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SIGNIFICANT EARTHQUAKES OF THE WORLD

1990

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NATIONAL EARTHQUAKE INFORMATION CENTER
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INTRODUCTION

This publication is a final listing of all the significant earthquakes for 1990. Significant earthquakes are defined for this publication as those of magnitude 6.5 or greater or ones that caused fatalities, injuries or substantial damage. The locations, comments and other data were taken from the Preliminary Determination of Epicenters Monthly Listing, U.S. Geological Survey. This listing of significant earthquakes was compiled to provide an accurate and readily available summary of the world's most important earthquakes for a given period of time.

DATE	ORIGIN TIME UTC HR MN SEC	GEOGRAPHIC COORDINATES LAT	LONG	DEPTH	MAGNITUDES GS MB	Msz	SD	NO. STA USED	REGION, CONTRIBUTED MAGNITUDES AND COMMENTS
1990									
FEB 08	07 15 32.2	9.755 N	124.694 E	26 G	6.2	6.6	1.4	322	MINDANAO, PHILIPPINE ISLANDS. Ms 6.5 (BRK), 6.3 (PAS). Mo=1.4*10**19 Nm (GS). Mo=1.5*10**19 Nm (HRV), Mo=3.0*10**19 Nm (PPT). Felt (VII RF) on Bohol; (VI) at Cebu; (V) at Cagayan de Oro and on Camiguin; (IV) at Cotoboto and (III) at Palo. Also felt on Negros. Two events about 2 seconds apart.
FEB 08	07 46 59.7	9.725 N	124.625 E	30 D	6.0	6.5	1.2	248	MINDANAO, PHILIPPINE ISLANDS. Mo=8.8*10**18 Nm (HRV). Felt (V RF) on Mactan.
FEB 09	17 57 26.4	31.677 N	121.032 E	10 G	5.0	4.3	1.2	72	EASTERN CHINA. One person injured slightly and minor damage in the Changshu area. Felt at Jiaxing, Nanjing, Nantang, Shonghai and Wuxi.
FEB 19	06 48 10.1	15.465 S	166.385 E	12 G	6.4	6.7	1.2	375	VANUATU ISLANDS. Ms 6.8 (BRK), 6.5 (PAS). Mo=2.2*10**19 Nm (GS). Mo=1.7*10**19 (HRV). Mo=2.0*10**19 Nm (PPT). Two events about 2 seconds apart.
FEB 28	23 43 36.6&	34.140 N	117.700 W	5	5.5	5.5		191	SOUTHERN CALIFORNIA. <PAS-P>. ML 5.2 (PAS), 6.2 (BRK). Mo=4.0*10**17 Nm (HRV). Thirty people received minor injuries and damage was estimated to be at least 12.7 million dollars. Some damage (VII) at Claremont, Covina, La Verne, Montclair, Mount Baldy, Ontario, Pomona, San Dimas, Upland and Walnut. Slight damage (VI) at Arcadia, Azuso, Chino, Colton, Compton, Glendora, Lincoln Heights, Lytle Creek, Pico Rivera and West Covina. Felt from Santa Barbara to Ensenada, Mexico and northeast as far as Las Vegas, Nevada.
MAR 03	12 16 27.9	22.122 S	175.163 E	33 G	6.3	7.4	1.3	322	SOUTH OF FIJI ISLANDS. Ms 7.4 (BRK), 7.1 (PAS). Mo=1.3*10**20 Nm (GS), Mo=3.0*10**20 Nm (HRV), Mo=4.0*10**20 Nm (PPT).
MAR 03	12 44 22.4	22.405 S	174.164 E	33 N	6.1	6.6	1.0	156	LOYALTY ISLANDS REGION
