Focal Mechanism Framework in Antelope

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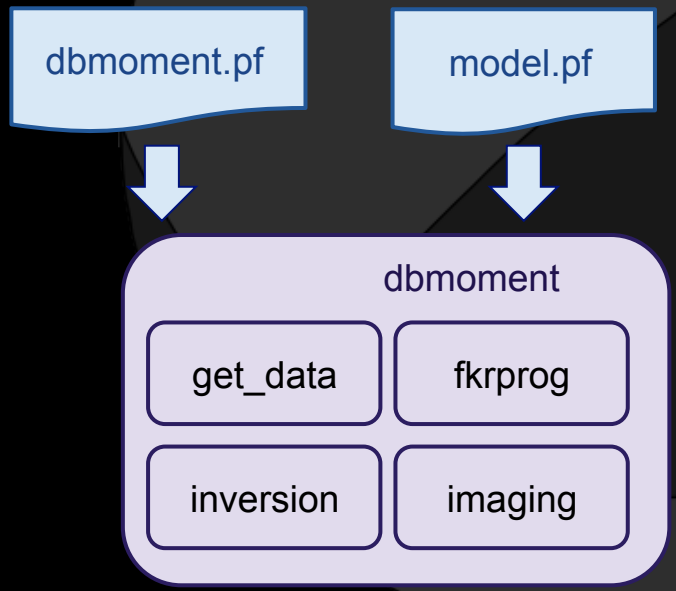
Introduction

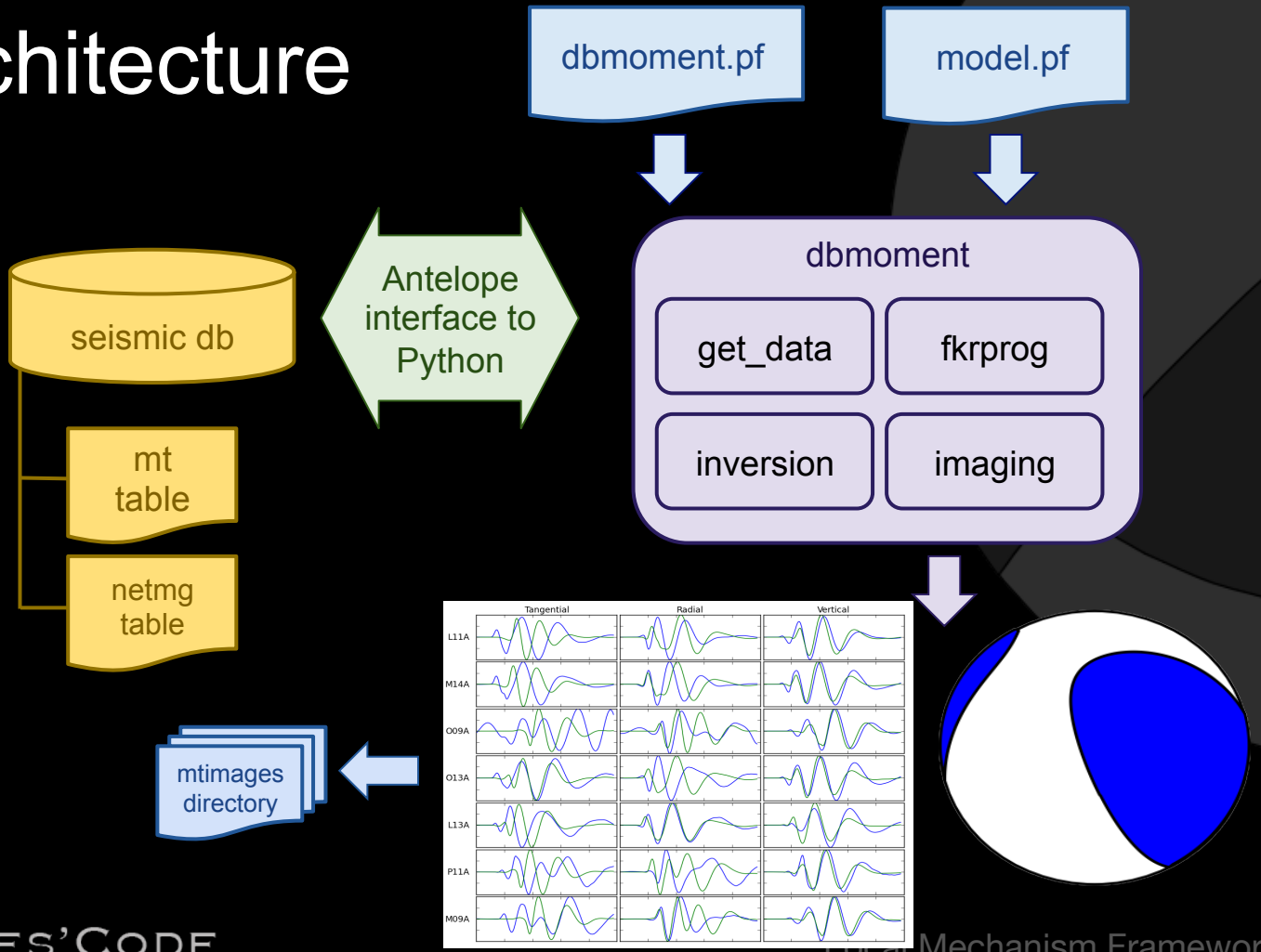
The time domain seismic moment tensor inversion software package written by Dreger has been packaged for inclusion into the Antelope Environmental Monitoring System. The new infrastructure was written natively in Python language.

Architecture

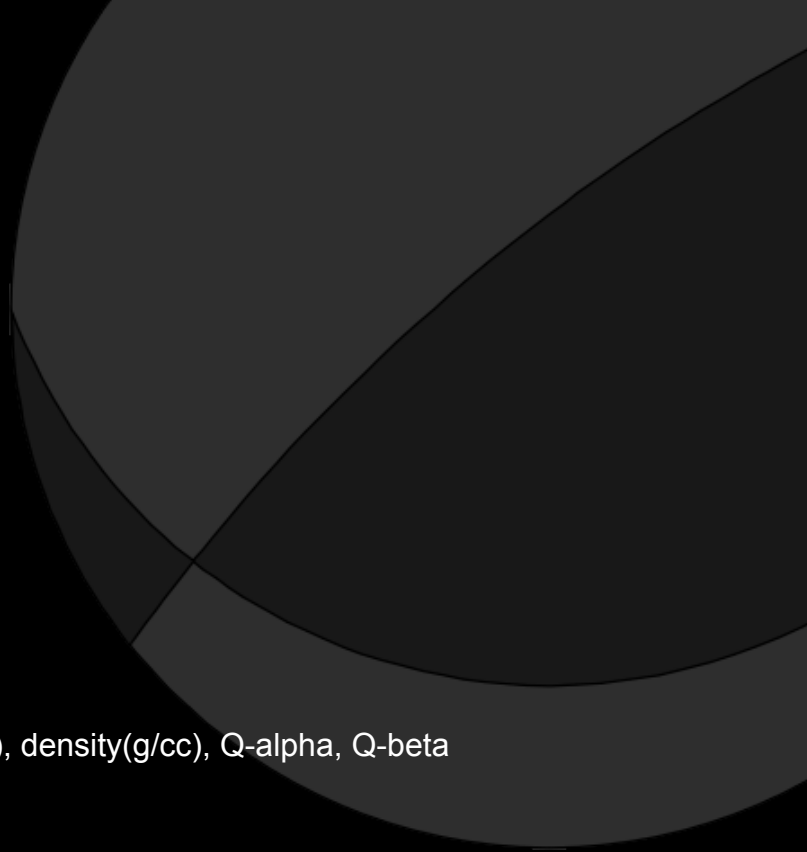
Internally, our code has been designed to be as modular as possible. The configuration parameters got consolidated and simplified. Unavoidably every seismic region will require a dedicated velocity model.



Architecture



Velocity Model



```
name            SOCAL_MODEL
decay           6.0
start_frequency 1
end_frequency   512
samplerate      4
cmax            10000
c1              30
c2              2.9
cmin            2.5
velocity_reduction  10
distance_min    0
distance_max    500
distance_step   5
# MODEL PARAMETERS
# Layer: thickness(km), p-velocity(km/s), s-velocity(km/s), density(g/cc), Q-alpha, Q-beta
model &Literal{
        5.5     5.5     3.18    2.4     600     300
        8.0     6.3     3.64    2.67    600     300
        19.0    6.7     3.87    2.8     600     300
        400.0   7.8     4.5     3.3     600     300
}
```

