

QUICK INFO: TSUNAMI TRAVEL TIME CALCULATION

For more info, see *TTT_README_AUG12.doc* or
ttt_auto_README_AUG12 in *TTT_bin* folder on desktop

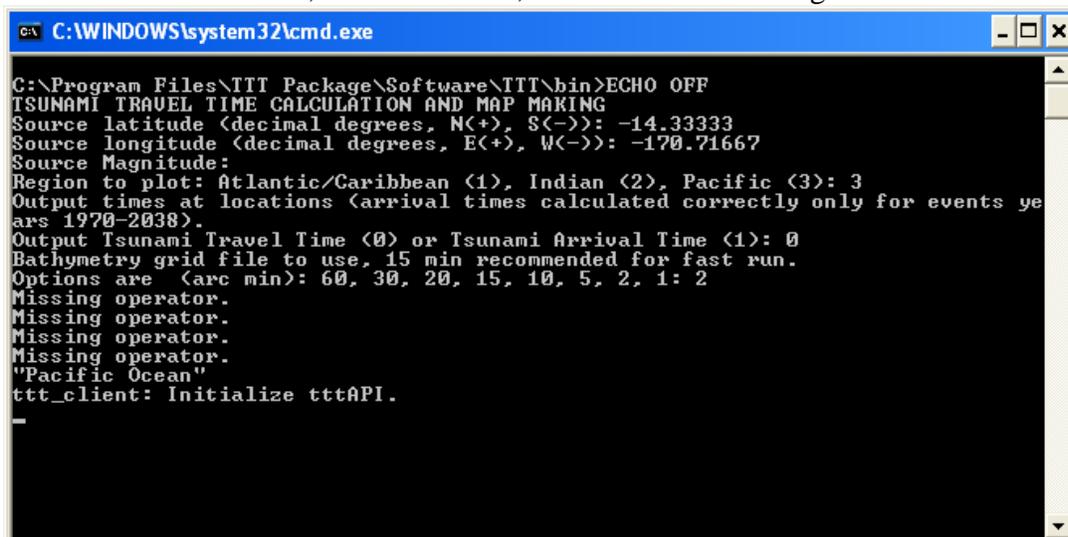
PLOT INSTRUCTIONS

1. Start *ttt_auto32.bat* or *ttt_auto64.bat* (select based on 32 or 64 bit OS) in *TTT_bin* folder on desktop
2. Follow directions in screen shot below, e.g., input
 - latitude, longitude, earthquake magnitude (if known)
 - location of plots to be made (Pacific)
 - output travel times (or arrival times)
 - bathy file to use (10-min grid for fast plot; 2 min-grid for most accurate (takes longer))
 - if desired, plot sea level stations, plot historical seismicity
3. The script will
 - create a binary grid file of tsunami travel times (or arrival times)
 - if desired, output file of tsunami arrival or travel times at user-input locations
 - create up to 3 tsunami travel time plots (in .png format and .ps format). Plots are Pacific, regional, local map boundaries
4. Plot files are found in *TTT_examples* under folder *TTT_AUTO_190806*, where 190806 corresponds to plot time (hrmnsec)
Nice versions (.png), with and without Sea Level stations plotted are found in
TTT_examples/TTT_AUTO_NWSPago_SLsta and *TTT_AUTO_NWSPago*

Notes:

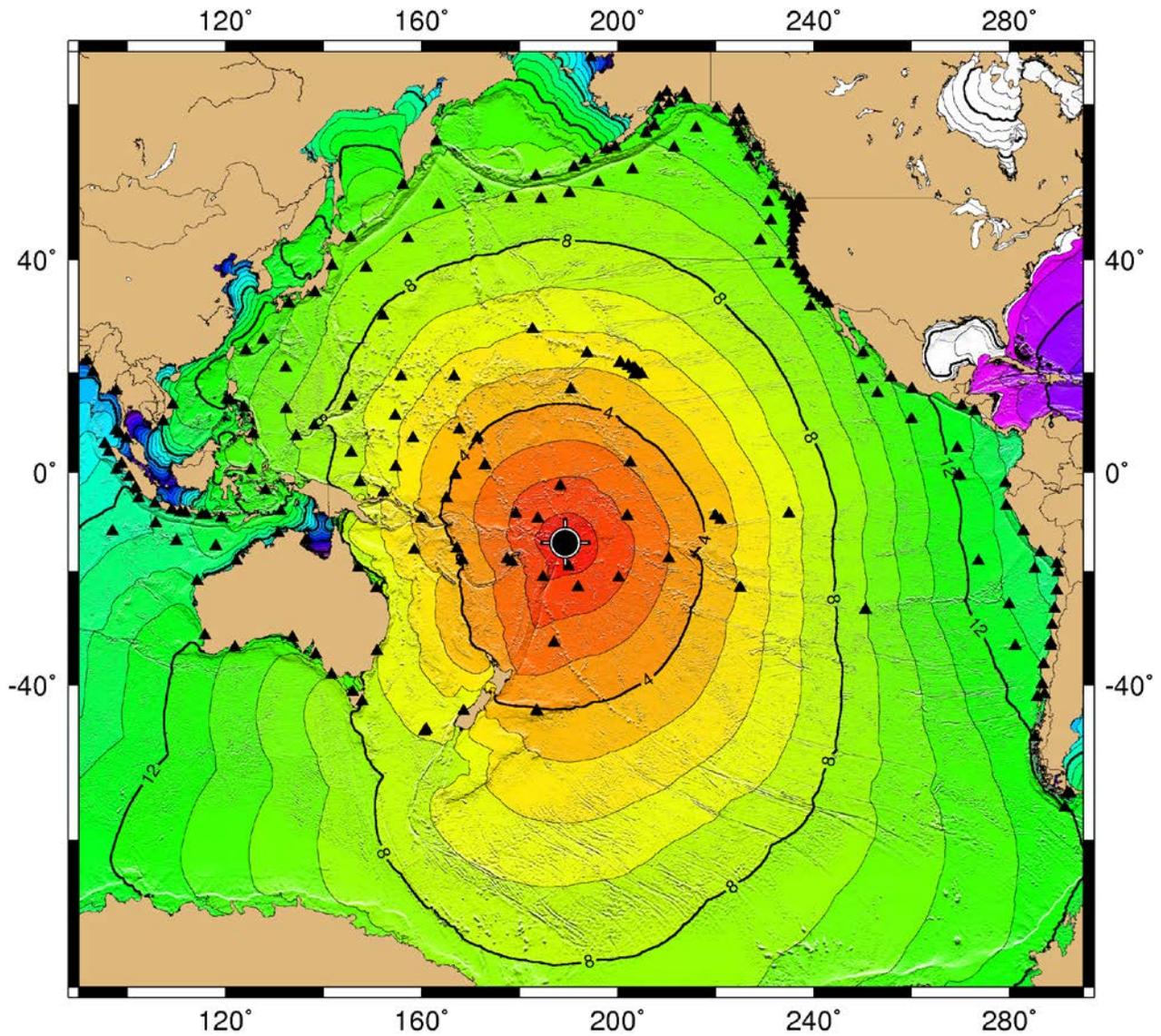
- Tsunami travel times are calculated from sea floor bathymetry. Therefore, they are estimates predicting the arrival time. The actual time may differ by 10s of minutes
- For local tsunamis, because the source is near, calculated tsunami travel times using the actual epicenter may over- or under-estimate because of uncertainties in the near-source bathymetry and nature of the earthquake rupture.

Example is source at NWS Pago Pago office. 2-min bathymetry is used and plots are made for the entire Pacific Ocean, near the source, and the SW Pacific region.

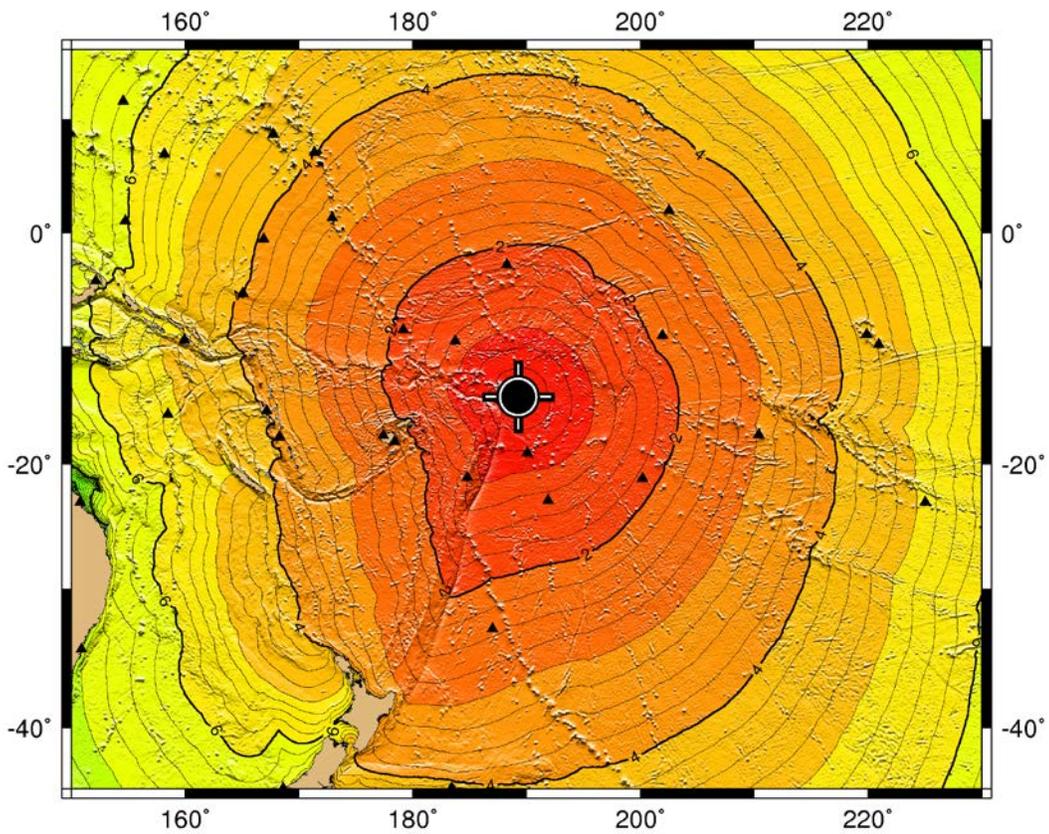


```
C:\WINDOWS\system32\cmd.exe
C:\Program Files\TTT Package\Software\TTT\bin>ECHO OFF
TSUNAMI TRAVEL TIME CALCULATION AND MAP MAKING
Source latitude (decimal degrees, N(+), S(-)): -14.33333
Source longitude (decimal degrees, E(+), W(-)): -170.71667
Source Magnitude:
Region to plot: Atlantic/Caribbean (1), Indian (2), Pacific (3): 3
Output times at locations (arrival times calculated correctly only for events ye
ars 1970-2038).
Output Tsunami Travel Time (0) or Tsunami Arrival Time (1): 0
Bathymetry grid file to use, 15 min recommended for fast run.
Options are (arc min): 60, 30, 20, 15, 10, 5, 2, 1: 2
Missing operator.
Missing operator.
Missing operator.
Missing operator.
'Pacific Ocean'
ttt_client: Initialize tttAPI.
```

