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RISK MANAGEMENT AND CLIMATE CHANGE

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Supporting material for a paper presented at a Conceptual Forum hosted by the Bombay
Management Association, Mumbai, India, 29 May 2008

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Risk Management & Climate Change

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Bombay Management Association, Mumbai, 29 May 2008

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Why is climate change important ?

The global climate is changing and will continue to change ... our children will face a different future

Climate change is likely to have pervasive impacts on business performance and viability

We must ensure climate change is addressed adequately in our strategic plans

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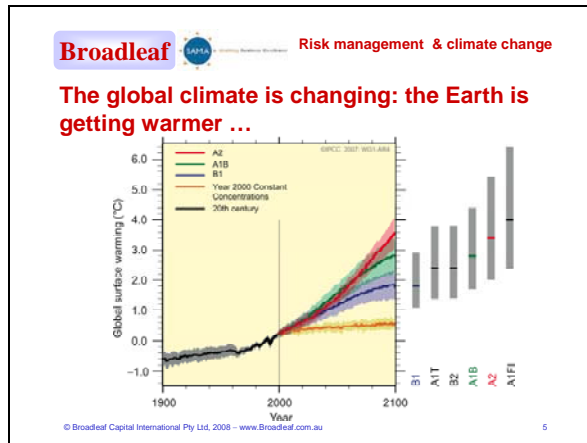
The Intergovernmental Panel on Climate Change (IPCC), the most authoritative analysis of information on climate change, has concluded that:

- Global temperatures increased by 0.7° C in the 20th century (a further 0.15° 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 huge impacts on India and its regional neighbours.

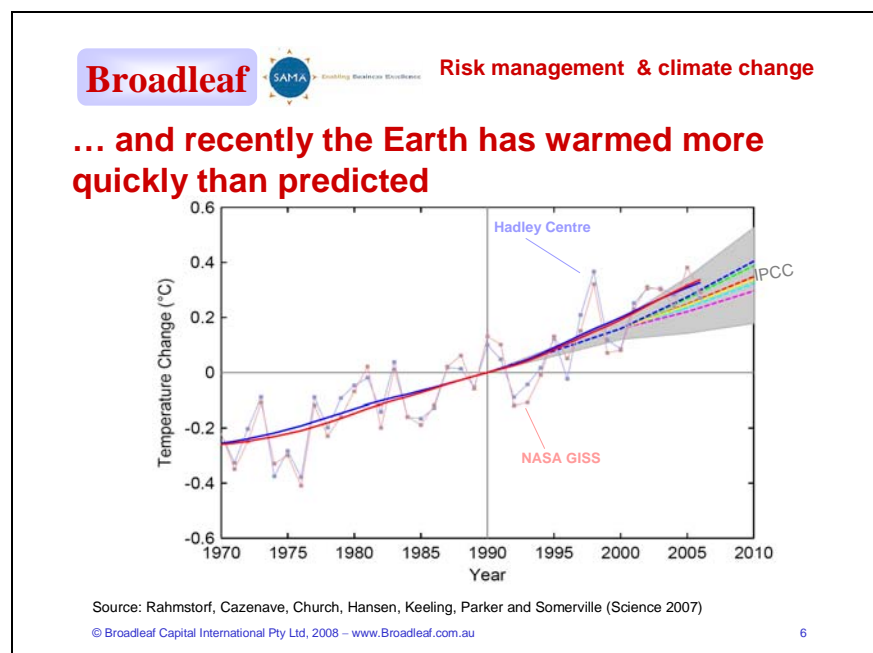
1.1 Temperatures are increasing



<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.

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



“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.”

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

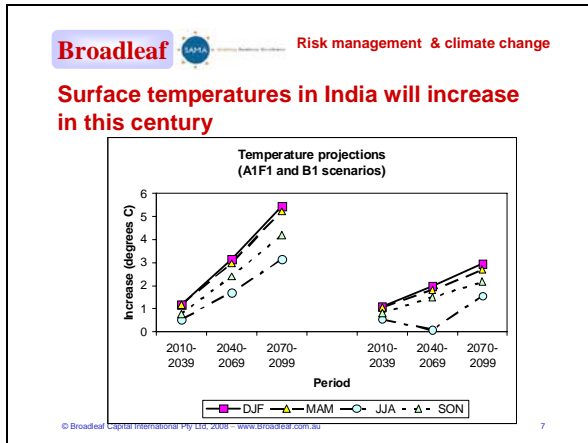


Figure SPM.6. Projected surface temperature changes for the late 21st century (2090-2099). The map shows the multi-AOGCM average projection for the A1B SRES scenario. Temperatures are relative to the period 1980-1999.

