Munich RE

TOPICS GEO

Natural catastrophes 2009
Analyses, assessments, positions

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In February 2009, the Australian state of Victoria suffered its worst bushfires for 100 years, in which 173 people lost their lives. Overall losses came to US$ 1,300m, of which just under 50% was insured. The photo shows a fire front east of Melbourne.

EDITORIAL

Although 2009 was a year of relatively moderate losses, with no exceptionally large natural catastrophes, the actual number of events continued to rise.

China has substantial exposure to natural hazards, and the risk of earthquakes, typhoons and floods is very high. We continue the series of country surveys that began with India in 2007 by taking a look at China. Although only 1–2% of natural catastrophe losses are insured in this fast-growing economic power, it is developing into a key insurance market. Munich Re, with its local presence, is a reliable partner for those seeking insurance solutions.

China has a twofold exposure to climate change: on the one hand, it is a major emitter of greenhouse gases and, on the other, it is directly impacted by climate change. We analyse the latest major findings yielded by global climate research together with the outcome and consequences of the climate summit in Copenhagen.

Last year, overall losses were at their lowest since 2001. The most expensive event was Winter Storm Klaus, which produced an overall loss of US$ 5bn and an insured loss of US$ 3bn. The event with the highest number of fatalities was the Sumatra earthquake, in which 1,200 died, whilst the death toll from Australia's severe bushfires and heatwaves was 500. The fires destroyed some 4,300 km^2 of land and laid waste to entire communities. We explain how Munich Re is responding to the growing loss potential.

Once again, special issues have been published for readers in the United States, Asia and Australasia/Oceania, featuring topics and statistics of local relevance. A detachable World Map of 2009 Natural Catastrophes, providing information on the main loss events, can be found on the inside back cover.

I hope you enjoy reading Topics Geo and find many of the articles useful for your work.

Munich, February 2010

Dr. Torsten Jeworrek

Member of the Board of Management and
Chairman of the Reinsurance Committee


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CHINA SURVEY

China, the world's fastest growing economy and a flourishing insurance market, is also prone to earthquakes, typhoons and floods. This survey examines these natural hazards, their effects on the insurance industry and the consequences of climate change.

Guangzhou, with its ten million inhabitants, is one of the country's main industrial and commercial centres as well as one of its most vibrant cities. For some time now, the construction industry has enjoyed an uninterrupted boom in this "global factory".

SLEEPING GIANT

No country has benefited more from globalisation in recent decades than China, where cities of over a million inhabitants are sprouting like mushrooms. However, China is increasingly susceptible to natural catastrophes due to a number of complex geological and climatic factors.

Authors: Tobias Farny, Eberhard Faust, Wolfgang Kron, Ernst Rauch, Michael Spranger, Werner Teichert

Tradition and technical progress exist side by side in China, where the spread of industrialisation continues unabated. Bicycles are being replaced by cars: in 2004, there were 30 million motor vehicles on China's roads and the current figure is 70 million. The government has therefore taken action to contain China's enormous environmental and traffic problems, and public officials now have to cycle to work or use public transport.

China has made immense progress since the political and economic reforms of the late 1970s heralded the opening of its doors to the outside world. Poverty has declined considerably according to the World Bank. China, the "workbench of the world", has become a major player in the global economy. Even the worldwide economic crisis left the country almost unscathed. Estimates indicate that the rise in gross domestic product could be 8% in both 2009 and 2010, well ahead of world economic growth. If this surge continues, China will reach or surpass the economic performance of the USA sometime between 2020 and 2025 to become the largest economy.

The skyscrapers sprouting up in China's metropolitan centres are unmistakable signs of its new-found wealth. At the same time, however, property assets like these are being built in regions exposed to natural perils. The Pudong district of Shanghai, for example, used to be a marshy, uninhabited river delta. Today, it is almost as densely developed as Manhattan, which creates new problems. Water is being squeezed out from under ground by the weight of the buildings and groundwater withdrawal is causing ground compaction. As a result, the terrain is sinking, thus increasing the risk of flooding. As in many other coastal areas, here too the threat will be further aggravated by rising sea levels due to climate change. According to the 2007 IPCC (Intergovernmental Panel on Climate Change) report, a combination of geological and climatic effects will lead to a sea-level rise of between 0.5 and 0.7 m in the Yangtze delta by mid-century. This is well above the worldwide average.

Not only are the coasts at risk. The many inland areas located along China's extensive river system will have to deal with floods costing billions of dollars in losses. Major flooding is a possibility in summer along the middle and lower reaches of the longest river, the Yangtze, the terrain east of the Tibetan plateau being relatively flat and the river losing only 100 m in altitude over a distance of 1,500 km on some stretches. The Yellow River (Huang He), which owes its name and colour to the considerable quantities of suspended sediments it carries, is also a significant potential hazard. Its extensive dykes have had to be raised several times due to sediment deposits. The river bed is now 12 m above ground level in places but, despite the potential danger, high population density and settlement pressures make it virtually impossible to restrict settlement in areas declared flood plains.

That is one of the reasons why flood losses have risen dramatically in recent decades, the ten largest events since 1980 accounting for an aggregate loss of over US$ 135bn. Insured losses make up no more than 1–2% of that figure.

Local torrential rain is very important from an insurance perspective. Since flooding caused by such events is extremely difficult to forecast, it is therefore impossible to take steps to mitigate losses. In the Pudong district of Shanghai rainwater can sometimes reach depths of over a metre and cause major damage to hotels, shops and the numerous warehouses. Virtually all towns and cities in eastern China are prone to torrential rain, and the capital Beijing also suffered floods following a thunderstorm in July 2006.

The Chinese state authority for flood and drought prevention has recognised the flood risk and warned the population to be prepared for extreme weather conditions. Government efforts, especially since the catastrophic floods on the Songhua and Yangtze in 1998, have been aimed at building dams, water retention basins and dykes to reduce the risk. Vast sums have been invested in flood protection, primarily along the Yangtze. Although it is claimed that the higher dykes can withstand even a once-in-a-century flood, there is no such thing as 100% certainty.

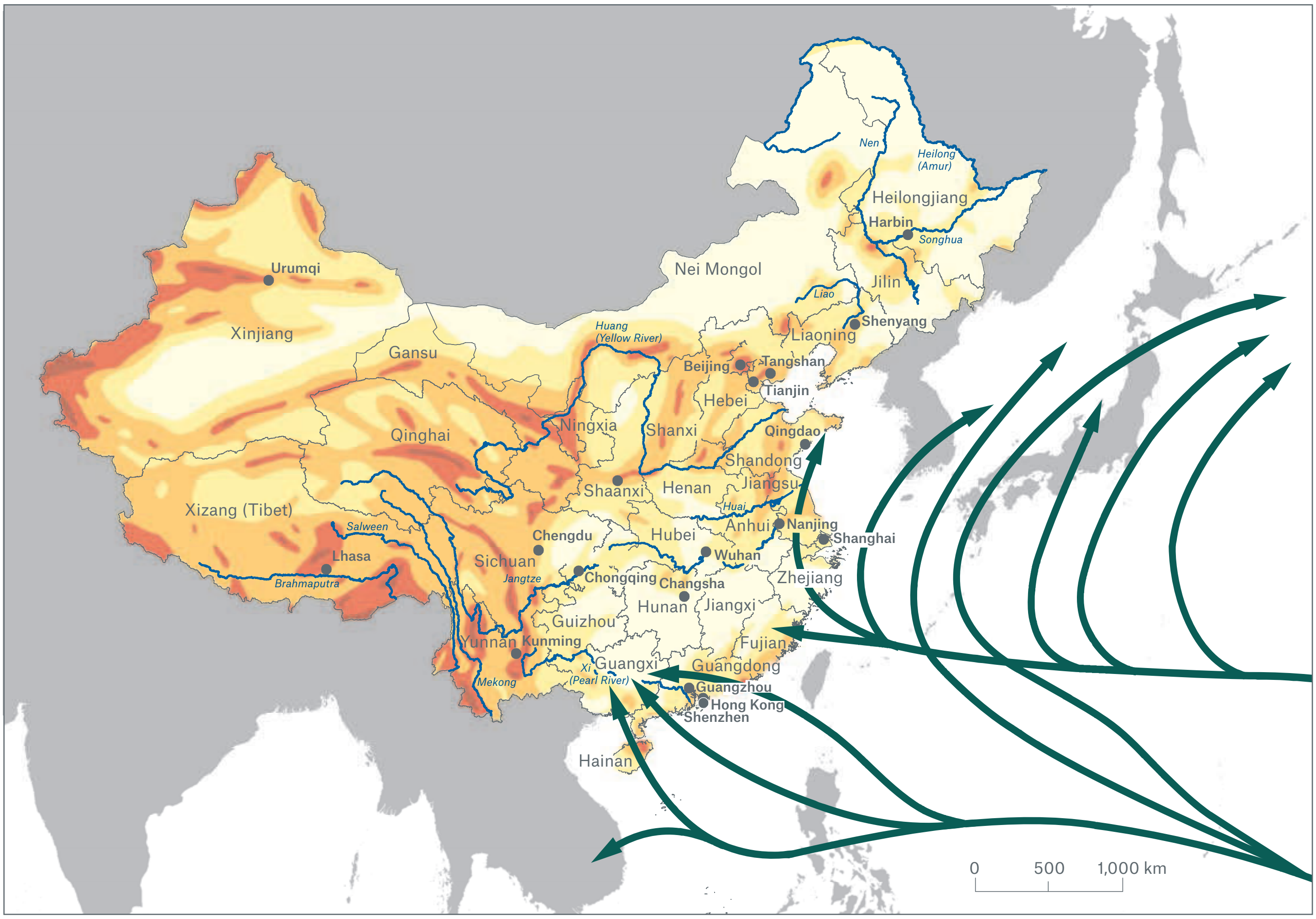
Earthquake risk underestimated

Whilst floods are more common, earthquakes have much greater loss potential in China. Four of the world's ten deadliest earthquakes occurred in densely populated eastern China. Although the eastern coastline is not directly on the plate boundary, the numerous faults located between a number of smaller segments of the earth's crustal blocks trigger rare but severe earthquakes. The earthquake hazard is highest in western China, where the influence of the Himalayan collision zone can give rise to catastrophic quakes. The magnitude 8 earthquake in Sichuan Province on 12 May 2008, for example, was one of the strongest on record in China: the death toll was over 84,000, more than five million homes were destroyed and another 21 million severely damaged. The buildings were only designed to withstand ground acceleration of around 0.1–0.15 g as opposed to the 0.4–0.5 g actually registered. The direct overall loss came to US$ 85bn.

When calculating probable maximum loss (PML), the insurance industry focuses primarily on the economic centres of Beijing and Tianjin, where the hazard has been highlighted by major earthquakes in the past (1679 Beijing, 1976 Tangshan). At the same time, the risk facing the Guangzhou metropolitan area in the Pearl River delta – the "workbench of the world" – should not be overlooked. Encompassing the cities of Guangzhou, Shenzhen and Hong Kong, the Guangzhou metropolitan area is the fastest growing economic centre in the world. The enormity of this exposure hazard has long since made up for the much lower earthquake hazard. Insured losses of as much as US$ 1.5bn are possible here – even excluding Hong Kong. This must be taken into account in PML calculations.

On average, seven typhoons make landfall each year between June and November, insured losses accounting for between 5% and 20% of the overall losses. The greatest exposure is in the southeast provinces of Guangdong, Fujian and Zhejiang, which frequently find themselves in the path of typhoons.

TROPICAL CYCLONE AND EARTHQUAKE HAZARD AREAS IN THE CHINESE PROVINCES



CLIMATE CHANGE IN CHINA

Zone 0: MM V and less

Zone 1: MM VI

Zone 2: MM VII

Zone 3: MM VIII

Zone 4: MM IX and above

Probable maximum intensity: (MM: Modified Mercalli Scale) with an exceedance probability of 10% in 50 years (corresponding to a return period of 475 years) given average subsoil conditions.

The green arrows show the typical track directions of tropical cyclones in the East and South China Seas.

China is confronted by a virtually unparalleled twofold challenge: as the world's largest emitter of greenhouse gases, it needs to develop strategies that ensure more climate-friendly economic development. At the same time, its development potential could be constrained by climate change impacts.

Melting glaciers in the Himalayan Mountains, torrential rain and rising sea levels: China faces a number of climate change impacts. Climate change will cause severe flooding in some regions and major droughts in others. The country will also have to brace itself for typhoon losses. Many climate researchers believe that typhoons will become not more frequent, but more intense, and that the number of category 4 and 5 storms will rise. However, these effects will probably be felt only in the long term.

In the coming years, typhoon activity will primarily depend on variations in certain natural climate phenomena such as the El Niño Southern Oscillation (ENSO) or Pacific Decadal Oscillation. Typhoon tracks are also subject to natural fluctuations. Over the decades, for instance, it has been found that the average number of typhoons heading towards Southeast Asia during La Niña or virtually neutral periods exceeds the long-term average.

A changed climate will create different risk conditions, and these will require a political response. China, the world's largest carbon dioxide emitter, plans to significantly cut increases in its greenhouse gas emissions in the next ten years. Although the country is already a leader in the field of wind power and produces more solar collectors than the rest of the world combined, further prevention measures are needed.

China's energy options are limited given the speed of its economic growth. Nuclear power is not among them because the country will not be able to build the necessary power plants quickly enough or in sufficient numbers. It would be extremely difficult to achieve a complete switch to renewable energies before mid-century and China will continue to rely on fossil fuels to satisfy its voracious energy appetite.
At present, coal-fired power plants with an installed capacity of 500–1,000 MW go on stream at the rate of almost one a week. They have a technical service life of 40–60 years and are likely still to be operational in 2050. CCS (carbon capture and storage) is a promising technology, having the potential to substantially reduce carbon dioxide emissions from fossil-fired power plants.

