**Point Source Object**: Used to concentrate the seismicity in a single point in space. The orientation of the rupture plane is specified using the strike and dip angles. This source object uses circular rupture area.

|  |  |
| --- | --- |
| point1 label mech style RA sRA gmmptr strike dip vertices | |
| label | unique source label |
| mechanism | Tectonic setting   * interface * intraslab * crustal |
| style | Style of faulting (integer, double or string)   * -999 (if mechanism is unspecified) * rake angle (°) * strike-slip, reverse/oblique, reverse, normal/oblique, or normal |
| RA | Rupture area (RA) handle   * null, wc1994,ellsworth, hanksbakun2001, somerville1999, wc1994r, wc1994s, strasser2010 |
| sRA | Rupture area uncertainty switch   * 0 (no uncertainty in RA model) * 1 (uncertainty considered in RA model) |
| gmmptr | Pointer to GMM object |
| strike | Strike angle (°) |
| dip | Dip Angle (°) |
| vertices | lon1 lat1 elev1 –or- X1 Y1 Z1 |

**Line Source Object**: Used to concentrate the seismicity along 3D line. The line source object handles single or multiple line segments. The orientation of the rupture plane is defined by the line vertices and the specified dip angle. This source object uses circular rupture area.

|  |  |
| --- | --- |
| line1 label mechanism style RA sRA gmmptr dip lmax nref vertices | |
| label | unique source label |
| mechanism | Tectonic setting   * interface * intraslab * crustal |
| style | Style of faulting (integer, double or string)   * -999 (if mechanism is unspecified) * rake angle (°) * strike-slip, reverse/oblique, reverse, normal/oblique, or normal |
| RA | Rupture area (RA) handle   * null, wc1994,ellsworth, hanksbakun2001, somerville1999, wc1994r, wc1994s, strasser2010 |
| sRA | Rupture area uncertainty switch   * 0 (no uncertainty in RA model) * 1 (uncertainty considered in RA model) |
| gmmptr | Pointer to GMM object |
| dip | Dip Angle (°) |
| lmax | Maximum length (km) of line segments used in the discretization |
| nref | Number of mesh refinements |
| vertices | lon1 lat1 elev1 lon2 lat2 elev2 … lon\_n lat\_n elev\_n  -or- X1 Y1 Z1 X2 Y2 Z2 … X\_n Y\_n Z\_n |

**Area1 Source Object**: source geometry defined by a 3D polygon. This source object uses circular rupture area.

|  |  |
| --- | --- |
| area1 label mechanism style RA sRA gmmptr lmax nref vertices | |
| label | unique source label |
| mechanism | Tectonic setting   * interface * intraslab * crustal |
| style | Style of faulting (integer, double or string)   * -999 (if mechanism is unspecified) * rake angle (°) * strike-slip, reverse/oblique, reverse, normal/oblique, or normal |
| RA | Rupture area (RA) handle   * null, wc1994,ellsworth, hanksbakun2001, somerville1999, wc1994r, wc1994s, strasser2010 |
| sRA | Rupture area uncertainty switch   * 0 (no uncertainty in RA model) * 1 (uncertainty considered in RA model) |
| gmmptr | Pointer to GMM object |
| lmax | Maximum length (km) of mesh edges used in the discretization |
| nref | Number of mesh refinements |
| vertices | lon1 lat1 elev1 lon2 lat2 elev2 … lon\_n lat\_n elev\_n  -or- X1 Y1 Z1 X2 Y2 Z2 … X\_n Y\_n Z\_n |

**Area2 Source Object**: Area geometry defined by the upper and lower seismogenic depths and the (lat,lon) of the surface projection of the upper edge of the fault. This source object uses circular rupture area.