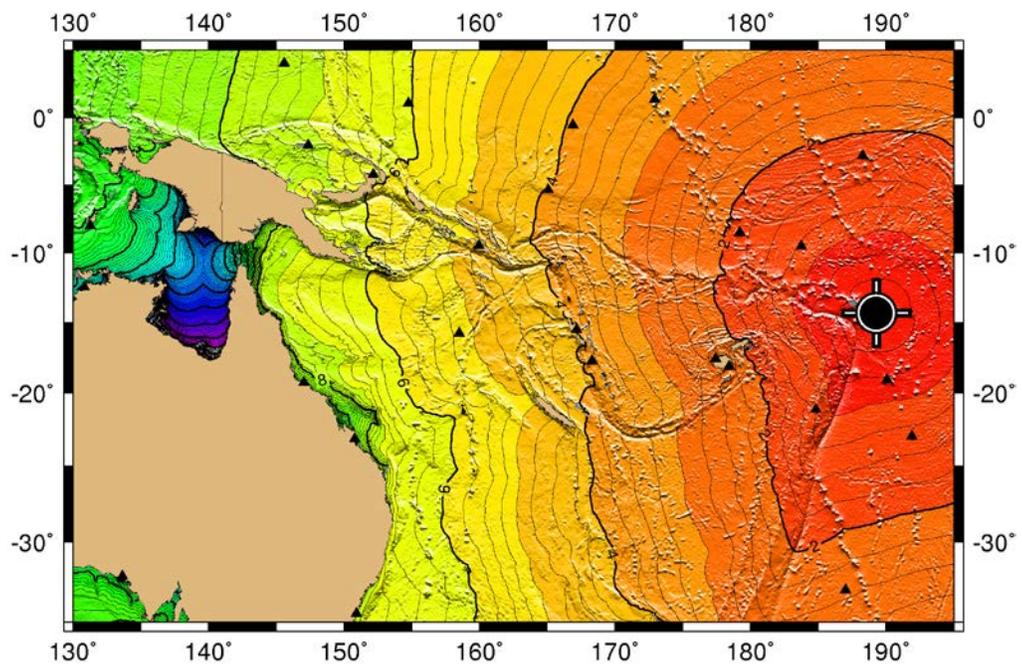
3 tsunami travel time maps automatically produced (.png format)



GM 2010 May 03 04:12:20 TSUNAMI TRAVEL TIMES



GM 2010 May 03 04:12:55 TSUNAMI TRAVEL TIMES



GM 2010 May 03 04:13:53 TSUNAMI TRAVEL TIMES

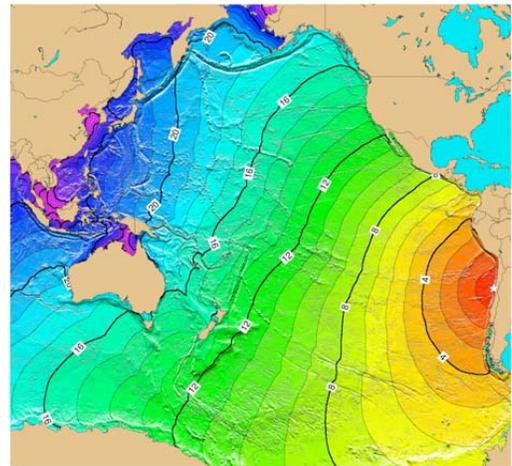


Tsunami Travel Time (TTT) Software Package Version 3.0, August 2012

TTT_README.DOC

NOAA's National Geophysical Data Center, as the World Data Center (WDC-MGG) for Geophysics and Marine Geology - Tsunamis, and the International Tsunami Information Center (ITIC), a NOAA-UNESCO/IOC Partnership, are collaborating to provide, free of charge, tsunami travel time calculation and display software to government organizations involved in providing tsunami warning and mitigation services. Other interested organizations and individuals are requested to obtain the software directly from the developer Geoware.

The Tsunami Travel Time software (TTT SDK v 3.3) was developed by Dr. Paul Wessel (Geoware, <http://www.geoware-online.com>), and is used by the NOAA Pacific Tsunami Warning Center. The ITIC and NGDC have purchased the TTT license to permit widespread free distribution. The public domain mapping software Generic Mapping Tools (GMT) was developed by Drs. Paul Wessel and Walter Smith (<http://gmt.soest.hawaii.edu/>). For this PC-environment distribution, the NGDC and ITIC are also providing easy-to-use, sample scripts for running the software and producing maps such as shown to the right.



The software included in this distribution is for systems using a Microsoft Windows XP and Vista operating system. The software code available is not platform-specific, so NGDC/ITIC is able to provide other distributions, such as for Linux, Unix or Mac OSX, upon request.

Components included on this CD

1. TTT (Tsunami Travel Time) software, TTT SDK version 3.3. Copyright Paul Wessel, Geoware, 2008. <http://www.geoware-online.com>. Licensed to NOAA/ITIC for redistribution.
2. Global bathymetry grids derived from NGDC's ETOPO1 at varying resolutions (60, 30, 20, 15, 10, 5, and 2 arc-minute, and 1 arc-minute grids for the Pacific, Atlantic, and Indian Oceans.
3. Easy-to-use scripts for automatically calculating and making a travel time maps.
4. Historical Earthquake and sea level station data sets. Historical Tsunamis TTT maps.
5. Hands-on exercises to illustrate how to make Indian Ocean, South China Sea, Pacific, and Caribbean region tsunami travel times maps.
6. GMT (Generic Mapping Tools), version 4.3.1. Released under the GNU General Public License (GPL). <http://gmt.soest.hawaii.edu/>
7. Ghostscript, version 8.63. Released under the Aladdin Free Public License (AFPL). <http://www.cs.wisc.edu/~ghost/>

For technical questions, please email Paula Dunbar (Paula.Dunbar@noaa.gov) or Jesse Varner (Jesse.Varner@noaa.gov) at NGDC. For general questions or copies, please email Laura Kong (laura.kong@noaa.gov) at ITIC.

Funding: NOAA Pacific Region Integrated Data Enterprise Program ITIC: FY05 Project "Analysis of Extreme Events and Trends in Pacific Ocean Water Level Data and its Application to Risk and Vulnerability Assessment (M. Merrifield, L. Kong, J. Marra)." NGDC: FY06 Project "Integrated Pacific Region Tsunami-related Data and Information Products (P. Dunbar)" and FY07 NGDC tsunami project money

Technical Background

Background information on the calculation of tsunami travel times is provided in *TTTSDK3.3_Docs.pdf* (in C:\TTT Package\Software\TTT\doc), *Annex V: Methods for Tsunami Travel Time Calculation used by PTWC, WC/ATWC, and JMA* of the PTWS Operational Users Guide (draft, December 2007, and *Analysis of Observed and Predicted Tsunami Travel Times for the Pacific and Indian Oceans* (Wessel, 2009) in C:\TTT Package\TTT_GMT_otherdocs). Accuracy is most dependent on the accuracy of the bathymetry file used for the calculations, e.g., the finer grid size of the bathymetric file, the more accurate the estimate - at the same time, however, computation time increases significantly as finer grid size bathymetric files are used (e.g., calculation using 2-min (distance, ~2 mile grid interval) bathymetry grid takes 10 minutes (time) or more to complete). Inadequate characterization of the tsunami source (epicenter point source vs. finite fault rupture length) can also result in significant differences between the predicted and observed times. Together, these errors can cause large delays (up to hours).

TTTSDK3.3 improves the usefulness of the estimated tsunami time of arrival output file by allowing a text string to be output as well as ordering the location listings from earliest to latest arrivals.

Installation Instructions

If you have an older version of the TTT Software package, please uninstall first. This can be done through the Control Panel ->Add/Remove Programs.

It may be required to run the installer as a user with administrative privileges. Run setup.exe to install the TTT software, examples, GMT, and Ghostscript. If you already have GMT or Ghostscript installed, you may choose not to install these packages at this time. All required software, except Ghostscript, will be installed in the directory specified (i.e. 'C:\TTT Package'). The installer will ask if you would like to install Ghostscript, and will then launch a separate installer for Ghostscript (loaded in C:\Program Files\gs).

Computer Requirements

The software included in this distribution is for systems using a Microsoft Windows XP and Vista operating system. The software code available is not platform-specific, so NGDC/ ITIC is able to provide other distributions, such as for Linux, Unix or Mac OSX, upon request.

The recommended computer specifications/requirements are:

- PC running Windows (98/Me/NT/2000/XP/Vista/7)
- At least 256 MB of RAM
- At least 900 MB of hard disk space
- No CPU speed requirements, but the software will run faster on faster CPUs.

Directory Structure for Software Usage

Files to be used for TTT calculation and plotting can be found in the following directories.

Directory: C:\TTT Package\Software\TTT\bin

TTT calculation: ttt_client.exe

TTT mapmaking (using GMT):

Fixed region: ttt_fancy_atl/ind/pac/world.bat

User-specified: ttt_fancy.bat

Examples using above scripts:

C:\TTT Package\Examples\EXAMPLE_CARIBBEAN or IO_SCS/MAKRAN/PACIFIC

Main Scripts for ttt_autoXX

ttt_autoXX.bat

ttt_fancy_atl/ind/pac_auto.bat

Output files from running ttt_auto.bat will be placed in sub-directory:
C:\TTT Package\Examples\TTT_AUTO_XXXXXX,
where XXXXXX equals computer clock HRMNSC

Data files:

Historical earthquakes (USGS Centennial List):

GMT-plot format: centennial6_ed.txt

Reference files: centennial6.txt, centennial.xyzm

Sea level stations (as received by PTWC, Oct 2008):

Data files: stations_atl/ind/pac.txt

Maps: SLmap-AO/IO/PO.jpg

Color pallets (as read by scripts): CPT\ttt1-30.cpt, centennial.cpt

Software Usage Instructions

The software included is to be run from the Windows command line, or by double-clicking on a .bat script in order to open a Window command window for running the software. Easy-to-use software (executable and scripts) for calculating travel times and making travel time maps are included in this distribution, and described in this section and the next (Easy TTT calculation and plotting). The executable ttt_client.exe and the plotting scripts are located in C:\TTT Package\Software\TTT\bin.