http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf

<http://www.ipcc.ch/graphics/graphics/syr/spm6.jpg>

1.2 Higher temperatures will reduce cereal yields

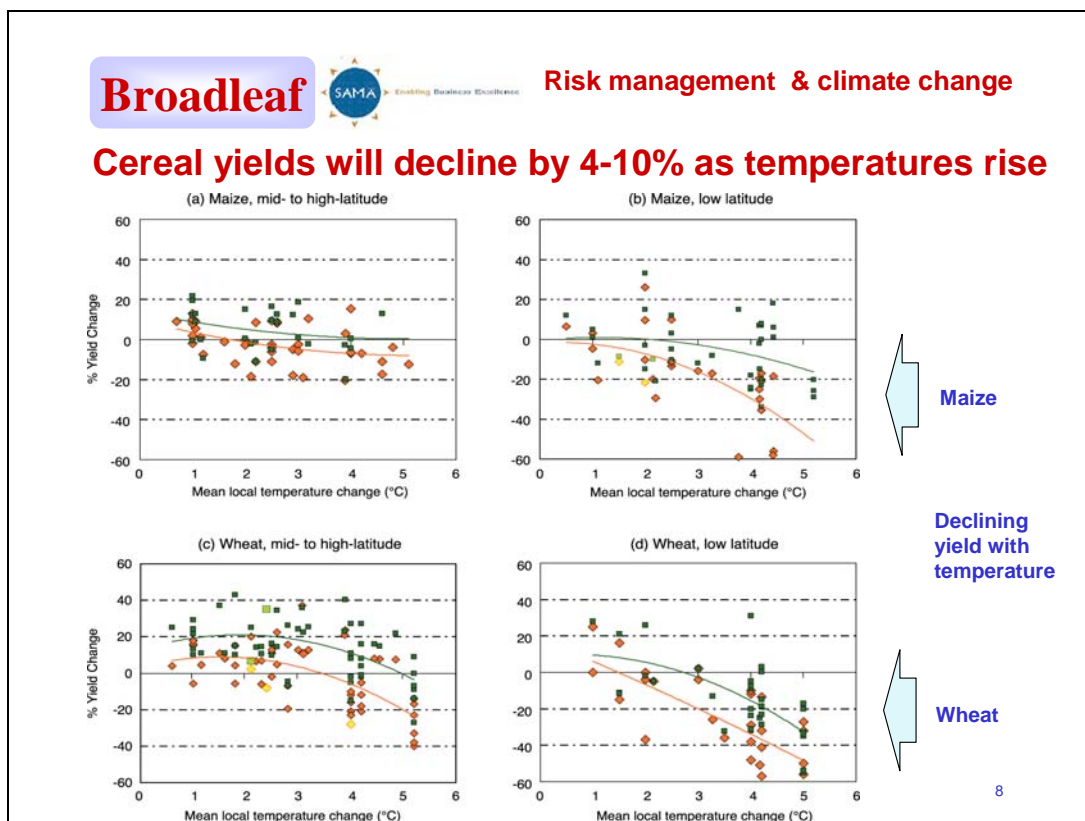



Figure TS.7. Sensitivity of cereal yield to climate change for maize and wheat. Responses include cases without adaptation (orange dots) and with adaptation (green dots). The studies on which this figure is based span a range of precipitation changes and CO₂ concentrations, and vary in how they represent future changes in climate variability. For instance, lighter-coloured dots in (b) and (c) represent responses of rain-fed crops under climate scenarios with decreased precipitation.

IPCC Assessment Report, Group II, Technical Summary, <http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-ts.pdf>

“The net cereal production in South Asian countries is projected to decline at least between 4 to 10% by the end of this century under the most conservative climate change scenario.”

<http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter10.pdf>

1.3 The Himalayan glaciers are retreating; this will have profound effects on India's water supply

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Himalayan glaciers are retreating ...