Like all technical innovations, the development of low-emission energy sources creates new risks and raises liability issues. In the case of CCS technology, the potential reduction in carbon dioxide has to be weighed up against the known and unknown risks for suppliers and operators of CCS plants. The sequestered gas has to be permanently stored in safe conditions, which raises issues of geological stability and possible leaks. A sudden escape of gas could claim many lives because carbon dioxide in high concentrations causes asphyxiation. Gradual leakage endangers not only environmental objectives: the operating company can expect to lose its emission certificates and suffer financial loss. China is an active player in the Kyoto Protocol's Clean Development Mechanism, under which foreign operating companies can acquire credits in the form of certificates for climate protection projects.

As an insurance-industry pioneer in climate change and renewable energies, Munich Re supports the development of new energy technologies and the goal of reducing global carbon dioxide emissions. Our strength lies in professional risk management and the capacity to develop innovative and economical risk-transfer solutions. Clients can rely on our specialist know-how, worldwide experience and tailored insurance solutions. Performance insurance for wind and solar power projects, for example, covers unexpected loss of income due to seasonal falls in irradiation intensity or lower-than-projected wind speeds.

THE TEN DEADLIEST EARTHQUAKES IN THE WORLD SINCE 1900*

Year	Event	Country	Fatilities
1976	Earthquake	China	242,000
1920	Earthquake, landslide	China	235,000
2004	Earthquake, tsunami	Esp. Indonesia, Sri Lanka, Thailand, India	220,000
1923	Earthquake	Japan	142,800
2005	Earthquake	Pakistan, India, Afghanistan	88,000
1908	Earthquake, tsunami	Italy	85,925
2008	Earthquake	China	84,000
1932	Earthquake	China	77,000
1970	Earthquake, landslide	Peru	67,000
1935	Earthquake	Pakistan	50,000

*Haiti: According to official reports, the earthquake that occurred on 12 January 2010 is likely to have claimed 225,000 lives and ranks among the ten deadliest quakes since 1900.

CHINA'S TEN COSTLIEST FLOODS SINCE 1980

Year	Main provinces/*rivers* affected	Overall losses*	Fatalities
1998	*Songhua, Yangtze*	30,700	4,150
1996	Guiyang, Zhejiang, Sichuan, Hunan	24,000	3,050
1991	Anhui, *Huai*	13,600	2,600
1993	Gansu, Inner Mongolia, Shanxi, Henan, Hubei, Zhejiang, Guizhou, Jiangxi, Shaanxi, Guangxi	11,000	3,300
1999	Anhui, Guangxi, *Yangtze*	8,000	800
2003	Hunan, Guangxi, Guizhou	7,890	800
1994	Guangdong, Jiangxi, Hunan, Zhejiang	7,800	1,400
2004	Sichuan, Chongqing, Hunan	7,800	1,000
2007	Jiangsu, Henan, Hubei, Anhui	6,800	650
1995	Hunan, Jiangxi	6,720	1,400

*US$ m, original values

In focus

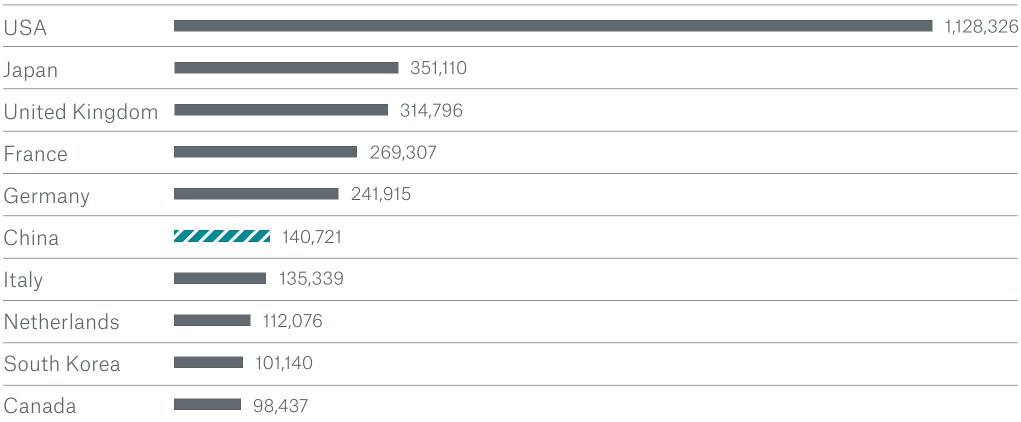
China's insurance market

Without adequate insurance, China's economic and social development is liable to be impeded by the enormous destructive potential of natural forces. Although China's insurance market is growing faster than the economy itself, and is already number six globally, it is still in its infancy. Growth here, as in other developing countries, is hampered by relatively low risk-awareness and, in consequence, demand. Personal lines contents, third-party liability or other business is virtually unknown, life and health fairly rudimentary. The rural population in particular lacks the financial means to insure against natural catastrophes. Microinsurance is likely to make great strides in the coming years, a prime government objective being to combat rural poverty and promote social security. The same goes for agricultural insurance, which has already experienced rapid growth. With rising incomes, social insurance reforms and liberalisation of the healthcare system, private pension and risk provision will gradually be given higher priority, and China has the potential to be the world's biggest insurance market in the foreseeable future.

The market is already developing at a phenomenal pace. However, in motor and other classes where the insurance industry has obtained a foothold, premiums are under pressure, competition being greater here than almost anywhere else. There is also room for improvement in property, where the combined ratio is over 100%. The supervisory authority (China Insurance Regulatory Commission – CIRC) is aware of these issues and recommends benchmark rates. Although introduced in fire insurance two years ago, they are not strictly applied.

Chinese insurers such as PICC or Ping An attract 80–85% of total business volume. Multinationals, on the other hand, soon reach their limits in China, where licences are often granted for a specific region. Consequently, western insurers still make up only a small share of the market but they will have more opportunity to become established as the market opens up. Munich Re is also active in China, collaborating with other companies on programmes to develop the market and new solutions for major natural hazards.

THE TEN LARGEST INSURANCE MARKETS*



*Insurance premium (estimated for 2009) in US$ m

Spurred by growing public awareness of the earthquake risk following the devastating Sichuan quake in 2008, the government is also pressing ahead with the development of special insurance solutions. Munich Re and various academic and political institutions are involved in a project to establish an earthquake insurance scheme. This includes both technical (modelling) and institutional aspects. A pool solution in the form of compulsory insurance offers interesting prospects.

In this case, as policyholder, the municipality or local authority would make payments to those who sustained a loss. The state, which attaches great importance to social equality, has already indicated that it would subsidise premiums for local authorities in poorer areas. However, it is difficult to apply models that calculate physical parameters like ground movement to a country the size of China due to insufficiently precise data. Instead, the insured event would have to be linked to a specific earthquake magnitude (parametric trigger), the traditional method of indemnifying according to individual scale of damage also being impracticable.

The health segment is effectively untapped and likely to offer considerable scope. In the absence of competition, pioneering companies will find market conditions here almost ideal. However, the risks inherent in the healthcare market should not be overlooked. Unlike motor insurance, the long policy terms make it difficult to calculate prices commensurate with the risk. Thanks to its long-standing experience, Munich Re is well placed to give advice on avoiding market-development pitfalls. This expertise is also available to our primary insurance clients since knowledge-sharing in the interests of more professional risk assessment and adequate pricing benefits all sides.

In the short to medium term, corporate business offers better growth prospects in China. Companies will increasingly purchase product liability and other covers as they come to appreciate the advantages of risk management. Property and casualty offer major potential, and China is the only Southeast Asian market where engineering insurance is experiencing rapid growth. For example, cover will be needed for the 250 kilometres of underground tunnels planned for Beijing over the next four years.

As the Chinese become more affluent, so interest in having the appropriate insurance protection will increase. At the same time, more and more insurance options will appear on the market. Industry and consumers will grow increasingly aware of the benefits of insurance and the vital role it plays in reducing everyday risks and providing for retirement. Numerous insurance companies are now vying for a position in the Chinese market. Despite that, however, not all Chinese will purchase life insurance, nor every company insure to western standards, for China is, and remains, a conglomeration of large and small markets whose economic performance, income and culture differ enormously.

JANUARY: WINTER STORM KLAUS

Winter storm Klaus, the costliest natural catastrophe in 2009, swept across France and Spain.

FEBRUARY: WILDFIRES IN AUSTRALIA

Record temperatures in 2009 caused widespread bushfires in which over 170 people lost their lives.

SEPTEMBER: EARTHQUAKE IN INDONESIA

On 30 September 2009, the island of Sumatra was struck by a strong earthquake. Scientists expect more major quakes.

Winter Storm Klaus swept across large parts of France and Spain with winds of over 170 km/h. This photo, taken on 24 January 2009, shows waves pounding the Atlantic coast in France.

JANUARY: WINTER STORM KLAUS HITS FRANCE AND SPAIN

From 24–27 January, Winter Storm Klaus swept across much of southern Europe bringing gale-force winds. Northern Spain and southern France were hardest hit.

Authors: Ernst Bedacht, Peter Miesen, Rudolf Schuster

Meteorological development and characteristics

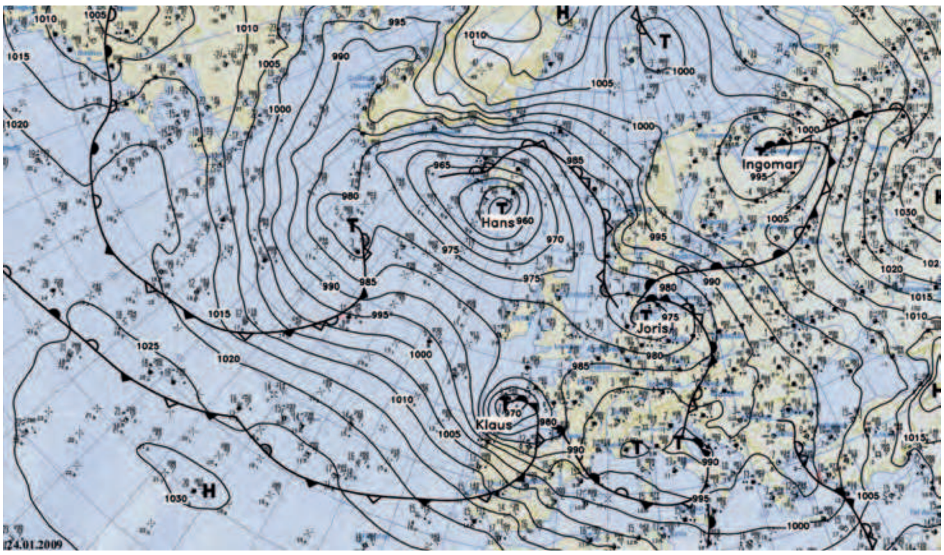
In the last ten days of January, two major low-pressure systems caused extensive damage in Europe. Both systems originated in the central depression Hans, with its focus between Iceland and the British Isles. Initially, a secondary depression, Joris, had formed, bringing stormy winds (in excess of 62 km/h) to many parts of England, France, Germany, Denmark and the Benelux countries, as well as occasional gale-force winds (over 103 km/h) over low-lying areas. Winds were gusting at speeds of up to 190 km/h, on the Wendelstein in south Germany's Alpine region.

Winter Storm Klaus developed over a smaller area, but with greater intensity, during the early hours of 24 January 2009 and throughout the following day, striking the north coast of Spain and southern Atlantic coast of France as well as the Mediterranean area.

Losses

The entire region exhibited a typical pattern of moderate damage to roofs and façades. In predominantly agricultural southwest France many farm buildings were damaged. There was extensive windthrow in forest areas, especially between Bordeaux and Arcachon, due to the predominantly sandy soils there. Elsewhere too, however, trees were toppled and uprooted, causing severe structural damage to buildings and masonry. Power lines, water pipes and even, in places, subterranean lines were affected. In Spain, there was substantial damage to photovoltaic systems, especially sun-tracking panels, which move into a horizontal position to offer less resistance when a given wind speed is exceeded. However, in some cases, buffeting by the wind caused oscillations which broke the rotating supports.

SURFACE PRESSURE CHART OF 24 JANUARY 2009



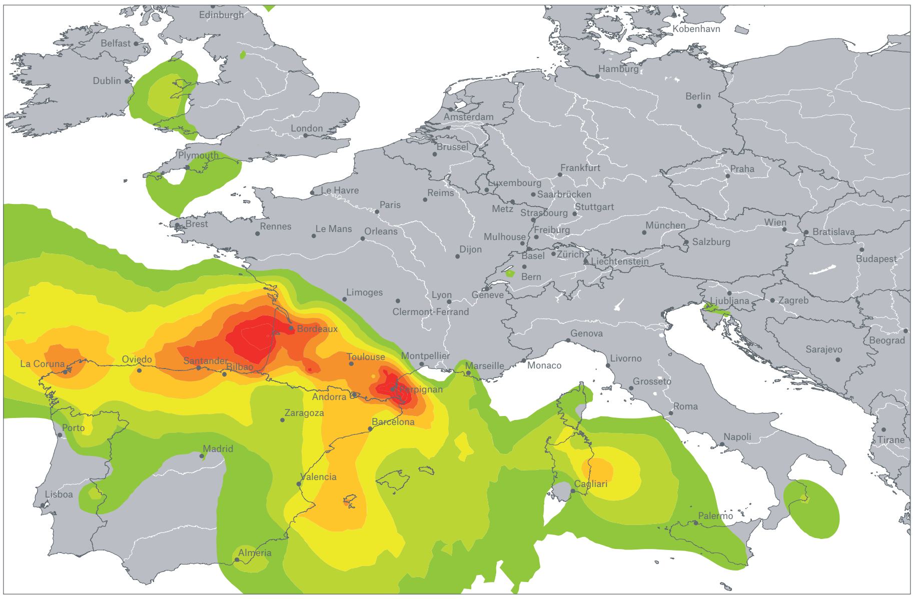
The surface pressure chart for 1 a.m. shows Winter Storm Klaus shortly before it reached the North Atlantic coast of Spain. The densely packed isobars (lines connecting points of equal atmospheric pressure) convey a very good impression of the force of the storm. Central depression Hans over Iceland and the already diminished secondary depression Joris over northern Germany and Denmark can also be seen.

