

The DSTX Manuals

Tsunami Computer Exercises

Theoretical computation of Tsunamis

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Tsunami Computer Exercises

Foreword

Synthetic tsunamigrams will be generated for given source and structural model configurations, taking into account 1D and 2D layered models.

Logging in and getting to the working directory

Six accounts have been made available for the students:

Username:	sg01	sg02	sg03	sg04	sg05	sg06
Password:

From the computer used to login into the system, connect to is01 server, using the Terminal application:

```
[it01:/XDST/sg01] sg01% ssh is01  
[is01:/XDST/sg01] sg01%
```

To get to the working directory, give the following commands:

```
[is01:/XDST/sg01] sg01% cdt  
[is01:/tmpXDST/sg01] sg01% cd Tsunami  
[is01:/tmpXDST/sg01/Tsunami] sg01%
```

1D computations, selected receivers

Example input files

Required input files can be found in `/XDST/Examples/Tsunami/Exercises/Inp1D` directory:

```
[is01:/tmpXDST/sg01/Tsunami] sg01% ls -lR /XDST/Examples/Tsunami/Exercises/Inp1D/
/XDST/Examples/Tsunami/Exercises/Inp1D/:
total 236
-rw-r--r-- 1 vaccari dstguest 188 Mar 24 09:49 adri.obs
-rw-r--r-- 1 vaccari dstguest 4913 Mar 24 09:49 adri.por
-rw-r--r-- 1 vaccari dstguest 236 Mar 24 09:49 adri.sut
-rw-r--r-- 1 vaccari dstguest 242 Mar 24 09:49 adri0001.stp
-rw-r--r-- 1 vaccari dstguest 291 Mar 24 09:49 adri0002.stp
-rw-r--r-- 1 vaccari dstguest 242 Mar 24 09:49 adri0003.stp
-rw-r--r-- 1 vaccari dstguest 312 Mar 24 09:49 adri0004.stp
-rw-r--r-- 1 vaccari dstguest 245 Mar 24 09:49 adri0005.stp
-rw-r--r-- 1 vaccari dstguest 271 Mar 24 09:49 adri0006.stp
-rw-r--r-- 1 vaccari dstguest 246 Mar 24 09:49 adri0007.stp
-rw-r--r-- 1 vaccari dstguest 242 Mar 24 09:49 adri0008.stp
-rw-r--r-- 1 vaccari dstguest 241 Mar 24 09:49 adri0009.stp
-rw-r--r-- 1 vaccari dstguest 279 Mar 24 09:49 adri0010.stp
-rw-r--r-- 1 vaccari dstguest 245 Mar 24 09:49 adri0011.stp
-rw-r--r-- 1 vaccari dstguest 246 Mar 24 09:49 adri0012.stp
-rw-r--r-- 1 vaccari dstguest 61 Mar 24 09:49 cells.par
-rw-r--r-- 1 vaccari dstguest 869 Mar 24 09:49 distsu.cpt
-rw-r--r-- 1 vaccari dstguest 868 Mar 24 09:49 distsu65.cpt
-rw-r--r-- 1 vaccari dstguest 869 Mar 24 09:49 distsu75.cpt
-rw-r--r-- 1 vaccari dstguest 880 Mar 24 09:49 distsucopia.cpt
-rw-r--r-- 1 vaccari dstguest 511 Mar 24 09:49 gusev01.xy
-rw-r--r-- 1 vaccari dstguest 642 Mar 24 09:49 gusev02.xy
-rw-r--r-- 1 vaccari dstguest 581 Mar 24 09:49 gusev03.xy
-rw-r--r-- 1 vaccari dstguest 726 Mar 24 09:49 gusev04.xy
-rw-r--r-- 1 vaccari dstguest 707 Mar 24 09:49 gusev05.xy
-rw-r--r-- 1 vaccari dstguest 817 Mar 24 09:49 gusev06.xy
-rw-r--r-- 1 vaccari dstguest 890 Mar 24 09:49 gusev07.xy
-rw-r--r-- 1 vaccari dstguest 1094 Mar 24 09:49 gusev08.xy
-rw-r--r-- 1 vaccari dstguest 1109 Mar 24 09:49 gusev09.xy
-rw-r--r-- 1 vaccari dstguest 974 Mar 24 09:49 gusev10.xy
-rw-r--r-- 1 vaccari dstguest 1989 Mar 24 09:49 itacode.dat
-rw-r--r-- 1 vaccari dstguest 2628 Mar 24 09:49 makehaz.par
-rw-r--r-- 1 vaccari dstguest 76 Mar 24 09:49 tsu1.par
-rw-r--r-- 1 vaccari dstguest 99397 Mar 24 09:49 tsugmt.sh
[is01:/tmpXDST/sg01/Tsunami] sg01%
```

Input data preparation

Create a dedicated directory, and copy into it the files needed:

```
[is01:/tmpXDST/sg01/Tsunami] sg01% mkdir Run1D
[is01:/tmpXDST/sg01/Tsunami] sg01% cp /XDST/Examples/Tsunami/Exercises/Inp1D/* Run1D/
[is01:/tmpXDST/sg01/Tsunami] sg01% cd Run1D/
[is01:sg01/Tsunami/Run1D] sg01%
```

Check the source information:

```
vi adri.sut (on is01)
```

or

```
edit adri.sut (on the local machine in front of you)
```

Magnitude should be 6.5 and source depth 10 km (to make a comparison with the results of Paulatto).

