

# Climate change implications for the Royal Australian Navy



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# Introduction

**Aim: To highlight the key challenges to the Royal Australian Navy posed by climate change.**



**Replenishment at sea**

# Carbon dioxide and the atmosphere

- **“Fossil fuels”**
- CO<sub>2</sub> mostly accumulated by plants over 60 million years during the Carboniferous period (300 million years BP)
- Stored in organic form as coal, oil, gas etc.
- Accumulated CO<sub>2</sub> being rapidly released to the atmosphere by human activities.



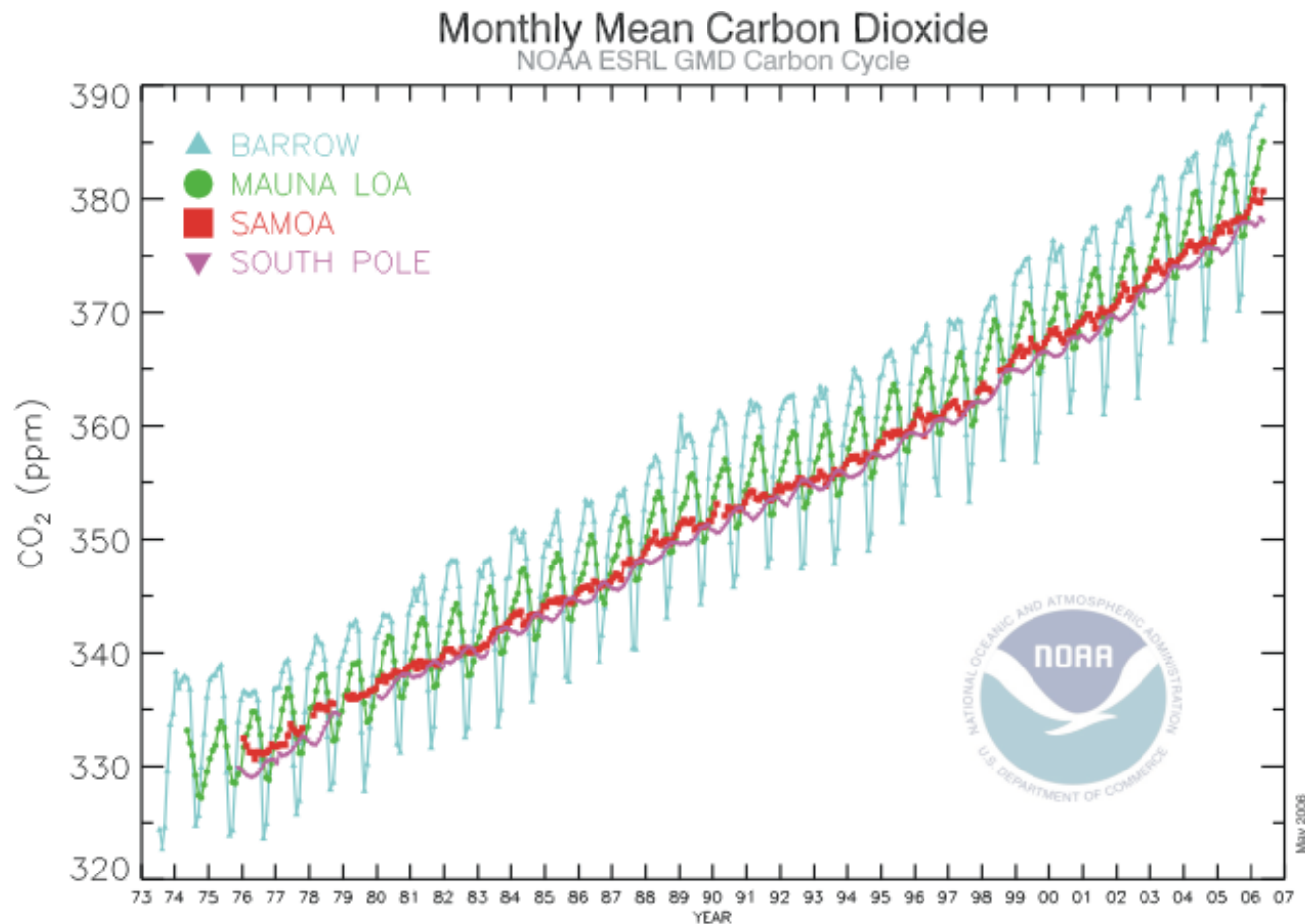
Australia relies on coal for 85% of electricity generation.

