



Severe weather in North America

Perils · Risks · Insurance

Executive summary

Knowledge Series

Natural Hazards

Preface

North America has been particularly hard hit by weather catastrophes in recent years: Hurricane Katrina, tornadoes, floods, wildfires, searing heat and drought. The intensities of certain weather events in North America are among the highest in the world, and the risks associated with them are changing faster than anywhere else. These developments form the backdrop to our new publication *Severe weather in North America: Perils · Risks · Insurance*. Changing weather risks not only affect society in general but also have a huge impact on the insurance industry, which needs to find adequate responses in the form of innovative insurance solutions.

In order to support this process, various experts from different units at Munich Re and a number of renowned guest authors shed light on the basic concepts and physical principles behind natural hazard phenomena, explain their occurrences and impacts, and analyze resulting loss events. They describe the underlying factors of changing risk, including climate variability and climate change. Munich Re's geoscientists are at the forefront of the latest research and work in close contact and cooperation with scientists from all relevant fields. *Severe weather in North America* also gives advice on risk reduction and on how to prepare for and deal with extreme events. Implications are drawn for the North American insurance markets based on the findings presented.

This brochure summarizes the key findings and messages of the detailed publication, which spans more than 270 pages. It is intended to whet your appetite and inspire you to read the in-depth version.

I believe that this publication will benefit not only clients transacting weather-related business but the public in general, as North America prepares to address the weather risk changes that lie ahead.



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Member of the Munich Re Board of Management
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Severe weather in North America

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The publication *Severe weather in North America* provides a comprehensive overview of weather hazards and risks in North America. It discusses perils, related losses, risk mitigation and insurance issues. Nowhere in the world is the rising number of annual natural catastrophes more evident than in North America. This increase is entirely attributable to weather events, as there has been a negative trend for geo-physical events. Results of the data and scenarios analyzed show that, due to socio-economic factors such as ongoing urbanization and increasing values, the potential for weather-related losses in North America is still rising. In addition, new technologies may give rise to new risks. Natural hazard insurance will therefore remain a challenge, with climate change bringing further uncertainty.

The publication is divided into three parts: perils, risks, and insurance.

Perils

The first part, perils, describes the various weather-related hazards in nine sections. For each peril and its secondary effects, the individual sections explain physics and characteristics, provide maps outlining threatened regions, look at outstanding historical events, present statistical analyses, and suggest risk-reducing prevention measures. Furthermore, peril-related insurance issues and underwriting aspects are discussed in each section.

- Winter storms can occur year-round despite their name. The types of hazard they produce vary greatly by region.
- Tropical cyclones (hurricanes) are among the most devastating weather events in North America. Hurricane indices may be useful for initial loss estimates. Offshore platforms and a possible scenario on the northeast coast constitute extraordinary risks.
- A strong upward trend in insured losses caused by severe thunderstorms has been observed in recent years. This hazard will most likely increase further as the climate changes.

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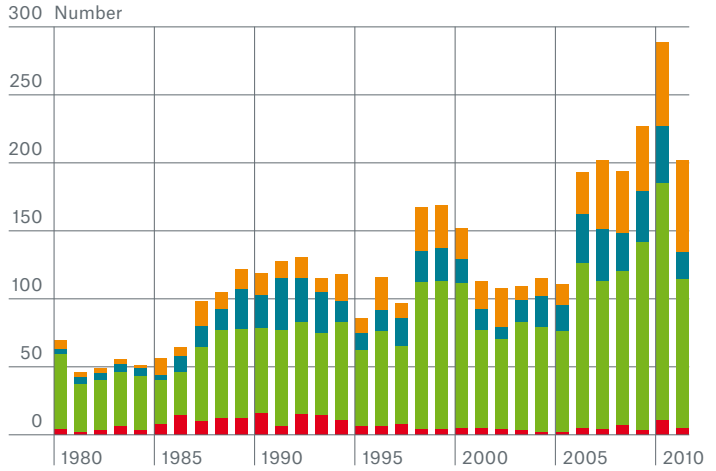
Perils

Winter storms
Tropical cyclones
Thunderstorms
Inland floods
Landslides
Subsidence and heave
Heatwaves and droughts
Wildfires
Natural perils in Canada