Glacier	Period	Retreat of Snout (m)	Ave retreat (m/yr)
Triloknath Glacier (Himachal Pradesh)	1969-1995	400	15.4
Pindari Glacier (Uttar Pradesh)	1845-1966	2,840	135.2
Milam Glacier (Uttar Pradesh)	1909-1984	990	13.2
Ponting Glacier (Uttar Pradesh)	1906-1957	262	5.1
Chota Shigri Glacier (Himachal Pradesh)	1986-1995	60	6.7
Bara Shigri Glacier (Himachal Pradesh)	1977-1995	650	36.1
Gangotri Glacier (Uttar Pradesh)	1977-1990	364	28
Zemu Glacier (Sikkim)	1977-1984	194	27.7

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Dr. Amir Muhammed, Dr. Bonnie A. Stewart, Dr. A.P Mitra, Dr. Kedar Lal Shrestha, Dr. Ahsan Uddin Ahmed, Dr. A.M. Chowdhury
 Asia-Pacific Network for Global Change Research
 Water Resources in South Asia: An Assessment of Climate Change-associated Vulnerabilities and Coping Mechanisms
 Final report for APN project 2004-02-CMY-Muhammed

Table 1. Record of retreat of some glaciers in the Himalayas

http://www.apn-gcr.org/en/products/project_reports/2004/Final%20Report/2004_02_CMY-Muhammed_.pdf

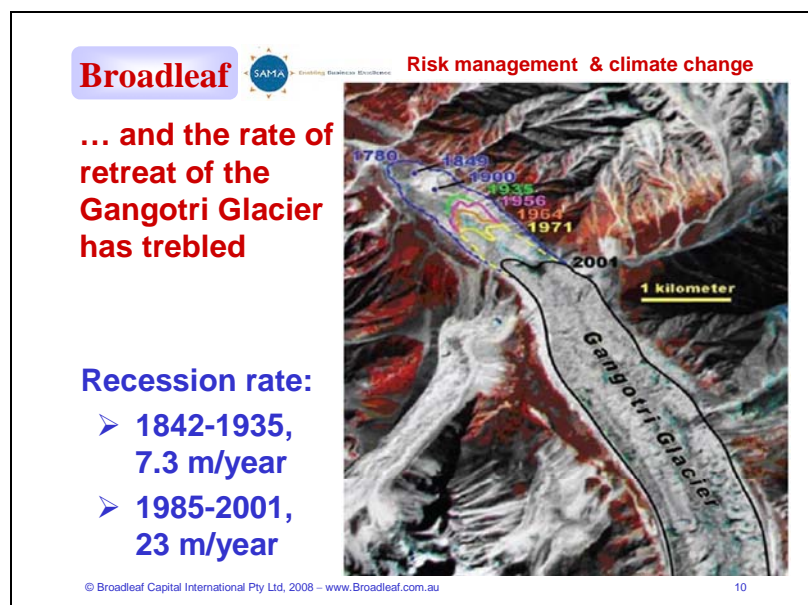
Quoted in IPCC Assessment Report, Working Group II Report "Impacts, Adaptation and Vulnerability", Chapter 10, Table 10.9

<http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter10.pdf>

Figure 10.6. Composite satellite image showing how the Gangotri Glacier terminus has retracted since 1780 (courtesy of NASA EROS Data Center, 9 September 2001).

<http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter10.pdf>

Between 1842 and 1935, the glacier was receding at an average of 7.3 m every year; the average rate of recession between 1985 and 2001 is about 23 m per year (Hasnain, 2002).



<http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter10.pdf>

Section 10.6.2 The Himalayan glaciers

Key points:


Himalayan glaciers ... form the largest body of ice outside the polar caps and are the source of water for the innumerable rivers that flow across the Indo-Gangetic plains. Himalayan glacial snowfields

store about 12,000 km³ of freshwater. About 15,000 Himalayan glaciers form a unique reservoir which supports perennial rivers such as the Indus, Ganga and Brahmaputra, the lifeline of millions of people in Pakistan, Nepal, Bhutan, India and Bangladesh. The Gangetic basin alone is home to 500 million people, about 10% of the total human population in the region.

Glaciers in the Himalaya are receding faster than in any other part of the world. If the present rate continues, the likelihood of them disappearing by the year 2035 and perhaps sooner is very high if the Earth keeps warming at the current rate. Its total area will likely shrink from the present 500,000 to 100,000 km² by 2035 (WWF, 2005).

