

Implications of Climate Change for Australia's National Security

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Thank you Senator Gallacher and distinguished members of the Standing Committee on Foreign Affairs, Defence, and Trade for the opportunity to provide this written submission per your request dated 23 June 2017. This is a privilege to discuss this very important topic.

I am David Titley and currently serve as the Founding Director of the Center for Solutions to Weather and Climate Risk at the Pennsylvania State University. I also hold appointments as a Professor of Practice in Meteorology and a Professor of International Affairs. I had the privilege of serving in the United States Navy for 32 years and retired in 2012 as a Rear Admiral and Assistant Deputy Chief of Naval Operations for Information Dominance. When I retired, I was also the Oceanographer and Navigator of the Navy, and Director of U.S. Navy Task Force Climate Change. Subsequent to my time in the Navy, I served as the Chief Operating Officer position of the National Oceanic and Atmospheric Administration (NOAA), the U.S. civilian weather, climate and ocean agency. However, the views expressed here are strictly my own and do not necessarily represent those of Penn State, the U.S. Navy or the U.S. Government. I am making this submission because I believe it's important to discuss the challenges to our nations' security posed by a changing climate.

In the U.S. Navy we have a saying, to just give me the 'Bottom Line Up Front' or BLUF. So here's my BLUF for this submission:

- **We know how to do Science:** Science is not a simple linear process, performed in an isolated, sterile environment, but rather an iterative process with continual interaction between exploration and discovery, feedback and input from peers, inputs from society, but most importantly, testing ideas, called hypotheses and theories, with evidence. New evidence can change existing ideas. The better ideas fit actual observations, disparate or seemingly unrelated observations or previously unknown observations, the more likely the idea is to be accepted widely by science. Results are provided in many venues, but

peer-reviewed journals are especially important. Peer-review does not guarantee the ideas being published are correct, but the process does ensure the work acknowledges previous work in that field, the experiments and methods were well-designed, the evidence cited logically leads to the conclusion. If new evidence becomes available, or subsequent researchers find errors in the methods published, the original ideas are modified.

- **The climate is changing more rapidly than has been observed in the past; we understand why that is so, and we understand that those changes will continue, absent meaningful action in reducing**

Greenhouse Gas emissions: The change in the climate, and therefore the change in the weather, is real. Multiple independent sources of data show a rise in temperatures and rise in the ratio of record high temperatures to record low temperatures; an increase in the intensity of precipitation events – that is, the hardest rains are getting harder; the continued collapse in the area and amount of summer-time sea ice in the Arctic Ocean; an acceleration of sea level rise; acidifying oceans; and ecosystems moving poleward and up in elevation where possible. We understand why the climate is changing, based on science extending back to the mid-19th century. The basic concept of greenhouse gasses trapping heat and keeping the atmosphere warmer than it would be in the absence of these gasses is extremely well understood. This idea explains not only the temperature of the Earth, but the same concept also applies to understanding the temperatures of Venus and Mars.¹

- **This rapid and continual change in climate will have significant impacts on our national security:**

The climate will continue to change, rapidly, for the remainder of the 21st Century and likely beyond. The days of climate stability that we have experienced for most of human civilization are over. All aspects of society, including the security enterprise, will no longer be able to assume that “the past is prologue” when considering the future physical environment. Specifically, the changing climate impacts National Security in three major ways:

- **Changing the battlespace, or the physical environment in which our Soldiers, Sailors, Airmen and Marines will operate.** The Arctic is one example of an operational environment that is changing rapidly today.
- **Posing increasing risks to the Department of Defense’s bases and training ranges.** Without fully operational bases and training ranges allied forces cannot maintain the levels of readiness required by our respective National Command Authorities to execute our security missions. In addition to sea level rise

¹ MacCracken, M. “Climate Change in Six Well-Documented Findings”.