Natural catastrophes in North America 1980-2011: Number of events

- Geophysical events
- Meteorological events
- Hydrological events
- Climatological events

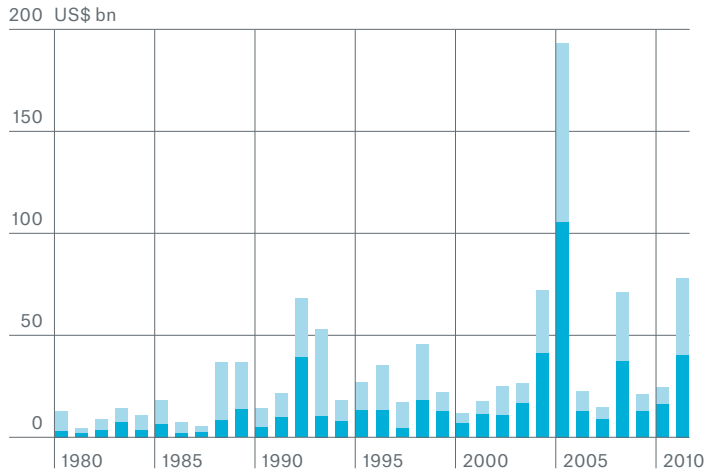
Source: Munich Re, NatCatSERVICE



Weather catastrophes in North America 1980-2011: Overall and insured losses (US\$ bn, 2011 values)

- Overall losses
- Insured losses

Source: Munich Re, NatCatSERVICE

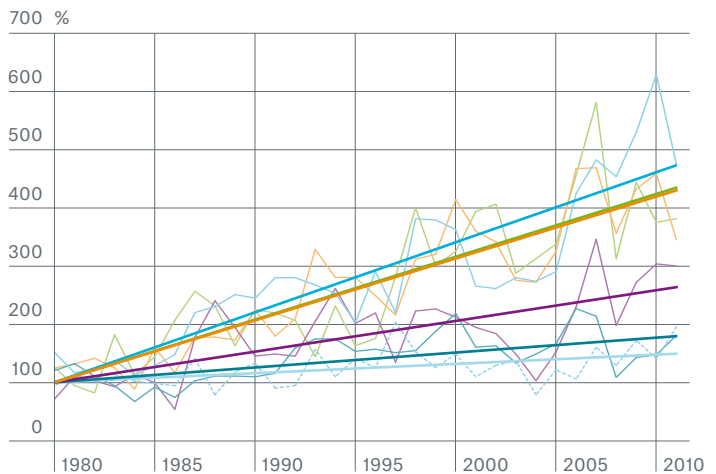


Upward trends in weather-related loss events per continent, 1980-2011

Remark: This analysis considers events in the United States, Canada, the Caribbean and Central America.

- North America
- Australia/Oceania
- Asia
- Africa
- Europe
- South America

Source: Munich Re, NatCatSERVICE



- Inland flooding, one of the most common hazards in North America, ranges from watershed-wide to local events. The ARkStorm scenario, a severe type of flood event could potentially strike California and involve costs in the order of hundreds of billions of dollars.
- Landslides may happen throughout North America. Even though they are geological hazards by nature, they are frequently set off by weather events.
- Subsidence and heave are also often triggered by weather phenomena. The heave hazard is not in the public focus, but highly relevant as it produces immense losses each year.
- Heatwaves and droughts are extreme deviations from regional temperature and rainfall norms. They feature a wide variety of consequences ranging from impacts on agriculture to human health. A highly relevant issue is maintaining stable power supplies.
- The wildfire hazard can be directly influenced by human activity. Therefore, prevention measures can be crucial. Third-party liability insurance is also an issue here.
- Weather perils in Canada comprise particularly floods, wildfires, severe winds and winter storms. Urban growth, aging infrastructure and climate change are expected to alter the risk situation.