The receding and thinning of Himalayan glaciers can be attributed primarily to the global warming. The relatively high population density and consequent deforestation and land-use changes have also adversely affected these glaciers. The current trends of glacial melts suggest that the Ganga, Indus, Brahmaputra and other rivers that criss-cross the northern Indian plain could likely become seasonal rivers in the near future and could likely affect the economies in the region.

1.4 The intensity of weather effects will increase

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Cyclones will be less frequent, but more intense


The frequency of monsoon depressions and cyclone formation in the Bay of Bengal and the Arabian Sea have been declining since 1970

... but cyclone intensity is increasing

... causing floods that are more severe in terms of damage to life and property

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<http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter10.pdf>

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There will be more intense rains & floods


Examples:

- Serious and recurrent floods in Bangladesh, Nepal and north-east states of India during 2002, 2003 and 2004
- A record 944 mm of rainfall in Mumbai, India on 26 to 27 July 2005 led to loss of over 1,000 lives with loss of more than US\$250 million
- Floods in Surat, Barmer and in Srinagar during summer monsoon season of 2006
- Floods in the southern province of Sri Lanka were triggered by 730 mm rain on 17 May 2003
- Cyclone Nargis in April 2008

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<http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter10.pdf>

1.5 There will be significant impacts on India's water supply

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The effects on water supply will be significant

By the 2050s, freshwater availability, particularly in large river basins, is projected to decrease

Coastal areas, especially heavily populated megadelta regions, will be at greatest risk due to increased flooding from the sea and, in some megadeltas, flooding from the rivers

Climate change is projected to compound the pressures on natural resources and the environment associated with rapid urbanisation, industrialisation and economic development


Endemic morbidity and mortality due to diarrhoeal disease primarily associated with floods and droughts are expected to rise due to projected changes in the hydrological cycle

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Climate Change 2007: Synthesis Report, from Table SPM.2

http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf

<http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-ts.pdf>

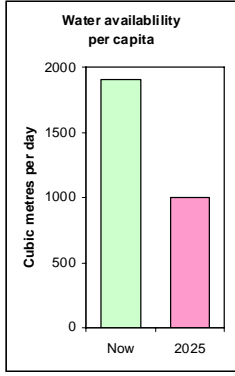
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Fresh water availability will decrease

Per capita availability of fresh water is expected to drop from around 1,900 m³ currently to 1,000 m³ by 2025, due to the combined effects of population growth and climate change

More intense rain and more frequent flash floods during the monsoon would result in a higher proportion of runoff and a reduction in the proportion reaching the groundwater


Water availability per capita



Year	Water availability per capita (Cubic metres per day)
Now	1900
2025	1000

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1.6 There will be other impacts on people and agriculture

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Increasing temperatures will have other effects on people and agriculture

More hot days and heatwaves, causing heat stress and increased mortality

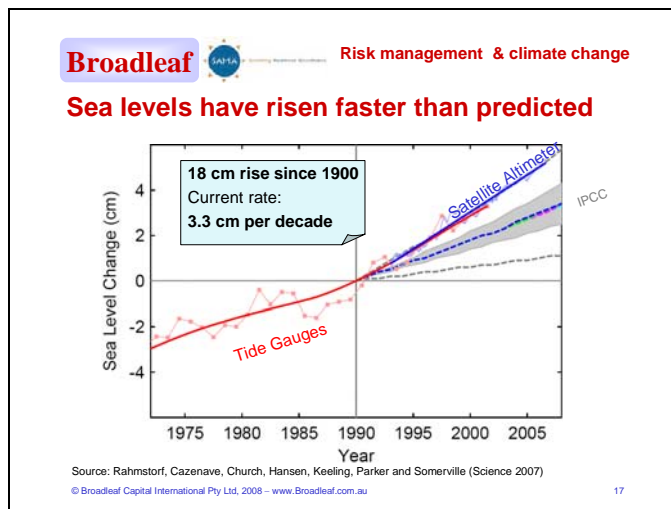
Increased proliferation of bacteria and pathogens, impacting human, animal and plant health

Lower mortality of insect vectors, leading to increased disease and decreased plant yields

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<http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter10.pdf>

