrial, residential, road and rail assets at risk from coastal flooding (DCCEE 2011). ADF infrastructure is also at risk from sea-level rise (Box 4).

Rising sea-level has already exacerbated the damage caused by cyclones.

2.5. Climate Change and Human Health

Climate change has been identified as the biggest global health threat of the 21st century, whilst tackling it could be one of the century's greatest global health opportunities (Costello et al 2009; Watts et al 2015). Climate change and its impacts outlined in Chapter 1 and Sections 2.1 - 2.4, undermine health in a number of ways, both directly and indirectly (Smith et al 2014).

Direct risks to health from climate change stem from the increasing frequency and severity of extreme weather events such as heatwaves, floods, storms, cyclones (Figure 24) and bushfires. More frequent and intense heatwaves result in more heart attacks, strokes, accidents, heat exhaustion and death. Extreme heat has caused more deaths than any other natural hazard across Australia over the past 100 years (Coates 1996). The European heatwaves of 2003 killed an estimated 70,000 people and heatwaves in Russia in 2010 killed approximately 56,000 (Robine et al 2008; Munich Re 2011). Other extreme weather events, particularly storms, floods and cyclones, can result in more injuries, deaths and post-traumatic stress. Bushfires can lead to smoke-induced asthma attacks, burns and deaths. Smoke from bushfires is estimated to have caused the deaths of over 300,000 people globally, with the largest proportion occurring in Africa and Southeast Asia (Johnston et al 2012; Climate Council 2013).

Figure 25: The city of Marikina in the Phillipines damaged by flooding in the wake of Typhoon Ketsana, 2009.

Climate change is affecting the spread of malaria and dengue fever.

Risks of flow-on effects from these direct risks to health, although more complex and harder to predict in timing and extent, are numerous. Exposure to some air pollutants and airborne allergens, such as pollens and moulds, exacerbate respiratory illnesses, such as asthma, hay fever and longer-term heart and lung diseases. Changing rainfall patterns, hotter temperatures and greater humidity affect the spread and activity of vectors of diseases such as malaria and dengue fever, and the probability of food-borne infections (Wong et al 2014). Enterovirus infections (e.g. meningitis), for example, peak during the warmer summer and autumn months in the USA (Smith et al 2014). Warming and drying in some regions can lead to a higher prevalence of mental health problems and lower morale in rural communities. For example, an analysis of suicide rates in NSW between 1970 and 2007 showed that drought increased the incidence of suicide amongst rural males in the 30 to 49 year age group by 15 percent (Hanigan et al 2012).

Figure 26: A US army medic treats a young girl in Kenya on world malaria day in 2010. Changing rainfall patterns, hotter temperatures and greater humidity affect the spread and activity of vectors of diseases such as malaria.

Figure 27: An ambulance rushes through traffic in the centre of Melbourne. During the January 2014 heatwave in Victoria, ambulance call-outs quadrupled.

As health risks increase, so does the pressure on the health system.

Food, water and health security are interlinked (Section 2.2). Yet the global food system is woefully unprepared to cope with climate change. Changing rainfall patterns and hotter temperatures threaten to eradicate recent gains in reducing hunger, and will increase global water insecurity (Oxfam 2013; Section 2.3). Interruptions to the availability, accessibility and quality of food and water has profound implications for human health. Climate change is also expected to increase the burden of several diseases such as diarrhea, which is the third leading cause of death among children under five (WHO 2015). Floods and droughts exacerbate these risks. For example, in Botswana hotter, drier conditions may increase diarrheal disease incidence during the dry season (Alexander et al 2013), and the rates of the two most common food-borne illnesses worldwide, *Salmonella* and *campylobacter,* increase when temperatures are warmer (Lake 2009). Diarrhea can affect the ability of the body to process nutrients. This can also lead to micronutrient deficiency related diseases, stunting and malnutrition, with potentially long-term, irreversible health effects as well as socio-economic consequences that can erode a person's well-being and development, and take a toll on countries' economies (Hanna et al 2011).

Changes, such as rising sea levels, hotter conditions and changed rainfall patterns, can contribute to the displacement of people (Yonetani 2014), with wide-ranging negative effects on social and economic well-being.

As health risks increase, so does the pressure on health systems and emergency responses, which can delay the effective delivery of health care. During the January 2014 heatwave in Victoria, ambulance call-outs quadrupled (The Age 2014; Climate Council 2014a; Figure 27).

While climate change has potentially significant health effects, many other non-climatic factors contribute to their severity, from the effectiveness of emergency management to the quality of health infrastructure and the vulnerability of individuals and communities. As climate change continues, scientists anticipate that these health impacts will worsen. Whilst forms of adaptation are possible, such as strengthening the resilience of health systems, there are limits to adaptation to health risks, particularly as parts of the world begin to experience temperatures that exceed the basic physiological limits of the human body (Hanna and Tait 2015).

3. CLIMATE CHANGE AS A THREAT MULTIPLIER

Military forces, and the security sector more broadly, are labelling climate change a "threat multiplier". Climate change and its impacts (Chapter 1), are undermining individual and societal well-being by affecting the availability of food and water (Chapter 2), which in turn can force migration within and between nations and exacerbate conflict. In Chapter 3 we define climate change as a threat multiplier before considering how it can play a role in forcing people to move (climate-induced migration) and worsen conflict.

3.1. Defining Climate Change as a Threat Multiplier

Due to the severity of the current and future impacts of climate change, many expert bodies, ranging from the United Nations Security Council to the Pentagon (Figure 28), consider a changing climate to be a significant threat to national security. Climate change presents a unique set of challenges as it is a global issue with local and regional impacts that will be felt differently by different countries depending on their geographic location and capacity to respond.

Climate change does not act in isolation in terms of its security-related risks; that is, climate change can exacerbate a wide range of interacting, non-climate threats to security. Climate change may contribute to a conflict, rather than being the sole cause. In this way, climate change is often viewed as a "threat multiplier". Analyses of recent global crises, such as the 2008 food-energy crisis show how climate change can act to multiply the impacts of other types of threats (e.g. Homer-Dixon et al 2015; Section 2.1). This chapter examines two of the key security implications that could result from climate change; climate-induced migration and conflict.

Climate change is a significant threat to national security.

Figure 28: The Pentagon as seen from the air. The US Department of Defence considers climate change to be a significant threat to national security.

3.2. Climate-induced Migration

Around 80 percent of all migration presently occurs within countries, most commonly from rural to urban coastal areas. Between 1990 and 2000, for example, there was a net migration to coastal zones of approximately 70 million people (UNDP 2009; Adger et al 2014).

There are multiple drivers of migration and displacement within and between states, and climate related drivers include drought and land degradation, flooding, sea-level rise and cyclones (Dun 2011; Gila et al 2011; McLeman 2013). Examples can be found in many regions of the world: drought-related famine has led to migration in Ethiopia;

Figure 29: A woman and child seek refuge at Kibati Camp, Goma, DRC. In 2012 the influx of internally displaced people was a direct consequence of conflict.

coastal flooding associated with Cyclone Aila contributed to significant movements of people in Bangladesh (Box 1) and sea-level rise has led to the displacement of communities in the Arctic and the Pacific islands (Meze-Hausken 2000; McCarthy et al 2005; Ballu et al 2011). In 2014 alone, 17.5 million people were forced to flee their homes due to weather-related hazards (IDMC 2015). Migration driven by extreme weather events often undermines individual and societal well-being; migrants often experience disrupted social networks, difficulties in accessing work, social services, and natural resources; and increased health problems (Barnett and O'Neill 2012; Adger et al 2014). Thus, people displaced by violent conflict and/or extreme events are often highly vulnerable to further harm from climate change (Barnett and Adger 2007) and under some circumstances migrants can increase the risk of violent conflict in places where they have sought refuge (Reuveny 2008).

In the Asia-Pacific region, future changes in climate coupled with demographic and economic trends suggest that increased migration within and between nations is likely. The region is one of the world's most disaster prone; in 2014 over half of the world's 226 natural disasters occurred here (UN 2014; Section 2.3), and many of these were associated with episodes of population displacement. The Pacific islands are also highly vulnerable to extreme weather events as many are low lying, remote and have limited disaster mitigation and adaptation capacity (Gero et al 2013). Increasing extreme events in the region in the short term are likely to lead to internal (within country) crises rather than international migration. However, in the long term the ability of atolls to sustain significant populations of people is at risk (Nurse et al 2014).

A world that has warmed 4°C above pre-industrial levels (by 2100 or later), producing a 0.5–2 m sea-level rise, has been estimated to expose between 1.2 and 2.2 million people from the Caribbean, Indian Ocean and Pacific Ocean to inundation (Nicholls et al 2011). Over half of the urban population in Asia lives in low-lying coastal zones and flood plains that are highly exposed to the effects of climate change (Section 2.4). Asia is also home to more than 90 percent of the global population that is exposed to tropical cyclones, with rising sea levels magnifying the impact of storms (Hijioka et al 2014). For example, in Bangladesh rising sea-level threatens saline intrusion, but also increases flooding associated with storms and cyclones. Cyclone Aila destroyed homes, infrastructure, land and livestock in 2009, forcing many Bangladeshi rural workers to migrate into urban areas following the destruction of their farms (Kartiki 2011; Box 1).

People displaced by violent conflict and/or extreme events are often highly vulnerable to further harm from climate change.

Figure 30: Survivors of cyclone Nargis seek refuge in a Monastery in Yagon, Myanmar.

It is important to note that when a climatic event is a factor in migration, it is more likely migrants will move within their own country, rather than across borders (Adger et al 2014). This is assuming, however, that people are able to move. Trapped populations are made up of people who are unable to plan and carry out safe migration despite needing to move, and as a result are often left vulnerable to environmental hazards (GOS 2011). For example, Cyclone Nargis struck Myanmar in April 2008 and left more than 130,000 people dead. The population were unable to move for a variety of reasons including poverty and lack of alternative livelihoods (UNEP 2008). In addition, their isolation meant access to humanitarian assistance was limited, threatening greater loss of life (GOS 2011).

Temporary migration, rather than permanent movement in response to an extreme event, is also much more likely (COIN 2013). In 2010, the Pakistan floods caused localised displacement, but a significant portion of the affected population returned home to rebuild (Adger et al 2014). Relocation is often a last resort, as there are significant dangers associated with forced relocation, such as increased vulnerability to extreme weather events (Adger et al 2014) and social, economic and health problems as a result of resettlement away from traditional homelands (Barnett and O'Neill 2012).

BOX 1: CLIMATE-INDUCED MIGRATION AND BANGLADESH

Bangladesh is one of the most densely populated nations on the planet (Kartiki 2011). It is situated within the world's largest delta and as a result 60 percent of its landmass is less than 6 m above sea-level (Paul and Routray 2010). Twenty-nine percent (40 million) of the Bangladeshi population lives in the coastal zone (Mallick et al 2011). Approximately 20-25% of the Bangladeshi landmass is inundated each year as a result of the monsoon and during extreme flooding events this figure can be as high as 40- 70 percent (Penning-Rowsell et al 2013). Sixty-three percent of the population is employed in industries such as agriculture, forestry and fisheries, which are all highly dependent on climate (Kartiki 2011). Sea-level rise can lead to saline intrusion (Section 2.4) but also increases flooding due to storms and cyclones. As a result, Bangladesh's population is one of the most vulnerable to displacement from climate-related events (Rawlani and Sovacool 2011).

In 2009 tropical cyclone Aila made landfall over Bangladesh, bringing vast destruction to large areas. In the aftermath of the storm many rural workers moved into urban areas following the decimation of their farms (Kartiki 2011). This migration in turn led to significant economic turmoil as workers competed for jobs, while relocation from the affected area often precluded migrants from claiming relief assistance (Kartiki 2011). In the case of cyclone Aila, as has been seen in a number of cases, migrants often returned to their homes (Kartiki 2011; Penning-Rowsell et al 2013). With limited skill sets and disconnection from loved ones, the financial and social costs of relocation following these natural disasters often drive migrants back to their original home (Kartiki 2011; Penning-Rowsell et al 2013). In this example a majority of the migration was internal with small numbers relocating across the border to India – visas were difficult to obtain and the wages received were small (Kartiki 2011). Projections indicate that should sea-level rise by 1 m about 15 million people will become landless in Bangladesh (Mallick et al 2011).

One metre sea-level rise could lead to the displacement of 15 million people in Bangladesh.

Figure 31: Residents wade through flood water in the aftermath of cyclone Aila in the Sundarbans, Bangladesh.

3.3. Climate Change and Conflict

Conflicts can occur within a country (intrastate), between countries (inter-state), without directly involving governments (non-state conflicts) or can involve violence organised against civilians (one-sided conflicts) (Themńer and Walensteen 2012; Adger et al 2014). There are many complex and interacting drivers of conflict, some of which are sensitive to climate change. For example, increasing extreme weather events can affect the accessibility and availability of food (Section 2.1), which can increase food prices and contribute to violent food riots.

Climate change can also increase the risk of armed conflict by exacerbating known risk factors such as poverty, economic shocks, and inconsistent state institutions (Adger et al 2014). On this basis, the IPCC has found that there is 'justifiable common concern' that climate change can increase the risk of armed conflict in certain circumstances (Adger et al 2014). As noted earlier, Defence departments and governments, such as those in the US and UK, generally view climate change as a 'threat multiplier' that has the potential to make unstable conditions worse, for example, by exacerbating food and water scarcity. These threats, in turn, can contribute to political instability and social tensions that result in violence and conflict (e.g. MoD 2010; The White House 2015).

A clear example of the role climate change can play in exacerbating conflict within states can be found when considering climate change and food security (Section 2.1). In recent years, extreme weather events such as heatwaves, droughts, floods and bushfires in major food producing countries have contributed to rising food prices (Garnaut 2011), affecting social and political stability (Barrett 2013). Extreme weather and water scarcity contributed to soaring food prices, which saw food riots erupt across Africa and the Middle East in 2008 (Section 2.1).

Links can also be drawn between climate change, water security and conflict. Rainfall variation and the mismanagement of water resources in arid areas can increase tensions. For example, rainfall variation in resource dependent economies, such as pastoral societies in Africa, can also increase the chance of localised violent conflict (Adger et al 2014; Figure 32).

Climate change can worsen tensions and increase the risk of conflict between states, as shown by the loss of sovereignty due to sea-level rise. Projected sea-level rise, coastline retreat and the eventual submergence of small low-lying islands may affect the maritime boundaries of nations and alter exclusive economic zones in which natural resources are located. This may intensify existing regional tensions and contribute to new conflicts over natural resources (Houghton et al 2010).

Take the South China Sea for example. It is home to a number of low-lying islands, the highest of which is Southwest Cay of the Spratley islands that sits only four metres above sea level. Many of these low-lying atolls are inundated at high tide (Beckman et al 2013). The region has witnessed an ongoing sovereignty dispute as neighbouring nations, such as China and Vietnam, seek to take advantage of the deposits of oil and gas that exist within the basin (Tow and Wah 2009). In addition, the South China Sea is a popular shipping route through which many trade vessels pass, for example in 2005 sixty-five thousand vessels travelled through the Malacca Strait and into the South China Sea (Rosenberg 2009). The dispute in the South China Sea has involved Brunei, China, Malaysia, Taiwan, the Philippines, Vietnam and more recently Australia, with rising sea levels set to complicate this issue further (Beckman et al 2013). Current rates of sea-level rise in the tropical western Pacific (12 mm yr^{-1}) are four times the global average and such rates, if unchecked, threaten to completely submerge a number of the low-

Figure 32: A herder in Mauritania, Africa struggles to find any pasture left for his cows. Rainfall variation in resource-dependent economies, such as pastoral societies in Africa, can increase the chance of localised violent conflict.

lying atolls found within the South China Sea (Nurse et al 2014; Chapter 1). Submergence of atolls can further complicate sovereignty disputes as was seen recently with the island of South Talpatty, also known as New Moore, located in the Bay of Bengal, which was disputed by Bangladesh and India. When the island was almost completely inundated, conflicting sovereignty claims were not laid to rest, with Bangladesh still reasserting its sovereignty claim after the inundation (Warner and Schofield 2012).

Whilst some resources are projected to decline, aggravating conflict, the availability of new resources may also have the potential to increase rivalry between nations. For example, since 1980, the Arctic has been warming at twice the normal rate, contributing to sea ice decline. Some projections predict that the Arctic Ocean could be entirely free of summertime ice by the end of the century (Adger et al 2014). Melting sea ice will make Arctic waters easier to navigate, opening up new shipping routes, lengthening the shipping season and increasing access to significant oil and gas reserves (Adger et al 2014). In the long term, this could increase the risk of potential disputes between nations over access and recovery of these reserves (CNA 2014).

The South China Sea and Arctic examples demonstrate how climate change, through rising sea level and shrinking sea ice, may serve to further complicate sovereignty tensions between nations, although at present existing political institutions have succeeded in managing these tensions (Ebinger and Zambetakis 2009; Wilson 2015).

Figure 33: Summer sea ice melt in the Arctic Sea. Since 1980 the Arctic has been warming at twice the normal rate.

