

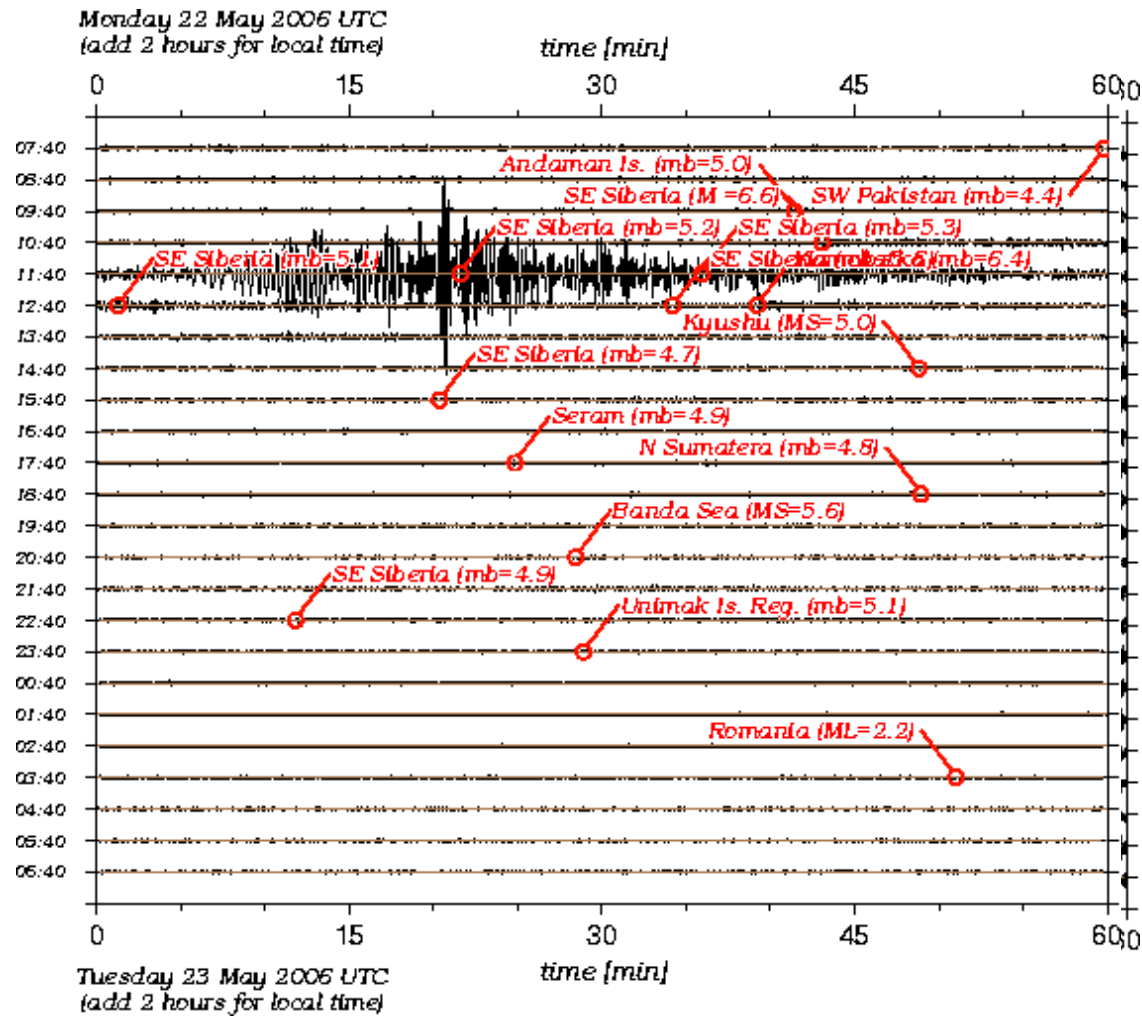
Naturkatastrophen: Erdbeben

Das Sumatra Beben 26.12.2004

Wie bricht das Erdinnere?
Wie breiten sich die Wellen im Erdinneren aus?
Wo gibt es Nachbeben?
Warum Probleme mit der Magnitudenbestimmung?
Wie konnte das Folgebeben am 28.3. vorhergesagt werden?
Wie bewegt sich die Erdoberfläche?

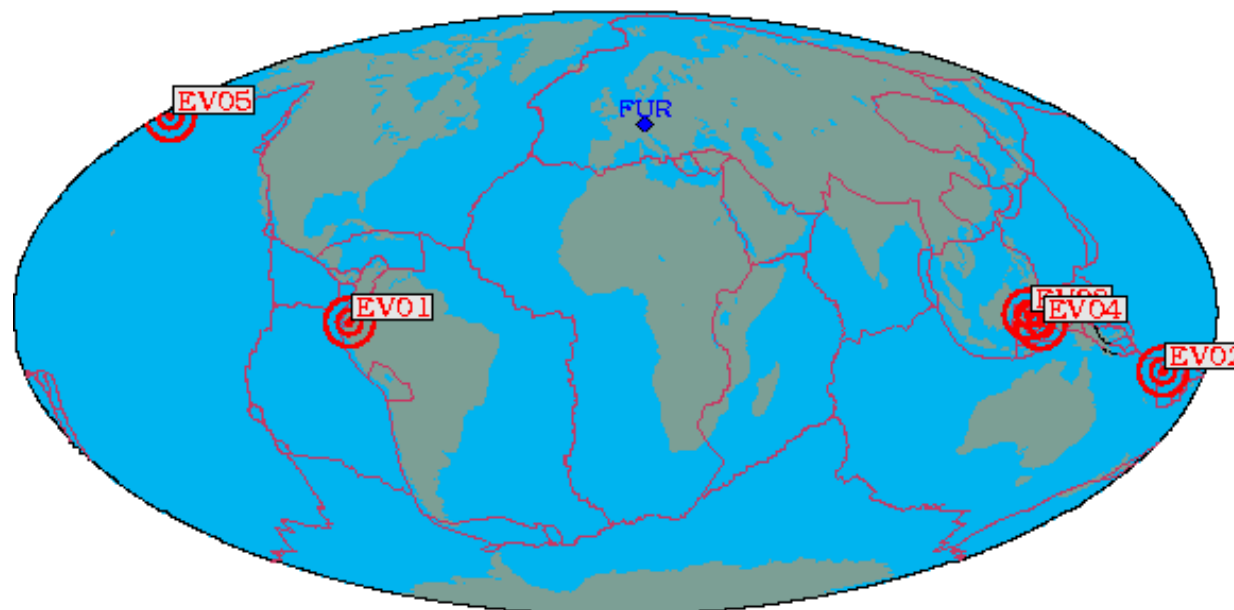
Heiner Igel, Sektion Geophysik - Seismologie
Department für Geo- und Umweltwissenschaften
Ludwig-Maximilians-Universität München

Aktuelle Erdbeben





Heute



List of Earthquakes

In the following list only seismic events with at least one manual location occur.

Only events with an average magnitude larger/equal than 3 are listed.

(Source: RedPuma (SSS))

NO.	DATE	TIME (UTC)	COORDINATES	MAGNI.	AGY	Flinn-Engdahl-Region
EVO1	04Jul2006	04:43:27.0	10.6S 162.0E100	mb=4.8	M GSR	NORTH OF SOLOMON ISLANDS
EVO2	04Jul2006	03:56:28.3	39.1N 116.2E 33	MS=4.6	M*GSR	NORTHEASTERN CHINA
EVO3	03Jul2006	16:33:39.0	6.6S 129.5E100	mb=4.7	M*GSR	BANDA SEA
EVO4	03Jul2006	16:07:13.8	28.1S 66.8W160	mb=4.6	M*GSR	CATAMARCA PROVINCE, ARGENTINA
EVO5	03Jul2006	15:07:22.4	19.4S 175.5W100	mb=4.5	M*GSR	WEST OF TONGA ISLANDS
EVO6	03Jul2006	13:40:01.8	20.3S 176.2W220	mb=5.7	M*GSR	FIJI ISLANDS REGION
EVO7	03Jul2006	11:33:15.5	31.8N 40.2W100	mb=4.5	M GSR	NORTHERN MID-ATLANTIC RIDGE
EVO8	03Jul2006	11:22:03.8	3.5S 126.6E120	mb=4.4	M*GSR	BURU, INDONESIA


Google News: erdbeben - "World Vision" - Netscape

http://news.google.de/news?hl=de&edition=de&ie=UTF-8&scoring=d&q=erdbeben+%22World+Vision%22

Deutschland
Wirtschaft
Wissen/Technik
Sport
Unterhaltung
Gesundheit

News Alerts
RSS | Atom
Über Feeds
Neu! News für Handys
Über Google News

Frankfurter Allgemeine Zeitung - vor 26 Minuten gefunden
... auch weiße Kleinbürger empfänglich: „Wenn hier mal alles untergeht, dann wird's am Karfreitag passieren," sagt der Gastwirt, „wie das **Erdbeben** und die ...

 [Bei Jamba gibt es „ANNO 1602" jetzt auch fürs Handy](#)
PresseBox (Pressemitteilung)(abonnement) - vor 33 Minuten gefunden
... Dabei ist er jedoch großen Gefahren ausgesetzt: Feindliche Schiffe, angreifende Piraten oder vernichtende **Erdbeben** rafften die Inselbewohner und deren ...

[Schätze der Welt](#)
NDR Online - vor 38 Minuten gefunden
... Rund 1.000 Jahre lang, bis **Erdbeben**, historische Umwälzungen und die schlammigen Fluten des Flusses Kladeos das Feld der Ehre versinken ließen. ...

[Alarmzentrale verzeichnet zehn Prozent mehr Meldungen](#)
Basler Zeitung - vor 1 Stunde gefunden
... Anrufen auf dem Vorjahresniveau hielten. Wegen **Erdbeben** klingelte das Alarmtelefon acht Mal, halb so viel wie im ersten Halbjahr 2005.

[Erdbeben der Stärke 5,1 in Peking](#)
Offenbach Post - vor 2 Stunden gefunden
Peking (dpa) - Ein **Erdbeben** der Stärke 5,1 hat Peking erschüttert aber offenbar keine weiteren Schäden angerichtet. Berichte ...

[Mehr als 300 Hochwasseropfer in China](#)
Salzburger Nachrichten - vor 3 Stunden gefunden
... Ein **Erdbeben** der Stärke 5,1 hat indessen am Dienstag die chinesische Hauptstadt Peking erschüttert, aber offenbar keine nennenswerten Schäden angerichtet. ...

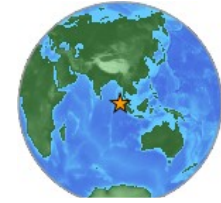
[Mehr als 300 Hochwasseropfer in China](#)
ÖÖNachrichten - vor 3 Stunden gefunden
... Ein **Erdbeben** der Stärke 5,1 hat indessen am Dienstag die chinesische Hauptstadt Peking erschüttert, aber offenbar keine nennenswerten Schäden angerichtet. ...

[Mehr als 300 Hochwasseropfer in China](#)
Kleine Zeitung - vor 3 Stunden gefunden
... Ein **Erdbeben** der Stärke 5,1 hat indessen am Dienstag die chinesische Hauptstadt Peking erschüttert, aber offenbar keine nennenswerten Schäden angerichtet. ...

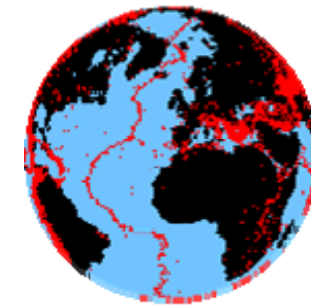
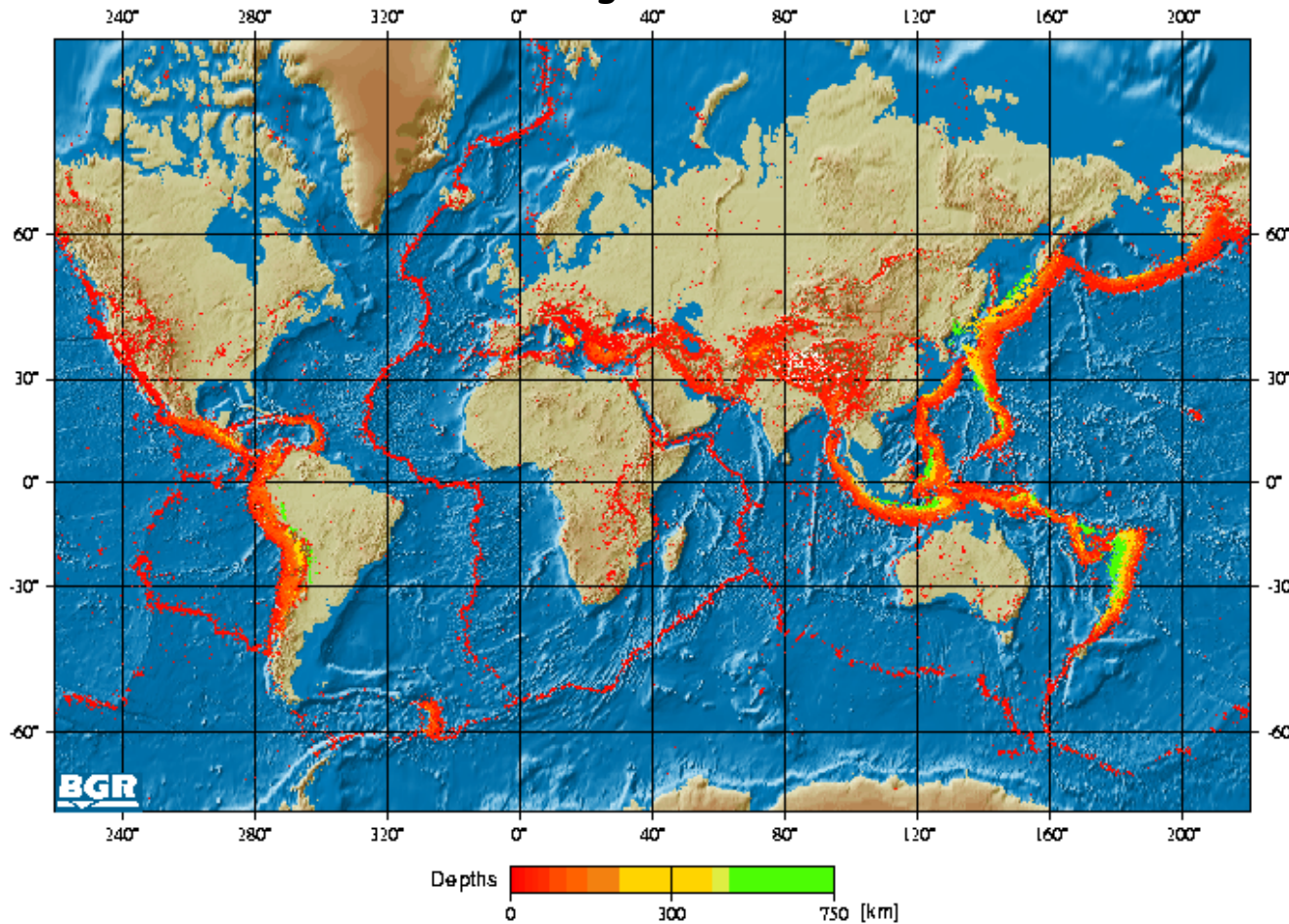
[Erdbeben der Stärke 5,1 in Peking](#)
Backnanger Kreiszeitung - vor 3 Stunden gefunden
Peking (dpa) - Ein **Erdbeben** der Stärke 5,1 hat Peking erschüttert aber offenbar keine weiteren Schäden angerichtet. Berichte ...

[Yogyakarta nach dem schweren Erdbeben](#)
Deutsche Welle - vor 3 Stunden gefunden
Ende Mai erschütterte ein schweres **Erdbeben** in Indonesien die Region um Yogyakarta auf der Hauptinsel Java. ... Rund 6.200 Menschen kamen bei dem **Erdbeben** am 27. ...

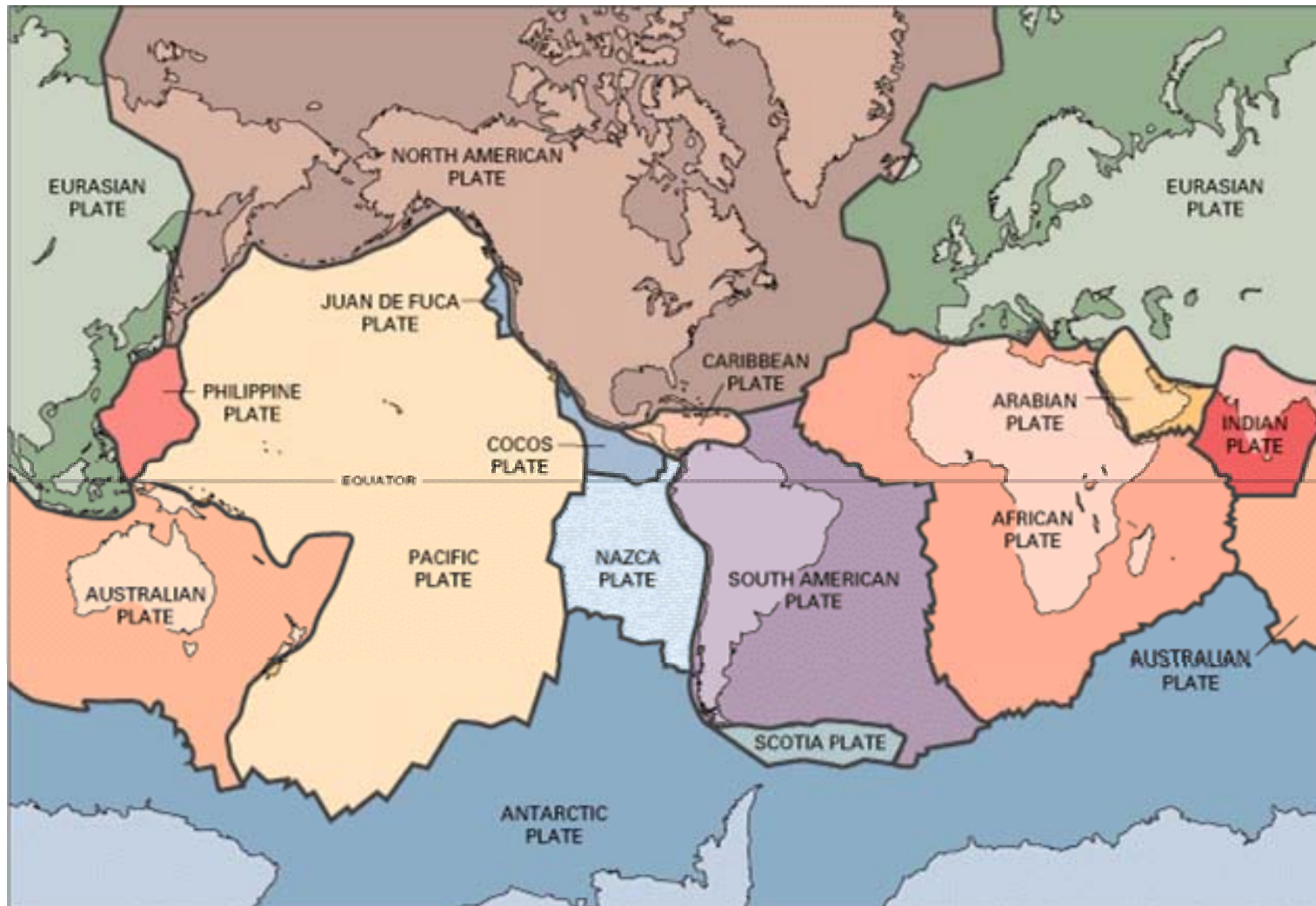
Neu! Erhalten Sie mit Google Alerts die [neuesten Nachrichten über erdbeben -World-Vision](#).



