World Map of Natural Hazards

Version 2009
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Münchener Rück
Munich Re Group

Compact knowledge – More transparency in risk management

An excellent example of the wealth of knowledge that Munich Re has developed is the World Map of Natural Hazards, which combines the geoscientific data and findings we have accumulated over a period of 35 years. First devised as a wall-map in 1978, the product has established itself as a standard work for the identification and risk management of natural hazards.

Since early 2009, the fully updated fourth-generation version has been available in print and on DVD. The interactive DVD shows natural hazards and climate effects for the first time at a glance worldwide: the global cartographic information is presented on a globe underlaid with satellite images. The user can home in on any location in the world and pinpoint the hazard situation there. Complex knowledge modules for historical catastrophes, megacities, and change processes are graphically linked with each other and can be displayed on the globe. The full integration of the topic of climate change is a new development: various depictions of climate effects and projections show in which regions of the world risk situations are likely to arise in future.

Thanks to its sound information, the World Map of Natural Hazards and the interactive globe are important tools for identifying specific locations worldwide, evaluating them from a geoscientific perspective, and thus increasing risk transparency.

Scales and effects

Windstorm

Beaufort Scale

Bft	Descriptive term	Mean wind speed (10-minute average)			Wind pressure	
		m/s	km/h	mph	knots	kg/m²
0	Calm	0 – 0.2	0 – 1	0 – 1	0 – 1	0
1	Light air	0.3 – 1.5	1 – 5	1 – 3	1 – 3	0 – 0.1
2	Light breeze	1.6 – 3.3	6 – 11	4 – 7	4 – 6	0.2 – 0.6
3	Gentle breeze	3.4 – 5.4	12 – 19	8 – 12	7 – 10	0.7 – 1.8
4	Moderate breeze	5.5 – 7.9	20 – 28	13 – 18	11 – 15	1.9 – 3.9
5	Fresh breeze	8.0 – 10.7	29 – 38	19 – 24	16 – 21	4.0 – 7.2
6	Strong breeze	10.8 – 13.8	39 – 49	25 – 31	22 – 27	7.3 – 11.9
7	Near gale	13.9 – 17.1	50 – 61	32 – 38	28 – 33	12.0 – 18.3
8	Gale	17.2 – 20.7	62 – 74	39 – 46	34 – 40	18.4 – 26.8
9	Strong gale	20.8 – 24.4	75 – 88	47 – 54	41 – 47	26.9 – 37.3
10	Storm	24.5 – 28.4	89 – 102	55 – 63	48 – 55	37.4 – 50.5
11	Violent storm	28.5 – 32.6	103 – 117	64 – 72	56 – 63	50.6 – 66.5
12	Hurricane	> 32.6	> 117	> 72	> 63	> 66.5

Saffir-Simpson Hurricane Scale

SS	Descriptive term	Mean wind speed (1-minute average)			
		m/s	km/h	mph	knots
1	Weak	32.7 – 42.6	118 – 153	73 – 95	64 – 82
2	Moderate	42.7 – 49.5	154 – 177	96 – 110	83 – 96
3	Strong	49.6 – 58.5	178 – 209	111 – 130	97 – 113
4	Very strong	58.6 – 69.4	210 – 249	131 – 155	114 – 134
5	Devastating	> 69.4	> 249	> 155	> 134

Enhanced Fujita Tornado Scale

EF	Descriptive term	Wind speed (3-second average)			
		m/s	km/h	mph	knots
0	Weak	29 – 38	105 – 137	65 – 85	57 – 74
1	Moderate	39 – 49	138 – 178	86 – 110	75 – 96
2	Strong	50 – 60	179 – 218	111 – 135	97 – 117
3	Devastating	61 – 74	219 – 266	136 – 165	118 – 143
4	Annihilating	75 – 89	267 – 322	166 – 200	144 – 174
5	Disaster	> 89	> 322	> 200	> 174

Earthquake

Earthquake Intensity Scales

MM	Descriptive term	Acceleration	EMS	RF	JMA
1956		% g	1992	1883	1951
I	Imperceptible	< 0.1	II	II	I
II	Very slight	0.1 – 0.2			
III	Slight	0.2 – 0.5	III	III	
IV	Moderate	0.5 – 1	IV	IV	II
V	Rather strong	1 – 2	V	V	III
VI	Strong	2 – 5	VI	VI	IV
VII	Very strong	5 – 10	VII	VII	V
VIII	Destructive	10 – 20	VIII	VIII	
IX	Devastating	20 – 50	IX	IX	VI
X	Annihilating	50 – 100 (≈1 g)	X	X	
XI	Disaster	1 – 2 g	XI		VII
XII	Major disaster	> 2 g	XII		

