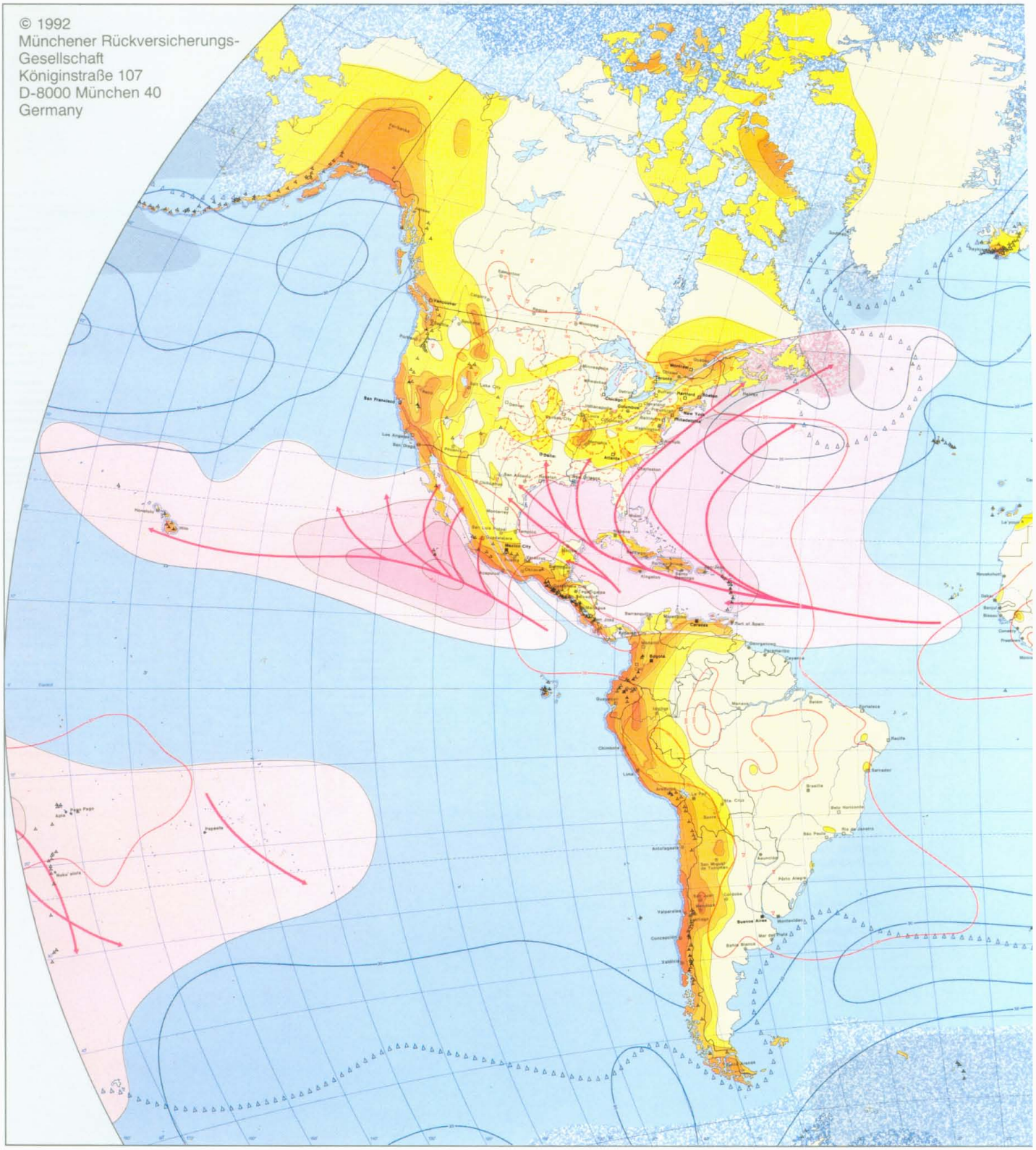
