



# 360

RISK PROJECT

# FACT: IF THE SEA LEVEL WERE TO RISE JUST FOUR METRES DUE TO CLIMATE CHANGE, ALMOST EVERY COASTAL CITY IN THE WORLD WOULD BE INUNDATED.

Population Reference Bureau, [www.prb.org](http://www.prb.org), 2006



[WWW.LLOYDS.COM/360](http://WWW.LLOYDS.COM/360)



Since merchants first met to insure their ships at Edward Lloyd's coffee shop over 300 years ago, nearly every aspect of the way we do business has changed. But one constant is the bold confidence proclaimed by our motto, reflected in both our unique appetite for risk and our worldwide reputation for settling valid claims.

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# CLIMATE CHANGE

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# CLIMATE CHANGE

## ADAPT OR BUST

**Until recently, world opinion has been divided: are current weather trends the result of long-term climate change or not? And what role, if any, has climate change played in the recent spate of weather-related catastrophes?**

The facts are often confused by politics and by a wealth of different – and sometimes conflicting – evidence from a range of scientific and other sources.

However, a growing body of expert opinion now agrees that the climate is changing – and that human activity is playing a major role. Most worryingly, the latest science suggests that future climate change may take place quicker than previously anticipated.

There will continue to be much argument, over both the extent of future climate change and its likely impact on society. But whatever the facts, there could hardly be a debate of greater importance to the insurance industry.

The past few years highlight bluntly the cost of weather-related catastrophes for the global economy and the insurance industry in particular. The industry's response has proven that it is financially strong and well-equipped to respond to these financial shocks.

It is equally clear that, so far, the industry has not taken changing catastrophe trends seriously enough. Climate change is likely to bring us all an even more uncertain future. If we do not take action now to understand the risks and their impact, the changing climate could kill us.

In publishing this report, it is not Lloyd's intention to take a particular position, or to support a specific scenario. We simply aim to present the facts from the most reliable sources in a way which we hope will be helpful for those who trade in, and with, our market. We also want to generate debate about the specific steps which we might take as an industry to prepare for the increasing volatility of the climate.

## THANKS & ACKNOWLEDGEMENTS

The scientific work in this report is not original. We wish to express our thanks and encouragement to scientists around the world who are carrying out this vital research. We would especially like to thank Climate Change Risk Management<sup>1</sup>, who have advised us on the scientific elements of the report.

The Intergovernmental Panel on Climate Change (IPCC) published their third assessment of the impact of climate change in 2001<sup>2</sup>. In this report, we refer to it as 'the IPCC report'. Since then, later scientific evidence has emerged in a number of areas, which generally suggests that the pace of change could be quicker and more extreme than previously thought. We also refer to this research throughout the report.

We would also like to thank the following organisations for their support in preparing this report:

Acclimatise<sup>3</sup>  
Insurance Information Institute, New York  
Lighthill Risk Network, London  
Lloyd's Market Association, London

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<sup>1</sup>Climate Change Risk Management's website is [www.ccrm.co.uk](http://www.ccrm.co.uk)

<sup>2</sup>Report URL is [www.grida.no/climate/ipcc\\_tar/](http://www.grida.no/climate/ipcc_tar/)

<sup>3</sup>Acclimatise's website is [www.acclimatise.uk.com](http://www.acclimatise.uk.com)

# EXECUTIVE SUMMARY

## 1 TOO LITTLE BUT NOT YET TOO LATE. THE INSURANCE INDUSTRY MUST DO MORE NOW TO UNDERSTAND AND ACTIVELY MANAGE CLIMATE CHANGE RISK

An increasing wealth of scientific evidence is available to predict the impact of changing weather patterns and future climate change on the insurance industry. So far, efforts to do so have been patchy and there is little evidence of industry behaviour changing as a result. Much of the latest science suggests that climate change will take place faster than we thought. Urgent and active management of climate change – starting with investment in research – is now imperative. It is not too late to change, but change is long overdue.

## 2 RECENT EVENTS HAVE SHOWN CAPITAL AND PRICING MODELS TO BE WANTING. WE MUST REGULARLY UPDATE AND RECALIBRATE OUR MODELS TO KEEP PACE WITH REALITY

Catastrophe modellers have now reacted to criticisms following the recent record US hurricane seasons. However, much of this work could and should have been done prior to these events. Going forward, the industry must take a new approach to underwriting, looking ahead and not simply basing decisions on historical patterns. Insurer pricing and capital allocation models must be updated regularly – and not just in extremis – to reflect the latest scientific evidence. Our responsibilities in this regard will be increasingly widely drawn: regulators will require the industry to maintain a level of capital adequate for changing levels of climate change risk.