Examples and hands-on exercises which utilize ttt_client.exe (calculation) and ttt_fancy (plotting) can be found in the Examples section of this document and in C:\TTT Package\Examples (for Caribbean, Indian Ocean, Pacific, South China Sea).

Producing TTT plots is a 2-stage process. First, the TTT program is executed to calculate the tsunami travel times over the specified map boundaries (e.g., create a grid file of tsunami travel times). Second, the GMT software is used to make a postscript plot of the travel times, and to create raster images (such as in jpg or png formats). The GMT software is a general plotting software that can be customized to produce many types of plots. Further information and documentation on GMT can be found in C:\TTT Package\TTT_GMT_otherdocs\GMT_Manuals

1. The TTT program (ttt_client.exe) is executed to calculate the tsunami travel time to each point on a grid. This calculation is made using input files giving 1) the earthquake epicenter (or a series of point locations representing a long fault rupture) 2) the water depth, which is extracted from the bathymetric file. TTT is run with the following command (text in square brackets, i.e. [], should be replaced with the appropriate file name):

ttt_client [bathymetry grid filename] -e[epicenter filename] -T[travel-time grid filename] -VL

The travel-time grid is the output file. The bathymetric grid name is given without the .i2 extension, all other filenames should be given with the file extensions.

Information on ttt_client.exe

ttt_client is a command-line program that generates tsunami travel time grids (in GMT grdfile or GeoTIFF format) given an input bathymetry grid and a source location. It can also be used to report the travel times to a list of stations given an existing travel-time grid as input.

Usage:

ttt_client <input_bathymetry_file> [-A<stations_file>] [-R(w/e/s/n)]

[-E<lon/lat> or -e<file>] [-I] [-N<nodes>] [-O|o<yyyy/mm/dd/hh/mi/ss>]
[S[<radius>][/<depth>]] [-T<output_ttt_file>] [-G<output_geotiff_file>] [-V[L]] [-U]

ttt_client attempts to decode <input_bathymetry_file> using the following order:

1. If filename ends in ".b" it is read as bathymetry data [GMT binary float format].
2. If \$TTT_DIR/<input_bathymetry_file>.i2 exists it will be used as bathymetry data [GMT binary short format].

OPTIONS:

- A Gives filename with multiple stations to which we will estimate the Estimated Tsunami Arrival time (ETA) if option -O is given ("tsunami origin time"). If -O is not given, ETA will output the tsunami travel time.
 - b Do NOT normalize the travel times to avoid bias [Default will correct for bias]
 - E Sets the location of the epicenter using the format <lon/lat>
 - e Gives filename with multiple "epicenters" to mimic a non-point source.
 - I Store travel times as 2 byte integers with units of 10 sec [Default is 4-byte float in hours]
 - N Number of Huygens nodes to use (8, 16, 32, 48, 64) [64]
 - O Sets "tsunami origin time" (UTC), which is assumed to be the earthquake origin time in the simplest case. Use lower case -o if local time is used
Note: this calculation will only work correctly for the years 1970 to 2038.
 - R Specify a sub-region of the grid [Use entire grid].
 - S Substitute nearest ocean node if epicenter is on land. Optionally, append search radius in degrees [5]. Furthermore, you may append the shallowest depth you want to place epicenter [0].
 - T Names the output grdf file with travel times in hrs [ttt.b or ttt.i2 (see -I)].
 - U Use UTC time when reporting ETAs (requires -A).
 - V Run in verbose mode. Append L to get progress messages from within the tttAPI library.
2. The output is then plotted using GMT (Generic Mapping Tools), which is a general command line controlled graphics tool. To simplify the plotting stage, basic batch script files are provided. These are four hardwired scripts for plotting the individual and world oceans (ttt_fancy_atl.bat, ttt_fancy_ind.bat, ttt_fancy_pac.bat, ttt_fancy_world.bat), and one interactive script (ttt_fancy.bat) to plot any desired region and to specify contour plotting interval and other simple customization. However, plots are entirely customizable if GMT is learned.

All the scripts have a similar run command format, e.g.,

ttt_fancy [travel-time grid filename] [bathymetry grid filename] [epicenter filename] [ps filename]

ttt_fancy_atl/ind/pac [travel-time grid filename] [bathymetry grid filename] [epicenter filename] [ps filename]

GMT batch script files:

**ttt_fancy_world, ttt_fancy_atl.bat, ttt_fancy_ind.bat, ttt_fancy_pac.bat, ttt_fancy_world.bat
ttt_fancy.bat**

Each of these batch files, run from the Windows command line, runs a series of GMT commands to generate colored contour maps (with shaded-relief bathymetry) of tsunami travel time grids generated by ttt_client.exe. Each batch file is customized for a specific bounding-box defining a

global extent (world), or each ocean (Pacific, Indian, Atlantic/Caribbean), or can be interactively specified (tft_fancy.bat).

tft_fancy_world/atl/ind/pac.bat creates output files under the current directory.

tft_fancy creates output files under a subdirectory (TTT_FANCY_timestamp) under C:\TTT Package\Examples, where timestamp is the current computer clock time (hr min sec).

With knowledge of GMT commands (documentation at <http://gmt.soest.hawaii.edu/>, and also in C:\TTT Package\TTT_GMT_otherdocs), these files can be modified to create other desired output. By default, a Postscript document and PNG image files are created, but other formats (.jpg, tif, etc) are available.

Usage:

```
tft_fancy_world <input_tftgrid> <input_bathygrid> <input_epicenter_file> <output_psfile>
tft_fancy_atl <input_tftgrid> <input_bathygrid> <input_epicenter_file> <output_psfile>
tft_fancy_ind <input_tftgrid> <input_bathygrid> <input_epicenter_file> <output_psfile>
tft_fancy_pac <input_tftgrid> <input_bathygrid> <input_epicenter_file> <output_psfile>
tft_fancy <input_tftgrid> <input_bathygrid> <input_epicenter_file> <output_psfile>
```

Easy TTT calculation and plotting

To provide for easier calculation and map-making, a user-friendly .bat script (Windows) named **tft_auto32.bat** and **tft_auto64.bat** (referred to as **tft_autoXX.bat**) is provided which simplifies and automates the process. **tft_autoXX.bat** and its associated scripts creates a travel time data file and two maps (ocean-wide and zoomed-in) using user-input information on the tsunami source location (latitude and longitude), magnitude (assumed to be from an earthquake), bathymetry file grid size, source origin time, and map region. To run quickly, 15-arc min bathymetry is recommended; for greater accuracy, a finer resolution bathymetric grid should be used.

tft_autoXX.bat runs specific regional tft_fancy scripts (**tft_fancy_atl/ind/pac_auto.bat**) to make the maps, Output files are created under C:\TTT Package\Examples\TTT_AUTO_xxxxxx), where is xxxxxx is the computer clock time (hr, min, sec) at the time the script is run.

Instructions for using tft_autoXX.bat and information on parameters that can be changed to customize plots are included in the file C:\TTT Package\Software\TTT\bin\tft_auto_README_AUG12.doc

Troubleshooting: Required environment variables

If the software does not work correctly, please check that these environment variables are properly set: TTT_DIR should be set to the TTT data directory

(i.e. C:\TTT Package\Software\TTT\data)

GMTHOME should be set to the GMT home directory

(i.e. C:\\TTT Package\Software\GMT)

GMT_SHAREDIRE should be set to the GMT share directory

(i.e. C:\TTT Package\Software\GMT\share)

The system PATH should contain:

- the TTT bin directory (i.e. C:\TTT Package\Software\TTT\bin)
- the GMT bin directory (i.e. C:\TTT Package\Software\GMT\bin)
- the Ghostscript bin directory (i.e. C:\Program Files\gs\gs8.63\bin)

These variables can be modified by opening the Control Panel, clicking on System, then clicking on Environment Variables, and editing the PATH variable (with semicolons separating entries in the PATH).

Examples

Software Usage Examples (provided by NGDC)

The software is to be run from the Windows command line, or by double-clicking on a .bat script in order to open a Window command window for running the script containing the software.

You can run these examples from the “bin” directory (i.e. C:\TTT Package\Software\TTT\bin). Or, if using another directory, please copy the files ‘epicenter_1960.txt’, ‘epicenters_2004.txt’, and ‘epicenter_1964.txt’, and ‘stations_pacific_ocean.txt’ in “bin” to this new directory and run the scripts from there. In C:\TTT Package\TTT_Maps, you can also find some example TTT maps for historical events.

- Generate a new global travel-time grid with the 1960 Chile earthquake as the source, using 5' bathymetry, and report the travel times to multiple stations listed in ‘stations_pacific_ocean.txt’:

```
ttt_client ttt_topo_5m -eepicenter_1960.txt -Ttt_chile_1960_5m.b -Astations_pacific_ocean.txt -VL
```

- Generate a colored contour map for the Pacific Ocean using the 'ttt_chile_1960_5m.b' global travel-time grid (this will create a Postscript file and a .PNG image as output):

```
ttt_fancy_pac ttt_chile_1960_5m.b ttt_topo_5m epicenter_1960.txt ttt_chile_1960_5m.ps
```

- Generate a new global travel-time grid in GMT grid format ('ttt_2004_1226.b') for the 2004 Indian Ocean tsunami, approximating the earthquake rupture with a list of multiple epicenters, then generate a global contour map (Postscript and .PNG image format) of the travel times:

```
ttt_client ttt_topo_5m -eepicenters_2004.txt -Ttt_2004_1226.b -VL  
ttt_fancy_world ttt_2004_1226.b ttt_topo_5m epicenters_2004.txt ttt_2004_1226.ps
```

- Generate a new travel-time grid ('ttt_alaska_1964.b') for the 1964 Alaska earthquake, automatically moving the epicenter to the nearest water node of at least 100 meters depth, then generate a colored contour map for the Pacific (Postscript and .PNG image format) of the travel times:

```
ttt_client ttt_topo_5m -eepicenter_1964.txt -Ttt_alaska_1964.b -S5/-100 -VL  
ttt_fancy_pac ttt_alaska_1964.b ttt_topo_5m epicenter_1964.txt ttt_alaska_1964.ps
```

Converting Tsunami Travel Time grid output to GeoTIFF (for importing into GIS software)

This series of commands will convert a tsunami travel time grid in GMT binary grid format ('example_ttt.b') into a GeoTIFF that can be imported into most GIS software (i.e. ArcGIS). The free software package GDAL/FWTools is required for this conversion (available at <http://fwtools.maptools.org/>)

```
gdreformat example_ttt.b=bf example_ttt.grd=cs
gdal_translate -a_ullr -180 90 180 -90 -a_srs epsg:4326 example_ttt.grd example_ttt.tif
```

Software Usage Examples (provided by ITIC)

Plots for Tsunami Warning Operations

These files, located in C:\TTT Package\Software\TTT\bin and in C:\TTT Package\Examples, create commonly-used images to support tsunami warning operations. The “Hands-on exercise” examples have been used in trainings by the ITIC and so are accompanied by instructions for installing and running the scripts.