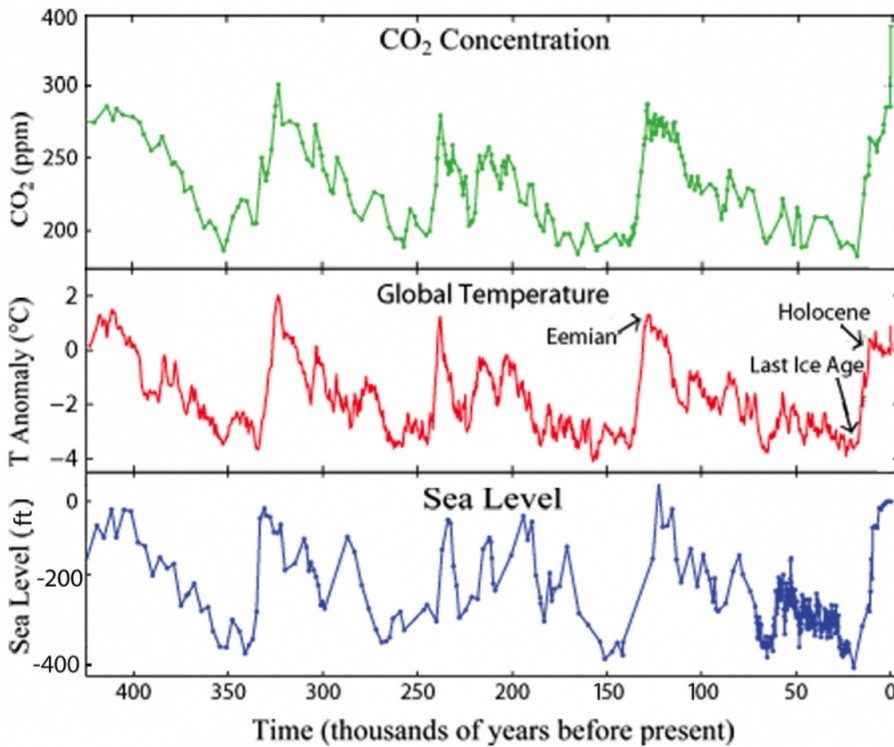
threatening our coastal installations, other bases and training ranges are at risk from increased frequency and severity of wildfires, droughts and floods not previously experienced. In addition, sustained smoke from wildfires and an increasing number of days with excessive heat and humidity can significantly degrade the training value of that base or range.

- **Making already unstable situations worse, sometimes catastrophically so.** Climate change is rarely the sole contribution to a nation-state failing, or conflict breaking out. However it can be a powerful link in a chain of events that, if not broken can lead to run-away instability. While large-scale human suffering often accompanies these situations, Australian and allied military forces are frequently directed to these areas and our troops are placed at risk. As we have seen with Syria, once the geopolitical situation deteriorates to a point where there are no good policy options, other opportunistic countries can move in and exploit the instability to their advantage – to the detriment of Western interests.
- **We know how to succeed even when the future is not perfectly known:** Traditional risk planning takes the chance or probability of an event and multiplies it by the impact. But even when it is difficult to assess the likelihood of a specific event, there are still available methods by which risk planning and mitigation can be accomplished. Our national security teams frequently have to account for these “deep uncertainties” and they have a variety of tools to assist them. Rich scenario planning, assumptions-based planning and similar methods can be used with the goal of identifying all plausible vulnerabilities and their subsequent impacts. National Security and strategic military planners have used these tools successfully for decades – we can apply these methods and adapt them to the climate change challenge.

Background

The earth's climate has naturally varied for millions of years (Figure 1). It will continue to do so for millions more. However, humans, primarily through the release of greenhouse gases, also have the capability to modify the earth's climate in a way that previously could occur only by nature. If the climate has always changed in the past and will do so in the future, then why do we care? We care because we are now forcing rapid change to a system that has been remarkably stable in the past 8-12 thousand years (Figure 2), during which time humans developed agriculture, civilization and our modern way of life. It's not that the climate of the past few thousand years was optimal *per se*, but its stability allowed us to base a civilization on an overall predictability of where our coasts would be, when the rains would come, and the length of the growing seasons. Later on we would construct our buildings, towns, and cities all based on a historical understanding of the averages and extremes of our historical climate. And

most importantly, we made a fundamental assumption that the future climate would be like the past. That assumption no longer holds.