## 3 WINDSTORM TRENDS WILL PUT PARTICULAR PRESSURE ON BUSINESSES AND THEIR INSURERS

Based on natural cycles alone, we can expect the current trend towards extreme windstorm events to continue and increase over the next decade. Climate change can only exacerbate this, and insurers must plan for a higher frequency of extreme events, over a longer storm season and over a wider geographical area. Insurers must also take advantage of scientific advances to factor forecasts for the season ahead into their planning, instead of relying only on long-term trends.

## 4 CLIMATE CHANGE MEANS EXPOSURES ARE CHANGING AND NEW ONES EMERGING. INSURERS MUST REGULARLY REVIEW AND COMMUNICATE CONDITIONS OF COVERAGE

We foresee an increasing possibility of attributing weather losses to man made factors, with courts seeking to assign liability and compensation for claims of damage. Exposures can also be expected to increase in respect of property, business interruption and political risks, demanding the same response. That means the insurance industry will want to regularly review conditions of coverage against risk appetite, and do more to educate the public about changing exposures. The industry can help by creating incentives for policyholders to reduce risk. Opportunities for those insurance markets which are flexible and innovative will emerge too: as society adapts to the impact of climate change, new technologies will be required and insurance of these developments will be needed.

## 5 INSURERS MUST PREPARE FOR THE IMPACT OF CLIMATE CHANGE ON ASSET VALUES. UNDERWRITING FOR PROFIT WILL BE KEY

As major corporate investors, insurers rely on returns from assets to boost their own financial performance. We expect climate change not only to produce extreme capital damaging events, but also to increase uncertainty around corporate business plans and potentially reduce asset values. This makes it even more important for the industry to price risk according to exposure and to underwrite for profit. We also see industry players having increased opportunity to use their influence as investors, in order to encourage responsible and climate proof behaviour from the boards of corporations in which they invest, and with which they do business.

## 6 EFFECTIVE PARTNERSHIP WITH BUSINESS AND GOVERNMENT WILL BE KEY TO MANAGING RISK. THE INSURANCE INDUSTRY MUST ENGAGE NOW

Based on long experience, Lloyd's believes that insurance markets operate most efficiently when left to free market forces, and the vast majority of natural perils are insurable – as long as the market is free to price risk adequately. However, if this freedom is removed, or if the pace of climate change grows faster than expected, this could change our view. Industry strategists will want to consider the long-term insurability of weather-related risk. We believe that a meaningful partnership with government and business, supported by a series of practical actions, has the best chance of providing solutions. In particular, this should address the issue of increasing concentrations of population and economic wealth in high risk areas, for example on coasts. This report focuses on adaptation but we recognise that mitigation of the risk itself (ie the reduction of CO<sub>2</sub> emissions) is crucial.

# THE ISSUES:

GREENHOUSE GASES

SEA TEMPERATURES

SEA LEVELS

LAND AND AIR TEMPERATURES

RAIN AND SNOW

UNSTABLE CLIMATE

# GREENHOUSE GASES

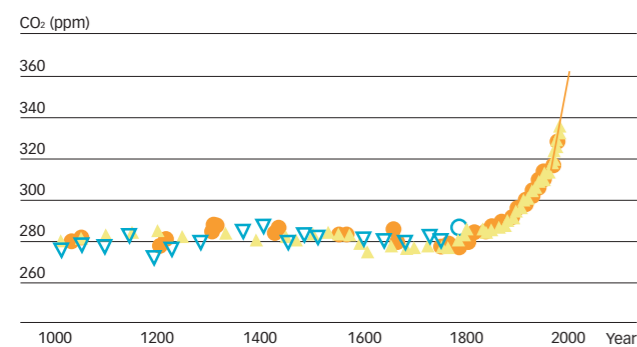
## CO<sub>2</sub> LEVELS ARE AT THEIR HIGHEST LEVELS FOR AT LEAST 650,000 YEARS

### FACTS & STATS

**Future temperature change is dependent on levels of atmospheric greenhouse gases, in particular CO<sub>2</sub>, and to a lesser extent methane and other greenhouse gases.**

Atmospheric carbon dioxide (CO<sub>2</sub>) concentrations are rising fast, from 280 to nearly 380 parts per million (ppm) over the last 150 years, due almost entirely to human activity. That represents an overall increase since industrialisation of 31%.

#### Carbon dioxide



Source: Intergovernmental Panel on Climate Change 2001

Current concentrations are the highest for at least 650,000 years, according to analysis of ice cores, and up to 24 million years based on some geologists.