Image: The Age



# Carbon dioxide and the atmosphere

- >20% rise in 30 years

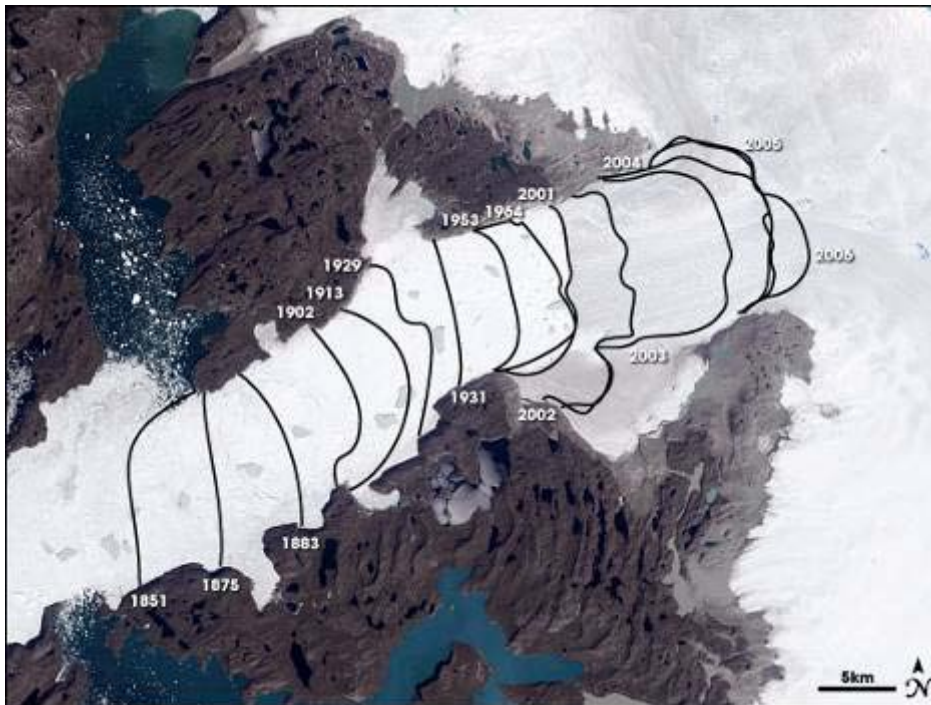


Atmospheric carbon dioxide mixing ratios determined from the continuous monitoring programs at the 4 GMD baseline observatories. Contact: Dr. Pieter Tans, NOAA ESRL GMD Carbon Cycle, Boulder, Colorado, (303) 497-6678 (pieter.tans@noaa.gov, <http://www.cmdl.noaa.gov/cogg>).



# Climate change challenges

- “Warming of the climate system is **unequivocal**, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level.” (4<sup>th</sup> IPCC Report 2007).



Jakobshavn Glacier  
Retreat: 1851-2006

# Overview

- Regional impacts of climate change
- RAN vulnerabilities
- Impact management strategies

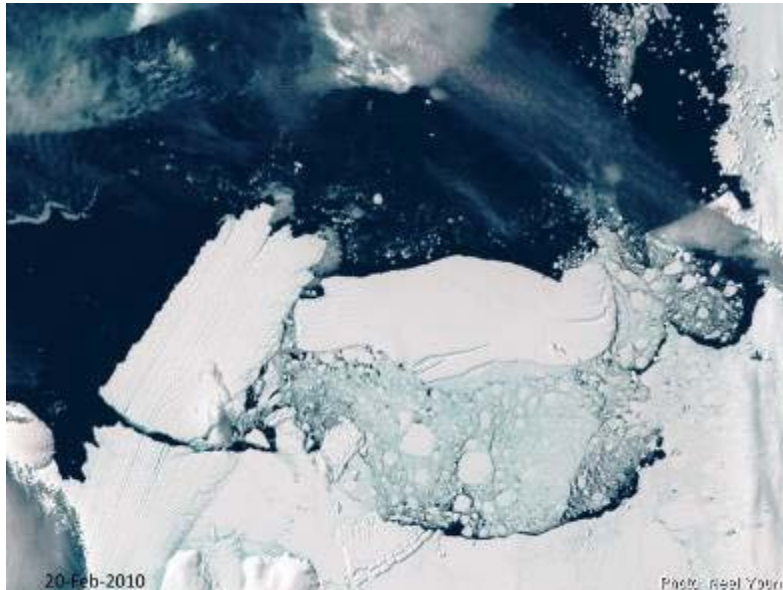


# Primary effects of climate change

- Coastal inundation
- More frequent heavy precipitation events (rainstorms, floods or snowstorms) in many areas
- More intense and longer droughts over wide areas
- Higher sea states and wind speeds
- Water and resource scarcity
- Degradation/changes to natural habitat and species resilience/distributions
- Increasing temperatures

# Regional effects of climate change

- **Rising sea level in Australian waters**
  - About 6-7 inches (150 mm) in the 20th century.
  - Predicted 40 inches (1.0-1.2m) by 2100 (AAD estimates).
- **Primary causes: Ice melt and thermal expansion**
- **Thinning ice caps in west Antarctica.**



