When the cities are heated up in the summer, they are threatened on several counts by thunderstorms and lightning. Thermal convection enhances the formation of thunderstorms, also, high buildings and antennae have an almost magical attraction to lightning. It is not unusual for this to result in serious overvoltage damage This picture was taken in Cologne, Germany.

A sudden onset of winter has a particularly fatal effect in cities since it usually brings traffic to a complete standstill Water pipes freeze up during cold spells and it is not until the thaw that the full extent of the damage emerges Last year too an extreme onset of winter hit the conurbations on the US East Coast This picture shows Times Square in New York City after a heavy blizzard in 1996

In the summer solar radiation heats up the concrete deserts of large cities more than their environs, which is why heat waves are usually much more unpleasant there and sometimes even catastrophic. The high ozone levels also put a strain on the population, especially older people In extreme heat waves it is not unusual for hundreds of people to die. This picture was taken in Paris, France

Some major natural catastrophes in large cities and conurbations

Year	Event	City	Fatalities	Economic losses (in US$ m, original values)	Insured losses (in US$ m, original values)
1906	Earthquake	San Francisco	3 000	524	180
1923	Earthquake	Tokyo	142,807	2,800	590
1955	Flood	Calcutta	1,700	65	
1962	Flood	Barcelona	1,000	100	
1962	Storm surge	Hamburg	347	600	40
1967	Flood	São Paulo, Rio de Janeiro	>600		
1972	Earthquake	Managua	11,000	800	100
1972	Landslide	Hong Kong	80		
1976	Earthquake	Tangshan	290,000	5,600	
1977	Flood	Karachi	375		
1984	Hail	Munich		950	480
1985	Earthquake	Mexico City	9,500	4,000	275
1986	Hail	Sydney		100	70
1987	Heat wave	Athens	>2,000		
1989	Earthquake	Newcastle (Sydney)	13	1,200	670
1991	Hail	Calgary		500	400
1992	Winter storm	New York	19	3,000	850
1992	Hurricane Andrew	Greater Miami	62	26,500	17,000
1994	Earthquake	Los Angeles (Northridge)	61	44,000	15,300
1995	Earthquake	Kobe	6,430	100,000	3,000
1995	Heat wave	Chicago	670		
1996	Winter storm	New York	85	1,200	600
1996	Hail	Riyadh		272	
1998	Ice storm	Montreal, Quebec, Toronto	28	1,500	950
1999	Hail	Sydney	1	1,500	960
1999	Tornado	Oklahoma City	51	2.000	1,485
1999	Earthquake	Izmit	17,200	12,000	600
2000	Tornado	Fort Worth	5	650	520

The figures in the table refer to the overall loss from each event In most cases, however, the lion's share of the loss was incurred in the cities listed

