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RISK MANAGEMENT AND CLIMATE CHANGE

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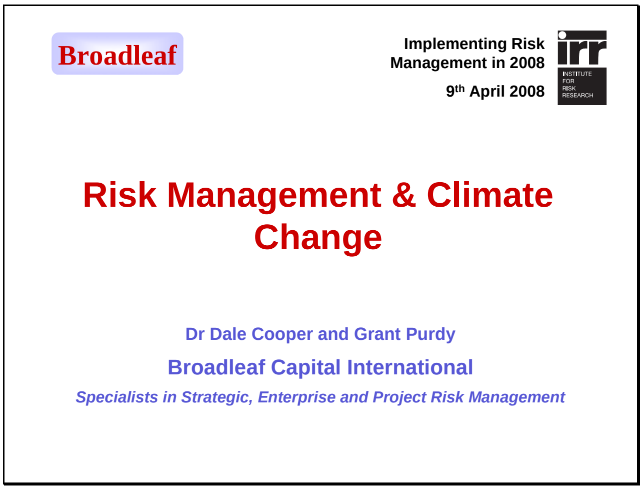
Supporting material for a paper presented at an Executive Workshop organised by the Institute for Risk Research at the University of Waterloo, PricewaterhouseCoopers LLP and Broadleaf Capital International, Toronto, Canada, 9 May 2008



The Intergovernmental Panel on Climate Change (IPCC), the most authoritative analysis of information on climate change, has concluded that:

- Global temperatures increased by 0.7^{o} C in the 20th century (a further 0.15^{o} C since turn of century).
- 1990-1999 was the warmest decade in the last 1000 years
- Most of the warming in the last 50 years is attributable to human activities
- Climate change will continue for decades or even centuries to come even if large scale action to reduce emissions is taken in the near future.
- A recent report for the Lowy Institute by Dr Alan Dupont (international security analyst) and Dr Graeme Pearman (former Chief of CSIRO atmospheric research) argues that climate change represents a major security threat globally and to Australia and that far from exaggerating the threat of climate change scientists may have understated it.

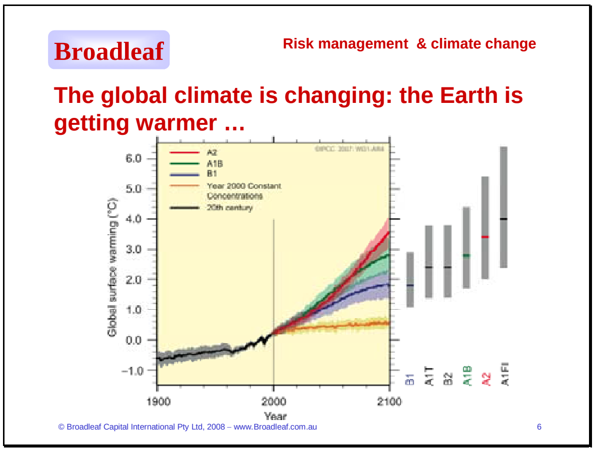
1 The climate is changing, and will continue to change

Climate change will have big impacts on Canada, particularly in Arctic and littoral areas.

1.1 Temperatures are increasing

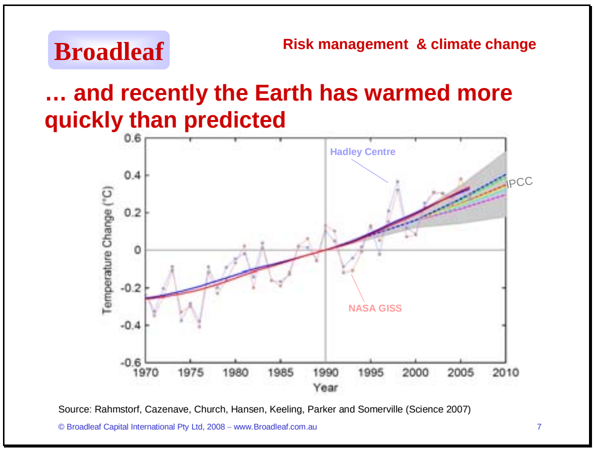
The big picture:

– The global climate is changing: the Earth is getting warmer
– Recently the Earth has warmed more quickly than predicted
– Canada seems to be getting warmer
– Winter temperatures have risen
– Permafrost temperature records show substantial recent warming
– Temperatures across Canada are forecast to increase substantially