MAR 04	19 46 19.6	28.925 N	66.331 E	10 D	5.8	6.1	1.2	339	PAKISTAN. Mo=8.4*10**17 Nm (GS). Mo=1.4*10**18 Nm (HRV). Complex event. At least 11 people killed, about 40 injured and many homes and buildings damaged in the Kalat area. Also felt at Quetta and Mastung.
MAR 05	16 38 12.5	18.318 S	168.063 E	21 G	5.6	7.0	1.2	335	VANUATU ISLANDS. Ms 7.0 (BRK), 6.8 (PAS). Mo=5.3*10**19 Nm (GS). Mo=3.3*10**19 Nm (HRV). Mo=6.0*10**19 Nm (PPT). Felt (V) at Port Vila.
MAR 12	14 41 19.4	51.484 N	175.032 W	14 G	6.0	6.2	1.1	487	ANDREANOF ISLANDS, ALEUTIAN IS. ML 5.7 (PMR). Ms 6.5 (BRK), 5.9 (PAS). Mo=3.5*10**18 Nm (GS). Mo=3.8*10**18 Nm (HRV). Felt (IV) on Adak and Atka.
MAR 25	13 22 55.6	9.919 N	84.808 W	22 G	6.2	7.0	1.1	494	COSTA RICA. Ms 6.8 (BRK). Mo=1.1*10**20 Nm (GS). Mo=7.8*10**19 Nm (HRV). Mo=6.0*10**19 Nm (PPT). Ten people slightly injured. Damage (VIII) in the Puntarenas area and about 60 buildings severely damaged (VII) in the San Jose area. Several landslides blocked roads in the area for a short time. Felt throughout Costa Rica and southwestern Nicaragua. Felt (IV) at Almirante and Puerto Armuelles and (III) at David, Panama.
MAR 26	22 47 16.7	9.253 N	125.606 E	39	5.6	5.5	1.1	190	MINDANAO, PHILIPPINE ISLANDS. Mo=8.0*10**17 Nm (HRV). One person killed, two injured and some damage in the Santiago area. Felt (IV RF) on Camiguin and (II) at Cotabato. Also felt at Gingoog.
APR 02	13 46 31.7	52.314 N	2.985 W	18	4.7		1.3	189	UNITED KINGDOM. ML 5.1 (LDG), 5.2 (BGS). MD 4.8 (STR). Damage (VI) in the Wrexham-Welshpool-Shrewsbury area. Some buildings damaged in Manchester and Liverpool. Felt throughout Wales, in eastern Ireland and in England from Newcastle-upon-Tyne to Kent and Cornwall.
APR 03	22 57 00.9	11.426 N	86.301 W	53	5.5	6.4	1.3	320	NEAR COAST OF NICARAGUA. Ms 6.7 (BRK), 5.9 (PAS). MD 6.6 (UPA), 5.9 (SJR). Mo=1.8*10**19 Nm (HRV). Mo=2.0*10**19 Nm (PPT). Felt (V) at Rivas and (IV) at Managua. Felt throughout much of Nicaragua. Felt (V) at Cuajiniquil and Liberia, (IV) at Puntarenas, (III) at San Jose and (II) at Limon, Costa Rica. Also felt (II) at San Salvador, El Salvador.
APR 05	21 12 35.5	15.125 N	147.596 E	11 G	6.5	7.5	1.2	328	MARIANA ISLANDS REGION. Ms 7.3 (PAS), 7.2 (BRK). Mo=6.5*10**19 Nm (GS). Mo=1.6*10**20 (HRV). Mo=3.0*10**20 Nm (PPT). Two events about 6 seconds apart. Felt (IV) on Guam. Also felt on Saipan. A small tsunami was generated with maximum wave heights (peak-to-trough) at selected tide stations as follows: 24 cm at Muroto-misaki, 24 cm at Kailua-Kona, 23 cm on Chichi-shima, 22 cm at Tosashimizu, 19 cm at Yaene, 6 cm on Midway, 4 cm on Wake Island and 3 cm on Truk. A tsunami was also observed on Guam and reported on Tinian and Saipan.
APR 17	01 59 33.4	39.436 N	74.900 E	33 N	6.0	6.2	1.2	277	SOUTHERN XINJIANG, CHINA. Mo=1.1*10**18 Nm (GS). Mo=1.2*10**18 Nm (HRV). Two people injured and many houses collapsed in Wuqia County. Felt at Koshi, Shufu and Wuqia.

