UNIVERSITÀ
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The DMG Manuals

NDSHA Reference Guide (Regional Scale)

Description of the computer package for the computation of seismic hazard maps with the neodeterministic approach

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FOREWORD

The Deterministic Seismic Zoning package is aimed at the definition of ground shaking maps for large territories, based on the computation of synthetic seismograms by the modal summation technique.

The package consists of several programs that must be executed in a given sequence and have been polished to become more user friendly. After the basic input files are prepared by the user, a simple script will call the sequence and will produce all the output automatically. Each program generates the input files for the next one to run, with default parameters. Power users can run each program separately, playing with input files to try parametric analyses.

In the package are included other programs useful to convert formats, compare results, ...

Program	Brief description
makehaz.out	preparation of hazard sequence
ecells.out	discretization of seismicity, with selection from adjacent catalogues
esmooth.out	smoothing of seismicity
einscat.out	introduction of seismogenic zones (polygons)
eselmec.out	choice of focal mechanisms
emecmed.out	preparation of database of sources
epatgen.out	definition of source-receiver paths
ecinput.out	preparation of input files for nsgr, nsgv, nsgl
esgrz0050.out	computation of radial and vertical component, and rotation to NS and EW
esgl0050.out	computation of transverse component, and rotation to NS ed EW
esne.out	sum EW and NS components from nsgr and nsgl
efft.out	perform scaling, derivatives, filtering, compute response spectra
esre.out	computes resultant component
ecou.out	extracts relevant parameters from the synthetic seismograms
efinmax.out	selects for each site the value to be reported on the map
efinmaxdgav.out	select for each site the dga value to be reported on the map
eexmaxsig.out	selects for each site the seismogram with the maximum peak
eexmaxsigdga.out	select for each site the seismograms responsible for the maximum dga and gather them into a single file
hazcpt.out	preparation of color palettes for plotting
hazlegend.out	preparation of color palettes for plotting with symbols
hazgmt.sh	shell script for plotting

haz_compare.out	compare two or more hazard results
ina.out	discretization of seismicity, with selection from adjacent catalogues, smoothing of seismicity, select sources within nodes and select sources within CN or M8 regions
isa.out	discretization of seismicity, with selection from adjacent catalogues, smoothing of seismicity, introduction of seismogenic zones (polygons) and select sources within CN or M8 regions
mag2cel.out	from .mag to .cel (?)

GETTING STARTED

Read very carefully the LIST OF REQUIRED INPUT FILES. From there jump to the description of the USER-CREATED DATA FILES, and prepare your files following strictly the required format, with due attention to the DETAILS, FAQS (Frequently Asked Questions) and WARNING associated with each file.

If you are new to this package, you are very likely going to perform a "default run". This is a run where default values are used. You should only take care of preparing the files described in the USER-CREATED DATA FILES section, nothing more than that. All the other parameter files will be created automatically by the programs. Even experienced users, 90% of the times will perform default runs.

List of required input files

For hazard mapping, you are strongly recommended to run the programs using the default parameters. If you follow this rule you have to prepare a reduced number of input files. The others will be set by the programs automatically.

To start the procedure with the default parameters you have to have in your folder the following files, listed below with the convention:

bold - file must be prepared by the user,

italic - file must be used "as is", independently on the run.

italic - file created by other package (see file 1d.pdf).

Each run must be uniquely identified by a sequence of characters (root) in the filename. All the examples in this manual refer to a test run with root "xxx". Since rather long filenames are generated by the programs, it is strongly suggested that the root does not exceed six characters length.

Input files include:

1. general parameter file (**makehaz.par**)
2. files for source definition (magnitude, focal mechanism, position)
3. files for structures definition
4. source spectra
5. design spectra for computing Design Ground Acceleration (DGA) (**.cod*)
6. optional files

Different types of run required different input files, as specified In the following.

Files for structures definition

xxx.por	the polygons associated with average regional structural models
xxx0001.spl	spectral quantities associated with polygon 1 defined in .por (SH)
xxx0001.spr	spectral quantities associated with polygon 1 defined in .por (P-SV)
…	
xxx000n.spl	spectral quantities associated with polygon n defined in .por (SH)
xxx000n.spr	spectral quantities associated with polygon n defined in .por (P-SV)
xxx0001.stp	physical layers associated with polygon 1 defined in .por (needed only if DWN program is used)
…	
xxx000n.stp	physical layers associated with polygon n defined in .por (needed only if DWN program is used)

	only MS	only DWN	MS + DWN
xxx.por	yes	yes	yes
xxxNNNN.spr, xxxNNNN.spl	yes	no	yes
xxxNNNN.stp	no	yes	yes

Files for source definition (magnitude, focal mechanism, position)

cells.par the parameter file for the first program of the sequence (discretizazion of seismicity)

xxx.fps the fault plane solutions available

yyy.eqc the earthquake catalogue with historical seismicity

yyy.poc the polygons defining the area where yyy.eqc has to be used

xxx.pos the polygons that define the seismogenic zones

xxx.pog the polygons that define the zones for recurrence and values of GR parameters

xxx.pcn the polygons that define CN regions

xxx.pm8 the polygons that define M8 circles

xxx.nod the nodes parameter

xxx.sut the selected sources

	classic	nodes	ZS + nodes	CN	M8					
cells.par										
xxx.fps										
yyy.eqc										
yyy.poc										
xxx.pos										
xxx.pog										
xxx.pcn										
xxx.pm8										
xxx.nod										
xxx.sut										

Source spectra

gusev01.xy Spectral curves for scaling seismograms with magnitude

gusev02.xy "

gusev03.xy "

gusev04.xy	"
gusev05.xy	"
gusev06.xy	"
gusev07.xy	"
gusev08.xy	"
gusev09.xy	"
gusev10.xy	"
guphas090.40	Spectral curves for scaling seismograms with magnitude (phase and amplitude)
...	"
guphas090.89	Specral curves for scaling seismograms with magnitude (phase and amplitude)

Optional files

***.obs**	the selected sites
.hazgmtregion	min and max longitude and latitude of the area (and other parameters) for plotting
hazdistance.max	maximum distance for different magnitudes thresholds
hazdistance.min	minimum distance for different magnitudes thresholds

xxx.por	the polygons associated with average regional structural models
***.obs**	the selected sites (optional)
itacode.cod	EC8 design spectra for computing Design Ground Acceleration (DGA)
gusev01.xy	Spectral curves for scaling seismograms with magnitude
gusev02.xy	"
…	
…	
gusev09.xy	"
gusev10.xy	"

xxx0001.spl	spectral quantities associated with polygon 1 defined in .por (SH)
xxx0001.spr	spectral quantities associated with polygon 1 defined in .por (P-SV)
…	
xxx000n.spl	spectral quantities associated with polygon n defined in .por (SH)
xxx000n.spr	spectral quantities associated with polygon n defined in .por (P-SV)

CN run

makehaz.par the parameter file that creates the script that activates the sequence of programs, with default parameters

cells.par the parameter file for the first program of the sequence

xxx.fps the fault plane solutions available

yyy.eqc the earthquake catalogue with historical seismicity

yyy.poc the polygons defining the area where xxx.eqc has to be used

xxx.por the polygons associated with average regional structural models

***.obs** the selected sites (optional)

xxx.pos the polygons that define the seismogenic zones

xxx.pcn the polygons that define CN regions

itacode.cod EC8 design spectra for computing Design Ground Acceleration (DGA)

gusev01.xy Spectral curves for scaling seismograms with magnitude

gusev02.xy "

gusev03.xy "

gusev04.xy "

gusev05.xy "

gusev06.xy "

gusev07.xy "

gusev08.xy "

gusev09.xy "

gusev10.xy "

xxx0001.spl spectral quantities associated with polygon 1 defined in .por (SH)

xxx0001.spr spectral quantities associated with polygon 1 defined in .por (P-SV)

…

xxx000n.spl spectral quantities associated with polygon n defined in .por (SH)

xxx000n.spr spectral quantities associated with polygon n defined in .por (P-SV)

M8 run

makehaz.par the parameter file that creates the script that activates the sequence of programs, with default parameters

cells.par the parameter file for the first program of the sequence

xxx.fps the fault plane solutions available

yyy.eqc the earthquake catalogue with historical seismicity

yyy.poc the polygons defining the area where xxx.eqc has to be used

xxx.por the polygons associated with average regional structural models

***.obs** the selected sites (optional)

xxx.pos the polygons that define the seismogenic zones

xxx.pm8 the polygons that define M8 circles

itacode.cod EC8 design spectra for computing Design Ground Acceleration (DGA)

gusev01.xy Specral curves for scaling seismograms with magnitude

gusev02.xy "

gusev03.xy "

gusev04.xy "

gusev05.xy "

gusev06.xy "

gusev07.xy "

gusev08.xy "

gusev09.xy "

gusev10.xy "

xxx0001.spl spectral quantities associated with polygon 1 defined in .por (SH)

xxx0001.spr spectral quantities associated with polygon 1 defined in .por (P-SV)

…

xxx000n.spl spectral quantities associated with polygon n defined in .por (SH)

xxx000n.spr spectral quantities associated with polygon n defined in .por (P-SV)

NODES run

makehaz.par the parameter file that creates the script that activates the sequence of programs, with default parameters

cells.par the parameter file for the first program of the sequence

yyy.eqc the earthquake catalogue with historical seismicity

yyy.poc the polygons defining the area where xxx.eqc has to be used

xxx.por the polygons associated with average regional structural models

***.obs** the selected sites (optional)

xxx.nod the nodes parameter

itacode.cod EC8 design spectra for computing Design Ground Acceleration (DGA)

gusev01.xy Specral curves for scaling seismograms with magnitude

gusev02.xy "

gusev03.xy "

gusev04.xy "

gusev05.xy "

gusev06.xy "

gusev07.xy "

gusev08.xy "

gusev09.xy "

gusev10.xy "

xxx0001.spl spectral quantities associated with polygon 1 defined in .por (SH)

xxx0001.spr spectral quantities associated with polygon 1 defined in .por (P-SV)

…

xxx000n.spl spectral quantities associated with polygon n defined in .por (SH)

xxx000n.spr spectral quantities associated with polygon n defined in .por (P-SV)

NODES+CN RUN

makehaz.par the parameter file that creates the script that activates the sequence of programs, with default parameters

cells.par the parameter file for the first program of the sequence

yyy.eqc the earthquake catalogue with historical seismicity

yyy.poc the polygons defining the area where xxx.eqc has to be used

xxx.por the polygons associated with average regional structural models

***.obs** the selected sites (optional)

xxx.pcn the polygons that define CN regions

xxx.nod the nodes parameter

itacode.cod EC8 design spectra for computing Design Ground Acceleration (DGA)

gusev01.xy Specral curves for scaling seismograms with magnitude

gusev02.xy "

gusev03.xy "

gusev04.xy "

gusev05.xy "

gusev06.xy "

gusev07.xy "

gusev08.xy "

gusev09.xy "

gusev10.xy "

xxx0001.spl spectral quantities associated with polygon 1 defined in .por (SH)

xxx0001.spr spectral quantities associated with polygon 1 defined in .por (P-SV)

…

xxx000n.spl spectral quantities associated with polygon n defined in .por (SH)

xxx000n.spr spectral quantities associated with polygon n defined in .por (P-SV)

NODES+M8 run

makehaz.par the parameter file that creates the script that activates the sequence of programs, with default parameters

cells.par the parameter file for the first program of the sequence

yyy.eqc the earthquake catalogue with historical seismicity

yyy.poc the polygons defining the area where xxx.eqc has to be used

xxx.por the polygons associated with average regional structural models

***.obs** the selected sites (optional)

xxx.pm8 the polygons that define M8 circles

xxx.nod the nodes parameter

itacode.cod EC8 design spectra for computing Design Ground Acceleration (DGA)

gusev01.xy Specral curves for scaling seismograms with magnitude

gusev02.xy "

gusev03.xy "

gusev04.xy "

gusev05.xy "

gusev06.xy "

gusev07.xy "

gusev08.xy "

gusev09.xy "

gusev10.xy "

xxx0001.spl spectral quantities associated with polygon 1 defined in .por (SH)

xxx0001.spr spectral quantities associated with polygon 1 defined in .por (P-SV)

…

xxx000n.spl spectral quantities associated with polygon n defined in .por (SH)

xxx000n.spr spectral quantities associated with polygon n defined in .por (P-SV)

SUT run

makehaz.par the parameter file that creates the script that activates the sequence of programs, with default parameters

xxx.por the polygons associated with average regional structural models

xxx.sut the selected sources

***.obs** the selected sites (optional)

itacode.cod EC8 design spectra for computing Design Ground Acceleration (DGA)

gusev01.xy Specral curves for scaling seismograms with magnitude

gusev02.xy "

gusev03.xy "

gusev04.xy "

gusev05.xy "

gusev06.xy "

gusev07.xy "

gusev08.xy "

gusev09.xy "

gusev10.xy "

xxx0001.spl spectral quantities associated with polygon 1 defined in .por (SH)

xxx0001.spr spectral quantities associated with polygon 1 defined in .por (P-SV)

…

xxx000n.spl spectral quantities associated with polygon n defined in .por (SH)

xxx000n.spr spectral quantities associated with polygon n defined in .por (P-SV)

Example of input files

These are examples of the files that the user should prepare in order to run the *hazard* script with default parameters. They are located in /XDST/HazExample(?). In this example it is assumed that the default run has the name *xxx.*

makehaz.par

Parameter file for the program that creates the hazard sequence. Older versions of makehaz.par are accepted.

```
Parameters for program makehaz                          (v0006)
-----------------------------------------------------------------
RUN DEFINITION
-----------------------------------------------------------------
z1d                                     Name of the run (max 15 char.)
  11 15           Min and max longitude              (degrees)
  45 47           Min and max latitude               (degrees)
1                 Use seismogenic zones (0=no, 1=yes)
0                 Use nodes (0=no, 1=yes, 2= yes separately)
0                 File with nodes coordinates (max 12 char.)(for nodes only)
0                 Use alerted areas (0=no, 1=CN, 2=M8S)
0                 Use recurrence (0=no, 1=Multiscale GR)
0                 File with recurrence parameters (max 12 char.)
1                 Execution (0=full ,1=until sources,2=until paths,3=obs+sut,4=0 minus
plot)
15                Clean level (0=no, 3=save all seismograms, 11=save unscaled, 15
clean all; see manual)
0                 Grid execution         (igrid)      (1=yes, 0=no)
0                 Big run  (ibig)  (1=yes, 0=no)
-----------------------------------------------------------------
SOURCE DEFINITION
-----------------------------------------------------------------
5.0               Min magnitude associated with the run
0  99             Min and maximum magnitude taken from catalogues
1000 2009         First and last year in catalogue   (years)
  .2              Cell size                          (degrees)
  3               Smoothing radius                   (cells)
  0               Min. events for smooth             (count)
  0  50           Min and max depth                  (km)
999               Source depth                       (sdepth)     (0=sut,
999=auto,x=km)
-----------------------------------------------------------------
PATH DEFINITION
-----------------------------------------------------------------
1   0             Min. and max source-site distance km (0=auto,>0 use the value)
0                 Short paths (ishortpaths) (0=elim,1=use rmin,2=adjust)
0                 File (.obs) with observation points (instead of default grid) (max
12 char.)
-----------------------------------------------------------------
TIME SERIES
-----------------------------------------------------------------
  0               Program for Green function computation (igreen) (0 - only MS; 1 - MS
and DWN for short distance; 2 - only DWN)
  1.              Peak frequency         (peakfr)     (1.0 or 10.0)
  1               Interpolation for MS   (npint)      (0-9)
  1               Interpolation for DWN  (npintp)     (0-9)
  1               Seismogram format      (iform)      (0=ASCII, 1=bin)
4096              Time series samples    (npts)       (4096)
  0               Time series length     (iall)       (0=truncated,1=complete)
  1               Type of motion         (itype)      (1=dis, 2=vel, 3=acc)
  1               Vertical component     (ivert)      (1=yes,0=no)
  1  90           Type of scaling        (iscale,iaz) (1=classic,2=pulsyn)(angle)
-----------------------------------------------------------------
OUTPUTS
-----------------------------------------------------------------
  0               Output formats (iouform) (0=ASCII, 1=bin)
itacode.cod       File with code response spectra for computing DGA (max 12 char.)
  0               Plot seismograms        (isis)      (1=yes,0=no)
  0               Compute response spectra (irs)      (0=no, 1=only 5% damping, 2=all
dampings)
```

FORTRAN statements to read file (see subroutine readmakehaz in hazard_library3)

```
 !!legge le righe di makehaz.f
 do i=1,4
  read(iunit,*)
 enddo
 name='namerun'
 call readname(iunit,name,15,tmp,err)
 if  (err.gt.0) then
     exitcode=1
     return
 end if
 namerun=tmp(1:15)
 istop=len_trim(namerun)
!!Controlla che il nome associato al run non sia vuoto
 if(len_trim(namerun).eq.0)then
  exitCode=1
 return
endif
 read(iunit,*,err=43)minlo,maxlo
 read(iunit,*,err=43)minla,maxla
 read(iunit,*,err=43)izs
 read(iunit,*,err=43)inod
 !read(iunit,'(a12)')filnod
 name='filnod'
 call readname(iunit,name,12,tmp,err)
 filnod=tmp(1:12)

 read(iunit,*,err=43)ipred
 if (iVersion.ge.2) then
    read(iunit,*,err=43)irec
    !read(iunit,'(a12)')filrec
    name='filrec'
    call readname(iunit,name,12,tmp,err)
    filrec=tmp(1:12)
 else if (iVersion.eq.1) then
    irec=0
    filrec=''
 end if
 read(iunit,*,err=43)ihaz
 if (ihaz.eq.3) then
    izs=0
    inod=0
 end if
 read(iunit,*,err=43)iclean
 if (iVersion.ge.6) then
   read(iunit,*,err=43)igrid
   read(iunit,*,err=43)ibig
 else
   ibig=0
 end if
 do i=1,3
  read(iunit,*)
 enddo
 read(iunit,*,err=43)smmin
 if (iVersion.ge.3) then
    read(iunit,*,err=43)magmin,magmax
 else
    magmin=-1.
    magmax=999.
 end if
```

```
read(iunit,*,err=43)year1,year2
read(iunit,*,err=43)divcel
read(iunit,*,err=43)ksmthr
read(iunit,*,err=43)nsmth
read(iunit,*,err=43)h1,h2
read(iunit,*,err=43)sdepth
do i=1,3
 read(iunit,*)
enddo
read(iunit,*,err=43)kmin,kmax
read(iunit,*,err=43)ishortpaths
!read(iunit,'(a12)')filobs
name='filobs'
call readname(iunit,name,12,tmp,err)
filobs=tmp(1:12)
do i=1,3
 read(iunit,*)
enddo
if  (iVersion.ge.5) then
  read(iunit,*,err=43)igreen
end if
read(iunit,*,err=43)peakfr
read(iunit,*,err=43)npint
if  (iVersion.ge.5) then
  read(iunit,*,err=43)npintp
else
  npintp=npint
end if
read(iunit,*,err=43)iform
read(iunit,*,err=43)npts
read(iunit,*,err=43)iall
read(iunit,*,err=43)itype
read(iunit,*,err=43)ivert
read(iunit,*,err=43)iscale,iaz
!read(iunit,'(a12)')fildat
if (iVersion.lt.6) then
  name='fildat'
  call readname(iunit,name,12,tmp,err)
  fildat=tmp(1:12)
  read(iunit,*,err=43)isis
end if
if  (igrid.eq.-1) then
    read(iunit,*,err=43)igrid
end if
if  (iVersion.ge.6) then
  do i=1,3
   read(iunit,*)
  enddo
  read(iunit,*,err=43)iouform
  name='fildat'
  call readname(iunit,name,12,tmp,err)
  fildat=tmp(1:12)
  read(iunit,*,err=43)isis
  read(iunit,*,err=43)irs
else
  irs=0
  iouform=0
end if
```

Explanation of data

namerun	Name of the run (max 15 char.)
minlo,maxlo	Min and max longitude (degrees)
minla,maxla	Min and max latitude (degrees)
izs	Use seismogenic zones (0=no, 1=yes)
inod	Use nodes (0=no, 1=yes, 2= yes separately)
filnod	File with nodes coordinates (max 12 char.)
ipred	Use alerted areas (0=no, 1=1=Multiscale GR)
irec	Use recurrence (0=no, 1=yes)
filrec	File with recurrence parameters (max 12 char.)
ihaz	Execution (0=full,1=until sources,2=until paths,3=from obs+sut,4=0 no plot)
iclean	Clean level (0 no, 3 save all seismograms, 15 clean all)
igrid	Adapt hazard script to computation on GRID infrastructure (1=yes,0=no)
ibig	Big run (1=yes, 0=no) (will divide the full run in many parallel jobs)
smmin	Min magnitude associated with the run
magmin,magmax	Min and max magnitude of events taken from catalogues
year1,year2	First and last year in catalogue (years)
divcel	Cell size (degrees)
ksmthr	Smoothing radius (cells)
nsmth	Min. events for smooth (count)
h1,h2	Min and max depth (km)
sdepth	Source depth (0=sut,999=auto,x=km)
kmin,kmax	Min. and max source-site distance km (0=auto; kmin=-1 for DWN)
ishortpaths	Short paths (0=elim,1=use rmin,2=adjust)
filobs	File (.obs) with observation points (instead of default grid) (max 12 char.)
igreen	Program for Green function computation (0 - only MS; 1 - MS and DWN for short distance; only DWN)
peakfr	Peak frequency (1.0 or 10.0)
npint	Interpolation for MS (0-9)
npintp	Interpolation for DWN (0-9)
iform	Seismogram format (0=ASCII, 1=bin)
npts	Time series samples (4096)
iall	Time series length (0=truncated,1=complete)
itype	Type of motion (1=dis, 2=vel, 3=acc)
ivert	Vertical component (1=yes,0=no)
iscale,iaz	Type of scaling (1=classic,2=pulsyn)(angle)
iouform	Output formats (0=ASCII, 1=bin)
fildat	File with code response spectra for computing DGA (max 12 char.)
isis	Plot seismograms (1=yes,0=no)
irs	Compute response spectra (0=no, 1=only 5% damping, 2=all dampings)

Details

You must specify the name of the run xxx (maximum 15 characters).