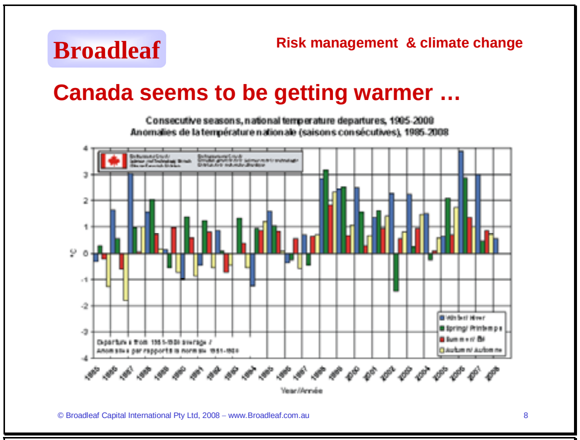
http://www.ipcc.ch/graphics/graphics/ar4-wg1/ppt/spm.ppt#263,6,Figure SPM.5

Figure SPM.5. Solid lines are multi-model global averages of surface warming (relative to 1980–1999) for the scenarios A2, A1B and B1, shown as continuations of the 20th century simulations. Shading denotes the ±1 standard deviation range of individual model annual averages. The orange line is for the experiment where concentrations were held constant at year 2000 values. The grey bars at right indicate the best estimate (solid line within each bar) and the **likely** range assessed for the six SRES marker scenarios. The assessment of the best estimate and **likely** ranges in the grey bars includes the AOGCMs in the left part of the figure, as well as results from a hierarchy of independent models and observational constraints. {Figures 10.4 and 10.29}

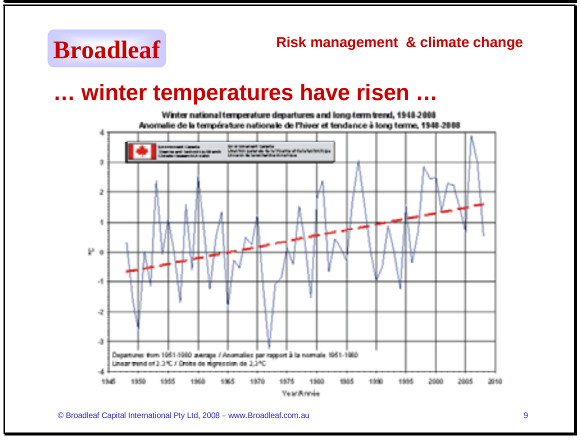


Source: Stefan Rahmstorf, Amy Cazanave, John A Church, James E Hansen, Ralph F Keeling, David E Parker and Richard CJ Somerville, 'Recent Cliamte Projections Compared to Projections', Science, Vol 316, 4 May 2007, p 709. http://www.pik-potsdam.de/~stefan/Publications/Nature/rahmstorf_etal_science_2007.pdf

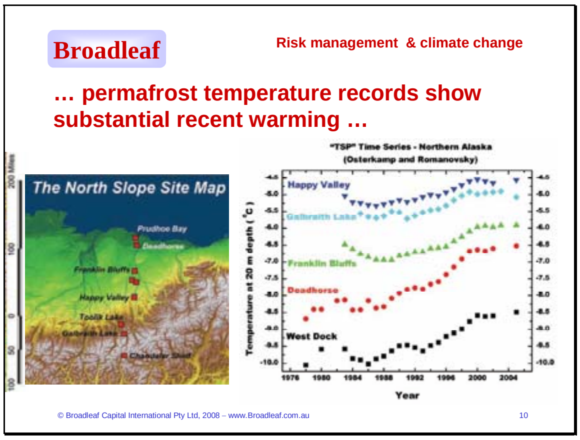
"Given the relatively short 16-year time period considered, it will be difficult to establish the reasons for this relatively rapid warming, although there are only a few likely possibilities. The first candidate reason is intrinsic variability within the climate system. A second candidate is climate forcings other than CO2: Although the concentration of other greenhouse gases has risen more slowly than assumed in the IPCC scenarios, an aerosol cooling smaller than expected is a possible cause of the extra warming. A third candidate is an underestimation of the climate sensitivity to CO2 (i.e., model error). The dashed scenarios shown are for a medium climate sensitivity of 3°C for a doubling of CO2 concentration, whereas the gray band surrounding the scenarios shows the effect of uncertainty in climate sensitivity spanning a range from 1.7° to 4.2°C."



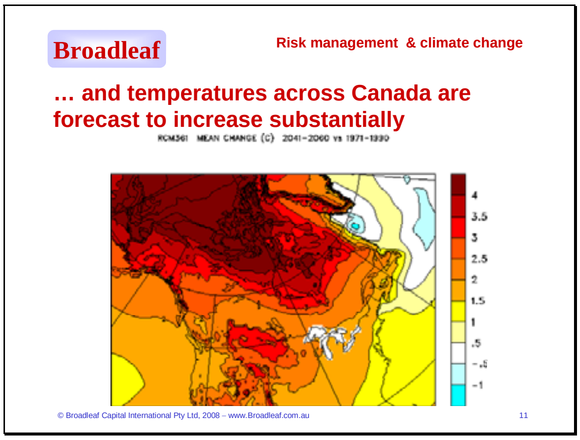
With the exception of the springs of 2002 and 2004, seasonal temperatures have remained above or near normal for almost 11 years, as shown in the consecutive seasons graph.
http://www.msc-smc.ec.gc.ca/ccrm/bulletin/national_e.cfm
http://www.msc-smc.ec.gc.ca/ccrm/bulletin/figseasont_e.html?season=Winter&date=2008



