UNIVERSITÀ DEGLI STUDI DI TRIESTE

dipartimento di matematica e geoscienze

The DMG Manuals

Tsunami Computer Exercises

Theoretical computation of Tsunamis

Document name: DMGTsunamiExercises.pdf
Document Version: 1.0
Date Issued: September 26, 2017 3:35 PM
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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 0.07      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     rlon     rlat     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
 sislab        source       slon     slat     sp     rlon     rlat     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    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
 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  0.3530E+01 -0.1109E+00
0.4313E+02  0.6917E+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   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 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 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 previuos 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     rlon     rlat     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   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     rlon     rlat     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 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 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 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 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 the 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 subsource-receiver couple. Check the output from this program with the command

*ll *.isg*

You should find une 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 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
-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)

```
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 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 the 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 subsource, 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 subsource-receiver couple. Check the output from this program with the command

*ll *.isg*

You should find une 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

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.