|  |  |
| --- | --- |
| area2 label mechanism style RA sRA gmmptr dip usd lsd lmax nref vertices | |
| label | unique source label |
| mechanism | Tectonic setting   * interface * intraslab * crustal |
| style | Style of faulting (integer, double or string)   * -999 (if mechanism is unspecified) * rake angle (°) * strike-slip, reverse/oblique, reverse, normal/oblique, or normal |
| RA | Rupture area (RA) handle   * null, wc1994,ellsworth, hanksbakun2001, somerville1999, wc1994r, wc1994s, strasser2010 |
| sRA | Rupture area uncertainty switch   * 0 (no uncertainty in RA model) * 1 (uncertainty considered in RA model) |
| gmmptr | Pointer to GMM object |
| dip | Dip angle (°) |
| usp | Upper Seismogenic Depth (km) , positive value for points below the earth surface |
| lsd | Lower Seismogenic Depth (km), positive value for points below the earth surface |
| lmax | Maximum length (km) of mesh edges used in the discretization |
| nref | Number of mesh refinements |
| vertices | lon1 lat1 lon2 lat2 … lon\_n lat\_n –or- X1 Y1 X2 Y2 … X\_n Y\_n |

**Area3 Source Object**: Rectangular source defined by the strike and dip angles, length, width, and the location of vertices. This area object uses rectangular rupture area with user specified aspect ratio

|  |  |
| --- | --- |
| area3 label mechanism style RA sRA gmmptr strike dip length width aratio dx vertices | |
| label | unique source label |
| mechanism | Tectonic setting   * interface * intraslab * crustal |
| style | Style of faulting (integer, double or string)   * -999 (if mechanism is unspecified) * rake angle (°) * strike-slip, reverse/oblique, reverse, normal/oblique, or normal |
| RA | Rupture area (RA) handle   * null, wc1994,ellsworth, hanksbakun2001, somerville1999, wc1994r, wc1994s, strasser2010 |
| sRA | Rupture area uncertainty switch   * 0 (no uncertainty in RA model) * 1 (uncertainty considered in RA model) |
| gmmptr | Pointer to GMM object |
| Strike | Strike Angle |
| Dip | Dip angle (°) |
| Length | Length along strike(km) |
| Width | Length along Width (km), if unknown set to -999 |
| aratio | Rupture length to rupture width ratio |
| dx | Maximum distance between rupture area positions |
| vertices | lon1 lat1 elev1 -or- X1 Y1 Z1 |

**Area4 Source Object**: Area source in which the geometry is imported from a \*.mat file. This area object uses circular rupture area

|  |  |
| --- | --- |
| area4 label mechanism style RA sRA gmmptr mat reduction | |
| label | unique source label |
| mechanism | Tectonic setting   * interface * intraslab * crustal |
| style | Style of faulting (integer, double or string)   * -999 (if mechanism is unspecified) * rake angle (°) * strike-slip, reverse/oblique, reverse, normal/oblique, or normal |
| RA | Rupture area (RA) handle   * null, wc1994,ellsworth, hanksbakun2001, somerville1999, wc1994r, wc1994s, strasser2010 |
| sRA | Rupture area uncertainty switch   * 0 (no uncertainty in RA model) * 1 (uncertainty considered in RA model) |
| gmmptr | Pointer to GMM object |
| datasource | file\_name.mat  The mat file containing the source geometry is a structure with the following fields:  vertices: [Enodes × 3] (edge node coordinates)  conn: [Nelem × 3] (element connectivity matrix)  xyzm: [Nnodes × 3] (mesh nodes, including edges)  aream: [Nelem × 1] (area of elements)  hypm: [Nelem × 3] (centroid coordinates)  normal: [Nelem × 3] (unit vector normal to each element)  Notation: Enodes is the number of edge nodes, Nelem is the number of triangular elements in the Delaunay triangularization, Nnodes is the number of nodes in the triangularization. |
| reduction | Percentage of ‘xyzm’ nodes used in the scenario mode generation. Recommended value: no less than 20. |

**Area5 Source Object**: Used to model seismicity distributed in a volume. The volume geometry is defined by a reference plane and the thickness perpendicular to the plane. The volume is formed by discretizing the reference plane and extruding the mesh along the normal to the plane in half a thickness along the positive and negative direction, see Figure x.