John Englander / "High Tide on Main Street" adapted from Hansen & Sato

Figure 1 – From John Englander "High Tide on Main Street"

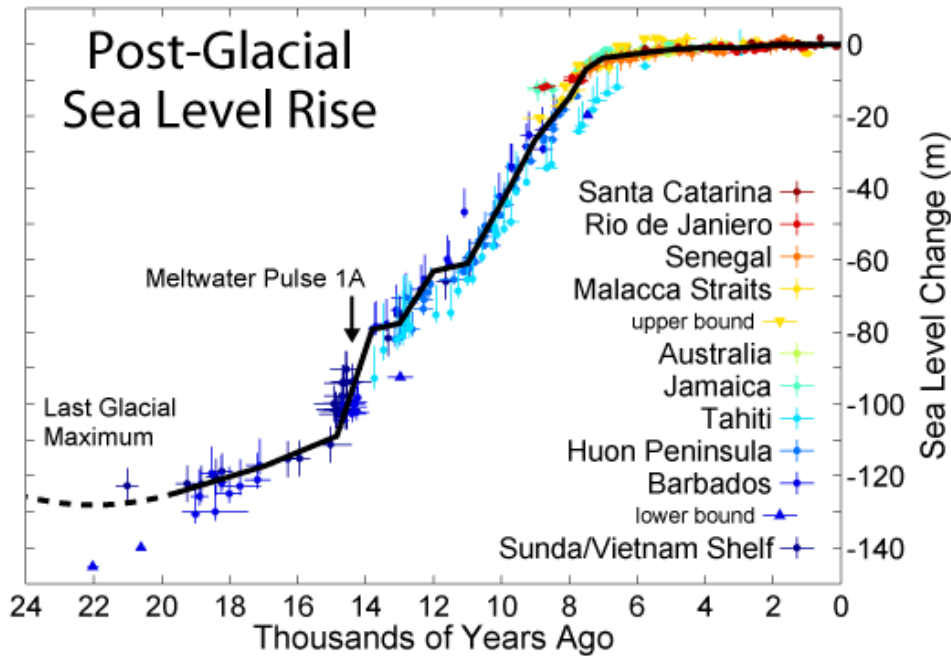


Figure 2 -- From John Englander "High Tide on Main Street"

Dr. John Holdren, former Director of the White House Office of Science and Technology Policy, provided extensive written testimony on the subject of climate change data and evidence to the U.S. House of Representatives Committee on Science, Space and Technology in September 2014. While I had no ties to the Obama administration (my NOAA position was a career Senior Executive Service position and not a political appointment), I believe Dr. Holdren described accurately the state of climate science. The following is an extract of his written statement:

“There is an immense amount of [climate science] primary, peer-reviewed, published research ... carried out by a wide variety of competent national and international bodies (including Federal agencies and scientific advisory boards and committees reporting to them). Important examples include the comprehensive reviews by the U.S. National Academies² and the Intergovernmental Panel on Climate Change (IPCC)³, the recent joint review by the U.S. National Academy of Sciences and the U.K.’s Royal Society of London⁴, the Second and Third U.S. National Climate Assessments⁵, the annual State of the Climate reports of the U.S. National Oceanic and Atmospheric Administration⁶, the periodic synthesis and assessment reports of the U.S. Global Change Research Program⁷, and the first Quadrennial Energy Technology Review of the U.S. Department of Energy⁸. Notably, the U.S. National Climate Assessments, which are required under the Global Change Research Act of 1990, reflect substantial input from the public, outside experts and stakeholders. The most recent such Assessment, which was released in May of 2014, was the result of a three-year analytical effort by a team of over 300 climate scientists and experts, informed by inputs gathered through more than 70 technical workshops and stakeholder listening sessions held across the country. The resulting product was subjected to extensive review by the public and by scientific experts inside and outside of government.

² The National Academies reports on climate change include the four-volume set, *America’s Climate Choices* (2010)

and a host of other reports completed since 2010, all accessible at: <http://nas-sites.org/americasclimatechoices/>.