Earthquake Magnitude Scale

According to Richter (1956):

$Log_{10}E = 11.8 + 1.5\ M$

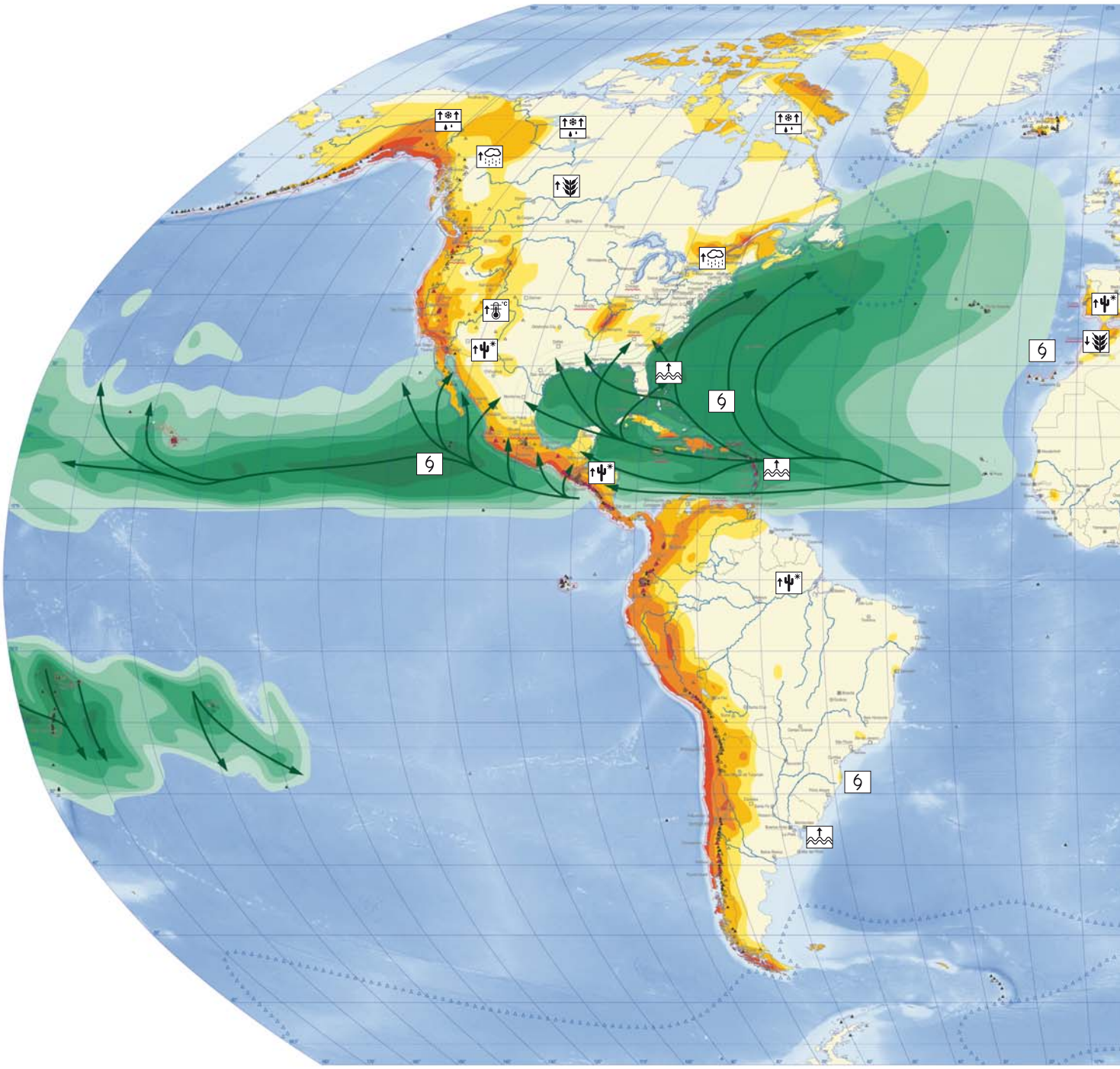
E = energy released (in erg); to be multiplied by 32 for each full M grade

M = Richter magnitude (up to M ≈ 9.5)

In addition to M, effects observed on the surface (→intensities) depend mainly on the depth of and the distance from the focus, the duration of the earthquake and the prevailing subsoil conditions.