Erdbeben 1954-1998 mit Magnitude ≥ 4.0



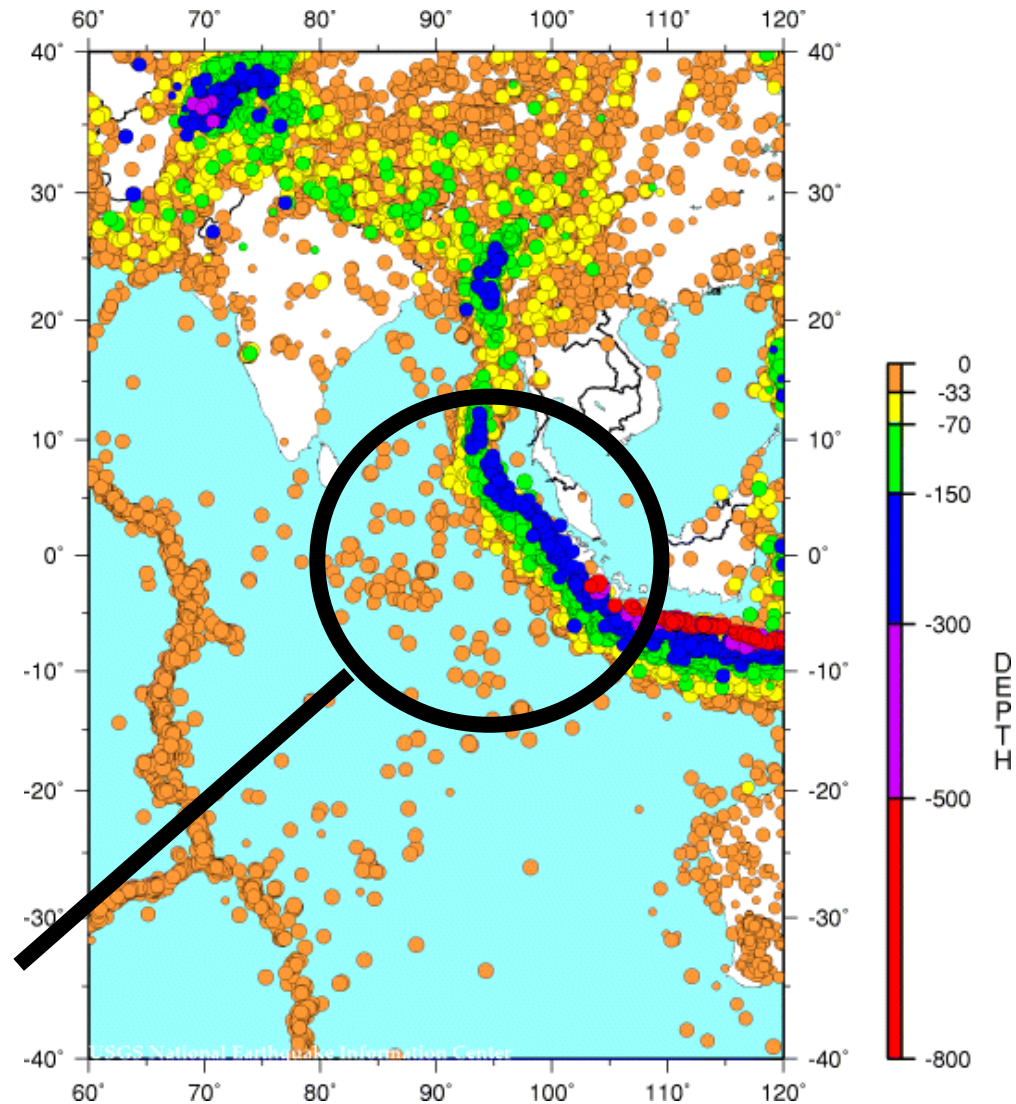
BGR Hannover



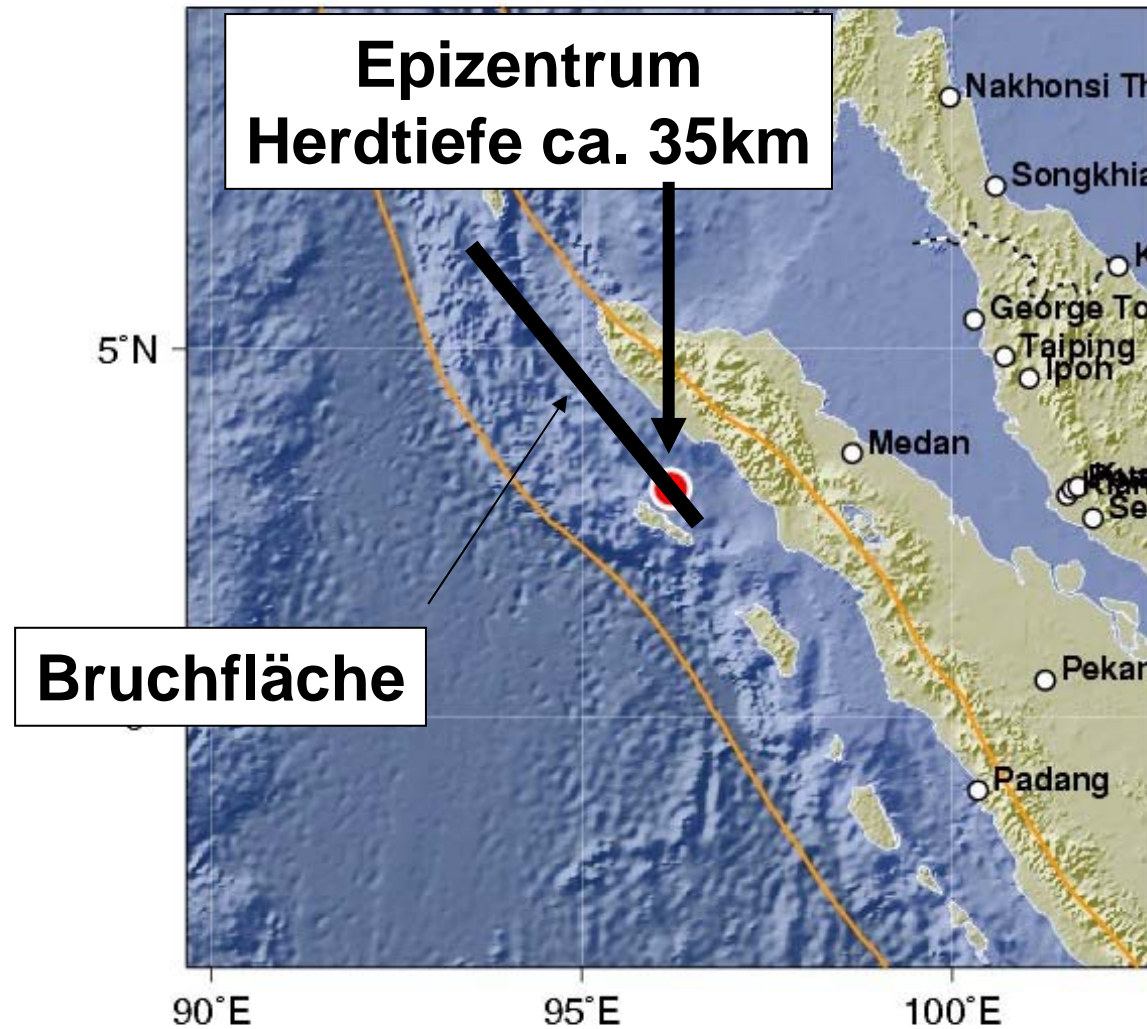
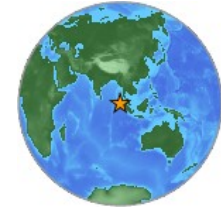
Seismizität vor 26.12.2004

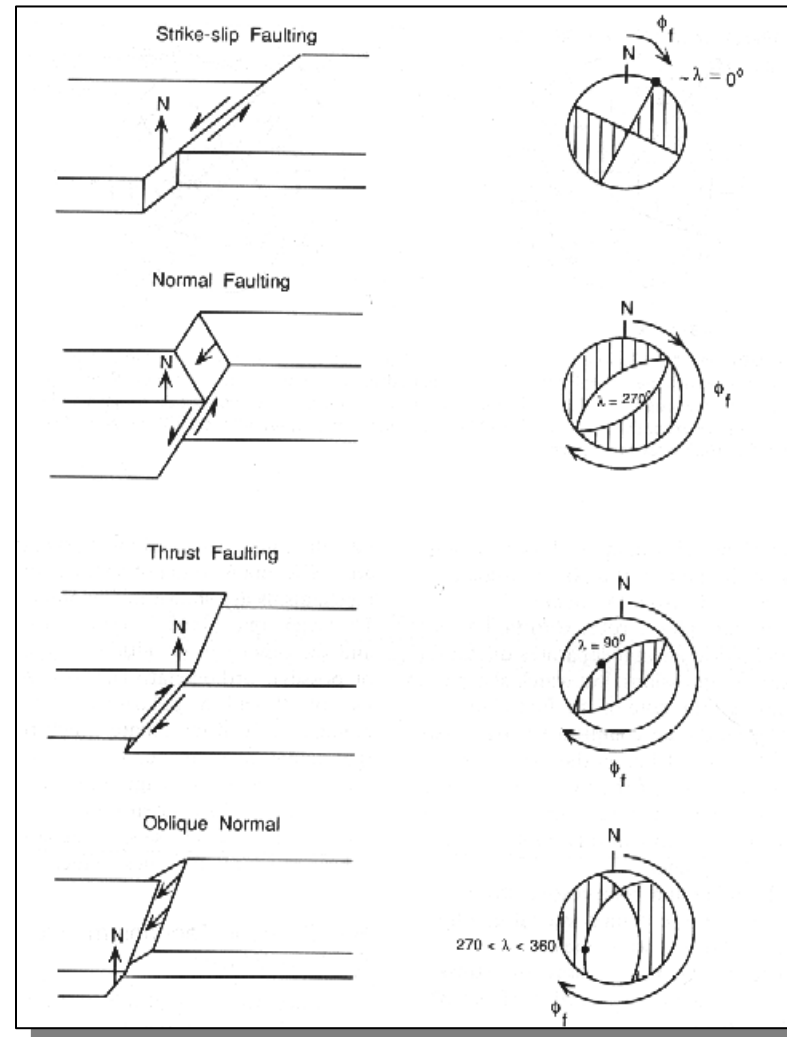


**Erdbeben M>5
1900 – Ende 2004**

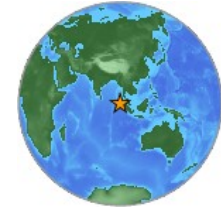


26 Dec 2004 01:58:53MET

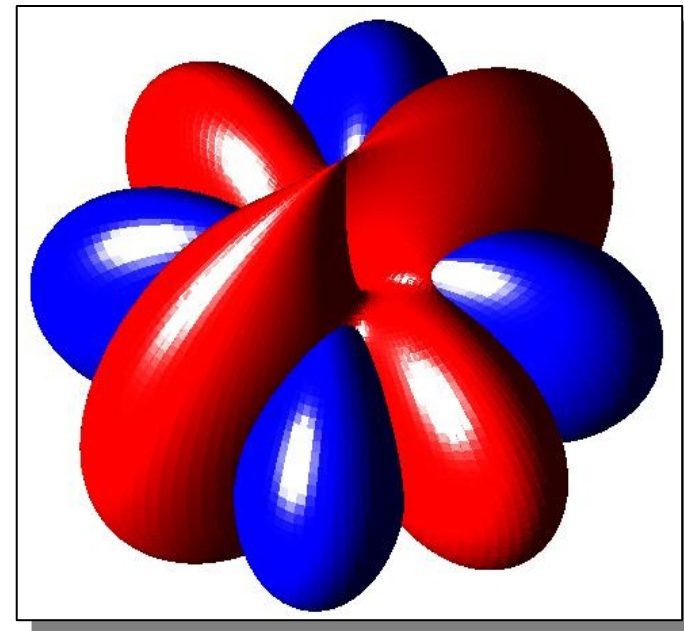
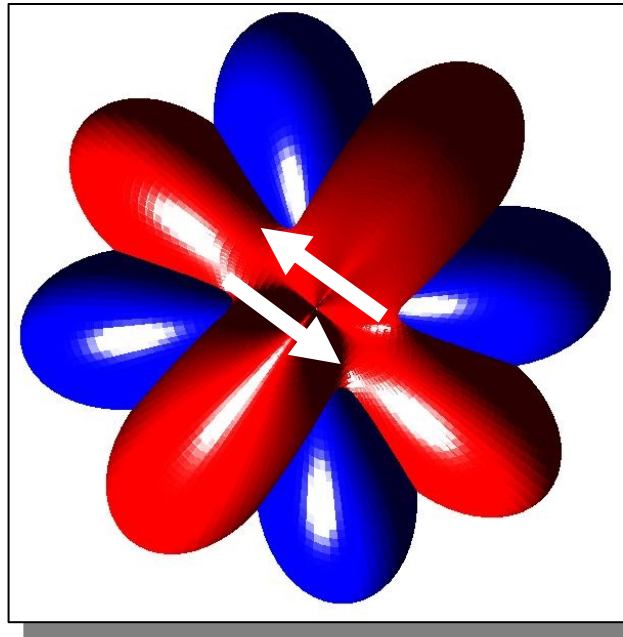


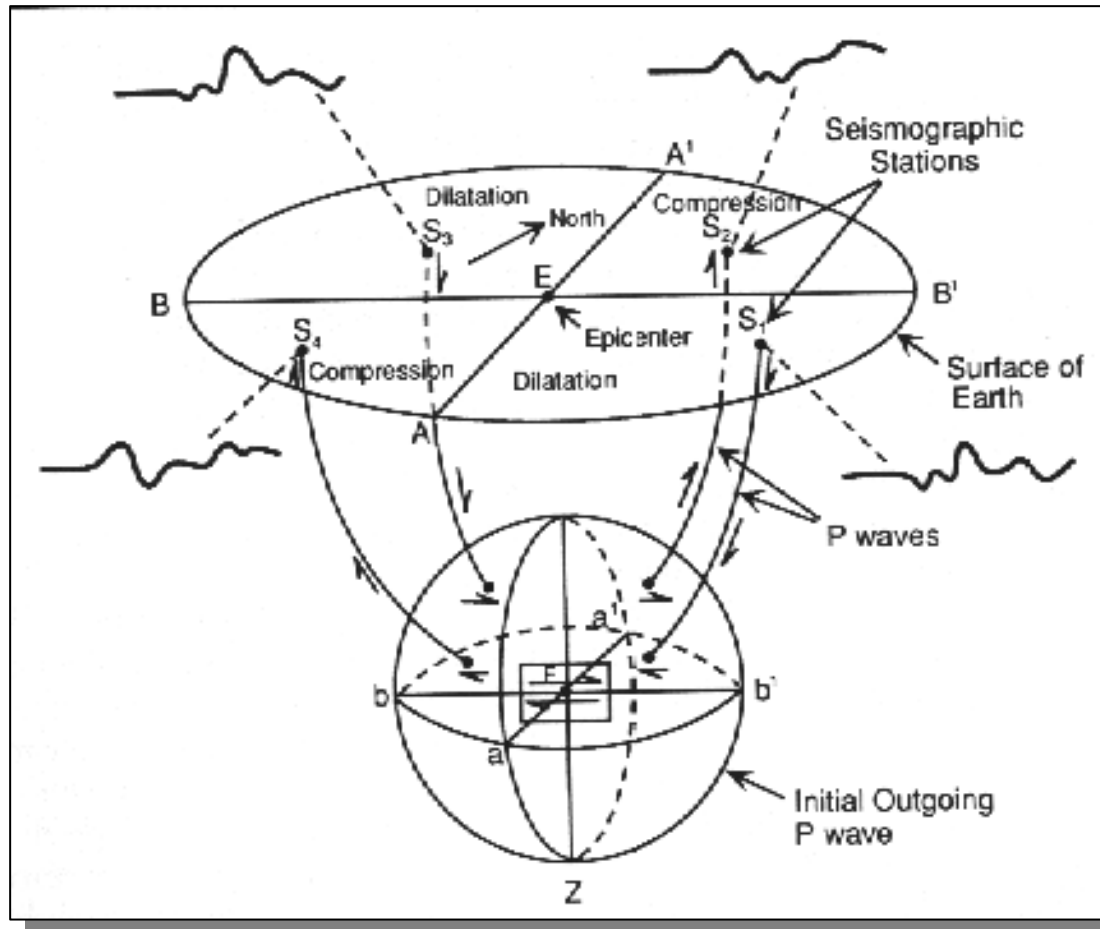


Basic fault types and their appearance in the focal mechanisms. Dark regions indicate compressional P-wave motion.



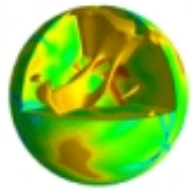
Far field P - blue
Far field S - red



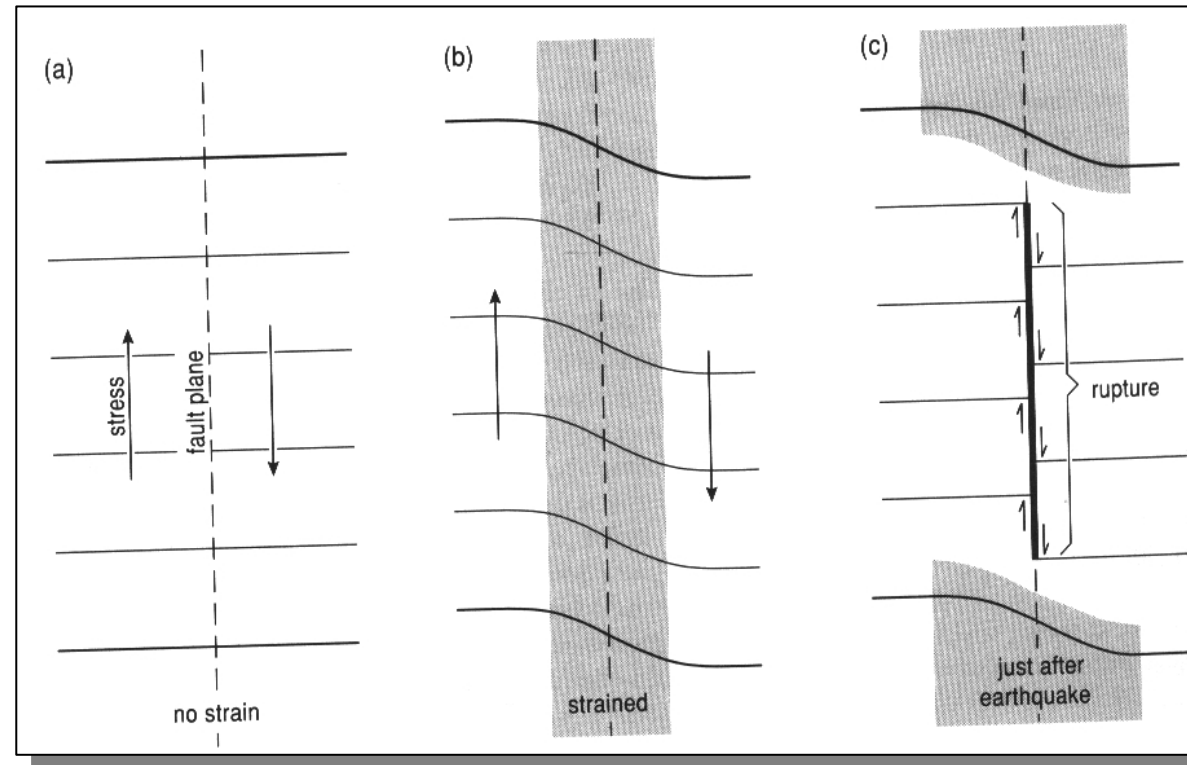


First motion of P waves at seismometers in various directions.