Execution

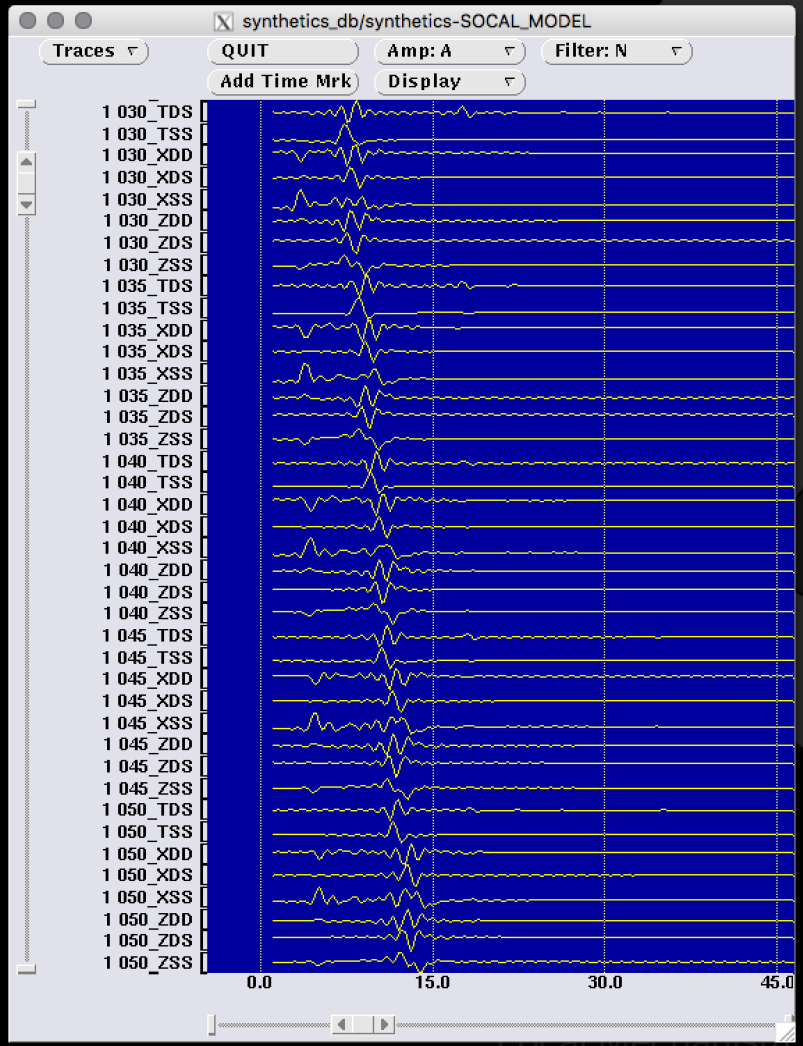
dbmoment [-xvd] [-m MODEL.pf] [-c min_variance] [-p pfname] [-z 'STA1:5,STA2:5'] [-s select] [-r reject] database ORID

dbmoment -e [-xvd] [-m MODEL.pf] [-c min_variance] [-p pfname] [-z 'STA1:5,STA2:5'] [-s select] [-r reject] database **EVID**

Options:

-e	id is EVID
-v	Verbose output
-d	Debug output
-x	Debug output each station plot
-c MIN_FIT	Set min. variance reduction threshold
-z ZCOR	Set some Zcor values for stations
-p PF	Parameter file path
-m MODEL	Forced this MODEL file
-f FILTER	Forced a filter on the data
-s SELECT	Only select these stations
-r REJECT	Reject these stations

Synthetics


synthetics_db/synthetics-SOCAL_MODEL
Traces
QUIT
Amp: A
Filter: N
Add Time Mrk
Display
1 030_TDS
1 030_TSS
1 030_XDD
1 030_XDS
1 030_XSS
1 030_ZDD
1 030_ZDS
1 030_ZSS
1 035_TDS
1 035_TSS
1 035_XDD
1 035_XDS
1 035_XSS
1 035_ZDD
1 035_ZDS
1 035_ZSS
1 040_TDS
1 040_TSS
1 040_XDD
1 040_XDS
1 040_XSS
1 040_ZDD
1 040_ZDS
1 040_ZSS
1 045_TDS
1 045_TSS
1 045_XDD
1 045_XDS
1 045_XSS
1 045_ZDD
1 045_ZDS
1 045_ZSS
1 050_TDS
1 050_TSS
1 050_XDD
1 050_XDS
1 050_XSS
1 050_ZDD
1 050_ZDS
1 050_ZSS
0.0
15.0
30.0
45.0

Output

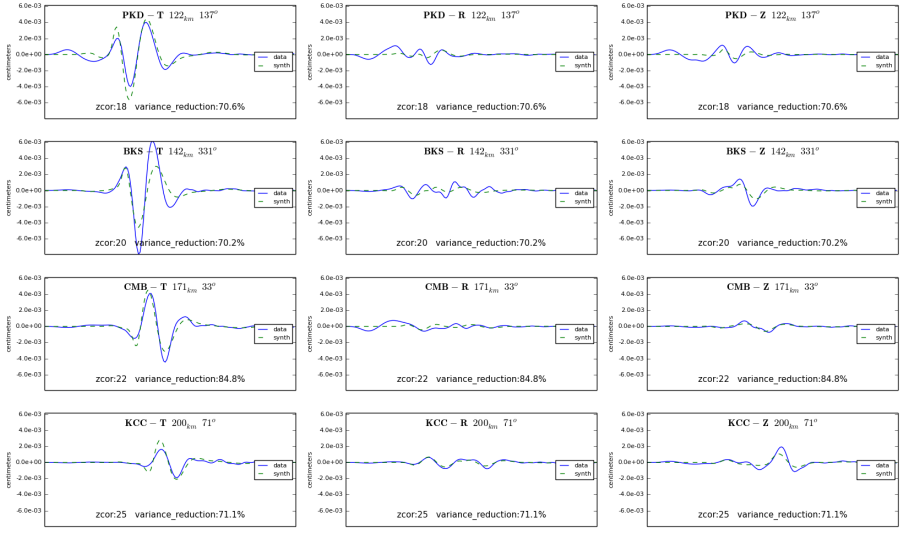
5.1 Mw 8/12/1998 14:10:23.000

8/12/1998 14:10:23.000

ID: 1 Quality: 3

Location:
  Lat: 36.755
  Lon: -121.464
  Depth: 8 km
Filter: BW 0.02 4 0.05 4
Model: SOCAL_MODEL

Mw: 5.1
Strike:[225, 135] Rake:[14, 179] Dip:[89, 76]
Pdc: 97 %
Pclvd: 3 %
VAR: 1.650e-07
VarRed: 7.367e+01
Var/Pdc: 1.692e-09
Mo: 5.2161e+23
Mxx:-5052.110 Mxy:22.896 Mxz:-811.769
Myy:5088.596 Myz:917.618 Mzz:-36.485



Moment tensor computed using the tdmt-invc package developed by Douglas Dreger of the Berkeley Seismological Laboratory, and Green's functions were computed using the FKRPROG software developed by Chandan Saikia with URS.

Antelope's implementation of code by "Juan Reyes"<jreyes1108@gmail.com>

/opt/antelope/5.6/contrib/bin/dbmoment -v example_2 1
Generated at 4/29/2016 3:58:04.053

Examples

system:~ reyes$ run_dbmoment_example

RUN DBMOMENT DEMO

ANTELOPE VERSION: /opt/antelope/5.6

YOU CAN ALSO RUN WITH EXPLICIT PATH: run_dbmoment_example /foo/bar/temp/folder

CHANGE TO DIRECTORY: [/Users/reyes/dbmoment_example/]

REMOVE TEMP FOLDER: [/Users/reyes/dbmoment_example//.dbmoment]

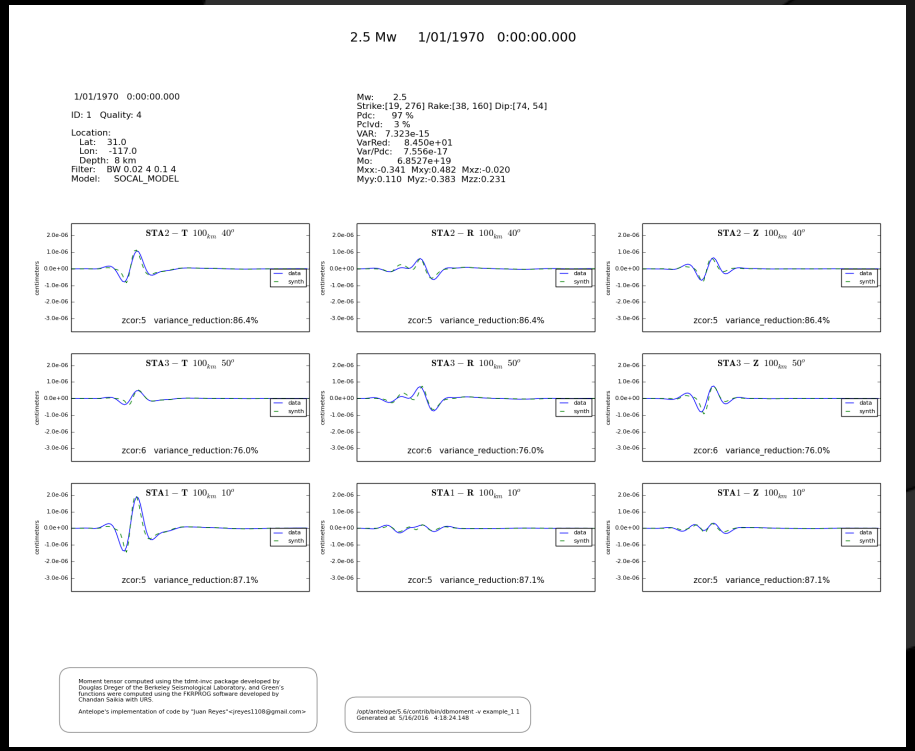
REMOVE TEMP FOLDER: [/Users/reyes/dbmoment_example//synthetics_db]

COPY [/opt/antelope/5.6/contrib/example/dbmoment/EXAMPLE_1/example_1] TO [/Users/reyes/dbmoment_example//]

COPY [/opt/antelope/5.6/contrib/example/dbmoment/EXAMPLE_2/example_2] TO [/Users/reyes/dbmoment_example//]