³ Intergovernmental Panel on Climate Change (IPCC) 2007 and 2013-2014 IPCC Fourth and Fifth Assessments, accessible at: http://www.ipcc.ch/publications_and_data/publications_and_data_reports.shtml#1

⁴ Climate Change: Evidence and Causes – An Overview from the Royal Society and the U.S. National Academy of Sciences, 2014: <http://dels.nas.edu/resources/static-assets/exec-office-other/climate-change-full.pdf>

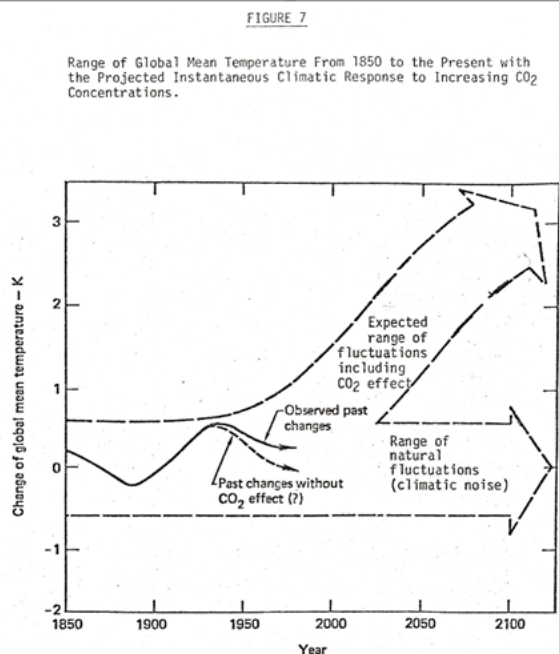
⁵ *Global Climate Change Impacts in the United States*, 2009: <http://nca2009.globalchange.gov> and *Climate Change Impacts in the United States*, 2014: <http://nca2014.globalchange.gov>.

⁶ National Oceanic and Atmospheric Administration (NOAA) State of the Climate reports, accessible at: <http://www.ncdc.noaa.gov/sotc/>

⁷ <http://www.globalchange.gov/browse/reports>

⁸ Department of Energy (DOE) 2011 Quadrennial Technology Review: http://energy.gov/sites/prod/files/QTR_report.pdf

It is worth noting that private industry independently arrived at these same conclusions decades ago. Recently released documents⁹ show that in 1980 Exxon researchers projected the impacts on global temperature due to increasing greenhouse gasses with astonishing accuracy (e.g., Figure 3). Again, the basis of the science of climate change is exceptionally well-understood and can be – and has been – applied by many researchers inside and outside the government.



Exxon research and Engineering Company's Tech Fcst CO2 Greenhouse Effect
H. Shaw & P.P. McCall December 1980

Figure 3 Exxon Projection of global temperatures

Risks to National Security from Rapid Climate Change

In the U.S. , our Department of Defense has taken the challenge of climate change and national security seriously for over a decade, spanning the George W. Bush, Obama and now Trump administrations. The security establishment does not view this issue as partisan, or a 'back door' argument to advocate for specific national policies or programs. At its most fundamental level, this is an issue about the future readiness of our Armed Forces. Our forces must be prepared to operate in a rapidly changing Arctic, with decreasing sea ice, increased human activity, and an ascendant Russia. Our forces must be equipped to operate in areas of increasingly prolonged extreme temperatures and heat stress. While airlines and passengers may suffer inconvenience

⁹ <http://insideclimatenews.org/news/01122015/documents-exxons-early-co2-position-senior-executives-engage-and-warming-forecast>

and disruption from flights cancelled due to extreme temperatures¹⁰ such failures of a logistics pipeline, at a critical point in an operation, can be the difference between success and failure in combat, or in a Humanitarian Assistance / Disaster Relief mission.

In addition to these readiness issues, the rapidly changing climate may create, accelerate, and exacerbate already unstable situations throughout the world. These impacts can come in the form of food shortages, extreme drought, and forced and unmanaged migration, making hundreds of thousands of people *de facto* climate refugees. Good governance, early intervention, and proactive diplomacy, lead by our respective Ministries of Foreign Affairs, with the Defense Establishment in a supporting role, can be effective mechanisms to manage this instability. But cases such as the Arab Spring and Syria are harbingers of unexpected disruptions to geopolitical stability. Their causes are multi-faceted and complex, but in each case, the weather events resulting from our rapidly changing climate played a significant role in the outcome.

U.S. Navy Task Force Climate Change

In May 2009, at the direction of then Chief of Naval Operations Admiral Gary Roughead, I initiated and led the U.S. Navy Task Force on Climate Change. The U.S. Navy started this task force, not in response to any perceived political pressure, but as a reaction to the collapse of sea-ice in the Arctic in the summer of 2007. Admiral Roughead asked me to assess the conditions in the Arctic, and provide him with recommendations for the Navy's response. My conclusions were that the sea-ice collapse in the Arctic, well ahead of most of the computer models of the time, was the leading edge of climate changes to come that would change the operating environment for the Navy. The goal of Task Force Climate Change was to prepare, in a deliberate manner, the U.S. Navy for this future environment, with an emphasis on getting ready for the Arctic, as it was the change that would likely impact the Navy first.

