

Updating the Global CMT Earthquake Focal Mechanism Portal content

This work flow was last updated on 2018-01-31.

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1) Types of CMT solutions

There are two types of CMT solutions: Final solutions generated 3-4 months after an event and preliminary ("Quick CMT") solutions generated within a day of an event. The preliminary solutions are subject to change. The portal contains only final solutions.

2) Files containing final solutions

Final solutions are available from two sources:

- a) IRIS SPUD
- b) Global CMT web page/Lamont

a) IRIS SPUD

The catalogue interface is at: <http://ds.iris.edu/spud/momenttensor>

The default catalogue provides all CMT solutions: pre-1976 CMTs, final CMTs for 1976-2013, final monthly CMTs since then, and preliminary "Quick CMTs" for the most recent events.

In order to apparently download just the final CMT solutions from IRIS SPUD, apply time window filters. Use a start date filter of 1st Jan 1976 and an end date filter that corresponds to the most recent event in the most recent NEW_MONTHLY file

(see Lamont section below).

The IRIS SPUD download takes a long time (about an hour or longer). The file is a standard ASCII "ndk" format with five 80-character lines per earthquake.

But, it's not obvious that the resultant downloaded file contains only final solutions since the events appear to be somewhat randomly ordered. We would need to carefully sort the records and do a comparison with the "official" files from Lamont to make a determination.

b) Global CMT web page/Lamont

The Global CMT web page (<http://www.globalcmt.org/>) provides the following:

- Final solutions for the period 1976-2013 are available here:
<http://www.globalcmt.org/CMTfiles.html> (click on the "all events 1976-2013" link).
- Monthly compilations of final solutions for months since 2013 are available here:
http://www.ldeo.columbia.edu/~gcmt/projects/CMT/catalog/NEW_MONTHLY/

Since these are the official final solutions and since there's a question as to whether or not the IRIS download produces the same events, we'll for now use the Lamont files obtained from the URL above. We check which files we already have, then right-click on each new monthly final solutions file to save it locally before transferring the new files over to machine seafloor to directory described below.

3) Generate updated catalogue

An updated catalogue will be created by taking the final solutions for 1976-2013 and appending the final solutions for each month since then. For efficiency, We'll create files for each year for which we have monthly data.

Each time the catalogue is to be updated, look in the most recent year to find the most recent month for which final solutions are available.

```
seafloor% pwd
/home/mgds/ingest/Global_CMT_catalog/CMT_files
```

a1) Main file

```
seafloor% ll 1976_2013
```

```
total 16044
```

```
-rw-rw-r-- 1 andrewg mgds 16408170 Jun  5 11:35 jan76_dec13.ndk
```

a2) Year 2014

```
seafloor% pwd
```

```
/home/mgds/ingest/Global_CMT_catalog/CMT_files/2014
```

```
seafloor% ll
```

```
total 2024
```

```
-rw-rw-r-- 1 andrewg mgds  95985 Jun  5 11:41 apr14.ndk
```

```
-rw-rw-r-- 1 andrewg mgds  74925 Jun  5 11:41 aug14.ndk
```

```
-rw-rw-r-- 1 andrewg mgds  80595 Jun  5 11:41 dec14.ndk
```

```
-rw-rw-r-- 1 andrewg mgds  63990 Jun  5 11:40 feb14.ndk
```

```
-rw-rw-r-- 1 andrewg mgds  71685 Jun  5 11:40 jan14.ndk
```

```
-rw-rw-r-- 1 andrewg mgds  78975 Jun  5 11:41 jul14.ndk
```

```
-rw-rw-r-- 1 andrewg mgds  70470 Jun  5 11:41 jun14.ndk
```

```
-rw-rw-r-- 1 andrewg mgds  85860 Jun  5 11:41 mar14.ndk
```

```
-rw-rw-r-- 1 andrewg mgds  91125 Jun  5 11:41 may14.ndk
```

```
-rw-rw-r-- 1 andrewg mgds 100845 Jun  5 11:41 nov14.ndk
```

```
-rw-rw-r-- 1 andrewg mgds 101655 Jun  5 11:41 oct14.ndk
```

```
-rw-rw-r-- 1 andrewg mgds  81405 Jun  5 11:41 sep14.ndk
```

```
seafloor% cat jan14.ndk feb14.ndk mar14.ndk apr14.ndk may14.ndk jun14.ndk jul14.ndk aug14.ndk
```

```
sep14.ndk oct14.ndk nov14.ndk dec14.ndk > 2014_all.ndk
```

```
seafloor% ll 2014*all*
```

```
-rw-rw-r-- 1 andrewg mgds 997515 Jun  5 12:48 2014_all.ndk
```