Risks

The second part, risks, looks initially at climate variability and climate change. Phenomena caused by climate variability, such as the Atlantic Multidecadal Oscillation (AMO) and El Niño Southern Oscillation (ENSO), and their influence on severe weather are examined. In the long term, anthropogenic climate change is believed to be a significant loss driver, though it influences various perils in different ways. For instance, it particularly affects formation of heatwaves, droughts, thunderstorms and – in the long run – tropical cyclone intensity. Short- and mid-term natural climate variability also play a crucial role in the latter. Climate-related changes in hazard – other than increases in exposure – are not automatically reflected in the premiums.

Three components, hazard, exposure (or values at risk) and vulnerability contribute to the risk. While hazards are inherently natural, humans determine where values are placed and how they are protected. An example is presented showing how a risk map is constructed.

Contents

Risks

Climate variability and
climate change
Risk = Hazard · Exposure ·
Vulnerability
Reducing vulnerabilities
through science

Ways to reduce the vulnerability of houses to wind, rain and wildfire are investigated by scientists at the Insurance Institute for Business & Home Safety (IBHS). By subjecting full-scale structures to a variety of weather conditions, they are trying to find weaknesses and develop solutions to create safer housing.

Insurance

The third part, insurance, presents a coverage summary of weather-related losses in the United States and Canada. In both countries, windstorm, hail, lightning, wildfire, and snow load are covered under the standard homeowners and commercial/business owners' policies. Flood coverage in the USA is available up to certain limits via the National Flood Insurance Program. In Canada, standard cover can be extended by flood insurance endorsements. Agricultural insurance and weather derivatives, two sectors which are not only concerned with catastrophic, but also with non-extreme weather conditions are also addressed.

Meeting the challenge

With losses in all types of severe weather events in North America increasing, combined efforts are necessary to manage these perils. All parties must work together to find solutions for mitigation and adaptation.

The North American continent is unique with regard to weather phenomena. The continent is exposed to every type of hazardous weather peril – tropical cyclone, thunderstorm, winter storm, tornado, wildfire, drought and flood. In reviewing the last 30 years of activity, it is clear that the intensity and frequency of most event types are on an upward trend, ultimately leading to growing economic and insured losses. This publication describes in great detail what is occurring in North America and the impact on society and the insurance industry, all of which leads to the question we continue to address – how do we effectively manage these risks?

The roots of our current U.S. efforts start with the devastation caused by Hurricane Andrew 20 years ago. This event served as a wake-up call for the country and the insurance industry as it highlighted our own "perfect storm" of loss potential: extreme weather events combined with a high accumulation of value, resulting in extraordinarily large property damage and loss of life. At that time, Hurricane Andrew was the largest insured loss in the United States due to a natural catastrophe. In response to Hurricane Andrew, several organizations partnered with the insurance industry to develop models to assess the risk and estimate maximum losses from wind-

Contents

Insurance

- Insurance aspects – United States
- Insurance aspects – Canada
- Agricultural insurance
- Weather derivatives

related events. However, loss events like Hurricanes Ivan (2004), Katrina, Rita and Wilma (2005), Ike (2008) and the Joplin tornado (2011) proved that wind-related loss potential was often greater than what the models predicted.

Severe weather has also affected Canadians across the country from diverse sources of events including the Slave Lake, Alberta wildfire (2011), the Quebec ice storm (1998), the Ontario rainstorm (2005) and the Alberta hailstorm (2010). Although largely not modeled, the frequency of these events is increasing and predictive efforts must be increased.

It seems we are always behind the curve, as the volatility of weather risks continues to increase and damages grow. What these models did not anticipate was socio-economic development, which is the most significant factor in large loss events. The population is growing and moving into more exposed areas like coastal regions. City boundaries are expanding, and former rural regions are becoming populated. Meanwhile, property values increase as our standard of living rises. When global warming combines with natural weather cycles such as the El Niño/La Niña phenomena, the risk of severe weather is intensified and these factors will result in even larger loss costs from natural peril events than what we have seen so far.

What can be done about this development? An alliance between homeowners, businesses, scientists and researchers, state/provincial and federal government and the insurance industry is needed to prevent and mitigate the results of such extraordinary events. All entities need to increase their awareness and understanding of the increased risks in exposed regions and how they can adequately prepare for a catastrophe. Properties in flood-exposed areas and inland locations still prone to hurricane exposure are good examples of areas that require heightened scrutiny.