Figure 34: Distribution of 40,000 liters of water amongst the local communities in El Srief, in North Darfur. The nearest water point is 15 kilometers away. Violence in Darfur can become more likely during excessively dry conditions.

Climate change is not the sole driver of tensions and conflict within nations and regions, but acts as a threat multiplier, as described previously. Research on climate change and armed conflict shows that a multitude of social factors, such as property rights institutions, mechanisms for conflict resolution, social protection, the availability of weapons, and the strength of civil society all mediate between changing climatic conditions and violent outcomes, which in turn shows that both climate mitigation and adaptation are necessary to manage this risk (Adger et al 2014). When viewed from a security perspective, however, climate change looms as a more direct threat. The Global Military Advisory Council on Climate Change (GMACCC) clearly states that climate change can be a persistent trigger, or accelerator, of conflict. An example drawn upon by GMACCC is violence in Darfur. Violence in this country becomes more likely during excessively wet and excessively dry conditions (GMACCC 2014; Figure 34).

4. THE SECURITY IMPLICATIONS OF CLIMATE CHANGE

In this chapter we provide an overview of the Australian security sector and its role in responding to climate change and its security implications. We outline how global military forces have identified climate change as a high-risk phenomenon, and consider how these conservative institutions estimate risk. In light of this analysis, we explain how climate change will affect the Australian Defence Force (ADF) and examine the limited climate change action the ADF has taken in comparison to Australia's key allies, the UK and US. Overwhelming, this assessment finds that Australia continues to lag behind its military allies on climate change, despite the significant security risks that it presents.

4.1. The Australian Security Sector and Climate Change

A priority for all governments is the security of its citizens. In Australia, the National Security Committee of Cabinet (NSCC) exercises oversight of essential national security requirements, and directs organisations and agencies to respond to any threats appropriately.

This whole-of-government effort harnesses the specific skills, knowledge and capabilities of a wide range of Australian Government agencies and institutions including intelligence, law enforcement, border security, defence, diplomacy, development and emergency management (Box 2).

National security policy, set out in the 2013 *National Security Strategy* (NSS) (Australian Government 2013b) identifies Australia's four national security objectives as:

- Protect and strengthen Australia;
- Ensure a safe and resilient population;
- Secure Australia's assets, infrastructure and institutions; and
- Promote a favourable international environment.

Each of these objectives will be affected by climate change, which has the potential to undermine security in a variety of ways as outlined in Chapter 2, and often requires a whole-of-government response. For example, protecting Australians from climate change and ensuring a safe and resilient population will become increasingly difficult as heatwaves, floods and bushfires adversely affect the most vulnerable people

Government service delivery will be tested as climate change exacerbates extreme weather events.

Figure 35: The Australian Defence Force provide strategic air lift support to civilian search and rescue personnel, including NSW Police and firefighters, as they prepare to head to Japan to assist in the wake of the Tsunami 2011.

and communities in our society. During the 2009 Black Saturday bushfires, 173 people were killed on February 7, while the extreme heatwave in the preceding week killed approximately twice as many (CFA 2012; Climate Council 2014b). In these situations, security agencies, supported by the emergency services, often play a lead role. For example, the Department of Defence in coordinating disaster relief, police forces in providing law and order, or the Australian Geospatial Intelligence Organisation in providing detailed maps to emergency services in the aftermath of disaster.
As climate change continues to affect extreme weather events, societal resilience and government service delivery will be increasingly tested.

Australia's assets, critical infrastructure and national institutions will also come under pressure from rising sea-level, storm-surges and extreme weather (Chapter 1). The Australian Strategic Policy Institute (ASPI) has repeatedly stated that Australia's security agencies will be affected by climate change and will have a role to play in responding to it (Bergin 2007; Press et al 2013). The Australian military has already spent $2 million examining how sea-level rise will affect its bases (Commonwealth of Australia 2012).
The security agencies will need to continually assess how climate change affects their installations because if they are undermined, Australia's security can be compromised.

Whilst no single agency will hold the solution to all of the challenges presented by climate change, each will be required to provide strategic advice to the government as to how it will affect their particular portfolio. Each agency will also be required to plan for greater disaster resilience within the Australian Emergency Management framework.

Drawing on the resources of the ADF to tackle climate change should be the last line of response.

The Australian Defence Force has a vital role to play in responding to a variety of contemporary security challenges, including those presented by climate change. However, the ADF will not be the lead organisation that responds to climate security, but rather its actions will be part of 'a comprehensive whole-of-Government' response (Press et al 2013; Box 2). National security planning traditionally involves a 'three layer approach' to risk reduction. The first involves taking preventative measures to stop a serious situation from developing, the second involves finding alternative ways to address the situation and the last is an ADF direct response, which in extreme situations involves armed force. When a 'three layer approach' is applied to the climate change challenge, it is clear that drawing on the resources of the ADF should be the last line of response, once other options have been exhausted. The first layer of response, to limit the impacts of climate change and thus its implications for security, requires the Australian Government to join global efforts to substantially reduce carbon emissions and rapidly move away from fossil fuels to renewable energy sources. The second layer of response, finding other ways to address the impacts of climate change, involves adaptation strategies. The third line of response is to deploy the Australian emergency services and, for particular security needs, the police forces to provide disaster relief, and in extreme cases the Australian Defence Force.

BOX 2: AUSTRALIAN AGENCIES OPERATING IN WHOLE-OF-GOVERNMENT SECURITY SPHERE

- Attorney-General's Department (AGD)
- Australian Crime Commission (ACC)
- Australian Security Intelligence Organisation (ASIO)
- Australian Secret Intelligence Service (ASIS)
- Australian Geospatial-Intelligence Organisation (AGO)
- Australian Signals Directorate (ASD)
- Australian Securities and Investments Commission
- Department of Agriculture, Fisheries and Forestry (DAFF)
- Department of Defence (Defence)
- Department of Foreign Affairs and Trade (DFAT)
- Department of Health and Ageing (DoHA)
- Department of Immigration and Border Protection (DIBP)
- Department of Infrastructure and Transport (DIT)
- Department of Prime Minister and Cabinet (PM&C)
- Office of National Assessments (ONA)

4.2. How Does the Security Sector Estimate Climate Risk?

Major nations worldwide have long considered climate change a key security risk. As findings from the Center for New American Security emphasise, *'[t]he security implications of climate change are about risk and how we are going to manage that risk'* (Gulledge 2010). Global military forces, and the security sector more broadly, have identified climate change as a high-risk phenomenon and are commencing their own campaigns to combat what has been coined *'the longest conflict'* (HM Government 2008; Defence 2009; White House 2010; CNAS 2010; HM Government 2010 Defence 2013; Press et al 2013; CNA 2014; White House 2015; Sturrock et al 2015).

By nature, defence forces are conservative institutions that objectively assess risk and do not succumb to the latest strategic fad. Militaries around the world have acted on climate change based on rigorous risk assessment methodologies (Brzoska 2012). Increasingly, considerations of climate change have been mainstreamed in work conducted by Defence and military institutions. This has occurred across the security community, with different institutions focusing on different aspects of risk. The IPCC Fifth Assessment Report for the first time included human security alongside food security as key climate risks (Adger et al 2014). Arctic militaries including Canada, Denmark, Finland, Norway, Russia, and the United States have long factored climate change into their strategic risk scenarios.

Global military forces have identified climate change as a high-risk phenomenon.

A risk assessment begins by asking: 'What might happen?', 'How bad would that be?', 'How likely is that?' and 'What can we do to avoid it?'. There is no one single risk method adopted by any one military or security agency, but there are overarching principles that are commonly used. At the broadest level, risk (r) is a combination of *likelihood* (l) and consequence (c) and can be expressed: r = l x c (Brauch 2011). The likelihood of an event occurring can be informed from historical experience and can be conveyed in terms of its frequency (e.g. how many extreme weather events occur per month or year?). The *consequences* of a threat relates to the level of destruction or damage caused by an event or phenomena (e.g, how many people may be affected, injured, killed or the economic damage to property). Consequence (c) can increase through greater exposure to climate events (e.g. heatwaves) or from increasing societal vulnerability as a result of poor planning, poor preparation and the failure to act on known risks (Guha-Sapir and Vos 2011).

This methodology for assessing risk is familiar to military planners and national security experts. The US Department of Homeland Security, for instance, uses this basic process as part of its Strategic National Risk Assessment that aims to identify and mitigate threats that pose the greatest risk to US security and resilience (Department of Homeland Security 2012). Using this process of risk assessment, its 2011 assessment found that 'natural hazards' such as floods, hurricanes, human pandemic outbreak and bushfires were all key security risks. Another important input into US national strategic risk comes from the widely respected non-partisan US Government Accountability Office (US GAO). In 2015, the US GAO's High Risk List found climate change to be a significant risk that could undermine US DoD military facilities and would require the US DoD to provide increased assistance in response to the impacts of extreme weather events.

The Australian government also uses risk-based approaches at the heart of its strategic security planning and emergency management arrangements (Commonwealth of Australia 2009; Commonwealth of Australia 2010). Similarly, militaries also use risk assessment methodologies that are future-focused and include a consideration of the risks presented by weather [climate]. The Australian military's risk assessment process has included some limited contributions by national scientific institutions, national academies of science and other specialised sources, particularly when trying to understand the security implications of climate change. For example, as part of its approach to strategic risk, the ADF includes input from the Defence Global Change and Energy Sustainability Initiative (GCESI) of the Defence Preparedness Branch. GCESI is a multi-disciplinary team of specialists that from 2011 has convened key leaders and eminent speakers from military, government, business and academic backgrounds to share expertise and inform ADF preparations for the onset of rapid global change, including climate change (GCESI 2012).

Whilst there is still uncertainty about the severity and extent of the security implications of climate change, militaries have not and cannot afford to wait for 100 percent certainty, or they risk being left behind and underprepared. Defence forces have already conducted extensive analysis and preparation for climate change and its security implications. Hence, this report focuses on the risks that climate change presents to the military and how the military have responded.

4.3. How Does Climate Change Affect the ADF?

Climate change presents two types of risk to the ADF (Figure 37). The first are *capability risks* that undermine the ability of the ADF to be prepared and limit military readiness and sustainment. The US military calls these types of risks 'burden-multipliers' since they burden the military before it can even move into action and drain its effectiveness when operating in the field.

The second type are *geostrategic risks* that may alter the types of roles and missions the ADF will need to undertake. Ultimately, these latter risks may affect the very structure and composition of the ADF. US strategists commonly refer to these types of climate risks as 'threat multipliers'. It is important to note that while the ADF is lagging behind their major allies the US DoD and UK MoD in responding to climate change and its security implications (Table 1), they have taken some steps in response to climate change (Box 3).

Figure 36: Soldiers in the Australian Army clear mud and sludge from a major intersection in Queensland after extensive flooding.

Climate change presents two types of risks to the Australian Defence Force, capability risks and geostrategic risks.

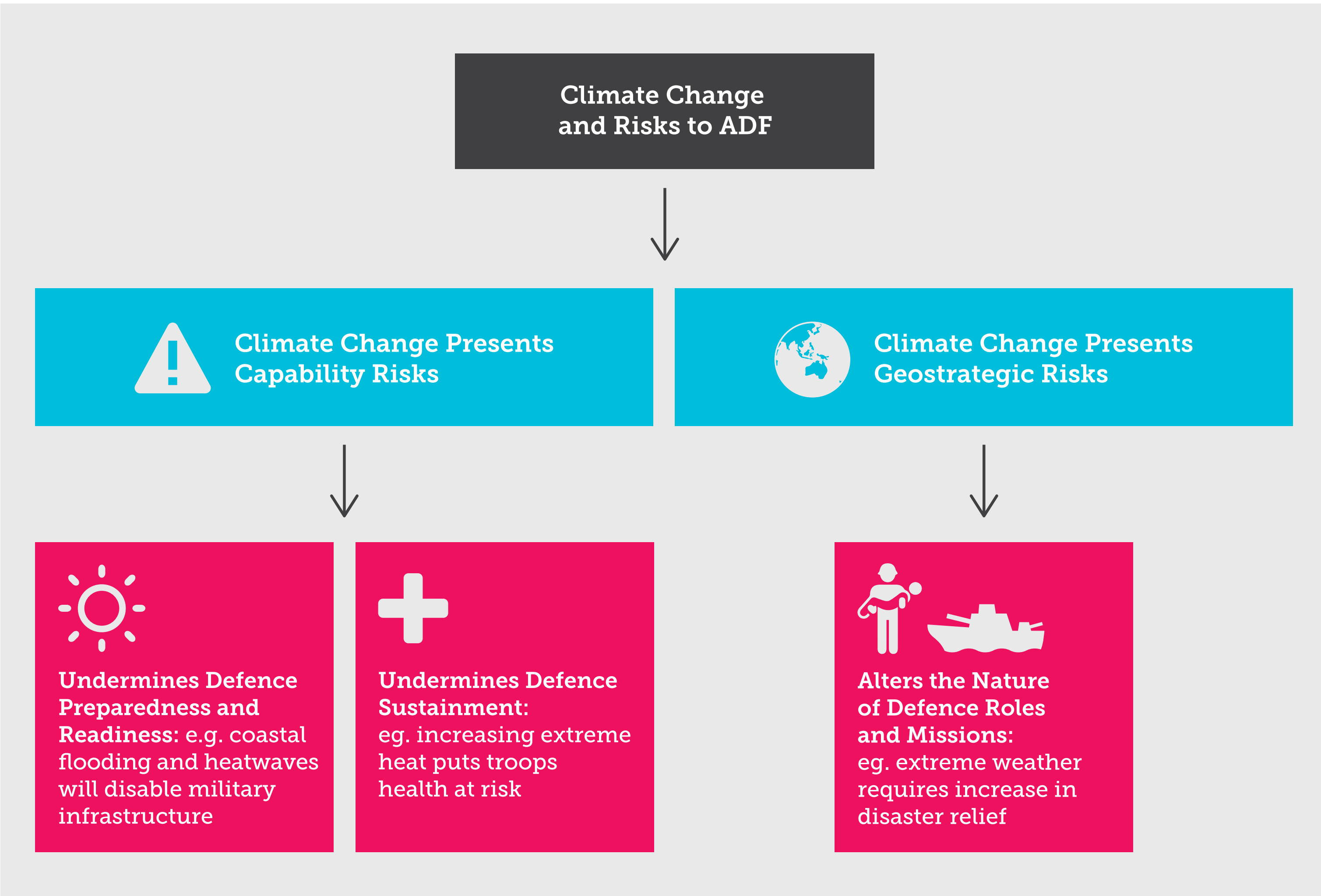


Figure 37: Climate change and risks to the ADF.

BOX 3: THE RESPONSE OF THE AUSTRALIAN DEFENCE FORCE TO CLIMATE CHANGE

- The ADF has been planning for the impacts of climate change since 2007. In 2008, the ADF launched the Combat Climate Change initiative to raise awareness about the issue across Defence and to restrict non-essential energy use (Department of Defence 2009; 2008).
- In 2011, the ADF launched the Global Change and Energy Sustainability Initiative to raise awareness, develop an integrated energy strategy and link the military with scientific, industry and academic experts on global change (Department of Defence 2015).
- The ADF has completed a detailed $2m study of how climate change (through sea-level rise and inundation) will affect its key military bases. The report was titled: *Adaptation and Planning Strategies to Mitigate the Impact of Climate Change Induced Sea Level Rise, Flooding and Erosion at Selected Sites* (Commonwealth of Australia 2012).
- Climate Change was mentioned as a national security issue with implications for the ADF in the 2009 and 2013 Defence White Papers and the 2008 and 2013 National Security Strategies.
- The ADF has partnered with industry to assist in the development of innovative clean energy technologies to provide renewable energy to its bases. In Western Australia, the navy's largest base HMAS Sterling, is partly powered by ocean wave energy developed in partnership with Carnegie Wave Energy Ltd (ARENA 2015).
- The ADF has developed strategies to minimise its environmental footprint that include recent enhancements to energy monitoring, 'green' procurement, energy efficiency building codes (including 5-star rated buildings) and fuel efficient commercial vehicle fleets (Department of Defence 2010).
- The ADF has been active as a first responder during climate-induced disaster relief missions. Between 2005 and 2013 the ADF responded to 275 disaster relief missions, some of which – outside of major war and peacekeeping operations - have been the largest in its history (ANAO 2014).

Figure 38: Australian navy personnel wait on a lowered stern door for a transfer of personnel from the US naval Ship Mercy during Pacific Partnership 2010.

4.3.1 Climate Risks to Defence Capability

Climate change will adversely affect ADF capability, which includes the ability of the military to be *ready* and to *sustain* its forces. When a military is ready it is able to commit to operations within a specified time and coordinate with trained personnel, using working and well-maintained equipment and sufficient facilities (ADF 2004). Sustainment refers to how well a military is able to provide follow-on personnel and logistic support for the entirety of its mission, until it is accomplished.