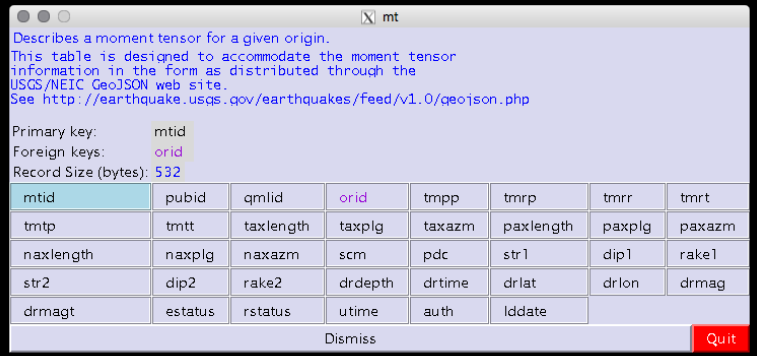
Output

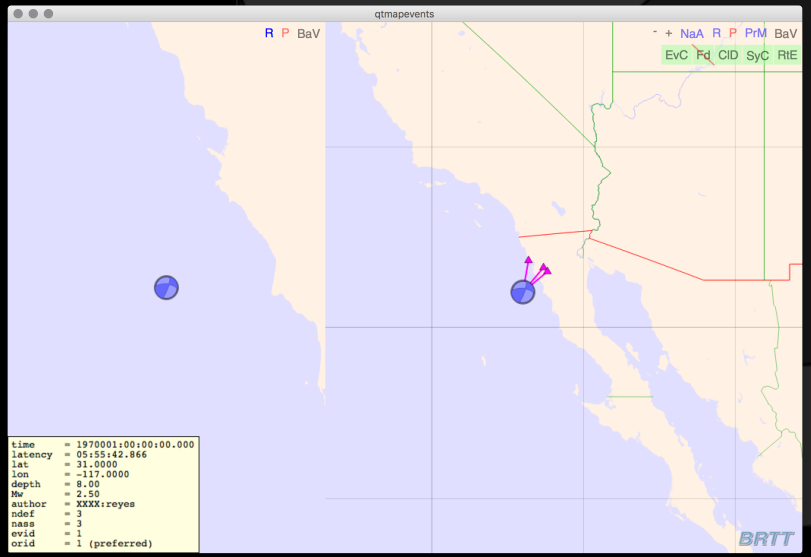

5.1 Mw 8/12/1998 14:10:23.000
8/12/1998 14:10:23.000
ID: 1 Quality: 3
Location:
Lat: 36.755
Lon: -121.464
Depth: 8 km
Filter: BW 0.02 4 0.05 4
Model: SOCAL_MODEL
Mw: 5.1
Strike:[225, 135] Rake:[14, 179] Dip:[89, 76]
Pdc: 97 %
Pclvd: 3 %
VAR: 1.650e-07
VarRed: 7.367e+01
Var/Pdc: 1.692e-09
Mo: 5.2161e+23
Mxx:-5052.110 Mxy:22.896 Mxz:-811.769
Myy:5088.596 Myz:917.618 Mzz:-36.485
PKD – T 122km 137°
PKD – R 122km 137°
PKD – Z 122km 137°
BKS – T 142km 331°
BKS – R 142km 331°
BKS – Z 142km 331°
CMB – T 171km 33°
CMB – R 171km 33°
CMB – Z 171km 33°
KCC – T 200km 71°
KCC – R 200km 71°
KCC – Z 200km 71°
data
synth
zcor:18 variance_reduction:70.6%
zcor:18 variance_reduction:70.6%
zcor:18 variance_reduction:70.6%
zcor:20 variance_reduction:70.2%
zcor:20 variance_reduction:70.2%
zcor:20 variance_reduction:70.2%
zcor:22 variance_reduction:84.8%
zcor:22 variance_reduction:84.8%
zcor:22 variance_reduction:84.8%
zcor:25 variance_reduction:71.1%
zcor:25 variance_reduction:71.1%
zcor:25 variance_reduction:71.1%
Moment tensor computed using the tdmt-invc package developed by Douglas Dreger of the Berkeley Seismological Laboratory, and Green's functions were computed using the FKRPROG software developed by Chandan Saikia with URS.
Antelope's implementation of code by "Juan Reyes"<jreyes1108@gmail.com>
/opt/antelope/5.6/contrib/bin/dbmoment -v example_2 1
Generated at 4/29/2016 3:58:04.053


2.5 Mw 1/01/1970 0:00:00.000
1/01/1970 0:00:00.000
ID: 1 Quality: 4
Location:
Lat: 31.0
Lon: -117.0
Depth: 8 km
Filter: BW 0.02 4 0.1 4
Model: SOCAL_MODEL
Mw: 2.5
Strike:[19, 276] Rake:[38, 160] Dip:[74, 54]
Pdc: 97 %
Pclvd: 3 %
VAR: 7.323e-15
VarRed: 8.450e+01
Var/Pdc: 7.556e-17
Mo: 6.8527e+19
Mxx:-0.341 Mxy:0.482 Mxz:-0.020
Myy:0.110 Myz:-0.383 Mzz:0.231
STA2 – T 100km 40°
STA2 – R 100km 40°
STA2 – Z 100km 40°
STA3 – T 100km 50°
STA3 – R 100km 50°
STA3 – Z 100km 50°
STA1 – T 100km 10°
STA1 – R 100km 10°
STA1 – Z 100km 10°
data
synth
zcor:5 variance_reduction:86.4%
zcor:5 variance_reduction:86.4%
zcor:5 variance_reduction:86.4%
zcor:6 variance_reduction:76.0%
zcor:6 variance_reduction:76.0%
zcor:6 variance_reduction:76.0%
zcor:5 variance_reduction:87.1%
zcor:5 variance_reduction:87.1%
zcor:5 variance_reduction:87.1%
Moment tensor computed using the tdmt-invc package developed by Douglas Dreger of the Berkeley Seismological Laboratory, and Green's functions were computed using the FKRPROG software developed by Chandan Saikia with URS.
Antelope's implementation of code by "Juan Reyes"<jreyes1108@gmail.com>
/opt/antelope/5.6/contrib/bin/dbmoment -v example_1 1
Generated at 5/16/2016 4:18:24.148