The polarities of the observed motion is used to determine the point source characteristics.



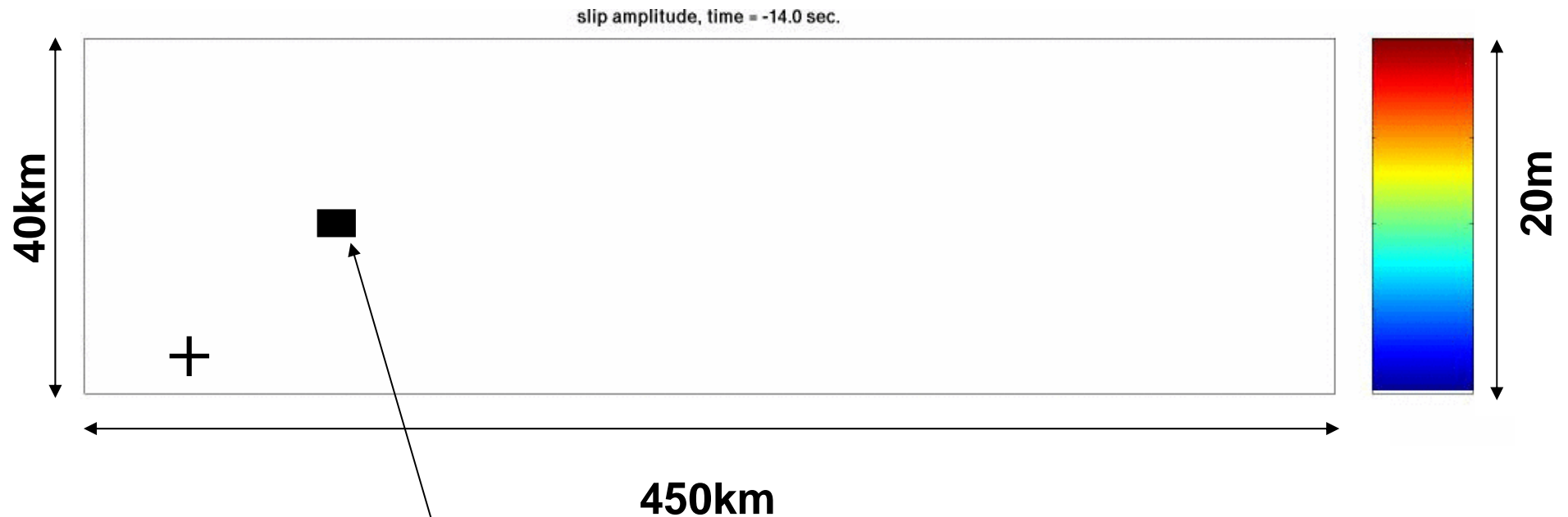
Elastic rebound (Reid, 1910)



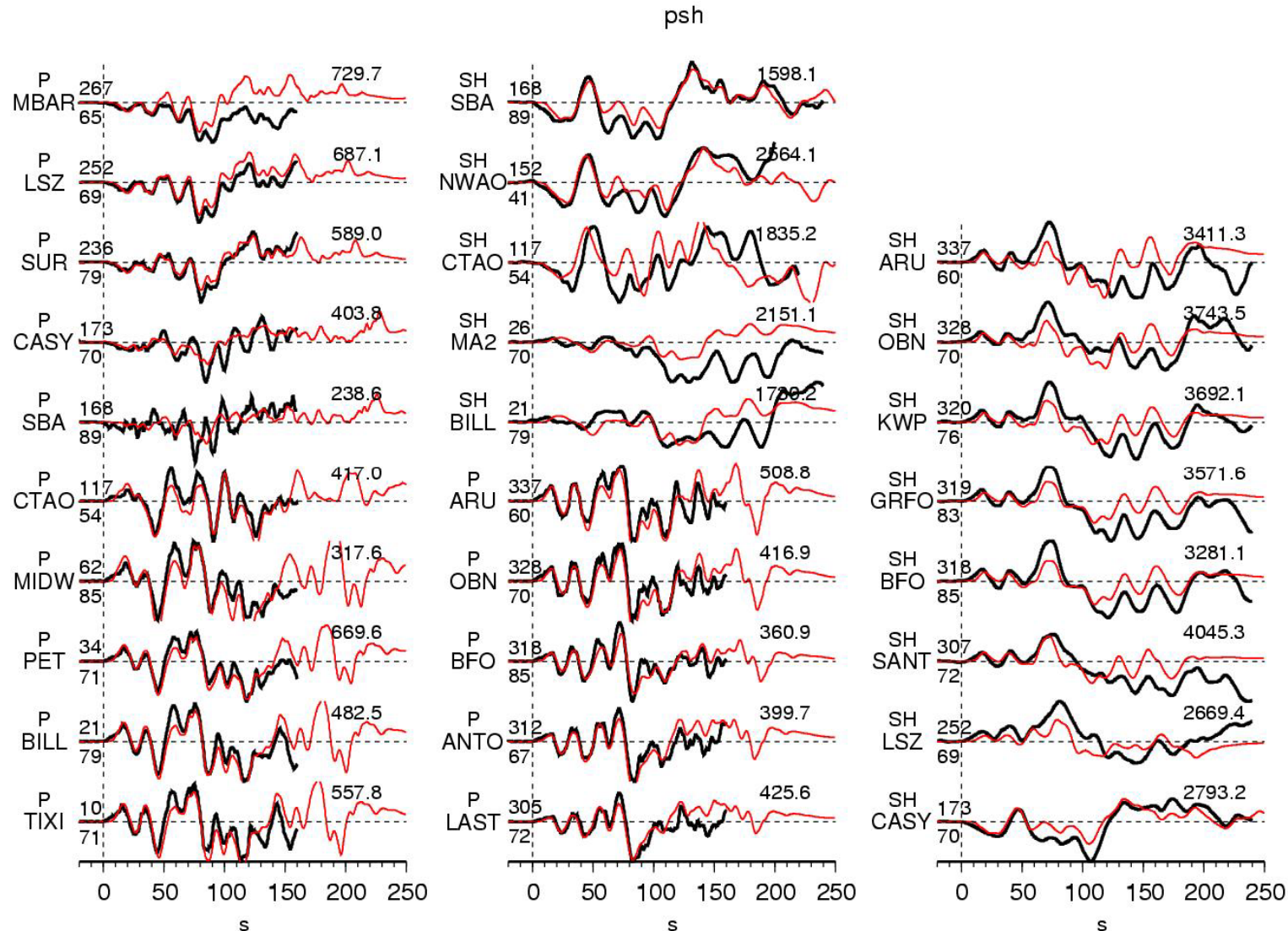
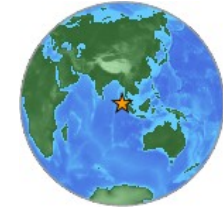
We need to relate the size of the (observed) displacement with the size (magnitude, power strength) of earthquakes:
How can we quantify earthquakes?



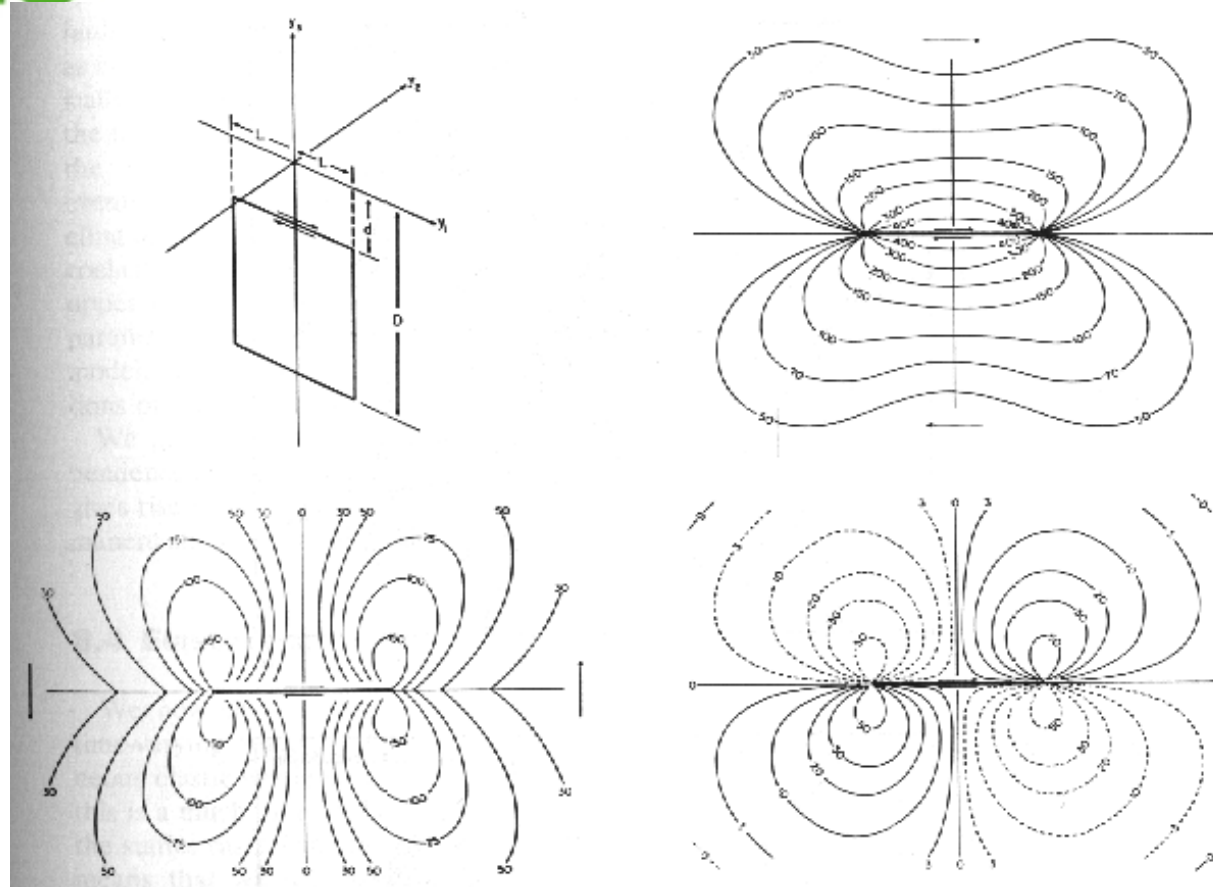
Der Bruchvorgang



Größe zu erwartende Bruchfläche in Deutschland

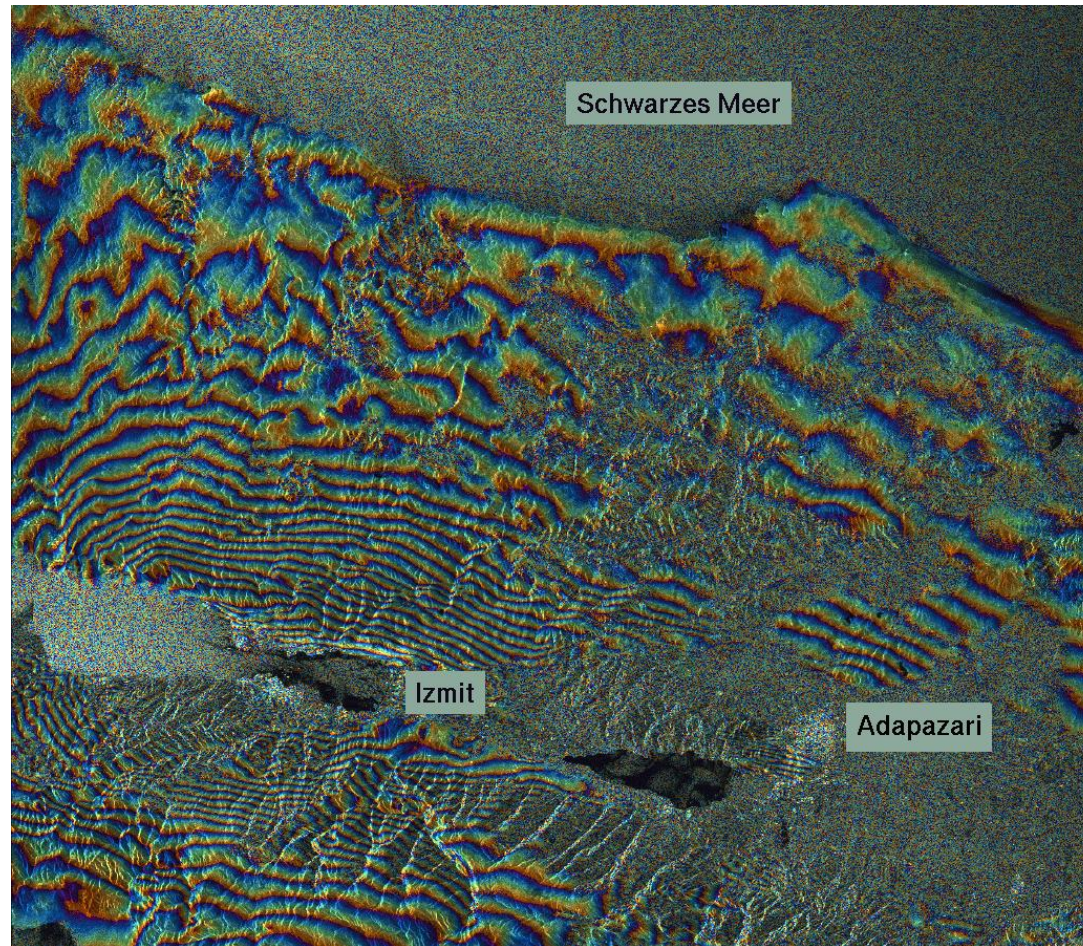


Statische Verschiebung



Ground displacement at the surface of a vertical strike slip.

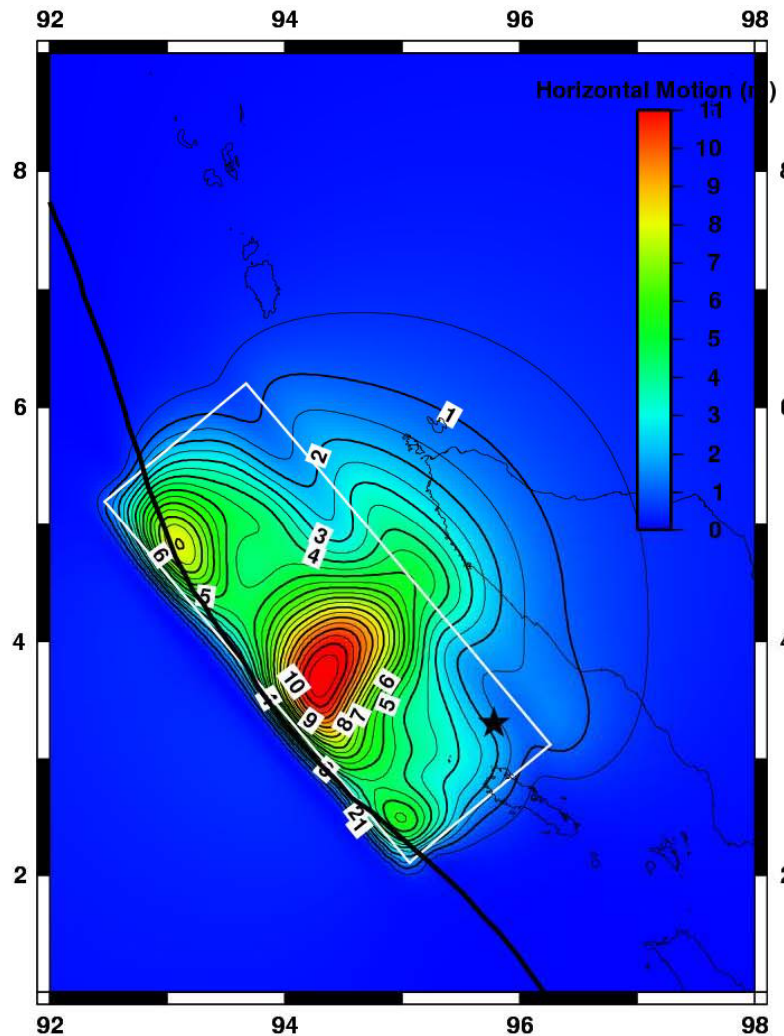
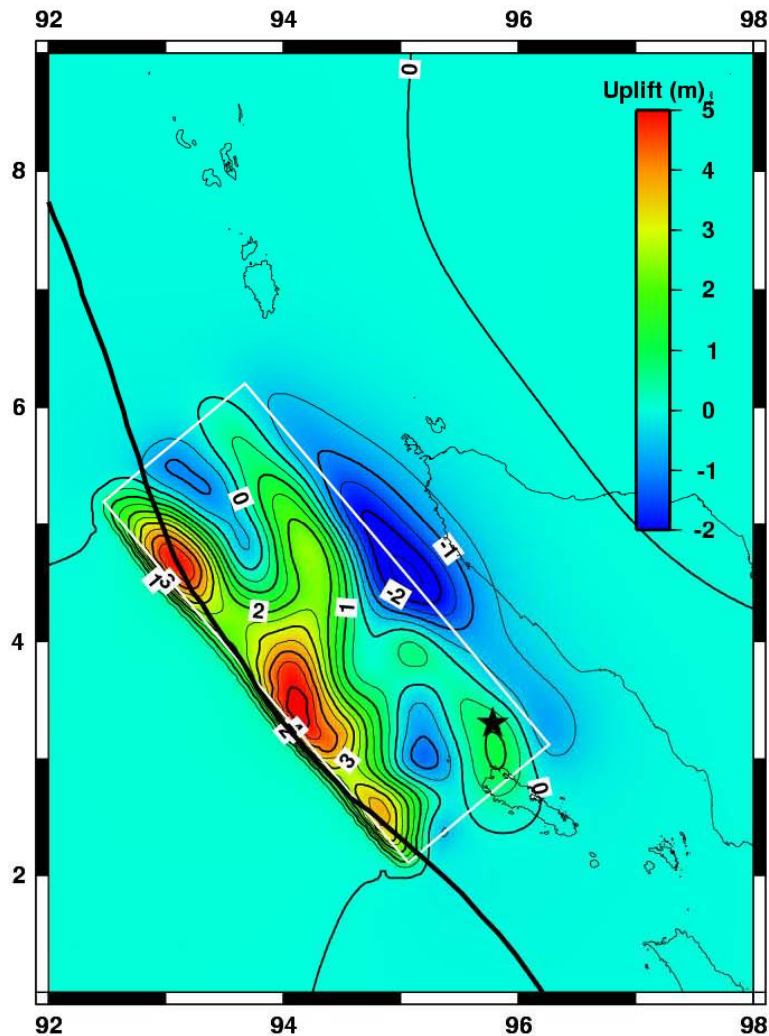
- Top right: fault parallel motion
- Lower left: fault perpendicular motion
- Lower right: vertical motion



Displacements after Turkey earthquake 1999.