Here are just a few examples of what each segment can focus on:

Homeowners

- Implement safe and affordable measures to protect property and life. Examples of these measures can be found on websites of organizations such as the Insurance Institute for Business and Home Safety, the Insurance Information Institute and the Institute for Catastrophic Loss Reduction;
- Prepare an effective evacuation plan;
- Ensure your home is properly covered for natural perils that are common in your area.

Businesses

- Rent or build enhanced structures that protect consumers and workers in commercial buildings, and enable quicker recovery from a catastrophe. Relatively low-cost building mitigation measures can significantly improve commercial building performance;
- Properly maintain equipment and facilities to protect against future damage.

Scientists and researchers

- Continue improving forecast and early-warning systems;
- Develop enhanced hazard mitigation to protect life (safety rooms and shelters) and property.

Governments

- Allow insurance premiums to adequately reflect risk, thereby indicating to the public the safety level of their homes and businesses;
- Promote preventive or protective measures that reduce vulnerability to property loss;
- Update flood maps;
- Strengthen dams, levees and infrastructure;
- Develop and enforce effective building codes that can withstand the weather events for that region and implement improved land-use planning with focused consideration of weather-related risks;
- Identify a means of coverage for risks the insurance industry cannot assume;
- Continue to support such programs as the National Atmospheric Administration's (NOAA) Weather-Ready Nation, dedicated to building community resilience in the face of increasing vulnerability to extreme weather and water events;
- Promote research and development in extreme-event meteorological sciences within Environment Canada.

Insurance industry

- Continue efforts to educate and advocate with all of above groups on the value of loss prevention and mitigation;
- Support organizations such as the Insurance Institute for Business & Home Safety that are working towards solutions for stronger construction methods;
- Understand all aspects of the risk and the correlated dynamics.

Detailed exposure and loss data, current hazard maps and vulnerability information are crucial to estimate loss potential from natural perils – particularly if they address the tail-end of the loss distribution, or in other words, have high return periods.

Risk-adequate premiums are necessary to guarantee sustainable insurability. The U.S. National Flood Insurance Program (NFIP) is a negative example of how subsidies over decades result in insufficient insurance cover, incentives to build houses in highly exposed areas and multi-billion dollar deficits in a very tight financial framework. Munich Re supports the reformed NFIP and appreciates the willingness of the U.S. Congress to address the immense flood exposure in the U.S. With the signing of the Flood Insurance Reform Act in July 2012, the government recognized that risk-adequate premiums are necessary to provide the protection people need. Only through measures such as this can the insurance principle of spreading risk be achieved. We continue to be interested in a dialog about how sustainable flood insurance can be provided, and will consider playing a role in this concept.

The weather risks that North America is facing in the 21st century are complex, have various facets and require combined efforts to master them. On the one hand, changing climate conditions create higher loss levels that are not immediately compensated. On the other hand, as in many parts of the world, exposure growth will continue to be the major factor in driving up the cost of future weather-related losses. Viewed from an insurance perspective, the two combined result in increased loss levels which will need to be reflected in increased, risk-adequate premiums. However, this is not a sustainable model. Clearly, from a risk management perspective, it is of crucial importance to learn about this risk of change and find mitigating solutions.

Wherever there are risks there are opportunities for the insurance industry. With the right partner, solutions can be found. Munich Re has the experience and expertise to find solutions for these risks and is willing to provide significant capacity and security to do so.

Knowledge Series

Natural Hazards

Weather risks are changing faster in North America than anywhere else in the world. *Severe weather in North America* addresses weather hazards on that continent from the viewpoint of a leading reinsurer. It has been written by experts from Geo Risks Research and other units within Munich Re, with contributions from renowned guest authors.

The publication sheds light on the basic concepts and physical principles behind natural hazard phenomena, explains their occurrences and impacts, and analyzes resulting loss events. The underlying factors, including climate variability and climate change, are described and supported by a wealth of statistical evidence.

Severe weather in North America also gives advice on risk reduction and on how to prepare for and deal with extreme events. Implications are drawn for the North American insurance markets based on the findings presented.