Source: Verein Berliner Wetterkarte

The main areas affected by the winter storms are illustrated alongside by the wind fields of Lothar 1999, Martin 1999 and Klaus 2009.

Lothar struck on 26 December 1999, the Paris metropolitan area being subjected to the highest wind speeds. Roofs were torn off, cranes toppled, trees uprooted and electricity pylons bent. Martin caused heavy losses primarily in southwest France in the period from 27–28 December 1999, including widespread damage to forests. Altogether, 300 million trees were blown down in France by the two storms.

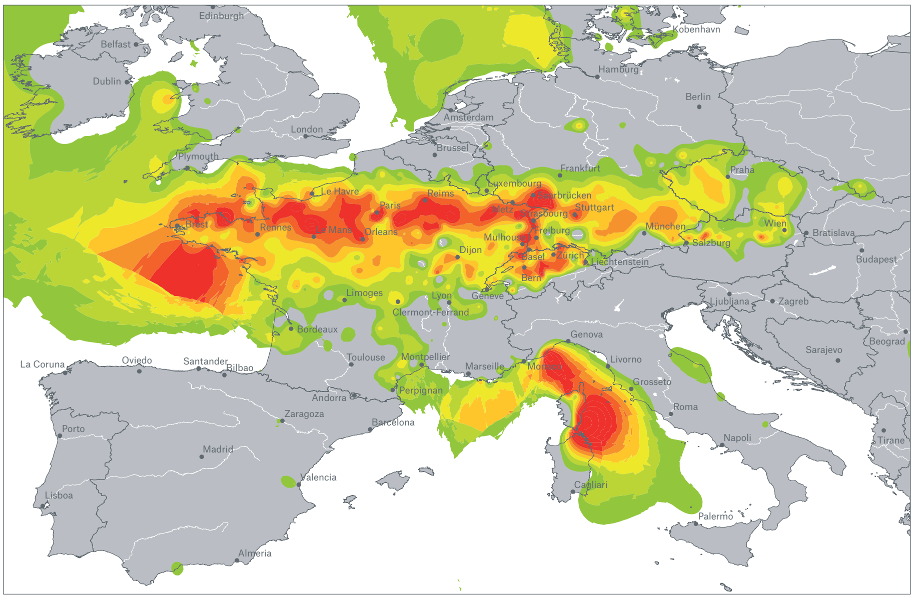
If Lothar were repeated today, the Paris metropolitan area taking the main impact, the insured loss would probably be in the order of €6–7bn (original loss €4.45bn) in France.



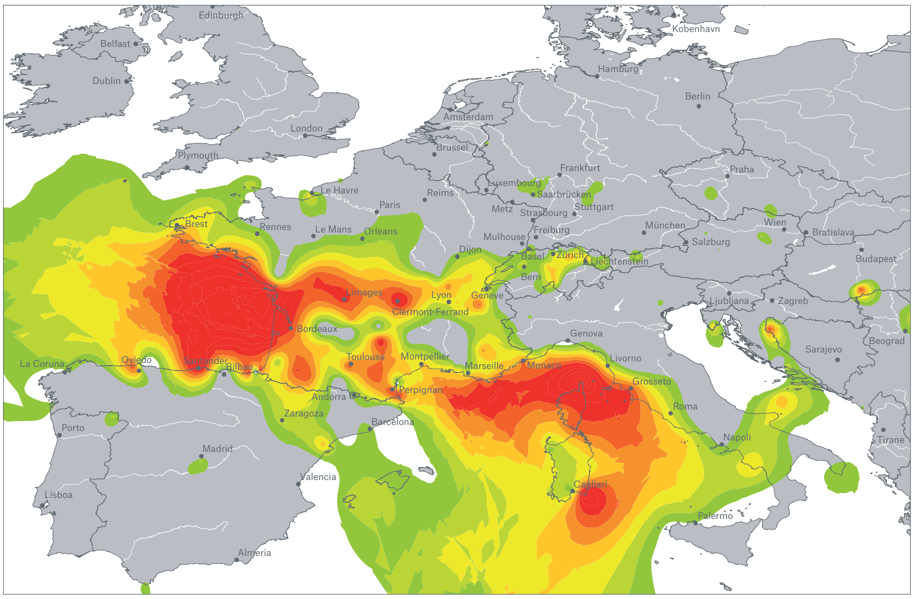
Wind field of Winter Storm Klaus, 24–27 January 2009

Gusts (km/h)

- 80–90
- 90–100
- 100–110
- 110–120
- 120–130
- 130–140
- 140 or more



Wind field of Winter Storm Lothar, 26 December 1999



Wind field of Winter Storm Martin, 27–28 December 1999

Winter Storm Klaus compared with Lothar and Martin

The media often compared Winter Storm Klaus to Lothar (December 1999). However, Lothar was more intense and affected different parts of France. Losses were especially heavy in northern France, including the Paris metropolitan area. The insured market loss for France totalled €4,450m in original 1999 values.

Windstorm Klaus bears more resemblance to Martin, which developed similar maximum wind speeds but took a more northerly path, just touching Spain. However, whilst Martin caused an insured market loss of €2,450m (1999 values) in France, losses from Klaus – €1,680m – were considerably lower.

Underwriting aspects

Klaus sparked an interesting underwriting debate in France and Spain.

The insured market loss in Spain was ultimately borne to a large extent by the state-owned Consorcio de Compensación de Seguros (CCS). In principle, this only covers windstorm where winds exceed 135 km/h (three-second peak gusts), which was not generally the case with Klaus. As a result of insurance market pressure, the threshold value was reduced from 135km/h to 120 km/h in the course of loss adjustment. The map on page 15 clearly shows what far-reaching consequences this had for the private insurance market. It shows the regions classified as "consorciable" before and after the threshold had been lowered. Over a period of time, the few orange areas were added to those initially classified as green. Ultimately, losses in the red areas were also met by the CCS.

Most losses in France were borne by the private insurance industry. A number of primary insurers yielded to government demands and also refunded insureds' deductibles. However, these extra payments cannot be covered by reinsurance because they were not factored into the price calculations prior to the event.

Conclusion

From the European perspective, Klaus was a loss event of a type that recurs every two to four years on roughly the same scale. Nevertheless, it tended to affect areas located on the fringes of those normally prone to winter storms, where such events are much less frequent. Klaus was Spain's most severe event for decades. That the insurance industry should have come through relatively unscathed is due solely to retroactive modification of the CCS's conditions. However, the heated debate following the event on the CCS's classification system shows that this type of insurance is in urgent need of review. The current uncertainties make it impossible to quote reliably for windstorm losses.

LOSS FIGURES

Winter Storm Lothar 1999

	Overall losses*		Insured losses*	
	€m	US$ m	€m	US$ m
Germany	1,600	1,600	650	650
France	8,000	8,000	4,450	4,450
Switzerland	1,500	1,500	800	800

Winter Storm Martin 1999

	Overall losses*		Insured losses*	
	€m	US$ m	€m	US$ m
France	4,000	4,000	2,450	2,450

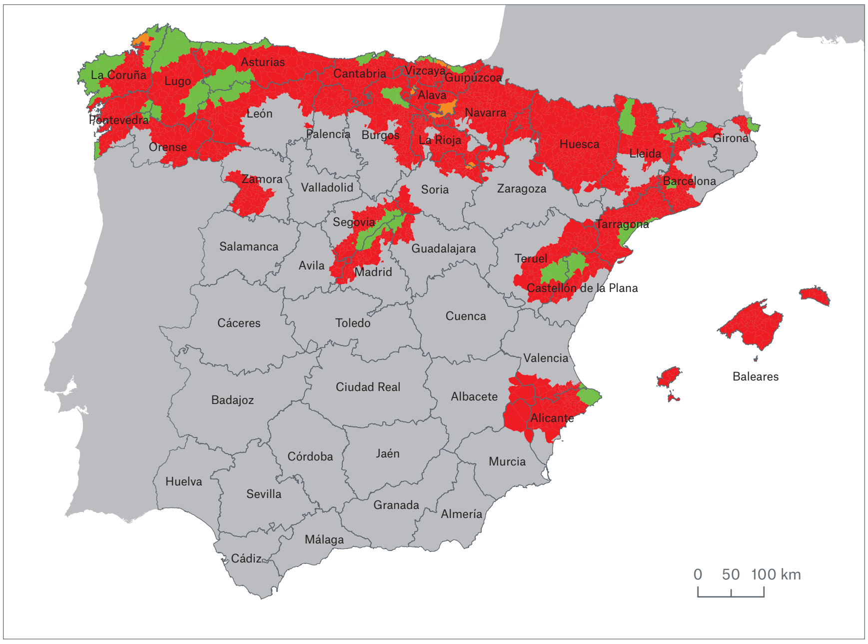
Winter Storm Klaus 2009

	Overall losses		Insured losses	
	€m	US$ m	€m	US$ m
France	2,500	3,200	1,680	2,100
Spain	1,500	1,900	700	900

*Original values

Winter Storm Klaus revealed new risk exposures such as solar power installations; in Spain for instance, storm losses to installations far exceeded the annual premium. The photo shows damage to a photovoltaic installation near Barcelona.

EVOLUTION OF CLAIMS SETTLEMENT IN SPAIN



Following pressure by Spain's insurance association, the CCS extended the area covered in the course of the year; this was also intended to close regional gaps caused by lower readings at some locations.

Source: Consorcio de Compensación de Seguros

- Position on 28 January 2009: Areas covered from the outset
- Position on 10 February 2009: Initial extension
- Position on 2 July 2009: Second extension

FEBRUARY: WILDFIRES IN SOUTHEAST AUSTRALIA

In February 2009, Australia experienced the worst bushfires in its recent history: 173 people died, 414 people were injured, insured losses amounted to US$ 700m.

Authors: Scott Hawkins, Sandra Schuster

Meteorological causes and background

Before the fires started, southeast Australia experienced exceptional heatwaves in late January (28–31) and early February (6–8). In the state of Victoria, many records were broken for maximum day and night temperatures as well as duration of extreme heat.

The first heatwave resulted from the combination of a slow moving high pressure system in the Tasman Sea, an intense tropical low off the northwest coast and an active monsoon trough. This constellation provided favourable conditions for the flow of hot air towards Victoria, with Melbourne reporting 45.1°C on 30 January.

A weak change in the weather brought some relief to southern coastal areas before the second heatwave reached its peak on 7 February. In Victoria, the day was accompanied by high winds, very low humidity and a record-breaking temperature of 48.8°C at Hopetown, in the state's north-west. This temperature is also believed to be the highest ever recorded in the world's southern latitudes. Melbourne experienced 46.4°C and far exceeded the previous all-time record based on 154 years of data, which was set on 13 January 1939. Known as Black Friday, this was the day on which temperatures rose to 45.6°C in Melbourne, triggering the biggest bushfire in Australian history hitherto.

The 2009 heatwave was also notable for its duration, with Adelaide and Melbourne experiencing more consecutive days above 43°C, namely four and three days, respectively. This confirms the trend observed since the 1960s, in the course of which the duration of heatwaves in Australia has almost doubled.

What started the fires?

Some fires started due to natural causes such as lightning, but it also appears that fires may have been caused by arson, accident or fallen power lines. A class action lawsuit has already been initiated against an electricity distribution company alleging negligent maintenance of the power lines. More are likely to follow.

Scale of damage

Some 4,300 km² of land were burnt, along with more than 2,029 properties and 61 businesses. Entire towns were destroyed, some 78 communities being affected and at least a million native animals killed. The townships of Kinglake and Marysville experienced one of the most destructive fires, with flames leaping 100 metres into the air and such radiant heat generated that aluminium road signs melted. Shortly after the fires, the authorities decided to remove water from some reservoirs due to concerns that rain could wash pollutants like ash and other substances into metropolitan catchments and impair the water quality.

Insurance-related aspects

Insurance companies received more than 10,000 claims with a total volume of US$ 700m. The losses included property, contents, vehicles and other assets, such as farming equipment. Domestic property and contents insurance accounts for around three-quarters of the total claims cost, commercial, industrial and farming policies accounting for one quarter. Initial damage surveys showed that houses were either destroyed totally or left virtually undamaged if residents took the risk and stayed to defend their property against the flames. Very few structures sustained only partial damage.

New building regulations will come into force in May 2010 as a consequence of the fires. A major public inquiry was set up immediately after the fires – conducted by a royal commission – focusing on areas which are particularly prone to bushfires. Areas will be defined according to six danger levels (so-called Bushfire Attack Levels) in future. New standards will apply in these areas with regard to construction materials and fire-resistant features for housing. However, these regulations merely constitute a minimum requirement. Although experts believe that they will not protect buildings against extreme fires and despite the absence of standards for fire shelters and bunkers, better fire protection with, for instance, sprinklers is essential. Some insurers have already incorporated such safety features into their policy terms and conditions.

Munich Re welcomes the reform of the building code, viewing the improvement in building resistance to all natural hazards as an important aspect. This will ultimately also strengthen the communities and benefit both the government and society. All catastrophic fires have underlined the importance of insurance, as community and government budgets would have been severely constrained without it.