Edit the file so that in its final form it looks like

```
0000adritsu001 15.210 43.200 10.000 45.000 45.000 90.000 6.50 1 0.1000E
+01 0.0000E+00
```

Selection of the run type

Edit file `makehaz.par`;

```
vi makehaz.par
```

The kind of run is selected in line 13, the index should be posed equal to 3:

```
3           Execution (0=full ,1=until sources,2=until paths,3=starting from obs+sut)
```

Structure files

In this case the structures represent the average bathymetry between the source and each selected receiver.

In file `adri.obs` the selected receivers (from top to bottom Venice, Ortona, Split and Durres) and their structure indexes are shown.

```
vi adri.obs
```

lon	lat	struc	rdep
12.35	45.30	0002	0.000
14.50	42.35	0005	0.000
16.42	43.02	0010	0.000
19.25	41.32	0012	0.000

Thus the reference average structures are in files `adri0002.stp`, `adri0005.stp`, `adri0010.stp` and `adri0012.stp`.

The thickness of the liquid layer is shown in the second line of every file, for example in `adri0002.stp` there is

```
H DENS VP VS QP QS Z Lon Lat "Delta VS+" "Delta VS-" "Delta H+" "Delta H-" VP/VS  
0.10 1.03 1.45 0.00 0.00 0.00 0.00 0.07 1
```

Check that the choice of average thickness (H) is correct for the four source-receiver paths, in particular it should be (looking at the map shown in the slides): 100m for Venice (as shown above), 150m for Ortona (check `adri0005.stp`), 150m for Split (check `adri0010.stp`) and 650m for Durres (check `adri0012.stp`). Modify the thickness H where required.

Programs execution

After all the input files are properly configured, you can perform the run. First create the spectra files from structures:

```
tsu.out
```

Then execute the program

```
makehaztsu.out
```

and then launch the script

```
sh haztsu
```

The results for peaks (cm) and arrival times (min) for the four selected receivers are in file `adrif0tsz.cou`. The values should be:

sislab	source	slon	slat	sp	r lon	r lat	rp	dist	az
hs	hr strike	dip	rake	strrec	mag	amaxa	amima2	tmax	
tmin	k nsub COU13		adri0002f0.tsz						
1	0000adritsu001	15.2100	43.2000	2	12.3500	45.3000	2	326.499	
316.597	10.000	0.000	45.000	45.000	90.000	1.543	6.50	0.1966E+01	-0.7372E-01
0.1733E+03	0.8545E+01	1	0						
hs	hr strike	dip	rake	strrec	mag	amaxa	amima2	tmax	
tmin	k nsub COU13		adri0005f0.tsz						
2	0000adritsu001	15.2100	43.2000	5	14.5000	42.3500	5	110.870	
211.848	10.000	0.000	45.000	45.000	90.000	3.371	6.50	0.1500E+01	-0.3627E-01
0.4761E+02	0.7731E+01	1	0						
hs	hr strike	dip	rake	strrec	mag	amaxa	amima2	tmax	
tmin	k nsub COU13		adri0010f0.tsz						
3	0000adritsu001	15.2100	43.2000	10	16.4200	43.0200	10	100.499	
101.065	10.000	0.000	45.000	45.000	90.000	5.305	6.50	0.3530E+01	-0.1109E+00
0.4313E+02	0.6917E+01	1	0						
hs	hr strike	dip	rake	strrec	mag	amaxa	amima2	tmax	
tmin	k nsub COU13		adri0012f0.tsz						
4	0000adritsu001	15.2100	43.2000	12	19.2500	41.3200	12	393.294	
120.699	10.000	0.000	45.000	45.000	90.000	4.962	6.50	0.1941E+01	-0.4111E-01
0.8260E+02	0.4883E+01	1	0						

These results will be compared to those obtained with "simplified 2D" computation and with those of Paulatto.