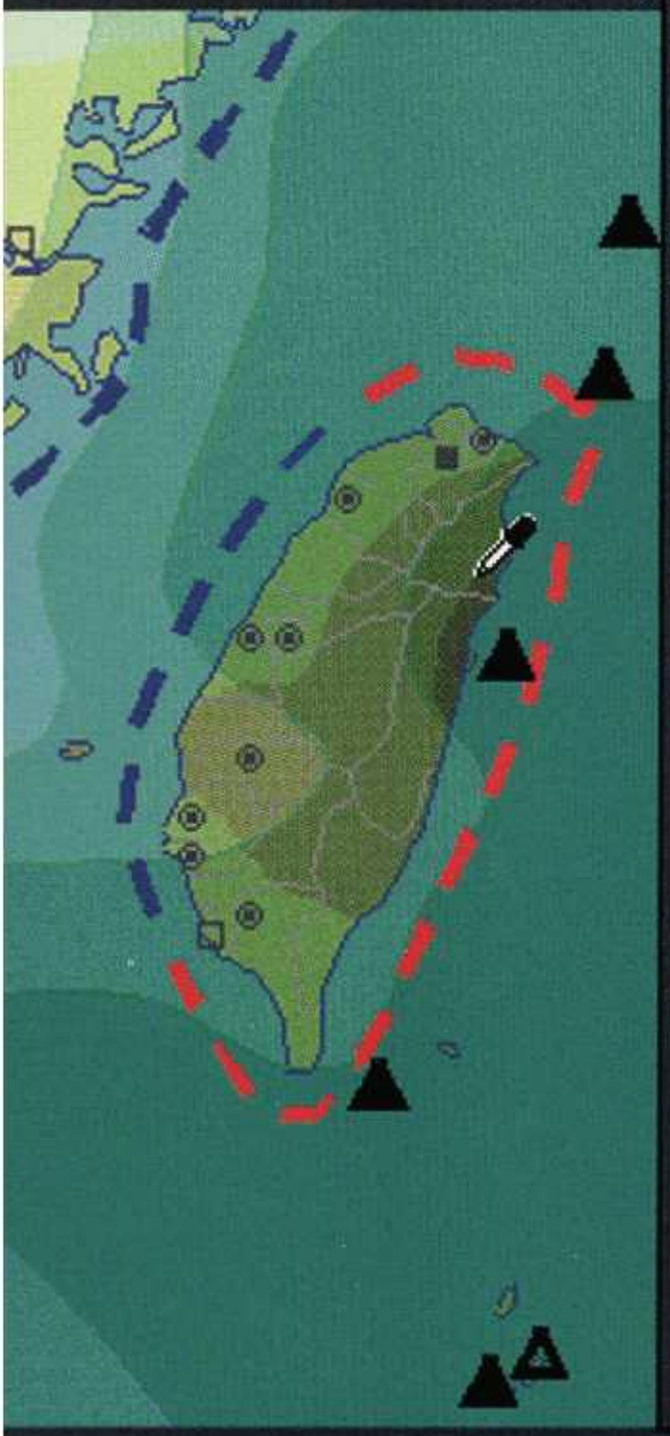
Natural events often result in traffic routes being blocked. Sometimes it is even impossible to evacuate or leave the affected area This picture, taken during Hurricane Frances in the United States, 1998, demonstrates this problem with great force.

Natural catastrophes often lead to the power network breaking down. In more severe events the power is sometimes cut off for weeks in millions of households, and work is constantly interrupted in industrial plants and commerce. If the power is largely supplied by overhead lines – as here in a suburb of Kyoto, Japan – the vulnerability is particularly high

54 Picture on the right
Narrow, congested roads considerably hamper those trying to give assistance. If a natural catastrophe involves several phenomena at the same time – as in this case of flood and conflagrations at Grand Forks on Red River, United States (1997) – helpers are often unable to even reach the scene

World Map of Natural Hazards

Catastrophe Catalogue Geo Specials Geo Services Country Profil



Hazard pointer

X

Find the exposure for the coordinates

24°30' N 121°36' E Location list

Exposure	none			high
Earthquake	☐	☐	☐	■
Volcanic Eruption	☐			■
Tsunami	☐	☐	■	☐
Tropical Storm	☐	☐	☐	■
Winter Storm	■	☐	☐	☐
Storm Surge	■			☐
Tornado	☐	■	☐	☐
Hailstorm	☐	☐	■	☐
Lightning	☐	☐	■	☐

General remark

MAP THEMES

LEGEND

HAZARD POINTER

DISTANCE

POSITION

HELP GLOSSARY SCALES EXIT

CD-ROM "World of Natural Hazards" A Munich Re service product of the new dimension

10

Background and review

Whenever a risk or a location is to be assessed, wherever it may be in the world, and the natural perils are to be included in that assessment, it is necessary to know how high the threatening risk potential from natural catastrophes is. The result of the risk assessment may on the one hand have an impact on the constructional design and choice of location of buildings, industrial plants, or infrastructure, and on the other hand influence the design of the insurance product and the premium required for it.

The geoscientists at Munich Re have always endeavoured to make their unique expertise in this field available to clients, engineers, authorities, and other interested parties. It was with this objective in mind that in 1978 they produced the "World Map of Natural Hazards", the first and even today unequalled global representation of natural hazards – adding to the many publications that had already appeared on individual topics This first version was followed by two updates in 1988 and 1998 and by the "Globe of Natural Hazards". However, it was becoming increasingly clear that such a form of representation could not provide the required degree of detail or "convey" the literally exploding volume of information and knowledge. It would therefore be necessary to forge new and modern paths.