The graph shows that winter temperatures have generally been increasing nationally, with temperatures remaining above normal since 1997. The red dashed line represents a warming trend of 2.3°C over the last 61 years.
http://www.msc-smc.ec.gc.ca/ccrm/bulletin/national_e.cfm
http://www.msc-smc.ec.gc.ca/ccrm/bulletin/figchartt_e.html?season=Winter&date=2008



State of the Arctic, October 2006
Figure 22: Top: Locations of long-term University of Alaska permafrost observatories in northern Alaska. Bottom: Changes in permafrost temperatures at a depth of 20 m over the last 20-25 years. (Updated from Osterkamp, 2003.)
http://www.pmel.noaa.gov/pubs/PDF/rich2952/rich2952.pdf

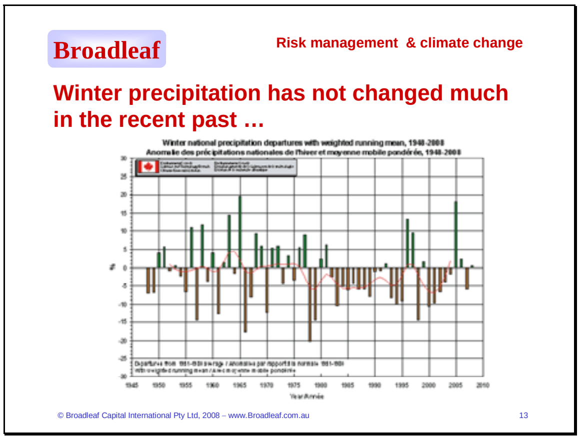


Diagnostic Plots from CRCM3.6
Change in annual mean screen (2m) temperature (°C) in 2041-2060 relative to 1971-1990 simulated by CRCM3.6.1
http://www.cccma.ec.gc.ca/diagnostics/crcm36/crcm36_st_ano.shtml

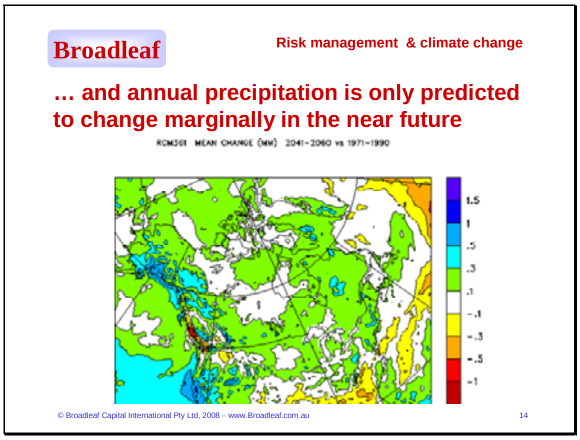
1.2 Precipitation across Canada may not change much in the short term

The big picture:

– Winter precipitation has not changed much in the recent past
– Annual precipitation is only predicted to change marginally in the near future



The graph shows most winters over the last 25 years have had precipitation levels near or below normal. http://www.msc-smc.ec.gc.ca/ccrm/bulletin/national_e.cfm http://www.msc-smc.ec.gc.ca/ccrm/bulletin/figchartp_e.html?season=Winter&date=2008



Diagnostic Plots from CRCM3.6 Change in annual mean precipitation rate (mm/day) in 2041-2060 relative to 1971-1990 simulated by CRCM3.6.1 http://www.cccma.ec.gc.ca/diagnostics/crcm36/crcm36_pcp_ano.shtml

1.3 The maritime environment is changing

The big picture:

– There is less sea ice around Canada
– Arctic sea ice is predicted to become thinner
– Its extent is predicted to decline substantially
– Sea levels have risen faster than predicted
– Arctic sea levels are rising
– Rising sea levels, combined with storm surges, will lead to problems in the coastal zone