EASY TTT CALCULATION AND PLOTTING (PRE-SET OPTIONS) – see previous section:

ttt_autoXX.bat: easy and quick creation of travel time contour maps using user-specified arc-min bathymetry files

ttt_autoXX.bat quickly outputs a map, one or two zoomed-in maps and a file of tsunami travel or arrival times to user-selected locations. Inputs are the earthquake epicenter, magnitude, region for the contour maps, and a location file where travel times (or arrival times if the origin time is specified) are tabulated. Output files are placed in a directory that is automatically created under the “Examples” subdirectory using the computer clock time for each run.

ttt_autoXX.bat calls **ttt_client.exe** and **ttt_fancy_atl/ind/pac_auto.bat**, and automatically creates pre-named output files. To run quickly, 15-arc min topography is recommended; for greater accuracy, especially for near-shore maps, a finer resolution bathymetric grid should be used but the travel time computation will take longer.

ttt_autoXX.bat can be run from any directory, but all data files that are plotted should reside in C:\TTT Package\Software\TTT\bin. In other words, if epicenters, stations, and/or historical earthquakes will be plotted, these files should exist in C:\TTT Package\Software\TTT\bin. Alternatively, **ttt_autoXX.bat** can be edited to include the full path of the data files.

For more detailed instructions for its usage, see *ttt_auto_README_AUG12.doc*

GENERAL PLOTTING

ttt_fancy.bat: Allows user-specified boundaries and several customization options, including option to color shade only some ttt contour intervals.

ttt_fancy.bat requires 30 files (ttt1.cpt to ttt30.cpt) that are in the sub-directory “CPT” The .cpt files are color palettes that differ by the number of hours contoured in colors versus non-colored (white). If this script is run in another directory, the “CPT” directory and **ttt_fancy.bat** should be copied to that new directory, and the .bat file should be edited to designate the correct directory to use for the scripts and other input files.

HANDS-ON TUTORIALS

These handouts are hands-on exercises providing step-by-step instructions for creating travel time contour maps using the TTT and GMT softwares.

Scenarios are from the Caribbean, Pacific Ocean, Indian Ocean, and South China Sea (C:\TTT Package\Examples\EXAMPLE_CARIBBEAN or IO_SCS / MAKRAN / PACIFIC)

Instruction for the usage of ttt_auto32.bat / ttt_auto64.bat

*The International Tsunami Information Centre
A UNESCO/IOC-NOAA Partnership
Version 9 August 2012*

General Information:

NOAA's National Geophysical Data Center, as the World Data Center (WDC-MGG) for Geophysics and Marine Geology - Tsunamis, and the International Tsunami Information Center (ITIC), a NOAA-UNESCO/IOC Partnership, are collaborating to provide, free of charge, tsunami travel time calculation and display software to government organizations involved in providing tsunami warning and mitigation services.

The Tsunami Travel Time software (TTT SDK v 3.3) was developed by Dr. Paul Wessel (Geoware, <http://www.geoware-online.com>), and is used by the NOAA Pacific Tsunami Warning Center. The ITIC and NGDC have purchased the TTT license to permit widespread free distribution. The public domain mapping software Generic Mapping Tools (GMT) was developed by Drs. Paul Wessel and Walter Smith

To provide for easier calculation and map-making, the ITIC has provided a user-friendly .bat script (Windows) named ttt_auto32.bat and ttt_auto64.bat (referred to as ttt_autoXX from here on) which simplifies and automates the process. ttt_autoXX.bat creates a travel time data file and two maps (ocean-wide and zoomed-in) using user-input information on the tsunami source location (latitude and longitude), magnitude (assumed to be from an earthquake), source origin time, and map region. ttt_autoXX.bat and its associated .bat scripts can be edited, thereby creating maps customized according to a user's needs. Information on the various parameters that can be changed is provided.

Preparation:

Run setup.exe to install the TTT software, examples, GMT, and Ghostscript.

Directory Structure related to ttt_autoXX.bat:

Directory: C:\TTT Package\Software\TTT\bin

TTT calculation: ttt_client.exe

TTT mapmaking (using GMT):

Fixed region: ttt_fancy_atl/ind/pac/world.bat

User-specified: ttt_fancy.bat

Examples using above scripts:

C:\TTT Package\Examples\EXAMPLE_CARIBBEAN or IO_SCS/MAKRAN/PACIFIC

Main Scripts for ttt_autoXX

ttt_autoXX.bat

ttt_fancy_atl/ind/pac_auto.bat

Output files from running ttt_autoXX.bat will be put in sub-directory:

C:\TTT Package\Examples\TTT_AUTO_XXXXXX,

where XXXXXX equals computer clock HRMNSC

Data files:

Historical earthquakes (USGS Centennial List):

GMT-plot format: centennial6_ed.txt

Reference files: centennial6.txt, centennial.xyzm

Sea level stations (as received by PTWC, Oct 2008):

Data files: stations_atl/ind/pac.txt

Maps: SLmap-AO/IO/PO.jpg

Color pallets (as read by scripts): CPT\ttt1-30.cpt, centennial.cpt

Simple Usage:

1. Open Command Prompt and move to the “C:” drive

Type **C:** to changes drive from H: (or other default drive) to C:

If it is already C:, this step can be skipped.

2. Run ttt_autoXX.bat

Type **ttt_auto32** or **ttt_auto64** (select based on 32 or 64 bit OS)

Enter **latitude**, **longitude**, **magnitude** and **region**

Enter whether to output **travel time** or **estimated time of arrival** (ETA) (1 = Yes, 0 = No)

Choose **bathymetry grid** file to use (arc min) (options are 60, 30, 20, 15, 10, 5, 2, 1)

If ETA is requested, enter the tsunami ‘**origin time**’ in format YYYY/MM/DD/HH/MN/SS

After calculating the travel times, plotting begins.

Enter whether to plot **sea level stations** (1 = Yes, 0 = No)

Enter whether to plot **historical earthquakes** (M > 6.0 in the past 100 years) (1 = Yes, 0 = No)

An option is included for 3rd zoomed plot, or a plot specified by the user.

Enter **area for 3rd zoomed plot for Indian Ocean** (1 = Mauritius, 2 = Mozambique, 3 = Other)

Enter **area for 3rd zoomed plot for Pacific Ocean** (1 = SW Pacific, 2 = S America, 3 = S China Sea / Philippines, 4 = Other)

Create a **3rd user-selected zoomed plot (Other) for Caribbean** (1 = No, 2=Yes)

If Other, then user inputs map boundaries.

Example

The following example is for the 26 Dec 2004 Indian Ocean tsunami. Source parameters are from USGS.

Parameters to use:

-- Latitude 3.316 (if it were 4.521**S** for another example, it would be -4.521)

-- Longitude 95.854 (if it were 64.3**W** for another example, it would be 295.7 or -64.3)

-- Magnitude 9.3

-- Region Indian Ocean => type 2

-- For Tsunami Arrival Times, type 1 (tsunami arrival times)

-- Bathymetry grid file 15

-- Tsunami ‘origin time’ 2004/12/26/00/58/53 (origin time was 00:58:53)

-- For plotting stations, type 1

-- For plotting earthquakes, type 1

-- For user-specified zoomed plot for Indian Ocean region, type 3 (Option “Other”)

```

C:\Windows\system32\cmd.exe - ttt_auto64

C:\TTT Package\Software\TTT\bin>ttt_auto64
C:\TTT Package\Software\TTT\bin>ECHO OFF
TSUNAMI TRAUEL TIME CALCULATION AND MAP MAKING
Source latitude <decimal degrees, N(+), S(-)>: 3.316
Source longitude <decimal degrees, E(+), W(-)>: 95.854
Source Magnitude: 9.3
Region to plot: Atlantic/Caribbean (1), Indian (2), Pacific (3): 2
Output times at locations <arrival times calculated correctly only for events ye
ars 1970-2038>.
Output Tsunami Travel Time (0) or Tsunami Arrival Time (1): 1
Bathymetry grid file to use, 15 min recommended for fast run.
Options are <arc min>: 60, 30, 20, 15, 10, 5, 2, 1: 15
Missing operator.
Missing operator.
Missing operator.
Missing operator.
"Indian Ocean"
Enter origin time as YYYY/MM/DD/HH/MI/SS <2004/12/26/00/58/53>: 2004/12/26/00/58
/53
ttt_client: Initialize tttAPI.
ttt_client: Calculate ttt grid.
TTT: Calculate slowness.
TTT: Initialize various offsets.
TTT: Calculate ttt.
TTT: Completed 100 %.
TTT: Normalization factor = 0.999197.
TTT: Maximum travel time = 81:25:47.
ttt_client: source position uncertainty factor: 12.5128 sec/km
ttt_client: Write ttt grid.
ttt_client64: [err=26] Station location for ETA calculation is on land!
Plot Sea Level Stations (0=No, 1=Yes)? 1
Plot Historical Earthquakes <Centennial List, 0=No, 1=Yes>? 1
Zoomed IO Region to plot: Mauritius (1), Mozambique (2), Other (3): 3
"For user-selected zoomed map, input the map range."
Southern Edge of map <decimal degrees, N(+), S(-)>: 0
Northern Edge of map <decimal degrees, N(+), S(-)>: 35
Western Edge of map <decimal degrees, E(+), W(-)>: 40
Eastern Edge of map <decimal degrees, E(+), W(-)>: 70

```

Notes:

- **ttt_autoXX.bat** can be run from any directory, but output files are placed, by default, in the “Examples” directory (see below). Create a shortcut of C:\TTT Package\Software\TTT\Examples and place it on the Desktop. Once done, you may double click on this icon to access the output directory.
- **ttt_autoXX.bat** can also be run from the Desktop by mouse-clicking the icon. Create a shortcut of C:\TTT Package\Software\TTT\bin.ttt_autoXX.bat and place it on the Desktop. Once done, you do not have to open Command Prompt. However, when the icon is double-clicked to run, the command window will disappear after the process finishes and you will not be able to check the log for error messages if they occur.