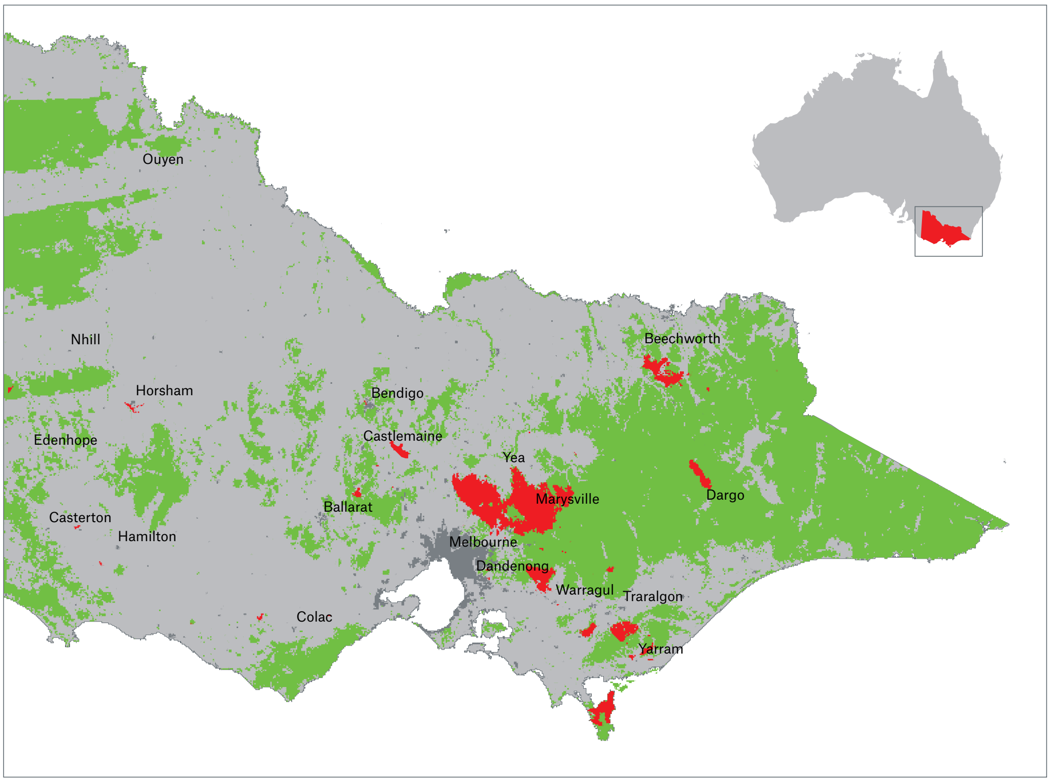
Underinsurance and non-insurance

The insurance industry considers underinsurance to be a greater problem than non-insurance. Estimates indicate that 25% of the people affected by the 2009 bushfires were not insured and that 80% of the remainder were underinsured, probably partly because insurance cover is usually based on past experience and not on future risks. Demand has increased strongly in the areas at risk since the 2009 bushfires.

However, non-insurance is also attributable to difficulties in establishing an adequate sum insured. Affordability is also an issue, especially in rural areas of Victoria and particularly for small to medium-sized businesses. Many had neither property insurance nor business interruption insurance.

The photo was taken near Kinglake, northeast of Melbourne. One home is left standing among the charred remains of trees and buildings.

EXTENT OF THE WILDFIRES IN FEBRUARY 2009



The map shows the areas affected by the fires. Over 400 individual fires were registered and in all 4,300 km² of land engulfed in flames.

- Areas affected by fires
- Forest areas

Source: Office of the Emergency Services Commissioner, Department of Justice, Victoria, Australia, 2010

The Victorian Bushfire Appeal Fund collected donations totalling A$ 388m, 80% being distributed to (insured and uninsured) individuals and 20% allocated to community projects. Although donations are at the core of all humanitarian relief, governments need to ensure that people do not solely rely on such exceptional relief and encourage personal risk management instead.

Lessons learned

The Royal Commission focused on the protection of life and investigated the cause of the fires, the measures taken to avert and fight the fires, and their impact on infrastructure and has already taken initial steps in response.

Bushfire warning systems

Since October 2009, the Australian Bureau of Meteorology has incorporated the new fire danger ratings used by fire agencies in its weather forecasts and warnings. Due to the high death toll, particular attention is now paid to ensuring clear and direct warning messages, something not always warranted to this degree before the disaster. In addition, a new "Emergency Alert" telephone warning system has been implemented for use by emergency services in situations such as bushfires and other extreme weather events. Warnings are communicated via landline and mobile phones.

Land-use planning and firebreaks

One point of interest for future land-use planning is that most of the fires started on private property (29% of the burnt area) and then spread to plantations (5%), state forests (43%) and national parks (23%). Even firebreaks such as roads and open spaces cleared of vegetation were unable to stop the fires which spread in and around Kinglake at high speed.

Controlled back-burning

One way to control bushfires and contain the subsequent loss is to reduce the amount of material available to fuel the fire ("fuel load"). This is done through controlled back-burning of scrub and undergrowth. Although disputed, it is an effective means of fighting bushfires as long as the Fire Danger Index (FDI) remains below 50. At an FDI of more than 50, it is increasingly difficult to suppress any part of the fire line in this way due to extreme and sudden changes in fire behaviour. Controlled back-burning is unlikely to have any effect at an FDI of 190, the highest value ever observed (7 February 2009). Even forest areas from which the fuel load had previously been removed were badly burned by raging fire fronts.

This fire management tool can at best create a false sense of security if it is the only method used to protect lives and property. On the other hand, the Country Fire Authority responsible for the rural areas of Victoria was able to prevent significant losses through its efforts to control the fires in the foothills of Mount Dandenong, a densely populated part of Melbourne.

Evacuation system

In Victoria, residents have so far had the choice of preparing and staying to defend their homes or leaving early on when a bushfire threatens. This "stay or go" policy is now under review since it emerged that 113 of the 173 victims were sheltering inside their homes or killed in the immediate vicinity. The common belief that people can save houses by extinguishing smaller fires caused by flying embers and that sheltering in houses can save lives now seems barely tenable. Last-minute evacuations are particularly risky and many lives have been lost as people have tried to escape in their vehicles. It is believed that the relatively low death toll of four from the fires on the outskirts of Canberra in early 2003 is attributable to timely evacuations.

Following the devastating bushfires of February 2009, the 1960s danger ratings were revised. The new Fire Danger Rating Index comprises six categories: low, high, very high, severe, extreme und catastrophic. "Catastrophic" indicates a fire that is uncontrollable, unpredictable and fast-moving. Warning signs erected at strategic points display the latest rating. Information is also provided by the meteorological services and a telephone warning system is being set up to indicate the overall hazard situation.

FDI 50–74: Severe
FDI 75–99: Extreme
FDI >100: Catastrophic – the highest category

Climate change – Higher risk of bushfires?

Bushfires are normal and unavoidable in Australia. The exposure is greatest during the Australian summer and autumn (November to March). The vegetation is dominated by more than 800 native species of eucalyptus trees. They make up roughly 70% of the Australian forest and have adapted to the regular fires. Due to its "Mediterranean" climate, southeast Australia, where the majority of the population lives, is predisposed to large wildfires. Fuel can grow abundantly during the mild, wet winters and the fire danger builds up continuously during the hot, dry summers. Periodic droughts aggravate the situation.

Media reports on the 2009 bushfires frequently raised the question as to the role of climate change. At present, there is no way of proving that the fires might be attributable to global warming. A certain connection cannot be denied, however, since the record temperatures created favourable conditions for the fires and climate change increases the probability of such record-breaking temperatures.

A scientific look into the future reveals bleak prospects. A scenario with global warming of 2.9°C by mid-century shows that the danger of catastrophic fire days is to be expected at 85% of the observation stations in southeast Australia, as opposed to the current 46%. In addition, model results suggest that the fire season will start earlier and end slightly later, and will also be more intense. This reduces the window for pre-season controlled back-burning and more resources will be required to maintain fire fighting standards. Shorter intervals between fires can have a major impact on ecosystems, threaten biodiversity and stretch emergency services and communities to their limits. To make matters worse, there is also the possibility of several major fires during a single fire season, which would affect the insurer's retention.

Conclusion

The recent Australian wildfires highlight the risks facing the insurance industry. Over the coming years and decades, climate change will probably lead to environmental conditions resulting in more frequent and more intense fires. Communities must therefore be adequately prepared to avert major losses. The financial burden resulting from such events can be eased by purchasing insurance. The future importance of this hazard is emphasised by Munich Re's decision to include wildfires in the Globe of Natural Hazards from 2010.

LOSS FIGURES

Year	Area	Homes destroyed	Overall losses US$ m*	Insured losses US$ m*	Overall losses A$ m*	Insured losses A$* m*	Fatalities
1926	Victoria	550	–	–	–	–	60
1939	Victoria, New South Wales	1,300	–	–	–	–	71
1943–44	Victoria	>500	–	–	–	–	46
1967	Tasmania	3,000	40	–	45	–	62
1983	Victoria, South Australia	2,500	300	150	335	175	83
2003	Australian Capital Territory	600	500	210	850	360	4
2009	Victoria esp. Kinglake	2,029	1,300	770	2,035	1,200	173

*Original values

The bushfires that raged in Victoria in February 2009 are the worst fire catastrophe in Australia's history. With the help of the Australian army, thousands of firefighters battled against the flames. Despite their efforts, vast areas were reduced to ashes. Over 2,000 homes were destroyed, 173 people killed and thousands left homeless.

SEPTEMBER: EARTHQUAKE IN INDONESIA

The death toll from the year's most devastating earthquake, which occurred on the island of Sumatra, on 30 September, was 1,200. It was the latest in a series of five major quakes that has hit the region in the space of five years. Further quakes are to be expected in the near future, as the pressure is unlikely to have been relieved completely in this subduction zone. Induced tremors are also expected along the Sumatra fault, which runs parallel to the coast.

Author: Michael Spranger

Scientific analysis

The magnitude 7.6 (Mw) earthquake struck at 5.16 p.m. local time, about 60 km northwest of Padang.
A second tremor was registered a few hours later near the town of Jambi, around 250 km from Padang. Since the quakes occurred within such a short space of time, this raised the question as to whether they constituted one or two events. The debate over the event clause has now been resolved: although they may have been tectonically related, the earthquakes indisputably constituted two separate events.

The earthquake on 30 September caused panic among Padang's 900,000 inhabitants, as thousands attempted to flee from the tsunami which might have ensued. Instead, inadequate evacuation procedures led to chaotic traffic conditions, which made it impossible to escape. In the worst case, this would have resulted in numerous fatalities. However, there was no tsunami, the fracture area being very deep (around 80 km below the surface).

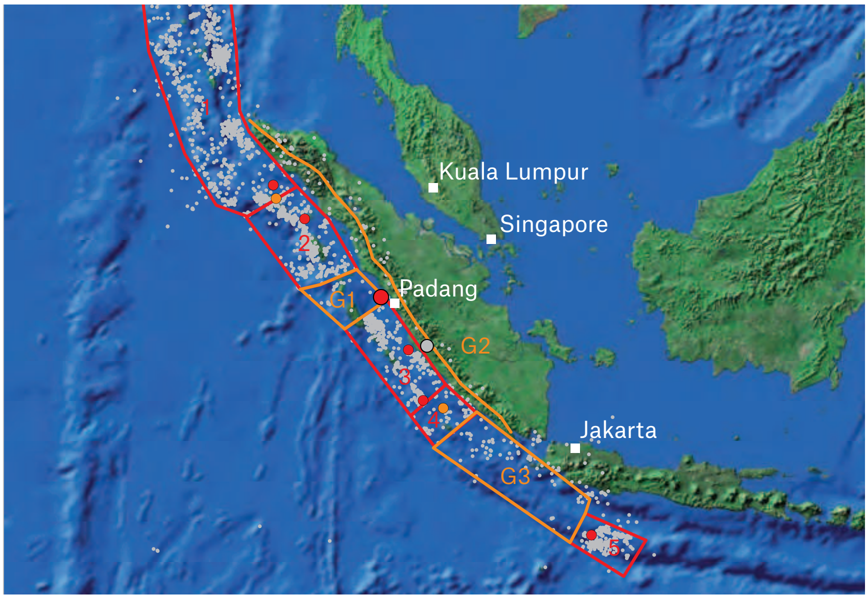
The earthquake's location and reconstruction of the fracture mechanism indicate that this quake – unlike its predecessors – did not occur along the boundary between the subducting Australian plate and the Eurasian plate. It was, in fact, a fracture within the Australian plate. Such occurrences are rarer but tend to cause more severe ground movement than a normal subduction quake of the same magnitude. On the basis of a single measurement of ground movement undertaken on solid bedrock outside Padang, it is assumed that the maximum acceleration was in the order of 0.3 g, which indicates that stronger shocks occurred in Padang itself. Based on more recent attenuation curves for tectonically comparable regions, the tremors probably exceeded 0.4 g. Due to the depth of the earthquake and the small fracture area, many scientists presume that this was not the expected major quake in the Mentawai segment of the subduction zone and that the pressure in this zone has not been reduced to any notable extent.
It was last active in 1797.

The map shows earthquake activity in Sumatra and the location of the major earthquakes in the period 2004–2009.

- Earthquakes of magnitude 4.8 and higher since 26 December 2004
- Earthquakes of magnitude 7.5 and higher, 1973–2004
- Earthquakes of magnitude 7.5 and higher since 26 December 2004
- Earthquake in Jambi on 1 October 2009
- Earthquake in Padang on 30 September 2009

- Sumatra fault
- Rupture zones since 2004 (1–5)
- Potential seismic gaps (G1–3)

Source: ESRI; Munich Re; USGS



Humanitarian catastrophe and losses

According to government estimates, around 1,200 people were killed. Roughly half the deaths were due to landslides and mudslides in the countryside around Padang. Lubuk Lawe to the northeast of Padang and the coastal districts of Padang Pariaman, Padang and Agam were worst affected. Far more people would have died in Padang itself had the earthquake occurred at a different time of day. As with many previous earthquakes, schools – with around 1,100 reported losses – hospitals, hotels, shopping centres, government and other buildings used by the general public suffered heavy losses. Fortunately, many had already closed when the tremor struck. All in all, some 135,000 buildings were seriously damaged or destroyed and almost as many sustained minor damage.

The extent of damage to older buildings is not surprising, since Indonesia's first earthquake construction code, issued in 1970, only took account of a maximum acceleration of 0.1 g for Padang, whilst the actual figure was several times higher. The fact that numerous more recent buildings were also severely damaged indicates inadequate supervision of the construction work, since the latest (2002) construction code generally represented the actual ground movements relatively well. Although a revised construction code is due out in 2010, the key lies in effective monitoring of the construction process.

