EarthQuake Catalog (.eqc) file format

by Peter Bird, UCLA, 2004.01.22

EarthQuake Catalog ("___.eqc") files contain only ASCII characters (A-Z, a-z, 0-9, '+', '-', '.', ':', ' ') and each line is terminated with CR and LF bytes, according to the DOS/Windows tradition.

Each line of the file is a separate seismic event. Typically, they are listed in time-order, but this is not required. Because .eqc files have no header or trailer lines, they are easy to combine, split, or sort. Here is a short 26-line .eqc file of some famous great, shallow earthquakes since 1960:

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PachecoSy 1960.05.21 10:02:00.0  -72.960 -37.170   0  8.17                    t
PachecoSy 1960.05.22 18:52:00.0  -73.340 -38.050  32  9.49                    t
PachecoSy 1960.05.22 19:11:00.0  -73.500 -38.200  32  9.64                    t
PachecoSy 1963.10.13 05:17:00.0  149.600  44.900  40  8.55                    t
PachecoSy 1964.03.28 03:36:00.0 -147.600  61.100  30  9.22                    t
PachecoSy 1965.01.24 00:11:00.0  126.000  -2.400  23  8.22                    t
PachecoSy 1965.02.04 05:01:00.0  178.600  51.300  35  8.73                    t
PachecoSy 1966.10.17 21:41:00.0  -78.790 -10.920  21  8.17                    t
PachecoSy 1968.05.16 00:48:00.0  143.400  40.900  35  8.26                    t
PachecoSy 1969.08.11 21:27:00.0  147.200  43.600  30  8.19                    t
PachecoSy 1971.07.14 06:11:00.0  153.900  -5.500  53  8.02                    t
PachecoSy 1971.07.26 01:23:00.0  153.200  -4.900  48  8.14                    t
PachecoSy 1972.12.02 00:19:00.0  126.600   6.470  33  8.02                    t
PachecoSy 1974.10.03 14:21:00.0  -77.660 -12.390  27  8.08                    t
PachecoSy 1976.08.16 16:11:00.0  124.020   6.260  33  8.15                    t
PachecoSy 1977.08.19 06:08:00.0  118.460 -11.090  23  8.22                    n
PachecoSy 1979.12.12 07:59:00.0  -79.360   1.600  24  8.27                    t
PachecoSy 1985.03.03 22:47:00.0  -71.870 -33.130  44  8.01                    t
PachecoSy 1986.05.07 22:47:00.0 -175.440  51.330  31  8.07                    t
PachecoSy 1989.05.23 10:54:00.0  160.570 -52.340  50  8.22                    s
Harv. CMT 1977.06.22 12:09:22.1 -174.910 -22.860  61  8.06 56 107  1  17 34 286
Harv. CMT 1977.08.19 06:09:33.1  118.230 -11.140  23  8.34 67 317  7  64 21 157
Harv. CMT 1979.12.12 08:00:07.0  -78.810   2.320  20  8.12 31 278  7 183 58  81
Harv. CMT 1989.05.23 10:55:12.2  160.410 -52.150  15  8.06  8 259 67 151 21 352
Harv. CMT 1994.10.04 13:23:28.5  147.630  43.600  68  8.28 20 112 37 218 46 359
Harv. CMT 1995.07.30 05:11:56.9  -70.740 -24.170  29  8.02 23 267  1 357 67  90
Harv. CMT 1995.10.09 15:36:28.8 -104.800  19.340  15  8.01 36 211  0 120 54  30
Harv. CMT 1996.02.17 06:00:02.8  136.620  -0.670  15  8.22 35  31  4 124 55 220
Harv. CMT 1998. 3.25 03:13:02.5  148.640 -62.990  29  8.12  7  54 72 300 16 146
Harv. CMT 2000.11.16 04:55:36.5  152.790  -4.560  24  8.03 29 292 43  54 33 181
Harv. CMT 2001.06.23 20:34:23.3  -72.710 -17.280  30  8.41 29 242  8 336 60  80
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The format within each line is easy to guess, but in the table below I spell everything out explicitly. Note that the first 58 bytes of each line have identical entries rigidly aligned in set columns, so this part is a "flat-file database" format. However, variations are allowed following the magnitude, and some entries will show focal mechanism or other auxiliary information.

	Bytes	Width	FORMAT	CONTENTS
Source	1-9	9	A9	text identifying the **source** catalog
Origin Time	10-14	5	I5	**year**; - sign indicates B.C. (or B.C.E.); + sign or omitted sign in first byte indicates A.D. (or C.E.). The year is right-justified; if there are less than 4 digits in the year number, leading spaces or zeros should be included.
	15	1	'.'	(period)
	16-17	2	I2	**month**, according to 1 = January, 2 = February, *etc.* Single-digit months may have a leading zero, or may have a leading space, but they must be right-justified.
	18	1	'.'	(period)
	19-20	2	I2	**day**. Single-digit days may have a leading zero, or may have a leading space, but they must be right-justified.
	21	1	1X	(space)
	22-23	2	I2	**hour**, in military/railroad style (0-23). Greenwich Mean Time. Single-digit hours may have a leading zero, or may have a leading space, but they must be right-justified.
	24	1	':'	(colon)
	25-26	2	I2	**minute** (0-59). Single-digit minutes may have a leading zero, or may have a leading space, but they must be right-justified.
	27	1	':'	(colon)
	28-31	4	F4.1	**seconds**, to nearest 0.1 s. Note that when the source is "Harv. CMT" this will refer to the centroid time; for most other catalogs it refers to the beginning of the event. Single-digit number of whole seconds may be written with a leading zero, or with a leading space, but they must be right-justified.
	32	1	1X	(space)
Location	33-40	8	F8.3	**longitude**, in degrees, to the nearest 0.001°. For Harvard CMT, this refers to the centroid; for most other catalogs it refers to the epicenter and hypocenter. Negative sign indicates West of Greenwich meridian; positive (or omitted) sign indicates East. Values exceeding ±180.000 are allowed, but values exceeding ±360.000 are not. Longitudes with fewer than 3 digits for the number of whole degrees may have leading zeros or spaces, but the number must be right-justified.
	41	1	1X	(space)
	42-48	7	F7.3	**latitude**, in degrees, to the nearest 0.001°. For Harvard CMT, this refers to the centroid; for most other catalogs it refers to the epicenter and hypocenter. Negative sign indicates South of equator; positive (or omitted) sign indicates North. Values exceeding ±90.000 are not allowed. Latitudes with fewer than 2 digits for the number of whole degrees may have leading zeros or spaces, but the number must be right-justified.
	49	1	1X	(space)