To check if there are no problems in your input files, you can run the program makehaz.out changing the value of “Execution” first into 1 and then into 2. If everything is ok, you can run the program makehaz.out with the value 0.

iclean must be converted in binary format and interpreted as follow:

	no clean	clean as soon as possible	clean at the end of the run	save scaled seismograms	save all seismograms
as soon as possible (2^0=1)	0	1	0	1	1
others (2^1=2)	0	1	1	1	1
unscaled seismograms (2^2=4)	0	1	1	1	0
scaled seismograms (2^3=8)	0	1	1	0	0
iclean (sum)	**0**	**15**	**14**	**7**	**3**

FAQs

(none)

Warning

- For current dimensioning in the programs, for a default run with the suggested cell size of 0.2° do not define areas more than 44° wide along longitude and 44° tall along latitude.
- Only two digits are used for latitude, longitude and cell size.
- At present, array dimensions is 220 x 220 (lat,lon grid points).

cells.par

Parameter file for the first program of the package (seismicity gridding). Older versions of makehaz.par are accepted.

```
parameters for program cells (filenames reading format: A20)  (v0002)
0                              selection criterium for magnitude (iselmag)
aaa.eqc                        file with first earthquake catalogue
aaa.poc                        file with first polygons of validity
bbb.eqc                        file with second earthquake catalogue
bbb.poc                        file with second polygons of validity
…
zzz.eqc                        file with nth earthquake catalogue
zzz.poc                        file with nth polygons of validity
```

Details

Each earthquake catalogue (.eqc) has a polygon file (.poc) that defines its validity area. This is important mostly when dealing with neighboring countries, each one having its own earthquake catalogue available.

Possible values for iselmag are:

0 - cells takes maximum magnitude value between m1, m2, m3, m4
1 - cells takes m1 for each event
2 - cells takes m2 value for each event
3 - cells takes m3 value for each event

4 - cells takes m4 value for each event

See aaa.eqc for explanation about m1, m2, m3, m4 variables.

FAQs

Q: Do I have to prepare a .poc file if I don't have to take care of neighboring countries?

A: Yes, this is required by the software. You can just assume the rectangle including all the events listed in your catalogue. Neverheless, there is generally no need of considering events at distances larger than 200 km from the region for which you'll compute the hazard.

Warning

- In general, when dealing with catalogues from neighboring countries, it's recommended to analyze and merge the earthquake catalogues with care about possible duplicates reported at different coordinates in neighboring catalogues.

aaa.eqc

Earthquake catalogue with observed seismicity

```
1005 1 1 0 0 0 4347  1188  0520520  05200
1005 1 1 0 0 0 4150  1375  0520520  05200
…
1991 531 949 0 4428  1005  5320  0  0  00
1991 53110 4 0 4346  1296 10220  0  0  00
```

FORTRAN statement to read one record

```
      read(1,1)iy,m,id,iho,mi,isc,la,lo,ih,m1,m2,
     *         m3,m4,idummy
    1 format(i4,5i2,i5,i6,5i3,i1)
```

Explanation of data:

iy	year
m	month
id	day
iho	hour
mi	minute
isc	second
la	latitude*100 (example: 1492 means 14.92 degrees North)
lo	longitude*100 (example: -12372 means 123.72 degrees West)
ih	depth (km)
m1	magnitude1 *100
m2	magnitude2 *100
m3	magnitude3 *100
m4	magnitude4 *100
idummy	unused, set to 0

Details

This file is the catalogue of known events that affected the studied area in the past. In parallel, file .poc contains the polygon that defines the area for which the catalogue can be assumed valid. When running for adjacent countries you have to carefully investigate the completeness of each national earthquake catalogue in the areas where they overlap. In this case files .poc should be set so that each catalogue is used where it is best compared with the others.

FAQs

Q: For historical events I do not have all the information. What can I do?

A: Just include what you know. You must include at least latitude, longitude and magnitude obtained from intensity. Put a 0 in all other fields.

Q: My catalogue is not complete. What can I do?

A: Opposite to what happens with probabilistic methods, in this deterministic approach we don't care much about catalogue completeness for magnitudes smaller than 5. Seismicity will be discretized into cells (0.2° x 0.2°), and only the biggest event that occurred in each cell will be considered. Furthermore, within seismogenic zones defined in file .pos, if magnitude observed in the catalogue is lower than 5 or no event is reported in the catalogue, magnitude 5 will be used by default.

Q: Can I include information on seismic potential of active faults known from geology, for which I have no information in the historical catalogue?

A: Yes, you can create a .eqc file with seismic potential data rather than observations. But remember that the default run is meant to be made with observations! You can rerun programs with the catalogue of seismic potential, and consider it as a parametric test.

xxx.fps

File with list of available focal mechanisms

```
-------------------- FPGNDT.DAT -Revised- July 1, 1977 -------------------------
NUMBEA YEARMODY HRMISEC LA.TITN LON.GITE DEPT MLMDMSMBMA AGEN AREADESCRI
NUMBEF ST1 D1 RA1  ST2 D2 RA2   PDI PI  TDI TI  BDI BI Q REFE AREADESCRI
NUMBEM M00 SF REFE DURA F2 M0XX ER1 M0YY ER2 M0ZZ ER3 M0XY ER4 M0XZ ER5 M0YZ ER6
NUMBET HDR SF M0 TVAL TD TAZ NVAL ND NAZ PVAL PD PAZ AST AD ARA BST BD BRA REFER
NUMBEU SF SMRR ER1 SMTT ER2 SMFF ER3 SMRT ER4 SMRF ER5 SMTF ER6
--------------------------------------------------------------------------------
   44A 19591223  929000 37.720N  14.610E  770  0 0 0 053      SICILY
00044F 077 43 004  344 87 132   041 29  289 34  161 43   0001 SICILY
   54A 19671031 2108000 37.840N  14.600E  380  0 0 0 050      SICILY
00054F 009 61 189  274 80 333   228 27  324 13  077 60   0001 SICILY
   58A 19680115  201000 37.780N  13.030E   30  0 0 0 054      SICILY
00058F 204 70 015  108 75 159   157 04  065 25  255 65   0001 SICILY
   58B 19680115  201085 37.750N  12.983E  100  0 0 054 0      SICILY
00058G 270 50 035  156 64 134   216 08  116 50  313 39   0002 SICILY

…

   88A 19760917  123000 38.100N  13.300E  330  0 0 0 044 XXXX SICILY
00088F 322 69 240  200 36 323   194 56  074 19  334 28   0001 SICILY
00676A 19771225 1150    37.000N  15.200E  090  0 0 0 0 0 XXXX ETNA
00676F 036 76 093  206 15 079   124 30  310 59  216 03   0038 ETNA
  601A 0000000000000    39.800N  19.000E  000  0 0 0 0 0 XXXX IONIAN SEA
  601F 030 90 180                                        0000 IONIAN SEA
```

FORTRAN statements to read the event records

(numer before label ‘A’,... - only for user)

```
      read(1,"(a)") rec1                ! character*80 rec1
  100 if(index('ABCDE',rec1(6:6)).ne.0) read(rec1,2)
     *          labr,r1lat,lb,r1lon,lc,ide,ml,md,ms,mb,ma
      do ilab=1,6
         if(labr(ilab:ilab).eq.' ') labr(ilab:ilab)='0'
      enddo
      if(lb.eq.'S'.or.lb.eq.'s') r1lat=-r1lat
      if(lc.eq.'W'.or.lc.eq.'w') r1lon=-r1lon
      read(1,1) rec2                    ! character*80 rec2
```

```
      if(index('ABCDE',recl(6:6)).ne.0) then
           rec1=rec2
           go to 100
      endif
      if(index('FGHIL',recl(6:6)).ne.0)
     *     read(rec2,3) istr1,idip,irak1,istr2,idip2,irak2,
     *                  iptre,ipplu,ittre,itplu
    1 format(a80)
    2 format(a6,17x,f7.3,a1,f8.3,a1,1x,i4,1x,5i2)
    3 format(7x,2i3,1x,i3,2x,2i3,1x,i3,3x,2i3,2x,2i3)
```

Explanation of data

labr	a 6-character label (5 digits and 1 letter - A...M)
r1lat	latitude in degrees (0≤r1lat≤90; example 45.68)
lb	latitude specification (N for North, S for South)
r1lon	longitude in degrees (0≤r1lon≤180; example 120.88)
lc	longitude specification (E for East, W for West)
ide	depth in km multiplied * 10
mL	local magnitude multiplied * 10
md	duration magnitude multiplied * 10
ms	surface waves magnitude multiplied * 10
mb	body waves magnitude multiplied * 10
ma	other magnitude multiplied * 10
istr1	strike angle of plane A
idip1	dip angle of plane A
irak1	rake angle of plane A
istr2	strike angle of plane B
idip2	dip angle of plane B
irak2	rake angle of plane B
iptre	p-axis trend
ipplu	p-axis plunge
ittre	t-axis trend
itplu	t-axis plunge

Details

This is the file with the list of focal mechanisms available for the region of interest. There are seven comment records to begin with (description of content for each type of record). After them, each fps has at least two records defined: record with label A (info for event) and F(fps). If you have different solutions proposed for the same event, you can enter them in the file with labels B and G (and then C and H, D and I and E and L) respectively. So at most 5 different solutions can be associated with the same event. All the solutions that you enter in the file will be used by the package, with no priorities. Records with label M (tensor components), T and U needn't to be defined.

You need to have at least one solution falling within each seismogenic zone defined in the file .pos. If you enter more than one mechanism per polygon program emecmed will compute a "representative" fps obtained as the average of the available moment tensors (each event and each solution together). This might not be a good choice in case the available solutions differ significatively one each other. It sounds more reasonable to include in the .fps file just one representative focal mechanism per seismogenic zone.

FAQs

(none)

Warning

- The package will just read event index, coordinates, magnitude and strike, dip and rake of nodal plane A. For the sake of information completeness, you should better fill in all the other fields.
- Event index (the numerical part of the label labr) must be different for different events. It must be equal only for different solutions associated with the same event.
- Strike, dip and rake must be defined using the convention reported in Aki and Richards. Positive rake angles remain untouched. Negative rake angles should be transformed to positive performing the operation (360 + negative_rake). Here you have some rake examples:

Aki and Richards	*Operation*	*Value for .fps file*
90	none	90
-50	360-50	310
0	none	0
180	none	180
-160	360-160	200

aaa.poc

Validity area for the earthquake catalogue

```
Polygon associated with the catalogue of seismicity (file xxx.eqc)
xxxaaa0001
             6.0    36.0
            20.0    36.0
            20.0    48.0
             6.0    48.0
```

FORTRAN statement to skip the first record

```
read(1,*)
```

FORTRAN statements to read each polygon

```
     read(1,1) label,num    ! polygon name
     read(1,*) xlon,ylat    ! vertex record
   1 format(a6,i4)
```

Explanation of data

label	a six-character label
num	a 4-digits number
xlon	longitude in degrees
ylat	latitude in degrees

Details

This file defines the area where the earthquake catalogue (aaa.eqc) has to be used. When running for a single nation the area should cover the whole territory plus about 100 km around the political borders. When running for adjacent nations one .poc file has to be defined for each catalogue, and the areas defined by each .poc file must not overlap. For each catalogue, only events falling within the relative .poc file will be considered.

FAQs

Q: Should I follow any specific order in the definition of the coordinates?

A: Yes, for each polygon corners should be listed following either clockwise or counterclockwise order, starting from any point.

Q: Should I close each polygon defining the same corner at the beginning and at the end of the coordinate list?

A: No.

Warning

- The label associated with each polygon must be made of 6 chars and 4 digits.
- Please follow strictly the format of the example file. Do not use TABS, just SPACES (and count them well…) when editing the files. With some editors tabs are inserted automatically to facilitate indentation. Be sure to avoid that option! Programs will complain quite a lot…
- Only one polygon has to be defined in file .poc, associated with the corresponding earthquake catalogue (.eqc)

xxx.por

Areas associated with different structural models

```
Polygons associated with regional structural models (files *.spl and *.spr)
struct0001
            11.750  44.250
            11.900  44.600
            11.300  44.650
            11.200  44.380
struct0002
            11.200  44.380
            11.300  44.650
            10.900  44.700
            10.750  44.500
struct0003
            10.750  44.500
            10.600  44.300
            11.500  44.000
            11.750  44.250
            11.200  44.380
```

FORTRAN statement to skip the first record

```
      read(1,*)
```

FORTRAN statements to read each polygon

```
      read(1,1) label,num    ; polygon name
      read(1,*) xlon,ylat    ; vertex record
    1 format(a6,i4)
```

Explanation of data

label	a six-character label
num	a 4-digits number
xlon	logitude in degrees
ylat	latitude in degrees

Details

This file defines the areas associated with different regional structural models, and therefore with files .spl and .spr. For minimization of CPU time, synthetic seismograms will be computed in a loop over structural models: there will be one .isg file for each polygon defined in the .por file.

The whole territory must be covered by the polygons, since synthetic seismograms will only be computed within them.

Polygons should not overlap, should not be defined off the coasts and should follow roughly the political borders in order to facilitate in the future the computation of joint maps with adjacent nations.

FAQs

Q: Should I follow any specific order in the definition of the coordinates?

A: Yes, for each polygon corners should be listed following either clockwise or counterclockwise order, starting from any point.

Q: Should I close each polygon defining the same corner at the beginning and at the end of the coordinate list?

A: No.

Warning

- It is strongly suggested that for .por files polygon sides defined exactly in the NS and EW directions are given coordinates ending with decimals .1, .3, .5, .7 or .9 when the cell size is (as always recommended) 0.2 degrees.
- The label associated with each polygon must be made of 6 chars and 4 digits.
- Please follow strictly the format of the example file. Do not use TABS, just SPACES (and count them well…) when editing the files. With some editors tabs are inserted automatically to facilitate indentation. Be sure to avoid that option! Programs will complain quite a lot…
- It is not necessary to set numbers of polygons (num) sequentially, but the number must be unique. It is very convenient that uniqueness remain even when joining the results of different countries. So please ask about numbers that you could better use.

xxx.pos

Seismogenic zones

```
Seismogenic zones. In file xxx.fps at least one mechanism per polygon!
region0001 6.14
            11.200  44.600
            11.600  44.600
            11.600  44.400
            11.200  44.400
region0002 6.60
            10.800  44.200
            11.200  44.200
            11.200  44.000
            10.800  44.000
```

FORTRAN statement to skip the first record

```
      read(1,*)
```

FORTRAN statements to read each polygon

```
      read(1,1) label,num,zmaxmag   ! zone name and max magnitude
      read(1,*) xlon,ylat           ! vertex record
    1 format(a6,i4,f5.2)
```

Explanation of data

label	a six-character label
num	a 4-digits number
zmaxmag	maximum magnitude for seismogenic sources
x	longitude in degrees
y	latitude in degrees

Details

This file defines the geometry of the seismogenic zones. In the computation of synthetic seismograms, sources will be considered only within these polygons.

Polygons should not overlap, and should account for all the active areas that could affect the region where seismograms will be computed, even off the coast and outside the political borders. Therefore they can (and should…) be placed also outside the area covered by .por file.

Later, programs eselmec and emecmed will assign one single focal mechanism to the sources belonging to the same seismogenic zone.

The magnitude for seismogenic zones is used only for accepting the zones. If the maximum magnitude is greater than the threshold alarm of CN and M8 region, the seismogenic zone is retained. If the zmaxmag value is blank the seismogenic zone is retained.

FAQs

Q: Should I follow any specific order in the definition of the coordinates?

A: Yes, for each polygon corners should be listed following either clockwise or counterclockwise order, starting from any point.

Q: Should I close each polygon, defining the same corner at the beginning and at the end of the coordinate list?

A: No.

Warning

- It is strongly suggested that for .pos files polygon sides defined exactly in the NS and EW directions are given coordinates ending with decimals .0, .2, .4, .6 or .8 when the cell size is (as always recommended) 0.2 degrees.
- The label associated with each polygon must be made of 6 chars and 4 digits.
- Please follow strictly the format of the example file. Do not use TABS, just SPACES (and count them well…) when editing the files. With some editors tabs are inserted automatically to facilitate indentation. Be sure to avoid that option! Programs will complain quite a lot…
- It is not necessary to set numbers of polygons (num) sequentially, but the number must be unique. It is very convenient that uniqueness remain even when joining the results of different countries. So please ask about numbers that you could better use.

xxx.pcn

CN region

```
Polygon that define a CN region
cnSUDc0001
            14.250  41.780
            15.760  41.050
            16.600  39.700
            17.150  39.690
            17.350  39.000
            16.160  37.870
            15.630  37.750
            15.190  37.530
            12.440  38.150
            12.750  38.430
            14.530  38.010
            13.920  38.770
            14.690  38.870
            15.530  38.320
            16.000  39.710
            14.130  41.400
```

FORTRAN statement to skip the first record

```
      read(1,*)
```

FORTRAN statements to read each polygon

```
      read(1,1) label,num    ; polygon name
      read(1,*) xlon,ylat    ; vertex record
    1 format(a6,i4)
    2 format(9x,f9.3,f8.3)
```

Explanation of data

label	a six-character label
num	a 4-digits number
zmaxmag	maximum magnitude for seismogenic sources
x	longitude in degrees
y	latitude in degrees

Details

This file defines the geometry of a single CN region. This file will be used only if requested in the file makehaz.par. In this case, in the computation of synthetic seismograms, sources will be considered only within seimogenic zones and this polygon.

xxx.pm8

M8 circles

CI	Lon	Lat	Rad
975	14.20	38.15	138
982	14.00	38.00	138
983	14.20	38.00	138

FORTRAN statement to skip the first record

```
           read(1,*,end=887)
```

FORTRAN statements to read each circles

```
read(1,*,end=999,err=888)cod(i),clon(i),clat(i),crad(i)
```

Explanation of data

icod2	numerical code for identify circles (integer)
clon	longitude in degrees
clat	latitude in degrees
crad	radius (km)

Details

This file defines the geometry of M8 regions. The maximum number of circles is now set to 1000. This file will be used only if requested in the file makehaz.par. In this case, in the computation of synthetic seismograms, sources will be considered only within seismogenic zones and these circles.

xxx.nod

List of nodes

number	lon	lat	rad	M1	M2	depth	ST1	D1	RA1	MecFoc	Ref
1001	8.840	44.32	25	6.5	6.5	10.00	171	61	8	C	z16A
1003	8.600	44.32	25	6.0	6.5	10.00	171	61	8	N	z16A
1005	7.760	44.31	25	6.5	6.5	10.00	295	58	175	C	z910
1006	8.320	44.02	25	6.0	6.5	10.00	295	58	175	N	z910
1006	8.320	44.02	25	6.0	6.5	10.00	54	54	129	M	00349A
1007	8.140	43.87	25	6.0	6.5	10.00	295	58	175	C	z910

FORTRAN statements to read each one node (each record by free format):

```
      read(1,'(a100)',end=8032)nodrecord
      read(nodrecord,*,err=8033)
1     ilab(1),rx,ry,rd(1),rmag1,rmag2,rh(1),rstr(1),rdip(1),rrak(1),
2     type_fm(1)
```

Explanation of data

ilab	numerical code for identify nodes (integer)
rx	longitude in degrees
ry	latitude in degrees
rd	radius (km)
rmag1	first magnitude associated to the node
rmag2	second magnitude associated to the node
rh	depth (km)
rstr	strike
rdip	dip
rrak	rake
type_fm	type of focal mecanism

Details

This is the file containing the characteristics of the nodes. In the computation of synthetic seismograms, sources will be considered only within these nodes. The maximum number of nodes is now set to 9999. The numerical code (ilab) must identify uniquely the node. MecFoc: N=taken from Nearest event, M=taken from Maximum event, C=Common (nearest is also maximum). The last column of the file (Ref) is not read by the program.

Magnitude M2 (rmag2) is used to define the source magnitude in a standard hazard run. M1 enters only when alerted areas are considered with M8 algorithm.

When dealing with design magnitude (Mdesign), node magnitude can be increased by 0.5 using the script *nodplus05*. So after you increase the magnitude you have the new nodes file to be used as Mdesign

Usage: *nodplus05 fileA.nod [fileB.nod] [fileC.nod]* …

Will add 0.5 to node magnitudes M1 and M2 and create

fileA05.nod [fileB05.nod] [fileC05.nod] ...

xxx????.spl, xxx????.spr

Normal modes (SH, P-SV) associated with structural models

Details

These are large files generated by programs ray and lov, which are part of the standard modal summation package developed at the Department of Geosciences of the University of Trieste. Please refer to the manuals of that package to understand how to prepare them.

In a default run, you have to chose maximum frequency xmaxfr = 1 Hz.

xxx????.stp

Physical layers of structural models

thk(km)	rho	Vp(km/s)	Vs(km/s)	Qp	Qs	depth(km)	layer
0.0500	2.000	2.400000	1.400000	2200.00	1000.00	0.05000	1
0.3000	2.100	2.400000	1.400100	2200.00	1000.00	0.35000	2
0.6500	2.200	2.400000	1.400400	2200.00	1000.00	1.00000	3
1.5000	2.300	2.400000	1.400700	2200.00	1000.00	2.50000	4
1.0000	2.400	2.400000	1.400900	2200.00	999.00	3.50000	5
1.5000	2.500	3.800000	2.200000	2200.00	1000.00	5.00000	6
2.0000	2.600	4.500000	2.550000	2200.00	1000.00	7.00000	7
5.0000	2.650	5.400000	3.100000	2200.00	1000.00	12.00000	8
13.0000	2.750	6.200000	3.500000	2200.00	1000.00	25.00000	9
10.0000	2.900	7.500000	4.200000	2200.00	1000.00	35.00000	10
65.0000	3.350	8.200000	4.600000	2200.00	1000.00	100.00000	11

FORTRAN statements to read each structural model (each record by free format):

```
do i=1,1000
read(lu,*,end=101) thknes,rho,alpha,beta,a2,b2
end do
101 numlay=i-1
```

Explanation of data

thknes	thikness
rho	density
alpha	velocity of P
beta	velocity of S
a2	quality factor of P wave
b2	quality factor of S wave

Details

If some stp files missing, they will be produced by the hazard script

itacode.cod

Design Acceleration Response Spectra

```
  0.0000E+00  0.1000E+01  0.1000E+01  0.9000E+00  0.1400E+01
  0.5000E-01  0.1750E+01  0.1500E+01  0.1237E+01  0.2100E+01
  0.1000E+00  0.2500E+01  0.2000E+01  0.1575E+01  0.2800E+01
  0.1500E+00  0.2500E+01  0.2500E+01  0.1913E+01  0.3500E+01
  0.2000E+00  0.2500E+01  0.2500E+01  0.2250E+01  0.3500E+01
  0.2500E+00  0.2500E+01  0.2500E+01  0.2250E+01  0.3500E+01
  0.3000E+00  0.2500E+01  0.2500E+01  0.2250E+01  0.3500E+01
  0.3500E+00  0.2500E+01  0.2500E+01  0.2250E+01  0.3500E+01
  0.4000E+00  0.2500E+01  0.2500E+01  0.2250E+01  0.3500E+01
  0.4500E+00  0.2222E+01  0.2500E+01  0.2250E+01  0.3500E+01
  0.5000E+00  0.2000E+01  0.2500E+01  0.2250E+01  0.3500E+01
  0.5500E+00  0.1818E+01  0.2500E+01  0.2250E+01  0.3500E+01
```

…

```
  0.3955E+02  0.1918E-02  0.2877E-02  0.3452E-02  0.4028E-02
  0.3960E+02  0.1913E-02  0.2870E-02  0.3444E-02  0.4017E-02
  0.3965E+02  0.1908E-02  0.2862E-02  0.3435E-02  0.4007E-02
  0.3970E+02  0.1903E-02  0.2855E-02  0.3426E-02  0.3997E-02
  0.3975E+02  0.1899E-02  0.2848E-02  0.3418E-02  0.3987E-02
  0.3980E+02  0.1894E-02  0.2841E-02  0.3409E-02  0.3977E-02
  0.3985E+02  0.1889E-02  0.2834E-02  0.3400E-02  0.3967E-02
  0.3990E+02  0.1884E-02  0.2827E-02  0.3392E-02  0.3957E-02
  0.3995E+02  0.1880E-02  0.2820E-02  0.3383E-02  0.3947E-02
  0.4000E+02  0.1875E-02  0.2813E-02  0.3375E-02  0.3938E-02
```

Details

This file is used by program efft to obtain Design Ground Acceleration (by definition at T = 0) out of a synthetic acceleration response spectrum calculated for T > 0 (by default in the package for T > 1 s).