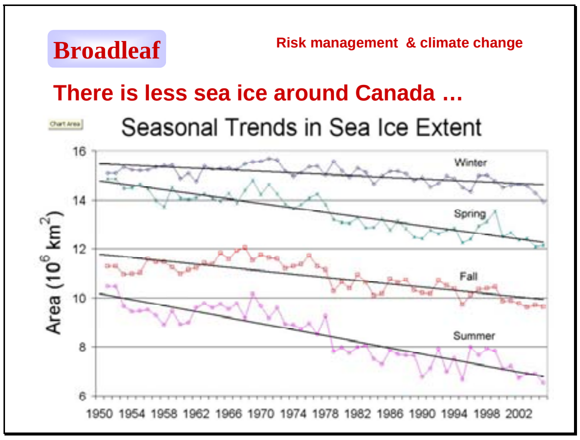
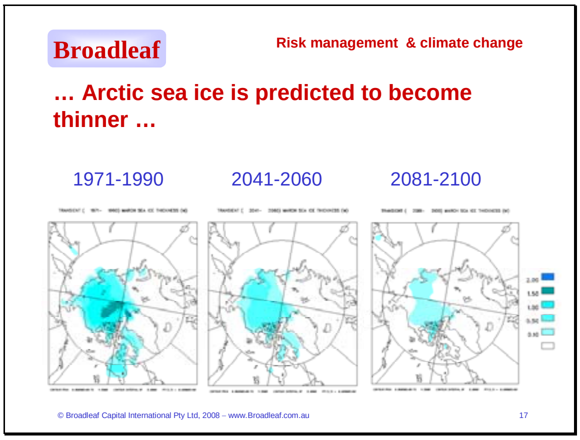
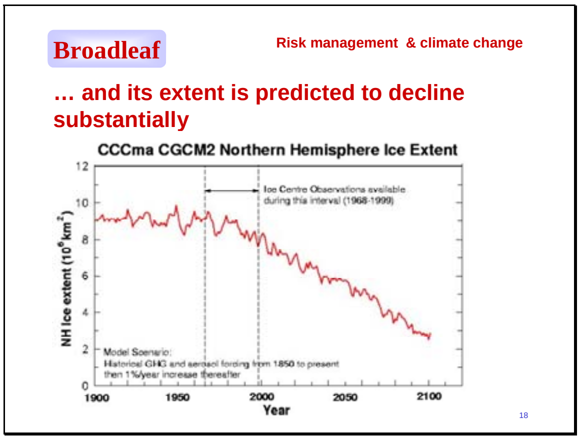


Figure 2: Monthly change in sea ice extent from 1979-1996 as compared to normal for the same period.
http://www.socc.ca/seaice/seaice_hist_e.cfm



http://www.socc.ca/seaice/seaice_future_e.cfm

Figure 1: Arctic sea-ice thickness (m) obtained from the CCCma Coupled Global Climate Model for March, averaged over years 1971-1990.
Figure 2: Arctic sea-ice thickness (m) obtained from the CCCma Coupled Global Climate Model for March, averaged over years 2041-2060.
Figure 3: Arctic sea-ice thickness (m) obtained from the CCCma Coupled Global Climate Model for March, averaged over years 2081-2100.
The oceanic and sea-ice components of GCMII are highly simplified. An ocean mixed-layer model is used together with an embedded thermodynamic sea-ice model. The oceanic component is simply a 50 m thick slab of quiescent seawater. Ice is allowed to form at the top of the water slab when it cools down to the freezing point of seawater.

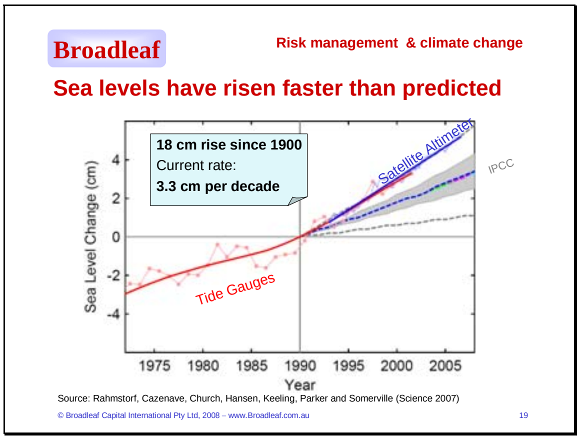


http://www.socc.ca/seaice/seaice_future_e.cfm

Figure 1: CCCma prediction of sea ice extent during the 21st century.

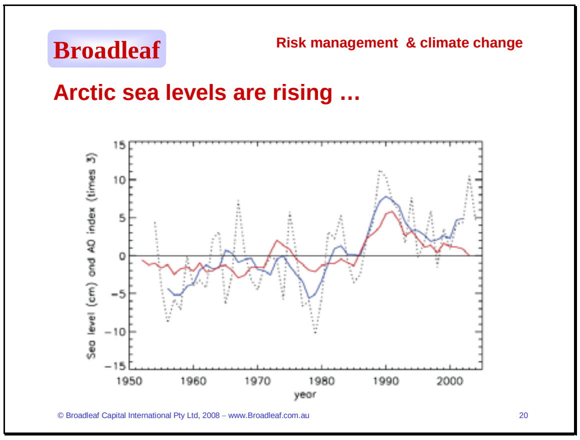
Figure 1 shows the sea ice extent for the Northern Hemisphere starting in 1900 to 2100. Sea ice extent begins to decrease around the time of the sea ice chart observational record from 1968 to 1999. The decrease is close to the observed decrease of 3% per decade seen in the observational record. Ice extent starts to decrease slightly more rapidly after 2000. By about 2050, summer sea ice cover over the Arctic Ocean has disappeared.