Output Files:

After running ttt_autoXX.bat, a [travel time or ETA data file](#) and [plots](#) are placed in a new sub-directory C:\TTT Package\Examples\TTT_AUTO_xxxxxx, where is xxxxxx is the computer clock time (hr, min, sec) at the time the script is run. To change the directory where files are output (“Examples”), edit each ttt_fancy_atl/ind/pac_auto.bat to rename the default directory path (located are the end of the script).

Travel Time or Estimate Time of Arrival (ETA)

The travel time or ETA data file (travel_time_atl/ind/pac.txt or ETA_atl/ind/pac.txt) gives the station location (lat, lon), tsunami travel/arrival time, distance from the nearest point on the grid to the station, uncertainty rates in sec/km, station name (or other descriptor from input file), and station

type (DART or SL) for each location. Output lines are ordered from shortest to longest travel time, or earliest to last estimated arrival. Information after the longitude, latitude in the input file is also output to the output file.

Note that tsunami arrival times are presently correctly calculated only for event years 1970-2038.

The 1st line in the output file gives the epicenter or the epicenter and origin time,

< **travel_time_ind.txt** >

```

Epicenter: LAT 3.316, LON 95.854
---LAT---||---LON---||--ARRIVAL--||---OFF---||---ERR---
 4.1275  96.1319  0h 40m 34s  19.302  28.45      #meul  SL
 0.0605  91.8872  0h 57m 59s  14.233   3.35      #53401 DART
 5.8333  95.3333  0h 59m 55s  13.066  11.77     #saba  SL

```

< **ETA_ind.txt** >

```

Epicenter: LAT 3.316, LON 95.854
Origin Time: 2004/12/26/00/58/53
---LAT---||---LON---||-----ARRIVAL-----||--OFF-km-||-ERR-s/km-
 4.1275  96.1319  Sun Dec 26 01:39:28 2004  19.302      28.45      #meul  SL
 0.0605  91.8872  Sun Dec 26 01:56:53 2004  14.233       3.35      #53401 DART
 5.8333  95.3333  Sun Dec 26 01:58:48 2004  13.066      11.77     #saba  SL

```

Station locations are from the input file (stations_atl / ind / pac.txt) which are stations received by the PTWC in each region. *You may edit and create your own list of points to plot (they can be any points, such as forecast points or important coastal towns, etc.) However, keep the 4th column DART or SL. If you write another keyword for the 4th column, the station will not be plotted unless you edit the tt_fancy...bat scripts to identify this keyword.*

Input file: < **stations_ind.txt** >

```

 88.5369  8.9050  #23401 DART
  91.9     0.05   #53401 DART
110.0039 -13.9614 #56001 DART

```

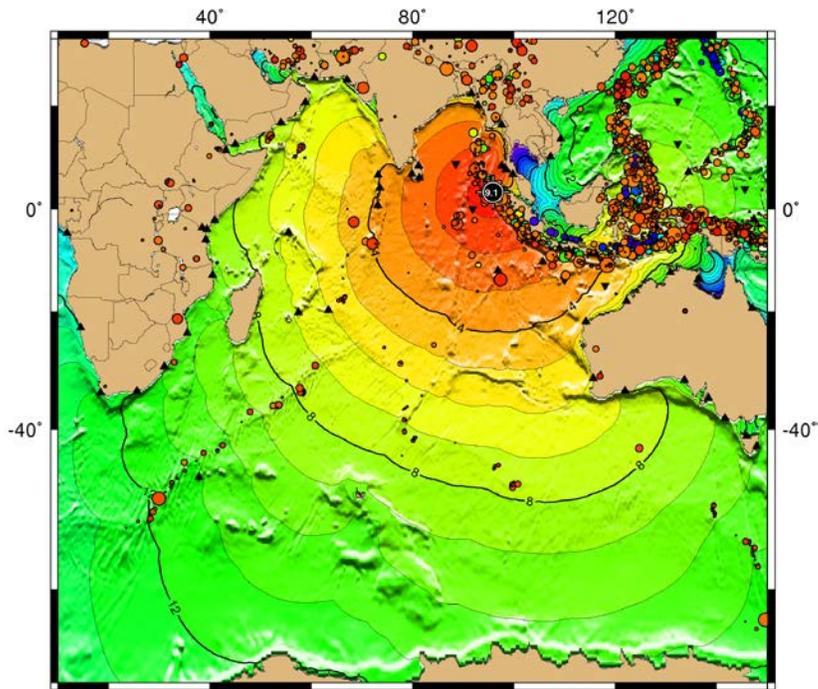
Plots

Depending on the region, several maps are automatically made.

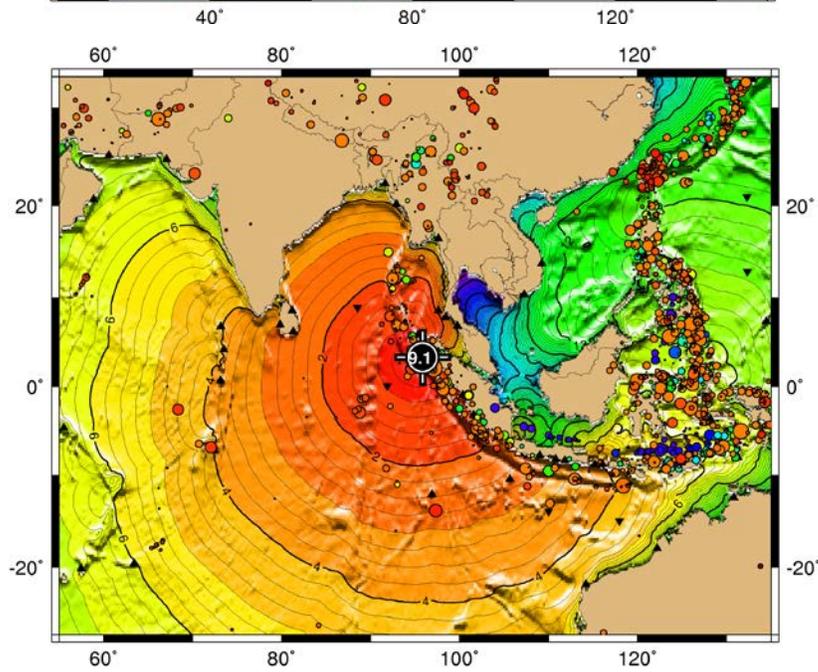
If region 1 (Atlantic Ocean) is selected, two plots are created; one is covering larger area and the other is zoomed-in around the source. If region 2 or 3 (Indian or Pacific Ocean) is selected, one additional zoomed plot around a selected region is created, or the user may specify the boundaries for the additional plot

Example Maps

The following are plots with sea level stations (black triangles), DART stations (black upside-down triangle) and historical earthquakes (colored dots) for the Sumatra event on 26 Dec 2004. Different symbols or symbol colors are possible by editing the .bat scripts (see later section)

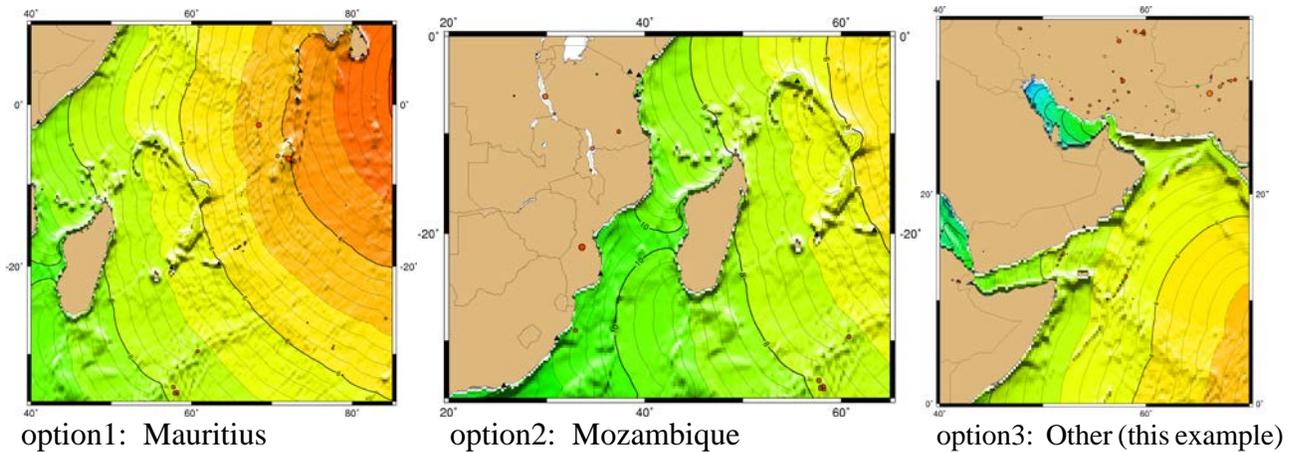


ttt_auto_15m.ps
 ttt_auto_15m.png
 plot covering
 larger area



ttt_auto_15m_zoom.ps
 ttt_auto_15m_zoom.png
 zoomed-in plot
 around source
 default range
 lat ± 30 , lon ± 40

ttt_auto_15m_zoom_wIO.ps
 ttt_auto_15m_zoom_wIO.png
 zoomed-in plot of western Indian Ocean for each option (option 3 for this example)
 Created when Indian Ocean.