The Design Response Spectrum used are the one defined in EC8 or in the Italian seismic code for a stiff soil of type A.

FAQs

Q: Can I use different Design Response Spectra?

A: Yes, for instance for Italy should use file itacode.cod

Warning

- Program efft will use always the first two columns of data, that is period and design spectrum for soil A. Roughly speaking, soils are classified A when Vs > 900 m/s. If the upper layer velocity is slower than that, you should consider other design spectra. This is still under testing.

guphas090.??

Curves for scaling of synthetic seismograms

```
    frequency       Modot-real       Modot-imag
 0.000000000      0.281838540E+10  0.000000000
 0.250000000E-02   585607300.     -0.240267640E+10
 0.500000000E-02 -0.140828900E+10  -800348300.
 0.750000000E-02  -568568510.       392827740.
 0.100000000E-01  -197389500.       133385620.
 0.125000000E-01  -186725340.       292260300.
 0.150000000E-01   125043510.       252983920.
 0.175000000E-01   148704710.       37476151.0
```

Details

These curves take account of a realistic rupture process over the fault surface made with PULSYN06. They can be used alternatively to gusev??.xy for 10 Hz run selecting 2 for type of scaling

gusev??.xy

Curves for scaling of synthetic seismograms

```
gusev21
-3.658  21
-3.465  21
-3.162  21
-2.826  21
-2.445  21
-2.138  20.992
-1.672  20.984
-1.209  20.97
-0.824  20.977
-0.407  20.967
-0.163  20.936
0.071   20.851
0.213   20.761

…

1.936   16.929
2.011   16.732
2.109   16.498
2.202   16.259
2.287   16.032
2.365   15.832
```

FORTRAN statements to read each fiel (each record by free format):

```
           do 200 n=1,100
             read(19,*,end=300)xgusev(i,n),ygusev(i,n)
  200      continue
```

Explanation of data

xgusev	logarithm of frequency
ygusev	logarithm of amplitude spectrum of seismic moment rate

Details

These files define the frequency scaling laws used by program efft to scale the synthetic seismograms with magnitude. Programs esgl, esgr, esgv generate the seismograms in the point source approximation with M0 = 1E+20 dyn cm. The true scalar seismic moment is obtained with the rule

log(M0) = 1.5 M + 16.05

where M is the magnitude. For the scaling, each seismogram is Fourier-transformed and its amplitude spectrum is multiplied by the curve having the right M0, obtained by bilinear interpolation from the basic curves reported by Aki and based on the original paper by Gusev. With another Fourier transform the signals are again defined in the time domain.

FAQs

Q: Can I use different scaling laws?

A: Yes, efft program is already set for using ω2 laws. You can also define different curves in the gusev??.xy files, but at this moment you can not use different filenames.

Warning

- Please note that with this kind of scaling source dimension is taken into account, but not the details of the rupturing process. Therefore the shape of the unscaled signal will be affected by thew scaling, but not its duration. To account for duration, complex sources should be used, built as a superposition of point sources properly weighted and distributed in space and time. “Pulsyn-like” scaling (option 2 of type of scaling in makehaz.par with guphas files) can account of a realistic rupture process over the fault surface made with PULSYN06.
- The Gusev scaling laws are appropriate and tested against observations for shallow events (roughly speaking h < 20 km). For deep events different laws should be used, and thoroughly tested.
- If you prepare new digitized curves, you have to define them for the log(M0) values of 21,22,… 30 as in the original gusev??.xy files, mantaining the same filenames. No more than 99 samples should be defined. Sampling interval doesn't need to be regular.

xxx.obs

Observation points to be used instead of the default grid

```
      lon      Lat      struc    rdep
-119.2000  34.2360   0003    0.000
-118.5600  34.7360   0003    0.000
-118.5600  33.7360   0003    0.000
```

FORTRAN statements to read one record:

```
        read(1,*) xloobs,ylaobs,istrobs,rdep
```

Explanation of data

```
xloobs,ylaobs           longitude and latitude of the site
istrobs                  index of structure for receiver
rdep                            receiver depth
```

Details

In case you don't want to perform the computations on a regular grid of sites distributed over the territory, but prefer to select some specific locations, then you can specify their coordinates in this file and use it with program epatgen. There is a first record with a comment. After it the coordinates of the selected locations are given, with free format.

Warning

This file will be used only if specified in makehaz.par.

xxx.sut

Sources used for the computation of synthetic seismograms

```
     label         slon     slat    depth   strike   dip   rake     mag  isub
weight      tshift MECM16 puglbas.mec  puglbas.mag
 0935aa00030001   14.5000  37.1000    .000 140.000  47.000 301.000  7.40    1   .
1000E+01   .0000E+00
 0935aa00040001   14.7000  37.1000    .000 140.000  47.000 301.000  7.40    1   .
1000E+01   .0000E+00
 0935aa00050001   14.9000  37.1000    .000 140.000  47.000 301.000  7.40    1   .
1000E+01   .0000E+00
 0935aa00060001   15.1000  37.1000    .000 140.000  47.000 301.000  7.40    1   .
1000E+01   .0000E+00
```

FORTRAN statements to read the file:

```
      read(1,1) lab8,xlon,xlat,xmagde,istr,idip,irak,xmaggr,nsub,one,zero
1     format(1x,a14,f10.4,f9.4,4f8.3,f6.2,i5,2e12.4)
```

Explanation of data

lab8	label associated with the source: index of the seismogenic zone, 2chars label plus grid coordinates
xlon,xlat	geographical coordinates of the source
xmagde	depth (the depth of the first fps in seis-zone)
istr,idip,irak	fault strike, dip and rake (average from .fps file
xmaggr	magnitude in use
nsub	number of subsources (not implemented yet)
one	for subsources (not implemented yet)
zero	shift time for subsources (not implemented yet)

Details

This file contains all the sources that will be used for the computation of synthetic seismograms.

Warning

- Skip this warning if you are doing a default run. In a non-default run, you may want to create the file .sut by yourself in order to start with program epatgen. Since the index of the seismogenic zone (izo) is associated with one fault plane solution, program ecinput will later mess up things if you specify two records with different focal mechanism (h, iang, idip, irak, xma) but with the same index (izo). You must specify different izo values for different focal mechanisms. There are no restrictions on label (levl), but better specify it like “aa000000”, that is without grid coordinates.

Optional configuration input files

hazdistance.max

Maximum distance for different magnitudes thresholds. It is an optional file.

```
magnitude   distance(km)
0    150
6    200
7    400
8    800
```

Details

The file is in free format, with one header record. First column: threshold magnitude; second column: maximum distance. If present, this file is used to override the default values or the forced value eventually defined in `makehaz.par`. You can set up to 10 thresholds at most. The file in the example means that:

- 0≤M<6, maximum distance=150 km
- 6≤M<7, maximum distance=200 km
- 7≤M<8, maximum distance=400 km
- M≥8, maximum distance=800 km

hazdistance.min

Minimum distance for different depth thresholds. It is an optional file.

```
depth   distance(km)
0         10
10        15
```

Details

The file is in free format, with one header record. First column: threshold magnitude; second column: minimum distance. If present, this file is used to override the default values or the forced value eventually defined in `makehaz.par`. You can set up to 10 thresholds at most. The file in the example means that:

- 0≤depth<10, minimum distance=10 km
- depth≥10, maximum distance=15 km

hazdepth.mag

```
mag     depth(km)
0     4
4     5
5     7
6    10
7    15
```

Details

With this optional file the user can force a custom depth for the sources, based on their magnitude. In the above example:

- 0≤M<4, sources will be placed at depth of 4 km
- 4≤M<5, sources will be placed at depth of 5 km
- 5≤M<6, sources will be placed at depth of 7 km

- 6≤M<7, sources will be placed at depth of 10 km
- M≥7, sources will be placed at depth of 15 km.

hazgmtregion (once .hazgmtregion)

hazgmt.sh reads min and max longitude and latitude of the area (and other parameters) from a file named `hazgmtregion`. If the file does not exist, the script call a program (*hazgmtregion.out*) that reads `makehaz.par` and writes the file. An example of contents of file is:

```
  11.00 minlon
  15.00 maxlon
  45.00 minlat
  47.00 maxlat
   1.00 dlatlab
   1.00 dlonlab
   0.50 dlatmin
   0.50 dlonmin
  1 portrait
  15.28 leglon
  46.00 leglat
   0.00 legLonbox
   0.00 legLatbox
g format
fancy  basemaptype
-JM4.5i projection
```

bighazard.par

This file is required if the corresponding flag ibig is set in makehaz.par (ibig=1)

```
parameters for big run
------------------------------
2        isplit (1 - split for receiver structure, 2 - split for receiver coordinates)
1.0      dlon (for isplit=2)
1.0      dlat (for isplit=2)
2        maxnumrun
60       seconds between two run_hazard executions
```

isplit, dlon, dlat

If isplit=1 the parallel jobs will be created according to common structural models. This can not be very effective if the regional polygons defined in `.por` file are very different in size. In such a case, setting isplit=2 would be more effective, splitting the jobs for groups of sites belonging to rectangular areas whose size is defined by don and dlat parameters.

maxnumrun

The maximum number of jobs allowed to run in parallel. System administrator can limit this value on a per user basis. Once a group of maxnumrun parallel jobs has ended, the next group will start after a delay indicated by the last record.

File extensions

The files that will populate your directory after one complete run will have the following extensions (files with **bold** extension can be plotted with hazgmt.sh):

Ext	Creator	Used by…	Brief description
.**amx**	efinmax	plotting	peak values
.box	epatgen	ecinput	standard input parameters for seismograms
.cel	ecells,mag2cel	esmooth	gridded seismicity from catalogues
.cou	ecou, efft (for dga)	efinmax	shaking parameters for all seismograms
.eqc	user	ecells	earthquake catalogue
.**dga**	efft	plotting	Design Ground Acceleration (one per site)
.exm	eexmaxsig, efft	efft	seismograms with the max amplitude per site
.fin	efinmax	eexmaxsig	info about peak values per site
.fps	user	eselmec	fault plane solutions
.frq	efft	ecou, efinmax	frequency information for all seismograms
.**gmt**	emecmed	gmt	source mechanisms for plotting
.gri	esmooth	einscat,ecircat,eselnod	smoothed seismicity
.isg	ecinput	esgl,esgrz, pavlov7	input parameters for seismogram computation
.lew	esgl	esne	Love (SH waves) EW component
.lns	esgl	esne	Love (SH waves) NS component
.mag	einscat,eselmag,ecircat	emecmed,mag2cel,eselmag	smoothed M within zones
.max	esre, efft	efft	max component between .sew ans .sns
.mec	eselmec	emecmed	source mechanisms per seismogenic zone
.nod	user,makehaz	makehaz	nodes
.obs	user	epatgen	observation points if grid is not used
.pat	epatgen	ecinput	source-receiver paths
.**poc**	user	ecells	polygon associated with earthquake catalogue
.**por**	user	epatgen	polygons associated with structural models
.**pos**	user	einscat,eselmec,eselmag,emecmed	polygons associated with seism. zones
.pcn	user	einscat,eselreg	polygons associated with CN regions
.pm8	user	ecircat,eselreg	circles associated with M8 regions
.rad	esgr		radial component
.res	esre, efft	ecou	resultant component from .sns and .sew
.rew	esgr	esne	Rayleigh (P-SV) EW component
.rns	esgr	esne	Rayleigh (P-SV) NS component
.rzz	esgv	efft	Rayleigh (P-SV) Z component
.sew	esne,pavlov7,efft	efft,esre	sum of .rew and .lew components
.sns	esne,pavlov7,efft	efft,esre	sum of .rns and .lns components
.spl	lov	esgl	modes (SH waves)
.spr	ray	esgrz	modes (P-SV waves)
.stp	user	pavlov7	physical structure
.srp	ecinput		details on source parameters
.sut	emecmed,eselnod,eselreg	epatgen,ecinput,eselreg	seismic sources within ZS
.tra	esgl		transverse component
.**uni**	einscat,ecircat	plotting	smoothed magnitudes within seism. zones
.**uns**	eselmag	plotting	smoothed magnitudes (with the correct magnitude!) within seism. zones
.**ucn**	user,eselmag	plotting	smoothed magnitudes within CN regions
.**um8**	ecircat,eselmag	plotting	smoothed magnitudes within M8 circles
.**und**	eselnod,eselreg	plotting	smoothed magnitudes within nodes
.**ung**	ecells	plotting	gridded magnitudes
.**unm**	esmooth	plotting	smoothed magnitudes

The files .sut, .uni, ucn and um8 have other extension:

.zs.???	from seismogenic zones
.nd.???	from seismogenic nodes
.zn.???	from zones and nodes

Data check

Before running the hazard script, one has to be sure that input data has been properly defined.

A possible list of test is:

1. check structural polygons (e.g. using **checkpor.out**: reads makehaz.par, and por file and produce an obs file with all point inside polygons that you can plot with hazgmt.sh)
2. check seismogenic zone polygons (e.g. using **checkpos.out**: produce a .no.ung file with the same format of ung file with events outside seismogenic zones and distance from observation points lower than maximum distance of the run)
3. run hazard script until path definition (ihaz=2); check the file .pri generated by each program to find if something went wrong. Also, check files .ung, .unm, .uni, .gmt and .por plotted with hazgmt.sh script.

After all the inconsistencies have been eliminated, the full hazard script can be run.

Plotting

The script hazgmt.sh plot maps of gridded data, passing as argument the datafile to be plotted. The script can accept not only input data files, but also some output data files generated by script hazard. The syntax of call to hazgmt.sh is:

```
hazgmt.sh [-option1 -option2 ... +file_over _file_under VARNAME=VARVALUE]
filename [filename2 filename3 ...]
```

where: file_over is the name of one (or more) file that will be plotted above the input file, file_under is the name of one (or more) file that will be plotted below the input file, VARNAME is the name of a internal variable of hazgmt.sh that will be set to the value specified by VARVALUE.

Options can be also passed to the script, according to the table below.

options	Extensions of input files	type of output data	Extensions of output files
	.amx, .dga, .uni, .ung, .unm, .uns,.poc, .por, .pos,.gmt	displacements, velocities, DGA, magnitudes, intensities, polygons, fault mechanisms	.ps
4	.amx	T of maximum (4th column)	.t.ps
4	.damx, .ddga, .duni, .dung, .dunm, .dint	ratios	.rat.ps
a	.mamx, .mdga, .muni, .mung, .munm, .mint, .mund	Averages plus one standard deviation	.ave.ps
b	all extensions	maps in gray scale (Black and white)	.bw.ps
c	all extensions	produce other format along with postscript (default is png)	.ps, .png
d'density_value'	all extensions	specify raster density (to be used with -c)	.ps,.png
e[subscal]	all extensions	special features for extended source scenario for .obs and plot of fault for all extensions; subscal is an optional value to scale the subsources size	.ps

i1,i2,i5	all extensions	maps with Topography in grey scale with different level of detail (t1 for regional scale (1km) – t2 for intermediate scale (etopo2)- t5 for global scale (etopo5))	.ps
l	all extensions (except polygons)	no component in Legend	.ps
m	.mamx, .mdga, .muni, .mung, .munm, .mint, .mund	mMaximum values	.max.ps
n	all extensions	No title	.ps
o	all extensions (excepts polygons)	select Outline (-o1 use thinnest outline, -o0 no outline)	.ps
p[period]	rspaf, rspvf, rspdf, rsppvf, rspamf, rspvmf, rspdmf, rsppvmf	period for response spectrum (-p1 = plot spectrum at 1 s). Period value is not optional for these files	[period]s.ps
r	amx, fin, cou, dga, amxm, dgam, finm, coum, nod	special features for Recurrence	.ps
s[size]	all extensions	Size of paper media	.ps
t1,t2,t5	all extensions	maps with Topography with different level of detail (t1 for regional scale (1km) – t2 for intermediate scale (etopo2)- t5 for global scale (etopo5))	.ps
x	all extensions (except polygons)	write maX value in legend	.ps
y	all extensions (except polygons)	plot values with different symbols (instead of filled circles)	.ps

z	files with acceleration values	classes for acceleration as defined for Italian Zones	.ps
--a	.fin, .cou	peAk values	
--a	rspamf, rspvmf, rspdmf, rsppvmf, finm, coum, amxm, dgam	median	.50.ps
--d	.sut	dip	.dip.ps
--e	*.fin, .cou, finm, coum*	*Epicentral distance*	*.edi.ps*
--f	*.sut*	*focal mechanism*	*.gmt.ps*
--g	*.sut*	*geological representation of a fault*	*.fault.ps*
--h	*.sut*	*source depth*	*.hs.ps*
--i	*rspamf, rspvmf, rspdmf, rsppvmf, finm, coum, amxm, dgam*	*ratio between 84° percentile and median*	*.84-50.ps*
--j	*rspamf, rspvmf, rspdmf, rsppvmf, finm, coum, amxm, dgam*	*ratio between 95° percentile and median*	*.95-50.ps*
--l	*.sut*	*source label*	*.lab.ps*
--m	*.fin, .cou, finm, coum*	*Magnitude*	*.mag.ps*
--m	*.sut*	*magnitude*	*.mag.ps*
--r	*.fin, .cou, finm, coum*	*source depth/ epicentral distance Ratio*	*.rat.ps*
--r	*.sut*	*rake*	*.rake.ps*
--s	*rspamf, rspvmf, rspdmf, rsppvmf, finm, coum*	*ratio between standard deviation and mean*	*.var.ps*
--s	*.sut*	*strike*	*.strike.ps*
--t	*.fin, .cou, finm, coum*	*period (T)*	*.t.ps*
--1D	*.fin, .cou, .finm, .coum*	*source structure = receiver structure - 1D case*	*.1D.ps*
--nz	*.fin, .cou, .finm, .coum*	*kind of source (Node or Zone)*	*.nz.ps*

--sz	*.fin, .cou, .finm, .coum*	*index of Seismogenic Zone*	*.sz.ps*
--nd	*.fin, .cou, .finm, .coum*	*index of Seismogenic Node*	*.nd.ps*
--6	rspamf, rspvmf, rspdmf, rsppvmf, finm, coum, amxm, dgam	5° percentile	.05.ps
--7	rspamf, rspvmf, rspdmf, rsppvmf, finm, coum, amxm, dgam	16° percentile	.95.ps
--8	rspamf, rspvmf, rspdmf, rsppvmf, finm, coum, amxm, dgam	84° percentile	.84.ps
--9	rspamf, rspvmf, rspdmf, rsppvmf, finm, coum, amxm, dgam	95° percentile	.95.ps

Options in italic are not standard: cpt file should be written by the user and are not well tested.

What is a default run

When first applying the procedure to a country, you should perform what is called "a default run".

By default run we mean a run where all the parameters are set according to the experience accumulated in running the job for Italy and several other countries (Albania, Algeria, Bulgaria, Croatia, Cuba, Ethiopia, Hungary, Romania, Slovenia). To have homogeneity in hazard maps for neighbouring countries, default runs are a must.

In a default run, the parameter file (.par) needed by each progam is prepared by some other program earlier in the sequence. So you have only to prepare the parameter file for the first program (cells.par) and forget about the rest. Well, of course when the job is finished you may want to know what was going on, so at the end you can check all the .par files generated automatically for you, to understand what the default parameters are and mean.

Parameter files for a default run have the name of the program that will read them with extension .par instead of .out (efft.out looks for the file fft.par, esne.out for sne.par and so on).

Power users can run programs with non-default parameters, generally to perform parametric analyses. There are two ways suggested. You may want to run one program at a time, wait for it to end its task, edit the default parameter file generated for the next program and run the next program. Or you may want to prepare a set of parameter files in advance, one for each program, and modify the hazard job so that the default parameter files generated automatically are immediately overwritten by the user-prepared files:

```
ecells.out
mv -f nondefaultsmooth.par smooth.par
smooth.out
mv -f nondefaultinscat.par inscat.par
einscat.out
…
…
```

Program ecells will generate a default parameter file for program smooth, but that file will be immediately overwritten by the user-prepared file. The same will happen between esmooth and einscat, and so on. Check the section PARAMETER FILES to see which program generate default parameter files.

Programs sequence

1. Preparation of color palette for plotting

hazcpt.out
hazlegend.out

2. Preparation of the label files for polygons

polabel.out

3. Selection of the sources:

- run with seismogenic zones

ecells.out
esmooth.out
einscat.out
eselmec.out
emecmed.out

- run with nodes

ina.out

- run with seismogenic zones and allerted area

ecells.out
isa.out
eselmec.out
emecmed.out

- run with nodes and allerted area

ina.out

4. Definition of source-receiver paths

epatgen.out

5. Preparation of input files for esg? and pavlov7

ecinput.out

6. Computation of seismograms

esgl0050.out
esgrz0050.out
pavlov7.out
esne.out
efft.out
esre.out

7. Extracts relevant parameters from the synthetic seismograms

ecou.out
efinmax.out
eexmaxsig.out
efinmaxdgav.out
eexmaxsigdga.out

8. Conversion of files *.exm in ASCII format

egconv.out

Parameter files

The listed filenames are the default for the programs. Each program first looks for the existence of its own .par file. If the file exists then the program runs silently without sending any output to the screen. If the file is not found then the program asks for a different parameter filename and during the execution it sends some information to the screen.

Users are strongly recommended to run the default execution using the script hazard.

In the default execution sequence, that is using the script hazard, the user has just to prepare the .par for the first two program of the sequence (makehaz.par and cells.par). All the other .par files will be automatically generated.

