SCEQSRC Package

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This MATLAB package implements the empirical earthquake source-scaling relations to enable Monte Carlo approach to predict the source parameter(s), i.e., magnitude, and source dimensions (rupture length, rupture width, rupture area) when either of them is provided.

For details on the source-scaling relations, please refer to Thingbaijam et al. (2017) and Thingbaijam and Mai (2020),

Primarily, two specific functions of this package are:

(1) **mw2srcdim**: evaluate the source dimensions, for given magnitude and faulting regime.
(2) **srcdim2mw**: estimate the magnitude, for given source dimension – either rupture length or rupture area and faulting regime.

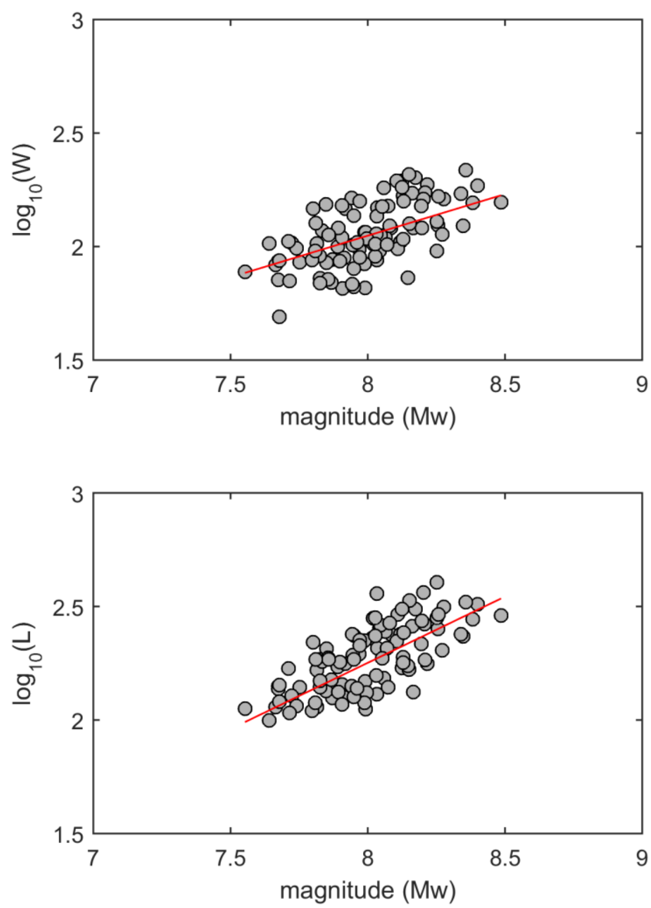
More detail on the syntax/usage of these functions is given later in this file. The same can be also read at MATLAB console by executing each function without the input parameter.

This package is intended to be part/sub-package of updated rupture generator algorithm: krupgen.

The following list two application examples.

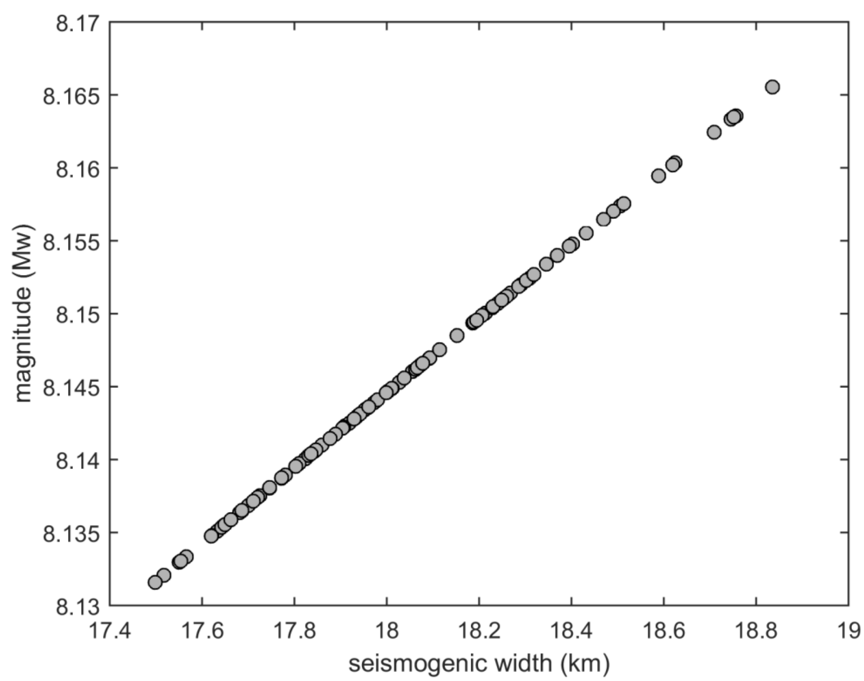
Example 1. For given uncertain magnitude defined by probability distribution (mean and standard deviation), estimate the corresponding rupture width and rupture length for subduction interface event.

```
% get the distribution of magnitudes
Mw      = 8.0 + 0.2*randn(100,1); % 100 sample would be good!

% estimate the source dimensions
[L, W, stats] = mw2srcdim('Mw', Mw, 'fault', 'reverse', 'regime', 'interface');

% plot the results
subplot(2,1,1);
plot(Mw, log10(W), 'ko', 'markerfacecolor', [0.7 0.7 0.7]);
hold on;
plot(Mw, log10(stats.medianW), 'r-');
xlabel('magnitude (Mw)'); ylabel('log_1_0(W)');
axis([7 9 1.5 3]);

subplot(2,1,2);
plot(Mw, log10(L), 'ko', 'markerfacecolor', [0.7 0.7 0.7]);
hold on;
plot(Mw, log10(stats.medianL), 'r-');
xlabel('magnitude (Mw)'); ylabel('log_1_0(L)');
axis([7 9 1.5 3]);
```