2D computations, selected receivers

Example input files

Required input files can be found in `/XDST/Examples/Tsunami/Exercises/Inp2D` directory:

```
[is01:/tmpXDST/sg01/Tsunami] sg01% ls -l /XDST/Examples/Tsunami/Exercises/Inp2D
total 224
-rw-r--r-- 1 vaccari dstguest 188 Mar 24 09:49 adri.obs
-rw-r--r-- 1 vaccari dstguest 4913 Mar 24 09:49 adri.por
-rw-r--r-- 1 vaccari dstguest 236 Mar 24 09:49 adri.sut
-rw-r--r-- 1 vaccari dstguest 242 Mar 24 09:49 adri0001.stp
-rw-r--r-- 1 vaccari dstguest 291 Mar 24 09:49 adri0002.stp
-rw-r--r-- 1 vaccari dstguest 242 Mar 24 09:49 adri0003.stp
-rw-r--r-- 1 vaccari dstguest 312 Mar 24 09:49 adri0004.stp
-rw-r--r-- 1 vaccari dstguest 245 Mar 24 09:49 adri0005.stp
-rw-r--r-- 1 vaccari dstguest 271 Mar 24 09:49 adri0006.stp
-rw-r--r-- 1 vaccari dstguest 246 Mar 24 09:49 adri0007.stp
-rw-r--r-- 1 vaccari dstguest 242 Mar 24 09:49 adri0008.stp
-rw-r--r-- 1 vaccari dstguest 241 Mar 24 09:49 adri0009.stp
-rw-r--r-- 1 vaccari dstguest 279 Mar 24 09:49 adri0010.stp
-rw-r--r-- 1 vaccari dstguest 245 Mar 24 09:49 adri0011.stp
-rw-r--r-- 1 vaccari dstguest 246 Mar 24 09:49 adri0012.stp
-rw-r--r-- 1 vaccari dstguest 61 Mar 24 09:49 cells.par
-rw-r--r-- 1 vaccari dstguest 869 Mar 24 09:49 distsu75.cpt
-rw-r--r-- 1 vaccari dstguest 511 Mar 24 09:49 gusev01.xy
-rw-r--r-- 1 vaccari dstguest 642 Mar 24 09:49 gusev02.xy
-rw-r--r-- 1 vaccari dstguest 581 Mar 24 09:49 gusev03.xy
-rw-r--r-- 1 vaccari dstguest 726 Mar 24 09:49 gusev04.xy
-rw-r--r-- 1 vaccari dstguest 707 Mar 24 09:49 gusev05.xy
-rw-r--r-- 1 vaccari dstguest 817 Mar 24 09:49 gusev06.xy
-rw-r--r-- 1 vaccari dstguest 890 Mar 24 09:49 gusev07.xy
-rw-r--r-- 1 vaccari dstguest 1094 Mar 24 09:49 gusev08.xy
-rw-r--r-- 1 vaccari dstguest 1109 Mar 24 09:49 gusev09.xy
-rw-r--r-- 1 vaccari dstguest 974 Mar 24 09:49 gusev10.xy
-rw-r--r-- 1 vaccari dstguest 1989 Mar 24 09:49 itacode.dat
-rw-r--r-- 1 vaccari dstguest 2628 Mar 24 09:49 makehaz.par
-rw-r--r-- 1 vaccari dstguest 76 Mar 24 09:49 tsul.par
-rw-r--r-- 1 vaccari dstguest 99397 Mar 24 09:49 tsugmt.sh
[is01:/tmpXDST/sg01/Tsunami] sg01%
```

Input data preparation

Create a dedicated directory, and copy into it the files needed:

```
[is01:/tmpXDST/sg01/Tsunami] sg01% mkdir Run2D
[is01:/tmpXDST/sg01/Tsunami] sg01% cp /XDST/Examples/Tsunami/Exercises/Inp2D/* Run2D
[is01:/tmpXDST/sg01/Tsunami] sg01% cd Run2D
[is01:sg01/Tsunami/Run2D] sg01%
```

Check the source information:

```
vi adri.sut (on is01)
```

or

```
edit adri.sut (on the local machine in front of you)
```

Magnitude should be 6.5 and source depth 10 km (to make a comparison with the results of Paulatto).

Edit the file so that in its final form it looks like

```
0000adritsu001 15.210 43.200 10.000 45.000 45.000 90.000 6.50 1 0.1000E
+01 0.0000E+00
```

Selection of the run type

Edit file makehaz.par;

```
vi makehaz.par
```

The kind of run is selected in line 13, the index should be posed equal to 3:

```
3          Execution (0=full ,1=until sources,2=until paths,3=starting from obs+sut)
```

Structure files

This case is different from the previous one, in fact here there is a reference structure for the source zone, in file sorg.stp, and four different files for the four receivers.

In file adri.obs the selected receivers (from top to bottom Venice, Ortona, Split and Durres) and their structure index are shown.

```
vi adri.obs
```

lon	lat	struc	rdep
12.35	45.30	0002	0.000
14.50	42.35	0005	0.000
16.42	43.02	0010	0.000
19.25	41.32	0012	0.000

In this case these structures (in particular the thickness of the liquid layer) should represent the characteristics of the receiver zone more than those of an average structure from source to receiver.

Selected values of liquid layer thickness are: **40 m** for Venice (adri0002.stp), **170 m** for Ortona (adri0005.stp), **200 m** for Split (adri0010.stp), **650 m** for Durres (adri0012.stp). Modify the thickness H where required.

Programs execution

After all the input files are properly configured, you can perform the run. First create the spectra files from structures:

```
tsu.out
```

Then execute the program

```
makehaztsu2d.out
```

and then launch the script

```
sh haztsu
```

The results for peaks (cm) and arrival times (min) for the four selected receivers are in file adrif0tsz.cou. The values should be:

sislab	source	slon	slat	sp	rln	rln	rln	rp	dist	az
hs	hr	strike	dip	rake	strrec	mag	amaxa	amima2	tmax	
tmin	k	nsub	COU13	adri0002f0.tsz						
	1	0000	adritsu001	15.2100	43.2000	10	12.3500	45.3000	2	326.499
316.597	10.000	0.000	45.000	45.000	90.000	1.543	6.50	0.3683E+01	-0.1750E+00	
0.1786E+03	0.5697E+01	1	0							
sislab	source	slon	slat	sp	rln	rln	rln	rp	dist	az
hs	hr	strike	dip	rake	strrec	mag	amaxa	amima2	tmax	
tmin	k	nsub	COU13	adri0005f0.tsz						

```

      2 0000adritsu001 15.2100 43.2000 10 14.5000 42.3500 5 110.870
211.848 10.000 0.000 45.000 45.000 90.000 3.371 6.50 0.7238E+01 -0.4753E-01
0.4313E+02 0.8545E+01 1 0
sislab source slon slat sp rlon rlat rp dist az
hs hr strike dip rake strrec mag amaxa amima2 tmax
tmin k nsub COU13 adri0010f0.tsz
      3 0000adritsu001 15.2100 43.2000 10 16.4200 43.0200 10 100.499
101.065 10.000 0.000 45.000 45.000 90.000 5.305 6.50 0.6301E+01 -0.2011E+00
0.3743E+02 0.6104E+01 1 0
sislab source slon slat sp rlon rlat rp dist az
hs hr strike dip rake strrec mag amaxa amima2 tmax
tmin k nsub COU13 adri0012f0.tsz
      4 0000adritsu001 15.2100 43.2000 10 19.2500 41.3200 12 393.294
120.699 10.000 0.000 45.000 45.000 90.000 4.962 6.50 0.2706E+01 -0.1194E+00
0.1086E+03 0.6104E+01 1 0