2500km<sup>2</sup> iceberg calved

February 2010

Photo courtesy AAD



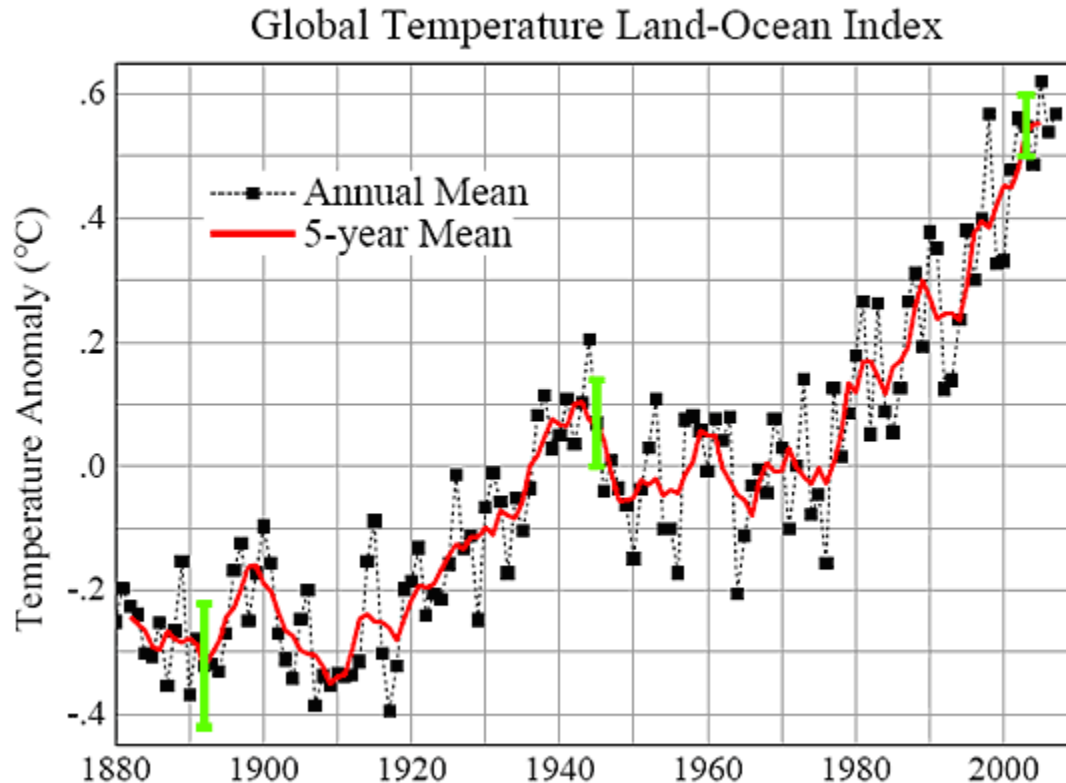
# Coastal inundation

0.5m sea level rise by 2050, ca. 1.2 m by 2100 (ACE CRC Report 2010)

- Sea level rise for Sydney currently 10 mm per year and is accelerating.
- Paleoclimate information supports the interpretation that the warmth of the last half century is unusual in at least the previous 1300 years.
- The last time the polar regions were significantly warmer than present for an extended period (about 125,000 years ago), **reductions in polar ice volume led to 4 to 6 metres (of sea level rise).**