Climate change could reduce military readiness and sustainment in a number of ways. For example, rising temperatures will likely make it more difficult for military forces to train. Extreme and prolonged heat can directly affect human health by causing heat stress and even death; heatwaves kill more Australians than any other natural disaster (PwC 2011; Climate Council 2014a). Rising temperatures and more frequent and intense heatwaves will have implications for the health of Australia's military personnel when undertaking training routines and conducting military exercises. Increasing heat is also contributing to increases in the length and intensity of bushfire seasons in parts of Australia (Chapter 1). This affects the ability of the ADF to use its training ranges. The 2013 State Mine Fire, one of NSW's biggest-ever bushfires, was caused by inadequate Defence planning, in which high explosive tank rounds were detonated on a day of 'high' bushfire danger. The fire that followed burnt 50,000 hectares of land and destroyed three homes in the Blue Mountains region (ABC 2014).

Climate change will affect the ability of the ADF to be ready and to sustain its forces.

Figure 39: Climate change is putting the ADF under pressure.

CLIMATE CHANGE IS PUTTING THE ADF UNDER PRESSURE

PNG FLOODING, 2007:

Operation Papua New Guinea assist drew upon 170 personnel and involved the delivery of 350 tonnes of humanitarian stores.

ASIA PACIFIC CLIMATE-INDUCED DISASTERS:

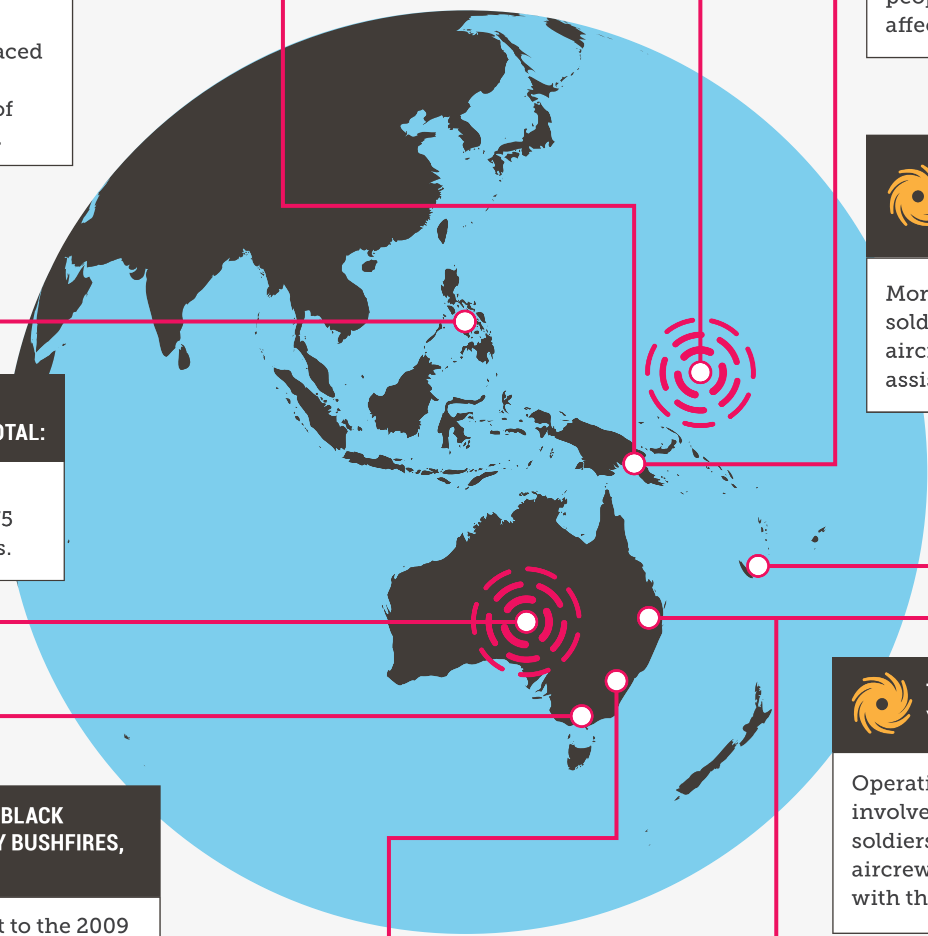
In 2014, over half of the world's 226 natural disasters occurred in the Asia-Pacific.

PNG DROUGHT, 1997:

Operation Ples Drai lasted 6 months, 450 ADF personnel delivered 3.2 million kilograms of aid to more than 90 000 people in ten drought affected provinces.

TYPHOON HAIYAN, PHILIPPINES, 2013:

ADF evacuated over 3,500 internally displaced persons and moved thousands of tonnes of aid in the Philippines.



TROPICAL CYCLONE PAM, VANUATU, MARCH 2015:

More than 500 Australian soldiers, sailors and aircrew were deployed to assist in the recovery.

DOMESTIC EMERGENCIES TOTAL:

In 2005-06 to 2012-13 Defence assisted in 275 domestic emergencies.

TROPICAL CYCLONE YASI, 2011, QUEENSLAND

Operation Yasi Assist involved more than 1200 soldiers, sailors and aircrew deployed to assist with the recovery.

VICTORIA BLACK SATURDAY BUSHFIRES, 2009:

Defence support to the 2009 bushfires reached a peak operational strength of about 800 military personnel per day, with more than 1,250 Defence personnel providing assistance over the seven weeks of the operation.

NSW BUSHFIRES, 2011:

The Army Engineer Remediation Force conducted over 200 demolition tasks, 338 tree felling tasks, 21 pool drainage tasks and over 200 site reconnaissance tasks.

QUEENSLAND FLOODS, 2011:

Defence deployed some 1,440 personnel with 26 aircraft flying 572 hours transporting about 1,000 people with more than one-half million kilograms of stores.

Sources: ANAO 2014; Australian Army 2011; Australian Government 2013a; Australian Government 2015; Department of Defence 1998; Department of Defence 2007; Department of Defence 2013; Press et al 2013; UN 2014.

Extreme weather could also impact on ADF capability by disabling critical military and civilian infrastructure at the crucial moments necessary for rapid ADF mobilisation. While military equipment is generally built to withstand extreme environmental conditions, civilian infrastructure, like roads and rail, are less prepared. Military bases rely on civilian infrastructure, such as water, power and transportation networks and they also rely on the civilian workforce for tasks like base security and estate management. Without the availability of the civilian road network, such as airstrips, trains, energy grids and communication networks, ADF military personnel would find it increasingly difficult to even gain access to ADF bases that are essential for mobilisation. Already, extreme heatwaves, bushfires and downpours producing flash floods have crippled rail networks, power grids, roads and other essential services. For example, in 2009, 500 rail services were cancelled in South Australia, Victoria and NSW because of a heatwave (ABC 2009). Any disruption to the civilian workforce would also have a large impact on the functioning of military bases.

If suitable measures are not put in place, ADF readiness may be eroded through the impact that climate change will have on Defence infrastructure, as well as national infrastructure more broadly. Primarily, this will occur through sea-level rise, storm surge, drought and other long-term changes to regional climatic conditions. While the direct risk to Naval bases is clear, the damage caused by a combination of these events may extend to some dozen or more Army and Air Force bases as well as strategic joint facilities operated in conjunction with the US government (Press et al 2013). Degradation to any of these assets will limit the ability for the ADF to sustain operations.

Navy bases and low-lying training areas (including airstrips) are vulnerable to sea-level rise.

ADF energy security may also be affected by climate change, as the transition away from fossil fuels drives innovation in the renewable sector. The US Navy serves as a clear example, by 2020 50 percent of all US Navy energy consumption will come from alternative sources, 50 percent of its shore installations will be carbon neutral ('net-zero') and in 2016 the US Navy will sail the 'Great Green Fleet' which will utilise alternative and renewable energy (US Department of Navy 2015; Figure 40). Such innovation is also extending to enhancing the energy security of military bases. For example, HMAS Stirling (a base of the Royal Australian Navy) in Western Australia is powered by the world's first grid-connected wave power station (Navy Daily 2013; ARENA 2015; Box 3). Eventually, such efforts may also lead to new forms of deployable renewable energy systems ('microgrids') that can harvest and convert solar, wind and thermal energy for use by remote military bases (Broekhoven et al 2013). Owing to the fluctuations in the price of oil and the danger associated with its transport during warfare (particularly the requirement to provide convoy and supply-line security), generating energy onsite offers energy security on a number of fronts (Broekhoven 2012; 2013).

Figure 40: The US Great Green Fleet demonstrates biofuels during the Rim of the Pacific (RIMPAC) 2012 exercise.

BOX 4: IMPACTS OF SEA-LEVEL RISE ON AUSTRALIAN MILITARY BASES AND INFRASTRUCTURE

The Defence Estate is vulnerable to climate change from sea-level rise and inundation. It is the most complex, specialised and expensive land and property holding in Australia, comprising more than 3 million hectares of land, 25,000 buildings located around more than 300 distinct sites with a replacement value in excess of $62 billion (DSRG 2015). Its assets include airfields, ports, field training areas and firing ranges, research laboratories, office complexes, residential accommodation and education, recreational, workshop and storage – including munitions – facilities (Department of Defence 2008). Defence has already analysed how sea-level rise will affect its key bases and identified those at high risk (Press et al 2013). Navy bases and low-lying training areas (including airstrips) are particularly vulnerable. Costs are difficult to estimate, but when Fleet Base East from Sydney was mooted to move to Jervis Bay in the mid-1980s, the cost was over $2 billion (2011 prices) (Davies 2013).

Some of the major risks climate change presents to Defence infrastructure includes:

- Degradation of Defence buildings via inundation from sea-level rise, coastal erosion or direct wave action from storm surges;
- Degradation of roads on Defence land via coastal erosion from inundation restricting base access, capability or damaging road surfaces and foundations;
- Degradation of airstrips via inundation restricting base access, or damaging runway, taxiway and flight apron surfaces and foundations;
- Degradation of Defence pier and marine infrastructure via inundation or wave damage restricting base access, safe use or capability;
- Damage of environmental assets via sea-level rise or storm surge leading to degradation of important flora and fauna habitat, changes to the nature of contaminated land or failure of storage facilities and environmental pollution;
- Degradation of heritage sites leading to damage of built or cultural sites of significance;
- Degradation of strategic allied facilities that contribute to US Alliance arrangements;
- Degradation of communications, explosive ordnance testing, logistics and storage sites; and
- Degradation of military training ranges from (long term) altered regional weather patterns affecting flora and fauna, ecosystems and exposing such ranges to increased drought, erosion and changed fire regimes.

4.3.2 Geostrategic Risks and Impact on ADF Roles and Missions

Climate change and its impacts are altering the types of roles and missions the ADF will need to undertake now and into the future.

Increases in the frequency and intensity of extreme weather events place more pressure on the ADF to provide disaster relief and humanitarian assistance both within Australia, and in the Asia-Pacific region. Climate change could also contribute to the forced movement of people and will serve to exacerbate conflict (Sections 3.2 and 3.3), which could increase ADF participation in regional stabilisation operations including humanitarian disaster response as well as Defence cooperation measures.

Worsening extreme weather places more pressure on the ADF to provide disaster relief.

BOX 5: THE AUSTRALIAN DEFENCE FORCE AND DOMESTIC DISASTER RELIEF

Climate change is increasing the severity, frequency and intensity of extreme weather events. This has resulted in more than 275 domestic emergency assistance deployments for the ADF since 2005. Examples of Defence assistance include airlift of equipment and personnel; engineering support; search and support; temporary accommodation; communications support; health and psychological support; and fuel services (ANAO 2014). Defence support to the 2009 bushfires reached a peak operational strength of about 800 military personnel per day, with more than 1,250 Defence personnel providing assistance over the seven weeks of the operation. During the 2011 Queensland Floods, Defence deployed some 1,440 personnel with 26 aircraft flying 572 hours transporting about 1,000 people with more than one-half million kilograms of stores (ANAO 2014; Figures 41 and 42).

Figure 41: The ADF assist in the evacuation of residents from the Queensland floods.

Figure 42: An Australian Army Aircrewman helps local residents during Operation Queensland Flood Assist, 2011.

A changing climate places increasing pressure on the ADF to assist in responding to domestic emergencies (see, for example, Figure 42). For instance, hot, dry conditions have a major influence on bushfires and Australia's rising temperature has driven an increase in extreme fire weather over the last 30 years in Australia's southeast (Climate Council 2013). Currently the ADF supports the civilian community in responding to emergencies, such as bushfires, by deploying personnel and equipment. From 2005-06 to 2012-13 Defence assisted in 275 domestic emergencies, although due to inconsistencies in record keeping this number is likely to be higher (ANAO 2014).

The ADF support during the 2009 Black Saturday bushfires involved some of the largest ADF deployments in Australia (Press et al 2013; Box 5). In the future, Australia is very likely to experience an increased number of days with extreme fire danger, which will not only strain emergency services and fire management agencies but also Defence resources. The ADF Reserve Force (comprised of individuals who only work for the military part-time and are called upon when required) may need to be drawn upon more frequently to assist the civilian community with disaster relief, particularly if the regular ADF is already deployed on other commitments (Woodward 2011).

The ADF Reserve Force may need be drawn upon more frequently to assist the civilian community with disaster relief.

Australia's proximity and relative prosperity in the Asia-Pacific region leave it well placed to assist with disaster response. The ADF already provides regional partners with humanitarian assistance and disaster relief. For example, Operation Pacific Assist was established in response to Tropical Cyclone Pam that devastated Vanuatu and the surrounding region in March 2015. More than 500 Australian soldiers, sailors and aircrew were deployed to assist in the recovery (Australian Government 2015). In the wake of Typhoon Haiyan in 2013, the ADF evacuated over 3,500 internally displaced persons and moved thousands of tonnes of aid in the Philippines (Australian Government 2013a). It should be noted that the ADF is not alone during such operations and often works in collaboration with other defence forces, aid agencies and NGOs to complement and supplement the effectiveness of relief operations. As the impact of extreme weather intensifies in the region there will be growing pressure on the ADF to increasingly coordinate with domestic emergency services and provide more humanitarian assistance at home and in Australia's neighbourhood (Dupont and Pearman 2006). Extreme weather events can occur concurrently; for example, there could be multiple bushfires in

Figure 43: Australian Defence Force Engineers on Operation Pakistan Assist II help to rebuild a school damaged by the Pakistan floods.

different Australian states as well as a coastal flooding event and a cyclone in the Asia-Pacific. The ADF will increasingly need to be prepared to assist in responding to multiple extreme weather events both in Australia and in the Asia-Pacific region simultaneously (Press et al 2013).

In addition to the ADF engaging in humanitarian relief and disaster response, regional instability and violence exacerbated by climate change (Section 3.3) may draw further on Australian defence resources as they are increasingly required to engage in stabilisation operations. For example, many countries to Australia's north rely on climate-sensitive crops. A rapidly changing climate – exacerbating the impact of El Niño Southern Oscillation events - could place increased pressure on food production, contributing to the destabilisation of societies and triggering an increase in stabilisation operations for the ADF. For example the 1997 El Niño event contributed to major drought in Papua New Guinea (PNG) that affected millions of its rural citizens, leading to hundreds of deaths and playing a role in widespread societal destabilisation. Crops failed, schools and major mines were closed and there were outbreaks of diseases such as typhoid (May

Figure 44: An Australian Army engineer sits with children in Vanuatu after completing an engineering assistance project for Pacific Partnership 2011, a five-month humanitarian assistance initiative.

Figure 45: The Australian medical task force set up and clean a medical health facility in Pakistan in the aftermath of the flooding, as part of Operation Pakistan Assist.

2009). In response to this the ADF conducted a stabilisation operation to support the PNG government. Operation Ples Drai was the largest ADF humanitarian effort at the time, costing $30 million, lasting six-months and involving 450 ADF personnel that delivered 3.2 million kilograms of aid to more than 90,000 people in ten drought affected provinces (Department of Defence 1998).

Whilst the 1997 drought did not escalate into violence, the provision of humanitarian assistance and disaster relief may not necessarily always occur in a benign environment. To avert this, the ADF and associated security agencies may find themselves increasingly deployed well in-advance of crisis point to provide capacity and resilience building across the Asia-Pacific (Press et al 2013).

The ADF and associated security agencies may find themselves increasingly deployed well in-advance of crisis point to provide capacity and resilience building across the Asia-Pacific.

4.4. The Response of Australia's Key Allies

In comparison to Australia, the US and UK militaries are taking significant steps to identify and respond to the security challenges exacerbated by climate change.

Table 1 compares the military's response across the four key areas of planning, training, infrastructure and supply purchasing (acquisition). It is clear that the US and UK militaries are well ahead of the Australian military in responding to climate change, particularly in terms of understanding its impact on military missions and its effect on the Defence estate.

Figure 46: Solar panel arrays at Fort Hunter Liggett, in California. Fort Hunter Liggett was selected by the US Army to be converted to a net zero energy base.

Table 1: A comparison of US DoD, UK MoD and Aus DoD military action on climate change. Green indicates an action that has been implemented or is underway, orange indicates a partial response and red indicated no action or evidence found. Sources used for the construction of this table can be found in Appendix A.