Note that these results are obtained from one particular model using one particular scenario for future greenhouse gas and aerosol forcing. They are provided here as an example of projected changes in the cryosphere which might accompany changing climate.



Source: Stefan Rahmstorf, Amy Cazanave, John A Church, James E Hansen, Ralph F Keeling, David E Parker and Richard CJ Somerville, 'Recent Cliamte Projections Compared to Projections', Science, Vol 316, 4 May 2007, p 709.

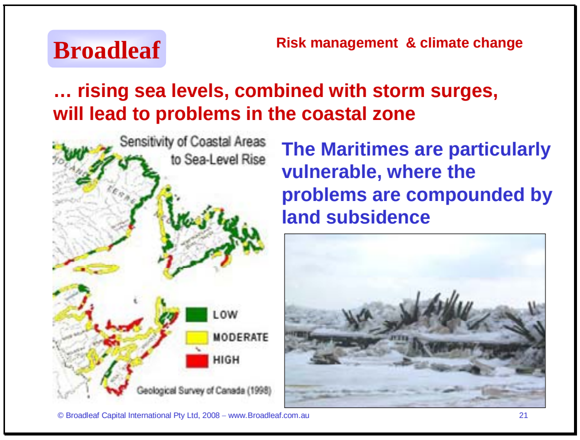
http://www.pik-potsdam.de/~stefan/Publications/Nature/rahmstorf_etal_science_2007.pdf



State of the Arctic, October 2006

Figure 13: Annual mean relative sea level from nine tide gauge stations in the Siberian seas (dotted line). The blue line is the 5-year running mean sea level. The red line is the 5-year running mean Arctic Oscillation index.

http://www.pmel.noaa.gov/pubs/PDF/rich2952/rich2952.pdf



http://atlantic-web1.ns.ec.gc.ca/slr/default.asp?lang=En&n=61BB75EF-1

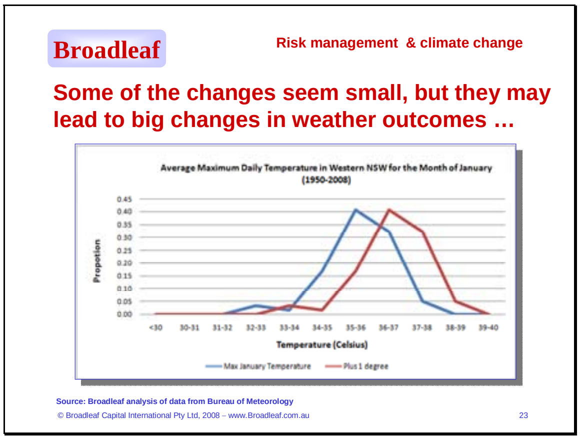
Sea-Level Rise
Storm-surge flooding and coastal erosion are problems that are with us today. According to the Geological Survey of Canada, parts of the Gulf of St. Lawrence are some of the most vulnerable areas in Canada to sea-level rise.
In addition to sea-level rise caused by climate change, land is subsiding in the Maritimes by about 20 cm per century.

In winter, sea ice can protect the shoreline from the impacts of ocean waves, but it can also become a hazard under extreme storm surge conditions—as evidenced by the devastating damage done to the Cap-des-Caissie wharf in January 2000

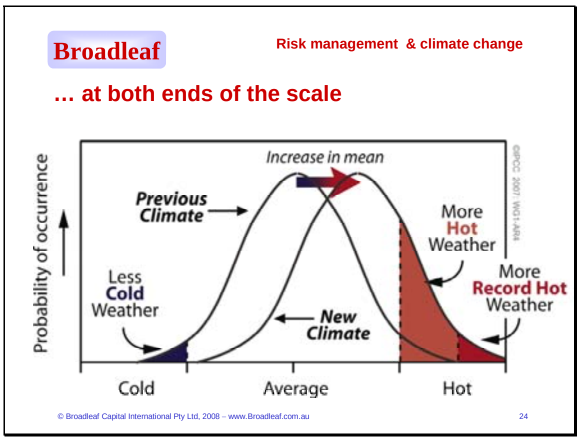
1.4 Small changes in averages can have highly non-linear effects

The big picture:

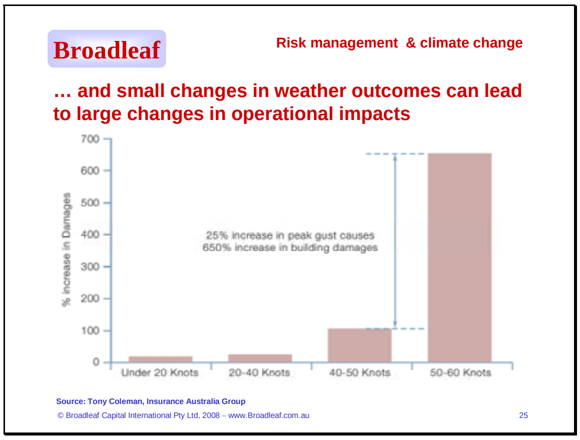
- Some of the changes in climate seem small, but they may lead to big changes in weather outcomes
- Small changes in weather outcomes can lead to large changes in operational impacts



Source: Broadleaf analysis of data from the Australian Bureau of Meteorology, www.BoM.gov.au



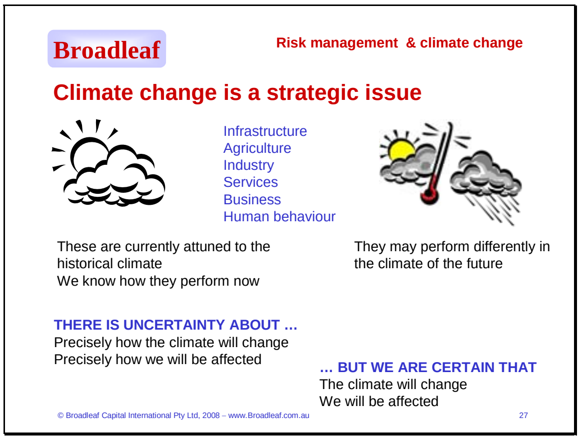
IPCC 2007: Box TS.5, Figure 1. Schematic showing the effect on extreme temperatures when the mean temperature increases, for a normal temperature distribution.
http://www.ipcc.ch/graphics/graphics/ar4-wg1/ppt/technical-summary.ppt#295,35,Box TS.5

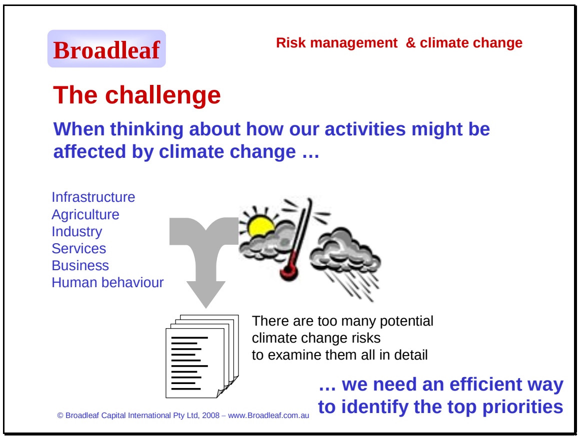


Insurance Australia Group: building claims versus peak wind gust speeds, showing disproportionate increase in claims cost from small increases in peak wind gust speed – that is, a 25% increase in peak gusts causes 650% increase in building damages.
Source: Quoted in CSIRO Climate Change, An Australian Guide to the Science and Potential Impacts

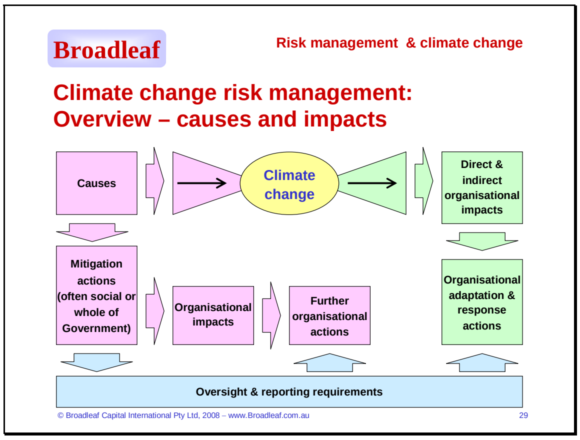
2 Climate change is a strategic issue

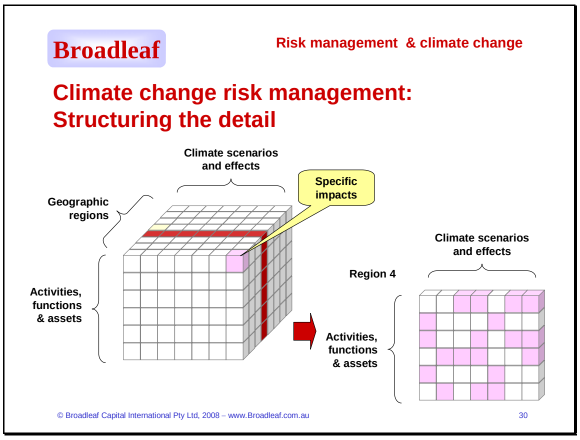
We need effective ways of thinking about climate change and its effects, and of integrating climate change management into our strategic plans