```

Compare them with those obtained with 1D computations and those by Paulatto (shown in slide, obtained using a detailed 2D approximation). It is evident that in this case this “simplified 2D model” works quite well.

1D computations, tsunami hazard scenarios

Example input files

Required input files can be found in `/XDST/Examples/Tsunami/Exercises/Inp1Dscen` directory:

```
[is01:/tmpXDST/sg01/Tsunami] sg01% ls -l /XDST/Examples/Tsunami/Exercises/Inp1Dscen
total 236
-rw-r--r-- 1 vaccari dstguest 188 Mar 24 09:49 adri.obs
-rw-r--r-- 1 vaccari dstguest 4913 Mar 24 09:49 adri.por
-rw-r--r-- 1 vaccari dstguest 236 Mar 24 09:49 adri.sut
-rw-r--r-- 1 vaccari dstguest 242 Mar 24 09:49 adri0001.stp
-rw-r--r-- 1 vaccari dstguest 291 Mar 24 09:49 adri0002.stp
-rw-r--r-- 1 vaccari dstguest 242 Mar 24 09:49 adri0003.stp
-rw-r--r-- 1 vaccari dstguest 312 Mar 24 09:49 adri0004.stp
-rw-r--r-- 1 vaccari dstguest 245 Mar 24 09:49 adri0005.stp
-rw-r--r-- 1 vaccari dstguest 271 Mar 24 09:49 adri0006.stp
-rw-r--r-- 1 vaccari dstguest 246 Mar 24 09:49 adri0007.stp
-rw-r--r-- 1 vaccari dstguest 242 Mar 24 09:49 adri0008.stp
-rw-r--r-- 1 vaccari dstguest 241 Mar 24 09:49 adri0009.stp
-rw-r--r-- 1 vaccari dstguest 279 Mar 24 09:49 adri0010.stp
-rw-r--r-- 1 vaccari dstguest 245 Mar 24 09:49 adri0011.stp
-rw-r--r-- 1 vaccari dstguest 246 Mar 24 09:49 adri0012.stp
-rw-r--r-- 1 vaccari dstguest 61 Mar 24 09:49 cells.par
-rw-r--r-- 1 vaccari dstguest 869 Mar 24 09:49 distsu.cpt
-rw-r--r-- 1 vaccari dstguest 868 Mar 24 09:49 distsu65.cpt
-rw-r--r-- 1 vaccari dstguest 863 Mar 24 09:49 distsu75.cpt
-rw-r--r-- 1 vaccari dstguest 880 Mar 24 09:49 distsucopia.cpt
-rw-r--r-- 1 vaccari dstguest 511 Mar 24 09:49 gusev01.xy
-rw-r--r-- 1 vaccari dstguest 642 Mar 24 09:49 gusev02.xy
-rw-r--r-- 1 vaccari dstguest 581 Mar 24 09:49 gusev03.xy
-rw-r--r-- 1 vaccari dstguest 726 Mar 24 09:49 gusev04.xy
-rw-r--r-- 1 vaccari dstguest 707 Mar 24 09:49 gusev05.xy
-rw-r--r-- 1 vaccari dstguest 817 Mar 24 09:49 gusev06.xy
-rw-r--r-- 1 vaccari dstguest 890 Mar 24 09:49 gusev07.xy
-rw-r--r-- 1 vaccari dstguest 1094 Mar 24 09:49 gusev08.xy
-rw-r--r-- 1 vaccari dstguest 1109 Mar 24 09:49 gusev09.xy
-rw-r--r-- 1 vaccari dstguest 974 Mar 24 09:49 gusev10.xy
-rw-r--r-- 1 vaccari dstguest 1989 Mar 24 09:49 itacode.dat
-rw-r--r-- 1 vaccari dstguest 2628 Mar 24 09:49 makehaz.par
-rw-r--r-- 1 vaccari dstguest 180 Mar 24 09:49 tsu1.par
-rw-r--r-- 1 vaccari dstguest 99397 Mar 24 09:49 tsugmt.sh
[is01:/tmpXDST/sg01/Tsunami] sg01%
```

Input data preparation

Create a dedicated directory, and copy into it the files needed:

```
[is01:/tmpXDST/sg01/Tsunami] sg01% mkdir Run1Dscen
[is01:/tmpXDST/sg01/Tsunami] sg01% cp /XDST/Examples/Tsunami/Exercises/Inp1Dscen/*
Run1Dscen/
[is01:/tmpXDST/sg01/Tsunami] sg01% cd Run1Dscen/
[is01:sg01/Tsunami/Run1Dscen] sg01%
```

Check the source information:

```
vi adri.sut (on is01)
```

or

```
edit adri.sut (on the local machine in front of you)
```

In a first run magnitude should be 6.5 and source depth 10 km (in a second run we'll set magnitude equal to 7.5 and source depth equal to 15 km).