A COMPARISON OF MILITARY ACTION ON CLIMATE CHANGE

	Potential Effects of Climate Change On:	Military Climate Action Checklist	US DoD	UK MoD	ADF
1	Military Planning and Operations	Incorporated and mainstreamed climate change into National Strategic (Military) planning.			
		Shown leadership by appointing a Senior Military authority as Climate Change planning officer/envoy.			
		Published a Climate Change Adaptation Strategy.			
		Participating member of Interdepartmental / Interagency Climate Change Working Group.			
		Analysis of climate change impacts on military base locations and base capacity (force posture).			
		Analysis of climate change impacts on how military is organised for combat missions, stabilisation operations and disaster relief (force structure).			
2	Military Training and Testing	Analysis of climate change risks to military training.			
		Analysis of climate change impacts on individual soldier, sailor and airmen readiness.			
		Analysis of climate change impacts on the preparedness of the military to respond to operations and emergencies.			
		Analysis / inclusion of climate change in military doctrine (eg., disaster relief doctrine or aid to civil community).			
		Analysis of health impacts of climate change on military forces and operational areas.			
3	Military Estate (Built and Natural Infrastructure)	Mandated renewable energy targets for military bases.			
		Conducted Risk Assessment of sea-level rise and inundation on military bases.			
		Conducted a Risk Assessment of climate affected extreme weather events on military bases.			
		Implemented 'Green' building codes and energy programs across military bases.			
4	Military Acquisition and Supply Chain	Mandated fuel and energy efficiency goals in purchase of major military hardware and platforms (eg., use of bio-fuels and hybrids).			
		Analysed climate change risks to critical civilian infrastructure and civilian workforce and resultant impacts on military infrastructure, operations and training.			
		Sustainable Procurement practices implemented (e.g. energy efficient civilian vehicle fleets, energy efficient lighting, heating, waste reduction strategies etc).			

Key	
	Implemented / Underway
	Partial Response
	No Action or Evidence Found

4.4.1 United States Military

BOX 6: THE US SECURITY SECTOR ON CLIMATE CHANGE AND ITS SECURITY IMPACTS

"Climate change constitutes a serious threat to global security, an immediate risk to our national security. And make no mistake, it will impact how our military defends our country."

President Obama,
Commander-in-Chief

"Climate change will cripple the security environment, probably more likely than the other scenarios we all often talk about."

Admiral Locklear (Ret.),
US Pacific Commander
2012 – 2015

"I see climate change as one of the driving forces in the 21st century."

Rear Admiral Titley (Ret.),
Former leader of the US Navy's Task Force on Climate Change

"Our bottom line is that climate change is a threat to national security and now is the time to take sensible action."

Sherri Goodman
Former Executive Director
CNA Military Advisory Board

"[Climate change] is like getting embroiled in a war that lasts 100 years ... There is no exit-strategy."

Brigadier-General King (Ret.),
the Chief Academic Officer at the US Army's Command and General Staff College

"Our responsibilities, our concerns, have to be tied to the effects of climate change."

Ray Mabus,
Secretary of US Navy

The US Department of Defence (DoD) has taken a number of comprehensive steps to address the threat of climate change. Since at least 2008, it has shown global leadership in assessing and acting on the threat of climate change. As outlined in Table 1 the US has implemented, or is currently implementing, a variety of responses to climate change across military planning, operations, training, testing, estate and acquisition and supply chains. In effect, climate change is in the process of slowly being mainstreamed across the entire breadth of the US military (US DoD 2012). This section looks at specific responses developed by the US Army, US Navy, US Combatant Commands as well as a timeline outlining US defence strategy and legislation that has been implemented over time (Box 7).

US Navy response

The US Department of the Navy (encompassing the US Marine Corps and, in times of war, the US Coast Guard) has been the most prominent Service to deal with climate change and its security implications. The Navy is faced with the rapid melting of the Arctic, significant portions of infrastructure at risk due to sea-level rise, and a major role in Humanitarian Assistance and Disaster Relief (HADR) missions. Secretary of the US Navy, Ray Mabus, has made energy transformation – and to a lesser extent climate change - his hallmark. On assuming office he declared 'I am committed as Secretary to addressing climate change and energy consumption' and promptly announced *US Navy Energy Program for Security and Independence* (Mabus 2009). This included landmark energy efficiency initiatives such as the 'Great Green Fleet', the aspiration to reduce petroleum use in its commercial fleet by 50 percent and by 2020 to have its shore based energy requirements derived from 50 percent renewable sources. And to have half of the US Navies bases at 'net zero' emissions. The US Navy also extended its energy conservation program into its aviation wing (which includes more than 3,700 aircraft that burn some 600 million gallons of fuel per year). As part of its energy vision, US Naval Aviation hopes to reduce its reliance on petroleum by achieving a 4 percent reduction on aviation fuel burn by 2020 (US Navy 2013).

Figure 47: US Marines carry food to distribute as part of the humanitarian assistance exercise in Okinawa Japan, 2011.

Figure 48: Pakistani boys unload food from a US Army helicopter in the wake of severe flooding in 2010.

Other important developments in the US Navy climate response have included the establishment of a 2009 *US Navy Task Force Climate Change* (TFCC) that published *US Navy Arctic Roadmap* in 2009 (updated in 2014) and the *US Navy Climate Change Roadmap* in 2010. Aside from energy transformation, the US Navy has invested some effort into increasing its presence in the Arctic. Former Chief of Naval Operations, Admiral Gary Roughead made the case for the Arctic in 2011, declaring '[t]here is a phenomenal event taking place on the planet today, and that is what I call the opening of the Fifth Ocean, that's the Arctic Ocean. We haven't had an ocean open on this planet since the end of the Ice Age' (Roughead 2011a). For Admiral Roughead and the US Navy, the climate change trends point 'undeniably towards a new venue of operations and responsibility for our global Navy...we remain committed to preparing exhaustively for the challenges and especially for the opportunities that are going to exist in an ice-diminishing Arctic' (Roughead 2011b).

US Army response

The US Army has also been active in its climate response. This has taken two forms. The first has focused on US Army energy security issues, including mitigation, by reducing its base emissions as part of its 'Net Zero' initiative. This initiative was a direct response to *EO 13514* and has seen the US Army partner with the National Renewable Energy Laboratory Net Zero and the US Army Corps of Engineers. Commencing in 2011, its key aim is to produce as much renewable energy on military bases as it uses over the course of a year. So far, 17 pilot bases are undergoing the Net Zero initiative with a plan to 'transition and institutionalise' the concept throughout the entire US Army (US DoE 2013: 3).

The second has been the response by the US Army Corps of Engineers (USACE) which has focused on climate adaptation and resilience planning. In 2011, USACE published its *Climate Adaptation Statement* and updated in 2014 as the *Climate Preparedness and Resilience Policy Statement*. Unambiguously, this document states: 'It is the policy of USACE to integrate climate change preparedness and resilience planning and actions in all activities for the purpose of enhancing the resilience of our built and natural water resource infrastructure and the effectiveness of our military support mission and to reduce the vulnerabilities of that infrastructure and those missions to the effects of climate change' (USACE 2014).

BOX 7: US MILITARY STRATEGIC AND LEGISLATIVE RESPONSE TIMELINE

2003 The Pentagon and Climate Security: The Pentagon explores how abrupt climate change could affect global security (Schwartz et al 2003).

2005 Hurricane Katrina Response: In the aftermath of Hurricane Katrina, the US government undertook extensive analysis of the security threats posed by climate change.

2006 National Intelligence Priority Framework: In 2006, the National Intelligence Priorities Framework identified climate change as an 'important global issue' with 'wide-ranging implications for US national security interests over the next 20 years' (National Intelligence Council 2008).

2007 Center for Naval Analysis report: The 2007 Center for Naval Analysis (now CNA Corporation) report by retired senior military officers makes a significant impact. It stated: 'as military leaders we know we cannot wait for certainty. Failing to act because warning isn't precise is unacceptable' (CNA 2007).

2008 National Intelligence Assessment: A 2008 National Intelligence Assessment declares climate change could have 'significant geopolitical consequences' and recommends it be factored into scenario planning to explore its impact on major power relationships (National Intelligence Council 2008).

2008 National Defense Authorization Act: The National Defense Authorization Act decreed that the US military must 'assess the risks of projected climate change to current and future missions ... update defense plans based on these assessments, including working with allies and partners to incorporate climate mitigation strategies' (Defense Authorization Act 2008).

2009 President Obama Directive: In 2008, President Obama directed the US military to reduce its non-operational emissions, enhance agency sustainability measures, publish a climate change adaptation plan and actively participate in the Interagency Climate Change Adaption Task Force (White House 2009).

2010 US *National Security Strategy* (NSS) and *Quadrennial Defense Review* (QDR): These documents were the first authoritative US national security documents in history to describe the climate security threat in detail.

2012 Climate Change Adaptation Roadmap: The US DoD also published a *Climate Change Adaptation Roadmap*, which required the Department to integrate climate change considerations across the Department, manage associated risks and collaborate with internal and external stakeholders on climate change challenges.

2012 US DoD Climate Change Adaptation Working Group (CCAWG) established: Has membership from all Services and multiple offices including Policy, Operational Energy Plans and Programs, Personnel and Readiness and the Joint Staff.

2013 Presidential Order: A 2013 presidential order - *Preparing the United States for the Impacts of Climate Change* required the US military to also engage in climate change partnering and information sharing, support risk-informed decision making tools, and undertake climate preparedness training (White House 2013).

2015 US National Security Strategy: The 2015 strategy states: '[c]limate change is an urgent and growing threat to our national security, contributing to increased natural disasters, refugee flows, and conflicts over basic resources' (White House 2015).

US Military Combatant Command response

The US military is also mainstreaming climate change throughout the missions, training and doctrine of its global network of Combatant Commands that extend from Africa, to Europe, across the Middle East, to the Pacific, the Arctic and beyond. The Combatant Commands form the frontline of the US military, controlling vast military equipment (planes, ships, soldiers, sailors and airmen). The Combatant Commands are important due to their ability to respond quickly during climate related natural disasters. The Combatant Commands already see climate change as a current security risk and are factoring climate related security risks into their planning, particularly for Humanitarian Assistance and Disaster Relief. Each Combatant Command is also focused on how climate change will impact its particular area of operations (eg., US Northern Command on the melting Arctic, US Pacific Command on rising sea-levels for small island states). It is worth highlighting that the Combatant Commands are also working with partner nations to reduce climate risks including in areas of infrastructure, training and equipment. In this way, climate change represents an opportunity for the military to engage in capacity building before a disaster strikes (US DOD 2015; Figure 49).

Figure 49: US Marines and sailors arrive using Landing Craft Air Cushions to offload vehicles, personnel and equipment in support of a non-combatant evacuation operation exercise being conducted in the Hawaiian islands.

4.4.2 UK Ministry of Defence

BOX 8: UK SECURITY SECTOR ON CLIMATE CHANGE AND ITS SECURITY IMPACTS

"If we bury our head in the sand we risk our world being engulfed...[we require] a whole new approach to how we analyse and act on security"

Margaret Beckett
Former British Foreign Secretary

"The physical effects of climate change are likely to become increasingly significant as a 'risk multiplier', exacerbating existing tensions around the world."

2010 UK National Security Strategy

"Climate change will require more deployment of British military in conflict prevention, conflict resolution or responding to increased humanitarian requirements due to extreme weather impacts"

Rear Admiral Neil Morisetti (Ret.), Former UK Climate and Energy Security Envoy

The UK Ministry of Defence (MoD) has also taken a number of comprehensive steps to address the threat of climate change. This section provides an overview of some of the key strategic and legislative decisions.

In 2007, British Foreign Secretary Margaret Beckett convened the first ever debate on climate change in the UN Security Council (UN 2007). As a result the UK MoD elevated climate change in the 2008 and 2010 *National Security Strategy*, stating:

> Climate change is potentially the greatest challenge to global stability and security, and therefore to national security. Tackling its causes, mitigating its risks and preparing for and dealing with its consequences are critical to our future security (HM Government 2008: 18).

In 2008 the MoD presented its *Climate Change Strategy* at a Parisian conference, *The Importance of Military Organisations in Protecting the Climate*. This conference

Figure 50: A UK serviceman provides humanitarian aid in Sierra Leone.

also included climate security presentations from the equivalent Defence Ministries of Australia, Brazil, Canada, Finland, France, Germany, India, Sweden, The Netherlands and the United States all of whom recognised the early security implications of a changing climate. In 2009, the MoD and the Foreign and Commonwealth Office (FCO) jointly appointed Rear Admiral Neil Morisetti as the two Departments' Climate and Energy Security Envoy. The role of the envoy was to act as a UK voice on climate and resource security, broaden and deepen the climate security debate and to integrate MoD's climate strategy across the organisation including full integration with other government departments (HM Government 2010). The appointment of Rear Admiral Morisetti provided a clear and authoritative voice on climate security matters that elevated the urgency to act on climate change, factored it into strategic planning and mainstreamed the issue within Defence and beyond.

The MoD's *Climate Strategy* was complemented in 2010 with two further works. The first, *Defence in a Changing Climate* outlined the threats that climate change poses as well as the opportunities presented as a result of the global move towards a low-carbon economy. The second, *MoD Climate Change Delivery Plan*, set forth detailed plans to deliver targets set out in the *Climate Change Strategy*. Included in this was the aim to reduce military estate CO_2 emissions by 80 percent by 2050 (UK MoD 2010).

From 2011, UK MoD climate strategies are now part of its *Sustainable Development Strategy*, which defined two core principles:

- **Principle 1. Adaptation.** Defence must be resilient to current and future environmental, social and economic threats.
- **Principle 2. Mitigation.** Defence must realise the positive and minimise the negative impacts that Defence activities can have on the environment, people and the economy in the UK and overseas.

In formulating its climate response, the *Sustainable Development Strategy* identified six core objectives (UK MoD 2011) that – amongst others - included reducing its Armed Force reliance on fossils fuels, reducing greenhouse gas emissions at Defence bases and factoring in environmental threats into Defence planning activities. To this end, the MoD undertook Climate Impacts Risk Assessments which identified risks to the defence estate from current and future climate events as well as action to maintain and optimise operational capabilities (HM Government 2012; 2013). In essence, these risk assessments ensure that the MoD estate becomes resilient to a changing climate (Box 9).

It is clear that both the US and UK are at the forefront of responding to the challenges presented by climate change, through integrating detailed considerations in military planning regarding how their militaries might mitigate and adapt to climate change and its resulting security impacts.

BOX 9: UK CLIMATE IMPACT RISK ASSESSMENT

Between 2010 and 2013 the UK MoD completed an extensive climate change impact risk assessment of approximately 70 of its most critical defence establishments. Using military risk methodologies, the MoD analysed how climate change would impact its bases in terms of temperature increases, changed rainfall patterns, extreme weather and sea-level rise. The risks were recorded on the UK MoD Climate Resilience Risk Register, which enables the UK military to commence adaptation of climate risks as they emerge. In addition, the Climate Resilience Risk Register has been incorporated into UK military business continuity plans, including areas such as training, health and safety, maintenance and environmental management (HM Government 2012; 2013).

Conclusion

Climate change poses significant risks for human and societal well-being. It acts as a threat multiplier with potentially devastating security implications by heightening social and political tensions and increasing the risk of conflict and violence. The UK and US Governments directed their militaries to examine and prepare for the security threats posed by climate change. Both militaries have responded by labelling climate change a significant security risk, which is shaping the current and future strategic environment within which militaries will need to operate. These nations have taken significant legislative and strategic steps to ensure that climate change is integrated into Defence planning and that the Army, Navy and Air Force are prepared for this contemporary security challenge.

In Australia, comparatively little action is being taken to ensure that the Australian Defence Force is prepared for climate change and its security implications. Increasingly, this is leaving the ADF out of step with its allies, and exposing Australian defence personnel, and Australia more broadly, to the considerable strategic risk and uncertainty that climate change brings. Given the scale of the climate change challenge and the potential for it to increase the risk of conflict and the forced migration of people within and between nations, Australia cannot afford to lag further behind its major allies. If Australia is to align with its military allies then the next Defence White Paper (which is due to be released in late 2015) should address climate change in detail.

Ultimately, whilst defence forces can respond to climate change and its impacts, they cannot solve it alone. It is extremely urgent that global emissions start tracking downward this decade if there is to be any chance of keeping the warming of the planet to below 2°C, and limiting the severity of climate change and its implications for security. To achieve this, we must join the global effort to substantially reduce carbon emissions and rapidly move away from fossil fuels to renewable energy. There is no time to lose; now is the time to get on with the job.

Appendix A:

Evidence underpinning Table One: military climate action comparison*

US Department of Defense

Military Planning and Operations

1. **Incorporated and mainstreamed into National Strategic (Military) planning.**
   Evidence/Reference: Climate change is factored into the 2006 US National Intelligence Priorities Framework, 2008 US National Intelligence Assessment, 2008 US National Defense Authorization Act, 2010 and 2015 US National Security Strategy, 2010 and 2014 Quadrennial Defense Review; Executive Order 13653 – Preparing the United States for the Impacts of Climate Change (2013).

2. **Shown leadership by appointing a Senior Military authority as Climate Change planning officer/ envoy.**
   Evidence/Reference: Admiral David W. Titley served as US Chief Oceanographer and initiated US Navy Task Force Climate Change.