In addition, repairs undertaken in Padang after the previous major earthquakes in March and September 2007 were often faulty. Cracks which appeared in buildings after those tremors were often simply wplastered over and repainted. This was the case with shopping centres and a number of other buildings that collapsed in the earthquake.

Underwriting assessment

Despite very low insurance density, the Padang earthquake, with an insured loss of at least US$ 100m, is the most expensive to have occurred in Indonesia in recent years. The extent of the loss is surprising, considering that the tremor occurred at some depth and in a remote region. Analysis of the insured losses has also revealed major irregularities in the accumulation figures supplied. Such problems could be signifcantly compounded if a large earthquake struck West Java, the principal economic centre.

The Padang earthquake also revealed coordination problems between the responsible public bodies, and this made it more difficult to bring relief to the population quickly. Some form of basic financial protection is needed for the poorest victims, possibly in the form of a single lump-sum payment, to prevent them losing their entire livelihood. The insurance industry is equipped with the necessary risk assessment and financing tools to facilitate the technical implementation of such a solution.

LOSS FIGURES

Overall losses (US$ m)	2,200
Insured losses (US$ m)	> 100
Fatalities	1,200

The photos show the Plasa Andalas shopping centre at Padang, West Sumatra, in 2007 and 2009. The building had already been heavily damaged in the 2007 earthquake but the renovation work did not stand up to the earthquake on 30 September 2009.


STOP
RAMP
30
M.P.H.




COPENHAGEN CLIMATE SUMMIT

The 15th Conference of the Parties was meant to pave the way for the successor to the Kyoto Protocol but the results were disappointing.

DATA, FACTS, BACKGROUND

The year was marked by the effects of El Niño – with very few hurricanes but floods and droughts in many parts of the world.

The different globes were part of an exhibition staged in the centre of Copenhagen – the venue of the 2009 UN climate conference.

COPENHAGEN CLIMATE SUMMIT

Missed opportunity – So where do we go from here?

In the end, all that could be achieved was a modest compromise. The participants at the World Climate Conference took note of the Copenhagen agreement but did not formally approve it, thus avoiding the impression that the summit had been a complete failure. However, as the agreement is in no way binding under national law and imposes no obligations on individual countries, climate protection is now back to where it was when the UNFCCC was signed in 1992.

Author: Peter Höppe

The centre of Copenhagen during the UN climate summit in 2009: Demonstrators hold aloft banners calling for action to protect the climate.

The outcome of two years of intensive summit preparations and two weeks of negotiations in Copenhagen was more than disappointing. Despite having painstakingly negotiated a compromise, the world's political leaders still failed to secure the necessary consensus of all 193 states at the 15th Conference of the Parties (COP15). Indeed, the compromise itself had already been watered down to virtual meaninglessness, its vague formulations falling far short of expectations. It specifies neither firm carbon reduction targets nor effective monitoring of voluntary targets. The question of how global warming is to be limited to the 2°C target is still unanswered.

Despite the great to-do, nothing has been achieved considering that, at the G8 summit in L'Aquila, Italy, in the summer of 2009, China, India and the eight principal industrial nations had already signed a deal to limit global warming to a maximum of 2°C. These countries are responsible for more than two-thirds of global carbon emissions. However, one step forward since L'Aquila is that recognition of the 2°C target in Copenhagen means there is now an official interpretation of Article 2 of the UNFCCC ("... avoid dangerous interference with the climate system ...").

The intention expressed at the climate summit of pledging US$ 100bn annually to developing countries from 2020 to help them adapt to climate change has also remained vague. None of the nations that supported this move, including the USA, has stated what portion of this sum it intends to contribute. Indeed, it is suspected that there are plans to simply re-label development aid that was, in any case, to have been paid.

Among the reasons for the failure of Copenhagen were that neither the USA nor China took a leading role in the negotiations, whilst the EU also proved incapable of filling the gap. At the same time, by asserting a number of excessive demands, the developing countries were also instrumental in the summit's downfall. Their attempt to link the climate issue with the fundamental but unsolved problems of the distribution of global assets and poverty was doomed to failure. Criticism has also been levelled at the summit's Danish hosts, firstly for failing to take the concerns of the smaller states seriously enough and, secondly, on account of procedural errors which opened the door to delaying tactics.

COP15 had been arranged as a "post-Kyoto conference" following COP13 in Bali in 2007, the intent being to set out firm conditions for a successor protocol. The significance of the conference was clear to all participants. As things now stand, it looks unlikely that a protocol which picks up directly where Kyoto left off will ever be signed. This carries the risk that climate protection may be further relegated to the sidelines after 2012. The incentive to switch a large portion of power generation to sustainable, carbon-free technologies could be lost.

Furthermore, the failure of Copenhagen raises doubts as to whether the negotiating process has any chance at all of succeeding within the scope of the UN framework convention. NGOs felt they were excluded, smaller countries passed over, and several large states took an uncompromising stance. This should be seen as an opportunity to rethink the process in general. Although the UNFCCC remains the only basis for a climate treaty binding under national laws, there is still a chance the current deadlock can be broken if a number of key states initially demonstrate their political will at a smaller forum by taking the lead and laying down binding emission targets. If other states then progressively adopt those targets, this will do more for climate protection than waiting for a grand plan to emerge from the UNFCCC process.

DATA, FACTS, BACKGROUND

2009 was the fifth-warmest year since 1850, despite the notable absence of record temperatures since 1998. Have the critics been right all along – is climate change a thing of the past?

Author: Eberhard Faust

Global mean annual temperatures

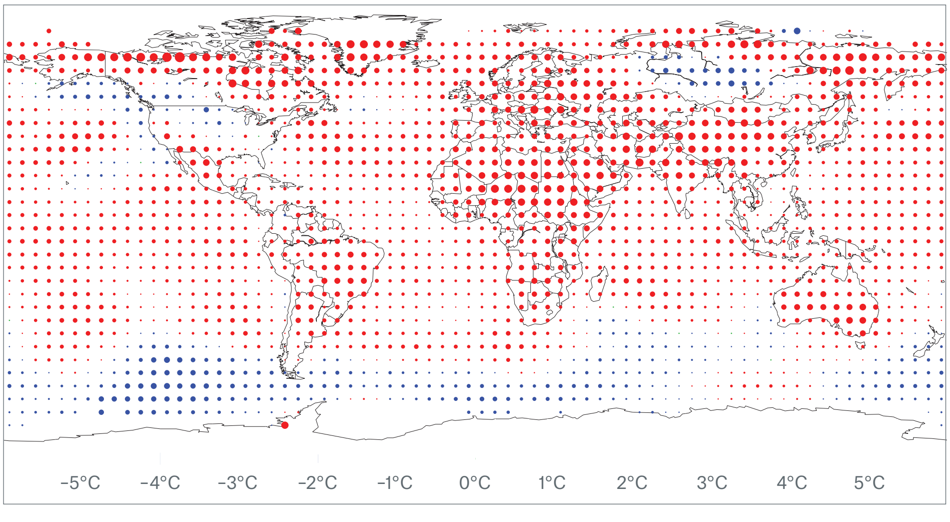
In 2009, global surface temperatures, according to provisional World Meteorological Organization (WMO) figures, were 0.44°C above the 1961–1990 average of 14°C. If confirmed, 2009 will exceed the previous three years and go down as the fifth-warmest year of the data series that began in 1850. In any case, 2000–2009 is the warmest decade since 1850.

Although 1998 – the warmest year on record – was followed by comparatively cooler years with a gradual reduction in mean annual temperatures following a relative maximum in 2005, this in no way proves that climate change has come to an end, as claimed by the climate-science contrarians in the run-up to the climate summit in Copenhagen. It is rather due to the fact that any long-term upward trend includes a number of phases when global mean annual temperatures stagnate or even fall.

Such linear trends-within-trends occurred, for instance, in the years subsequent to 1944 and in the periods 1981–1986 and 1997–2000. Thus, in 1997/98, an El Niño event prevented cold deep water from rising to the surface of the tropical East Pacific, so that 1998 was an exceptionally warm year. In 2007/2008, a large expanse of cold sea-surface water in the Pacific caused by a La Niña event brought comparatively low temperatures. Despite these natural fluctuations in the time series, the warming trend will continue in the medium term, there having been no fundamental change in the physical causes such as increasing greenhouse gas concentrations.

The year began with a waning La Niña regime in the Equatorial Pacific giving way to an El Niño regime from mid-2009 onwards. This accounted for a rise in global mean temperatures relative to 2007 and 2008. Central Africa, much of South Asia and China, Australia, the southern part of North America and northern high latitudes in particular experienced exceptionally warm temperatures in 2009.

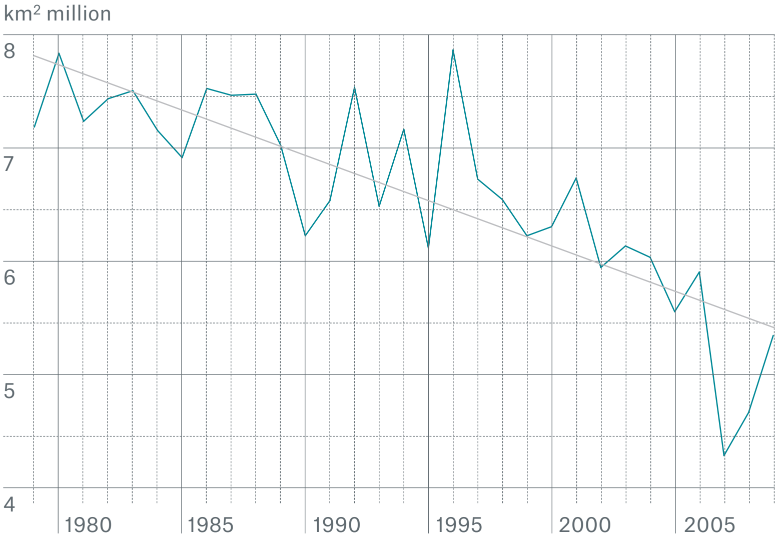
REGIONAL ANOMALIES OF MEAN ANNUAL TEMPERATURE IN 2009 WITH RESPECT TO THE 1971–2000 MEAN



In many parts of the world, 2009 temperatures were significantly above the 1971–2000 average (red dots). Lower temperatures (blue dots) were recorded in only a few regions, primarily in southern latitudes. The larger the dot, the greater the deviation from the mean temperature.

Source: National Climatic Data Center/NESDIS/NOAA

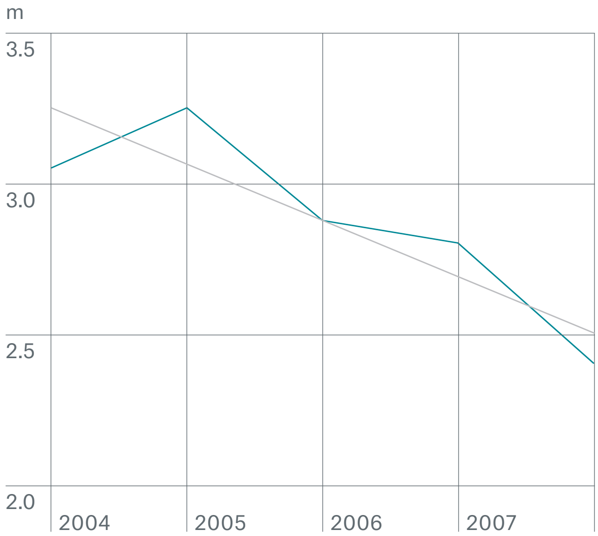
Arctic sea ice extent in September



Arctic sea ice extent in September declined sharply between 1979 and 2009.

Source: National Snow and Ice Data Center 2009

Arctic sea ice thickness in winter



In recent years, the sea ice has reduced during the Arctic winter from around 3 m to 2.4 m (blue line), the trend (grey) being an annual decrease of 0.17 m.

Source: Cf. Kwok et al 2009; Kwok et Rothrock 2009

Hurricane season

Hurricane activity was impeded by the mid-year onset of the El Niño regime. It is true that, up to August/October, tropical North Atlantic sea surface temperatures, in line with the current warm phase of the Atlantic Multidecadal Oscillation (AMO), were above average, and surface air pressure was below the climatological average – each of which in itself is conducive to increased hurricane activity. However, in the second half of the year, El Niño generated much greater wind shear between the upper west-to-east winds and sea-surface winds moving in the opposite direction. This vertical wind shear, which was particularly marked over the Caribbean, prevented the formation of cyclones and destructive hurricanes. No fewer than five named storms (Ana, Danny, Erika, Fred, Henri) dissipated when they entered areas of especially high vertical wind shear. A second major, typical El Niño effect was sinking air masses over much of the Caribbean and tropical North Atlantic. These caused a decrease in humidity in the lower and middle atmosphere, so that a major criterion for the formation of cyclones was absent.

North Atlantic hurricane activity was thus well below the average for the warm phase beginning in 1995: 14.3 named storms including 7.5 hurricanes and 3.7 major hurricanes. There were only nine named systems. Three reached hurricane force, and two of these developed into major storms (Category 3 and above): Bill, which became a Category 4, and Fred, a Category 3 on the Saffir-Simpson Scale. Only Claudette and Ida made landfall in the USA.

Of particular note was Tropical Storm Grace, which formed off Europe, northeast of the Azores, in October and moved towards Ireland, where it was absorbed by an eastern Atlantic frontal system a few hundred kilometres southwest of the coast. This was the most north-easterly point at which a tropical storm had formed in the North Atlantic since the start of satellite measurements. It had last happened in 2005, when a hurricane which formed near Madeira headed towards Spain.

The warm phase itself (identifiable in North Atlantic cyclone activity only over the multi-annual average) was merely masked by El Niño's moderating effects and still persists.