Edit the file so that in its final form it looks like

```
0000adritsu001    15.210    43.200    10.000    45.000    45.000    90.000    6.50    1    0.1000E
+01 0.0000E+00
```

Selection of the run type

Edit file `makehaz.par`;

```
vi makehaz.par
```

The kind of run is selected in line 13, the index should be posed equal to 4 (selected source and grid of receivers):

```
4          Execution (0=full ,1=until sources,2=until paths,3=starting from obs+sut)
```

Structure files

In this case the structures represent the average bathymetry between the source and each receiver. You do not need to modify the structures, defined in *.stp files. They are associated to polygons defined in file `adri.por`.

Programs execution

After all the input files are properly configured, you can perform the run. First create the spectra files from structures:

```
tsu.out
```

Then execute the program

```
makehaztsu.out
```

and then launch the script

```
sh haztsu
```

The results for peaks (cm) and arrival times (min) for the receivers are in file `adrif0tsz.cou`.

Plotting of the tsunami hazard scenario

Now we are interested in plotting the hazard scenario from this source. First select the right color palette for this magnitude:

```
cp distsu65.cpt distsu.cpt
```

and then launch the script for plot

```
sh tsugmt.sh -t1 adrif0tsz.tmx
```

Check using command `lt` if you have obtained file `adrif0tsz.tmx.ps` and visualize it on screen:

```
gs adrif0tsz.tmx.ps
```

Then you can rename it to to keep it for a comparison with the one obtained using another magnitude:

```
cp adrif0tsz.tmx.ps 1d65.ps
```

Repeat the steps above and obtain the hazard map, considering magnitude 7.5 and source depth 15 km. For this, you need to modify file `adri.sut`, which must be corrected in the following way:

```
label      slon      slat      depth  strike  dip  rake      mag  isub
weight     tshift  MECM16  prova.mec  prova.mag
0000adritsu001  15.210  43.200  15.000  45.000  45.000  90.000  7.50  1
0.1000E+01  0.0000E+00
```

In addition, the proper color palette has to be used for plotting:

```
cp distsu75.cpt distsu.cpt
```

When you have obtained the hazard map for this magnitude you can compare it to the other one to highlight the effect of magnitude and depth on the tsunami hazard scenario.

2D computations, tsunami hazard scenarios

Example input files

Required input files can be found in `/XDST/Examples/Tsunami/Exercises/Inp2Dscen` directory:

```
[is01:/tmpXDST/sg01/Tsunami] sg01% ls -l /XDST/Examples/Tsunami/Exercises/Inp2Dscen
total 236
-rw-r--r-- 1 vaccari dstguest 188 Mar 24 09:49 adri.obs
-rw-r--r-- 1 vaccari dstguest 4913 Mar 24 09:49 adri.por
-rw-r--r-- 1 vaccari dstguest 236 Mar 24 09:49 adri.sut
-rw-r--r-- 1 vaccari dstguest 242 Mar 24 09:49 adri0001.stp
-rw-r--r-- 1 vaccari dstguest 291 Mar 24 09:49 adri0002.stp
-rw-r--r-- 1 vaccari dstguest 242 Mar 24 09:49 adri0003.stp
-rw-r--r-- 1 vaccari dstguest 312 Mar 24 09:49 adri0004.stp
-rw-r--r-- 1 vaccari dstguest 245 Mar 24 09:49 adri0005.stp
-rw-r--r-- 1 vaccari dstguest 271 Mar 24 09:49 adri0006.stp
-rw-r--r-- 1 vaccari dstguest 246 Mar 24 09:49 adri0007.stp
-rw-r--r-- 1 vaccari dstguest 242 Mar 24 09:49 adri0008.stp
-rw-r--r-- 1 vaccari dstguest 241 Mar 24 09:49 adri0009.stp
-rw-r--r-- 1 vaccari dstguest 279 Mar 24 09:49 adri0010.stp
-rw-r--r-- 1 vaccari dstguest 245 Mar 24 09:49 adri0011.stp
-rw-r--r-- 1 vaccari dstguest 246 Mar 24 09:49 adri0012.stp
-rw-r--r-- 1 vaccari dstguest 61 Mar 24 09:49 cells.par
-rw-r--r-- 1 vaccari dstguest 869 Mar 24 09:49 distsu.cpt
-rw-r--r-- 1 vaccari dstguest 868 Mar 24 09:49 distsu65.cpt
-rw-r--r-- 1 vaccari dstguest 863 Mar 24 09:49 distsu75.cpt
-rw-r--r-- 1 vaccari dstguest 880 Mar 24 09:49 distsucopia.cpt
-rw-r--r-- 1 vaccari dstguest 511 Mar 24 09:49 gusev01.xy
-rw-r--r-- 1 vaccari dstguest 642 Mar 24 09:49 gusev02.xy
-rw-r--r-- 1 vaccari dstguest 581 Mar 24 09:49 gusev03.xy
-rw-r--r-- 1 vaccari dstguest 726 Mar 24 09:49 gusev04.xy
-rw-r--r-- 1 vaccari dstguest 707 Mar 24 09:49 gusev05.xy
-rw-r--r-- 1 vaccari dstguest 817 Mar 24 09:49 gusev06.xy
-rw-r--r-- 1 vaccari dstguest 890 Mar 24 09:49 gusev07.xy
-rw-r--r-- 1 vaccari dstguest 1094 Mar 24 09:49 gusev08.xy
-rw-r--r-- 1 vaccari dstguest 1109 Mar 24 09:49 gusev09.xy
-rw-r--r-- 1 vaccari dstguest 974 Mar 24 09:49 gusev10.xy
-rw-r--r-- 1 vaccari dstguest 1989 Mar 24 09:49 itacode.dat
-rw-r--r-- 1 vaccari dstguest 2628 Mar 24 09:49 makehaz.par
-rw-r--r-- 1 vaccari dstguest 180 Mar 24 09:49 tsul.par
-rw-r--r-- 1 vaccari dstguest 99397 Mar 24 09:49 tsugmt.sh
[is01:/tmpXDST/sg01/Tsunami] sg01%
```