	50-52	3	I3	**depth**, in km. Negative values are not recommended! For Harvard CMT this is the centroid depth; for most other catalogs it is the hypocenter depth. Reference spheroid depends on source catalog; for Harvard CMT it is the sea-level spheroid of the PREM Earth model.
	53	1	1X	(space)
Magnitude	54-58	5	F5.2	**magnitude**. Note that format allows for values exceeding 10! The preferred magnitude type is moment-magnitude $\boldsymbol{m}$ or $\boldsymbol{m}_{\mathbf{w}}$ defined by *Hanks and Kanamori* [1979]: $\boldsymbol{m} = (2/3)(\log_{10} \boldsymbol{M} - 9.05)$ where $\boldsymbol{M}$ is the scalar seismic moment in N m (SI units), or: $\boldsymbol{m} = (2/3)(\log_{10} \boldsymbol{M} - 9.05 - 7)$ when M is the scalar seismic moment in dyne cm (cgs units). Other magnitude scales may be used in other source catalogs. *Mixing of magnitude types within one .eqc file is a bad idea!*

If available, information on the focal mechanism follows the magnitude. Pacheco and Sykes [1992] provide only one-letter codes for general mechanism type, according to: u = unknown, t = thrust, r = reverse, c = outer arc compression, n = normal, s = strike-slip, ts = oblique thrust, rs = oblique reverse, ns = oblique normal. When used, one of these codes is placed in columns 78-79, so add "19X, A2" to the Fortran FORMAT listed above. When the code is a single letter, it is placed in column 79 (right-justified, like all other fields).

The preferred focal-mechanism format is one that describes the principal axes of the moment tensor:

Orientation of Focal Mechanism	59	1	1X	(space)
	60-61	2	I2	plunge of most-compressive principal axis (P-axis), in degrees below horizontal. Must be in range of (0-90).
	62	1	1X	(space)
	63-65	3	I3	azimuth of most-compressive principal axis (P-axis), in degrees clockwise from North. Must be in range (0-360).
	66	1	1X	(space)
	67-68	2	I2	plunge of intermediate principal axis (B-axis), in degrees below horizontal. Must be in range of (0-90).
	69	1	1X	(space)
	70-72	3	I3	azimuth of intermediate principal axis (B-axis), in degrees clockwise from North. Must be in range (0-360).
	73	1	1X	(space)
	74-75	2	I2	plunge of most-extensional principal axis (T-axis), in degrees below horizontal. Must be in range of (0-90).
	76	1	1X	(space)
	77-79	3	I3	azimuth of most-extensional principal axis (T-axis), in degrees clockwise from North. Must be in range (0-360).

The subcatalog files is this folder ("**subcatalogs**") include additional information on the plate boundary class and step assignment for each event:

	Bytes	Width	FORMAT	CONTENTS
Plate Boundary Class and Step Assignment	80	1	1X	(space)
	81	1	A1	'*' appears if this centroid/epicenter falls within any of the 13 orogen regions defined in the PB2002 model of *Bird* [2003]
	82-84	3	A3	The class to which this earthquake is assigned appears with one of the following codes: CCB, CTF, CRB, OSR, OTF, OCB, SUB, or INT. See *Bird* [2003] for definitions.
	85	1	A1	'*' appears if the center of the plate boundary step associated with this earthquakes (see below) falls within any of the 13 orogen regions defined in the PB2002 model of *Bird* [2003]
	86	1	1X	(space)
	87-91	5	I5	integer number (right-justified) identifying the associated plate boundary step, according to the numbering in file PB2002_steps.dat provided as part of the PB2002 model by *Bird* [2003]
	92-119	28	7(1X,I3)	Summed (over all plate boundary steps) relative probabilities for association with each of the 7 plate boundary classes are expressed as % of total relative probability (rounded to the nearest integer) and listed in the following order: CCB, CTF, CRB, OSR, OTF, OCB, SUB Normally these 7 integers will sum to 100%. If all numbers are 0, then this event is INT (intraplate). Note that in "**Monte Carlo**" subcatalog sets, these numbers were used (together with a random number generator) to assign the earthquake to one of the 7 boundary classes with a non-zero relative probability. (As you will see, the earthquake is not always associated with the most probable class.) Note that in "**maximum probability**" subcatalog sets, these 7 integers were not used for classification. Instead, the earthquake was assigned to the plate boundary step with the highest relative probability, regardless of the summed relative probabilities for the different step classes.
	120-127	8	F8.1	Distance of the epicenter (or surface point above the centroid) from the nearest plate boundary step (of the class to which the earthquake was assigned), in km.