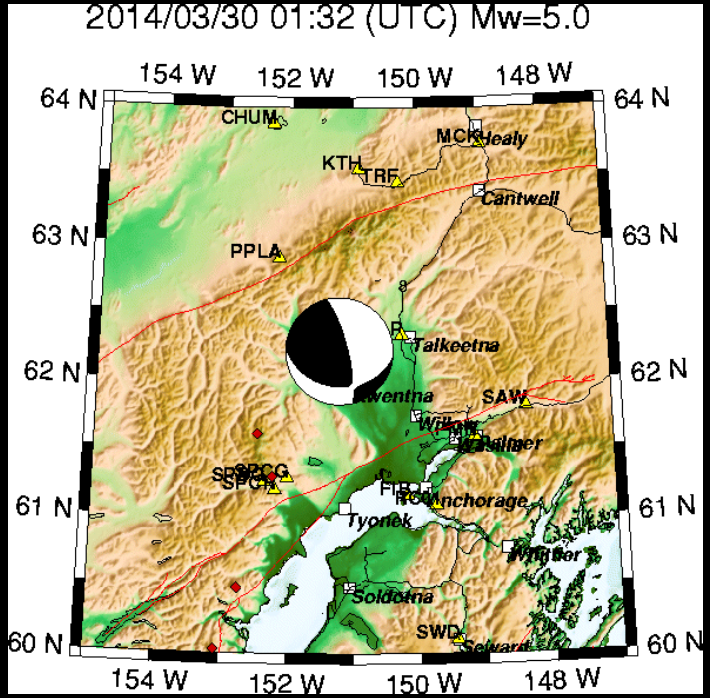
Databases and Maps

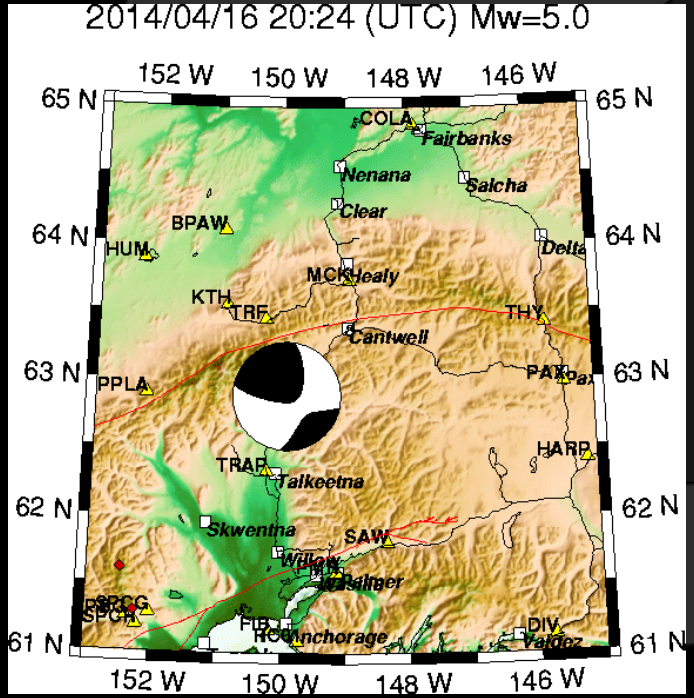
qtmapevents example_1



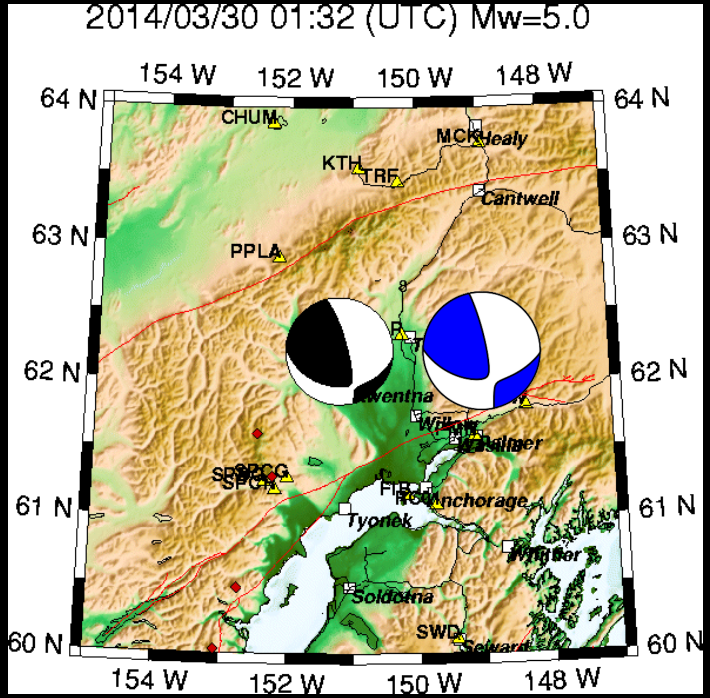


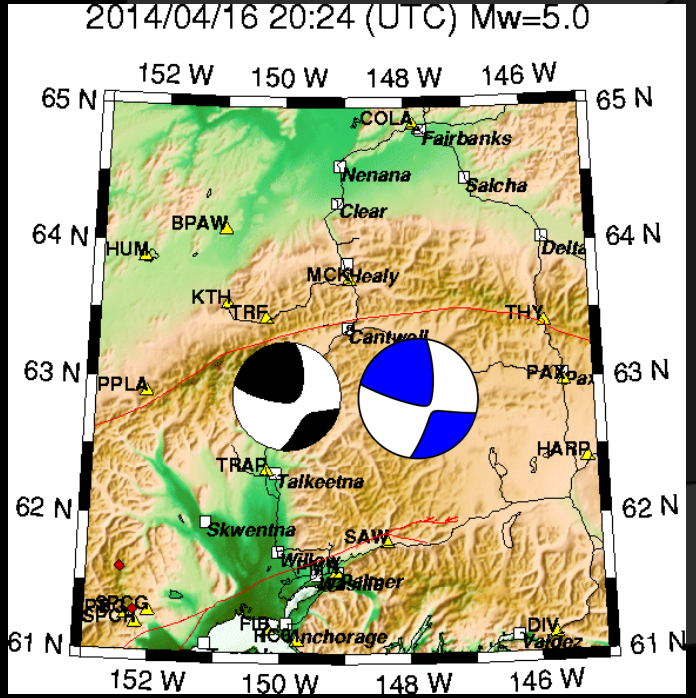
Comparisons ALASKA



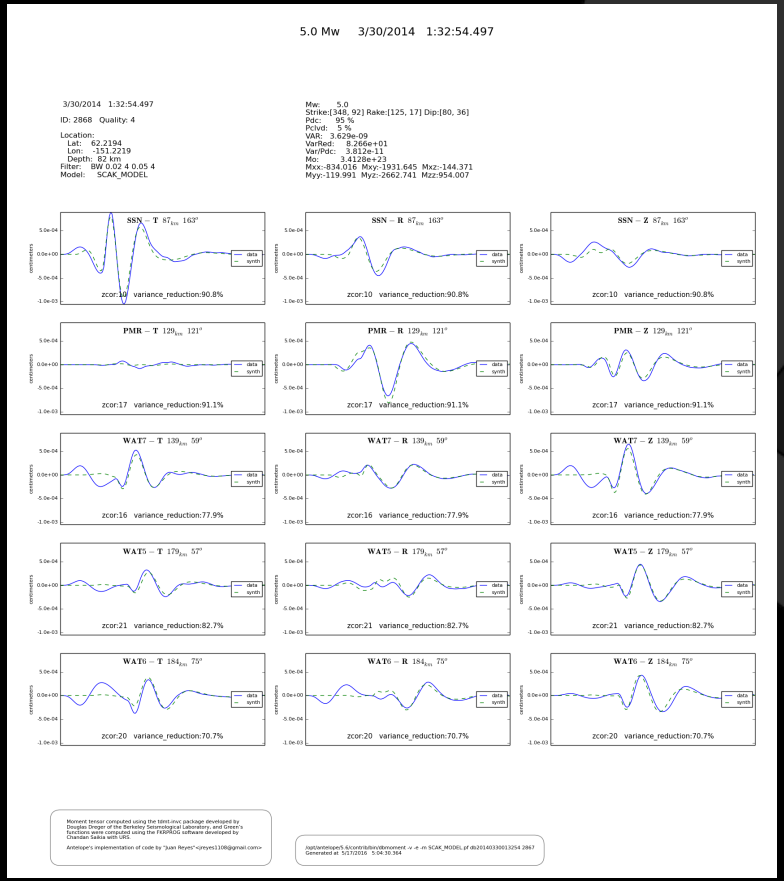


Comparisons ALASKA





Comparisons ALASKA



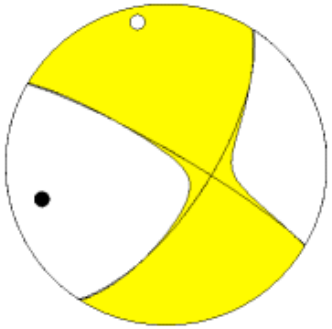
Comparisons TransportableArray

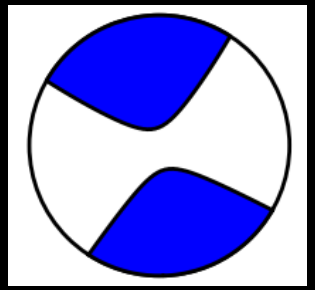
Oklahoma 4.7
2011-11-05

USGS/SLU Regional Moment Solution

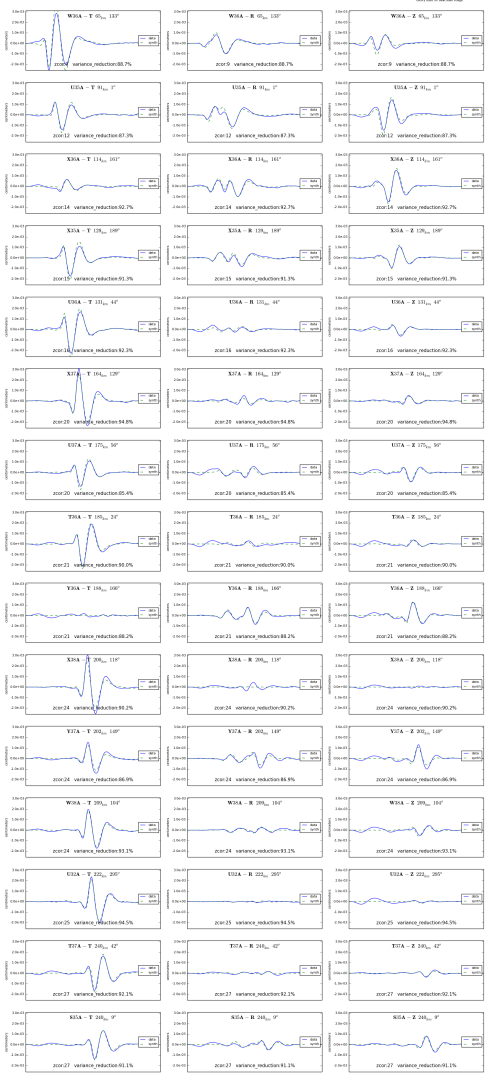
OKLAHOMA

```
11/11/05 07:12:45.13

Epicenter:  35.553  -96.748
MW 4.8

USGS/SLU REGIONAL MOMENT TENSOR
Depth   4          No. of sta: 45
Moment Tensor;   Scale 10**16 Nm
  Mrr=-0.12        Mtt= 1.66
  Mpp=-1.54        Mrt= 0.51
  Mrp=-0.60        Mtp= 0.82
 Principal axes:
  T  Val=  1.92  Plg=11  Azm=348
  N        0.08      66      104
  P       -2.00      21      254

Best Double Couple:Mo=2.0*10**16
 NP1:Strike= 33 Dip=68 Slip=-172
 NP2:       300     83       -23
```





Mw: 4.9
Strike:[31, 121] Rake:[178, 2] Dip:[88, 88]
Pdc: 78 %
Pclvd: 22 %
VAR: 1.143e-08
VarRed: 9.097e+01
Var/Pdc: 1.464e-10
Mo: 2.27856e+23
Mxx:2149.965 Mxy:-1041.353 Mxz:142.987
Myy:-1894.060 Myz:-40.750 Mzz:-255.905