The IPCC report indicates that concentration of CO<sub>2</sub> could increase by about a factor of two to four above pre-industrial levels by the end of this century. However, recent scientific work suggests that a component of these IPCC scenarios may be underestimated.

In the past, about half of all carbon dioxide emissions have been absorbed by natural 'sinks' in ecosystems and oceans. Until recently, it was assumed that this would continue. However, new studies suggest that this is not a reliable assumption. Rising temperatures could reverse this process, turning some of the present day sinks into future sources of carbon dioxide emissions.

Methane is also an important greenhouse gas whose levels are known to be a contributor to temperature change. Again, concentrations have risen fast. They are now the highest for at least 420,000 years, and have risen 151% since industrialisation.

Methane is a more vigorous greenhouse gas than CO<sub>2</sub>. It absorbs and radiates more heat back to the Earth's surface, causing ocean warming and potentially leading to further emission of methane from the ocean floor and permafrost. Emissions from these sources, though currently unlikely, could be extremely large, contributing to very rapid climate change.

### WHAT DOES IT ALL MEAN?

Although debate continues, the growing body of evidence on greenhouse gases suggests that significant climate change is inevitable. Even if we stopped producing greenhouse gas emissions immediately, we would still experience rising temperatures for decades to come and sea temperatures will continue to rise for many centuries, due to inertia in the climate system.

We might hope that extreme 'tipping points' – the point beyond which change cannot be reversed – can be avoided. However, evidence so far must lead us to conclude that some level of change has already occurred and that it will continue to occur, perhaps at a higher level than previously thought.

One recent paper in Nature warns starkly: "Global warming may proceed at or even above the upper extreme of the range projected by the Intergovernmental Panel on Climate Change."

### WHAT NEXT?

The insurance industry must start actively adapting in response to greenhouse gas trends if it is to survive.

**1** The industry should invest both time and money in business focused academic research. Considerable work is needed to convert scientific predictions into practical guidance for the industry, for example on the financial impact of climate change. In this context, Lloyd's has recently become a core member of the Lighthill Risk Network, a UK organisation

which aims to connect business issues to scientific solutions. Lloyd's is also very supportive of the work currently being undertaken by the Insurance Information Institute to consider the issues around climate change and extreme weather events from the perspective of US insurers and reinsurers.

**2** Going forward, we believe that the insurance industry should take a new approach to underwriting, looking ahead and not simply basing decisions on historical patterns, as has traditionally been the case. Pricing and capital allocation models must be updated regularly to reflect the latest scientific evidence, and not just in extremis, as has tended to happen in the past, for example after Hurricane Katrina. Regulators will add further impetus in this regard. The UK's Financial Services Authority (FSA) has made it clear that industry management must take responsibility: capital must be adequate for the climate risk prevailing at the time, and not just 'on average' over a long period.

**3** In the longer term, strategists will want to consider the future insurability of weather-related risk. Based on long experience, Lloyd's believes that the vast majority of natural perils are currently insurable. However, we recognise that some industry participants take an alternative view. Should insurers be prevented from pricing risk adequately (for example because of regulatory action) or should they fail to do so (because of the pressure of market cycles), this may no longer be the case. Alternatively, if the pace of climate change grows faster than expected, this could change our view.

# SEA TEMPERATURES

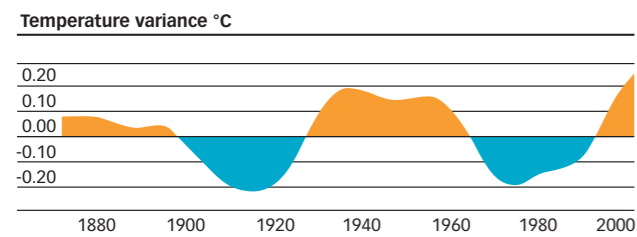
## WE CAN EXPECT SEVERE HURRICANE ACTIVITY FOR AT LEAST THE NEXT 20 YEARS – BASED ON NATURAL CYCLES ALONE

### FACTS & STATS

High sea temperatures are a key ingredient to windstorm formation. The ‘hurricane season’ and ‘typhoon season’ exist because the sea is at the right temperature for a few months each year to allow storms to form.