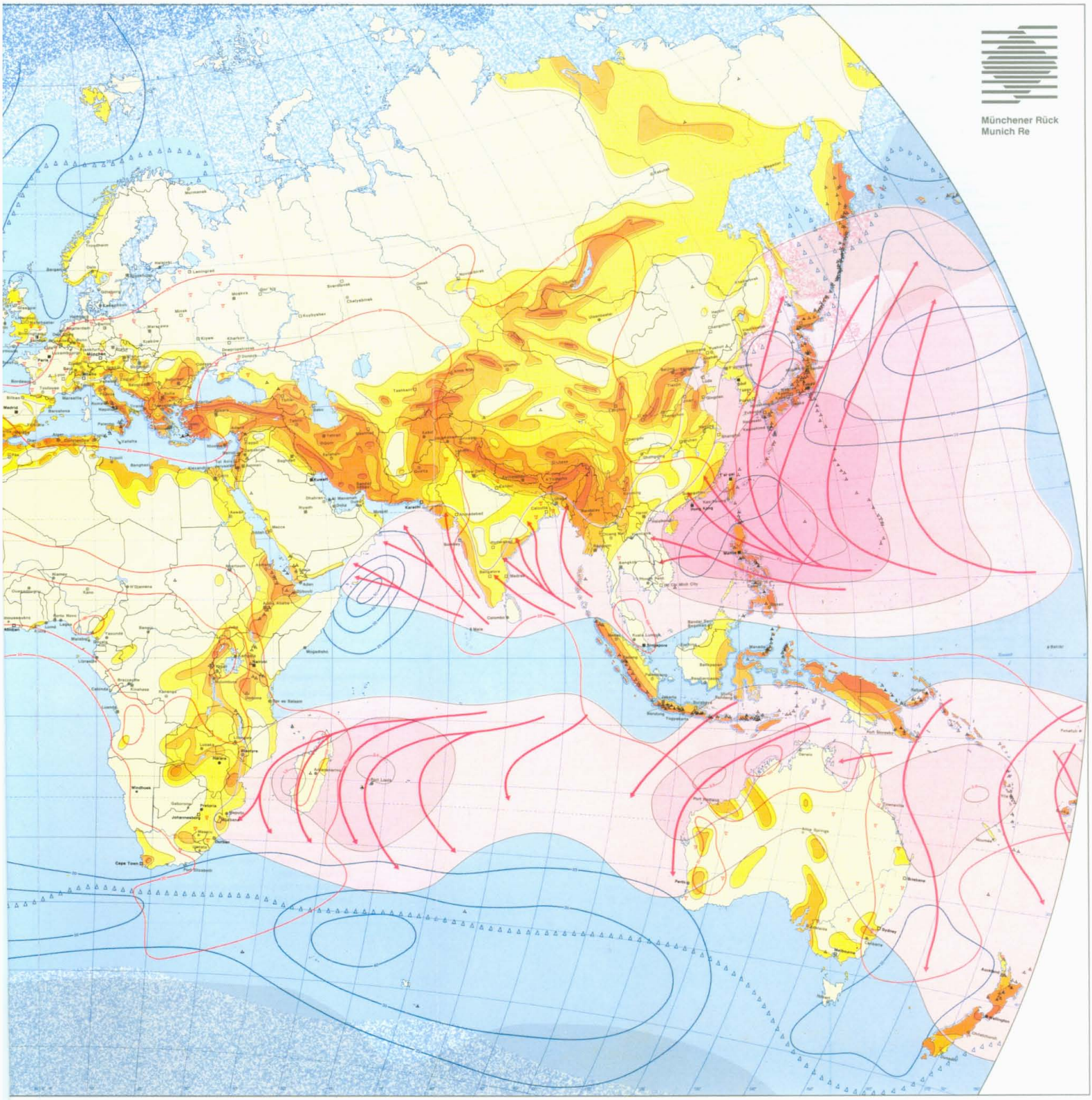
World Map of Natural Hazards