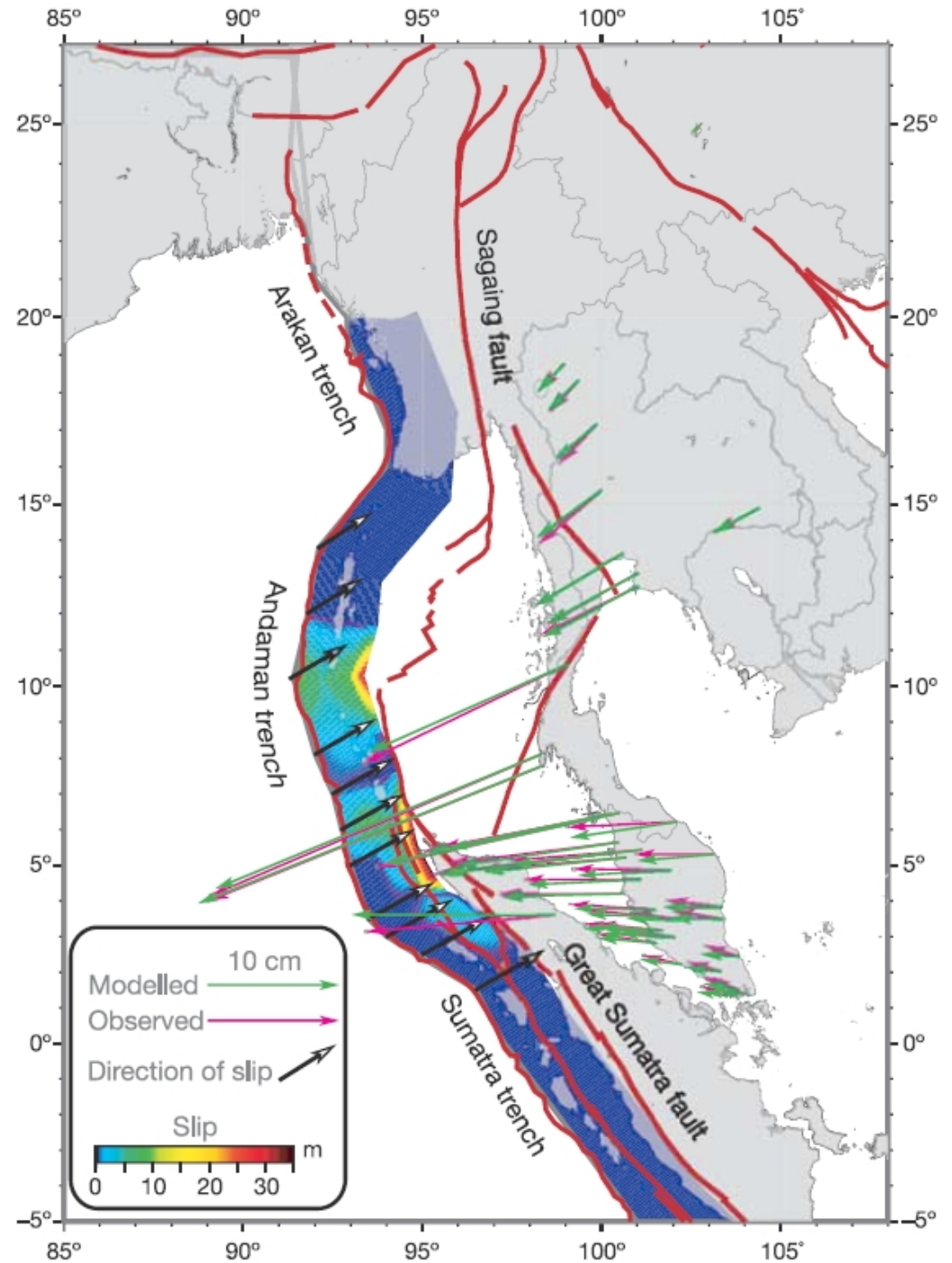


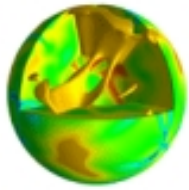
Verschiebung am Meeresboden



GPS

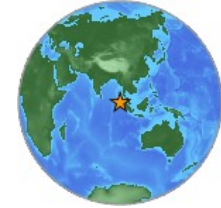
Messungen der Verschiebungen



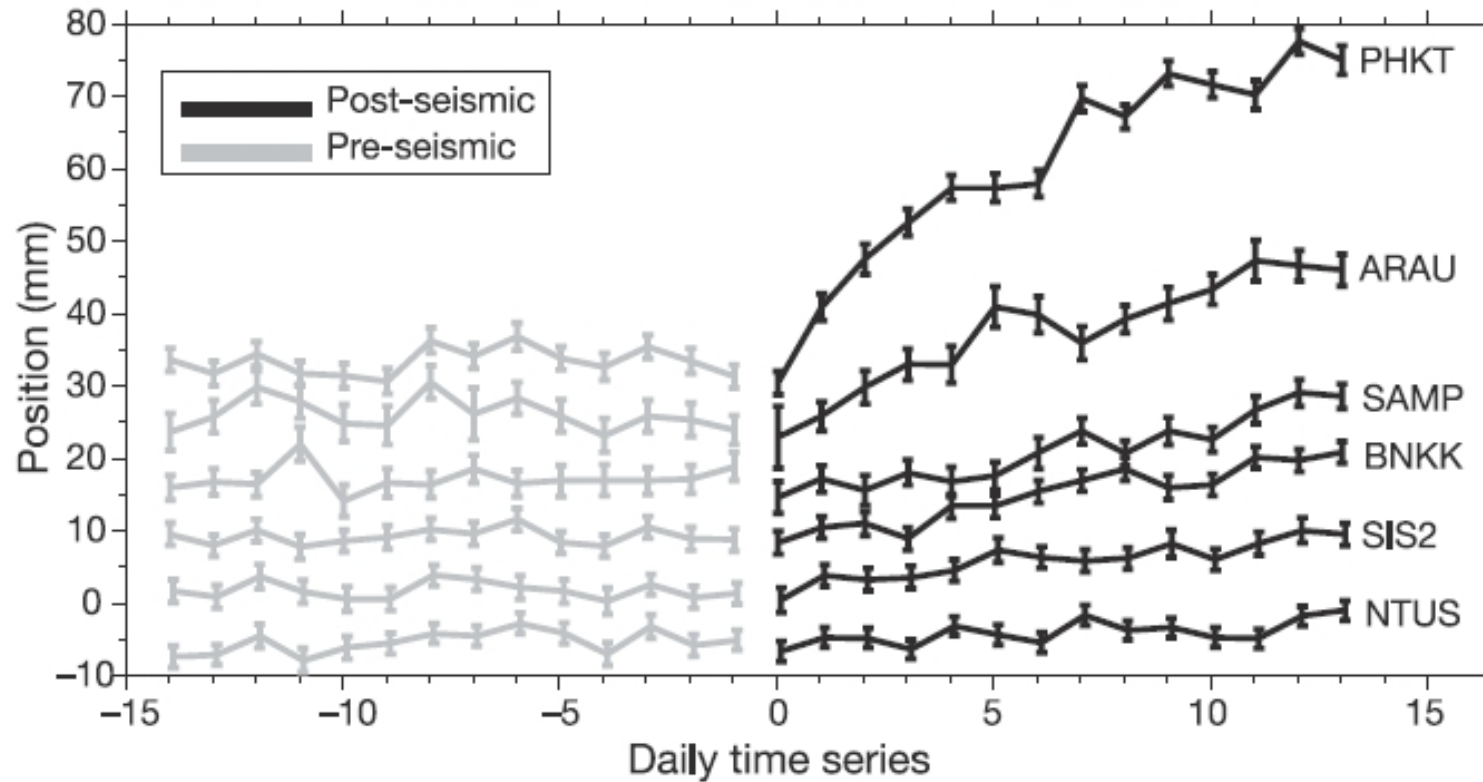


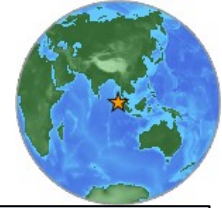
**GEO
LMU**

Postseismische Deformation



GPS Messungen





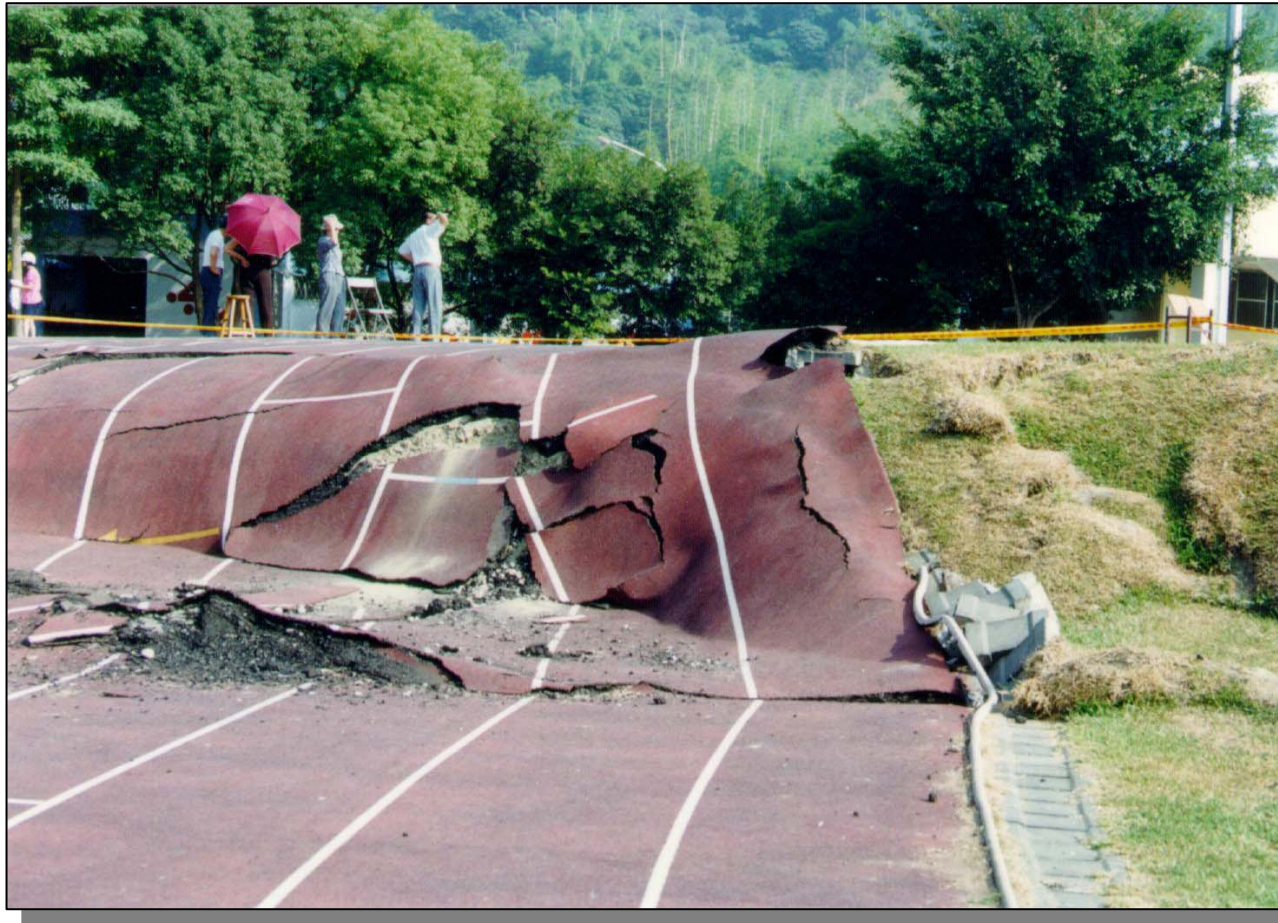
Landers, Kalifornien

Epizentrum des
M7.4 Erdbeben von
1992. Horizontale
Verschiebung 6m!





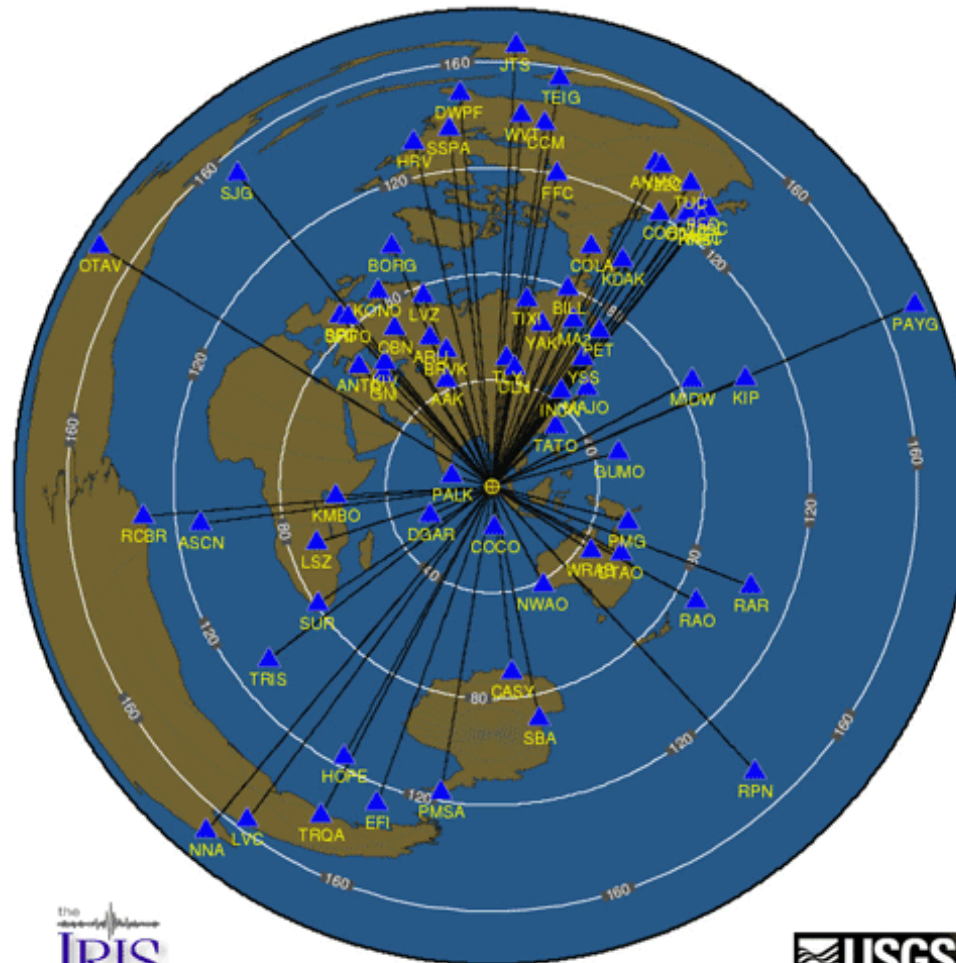
1500m „Hindernis“



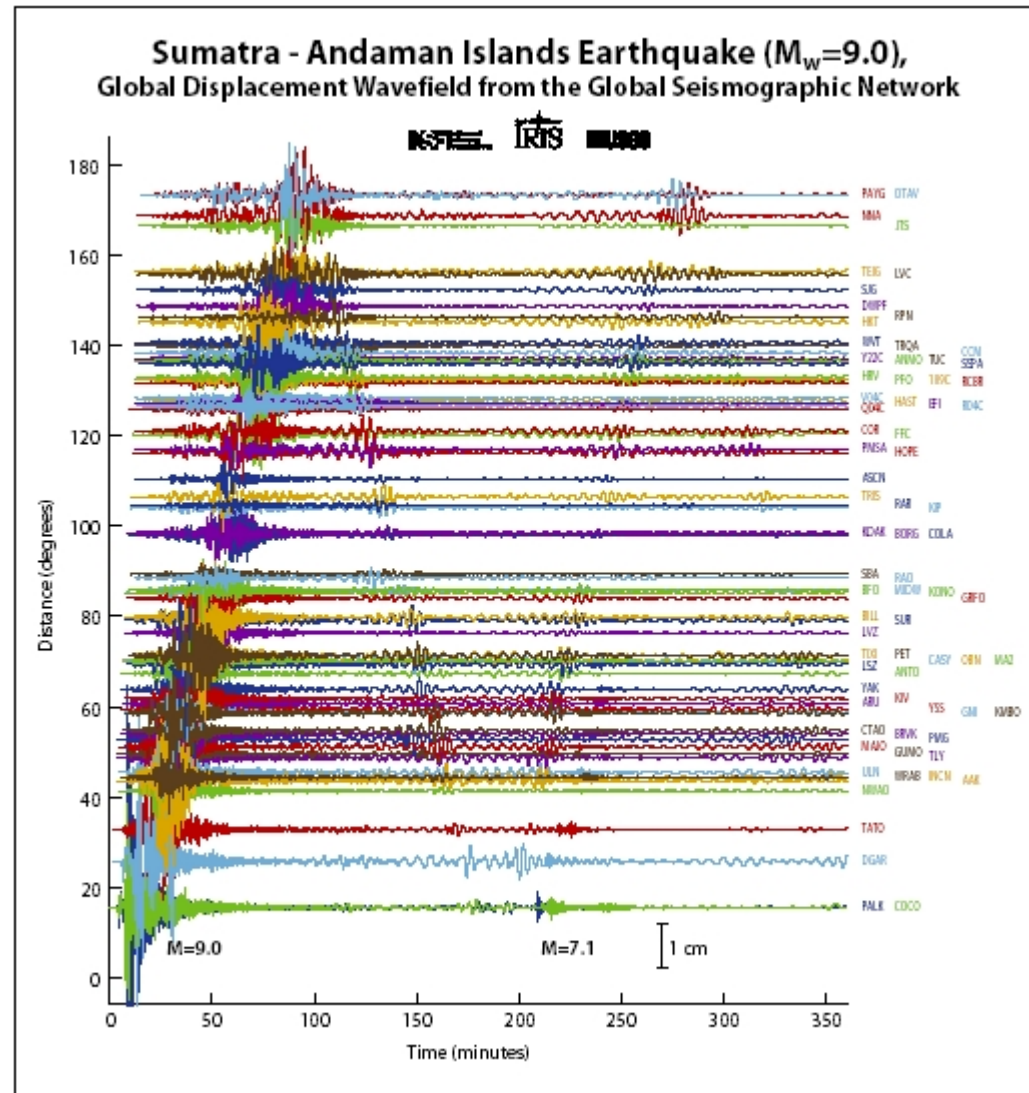
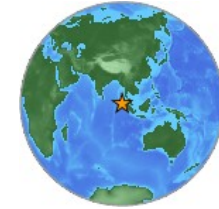
Globale Wellenausbreitung