a3) Year 2015

```
seafloor% pwd
```

```
/home/mgds/ingest/Global_CMT_catalog/CMT_files/2015
```

```
seafloor% ll
```

```
total 2460
```

```
-rw-rw-r-- 1 andrewg andrewg  63180 Aug 17 2015 apr15.ndk
```

```
-rw-rw-r-- 1 andrewg mgds    68850 Mar  2 11:17 aug15.ndk
```

```
-rw-rw-r-- 1 andrewg mgds    66825 May 27 14:51 dec15.ndk
```

```
-rw-rw-r-- 1 andrewg andrewg  76545 Aug 17 2015 feb15.ndk
```

```
-rw-rw-r-- 1 andrewg mgds 85050 Jun 5 2015 jan15.ndk
-rw-rw-r-- 1 andrewg mgds 77760 Mar 2 11:17 jul15.ndk
-rw-rw-r-- 1 andrewg mgds 65610 Nov 11 2015 jun15.ndk
-rw-rw-r-- 1 andrewg andrewg 66825 Aug 17 2015 mar15.ndk
-rw-rw-r-- 1 andrewg mgds 80595 Nov 11 2015 may15.ndk
-rw-rw-r-- 1 andrewg mgds 76140 May 27 14:51 nov15.ndk
-rw-rw-r-- 1 andrewg mgds 59130 Mar 2 11:18 oct15.ndk
-rw-rw-r-- 1 andrewg mgds 93150 Mar 2 11:18 sep15.ndk
```

```
seafloor% cat jan15.ndk feb15.ndk mar15.ndk apr15.ndk may15.ndk jun15.ndk jul15.ndk aug15.ndk
sep15.ndk oct15.ndk nov15.ndk dec15.ndk > 2015_all.ndk
seafloor% ll 2015*all*
-rw-rw-r-- 1 andrewg mgds 879660 May 27 14:50 2015_all.ndk
```

a4) Year 2016

```
seafloor% pwd
/home/mgds/ingest/Global_CMT_catalog/CMT_files/2016
```

```
seafloor% ll
-rw-rw-r-- 1 andrewg mgds 83025 Oct 7 2016 apr16.ndk
-rw-rw-r-- 1 andrewg mgds 75735 Feb 6 16:56 aug16.ndk
-rw-rw-r-- 1 andrewg mgds 89910 Jun 13 2017 dec16.ndk
-rw-rw-r-- 1 andrewg mgds 62775 Oct 7 2016 feb16.ndk
-rw-rw-r-- 1 andrewg mgds 68850 May 27 2016 jan16.ndk
-rw-rw-r-- 1 andrewg mgds 74925 Feb 6 16:56 jul16.ndk
-rw-rw-r-- 1 andrewg mgds 81000 Feb 6 16:56 jun16.ndk
-rw-rw-r-- 1 andrewg mgds 61155 Oct 7 2016 mar16.ndk
-rw-rw-r-- 1 andrewg mgds 76140 Oct 7 2016 may16.ndk
-rw-rw-r-- 1 andrewg mgds 73710 Jun 13 2017 nov16.ndk
-rw-rw-r-- 1 andrewg mgds 69660 Jun 13 2017 oct16.ndk
-rw-rw-r-- 1 andrewg mgds 89910 Feb 6 16:56 sep16.ndk
```

```
seafloor% cat jan16.ndk feb16.ndk mar16.ndk apr16.ndk may16.ndk jun16.ndk jul16.ndk aug16.ndk
sep16.ndk oct16.ndk nov16.ndk dec16.ndk > 2016_all.ndk
seafloor% ll 2016*all*
-rw-rw-r-- 1 andrewg mgds 906795 Jun 13 15:41 2016_all.ndk
```