Against this backdrop, at the beginning of 1999, Munich Re started work on a CD-ROM with the title "World of Natural Hazards". The aim was to create for the first time a multimedia tool designed to present a global view of current knowledge on natural hazards and natural catastrophes and hence provide decisive support for risk management. For this purpose, the knowledge Munich Re had gathered on the subject of natural hazards over the preceding 25 years was drawn together in a unique collection of data. Digital technology and the analysis of spatial information using geographical information systems (GIS) now provide a simple and fast method of identifying at the press of a button the natural hazards threatening any point on the globe and of making an initial approximate evaluation.

What issues can be considered?

In the following we will use a typical example from the insurance industry – specifically an underwriter's investigation of a distinct insured object – to show how the CD can be used (Within the framework of this publication we will only be able to deal with a fragment of the wide range of functions available.)

Example

Natural hazards cover for a semiconductor factory in Taiwan, about 60 km south of Taipei:

The "Country Profile" module first gives a statistical overview of the geography, population, and economic strength of the country, and the natural hazards threatening the country as a whole. As the example shows, Taiwan is highly exposed to the hazards of earthquake and tropical storm (Fig 56) This is confirmed by a list and a map of historical events taken from the "Catastrophe Catalogue" module (Fig 57)

The exact spatial distribution of natural hazards and their intensities is best viewed in the "World Map" module. The user locates Taiwan as the target area using the navigating tool and zooms in The various hazard themes can be selected and displayed one by one. Cities, borders, waterways, and a latitude/longitude grid can also be activated for better orientation within the map The risk location can be pinpointed exactly using a list of places (including all cities with a population of more than 100,000) and the measuring facility. Finally, the high-powered "Hazard Pointer" may then be used to make a qualitative risk assessment (Fig 55)

In the chosen example, there are other hazards of very great significance in addition to those mentioned above, namely volcanic eruption, hailstorm, and lightning stroke. In the vicinity of the coast tsunami has to be considered too If more detailed explanations are needed on any of the hazards, the "Basic Information" module with essential descriptions and illustrative pictures (Fig. 58) can be activated.

Further useful information may be found in the "Geo Specials" module, where topical issues from the thematic complex of economics and environmental change are dis-

55 With the Hazard Pointer the user can make a quick assessment of the natural hazard potential at any position on land

56 The Country Profile provides a unique view of the situation with regard to natural hazards for the country as a whole

57 The user can formulate specific inquiries in the Catalogue of Natural Catastrophes

58 Basic Information provides comprehensive background facts on 16 natural hazards

59 The scales provide an edifying view of how humans, animals, and property are affected by windstorm and earthquake

cussed The sections dealing with climate change, El Niño/La Niña, and megacities are packed with images and film material as well as tables, thus providing an excellent basis for in-depth discussions

The tools "Glossary" and "Scales" may be accessed at all times from anywhere in the application and provide constant support on questions of definition or frequently used units and scales in the field of geosciences (e.g. Beaufort, Richter, Fahrenheit) (Fig. 59).

This comprehensive information, which is available in two languages (German and English), enables the user to make a quick assessment of the natural hazards that will serve as a starting point for further action and consultation. The various subject areas and detailed information on the subject of natural hazards can be selected and linked together on the basis of the user's own individual interests and questions.