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Earthquakes, Tsunamis and Volcanoes

Probable maximum intensity (Modified Mercalli Scale: MM) with an exceedance probability of 20% in 50 years equivalent to one occurrence in 250 years ("return period") on average, for medium subsoil conditions:

- Zone 0: MM V and below
- Zone 1: MM VI
- Zone 2: MM VII
- Zone 3: MM VIII
- Zone 4: MM IX and above
- Coasts exposed to tsunamis (seismic sea waves)
- Active volcanoes
- High-risk volcanoes

Further Natural Hazards, Other

- Limit of iceberg drift
- Temporary pack ice
- Permanent pack ice
- Sea fog frequency above 30% (July)
- —100— Isoline of thunderstorm days per year

- Bombay — more than 1 million inhabitants
- Chimbote — 100,000 to 1 million inhabitants
- Townsville — less than 100,000 inhabitants
- Bonn — capital city
- **Sydney** — MR office abroad

- State borders (These should not be regarded as official.)
- Rivers

Windstorms

1. Tropical storms and cyclones (Beaufort 8 and above)
   - 0.1 bis 0.9 per year
   - 1.0 bis 2.9 per year
   - 3.0 and more per year
   - —2.5— Isoline of maximum frequency
   - Average tracks
2. Winter gales
   - (Arabian Sea: monsoon gales)
   - Per cent frequency of Beaufort 7 and above
   - North Atlantic and North Pacific: December
   - Southern hemisphere and Arabian Sea: June
   - —20— Isoline of per cent gale frequency
3. Tornadoes
   - Number of symbols per major area: average frequency per year
   - —•50•— USA: isoline of tornado frequency, in centuries (eg 50 = "return period" of 5,000 years per location)

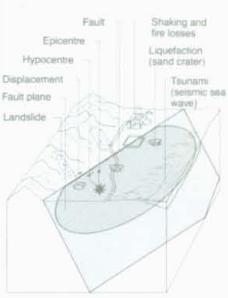
Earthquake: Scales and Effects

Earthquake Intensity Scales

MM 1956	Descriptive term	Acceleration %g	MSK 1964	RF 1883	JMA 1951
I	Imperceptible	<0.1	II	II	I
II	Very slight	0.1–0.2	III	III	
III	Slight	0.2–0.5	IV	IV	II
IV	Moderate	0.5–1	V	V	III
V	Rather strong	1–2	VI	VI	IV
VI	Strong	2–5	VII	VII	
VII	Very strong	5–10	VIII	VIII	V
VIII	Destructive	10–20	IX	IX	
IX	Devastating	20–50	X	X	VI
X	Annihilating	50–100 (≈1g)	XI	XI	VII
XI	Disaster	1–2g	XII		
XII	Major disaster	>2g			

MM 1956 Modified Mercalli · MSK 1964 Medvedev-Sponheuer-Karnik
RF 1883 Rossi-Forel · JMA 1951 Japan Meteorological Agency

Earthquake effects and source model



Earthquake and Tsunami Magnitude Scales

Earthquake magnitude (according to Richter, 1956)

$\text{Log}_{10}E = 11.8 + 1.5\,M$

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

M = Richter magnitude (up to M = 9)

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.

Tsunami magnitude (according to Iida, 1970)

Grade	Descriptive term	Water level in m
0	Slight	0–1
1	Moderate	1–3
2	Strong	4–6
3	Very strong	7–20
4	Disaster	20–

Windstorm: Scales and Effects

Beaufort Scale

Bft	Descriptive term	Mean wind speed at 10 m above surface				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	32.7–	118–	73–	64–	66.6–

Saffir Simpson Scale (up to hurricane force)

SS	Descriptive term	Mean wind speed			
		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	69.5–	250–	156–	135–

Fujita Scale (up to tornado force)

F	Descriptive term	Wind speed			
		m/s	km/h	mph	knots
0	Weak	17.2–32.6	62–117	39–72	34–63
1	Moderate	32.7–50.1	118–180	73–112	64–97
2	Strong	50.2–70.2	181–253	113–157	98–136
3	Devastating	70.3–92.1	254–332	158–206	137–179
4	Annihilating	92.2–116.2	333–418	207–260	180–226
5	Disaster	116.3–	419–	261–	227–

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