3. **Published a Climate Change Adaptation Strategy.**
   Evidence/Reference: US Climate Change Adaptation Roadmap within US DoD Strategic Sustainability Performance Plan; US Navy Climate Change Roadmap; US Army Corps of Engineers Climate Adaptation Statement (2011) and Climate Preparedness and Resilience Policy Statement (2014).

4. **Participating member of Interdepartmental / interagency Climate Change Working Group.**
   Evidence/Reference: Member of Interagency Climate Change Adaptation Task Force (2009); Member of Council on Climate Preparedness and Resilience (2013); Executive Order 13514 – Federal Leadership in Environmental, Energy and Economic Performance (2009); Executive Order 13653 – Preparing the United States for the Impacts of Climate Change (2013).

5. **Analysis of climate change impacts on military base locations and base capacity (force posture).**
   Evidence/Reference: 2008 National Defense Authorization Act; The Presidents Climate Action Plan (2013); Executive Order 13514 – Federal Leadership in Environmental, Energy and Economic Performance (2009); 2010/2015 QDR and NSS; US Climate Change Adaptation Roadmap within US DoD Strategic Sustainability Performance Plan; Executive Order 13653 – Preparing the United States for the Impacts of Climate Change (2013).

6. **Analysis of climate change impacts on how military is organised for combat missions, stabilisation operations and disaster relief (force structure).**
   Evidence/Reference: 2008 National Defense Authorization Act; Executive Order 13514 – Federal Leadership in Environmental, Energy and Economic Performance (2009); US Climate Change Adaptation Roadmap within US Strategic DoD Sustainability Performance Plan; Executive Order 13653 – Preparing the United States for the Impacts of Climate Change (2013).

* Sources identified in this Appendix are non-exhaustive, only include open-source public documents and are identified as a guide to readers only.

Military Training and Testing

1. **Analysis of climate change risks to military training.**
Evidence/Reference: US Climate Change Adaptation Roadmap within US DoD Strategic Sustainability Performance Plan; US DoD Response to Congress on National Security Implications of Climate Change (23 July 2015 in response to Senate Report 113-211, H.R. 4870).

2. **Analysis of climate change impacts on individual soldier, sailor and air force personnel readiness.**
Evidence/Reference: US Climate Change Adaptation Roadmap within US Strategic Sustainability Performance Plan; US DoD Response to Congress on National Security Implications of Climate Change (23 July 2015 in response to Senate Report 113-211, H.R. 4870).

3. **Analysis of climate change impacts on the preparedness of the military to respond to operations and emergencies**
Evidence/Reference: 2008 National Defense Authorization Act; 2010 QDR; 2010 NSS; US DoD Response to Congress on National Security Implications of Climate Change (23 July 2015 in response to Senate Report 113-211, H.R. 4870); US Climate Change Adaptation Roadmap within US DoD Strategic Sustainability Performance Plan.

4. **Analysis / inclusion of climate change in military doctrine (eg., disaster relief doctrine or aid to civil community).**
Evidence/Reference: 2008 National Defense Authorization Act; Executive Order 13514 – Federal Leadership in Environmental, Energy and Economic Performance; US DoD Response to Congress on National Security Implications of Climate Change (23 July 2015 in response to Senate Report 113-211, H.R. 4870); US Climate Change Adaptation Roadmap within US DoD Strategic Sustainability Performance Plan.

5. **Analysis of health impacts of climate change on military forces and operational areas.**
Evidence/Reference: Executive Order 13514 – Federal Leadership in Environmental, Energy and Economic Performance; US Climate Change Adaptation Roadmap within US DoD Strategic Sustainability Performance Plan.

Military Estate (Built and Natural Infrastructure)

1. **Mandated renewable energy targets for military bases.**
Evidence/Reference: The Presidents Climate Action Plan (2013); US DoD Strategic Sustainability Performance Plan; Executive Order 13653 – Planning for Federal Sustainability in the Next Decade (2015); US DoD Instruction 4170.11, 'Installation Energy Management' (Dec 2009).

2. **Conducted Risk Assessment of sea-level rise on military bases.**
Evidence/Reference: 2008 National Defense Authorization Act; 2010 QDR; US DoD Response to Congress on National Security Implications of Climate Change (23 July 2015 in response to Senate Report 113-211, H.R. 4870).

3. **Conducted Risk Assessment of extreme weather on military bases.**
Evidence/Reference: 2008 National Defense Authorization Act; US DoD Response to Congress on National Security Implications of Climate Change (23 July 2015 in response to Senate Report 113-211, H.R. 4870).

4. **Implemented 'Green' building codes and energy programs across military bases.**
Evidence/Reference: US Army Net Zero Program; US Navy Energy Program (2010); US Strategic Sustainability Performance Plan; Executive Order 13693 – Planning for Federal Sustainability in the Next Decade (2015); US DoD Instruction 4170.11, 'Installation Energy Management' (Dec 2009); US Green Building Council Leadership in Energy and Environmental Design (LEED; Department of Defense Sustainable buildings Policy (10 Nov 2013); Unified Facilities Criteria 1-200-02, 'High Performance and Sustainable Building Requirements' (1 Mar 2013); NAVFAC Sustainability and Energy Requirements 2014-02 (2014).

Military Acquisition and Supply Chain

1. **Mandated fuel and energy efficiency goals in purchase of major military hardware & platforms (eg., use of bio-fuels and hybrids).**
   Evidence/Reference: Energy for the Warfighter: Operational Energy Strategy (2011); Operational Energy Strategy Implementation Plan (March 2012); US DoD Strategic Sustainability Performance Plan; US Navy Energy Program (2010); Executive Order 13693 – Planning for Federal Sustainability in the Next Decade (2015).

2. **Analysed climate change risks to critical civilian infrastructure and civilian workforce and resultant impacts on military infrastructure, operations and training.**
   Evidence/Reference: Executive Order 13514 – Federal Leadership in Environmental, Energy and Economic Performance (2009); Executive Order 13653 – Preparing the United States for the Impacts of Climate Change (2013).

3. **Sustainable Procurement practices implemented (eg., energy efficient civilian vehicle fleets, energy efficient lighting, heating, waste reduction strategies etc).**
   Evidence/Reference: Executive Order 13514 – Federal Leadership in Environmental, Energy and Economic Performance (2009); Executive Order 13653 – Preparing the United States for the Impacts of Climate Change (2013); US DoD Strategic Sustainability Performance Plan; Executive Order 13693 – Planning for Federal Sustainability in the Next Decade (2015).

UK Armed Forces

Military Planning and Operations

1. **Incorporated and mainstreamed into National Strategic (Military) Planning.**
   Evidence/Reference: 2008 and 2010 National Security Strategy; MoD Strategic Trends Programme: Global Strategic Trends out to 2014 (2010).

2. **Shown leadership by appointing a Senior Military authority as Climate Change planning officer/envoy.**
   Evidence/Reference: Rear Admiral Morisetti (2009) – UK Climate Envoy.

3. **Published a Climate Change Adaptation Strategy.**
   Evidence/Reference: 2010 Climate Strategy (Defence in a Changing Climate); 2010 MoD Climate Change Delivery Plan; 2011 MoD Sustainable Development Strategy.

4. **Participating member of Interdepartmental / interagency Climate Change Working Group.**
   Evidence/Reference: The appointment in 2009 by Foreign and Commonwealth Office of military climate envoy to integrate climate change across government departments; UK Climate Impacts Programme (UKCIP).

5. **Analysis of climate change impacts on military base locations and base capacity (force posture).**
   Evidence/Reference: 2010 Climate Strategy (Defence in a Changing Climate); 2010 MoD Climate Change Delivery Plan; MoD Climate Impact Risk Assessment (2012); MoD Climate Impacts Risk Assessment Methodology (2012).

6. **Analysis of climate change impacts on how military is organised for combat, stabilisation operations and disaster relief (force structure).**
   Evidence/Reference: 2010 Climate Strategy (Defence in a Changing Climate); 2010 MoD Climate Change Delivery Plan; MoD Climate Impact Risk Assessment (2012); MoD Climate Impacts Risk Assessment Methodology (2012).

Military Training and Testing

1. **Analysis of climate change risks to military training.**
   Evidence/Reference: 2010 Climate Strategy (Defence in a Changing Climate); 2010 MoD Climate Change Delivery Plan; MoD Climate Impact Risk Assessment (2012); MoD Climate Impacts Risk Assessment Methodology (2012).

2. **Analysis of climate change impacts on individual soldier, sailor and air force personnel readiness.**
   Evidence/Reference: No evidence found in publications.

3. **Analysis of climate change impacts on the preparedness of the military to respond to operations and emergencies.**
   Evidence/Reference: 2010 Climate Strategy (Defence in a Changing Climate); 2010 MoD Climate Change Delivery Plan; MoD Strategic Trends Programme: Global Strategic Trends out to 2014 (2010); MoD Climate Impact Risk Assessment (2012); MoD Climate Impacts Risk Assessment Methodology (2012).

4. **Analysis / inclusion of climate change in military doctrine (eg., disaster relief doctrine or aid to civil community).**
   Evidence/Reference: 2010 MoD Strategic Trends Programme: Global Strategic Trends out to 2040.

5. **Analysis of health impacts of climate change on military forces and operational areas.**
   Evidence/Reference: No evidence found in publications.

Military Estate (Built and Natural Infrastructure)

1. **Mandated renewable energy targets for military bases.**
   Evidence/Reference: UK MoD Sustainability Strategy (2011); UK Greening Government Commitment Targets (2014).

2. **Conducted Risk Assessment of Sea Level rise on military bases.**
   Evidence/Reference: MoD Climate Impact Risk Assessment (2012); MoD Climate Impacts Risk Assessment Methodology (2012); 2010 MoD Strategic Trends Programme: Global Strategic Trends out to 2040.

3. **Conducted Risk Assessment of extreme weather on military bases.**
   Evidence/Reference: MoD Climate Impact Risk Assessment (2012); MoD Climate Impacts Risk Assessment Methodology (2012); 2010 MoD Strategic Trends Programme: Global Strategic Trends out to 2040.

4. **Implemented 'Green' building codes and energy programs across military bases.**
   Evidence/Reference: UK MoD Sustainability Strategy (2011).

Military Acquisition and Supply Chain

1. **Mandated fuel and energy efficiency goals in purchase of major military hardware & platforms (eg., use of bio-fuels and hybrids).**
   Evidence/Reference: 2010 Climate Strategy (Defence in a Changing Climate); 2010 MoD Climate Change Delivery Plan.

2. **Analysed climate change risks to critical civilian infrastructure and civilian workforce and resultant impacts on military infrastructure, operations and training.**
   Evidence/Reference: MoD Climate Impact Risk Assessment (2012); MoD Climate Impacts Risk Assessment Methodology (2012).

3. **Sustainable Procurement practices implemented (eg., energy efficient civilian vehicle fleets, energy efficient lighting, heating, waste reduction strategies etc).**
   Evidence/Reference: UK MoD Sustainability Strategy (2011); UK Greening Government Commitment Targets (2014).

Australian Defence Force (ADF)

Military Planning and Operations

1. **Incorporated and mainstreamed into National Strategic (Military) Planning.**
   Evidence/Reference: Partial response. Climate change has been included as a point in the 2009 and 2013 Defence White Papers and the 2008 and 2013 National Security Strategies but is unlikely to be included in the 2015 Defence White Paper.

2. **Shown leadership by appointing a Senior Military authority as Climate Change planning officer/envoy.**
   Evidence/Reference: No action taken.

3. **Published a Climate Change Adaptation Strategy.**
   Evidence/Reference: No action taken.

4. **Participating member of Interdepartmental / Interagency Climate Change Working Group.**
   Evidence/Reference: ADF Global Change and Energy Sustainability Initiative has convened interagency forums (2011/12); Defence was also identified as a member of the Inter Departmental Committee on Climate Change (2009/10) and was noted for participating in the Cockburn Councils Coastal Climate Change Study Project (2010).

5. **Analysis of climate change impacts on military base locations and base capacity (force posture).**
   Evidence/Reference: The 2012 Force Posture Review did not include any analysis of climate change.

6. **Analysis of climate change impacts on how military is organised for combat, stabilisation operations and disaster relief (force structure).**
   Evidence/Reference: "No evidence that climate change is yet part of detailed Defence White Paper strategic planning or Capability Context Scenarios".

Military Training and Testing

1. **Analysis of climate change risks to military training.**
   Evidence/Reference: No evidence available.

2. **Analysis of climate change impacts on individual soldier, sailor and airmen readiness.**
   Evidence/Reference: No evidence available.

3. **Analysis of climate change impacts on the preparedness of the military to respond to operations and emergencies.**
   Evidence/Reference: ADF Global Change and Energy Sustainability Initiative.

4. **Analysis / inclusion of climate change in military doctrine (eg., disaster relief doctrine or aid to civil community).**
   Evidence/Reference: Climate change has been discussed in a number of ADF doctrinal publications including 'Joint Operations in the 21st century'; Future Maritime Operating Concept – 2025; Army's Future Land Operating Concept (2009); Operations Series ADDP 3.8 Peace Operations; Australian Maritime Doctrine (2010); Future Land Warfare Report 2014.

5. **Analysis of health impacts of climate change on military forces and operational areas.**
   Evidence/Reference: No evidence available.

Military Estate (Built and Natural Infrastructure)

1. **Mandated renewable energy targets for military bases.**
   Evidence/Reference: Defence Estate Energy Strategy 2014 – 2019. This Strategy fails to establish any mandated renewable energy targets for military bases.

2. **Conducted Risk Assessment of Sea Level rise on military bases.**
   Evidence/Reference: 'Adaptation and Planning Strategies to Mitigate the Impact of Climate Change Induced Sea Level Rise, Flooding and Erosion at Selected Sites' (2011 - 2012).

3. **Conducted Risk Assessment of extreme weather on military bases.**
   Evidence/Reference: No evidence available.

4. **Implemented 'Green' building codes and energy programs across military bases.**
   Evidence/Reference: Defence Green Building Guidelines (2004); Defence Estate Energy Strategy 2014 – 2019; Defence Environmental Strategy 2010 – 2014; Energy Efficiency in Government Operation (EEGO) Policy (2006); Defence Procurement Policy Manual (2014); National Green Leasing Policy (2010); 'ADF Combat Climate Change' program (from 2008).

Military Acquisition and Supply Chain

1. **Mandated fuel and energy efficiency goals in purchase of major military hardware & platforms (eg., use of bio-fuels and hybrids).**
   Evidence/Reference: RAN has undertaken some bio-fuel use in its operational platforms; limited discussion in Defence Estate Energy Strategy 2014 – 2019; Energy Use in the Australian Government Operations 2011-12 (this was the final report and was published in 2013) stated 'there is no policy requirement to reduce operational fuel consumption' (p. ii).

2. **Analysed climate change risks to critical civilian infrastructure and civilian workforce and resultant impacts on military infrastructure, operations and training.**
   Evidence/Reference: No evidence available.

3. **Sustainable Procurement practices implemented (eg., energy efficient civilian vehicle fleets, energy efficient lighting, heating, waste reduction strategies etc).**
   Evidence/Reference: Defence Environmental Strategy 2010 – 2014; Waste Minimisation Policy; Defence Sustainable Water Strategy; Defence Procurement Policy Manual (2014).

References

ABC (Australian Broadcasting Corporation) (29 January 2009) Train tracks buckle under record heat. 7.30 Project. Accessed at http://www.abc.net.au/7.30/content/2008/s2477773.htm.

ABC (18 June 2014) State Mine Fire: two ADF members referred to Chief of Army over Blue Mountains Blaze. Accessed at http://www.abc.net.au/news/2014-06-18/lithgow-fire-report-critical-of-defence-force-members/5531174.

ABC (2015a) (17 March 2015) Cyclone Pam: 24 confirmed dead in Vanuatu with fears for many more, president pleads for help to rebuild. Accessed at http://www.abc.net.au/news/2015-03-16/cyclone-pam-vanuatu-24-dead-thousands-displaced/6323260.

ABC (2015b) (22 March 2015) Tropical Cyclone Pam: Vanuatu death toll ries to 16 as relief effort continues. Accessed at http://www.abc.net.au/news/2015-03-21/un-raises-vanuatu-cyclone-death-toll/6337816.

ADF (Australian Defence Force) (2004) Executive Series ADDP 00.1 Preparedness and Mobilisation ed. Department of Defence. Canberra: Australian Defence Force.

Adger WN, Pulhin JM, Barnett J, Dabelko GD, Hovelsrud GK, Levy M, Oswald Spring U and Vogel CH (2014) Human security. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 755-791.

AEM (2015a) Cyclone Yasi, Queensland. Accessed at https://www.emknowledge.gov.au/resource/503/2011/cyclone-yasi-queensland-2011.

AEM (Australian Emergency Management) (2015b) Perth Hills Fire, Western Australia 2011. Accessed at https://www.emknowledge.gov.au/resource/502/2011/bushfire---perth-hills-western-australia-2011.

Alexander AK, Carzolio M, Goodin D, Vance E (2013) Climate change is likely to worsen the public health threat of diarrhoea diseases in Botswana. International *Journal of Environmental Research and Public Health, 10: 1202-1230.*

Alexandratos N and Bruinsma J (2012) World agriculture towards 2030/2050: the 2012 revision. *ESA Working paper No. 12-03.* Rome, FAO.