|  |  |
| --- | --- |
| area5 label mechanism style RA sRA gmmptr lmax nref thick slices vertices | |
| label | unique source label |
| mechanism | Tectonic setting   * interface * intraslab * crustal |
| style | Style of faulting (integer, double or string)   * -999 (if mechanism is unspecified) * rake angle (°) * strike-slip, reverse/oblique, reverse, normal/oblique, or normal |
| RA | Rupture area (RA) handle   * null, wc1994,ellsworth, hanksbakun2001, somerville1999, wc1994r, wc1994s, strasser2010 |
| sRA | Rupture area uncertainty switch   * 0 (no uncertainty in RA model) * 1 (uncertainty considered in RA model) |
| gmmptr | Pointer to GMM object |
| lmax | Maximum length (km) of mesh edges used in the discretization |
| nref | Number of mesh refinements in the reference place |
| thick | Thickness (km) |
| slices | Number of slices in the normal direction |
| vertices | lon1 lat1 elev1  or  X1 Y1 Z1 |

**txt2source Source Object**: Used to include seismic sources from a text file following the format shown above.

|  |  |
| --- | --- |
| txt2soure filename gmmptr lmax nref radius center | |
| filename | textfile containing the sources described |
| gmmptr | Pointer to GMM object |
| lmax | Maximum discretization distance |
| nref | Number of mesh refinements |
| radius | Search Radius (km) of sources |
| center | Lon – lat (°), center coordinates of the circumference |

|  |  |
| --- | --- |
| delta label stype svalue Mchar | |
| label | unique source label |
| stype | Seismic Productivity Type (string)   * NM * SR |
| svalue | Number of events per year above MMin  Slip rate in units of mm/yr |
| Mchar | Characteristic Magnitude |

|  |  |
| --- | --- |
| truncexp label stype svalue bvalue MMin MMax sigmab sigmaMMax | |
| label | unique source label |
| stype | Seismic Productivity Type (string)   * NM * SR |
| svalue | Number of events per year above MMin  Slip rate in units of mm/yr |
| bvalue | Slope of log(lambdaM) vs M |
| MMin | Minimum Magnitude |
| MMax | Maximum Magnitude |
| sigmab | Standard deviation of b-value (Gamma pdf), set to 0 if no uncertainty is considered |
| sigmaMMax | Standard deviation of MMax (Uniform pdf) , set to 0 if no uncertainty is considered |

|  |  |
| --- | --- |
| truncnorm label stype svalue MMin MMax Mchar sigmaMChar | |
| label | unique source label |
| stype | Seismic Productivity Type (string)   * NM * SR |
| svalue | Number of events per year above MMin  Slip rate in units of mm/yr |
| MMin | Minimum Magnitude |
| MMax | Maximum Magnitude |
| Mchar | Characteristic Magnitude (MMin<Mchar<MMax) |
| sigmaMChar | Standard deviation of MChar (normal pdf) |

|  |  |
| --- | --- |
| yc1985 label stype svalue bvalue MMin Mchar | |
| label | unique source label |
| stype | Seismic Productivity Type (string)   * NM * SR |
| svalue | Number of events per year above MMin  Slip rate in units of mm/yr |
| bvalue | Slope of log(lambdaM) vs M |
| MMin | Minimum Magnitude |
| Mchar | Characteristic Magnitude (MMin<Mchar-0.25) |

|  |  |
| --- | --- |
| magtable label Mmin binwidth occurrates | |
| label | unique source label |
| MMin | Minimum Magnitude |
| binwidth | Magnitude bin width |
| occurrates | Mean rate of occurrence for each magnitude |

|  |  |
| --- | --- |
| catalog label filename FDsup FDinf | |
| Label | unique source label |
| filename | Earthquake catalog (\*.mat or \*.csv) |
| FDsup | Upper depth |
| FDinf | Lower depth |

Known Limitations

* Ill posed automatic triangulation may occur in highly warped **area1** source objects. When possible, prefer **area2** source objects.
* For complex 3D geometries, **area6** objects overcomes the limitations of other source objects.
* If a conditional model uses style-of-fault as an input parameter, it must be specified in the GMM declaration, i.e., no automatic definition of SOF. However, the conditioning GMM can have a SOF set to ‘auto’.