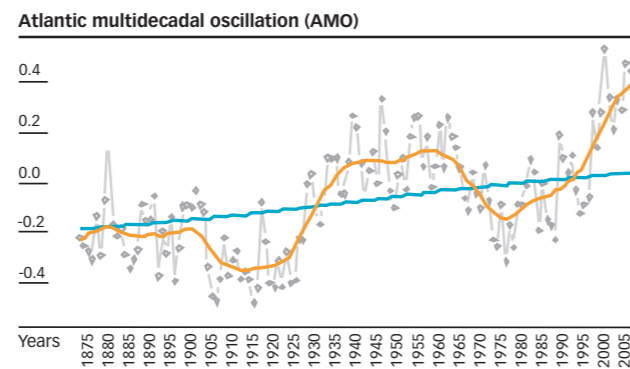
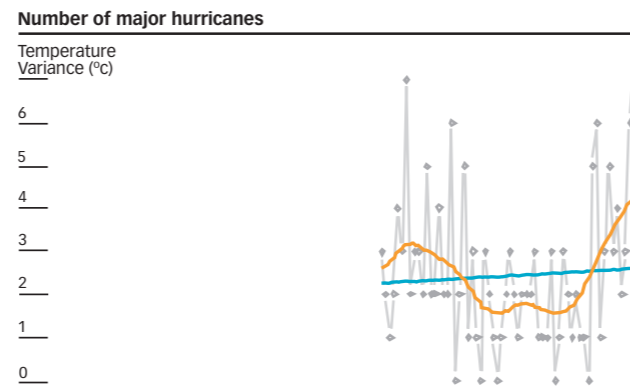
Overall sea surface temperatures globally have risen between 0.2°C to 0.6°C over the past century, according to climate models and observations.

Natural rhythms play a significant role, as analysis in the North Atlantic shows. Here, the effect of natural variation in ocean temperature is expressed as Atlantic Multidecadal Oscillation (AMO). In the 1950s, hurricane activity in the Atlantic was very extreme, demonstrated by the middle peak, shaded orange in the graph below. Likewise, the graph highlights that we entered a new cycle of extreme activity in the 1990s. As the last cycle lasted 30 years, we can expect very severe hurricane activity to continue for the short to medium term due to this natural cycle alone.



Source: Atlantic Ocean Forcing of North American and European Summer Climate Rowan T. Sutton and Daniel L. R. Hodson. Science

However, it is important to realise that the above graph has been deliberately adjusted to remove any long-term temperature trend. If unadjusted average sea surface temperatures in the North Atlantic since 1870 are accurately plotted and tracked we get the following graph.



Source: Data from the National Oceanic and Atmospheric Association

The top graph tracks the actual number of major hurricanes per year with the orange line illustrating the cyclical trend over the period and blue line showing an increasing trend. The lower graph shows the unadjusted AMO cycle. Again the orange line tracks the underlying temperature cycle, while the blue line highlights the increasing long-term temperature trend.

There is clearly a strong correlation between ‘warm’ phases of the cycle and more intense hurricane activity. On this basis, the intense hurricane seasons in 2004 and 2005 can hardly have been a surprise as warned in 2001 by academics.

The long-term temperature trend shows an increase of a little above 0.2°C over the period. Scientists believe that this increase cannot be explained solely by natural causes, with climate change likely having a growing impact.

### WHAT DOES IT ALL MEAN?

Taken together, it suggests that we can now say, with a higher degree of confidence, that observed changes in sea surface temperature are partly due to human activity.

Current high Atlantic sea surface temperatures are of particular concern for the North American economy and for the insurance sector, given the resultant insurance exposures. Recent temperatures are probably outside the range of past oscillations, and seem to suggest we will be caught in an upward cycle for some time to come. It is now vitally important that we monitor and keep pace with scientific developments going forward.

### WHAT NEXT?

The insurance industry must expect and plan for increased windstorm activity.

1 Whether attributable to climate change or not, current sea levels and ocean temperatures are higher in the Gulf of Mexico than in the past. Therefore, severe Atlantic hurricanes are likely to continue in the short to medium term. Insurers with US exposures in particular will want to model and plan for this scenario.

2 As climate change causes temperatures to rise further, insurers should be prepared for increased frequency of extreme storms not just in the Atlantic but around the world, as record typhoon seasons in Asia also show. Warmer sea surface temperatures also appear to make windstorm landfall more likely. This combination means that particularly destructive storms are a likely scenario. Insurers must build these considerations into their risk modelling and pricing.

3 With higher temperatures creating the right conditions for storm formation, we can also expect windstorm seasons to lengthen, causing the insurance industry to be ‘on risk’ for longer each year. For example the recent Tropical cyclone Monica which hit Australia was the most intense cyclone in Southern Hemisphere history and yet it occurred at a time when the season is usually all but over.