Locally reduced vertical wind shear during El Niño phases can result in above-average cyclone activity in the eastern North Pacific. This also proved to be the case in 2009, with 20 named storms, eight of which developed into hurricanes and five into major hurricanes. The long-term average for this area is 16 named storms, including nine hurricanes and four major hurricanes. Such systems generally head into the Pacific and seldom cause heavy losses.

Changes in the upper latitudes

Spring snow cover extent in the northern hemisphere was the sixth lowest since the start of the data series in 1967, and followed the downward linear trend for the period as a whole. Mean Arctic sea ice extent in September, the annual minimum, was above that of the previous year but, at 5.4 million km², the third lowest since the start of the data series in 1979. Taking into account the fact that the extent of ice cover had already decreased quite considerably, the lowest reading being registered in 2007 (4.3 million km²) and second-lowest in 2008 (4.7 million km²), the 2007 figure is again almost exactly on the downward trend line. September sea ice cover is currently decreasing by 11.2% per decade relative to the 1979–2000 average.

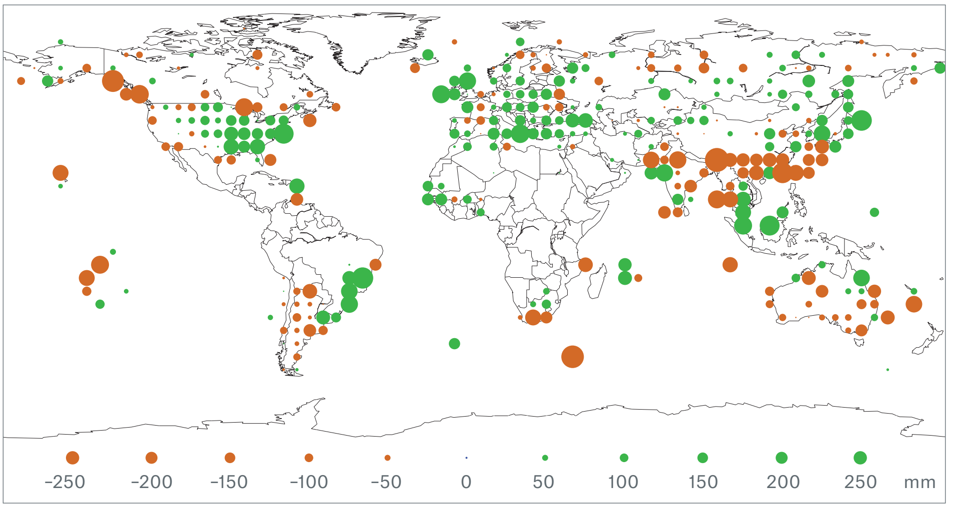
Apart from the reduction in summer sea ice extent, thinning of the ice in winter is especially significant, satellite measurements showing 0.6 m thinning on average in the period 2004–2008 alone. Thus, the volume of ice has also fallen substantially in recent years.

The greater the decline in reflecting ice surface area in northern waters during the summer and the larger the increase in the absorbent water surface, the more the ocean and atmosphere are warmed at higher latitudes. This creates conditions that favour the melting of Greenland's ice sheet. As a result, sea level rise is accelerating and the need for adaptation plans to prevent losses in coastal towns and ports is becoming more pressing.

Temperature and drought extremes

South and southeast Australia suffered extreme heatwaves, one in January and one in February 2009 which, combined with a drought and other factors, caused severe bushfires in Victoria and New South Wales. An all-time temperature record of 48.8°C was registered in Victoria. For the ninth successive year, conditions were far too dry in the Murray-Darling Basin, a key agricultural area in southeast Australia. Subtropical eastern Australia experienced a hot spell in August and southeast Australia in November. Northern China was hit by a heatwave in June. Many parts of the country faced their most severe drought for five decades in 2009 and harvests were seriously affected. The north of India also experienced a very weak summer monsoon with extremely low precipitation due to the evolving El Niño conditions. Likewise,

REGIONAL ANOMALIES OF ANNUAL PRECIPITATION IN 2009
WITH RESPECT TO THE 1961–1990 MEAN



Typhoons were among the factors responsible for above-average precipitation (green dots) in southeast Asia in 2009. By contrast, much of China experienced the worst drought in decades (orange dots).

Source: National Climatic Data Center/ NESDIS/NOAA

Mexico and Central Argentina had to contend with persistent drought, poor harvests and livestock losses in September. Kenya suffered food shortages when lack of precipitation resulted in a 40% decline in the corn harvest.

Heavy rainfall

Extreme rainfall from a number of typhoons (notably Morakot, Ketsana, Melor and Parma) in southeast Asia, and above all the Philippines, caused widespread floods, the heaviest for 40 years in Manila. In the Mediterranean region, southeast Spain and North Africa were affected in late summer. In Sicily, 200 mm of rain fell in three hours, triggering mudslides. More than 100,000 people faced floods in West Africa, particularly Burkina Faso. Parts of Istanbul in northwest Turkey were also hit by flooding. In November, persistent heavy rain caused problems in southern Brazil, northeast Argentina and Uruguay, whilst the USA had its wettest October in 115 years following on from severe floods on the northern Great Plains in March. Scotland and the north of England experienced record rainfall. In November, over 370 mm were recorded in 44 hours at Seathwaite.

Conclusion

2009, which can be classified as a moderate El Niño year, illustrates the substantial effect that natural climate variability can have on losses. Typical warm-phase hurricane activity in the Atlantic was mitigated, resulting in much lower losses than in 2008. By contrast, reduced monsoon activity in southeast Asia due to El Niño led to drought losses, and dry conditions in southern Africa, for example, were further accentuated by the same climate phenomenon. It would be wrong to conclude from recent global mean annual temperatures that climate change had come to a halt. The fact is that, over shorter timescales, climate change can be obscured by natural fluctuations. The change in the world's climate system is unmistakable in the medium to long term. It will result in more frequent precipitation and temperature extremes, and loss volatility will typically increase.

In the second half of 2009 east and southeast China and Vietnam suffered a severe drought. Rivers and lakes dried up and shipping was impossible in many places. There were substantial livestock losses – some 500,000 animals died.


ARCA É JESUS

THE YEAR IN FIGURES

GREAT NATURAL CATASTROPHES 1950–2009

THE YEAR IN PICTURES

GEO NEWS

Flooded streets in Maraba, northern Brazil, on 6 May 2009 – persistent rainfall triggered floods and mudslides in the Tocantins basin leaving 186,000 homeless.

THE YEAR IN FIGURES

Author: Angelika Wirtz

With 860 loss events due to natural hazards, the number of catastrophes documented in 2009 exceeded the previous year's 750 and the ten-year average (770). The overall loss amounted to US$ 50bn, with 17 events exceeding the US$ 1bn threshold. The insurance industry incurred losses of US$ 22bn.

Number of events

All loss events due to natural hazards resulting in property damage and/or bodily injury are recorded in Munich Re's NatCatSERVICE database. Events are divided into six categories according to their monetary or humanitarian impact – from very small loss events to major natural catastrophes. None of last year's events qualified as a great natural catastrophe, although 27 were classed as category 5 (devastating catastrophe: losses exceeding US$ 500m or more than 500 fatalities). There were 40 events classed as severe catastrophes (more than US$ 200m in losses or over 100 fatalities)

Out of all natural catastrophes worldwide, 93% were caused by atmospheric conditions and 7% were attributable to earthquakes and volcanic eruptions. The percentage breakdown of the main perils corresponds to the long-term average. The breakdown by continent shows that most of the events occurred in America, with a total of 300, and Asia, with 290 – compared with just under 130 in Europe and roughly 70 each in Australia and Africa.

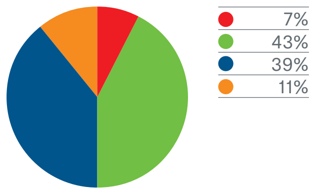
Fatalities

Natural catastrophes accounted for 11,000 deaths in 2009, far fewer than the long-term average of 57,000 per year since 1980. Severe wildland fires and extreme heatwaves caused over 500 deaths in Australia in 2009. The deadliest event of the past year was the Sumatra earthquake in Indonesia on 30 September, in which 1,200 died. Altogether 2,000 people died in the series of severe typhoons in Asia.

Claims

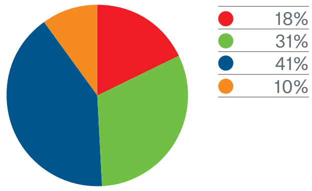
Last year's overall losses of US$ 50bn were lower than at any time since 2001. Half were in North America, which also made up 62% of the US$ 22bn insured losses whilst Europe accounted for 30%. The most expensive losses in Europe were Winter Storm Klaus (US$ 3bn) and severe weather in Switzerland and Austria (US$ 1.2bn).

860 EVENTS



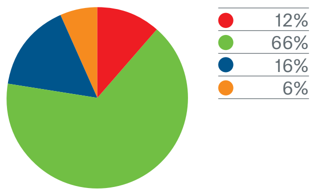
Percentage distribution worldwide

FATALITIES: 11,000



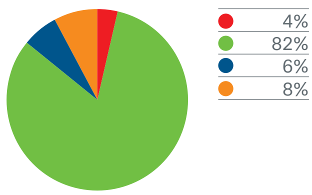
Percentage distribution worldwide

OVERALL LOSSES: US$ 50bn



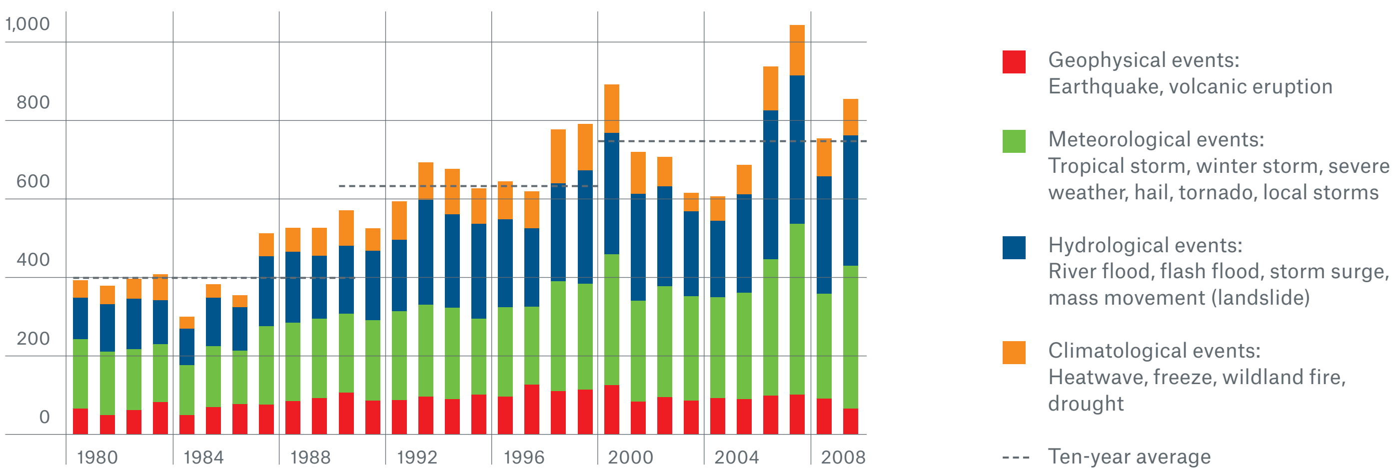
Percentage distribution worldwide

INSURED LOSSES: US$ 22bn



Percentage distribution worldwide

NUMBER OF NATURAL CATASTROPHES 1980–2009



GREAT NATURAL CATASTROPHES – CAUSES AND EFFECTS

Author: Angelika Wirtz

In 2009, no recorded loss event met the criteria of a "great natural catastrophe". However, this did not signal the all-clear: shortly after the start of the year, on 12 January 2010, one of the most devastating earthquake catastrophes of the last 100 years occurred in Haiti.

Every year, we research several hundred natural hazard events worldwide and enter them in our NatCatSERVICE database. In 2009, 860 events were added. For our long-term trend analysis, however, we only look at "great natural catastrophes". Smaller loss events are not taken into account to avoid inflating the figures. Major natural catastrophes have always been given good coverage but, today, even news of minor events in remote areas soon spreads, data and information flows having been revolutionised in recent decades.

The following remarks concerning great natural catastrophes since 1950 address the issues: What criteria have to be met? What are the main reasons for the increase in the number of natural catastrophes and losses? Which of the events of the last 60 years have been the worst?

Definition: Great natural catastrophe

Based on the United Nations definition, natural catastrophes are classified as great if a region's ability to help itself is distinctly overtaxed, making supraregional or international assistance necessary. As a rule, this is the case when there are thousands of fatalities, hundreds of thousands are left homeless, and/or overall losses are of exceptional proportions given the economic circumstances of the country concerned.

In terms of our great natural catastrophe statistics, this means specifically:

- Number of fatalities exceeds 2,000 and/or
- Number of homeless exceeds 200,000 and/or
- Overall losses exceed 5% of that country's per capita GDP and/or
- The country is dependent on international aid

Since 1950, 285 catastrophes have fulfilled these criteria. Some 60% of the events have been included in the statistics on the basis of economic losses alone, and just under 10% due to their humanitarian consequences, i.e. number of fatalities or homeless. Approximately 30% met all criteria.

Main reasons for the rise in loss events

A natural catastrophe can only come about if a society is not sufficiently prepared for an extreme natural event. Global changes have meant increased vulnerability nearly everywhere. The growth in numbers and losses is largely due to socio-economic changes. Climate change is probably playing an increasingly decisive role.

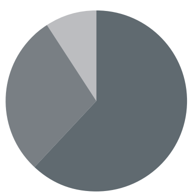
The following aspects can turn events that are entirely natural into devastating catastrophes:

Population growth: Today, the earth has 6.8 billion inhabitants. According to UN forecasts, the population will climb to more than nine billion by 2050. People will only be able to create the necessary settlement areas by making use of new sites, where natural hazard exposure can be very high.