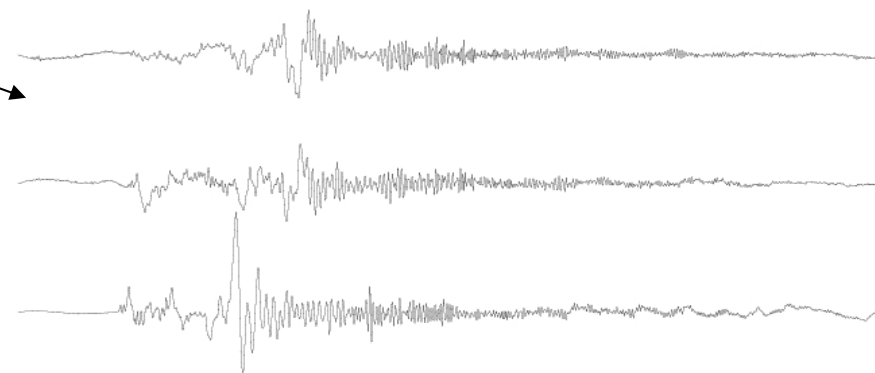
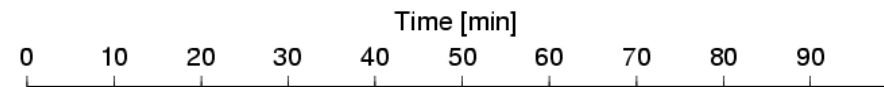
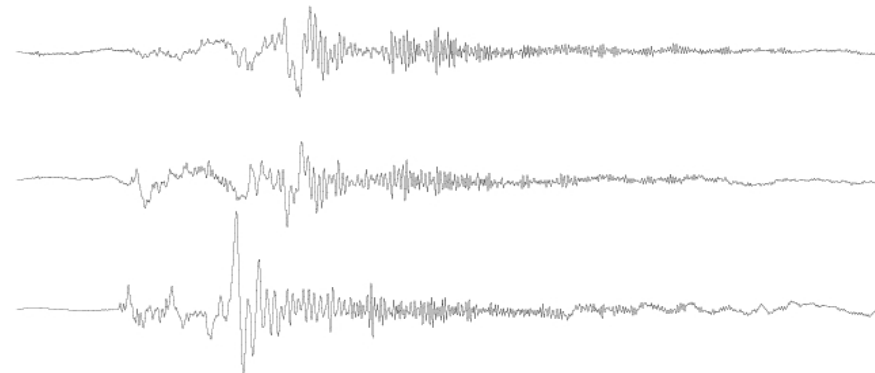
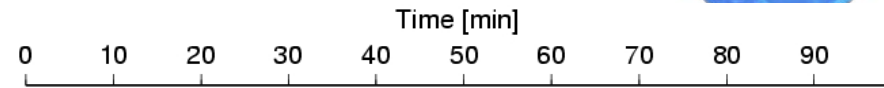
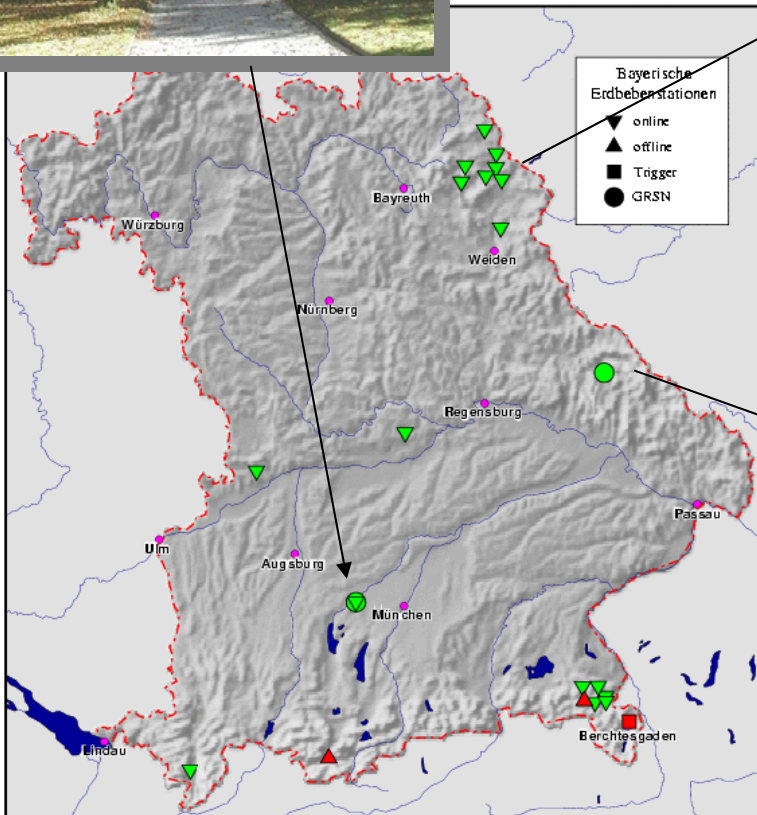
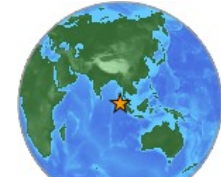


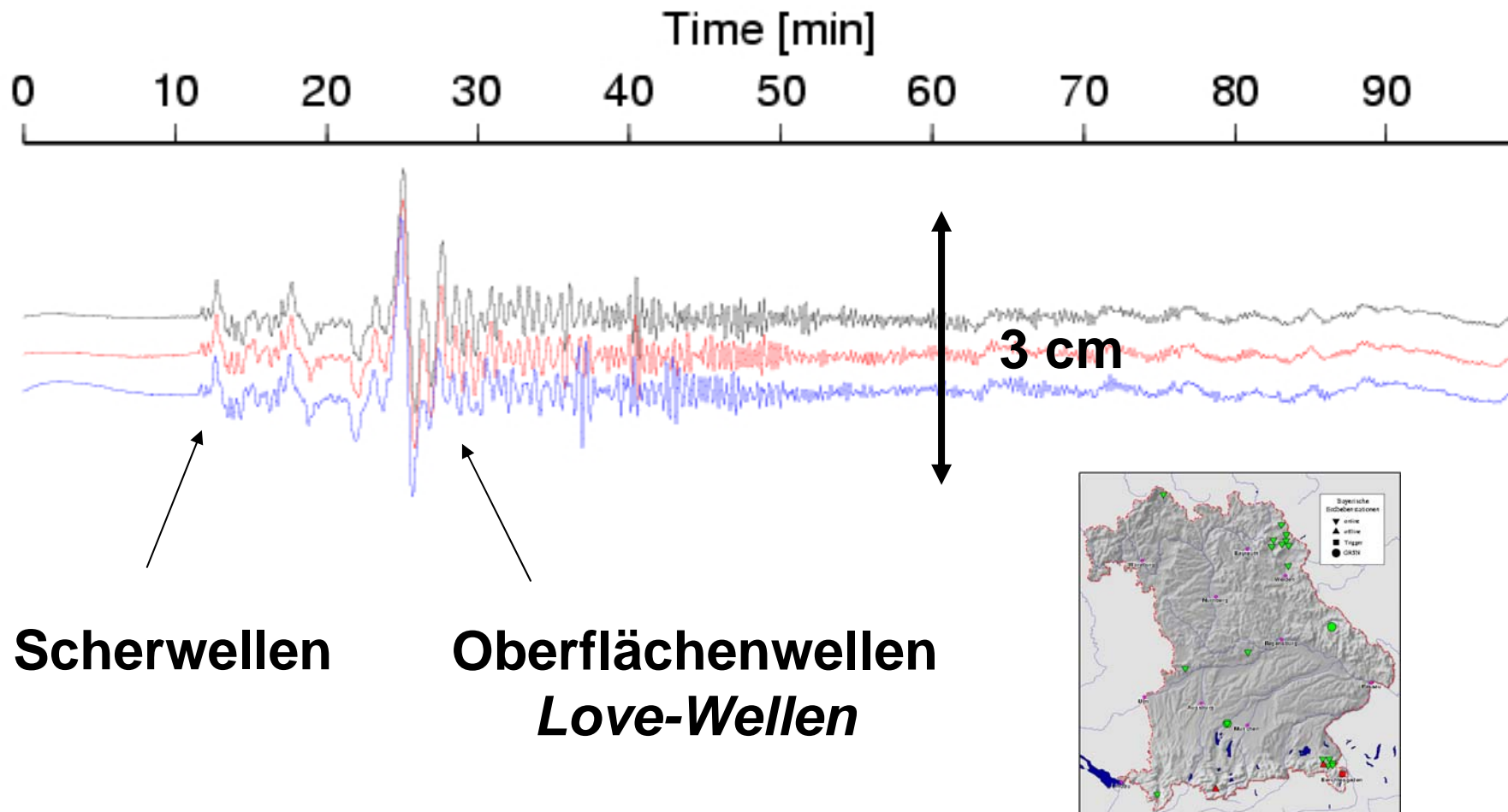
Sumatra - Andaman Islands Earthquake Global Seismographic Network Stations



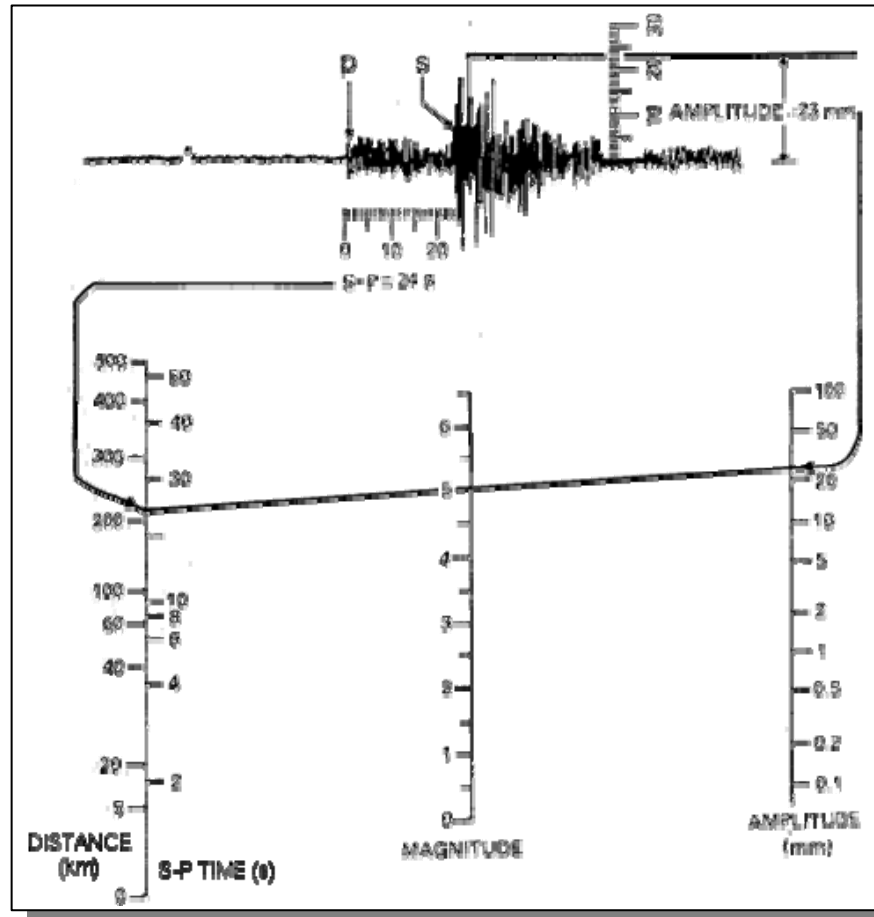
Globale Wellenausbreitung







Richter Skala



Grafische
Bestimmung der
Magnitude eines
Erdbebens

$$M_L = \log_{10} A(mm) + (\text{Distance correction factor})$$

Mercalli Intensität und Richter Magnitude

Magnitude	Intensity	Description
1.0-3.0	I	I. Not felt except by a very few under especially favorable conditions.
3.0 - 3.9	II - III	II. Felt only by a few persons at rest, especially on upper floors of buildings. III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
4.0 - 4.9	IV - V	IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably. V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
5.0 - 5.9	VI - VII	VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight. VII. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
6.0 - 6.9	VII - IX	VIII. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
7.0 and higher	VIII or higher	X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent. XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly. XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air.



AutoLoc alert for event ev041226010654



[Click for a larger version](#)

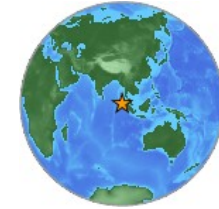
Region: Northern Sumatra, Ind
 Magnitude: 7.0
 Origin time: 2004/12/26 00:58:49 UT
 Longitude: 96.2°E
 Latitude: 3.1°N
 Focal depth: n.d.

LocSAT solution (with start solution, 14 stations used, weight 27):

NORTHERN SUMATERA, INDONESIA mb=7.0 2004/12/26 00:58:49 3.1 N 96.2 E

Stat	Net	Date	Time	Amp	Per	Res	Dist	Az	mb	ML
TLY	II	04/12/26	01:07:35.1	28182.0	3.6	1.0	48.8	189.9	7.7	0.0
KMBO	GE	04/12/26	01:08:49.5	1061.1	1.9	-0.1	59.1	85.8	6.5	0.0
GNI	IU	04/12/26	01:08:50.9	3049.0	2.3	0.5	59.3	114.7	6.9	0.0
ARU	II	04/12/26	01:09:01.0	5620.7	1.8	-1.5	61.1	135.8	7.1	0.0
KIV	II	04/12/26	01:09:09.3	2942.3	1.9	-1.3	62.2	114.9	7.2	0.0
MALT	GE	04/12/26	01:09:16.0	7042.0	3.6	-0.7	63.1	108.8	7.2	0.0
EIL	GE	04/12/26	01:09:21.3	1819.8	2.5	1.2	63.6	102.3	6.9	0.0
MBAR	II	04/12/26	01:09:32.0	1797.3	1.9	-1.0	65.5	86.4	7.0	0.0
CSS	GE	04/12/26	01:09:37.3	637.6	1.6	0.8	66.1	103.7	6.6	0.0
ANTO	IU	04/12/26	01:09:46.7	4815.0	3.5	-0.2	67.8	105.3	7.1	0.0
ISP	GE	04/12/26	01:09:55.4	983.1	1.8	0.6	69.0	102.9	6.7	0.0
OBN	II	04/12/26	01:10:02.1	31412.0	3.5	-1.5	70.5	113.9	7.9	0.0
ARG	HL	04/12/26	01:10:04.7	867.3	1.6	0.4	70.6	100.8	6.6	0.0
ZKR	GE	04/12/26	01:10:14.2	801.8	1.6	1.7	71.9	99.2	6.6	0.0

Location type: L



ALERT: Mw 8.2 OFF W. CST OF NORTHERN SUMATERA 69 km NW Sumbue 26/12/2004...

Datei Bearbeiten Anzeigen Gehe Nachricht Extras Fenster Hilfe
 Nachr. abrufen Verfassen Antwort Antwort an alle Weiterleiten Weiter Junk Löschen

Betreff: ALERT: Mw 8.2 OFF W. CST OF NORTHERN SUMATERA 69 km NW Sumbue 26/12/2004 00:58 (UTC)
Von: EMSC <alert@emsc-csem.org>
Datum: 26.12.2004 03:39
An: list_emsc@emsc-csem.org

EARTHQUAKE on 26/12/2004 at 00:58 (UTC)
 OFF W. CST OF NORTHERN SUMATERA 69 km NW Sumbue

 MAGNITUDE: Mw 8.2

 Data provided by: BRA ELRO EVRO FLN GFZ INGV KAN LJU LVV MCSM
 MOLD NEIC NEWS NOR ODC OGS RNS SED

 Latitude = 3.50 N
 Longitude = 95.72 E
 Origin Time = 00:58:50.7 (UTC)
 Depth = 10 Km
 RMS = 1.02 sec
 Gap = 61 degrees
 95% confidence ellipse: - Semi major = 11.6 Km
 - Semi minor = 8.0 Km
 - Azimuth of major axis = 179 degrees

 Number of data used = 288

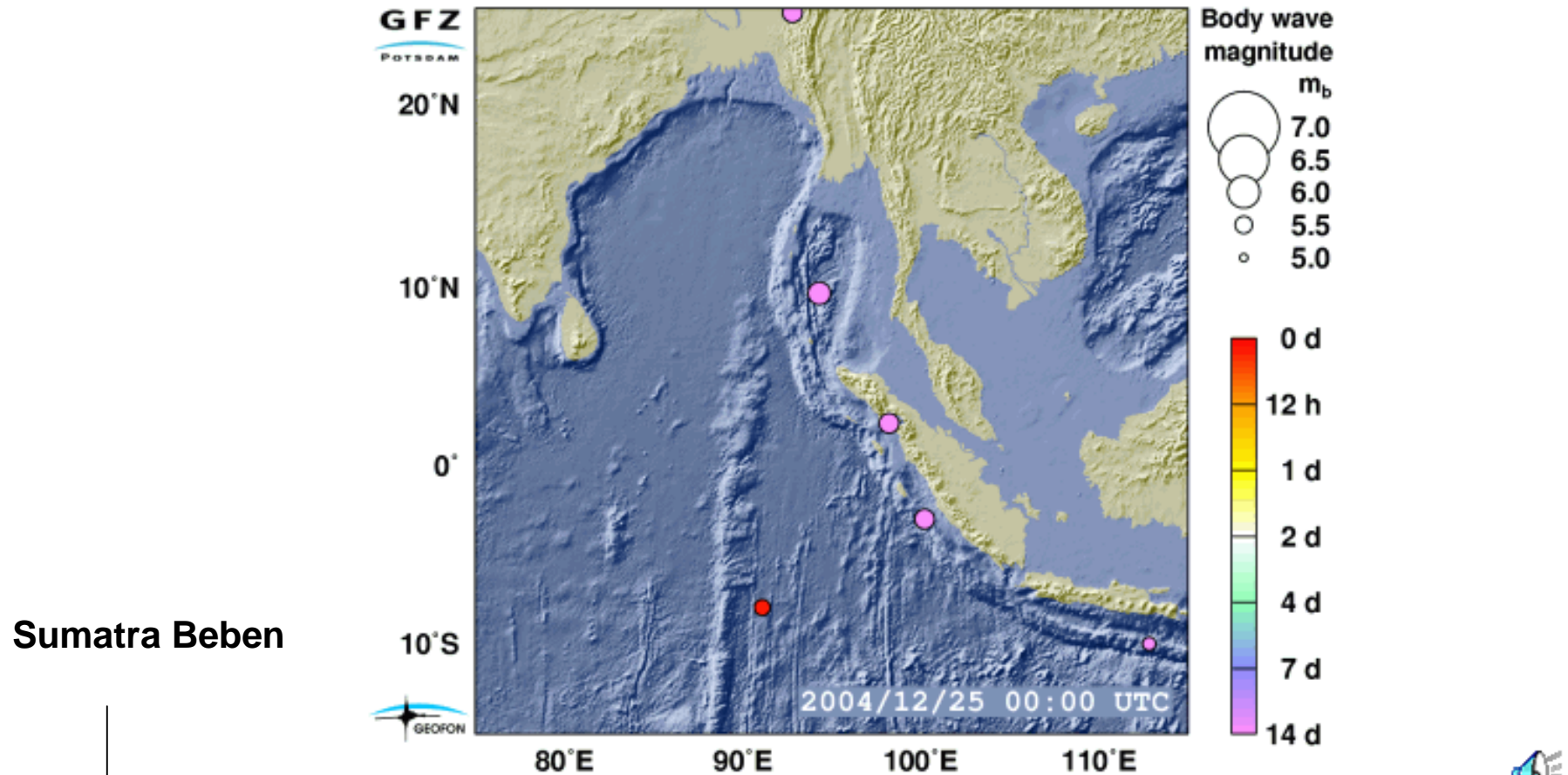
 Preliminary location computed on Sun Dec 26 02:38:55 2004 (UTC)
 Done by Pascal Roudil