Input data preparation

Create a dedicated directory, and copy into it the files needed:

```
[is01:/tmpXDST/sg01/Tsunami] sg01% mkdir Run2Dscen
[is01:/tmpXDST/sg01/Tsunami] sg01% cp /XDST/Examples/Tsunami/Exercises/Inp2Dscen/*
Run2Dscen/
[is01:/tmpXDST/sg01/Tsunami] sg01% cd Run2Dscen
[is01:sg01/Tsunami/Run2Dscen] sg01%
```

Check the source information:

```
vi adri.sut (on is01)
```

or

```
edit adri.sut (on the local machine in front of you)
```

In a first run magnitude should be 6.5 and source depth 10 km (in a second run we'll set magnitude equal to 7.5 and source depth equal to 15 km).

Edit the file so that in its final form it looks like

```
0000adritsu001    15.210    43.200    10.000  45.000  45.000  90.000  6.50    1  0.1000E
+01 0.0000E+00
```

Selection of the run type

Edit file `makehaz.par`;

```
vi makehaz.par
```

The kind of run is selected in line 13, the index should be posed equal to 4 (selected source and grid of receivers):

```
4          Execution (0=full ,1=until sources,2=until paths,3=starting from obs+sut)
```

Structure files

In this case the structures represent the average bathymetry of each polygon defined in file `adri.por`. You do not need to modify the structures, defined in `*.stp` files.

Programs execution

After all the input files are properly configured, you can perform the run. First create the spectra files from structures:

```
tsu.out
```

Then execute the program

```
makehaztsu2d.out
```

and then launch the script

```
sh haztsu
```

The results for peaks (cm) and arrival times (min) for the receivers are in file `adrif0tsz.cou`.

Plotting of the tsunami hazard scenario

Now we are interested in plotting the hazard scenario from this source. First select the right color palette for this magnitude:

```
cp distsu65.cpt distsu.cpt
```

and then launch the script for plot

```
sh tsugmt.sh -t1 adrif0tsz.tmx
```

Check using command `lt` if you have obtained file `adrif0tsz.tmx.ps` and visualize it on screen:

```
gs adrif0tsz.tmx.ps
```

Then you can rename it to to keep it for a comparison with the one obtained using another magnitude:

```
cp adrif0tsz.tmx.ps 2d65.ps
```


Repeat the steps above and obtain the hazard map, considering magnitude 7.5 and source depth 15 km. For this, you need to modify file `adri.sut`, which must be corrected in the following way:

```
label      slon      slat      depth      strike      dip      rake      mag      isub
weight     tshift  MECM16  prova.mec  prova.mag
0000adritsu001  15.210  43.200  15.000  45.000  45.000  90.000  7.50  1
0.1000E+01  0.0000E+00
```

In addition, the proper color palette has to be used for plotting:

```
cp distsu75.cpt distsu.cpt
```

When you have obtained the hazard map for this magnitude you can compare it to the other one to highlight the effect of magnitude on the tsunami hazard scenario, and to the one obtained using the 1D modelling (open it using another terminal) to study how a more precise bathymetry choice affects the final result.

Extended source computations, 2D model, M=6.5

In this example we'll use the routine that computes tsunami signals for an extended source model and then we'll compare the results with those obtained using a point source model. In the following computations we'll use also a simplified 2D model in which the spectrum relative to the source structure is in file `sorg.spt`.

Example input files

Required input files can be found in `/XDST/Examples/Tsunami/Exercises/InpExt2D65` directory:

```
[is01:xtmp/sg01/Tsunami] sg01% ls -l /XDST/Examples/Tsunami/Exercises/InpExt2D65
total 1960
-rw-r--r-- 1 vaccari dstguest 1783 Mar 24 09:49 GUSEV83.TB5
-rw-r--r-- 1 vaccari dstguest 715 Mar 24 09:49 adria.ste
-rw-r--r-- 1 vaccari dstguest 26300 Mar 24 09:49 adria1.src
-rw-r--r-- 1 vaccari dstguest 286452 Mar 24 09:49 adria10002.spt
-rw-r--r-- 1 vaccari dstguest 286452 Mar 24 09:49 adria10005.spt
-rw-r--r-- 1 vaccari dstguest 286531 Mar 24 09:49 adria10010.spt
-rw-r--r-- 1 vaccari dstguest 286452 Mar 24 09:49 adria10012.spt
-rw-r--r-- 1 vaccari dstguest 689 Mar 24 09:49 plot.par
-rw-r--r-- 1 vaccari dstguest 99 Mar 24 09:49 pul.par
-rw-r--r-- 1 vaccari dstguest 126997 Mar 24 09:49 punt1.plt
-rw-r--r-- 1 vaccari dstguest 126997 Mar 24 09:49 punt2.plt
-rw-r--r-- 1 vaccari dstguest 126997 Mar 24 09:49 punt3.plt
-rw-r--r-- 1 vaccari dstguest 126997 Mar 24 09:49 punt4.plt
-rw-r--r-- 1 vaccari dstguest 286531 Mar 24 09:49 sorg.spt
-rw-r--r-- 1 vaccari dstguest 689 Mar 24 09:49 syt.par
```