4 The industry could become ‘on risk’ over a wider geographical area than previously. For example, a hurricane hit the coast of Brazil in 2004 for the first time, and in 2005 Vince was the first tropical storm to make landfall on the Iberian Peninsula. While these two events do not alone prove climate change, they do illustrate that areas previously ‘hurricane free’ or at lower risk may become more susceptible. Lloyd’s has recently responded to this trend by introducing a Realistic Disaster Scenario to test the financial impact of a hurricane making landfall in New York State. We believe that emerging insurance markets in the Indian sub-continent may also be at risk from a potential increase in tropical cyclone activity in the Bay of Bengal.

5 With more – and more accurate – scientific information now available<sup>4</sup>, insurers are increasingly able to respond to the scientific predictions of each season ahead. This means a shift in emphasis when pricing catastrophe risk – away from basing price on a long-term baseline trend, which only very gradually allows for the impact of climate change.

<sup>4</sup>For example Professor Mark Saunders at Benfield Hazard Research Centre, University College London and Phillip Klotzbach at Colorado State University provide predictions of the coming hurricane season which illustrate the expected level of risk prevailing.



# SEA LEVELS

## COULD THE WEST ANTARCTIC ICE SHEET COLLAPSE? THIS QUESTION NEEDS TO BE REASSESSED

### FACTS & STATS

**Sea level rise is actually very difficult to measure and predict. A significant contribution comes from the thermal expansion of sea water, but the world's continents are also moving – in some cases upwards and some cases downwards.**

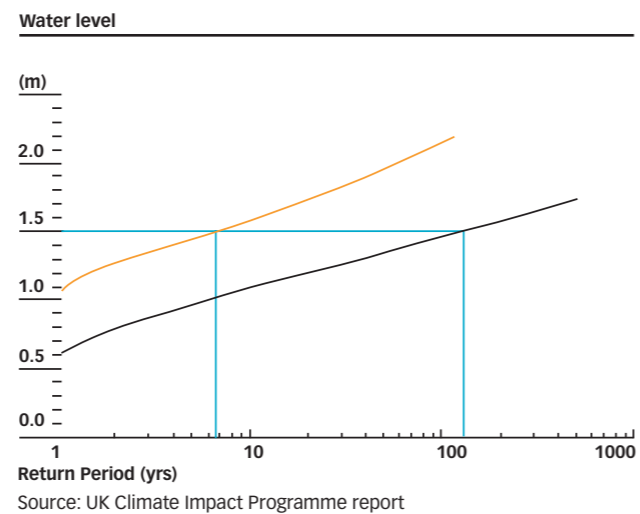
The consensus is that the global average sea level rose by somewhere between 10cm and 20cm during the 20th century.

However, recent studies suggest that future changes could be greater than the IPCC report predicted, with the timeframe for icecaps melting reducing from millennia to hundreds of years. The rate of thermal expansion is also rising, and is projected to continue to increase through the 21st century. Modellers agree that sea level rise will not be geographically uniform, but there is no agreement yet about the geographical pattern.

Today, approximately half the world's population – some three billion people – live within 200 kilometres of the coastline. By 2025, the number is likely to double to six billion if current trends continue unchecked.

These populations will be increasingly at risk from large, sudden changes in sea level, in addition to the slow change we might expect from gradual melting. Land-locked ice does not have to melt to impact sea levels; once it breaks off and floats freely on the ocean the sea level rises immediately.

The following graph (from a UK Climate Impact Report) shows the impact of a 30cm rise in sea levels at the port of Immingham, a typical port in Eastern England. It charts the likelihood of water levels reaching the critical surge height of 1.5m, and shows that under this scenario, this level would be reached much more frequently, converting a 1 in 120 year flood event into just a 1 in 7 year event.



The Antarctic Peninsula has warmed five times more than the global average with around 13,500 km<sup>2</sup> of ice shelf lost over the past 50 years and 40% of this happening in the last decade.

Many smaller Antarctic glaciers have undergone significant recent recession (shrinking), while there is evidence that some of the large ice shelves are now in recession too.

At the time of the IPCC report, the major West Antarctic Ice sheet was thought to be stable for many years to come. Recent research has begun to question this assumption, and the likelihood of collapse now needs to be reassessed. Such a collapse could lead to rapid increases in sea level, of a scale up to seven metres if the sheet were to melt completely.

Moving north, the tipping point for melting of the Greenland ice sheet will probably be met during the next 20 to 50 years. The latest research indicates that glacier speed has almost doubled in the last decade. Complete melting might take millennia, and will raise levels by at least another seven metres. But research suggests that once it begins to contract it may not expand again, even if atmospheric greenhouse gas concentrations were reduced back to pre-industrial levels.