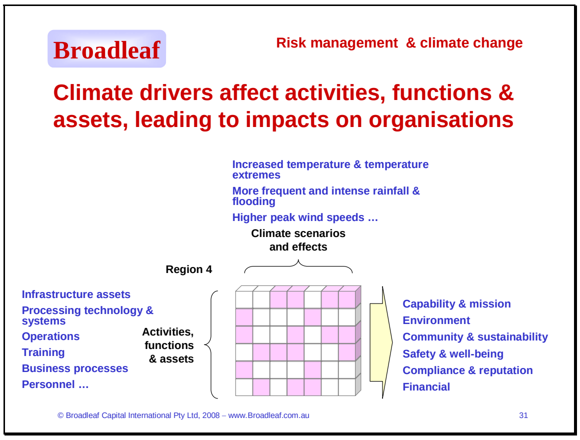


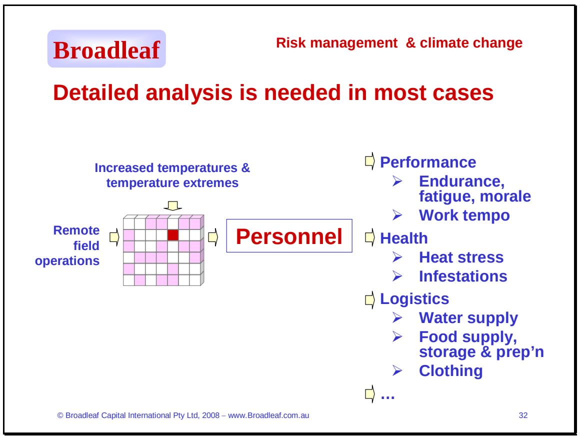


2.1 We must structure our thinking, and get into the detail

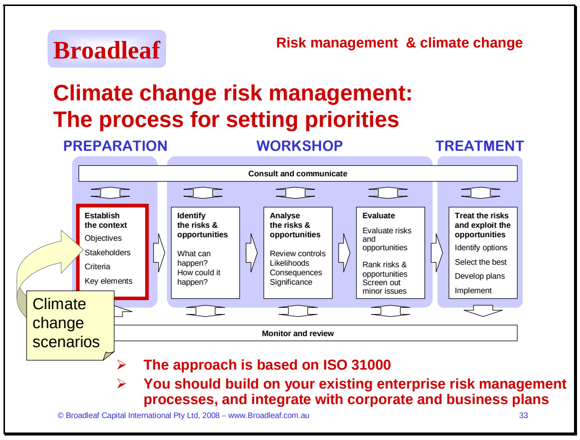






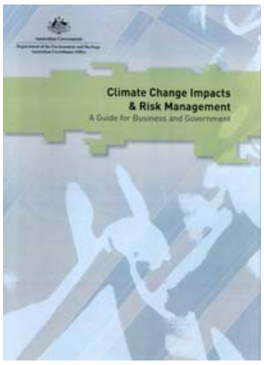


2.2 We must set priorities consistently



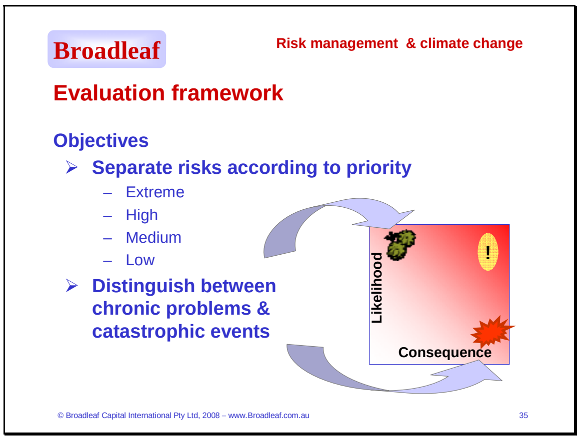
This presentation does not spend much time on the basics of the risk management process – it focuses on how it can be applied to the impacts of climate change.

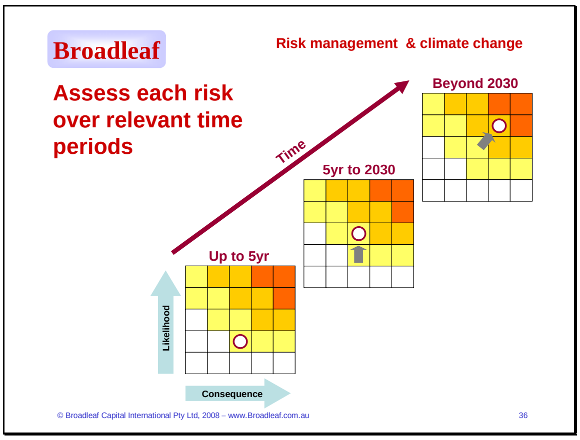
One important point should be noted: the process identifies risks and opportunities. Although many of the impacts of climate change will be negative, some of them will be positive, and it is important to recognise such opportunities and understand how they might be exploited. (For example, the effects of warmer temperatures and higher concentrations of CO_2 may be beneficial in some agricultural areas.)