USGS/SLU Regional Moment Solution

OKLAHOMA

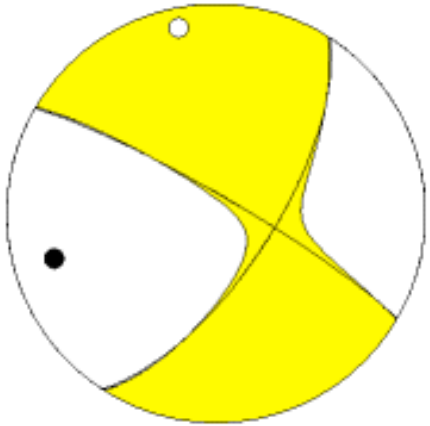
11/11/05 07:12:45.13

Epicenter: 35.553 -96.748
MW 4.8

USGS/SLU REGIONAL MOMENT TENSOR
Depth 4 No. of sta: 45
Moment Tensor; Scale 10**16 Nm
Mrr=-0.12 Mtt= 1.66
Mpp=-1.54 Mrt= 0.51
Mrp=-0.60 Mtp= 0.82
Principal axes:

	Val=	Plg=	Azm=
T	1.92	11	348
N	0.08	66	104
P	-2.00	21	254

Best Double Couple:Mo=2.0*10**16
NP1:Strike= 33 Dip=68 Slip=-172
NP2: 300 83 -23

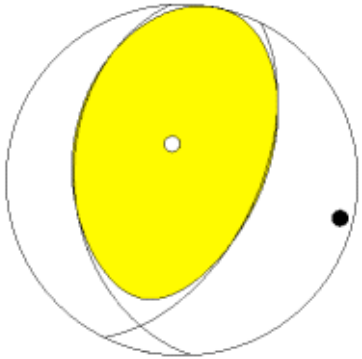


Comparisons TransportableArray

Virginia 5.7
2011-08-23

USGS/SLU Regional Moment Solution

```
11/08/23 17:51:04.59

Epicenter:  37.936  -77.933
MW 5.7

USGS/SLU REGIONAL MOMENT TENSOR
Depth    6          No. of sta: 25
Moment Tensor;    Scale 10**17 Nm
  Mrr= 4.20        Mtt=-0.15
  Mpp=-4.05        Mrt= 1.52
  Mrp= 0.96        Mtp=-0.79
 Principal axes:
  T  Val=  4.73  Plg=73  Azm=344
  N        -0.35      15      196
  P        -4.39       9      104

Best Double Couple:Mo=4.6*10**17
 NP1:Strike=177 Dip=39 Slip=  66
 NP2:         26     55       108
```



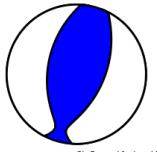
5.7 Mw 8/23/2011 17:51:04.590

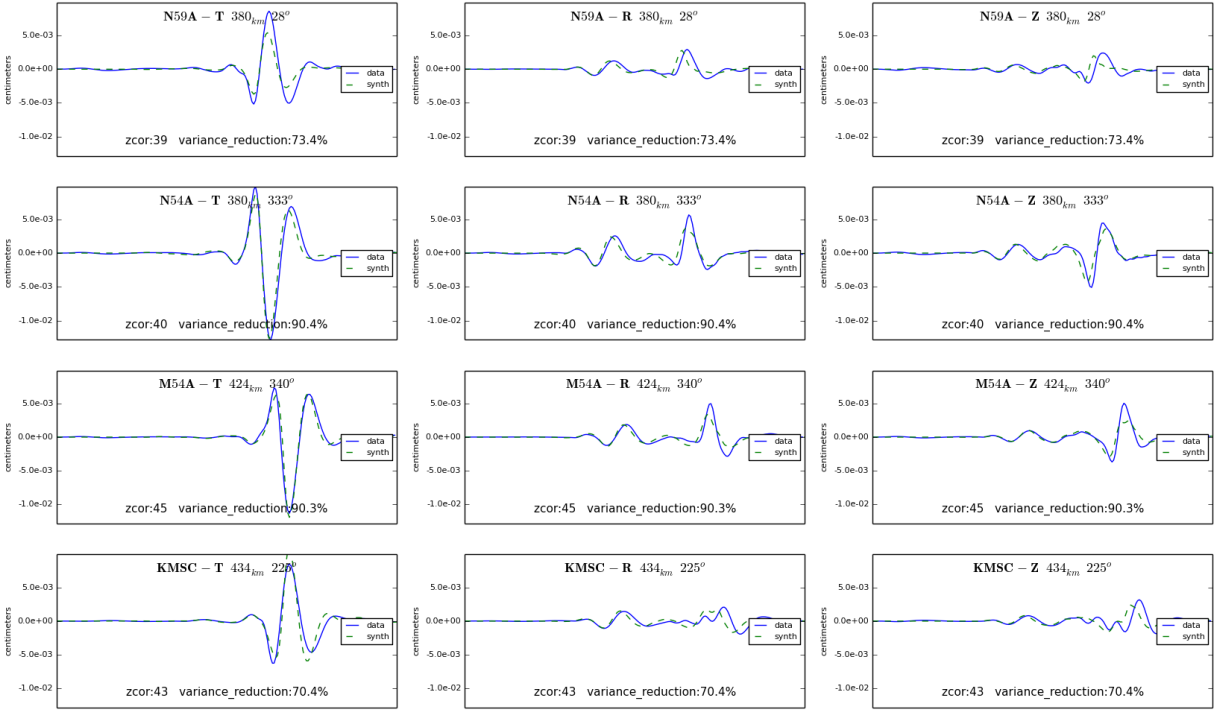
8/23/2011 17:51:04.590

ID: 265866 Quality: 4

Location:
  Lat: 37.936
  Lon: -77.933
  Depth: 6 km
Filter: BW 0.02 4 0.05 4
Model: SOCAL_MODEL

Mw: 5.7
Strike:[26, 185] Rake:[105, 75] Dip:[47, 45]
Pdc: 98 %
Pclvd: 2 %
VAR: 3.666e-07
VarRed: 8.429e+01
Var/Pdc: 3.733e-09
Mo: 3.74606e+24
Mxx:-1163.780 Mxy:10083.607 Mxz:7024.665
Myy:-34792.345 Myz:67.655 Mzz:35956.125





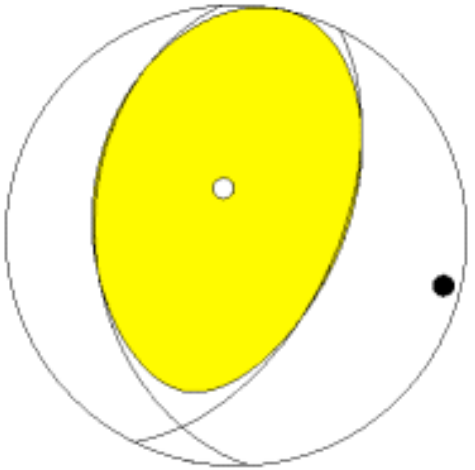
USGS/SLU Regional Moment Solution

11/08/23 17:51:04.59

Epicenter: 37.936 -77.933
MW 5.7

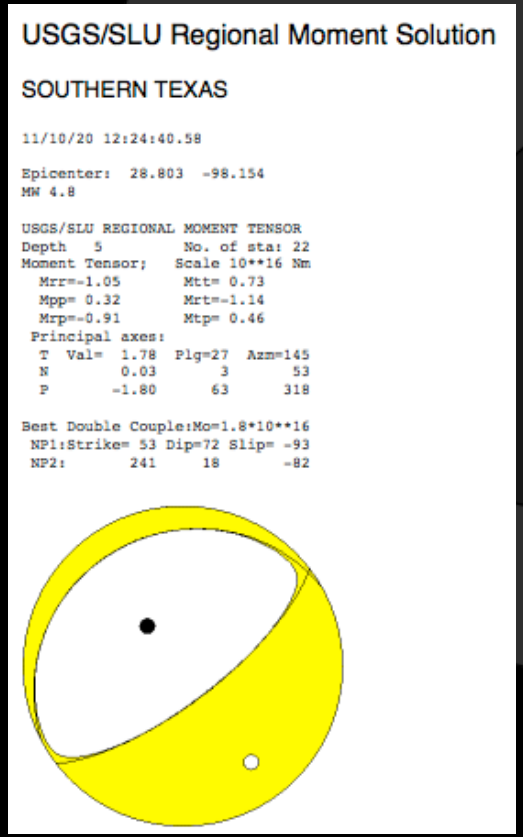
USGS/SLU REGIONAL MOMENT TENSOR
Depth 6 No. of sta: 25
Moment Tensor; Scale 10**17 Nm
  Mrr= 4.20 Mtt=-0.15
  Mpp=-4.05 Mrt= 1.52
  Mrp= 0.96 Mtp=-0.79
 Principal axes:
  T Val= 4.73 Plg=73 Azm=344
  N -0.35 15 196
  P -4.39 9 104

Best Double Couple:Mo=4.6*10**17
 NP1:Strike=177 Dip=39 Slip= 66
 NP2: 26 55 108



Comparisons TransportableArray

Southern Texas 4.8
2011-10-20


USGS/SLU Regional Moment Solution

SOUTHERN TEXAS

11/10/20 12:24:40.58

Epicenter: 28.803 -98.154
MW 4.8

USGS/SLU REGIONAL MOMENT TENSOR
Depth 5 No. of sta: 22
Moment Tensor; Scale 10**16 Nm
Mrr=-1.05 Mtt= 0.73
Mpp= 0.32 Mrt=-1.14
Mrp=-0.91 Mtp= 0.46
Principal axes:
T Val= 1.78 Plg=27 Azm=145
N 0.03 3 53
P -1.80 63 318