MM: 1956 Modified Mercalli
EMS: 1992 European Macroseismic Scale (Improvement of Medwedew-Sponheuer-Karnik, 1964)
RF: 1883 Rossi-Forel
JMA: 1951 Japan Meteorological Agency

World Map of Natural Hazards



Earthquakes

- Zone 0: MM V and below
- 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 (equivalent to a "return period" of 475 years) for medium subsoil conditions.

Osaka Large city with "Mexico City effect"

Tropical cyclones

Peak wind speeds*

- Zone 0: 76–141 km/h
- Zone 1: 142–184 km/h
- Zone 2: 185–212 km/h
- Zone 3: 213–251 km/h
- Zone 4: 252–299 km/h
- Zone 5: ≥ 300 km/h

* Probable maximum intensity with an exceedance probability of 10% in 10 years (equivalent to a "return period" of 100 years).

Typical track directions

Volcanoes

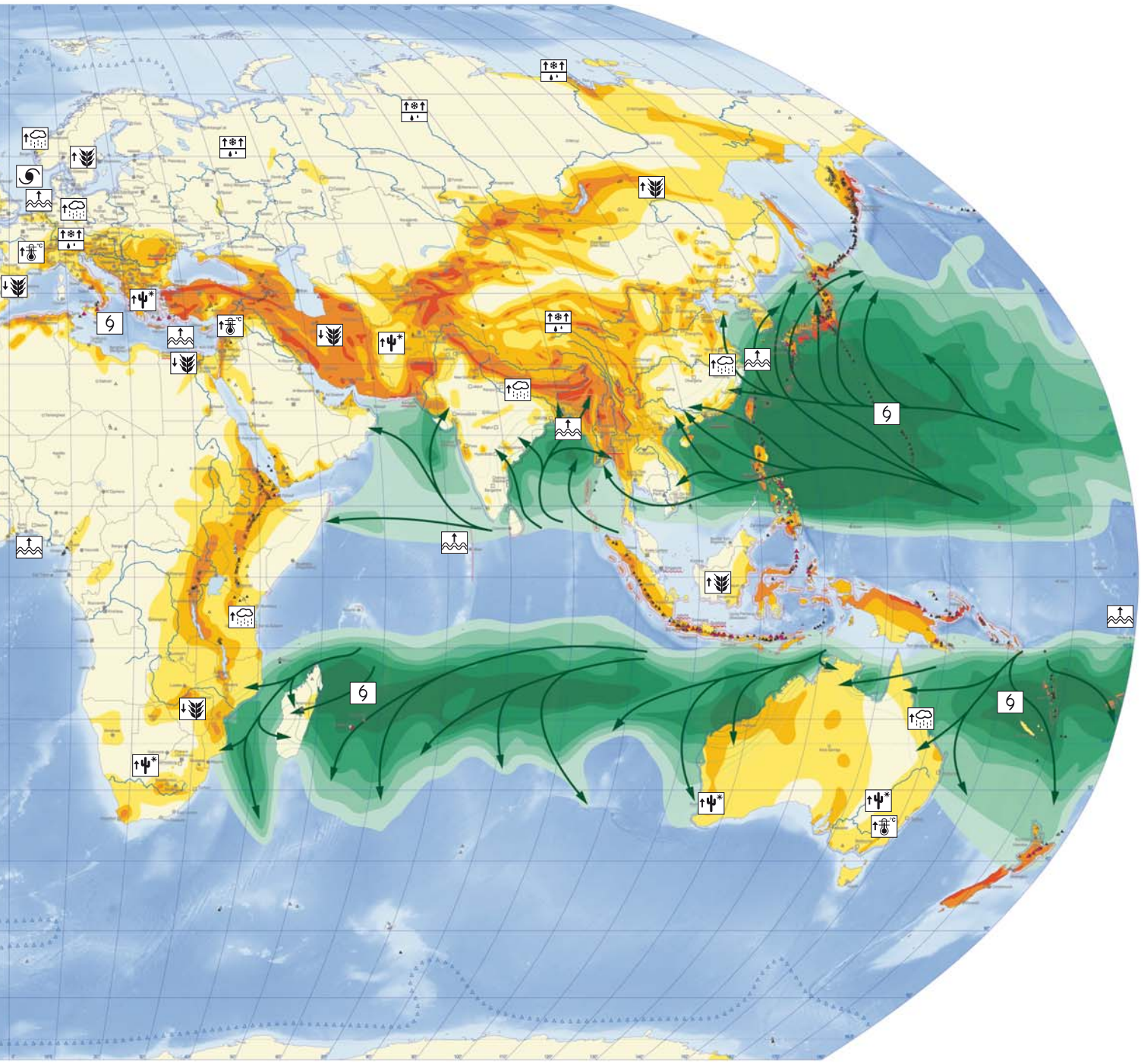
- △ Last eruption before 1800 AD
- ▲ Last eruption after 1800 AD
- Particularly hazardous volcanoes

