Mapping and modeling Earth Science Data

Segment II: Making maps with GMT, another exercise and iGMT

Thorsten Becker
University of Southern California, Los Angeles

Università di Roma TRE, June 2012
GMT exercise: Example 2

- Plot CMT data
- From the files in `examples.tgz` go to `examples/gmt/example_2` (or from UGESCE ~:/Desktop/user_data) and check out `cmt_012112.mdat`
- Generate a regional focal mechanism map for Tonga with plate boundaries and coastlines, using seismicity deeper than 100 km, plotted shallow events on top, color coded by depth. Use `gmtselect` to cut out regional data from `cmt_012112.mdat`
Hint for exercise 2: psmeca

psmeca 4.5.7 [64-bit] - Plot seismological symbols on maps

Usage: psmeca <infiles> -J<params> -R<west>/<east>/<south>/<north>[r]
-S<format><scale>[/fontsize[/justify/offset/angle/form]]
[-B<params>] [-C<pen>[P<points>]]
[-D<params>][<E<fill>][<G<fill>]]
[-H<nrec>][<K][<L<pen>][<M][<N][<O][<P][<R]
[-T<plane>][<pen>]] [-U<just>/<dx>/<dy>]/[c<label>]]
[-V][-W<pen>][-X[a|c|r]<x_shift>[u]][-Y[a|c|r]<x_shift>[u]]
[-Z<cpt>][-z][-a[size[/Psymbol[Tsymbol]]]]

(...)

(m) Sesmic moment tensor (Harvard CMT, with zero trace)
   X, Y, depth, mrr, mtt, mff, mrt, mrf, mtf, exp, newX, newY, event_title

(...)

Hint for exercise 2: world map
#!/bin/bash
# plot CMTs for Tonga
dfile=../cmt_012112.mdat           # data
dmin=100                          # minimum depth
tfile=tonga.ps
reg=-R172/190/-30/-14
proj=-JH\`echo $reg | gawk -f reg2midlon.awk\`/7
makecpt -T$dmin/700/10 -Cno_green -D > tmp cpt
ann=-Ba5f1WeSn
# data selection
gmtselect $reg -fg $dfile > regional_cmt.dat
pscoast -Df -A5000 $reg $proj -K -P -G128 -S200 > $ofile
# for moment tensor
sort -n +2 -r regional_cmt.dat | psmeca $reg $proj -Ztmp cpt  
-Sm0.15/-1 -D$dmin/1000 -K -O >> $ofile
# for actual double couple
#sort -n +2 -r regional_cmt.dat | psmeca $reg $proj -Ztmp cpt  
-Sc0.15/-1 -D$dmin/1000 -K -O >> $ofile
psxy ../nuvel.360.xy -O $reg $proj -K -m -fg -W2,darkorange >> $ofile
psscale -D6/1.5/2/.2 -Ctmp cpt -Ba200/"z [km]": -O -K >> $ofile
psbasemap $ann $reg $proj -O >> $ofile
echo $0: output in $ofile
modifybb $ofile
rm tmp.*
My example 2 solution
Worked GMT examples:  
Example 3

- Plot velocities and Interpolate point data
- From the files in examples.tgz go to examples/gmt/example_3

and check out gps.vel
iGMT
Interactive mapping of geoscientific datasets

- Written by Thorsten Becker and Alexander Braun
- UNIX based, TclTk script graphical user interface for GMT
- Access to several Earth science datasets
- Produces GMT/bash scripts
- (development discontinued, in favor of python based SEATREE)
- [http://geodynamics.usc.edu/~becker/igmt/](http://geodynamics.usc.edu/~becker/igmt/)
iGMT: Interactive Mapping of Geoscientific Datasets

Welcome to the home page of the interactive mapping interface iGMT. This program is intended to make working with the Generic Mapping Tools (GMT) easier. iGMT provides a graphical user interface for GMT and is written in the Tcl/Tk computer language. Besides supplying a user friendly way of handling GMT, iGMT comes with built-in support for many different geoscientific data sets, such as topography, gravity, seafloor age, hypocenter catalogs, plate boundary files, hotspot lists, CMT solutions etc.

Our software is a useful tool for learning GMT, taking advantage of both GMT's data processing capabilities and the increasing availability of geoscientific data sets in electronic form. More than 240 institutions worldwide are registered iGMT users, used the program in 2002 for map-making and teaching GMT. We stopped counting a while back.

- Installed on USC Geodynamics Earth Science Computing Environment
iGMT on desktop
Solid Earth Teaching and Research Environment (SEATREE)

SEATREE is a modular and user-friendly software to facilitate using solid Earth research tools in the classroom and for interdisciplinary, scientific collaboration. We use python wrappers and make use of modern software design concepts, while remaining compatible with traditional scientific coding. Our goals are to provide a fully contained, yet transparent package that lets users operate in an easy, graphically supported "black box" mode, while also allowing to look under the hood. In the long run, we envision SEATREE to contribute to new ways of sharing scientific research, and making (numerical) experiments truly reproducible again. (\textit{\textsuperscript{Eos} Article})

SEATREE is module based, and the current SVN version includes tools for computing 2D mantle convection, 3D body wave mantle seismic tomography, 3D spherical mantle flow, for inverting for Earth structure by means of surface wave, phase velocity tomography, and a two-dimensional synthetic tomography teaching module. A rudimentary module for earthquake location inversions is also available. The main software design consists of transparent python wrappers that drive the modules, including a GMT plotting tool, a VTK/Paraview 3D visualization interface, and a graphical user interface.

SEATREE is freely available under the GNU license; a desktop installation is required to use SEATREE right now but we are planning on a web-based version as well. We encourage you to take the software for a test drive. If you want to use SEATREE in a classroom setting, we might be able to offer you some installation support and always welcome your feedback. Also, if you like to add your own module to SEATREE, please let us know; we might be able to provide some assistance.

\textit{Screenshots} Illustrations of the softwares capabilities and design concepts.

\textit{Download and installation} Instructions on how to obtain and install the whole package. (Release: version 2.0, as of Sep, 2011)

\textit{User Documentation} User-level documentation of SEATREE and the modules.

\textit{Developer Documentation} Start here if you want to extend SEATREE and/or add modules.
Python interface for GMT plots

(Only very rudimentary implementation; there are previous attempts on python-GMT, and a proper interface is in the works.)
Making movies with GMT

- Write a script that loop through parameters
- Convert PS to GIF
- Use gifsicle or similar to make a GIF movie
Making movies with GMT
#!/bin/bash

i=1
lon=0
while [ $lon lt 360 ]; do
    il=`echo $i | awk '{printf("%05i",$i)}'` # for labeling
    pscoast -Rg -Jlon/20/7 -Bg60 -Df -A5000 -Sblue -Ggreen > tmp.ps
    /usr/bin/convert -rotate 90 tmp.ps tmp.$il.gif
    rm tmp.ps
    ((i=i+1))
    ((lon=lon+5))
done
gifsicle tmp.000*gif > wmov.gif