Eight years later, I would assess the Task Force met its primary objectives of moving the U.S. Navy down a road that lead to great awareness of the security risks stemming from climate change, and the need for thoughtful, deliberate adaptation. It can be a matter of debate and perspective (and of course finances) when assessing whether that rate of adaptation has been commensurate with the rate of climate change – but the Task Force, now in it's eighth year of existence, focused the U.S. Navy on this novel challenge.

Security Issues in the Arctic

¹⁰ <http://www.cnn.com/2017/06/20/us/weather-west-heat-wave/index.html>

While Australia is of course very far removed physically from the Arctic, it cannot escape the geo-political implications of a changing Arctic. China, Japan, India, Korea and Singapore, along with Britain and many traditional western European Allies all pay great attention to the opening of the Arctic Ocean. A 'new' ocean ultimately implies commitments of time and ships and training activities. While it's too soon to determine exactly how that will change security commitments and postures in the western Pacific and Indian Oceans, it would be naïve to expect no impact at all.

Over the past few years in the Arctic, we have seen an almost exponential rise in the activity in the Arctic; more shipping, more resource extraction and more posturing for control over the resources. The Arctic is an example of where climate change should serve as a catalyst for international cooperation. The world is not yet prepared to respond to an accident or disaster that could occur with increasing shipping and energy exploration in this fragile region with limited infrastructure and extreme operating conditions. Some great work has been done across the U.S. government in putting together plans for increased future operation in the Arctic, with the Navy's 2014 Arctic Roadmap as one example. The challenge is that the increase is happening now. 73 ships sailed through the Northwest Passage in 2013, up from 4 in 2007; meanwhile the Russians planted a flag on the sea bottom near the North Pole. Preparations for energy exploration are well underway and when oil prices rise, as they always do, the Arctic will be a tempting and economically viable area for exploitation. We assess that today we do not have the communications equipment, navigation aids, and sufficient ice hardened ships to respond to natural or manmade disasters in that fragile area or to protect our vital interests. In other words, we are not prepared in the short term for the rate of increase and we must invest today in increasing our capability and capacity.

This increase in Arctic human activity is playing out on a backdrop of increasingly assertive Russian activity in the Arctic. While the Russians maintain their military buildup in the High North is peaceful and for defensive purposes only, it is impossible for us, our NATO allies, and our partners to ignore the aggressive operations of Russian forces in that part of the world and their high-readiness, no-notice snap exercises. Regardless of intent, Russian forces have, over the past few years, significantly upgraded the ability to operate and command and control forces in the Arctic. Their actions are disconcerting to our allies; we would be remiss to completely ignore this change in security dynamics.

Climate Risk Interacts with other large 21st Century Trends

It is also important to remember that the risks posed by rapid climate change do not exist in a vacuum. They affect, and are affected by, other large-scale 21st century trends: population growth, urbanization, expanding demand for food, energy and water resources, and globalization.

The 2014 CNA Military Advisory Board (MAB) report on the “Accelerating Risks of Climate Change”¹¹ expands on this theme. Half a billion people have been added since 2007 and another half billion will be added by 2025. Most of this growth is in Africa and Asia, two of the areas likely to be most impacted by climate change. Nearly half of the world now lives in urban areas with 16 out of 20 of the largest urban areas being near coastlines. The result is more of the world’s population is at risk from extreme weather events and sea level rise. There is a global increase in the middle class with an accompanying growth in demand for food, water, and energy. The U.S. National Intelligence Community predicts that by 2030 demand for food would increase by 35 percent, fresh water by 40 percent, and energy 50 percent. Even without the climate changing, it will be a challenge to meet these growth targets. Climate change will further stress the world’s ability to produce food and drinkable water at levels necessary to meet demand. A 2012 National Intelligence Council assessment found that water challenges will likely increase the risk of instability and state failure, exacerbate regional tensions, and divert attention from working with key allies on important policy objectives. Finally, the world is becoming more politically complex and economically and financially interdependent. As such, it is no longer adequate to think of the projected climate impacts to any one region of the world in isolation. Climate change impacts, combined with globalization, transcend international borders and geographic areas of responsibility.