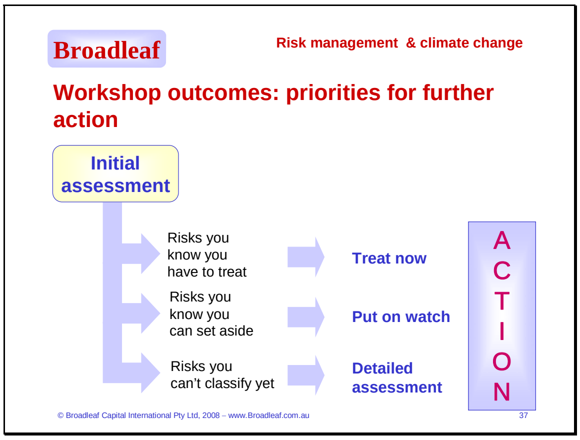


The process is described in detail in 'Climate Change Impacts and Risk Management: A Guide for Business and Government', published by the Australian Greenhouse Office. It is available from http://www.broadleaf.com.au/climate/index.html or http://www.greenhouse.gov.au/impacts/publications/risk-management.html

The guide was co-authored by Broadleaf and tested through a series of case studies – a large private company, a public utility, a State government agency and a local government authority – and we have undertaken many subsequent applications.



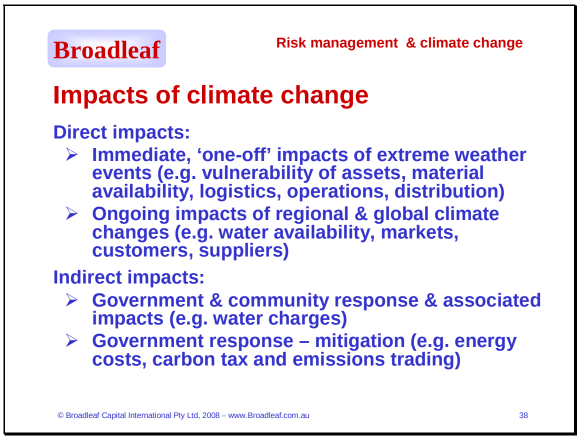




The outcome from the workshop is a triage of the risks and opportunities that have been identified:

– Risks that require action now.
– Those that can be set aside, either because they are genuinely low risks, or because action may not be needed immediately or urgently. Note that these risks are not discarded – they are set aside on a watch list to be reviewed regularly, to determine whether the priority has changed or whether the triggers for more immediate action have arisen.
– Those, risks, generally not many of them, for which we need more information and more detailed assessment before we can make a decision about the need for immediate action.

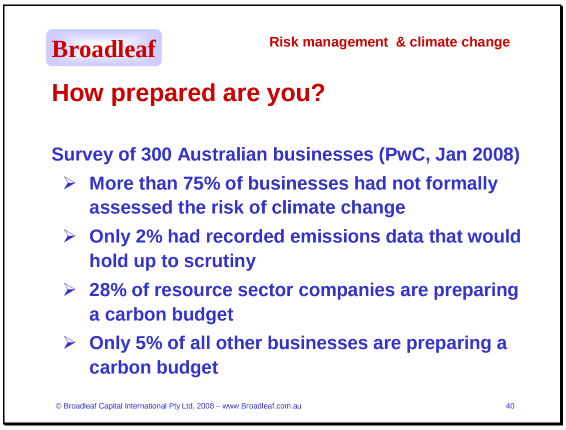
3 Summary and conclusions



The direct and indirect effects of climate change are likely to generate both risks and opportunities for companies.

Importantly, even if you don't accept the current science of human-induced climate change it is important that you take a strategic approach to the issue. For example:

– considering the risks posed by natural climate variability
– considering the risks (and opportunities) posed by government, community and competitor response to the issue.



PwC, Carbon Countdown, http://www.pwc.com/Extweb/onlineforms.nsf/docid/0EDACFFBA83712AB852573DB000F55FF#

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Risk management & climate change

Summary

Climate change is happening (whatever the cause!)

Nothing we do now will reverse the effects in the medium term

Climate change is a strategic issue

Integrating climate change risk management into your strategic planning process now makes sense

Treat the risks

- Minimise the downsides
- Maximise the upsides

Achieve strategic advantage

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4 Contact us for more information

See the climate change risk pages on our web site: www.broadleaf.com.au/climate/index.html

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Risk management & climate change

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