ANAO (Australian National Audit Office) (2014) The Auditor-General, Audit Report No. 24 2013-14 Performance Audit: Emergency Defence Assistance to the Civil Community, ed. Department of Defence. Canberra: Commonwealth of Australia.

ARENA (Australian Renewable Energy Agency) (2015) “Perth Wave Energy Project”. Accessed at: http://arena.gov.au/project/perth-wave-energy-project/.

Australian Army (2011) Operation Yasi Assist. Department of Defence. Accessed at http://www.army.gov.au/Our-work/Community-engagement/Disaster-relief-at-home/Operation-YASI-ASSIST-2011.

Australian Government (2013a) Australian Defence Force completes Phillipines recovery option. Department of Defence. Accessed at http://news.defence.gov.au/2013/12/18/australian-defence-force-completes-philippines-recovery-operation/.

Australian Government (2013b) Strong and secure: a strategy for Australia’s national security. Department of the Prime Minister and Cabinet.

Australian Government (2015) Operation Pacific Assist 2015. Department of Defence. Accessed at http://www.defence.gov.au/Operations/Vanuatu/.

Australian Red Cross (2011) Queensland Floods 2011. Accessed at http://www.redcross.org.au/queensland-floods-2011.aspx.

Australian Red Cross (2015) Cyclone Pam (Vanuatu) 2015 Appeal. Accessed at http://www.redcross.org.au/cyclone-pam-vanuatu-2015-appeal.aspx.

Bailey R, Benton GT, Challinor A, Elliott J, Gustafson D, Hiller B. Jones A, Jahn M, Kent C, Lewis K, Meacham T, Rington M, Ballu V, Bouinc M, Siméonid P, Crawford WC, Calmante S, Boréf J, Kanasg T and Pelletiera B (2011) Comparing the role of absolute sea-level rise and vertical tectonic motions in coastal flooding, Torres Islands (Vanuatu). *Proceedings of the National Academy of Sciences of the United States of America, 108(32): 13019-13022.*

Ballu V, Bouinc M, Siméonid P, Crawford WC, Calmante S, Boréf J, Kanasg T, Pelletiera B. (2011) Comparing the role of absolute sea-level rise and vertical tectonic motions in coastal flooding, Torres Islands (Vanuatu). Proceedings of the National Academy of Sciences of the United States of America, 108(32),13019-13022.

Barnett J and Adger W. N. (2007) Climate Change, Human Security and Violent Conflict. Political Geography pp 639-655.

Barnett J and O’Neill SJ (2012) Islands, resettlement and adaptation. Nature Climate Change 2: 8–10.

Barrett CB (2013) Food or consequences: food security and its implications for global sociopolitical stability. In: *Food Security and Sociopolitical Stability* [Barrett CB (ed.)]. Oxford University Press, Oxford, UK, pp 1-34.

Beckman RC, Townsend-Gault I, Schofield C, Davenport T and Bernard L (2013) Beyond territorial disputes in the South China sea: Legal frameworks for the joint development of hydrocarbon resources. Edward Elgar Publishing.

Bergin A and Townsend J (2007) A change in climate for the Australian Defence Force. In *Special Report. Canberra: Australian Strategic Policy Institute.*

Berry S, Roberts M and Schlenker W (2012) Corn production shocks in 2012 and beyond: implications for food price volatility. Working Paper 18659. National Bureau of Economic Research, Cambridge, Massachusetts, USA.

Berthelot R (2010) The Army response to Hurrican Katrina. Accessed at http://www.army.mil/article/45029/The_Army_response_to_Hurricane_Katrina/.

BoM (Bureau of Meteorology) (2013) Special Climate Statement 43 – Extreme heat in January 2013. Accessed at www.bom.gov.au/climate/current/statements/scs43e.pdf.

BoM (2014) State of the climate. Accessed at http://www.bom.gov.au/state-of-the-climate/.

BoM and CSIRO (2014) Climate Variability, Extreme and Change in the Western Tropical Pacific: new science and updated country reports. Accessed at http://www.pacificclimatechangescience.org/wp-content/uploads/2014/07/PACCSAP_CountryReports2014_WEB_140710.pdf.

Brauch HG (2011) Concepts of Security Threats, Challenges, Vulnerabilities and Risks. In: *Coping with Global Environmental Change, Disasters and Security: Threats, Challenges, Vulnerabilities and Risks [*Brauch HG, Spring UO, Mesjasz C, Grin J, Kameri-Mbote P, Chourou B, Dunay P, and Birkmann J (eds.)]. Hexagon Series on Human and Environmental Security and Peace. Berlin: Springer.

Broekhoven SV, Judson N, Nguyen S and Ross W (2012) Microgrid Study: Energy Security for DoD Installations. Technical Report, pp1164.

Broekhoven SV, Judson N, Galvin J and Marqusee J (2013) Leading the charge: Microgrids for domestic military installations. Power and Energy Magazine, IEEE, 11(4): 40-45.

Brzoska M (2012) Climate Change as a Driver of Security Policy. In: *Climate Change, Human Security and Violent Conflict: Challenges for Societal Stability [*Scheffran J, Brzoska M, Brauch HG, Link PM, and Schilling J (eds.)]. Hexagon Series on Human and Environmental Security and Peace, vol. 8. Berlin: Springer.

Cazenave A and Remy F (2011) Sea level and climate: measurements and causes of changes. Wiley Interdisciplinary Reviews: Climate Change 2(5): 647–662.

CFA (Country Fire Authority) (2012). Major fires. Accessed at http://www.cfa.vic.gov.au/about/major-fires/.

Chantrill C (2015) UK Defence Sector Spending. Public Spending Details for 2016 (from Public Expenditure Statistical Analyses). Accessed at http://www.ukpublicspending.co.uk/uk_defence_spending_30.html.

Church JA, Clark PU, Cazenave A, Gregory JM, Jevrejeva S, Levermann A, Merrifield MA, Milne GA, Nerem RS, Nunn PD, Payne AJ, Pfeffer WT, Stammer D. and Unnikrishnan AS (2013). Sea Level Change. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker TF, Qin D, Plattner GK, Tignor M, Allen SK, Boschung J, Nauels A, Xia Y, Bex V and Midgley PM (eds)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Church JA, Hunter JR, McInnes KL and White NJ (2006) Sea-level rise around the Australian coastline and the changing frequency of extreme sea-level events, Australian Meteorological Magazine 55: 253–260.

Ciais P, Sabine C, Bala G, Bopp L, Brovkin V, Canadell J, Chhabra A, DeFries R, Galloway J, Heimann M, Jones C, Le Quéré C, Myneni RB, Piao S and Thornton P (2013) Carbon and Other Biogeochemical Cycles. In: *Climate Change 2013: The Physical Science Basis*. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Cisneros J, Oki T, Arnell NW, Benito G, Cogley JG, Döll P, Jiang T and Mwakalila SS (2014) Freshwater resources. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability.* Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 229-269.

Clarke H, Smith PL and Pitman AJ (2011) Regional signatures of future fire weather over eastern Australia from global climate models. International Journal of Wildland Fire 20: 550-562.

Clarke H, Lucas C, Smith P (2013) Changes in Australian fire weather between 1973 and 2010. International Journal of Climatology 33: 931-944.

Climate Council (2013) Be Prepared: Climate Change and the Australian Bushfire Threat. Hughes L. Accessed at http://www.climatecouncil.org.au/uploads/c597d19c0ab18366cfbf7b9f6235ef7c.pdf.

Climate Council (2014a) Heatwaves: Hotter, Longer and More Often. Hughes L and Steffen W. Accessed at http://www.climatecouncil.org.au/uploads/9901f6614a2cac7b2b888f55b4dff9cc.pdf.

Climate Council (2014b) Be Prepared: Climate Change and the Victorian Bushfire Threat. Hughes L. Accessed at https://www.climatecouncil.org.au/sabushfirereport.

Climate Council (2015). Climate Council Briefing Statement: Damage From Cyclone Pam Was Exacerbated By Climate Change. Steffen W, Flannery T. Accessed at https://www.climatecouncil.org.au/damage-from-cyclone-pam-was-exacerbated-by-climate-change.

CNA (Centre for Naval Analysis) (2007) National Security and The Threat of Climate Change. Accessed at http://www.cna.org/reports/climate.

CNA (Centre for Naval Analysis) (2014) National Security and The Accelerating Risks of Climate Change. ed. CNA Military. Alexandria: Center for Naval Analysis.

CNAS (Centre for a New American Security) (2010) Broadening Horizons: Climate Change and the U.S. Armed Forces, eds. Carmen HE, Parthemore C, and Rogers W. Washington: Center for a New American Century.

Coates L (1996) An overview of fatalities from some natural hazards. Proceedings, NDR96 conference on natural disaster reduction, Gold Coast, 29 September - 2 October.

COIN (Climate Outreach and Information Network) (2013) Mythbuster: migration, displacement and climate change. Accessed at http://climatemigration.org.uk/wp-content/uploads/2013/06/Myth_buster_climate_migration_displacement.pdf.

Commonwealth of Australia (2009) Australian Emergency Management Arrangements, ed. The Attorney-Generals Department. Canberra: The Attorney-Generals Department.

Commonwealth of Australia (2010) The Strategy Framework, ed. Department of Defence. Canberra: Commonwealth of Australia.

Commonwealth of Australia (2012) Senate Standing Committee on Foreign Affairs, Defence and Trade (Senate Budget Estimates - 28/29 May 2012, Questions On Notice - Committees). Australian Parliament: Commonwealth of Australia.

Cook KH and Vizy EK (2008) Effects of twenty-first century climate change on the Amazon rain forest. *Journal of Climate* 21: 542-560.

Costello A, Abbas M, Allen A, Ball S, Bell S, Bellamy R, Friel S, Groce N, Johnson A, Kett M, Lee M, Levy C, Maslin M, McCoy D, McGuire B, Montgomery H, Napier D, Pagel C, Patel J, de Oliveira JA, Redclift N, Rees H, Rogger D, Scott J, Stephenson J, Twigg J, Wolff J, and Patterson C (2009) Managing the health effects of climate change. The Lancet 373: 1693-1733.

CSIRO and BoM (2012) State of the Climate 2012. CSIRO and Bureau of Meteorology, Melbourne. Accessed at http://www.csiro.au/Outcomes/Climate/Understanding/State-of-theClimate-2012.aspx.

CSIRO and BoM (2015) Climate change in Australia: projections for Australia's NRM regions. Australian Government. Accessed at http://www.climatechangeinaustralia.gov.au/en/publications-library/technical-report/.

Dasgupta S, Laplante B, Meisner C, Wheeler D and Yan J (2009) The impact of sea level rise on developing countries: a comparative analysis. *Climatic Change, 93(3-4): 379-388.*

Davies A (2013) Challenges for Mr Rudd's northern naval posture. The Strategist. Accessed at http://www.aspistrategist.org.au/challenges-for-mr-rudds-northern-naval-posture/.

DCCEE (Department of Climate Change and Energy Efficiency) (2011) Climate Change Risks to Coastal Buildings and Infrastructure, DCC, Canberra. Accessed at http://www.climatechange.gov.au/sites/climatechange/files/documents/03_2013/risks-coastalbuildings.pdf.

Defense Authorization Act (2008) National Defense Authorization Act for Fiscal Year 2008. In *110th Congress, Public Law 181,* ed. Senate and House of Representatives of the United States of America in Congress: US Government Printing Office.

Department of Defence (1998) ADF flies final aid deliveries into PNG. Department of Defence. Canberra. Accessed at http://www.defence.gov.au/media/1998/04798.html.

Department of Defence (2007) Airforce Newspaper. Vol. 49, No. 23, December 13, 2007. Accessed at http://www.defence.gov.au/news/raafnews/editions/4923/4923.pdf.

Department of Defence (2009). Defending Australia in the Asia Pacific Century: Force 2030, ed. Department of Defence. Canberra: Commonwealth of Australia.

Department of Defence (2010). Defence Environmental Strategic Plan 2010 - 2014, ed. Department of Defence. Canberra: Department of Defence, Defence Support Group.

Department of Defence (2013). Defence White Paper 2013, ed. Department of Defence. Canberra: Commonwealth of Australia.

Department of Defence (2013) Remediation force concludes recovery effort. Accessed at http://www.defence.gov.au/Operations/PastOperations/nswbushfireassist/.

Department of Defence (2008). Estate Companion Review: A Strategic Framework for the Defence Estate, ed. Department of Defence: Department of Defence.

Department of Defence (2015) The Global Change and Energy Sustainability Initiative Team. Joint Capability Coordination Division. Accessed at http://www.defence.gov.au/VCDF/JCC/DPREP/GCESI.asp.

Department of Homeland Security (2012) The Strategic National Risk Assessment ed. Department of Homeland Security: US Government.

DSRG (Defence Support and Reform Group (2015) Defence Estate. Accessed at http://www.defence.gov.au/dsg/.

Dun O (2011) Migration and displacement triggered by floods in the Mekong Delta. International Migration, pp 49.

Dupont A and Pearman G (2006). Heating up the Planet: Climate Change and Security. Accessed at http://lowyinstitute.richmediaserver.com/docs/AD_GP_ClimateChange.pdf.

Ebinger CK and Zambetakis E (2009) The geopolitics of Arctic melt. International Affairs, 85, 1215-1232.

FAO (Food and Agriculture Organization) (1996) Rome Declaration and World Food Summit Plan of Action. Food and Agricultural Organisation of the United Nations (FAO) World Food Summit, Rome, Italy,13-17 November 1996. Accessed at www.fao.org/docrep/003/w3613e/w3613e00.HTM.

FAO (2008) Soaring food prices: facts, perspectives, impacts and actions required. In 'High Level Conference on World Food Security: the challenges of climate change and bioenergy'. April 2008, HLC/08/ INF/1. (FAO: Rome). Accessed at http://www.fao.org/fileadmin/user_upload/foodclimate/HLCdocs/HLC08-inf-1-E.pdf.

FAO (2009) Global agriculture towards 2050. In High Level Expert Forum: How to feed the world in 2050. Rome 12-13 October 2009. Accessed at http://www.fao.org/fileadmin/templates/wsfs/docs/expert_paper/How_to_Feed_the_World_in_2050.pdf.

Fernando N, Panozzo J, Tausz M, Norton R, Fitzgerald G, Khan A and Seneweera S (2015) Rising CO2 concentration altered wheat grain proteome and flour rheological characteristics. Food Chemistry 170: 448-454.

Fuglie K (2010) Total factor productivity in the global agricultural economy: evidence from FAO data. In: *The shifting patterns of agricultural production and productivity* [Alston J, Babcock B, and Pardey P (eds.)] Midwest Agribusiness Trade Research and Information Center, Iowa State University, Ames, Iowa, USA, pp. 63-91.

Ganachaud A, Gupta SA, Brown NJ, Evans K, Maes C, Muir LC and Graham SF (2013) Projected changes in the tropical Pacific Ocean of importance to tuna fisheries. *Climatic Change,* 119: 163-179.

Garnaut R (2011) The Garnaut Review 2011: Australia in the Global Response to Climate Change. Cambridge University Press. Accessed at http://www.garnautreview.org.au/update-2011/garnaut-review-2011/garnaut-review-2011.pdf.

GCESI (The Global Change and Energy Sustainability Initiative Team) (2012) Global Change and Energy Sustainability Initiative. Joint Capability Coordination Division. Accessed at http://www.defence.gov.au/VCDF/JCC/DPREP/GCESI.asp.

GOS (The Government Office for Science) (2011) Foresight: migration and global environmental change: final project report. London. Accessed at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/287717/11-1116-migration-and-global-environmental-change.pdf.

Gero A, Fletcher S, Rumsey M, Thiessen J, Kuruppu N, Buchan J, Daly J, Willetts J (2013) Disaster response and climate change in the Pacific. National Climate Change Adaptation Research Facility. Gold Coast. pp 202.

Gila OA, Zaratiegui AU and Dieguez VLDM (2011) Western Sahara: migration, exile and environment. International migration, 49: 146-163.

GMACC (Global Military Advisory Council on Climate Change) Climate change & security in Africa. Moran MA, Mulugetta Y, Raleigh C. Accessed at http://www.envirosecurity.org/Climate_Change_and_Security_in_Africa.pdf.

Godfray HCJ, Beddington JR, Crute IR, Haddad L, Lawrence D, Muir JF, Pretty J, Robinson S, Thomas SM and Toulmin C (2010) Food Security: The challenge of feeding 9 billion people. *Science* 327: 812.

Guha-Sapir D and Vos F (2011) Quantifying Global Environmental Change Impacts: Methods, Criteria and Definitions for Compiling Data on Hydro-meteorological Disasters. In: *Coping with Global Environmental Change, Disasters and Security: Threats, Challenges, Vulnerabilities and Risks* [Brauch HG, Spring UO, Mesjasz C, Grin J, Kameri-Mbote P, Chourou B, Dunay P and Birkmann J (eds.)] Berlin: Springer.

Guha-Sapir D, Vos F, Below R, Ponserre S (2012) Annual Disaster Statistical Review 2011: the numbers and trends. Centre for Research on the Epidemiology of Disasters.