a5) Year 2017

Currently, final solutions for only the first few months of 2017 are available. As more files are released, re-run the the following whole-year cat command to include them (a warning for any non-existent files will pop up).

```
seafloor% pwd
/home/mgds/ingest/Global_CMT_catalog/CMT_files/2017
```

```
seafloor% ll
-rw-rw-r-- 1 andrewg mgds 422010 Oct 25 13:54 2017_all.ndk
-rw-rw-r-- 1 andrewg mgds 74115 Oct 25 13:50 apr17.ndk
-rw-rw-r-- 1 andrewg mgds 68445 Jan 31 14:57 aug17.ndk
-rw-rw-r-- 1 andrewg mgds 61560 Jun 13 2017 feb17.ndk
-rw-rw-r-- 1 andrewg mgds 70470 Jun 13 2017 jan17.ndk
-rw-rw-r-- 1 andrewg mgds 59130 Jan 31 14:57 jul17.ndk
-rw-rw-r-- 1 andrewg mgds 65610 Oct 25 13:52 jun17.ndk
-rw-rw-r-- 1 andrewg mgds 76140 Oct 25 13:50 mar17.ndk
-rw-rw-r-- 1 andrewg mgds 74115 Oct 25 13:50 may17.ndk
-rw-rw-r-- 1 andrewg mgds 77760 Jan 31 14:57 sep17.ndk
```

```
seafloor% cat jan17.ndk feb17.ndk mar17.ndk apr17.ndk may17.ndk jun17.ndk jul17.ndk aug17.ndk
sep17.ndk oct17.ndk nov17.ndk dec17.ndk > 2017_all.ndk
seafloor% ll 2017*all*
-rw-rw-r-- 1 andrewg mgds 627345 Jan 31 14:59 2017_all.ndk
```

Nothing for 2018 yet but it will follow the same type of approach as for year 2017.

b) Combine the yearly files

Here, we create a combined file and give it a name that contains the most recent year/month to allow us to easily see what it contains. So, each time we create the new combined file, ensure that the combined file name is updated to match the contents.

```
seafloor% pwd
/home/mgds/ingest/Global_CMT_catalog/CMT_files
```

```
seafloor% ll
total 16
drwxrwsr-x 2 andrewg mgds 4096 Jun 5 12:38 1976_2013
drwxrwsr-x 2 andrewg mgds 4096 Jun 5 12:48 2014
drwxrwsr-x 2 andrewg mgds 4096 May 27 14:50 2015
```

```
drwxrwsr-x 2 andrewg mgds 4096 May 27 14:55 2016
drwxrwsr-x 2 andrewg mgds 4096 Jun  5 13:16 combined
```

```
seafloor% cat 1976_2013/jan76_dec13.ndk 2014/2014_all.ndk 2015/2015_all.ndk 2016/2016_all.ndk
2017/2017_all.ndk > combined/1976_2017sep.ndk
```

```
seafloor% ll combined/1976_2017*.ndk
-rw-rw-r-- 1 andrewg mgds 19819485 Jan 31 15:00 1976_2017sep.ndk
```

```
seafloor% wc -l combined/1976_2017*.ndk
238570 combined/1976_2017feb.ndk
242150 combined/1976_2017jun.ndk
244685 combined/1976_2017sep.ndk
```

4) Format of catalogue is ndk

The catalogue created above is in the ASCII "ndk" format:

http://www.ldeo.columbia.edu/~gcmt/projects/CMT/catalog/allorder.ndk_explained

It contains five 80-character lines per earthquake. Example:

```
seafloor% tail jan76_dec13.ndk
PDEW 2013/12/31 21:32:01.6 19.12 120.18 10.0 0.0 5.2 PHILIPPINE ISLANDS REGIO
C201312312132A B: 26 30 40 S:103 142 50 M: 0 0 0 CMT: 1 TRIHD: 0.7
CENTROID: 2.0 0.3 19.09 0.02 120.25 0.03 12.0 0.0 FIX S-20140405215021
23 -2.210 0.090 2.150 0.069 0.055 0.093 -0.630 0.289 0.328 0.372 1.170 0.069
V10 2.713 5 157 -0.310 16 248 -2.408 73 49 2.561 230 42 -114 81 52 -70
PDEW 2013/12/31 23:41:47.4 19.17 120.08 10.3 0.0 5.2 PHILIPPINE ISLANDS REGIO
C201312312341A B: 95 148 40 S:134 243 50 M: 0 0 0 CMT: 1 TRIHD: 1.0
CENTROID: 1.5 0.1 19.14 0.01 120.20 0.01 12.0 0.0 FIX S-20140405225441
24 -0.825 0.012 0.706 0.011 0.119 0.012 0.159 0.033 0.145 0.038 0.335 0.010
V10 0.882 7 335 -0.028 4 245 -0.855 82 122 0.869 70 38 -83 241 52 -96
seafloor%
```

5) Convert to 1-line format required by GMA

The original ndk-to-one-line format conversion script, "earthquake_parser.php", sits

in the GMA directory space, and is in PHP, and may have contained errors. In 2013, Ben Holtzman's intern Rachel Marincola updated the script, and re-wrote it to be in Python. (Rachel did not know how to program in PHP). But, that script contained errors.

Ben corrected the errors in the Python script, in Nov 2013, which is the last time the script was used to generate a CMT file for GMA. Samantha had written a work flow on the IEDA wiki

(<http://wiki.iedadata.org/display/~samantha/2015/04/30/GeoMapApp+CMT+Portal+Update>) but that work flow needs clarifications and some expansion so that anyone can update the CMT catalogue. Samantha's text contained a link to the script which was not stored on our servers - the script had to be downloaded from the wiki page and run locally.

The contents of Samantha's work flow are contained and amended in this document, and the script has been copied onto the server.

The Python script required `"/usr/bin/pythonw"` which appears to be a GUI version of Python that we do not have. So, the first line of the script was modified by Andrew, in June 2015, to look for the regular command-line `"/usr/bin/python"`. The script was also modified by Andrew as follows:

- to round Mw values to 1 decimal place (an unexplained step in the original work flow);
- to capture the full 16 characters used for event IDs (the script looked only for pre-2005 8-character strings);
- to disable the unnecessary stdout output to the screen;
- and, was commented to note that the name of the "Hypocenter reference catalogue" uses a 4-character code for post-2005 events. (The new codes have the form as "PDEW" whereas the script looks for the older three-letter codes such as "PDE", "ISC", "SWE". However, since the reference catalogue code is not output for the GMA portal, that error can be ignored for now).
- (The original Python script is stored as a .orig file for completeness.)

```
seafloor% pwd
/home/mgds/ingest/Global_CMT_catalog/
```

```
seafloor% ll
total 12
drwxrwsr-x 6 andrewg mgds 4096 Jun  5 12:47 CMT_files
-rw-rw-r-- 1 andrewg mgds  3926 Aug 18 13:28 earthquake_parser.py
-rwxr-xr-x 1 andrewg mgds 2850 Jun  1 11:30 earthquake_parser.py.orig
-rw-rw-r-- 1 andrewg mgds  478 Aug 18 13:58 README.txt
```

The script is currently hard-coded to write its output to a generically-named file

called "parsed_CMT_final_solutions.txt". After the script is run, we can rename that file to indicate the date range of the final solutions contained within it.

The script takes as input just one argument - the name of the file of final solutions created in step 3 above. Its output is the generically-named file called "parsed_CMT_final_solutions.txt"

Check the input file:

```
seafloor% pwd
/home/mgds/ingest/Global_CMT_catalog
```

```
seafloor% wc -l CMT_files/combined/1976_2017sep.ndk
244685 combined/1976_2017sep.ndk
```

So, the script output should be that number, divided by 5 since we are collapsing 5 rows into 1 for each earthquake, plus one line for the header.