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1990									
APR 18	13 39 19.0	1.186 N	122.857 E	26 G	6.2	7.4	1.2	294	MINAHASSA PENINSULA. Ms 7.3 (BRK). Mo=1.4*10**20 Nm (GS). Mo=3.3*10**20 Nm (HRV). Mo=2.0*10**20 Nm (PPT). At least 3 people killed and 25 people injured. More than 1,140 houses damaged in the Bolaang-Gorantalo area. Felt strongly throughaut the Minahassa Peninsula. Also felt in central Sulawesi. Two events about 4.5 seconds apart.
APR 26	09 37 15.0	35.986 N	100.245 E	8 G	6.5	6.9	1.2	127	QINGHAI PROVINCE, CHINA. Ms 6.7 (BRK), 6.4 (PAS). Mo=1.8*10**18 Nm (GS). Mo=5.6*10**18 Nm (HRV). Mo=8.0*10**18 Nm (PPT). At least 126 people killed, many injured, extensive damage and landslides in the Gonghe-Xinghai area. Also felt in Gansu Province.
MAY 05	07 21 29.5	40.775 N	15.766 E	10 G	5.3	5.4	1.4	110	SOUTHERN ITALY. MD 5.6 (TTG), 5.5 (TRI), 5.4 (STR). ML 5.3 (LJU), 5.2 (THE). Mo=5.7*10**17 Nm (HRV). Two people died fram heart attacks, 16 injured and damage (VII) in the Potenza area. Felt strongly in many parts af southern Italy. Also felt along the caast of Montenegro, Yugoslavia.
MAY 08	00 01 40.0	6.905 N	82.622 W	10 G	6.2	6.3	1.0	462	SOUTH OF PANAMA. Ms 6.5 (BRK). MD 6.1 (UPA), 5.9 (HDC). Mo=5.4*10**18 Nm (GS). Mo=5.8*10**18 Nm (HRV). Mo=8.0*10**18 Nm (PPT). Felt (V) at Santiago; (IV) at David; (III) at Panama City and Chitre. Also felt in much af Costa Rica.
MAY 12	04 50 08.7	49.037 N	141.847 E	606 G	6.5		0.8	697	SAKHALIN ISLAND. mb 6.8 (BRK), 6.2 (PAS). Mo=7.9*10**19 Nm (GS). Ma=8.2*10**19 Nm (HRV). Mo=6.0*10**19 Nm (PPT). Felt (V) at Aniva, Ogonki and Peschanskoye; (IV) in the Korsakov-Nevelsk-Tomari area; (III) in the Uglegorsk-Poronaysk-Makarov area, Sakhalin. Felt (II) at Komsomolsk-na-Amure, USSR. Felt (III JMA) at Kushiro, Hokkaido. Also felt (III JMA) at Hachinohe and Morioka; (II JMA) at Tokyo and Yakohama, Honshu.
MAY 13	04 23 09.6	40.296 S	176.064 E	21 G	6.0	6.3	1.2	395	NORTH ISLAND, NEW ZEALAND. Ms 6.1 (BRK). ML 6.7 (WEL). Mo=4.6*10**18 Nm (GS). Mo=4.6*10**18 Nm (HRV). Mo=5.0*10**18 Nm (PPT). Some damage (VIII) in the Dannevirke area. Felt at Wellington.
MAY 20	02 22 01.6	5.121 N	32.145 E	15 G	6.7	7.1	1.1	494	SUDAN. Ms 7.4 (BRK), 7.2 (PAS). Mo=7.4*10**19 Nm (GS). Mo=5.3*10**19 Nm (HRV). Mo=1.6*10**20 Nm (PPT). Believed to be the largest eorthquake ever recorded in Sudan. Some buildings damaged in the Juba area. Also some damage in the Moya area, Uganda. Felt in the Nakuru area, Kenya and in Uganda.
MAY 24	19 34 44.2	5.277 N	31.829 E	17 G	5.9	6.6	1.1	380	SUDAN. Ms 6.7 (PAS), 6.6 (BRK). Mo=5.1*10**18 Nm (GS). Mo=6.4*10**18 Nm (HRV). Felt in the Juba area. Also felt in the Kapenguria area, Kenya ond in Uganda.
MAY 24	20 00 08.1	5.358 N	31.848 E	16 G	6.5	7.0	1.0	404	SUDAN. Ms 7.0 (BRK), 6.9 (PAS). Mo=4.8*10**19 Nm (HRV). Mo=1.1*10**20 Nm (PPT). Some buildings damaged in the Juba area. Felt in the Kapenguria area and at Nakuru, Kenya. Also felt in Uganda.
MAY 30	02 34 05.8	6.016 S	77.229 W	24 G	6.1	6.5	1.0	461	NORTHERN PERU. Ms 6.6 (BRK), 5.9 (PAS). Mo=8.0*10**18 Nm (GS). Mo=7.7*10**18 Nm (HRV). Mo=1.3*10**19 Nm (PPT). Three events about 1.5 and 4.8 seconds apart respectively. At least 135 people killed, more than 800 injured and severe damage (VI) in the Mayobamba-Rioja area. Felt (V) at Chachapoyas; (IV) at Cajamarca; (III) at Chiclayo and Chimbote. Also felt (IV) at Guayaquil, Ecuador.
MAY 30	10 40 06.1	45.841 N	26.668 E	89 G	6.7		1.0	648	ROMANIA. mb 7.1 (PAS). Mo=3.0*10**19 Nm (HRV). Mo=7.0*10**19 Nm (PPT). Nine people killed, more than 700 injured and severe damage in the Bucharest-Braila-Brasov area. Four people killed, some injured and many buildings damaged in Moldavia, USSR. One person died of a heart attack and extensive damage in northern Buglaria. Felt (VI) at Silistra and (V) at Sofia, Bulgaria. Felt (VI) at Kishinev; (IV) at Kiev, Lvav, Moscaw, Rostov, Sochi and Uzhgorod; (III) at Stavrapol and Leningrad, USSR. Also felt in Hungary, Greece, Poland, Turkey and Yugoslavia.
MAY 31	00 17 47.8	45.811 N	26.769 E	88 G	6.1		1.0	572	ROMANIA. mb 6.5 (PAS), 6.2 (BRK). Mo=3.2*10**18 Nm (HRV). Two events about 2.3 seconds apart. Additional damage in Ramania. Felt (V) in northern Bulgaria and at Kishinev, USSR. Felt throughout Bulgaria and in parts of Yugoslavia. Also felt at Lvov, USSR and Istanbul, Turkey.
JUN 07	09 25 19.1	3.563 S	144.432 E	29 D	5.9	6.5	1.2	140	NEAR NORTH COAST OF PAPUA NEW GUINEA. Mo=4.7*10**18 Nm (GS). Mo=5.8*10**18 Nm (HRV). Mo=1.1*10**19 Nm (PPT). Ms 6.9 (BRK), 6.1 (PAS).
JUN 09	01 14 34.5	6.062 S	77.136 W	26 D	5.5	4.9	1.0	171	NORTHERN PERU. Mo=2.0*10**17 Nm (HRV). One person killed and at least 14 houses destrayed (VI) in the Rioja-Moyobamba area. Felt (II) at Iquitas.