# RAN vulnerabilities

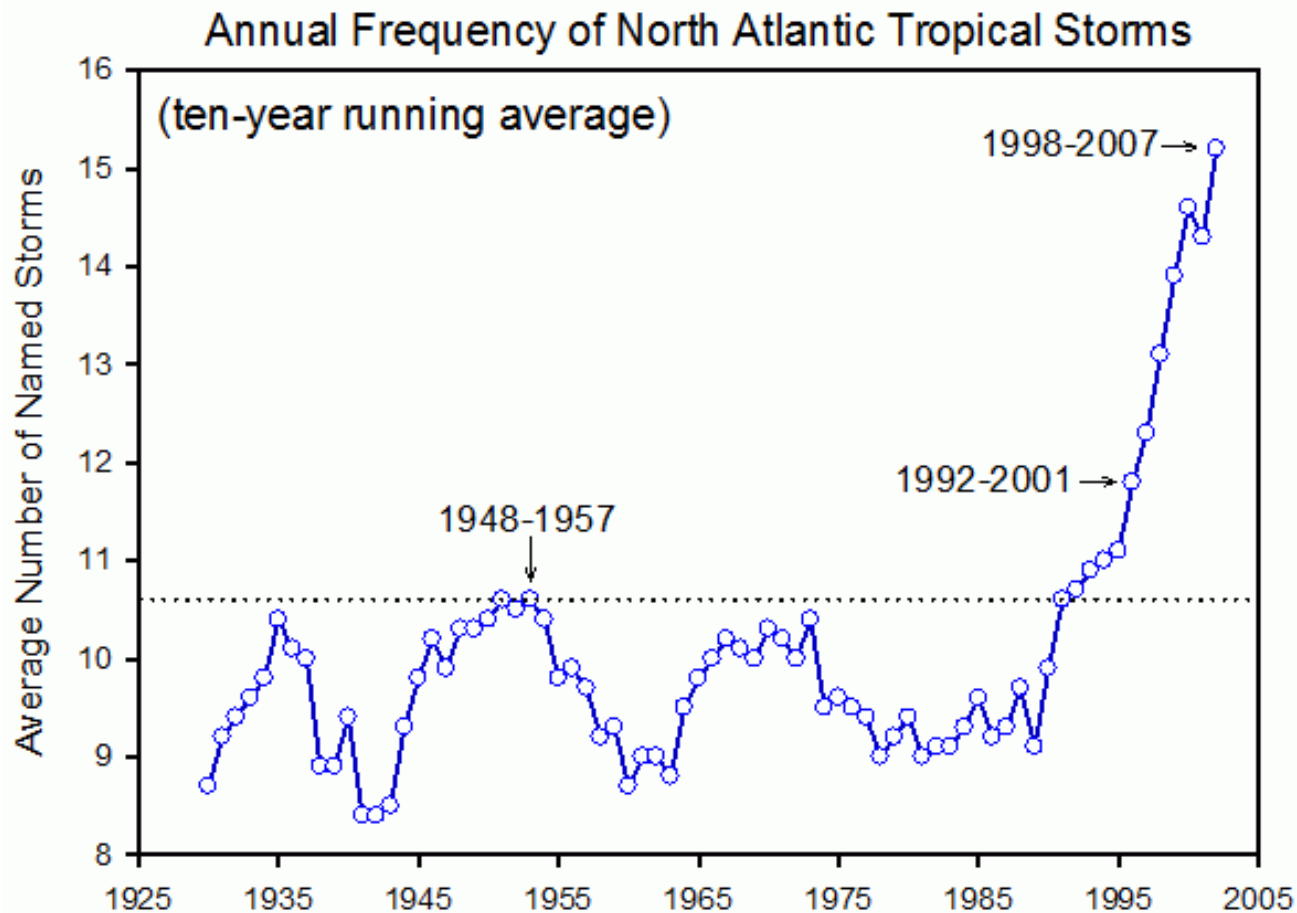
- Temperature effects – greater energy consumption



Source: Pew  
website

# More severe storms

- Severe storm incidence will increase
- More energy in system



Source:  
Pew website



# Climate change infrastructure implications

## Infrastructure impacts:

- Reduced performance of stormwater drainage systems
- Reduced performance of breakwaters
- Reduced wharf deck clearances
- More maintenance, greater costs
- Increased energy requirements
- Loss of some coastal facilities



# Climate change –impacts on regional countries

## Impacts on regional countries:

- High proportion of population in coastal areas
- Some countries very low lying
- Loss of fisheries
- Less developed countries lack resilience
- Destabilising influence on regional security
- Potential loss of some sovereign nations
- Climate refugees from SW Pacific and elsewhere
- Increased Defence civil community aid requirements



Kiribati Flag

# Climate change – operational impacts

## Operational impacts:

- Challenges to maintaining capability at sea



Maritime helicopter and RAS operations are sea state limited, and sea states may increase in many areas.

# Climate change – operational impacts

## Operational impacts:

- Increased illegal fishing effort as regional resources decline
- Climate refugees from SW Pacific and elsewhere



# Climate change – operational impacts

## Operational impacts:

- Increased Defence civil community aid requirements
- Search and rescue obligations will expand from more extreme weather events and increased access to the Southern Ocean



*MV Explorer*

Source: *The Age*



# Resilience to climate change

- We will need bigger, more seaworthy and more capable ships to cope with projected operational requirements and limitations imposed by climate change.
- Most current ships are being replaced with larger vessels.
- Eg from LPA (8550 t) to LHD (27,000 t).



# Resilience to climate change

- Patrol boats: more flexible capability and larger to meet increased surveillance and interdiction requirements



# Resilience to climate change

- Improving shore infrastructure resilience is challenging
- Likely this will be the largest cost imposition on Defence

## *Key issues:*

*Wharf decks/hardstands*

*Buildings*

*Drainage systems*

*Wave mitigation devices*

*Berthing and wind/wave  
action*

## *Key attributes:*

*Location*

*Elevation*

*Substrate*

*Infrastructure value*

*Cost of modifications*



# RAN and climate change

Lake Boga, NSW, then and now after 10 years of drought



QUESTIONS?