 Comments :

 Message number: 430

 All magnitudes estimations :

mb6.6 (BRA)	Mw8.1 (ELRO)	Mw8.7 (EVRO)	Mw8.5 (FLN)
mb6.9 (GFZ)	mb6.7 (GFZ)	mb6.9 (INGV)	mb6.3 (NEIC)
mb6.3 (NEIC)	M 8.5 (NEIC)	mb5.5 (NEWS)	mb5.6 (NEWS)
mb6.3 (NOR)	mb7.3 (ODC)	mb6.4 (RNS)	mb6.1 (SED)



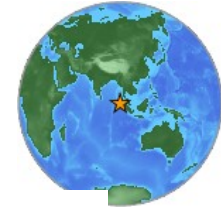
Sumatra Beben



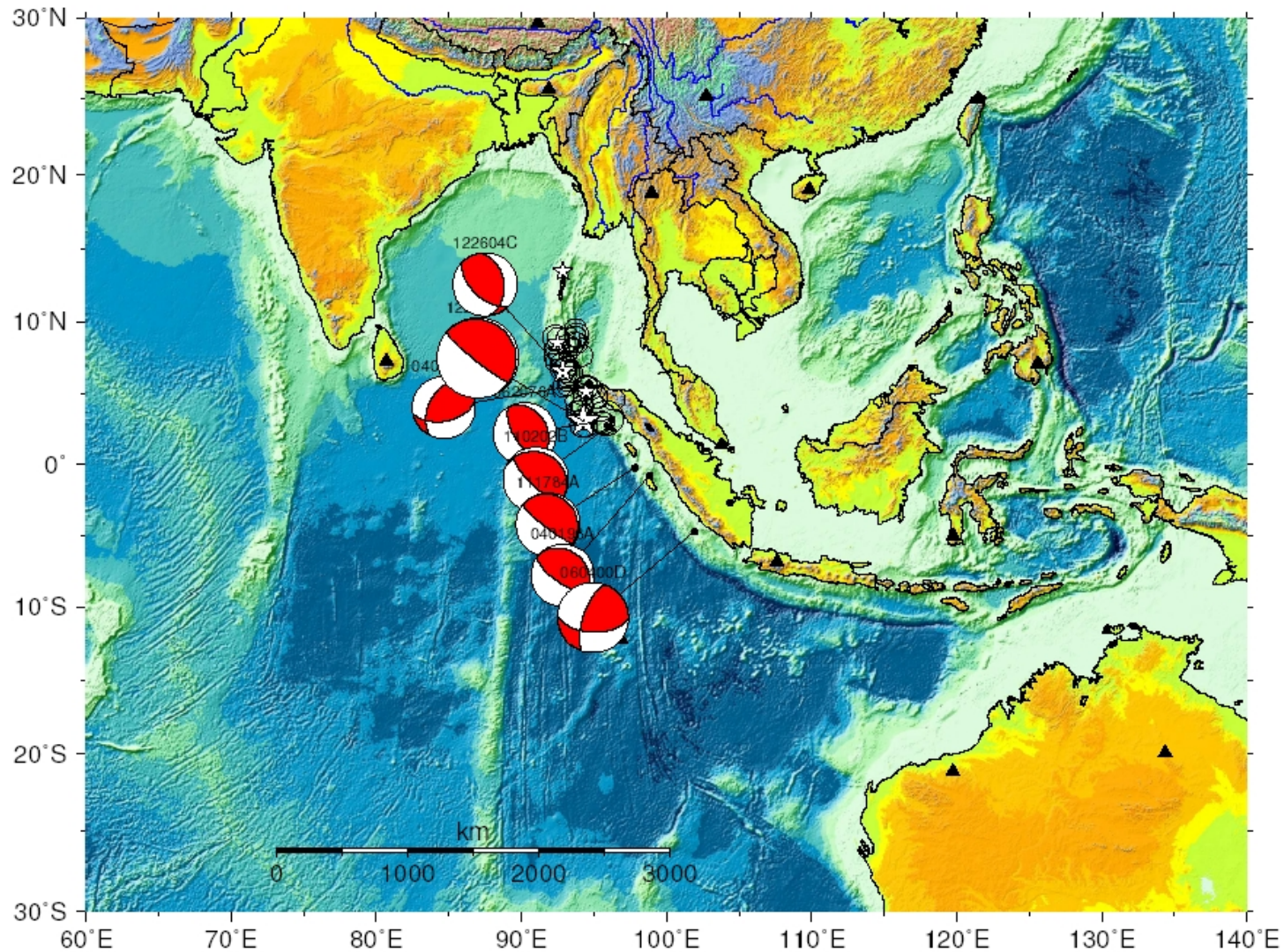
Bodenbewegung in FFB 26.-29.12.2004



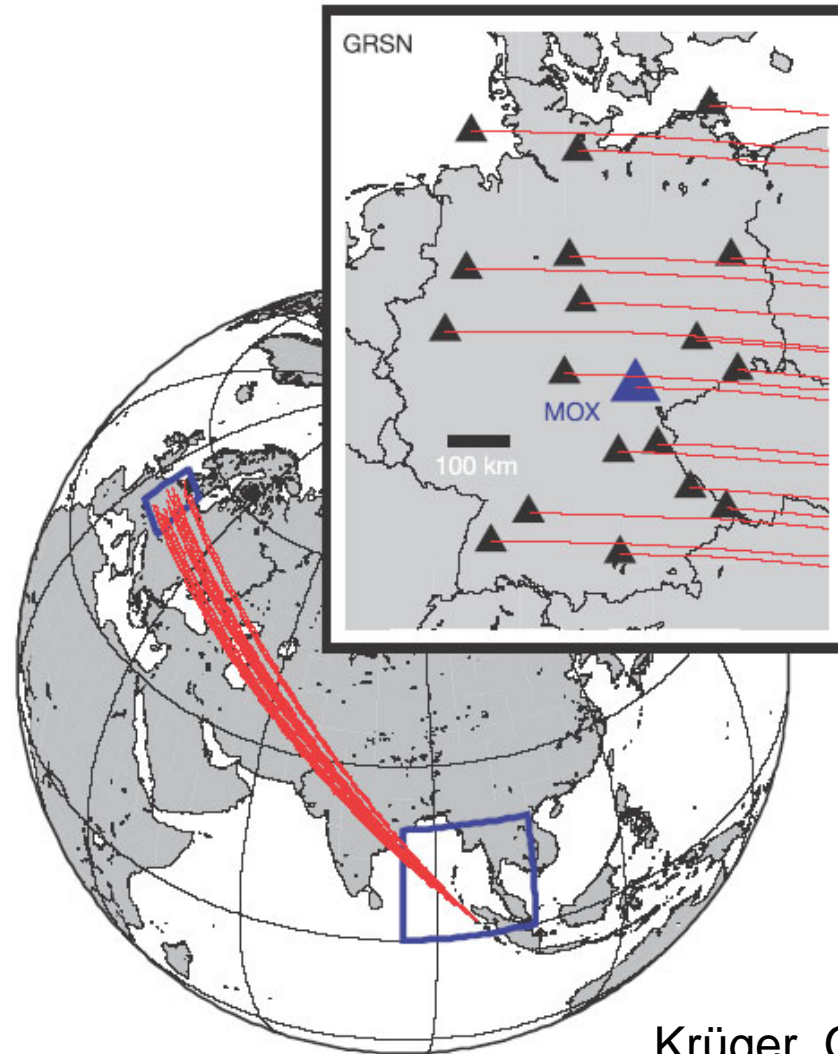
Nachbeben



Mw 9.0 Earthquake on 12/26/2004 Off West Coast of Northern Sumatra



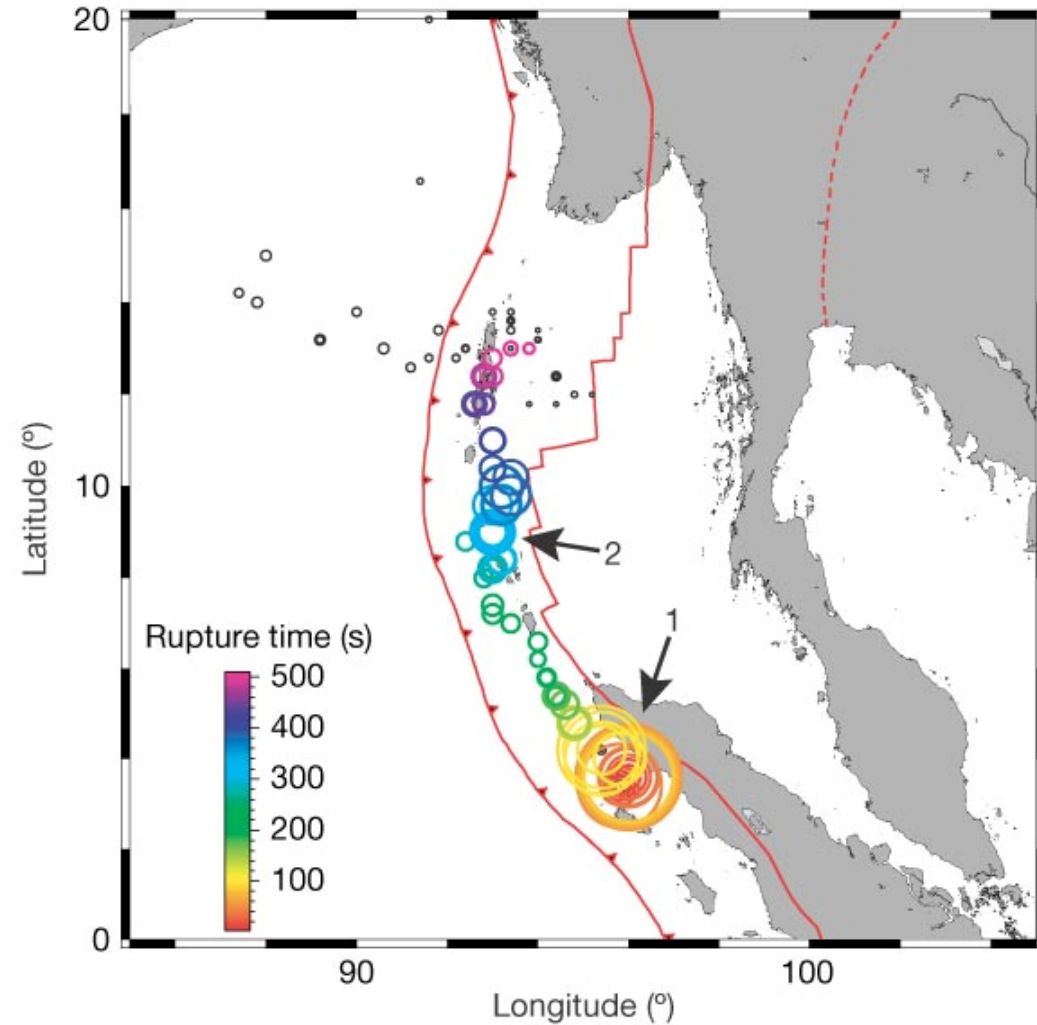
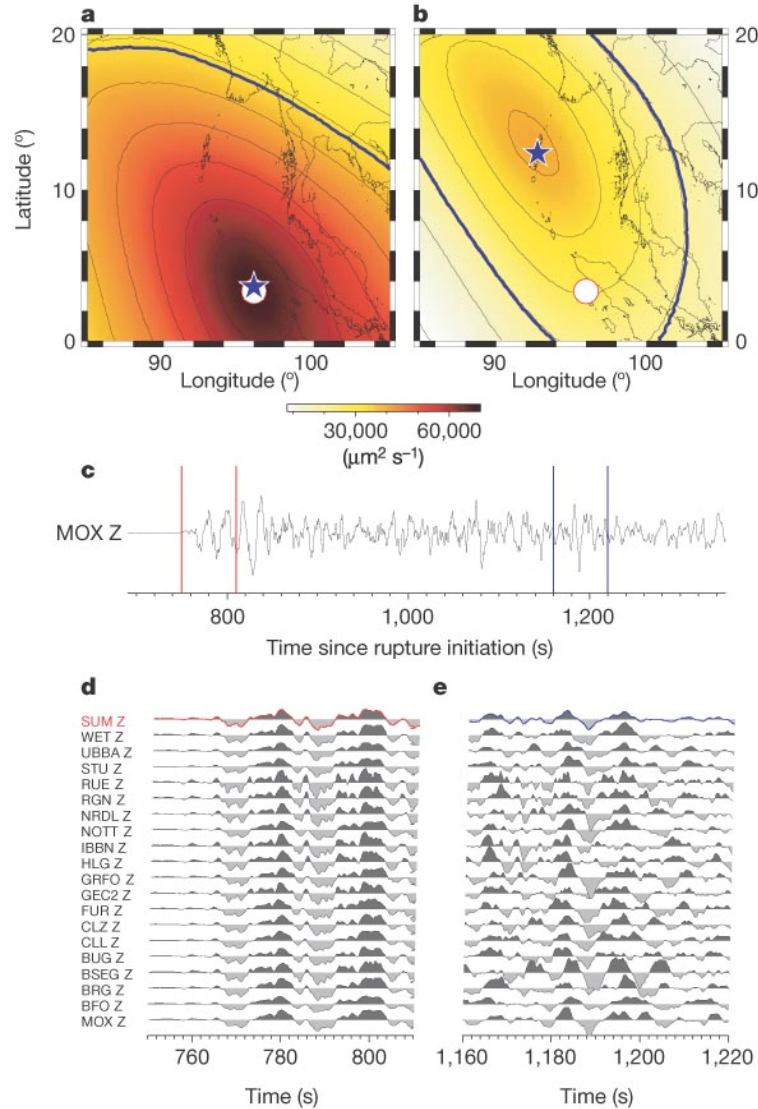
Messungen in Deutschland

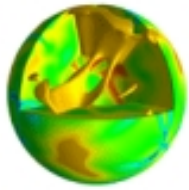


Krüger, Ohrnberger, Nature, 2005

Bruchbestimmung

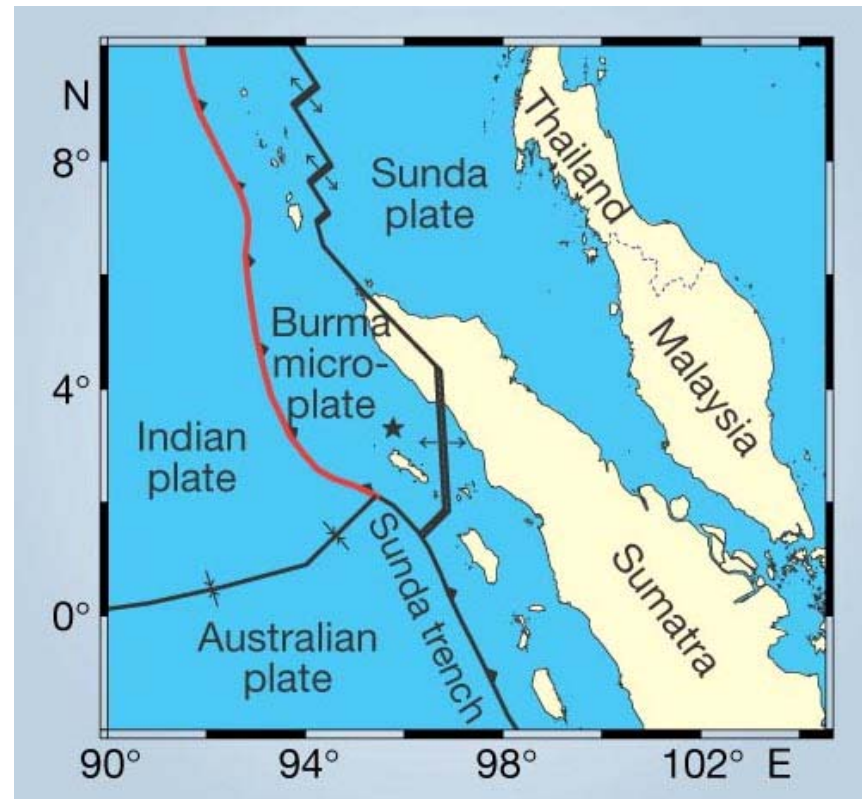
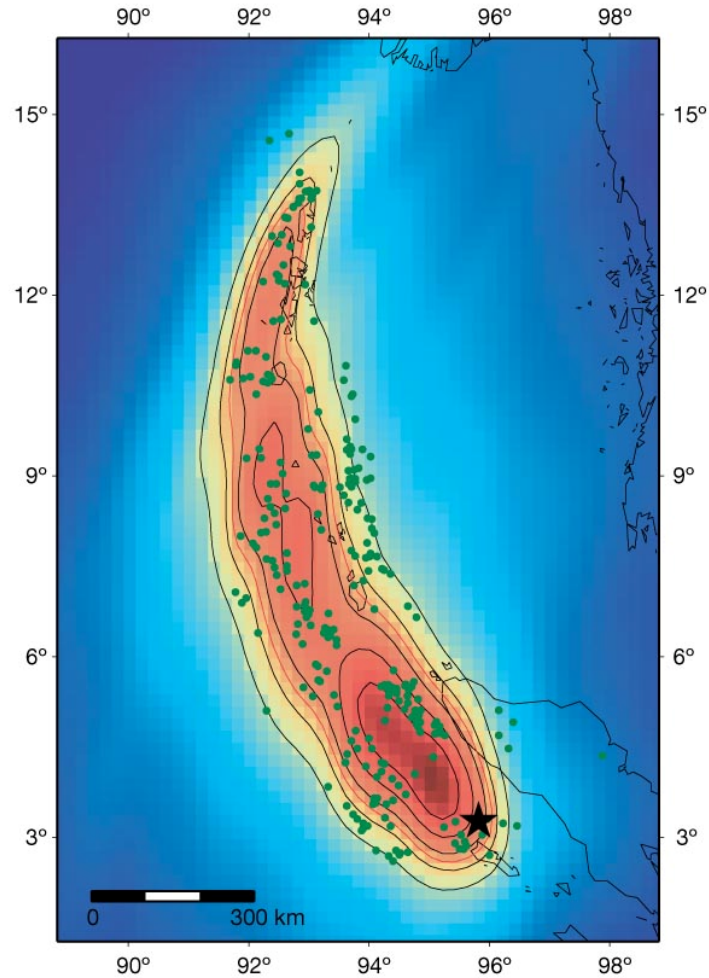
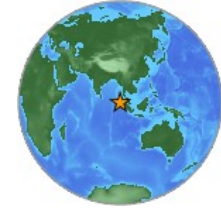
... aus der Ferne ...