Each program can also be run independently from the others. Then the user must carefully prepare the input files manually, and typing errors and other mistakes are just behind the corner…

Filename	Generated by…	Used by…
makehaz.par	user	all
cells.par	user	ecells,makehaz,isa,ina,inna
cinput.par	epatgen	ecinput
cou.par	esre	ecou
exmaxsig.par	ecou	eexmaxsig
exmaxsigdga.par	efft	eexmaxsigdga
fft.par	esne	efft
finmax.par	ecou	efinmax
finmaxdga.par	efft	efinmaxdga
gconv.par	makehaz	egconv
haz_compare.par	user	haz_compare.out
inscat.par	esmooth,makehaz	einscat
mecmed.par	eselmec	emecmed
patgen.par	emecmed,makehaz	epatgen
polabel.par	makehaz	polabel
pvl.par	ecinput	pavlov7
selmec.par	einscat,ecircat	eselmec
sgl.par	ecinput	esgl
sgrz.par	ecinput	esgrz
smooth.par	ecells	esmooth
sne.par	nsgr	esne
sre.par	esne	esre
mag2cel.par	makehaz	mag2cel
selmag.par	makehaz	eselmag

makehaz.par

```
Parameters for program makehaz                  (v0005)
-----------------------------------------------------------------
RUN DEFINITION
-----------------------------------------------------------------
xxx               Name of the run (max 15 char.)
   6 20           Min and max longitude              (degrees)
  36 48           Min and max latitude               (degrees)
1                 Use seismogenic zones (0=no, 1=yes)
0                 Use nodes (0=no, 1=yes, 2= yes separately)
nodes.nod         File with nodes coordinates (max 12 char.)(for nodes only)
0                 Use alerted areas (0=no, 1=CN, 2=M8S)
0                 Use recurrence (0=no, 1=multiscale GR)
kron7.pog         File with recurrence parameters (max 12 char.)
0                 Execution (0=full,1=until sources,2=until paths,3=from sut,4=0 no
plot)
0                 Clean level (0 no, 3 save all seismograms, 15 clean all; see manual)
-----------------------------------------------------------------
SOURCE DEFINITION
-----------------------------------------------------------------
5.0               Min magnitude associated with the run
   0 99           Min and max magnitude taken from catalogues
-200 2009         First and last year in catalogue   (years)
  .2              Cell size                          (degrees)
  3               Smoothing radius                   (cells)
  0               Min. events for smooth             (count)
  0  50           Min and max depth                  (km)
999               Source depth                       (sdepth)     (0=sut,
999=auto,x=km)
-----------------------------------------------------------------
PATH DEFINITION
-----------------------------------------------------------------
1   150           Min. and max source-site distance km (0=auto, if 0 look for
hazdistance.min|.max)
0                 Short paths (ishortpaths) (0=elim,1=use rmin,2=adjust)
0                 File (.obs) with observation points (instead of default grid) (max
12 char.)
-----------------------------------------------------------------
TIME SERIES
-----------------------------------------------------------------
  0               Program for Green function computation (igreen) (0 - only MS; 1 - MS
and DWN for short distance; 2 only DWN)
  1.              Peak frequency         (peakfr)     (1.0 or 10.0)
  1               Interpolation for MS   (npint)      (0-9)
  1               Interpolation for DWN  (npintp)      (0-9)
  1               Seismogram format      (iform)      (0=ASCII, 1=bin)
4096              Time series samples    (npts)       (4096)
  0               Time series length     (iall)       (0=truncated,1=complete)
  1               Type of motion         (itype)      (1=dis, 2=vel, 3=acc)
  1               Vertical component     (ivert)      (1=yes,0=no)
  1  90           Type of scaling        (iscale,iaz) (1=classic,2=pulsyn)(angle)
itacode.cod       File with code response spectra for computing DGA (max 12 char.)
  0               Plot seismograms       (isis)       (1=yes,0=no)
  0               Grid computation       (igrid)      (1=yes,0=no)
```

cells.par

```
parameters for program cells (filenames reading format: A20)  (v0002)
0                              selection criterium for magnitude (iselmag)
aaa.eqc                        file with first earthquake catalogue
aaa.poc                        file with first polygons of validity
bbb.eqc                        file with second earthquake catalogue
bbb.poc                        file with second polygons of validity
…
zzz.eqc                        file with nth earthquake catalogue
zzz.poc                        file with nth polygons of validity
```

cinput.par

```
Parameters for program cinput generated by patgen: z1d     (v0003)
makehaz.par                       File with additional parameters
z1d.sut                                 File with selected sources (.SUT)
1                                       Computation method (0=MS,1=MS+DWN,2=DWN)
z1d.box                                 File with example input box (MS) (.BOX)
z1d.pat                                 File with source-site pairs (MS) (.PAR)
z1d.pvl.box                             File with example input box (DWN) (.BOX)
z1d.pvl.pat                             File with source-site pairs (DWN) (.PAR)
```

cou.par

```
Parameters for program cou generated by sre:       xxx
 1    0=ASCII  1=BINARY seismogram files
 1    1=use frequency information  0=do not
xxx0004f0.res
xxx0003f0.res
xxx0004f1.res
xxx0003f1.res
xxx0004f2.res
xxx0003f2.res
xxx0004f0.max
xxx0003f0.max
xxx0004f1.max
xxx0003f1.max
xxx0004f2.max
xxx0003f2.max
xxx0004f0.rzz
xxx0003f0.rzz
xxx0004f1.rzz
xxx0003f1.rzz
xxx0004f2.rzz
xxx0003f2.rzz
```

exmaxsig.par

```
Parameters for program exmaxsig generated by cou:  xxx
xxxf2max.fin                              hazard max parameters
1                                         0=ASCII  1=BINARY seismogram files
xxx0004f2.max                             seismograms file to search in
xxx0003f2.max                             seismograms file to search in
```

exmaxsigdga.par

```
Parameters for program exmaxsigdga generated by efft: xxx
xxxf2dga.fin                            hazard max parameters
1                                       0=ASCII  1=BINARY seismogram files
xxx0004f2.sns                           seismograms file to search in
xxx0004f2.sew                           seismograms file to search in
xxx0003f2.sns                           seismograms file to search in
xxx0003f2.sew                           seismograms file to search in
```

fft.par (for scaling)

```
Parameters for program fft generated by sne:       xxx
SEISMOGRAM FORMAT ------------------------------------------------------------
```

```
 1          ikinds  flag (0=gndt ASC,1=gndt BIN,2=frires,3=mars,4=syr,5=FD)
TREND AND AVERAGE REMOVAL ----------------------------------------------------
 2          iavg    flag (0 no, 1 rem. average, 2 rem. trend and average)
GAUSSIAN LOW-PASS FILTER -----------------------------------------------------
 0          igauss  flag (0 no, 1 yes, 2 auto)
 .0000e+00  cmaxf   cutoff frequency in Hz
 .0000e+00  pfocf   percentage of cutoff with unit response (sugg. 0.9)
 .0000e+00  cutamp  amplitude at cutoff (sugg. 0.1d-5)
GAUSSIAN HI-PASS FILTER ------------------------------------------------------
 2          igauhp  flag (0 no, 1 yes, 2 auto)
 .0000e+00  xpeah   lowest frequency in Hz with unit response
 .0000e+00  pfohf   percentage of xpeah which defines the cutoff (sugg. 0.5)
 .0000e-00  cutahp  amplitude at cutoff (sugg. 0.1e-5)
INSTRUMENT RESPONSE ----------------------------------------------------------
 0          iesres  flag(0 no,1 mec,2 el,3 geo, + conv, - deconv)
  0         itycal  calibr. function (0 delta,1 step)
  0         itysig  calibr. function (1 displ,2 vel,3 acc)
 .0000e+00  xmag    magnification (mec, ele, geo)
 .0000e+00  t0      pendulum period (s) (mec, geo)
 .0000e+00  damcoe  damping coefficient (critic=1)
 .0000e+00  t1      pendulum period (s) (ele)
 .0000e-00  t2      galvanometer period (s) (ele)
 .0000e+00  h1      pendulum damping factor (ele)
 .0000e+00  h2      galvanometer damping factor (ele)
 .0000e+00  sigsq   instrument coupling factor (ele)
 .0000e+00  t3      pendulum period (s) (geo)
 .0000e+00  g0      sensitivity (v/m/s) (geo)
 .0000e+00  shur    shunt resistence (geo)
 .0000e+00  coir    coil resistence (geo)
 .0000e+00  zerod   open circuit damping (geo)
SOURCE DURATION --------------------------------------------------------------
 0          istd    flag (0 no,1 d1, 2 d2, 3 par, 4 kg, 5 hk, 6 are)
 .0000e+00  durat
DERIVATIVES OR INTEGRATIONS (two files can be generated) ----------------------
  1         ider1   flag (-2 int 2, -1 int 1, 0 no, 1 der 1, 2 der 2)  1st file
  2         ider2   flag (-2 int 2, -1 int 1, 0 no, 1 der 1, 2 der 2)  2nd file
APPLY ARBITRARY FREQUENCY-DEPENDENT RESPONSE CURVE ---------------------------
 0          ifrqcon flag (-1 deconvolve, 0 no, 1 convolve)
iesresp     filename of curve (file name max 12 char., first line is a comment)
SCALING LAW ------------------------------------------------------------------
 1          iscale  index (0 no, 1 Gusev, 2 Gusev at freq. gufreq, 3 f**2)
 0          mmrel   index magnitude-moment relation (0 kanamori, 1 boore)
 .5000e+01  xmamin  minimum magnitude for scaling
 .0000e+00  gufreq  frequency for the constant Gusev weight (iscale=2)
RESPONSE SPECTRA-------------------------------------------------------------
 1          irsp    flag (0 no, 1 compute response spectra)
 3          id1     index (first damping 1=0%, 2=2%, 3=5%, 4=10%, 5=20%)
 3          id2     index (last  damping 1=0%, 2=2%, 3=5%, 4=10%, 5=20%)
 0          iper    flag (0 ENEA standard periods, 1 IGG 200 freq. data)
 2 itacode.cod ieuro,filcode (0 no, 1 compare code, 2 compare code f(m) and name of
the code spectrum - max 12 char., no comment line)
ENERGY COMPUTATION (W)-------------------------------------------------------
 0          iw      flag (1 compute energy W from accelerations, 0 do not)
 0.0        wpcent  percent of amax that discriminates signal from noise (5.0)
FILES FOR PLOTTING AND PLOTTING PARAMETERS -----------------------------------
0           filpli  file with indexes of seis. to plot (file=select,0=no file)
 0          iplspe  flag (1 prepare file for plotting spectra, 0 no)
 0          iplsei  flag (1 prepare file for plotting seismograms, 0 no)
 0          iplrsp  flag (1 prepare file for plotting response spectra, 0 no)
 0          izero   flag (0 = plot all, 1 = t>1st arrival, 2 = 1st<t<last)
 0          iconvg  flag (1 convert acceleration to g, 2 to g/10, 0 do not)
 0.00       slotst  allowed relative slope variation to omit point for plotting
INPUT FILES TO BE PROCESSED --------------------------------------------------
xxx0004.sns
xxx0004.sew
xxx0003.sns
```

```
xxx0003.sew
```

finmax.par

```
Parameters for program finmax generated by cou:    xxx
xxxf0res.cou                          hazard parameters
xxxf1res.cou                          hazard parameters
xxxf2res.cou                          hazard parameters
xxxf0max.cou                          hazard parameters
xxxf1max.cou                          hazard parameters
xxxf2max.cou                          hazard parameters
```

finmaxdga.par

```
Parameters for program finmaxdga generated by efft: xxx
xxxf2dga.cou                          hazard parameters
```

gconv.par

```
Parameters for program egconv generated by makehaz: xxx
1                                     Input format (0=GNDT ASCII, 1=GNDT BIN)
xxxf2max.exm                         Filename
xxxf2dga.exm                         Filename
```

inscat.par

```
Parameters for program inscat generated by smooth: xxx
xxx.pos                                        File with seismogenic zones
xxx.gri                                        File with gridded seismicity
0.00                                           Minimum magnitude for the zone
```

mecmed.par

```
Parameters for program mecmed generated by selmec: xxx              (v0002)
1                                     Label for choice of kind of average: 0=simple
mean, 1=average on moment tensors
aa                                    Label associated with the run
xxx.mec                               File with FPS for the seismogenic zones
```

patgen.par

```
Parameters for program epatgen generated by makehaz:  z1d  (v0002)
z1d.sut                               File with selected sources
z1d.por                               File with structural polygons
0                                     File with  observation coord (0=grid)
  15.0                                Min. source-site distance km (0=auto)
   0.0                                Max. source-site distance km (0=auto)
3                                     Short paths: 0=elim,1=use rmin,2=adjust,3=use
pavlov
1                                     Program for Green function computation: 0 -
only MS; 1 - MS and DWN for short distance; 2 - only DWN
```

polabel.par

```
Parameters for program polabel generated by makehaz: 0710
0710.por                               File with polygons
0710.pos                               File with polygons
```

pvl.par

```
1                       ! output format (0 - ASCII, 1 - binary)
z1d.tun                 ! coordinate system [1 - (N,W,U);  2 - (rad,tra_left,U)] or
name of tun file
z1d0012p.isg                                  input parameters   1
z1d0012.stp                                   spectrum           1
z1d0014p.isg                                  input parameters   2
z1d0014.stp                                   spectrum           2
```

selmec.par

```
Parameters for program selmec generated by inscat: xxx
xxx.pos                                        File with seismogenic zones
xxx.fps                                        File with fault plane solutions
0                                              Output for plotting with GMT (0/1)
```

sgl.par

```
Parameters for program sgl generated by cinput:    xxx
1    0=ASCII  1=BINARY seismogram files
xxx0004.spl                                   spectrum           1
xxx0004.isg                                   input parameters   1
xxx0003.spl                                   spectrum           2
xxx0003.isg                                   input parameters   23
```

sgrz.par

```
Parameters for program sgr generated by cinput:    xxx
1    0=ASCII  1=BINARY seismogram files
0    0=truncated   1=complete seismograms
0   0=all, 1=only horizontal, 2=only vertical
xxx0004.spr                                   spectrum           1
xxx0004.isg                                   input parameters   1
xxx0003.spr                                   spectrum           2
xxx0003.isg                                   input parameters   23
```

smooth.par

```
Parameters for program smooth generated by cells:  xxx
xxx.cel                                            File with gridded seismicity
```

sne.par

```
Parameters for program sne generated by cin: z1d  (v0002)
1    0=ASCII  1=BINARY seismogram files
 1.0 Maximum frequency content
1       1=point source 2=semi-extended with fixed angle, 3=semi-extended with proper
angle, 4=extended source
0            source curve (for iscale=2,3,4)
xxx0004.rns
xxx0003.rns
```

sre.par

```
Parameters for program sre generated by sne:       xxx
 1    0=ASCII  1=BINARY seismogram files
 2    0=compute resultant, 1=maximum, 2=both
xxx0004f0.sns
xxx0003f0.sns
xxx0004f1.sns
xxx0003f1.sns
xxx0004f2.sns
xxx0003f2.sns
```

mag2cel.par

```
Parameters for program mag2cel generated by makehaz: xxx
zs4nt4.mag                                        File with magnitude within zones
```

Comparison of results for different executions

Program *haz_compare.out* can be used to compare results coming from different computations. Typically it is used when running parametric tests to verify the influence of input data on hazard, by comparing the ground shaking files (.amx, .dga). It can be used also to compare magnitudes between earthquake catalogues available for the considered region (.ung, .uni, .unm). It is also used to create the all-in scenarios for seismogenic nodes.

In order to do the comparison, output files coming from different computations should have different naming and should be placed in a common directory. The parameter file required for the run is like this:

```
Parameters file for program haz_compare (v0002)
0              execution mode (1=only extracted data, 2=1 and max/medium values, 3=1
and diff/ratios, 4=1 and intensities, 0=1,2,3)
prova.mamx                                          output file with max/medium values
0                                                   input file with polygons (0=all
data)
0  number of common points required to perform the comparison (0=as many as the files
are)
0              both values required to compute differences (0=no, 1=yes)
0 0            min and max input values for intensity calculation
af2res.amx
bf2res.amx
cf2res.amx
…
yf2res.amx
zf2res.amx
```

File extensions obtained for differences depend on input file, and may assume the following values:

Extension	Brief description
.**damx**	difference and ratio in displacement, velocity or acceleration
.**ddga**	difference and ratio in Design Ground Acceleration (DGA)
.**duni**	difference and ratio in magnitude within seismogenic zones
.**dung**	difference and ratio in magnitude after gridding
.**dunm**	difference and ratio in magnitude after smoothing
.**dint**	difference and ratio in intensity

File extensions for maxima should be manually typed (see third record, **prova.mamx**, and the following extensions should be used in order to obtain proper plots with hazgmt.sh:

.**mamx**	maximum and average+1 sigma (displacement, velocity, acceleration)
.**mdga**	maximum and average+1 sigma (DGA)
.**muni**	maximum and average+1 sigma (magnitude within seismogenic zones)
.**mund**	maximum and average+1 sigma (magnitude within nodes)
.**mung**	maximum and average+1 sigma (magnitude after gridding)
.**munm**	maximum and average+1 sigma (after smoothing)
.**mint**	maximum and average+1 sigma (intensity)

Execution mode

Execution mode decides which files are generated by the run:

1 - for each input file, extracts the data falling inside the polygon set and put them in files `*in.*`. Put the data falling outside of the polygon set in file `*out.*`

2 - in addition to 1, also generate file with max and medium values and put them in the requested output file `*.m*;` user provided filename extension should be consistent with the input data type (amx —> mamx; uni —> muni etc…)

3 - in addition to 1, also generate differences and ratios for the all the possible couples of input files and put them in files df.xxxyyy.d*

4 - convert ground shaking values into macroseismic intensities

0 - in addition to 1, generate also max/medium as in 2 and differences as in 3

Difference and ratio

Files with differences (with extension .d*) will be generated for couples of files taken from `haz_compare.par`, in the form `df.xxxyyy.d*`, where xxx is the index of the first file and yyy is the index of the second file, and refer to their order of appearance in `haz_compare.par`. Referring to the example parameter file shown above, `df001002.damx` compares af2res.amx with bf2res.amx (a-b and a/b); `df002003.damx` compares bf2res.amx with cf2res.amx (b-c and b/c) etc. Each file listed in `haz_compare.par` will be compared with the others.

Conditions for comparison

Besides the belonging to the specified polygon set (if requested), the content of files with differences and ratios will be controlled by two records of the parameter file:

```
x       number of common points required to perform the comparison (0=as many as the files are)
```

requires that, for each coordinate, at least x data files have a value in that position, while

```
y       both values required to compute differences (0=no, 1=yes)
```

requires that, for the specific couple of files under consideration, both have to have a value (y=1), or just one exists (y=0).

If y=0 is chosen, the **ratios** will assume a conventional value of 99999 if the denominator is missing (and will appear on map as upward triangles), or -99999 if the numerator is missing (and will appear on map as downward triangles).

The maps containing the highest number of differences and ratios are those obtained setting x=1 and y=0.

The maps containing the lowest number of differences and ratios are those obtained setting x=0 (y has no influence when x=0, as of course x=0 implicitly requires that both values are present in the couple of files being compared).

Maximum and average

File with maximum and average (with name and extension .m* to be explicitly specified by the user in file `haz_compare.par`). The user provided filename extension should be consistent with the input data type (amx —> mamx; uni —> muni etc…)

Conditions for comparison

Besides the belonging to the specified polygon set (if requested), the content of files with maximum and average will be controlled by this record of the parameter file:

```
x       number of common points required to perform the comparison (0=as many as the files are)
```

It means that, for each coordinate, at least x data files have a value in that position.

Plotting

In order to do the plotting of the comparison files, they have to be passed to *hazgmt.sh*, with possible options listed in the table about “Plotting”. Also, you need to run *hazcpt.out* in advance for the preparation of the color palettes.

Differences and ratios

Files `df.xxxyyy.d*`

hazgmt.sh df001002.damx	plot differences
hazgmt.sh -4 df001002.damx	plot ratios

Max and average

Files `*.mamx .mdga` etc

hazgmt.sh prova.mamx	plot average
hazgmt.sh -a prova.mamx	plot average + 1 standard deviation
hazgmt.sh -m prova.mamx	plot maximum

Programs with I/O description

Programs are listed here in the order of execution. The exceptions are *ina*, *inna* and *isa* that aren't executed in a "classical" run .

The "unit num" is the logical number inside program for I/O statements

makehaz.out

creation of hazard sequence

INPUT

makehaz.par	default parameter file
cells.par	gridded seismicity
orig.nod	list of nodes (only for nodes)
job.sut	the selected sites (only for obs+sut run)
job.fps	the fault plane solutions available
job.poc	the polygons defining the area where xxx.eqc has to be used (only for run with seismogenic zones)
job.por	the polygons associated with average regional structural models
job.pm8	the polygons that define M8 circles (only for M8 run)
job.pcn	the polygons that define CN regions (only for CN run)
gusev??.xy	Specral curves for scaling seismograms with magnitude
xxx0001.spl	spectral quantities associated with polygon 1 defined in .por (SH)
xxx0001.spr	spectral quantities associated with polygon 1 defined in .por (P-SV)
…	
xxx000n.spl	spectral quantities associated with polygon n defined in .por (SH)
xxx000n.spr	spectral quantities associated with polygon n defined in .por (P-SV)

OUTPUT

hazard	scripts that activates the sequence of programs
gconv.par	parameter file for program egconv
patgen_makehaz.par	default parameter file for epatgen
polabel.par	parameters for program polabel
selmec.par	parameters for program eselmec
job.obs	receiver coordinates

hazcpt.out

creation of cpt files used for plotting with *hazgmt.sh* the hazard maps created by script hazard

OUTPUT

accg.cpt	color palette for plotting PGA and DGA map (unit 1)
bwaccg.cpt	color palette for plotting PGA and DGA map in greyscale (unit1)
bwdis.cpt	color palette for plotting PGD map in greyscale (unit 1)
bwdmag.cpt	color palette for plotting difference of magnitude map in greyscale (unit 1)
bwint.cpt	color palette for plotting intensity map in greyscale (unit 1)
bwmag.cpt	color palette for plotting magnitude map in greyscale (unit 1)
bwratio.cpt	color palette for plotting ratio map for comparison between different runs in greyscale (unit 1)
bwt.cpt	color palette for plotting periods map in greyscale (unit 1)
bwvel.cpt	color palette for plotting PGV map in greyscale (unit 1)
dis.cpt	color palette for plotting PGD map (unit 1)
dmag.cpt	color palette for plotting difference of magnitude map for comparison between different runs (unit 1)
int.cpt	color palette for plotting intensity map (unit 1)
mag.cpt	color palette for plotting magnitude map (unit 1)
ratio.cpt	color palette for plotting ratio map for comparison between different runs (unit 1)
t.cpt	color palette for plotting periods map (unit 1)
vel.cpt	color palette for plotting PGV map (unit 1)

hazlegend.out

creation of the legend files for plotting with *hazgmt.sh* the hazard maps created by script hazard, using symbols instead of the standard circles.