Tsunamis and storm surges

- Tsunami hazard (seismic sea-wave)
- Storm surge hazard
- Tsunami and storm surge hazard

Iceberg drifts

△ △ △ △ Extent of observed iceberg drifts



Climate impacts

Main impacts of climate change already observed and/or expected to increase in the future

- Change in tropical cyclone activity
- Intensification of extratropical storms
- Increase in heavy rain
- Increase in heatwaves
- Increase in droughts
- Threat of sea level rise
- Permafrost thaw
- Improved agricultural conditions
- Unfavourable agricultural conditions

Political borders

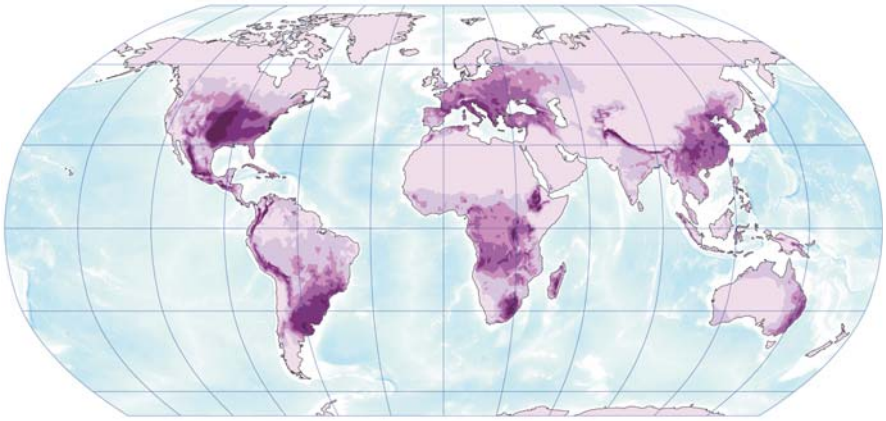
- State border
- State border controversial (political borders not binding)

Cities

□	Denver	> 1 million inhabitants
⊙	San Juan	100,000 to 1 million inhabitants
○	Maun	< 100,000 inhabitants
■●●	Berlin	Capital city
□	Melbourne	Munich Re office

Data resources

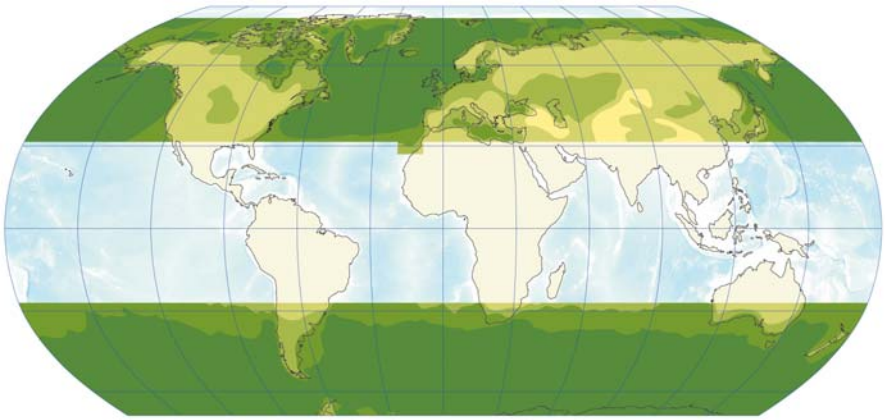
Bathymetry: Amante, C. and B. W. Eakins, ETOPO1 1 Arc-Minute Global Relief Model: Procedures, Data Sources and Analysis, National Geophysical Data Center, NESDIS, NOAA, U.S. Department of Commerce, Boulder, CO, August 2008. **Extratropical storms:** KNMI (Royal Netherlands Meteorological Institute). **Lightning strokes:** NASA LIS/OTD Science Team, NASA/MSFC/GHRC. **Temperature/Precipitation 1978–2007:** Climatic Research Unit, University of East Anglia, Norwich.