Input data preparation

Create a dedicated directory, and copy into it the files needed:

```
[is01:xtmp/sg01/Tsunami] sg01% mkdir RunExt2D65
[is01:xtmp/sg01/Tsunami] sg01% cd RunExt2D65/
[is01:sg01/Tsunami/RunExt2D65] sg01% cp /XDST/Examples/Tsunami/Exercises/InpExt2D65/
* .
[is01:sg01/Tsunami/RunExt2D65] sg01%
```

Check file `pul.par` that indicates parameter files for source and receiver:

```
vi pul.par (on is01)
```

or

```
edit pul.par (on the local machine in front of you)
```

```
adria1.src
adria.ste
```

File `adria1.src` is the file describing the source, file `adria.ste` is the file for the receivers. If you check the content of `adria.ste`, you see that the receivers are the same of the point source case described above, corresponding to Venice, Ortona, Split and Durres. (In the file, also the corresponding structure indexes are shown).

The information about the extended source model are in file `adria1.src`. Check some important information inside it:

```
vi adrial.src
```

or

```
edit adrial.src
```

At line 24 the depth of the upper side of the fault model is shown, in this run should be 4

```
4.          !(6) depth, km, for RFC,
```

The index at line 57 refers to the use of a preset final slip model. In this case we use a random one so this parameter must be 0

```
0 !(19) mode_ext_finslip:(0)regular case==simulated slip, (1)use preset final slip f.
```

Magnitude is specified at line 115, in this case is set equal to 6.5

```
6.5          !(25) Mw          MOMENT MAGNITUDE.
```

In lines 155 and 156 we select the number of subsources for row and column respectively, in this case they are fixed to 5 and 3.

```
5          !(46) nxsub  no of subsources along x; (-1)auto;(0)point source mode4  
3          !(47) nysub  no of subs. along y; (-1)==auto; (1) line_source .
```

Structure files

For this exercise the spectra (.spt files) for the structures (.stp files) have been already computed using the program *tsu.out*.

Programs execution

After all the input files are properly configured, you can perform the run. First run program

```
pulsyn06.out
```

that prepares the input files (files *.isg) for every subsorce-receiver couple. Check the output from this program with the command

```
ll *.isg
```

You should find one files .isg for each structure considered:

```
[is01:sg01/Tsunami/RunExt2D65] sg01% ll *.isg
```

```
-rw-r--r-- 1 sg01 dstguest 9419 Mar 24 15:48 adria10002.isg  
-rw-r--r-- 1 sg01 dstguest 9419 Mar 24 15:48 adria10005.isg  
-rw-r--r-- 1 sg01 dstguest 9419 Mar 24 15:48 adria10010.isg  
-rw-r--r-- 1 sg01 dstguest 9419 Mar 24 15:48 adria10012.isg  
[is01:sg01/Tsunami/RunExt2D65] sg01%
```

Using the command `ls *spt` check if for each of these files is present the corresponding spectrum file .spt (for example `adria10002.isg` and `adria10002.spt`) and the spectrum file for the source (`sorg.spt`). The pair of requested parameter-spectra file are also listed in file `syt.par`.

If all the requested files are present launch the program that computes tsunamigrams:

```
syt2d.out
```

and then correct the parameter file `fft.par` that has been generated, so that line 43 will become

```
0          iscale  index (0 no, 1 Gusev, 2 Gusev at freq. gufreq, 3 f**2)
```

After that, you can execute program

```
efft.out
```

that will scale the tsunamigrams according to the source model requested.

Plotting of the tsunamigrams

Now you can plot the signals using the command

```
plotxy.pl plot.par
```

obtaining the file `f0.1.ps` that can be visualized using the command

```
gs f0.1.ps
```

Besides the signals just computed with the extended source model, also those obtained for the point source model (already computed and present in the folder, files) are shown in `f0.1.ps`. What you can say about this comparison?

Extended source computations, 2D model, M=7.5

In this example we'll use the routine that computes tsunami signals for an extended source model and then we'll compare the results with those obtained using a point source model. In the following computations we'll use also a simplified 2D model in which the spectrum relative to the source structure is in file `sorg.spt`.