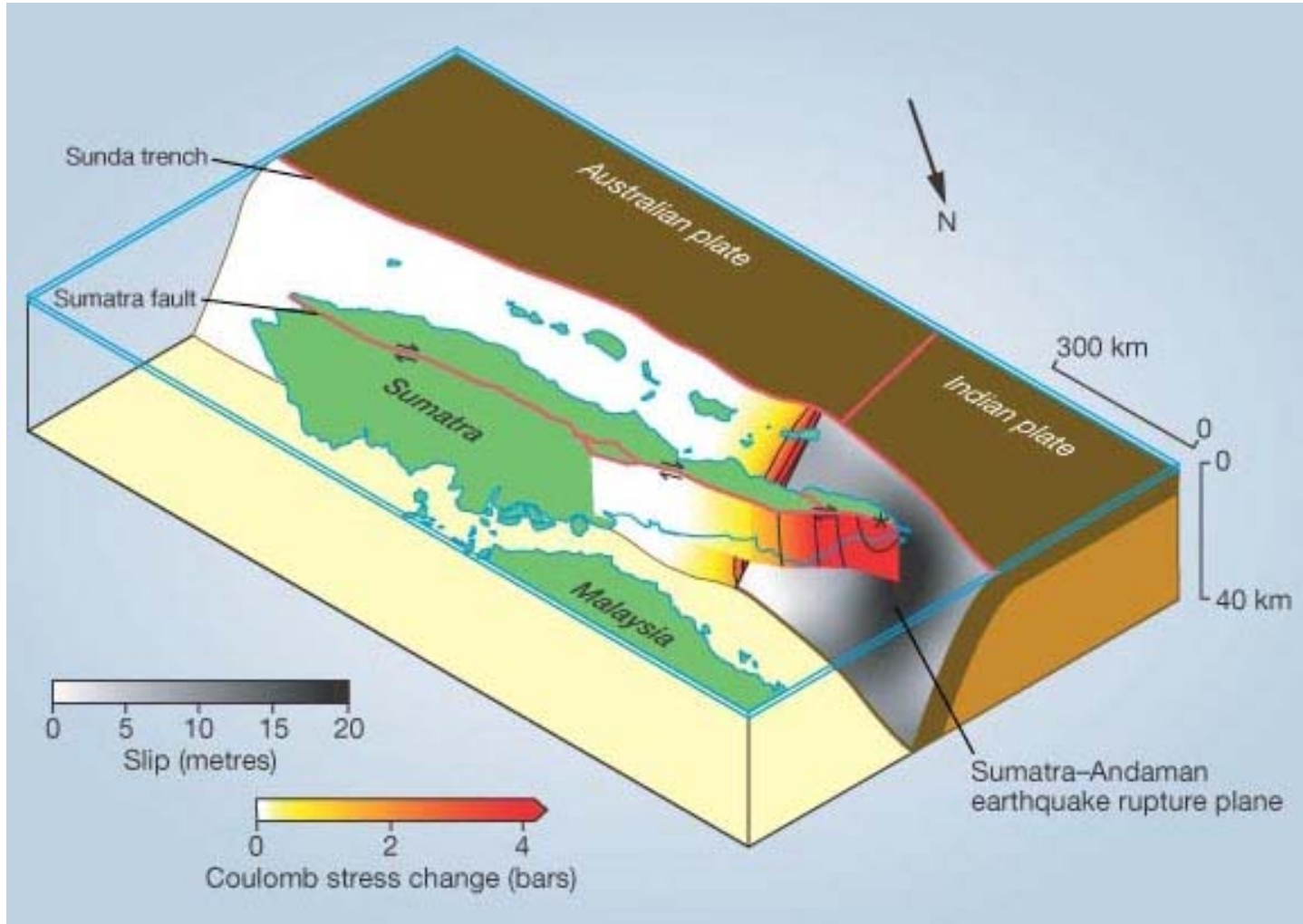
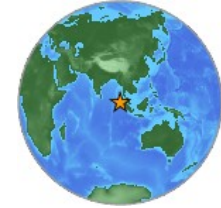


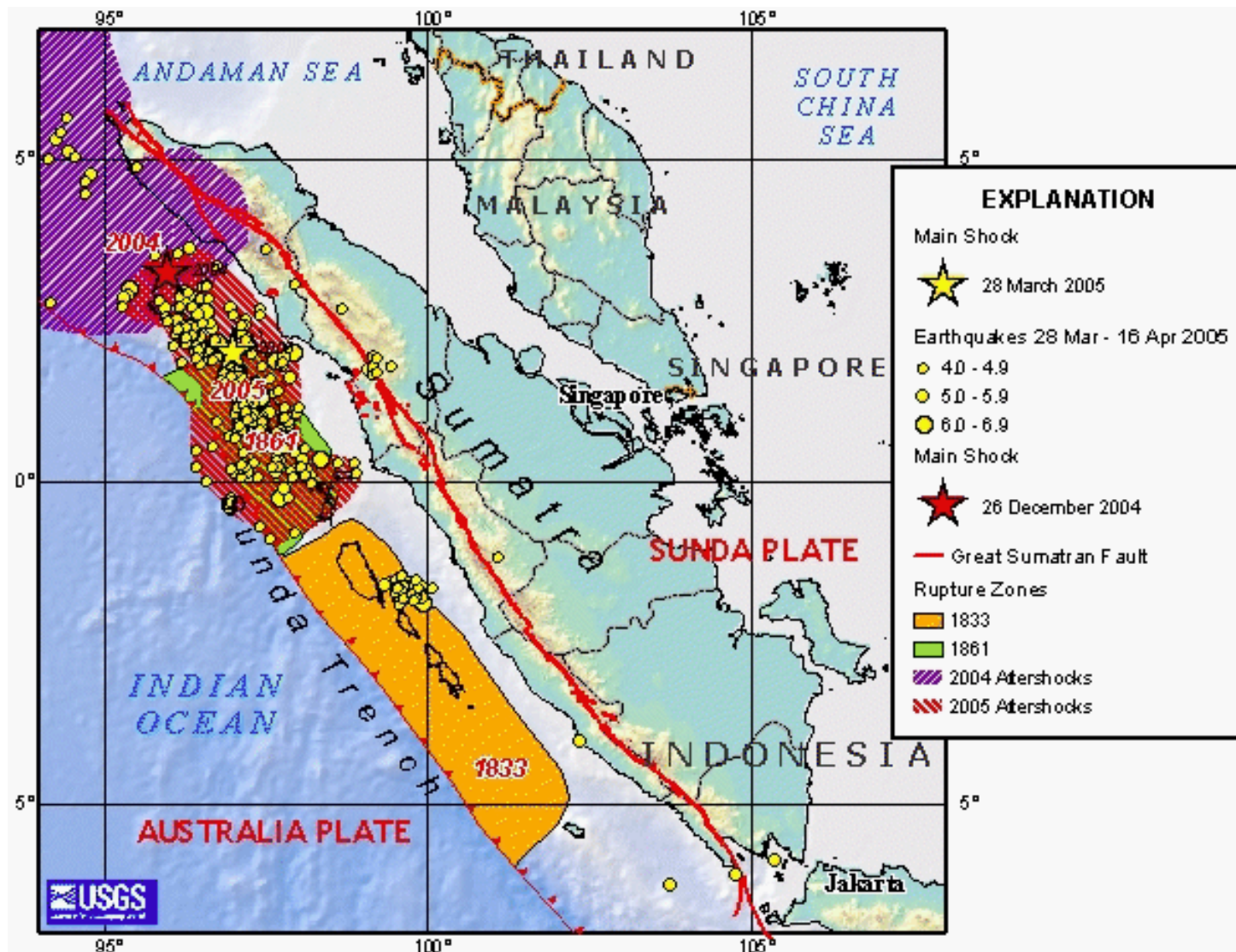
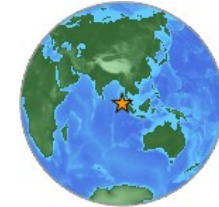


**GEO
LMU**

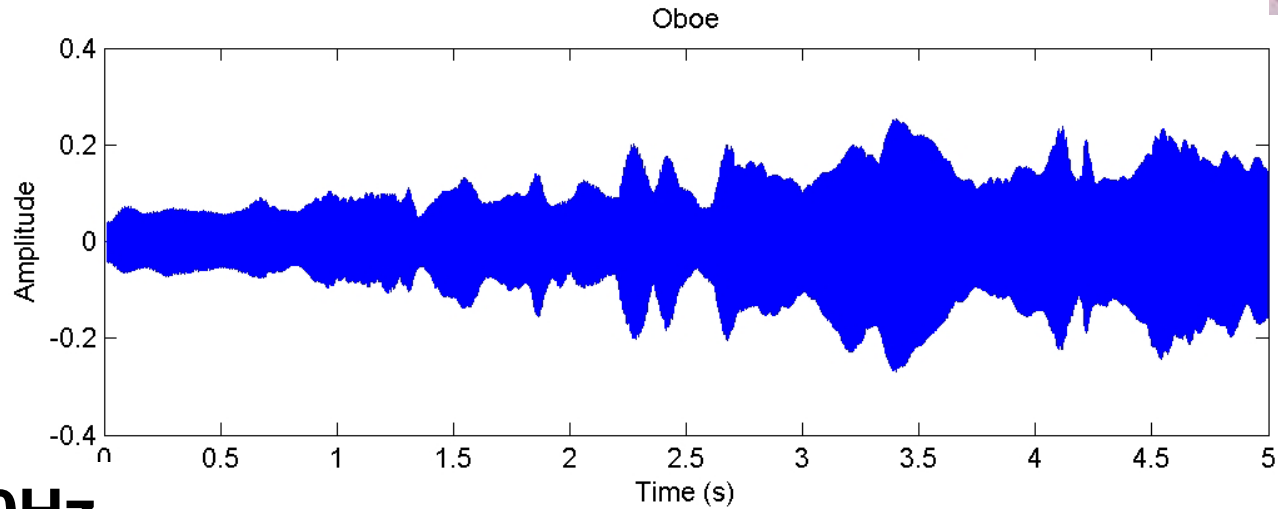
Endgültig ermittelte Bruchfläche



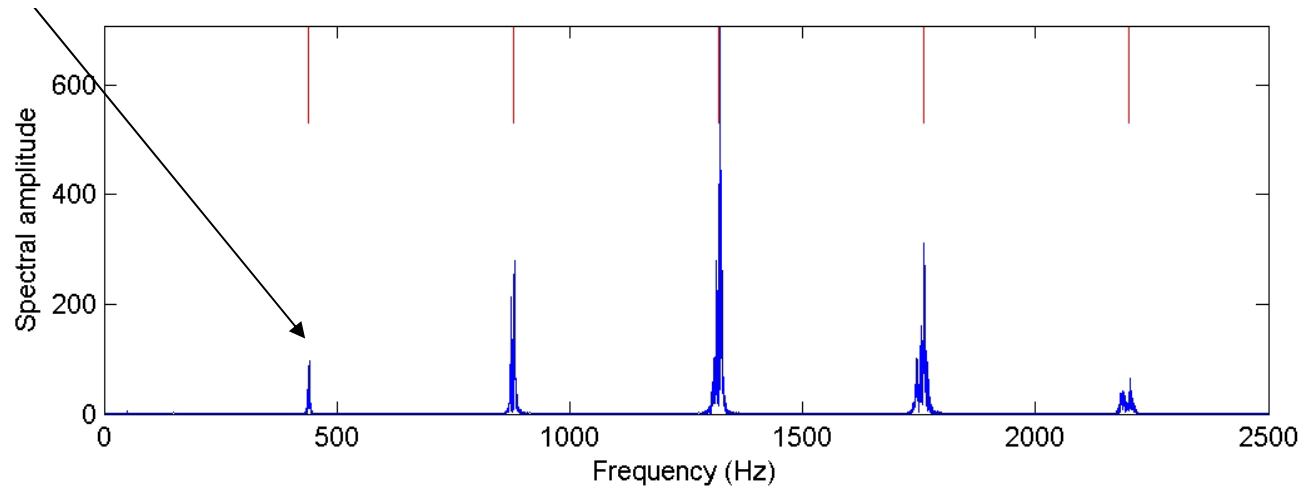


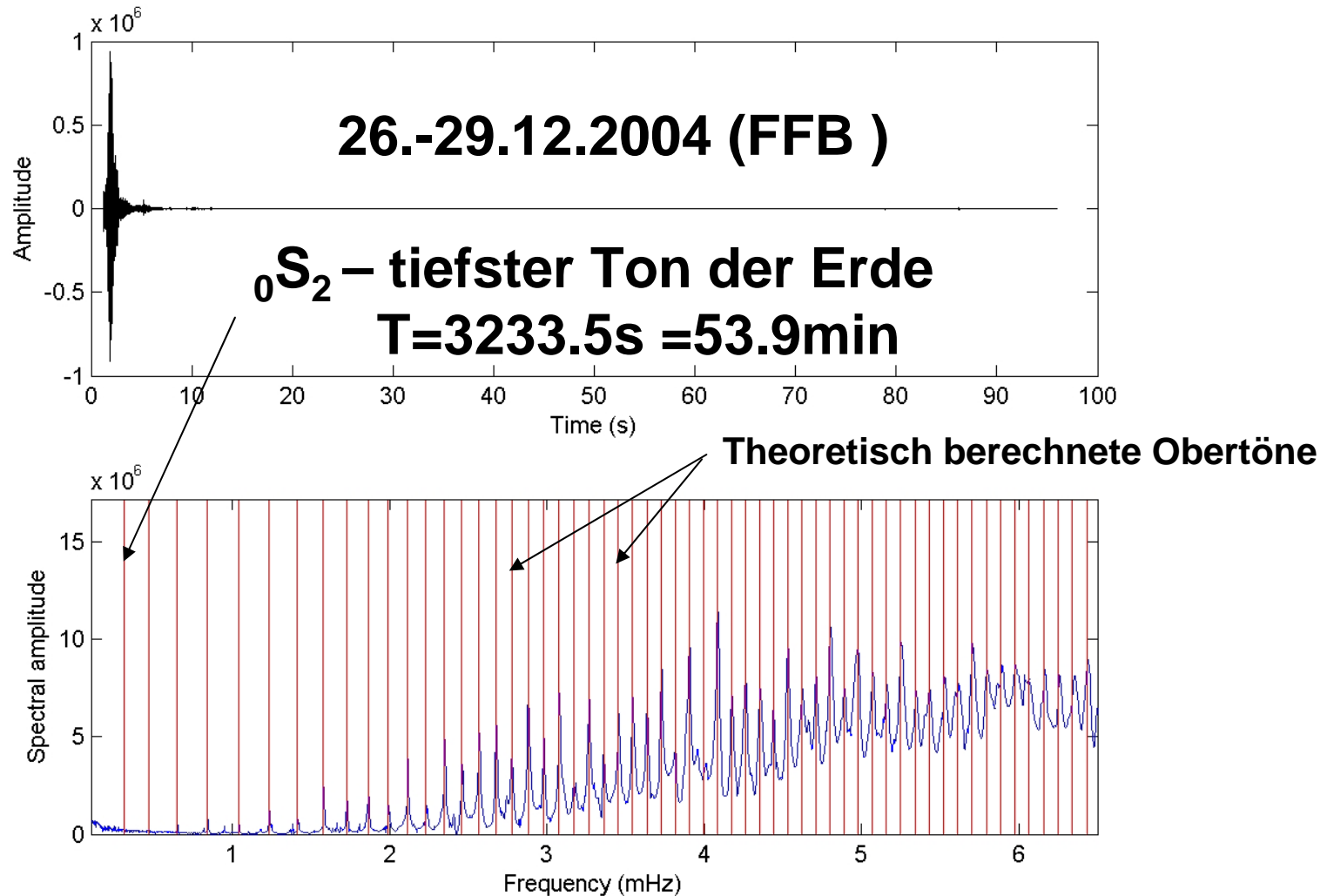


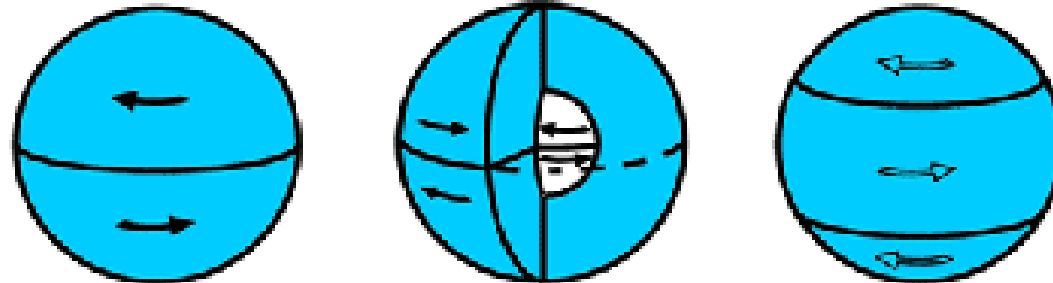
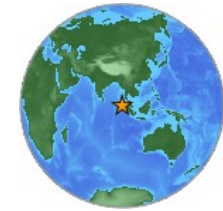
Klang eines Instruments