### WHAT DOES IT ALL MEAN?

Although rising sea levels are often viewed as a long-term issue, society could also be impacted in the short-term. Precise predictions are very difficult to make, but we do know that, driven by melting ice, society will experience very significant sea level rises over the coming centuries, threatening huge concentrations of population and economic activity. The trend is probably irreversible, and certainly unpredictable, likely to result in sudden periods of catastrophic melting.

If the level were to rise in excess of four metres almost every coastal city in the world would be inundated, with severely negative implications for economic and political systems, and a severe impact on the commercial insurance market. Even small rises in sea levels are likely to create severe economic and demographic problems, since large populations are concentrated near present sea level.

Should glaciers decline rapidly, this could also have a significant negative impact because one sixth of the Earth's population currently rely on glaciers for their water supply. For example, rapid melt could have the effect of slowing major rivers, such as the Rhine, to a trickle.

### WHAT NEXT?

**1** The insurance industry will want to consider more closely the increasing concentrations of exposure in coastal areas. Even small sea level rises have a dramatic effect in reducing the standard of protection offered by coastal defences. This leaves coastal cities at risk in times of additional stress, for example during storm surge, as we saw in New Orleans. We do not need to wait to reach 'ultimate' levels to start seeing considerable damage.

**2** Insurers will want to regularly review their risk appetite to keep pace with change. They may consider withdrawing or restricting cover in flood-prone hotspots. They might do more to encourage simple risk management measures such as placing a cap on contents insurance to encourage policyholders to take steps to protect their more valuable property – for example keeping electric equipment away from the floor in flood zones.

**3** Solutions must be found now to reverse the trend towards further increasing population concentrations in affected areas, especially coastal areas. We believe that a meaningful partnership between government, society and the insurance industry has the best chance of success. This should lead to appropriate land-use and building policies for affected areas, with construction in high risk areas discouraged, and the insurance industry creating incentives for policyholders to respond appropriately to manage risk, building these into terms and conditions of policies.

**4** Lloyd's welcomes discussion with government and regulators about appropriate catastrophe insurance structures for the future. Our experience is that insurance markets operate most effectively and most efficiently when left to free market forces. We recognise that some industry participants may take an alternative view. We also acknowledge that there are some exceptions to this rule. Alternative solutions may be called for where the economic impact is potentially more than the private market is willing or able to bear, for example for terrorism. But, unlike terrorism, we should be able to model the impact of natural disasters with increasing accuracy, so that exposure can be managed and risk spread.

# LAND AND AIR TEMPERATURES

## THE 1990S WAS THE WARMEST DECADE FOR A THOUSAND YEARS

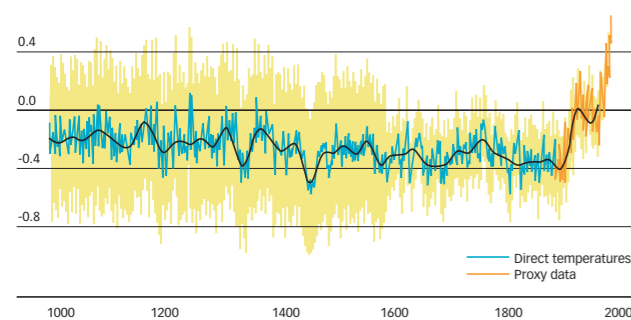
### FACTS & STATS

**In addition to sea temperatures, land and air temperatures provide an important measure of climate variation, and have been reliably monitored for many decades.**

It is generally agreed that the 1990s was the warmest decade, and 2005 the warmest year, in a millennium. The below well known graph illustrates that current temperature levels are well out of line with the past.

#### The past 1000 years (Northern Hemisphere)

Departures in temperature in °C  
(from the 1961-1990 average)



Source: Intergovernmental Panel on Climate Change 2001

The projected rate of increase in global temperatures for the 21st century is likely to be the fastest of any century in the past 10,000 years.

Some of the causes of these trends are natural. However, scientists have now shown beyond reasonable doubt that global warming caused by human activity is also a key factor.

Recent evidence suggests that the impact will be worse than the IPCC report predicts. One reason for this is that natural carbon sinks are not performing as well as they have in the past. A second reason relates to global dimming. Global dimming is caused by air pollution reflecting the sun's energy back into space; in a sense the opposite of the greenhouse effect. Higher levels of pollution in the past have masked the impact of global warming and some scientists have recently suggested that their projections for warming have been understated.

Forest fires are expected to increase in frequency and severity under most predicted scenarios. In some areas, it is estimated that fire frequency and areas affected could double by 2069.