Prospects

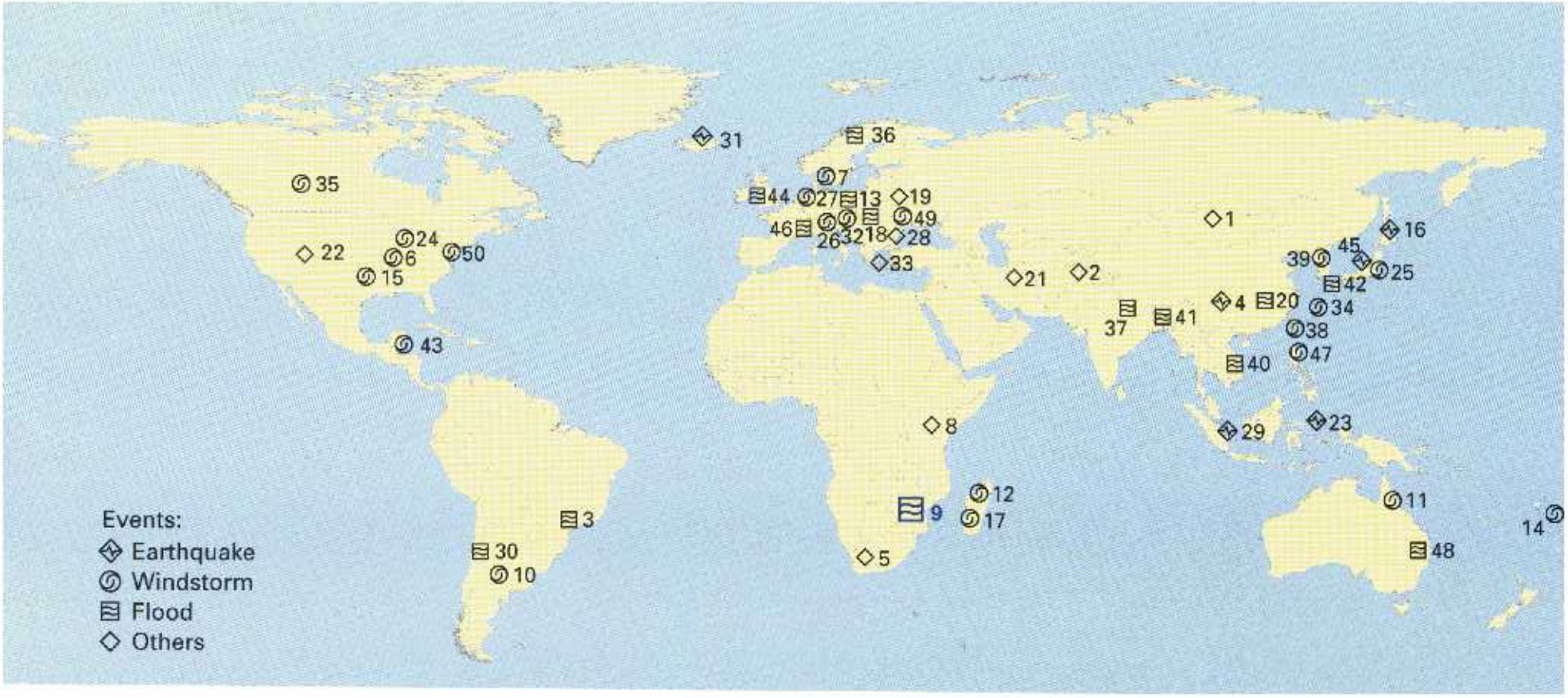
Future developments will focus on extending the range and depth of topics considered and increasing the geographical resolution, which is necessary for individual natural hazards such as flood, landslide, and avalanche. Our work will also have to go in the direction of a rating tool that will provide risk management with even more comprehensive support. For a better distribution and updating of information in the global focus, the Internet will soon become an important supplementary component in the dissemination of expertise and service products.

In the production of this CD we endeavoured to set up an optimum link between geoscientific and insurance aspects. The CD-ROM is a modern work that reflects its own age. It is certainly not a product that is meant for eternity, but it is among the best (in its field) at the beginning of this new millennium.