1.7 Sea level rises will affect the region



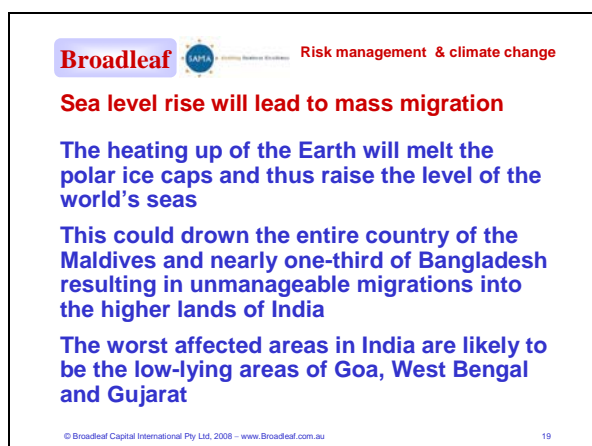
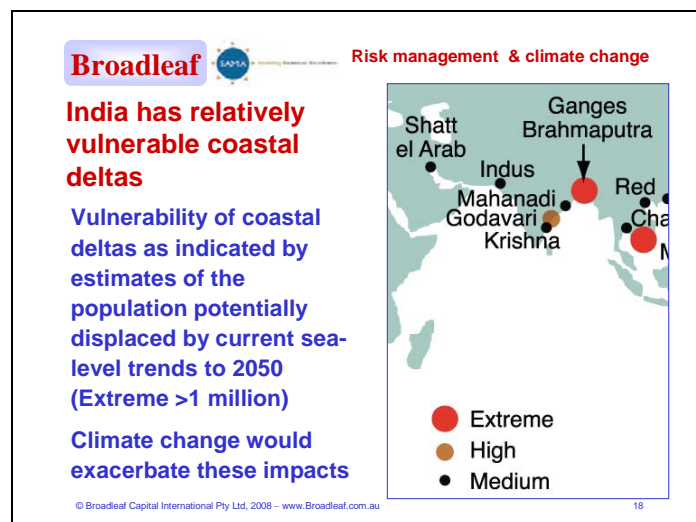
Source: Stefan Rahmstorf, Amy Cazanave, John A Church, James E Hansen, Ralph F Keeling, David E Parker and Richard CJ Somerville, 'Recent Climate Projections Compared to Projections', Science, Vol 316, 4 May 2007, p 709.

http://www.pik-potsdam.de/~stefan/Publications/Nature/rahmstorf_et_al_science_2007.pdf

Figure TS.8. Relative vulnerability of coastal deltas as indicated by estimates of the population potentially displaced by current sea-level trends to 2050 (extreme >1 million; high 1 million to 50,000; medium 50,000 to 5,000) [B6.3]. Climate change would exacerbate these impacts.

The Ganges-Brahmaputra is one of three deltas with vulnerability rated as Extreme; the other two are the Nile and the Mekong.

IPCC Assessment Report, Group II, Technical Summary,
<http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-ts.pdf>



Source: Jyoti Parikh and Kirit Parikh u.d., Free Ride through Delay: Risk and Accountability for Climate Change, mimeo. Cited in CSE Factsheet 2: Impacts of Global Warming, Possible effects on a country like India, Fourth Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change, Buenos Aires, November 2-13, 1998

<http://www.cseindia.org/programme/geg/pdf/fact2.pdf>

1.8 Climate change impacts are compounded by other factors

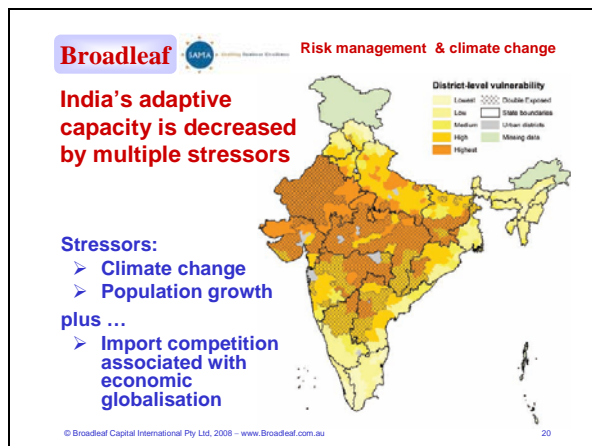


Figure TS.17. Districts in India that rank highest in terms of (a) vulnerability to climate change and (b) import competition associated with economic globalisation, are considered to be double-exposed (depicted with hatching). From O'Brien et al. (2004).