Note: You may see some messages such as “Missing Operator”, “Warning”, etc. in the Command Window terminal. These messages are not actually errors, so just ignore them.

```

C:\>ECHO OFF
Source latitude (decimal degrees):3.316
Source longitude (decimal degrees):95.854
Source Magnitude:9.1
Region to plot: Atlantic (1), Indian (2), Pacific (3) 2
Output Tsunami Travel Time (0) or Tsunami Arrival Time (1) ?1
Missing operator.
Missing operator.
Missing operator.
Missing operator.
"Indian Ocean"
Type origin time YYYY/MM/DD/HH/MI/SS e.g. 2004/12/26/00/58/53:2004/12/26/00/58/53
ttt_client: Initialize tttAPI
grdcontour: Warning: Your -Gd!D option produced no contour labels for z = 8
grdcontour: Warning: Your -Gd!D option produced no contour labels for z = 8
grdcontour: Warning: Your -Gd!D option produced no contour labels for z = 8
grdcontour: Warning: Your -Gd!D option produced no contour labels for z = 8
grdcontour: Tracing the 8.25 contour
grdcontour: Tracing the 8.5 contour

```

To further customize the automatically-made plots, you may edit the `ttt_autoXX.bat` and `ttt_fancy_atl/ind/pac_auto.bat` files to change the map boundaries, symbols plotted, and contouring or color shading done.

The following pages provide a brief summary on the various parameters. Further information and documentation on GMT can be found in `C:\TTT Package\TTT_GMT_otherdocs\GMT_Manuals`, or at <http://gmt.soest.hawaii.edu/>.

Customizing ttt_autoXX.bat and ttt_fancy_atl/ind/pac_auto.bat

The following pages provide a brief summary on the various parameters.

ttt_autoXX.bat ... change ranges of a zoomed map and grid of topography.

ECHO OFF

----- omitted the lines with REM here (lines beginning with REM are ignored by command processor). -----
cd "C:\TTT Package\Software\TTT\bin"

```
set LAT=  
set /P LAT="Source latitude (decimal degrees): "  
set LON=  
set /P LON="Source longitude (decimal degrees): "  
set MAG=  
set /P MAG="Source Magnitude: "  
set REGION=  
set /P REGION="Region to plot: Atlantic/Caribbean (1), Indian (2), Pacific (3): "  
set OPTION=  
echo "Output times at locations (arrival times calculated correctly only for events years 1970-2038)."  
set /P OPTION="Output Tsunami Travel Time (0) or Tsunami Arrival Time (1): "
```

Set four values input from a keyboard.

Choose the option which to have, tsunami travel time or arrival time. (travel time → type 0, arrival time → 1)

Choose bathymetry grid file: smaller means more detail, and takes longer for calculation – it is a trade-off of time for calculation and accuracy needed.

```
echo Bathymetry grid file to use, 15 min recommended for fast run.  
set /P BATHY="Options are (arc min): 60, 30, 20, 15, 10, 5, 2, 1: "
```

```
echo %LON% %LAT% > epicenter_auto.txt  
echo %LON% %LAT% 7 0 1 CM %MAG% > epi_auto_symbol.txt  
echo %LON% %LAT% 12 0 1 CM %MAG% > epi_auto_symbol_z.txt
```

Create input files.

Values highlighted in yellow are font sizes in the symbol of an epicenter.

```
set /a ZLONmin_tmp=%LON%/1  
set /a ZLONmax_tmp=%LON%/1  
set /a ZLATmin_tmp=%LAT%/1  
set /a ZLATmax_tmp=%LAT%/1
```

Round down parameters since DOS can't calculate floats.

```
set /a ZLONmin=%ZLONmin_tmp%-40  
set /a ZLONmax=%ZLONmax_tmp%+40  
set /a ZLATmin=%ZLATmin_tmp%-30  
set /a ZLATmax=%ZLATmax_tmp%+30
```

Set ranges for zoomed map. You can change ranges by changing values highlighted in yellow. You can create a map without an epicenter but another way is recommended (see later). **INTEGER ONLY!**

```
if %REGION%==1 if %OPTION%==0 goto TASK1  
if %REGION%==2 if %OPTION%==0 goto TASK2  
if %REGION%==3 if %OPTION%==0 goto TASK3  
if %REGION%==1 if %OPTION%==1 goto TASK4  
if %REGION%==2 if %OPTION%==1 goto TASK5  
if %REGION%==3 if %OPTION%==1 goto TASK6
```

Choose task depending on the region and your option choice.

Each task calculates travel time, creates travel time or arrival time data file and plots the results.

:TASK1

echo "Atlantic Ocean"

```
echo Epicenter: LAT %LAT%, LON %LON% > travel_time_atl.txt
```

Add epicenter info at the top of travel time file.

```
if %BATHY% EQU 1 set filename=atl_topo_%BATHY%m
```

Set bathymetry file name following your request.

```
if %BATHY% NEQ 1 set filename=ttt_topo_%BATHY%m
```

```
ttt_client %filename% -eepicenter_auto.txt -Ttt_auto_%BATHY%m.b -Astations_atl.txt -VL >> travel_time_atl.txt
```

```
ttt_fancy_atl_auto ttt_auto_%BATHY%m.b ttt_topo_%BATHY%m epicenter_auto.txt ttt_auto_%BATHY%m.ps
```

```
ttt_auto_%BATHY%m_zoom.ps ttt_auto_%BATHY%m_zoom_AO.ps
```

The file highlighted in blue is output and input file for the first and second procedure, respectively.

:TASK2

echo "Indian Ocean"

```
echo Epicenter: LAT %LAT%, LON %LON% > travel_time_ind.txt
```

```
if %BATHY% EQU 1 set filename=ind_topo_%BATHY%m
```

```

if %BATHY% NEQ 1 set filename=ttt_topo_%BATHY%m
ttt_client %filename% -eepicenter_auto.txt -Tttt_auto_%BATHY%m.b -Astations_ind.txt -VL >> travel_time_ind.txt
ttt_fancy_ind_auto tttt_auto_%BATHY%m.b ttt_topo_%BATHY%m epicenter_auto.txt tttt_auto_%BATHY%m.ps
ttt_auto_%BATHY%m_zoom.ps tttt_auto_%BATHY%m_zoom_wIO.ps

```

Files highlighted in purple are plots and you can put whatever names.

```

:TASK3
echo "Pacific Ocean"
echo Epicenter: LAT %LAT%, LON %LON% > travel_time_pac.txt
if %BATHY% EQU 1 set filename=pac_topo_%BATHY%m
if %BATHY% NEQ 1 set filename=ttt_topo_%BATHY%m
ttt_client %filename% -eepicenter_auto.txt -Tttt_auto_%BATHY%m.b -Astations_pac.txt -VL >> travel_time_pac.txt
ttt_fancy_pac_auto tttt_auto_%BATHY%m.b ttt_topo_%BATHY%m epicenter_auto.txt tttt_auto_%BATHY%m.ps
ttt_auto_%BATHY%m_zoom.ps tttt_auto_%BATHY%m_zoom_PO.ps

```

```

:TASK4
echo "Atlantic Ocean"
set ORIGIN=
set /P ORIGIN="Enter origin time as YYYY/MM/DD/HH/MI/SS (2004/12/26/00/58/53): "
echo Epicenter: LAT %LAT%, LON %LON% > ETA_atl.txt
echo Origin Time: %ORIGIN% >> ETA_atl.txt
if %BATHY% EQU 1 set filename=atl_topo_%BATHY%m
if %BATHY% NEQ 1 set filename=ttt_topo_%BATHY%m
ttt_client %filename% -eepicenter_auto.txt -Tttt_auto_%BATHY%m.b -Astations_atl.txt -O%ORIGIN% -VL >> ETA_atl.txt
ttt_fancy_atl_auto tttt_auto_%BATHY%m.b ttt_topo_%BATHY%m epicenter_auto.txt tttt_auto_%BATHY%m.ps
ttt_auto_%BATHY%m_zoom.ps tttt_auto_%BATHY%m_zoom_AO.ps

```

Set origin time for ETA data file.

Add origin time and epicenter info at the top of ETA file.

```

:TASK5
echo "Indian Ocean"
set ORIGIN=
set /P ORIGIN="Enter origin time as YYYY/MM/DD/HH/MI/SS (2004/12/26/00/58/53): "
echo Epicenter: LAT %LAT%, LON %LON% > ETA_ind.txt
echo Origin Time: %ORIGIN% >> ETA_ind.txt
if %BATHY% EQU 1 set filename=ind_topo_%BATHY%m
if %BATHY% NEQ 1 set filename=ttt_topo_%BATHY%m
ttt_client %filename% -eepicenter_auto.txt -Tttt_auto_%BATHY%m.b -Astations_ind.txt -O%ORIGIN% -VL >> ETA_ind.txt
ttt_fancy_ind_auto tttt_auto_%BATHY%m.b ttt_topo_%BATHY%m epicenter_auto.txt tttt_auto_%BATHY%m.ps
ttt_auto_%BATHY%m_zoom.ps tttt_auto_%BATHY%m_zoom_wIO.ps

```

```

:TASK6
echo "Pacific Ocean"
set ORIGIN=
set /P ORIGIN="Enter origin time as YYYY/MM/DD/HH/MI/SS (2004/12/26/00/58/53): "
echo Epicenter: LAT %LAT%, LON %LON% > ETA_pac.txt
echo Origin Time: %ORIGIN% >> ETA_pac.txt
if %BATHY% EQU 1 set filename=pac_topo_%BATHY%m
if %BATHY% NEQ 1 set filename=ttt_topo_%BATHY%m
ttt_client %filename% -eepicenter_auto.txt -Tttt_auto_%BATHY%m.b -Astations_pac.txt -O%ORIGIN% -VL >> ETA_pac.txt
ttt_fancy_pac_auto tttt_auto_%BATHY%m.b ttt_topo_%BATHY%m epicenter_auto.txt tttt_auto_%BATHY%m.ps
ttt_auto_%BATHY%m_zoom.ps tttt_auto_%BATHY%m_zoom_PO.ps

```

ECHO ON

ttt_fancy_atl / ind / pac_auto.bat ... change strokes, map boundaries, contouring, etc

For the following description, %1 %2 %3 %4 %5 %6 in ttt_fancy_atl / ind / pac_auto.bat correspond to underlined files in this order:

ttt_fancy_atl_auto ttt_auto ##m.b ttt_topo ##m epicenter auto.txt ttt_auto ##m.ps ttt_auto ##m zoom.ps
ttt_auto ##m zoom AO.ps

The following script is ttt_fancy_ind_auto.bat

ECHO OFF

----- omitted the lines with REM here (lines beginning with REM are ignored by command processor). -----

```
set time2=%time: =0%
set hr=%time2:~0,2%
set min=%time2:~3,2%
set sec=%time2:~6,2%
set dirname=TTT_AUTO_%hr%%min%%sec%
mkdir %dirname%
```

Automatically create folder for each calculation. Folders named with time (hour, min, sec) based on computer clock time

```
set SL-OPTION=
set /P SL-OPTION="Plot Sea Level Stations (0=No, 1=Yes)? "
set EQ-OPTION=
set /P EQ-OPTION="Plot Historical Earthquakes (Centennial List, 0=No, 1=Yes)? "
set /P WIO-OPTION="Zoomed IO Region to plot: Mauritius (1), Mozambique (2), Other (3):"
```

Set options whether or not to plot sea level stations and historical earthquakes on the output maps.

```
if %WIO-OPTION% == 1 goto SKIP99
if %WIO-OPTION% == 2 goto SKIP99
echo "For user-selected zoomed map, input the map range."
set S=
set /P S="Southern Edge of map (decimal degrees, N(+), S(-)):"
set N=
set /P N="Northern Edge of map (decimal degrees, N(+), S(-)):"
set W=
set /P W="Western Edge of map (decimal degrees, N(+), S(-)):"
set E=
set /P E="Eastern Edge of map (decimal degrees, N(+), S(-)):"
```

ttt_autoXX creates three plots for the Indian Ocean. The third plot has an option for the region (1: Mauritius, 2: Mozambique, 3: Other = need to set the map range.) This part sets the option and the map range for option 3.