50 SIGNIFICANT LOSS EVENTS IN 2000

No.	Date	Loss event	Region	Deaths	Economic losses US$ m	Insured losses US$ m	Remarks, description of losses
1	Jan.–Apr.	◇ Winter damage	Mongolia: S,W	7	80		Temperatures as low as -45°C. Severest winter for 30 years. 2.4 million farm animals killed.
2	Jan.–Dec.	◇ Drought	Afghanistan. Pakistan. India. Tajikistan	35	590		Food and water shortages. Heavy losses in the livestock sector. 50 million pec affected.
3	1–5.1	▤ Floods, landslides	Brazil: SE	26			Towns cut off from the outside world. 70,000 homeless.
4	14.1	◈ Earthquakes	China: SW	5	75		Two quakes (M 5.9, 6.5). 290,000 houses damaged or destroyed.
5	15–19.1	◇ Forest fires	South Africa: Cape Town region		10	8	Worst forest fire in 30 years. Wine-growing area affected.
6	22–25.1	◎ Winter storm	USA: AL, GA, LA, NC, SC, TN, VA, NY, PA, MA	4	350	280	More than 500,000 without electricity. Car industry affected.
7	29–30.1	◎ Winter storm Kerstin	Germany: N. Denmark	4	100	60	Wind speeds of up to 160 km/h. Heavy coastal erosion on the island of Sylt.
8	February	◇ Frost	Kenya: SW				Severest period of frost in years. Tea plantations affected.
9	Feb.–March	▤ Floods, tropical cyclone Eline	Mozambique. South Africa. Botswana. Swaziland. Zimbabwe. Malawi. Zambia	>1,000	660	50	Worst floods in 50 years. Rivers burst their banks. Dams breached. Infrastruct destroyed. Food and water supplies impaired. Evacuations held up. 950,000 h less. Millions affected.
10	5.2	◎ Hailstorm	Argentina: C, Santa Isabel		20	14	Damage to car factory and vehicles.
11	27.2–13.3	◎ Tropical cyclone Steve	Australia: NE	1	90	10	Gusts of up to 170 km/h. Heavy losses in agricultural and livestock sectors.
12	2.3	◎ Tropical cyclone Gloria	Madagascar: W, N	130			Numerous houses flooded. 150 school buildings destroyed. 750,000 affected.
13	9–16.3	▤ Floods	Czech Republic: C, W		80	55	Rivers burst their banks. Industrial losses. Damage to infrastructure.
14	10.3	◎ Tropical cyclone Mona	Tonga: C		4		Damage to supply facilities and agricultural losses.
15	28–29.3	◎ Tornadoes	USA: TX, Fort Worth, LA	5	650	520	1,500 houses damaged. Damage to infrastructure.
16	31.3–13.4	◈ Volcanic eruption: Mt. Usu	Japan: N, Hokkaido, Abuta				More than 10,000 evacuated.
17	2.4	◎ Tropical cyclone Hudah	Madagascar: NE. Mozambique: C	>23			Gusts of up to 280 km/h. 100,000 without food or water.
18	6–10.4	▤ Floods	Romania: C, W. Hungary: E, NE. Serbia	10	100		Rivers flooded their banks, approx. 10,000 houses and 2,000 km² of agricultur land flooded.
19	May	◇ Freeze, frost	Ukraine. Belarus		115		Severe losses in the agricultural sector.
20	May–June	▤ Floods	China: SE, C	410	960		Hundreds of thousands of houses flooded. Damage to infrastructure and agricultural losses. Oil production affected.
21	May–Aug.	◇ Drought	Iran: C, E, S		3,500*		Rivers and lakes dried up. 800,000 farm animals killed. 3 million tonnes of wh and barley destroyed. (*Loss amount 1999/2000)
22	May–Sept.	◇ Forest fires, drought	USA: AZ, CA, CO, ID, FL, MT, NV, NM, OR, TX, UT, WA, WY	9	>1,000	140	85,000 single forest fires throughout the year. 850 houses and 28,000 km² of f burnt. International fire brigades in action.
23	4.5	◈ Earthquake, tsunami	Indonesia: E	41	30		M 6.5. Tsunami 6 metres high. More than 10,000 buildings destroyed. Severe damage to infrastructure.
24	17–19.5	◎ Severe storm, tornadoes, floods	USA: CT, IA, IL, IN, NJ, NY, OH, PA, WI, NE, MN, WY, CO	1	300	240	Buildings and vehicles damaged. Airports closed.
25	24.5	◎ Hail	Japan: C		350	290	Hailstones up to 5 cm in diameter. Damage to buildings and crops.
26	27.5	◎ Hail	Austria: NW, Upper Austria		20	14	Cars, greenhouses, and crops damaged.
27	28.5	◎ Winter storm Ginger	Germany. Belgium. Netherlands	6	200	150	Gusts of up to 140 km/h. Cranes, scaffolding blown over. Losses in the agricultural sector.