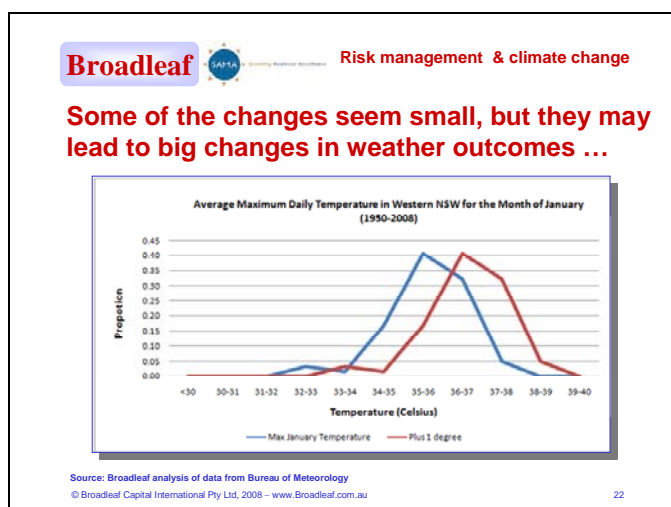
<http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-ts.pdf>

The capacity to adapt to climate change is not evenly distributed across or within nations. In India, for example, both climate change and trade liberalisation are changing the context for agricultural production. Some farmers are able to adapt to these changing conditions, including discrete events such as drought and rapid changes in commodity prices, but others are not. Identifying the areas where both processes are likely to have negative outcomes provides a first step in identifying options and constraints in adapting to changing conditions.

Figure TS.17 shows regional vulnerability to climate change, measured as a composite of adaptive capacity and climate sensitivity under exposure to climate change. The superimposed hatching indicates those areas which are doubly exposed through high vulnerability to climate change and high vulnerability to trade liberalisation. The results of this mapping show higher degrees of resilience in districts located along the Indo-Gangetic Plains (except in the state of Bihar), the south and east, and lower resilience in the interior parts of the country, particularly in the states of Bihar, Rajasthan, Madhya Pradesh, Maharashtra, Andhra Pradesh and Karnataka.

1.9 Small changes in climate averages can have highly non-linear impacts

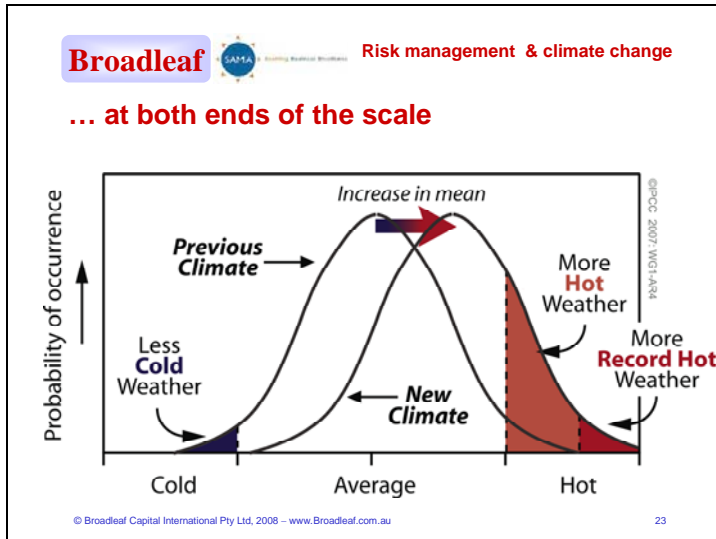
Some of the changes in climate seem small, but they may lead to big changes in weather outcomes. In turn, small changes in weather outcomes can lead to large changes in operational impacts



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

The frequency of hot days and multiple-day heatwave has increased in the past century. There has been an increase in deaths due to heat stress in recent years.