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1990									
JUN 14	07 40 56.2	11.760 N	121.899 E	18 G	6.0	7.1	1.2	283	PANAY, PHILIPPINE ISLANDS. Ms 6.8 (BRK). Mo=3.6*10**19 Nm (GS). Mo=4.7*10**19 Nm (HRV). Mo=6 0*10**19 Nm (PPT). At least four people killed, 15 injured in the Culasi area. Considerable damage in other parts of Panay. Felt (VI RF) at Iloilo; (V RF) at Bacolod, Negros and on Cebu; (III RF) on Camiguin; (II RF) at Sorsogon and (I RF) at Manila, Luzon.
JUN 14	12 47 28.8	47.869 N	85.076 E	58 G	6.1	6.8	1.0	501	KAZAKH-XINJIANG BORDER REGION. mb 6.5 (PAS). Ms 6.6 (BRK), 6.4 (PAS). Mo=8.6*10**18 Nm (GS). Mo=9.7*10**18 Nm (HRV). One person killed, 3,000 houses destroyed and 20,000 people left homeless in the Ust-Kamenogorsk-Zaysan area, USSR. Damage in Jeminay and Hobahe Counties, China. Felt (V) at Novosibirsk, Semipalotinsk and Ust-Kamenogorsk and (III) at Andizhan and Frunze, USSR. Also felt at Urumqi, China.
JUN 16	02 16 21.1	39.258 N	20.528 E	32 D	5.6	5.2	1.3	389	GREECE-ALBANIA BORDER REGION. MD 5.4 (TTG). Mo=2.5*10**17 Nm (HRV). One person slightly injured and damage in the Preveza area. Felt strongly in much of northwestern Greece and on Kerkira.
JUN 17	04 51 45.5	27.398 N	65.719 E	15 G	5.9	6.3	1.2	390	PAKISTAN. Ms 6.4 (BRK), 6.2 (PAS). Mo=1.8*10**18 Nm (GS). Mo=1.8*10**18 Nm (HRV). At least six people injured and damage in southern Baluchistan Province. A 13-meter deep fissure was reported in the epicentral area. Felt in the Khuzdar-Surab area.
JUN 20	21 00 09.9	36.957 N	49.409 E	19 D	6.4	7.7	1.2	352	WESTERN IRAN. Ms 7.7 (BRK), 7.4 (PAS). Mo=1.1*10**20 Nm (GS). Mo=1.4*10**20 Nm (HRV). 2.0*10**20 Nm (PPT). Complex event. Estimated 40,000 to 50,000 people killed, more than 60,000 injured, 400,000 or more homeless and extensive damage and landslides in the Rosht-Qazvin-Zanjan area, Iran. Nearly all buildings were destroyed in the Rudbar-Manjil area. Substantial damage occurred as far away as Khalkhal and New Shahr and slight damage occurred at Tehran. Felt in most of northwestern Iran, including Arak, Bokhtoran and Tabriz. Slight damage also occurred in southern Azerbaijan, USSR. Felt (VII) at Astra and Lenkoran; (VI) at Dzhibrail, Lerik, Massany and Yardyshny; (III) at Baku, USSR.
JUN 21	09 02 14.6	36.636 N	49.799 E	15 G	5.8	5.3	1.1	366	WESTERN IRAN. Mo=4.9*10**17 Nm (HRV). At least 20 people killed and additional damage in the Lowshan-Manjil area.
JUN 23	21 38 18.7	21.568 S	176.483 W	181 G	6.4		1.0	537	FIJI ISLANDS REGION. mb 6.5 (BRK), 6.4 (PAS). Mo=2.6*10**19 Nm (GS). Mo=2.2*10**19 Nm (HRV). Mo=5.0*10**19 Nm (PPT).
JUL 06	00 16 20.4	6.904 S	108.120 E	14 G	5.8	4.8	1.4	131	JAVA. Mo=2.2*10**17 Nm (GS). Mo=2.3*10**17 Nm (HRV). At least 103 people injured and about 10,300 buildings damaged or destroyed in the Kuningan-Majalengo-Sumedang area.
JUL 06	19 34 52.4	36.861 N	49.303 E	35 D	5.3	4.4	0.9	278	WESTERN IRAN. Mo=9.6*10**16 Nm (HRV). Two people injured and two roads blocked by landslides in the Rudbar area. Also felt at Rasht and Tehran.
JUL 09	15 11 20.3	5.395 N	31.654 E	13 G	5.9	6.4	1.2	387	SUDAN. Ms 6.6 (BRK), 6.3 (PAS). Mo=8.8*10**18 Nm (GS). Mo=3.3*10**18 Nm (HRV). Mo=5 0*10**18 Nm (PPT).
JUL 13	13 50 25.6	12.925 N	87.723 W	22 D	4.9	5.0	1.1	57	NEAR COAST OF NICARAGUA. Some injured and slight damage (V) in eastern El Salvador. Also felt in southern Honduras.
JUL 13	14 20 43.4	36.415 N	70.789 E	217 D	5.6		1.1	500	HINDU KUSH REGION. Mo=3.8*10**18 Nm (GS). Mo=1.3*10**17 Nm (HRV). At least 43 mountain climbers were killed on Pik Lenina, USSR by an avalanche which was triggered by the earthquake. Felt (IV) at Dushanbe, Garm, Gezan, Gissar, Kharog, Kulyab, Langar, Leninabad, Namangan and Pyandzh; (III) at Andizhan, Fergana and Ura-Tyube; (II) at Tashkent, USSR.
JUL 16	07 26 34.6	15.679 N	121.172 E	25 D	6.5	7.8	1.1	487	LUZON, PHILIPPINE ISLANDS. Ms 7.6 (BRK), 7.3 (PAS). Mo=4.1*10**20 Nm (HRV). Mo=8.0*10**20 Nm (PPT). At least 1,621 people killed, more than 3,000 people injured and severe damage, landslides, liquefaction, subsidence, and sandblows in the Baguio-Cabanatuan-Dagupan area. Damage also occurred in Bataan Province and at Manila. Large fissures were observed in the epicentral area. Surface faulting occurred along the Philippine and Digdig faults. Felt (VII RF) in the Manila area, (VI RF) at Santa, (V RF) at Cubi Point and (IV RF) at Callao Caves.
JUL 17	21 14 43.8	16.495 N	120.981 E	23 G	6.1	6.6	1.3	483	LUZON, PHILIPPINE ISLANDS. Ms 6.0 (PAS). Mo=5.8*10**18 Nm (GS). Mo=6.2*10**18 Nm (HRV). Mo=1.6*10**19 Nm (PPT). Felt in the Manila area.
JUL 18	11 29 24.9	36.990 N	29.595 E	17 D	5.2	5.1	1.2	346	TURKEY. MD 5.0 (ATH). Mo=2.2*10**17 Nm (HRV). At least 393 houses damaged in the Comeli-Denizli area. Felt in Antalya, Denizli, Isparta and Mugla Provinces.