28	June–July	◇ Heat wave, drought	Eastern Europe. Southeastern Europe	70	300		Temperatures of up to 45°C. Major losses in the agricultural and livestock sec
29	4.6	◈ Earthquake	Indonesia: W	130	6		M 7.7 Mw. Damage to buildings and infrastructure. 2,500 injured.
30	12–26.6	▤ Severe storm, floods	Chile: N, S, C, esp. Santiago, Valparaiso		15		Worst storm in 20 years. Thousands of houses flooded. Damage to the infrast and agricultural losses. More than 70,000 affected.
31	17.6	◈ Earthquake	Iceland: S, Hella		20		M 6.6. Damage to buildings, roads, and pipelines.
32	3–7.7	◎ Hailstorms	Austria: C, SE, W	2	125	70	Hailstones up to 5 cm in diameter. Car depots affected. Losses in the agricultu sector.
33	5–13.7	◇ Forest fires, heat wave	Greece: C, W, E, S	25			Numerous farms burnt down, hundreds of greenhouses destroyed. Damage i olive plantations and wine-growing areas.
34	6–9.7	◎ Typhoon Kirogi (Ditang)	Philippines. Japan. Taiwan	44	300	200	Wind speeds of up to 150 km/h, torrential rain (300 mm in a few hours). Loss the agricultural and livestock sectors.
35	14.7	◎ Tornado	Canada: W, Alberta, Red Deer	10	13	10	F-3 tornado (Fujita scale). Camping site devastated.
36	21–25.7	▤ Floods	Sweden: C, N		8	5	Infrastructure affected. Hydroelectric power stations damaged.
37	Aug.–Oct.	▤ Floods	India: E, N, NE. Nepal: C	1,550	1,200		Thousands of villages flooded. Traffic routes blocked. Severe losses in the agricultural and livestock sectors. 3.5 million homeless/evacuated.
38	22–23.8	◎ Typhoon Bilis	Taiwan: S	11	135	3	Wind speeds exceeding 180 km/h. Road and air traffic disrupted. One million households without electricity. Financial markets closed.
39	30–31.8	◎ Typhoon Prapiroon (No.12)	South Korea. North Korea: NE, E	42			150,000 houses damaged or destroyed. Damage to infrastructure.
40	Sept.–Oct.	▤ Floods	Cambodia. Vietnam. Laos. Thailand	>900	460		More than 320,000 houses badly damaged or destroyed. Losses in agricultura livestock sectors. Four million homeless.
41	Sept.–Oct.	▤ Floods	Bangladesh: W, SE	130	500		700,000 houses, 1,100 km of road damaged. Losses in aquaculture sector. 1.3 evacuated.
42	13–19.9	▤ Floods, Typhoon Saomai	Japan. South Korea. Russia	25	1,500	1,050	Record precipitation. Tens of thousands of buildings flooded. Car industry aff
43	29.9–3.10	◎ Hurricane Keith	Belize. Mexico. Nicaragua. Honduras. Guatemala	21	280		Wind speeds of up to 215 km/h. Damage to infrastructure and agricultural los
44	Oct.–Nov.	▤ Floods	Great Britain: England, Wales. Ireland: S	10	>1,500	>700	Rivers burst their banks. Buildings damaged. Thousands evacuated.
45	6.10	◈ Earthquake	Japan: W, Tottori		150	20	M 6.5 Mw. 2,200 buildings damaged. Port facilities damaged. Liquefaction. Da to infrastructure.
46	13–20.10	▤ Floods, landslides	Italy. Switzerland. France	38	8,500	420	Damage to buildings and infrastructure. Electricity and water supply interrupt Car industry affected.
47	28–31.10	◎ Typhoon Xangsane	Philippines. Taiwan	103	70		Numerous villages flooded. 40,000 homeless.
48	16–23.11	▤ Floods	Australia: E		250		Torrential rain (up to 300 mm/12 hours). 200,000 km² flooded. Damage to infr structure and agricultural losses.
49	26–27.11	◎ Winter storm	Moldavia: N, C		30		36,000 power pylons damaged, two-thirds of the country without electricity. Damage to infrastructure.
50	16–17.12	◎ Severe storm, tornadoes	USA: AL, CT, FL, GA, KY, MA, MS, NC, NJ, NY, PA, RI, SC, TE	12	500	300	F-4 tornado (Fujita scale). Buildings and cars damaged. Power supply interrup

topics WORLD MAP OF NATURAL CATASTROPHES 2000



Great natural catastrophe

No.	Date	Area	Loss event	Deaths	Economic losses (US$ m)	Insured losses (US$ m)
9	Feb.–March	Mozambique. South Africa. Botswana. Swaziland Zimbabwe. Malawi. Zambia	Floods, tropical cyclone Eline	>1,000	660	50

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