Example input files

Required input files can be found in `/XDST/Examples/Tsunami/Exercises/InpExt2D65` directory:

```
[is01:sg01/Tsunami/RunExt2D75] sg01% ls -l /XDST/Examples/Tsunami/Exercises/InpExt2D75
total 1964
-rw-r--r-- 1 vaccari dstguest 1783 Mar 24 09:49 GUSEV83.TB5
-rw-r--r-- 1 vaccari dstguest 715 Mar 24 09:49 adria.ste
-rw-r--r-- 1 vaccari dstguest 26300 Mar 24 09:49 adrial.src
-rw-r--r-- 1 vaccari dstguest 286452 Mar 24 09:49 adrial0002.spt
-rw-r--r-- 1 vaccari dstguest 286452 Mar 24 09:49 adrial0005.spt
-rw-r--r-- 1 vaccari dstguest 286531 Mar 24 09:49 adrial0010.spt
-rw-r--r-- 1 vaccari dstguest 286452 Mar 24 09:49 adrial0012.spt
-rw-r--r-- 1 vaccari dstguest 689 Mar 24 09:49 plot.par
-rw-r--r-- 1 vaccari dstguest 99 Mar 24 09:49 pul.par
-rw-r--r-- 1 vaccari dstguest 126997 Mar 24 09:49 punt1.plt
-rw-r--r-- 1 vaccari dstguest 126997 Mar 24 09:49 punt2.plt
-rw-r--r-- 1 vaccari dstguest 126997 Mar 24 09:49 punt3.plt
-rw-r--r-- 1 vaccari dstguest 126997 Mar 24 09:49 punt4.plt
-rw-r--r-- 1 vaccari dstguest 286531 Mar 24 09:49 sorg.spt
-rw-r--r-- 1 vaccari dstguest 689 Mar 24 09:49 syt.par
-rw-r--r-- 1 vaccari dstguest 55 Mar 24 09:49 test.fsl
[is01:sg01/Tsunami/RunExt2D75] sg01%
```

Input data preparation

Create a dedicated directory, and copy into it the files needed:

```
[is01:xtmp/sg01/Tsunami] sg01% mkdir RunExt2D75
[is01:xtmp/sg01/Tsunami] sg01% cd RunExt2D75/
[is01:sg01/Tsunami/RunExt2D75] sg01% cp /XDST/Examples/Tsunami/Exercises/InpExt2D75/
* .
[is01:sg01/Tsunami/RunExt2D75] sg01%
```

Check file `pul.par` that indicates parameter files for source and receiver:

```
vi pul.par (on is01)
```

or

```
edit pul.par (on the local machine in front of you)
```

```
adrial.src
adria.ste
```

File `adrial.src` is the file describing the source, file `adria.ste` is the file for the receivers. If you check the content of `adria.ste`, you see that the receivers are the same of the point source case described above, corresponding to Venice, Ortona, Split and Durres. (In the file, also the corresponding structure indexes are shown).

The information about the extended source model are in file `adria1.src`. Check some important information inside it:

```
vi adria1.src
```

or

```
edit adria1.src
```

At line 24 the depth of the upper side of the fault model is shown, in this run should be 7

```
7.          !(6)  depth, km, for RFC,
```

The index at line 57 refers to the use of a preset final slip model. In this case we use a preset one, so this parameter must be 1 (the file with preset final slip is named `test.fsl`)

```
1  !(19) mode_ext_finslip:(0)regular case==simulated slip, (1)use preset final slip f.
```

Magnitude is specified at line 115, in this case is set equal to 6.5

```
7.5          !(25) Mw      MOMENT MAGNITUDE.
```

In lines 155 and 156 we select the number of subsources for row and column respectively, in this case they are fixed to 5 and 3.

```
5          !(46) nxsub  no of subsources along x; (-1)auto;(0)point source mode4
3          !(47) nysub  no of subs. along y; (-1)==auto; (1) line_source
```

If you check the file `test.fsl` you'll find a matrix of numbers. Considering that the first column represents the upper side of the fault model, and that the gridded numbers represents the weight of the slip in every subsurface, we can say that the most active part of this model is the shallower one.

Structure files

For this exercise the spectra (`.spt` files) for the structures (`.stp` files) have been already computed using the program `tsu.out`.

Programs execution

After all the input files are properly configured, you can perform the run. First run program

```
pulsyn06.out
```

that prepares the input files (files `*.isg`) for every subsurface-receiver couple. Check the output from this program with the command

```
ll *.isg
```

You should find some files `.isg` for each structure considered:

```
[is01:sg01/Tsunami/RunExt2D65] sg01% ll *.isg
```

```
-rw-r--r-- 1 sg01 dstguest 9419 Mar 24 15:48 adria10002.isg
-rw-r--r-- 1 sg01 dstguest 9419 Mar 24 15:48 adria10005.isg
-rw-r--r-- 1 sg01 dstguest 9419 Mar 24 15:48 adria10010.isg
-rw-r--r-- 1 sg01 dstguest 9419 Mar 24 15:48 adria10012.isg
[is01:sg01/Tsunami/RunExt2D65] sg01%
```

Using the command `ls *.spt` check if for each of these files is present the corresponding spectrum file `.spt` (for example `adria10002.isg` and `adria10002.spt`) and the spectrum file for the source (`sorg.spt`). The pair of requested parameter-spectra file are also listed in file `synt.par`.

If all the requested files are present launch the program that computes tsunamigrams:

```
syt2d.out
```

and then correct the parameter file `fft.par` that has been generated, so that line 43 will become

```
0          iscale  index (0 no, 1 Gusev, 2 Gusev at freq. gufreq, 3 f**2)
```

After that, you can execute program

```
efft.out
```

that will scale the tsunamigrams according to the source model requested.

Plotting of the tsunamigrams

Now you can plot the signals using the command

```
plotxy.pl plot.par
```

obtaining the file `f0.1.ps` that can be visualized using the command

```
gs f0.1.ps
```

Also in this case the signals just computed with extended source are plotted together with those obtained for the point source model (already computed and present in the folder). What can you say now about this comparison? You see that at least for 3 out of the 4 chosen receivers the finiteness of the source affects the final results.