OUTPUT

accg.legend	color palette for plotting PGA and DGA map (unit 1)
bwaccg.legend	color palette for plotting PGA and DGA map in greyscale (unit1)
bwdis.legend	color palette for plotting PGD map in greyscale (unit 1)
bwint.legend	color palette for plotting intensity map in greyscale (unit 1)
bwmag.legend	color palette for plotting magnitude map in greyscale (unit 1)
bwrec.legend	color palette for plotting for recurrence (unit 1)
bwvel.legend	color palette for plotting PGV map in greyscale (unit 1)
dis.legend	color palette for plotting PGD map (unit 1)
int.legend	color palette for plotting intensity map (unit 1)
mag.legend	color palette for plotting magnitude map (unit 1)
vel.legend	color palette for plotting PGV map (unit 1)

polabel.out

program to create a label file for a polygon file, for plotting with hazgmt.sh

INPUT

polabel.par	default parameter file (unit 15)
job.**po?**	polygon file (unit 1)

OUTPUT

job.por.label	file with label for plotting of polygon file (unit 2)

ecells.out

discretization of historical seismicity

INPUT

catname.eqc	seismicity catalogue in ASCII “format 41 byte” (unit 1)
makehaz.par	general parameters (unit 3)
catname.poc	polygon defining the area where the catalogue is assumed to be valid (unit 4)
cells.par	default parameter file (unit 15)

OUTPUT

job.cel	discretized magnitudes associated with the grid coordinates (unit 2)- for esmooth
job.ung	output for the plotting program (unit 7)
*job*cel.pri	execution summary (unit 8)
catname.dac	events from .eqc catalogue within .poc polygon (unit 10)
smooth.par	default parameter file for esmooth (unit 16)

WARNING

When running with more than one seismicity catalogue (and relative .poc file), each catname must be different from job. If only one catalogue is considered, then it is suggested that catname is equal to job.

esmooth.out

smoothing of historical seismicity

INPUT

smooth.par	default parameter file (unit 15)
job.cel	discretized magnitudes associated with the grid coordinates (unit 1)
makehaz.par	general parameters (unit 3)

OUTPUT

job.gri	smoothed magnitudes associated with the grid coordinates (unit 2)- for einscat
job.unm	output for the plotting program (unit 7)
*job*smo.pri	execution summary (unit 8)
inscat.par	default parameter file for einscat (unit 16)

einscat.out

introduction of seismogenic zones

INPUT

inscat.par	default parameter file (unit 15)
makehaz.par	general parameters (unit 3)
job.**pos**	contains the geometry of the seismogenic zones (unit 1)
job.**gri**	smoothed magnitude value associate with the grid coordinates (unit 8)

OUTPUT

seiszone.**mag**	smoothed magnitudes associated with the grid coordinates, only for the grid points belonging to the seismogenic zones defined in the file .pos (unit 9) - for emecmed
job.uni	output for the plotting program (unit 10)
*job*ins.pri	execution summary (unit 11)
selmec.par	default parameter file for eselmec (unit 16)

eselmec.out

choice of focal mechanisms

INPUT

selmec.par	default parameter file (unit 15)
seiszone.**pos**	contains the geometry of the seismogenic zones (unit 1)
job.**fps**	available fault plane solutions (unit 8)

OUTPUT

seiszone.mec	available mechanisms sorted by seismogenic zones (unit 3) - for emecmed
*seiszone*nnn.stp	t and p axes values (unit 9) (only for user) (nnn=001,...-num of structural zone)
seiszone.gmt	file for plotting mechanisms with gmt software (unit 11)
*seiszone*sel.pri	execution summary (unit 2), including number FPS in each seismogenic zone
mecmed.par	default parameter file for emecmed (unit 16)

WARNING

When running with the defaults, seiszone must be the same as job. (to be checked).

emecmed.out

preparation of database of sources

INPUT

mecmed.par	default parameter file (unit 15)
seiszone.mec	available mechanisms sorted by seismogenic zones (unit 2)
seiszone.mag	smoothed magnitude value associate with the grid coordinates (unit 8)
seiszone.**pos**	contains the geometry of the seismogenic zones (unit 1)

OUTPUT

seiszone.sut	list of sources distributed in the seismogenic zones, with average focal mechanism (the same for each source) and magnitude (individual for source) (unit 9)
patgen.par	default parameter file for epatgen (unit 16)
job.gmt	file for plotting mechanisms with gmt software (unit 11): FPS for each seismogenic zone,
*med.pri	execution summary (unit 4)

WARNING

The old default setting is mean without taking account on magnitude of events (the new option 0). If you use old format of parameter file, option 0 will be used.

epatgen.out

definition of source-receiver paths

INPUT

patgen.par	default parameter file (unit 15)
makehaz.par	general parameters (unit 7)
*.**por**	contains the geometry of the structural polygons (unit 1)
[*.**obs**]	optional file with coordinates of receivers if the standard grid is not used (unit 3)
[hazdistance.min]	optional file with minimum distance
[hazdistance.max]	optional file with maximum distance
job.sut	list of sources distributed in the seismogenic zones, with magnitude and with average focal mechanism for each seismogenic zone (unit 4)

OUTPUT

job.pat	set of source-receiver paths for which synthetic seismograms must be computed (unit 2)
*job*pat.pri	execution summary (unit 10)
j*ob*.box	general input parameters for the calculation of synthetic seismograms (unit 10)
cinput.par	default parameter file for ecinput (unit 16)

FAQS

Q: I don't get any receiver associated with a source. Why?

A: Check if the .por file is properly prepared. Polygon labels must be made of 6 characters plus 3 digits (eg: region001), and the coords must be properly formatted (see the .par file description). The region defined in the makehaz.par file must contain source and receivers. Be sure that the conditions set in patgen.par file are not too strict. Be sure not to have inverted longitude and latitude in any of the abovementioned files.

ecinput.out

preparation of input files for *esgrz*, *esgl* and *pavlov7*

INPUT

cinput.par	default parameter file (unit 15)
boxname.**box**	general input parameters for the calculation of synthetic seismograms (unit 1)
seiszone.sut	list of sources distributed in the seismogenic zones, with average focal mechanism for each seismogenic zone (unit 2)
seiszone.pat	set of source-receiver paths for which synthetic seismograms must be computed (unit 3)
makehaz.par	file with general parameters (only format and type of scaling low are needed)

OUTPUT

sne.par	input file for program sne (unit 8)
*.srp	information about Source and Receiver Parameters (unit 9)
*boxname*nnn.isg	Input files for programs nsgr, nsgl and nsgv (units 21 through 36) (nnn=001,002,... - for each structural zone)
*boxname*cin.pri	execution summary (unit 10)
sgr.par	default parameter file for nsgr (unit 16)
sgv.par	default parameter file for nsgv (unit 17)
sgl.par	default parameter file for nsgl (unit 18)

FAQS

Q: I run ecinput but the depth in .isg files is not the one I define in .sut file. Why?

A: By default, the .box file has a value of 999 for the depth, that means “select the source depth as a function of magnitude”. You have to put 0 in .box file as the source depth if you want to use the depth defined in the .sut file, or put a real depth value to force ecinput to use it.

esgrz0050.out

computation of radial component, and rotation to NS and EW

INPUT

sgr.par	fixed parameter file (unit 15)
*.spr	spectrum generated by program ray (unit 1)
isgname.isg	input parameters for source and receiver (unit 3) (isgname== boxnamennn)

OUTPUT -

isgname.rns	seismograms, NS component due to Rayleigh (P-SV) waves (unit 12)
isgname.rew	seismograms, EW component due to Rayleigh (P-SV) waves (unit 13)
isgname.rad	seismograms, radial component due to Rayleigh (P-SV) waves (unit 14)
isgname.rzz	seismograms, Z component due to Rayleigh (P-SV) waves (unit 18)
label sgrz.pri	execution summary (unit 16)

esgl0050

computation of transverse component, and rotation to NS and EW

INPUT

sgl.par	fixed parameter file (unit 15)
*.spl	spectrum generated by program lov (unit 1)
isgname.isg	input parameters for source and receiver (unit 3)

OUTPUT

isgname.lns	seismograms, NS component due to Love (SH) waves (unit 12)
isgname.lew	seismograms, EW component due to Love (SH) waves (unit 13)
isgname.tra	seismograms, transverse component due to Love (SH) waves (unit 14)
label sgl.pri	execution summary (unit 16)

pavlov7.out

computation of NS, EW and vertical component

INPUT

pvl.par	fixed parameter file (unit 1)
job.tun	tuning parameter file (unit 3)
*.stp	physical layers of structural model (unit 10)
isgname.isg	input parameters for source and receiver (unit 7) (isgname== boxnamennn)

OUTPUT -

isgname.sns	seismograms, NS component (unit 8)
isgname.sew	seismograms, EW component (unit 9)
isgname.rzz	seismograms, Z component (unit 10)

esne

sum EW and NS components generated by esgrz and esgl

INPUT- seismograms (must have the same name==isgname)

sne.par	default parameter file (unit 15)
makehaz.par	parameter file (optional)
name.rns	seismograms, NS component due to Rayleigh (P-SV) waves (unit 1)
name.lns	seismograms, NS component due to Love (SH) waves (unit 2)
name.rew	seismograms, EW component due to Rayleigh (P-SV) waves (unit 3)
name.lew	seismograms, EW component due to Love (SH) waves (unit 4)

OUTPUT- seismograms, Love+ Rayleigh

name.sns	seismograms, NS component, P-SV + SH waves (unit 7)
name.sew	seismograms, EW component, P-SV + SH waves (unit 8)
*name*sne.pri	execution summary (unit 16)
fft.par	default parameter file for efft (unit 17)
sre.par	default parameter file for esre (unit 17)

efft.out

perform scaling, derivatives, filtering, compute response spectra

INPUT

fft.par	default parameter file (unit 14)
name.ext	seismograms to be processed (unit 1) - “ext” sns, sew, rns, rew, lns, lew, tra, rad, rzz, max, res, exm
gusev??.xy	digitized Gusev curves for scaling (unit 19)
*.cod	normalized code design acceleration respons spectra (unit 88)
anyfile	optional file with list of seismograms for which to produce the xy plot file (unit 15)

OUTPUT

*name*f0.ext	seismograms (unit 2)
*name*f1.ext	processed seismograms, first deriv/integration request (unit 3)
*name*f2.ext	processed seismograms, second deriv/integration request (unit 4) files with peak frequency
*name*f0ext.frq	for processed seismograms (unit 32)
*name*f1ext.frq	for first deriv/integration request (unit 33)
*name*f2ext.frq	for second deriv/integration request (unit 34) files for plotting using general-purpose plotting tools (if requested)
*name*f?ext.nnnnnn.plf	for plotting seismogram spectra (unit 22)
*name*f?ext.nnnnnn.plt	for plotting seismogram time series (unit 20)
*name*f?ext.nnnnnn.plr	for plotting seismogram response spectra (unit 23)

other files:

*name*nnnf2xxx.dga	design ground acceleration, if comparison with EC8 is requested (unit 88), xxx is max or res or exm
*label*lfft.pri	execution summary (unit 16); label is taken from file *.inp
*f{0,1,2}???.sta	empty files-must be deleted. (if reweqst w - content energy for each f2-series in the order as in the input file)

If dga is requested:

*name*f2dga.cou	dga extracted from seismograms
finmaxdga.par	default parameter file for efinmaxdga
exmaxsigdga.par	default parameter file for eexmaxsigdga

If the plotting of files is requested:

plotxyf0.par	parameter file for plot displacement seismograms with plotxy.pl
plotxyf1.par	parameter file for plot velocity seismograms with plotxy.pl
plotxyf2.par	parameter file for plot accelerartion seismograms with plotxy.pl

esre.out

computes resultant component

INPUT

sre.par	default parameter file (unit 15)
name.sns	seismograms, NS component, P-SV + SH waves (unit 1)
name.sew	seismograms, EW component, P-SV + SH waves (unit 2)

OUTPUT

name.res	resultant component: sqrt(NS*NS+EW*EW) (unit 9)
name.max	seismograms, dominating component between NS and EW (unit 10)
*sre.pri	execution summary (unit 16)
cou.par	default parameter file for ecou (unit 17)

ecou.out

extract relevant parameters from the synthetic seismograms

INPUT

cou.par	default parameter file (unit 15)
name.ext	seismograms (unit 1) (the same format for set of seismograms)
*name*f?ext.frq	file with peak frequency for NS or Z component (unit 3)
*name*f?ext.frq	file with peak frequency for EW component (unit 4)

OUTPUT

name ext.cou	parameters extracted from seismograms (unit 2)
*label*cou.pri	execution summary (unit 10); label is taken from file cou.inp
finmax.par	default parameter file for efinmax (unit 17)
exmaxsig.par	default parameter file for eexmaxsig (unit 18)

efinmax.out

select for each site the value to be reported on the map

INPUT

finmax.par	default parameter file (unit 15)
makehaz.par	general parameters (unit 2).
*.cou	parameters extracted from seismograms - many per site (unit 1)
[*.obs]	optional file with coordinates of receiver

OUTPUT

*.fin	parameters extracted from seismograms - one per site (unit 3)
*.amx	output for the plotting program (unit 4)
*label*fin.pri	execution summary (unit 10)

efinmaxdgav.out

select for each site the dga value to be reported on the map

INPUT

finmaxdga.par	default parameter file (unit 15)
makehaz.par	general parameters (unit 2).
*f2dga.cou	dga extracted from seismograms - many per site (unit 1)
[*.obs]	optional file with coordinates of receiver

OUTPUT

*f2dga.fin	parameters extracted from seismograms - one per site (unit 3)
*f2max.dga	output for the plotting program (orizontal component) (unit 4)
*f2rzz.dga	output for the plotting program (vertical component) (unit 4)
*label*findga.pri	execution summary (unit 10)

eexmaxsig.out

select for each site the seismograms responsible for the maximum amplitude and gather them into a single file

INPUT

exmaxsig.par	default parameter file (unit 15)
*.fin	parameters extracted from seismograms - one per site (unit 1)
*.max	seismograms generated by esre (unit 2)

OUTPUT

*.exm	gathered seismograms (unit 3)
*label*exm.pri	execution summary (unit 16)

eexmaxsigdga.out

select for each site the seismograms responsible for the maximum dga and gather them into a single file

INPUT

exmaxsigdga.par	default parameter file (unit 15)
*f2dga.fin	parameters extracted from seismograms - one per site (unit1)
*.sns	seismograms generated by esne (unit 2)
*.sew	seismograms generated by esne (unit 2)

OUTPUT

*f2dga.exm	gathered seismograms (unit 3)
*label*exmdga.pri	execution summary (unit 16)

egconv.out

convert GNDT seismograms from BINARY to ASCII format and viceversa.

INPUT

egconv.par	parameter file (unit 15)
name.ext	seismograms (unit 1)

OUTPUT

name.ext	seismograms (unit 1)

isa.out

select sources within the alerted areas within seismogenic zones

INPUT

makehaz.par	general parameter file
cells.par	parameter file for program ecells
catalogue.eqc	seismicity catalogue in ASCII “format 41 byte”
catalogue.poc	polygon defining the area where the catalogue is assumed to be valid
job.pos	contains the geometry of the seismogenic zones
job.pcn	file for plot of polygon that define a CN region
job.pm8	file for plot of circles of M8 allert

Output

job.mag	smoothed magnitude value associate with the grid coordinates
job.ucn	file for plot of smoothed magnitude value associate with the grid coordinates in CN region
job.um8	file for plot of smoothed magnitude value associate with the grid coordinates in M8 circles

ina.out

select sources within the alerted areas within nodes

INPUT

makehaz.par	general parameter file
cells.par	parameter file for program ecells
catalogue.eqc	seismicity catalogue in ASCII “format 41 byte”
catalogue.poc	polygon defining the area where the catalogue is assumed to be valid
name.nod	list of nodes
job.pcn	file for plot of polygon that define a CN region
job.pm8	file for plot of circles of M8 alert

OUTPUT

job.nod	list of alerted nodes
job.sut	catalogue of alerted seismic sources
job.ucn	file for plot of alerted seismic sources within CN region
job.um8	file for plot of alerted seismic sources within M8 circles

HAZARD_LIBRARY

Some subroutines that are used by programs (makehaz, ina, inna, isa, selpeaks) of hazard are in the hazard_library.

LIST OF SUBROUTINES

readmakehaz	read makehaz.par file
readcells	read cells.par
cells	read seismicity catalogues and discretize seismicity
readpo	read polygon file
readrec	read rec file
readpog	read recurrence polygon file
poligo	check if a point is in a polygon
insquare	check if whether a point lies in a square (not used)
smooth1	smoothing of events
smooth2	choice magnitudes after the smooting
inscat	choice the events in a polygon
circat	choice the events in a M8 circles or in a node
selmag	choice the magnitude of a source
selnod	choice the nodes with a appropriate magnitude for a run
writeuni	write .uni file
writemag	write .mag file
setrec	estimates the earthquake recurrence in a given source
nodrec	estimates the earthquake recurrence in a given nodes (not used)
binclean	translate binary format of iclean
seldepth	select depth of sources
checkobs	write obs with all observation points inside structural polygons
readname	read filename and remove empty field

PROGRAM-CREATED DATA FILES

(listed by alphabetical order of extension)

You don't have to worry about preparing the files yourself. The programs will do it for you. In the default run this will be completely transparent to the user.

It is always suggested that a default run is made before power users start playing with input files and run each program separately to make parametric tests.

hazard

the script that performs the default run of the deterministic procedure

```
#!/bin/bash
set -e
data=`date +%Y/%m/%d%t%T`
echo "$data""        hazard     hazard job started"
PATH_PREFIX=""

# Hazard sequence for seismogenic zones

mkdir -p "Input"
#copy of input files into Input directory
cp *.xy Input
cp *.sp? *.eqc *.cod *.po? cells.par makehaz.par Input
cp *.fps Input
if [ -e hazdistance.max ]
then
cp hazdistance.max Input
fi
if [ -e hazdistance.min ]
then
cp hazdistance.min Input
fi


#preparation of color palette for plotting
${PATH_PREFIX}hazcpt.out

#preparation of the label files for polygons
${PATH_PREFIX}polabel.out

#discretization of seismicity, with selection from adjacent catalogues
${PATH_PREFIX}ecells.out

#smoothing of seismicity
${PATH_PREFIX}esmooth.out

#introduction of seismogenic zones
${PATH_PREFIX}einscat.out

#choice of focal mechanisms
${PATH_PREFIX}eselmec.out

#preparation of database of sources
${PATH_PREFIX}emecmed.out


#definition of source-receiver paths
${PATH_PREFIX}epatgen.out

#preparation of input files for esg?
${PATH_PREFIX}ecinput.out

#computation of transverse component, and rotation to NS and EW
${PATH_PREFIX}esgl0050.out
rm -f *.eil *.tra

#computation of radial and vertical component, and rotation to NS and EW
${PATH_PREFIX}esgrz0050.out
rm -f *.eir *.rad
rm -f *.eiv *.ver

#sum EW and NS components from nsgr and nsgl
${PATH_PREFIX}esne.out
rm -f *.lew *.lns *.rew *.rns

#consider vertical component seismograms too
find . \( -maxdepth 1 -name "*.rzz" \! -name "*f[012].*" -type f \) -print0| xargs -0
ls -1 >> fft.par

#perform scaling,derivatives,filtering,compute response spectra
${PATH_PREFIX}efft.out

#computes resultant component
${PATH_PREFIX}esre.out

#extracts relevant parameters from the synthetic seismograms
ls -1 *f0.rzz >> cou.par
```

```
ls -1 *f1.rzz >> cou.par
ls -1 *f2.rzz >> cou.par
${PATH_PREFIX}ecou.out

rm -f *.sre

#selects for each site the value to be reported on the map
${PATH_PREFIX}efinmax.out

#selects for each site the seismogram with the maximum peak
${PATH_PREFIX}eexmaxsig.out

#selects for each site the dga value to be reported on the map
${PATH_PREFIX}efinmaxdgav.out

#selects for each site the seismogram responsible for the maximum dga
${PATH_PREFIX}eexmaxsigdga.out

#conversion of files *.exm in ASCII format
${PATH_PREFIX}egconv.out

${PATH_PREFIX}hazgmt.sh *.po? *.un? *res.amx *.gmt *rzz.amx *.obs
${PATH_PREFIX}hazgmt.sh *f2max.dga *f2rzz.dga
${PATH_PREFIX}hazgmt.sh -4 *res.amx *rzz.amx

./clean.sh

data=`date +%Y/%m/%d%t%T`
echo "$data""         hazard     hazard job finished"
```

DETAILS

This is the script hazard. Indeed it is not too complicated… You can control the progress of you job looking at the file .log

FAQS

Q: I run the script and an error message appears on the screen.

A: There is an error in one of the user prepared input files. Check the file *.pri to see where the problem is.

WARNING

• Run it in the same directory where you have prepared the required input files.

• Check that all the files listed in this chapter exist and are error free. If syntax or data errors affect one single file, execution of the job will continue and you'll get wrong or no results at all. This will be fixed in a future release, where execution will be stopped with an error message.

xxx*.amx

ground motion parameters for mapping

```
amaxa values xxxf0res.cou
    1 0.1000E+01 : file type and normalizing factor
 0.36000E+02 0.48000E+02 : min. and max. latitude  of the area
 0.60000E+01 0.20000E+02   min. and max. longitude of the area
 0.20000E+00             : cell size
    7.0000  44.4000 0.82730E-01 0.76920E+01 0.76920E+01 0.57000E+01
    7.0000  44.6000 0.76510E-01 0.10260E+02 0.75470E+01 0.57000E+01
    7.0000  44.8000 0.80700E-01 0.10260E+02 0.75470E+01 0.57000E+01
    7.0000  45.0000 0.74240E-01 0.10530E+02 0.76920E+01 0.57000E+01
    7.0000  45.2000 0.62010E-01 0.11110E+02 0.78430E+01 0.57000E+01
    7.2000  44.4000 0.93520E-01 0.70180E+01 0.70180E+01 0.57000E+01
```

FORTRAN statements to read the file:

```
      read(1,1) title
      read(1,2) itype,xfact
      read(1,3) fy1,fy2
      read(1,3) fx1,fx2
      read(1,4) divcel
      do i=1,ndata
           read(4,6)rx(i),ry(i),amaxa(i),peri1(i),peri2(i),rmag(i)
      enddo
  6   format(f10.4,f9.4,4e12.5)
  1   format(a80)
  2   format(i5,e11.4,' : file type and normalizing factor')
  3   format(2e12.5,' : min. and max. latitude  of the area')
  3   format(2e12.5,'   min. and max. longitude of the area')
  4   format(e12.5,12x,' : cell size')
```

EXPLANATION OF DATA

title	first header record
itype	type of file (1=displ, 2=vel, 3=acc)
xfact	normalizing factor
fy1,fy2	min. and max. latitude of the area
fx1,fx2	min. and max. longitude of the area
divcel	cell size used for discretization
rx(i),ry(i)	lon,lat of the site
amaxa(i)	peak value
peri1	period of the peak for max component between NS and EW
peri2	period of the peak for min component between NS and EW
rmag(i)	magnitude of the event that generated the peak amaxa(i)

DETAILS

This file is the one to be plotted on maps, together with the .dga file. After the header, it contains just one record per site, corresponding to the signal with maximum amplitude. Amplitudes are given in cm, or cm/s or cm/s/s for displacement (itype = 1), velocity (itype = 2) and acceleration (itype = 3).