<http://www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter10.pdf>

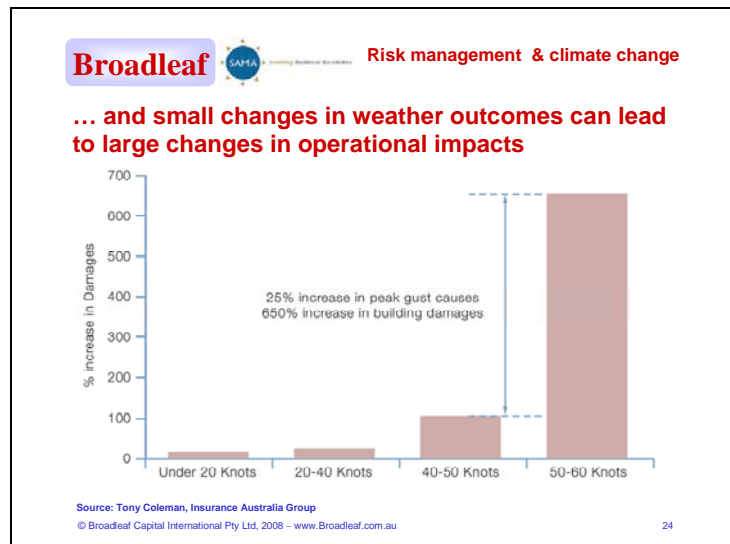


IPCC 2007: Box TS.5, Figure 1. Schematic showing the effect on extreme temperatures when the mean temperature increases, for a normal temperature distribution.

http://www.ipcc.ch/graphics/graphics/a_r4-wg1/ppt/technical-summary.ppt#295,35, Box TS.5

Source: 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.

Quoted in: CSIRO Climate Change, An Australian Guide to the Science and Potential Impacts



1.10 Summary: climate change has profound strategic implications for India

There will be major strategic impacts:

- Reduced access to fresh water
- Impaired food production
- Spread of infectious diseases
- Mass migration associated with loss of habitable land


... compounded by population growth and increasing urbanisation.

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.

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Climate change is a strategic issue



Infrastructure
Agriculture
Industry
Services
Business
Human behaviour



These are currently attuned to the historical climate
We know how they perform now

They may perform differently in the climate of the future

THERE IS UNCERTAINTY ABOUT ...
Precisely how the climate will change
Precisely how we will be affected

... BUT WE ARE CERTAIN THAT
The climate will change
We will be affected


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The challenge

When thinking about how our activities might be affected by climate change ...

Infrastructure
Agriculture
Industry
Services
Business
Human behaviour



There are too many potential climate change risks to examine them all in detail

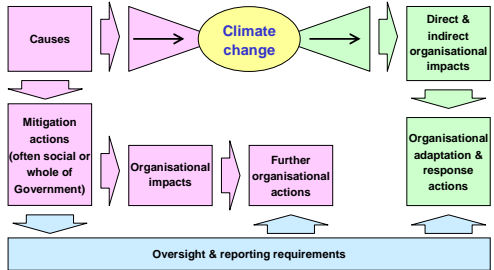
... we need an efficient way to identify the top priorities

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

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Climate change risk management: overview, causes and impacts



Causes → **Climate change** → **Direct & indirect organisational impacts**

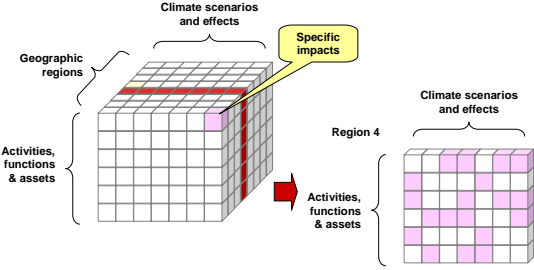
Mitigation actions (often social or whole of Government) → **Organisational impacts** → **Further organisational actions** → **Organisational adaptation & response actions**

Oversight & reporting requirements

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Climate change risk management: structuring the detail



Geographic regions

Activities, functions & assets

Climate scenarios and effects

Specific impacts

Region 4

Activities, functions & assets

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Climate drivers affect activities, functions & assets, leading to impacts on organisations

Increased temperature & temperature extremes
More frequent and intense rainfall & flooding
Higher peak wind speeds ...

Climate scenarios and effects

Region 4

Activities, functions & assets

Infrastructure assets
Processing technology & systems
Operations
Training
Business processes
Personnel ...