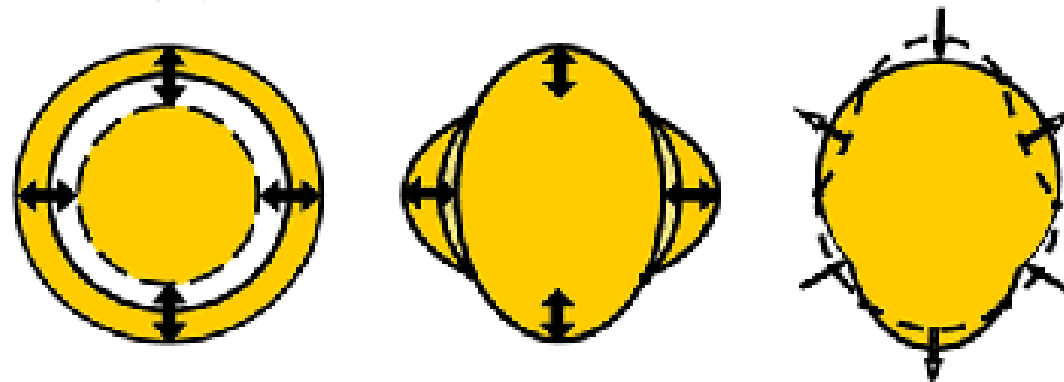
a' - 440Hz







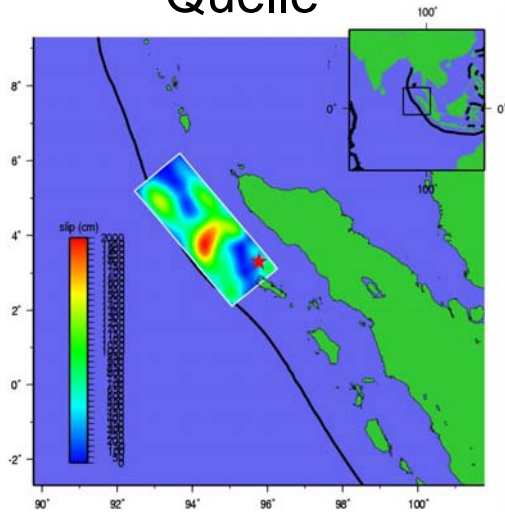
Toroidal modes ${}_0T_2$ (44.2 min), ${}_1T_2$ (12.6 min)
and ${}_0T_3$ (28.4 min)



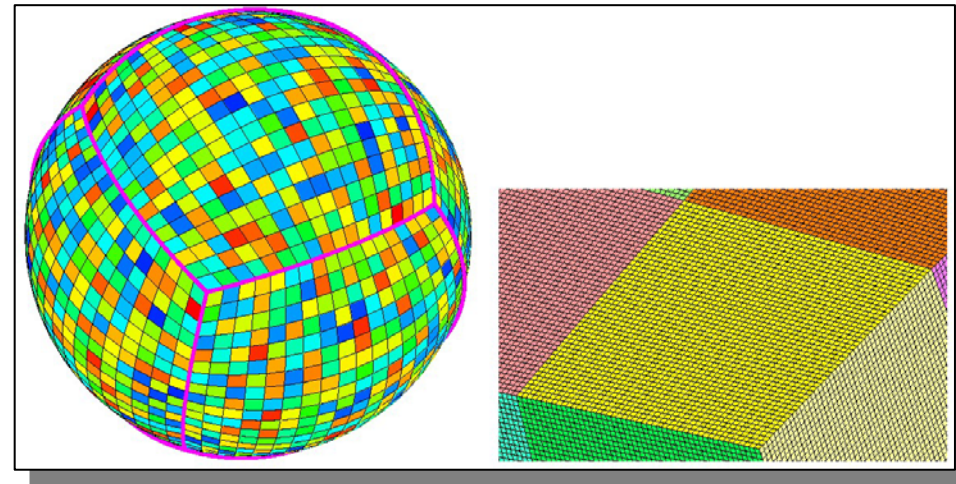
Spheroidal modes ${}_0S_0$ (20.5 min), ${}_0S_2$ (53.9 min)
and ${}_0S_3$ (25.7 min)



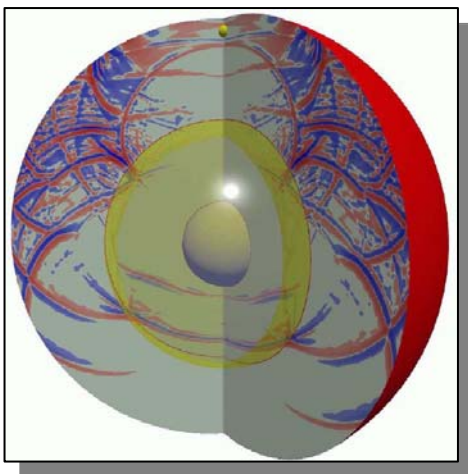
Quelle



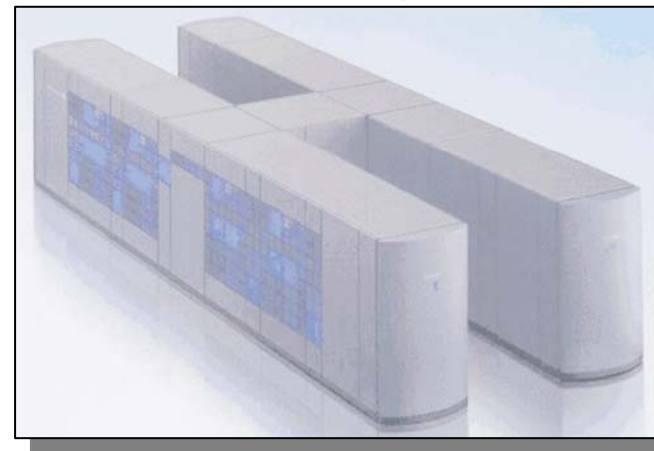
Gitter



Seismische Wellen

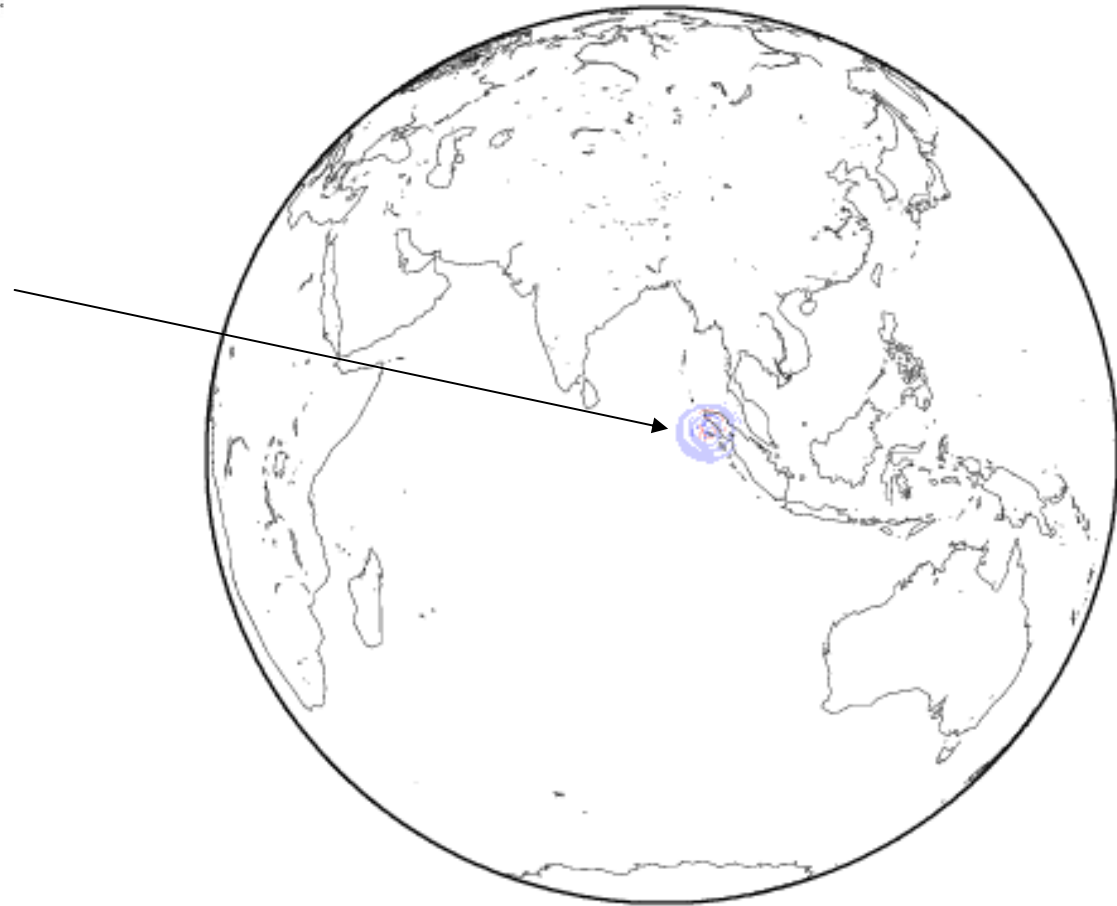
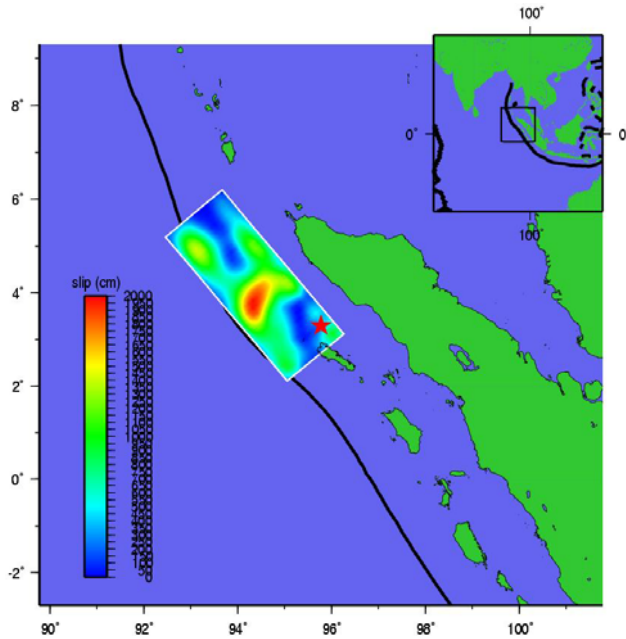


Parallelcomputer



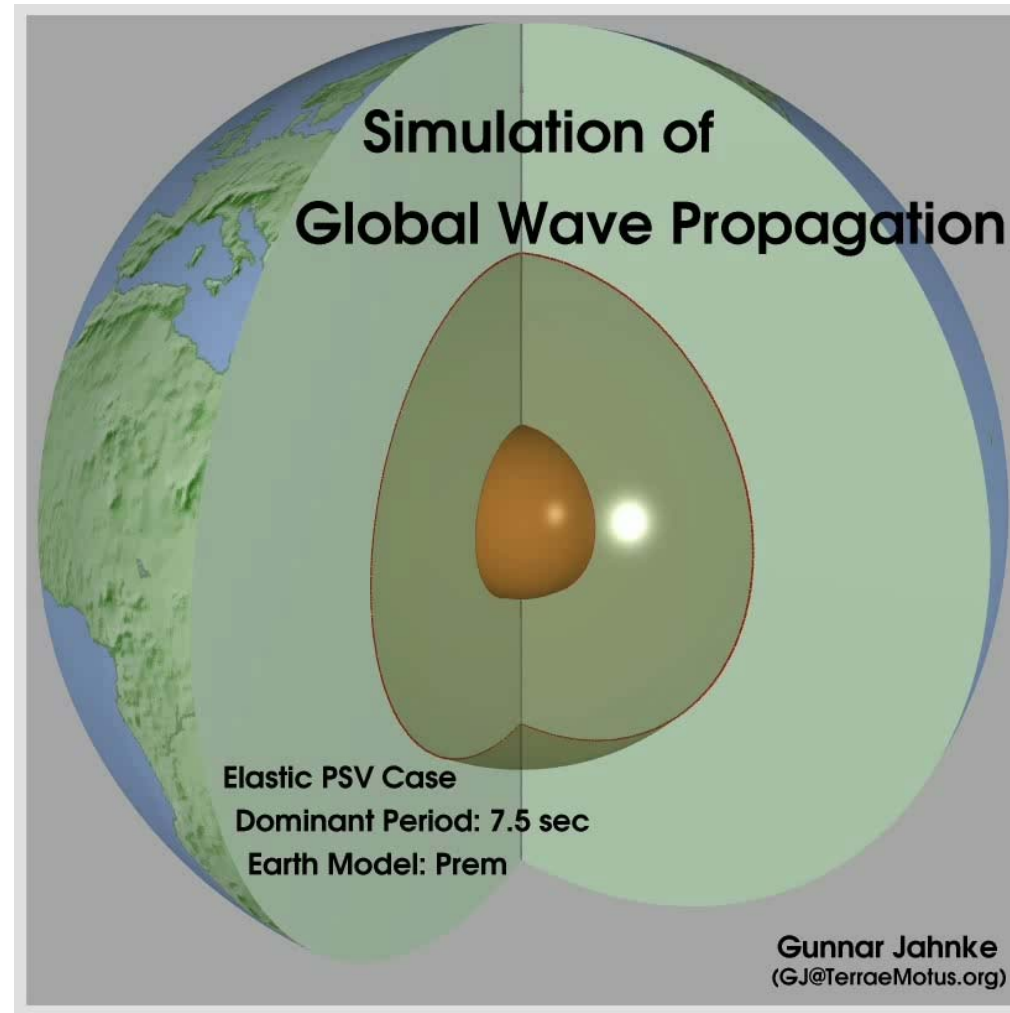
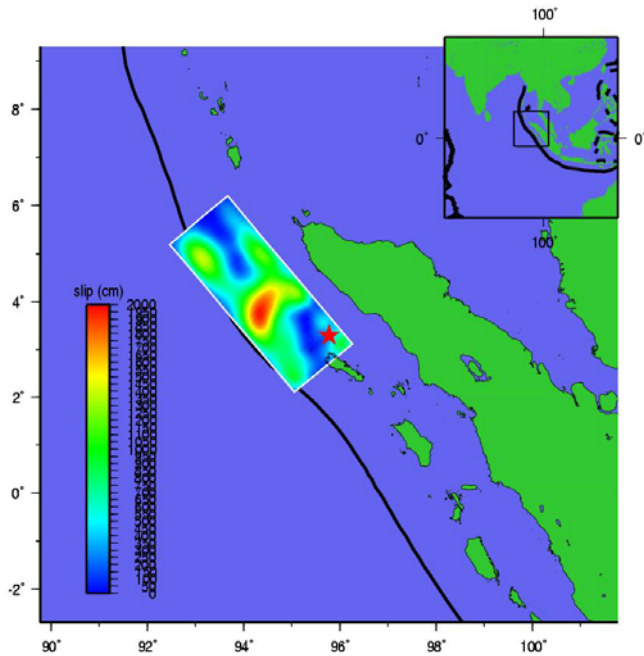
26 Dec 2004 01:58:53MET

Wellenausbreitung

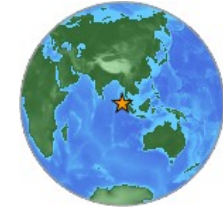




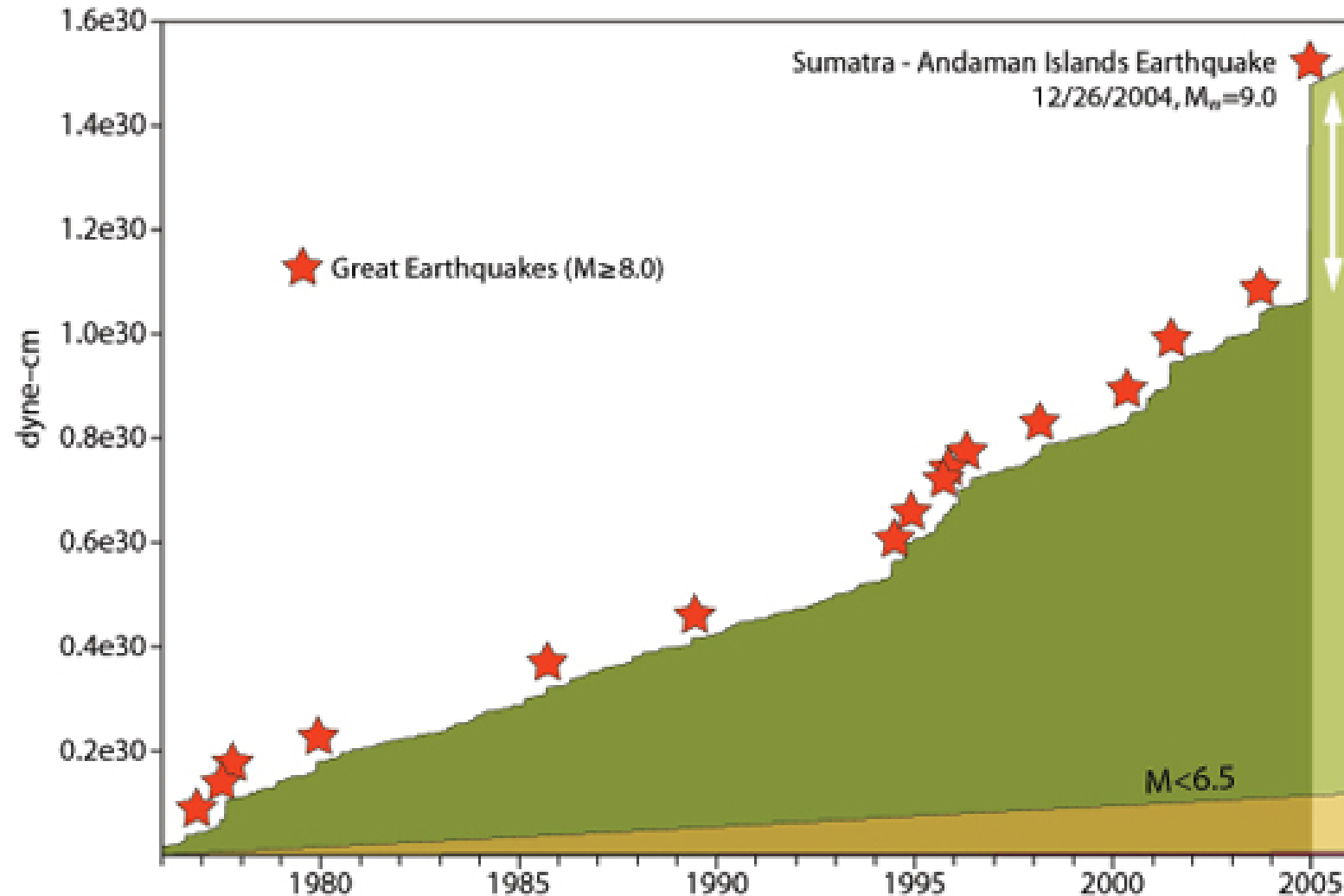
Wellenausbreitung



Kumulative Energie



Cumulative moment release since 1976





- ... regte die ganze Erde zu ihren **Eigenschwingungen** an, die tagelang anhalten ...
- ... führte in Bayern – 9400km entfernt – noch zu **2.5cm** horizontaler Bodenverschiebung ...
- ... wird auf lange Zeit die **Erdbebentätigkeit** im indonesischen Raum (und darüber hinaus) beeinflussen (erhöhen)...
- ... hat die Schwierigkeit gezeigt, die **Stärke sehr großer Beben in Echtzeit zu bestimmen** ...
- ... wird die Geo-forschung global ähnlich verändern wie das **Kobe Erdbeben** 17.1.1995 in Japan ...