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1990									
JUL 27	12 37 59.5	15.355 S	167.464 E	126 G	6.4		1.0	476	VANUATU ISLANDS. mb 6.9 (BRK). Mo=6.8*10**19 Nm (GS). Mo=7.2*10**19 Nm (HRV). Mo=2.0*10**20 Nm (PPT). Two events about 5 seconds apart. Two people injured and many buildings damaged on Espiritu Santo. Felt (V) at Mont Dzumac, New Caledonia and Suva, Fiji.
AUG 03	09 15 06.1	47.963 N	84.961 E	33 G	6.0	6.1	1.0	553	KAZAKH-XINJIANG BORDER REGION. Ms 5.8 (BRK), 5.7 (PAS). Mo=2.3*10**18 Nm (GS). Mo=2.0*10**18 Nm (HRV). Mo=2.0*10**18 Nm (PPT). Eight people injured and about 500 buildings destroyed (VII) in the Akkol area, USSR. Felt (IV) at Ust-Kamenogorsk and Semipalatinsk; (III) at Pavlodar and Taldy-Kurgan, USSR. Also felt at Alma-Ata and Boravay, USSR. Felt strongly in northern Xinjiang Province, China.
AUG 05	01 34 55.8	29.551 N	137.630 E	496 G	6.0		1.1	466	SOUTH OF HONSHU, JAPAN. mb 6.5 (BRK), 6.3 (PAS). Mo=5.2*10**18 Nm (GS). Mo=5.7*10**18 Nm (HRV). Felt (II JMA) in parts of Honshu.
AUG 11	02 59 54.9	0.059 S	78.449 W	5 G	5.0	4.4	1.2	136	ECUADOR. Mo=9.4*10**16 Nm (HRV). At least 4 people killed, 10 injured, 1,300 houses damaged and landslides in the Pamosqui area. Felt strongly at Quito.
AUG 12	21 25 21.9	19.435 S	169.132 E	140 G	6.3		1.1	551	VANUATU ISLANDS. mb 6.6 (PAS). Mo=3.9*10**19 Nm (GS). Mo=4.3*10**19 Nm (HRV). Two events about 4 seconds apart. Felt on Efate, Vanuatu and on Ouvea, Loyalty Islands. Felt (III) at Noumea, New Caledonia.
AUG 17	13 07 17.4	11.164 S	161.997 E	29 G	5.9	6.8	1.4	334	SOLOMON ISLANDS. Ms 6.7 (BRK), 6.7 (PAS). Mo=1.1*10**19 Nm (GS). Mo=1.3*10**19 Nm (HRV). Mo=1.3*10**19 Nm (PPT). Felt at Honiara and Kirakira.
SEP 23	21 13 07.4	33.267 N	138.643 E	10 G	6.0	6.5	1.3	286	SOUTH OF HONSHU, JAPAN. Ms 6.3 (BRK), 5.9 (PAS). Mo=7.2*10*18 Nm (GS). Mo=7.1*10**18 Nm (HRV). Mo=6.0*10**18 Nm (PPT). Complex event. Felt (III JMA) on Hachijo-jima and Miyake-jima and in the Osaka-Owase-Yokkaichi area, Honshu. A slight tsunami was reported on Hachijo-jima and Oshima.
SEP 26	23 08 23.9	28.014 S	26.727 E	5 G	5.4	4.2	0.9	157	REPUBLIC OF SOUTH AFRICA. Mo=3.6*10**16 Nm (HRV). Two people killed and five injured in a mine in the Welkom area. Slight damage in the Welkom area.
OCT 10	05 54 53.5	23.497 S	179.029 E	549 G	6.0		0.9	483	SOUTH OF FIJI ISLANDS. mb 6.6 (PAS), 6.5 (BRK). Mo=1.3*10**18 Nm (GS). Mo=1.4*10**18 Nm (HRV).
OCT 15	01 35 44.5	2.211 S	92.249 E	32 D	5.9	6.5	1.0	432	SOUTHWEST OF SUMATERA. Ms 6.4 (PAS). Complex event. Mo=1.6*10**19 Nm (GS). Mo=1.4*10**19 Nm (HRV). Mo=4.0*10**18 Nm (PPT).
OCT 17	14 30 13.1	10.970 S	70.776 W	599 G	6.7		1.0	608	PERU-BRAZIL BORDER REGION. mb 6.8 (BRK), 6.8 (PAS). Mo=3.6*10**19 Nm (GS). Mo=3.2*10**19 Nm (HRV). Mo=3.0*10**19 Nm (PPT). Slight damage at Rio Branca, Brazil. Felt (IV) at Pucallpa, Peru and (III) at La Paz, Bolivia.
OCT 18	09 30 44.4*	26.390 S	27.349 E	5 G	4.0		1.1	6	REPUBLIC OF SOUTH AFRICA. mbLg 4.0 (BUL). ML 3.8 (PRE). At least 9 people killed, one missing and 6 injured in a mine near Carletonville. Probable rockburst.
OCT 20	08 07 27.5	37.093 N	103.781 E	12 D	5.6	5.8	1.4	268	GANSU PROVINCE, CHINA. Ma=4.7*10**17 Nm (HRV). One person killed, two injured and damage in the Tianzhu area. Felt at Lanzhou.
OCT 25	04 53 59.9	35.121 N	70.486 E	114 G	6.0		1.0	444	HINDU KUSH REGION. Mo=6.6*10**17 Nm (GS). Ma=6.3*10**18 Nm (HRV). Eleven people killed, more then 250 injured and damage in the Chitral-Mardan-Malakand area, Pakistan. Felt throughout northern and central Pakistan. Also felt in northwestern India. Felt (IV) at Ishkashim; (III) at Andizhan, Dushanbe, Dzhirgatal, Fergana, Khorog, Kulyab, Nurek and Tashkent; (II) at Samarkand, USSR.
NOV 06	18 45 52.2	28.251 N	55.462 E	11 G	6.2	6.7	1.0	558	SOUTHERN IRAN. Ms 6.7 (BRK), 6.2 (PAS). Mo=5.3*10**18 Nm (GS). Mo=8.3*10**18 Nm (HRV). Mo=1.3*10**19 Nm (PPT). At least 22 people killed, 100 injured, 21,000 homeless and 18 villages severely damaged in the Darab area.
NOV 06	20 14 29.7	53.452 N	169.871 E	25 G	6.3	7.0	0.9	561	KOMANDORSKY ISLANDS REGION. Ms 6.8 (BRK), 6.5 (PAS). Mo=4.6*10**19 Nm (GS). Mo=5.8*10**19 Nm (HRV). Mo=5.0*10**19 Nm (PPT). Two events about 1.5 seconds apart. Felt (IV) on Attu and Shemya.