Temperatures are expected to rise fast in Northern & Western Europe. According to some experts, 2003's record summer could become the norm by the middle of the century, leading to higher rates of mortality and serious illness.

### WHAT DOES IT ALL MEAN?

Increasing temperatures present significant risks for urban and rural communities across the world. Issues such as subsidence, lower water quality and shortages and overheating in buildings are all likely. With increasing development taking place at the forest/urban fringe, greater economic loss will result from forest fires in the future.

The health of older age groups and the urban poor will be most affected by heatwaves, particularly in Western Europe. This will be accompanied by increased heat stress in livestock and wildlife, shifts in tourist destinations, increased risk of damage to some crops, increased electric cooling demand and reduced energy supply reliability.

### WHAT NEXT?

Higher land and air temperatures raise a number of concerns for insurers.

**1** Property insurers will want to monitor aggregations of risk in the expanded areas likely to be affected by forest fires, and prepare for the likelihood of increased subsidence events as a result of hotter drier summers in some areas. Climate scientists can not be sure precisely which areas will

be affected; this uncertainty just leads to increased risk which should be priced accordingly.

**2** We foresee an increasing possibility of attributing weather-related losses to man-made climate change factors. This opens the possibility of courts assigning liability and compensation for claims of damage. Legal liability is now being actively pursued by several groups of lawyers and scientists who wish to use the same lines of argument as used against tobacco companies. If the courts conclude that damage was reasonably foreseeable then liability could follow, as would the search for 'deep pockets' to meet the costs, with insurers a likely port of call.

**3** In addition, insurers should carefully consider business interruption clauses in their policies, which may be called upon more regularly in future.

**4** But rising temperatures could also present insurers with potential opportunities. Society will adapt to change, and new technologies will be developed. The economy will require insurance for these innovations, and markets such as Lloyd's, which have the appetite and expertise to provide cover, could benefit from new business streams.

# RAIN AND SNOW

## IN 2005 THERE WERE RECORD WATER LEVELS AND FLOODS IN SWITZERLAND, AUSTRIA AND GERMANY AND INSURED LOSSES OF \$1.7BN

### FACTS & STATS

**Changing patterns of precipitation are likely to be a further result of climate change, with a potentially significant impact on society and the environment. Urban drainage systems were designed on historic climate data and will not meet the challenges of the future, leading inevitably to significant increases in insurance claims.**

Whether or not related to climate change the number and intensity of heavy snow and rainfall events has increased in mid to high latitudes in recent years. Examples include Italy's heavy winter snowfalls in 2004/05, Europe's summer floods in 2002 and other events such as the Carlisle and Boscastle flash floods in the UK.

Studies show that the number of extreme rain and snow-related events is expected to increase faster than the trend line for precipitation itself, as climate change alters weather patterns

and makes them less predictable. Different parts of the world will experience very different changes in precipitation. In the UK we can expect a greater proportion of annual rainfall in the winter months.

Research shows that the potential increase in landslide frequency varies both with rainfall duration and the level of total annual precipitation. Canadian research suggests that in areas currently getting around 1,300mm of annual rainfall, an increased in average annual precipitation of 10% could almost double the likelihood of landslides, with the average return period falling from 10.4 to 6.3 years.

Regions where glaciers are in recession are particularly prone to instability – catastrophic rockfalls, debris flows and glacial lake flash floods are potential major hazards. In regions where economic activity is either dependent upon the natural resources of glacial areas, or is concentrated in these areas, landscape instability becomes a growing issue.

### WHAT DOES IT ALL MEAN?

Once again, the scientific evidence points to increased volatility of insurance losses due to extreme events. There are many issues to consider: scarce water resources will affect the population and business alike.

Soil erosion will increase, affecting crop yields and also reducing the ability of the ground to absorb water; in turn this will increase flood risk.

In other areas, changing patterns of precipitation will cause, or increase, drought.

### WHAT NEXT?

There are a number of areas insurers should consider in preparation.

**1** We foresee increased pressure on governments and the insurance industry for disaster relief. It will be increasingly important to think proactively about 'on the ground' response to flood events and work closely with government and disaster relief agencies on disaster planning.

**2** Insurers should plan for increased flood risk in areas expected to suffer greater rainfall. Scientific information can and should be used to adjust loss distributions, for example those used in the UK regulator's Individual Capital Assessment (ICA) modelling and pricing. In many cases the information is available and waiting to be adapted and used.