**gmm Object**: The gmm command is used to create/add a ground motion model to the ground motion library.

|  |  |
| --- | --- |
| gmm label handle <usp> | |
| label | unique ground motion model |
| handle | String containing the name of the m-file that executes the ground motion model. |
| usp | user specific parameters, specific to each gmm |

|  |  |
| --- | --- |
| **Youngs1997 mechanism** | |
| mechanism | * interface * intraslab |

|  |  |
| --- | --- |
| **AtkinsonBoore2003 mechanism region** | |
| mechanism | * interface * intraslab |
| region | * general * cascadia * japan |

|  |  |
| --- | --- |
| **Zhao2006 mechanism** | |
| mechanism | * interface * intraslab * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |

|  |  |
| --- | --- |
| **Mcverry2006 mechanism rvol** | |
| mechanism | * interface * intraslab * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |
| rvol | Length in km of the source-to-site path in the volcanic zone |

|  |
| --- |
| **ContrerasBoroschek2012** |

|  |  |
| --- | --- |
| **BCHydro2012 mechanism arc DeltaC1** | |
| mechanism | * interface * intraslab |
| arc | * forearc * backarc * unknown |
| DeltaC1 | * lower * central * upper * none |

|  |  |
| --- | --- |
| **BCHydro2018 mechanism** | |
| mechanism | * interface * intraslab |

|  |  |
| --- | --- |
| **Kuehn2020 mechanism region AlfaBackArc AlphaNankai Z10 Z25 Nepist** | |
| mechanism | * interface * intraslab |
| region | * global * aleutian * alaska * cascadia * central\_america\_s * central\_america\_n * japan\_pac * japan\_phi * new\_zealand\_n * new\_zealand\_s * south\_america\_n * south\_america\_s * taiwan\_w * taiwan\_e |
| **AlfaBackArc** | Fraction of Rrup in Backarc |
| **AlphaNankai** | Fraction of Rrup in Nankai Region (Japan only) |
| **Z10** | Depth to 1.0 km/sec shear-wave velocity horizon below site (km) |
| **Z25** | Depth to 2.5 km/sec shear-wave velocity horizon below site (km) |
| **Nepist** | Samples in Epistemic Uncertainty (0=none or 100-800) |

|  |  |
| --- | --- |
| **Arteta2018 arc** | |
| arc | * forearc * backarc |

|  |  |
| --- | --- |
| **Idini2016 mechanism spectype** | |
| mechanism | * interface * intraslab |
| spectype | * sI * sII * sIII * sIV * sV * sVI |

|  |  |
| --- | --- |
| **MontalvaBastias2017 mechanism arc** | |
| mechanism | * interface * intraslab |
| arc | * forearc * backarc * unknown |

|  |  |
| --- | --- |
| **MontalvaBastias2017HQ mechanism arc** | |
| mechanism | * interface * intraslab |
| arc | * forearc * backarc * unknown |

|  |  |
| --- | --- |
| **Montalva2018 mechanism** | |
| mechanism | * interface * intraslab |

|  |  |
| --- | --- |
| **SiberRisk2019 mechanism** | |
| mechanism | * interface * intraslab |

|  |  |
| --- | --- |
| **Garcia2005 component** | |
| component | * horizontal * vertical |

|  |
| --- |
| **Jaimes2006** |

|  |  |
| --- | --- |
| **Jaimes2015 station** | |
| Station | * cu * sct * cdao |

|  |
| --- |
| **Jaimes2016** |

|  |  |
| --- | --- |
| **GarciaJaimes2017 component** | |
| component | * interface * intraslab |

|  |
| --- |
| **GarciaJaimes2017HV** |

|  |  |
| --- | --- |
| **Bernal2014 mechanism** | |
| mechanism | * interface * intraslab |

|  |  |
| --- | --- |
| **Sadigh1997 SOF** | |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |

|  |  |
| --- | --- |
| **I2008 SOF** | |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |

|  |  |
| --- | --- |
| **CY2008 Z10 SOF event VS30type** | |
| **Z10** | Depth to 1.0 km/sec shear-wave velocity horizon below site (km) |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |
| event | * mainshock * foreshock |
| Vs30type | * measured * inferred |

|  |  |
| --- | --- |
| **BA2008 SOF** | |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |

|  |  |
| --- | --- |
| **CB2008 Z25 SOF sigmatype** | |
| Z25 | Depth to 2.5 km/sec shear-wave velocity horizon below site (km) |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |
| sigmatype | * arbitrary * average |