Settlement and industrialisation of highly exposed regions: Cities are spreading rapidly, frequently in highly exposed regions such as flood and wildfire zones as well. Above all, the progressive settlement of coastal areas brings with it the risk of tropical-storm, tsunami or storm-surge losses. Even now, one-third of the world's population lives within 50 km of the coast.

Concentration of population and values: The more conurbations there are in earth's danger zones, the greater the probability that a natural hazard event will affect one of them. The number of cities worldwide with more than a million inhabitants has risen from around 80 in the 1950s to about 400 today. Already, more than 50% of the world's population lives in cities, and that figure is steadily rising. By 2030, it will be over 60%.

GREAT NATURAL CATASTROPHES – MAIN CRITERIA



Economic impact	62%
Economic impact and fatalities	29%
Fatalities	9%

Since 1950, 285 events have qualified as great natural catastrophes based on the criteria described.

Improved living standards: In virtually all regions of the world, population growth is associated with a rise in aggregate property value.

Vulnerability of modern societies: Modern technologies are more sophisticated and harbour new risks, which is why events like power cuts, computer network failures and infrastructure breakdowns can entail huge losses.

Rising insurance density and global networking: The increasing prevalence of insurance cover inevitably leads to an increase in insured events. The proportion of the overall loss figure borne by the global insurance sector averaged 18% in the 1980s, 21% in the 1990s and 30% in the last ten years. In addition, greater global networking (e.g. tourism) means that natural catastrophes now have more wide-reaching effects. This was highlighted by the tsunami of December 2004 which, like no other catastrophe before, affected many nations: 220,000 people from 40 different countries lost their lives.

Climate change: Climate change is leading to a rise in extreme weather events and its effect on natural catastrophe losses will increase.

Costliest and deadliest great natural catastrophes

Hurricane Katrina, which hit the US in 2005, has been – in original values – the most expensive natural catastrophe to date, in terms of overall damage and insured losses. However, it is mostly earthquakes that result in extremely high economic losses, three of the four most expensive catastrophes since 1950 being of geophysical origin. A list of the most expensive events for the insurance sector presents a different picture. Nine of the ten most serious catastrophes were due to storms, for which worldwide insurance penetration is high.

More than half of great natural catastrophe fatalities are the result of earthquakes. The deadliest earthquakes from 1950–2009 were the Tangshan quake in China in 1976 (242,000 fatalities) and the 2004 earthquake/tsunami in southern Asia (220,000).

Trend analysis

To adjust great natural catastrophe losses to the general trend in prices, overall and insured losses are extrapolated using the nominal consumer price index. No account is taken, however, of the impact population trends and real growth in values have on loss amounts. The bars representing losses in the diagram on page 37 show the monetary consequences that the catastrophes would have had under precisely the same conditions at today's prices.

The clear upward trends observed, i.e. towards more frequent and more expensive events, will also continue, due to the socio-economic and climatic changes described above. Since 1950, only three years have not been marred by great natural catastrophes: 1952, 1958 and 2009, showing that last year is rightly to be regarded as an exception.

GREAT NATURAL CATASTROPHES SINCE 1950

COSTLIEST EVENTS FOR THE OVERALL ECONOMY

Year	Event	Country	Overall losses (US$ m)*
2005	Hurricane Katrina	USA	125,000
1995	Earthquake	Japan	100,000
2008	Earthquake	China	85,000
1994	Earthquake	USA	44,000
2008	Hurricane Ike	USA, Caribbean	38,000

*Original values

COSTLIEST EVENTS FOR THE INSURANCE INDUSTRY

Year	Event	Country	Insured losses (US$ m)*
2005	Hurricane Katrina	USA	62,000
2008	Hurricane Ike	USA Caribbean	18,500
1992	Hurricane Andrew	USA, Bahamas	17,000
1994	Earthquake	USA	15,300
2004	Hurricane Ivan	USA, Caribbean	13,800

*Original values

DEADLIEST EVENTS

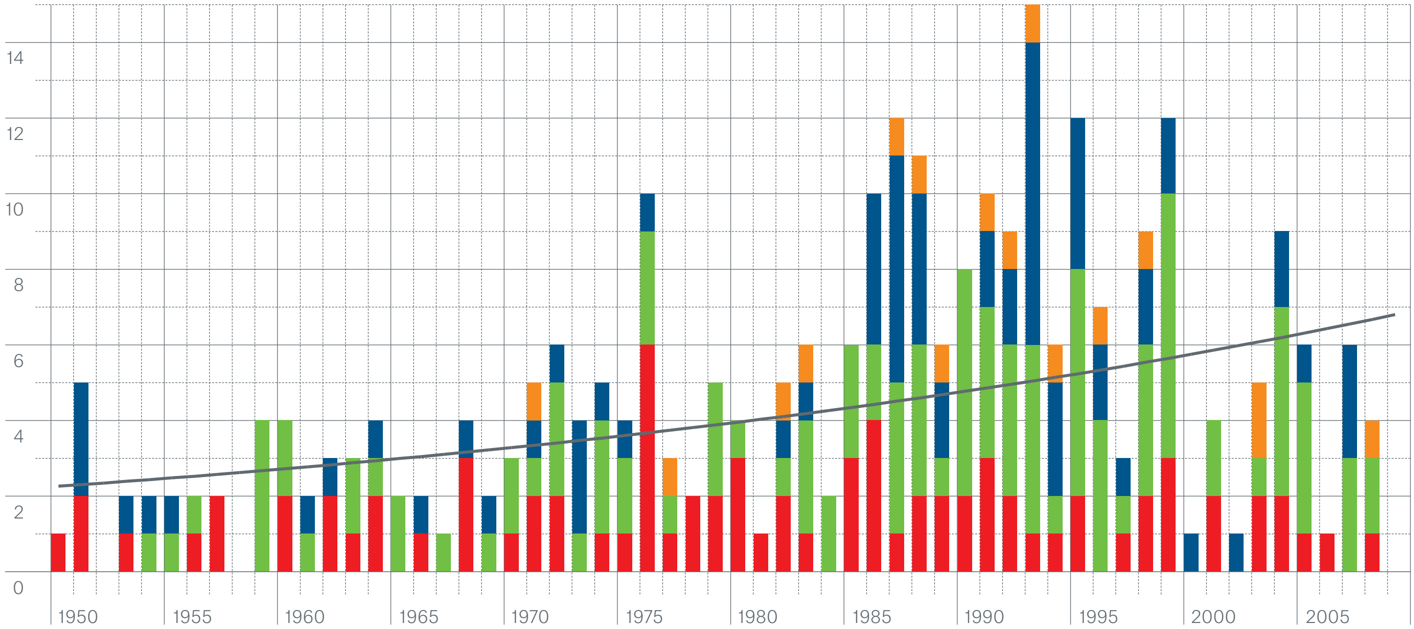
Year	Event	Country	Fatalities
1970	Tropical cyclone, floods	Bangladesh	300,000
1976	Earthquake	China	242,000
2004	Earthquake, tsunami	Esp. Indonesia, Sri Lanka, Thailand, India	220,000
1991	Tropical cyclone, storm surge	Bangladesh	139,000
2005	Earthquake	Pakistan, India, Afghanistan	88,000

Haiti: According to official reports, the earthquake that occurred on 12 January 2010 is likely to have claimed 225,000 lives and ranks among the deadliest events since 1950.

NUMBER OF EVENTS

The chart shows for each year the number of great natural catastrophes, divided up by type of event.

Number



Geophysical events: Earthquake, volcanic eruption

Meteorological events: Tropical storm, winter storm, severe weather, hail, tornado, local storms

Hydrological events: River flood, flash flood, storm surge, mass movement (landslide)

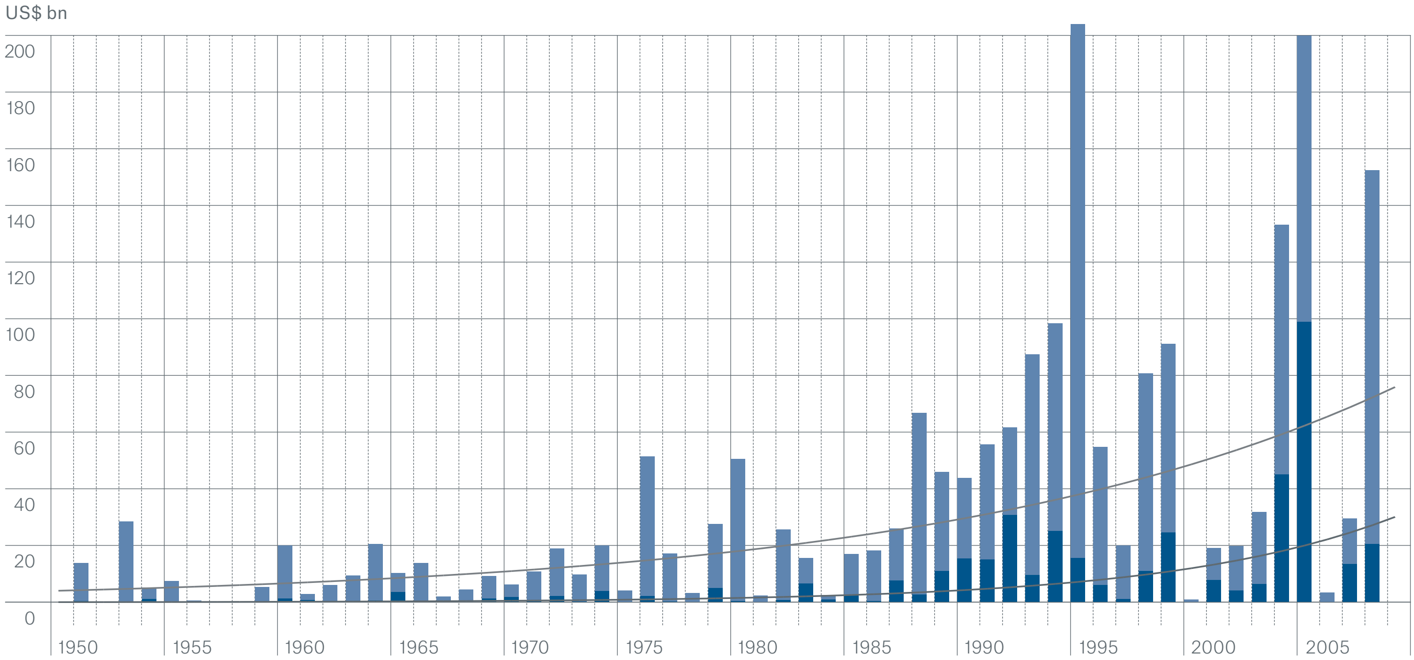
Climatological events: Heatwave, freeze, wildland fire, drought

Trend

OVERALL LOSSES AND INSURED LOSSES – ABSOLUTE VALUES AND LONG-TERM TRENDS

The chart presents the overall losses and insured losses – adjusted to present values. The trend curves document the increase in losses since 1950.

US$ bn



Overall losses (2009 values)

Of which insured losses (2009 values)

Trend: overall losses

Trend: insured losses

THE YEAR IN PICTURES

24–27 January
Winter Storm Klaus: France, Spain, Italy
Overall losses: US$ 5,100m
Insured losses: US$ 3,000m
Fatalities: 26

7–28 February
Black Saturday wildfires: Australia
Overall losses: US$ 1,300m
Insured losses: US$ 770m
Fatalities: 173

19 February
Volcanic eruption Chaiten: Chile
Evacuations

March–April
Flood: USA, Canada
Overall losses: US$ 1,000m
Insured losses: US$ 75m
Fatalities: 2

6 April
Earthquake: Italy
Overall losses: US$ 2,500m
Insured losses: US$ 260m
Fatalities: 295

25–27 May
Cyclone Aila: Bangladesh, Bhutan, India
Overall losses: US$ 500m
Fatalities: 320

28 May
Earthquake: Honduras, Belize
Overall losses: US$ 100m
Fatalities: 7

10–18 June
Severe weather, tornadoes USA
Overall losses: US$ 2,000m
Insured losses: US$ 1,100m
Fatalities: 1

22–28 June
Floods: Austria, Czech Republic, Poland, Germany
Overall losses: US$ 600m
Insured losses: US$ 300m
Fatalities: 16

23–24 July
Severe weather, hail: Switzerland, Austria, Germany, Poland, Czech Republic
Overall losses: US$ 1,800m
Insured losses: US$ 1,200m
Fatalities: 11

7–10 August
Typhoon Morakot: Taiwan, China, Philippines
Overall losses: US$ 4,600m
Insured losses: US$ 110m
Fatalities: 614

August–September
Floods: West Africa, central Africa
Overall losses: US$ 300m
Fatalities: 215

8–11 September
Flash flood: Turkey
Overall losses: US$ 550m
Insured losses: US$ 250m
Fatalities: 38

30 September
Earthquake: Indonesia
Overall losses: US$ 2,200m
Insured losses: US$ 100m
Fatalities: 1,200

8–9 October
Typhoon Melor: Japan
Overall losses: US$ 1,000m
Insured losses: US$ 625m
Fatalities: 4

27 October–7 November
Flood: Kenya, Somalia
Fatalities: 7
Evacuations

4–13 November
Hurricane Ida: Mexico, El Salvador, Nicaragua, USA
Overall losses: US$ 1,500m
Insured losses: US$ 250m
Fatalities: 204

15 December
Winter Storm Sochi: Russia
Overall losses: US$ 150m
Insured losses: US$ 30m

Modelling wildfire hazard

Author: Andreas Siebert

Each year, wildfires cost billions in worldwide losses. The worst hit regions include the southwest United States and southeast Australia. But exposure has been rising steadily in the Mediterranean, too, over the last few years.

In February 2009, the Australian state of Victoria suffered its most devastating bushfires for decades. More than 173 people were killed and property losses came to over US$ 1bn, most of which was insured. The southwest United States was also hit by fires in 2009, with losses of several hundred million US dollars.

Wildfires primarily occur after prolonged dry spells. In the dried-out vegetation, a careless act, like disposing of a burning cigarette butt, can easily escalate into a wildfire which, fanned by strong winds, is very difficult to control.