Best Double Couple:Mo=1.8*10**16
NP1:Strike= 53 Dip=72 Slip= -93
NP2: 241 18 -82

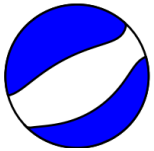
4.7 Mw 10/20/2011 12:24:41.600

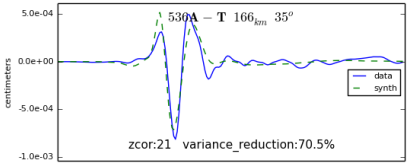
10/20/2011 12:24:41.600

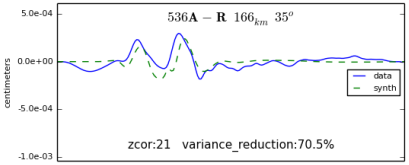
ID: 267274 Quality: 2

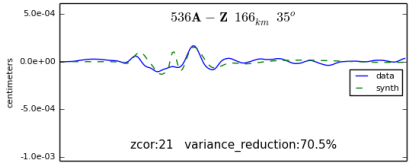
Location:
Lat: 28.865
Lon: -98.079
Depth: 5 km
Filter: BW 0.01 4 0.05 4
Model: SOCAL_MODEL

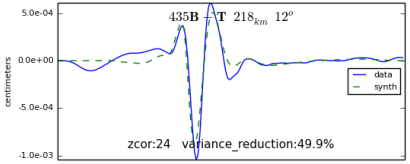
Mw: 4.7
Strike:[244, 53] Rake:[-84, -99] Dip:[57, 33]
Pdc: 88 %
Pclvd: 12 %
VAR: 8.725e-09
VarRed: 5.379e+01
Var/Pdc: 9.961e-11
Mo: 1.39514e+23
Mxx:943.740 Mxy:-629.896 Mxz:537.164
Myy:280.062 Myz:-183.567 Mzz:-1223.802

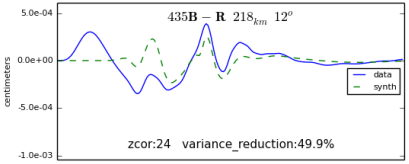


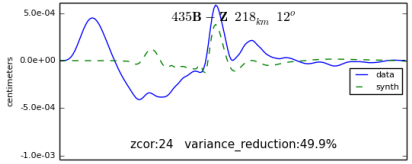


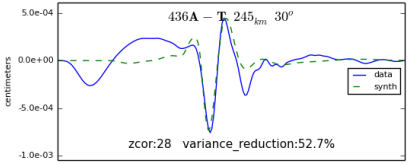


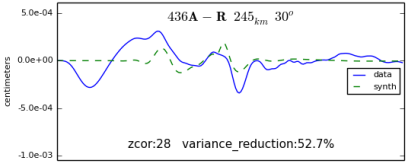


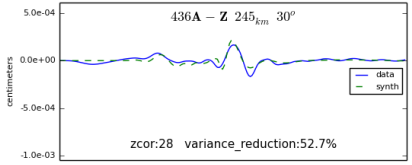












Moment tensor computed using the tdmt-invc package developed by Douglas Dreger of the Berkeley Seismological Laboratory, and Green's functions were computed using the FKRPROG software developed by Chandan Saikia with URS.

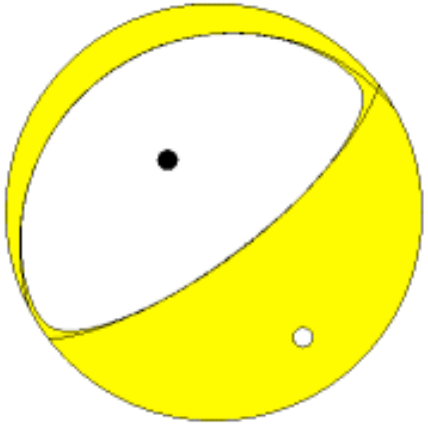
Antelope's implementation of code by "Juan Reyes"<jreyes1108@gmail.com>

/opt/antelope/5.6/contrib/bin/dbmoment -v -e -b -f BW 0.01 4 0.05 4 usarray 163753
Generated at 5/14/2016 21:31:37.432

USGS/SLU Regional Moment Solution

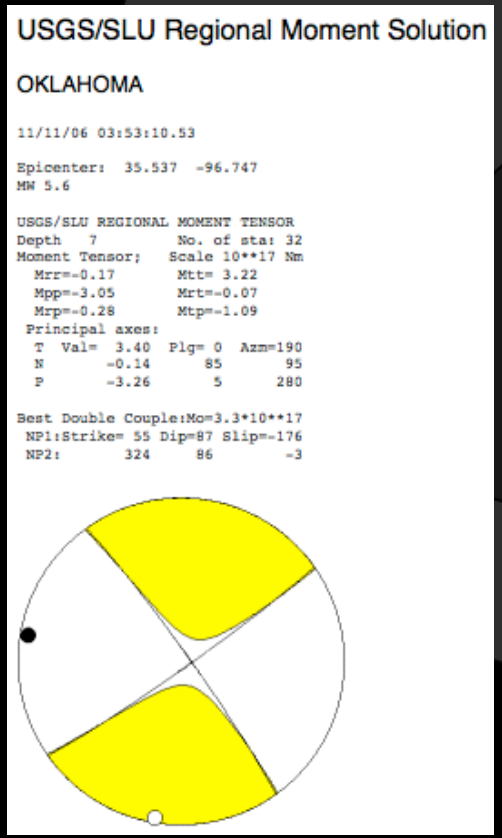
SOUTHERN TEXAS

```
11/10/20 12:24:40.58

Epicenter:  28.803  -98.154
MW 4.8

USGS/SLU REGIONAL MOMENT TENSOR
Depth    5          No. of sta: 22
Moment Tensor;   Scale 10**16 Nm
  Mrr=-1.05        Mtt= 0.73
  Mpp= 0.32        Mrt=-1.14
  Mrp=-0.91        Mtp= 0.46
 Principal axes:
  T  Val=  1.78  Plg=27  Azm=145
  N        0.03      3       53
  P       -1.80     63      318

Best Double Couple:Mo=1.8*10**16
 NP1:Strike= 53 Dip=72 Slip= -93
 NP2:       241     18       -82
```



Comparisons TransportableArray

Oklahoma 5.6
2011-11-06



USGS/SLU Regional Moment Solution

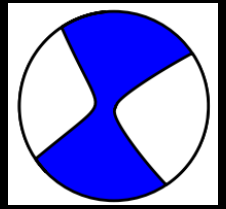
OKLAHOMA

11/11/06 03:53:10.53

Epicenter: 35.537 -96.747
MW 5.6

USGS/SLU REGIONAL MOMENT TENSOR
Depth 7 No. of sta: 32
Moment Tensor; Scale 10**17 Nm
Mrr=-0.17 Mtt= 3.22
Mpp=-3.05 Mrt=-0.07
Mrp=-0.28 Mtp=-1.09
Principal axes:
T Val= 3.40 Plg= 0 Azm=190
N -0.14 85 95
P -3.26 5 280

Best Double Couple:Mo=3.3*10**17
NP1:Strike= 55 Dip=87 Slip=-176
NP2: 324 86 -3



Mw: 5.7
Strike:[237, 146] Rake:[-171, -5] Dip:[85, 81]
Pdc: 91 %
Pclvd: 9 %
VAR: 2.568e-06
VarRed: 8.958e+01
Var/Pdc: 2.810e-08
Mo: 3.63997e+24
Mxx:32795.212 Mxy:13642.491 Mxz:3110.743
Myy:-33245.207 Myz:-6370.573 Mzz:449.995

USGS/SLU Regional Moment Solution

OKLAHOMA

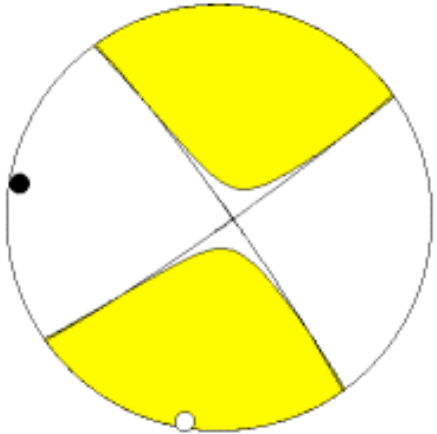
11/11/06 03:53:10.53

Epicenter: 35.537 -96.747
MW 5.6

USGS/SLU REGIONAL MOMENT TENSOR
Depth 7 No. of sta: 32
Moment Tensor; Scale 10**17 Nm
Mrr=-0.17 Mtt= 3.22
Mpp=-3.05 Mrt=-0.07
Mrp=-0.28 Mtp=-1.09
Principal axes:

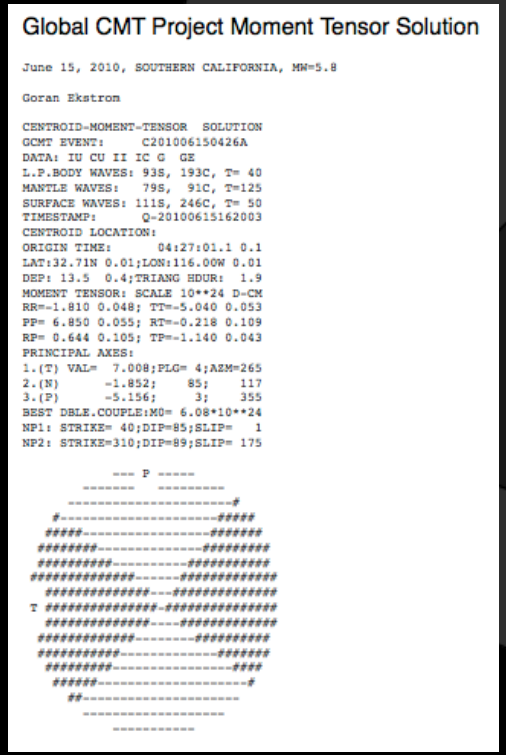
	Val=	Plg=	Azm=
T	3.40	0	190
N	-0.14	85	95
P	-3.26	5	280