|  |  |
| --- | --- |
| **AS2008 Z10 SOF event Vs30type** | |
| Z10 | Depth to 1.0 km/sec shear-wave velocity horizon below site (km) |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |
| event | * aftershock * mainshock * foreshock * swarms |
| Vs30type | * measured * inferred |

|  |  |
| --- | --- |
| **AS1997h SOF location sigmatype** | |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |
| location | * hangingwall * footwall |
| sigmatype | * arbitrary * average |

|  |  |
| --- | --- |
| **I2014 SOF** | |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |

|  |  |
| --- | --- |
| **CY2014 Z10 SOF Vs30type region** | |
| Z10 | Depth to 1.0 km/sec shear-wave velocity horizon below site (km) |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |
| VS30type | * measured * inferred |
| region | * global * california * japan * china * italy * turkey |

|  |  |
| --- | --- |
| **CB2014 Z25 SOF HWeffect region** | |
| Z25 | Depth to 2.5 km/sec shear-wave velocity horizon below site (km) |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |
| HWeffect | * include * exclude |
| region | * global * california * japan * china * italy * turkey |

|  |  |
| --- | --- |
| **BSSA2014 Z10 SOF region** | |
| Z10 | Depth to 1.0 km/sec shear-wave velocity horizon below site (km) |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |
| region | * global * california * japan * china * italy * turkey |

|  |  |
| --- | --- |
| **ASK2014 Z10 SOF event Vs30type region** | |
| Z10 | Depth to 1.0 km/sec shear-wave velocity horizon below site (km) |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |
| event | * mainshock * aftershock |
| Vs30type | * measured * inferred |
| region | * global * california * japan * china * italy * turkey |

|  |  |
| --- | --- |
| **AkkarBoomer2007 stiff SOF damping** | |
| media | * rock * stiff * soft |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |
| damping | Damping ratio of single degree of freedom oscillator, integer: 2, 5, 10, 20 or 30 |

|  |  |
| --- | --- |
| **AkkarBoomer2010 media SOF** | |
| Media | * rock * stiff * soft |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |

|  |
| --- |
| **Arroyo2010** |

|  |  |
| --- | --- |
| **Bindi2011 SOF component** | |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |
| component | * geoh * z |

|  |
| --- |
| **Kanno2006** |

|  |  |
| --- | --- |
| **Cauzzi2015 Vs30form SOF** | |
| Vs30form | Vs30 formulation   * 1 Vs30 from eq(5) * 2 Vs30 from eq(6) * 3 Vs30 from eq(7) |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |

|  |  |
| --- | --- |
| **DW12 SGSCLASS SOF** | |
| SGSCLASS | SGS Site class (Rodriguez-Marek et al. 2001)   * B * C * D |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |

|  |  |
| --- | --- |
| **FG15 SOF forearc rtype** | |
| SOF | * interface * intraslab * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |
| arc | * forearc * backarc |
| rtype | Regression type   * linear * nonlinear |

|  |  |
| --- | --- |
| **TBA03 SGSCLASS SOF** | |
| SGSCLASS | SGS Site class (Rodriguez-Marek et al. 2001)   * B * C * D |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |

|  |  |
| --- | --- |
| **BU17 SOF CAV** | |
| SOF | * intraplate * subduction-interface * subduction-intraslab * subduction-unknown * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |

|  |  |
| --- | --- |
| **CB10 Z25 SOF** | |
| Z25 | Depth to 2.5 km/sec shear-wave velocity horizon below site (km) |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |

|  |  |
| --- | --- |
| **CB11 Z25 SOF Database** | |
| Z25 | Depth to 2.5 km/sec shear-wave velocity horizon below site (km) |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |
| Database | * CB08-NGA-PSV * CB08-NGA-NoPSV * PEER-NGA-PSV * PEER-NGA-NoPSV |

|  |  |
| --- | --- |
| **CB19 Z25 SOF region** | |
| Z25 | Depth to 2.5 km/sec shear-wave velocity horizon below site (km) |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |
| region | * global * california * japan * china * italy * turkey |

|  |  |
| --- | --- |
| **KM06 SOF** | |
| SOF | * strike-slip * normal * normal-oblique * reverse * reverse-oblique * unspecified |