FAQS

Q: Why I do not get any value for periods?

A: Probably because you didn't do a default run, and you didn't ask ecou to read the frequency information generated by efft.

WARNING

- in a default run, naming result: xxxaabbb.amx, where xxx is the job name, aa is f0 for displacement, f1 for velocity, f2 for acceleration, bbb is res for resultant component, max for maximum component.

xxx.box

mask for preparation of input files for nsgl, nsgr, nsgv

```
I N P U T   P A R A M E T .   F O R        1  S E I S M O G R A M (S)
001*****************************************************************************
 SEISMOGRAM  NAME                :       xxx       (7 ALPHANUMERICAL CHAR.)
G E N E R A L  P A R A M E T E R
 SEISMOGRAM TYPE                 :         1       (1=DISPL.,2=VEL.,3=ACCEL)
 INTERPOLATION                   :         1       (0=NO,9=YES)
 GROUND MOTION COMPONENT         :         0       (RADIAL=1,VERTICAL=2)
 RECEIVER DEPTH                  :  .000000000D+00 (KM)
 NO. OF FIRST MODE TO BE USED    :         0       (ALL=0)
 NO. OF LAST  MODE TO BE USED    :         0       (ALL=0)
 INPUT GROUND MOTION             :         0       (COMPUTED=0, READ IN=1)
 INPUT EIGENFUNCTIONS            :         0       (COMPUTED=0, READ IN=1)
 MAXIMUM FREQUENCY               : 0.100000000E+01 (1 OR 10 HZ)
 SPECTRUM FREQUENCY INTERVAL     : 0.500000000E-02 (.005 FOR 1HZ, .05 FOR 10HZ)
 NUMBER OF FREQUENCY POINTS      :       201       (FIXED TEMPORARILY)
 NUMBER OF TIME SERIES POINTS    :      4096       (1024,2048,4096,8192)
S O U R C E  P A R A M E T E R S
 DISTANCE                        :  .000000000D+00 (KM)
 SOURCE DEPTH                    : 0.999000000E+03 (KM DEEP)
 ANGLE STRIKE-RECEIVER           :  .000000000D+00 (DEGREES)
 FAULT DIP                       :  .000000000D+00 (DEGREES)
 RAKE (WITH RESPECT TO STRIKE)   :  .000000000D+00 (DEGREES)
 FORCE SYSTEM                    :         1       (1=D-C,2=SINGLE,3=DIPOLAR)
                                                  4=S-C,5=P.EXPL,6=CAVITY EXPL)
 TIME FUNCTION                   :         1       (0=DELTA,1=STEP)
 SOURCE DURATION                 :  .000000000D+00 (SECONDS)
  DURATION SHAPE FUNCTION        :         0       (0=INS,1=D1,2=D2,3=PARZ,
                                                    4=K-G,5=H-K,6=MA)
 SOURCE FINITENESS               :         0       (POINT=0,UNIL.=1,BILAT.=2)
  RUPTURE VEL./SOURCE S-WAVE VEL.:  .000000000D+00
  ALONG-STRIKE FAULT LENGHT      :  .000000000D+00 (KM)
  ANTI-STRIKE FAULT LENGHT       :  .000000000D+00 (KM)
I N S T R U M E N T RESPONSE     :         0       (0=NO,1=MEC,2=EM, 3=GEOPH)
 CALIBRAT. TYPE: (0=DELTA)       :         0            ITYCAL
 MAGNIFICATION                   :  .000000000D+01 XMAG
 MECHANICAL       (1)
  NATURAL PERIOD                 :  .000000000D+01 T0(SECONDS)
  DAMPING RATIO                  :  .000000000D+70 DAMPRA
 ELECTROMAGNETIC  (2)
  PENDULUM PERIOD                :  .000000000D+02 T1(SECONDS)
  GALVANOMETER PERIOD            :  .000000000D+03 T2(SECONDS)
  PENDULUM DAMPING FACTOR        :  .000000000D+01 H1
  GALVANOMETER DAMPING FACTOR    :  .000000000D+01 H2
  INSTRUMENT COUPLING FACTOR     :  .000000000D+00 SIGSQ
 GEOPHONE         (3)
  NATURAL PERIOD                 :  .000000000D+01 TG(SECONDS)
  DAMPING RATIO                  :  .000000000D+70 GEODAM
G A U S S I A N ROLL-OFF FILTER  :         0       (0=NO),(1=YES)
 MAX CUT-OFF FREQUENCY           :  .000000000D+01 (HZ)
 XPEAK/(MAX CUT-OFF FREQ)        :  .000000000D+00 (BETWEEN 0 AND 1)
 AMPLITUDE AT CUT-OFF FREQ       :  .000000000D+00 (BETWEEN 0 AND 1)
E X T R A   P A R A M E T E R S
 EMPTY1                          :  .000000000D+00
 EMPTY2                          :  .000000000D+00
 EMPTY3                          :  .000000000D+00
```

```
 EMPTY4                          :  .000000000D+00
 EMPTY5                          :  .000000000D+00
```

DETAILS

The file is derived from the input to programs syr and syl, belonging to the standard package for the computation of synthetic seismograms in 1D models by the modal summation technique. Please refer to the manual of that package for details

This file is used by program ecinput as a mask to generate the input files that will be read by nsgr, nsgl and nsgv. It is strongly recommended that you do not modify the parameters given in the example file.

At the end of the records shown, the variables used in programs nsgl, nsgr, nsgv are given. They are removed in the example file, even if they do not disturb the execution of the programs.

WARNING

- Many of the parameters listed in the file will be overridden by the information contained in files .sut and .pat.
- There are a couple of differences with respect to syr and syl programs of the standard 1D package:
  1. Ground motion component is set to zero in the mask. It will be set to the proper value by programs nsgl (3), nsgr (1) and nsgv (2).
  2. Source depth. If thk = 0 the depth coming from the .fps file will be used, if 0 < thk < 999 then thk itself will be used, if thk ≥ 999 depth will be chosen according to the event magnitude: 10 km for M < 7, or 15 km for 7 ≤ M < 8, 20 for M ≥ 8. In the default run thk = 999.

xxx.cel

gridded seismicity (from one or more catalogues)

```
    slon    slat   mag  ix  iy                                0.2 smooth=  3 mag0=  0.
kprnt0=  0
   15.100  36.300  4.6  46   2
   14.700  36.500  4.8  44   3
   12.100  36.700  4.6  31   4
   15.100  36.700  4.8  46   4
   12.100  36.900  4.8  31   5
   14.500  36.900  5.0  43   5
```

FORTRAN statements to read the data:

```
      read(1,1)xglon,xglat,u,i,j
    1 format(f9.3,f8.3,f5.1,2i4)
```

EXPLANATION OF DATA

xglon,xglat	longitude and latitude of the grid point
u	discretized magnitude associated with the grid point
i,j	indexes along longitude and latitude, referred to the grid point

DETAILS

This file contains the information about gridded seismicity. When running a job for several adjacent countries, the gridded magnitude values are obtained from the catalogue associated with the .poc file containing the coordinates slon,slat.

The gridded seismicity will be then smoothed by program smooth and removed outside the seismogenic zones by program einscat.

FAQS

Q: What will happen to magnitude 0 grid points?

A: If the coordinates fall outside the seismogenic zones defined in file .pos, they will be removed as usual by einscat. If the coordinates fall within seismogenic zones, magnitude 5 will be forced by efft.

WARNING

- the grid indexes can not be larger than 333 both along longitude and latitude. This limit the size of the area that can be studied with a single run.

xxx*.cou

ground motion parameters and related data for all the computed seismograms

```
 sislab        source       slon     slat     sp    rlon     rlat     rp    dist    az
hs      hr    strike    dip    rake   strrec   mag     amaxa       amima2      permax
permin    k nsub COU13  z1d0012f0.max              (v0002)
        1 0906sz00030003   11.5000  45.5000   12   12.0000  45.4000   12   40.663
105.684  10.000   0.000  51.000  29.000 316.000 305.316  6.60  0.9969E+01  0.8890E+01
0.1053E+02  0.1481E+02 1     1
        2 0906sz00040004   11.7000  45.7000   12   12.0000  45.4000   12   40.750
144.801  10.000   0.000  51.000  29.000 316.000 266.199  6.60  0.7957E+01  0.7070E+01
0.1000E+02  0.1379E+02 1     1
        3 0905sz00050004   11.9000  45.7000   12   12.0000  45.4000   12   34.245
166.783  10.000   0.000 289.000  23.000 140.000 122.217  6.60  0.1247E+02  0.1164E+02
0.1053E+02  0.1739E+02 1     1
        4 0906sz00030003   11.5000  45.5000   12   12.0000  45.6000   12   40.596
73.933  10.000   0.000  51.000  29.000 316.000 337.067  6.60  0.1000E+02  0.8557E+01
0.1026E+02  0.1333E+02 1     1
```

FORTRAN statements to read the event records:

```
      read(1,couform)sislab,lev1,elon,elat,ipsou,slon,slat,istr,dist1,
     1  azim,thks,thkr,angl,xdip,xrake,phideg,rmag,amaxa,amaxa2,
     2  perzz,perew,itype,nsub

      couform= '(a9,1x,a14,2(f10.4,f9.4,i5),f9.3,7f8.3,f6.2,4e12.4,i2,i5)'
```

EXPLANATION OF DATA

sislab	seismogram index in file
lev1	xxxyyy = ix,iy - coordinates on grid
elon,elat	coordinates of source
ipsou	index of structural poligon (in file *.POR) where the source is
slon, slat	coordinates of site where receiver is placed
rp	index of structural poligon (in file *.POR) where the receiver is
dist,az	see*.PAT
hs, hr	depths of source (hs) and receiver (hr) in km
angle,xdip,xrake	strike, dip and rake of used mechanism
phideg	angle between strike and direction source-reseiver
rmag	used magnitude
amaxa	max Amplitude
amaxa2	unused by users (internal test value)
perzz	period of MAX of spectrum on NS component
perew	period of MAX of spectrum on EW component

itype	type of time series (1-Displ., 2- velocities, 3 - accel.)
nsub	number of subsources (not implemented yet)

DETAILS

This file contains one line for each synthetic seismogram computed. All records in each .cou file refer to the same type of motion (displacement or velocity or acceleration).

xxxf2dga.cou

ground motion parameters and related data for all the computed seismograms

```
 sislab        source       slon     slat     sp    rlon     rlat     rp   dist    az
hs      hr    strike    dip    rake   strrec   mag    designa     designb     designc
perioda     periodb     periodc   comp   COU13                              (v0002)
        1 0906sz00030003   11.5000  45.5000   12   12.0000  45.4000   12   40.663
105.684  10.000   0.000  51.000  29.000 316.000 305.316  6.60 0.58197E+02 0.37194E+02
0.21539E+02 0.28000E+01 0.28000E+01 0.28000E+01 sns
        2 0906sz00040004   11.7000  45.7000   12   12.0000  45.4000   12   40.750
144.801  10.000   0.000  51.000  29.000 316.000 266.199  6.60 0.88994E+02 0.56876E+02
0.32937E+02 0.28000E+01 0.28000E+01 0.28000E+01 sns
        3 0905sz00050004   11.9000  45.7000   12   12.0000  45.4000   12   34.245
166.783  10.000   0.000 289.000  23.000 140.000 122.217  6.60 0.15397E+03 0.98645E+02
0.57039E+02 0.26000E+01 0.26000E+01 0.26000E+01 sns
```

FORTRAN statements to read the event records:

```
      read(1,620)sislab,lev1,elon,elat,ipsou,slon,slat,istr,dist1,
     1  azim,thks,thkr,angl,xdip,xrake,phideg,rmag,dga1,dga2,dga3,
     2  per1,per2,per3,comp
620  format
     1(a9,1x,a14,2(f10.4,f9.4,i5),f9.3,7f8.3,f6.2,6e12.5,1x,a3)
```

EXPLANATION OF DATA

sislab	seismogram index in file
lev1	xxxyyy = ix,iy - coordinates on grid
elon,elat	coordinates of source
ipsou	index of structural poligon (in file *.POR) where the source is
slon, slat	coordinates of site where receiver is placed
rp	index of structural poligon (in file *.POR) where the receiver is
dist,az	see*.PAT
hs, hr	depths of source (hs) and receiver (hr) in km
angle,xdip,xrake	strike, dip and rake of used mechanism
phideg	angle between strike and direction source-reseiver
rmag	used magnitude
dga1,dga2,dga3	Design Ground Acceleration for 3 type of soils - A, B, C (cm/s/s)
per1,per2,per3	period (s) at which the connection has been made between synthetic response spectra and design response spectra for soils A, B, C.
comp	component (ew or ns) that gives the dga values

DETAILS

This file contains one line for each synthetic seismogram computed.

xxx*.dga

Design Ground Acceleration

```
   rlon     rlat      designa     designb     designc     perioda     periodb
periodc     - acceleration in cm s-2
   15.0000  41.8000 0.13686E+02 0.87465E+01 0.50651E+01 0.28000E+01 0.28000E+01
0.28000E+01
   15.0000  41.8000 0.61505E+01 0.39308E+01 0.22763E+01 0.28000E+01 0.28000E+01
0.28000E+01
   15.0000  41.8000 0.87556E+01 0.55957E+01 0.32405E+01 0.28000E+01 0.28000E+01
0.28000E+01
```

FORTRAN statements to read each record:

```
        read(1,1) r1lon,r1lat,facta,factb,factc,pera,perb,perc
      1 format(f10.4,f9.4,6e12.5)
```

EXPLANATION OF DATA

r1lon, r1lat	coordinates of receiver (degree)
facta,factb,factc	Design Ground Acceleration for 3 type of soils - A, B, C (cm/s/s)
pera,perb,perc	period (s) at which the connection has been made between synthetic response spectra and design response spectra for soils A, B, C.

DETAILS

This file contains one record with Design Ground Acceleration (DGA) for each site located within the polygons (file .por) associated with structural models. The response specrum is computed at each site starting from the acceleration time series with the highest peak, among the ones fenerated by the surrounding sources. This is an approximation, since it is not given that the highest DGA is associated with the signal with the highest peak. Further testing is needed.

WARNING

- DGA values are computed using synthetic response spectra together with design response spectra (the default is EC8) for soils A,B and C. Structural models in a default run are by definition soils A, since the lowest velocities are anyway larger than 900 m/s, so designa should be used.

xxx*.exm

file with one seismogram per each site falling within the .por polygons

DETAILS

This file is in the format of GNDT synthetic seismograms, ASCII or binary. It is generated by eexmaxsig looking at each site for the synthetic seismogram with the highest peak, independently on the component (NS or EW). It will be read by efft in order to compute the acceleration response spectra and estimate the DGA to be plotted on the map.

FAQS

Q: Why I have file .exm only for acclerations?

A: Response spectra and DGA are computed starting from accelerations, therefore in a default run the corresponding files with displacements and velocities are not generated.

WARNING

- in a default run, naming result: xxxf2max.exm, where xxx is the job name. When computing DGA, efft will generate a file xxxf2maxf0.exm that can be removed when efft terminates its duties.

xxx*.fin

ground motion parameters and related data (one per site only)

```
 sislab        source       slon     slat     sp    rlon     rlat     rp   dist    az
hs      hr   strike    dip    rake   strrec   mag     amaxa       amima2       permax
permin   k nsub    rec  z1df0max.cou
(v0002)
        3 0905sz00050004   11.9000  45.7000   12   12.0000  45.4000   12   34.245
166.783  10.000   0.000 289.000  23.000 140.000 122.217  6.60  0.1247E+02  0.1164E+02
0.1053E+02  0.1739E+02 1    1  0.0000E+00
        8 0905sz00050004   11.9000  45.7000   12   12.0000  45.6000   12   13.576
144.921  10.000   0.000 289.000  23.000 140.000 144.079  6.60  0.1803E+02  0.1781E+02
0.9756E+01  0.1212E+02 1    1  0.0000E+00
       19 0905sz00050004   11.9000  45.7000   12   12.0000  45.8000   12   13.568
34.960  10.000   0.000 289.000  23.000 140.000 254.040  6.60  0.2468E+02  0.1796E+02
0.1290E+02  0.1429E+02 1    1  0.0000E+00
```

FORTRAN statements to read the event records:

```
      read(1,1)sislab,lev1,sx,sy,ipsou,rx,ry,istr,dist1,
     *      azim,thks,thkr,angl,xdip,xrake,phideg,rmag,amaxa,amaxa2,
     *      peri1,peri2,ikind,nsub
1    format
     1(a9,1x,a14,2(f10.4,f9.4,i5),f9.3,7f8.3,f6.2,4e12.4,i2,i5)
```

EXPLANATION OF DATA

sislab	seismogram index in file
lev1	xxxyyy = ix,iy - coordinates on grid
sx,sy	coordinates of source
ipsou	index of structural poligon (in file *.POR) where the source is
rx, ry	coordinates of site where receiver is placed
istr	index of structural poligon (in file *.POR) where the receiver is
dist1,azim	see*.PAT
thks, thkr	depths of source (hs) and receiver (hr) in km
angl,xdip,xrake	strike, dip and rake of used mechanism
phideg	angle between strike and direction source-reseiver
rmag	used magnitude
amaxa	max Amplitude
amaxa2	unused by users (internal test value)
peri1	period of MAX of spectrum on NS component
peri2	period of MAX of spectrum on EW component
ikind	type of time series (1-Displ., 2- velocities, 3 - accel.)
nsub	number of subsources (not implemented yet)

DETAILS

This file contains a subset of the records written in the corresponding .cou file. There is only one record for each site falling within the .por polygons associated with structural models. The record is the one pointing at the synthetic seismogram with the highest peak among those computed at the same site using the surrounding sources.

xxxf2dga.fin

ground motion parameters and related data (one per site only)

```
 sislab        source       slon     slat     sp    rlon     rlat     rp   dist    az
hs      hr   strike    dip    rake   strrec  mag    designa     designb     designc
perioda     periodb     periodc   comp    rec   z1df2dga.cou
(v0002)
        1 0906sz00030003   11.5000  45.5000   12   12.0000  45.4000   12   40.663
105.684  10.000   0.000  51.000  29.000 316.000 305.316  6.60 0.15729E+03 0.10078E+03
0.58271E+02 0.26000E+01 0.26000E+01 0.26000E+01 sew      0.0000E+00
        8 0905sz00050004   11.9000  45.7000   12   12.0000  45.6000   12   13.576
144.921  10.000   0.000 289.000  23.000 140.000 144.079  6.60 0.62216E+03 0.39762E+03
0.23026E+03 0.28000E+01 0.28000E+01 0.28000E+01 sns      0.0000E+00
       21 0905sz00050005   11.9000  45.9000   12   12.0000  45.8000   12   13.560
145.017  10.000   0.000 289.000  23.000 140.000 143.983  6.60 0.62255E+03 0.39787E+03
0.23041E+03 0.28000E+01 0.28000E+01 0.28000E+01 sns      0.0000E+00
```

FORTRAN statements to read the event records:

```
      read(1,1)sislab,lev1,sx,sy,ipsou,rx,ry,istr,dist1,
     *      azim,thks,thkr,angl,xdip,xrake,phideg,rmag,dga1,dga2,dga3,
     *  per1,per2,per3,comp
    1   format
     1(a9,1x,a14,2(f10.4,f9.4,i5),f9.3,7f8.3,f6.2,6e12.5,1x,a3)
```

EXPLANATION OF DATA

sislab	seismogram index in file
lev1	xxxyyy = ix,iy - coordinates on grid
sx,sy	coordinates of source
ipsou	index of structural poligon (in file *.POR) where the source is
rx, ry	coordinates of site where receiver is placed
istr	index of structural poligon (in file *.POR) where the receiver is
dist1,azim	see*.PAT
thks, thkr	depths of source (hs) and receiver (hr) in km
angl,xdip,xrake	strike, dip and rake of used mechanism
phideg	angle between strike and direction source-reseiver
rmag	used magnitude
dga1,dga2,dga3	Design Ground Acceleration for 3 type of soils - A, B, C (cm/s/s)
per1,per2,per3	period (s) at which the connection has been made between synthetic response spectra and design response spectra for soils A, B, C.
comp	component (ew or ns) that gives the dga values

DETAILS

This file contains a subset of the records written in the corresponding .cou file. There is only one record for each site falling within the .por polygons associated with structural models. The record is the one pointing at the synthetic seismogram with the highest dga among those computed at the same site using the surrounding sources.

xxx*.frq

frequency information associated with seismograms

```
  seismo   source      rec.lon  rec.lat   frequency   amplitude
    31104 0201sz00410052   13.6000  45.8000  0.6275E+00  0.3849E+02
    31105 0201sz00420051   13.6000  45.8000  0.6450E+00  0.1906E+02
    31106 0201sz00420052   13.6000  45.8000  0.8325E+00  0.9642E+01
```

FORTRAN statements to read the file:

```
        read(1,1) sislab,lgrid,r1lon,r1lat,frpeak,ampeak
  1     format(a9,1x,a14,f10.4,f9.4,2e12.4)
```

EXPLANATION OF DATA

sislab	seismogram index in file
lgrid	xxxyyy = ix,iy - coordinates on grid
r1lon,r1lat	coordinates of site
frpeak	frequency of the peak spectral amplitude
ampeak	amplitude

DETAILS

This file carries the spectral information about the frequency at which the Fourier spectrum has its maximum amplitude.

WARNING

- In a default run, naming result: xxxnnnaabbb.frq, where xxx is the job name, nnn is the number of polygon in .por file, aa is f0 for displacement, f1 for velocity, f2 for acceleration, bbb can be sns, sew, res, max, exm. The corresponding seismograms are in the file xxxnnnaa.bbb

xxx.gri

smoothed seismicity

```
    slon    slat   mag  ix  iy SMOOTH 0710.cel     Cell size: 0.2 smooth=  3 mag0=  0.
kprnt0=  0
    6.100  36.100  0.0   1   1
    6.300  36.100  0.0   2   1
    6.500  36.100  0.0   3   1
    6.700  36.100  0.0   4   1
    6.900  36.100  0.0   5   1
```

FORTRAN statements to read the data:

```
        read(1,1)xlon,xlat,u,i,j
    1   format(f9.3,f8.3,f5.1,2i4)
```

EXPLANATION OF DATA

xlon,xlat	longitude and latitude of the grid point
u	smoothed magnitude associated with the grid point
i,j	indexes along longitude and latitude, referred to the grid point

DETAILS

This file contains the information about smoothed seismicity. It is obtained starting from the discretized seismicity file generated by program ecells.