Gulledge J (2010) Scientific Uncertainty and the Security Risks of Climate Change. In: *Climate & Energy Symposium* 2010 [Angela Hughes (ed.)] John Hopkins University Applied Physics Laboratory.

Hanigan IC, Butler CD, Kokic PN and Hutchinson MF (2012) Suicide and drought in New South Wales, Australia, 1970–2007. *Proceedings of the Royal Academy of Sciences* 35: 13950–13955.

Hanna EG, Harley DO, Xu C, and McMichael AJ (2011). Overview of Climate Change Impacts on Human Health in the Pacific Region Canberra: Australian National University, Australian Department of Climate Change & Energy Efficiency, AusAID,; December. Available from: http://www.climatechange.gov.au/sites/climatechange/files/documents/06_2013/anu-impacts-on-human-health.pdf.

Hanna EG and Tait PW (2015). Limitations to thermoregulation and acclimatisation challenges human adaptation to global warming. *Int. J. Environ. Res. Public Health* 12 (7), 8034-8074.

Hijioka Y, Lin E, Pereira JJ, Corlett RT, Cui X, Insarov GE, Lasco RD, Lindgren E and Surjan A (2014) Asia. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability.* Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1327-1370.

Hirota M, Holmgren M, Van Nes EH and Scheffer M (2011) Global resilience of tropical forest and savanna to critical transitions. *Science*, 334: 232–235.

HM Government (Her Majesty's Government) (2008) The National Security Strategy of the United Kingdom: Security in an interdependent world. London.

HM Government (2010a) Senior Personnel Issues, Foreign Affairs Committee. In *Foreign and Commonwealth Office Annual Report 2008 - 09,* ed. Foreign and Commonwealth Office. London: Foreign and Commonwealth Office.

HM Government (2010b) A Strong Britain in an Age of Uncertainty: The National Security Strategy. London.

HM Government (2012) Defence Infrastructure Organisation: estate and sustainable development. Accessed at https://www.gov.uk/guidance/defence-infrastructure-organisation-estate-and-sustainable-development.

HM Government (2013) The national Adaptation Programme: making the country resilient to a changing climate.

Hobday A, Griffiths S, Ward T (2009) Pelagic fishes and sharks. Marine Climate Change Impacts and Adaptation Report Card for Australia 2009. Eds. Poloczanska ES, Hobday AJ, Richardson AJ. NCCARF Publications. Accessed at http://www.afma.gov.au/wp-content/uploads/2014/02/Pelagic-fishes-and-sharks-2009-PDF-223-KB.pdf.

Hobday A, Bell DJ, Cook RT, Gasalla AM and Weng CK (2015) Reconciling conflicts in pelagic fisheries under climate change. *Deep-Sea Research II*, 113: 291-300.

Hoegh-Guldberg O, Mumby PJ, Hooten AJ, Steneck RS, Greenfield P, Gomez E, Harvell CD, Sale PF, Edwards AJ, Caldeira K, Knowlton N, Eakin CM, Iglesias-Prieto R, Muthiga N, Bradbury RH, Dubi A and Hatziolos ME (2007) Coral Reefs under Rapid Climate Change and Ocean Acidification. *Science,* 318(5857): 1737-1742.

Hoeke RK, McInnes KL, Kruger J, McNaught R, Hunter J, and Smithers S (2013) Widespread inundation of Pacific islands by distant-source wind-waves. Global and Planetary Change 108: 128–138.

Homer-Dixon T, Walker B, Biggs R, Crépin AS, Folke C, Lambin EF, Peterson GD, Rockström J, Scheffer M, Steffen W, and Troell M (2015) Synchronous failure: the emerging causal architecture of global crisis. Ecology and Society 20(3): 6.

Houghton KJ, Vafeidis AT, Neumann B and Proelss A (2010) Maritime boundaries in a rising sea. Nature Geoscience, 3(12), 813-816.

Hunter J (2012) A simple technique for estimating an allowance for uncertain sea-level rise. Climatic Change 113: 239–252, doi:10.1007/s10584-011-0332-1.

IDMC (Internal Displacement Monitoring Centre) (2015) Global Estimates 2015: people displaced by disasters. Norwegian Refugee Council. Accessed at http://www.internal-displacement.org/assets/library/Media/201507-globalEstimates-2015/20150713-global-estimates-2015-en-v1.pdf.

IPCC (Intergovernmental Panel on Climate Change) (2012) Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA, 582 pp.

IPCC (2013) Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp.

IPCC (2014) Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1132.

Johnston FH, Henderson SB, Chen Y, Randerson JT, Marlier M, DeFries RS, Kinney P, Bowman DMJS and Brauer M (2012) Estimated global mortality attributable to smoke from landscape fires. Environmental Health Perspectives 120:695- 701.

Kartiki K (2011) Climate change and migration: a case study from rural Bangladesh. Gender & Development 19(1): 23-38.

Lake IR (2009) A re-evaluation of the impact of temperature and climate change on foodborne illness. Epidemiology and Infection, 137(11), 1538.

Lambin EF, Gibbs HK, Ferreira L, Grau R, Mayaux P, Meyfroidt P, Morton DC, Rudel TK, Gasparri I, and Munger J (2013) Estimating the world's potentially available cropland using a bottom-up approach. Global Environmental Change 23:892-901.

Le Quéré C, Andres R, Boden T, Conway T, Houghton R, House J, Marland G, Peters G, van der Werf G, Ahlström A, Andrew R, Bopp L, Canadell J, Ciais P, Doney S, Enright C, Friedlingstein P, Huntingford C, Jain A, Jourdain C, Kato E, Keeling R, Klein K, Goldewijk S, Levis S, Levy P, Lomas M, Poulter B, Raupach M, Schwinger J, Sitch S, Stocker B, Viovy N, Zaehle S and Zeng N (2013) The Global Carbon Budget 1959–2011. *Earth System Science Data Discussions,* 5: 165-185. doi:10.5194/essdd-5-1107-2012.

Lenton TM, Held H, Kriegler E, Hall JW, Lucht W, Rahmstorf S and Schellnhuber HJ (2008) Tipping elements in the Earth's climate system. Proceedings of the National Academy of Sciences (USA) 105: 1786-1793.

Lobell DB, and Field CB (2007) Global scale climate-crop yield relationships and the impacts of recent warming. Environmental Research Letters 2(1)014002.

Mabus R (2009) Remarks by the Honourable Ray Mabus Secretary of the Navy, Hilton McLean, Tysons Corner, McLean, Virginia (14 October)". Naval Energy Forum. Accessed at http://www.navy.mil/navydata/people/secnav/Mabus/Speech/SECNAV%20Energy%20Forum%2014%20Oct%2009%20Rel1.pdf.

Mallick B, Rahaman K and Vogt J (2011) Coastal livelihood and physical infrastructure in Bangladesh after cyclone Aila. Mitigation and Adaptation Strategies for Global Change 16(6): 629-648.

May RJ (2009) Policy making and implementation: studies from Papua New Guinea.

McCarthy JJ, Martello LM (2005) Climate change in the context of multiple stressors and resilience. In: *ACIA* (2005) Arctic Climate Impact Assessment. Cambridge University Press. pp. 1042.

McLeman RA (2013) Climate and human migration: past experiences, future challenges. Cambridge University Press, Cambridge.

McMichael C, Barnett J and McMichael AJ (2012) An Ill Wind? Climate Change, Migration, and Health. Environmental Health Perspective 120: 646–654.

McMichael P (2009) A food regime analysis of the 'world food crisis'. Agriculture and Human Values 26(4): 281-295.

Mittal A (2009) The 2008 Food Price Crisis: rethinking food security policies. G-24 discussion paper series: United Nations.

MoD (Ministry of Defence) (2010) Strategic Trends Programme: global strategic trend out to 2040. Accessed at https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/33717/GST4_v9_Feb10.pdf.

Munich Re (2011) Heatwave, drought, wildfires in Russia (Summer 2010) MR Touch Natural hazards – Event report. Accessed at http://www.munichre.com/app_pages/www/@res/pdf/natcatservice/catastrophe_portraits/event_report_hw_dr_wf_russia_touch_en.pdf. Geo Risks Research, NatCatSERVICE.

NASA (National Aeronautics and Space Administration) and NOAA (National Oceanic and Atmospheric Administration) (2015) NASA, NOAA Find 2014 Warmest Year in Modern Record. Accessed at https://www.nasa.gov/press/2015/january/nasa-determines-2014-warmest-year-in-modern-record.

National Intelligence Council (2008) National Intelligence Assessment on the National Security Implications of Global Climate Change. Joint Hearing Before the Select Committee on Energy Independence and Global Warming and Subcommittee on Intelligence, Community Management, Permanent Select Committee on Intelligence House of Representatives. Accessed at https://www.fas.org/irp/congress/2008_hr/climate.pdf.

National Research Council (2013) Abrupt impacts of climate change: anticipating surprises. Washington, DC: The National Academies Press.

National Water Commission (2012) Groundwater Essentials. Australian Government. Accessed at http://www.nwc.gov.au/__data/assets/pdf_file/0020/21827/Groundwater_essentials.pdf.

Navy Daily (2013) "HMAS Stirling home to Perth Wave Energy Project". Accessed at http://news.navy.gov.au/en/Jul2013/Community/123/HMAS-Stirling-home-to-Perth-Wave-Energy-Project.htm#.VeUq5PaqpBc.

Nicholls RJ, Marinova N, Lowe JA, Brown S, Vellinga P, De Gusmão D, Hinkel J and Tol RSJ (2011) Sea-level rise and its possible impacts given a 'beyond 4°C world' in the twenty-first century. Philosophical Transactions of the Royal Society A: Mathematical Physical and Engineering Sciences 369: 161–181.

NOAA (National Oceanic and Atmospheric Administration) (2015a) Global Analysis - Annual 2014. Accessed at http://www.ncdc.noaa.gov/sotc/global/2014/13.

NOAA (2015b) Global analysis- June 2015. Accessed at https://www.ncdc.noaa.gov/sotc/global/201506.

NSW Government (2015) What are algal blooms? Department of Primary Industries. Accessed at http://www.water.nsw.gov.au/water-management/water-quality/algal-information/what-are-algal-blooms.

Nurse LA, McLean RF, Agard J, Briguglio LP, Duvat-Magnan V, Pelesikoti N, Tompkins E and Webb A (2014) Small islands. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability.* Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1613-1654.

Okello C , Antonellini M, Greggio N, Wambiji N (2015) Freshwater resource characterization and vulnerability to climate change of the Shela aquifer in Lamu, Kenya. Environmental Earth Sciences 73(7): 3801-3817.

Oxfam (2104) Hot and Hungry: How to stop climate change derailing the fight against hunger. Oxford: Oxfam International; 25th March. Accessed at http://oxfamilibrary.openrepository.com/oxfam/bitstream/10546/314512/1/mb-hot-hungry-food-climate-change-250314-en.pdf.

Paul SK and Routray JK (2011) Household response to cyclone and induced surge in coastal Bangladesh: coping strategies and explanatory variables. Natural Hazards, 57(2), 477-499.

Penning-Rowsell EC, Sultana P. and Thompson PM (2013) The 'last resort'? Population movement in response to climate-related hazards in Bangladesh. Environmental Science & Policy 27S: 44-59.

Perkins S and Alexander L (2013) On the measurement of heat waves. *Journal of Climate* 26:4500-4517.

Porter JR, Xie L, Challinor A, Cochrane K, Howden SM, Iqbal MM, Lobell DB and Travasso MI (2014) Food security and food production systems. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability.* Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 485-533.

Press A, Bergin A and Garnsey E (2013) Heavy Weather: Climate and the Australian Defence Force. Canberra: Australian Strategic Policy Institute.

PwC (PricewaterhouseCoopers) (2011) Protecting human health and safety during severe and extreme heat events: A national framework. Report by PriceWaterhouseCoopers Australia for the Commonwealth Government, November 2011. Accessed at http://www.pwc.com.au/industry/government/assets/extreme-heat-events-nov11.pdf.

Quiggan J (2007) Drought, climate change and food prices in Australia. Australian Conservation Foundation. Accessed at https://www.acfonline.org.au/sites/default/files/resources/Climate_change_and_food_prices_in_Australia.pdf.

Ramanathan V, Chung C, Kim D, Bettge T, Buja L, Kiehl JT, Washington WM, Fu Q, Sikka DR and Wild M (2005) Atmospheric Brown Clouds: Impacts on South Asian Climate and Hydrological Cycle. *Proceedings of the National Academy of Sciences (USA)* 102: 5326-5333.

Rawlani AK and Sovacool BK (2011) Building responsiveness to climate change through community based adaptation in Bangladesh. Mitigation and Adaptation Strategies for Global Change 16: 845-863.

Reuveny R (2008) Ecomigration and Violent Conflict: Case Studies and Public Policy Implications. Human Ecology, 36: 1-13.

Rhein M, Rintoul SR, Aoki S, Campos E, Chambers D, Feely RA, Gulev S, Johnson GC, Josey SA, Kostianoy A, Mauritzen C, Roemmich D, Talley LD and Wang F (2013) Observations: Ocean. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker TF, Qin D, Plattner G-K, Tignor M, Allen SK, Boschung J, Nauels A, Xia Y, Bex V and Midgley PM eds.)]. Cambridge University Press, Cambridge, United Kingdom and NewYork, NY, USA, pp. 255–316, doi:10.1017/CBO9781107415324.010.

Rosenberg D (2009) The political economy of piracy in the South China Sea.Naval War College Review, 62(3), 43-58.

Richardson K, Steffen W, Liverman D, Barker T, Jotzo F, Kammen D, Leemans R, Lenton T, Munasinghe M, Osman-Elasha B, Schellnhuber J, Stern N, Vogel C and Waever O (2011) Climate Change: Global Risks, Challenges and Decisions. Cambridge: Cambridge University Press, pp. 502.

Robine J-M, Cheung SLK, Le Roy S, van Oyen H, Griffiths C, Michel J-P, Herrmann FOR (2008). Death toll exceeded 70,000 in Europe during the summer of 2003. Comptes rendus biologies, 331, 171-178.

Roughead G (2011a) Chief of Naval Operations (CNO) Adm. Gary Roughead speaks at Active in the Arctic Seminar June 16, 2011. Chief of Navy Speeches. Accessed at http://www.navy.mil/navydata/people/cno/Roughead/Speech/110616%20Arctic%20Capitol%20Hill.pdf.

Roughead G (2011b) Chief of Naval Operations Adm. Gary Roughead delivers remarks at the 4th Symposium on the Impacts of an Ice-Diminishing Arctic on Naval & Maritime Operations. Chief of Naval Operations Speeches. Accessed at http://www.navy.mil/navydata/people/cno/Roughead/Speech/110620%20Arctic%20Symposium.pdf.

Schwartz P and Randall D (2003) An Abrupt Climate Change Scenario and Its Implications for United States National Security. Accessed at http://stephenschneider.stanford.edu/Publications/PDF_Papers/SchwartzRandall2004.pdf.

Slaughter AM, Sternberg T, Johnstone S, Mazo J, Femia F, Werrell C, Werz M, Hoffman M, Michel D, and Yacoubian M (2013) The Arab Spring and Climate Change. In *A Climate and Security Correlations Series,* eds. Caitlin E. Werrell, and Francesco Femia. Washington DC: The Center for American Progress.

Smith KR, Woodward A, Campbell-Lendrum D, Chadee DD, Honda Y, Liu Q, Olwoch JM, Revich B and Sauerborn R (2014) Human health: impacts, adaptation, and co-benefits. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability.* Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel,A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 709-754.

Strassburg WM, Hamlington BD, Leben RR, Manurung P, Gaol LJ, Nababan B, Vignudelli S and Kim KY (2015) Sea level trends in Southeast Asian seas. *Climate of the Past*, 11: 743-750.

Sturrock R and Ferguson P (2015) The Longest Conflict: Australia's Climate Security Challenge. Melbourne: Centre for Policy Development.

Syvitski JPM, Kettner AJ, Overeem I, Hutton EWH, Hannon MT, Brakenridge GR, Day J, Vörösmarty C, Saito Y, Giosan L and Nicholls RJ (2009) Sinking deltas due to human activities. Nature Geoscience, 2: 681-686.

Taub DR, Miller B and Allen H (2008) Effect of elevated CO2 on the protein concentration of food crops: a meta-analysis. *Global Change Biology* 14: 565-575.

The Age (15 January 2014). Meltdown as heatwave cripples state's power supply. Accessed at http://www.theage.com.au/victoria/meltdown-as-heatwave-cripples-states-power-supply-20140115-30uth.html.

The White House (2009) Executive Order 13514 Federal Leadership in Environmental, Energy, and Economic Performance. Presidential Documents, Federal Register. Accessed at http://www.gpo.gov/fdsys/granule/FR-2009-10-08/E9-24518/content-detail.html.

The White House (2010) The National Security Strategy of the United States of America. Accessed at http://www.whitehouse.gov/sites/default/files/rss_viewer/national_security_strategy.pdf.

The White House (2013) Executive Order - Preparing the United States for the Impacts of Climate Change. Accessed at https://www.whitehouse.gov/the-press-office/2013/11/01/executive-order-preparing-united-states-impacts-climate-change.