Run the script, after making a copy of the previous output file:

```
seafloor% pwd
/home/mgds/ingest/Global_CMT_catalog
```

```
seafloor% mv parsed_CMT_final_solutions.txt parsed_CMT_final_solutions.txt.old
```

```
seafloor% ./earthquake_parser.py CMT_files/combined/1976_2017sep.ndk
```

```
seafloor% ll
drwxrwsr-x 8 andrewg mgds  4096 Jun 13  2017 CMT_files
-rwxrwxr-x 1 andrewg mgds  3991 Aug 18  2015 earthquake_parser.py
-rwxr-xr-x 1 andrewg mgds  2850 Jun  1  2015 earthquake_parser.py.orig
-rw-rw-r-- 1 andrewg mgds 5040641 Jan 31 15:04 parsed_CMT_final_solutions.txt
-rw-rw-r-- 1 andrewg mgds 4988420 Oct 25 14:00 parsed_CMT_final_solutions.txt.old
```

The new file should contain more records than the previously-used file.

```
seafloor% wc -l parsed_CMT_final_solutions.txt parsed_CMT_final_solutions.txt.old
48938 parsed_CMT_final_solutions.txt
48431 parsed_CMT_final_solutions.txt.old
```



```
seafloor% head -3 parsed_CMT_final_solutions.txt
```

ID	date	time	latitude	longitude	depth_km	mb	ms	mw	1st_np_strike	1st_np_dip	1st_np_rake	2nd_np_strike	second_np_dip	second_np_rake
M010176A	1976/01/01	01:29:39.6	-29.25	-176.96	47.8	6.2	0.0	7.3	202	30	93	18	60	88
C010576A	1976/01/05	02:31:36.3	-13.42	-75.14	85.4	6.0	0.0	5.7	350	28	-60	137	66	-105

```
seafloor% tail -3 parsed_CMT_final_solutions.txt
```

C201709301919A	2017/09/30	19:19:04.0	-4.87	68.24	23.0	0.0	4.8	4.8	143	40	-	61	287	56	-112
C201709302014A	2017/09/30	20:14:47.2	21.36	143.85	12.0	0.0	4.7	4.9	275	34	-107	114	58	-79	
C201709302315A	2017/09/30	23:15:29.4	4.11	128.49	18.8	0.0	5.6	5.6	155	39	-72	312	54	-104	

6) Copy the file to the GMA location

The GMA CMT portal does --NOT-- use the gma_menu/portals_menu.xml file to point to the location of the portal input file. Instead, as explained in more detail in the next section, it looks in the following paths file:

/turf/geoinformatics/web/app.geomapapp.org/htdocs/gma_paths/GMA_paths.xml

First, make a local duplicate of the CMT solutions file just created so that it has a more useful file name that includes the date range:

```
seafloor% pwd
```

```
/home/mgds/ingest/Global_CMT_catalog
```

```
seafloor% cp -p parsed_CMT_final_solutions.txt parsed_CMT_final_solutions_1976Jan_2017sep.txt
```

```
seafloor% ll
```

```
total 19608
```

```
drwxrwsr-x 8 andrewg mgds 4096 Jun 13 2017 CMT_files
```

```
-rwxrwxr-x 1 andrewg mgds 3991 Aug 18 2015 earthquake_parser.py
```

```
-rwxr-xr-x 1 andrewg mgds 2850 Jun 1 2015 earthquake_parser.py.orig
```

```
-rw-rw-r-- 1 andrewg mgds 4988420 Oct 25 14:00 parsed_CMT_final_solutions_1976Jan_2017jun.txt
```

```
-rw-rw-r-- 1 andrewg mgds 5040641 Jan 31 15:04 parsed_CMT_final_solutions_1976Jan_2017sep.txt
-rw-rw-r-- 1 andrewg mgds 5040641 Jan 31 15:04 parsed_CMT_final_solutions.txt
-rw-rw-r-- 1 andrewg mgds 4988420 Oct 25 14:00 parsed_CMT_final_solutions.txt.old
-rw-rw-r-- 1 andrewg mgds 478 Aug 18 2015 README.txt
```