Program einscat will then remove all the grid points falling outside the seismogenic zones definened in .pos file.

FAQS

Q: What will happen to magnitude 0 grid points?

A: If the coordinates fall outside the seismogenic zones defined in file .pos, they will be removed as usual by einscat. If the coordinates fall within seismogenic zones, magnitude 5 will be forced by efft.

WARNING

- the grid indexes can not be larger than 333 both along longitude and latitude. This limit the size of the area that can be studied with a single run.

xxx*.isg

input parameters for the computation of synthetic seismograms

```
I N P U T   P A R A M E T E R S   F O R  503  S E I S M O G R A M (S)
       209 1  1  0    .000    0   0 0 0  .1000E+01  .5000E-02  201 4096  88.894  15.000 338.890  75.000   5.000 GEN.
 1 1  .0000E+00 0 0  .0000E+00  .0000E+00  .0000E+00 FORCE SYSTEM AND DURATION
 0 0  .0000E+00  .0000E+00  .0000E+00  .0000E+00  .0000E+00  .0000E+00  .0000E+00  .0000E+00  .0000E+00  .0000E+00 INSTRUMENT
 0  .0000E+00  .0000E+00  .0000E+00  .0000E+00  .0000E+00 310.000 FILTER AND EXTRA
 0929aa00120010   16.3000  38.9000    .000 310.000  75.000   5.000  7.10    1   .1000E+01   .0000E+00 S
 0929aa00120010  7.10    3   15.8000  39.6000    3  88.894 331.110  88.894   .1000E+01    1    .000   R
       210 1  1  0    .000    0   0 0 1  .1000E+01  .5000E-02  201 4096  70.278  15.000 347.669  75.000   5.000 GEN.
 1 1  .0000E+00 0 0  .0000E+00  .0000E+00  .0000E+00 FORCE SYSTEM AND DURATION
 0 0  .0000E+00  .0000E+00  .0000E+00  .0000E+00  .0000E+00  .0000E+00  .0000E+00  .0000E+00  .0000E+00  .0000E+00 INSTRUMENT
 0  .0000E+00  .0000E+00  .0000E+00  .0000E+00  .0000E+00 310.000 FILTER AND EXTRA
 0929aa00120011   16.3000  39.1000    .000 310.000  75.000   5.000  7.10    1   .1000E+01   .0000E+00 S
 0929aa00120011  7.10    3   15.8000  39.6000    3  70.278 322.331  70.278   .1000E+01    1    .000   R
```

FORTRAN statements to read the file:

```
        read(3,1)sisnam,itype,npint,iflg,thkr,modest,modetr,igrdmo,
       1
   marflg,fifr,delfrq,nfqm,npts,dist,thk,phideg,deldeg,xlmdeg
      1 format(1x,a9,i2,2i3,f8.3,2i4,2i2,2e11.4,2i5,5f8.3)
        read(3,2)iptf,itystf,durat,istd,ifinit,frbsou,falen1, falen2
      2 format(2i2,e11.4,2i2,3e11.4)
        read(3,3)iesres,itycal,xmag,t0,dampra,t1,t2,h1,h2,sigsq,tg,geodam
      3 format(2i2,10e11.4)
        read(3,4)igauss,cmaxf,pfocf,cutamp,extra1,extra2,extra3
      4 format(i2,5e11.4,f8.3)

   read(3,5)iev,lev,elon,elat,xdepth,xangl,xdip,xrake,xma,nsub,sweight,tshif
   t
      5 format(1x,i4,a10,f10.4,f9.4,4f8.3,f6.2,i5,2e12.4)

   read(3,6)ne,lev1,xma,ipsou,slon,slat,istr,dist,azim,distr,weicor,nsubp,th
   kr
      6 format(1x,i4,a10,f6.2,i5,f10.4,f9.4,i5,3f8.3,e12.4,i5,f8.3)
```

EXPLANATION OF DATA

record 0 (title)
number of seismogram to be created by program
record 1 (“gen”)

sisnam	name (or num) of seismogram
itype	type (1-displ., 2-vel., 3-accel) - from box
npint	interpolation (0, 1-9) - from box
iflg	ground motion component =0 (see box) - computed
thkr	receiver depth - from box
modest,modetr	first,last used modes (0-all) - from box
igrdmo	input ground motion (0-calc, 1-read in) - from box
marflg	input(1)/calculate(0) eigenfunctions - computed

fifr	final frequency - from box
delfrq	spectrum frequency “interval” (step) - from box
nfqm	number of frequency points (==201) - from box
npts	number of time series points (2**n)=1024,..8192 - from box
dist	distance source-receiver (km) - computed
thk	source depth (km)
phideg	angke (strike-receiver) with strike
deldeg	dip - (see idip in box) = idip in rec.5
xlmdeg	rake - (see irake in box) = irake in rec.5

record 2 (“force system and duration”)

iptf	force type (1 = double couple)
itystf	time function (1=step)
durat	source duration (=0)
istd	shape of time function
ifinit	source fitiness (0-point)
frbsou	rupture velocity (see box)
falen1	fault length along strike (km)
falen2	fault length anti-strike (km)

record 3 (“instrument”) - see identificators in box

record 4 (“filter and extra”)

igauss	flag for computation of low-pass gaussian filter
cmaxf	cutoff frequency (Hz)
pfocf	percentage of cutoff with unit response
cutamp	amplitude at cutoff
extra1,extra2,extra3,extra4,extra5	not used (extra5=iangl - see record5)

record 5(“source”)

iev	index of source in *.fps
lev	aa-run name, ix,iy - coordinates on grid
elon,elat	coordinates of source (longitude,latitude)
xdepth	depth of source in used fps (info only)
xangl	fps: strike
xdip,xrake	fps: dip and rake (= deldeg and xlmdeg in rec.1)
xma	magnitude (== xma1 in rec.6)
nsub	number of subsources (not implemented yet)
sweight	for subsources (not implemented yet)
tshift	shift time for subsources (not implemented yet)

record 6(“receiver”)

ne	index of seismogenic zone(by order in file pos)
lev1	2 symbols- name of run, xxxyyy - two int value (see file *.sut)
xma	magnitude (==xma in rec.5)
ipsou	index poligon source(num of struct.zone -# by order in file por)
slon,slat	coordinates of site (longitude,latitude)
istr	index of structure for receiver (# by order in file por)
dist	== dist (rec.1)
azim	azimut of receiver
distr	dist in use (in the case *.obs may differ from dist in record1)
weicor	correction factor for distance when dist.ne.distl
nsubp	for subsources (not implemented yet)
thkr	receiver depth

DETAILS

This file contains the input parameters necessary for the computation of the synthetic seismograms. It is read by nsgl, nsgr and nsgv. The content is a summary of what was previously prepared by the the other programs executed before ecinput. Each .isg file contains the input for all the seismograms associated with a single structural model.

WARNING

- in a default run, naming result: xxxnnn.isg, where xxx is the job name and nnn is the sequential number of the polygon in .por file.

xxx*.lew

synthetic seismograms, EW component (SH waves)

EXAMPLE FILE:(ASCII format)

```
synthetic seismograms - modal summation  503 created by ngconv
      209 1  1  3  5  15.000    .000    0 205  1.0  4096   132  1518 1 1   .0000E+00 0 0    .000    .000    .000 0 0 338.890  .976562500E-01
 0929aa00120010   16.3000  38.9000    .000 310.000  75.000   5.000  7.10    1   .1000E+01   .0000E+00 S
 0929aa00120010  7.10    3   15.8000  39.6000    3  88.894 331.110  88.894   .1000E+01    1    .000   R
   .000000E+00  .101053E-08  .397949E-08  .765889E-08  .101047E-07  .103690E-07  .990403E-08  .125377E-07  .226680E-07  .424613E-07
   .696593E-07  .975472E-07  .117613E-06  .123920E-06  .117005E-06  .105000E-06  .100790E-06  .116009E-06  .154493E-06  .208513E-06
   .260155E-06  .287950E-06  .276245E-06  .223217E-06  .143620E-06  .644930E-07  .152238E-07  .158183E-07  .703456E-07  .165324E-06
   .273594E-06  .363072E-06  .407450E-06  .395122E-06  .333208E-06  .245188E-06  .162917E-06  .115750E-06  .120568E-06  .176153E-06
   .263882E-06  .354435E-06  .418126E-06  .435203E-06  .402507E-06  .334217E-06  .256554E-06  .198452E-06  .181639E-06  .213669E-06
   .286297E-06  .379584E-06  .469954E-06  .539017E-06  .579732E-06  .597584E-06  .606420E-06  .620711E-06  .647458E-06  .681164E-06
   .704197E-06  .692745E-06  .626391E-06  .497718E-06  .318143E-06  .117358E-06 -.640132E-07 -.186387E-06 -.223883E-06 -.173238E-06
  -.557006E-07  .890464E-07  .215080E-06  .284534E-06  .279166E-06  .205273E-06  .903333E-07 -.273458E-07 -.112238E-06 -.143598E-06
  -.121623E-06 -.656978E-07 -.557157E-08  .310832E-07  .299554E-07 -.411976E-08 -.491326E-07 -.749386E-07 -.559427E-07  .174817E-07
   .133400E-06  .261015E-06  .361032E-06  .400075E-06  .363854E-06  .263988E-06  .135530E-06  .256074E-07 -.231165E-07  .116975E-07
   .122726E-06  .273926E-06  .411930E-06  .484279E-06  .458261E-06  .333633E-06  .144433E-06 -.512087E-07 -.190127E-06 -.225684E-06
  -.144369E-06  .285040E-07  .236295E-06  .409484E-06  .488965E-06  .446283E-06  .293797E-06  .811418E-07 -.121012E-06 -.244538E-06
  -.246843E-06 -.125513E-06  .803745E-07  .302734E-06  .466632E-06  .514785E-06  .426388E-06  .224250E-06 -.318454E-07 -.263181E-06
  -.395651E-06 -.381575E-06 -.213555E-06  .728361E-07  .407123E-06  .699230E-06  .857123E-06  .802363E-06  .481128E-06 -.129428E-06
  -.101795E-05 -.213715E-05 -.340305E-05 -.469695E-05 -.587295E-05 -.677409E-05 -.725774E-05 -.722728E-05 -.666264E-05 -.564014E-05
  -.433212E-05 -.298114E-05 -.185067E-05 -.116224E-05 -.103515E-05 -.144723E-05 -.223108E-05 -.311140E-05 -.377709E-05 -.396991E-05
  -.356493E-05 -.261754E-05 -.136023E-05 -.145937E-06  .648954E-06  .735667E-06  .583111E-08 -.142273E-05 -.322343E-05 -.493962E-05
  -.610419E-05 -.636680E-05 -.559229E-05 -.390128E-05 -.164067E-05  .707843E-06  .265487E-05  .382953E-05  .406868E-05  .344512E-05
   .222903E-05  .797217E-06 -.480201E-06 -.134070E-05 -.168840E-05 -.159640E-05 -.125662E-05 -.897553E-06 -.700014E-06 -.739727E-06
  -.974818E-06 -.127990E-05 -.151169E-05 -.158017E-05 -.149741E-05 -.138452E-05 -.143216E-05 -.182714E-05 -.267031E-05 -.391565E-05
  -.535407E-05 -.665169E-05 -.743410E-05 -.739244E-05 -.637896E-05 -.446187E-05 -.192086E-05  .816768E-06  .328189E-05  .508063E-05
........
        AMAX  =  .599754598E-05          AMIN  = -.743409944E-05 AMAXA  =  .743409944E-05  .113663428E+01  .578423040E+01
      210 1  1  3  5  15.000    .000    0 205  1.0  4096    99  1221 1 1   .0000E+00 0 0    .000    .000    .000 0 0 347.669  .976562500E-01
 0929aa00120011   16.3000  39.1000    .000 310.000  75.000   5.000  7.10    1   .1000E+01   .0000E+00 S
 0929aa00120011  7.10    3   15.8000  39.6000    3  70.278 322.331  70.278   .1000E+01    1    .000   R
   .000000E+00  .963889E-09  .306548E-08  .604711E-08  .111267E-07  .202458E-07  .345752E-07  .533177E-07  .737251E-07  .925059E-07
   .107875E-06  .120964E-06  .135530E-06  .155831E-06  .183663E-06  .216261E-06  .246517E-06  .265884E-06  .268822E-06  .256590E-06
   .238197E-06  .227505E-06  .237347E-06  .273192E-06  .329391E-06  .390130E-06  .436849E-06  .454988E-06  .438032E-06  .391938E-06
   .333818E-06  .286383E-06  .269982E-06  .295025E-06  .357621E-06  .440198E-06  .517138E-06  .563641E-06  .564752E-06  .521285E-06
   .450364E-06  .380099E-06  .340057E-06  .350708E-06  .415587E-06  .519075E-06  .630878E-06  .715929E-06  .746554E-06  .712761E-06
   .627066E-06  .521947E-06  .440496E-06  .423098E-06  .494354E-06  .654468E-06  .877868E-06  .111955E-05  .132715E-05  .145492E-05
........
........
  -.369066E-08 -.176212E-08  .880032E-09  .318433E-08  .426449E-08  .371382E-08  .173407E-08 -.962115E-09 -.343213E-08 -.485768E-08
  -.483826E-08 -.351595E-08 -.148355E-08  .436695E-09  .155578E-08  .163042E-08  .936018E-09  .946225E-10 -.250103E-09  .249771E-09
   .148655E-08  .296227E-08  .403639E-08  .422825E-08  .342873E-08  .192813E-08  .261879E-09 -.103792E-08 -.166031E-08 -.160530E-08
  -.112107E-08 -.541636E-09 -.119824E-09  .608967E-10  .666896E-10  .195837E-10  .000000E+00
        AMAX  = -.149755625E-05          AMIN  =  .121068730E-05 AMAXA  =  .149755625E-05  .113663428E+01  .578423040E+01
```

FORTRAN statements to read one set of seismograms in ASCII format:

```
      read(12,1) c40,nsimax,c35
      read(12,2)sislab,itype,npint,iflg,iflgew,thksou,thkrec,
     1  modest,modetr,fifr,npts,nbefor,nsig,iptf,itystf,durat,istd,
     2  ifinit,frbsou,falen1,falen2,iesres,igauss,phideg,deltim
      read(12,3) sili48
      read(12,4) sili49
      nnsta=nbefor+1
      nnsto=npts-nafter
      read(12,5) (f(i)*cosph,i=nnsta,nnsto)
      amax=0.0d+00
      amin=0.0d+00
      do i=1,npts
        if(f(i).gt.amax) amax=f(i)
        if(f(i).lt.amin) amin=f(i)
      enddo
      amaxa=amax
      amina=dabs(amin)
      if(amina.gt.amax) amaxa=amina
      write(12,6) amax*cosph,amin*cosph,amaxaw,vmin,vmax
    1 format(a40,i5,a35)
    2
  format(a9,i2,3i3,2f8.3,2i4,f5.1,3i6,2i2,e12.4,2i2,3f8.3,2i2,f8.3,e16.9)
    3 format(a103)
```

```
4 format(a103)
5 format(1x,10e13.6)
6 format(10x,'AMAX  =',e16.9,10x,'AMIN  =',e16.9,' AMAXA  =',3e16.9)
```

EXPLANATION OF DATA

record 1	
nsimax	number of seismograms in the file (inside title)
record 2	
sislab	number by order in file
itype	type (1-displ, 2-vel, 3-accel) -see *.isg
npint	num. of point for interpolation
iflg	ground motion component: 1=radial,2=vertical,3=transverse,4=NS,5=EW
iflgew	ground motion component (additional info): ns or ew
thksou	depth of source
thkrec	depth of receiver
modest,modetr	used modes (start, final)
fifr	upper frequency content
npts	number of time series points
nbefor	points in seismogram skipped before writing to file
nsig	real number of seismogram samples written to file
iptf	force system
itystf,durat,istd	parameters of time function
ifinit	source finiteness
frbsou	rupture vel.
falen1, falen2	fault size
iesres	instrument response
igauss	gaussian low-pass filter
phideg	strike-receiver angle
deltim	sampling interval
record 3	source parameters - see *.isg
record 4	receiver parameters - see *.isg

The header records report what is defined in the corresponding .isg file, in case modified by program efft where filtering, instrument response, derivatives, integration and other operations could have been applied. Please refer to files .box, .isg and fft.par for more details. Then there are the samples with units in cm, cm/s or cm/s/s for displacement, velocity or acceleration and at the end the peak values.

DETAILS

These files contain synthetic seismograms. In a default run they are written as binary files, that can be converted to ASCII files using program ngconv. For unscaled seismograms the amplitudes correspond to a scalar seismic moment of 1.0e+20 dyn cm. For magnidude-scaled signals M0 is obtained from magnitude: log(M0) = 1.5 M + 16.05, and a frequency dependent law is applied by program efft.

WARNING

- in a default run, for unscaled seismograms naming result: xxxnnn.eee, where xxx is the job name, nnn is the sequential number of the polygon in .por file, eee is the extension (lns, lew etc). For scaled seismograms naming result: xxxnnnaa.eee, where xxx is the job name, nnn is the sequential number of the polygon in .por file, aa is f0 for displacement, f1 for velocity, f2 for acceleration, eee is the extension (lns, lew etc).

xxx*.lns

synthetic seismograms, NS component (SH waves)

DETAILS

See file .lew for details about the format.

xxx.mag

magnitudes for sources within seismogenic zones

```
 slon    slat   maz  mac  ix  iy  sz INSC11 xxx.gri  xxx.pos
14.500  37.100  7.4  7.4   3   1 0935
14.700  37.100  7.4  7.4   4   1 0935
14.900  37.100  7.4  7.4   5   1 0935
15.100  37.100  7.4  7.4   6   1 0935
```

FORTRAN statements to read one record:

```
      read(1,1,)r1lon,r1lat,wmag,u,i,j,insid
    1 format(f9.3,f8.3,2f5.1,2i4,1x,a4)
```

EXPLANATION OF DATA

r1lon,r1lat	coordinates (geographical)
wmag	max magnitude in seismogenic zone
u	magnitude at the coordinates
i,j	grid index
insid	index of seismogenic zone (index = number by order in file .pos)

DETAILS

Smoothed magnitude value associate with the grid coordinates only for the grid points belonging to the seismogenic zones defined in the .pos file. One record per each cell (“source”).

xxx*.max

synthetic seismograms, max component between .sns and .sew

DETAILS

Generated by program esre. See file .lew for details about the format.

xxx.mec

magnitudes for sources within seismogenic zones

```
   label       flon    flat      h   st di  ra  mag ptr pp ttr tp SELM11 xxx.pos
xxx.fps
 090100006A    6.761  46.096    .00 332 43  32  5.3   0  0   0  0
 090200007A    7.656  46.199    .00 164 78 353  4.8   0  0   0  0
 090300003A    9.980  46.499    .00 300 50 229  5.0   0  0   0  0
```

FORTRAN statements to read one record:

```
      read(1,1) izo,labrec,r1lon,r1lat,depth,istrik,idip,irake,xmc,
     1          iptre,ipplu,ittre,itplu
  160 format(1x,a4,a6,f9.3,f8.3,f7.2,i4,i3,i4,f5.1,2(i4,i3))
```

EXPLANATION OF DATA

izo	index of the seismogenic zone
labrec	label of the solution from .fps file
r1lon,r1flat,depth	coordinates of hypocentre
istrik,idip,irake	strike, dip, rake for first (only) nodal plane
xmc	magnitude of the event
iptre,ipplu	p-axis trend and plunge
ittre,itplu	t-axis trend and plunge

DETAILS

This file contains the fault plane solutions selected from file .fps that fall within the seismogenic zones defined in .pos file, sorted by number of seismogenic zone. One header record and then.one record per each fault plane solution.

xxx.pat

Info about each path considered in the computations

```
    source        mag   sp    rlon      rlat    rp   dist    az      gdist  correction
subso rdep PATGE4 0710.sut     0710.por
 1028nc00060044  6.00   10    6.8000  45.0000   10  40.913 324.678  40.913  0.1000E+01
1   0.000
 1028nc00070045  6.00   10    6.8000  45.0000   10  40.993 285.905  40.993  0.1000E+01
1   0.000
 1029nc00030044  6.50   10    6.8000  45.0000   10  40.913  35.322  40.913  0.1000E+01
1   0.000
```

FORTRAN statements to read one record:

```
      READ(1,1)
     *
  lgrid,xma,iwpsou,r1lon,r1lat,indind,disgri,az,dist,weicor,nsub,zero
    1   format(1x,a14,f6.2,i5,f10.4,f9.4,i5,3f8.3,e12.4,i5,f8.3)
```

EXPLANATION OF DATA

lgrid	label associated with the source: index of the seismogenic zone, 2chars label plus grid coordinates
xma	magnitude associated with the source (may be zero)
iwpsou	index of the structure where the source is located (see file .por)
r1lon,r1lat	geographical coordinates of receiver site
indind	index of the structure where the receiver is located (see file .por)
disgri, az	distance and direction (source-receiver)
dist	corrected distance (if dist < distmin, see patgen.par)
weicor	correction factor for distance (1-without correction)
nsub	number of subsources (not implemented yet)
zero	receiver depth

DETAILS

This file contains the information about all the source-site paths for which synthetic seismograms will be computed.

FAQS

Q: Why isp = 0 for some paths?

A: Because it's not given that a source is located within a polygon defined in .por file. Remember that computations are performed in the 1D approximation, and that the structural model associated with the receiver site will be assumed representative for the whole path length.

Q: Why xma = 0 for some paths?

A: It means that even with the smoothing procedure, no magnitude is associated with the source, but nevertheless the source falls within a seismogenic zone defined in .pos file. For such a case, program efft will assume by default a magnitude 5 and will scale the seismogram accordingly.

WARNING

xxx*.rew

synthetic seismograms, EW component (P-SV waves)

DETAILS

See file .lew for details about the format.

xxx*.rad

synthetic seismograms, radial component (P-SV waves).