Example 2. Estimate the magnitude, given fault length for strike-slip event and finite seismogenic width.

```
% median prediction
[Mw, ~] = srcdim2mw('length', 853, 'fault', 'strike-slip', ...
    'seismogenic_width',18, 'scale', 'median');
disp(Mw);

% examine effect of uncertain seismogenic width - 100 samples, for
% seismogenic width described with lognormal-distributed errors

res = lognrnd(0.05,0.3, 100,1); res=res-median(res);
seismogenic_width = 18+res;

[Mw, stats] = srcdim2mw('length', 853.*ones(100,1), 'fault', 'strike-slip', ...
    'seismogenic_width',seismogenic_width);

plot(seismogenic_width, Mw, 'ko', 'markerfacecolor', [0.7 0.7 0.7]);

ylabel('magnitude (Mw)');
xlabel('seismogenic width (km)');
```



USAGE/SYNTAX

```
function [L, W, stats] = mw2srcdim(varargin)
% Estimates rupture length L (km) and rupture width (km) for given
% magnitude, using the empirical earthquake source-scaling relations.
%
% SYNTAX
%    [L, W, stats] = Mw2SrcDim(...,'ParameterName',ParameterValue,...)
%
%
% LIST of PARAMETERNAMES
%    Mw                   - Moment Magnitude, for example, 'Mw',7.6
%
%    fault                - faulting type/style.
%                           ParameterValue can be one of the following:
%                           'strike-slip', 'reverse', 'normal'
%
%    regime               - seimogenic regime.
%                           ParameterValue can be one of the following:
%                           'crustal', 'interface'
%                           Interface refers to subduction interface.
%                           Also see: "How to implement scaling relations
%                           from other authors" in Additional notes.
%
%    The above input parameters are mandatory. Optional ones are:
%    Author               - a unique shorthand for the authors
%                           Example: 'Author', 'TMG2017'
%                           This explicitly specify that the relations of
%                           Thingbaijam, Mai and Goda(2017) be applied,
%                           which  is default value.
%
%                           Also see: "How to implement scaling relations
%                           from other authors" in Additional notes.
%
%    seismogenic_width    - Set fixed (maximum) seismogenic width/s (in km).
%                           If this is array, its size should be same as Mw.
%                           Array can be used to account for uncertain
%                           seismogenic width. Seismogenic width (Wseis) is
%                           different from seismogenic depth (Zseis.
%                           Wseis = Zseis/sind(dipAn),
%                           where dipAn is fault-dip in degrees.
%                           Default value is set 6378 km.
%
%    scale                - This can be use to avoid random sampling.
%                           For example: 'scale', 'median'
%                           In this case, output stats is not set.
%                           Default value: 'random'
%
% OUTPUTS
%    L, W                 - Rupture length (in km), Rupture width (in km)
%    stats                - A structure with field:
%                           medianL: median rupture length (in km)
%                           medianW: median rupture width (in km)
%                           Lseed  : seed for random sampling of L
%                           Wseed  : seed for random sampling of W
```

```
function [Mw, stats] = srcdim2mw(varargin)
% Estimates magnitude (Mw) for given source dimension, either rupture length (km)
% or rupture area (sq. km), using the empirical earthquake source-scaling
% relations. If both rupture length and rupture area are provided, then the
% magnitude is estimated based on rupture area.
%
% SYNTAX
%    [L, W, stats] = Mw2SrcDim(...,'ParameterName',ParameterValue,...)
%
% LIST of PARAMETERNAMES
%    Length               - Rupture length (in km)
%
%    Area                 - Rupture Area (in sq. km)
%
%    fault                - faulting type/style.
%                             ParameterValue can be one of the following:
%                             'strike-slip', 'reverse', 'normal'
%
%    regime               - seimogenic regime.
%                             ParameterValue can be one of the following:
%                             'crustal', 'interface'
%                             Interface refers to subduction interface.
%                             Also see: "How to implement scaling relations
%                             from other authors" in Additional notes.
%
%    The above input parameters are mandatory. Optional ones are:
%    Author               - a unique shorthand for the authors
%                             Example: 'Author', 'TMG2017'
%                             This explicitly specify that the relations of
%                             Thingbaijam, Mai and Goda(2017) be applied,
%                             which  is default value.
%
%                             Also see: "How to implement scaling relations
%                             from other authors" in Additional notes.
%
%   seismogenic_width    - Set fixed (maximum) seismogenic width/s (in km).
%                             If this is array, its size should be same as Mw.
%                             Array can be used to account for uncertain
%                             seismogenic width. Seismogenic width (Wseis) is
%                             different from seismogenic depth (Zseis.
%                             Wseis = Zseis/sind(dipAn),
%                             where dipAn is fault-dip in degrees.
%                             Default value is set 6378 km.
%
%    scale                - This can be use to avoid random sampling.
%                             For example: 'scale', 'median'
%                             In this case, output stats is not set.
%                             Default value: 'random'
%
% OUTPUTS
%    Mw                   - Moment Magnitude
%    stats                - A structure with field:
%                             medianMw: median magnitude (Mw)
%                             seed  : seed used for random sampling
%
```

References

Thingbaijam, K.K.S., and P.M. Mai (2020). Notes on empirical earthquake source-scaling laws, Bulletin of Seismological Society America, under review

Thingbaijam, K.K.S., P.M. Mai, and K. Goda (2017). New empirical earthquake source-scaling laws, Bulletin of Seismological Society America, 107, 2225–2246.