Then, copy the generically-named file to the GMA directory:

```
seafloor% cp -p parsed_CMT_final_solutions.txt
/public/mgg/web/app.geomapapp.org/htdocs/data/portals/eq_fms_cmt/beachball_plot
```

```
seafloor% cd /public/mgg/web/app.geomapapp.org/htdocs/data/portals/eq_fms_cmt/beachball_plot
```

```
seafloor% ll
total 12080
-rw-rw-r-- 1 samantha mgds 4056057 Nov 26 2013 CMTData_Jan1976_Aug2013.txt
-rw-rw-r-- 1 dep2127 mgds 3780454 Sep 19 2012 CMTData_Jan1976_May2012.txt
-rw-rw-r-- 1 samantha mgds 27 Jun 13 16:07 data_date_range.txt
-rw-rw-r-- 1 dep2127 mgds 5 Sep 17 2012 density.txt
-rw-rw-r-- 1 andrewg mgds 5040641 Jan 31 15:04 parsed_CMT_final_solutions.txt
-rw-rw-r-- 1 dep2127 mgds 2 Sep 17 2012 zoom.txt
```

7) Update the CMT solutions date range file

Samantha modified the GMA CMT portal layout so that the date range of solutions on display in the map is listed in the right pane. That date range is controlled by a file called "data_date_range.txt". Make a copy of it, then update it.

```
seafloor% pwd
/public/mgg/web/app.geomapapp.org/htdocs/data/portals/eq_fms_cmt/beachball_plot
```

```
seafloor% ll data_date_range.txt
-rw-rw-r-- 1 samantha samantha 24 Aug 18 16:31 data_date_range.txt
seafloor% cp -p data_date_range.txt /tmp
seafloor% vi data_date_range.txt
seafloor% cat data_date_range.txt
January 1976
September 2017
seafloor%
```

8) Update the generic GMA menu time stamp, and check the path

The GMA menus time stamp is in this file:

`/data/mgds/web/app.geomapapp.org/htdocs/gma_menus/menu_updated.txt`

Copy that file before making any changes to it. (Note: If using "vi", the file must be edited in binary mode so as not to introduce an end-of-line character. So, use "vi -b menu_updated.txt".)

Next, check that the path to the new catalogue file is still good. It is given in the GMA paths file:

`/data/mgds/web/app.geomapapp.org/htdocs/gma_paths/GMA_paths.xml`

In that paths file, the following lines govern the CMT portal although some are no longer needed. The one that points to the current CMT solutions file is given as "V3":

```
<layer
  name="EARTHQUAKE_FOCAL_MECHANISMS_PATH"
  url="data/portals/eq_fms_cmt/">
</layer>

<layer
  name="EARTHQUAKE_FOCAL_MECHANISMS_TILE_PATH"
  url="data/portals/eq_fms_cmt/tiles/cmt_1976-may2012_zoom_">
</layer>

<layer
  name="EARTHQUAKE_FOCAL_MECHANISMS_PATH"
  url="data/portals/eq_fms_cmt/beachball_plot/">
</layer>

<layer
  name="EARTHQUAKE_FOCAL_MECHANISMS_DATA"
  url="data/portals/eq_fms_cmt/beachball_plot/CMTData_Jan1976_May2012.txt">
</layer>

<layer
  name="EARTHQUAKE_FOCAL_MECHANISMS_DATA_V2"
  url="data/portals/eq_fms_cmt/beachball_plot/CMTData_Jan1976_Aug2013.txt">
</layer>

<layer
```

```
    name="EARTHQUAKE_FOCAL_MECHANISMS_DATA_V3"
    url="data/portals/eq_fms_cmt/beachball_plot/parsed_CMT_final_solutions.txt">
</layer>

<layer
    name="EARTHQUAKE_FOCAL_MECHANISMS_DENSITY"
    url="data/portals/eq_fms_cmt/beachball_plot/density.txt">
</layer>

<layer
    name="EARTHQUAKE_FOCAL_MECHANISMS_ZOOM"
    url="data/portals/eq_fms_cmt/beachball_plot/zoom.txt">
</layer>
```

The GMA code looks for a data file pointed to by the URL listed in the name="EARTHQUAKE_FOCAL_MECHANISMS_DATA_V3" section. Check that the new file exists at the end of that path.

(According to Samantha's notes, do not change the original item called name="EARTHQUAKE_FOCAL_MECHANISMS_DATA" which is used by some old versions of GMA.)

9) Request an rsynch to the commercial provider

Send e-mail to Bob to request the rsynch.

10) Samantha's original work flow, for completeness

<http://wiki.iedadata.org/display/~samantha/2015/04/30/GeoMapApp+CMT+Portal+Update>