Best Double Couple:Mo=3.3*10**17
NP1:Strike= 55 Dip=87 Slip=-176
NP2: 324 86 -3



Comparisons ANZA

El Centro 5.7
2010-06-15

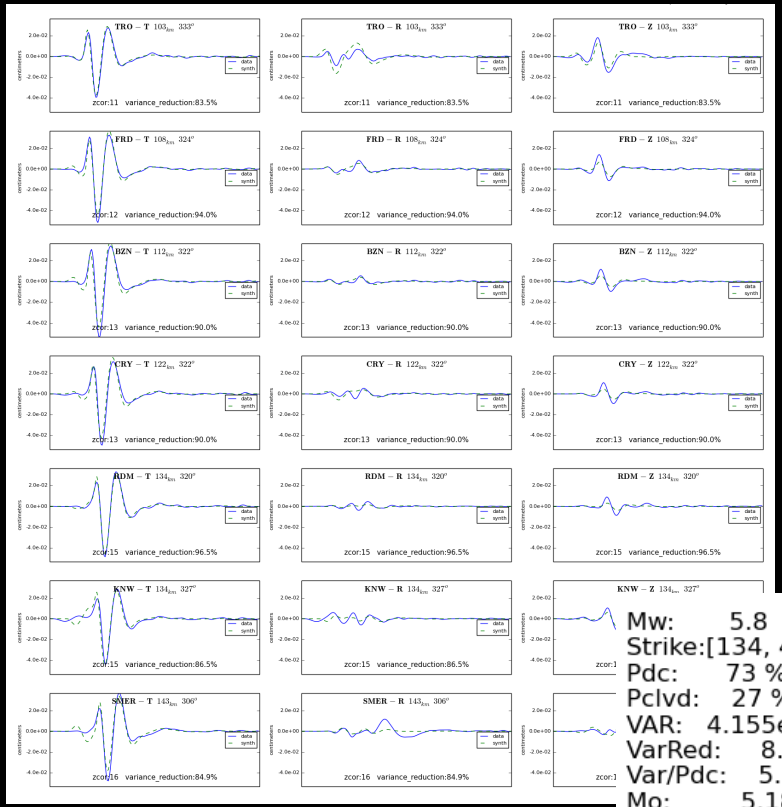


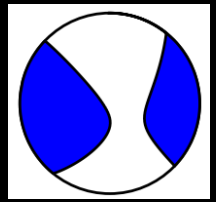
Global CMT Project Moment Tensor Solution

June 15, 2010, SOUTHERN CALIFORNIA, MW=5.8

Goran Ekstrom

CENTROID-MOMENT-TENSOR SOLUTION
GCMT EVENT: C201006150426A
DATA: IU CU II IC G GE
L.P.BODY WAVES: 93S, 193C, T= 40
MANTLE WAVES: 79S, 91C, T=125
SURFACE WAVES: 111S, 246C, T= 50
TIMESTAMP: Q=20100615162003
CENTROID LOCATION:
ORIGIN TIME: 04:27:01.1 0.1
LAT:32.71N 0.01;LON:116.00W 0.01
DEP: 13.5 0.4;TRIANG HDUR: 1.9
MOMENT TENSOR: SCALE 10**24 D=CM
RR=-1.810 0.048; TT=-5.040 0.053
PP= 6.850 0.055; RT=-0.218 0.109
RP= 0.644 0.105; TP=-1.140 0.043
PRINCIPAL AXES:
1.(T) VAL= 7.008;PLG= 4;AZM=265
2.(N) -1.852; 85; 117
3.(P) -5.156; 3; 355
BEST DBLE.COUPLE:M0= 6.08*10**24
NP1: STRIKE= 40;DIP=85;SLIP= 1
NP2: STRIKE=310;DIP=89;SLIP= 175

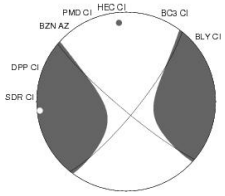




Mw: 5.8
Strike:[134, 41] Rake:[-148, -4] Dip:[86, 58]
Pdc: 73 %
Pclvd: 27 %
VAR: 4.155e-06
VarRed: 8.955e+01
Var/Pdc: 5.656e-08
Mo: 5.18957e+24
Mxx:-40074.086 Mxy:5581.297 Mxz:-18011.894
Myy:47737.180 Myz:-20165.020 Mzz:-7663.094

SCSN Moment Tensor Solution

Computer-generated solution; not reviewed



Hypocentral Location:

Event ID	14745580
Origin Time	2010/06/15 04:26:58
Latitude	32.6978
Longitude	-115.9235
Depth (TT)	6.9 km
Depth (MT; not authoritative)	8 km

Magnitudes:
Ml 5.87 (not authoritative)
Mw 5.72 (authoritative)

Deviatoric Solution:
Scale 1.0e+24 Dyne-cm

Axis	Value	Plunge	Azimuth
T	5.145	3	264
N	-0.761	77	162
P	-4.377	13	355

Source Composition:

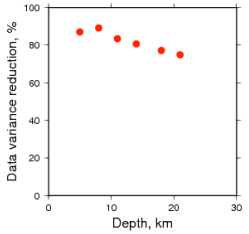
Type	Percent
DC	70
CLVD	30
Iso	(null)

Moment Tensor:

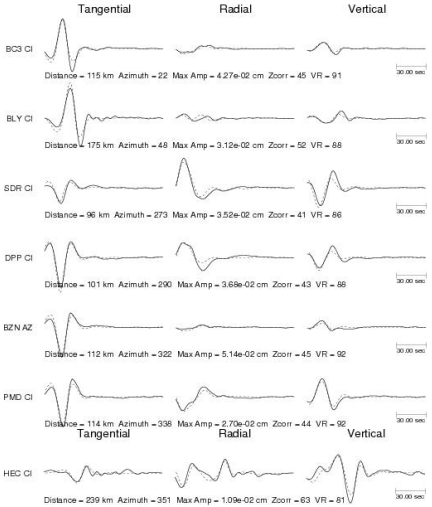
Moment	4.76e+24 Dyne-cm
Scale	1.0e+24 Dyne-cm
Mxx	-4.115
Mxy	0.908
Mxz	-0.809
Myy	5.038
Myz	-0.227
Mzz	-0.924
Variance Reduction	89%

Best-fit Double Couple Solution

	Plane	Strike	Rake	Dip
NP1	130	-169	83	
NP2	39	-7	79	



Waveform data (solid line) and synthetic data (dashed line) from the moment tensor inversion:

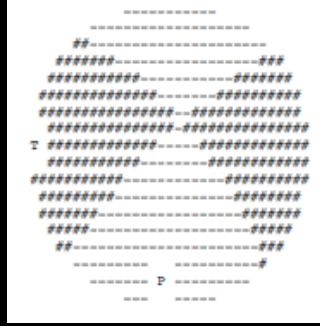


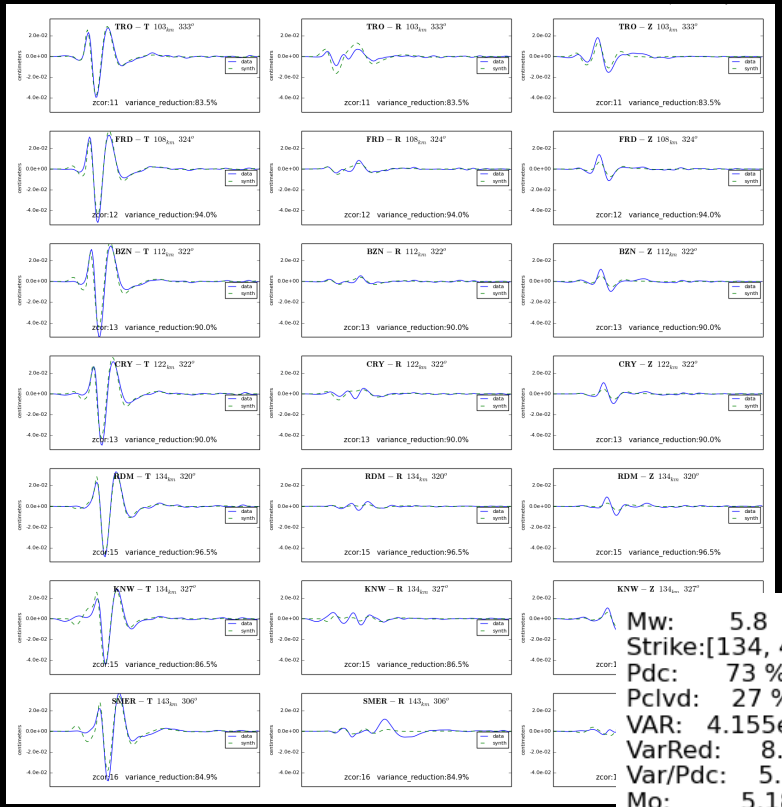
Comparisons ANZA

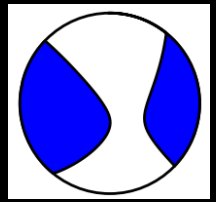
Borrego 5.4
2010-07-07

Global CMT Project Moment Tensor Solution

```
July 7, 2010, SOUTHERN CALIFORNIA, MW=5.5

Goran Ekstrom

CENTROID-MOMENT-TENSOR  SOLUTION
GCMT EVENT:     C201007072353A
DATA: IU CU II IC GE G
L.P.BODY WAVES: 75S, 122C, T= 40
MANTLE WAVES:   32S,  32C, T=125
SURFACE WAVES: 100S, 191C, T= 50
TIMESTAMP:      Q-20100708021613
CENTROID LOCATION:
ORIGIN TIME:      23:53:37.2 0.2
LAT:33.46N 0.01;LON:116.51W 0.01
DEP: 20.8  0.7;TRIANG HDUR:  1.4
MOMENT TENSOR: SCALE 10**24 D=CM
RR=-0.345 0.034; TT=-2.100 0.035
PP= 2.450 0.036; RT= 0.595 0.073
RP= 0.235 0.062; TP= 0.266 0.029
PRINCIPAL AXES:
1.(T) VAL=  2.492;PLG= 6;AZM=274
2.(N)      -0.197;    72;     22
3.(P)      -2.290;    17;    182
BEST DBLE.COUPLE:M0= 2.39*10**24
NP1: STRIKE=319;DIP=74;SLIP=-172
NP2: STRIKE=227;DIP=82;SLIP= -16
```