:SKIP99

```
REM -----
REM create a plot
REM -----
```

Color pallet file highlighted in red controls hours to plot contours in color. ttt30.cpt plots 30 hours with color and later hours with lines only (no color). ttt1.cpt~ttt30.cpt are available: each of them plots 1~30 hours in color, respectively.

```
gdgradient "%TTT_DIR%\%2%.i2"=2/1/0/32767 -A0 -Nt6.0 -Gintens.grd
grdimage %1=1 -lintens.grd -R-100/50/-68/75 -JM7i -CCPT\%3% -P -K -V -X0.75i > %4
grdcontour %1=1 -R -JM -O -K -A4 -C1 -Gd3c -V >> %4
pscoast -R -JM -O -B40f20NSEW -G222/184/125 -C255/255/255 -W0.25p -Di -N1/0.5 -A2000 -U"TSUNAMI TRAVEL TIMES" -K >> %4
```

From the station list, a list for only DART stations and for only SL stations are created, to plot in different symbols.

```
findstr DART stations_ind.txt > DART_ind_tmp.txt
findstr SL stations_ind.txt > SL_ind_tmp.txt
```

```
if %SL-OPTION% == 0 goto SKIP1
psxy DART_ind_tmp.txt -R -JM -Si0.1 -G0 -O -K -V >> %4
psxy SL_ind_tmp.txt -R -JM -St0.1 -G0 -O -K -V >> %4
```

When you chose not to plot the sea level stations, skip the command line for station plotting. Also, when you chose not to plot the historical events, skip a command line for EQ plotting.

:SKIP1

```
if %EQ-OPTION% == 0 goto SKIP2
psxy centennial6_ed.txt -R -JM -Sc -W0.5p/0/0/0 -CCPT\centennial.cpt -O -K -V >> %4
```

:SKIP2

```
psxy %3 -R -JM -Sx25p -W2p/0 -O -K -V >> %4  
psxy %3 -R -JM -Sx22p -W0.5p/255 -O -K -V >> %4  
psxy %3 -R -JM -Sc16p -G0 -O -K -V >> %4  
psxy %3 -R -JM -Sc14p -W0.5p/255 -O -K -V >> %4  
pstext epi_auto_symbol.txt -R -JM -G255 -O -V >> %4
```

Numbers highlighted in green are strokes, and numbers highlighted in purple are symbol sizes. Larger means thicker and bigger, respectively. Letters after S (x, c, etc.) control shapes, e.g. x is cross and c is circle but maybe need not change shapes.

```
REM -----  
REM create a zoomed map around the source  
REM -----
```

```
grdimage %1=1 -lintens.grd -R%ZLONmin%/%ZLONmax%/%ZLATmin%/%ZLATmax% -JM7i -CCPT\%tt30.cpt -P -K -V -X0.75i > %5  
grdcontour %1=1 -R -JM -O -K -A2 -C0.25 -Gd3c -V >> %5  
pscoast -R -JM -O -B20f10NSEW -G222/184/125 -C255/255/255 -W0.25p -Di -N1/0.5 -A2000 -U"TSUNAMI TRAVEL TIMES" -K >> %5
```

Numbers and parameters highlighted in light blue are ranges of maps; they are western, eastern, southern and northern edges from left to right. Recommend to leave the values for first 2 maps; change only bottom part "W/E/S/N" for the last plot.

```
if %SL-OPTION% == 0 goto SKIP3  
psxy DART_ind_tmp.txt -R -JM -Si0.1 -G0 -O -K -V >> %5  
psxy SL_ind_tmp.txt -R -JM -St0.1 -G0 -O -K -V >> %5
```

:SKIP3

```
if %EQ-OPTION% == 0 goto SKIP4  
psxy centennial6_ed.txt -R -JM -Sc -W0.5p/0/0/0 -CCPT\centennial.cpt -O -K -V >> %5
```

:SKIP4

```
psxy %3 -R -JM -Sx40p -W5p/0 -O -K -V >> %5  
psxy %3 -R -JM -Sx36p -W1p/255 -O -K -V >> %5  
psxy %3 -R -JM -Sc24p -G0 -O -K -V >> %5  
psxy %3 -R -JM -Sc20p -W1p/255 -O -K -V >> %5  
pstext epi_auto_symbol_z.txt -R -JM -G255 -O -V >> %5
```

Numbers highlighted in yellow are contour intervals. Each means hour so 1 is 1 hour and 0.25 is 15 minutes. -A is for labeled contours and -C is for regular ones.

```
REM -----  
REM create a zoomed map far from the source  
REM -----
```

```
if %WIO-OPTION% == 2 goto SKIP12  
if %WIO-OPTION% == 3 goto SKIP13
```

REM zoomed map around Mauritius

```
grdimage %1=1 -lintens.grd -R40/85/-35/10 -JM7i -CCPT\%tt30.cpt -P -K -V -X0.75i > %6  
grdcontour %1=1 -R -JM -O -K -A2 -C0.25 -Gd3c -V >> %6  
pscoast -R -JM -O -B10f5NSEW -G222/184/125 -C255/255/255 -W0.25p -Di -N1/0.5 -A2000 -U"TSUNAMI TRAVEL TIMES" -K >> %6
```

Numbers and letters highlighted in gray control the labeling and scaling of the axis of maps. B20 sets label in 20-degree interval and f10 sets bars to change color at 10-degree intervals. NSEW will label 4 axes. Capital is for labelling and small letter is for not labelling, e.g. nSEw will label only right and bottom axes.

```
if %SL-OPTION% == 0 goto SKIP5  
psxy DART_ind_tmp.txt -R -JM -Si0.1 -G0 -O -K -V >> %6  
psxy SL_ind_tmp.txt -R -JM -St0.1 -G0 -O -K -V >> %6
```

:SKIP5

```
if %EQ-OPTION% == 0 goto SKIP6  
psxy centennial6_ed.txt -R -JM -Sc -W0.5p/0/0/0 -CCPT\centennial.cpt -O -K -V >> %6
```

:SKIP6

```
psxy %3 -R -JM -Sx40p -W5p/0 -O -K -V >> %6
```

Map range differs depending on the choice which region to plot. This part reads the option and jumps to the appropriate part in the script.

```

psxy %3 -R -JM -Sx36p -W1p/255 -O -K -V >> %6
psxy %3 -R -JM -Sc24p -G0 -O -K -V >> %6
psxy %3 -R -JM -Sc20p -W1p/255 -O -K -V >> %6
pstext epi_auto_symbol.txt -R -JM -G255 -O -V >> %6

```

```

goto TASK99
REM zoomed map off Mozambique

```

```

:SKIP12

```

```

grdimage %1=1 -lintens.grd -R20/65/-35/0 -JM7i -CCPT\ttt30.cpt -P -K -V -X0.75i > %6
grdcontour %1=1 -R -JM -O -K -A2 -C0.25 -Gd3c -V >> %6
pscoast -R -JM -O -B10f5NSEW -G222/184/125 -C255/255/255 -W0.25p -Di -N1/0.5 -A2000 -U"TSUNAMI
TRAVEL TIMES" -K >> %6

```

```

if %SL-OPTION% == 0 goto SKIP5
psxy DART_ind_tmp.txt -R -JM -Si0.1 -G0 -O -K -V >> %6
psxy SL_ind_tmp.txt -R -JM -St0.1 -G0 -O -K -V >> %6

```

```

:SKIP5

```

```

if %EQ-OPTION% == 0 goto SKIP6
psxy centennial6_ed.txt -R -JM -Sc -W0.5p/0/0/0 -CCPT\centennial.cpt -O -K -V >> %6

```

```

:SKIP6

```

```

psxy %3 -R -JM -Sx40p -W5p/0 -O -K -V >> %6
psxy %3 -R -JM -Sx36p -W1p/255 -O -K -V >> %6
psxy %3 -R -JM -Sc24p -G0 -O -K -V >> %6
psxy %3 -R -JM -Sc20p -W1p/255 -O -K -V >> %6
pstext epi_auto_symbol.txt -R -JM -G255 -O -V >> %6

```

```

goto TASK99
REM zoomed map – user-input boundaries

```

```

:SKIP13

```

```

grdimage %1=1 -lintens.grd -R%W%/%E%/%S%/%N% -JM7i -CCPT\ttt30.cpt -P -K -V -X0.75i > %6
grdcontour %1=1 -R -JM -O -K -A2 -C0.25 -Gd3c -V >> %6
pscoast -R -JM -O -B10f5NSEW -G222/184/125 -C255/255/255 -W0.25p -Di -N1/0.5 -A2000 -U"TSUNAMI
TRAVEL TIMES" -K >> %6

```

```

if %SL-OPTION% == 0 goto SKIP5
psxy DART_ind_tmp.txt -R -JM -Si0.1 -G0 -O -K -V >> %6
psxy SL_ind_tmp.txt -R -JM -St0.1 -G0 -O -K -V >> %6

```

```

:SKIP5

```

```

if %EQ-OPTION% == 0 goto SKIP6
psxy centennial6_ed.txt -R -JM -Sc -W0.5p/0/0/0 -CCPT\centennial.cpt -O -K -V >> %6

```

```

:SKIP6

```

```

psxy %3 -R -JM -Sx40p -W5p/0 -O -K -V >> %6
psxy %3 -R -JM -Sx36p -W1p/255 -O -K -V >> %6
psxy %3 -R -JM -Sc24p -G0 -O -K -V >> %6
psxy %3 -R -JM -Sc20p -W1p/255 -O -K -V >> %6
pstext epi_auto_symbol.txt -R -JM -G255 -O -V >> %6

```

```

goto TASK99

```

goto TASK99 means “jump to (= ignore lines till) TASK99”. This part is for option 1 (Mauritius), so after plotting a map around Mauritius, ignore the command lines for option 2 and 3 and read the lines after TASK99.