DATE	ORIGIN TIME UTC HR MN SEC	GEOGRAPHIC COORDINATES LAT	LONG	DEPTH	MAGNITUDES GS MB	Msz	SD	NO. STA USED	REGION, CONTRIBUTED MAGNITUDES AND COMMENTS
1990									
NOV 15	02 34 32.4	3.908 N	97.457 E	48 D	6.0	6.8	1.1	433	NORTHERN SUMATERA. Ms 6.8 (BRK), 6.7 (PAS). Mo=8.5*10**18 Nm (GS). Mo=1.2*10**19 Nm (HRV). Mo=1.6*10**19 Nm (PPT). Complex event. At least 1 person killed, 32 injured and estimated 2.1 million U.S. dollars damage caused in the Blangkejeren-Kutacane-Medan area. Landslides occurred in the epicentral area. Felt at Banda Aceh and Lhokseumawe. Also felt at Ipah, Keland, Kuala Lumpur, Pinang and Taiping, Malaysia and Bangkok ond Phuket, Thailand.
NOV 27	04 37 58.5	43.853 N	16.633 E	24 D	5.1	5.6	1.1	381	YUGOSLAVIA. ML 5.6 (ZAG), 5.6 (KBA), 5.5 (TTG). Mo=2.6*10**17 Nm (HRV). Ten people injured and damage (VIII) in the Dinara Mountains. Felt (IV) at Titagrad, Niksic, Budva and Herceg Novi. Also felt at Belgrade. Landslides stopped rail traffic on main line between Split and central Yugoslavia. Felt (IV) at Trieste, Italy. Also felt at Pordenone and Trento, Italy.
DEC 01	18 09 28.8	40.854 N	73.553 E	29 D	5.0	4.6	0.9	165	KIRGHIZ SSR. Mo=8.3*10**16 Nm (HRV). Approximately 3,000 people homeless, 1,100 hauses and 10 schaals damaged (VI) in the Uzgen area. One hundred kilometers of roads were impaired in the epicentral area. Felt (V) at Dzhalal-Abad; (IV) at Osh and Namangan; (III) at Fergana, Andizhan and Alma-Ata; (II) at Tashkent. Also felt at Frunze.
DEC 13	00 24 25.7	37.300 N	15.438 E	11	5.5	5.3	1.4	367	SICILY. MD 5.6 (TRI), 5.3 (TTG), 5.2 (THE). Mo=3.3*10**17 Nm (HRV). Mo=4.0*10**17 Nm PPT. At least 19 people killed, abaut 200 injured, 2,500 homeless and severe damage (VII) in the Carlentini areo. Damage also occurred at Augusta, Lentini and Noto and slight damage occurred as far away as Cefalu. Felt as far west as Trapani.
DEC 13	03 01 48.0	23.916 N	121.636 E	12 D	5.9	6.2	1.2	315	TAIWAN. Mo=1.2*10**19 Nm (GS). Mo=3.2*10**18 Nm (HRV). Mo=3.0*10**18 Nm (PPT). At least 2 people killed and 3 peaple injured. Damage (IV JMA) at Hualien. Also felt (IV JMA) at Taipei, (III JMA) ot Chiai, Hsinchu and Ilan, (II JMA) at Chilung and Taitung and (I JMA) at Kaohsiung.
DEC 16	22 18 49.8	29.044 N	51.304 E	15 D	5.3	5.4	1.2	257	SOUTHERN IRAN. Mo=4.1*10**17 Nm (HRV). Sixteen people injured and some domage and landslides in the Borazjan areo.
DEC 21	06 57 42.9	41.004 N	22.300 E	13 G	5.8	5.9	1.1	423	YUGOSLAVIA. Mo=1.7*10**18 Nm (HRV). One person killed, at least 60 injured and damage in the Edhessa-Kilkis area, Greece. Several people injured and some buildings damaged (VII) in the Gevgelija-Strumica area. Felt (VII) at Begorci and Dojran; (VI) at Kavadarci and Strumica; (V) at Bitala, Stip, Berovo, Ohrid and Titov Veles; (IV) at Skopje, Gostivar, Tetovo and Kumanovo. Felt at Larisa, Greece and Korca, Pogradeci and Tirana, Albanio. Also felt at Mikhallovgrad and Plovdiv and (IV) at Sofia, Bulgaria. Felt (III) at Bucharest, Romania.
DEC 22	17 27 54.8	9.869 N	84.302 W	17	5.3	5.7	0.9	188	COSTA RICA. Ms 6.1 (BRK). Mo=1.0*10**18 Nm (HRV). One person killed at Alajuela, one person died of a heart attack and about 350 people injured in central Costa Rico. Damage (VIII) at Sontiago de Puriscal, (VII) at Alajuela and (VI) at Heredia and San Jose. Felt (VII) at Naranjo, Grecia and Alosta; (VI) at San Ramon, (V) at Cortago, Puntorenas and Poraiso, (IV) at San Isidro del General and Turrialba; (III) at La Fortuna de San Carlos, Canos and Siquirres; (II) at Sixaola, Los Chiles, Limon, Borra del Colorado, Liberia and Golfita. Felt throughout Costa Rica and in western Panama.
DEC 30	19 14 18.9	5.097 S	150.967 E	179 G	6.6		1.2	341	NEW BRITAIN REGION. Mo=2.0*10**20 Nm (GS). Mo=1.8*10**20 Nm (HRV). Mo=8.0*10**19 Nm (PPT). Twa events about 6 seconds apart. Same damage in the Hoskins area. Felt at Port Moresby and in many parts of Papua New Guinea.