DETAILS

See file .lew for details about the format. This file is not used in a default run, and can be removed.

xxx*.res

synthetic seismograms, resultant component between .sns and .sew

DETAILS

See file .lew for details about the format.

xxx*.rns

synthetic seismograms, NS component (P-SV waves)

DETAILS

See file .lew for details about the format.

xxx*.rzz

synthetic seismograms, z-component (P-SV waves)

DETAILS

Vertical component is not computed in a default run. See file .lew for details about the format.

xxx*.sew

synthetic seismograms, EW component (SH + P-SV waves)

DETAILS

See file .lew for details about the format.

xxx*.sns

synthetic seismograms, NS component (SH + P-SV waves)

DETAILS

See file .lew for details about the format.

xxx*.srp

source and receiver parameters for all the paths

```
     source     slon     slat      sp    rlon     rlat     rp   dist    az      h     strike    dip    rake   str/rec  mag CIN0003puglbas.pat
puglbas.sut  puglbas.box
 927aa00040021   14.7000  41.1000    4   15.0000  41.8000    4  81.685  17.773  15.000 136.000  41.000 279.000 118.227  7.00
 927aa00050021   14.9000  41.1000    4   15.0000  41.8000    4  78.191   6.102  15.000 136.000  41.000 279.000 129.898  7.00
 927aa00060021   15.1000  41.1000    4   15.0000  41.8000    4  78.191 353.898  15.000 136.000  41.000 279.000 142.102  7.00
 927aa00030022   14.5000  41.3000    4   15.0000  41.8000    4  69.455  36.750  15.000 136.000  41.000 279.000  99.250  7.00
 927aa00040022   14.7000  41.3000    4   15.0000  41.8000    4  60.912  24.164  15.000 136.000  41.000 279.000 111.836  7.00
 927aa00050022   14.9000  41.3000    4   15.0000  41.8000    4  56.155   8.511  15.000 136.000  41.000 279.000 127.489  7.00
```

FORTRAN statements to read the file:

```
      read(1,1)ne,lev1,elon,elat,ipsou,slon,slat,istr,dist1,
     *              azim,thk,xangl,xdip,xrake,phideg,rmag
1     format(i4,a10,2(f10.4,f9.4,i5),7f8.3,f6.2)
```

EXPLANATION OF DATA

ne	index of the seismogenic zone
lev1	label associated with the source: 2chars label plus grid coordinates
elon,elat	geographical coordinates of source site
ipsou	index of the structure where the source is located (see file .por)
slon,slat	geographical coordinates of receiver site
istr	index of the structure where the receiver is located (see file .por)
dist1, azim	distance and direction (source-receiver)
thk	source depth
xang,xdip,xrak	fault strike, dip and rake
phideg	strike-receiver angle
rmag	magnitude

DETAILS

This file contains information about source and receivers for all the paths for which synthetic seismograms are computed. It is just meant for doing some statistics after importing it into a database or spreadsheet.

FAQS

Q: Why isp = 0 for some paths?

A: Because it's not given that a source is located within a polygon defined in .por file. Remember that computations are performed in the 1D approximation, and that the structural model associated with the receiver site will be assumed representative for the whole path length.

Q: Why xma = 0 for some paths?

A: It means that even with the smoothing procedure, no magnitude is associated with the source, but nevertheless the source falls within a seismogenic zone defined in .pos file. For such a case, program efft will assume by default a magnitude 5 and will scale the seismogram accordingly.

xxx.sut

sources used for the computation of synthetic seismograms

```
     label         slon     slat    depth   strike   dip   rake     mag  isub
weight      tshift MECM16 puglbas.mec  puglbas.mag
 0935aa00030001   14.5000  37.1000    .000 140.000  47.000 301.000  7.40    1   .
1000E+01   .0000E+00
 0935aa00040001   14.7000  37.1000    .000 140.000  47.000 301.000  7.40    1   .
1000E+01   .0000E+00
 0935aa00050001   14.9000  37.1000    .000 140.000  47.000 301.000  7.40    1   .
1000E+01   .0000E+00
 0935aa00060001   15.1000  37.1000    .000 140.000  47.000 301.000  7.40    1   .
1000E+01   .0000E+00
```

FORTRAN statements to read the file:

```
      read(1,1) lab8,xlon,xlat,xmagde,istr,idip,irak,xmaggr,nsub,one,zero
    1 format(1x,a14,f10.4,f9.4,4f8.3,f6.2,i5,2e12.4)
```

EXPLANATION OF DATA

lab8	label associated with the source: index of the seismogenic zone, 2chars label plus grid coordinates
xlon,xlat	geographical coordinates of the source
xmagde	depth (the depth of the first fps in seis-zone)
istr,idip,irak	fault strike, dip and rake (average from .fps file

xmaggr	magnitude in use
nsub	number of subsources (not implemented yet)
one	for subsources (not implemented yet)
zero	shift time for subsources (not implemented yet)

DETAILS

This file contains all the sources that will be used for the computation of synthetic seismograms.

FAQS

Q: Why xma = 0 for some sources?

A: It means that even with the smoothing procedure, no magnitude is associated with the source, but nevertheless the source falls within a seismogenic zone defined in .pos file. For such a case, program efft will assume by default a magnitude 5 and will scale the seismogram accordingly.

WARNING

- Skip this warning if you are doing a default run. In a non-default run, you may want to create the file .sut by yourself in order to start with program epatgen. Since the index of the seismogenic zone (izo) is associated with one fault plane solution, program ecinput will later mess up things if you specify two records with different focal mechanism (h, iang, idip, irak, xma) but with the same index (izo). You must specify different izo values for different focal mechanisms. There are no restrictions on label (levl), but better specify it like “aa000000”, that is without grid coordinates.

xxx*.tra

synthetic seismograms, transverse component (SH waves)

DETAILS

See file .lew for details about the format. This file is not used in a default run, and can be removed.

Old input files version:

makehaz.par

v0001

```
Parameters for program makehaz
-----------------------------------------------------------------
RUN DEFINITION
-----------------------------------------------------------------
0710                                  Name of the run (max 15 char.)
   6 20           Min and max longitude              (degrees)
  36 48           Min and max latitude               (degrees)
0                 Use seismogenic zones (0=no, 1=yes)
1                 Use nodes (0=no, 1=yes, 2= yes separately)
nodes.nod         File with nodes coordinates (max 12 char.)(for nodes only)
0                 Use alerted areas (0=no, 1=CN, 2=M8S)
0                 Execution (0=full,1=until sources,2=until paths,3=from obs+sut,4=0
no plot)
1                 Clean level (0=no,1=yes)
-----------------------------------------------------------------
SOURCE DEFINITION
-----------------------------------------------------------------
6.0               Min magnitude associated with the run
-200 2009         First and last year in catalogue   (years)
  .2              Cell size                          (degrees)
  3               Smoothing radius                   (cells)
  0               Min. events for smooth             (count)
  0  50           Min and max depth                  (km)
999               Source depth                       (sdepth)     (0=sut,
999=auto,x=km)
-----------------------------------------------------------------
PATH DEFINITION
-----------------------------------------------------------------
1   150           Min. and max source-site distance km (0=auto)
0                 Short paths (ishortpaths) (0=elim,1=use rmin,2=adjust)
0                 File (.obs) with observation points (instead of default grid) (max
12 char.)
-----------------------------------------------------------------
TIME SERIES
-----------------------------------------------------------------
  1.              Peak frequency         (peakfr)     (1.0 or 10.0)
  1               Interpolation          (npint)      (0-9)
  1               Seismogram format      (iform)      (0=ASCII, 1=bin)
4096              Time series samples    (npts)       (4096)
  0               Time series length     (iall)       (0=truncated,1=complete)
  1               Type of motion         (itype)      (1=dis, 2=vel, 3=acc)
  1               Vertical component     (ivert)      (1=yes,0=no)
  1  90           Type of scaling        (iscale,iaz) (1=classic,2=pulsyn)(angle)
itacode.cod       File with code response spectra for computing DGA (max 12 char.)
  0               Plot seismograms       (isis)       (1=yes,0=no)
```

Explanation of data

namerun	Name of the run (max 15 char.)
minlo,maxlo	Min and max longitude (degrees)
minla,maxla	Min and max latitude (degrees)
izs	Use seismogenic zones (0=no, 1=yes)
inod	Use nodes (0=no, 1=yes, 2= yes separately)
filnod	File with nodes coordinates (max 12 char.)
ipred	Use alerted areas (0=no, 1=CN, 2=M8S)
ihaz	Execution (0=full,1=until sources,2=until paths,3=from obs+sut,4=0 no plot)
iclean	Clean level (0=no,1=yes)
smmin	Min magnitude associated with the run
year1,year2	First and last year in catalogue (years)
divcel	Cell size (degrees)
ksmthr	Smoothing radius (cells)
nsmth	Min. events for smooth (count)
h1,h2	Min and max depth (km)
sdepth	Source depth (0=sut,999=auto,x=km)
kmin,kmax	Min. and max source-site distance km (0=auto)

ishortpaths	Short paths (0=elim,1=use rmin,2=adjust)
filobs	File (.obs) with observation points (instead of default grid) (max 12 char.)
peakfr	Peak frequency (1.0 or 10.0)
npint	Interpolation (0-9)
iform	Seismogram format (0=ASCII, 1=bin)
npts	Time series samples (4096)
iall	Time series length (0=truncated,1=complete)
itype	Type of motion (1=dis, 2=vel, 3=acc)
ivert	Vertical component (1=yes,0=no)
iscale,iaz	Type of scaling (1=classic,2=pulsyn)(angle)
fildat	File with code response spectra for computing DGA (max 12 char.)
isis	Plot seismograms (1=yes,0=no)

v0002

Added recurrence estimation option

```
Parameters for program makehaz                    (v0002)
-----------------------------------------------------------------
RUN DEFINITION
-----------------------------------------------------------------
0710                                  Name of the run (max 15 char.)
   6 20           Min and max longitude              (degrees)
  36 48           Min and max latitude               (degrees)
0                 Use seismogenic zones (0=no, 1=yes)
1                 Use nodes (0=no, 1=yes, 2= yes separately)
nodes.nod         File with nodes coordinates (max 12 char.)(for nodes only)
0                 Use alerted areas (0=no, 1=CN, 2=M8S)
0                 Use recurrence (0=no, 1=multiscale GR)
kron7.pog          File with recurrence parameters (max 12 char.)
0                 Execution (0=full,1=until sources,2=until paths,3=from obs+sut,4=0
no plot)
1                 Clean level (0=no,1=yes)
-----------------------------------------------------------------
SOURCE DEFINITION
-----------------------------------------------------------------
6.0               Min magnitude associated with the run
-200 2009         First and last year in catalogue   (years)
  .2              Cell size                          (degrees)
  3               Smoothing radius                   (cells)
  0               Min. events for smooth             (count)
  0  50           Min and max depth                  (km)
999               Source depth                       (sdepth)     (0=sut,
999=auto,x=km)
-----------------------------------------------------------------
PATH DEFINITION
-----------------------------------------------------------------
1   150           Min. and max source-site distance km (0=auto)
0                 Short paths (ishortpaths) (0=elim,1=use rmin,2=adjust)
0                 File (.obs) with observation points (instead of default grid) (max
12 char.)
-----------------------------------------------------------------
TIME SERIES
-----------------------------------------------------------------
  1.              Peak frequency         (peakfr)     (1.0 or 10.0)
  1               Interpolation          (npint)      (0-9)
  1               Seismogram format      (iform)      (0=ASCII, 1=bin)
4096              Time series samples    (npts)       (4096)
  0               Time series length     (iall)       (0=truncated,1=complete)
  1               Type of motion         (itype)      (1=dis, 2=vel, 3=acc)
  1               Vertical component     (ivert)      (1=yes,0=no)
  1  90           Type of scaling        (iscale,iaz) (1=classic,2=pulsyn)(angle)
itacode.cod       File with code response spectra for computing DGA (max 12 char.)
  0               Plot seismograms       (isis)       (1=yes,0=no)
  0               Grid computation       (igrid)      (1=yes,0=no)
```

Explanation of data

namerun	Name of the run (max 15 char.)
minlo,maxlo	Min and max longitude (degrees)
minla,maxla	Min and max latitude (degrees)
izs	Use seismogenic zones (0=no, 1=yes)

inod	Use nodes (0=no, 1=yes, 2= yes separately)
filnod	File with nodes coordinates (max 12 char.)
ipred	Use alerted areas (0=no, 1=CN, 2=M8S)
irec	Estimate recurrence
filrec	File with recurrence polygon
ihaz	Execution (0=full,1=until sources,2=until paths,3=from obs+sut,4=0 no plot)
iclean	Clean level (0=no,1=yes)
smmin	Min magnitude associated with the run
year1,year2	First and last year in catalogue (years)
divcel	Cell size (degrees)
ksmthr	Smoothing radius (cells)
nsmth	Min. events for smooth (count)
h1,h2	Min and max depth (km)
sdepth	Source depth (0=sut,999=auto,x=km)
kmin,kmax	Min. and max source-site distance km (0=auto)
ishortpaths	Short paths (0=elim,1=use rmin,2=adjust)
filobs	File (.obs) with observation points (instead of default grid) (max 12 char.)
peakfr	Peak frequency (1.0 or 10.0)
npint	Interpolation (0-9)
iform	Seismogram format (0=ASCII, 1=bin)
npts	Time series samples (4096)
iall	Time series length (0=truncated,1=complete)
itype	Type of motion (1=dis, 2=vel, 3=acc)
ivert	Vertical component (1=yes,0=no)
iscale,iaz	Type of scaling (1=classic,2=pulsyn)(angle)
fildat	File with code response spectra for computing DGA (max 12 char.)
isis	Plot seismograms (1=yes,0=no)
igrid	Adapt hazard script to computation on GRID infrastructure (1=yes,0=no)

v0003

```
Parameters for program makehaz                   (v0003)
-----------------------------------------------------------------
RUN DEFINITION
-----------------------------------------------------------------
0710                                  Name of the run (max 15 char.)
   6 20           Min and max longitude              (degrees)
  36 48           Min and max latitude               (degrees)
0                 Use seismogenic zones (0=no, 1=yes)
1                 Use nodes (0=no, 1=yes, 2= yes separately)
nodes.nod         File with nodes coordinates (max 12 char.)(for nodes only)
0                 Use alerted areas (0=no, 1=CN, 2=M8S)
0                 Use recurrence (0=no, 1=multiscale GR)
kron7.pog          File with recurrence parameters (max 12 char.)
0                 Execution (0=full,1=until sources,2=until paths,3=from obs+sut,4=0
no plot)
1                 Clean level (0=no,1=yes)
-----------------------------------------------------------------
SOURCE DEFINITION
-----------------------------------------------------------------
6.0               Min magnitude associated with the run
   0 99           Min and max magnitude taken from catalogues
-200 2009         First and last year in catalogue   (years)
  .2              Cell size                          (degrees)
  3               Smoothing radius                   (cells)
  0               Min. events for smooth             (count)
  0  50           Min and max depth                  (km)
999               Source depth                       (sdepth)     (0=sut,
999=auto,x=km)
-----------------------------------------------------------------
PATH DEFINITION
-----------------------------------------------------------------
1   150           Min. and max source-site distance km (0=auto)
0                 Short paths (ishortpaths) (0=elim,1=use rmin,2=adjust)
0                 File (.obs) with observation points (instead of default grid) (max
12 char.)
-----------------------------------------------------------------
```

```
TIME SERIES
-----------------------------------------------------------------
  1.              Peak frequency         (peakfr)     (1.0 or 10.0)
  1               Interpolation          (npint)      (0-9)
  1               Seismogram format      (iform)      (0=ASCII, 1=bin)
4096              Time series samples    (npts)       (4096)
  0               Time series length     (iall)       (0=truncated,1=complete)
  1               Type of motion         (itype)      (1=dis, 2=vel, 3=acc)
  1               Vertical component     (ivert)      (1=yes,0=no)
  1  90           Type of scaling        (iscale,iaz) (1=classic,2=pulsyn)(angle)
itacode.cod       File with code response spectra for computing DGA (max 12 char.)
  0               Plot seismograms       (isis)       (1=yes,0=no)
  0               Grid computation       (igrid)      (1=yes,0=no)
```

v0004

```
Parameters for program makehaz                  (v0004)
-----------------------------------------------------------------
RUN DEFINITION
-----------------------------------------------------------------
xxx               Name of the run (max 15 char.)
   6 20           Min and max longitude              (degrees)
  36 48           Min and max latitude               (degrees)
1                 Use seismogenic zones (0=no, 1=yes)
0                 Use nodes (0=no, 1=yes, 2= yes separately)
nodes.nod         File with nodes coordinates (max 12 char.)(for nodes only)
0                 Use alerted areas (0=no, 1=CN, 2=M8S)
0                 Use recurrence (0=no, 1=multiscale GR)
kron7.pog          File with recurrence parameters (max 12 char.)
0                 Execution (0=full,1=until sources,2=until paths,3=from obs+sut,4=0
no plot)
0                 Clean level (0 no, 3 save all seismograms, 15 clean all; see manual)
-----------------------------------------------------------------
SOURCE DEFINITION
-----------------------------------------------------------------
6.0               Min magnitude associated with the run
   0 99           Min and max magnitude taken from catalogues
-200 2009         First and last year in catalogue   (years)
  .2              Cell size                          (degrees)
  3               Smoothing radius                   (cells)
  0               Min. events for smooth             (count)
  0  50           Min and max depth                  (km)
999               Source depth                       (sdepth)     (0=sut,
999=auto,x=km)
-----------------------------------------------------------------
PATH DEFINITION
-----------------------------------------------------------------
1   150           Min. and max source-site distance km (0=auto)
0                 Short paths (ishortpaths) (0=elim,1=use rmin,2=adjust)
0                 File (.obs) with observation points (instead of default grid) (max
12 char.)
-----------------------------------------------------------------
TIME SERIES
-----------------------------------------------------------------
  1.              Peak frequency         (peakfr)     (1.0 or 10.0)
  1               Interpolation          (npint)      (0-9)
  1               Seismogram format      (iform)      (0=ASCII, 1=bin)
4096              Time series samples    (npts)       (4096)
  0               Time series length     (iall)       (0=truncated,1=complete)
  1               Type of motion         (itype)      (1=dis, 2=vel, 3=acc)
  1               Vertical component     (ivert)      (1=yes,0=no)
  1  90           Type of scaling        (iscale,iaz) (1=classic,2=pulsyn)(angle)
itacode.cod       File with code response spectra for computing DGA (max 12 char.)
  0               Plot seismograms       (isis)       (1=yes,0=no)
  0               Grid computation       (igrid)      (1=yes,0=no)
```

cells.par

v0001

```
parameters for program ecells   (filenames reading format: A40)
aaa.eqc                         file with first earthquake catalogue
aaa.poc                         file with first polygons of validity
bbb.eqc                         file with second earthquake catalogue
bbb.poc                         file with second polygons of validity
…
zzz.eqc                         file with nth earthquake catalogue
zzz.poc                         file with nth polygons of validity
```

With this version of file, ecells.out will read just m1 from earthquake catalogues. So you should put in m1 the maximum magnitude value available. Program edcatsun.out can help you in this.

*.cou and *.fin

v0001

```
 sislab        source       slon     slat     sp    rlon     rlat     rp   dist    az
hs      hr   strike    dip    rake   strrec   mag     amaxa       amima2      permax
permin   k nsub COU13   07100010f0.max
        1 0911sz00140044    8.7000  44.7000    9    7.0000  44.4000   10 139.137
256.733  10.000   0.000 133.000  29.000 255.000 236.267  5.70  0.8089E-01  0.7510E-01
0.7692E+01  0.7692E+01 1    1
        2 0911sz00140044    8.7000  44.7000    9    7.0000  44.6000   10 135.310
265.885  10.000   0.000 133.000  29.000 255.000 227.115  5.70  0.7607E-01  0.7111E-01
0.7547E+01  0.1026E+02 1    1
        3 0911sz00140044    8.7000  44.7000    9    7.0000  44.8000   10 135.079
275.315  10.000   0.000 133.000  29.000 255.000 217.685  5.70  0.7455E-01  0.7360E-01
0.1026E+02  0.7547E+01 1    1
        4 0911sz00140044    8.7000  44.7000    9    7.0000  45.0000   10 138.462
284.529  10.000   0.000 133.000  29.000 255.000 208.471  5.70  0.6692E-01  0.5971E-01
0.7692E+01  0.1053E+02 1    1
```

FORTRAN statements to read the event records:

```
      read(1,620)sislab,lev1,elon,elat,ipsou,slon,slat,istr,dist1,
     1  azim,thks,thkr,angl,xdip,xrake,phideg,rmag,amaxa,amaxa2,
     2  perzz,perew,itype,nsub
  620 format
     1(a9,1x,a14,2(f10.4,f9.4,i5),8f8.3,f6.2,4e12.4,i2,i5)
```

*dga.cou and *dga.fin

v0001

```
 sislab        source       slon     slat     sp    rlon     rlat     rp   dist    az
hs      hr   strike    dip    rake   strrec   mag    designa     designb     designc
perioda     periodb     periodc   comp   COU13
        1 0911sz00140044    8.7000  44.7000    9    7.0000  44.4000   10 139.137
256.733  10.000   0.000 133.000  29.000 255.000 236.267  5.70 0.16943E+01 0.10846E+01
0.62784E+00 0.15000E+01 0.15000E+01 0.15000E+01 sns
        2 0911sz00140044    8.7000  44.7000    9    7.0000  44.6000   10 135.310
265.885  10.000   0.000 133.000  29.000 255.000 227.115  5.70 0.23970E+01 0.15335E+01
0.88721E+00 0.14000E+01 0.14000E+01 0.14000E+01 sns
        3 0911sz00140044    8.7000  44.7000    9    7.0000  44.8000   10 135.079
275.315  10.000   0.000 133.000  29.000 255.000 217.685  5.70 0.26723E+01 0.17106E+01
0.99025E+00 0.15000E+01 0.15000E+01 0.15000E+01 sns
        4 0911sz00140044    8.7000  44.7000    9    7.0000  45.0000   10 138.462
284.529  10.000   0.000 133.000  29.000 255.000 208.471  5.70 0.28034E+01 0.17945E+01
0.10388E+01 0.15000E+01 0.15000E+01 0.15000E+01 sns
```

FORTRAN statements to read the event records:

```
      read(1,620)sislab,lev1,elon,elat,ipsou,slon,slat,istr,dist1,
     1  azim,thks,thkr,angl,xdip,xrake,phideg,rmag,dga1,dga2,dga3,
     2  per1,per2,per3,comp
  620 format
     1(a9,1x,a14,2(f10.4,f9.4,i5),8f8.3,f6.2,6e12.5,1x,a3)
```

mecmed.par

v0001

```
Parameters for program mecmed generated by selmec: xxx
aa                                  Label associated with the run
xxx.mec                             File with FPS for the seismogenic zones
```

cinput.par

v0001

```
Parameters for program cinput generated by patgen: xxx
xxx.gen                             File with general parameters (.GEN)
xxx.box                             File with example input box (.BOX)
xxx.sut                             File with selected sources (.SUT)
xxx.pat                             File with source-site pairs (.PAR)
```

patgen.par

```
Parameters for program patgen generated by mecmed: xxx
xxx.sut                                 File with selected sources
xxx.por                                 File with structural polygons
0                                       File with observation coords (0=grid)
1                                       Min. source-site distance km (0=auto)
0                                       Max. source-site distance km (0=auto)
0                                       Short paths: 0=elim,1=use rmin,2=adjust
```