SKIP 12 is for option 2 (Mozambique) and SKIP 13 is for option 3 (Other). Same as for the option 1, after plotting a map, it jumps to TASK99 and continues operation after TASK99.

REM move files to TTT_AUTO_timestamp directory

```
:TASK99  
del intens.grd  
del epi_auto_symbol.txt  
del epi_auto_symbol_z.txt  
del DART_ind_tmp.txt  
del SL_ind_tmp.txt  
move %1 %dirname%  
move epicenter_auto.txt %dirname%  
move travel_time_atl.txt %dirname%  
move ETA_atl.txt %dirname%
```

REM convert ps file to png for convenience; other options possible

```
ps2raster %4 -A -Tg  
ps2raster %5 -A -Tg  
ps2raster %6 -A -Tg  
move ttt_auto_*.png %dirname%
```

```
move %4 %dirname%  
move %5 %dirname%  
move %6 %dirname%
```

All files created in one simulation using ttt_autoXX are moved to a folder, which is automatically created with name TTT_AUTO_**(time)**.

The last move command moves the whole folder under "C:\TTT Package\Examples", so when you check your output files, go to "Examples" folder. You can change the output directory by editing this line.

REM moves files to Examples directory.

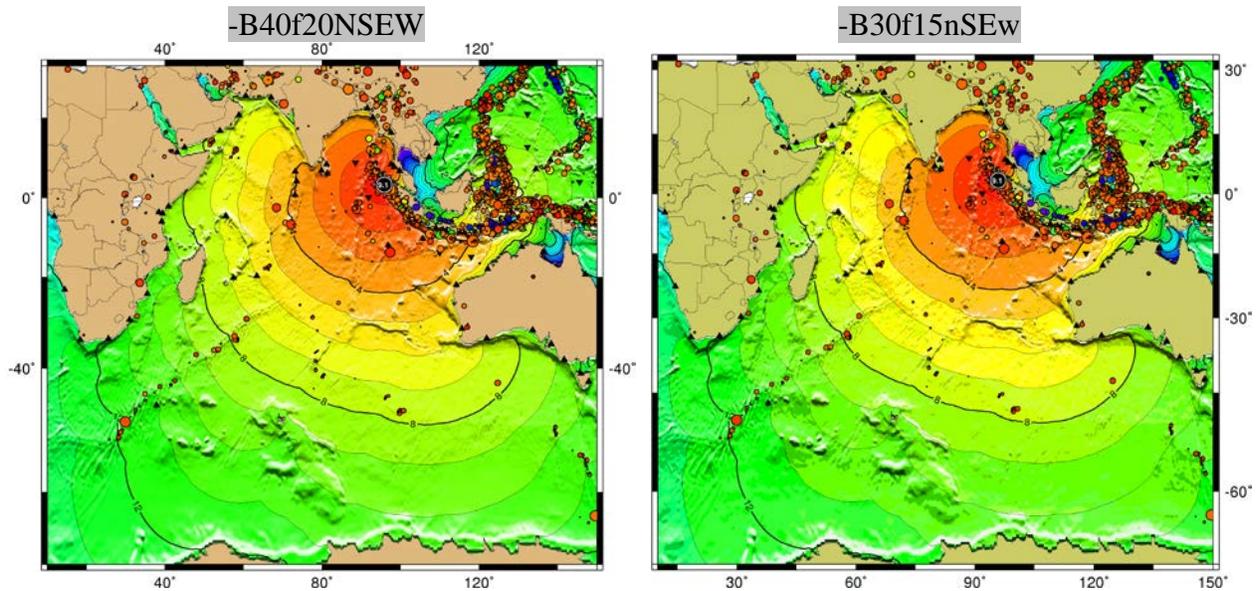
REM Edit this next line to change the directory where output files will be moved.

```
move %dirname% "C:\TTT Package\Examples\%dirname%"
```

ECHO ON

Example of customization ~comparison of maps~

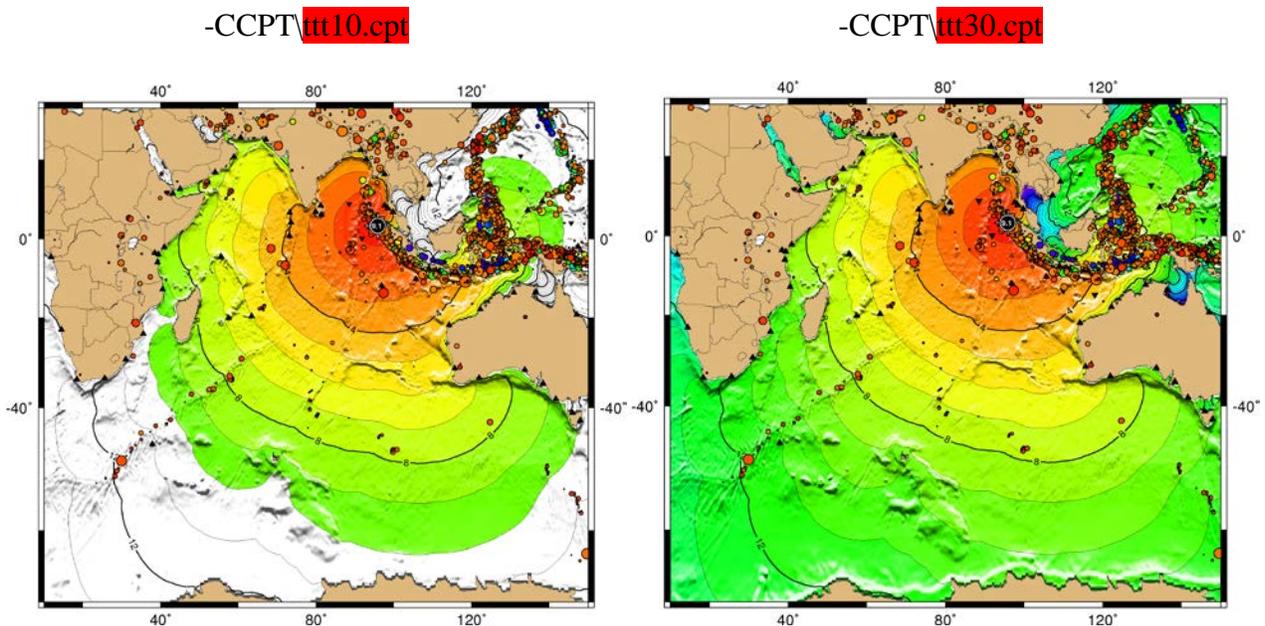
1. Labelling and scaling of axis: *Change the values and letters highlighted in gray*



Change the values and letters (capital or small) of the part highlighted in gray in each script. Two figures are given as examples; the values change the labelling and scaling intervals of axes, and letters controls which axes to be label. These examples plot the sea level stations and historical earthquakes.

2. Hours to plot contour with color: *Change color pallet filename highlighted in red (1 – 30, integer only)*

These examples are with the sea level stations and historical earthquakes.



ttt_fancy_atl / ind / pac_auto.bat Other Customization

1. Change sizes of symbols of historical events: *Edit centennial6_ed.txt (last column of each line)*

```
122.000 -7.000 720.000 0.058
145.066 19.134 692.500 0.064
-179.014 -20.039 691.400 0.010
: : : :
```

centennial6_ed.txt format: longitude, latitude, depth (km) and size (corresponds to magnitude) This input file was originally given as longitude, latitude, depth (km) and magnitude:

```
122.000 -7.000 720.0 6.8
145.066 19.134 692.5 6.9
-179.014 -20.039 691.4 6.0
: : : :
```

but the magnitude like 6.8 results in a symbol size that is too large, so the values are made smaller using the formula $\frac{M - 6.0}{10 - 6.0} \times 0.24 + 0.01$.

This formula can be modified if a different size is preferred (e.g. magnitude $\times 0.01$ to all events).

2. Change criteria of historical events: *Edit centennial6_ed.txt*

centennial6_ed.txt lists events of magnitude 6.0 or greater in the past 100 years. The master list is maintained by the US Geological Survey. To plot other events, such as those of magnitude 5.0 or greater, those in the past 50 years, etc., edit this input file. For reference, centennial.xyzm (provided by PTWC using the USGS dataset) is provided, which lists events of magnitude 5.0 or greater in the past 100 years.

3. Change station list: *Edit stations_atl/ind/pac.txt*

If you need to add or omit some stations to / from the travel time data file, edit stations_atl(ind/pac).txt, which contains longitude, latitude and station name. Any words can be used for the station names.

You can also plot other data (e.g., not just stations, but cities, forecast points, etc). Symbol types and colors are customizable. The keyword *SL* or *DART* in column 4 is used to specify the type of symbol to plot. See also 4. below for adding lines to plot other specific data.

4. Plot some other information: *Add one line as follows*

For example, if you need to plot cities on the map, create a city list with longitude and latitude (here, name cities_add.txt), add the highlighted line in the script between the lines of psxy %3 -R -JM -Sc14p -W0.5p/255 -O -K -V >> %4 and pstext epi_auto_symbol.txt -R -JM -G255 -O -V >> %4

```
psxy %3 -R -JM -Sc14p -W0.5p/255 -O -K -V >> %4
psxy cities_add.txt -R -JM -Si0.5 -G0 -O -K -V >> %4
pstext epi_auto_symbol.txt -R -JM -G255 -O -V >> %4
```

Example information on symbols and sizes:

-Si0.5 set the shape (I is an upside-down triangle) and size (0.5)

-G controls color . "0" is black. If you add the -W option, only the outline of the shape is drawn.

Addition of any lines that overlay another plot command to the existing plot need to include the option -K.

The last plot command line of the script (before ECHO ON) should not have the option -K in it.

For example,

```
pstext epi_auto_symbol_z.txt -R -JM -G255 -O -K -V >> %4
psxy cities_add.txt -R -JM -Si0.5 -G0 -O -V >> %4
```

In this case, the pstext line has to be added "-K" but psxy need not "-K"