EXPLANATION OF ABBREVIATIONS AND SYMBOLS APPEARING IN THIS PUBLICATION

Abbreviations in Heading

MB - Body wave magnitudes.
Msz - Vertical surface wave magnitudes.
UTC - Coordinated Universal Time. HR MN SEC - Hour, minute, second.
SD - Standard Deviation from the arithmetic mean of residuals.
No. Sta. - Number of stations reporting P or PKP phases used in computation.

Symbols and Abbreviations Used in Comments

BRK--University of California, Berkeley, CA. PAS--California Institute of Technology, Pasadena, CA.
ATH--Athens Observatory, Greece. BGS--British Geological Survey, Edinburgh, United Kingdom. BUL--Bulawoya, Zimbabwe
HDC--Universidad Nacional, Heredia, Costa Rica. KBA--Barrage Kaelnbrein, Austria.
LDG--Laboratoire de Detection et de Geophysique, France. LJU--Seizmoloski Zavod, Slavenija, Ljubljana, Yugoslavia.
PMR--Alaska Tsunami Warning Center, Palmer, Alaska. PRE--Geological Survey of South Africa, Pretoria, South Africa.
SJR--Universidad de Costa Rica, San Jose, Costa Rica. STR--Institute de Physique du Globe, Strasbourg, France.
THE--University of Thessaloniki, Greece. TRI--Osservatorio Geofisico Sperimentale, Trieste, Italy.
TTG--Seismological Institute of Montenegro, Titograd, Yugoslavia. UPA--Universidad de Panama, Panama.
WEL--Department of Scientific and Industrial Research, Wellington, New Zealand. ZAG--University of Zagreb, Yugoslavia.

GM U.S. Geological Survey, Menlo Park, California.
GS U.S. Geological Survey, National Earthquake Information Service (NEIS), Golden, Colorado.
HRV Harvard University, Cambridge, Massachusetts
PPT Laboratoire de Geophysique, Papeete, French Polynesia
JMA Japan Meteorological Agency, Tokyo (also used to indicate 7-point Japanese Intensity Scale).
MD Duration Magnitude.
RF Rossi-Forel Intensity Scale.
SPEC An NEIS solution based on use of dense local networks, a local crustal model, or other methods not routinely applied in calculating the hypocenter parameters.
Roman Numerals Used to indicate intensity (when not followed by RF or JMA they refer to the Modified Mercalli Scale or any 12-point intensity scale closely related to it).

Symbols Following Depth

N Indicates the depth was restrained at 33 km for earthquakes whose character on seismograms indicates a shallow focus but whose depth is not satisfactorily determined by the data.

D Indicates the depth was restrained by the computer program based on 2 or more compatible pP phases and/or unidentified secondary arrivals used as pP.

G Indicates the depth was restrained by a geophysicist. Some depths are from broadband displacement seismograms.

* Indicates a less well-constrained free depth. The 90% marginal confidence interval on depth is greater than 8.5 km and less than or equal to 16.0 km.

The lack of any symbol indicates that the 90% marginal confidence interval on depth is less than or equal to 8.5 km, or that a contributed hypocenter was computed with a free depth, regardless of the size of the confidence interval.