The White House (2015) National Security Strategy. February 2015, Washington DC, US. Accessed at https://www.whitehouse.gov/sites/default/files/docs/2015_national_security_strategy.pdf.

Themnér L and Wallensteen P (2012) Armed conflicts, 1946-2011. Journal of Peace Research, 49(4), 565-575.

Thornton P and Cramer L (eds) (2012) Impacts of climate change on the agricultural and aquatic systems and natural resources within the CGIAR's mandate. CCAFS Working Paper 23. Copenhagen, Denmark: CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). p. 13.

Tow WT and Wah CK (2009) ASEAN-India-Australia: Towards Closer Engagement in a New Asia. Institute of Southeast Asian Studies.

UK MoD (UK Ministry of Defence) (2008) UK MOD Climate Change Strategy. In *The Importance of Military Organisations in Protecting the Climate [*Tom Cook (ed.)]. Paris: Institute for Governance and Sustainable Development.

UK MoD (UK Ministry of Defence) (2010) Defence in a Changing Climate ed. UK Ministry of Defence. London: UK Ministry of Defence.

UK MoD (UK Ministry of Defence) (2011) MoD Sustainable Development Strategy and Delivery Plan 2011 - 2030, ed. UK Ministry of Defence. London: UK Ministry of Defence.

UNEP (United Nations Environment Programme) (2009). Learning from Cyclone Nargis. Acessed at http://postconflict.unep.ch/publications/nargis_case_study.pdf.

UN (United Nations) (2007) Security Council Holds First-Ever Debate on Impact of Climate Change on Peace, Security, Hearing over 50 speakers. Accessed at http://www.un.org/press/en/2007/sc9000.doc.htm.

UN (2014) Disasters in Asia and the Pacific: 2014. Economic and Social Commission for Asia and the Pacific.

UN News Centre (2015) In wake of Cyclone Pam, UN launches humanitarian appeal for Vanuatu. Accessed at http://www.un.org/apps/news/story.asp?NewsID=50412#.VflcILyqqko.

UNDP (United Nations Development Program) (2009) Human Development Report 2009: Overcoming Barriers: Human Mobility and Development. Palgrave Macmillan, Houndmills, Basingstoke, Hampshire, UK and New York, NY, USA, pp 217.

UNISDR (United Nations Office for Disaster Risk Reduction) (2015) Ten year Review: 87% of disasters climate-related. Accessed at http://www.unisdr.org/files/42862_2015no05.pdf.

USACE (United States Army Corps of Engineers) (2014) Adaption Policy Statement. In: *USACE Climate Preparedness and Resilience Policy Statement [*Jo-Ellen Darcy (ed.)]. US Army Corps of Engineers.

US DoD (US Department of Defense) (2012) DoD FY 2012 Climate Change Adaptation Roadmap. Department of Defense Strategic Sustainability Performance Plan FY 2012. Accessed at http://www.acq.osd.mil/ie/download/green_energy/dod_sustainability/2012/Appendix%20A%20-%20DoD%20Climate%20Change%20Adaption%20Roadmap_20120918.pdf.

US DoD (2015) National security implications of climate-related risks and a changing climate.

US DoE (US Department of Energy) (2013) Army Net Zero: Energy Roadmap and Program Summary Fiscal Year 2013. United States: National Renewable Energy Laboratory.

US Department of Navy (2015) Secnavy energy goals. Department of Defence. Accessed at http://greenfleet.dodlive.mil/files/2012/06/20120620_SECNAVEnergyGoals.pdf.

US Navy (2013) Aviation Energy Conservation Program (Air ENCON) overview.Accessed at http://airencon.dodlive.mil/files/2013/07/Program-Fact-Sheet_FINAL_June-2013.pdf.

von Braun J (2008) The food crisis isn't over. *Nature, 456(7223): 701-701.*

Vörösmarty CJ, McIntyre PB, Gessner MO, Dudgeon D, Prusevich A, Green P, Glidden S, Bunn SE, Sullivan CA, Liermann CR and Davies PM (2010) Global threats to human water security and river biodiversity. *Nature,* 467(7315): 555-561.

Warner R and Schofield CH (Eds.). (2012). Climate change and the oceans: Gauging the legal and policy currents in the Asia Pacific and beyond. Edward Elgar Publishing.

Watta N, Adger WN, Agnolucci P, Blackstock J, Byass P, Cai W, et al Health and climate change: policy responses to protect public health. The Lancet 2015, 7-59.

Werrell C and Femia F (2013) The Arab Spring and Climate Change: A Climate and Security Correlations Series , February 2013, Center for American Progress, Stimson Center, The Center for Climate and Security, pp. 35.

White NJ, Haigh ID, Church JA, Koen T, Watson CS, Pritchard TR, Watson PJ, Burgette RJ, McInnes KL, You Z-J, Zhang X and Tregoning P (2014) Australian sea levels—trends, regional variability and influencing factors, Earth Science Reviews 136: 155–174, doi:10.1016/j.earscirev.2014.05.011.

Wilson P (2015) Society, steward or security actor? Three visions of the Arctic Council. Cooperation and Conflict: 1-20.

Woodward P (2011) The Reserve Response Force and Public Safety. Australian Army Journal. V3: 3.

Wong PP, Losada IJ, Gattuso JP, Hinkel J, Khattabi A, McInnes KL, Saito Y and Sallenger A (2014) Coastal systems and low-lying areas. In: *Climate Change 2014: Impacts,Adaptation, and Vulnerability*. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 361-409.

World Bank (2015) Annual freshwater withdrawals, agriculture (% of total freshwater withdrawal). Accessed at http://data.worldbank.org/indicator/ER.H2O.FWAG.ZS.

World Health Organization (WHO) (2015) Water Sanitation Health: Key Facts from the JMP 2015 Report. Accessed at http://www.who.int/water_sanitation_health/monitoring/jmp-2015-key-facts/en/.

Wyett K (2014) Escaping a rising tide: sea level rise and migration in Kiribati. Asia and the Pacific Policy Studies. 1: 171-185.

Xiong W, Holman I, Lin E, Conway D, Jiang J, Xu Y, and Li Y (2010) Climate change, water availability and future cereal production in China. Agriculture, Ecosystems & Environment, 135(1-2), 58-69.

Yonetani M, Lavell C, Meneghetti L, Richter S, Holladay S (2014) Global Estimates People displaced by disasters. Geneva: Internal Displacement Monitoring Centre, Norwegian Refugee Council; 2014. Available from: http://www.nrc.no/arch/_img/9184209.pdf. Accessed: 6th June 2015.

Zickfeld K, Knopf B, Petoukhov V and Schellnhuber HJ (2005) Is the Indian summer monsoon stable against global change? *Geophysical Research Letters* 32: L15707.

Image Credits

Page 2: Figure 2 “a floodway shimmers in Ashburton Western Australia” by Flickr user Michael Theis licensed under CC by –ND 2.0.

Page 3: Chapter 1 cover photo CSIRO licensed under CC by 2.0

Page 4: Figure 1 “title” by Flickr user Paul Falardeau licensed under CC by –ND 2.0.

Page 6: Figure 4 “Arid soils in Mauritania, Africa” by Flickr user Oxfam International licensed under CC by –NC-ND 2.0.

Page 7: Figure 5 “melt water from Columbia Glacier in Alaska” by Flickr user NASA Goddard Space Flight Centre licensed under CC by 2.0.

Page 8: Figure 6 “Cyclone Pam hits Vanuatu” by Flickr user Salvation Army licensed under CC by –NC-ND 2.0.

Page 11: Figure 8 “Bushfire smoke hangs over the city of Sydney” by Flickr user Andrea Schaffer licensed under CC by 2.0.

Page 13: Figure 10 “Children in the ocean in Vanuatu” by Flickr user Meredith James licensed under CC by –NC-ND 2.0.

Page 14: Figure 11 “Lake Hume drought, Victoria” by Flickr user Tim J Keegan licensed under CC by –SA 2.0.

Page 15: Figure 12 “Greenland ice sheet” by Flickr user NASA Goddard Space Flight Centre licensed under CC by 2.0.

Page 16: Figure 13 “Ariel view of the Amazon rainforest” by Flickr user CIFOR licensed under CC by –NC-ND 2.0.

Page 18: Chapter 2 Photo “Parched” By Flickr user Siaron James licensed under CC by CC by –NC 2.0.

Page 19: Figure 15 “A woman holds a malnourished child waiting for medical assistance in Somalia” by Flickr user United Nations Photo licensed under CC by –NC-ND 2.0.

Page 20: Figure 16 “Bleached coral” by Flickr user John Howell licensed under CC by –NC-ND 2.0.

Page 21: Figure 17 “women in Mauritania inspect their failed crops in the wake of low rainfall” by Flickr user Oxfam International licensed under CC by –NC-ND 2.0.

Page 25: Figure 19 “Gokyo Peak in the Khumbu region of the Nepal Himalayas” by Flickr user Davie Zanchettin licensed under CC by –NC 2.0.

Page 26: Figure 20 “Cracked earth in Rajasthan, India” by Flickr user Austin Yoder licensed under CC by –NC 2.0.

Page 27: Figure 21 “Oxen working in rice paddy” by Flickr user Robert Levy licensed under CC by –NC-ND 2.0.

Page 29: Figure 22 “Tuvalu damaged and flooded” by Flickr user United National Development Programme licensed under CC by –NC-ND 2.0.

Page 30: Figure 23 “Residents of the low-lying Pacific island of Kiribati use coral rocks to build temporary walls in an attempt to break the swell of increasingly large king tides” by Flickr user UN ISDR licensed under CC by –NC-ND 2.0.

Page 31: Figure 24 "The main square of Nui island, Tuvalu, still under water over a month after Cyclone Pam hit" by Flickr user United Nations Development Programme licensed under CC by –NC-ND 2.0.

Page 32: Figure 25 "The city of Marikina in the Phillipines damaged by flooding in the wake of Typhoon Ketsana, 2009" by Flickr user Global Water Partnership licensed under CC by –NC-SA 2.0.

Page 33: Figure 26 "A US army medic treats a young girl in Kenya on world malaria day in 2010." By Flickr user US Army Africa licensed under CC by 2.0.

Page 34: Figure 27 "An ambulance rushes through traffic in the centre of Melbourne" by Flickr user Justin licensed under CC by –NC-ND 2.0.

Page 35: Chapter 3 Photo "Climate risk and resilience: securing the region's future" by Flickr user Asian Development Bank CC by –NC-ND 2.0.

Page 36: Figure 28 "The Pentagon as seen from the air. The US Department of Defence considers climate change to be a significant threat to national security" by Flickr user David B Gleason licensed under CC by –NC-ND 2.0.

Page 37: Figure 29 "A woman and child seek refuge at Kibati Camp, Goma, DR C. In 2012 the influx of internally displaced people was a direct consequence of conflict" by Flickr user United Nations Photo licensed under CC by –NC-ND 2.0.

Page 39: Figure 30 " Survivors of cyclone Nargis seek refuge in a Monastery in Yagon, Myanmar" by Flickr user United Nations Photo licensed under CC by –NC-ND 2.0.

Page 40: Figure 31 "Residents wade through flood water in the aftermath of cyclone Aila in the Sundarbans, Bangladesh" by Flickr user Marcus Bauer licensed under CC by –NC 2.0.

Page 42: Figure 32 "A herder in Mauritania, Africa struggles to find any pasture left for his cows. Rainfall variation in resource dependent economies, such as pastoral societies in Africa, can increase the chance of localised violent conflict" by Flickr user Oxfam International licensed under CC by –NC –ND 2.0.

Page 43: Figure 33 "Summer sea ice melt in the Arctic Sea. Since 1980 the Arctic has been warming at twice the normal rate" by Flickr user NASA Goddard Flight Space Centre licensed under CC by 2.0.

Page 44: Figure 34 "Distribution of 40,000 liters of water amongst the local communities in El Srief, in North Darfur. The nearest water point is 15 kilometers away. Violence in Darfur can become more likely during excessively dry conditions" by Flickr user UNAMID licensed under CC by –NC-ND 2.0.

Page 45: Chapter 4 Photo "US Army in Montenegro" by Flickr user US Department of Defence licensed under CC by –NC-ND 2.0.

Page 47: Figure 35 "The Australian Defence Force provide strategic air lift support to civilian search and rescue personnel, including NSW Police and firefighters, as they prepare to head to Japan to assist in the wake of the Tsunami 2011" by Flickr user Australian Department of Defence licensed under CC by –NC-ND 2.0.

Page 51: Figure 36 "Soldiers in the Australian Army clear mud and sludge from a major intersection in Queensland after extensive flooding" by Flickr user Australian Department of Defence licensed under CC by –NC-ND 2.0.

Page 53: Figure 38 "Australian navy personnel wait on a lowered stern door for a transfer of personnel from the US naval Ship Mercy during Pacific Partnership 2010" by Flickr user Australian Department of Defence licensed under CC by –NC-ND 2.0.

Page 57: Figure 40 "The US Great Green Fleet demonstrates biofuels during the Rim of the Pacific (RIM PAC) 2012 exercise" by Flickr user official US Navy page licensed under CC by 2.0.

Page 60: Figure 41 "The ADF assist in the evacuation of residents from the Queensland floods" by Flickr user Australian Department of Defence licensed under CC by –NC-ND 2.0.

Page 61: Figure 42 "An Australian Army Aircrewman helps local residents during Operation Queensland Flood Assist, 2011" by Flickr user Australian Department of Defence licensed under CC by –NC-ND 2.0.

Page 62: Figure 43 "Australian Defence Force Engineers on Operation Pakistan Assist II help to rebuild a school damaged by the Pakistan floods" by Flickr user Australian Department of Defence licensed under CC by –NC-ND 2.0.

Page 63: Figure 44: "An Australian Army engineer sits with children in Vanuatu after completing an engineering assistance project for Pacific Partnership 2011, a five-month humanitarian assistance initiative" by Flickr user Australian Department of Defence licensed under CC by –NC-ND 2.0.

Page 64: Figure 45 "The Australian medical task force set up and clean a medical health facility in Pakistan in the aftermath of the flooding, as part of Operation Pakistan Assist" by Flickr user licensed under CC by –NC-ND 2.0.

Page 65: Figure 46 "solar panel arrays at Fort Hunter Liggett, in California. Fort Hunter Liggett was selected by the US Army to be converted to a net zero energy base" by Flickr user US Army Corps Engineers licensed under CC by 2.0.

Page 68: Figure 47 "US Marines carry food to distribute as part of the humanitarian assistance exercise in Okinawa Japan, 2011" by Flickr user Marines licensed under CC by –NC 2.0.

Page 69: Figure 48 "Pakistani boys unload food from a US Army helicopter in the wake of severe flooding in 2010" by Flickr user the US Army licensed under CC by 2.0.

Page 71: Figure 49 "US Marines and sailors arrive using Landing Craft Air Cushions to offload vehicles, personnel and equipment in support of a non-combatant evacuation operation exercise being conducted in the Hawaiian islands" by Flickr user Marines licensed under CC by –NC 2.0.

Page 73: Figure 50 "A UK serviceman provides humanitarian aid in Sierra Leone" by Flickr user Defence images licensed under CC by –SA 2.0.

THE AUSTRALIAN CLIMATE SECURITY PANEL

Australia and its neighbours are on the frontline of climate change. Soaring temperatures, rising sea levels and increases in extreme weather events will play a role in raising the risk of conflict, increasing the displacement of people and worsening the extent of destruction caused by extreme weather events in our region. Climate change exposes Australian soldiers, sailors and airforce personnel, as well as Australia more broadly, to considerable strategic risk and uncertainty.

CLIMATE COUNCIL

UNSW AUSTRALIA

UNSW Canberra has partnered with the Climate Council to host The Australian Climate Security Panel. Hosted by UNSW Canberra at the Australian Defence Force Academy, this panel will bring together world renowned Defence leaders and a scientific expert to discuss climate change, its security implications and the steps being taken by the US and UK militaries to be prepared.

SPEAKERS:

- **Rear Admiral David Titley, USN (Ret.),** who initiated and led the US Navy's Task Force on Climate Change whilst serving in the Pentagon.
- **Rear Admiral Neil Morisetti, RN (Ret.),** who acted as the UK Government's Climate and Energy Security Envoy.
- **Admiral Chris Barrie (Ret.),** Australia's former Chief of Defence.
- **Professor Will Steffen,** world leading climate change expert and Climate Councillor, the Climate Council.

DATE/TIME:

Wednesday the 28th of October 2015, 10am-11.30am

WHERE:

UNSW Canberra at the Australian Defence Force Academy
Adams Auditorium, Building 111
Northcott Drive, Campbell ACT

SHARE ON FACEBOOK

SHARE ON TWITTER

MORE INFORMATION

CLICK HERE TO REGISTER

Thank you for supporting the Climate Council.

The Climate Council is an independent, crowd-funded organisation providing quality information on climate change to the Australian public.

CLIMATE COUNCIL

facebook.com/climatecouncil

twitter.com/climatecouncil

info@climatecouncil.org.au

climatecouncil.org.au

CLIMATE COUNCIL