Capability & mission
Environment
Community & sustainability
Safety & well-being
Compliance & reputation
Financial

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Detailed analysis is needed in most cases

Increased temperatures & temperature extremes

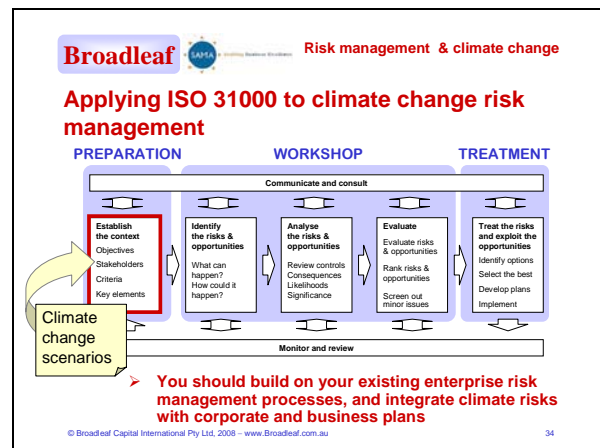
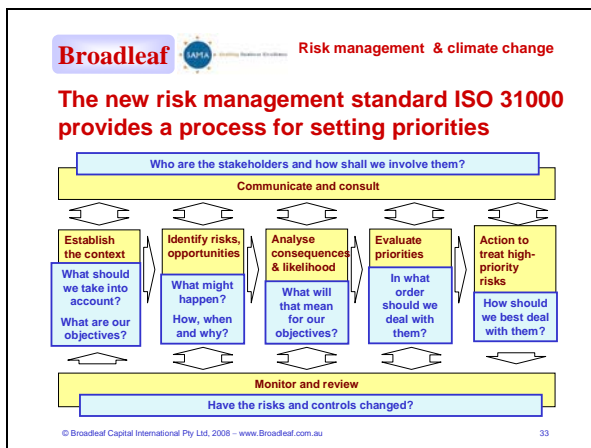
Remote field operations

Personnel

- ☐ Performance
 - Endurance, fatigue, morale
 - Work tempo
- ☐ Health
 - Heat stress
 - Infestations
- ☐ Logistics
 - Water supply
 - Food supply, storage & prep'n
 - Clothing
- ☐ ...

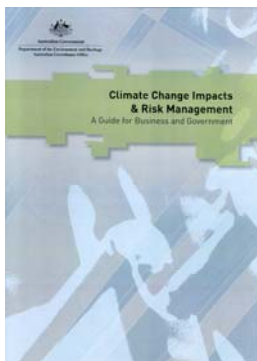
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2.2 ISO 31000 provides an excellent framework for setting priorities consistently



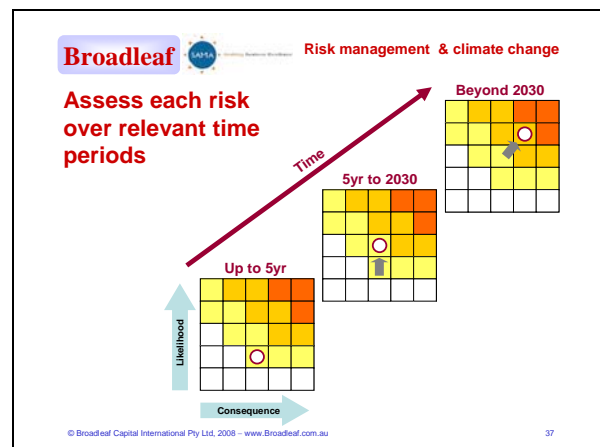
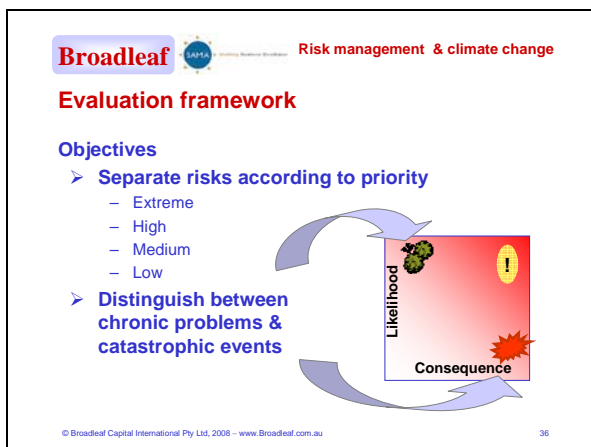
This presentation does not spend much time on the basics of the risk management process – it focuses on how it can be applied to the impacts of climate change.

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 CO₂ may be beneficial in some agricultural areas, although the benefits may be offset to some extent by decreasing yields as temperatures increase.)



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.



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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 page on our web site: www.Broadleaf.com.au/climate/index.html

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