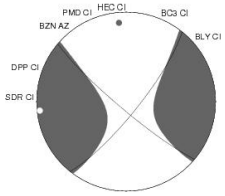




Mw: 5.8
Strike:[134, 41] Rake:[-148, -4] Dip:[86, 58]
Pdc: 73 %
Pclvd: 27 %
VAR: 4.155e-06
VarRed: 8.955e+01
Var/Pdc: 5.656e-08
Mo: 5.18957e+24
Mxx:-40074.086 Mxy:5581.297 Mxz:-18011.894
Myy:47737.180 Myz:-20165.020 Mzz:-7663.094

SCSN Moment Tensor Solution

Computer-generated solution; not reviewed



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Scale 1.0e+24 Dyne-cm

Axis	Value	Plunge	Azimuth
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Scale	1.0e+24 Dyne-cm
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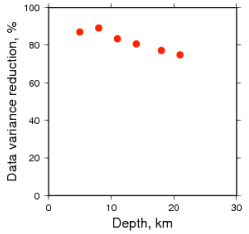

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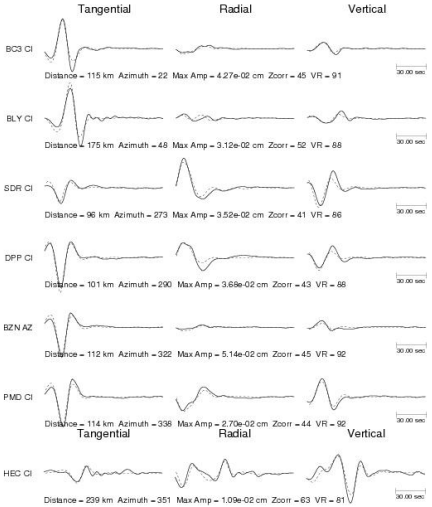
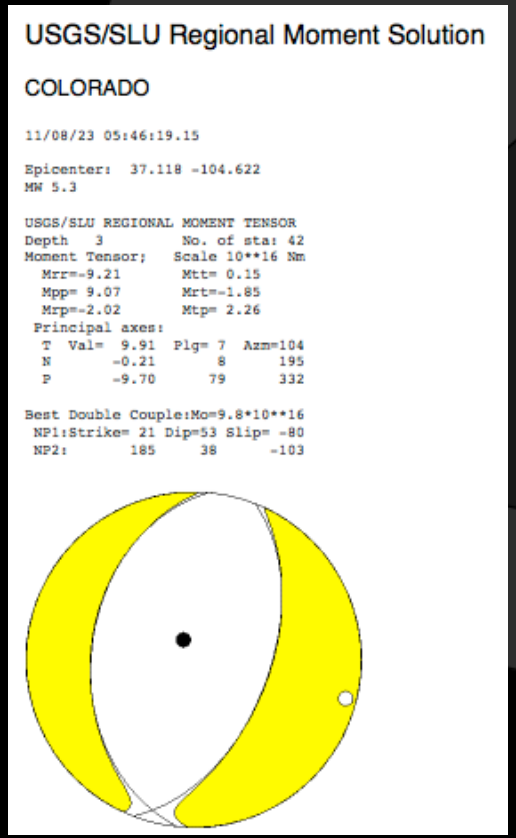


Comparisons TransportableArray

Colorado 5.3
2011-08-23



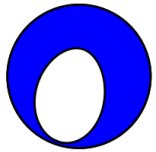
5.3 Mw 8/23/2011 5:46:18.250

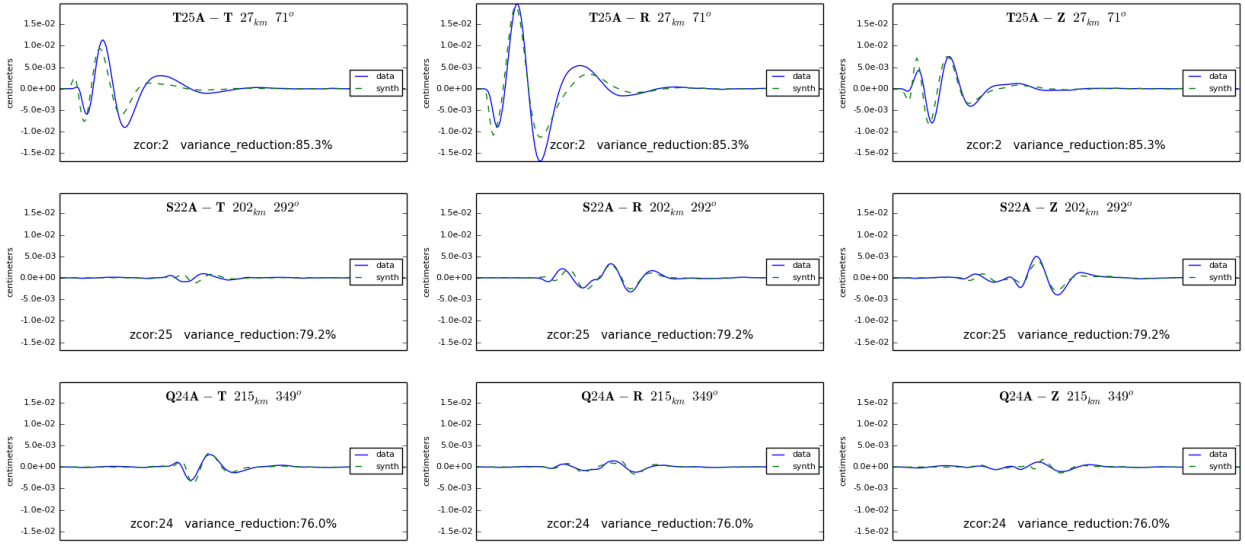
8/23/2011 5:46:18.250

ID: 265845 Quality: 4

Location:
  Lat: 37.063
  Lon: -104.701
  Depth: 4 km
Filter: BW 0.02 4 0.05 4
Model: SOCAL_MODEL

Mw: 5.3
Strike:[354, 216] Rake:[-118, -56] Dip:[55, 44]
Pdc: 54 %
Pclvd: 46 %
VAR: 7.562e-07
VarRed: 8.255e+01
Var/Pdc: 1.391e-08
Mo: 1.06183e+24
Mxx:1214.061 Mxy:-2379.114 Mxz:4634.829
Myy:8356.645 Myz:3124.339 Mzz:-9570.706





Moment tensor computed using the tdmt-invc package developed by Douglas Dreger of the Berkeley Seismological Laboratory, and Green's functions were computed using the FKRPROG software developed by Chandan Saikia with URS.

Antelope's implementation of code by "Juan Reyes"<jreyes1108@gmail.com>

/opt/antelope/5.6/contrib/bin/dbmoment -b -v -e usarray 162850
Generated at 5/14/2016 22:08:31.434

USGS/SLU Regional Moment Solution

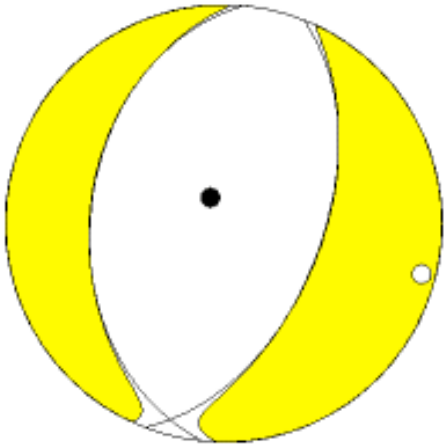
COLORADO

```
11/08/23 05:46:19.15

Epicenter:  37.118 -104.622
MW 5.3

USGS/SLU REGIONAL MOMENT TENSOR
Depth    3          No. of sta: 42
Moment Tensor;   Scale 10**16 Nm
  Mrr=-9.21        Mtt= 0.15
  Mpp= 9.07        Mrt=-1.85
  Mrp=-2.02        Mtp= 2.26
 Principal axes:
  T  Val=  9.91  Plg= 7  Azm=104
  N       -0.21       8       195
  P       -9.70      79       332

Best Double Couple:Mo=9.8*10**16
 NP1:Strike= 21 Dip=53 Slip= -80
 NP2:       185     38      -103
```



Q & A