Symbols Following Origin Time

& Indicates that parameters of the hypocenter were supplied or determined by a computational procedure not normally used by the National Earthquake Information Service (NEIS). The source or nature of the determination is indicated by a 2 to 5 letter code enclosed by angle brackets and appearing in the first line of comments. These codes are included with the list of abbreviations above.

* Indicates a less reliable solution. In general, the geometric mean of the semi-major and semi-minor axes of the horizontal 90% confidence ellipse is greater than 8.5 km and less than or equal to 16.0 km.

? Indicates a poor solution, published for completeness of the catalog. In general, the geometric mean of the semi-major and semi-minor axes of the horizontal 90% confidence ellipse is greater than 16.0 km. This includes a poor solution computed using data reported by a single network.

The lack of any symbol indicates that the geometric mean of the semi-major and semi-minor axes of the horizontal 90% confidence ellipse is less than or equal to 8.5 km.

APPROXIMATE CORRELATION OF GRADES FOR INTENSITY SCALES REPORTED IN THIS PUBLICATION

Modified Mercalli 1931	Japanese, 1950 (JMA)	Rossi-Forel, 1873 (RF)
I	0	I
II	I	I-II
III	II	III
IV	II-III	IV-V
V	III	V-VI
VI	IV	VI-VII
VII	IV-V	VIII-
VIII	V	VIII+-IX
IX	V-VI	IX+
X	VI	X
XI	VII	X
XII	VII	X

TRAVEL-TIME TABLES

In general, all hypocenters have been computed based on the 1940 Jeffreys-Bullen P and 1968 Bolt PKP travel-time tables. Some other earth model or computational procedure may have been used for those hypocenters which have been indicated by an ampersand (&) following the origin time.

MACROSEISMIC INFORMATION

Macroseismic information is compiled from various sources, including newspaper articles, Foreign Broadcast Information Service messages, U.S. Geological Survey Earthquake Reports and seismological station reports. Sources of information for particular events can be supplied on request from: U.S. Geological Survey, National Earthquake Information Center, Stop 967, Box 25046, Denver Federal Center, Denver, CO 80225, U.S.A.

GEOGRAPHIC REGIONS

The regions shown in the comments column are from the seismic and geographical regionalization of Flinn, Engdahl and Hill (1974), with occasional name changes which have been given in various issues of the Preliminary Determination of Epicenters Monthly Listing. The boundaries of these regions are defined at one degree intervals and differ slightly from irregular political boundaries.

NEIS MAGNITUDES

All magnitudes are NEIS magnitudes unless otherwise indicated. Average magnitudes are computed by a 25% trimmed mean as described by Rosenberger, J. L. and Gasko, M., 1983, "Comparing location estimators: trimmed means, medians, and trimean" in Understanding Robust and Exploratory Data Analysis, ed. Hoaglin, D.C., Mosteller, F., and Tukey, J. W., John Wiley, New York.

Ms These surface wave magnitudes are computed from the I.A.S.P.E.I. formula:

$$Ms = \text{Log}\ (A/T) + 1.66\ \text{Log}\ D + 3.3$$

where:

A is the maximum ground amplitude in micrometers (microns) of the vertical component of the surface wave within the period range $18 \leq T \leq 22$.

T is the period in seconds.

D is the distance in geocentric degrees (station to epicenter) and $20^\circ \leq D \leq 160^\circ$.

No depth corrections are applied, and Ms magnitudes are not generally computed for depths greater than 50 km. The Ms value published is the average of the individual station magnitudes from reported T and A data.

If the uncertainty of the computed depth is considered great enough that the depth could be less than 50 km, an MS value may still be published, computed by the I.A.S.P.E.I. formula and not corrected for depth.

In general, the Ms magnitude is more reliable than the MB magnitude as a means of yielding the relative "size" of a shallow-focus earthquake.

MB These compressional body wave (P-wave) magnitudes are computed according to the formula:

$$MB = \text{Log}\ (A/T) + Q(D,h)$$

defined by Gutenberg and Richter (1956) except that T, the period in seconds, is restricted to $0.1 \leq T \leq 3.0$ and A, the ground amplitude in micrometers, is not necessarily the maximum in the P group. Q is a function of of distance (D) and depth (h) where $D \geq 5^\circ$.

mbLg These Lg body wave magnitudes are computed according to the formula:

$$mbLg = 3.75 + 0.90\ \text{Log}\ D + \text{Log}\ (A/T) \text{ for } 0.5^\circ \leq D \leq 4^\circ$$

$$mbLg = 3.30 + 1.66\ \text{Log}\ D + \text{Log}\ (A/T) \text{ for } 4^\circ \leq D \leq 30^\circ$$

as proposed by Nuttli (1973) where A is the ground amplitude in micrometers and T is the period in seconds calculated from the vertical component 1-second Lg waves. D is the distance in geocentric degrees.

ML These local magnitudes are computed according to the formula:

$$ML = \text{Log}\ A - \text{Log}\ Ao$$

defined by Richter (1935) where A is the maximum trace amplitude in micrometers recorded on a standard short-period torsion seismometer and Log Ao is a standard value as a function of distance where distance $\leq$ 600 km.

CONTRIBUTED MAGNITUDES

Magnitudes appearing in the comments which have been contributed by organizations operating a network of stations may have been calculated from any one station in the network or may be an average magnitude from a number of stations from the network.

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