**3** As recent events in Europe and North America show, structural damage is a major risk when extreme hail, ice and snow events occur. The insurance industry should consider how best to work with government to ensure that stricter building codes are developed where necessary, that they are more consistently enforced, and that these are more closely linked to policy terms and conditions. In particular pricing for older properties should consider the additional risks they pose.

**4** Weather derivatives and pluvial policies are especially at risk of becoming mispriced as weather patterns change. Insurers involved in these products should review and update pricing parameters regularly.

# UNSTABLE CLIMATE

## THE PAST CLIMATE IS MUCH MORE VARIABLE THAN WAS THOUGHT. COULD IT HAPPEN AGAIN?

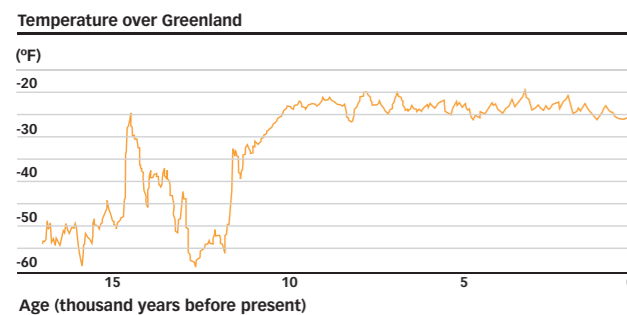
### FACTS & STATS

**Long-term historic climatic patterns are now known to be much more volatile than the stability of the recent past would make us believe.**

Until about 30 years ago, most experts agreed that climate change occurs slowly.

After analysis of ice-core records from the Greenland and Antarctic ice sheets, it is now clear that change has been very rapid at times.

The graph below shows changes in temperature in Greenland, a useful guide for the Northern hemisphere, over the last 17,000 years. It shows that, beyond the past 10,000 years, the temperature was significantly more variable than it is today – in the Northern hemisphere at least.



Source: 2 Mile Time Machine; Richard Alley

If the climate sensitivity of the atmosphere is indeed higher than we originally believed, it is possible that the relatively benign phase of weather and climate we have enjoyed more recently could end very suddenly.

We do not subscribe to scare stories, and we do not know how the climate will react to the highly elevated CO<sub>2</sub> levels. However, while some use this uncertainty as an excuse for inaction, prudent risk managers will take the opposite view. If uncertainty has increased, so has risk, and we must seek to manage it.

### WHAT DOES IT ALL MEAN?

The impact of small-scale climate fluctuations over the last 1,000 years, perhaps 0.5°C had a significant impact on society at the time, such as the Akkadian empire which failed owing to severe drought, or the Tiwanaku culture which was wiped out several thousand years later. Future temperature changes are likely to be even greater and despite advances in society and the economy, we might experience major disruption as a result.

### WHAT NEXT?

Insurers need to consider the impact that an unstable climate could have on global asset values, which may generate a mismatch against insurance liabilities. Asset values tend to react to new information as soon as it is known, and adjust accordingly even if the effects are likely to take effect some time in the future.

**1** Insurers rely on returns from assets to boost financial performance. If these returns reduce, whether gradually or suddenly, then insurer profits will be lower. Consequently, it will become even more important for insurers to price risk according to exposure, and to underwrite for profit, without reliance on investment income.

**2** The global financial services industry holds a significant proportion of the world's financial assets. Insurance industry participants can therefore make a difference by using their influence as investors to encourage 'climate proof' behaviour from the boards of large corporations.

**3** In addition to economic disruption from unstable climate, political unrest may result from competition for water and other resources, forcing demographic changes. Policies in respect of political and terrorism risks should be reviewed regularly to ensure the level of risk is within appetite.

# CONCLUSIONS:

- We don't know exactly what impact climate change will have. But we do know that it presents society and the economy with an increasing level of uncertainty as it seeks to manage its risk.
- We believe that it is time for the insurance industry to take a more leading role in understanding and managing the impact of climate change.
- This means that the industry can no longer treat climate change as some peripheral workstream, simply to tick the regulatory and compliance box, or to support its public relations strategy.
- Instead, understanding and responding to it must become 'business as usual' for insurers and those they work with. Failure to take climate change into account will put companies at risk from future legal actions from their own shareholders, their investors and clients.
- Climate change must inform underwriting strategy – from the pricing of risk to the wording of policies.
- It must guide and counsel business strategy – including business development and planning.
- And it must lie at the heart of a new impetus to engage with the wider world through meaningful, tangible partnerships to mitigate risk – bringing corporate and social responsibility plans to life.
- The insurance industry must now seize the opportunity to make a difference, not just to the future of our own industry, but to the future of society.

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