Recommendations

So what should we do? I recommend we take a risk-management approach, similar to how the CNA Military Advisory Board (MAB) has done in their most recent report on the risks of climate change to security.¹² Although most of the CNA MAB members are not scientists, their positions as former senior three- and four-star leaders in the United States Military trained them to seek and assess technical advice from many different fields of expertise. They have accepted the overwhelming evidence of the mainstream, international science community, and understand that if significant new and compelling evidence is discovered, the conclusions may need to be adjusted accordingly. Climate risks and security risks share another trait in common: “The worst matters much more than the bad”¹³. In other words: What are the near-term and future

¹¹ “National Security and the Accelerating Risks of Climate Change.”, CNA Corporation, May 2014. https://www.cna.org/cna_files/pdf/MAB_5-8-14.pdf

¹² “National Security and the Accelerating Risks of Climate Change.”, CNA Corporation, May 2014. https://www.cna.org/cna_files/pdf/MAB_5-8-14.pdf

¹³ Burroughs, William “Climate Change in Prehistory: The End of the Reign of Chaos”, Cambridge University Press, 2005

risks to our way of life – and what policies and structures should we put in place to manage and mitigate those risks?

How might we meet this challenge? Here are **four recommendations** to start:

- **Set up and support a monitoring system** that will allow Australia and the world to detect and assess changes to future climate. Assign specific responsibilities. Many U.S. National Academies of Science (NAS) reports have called for such a monitoring system. As a recent example, the NAS ‘Abrupt Climate Changes’ report calls for such a monitoring system.
- **Adjust policies today for what we know** – and for what we might reasonably expect in the coming decades. Ensure we do not simply plan for the best case or even the most likely, but also consider seriously the most damaging and harmful scenarios (e.g., major bushfires, droughts, cyclones). We learned in the military a long time ago that hope by itself is rarely a good strategy. We must understand that the ‘new normal’ for several generations to come will be ever-increasing temperatures, sea-levels rising at rapid rates compared to the historical norms, and an increase in the number and severity of droughts, extreme rainfall events, and likely bushfires. These extreme ‘weather-related’ events will pressurize our critical infrastructure and our food and water security
- **Leverage the civilian scientific investments you make to support wise climate-related decisions in the security enterprise.** In the U.S., the Department of Defense, along with many others, has leveraged that investment in basic and applied science to better understand the parameters of the future risks it faces. The research conducted by NOAA, NASA and the National Science Foundation is part of the fabric of our overall security structure. **One of the great challenges today is to invest in better understanding – and ultimately prediction – at the boundary between weather and climate.** While scientifically this is very challenging, it is also very important for people and a myriad of decisions. From a security, economic, agricultural, infrastructure and policy perspective, greater climate knowledge of the next few seasons to the next decade or two would be extremely useful. While we should not use today’s uncertainty as an excuse to defer action, better understanding of the climate over the next 2-20 years would be very useful in allocating scarce resources.
- As we work on adapting to our changing climate **we should not lose sight of the big picture: how to move the world’s energy system to a predominantly non-carbon based energy source to power the world.** How can we unleash the innovation and energy that makes our country great to solve one of the grand challenges of the 21st Century? The West has responded to grand challenges of the past, in part by investing for the future. To date though, there has been no serious response to the need to transforming our energy system. With the right policies and encouragement from the Federal Government I am sure the private sector can develop – and profit from – energy solutions that will power the world in a sustainable fashion into the future.

In closing, our two countries, and in fact the entire world, is dealing with a significant change in the world's climate; it is a very serious challenge and if we do not manage this risk climate change, unchecked, will make many of our existing threats worse. But we have met challenges of this magnitude before and succeeded – and we will do so again. While we don't know everything – and we never will – we do know more than enough to act now. By focusing our efforts in a risk-based framework on meeting the climate challenge, we can prepare for the short-term while shaping our longer-term future. We can provide the policies, stability and guidance our country needs to unleash our country's energy, creativity and initiative. I am convinced we will be proud and amazed at what we can accomplish.

Thank you very much for your time and attention, and for the opportunity to make this written submission to you committee.