Hailstorms

Frequency and intensity of hailstorms

- Zone 1: low
- Zone 2:
- Zone 3:
- Zone 4:
- Zone 5:
- Zone 6: high

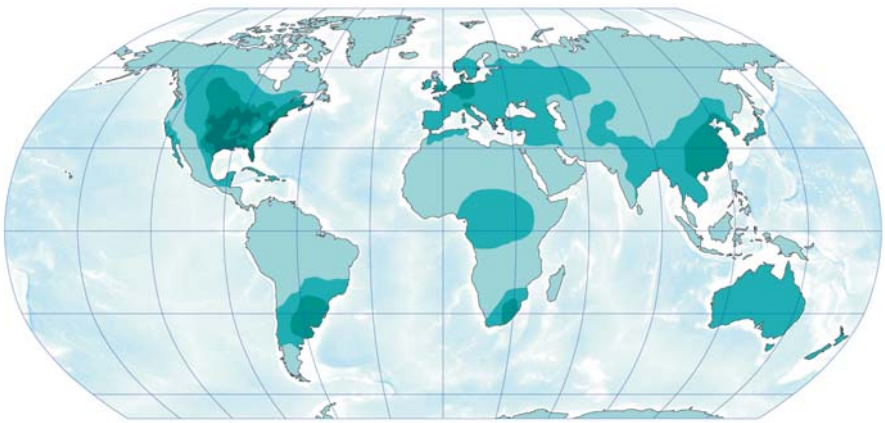


Extratropical storms (winter storms)

Peak wind speeds*

- Zone 0: ≤ 80 km/h
- Zone 1: 81–120 km/h
- Zone 2: 121–160 km/h
- Zone 3: 161–200 km/h
- Zone 4: > 200 km/h

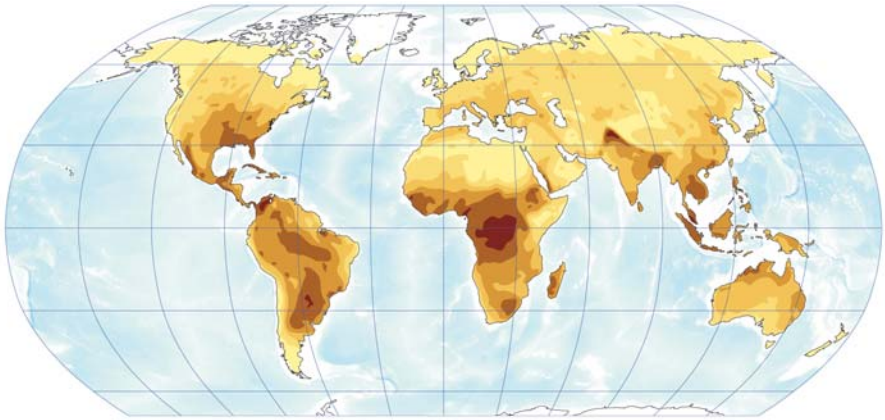
Areas were examined in which there is a high frequency of extratropical storms (approx. 30°–70° north and south of the equator).
* See “Tropical cyclones”



Tornadoes

Hazard

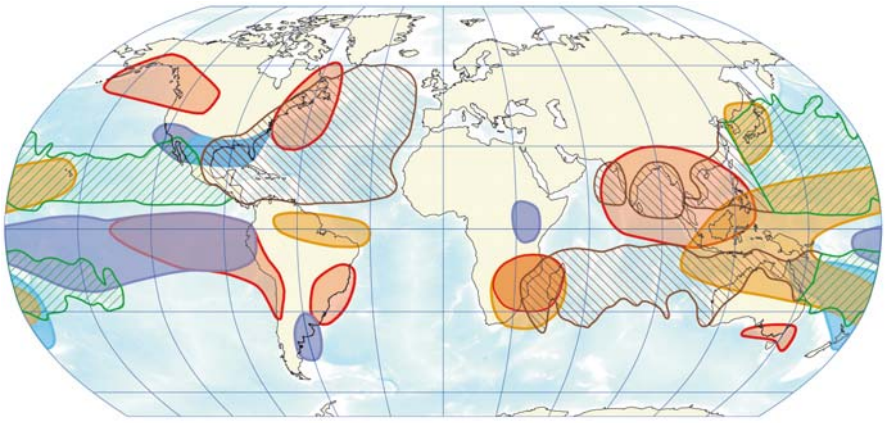
- Zone 1: low
- Zone 2:
- Zone 3:
- Zone 4: high