Apart from the climate aspects, urban spread is another key factor in rising loss potentials. People are increasingly setting up home on city boundaries, between the suburbs and nearby woodlands. This increases the risk of heavy insurance losses in the case of extreme wildfire events.

Commercial suppliers of (natural) hazard models such as RMS, EQECAT and AIR have responded to these developments. For some years now, they have offered models that estimate wildfire losses. However, more are needed, since most of the existing models relate to California.

Munich Re will be focusing on this highly topical issue during 2010 and preparing a global wildfire exposure map.

The satellite image shows the wildfires that raged in South California from the end of October to the beginning of November 2007. Hundreds of fires destroyed over 2,000 houses and thousands of cars. Eight people were killed. Overall losses came to US$ 2.7bn, and insured losses US$ 2.3bn.

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TOPICS GEO – 50 MAJOR EVENTS

No.	Date	Loss event	Region	Fatal-ities	Overall losses US$ m	Insured losses US$ m	Explanations, descriptions
1	8.1	Earthquake	Costa Rica	40	200	100	Mw 6.1. Landslides. Buildings destroyed. Infrastructure losses.
2	13.1–25.2	Floods	Australia	7	150	12	Remnants of Tropical Cyclone Ellie. 3,000 houses damaged/destroyed. Severe losses to infrastructure and agriculture (more than 100,000 cattle killed).
3	24–27.1	Winter Storm Klaus	France, Spain, Italy	26	5,100	3,000	Wind speeds up to 195 km/h. Buildings damaged. Losses to photovoltaic systems. Forestry losses. Power failures.
4	26–28.1	Winter damage, ice storm	USA: esp. AR, KY	58	1,100	565	Major losses to electricity infrastructure (40,000 pylons downed).
5	January	Winter damage, cold wave	Hungary, Poland, Romania	152			Frost damage to water and gas pipes. Power failures.
6	27.1–8.2	Heatwaves	Australia	347			Temperatures up to 48,8°C.
7	7–28.2	Wildfires "Victoria"	Australia	173	1,300	770	>400 bush fires. 4,300 km_ affected. 2,029 houses destroyed. Evacuations.
8	10–13.2	Severe storms, tornadoes	USA: esp. OH, OK	15	2,500	1,350	Thousands of houses, mobile homes, business premises, vehicles damaged/destroyed. Power failures.
9	Feb.–March	Floods	Angola, Namibia, Zambia	109			Torrential rain. Thousands of houses flooded. Major losses to agriculture, >25,000 head of livestock killed.
10	25–26.3	Severe storms, hailstorm, tornadoes	USA: esp. TX		1,500	995	Snowstorm, floods. Losses to buildings and infrastructure. Losses to industry.
11	27.3	Flash floods	Indonesia	100			Torrential rain. Dam damaged. Hundreds of houses destroyed.
12	March–April	Floods	USA, Canada	3	1,000	75	Heavy rain, snowmelt, ice jams, snowstorms, mudslides. Thousands of houses damaged. Infrastructure losses.
13	6.4	Earthquake	Italy	295	2,500	260	Mw 6.3. >15,000 buildings damaged/destroyed. Losses to historic buildings. Injured: >1,500.
14	9–11.4	Severe storms, tornadoes	USA: esp. AL, GA	9	1,700	1,150	Thousands of houses damaged/destroyed. Severe losses to infrastructure and agriculture.
15	21.4–15.5	Floods	Tajikistan	21	1		Landslides. 25 districts affected. Hundreds of houses damaged/destroyed.
16	24–28.4	Severe storms, tornadoes, hailstorm	USA: esp. KS, TX	6	450	320	Flash floods, lightning. Losses to buildings, infrastructure, agriculture and livestock.
17	April–May	Floods, landslides	Afghanistan	160	20		Hail, snowmelt. >16,000 houses damaged/destroyed. Losses to crops, livestock killed.
18	April–May	Floods	Brazil	60	550		>400 municipalities affected. Tens of thousands of houses flooded. Evacuated: >400,000.
19	7–8.5	Tropical Cyclone Chan-hom (Emong)	Philippines	60	130		Hundreds of villages flooded. >50,000 houses damaged/destroyed. Losses to infrastructure and agriculture. Power failures.
20	7–9.5	Severe storms, tornadoes	USA: esp. IL, MO	7	850	600	Thousands of houses and businesses, >20,000 cars damaged/destroyed.
21	25–27.5	Cyclone Aila	Bangladesh, Bhutan, India	320	500		Storm surge. >1.5 million houses damaged/destroyed. 1,400 km of embankments destroyed. >58,000 livestock killed.
22	5–8.6	Severe storms, tornadoes, hailstorm	USA: esp. CO		700	505	Thousands of houses damaged. Major losses to crops, livestock killed.
23	10–18.6	Severe storm, tornadoes	USA: esp. TX	1	2,000	1,100	>100,000 houses, businesses damaged. Major losses to agriculture.
24	21–22.6	Tropical Storm Linfa	China, Taiwan	1	50		Landslides, waves up to 4 m. Oil tanker ran aground. >300 km² of crops flooded.
25	22–28.6	Floods	Austria, Poland, Czech Republic, Germany	16	600	300	Depression Quinton. Floods. Thousands of buildings damaged. Losses to agriculture.
26	29.6–30.7	Floods	China	75	1,000		Landslides, heavy rainfall. Dam damaged. >100,000 buildings damaged/destroyed.
27	July–Sept.	Floods	India	>300	220		Monsoon rain. >55,000 houses damaged/destroyed. Major losses to infrastructure and agriculture, 1,100 livestock killed. Homeless: 177,500.
28	7–10.7	Severe storms, torna-does	USA: esp. KS		600	385	Tens of thousands of buildings and vehicles damaged/destroyed. Losses to infrastructure and agriculture. Livestock killed.
29	16–17.7	Hailstorm	France		300	140	Wind speeds up to 100 km/h. Cars, buildings damaged. Losses to crops.
30	20–21.7	Severe storms, hailstorm, tornadoes	USA: esp. CO	1	1,100	800	>30,000 houses, 19,500 vehicles damaged. Major losses to agriculture and infrastructure.
31	23–24.7	Severe storm, hailstorms	Austria, Switzerland, Germany	11	1,800	1,200	Depression Xystus. Wind speeds up to 130 km/h, flash floods. Losses to buildings, cars and agriculture.
32	24–25.7	Severe storms, hailstorms	USA: esp. MN, WI		310	220	Flash floods. Losses to infrastructure and agriculture.
33	1–5.8	Tropical Cyclone Goni (Jolina)	China, Philippines, Taiwan	20	10		Flash flood, landslides. Thousands of houses damaged/destroyed. Losses to agriculture.
34	7–10.8	Typhoon Morakot (Kiko)	China, Philippines, Taiwan	614	4,600	110	Torrential rain. Hundreds of villages flooded, thousands of houses destroyed. 1,400 km² of farmland affected. Evacuated: >1.4 million.
35	21.8–15.9	Floods	India	223	23		>3,000 villages flooded. Severe agricultural losses, livestock killed. Homeless: 500,000.
36	Aug–Sept.	Floods	Burkina Faso, Ghana, Sierra Leone, Nigeria	215	300		Flood. >30,000 houses damaged/destroyed. Lack of drinking water. Grain stocks destroyed, livestock killed, arable land damaged.
37	8–11.9	Floods, flash floods	Turkey	38	550	250	>4,000 houses, vehicles, industrial facilities flooded/damaged. Major damage to infrastructure.
38	16.9	Hailstorm, flash floods	USA: esp. TX	1	600	400	10,000 houses, 20,000 vehicles damaged. Power failures. Losses to agriculture.
39	26–30.9	Typhoon Ketsana (Ondoy)	Philippines, Laos, Vietnam	694	1,300	250	Hundreds of thousands of buildings, thousands of vehicles damaged/destroyed. Severe losses to infra-structure, fisheries and agriculture. Irrigation systems damaged. Tree plantations destroyed.
40	29.9	Earthquake, tsunamis	American Samoa, Samoa, Tonga	192	160		Mw 8.1. Villages, houses, vehicles destroyed. Infrastructure damage. Power and communication lines downed.
41	29.9–15.10	Floods, landslides	India	321	500		>700,000 houses damaged, >400 irrigation tanks breached. 35,000 head of cattle killed.
42	30. 9	Earthquake	Indonesia	1,200	2,200	100	Mw 7.5. Landslides. 84,000 houses, 200 official buildings, 800 schools destroyed, >214,000 houses damaged. Roads, bridges, water supply systems, power and communication lines destroyed. Injured: >2,900.
43	3–14.10	Typhoon Parma	Philippines, Taiwan, China	469	600		>50,000 houses damaged/destroyed. Factories, shopping malls, vehicles damaged. Losses to agriculture. Fishing boats sunk.
44	8–9.10	Typhoon Melor	Japan	4	1.000	625	Storm surge, waves up to 6 m. Thousands of houses damaged/destroyed. Losses to infrastructure.
45	30.10–3.11	Typhoon Mirinae (Santi)	Philippines, Vietnam, Cambodia	159	285	1	Villages cut off. >150,000 houses damaged/destroyed. Crops destroyed, major losses to livestock/aquaculture farms.
46	4–13.11	Hurricane Ida, floods	El Salvador, Nica-ragua, Mexico,USA	204	1,500	250	Wind speeds up to 165 km/h, high waves. Thousands of houses damaged/destroyed. Roads, bridges damaged. Oil and gas operations shut down.
47	13.11–4.12	Floods	Great Britain, Ireland	2	300	160	Thousands of houses damaged/destroyed. Power failures. Severe losses to infrastructure.
48	25.11	Flash floods	Saudi Arabia	125	500		>8,000 houses, >7,000 cars damaged. Losses to infrastructure.
49	8–9.12	Winter storm	USA: esp. KY, TN	17			Wind speeds up to 160 km/h. Hundreds of houses damaged. Power failure.
50	15.12	Winter storm	Russia		150	30	High waves (4 m). Port under construction damaged. Maritime shipping affected.

TOPICS GEO – WORLD MAP OF NATURAL CATASTROPHES

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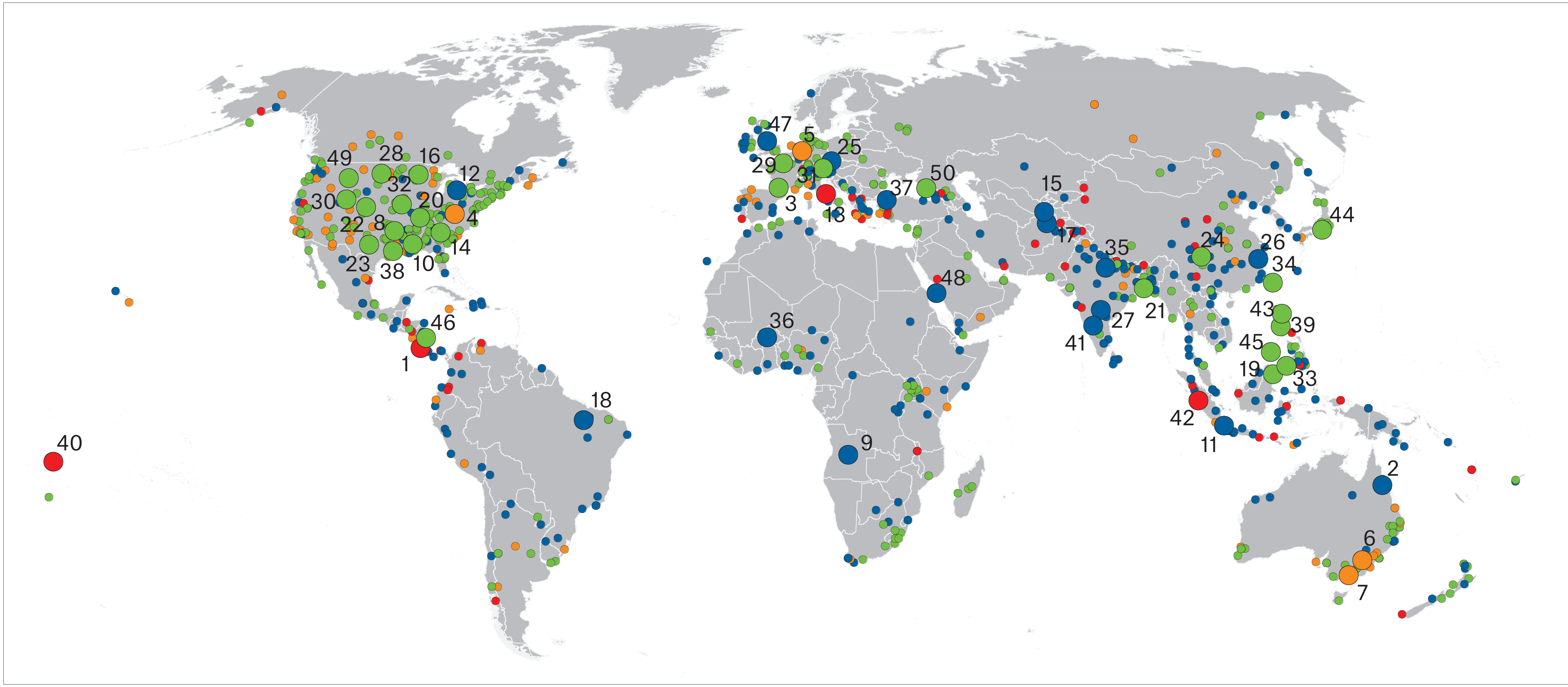

860 natural hazard events, thereof

○ 50 major events (selection)

○ In 2009, no event fulfilled the criteria applicable to a great natural catastrophe.

- **Geophysical events:** Earthquake, volcanic eruption
- **Meteorological events:** Tropical storm, winter storm, severe weather, hail, tornado, local storm
- **Hydrological events:** River flood, flash flood, storm surge, mass movement (landslide)
- **Climatological events:** Heatwave, cold wave, wildfire, drought

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