Lightning strokes

Global frequency of lightning strokes per km² and year

- No data
- 0.2–1
- 1–4
- 4–10
- 10–20
- 20–40
- 40–80



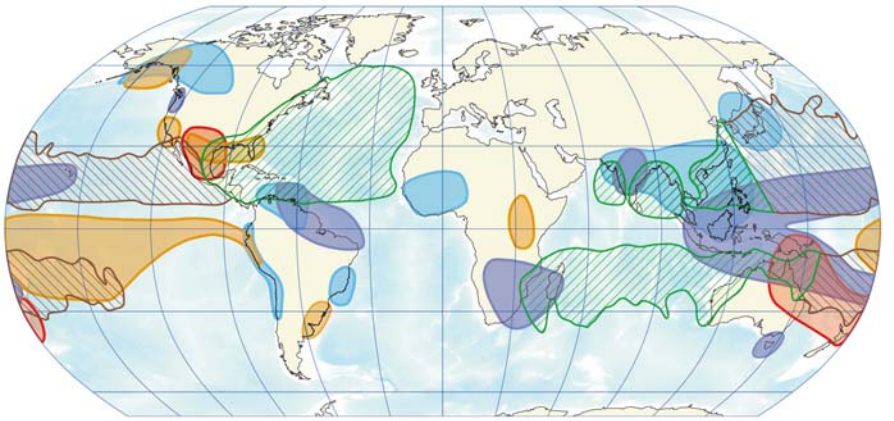
Anomalies during El Niño

Weather conditions

- wetter
- drier
- cooler
- warmer

Tropical cyclone activity

- fewer storms
- more storms



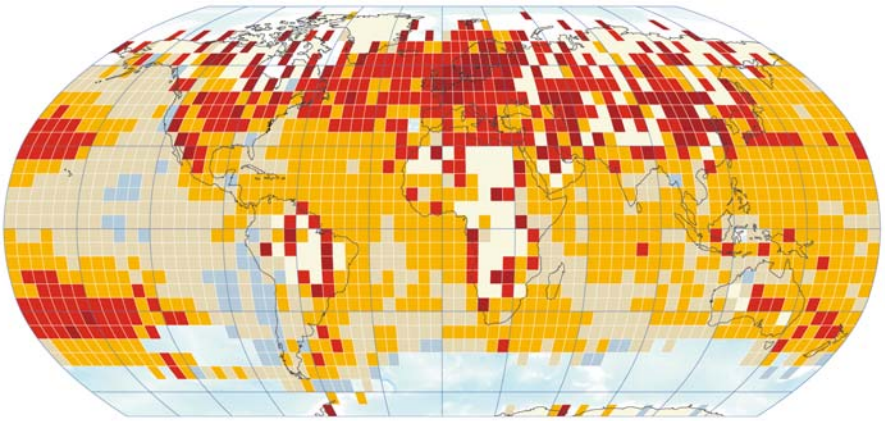
Anomalies during La Niña

Weather conditions

- wetter
- drier
- cooler
- warmer

Tropical cyclone activity

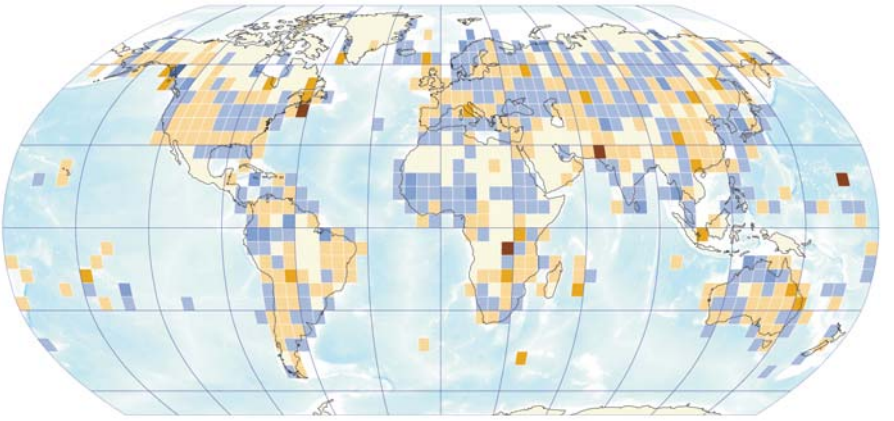
- fewer storms
- more storms



Observed trend in mean temperature in the period 1978–2007

given in °C per decade

–0.1 0.1 0.3 0.5



Observed trend in precipitation depth in the period 1978–2007

stated as a percentage per decade

–30 –15 0 15 30

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