

# **Making maps and plotting data with GMT and *i*GMT**

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# The problem

- Produce publication quality plots (including  $x - y$ ) and geographic maps
- Achieve flexibility and automated processing (which requires modularity and script based operation)
- Do it the open source way (low cost, high transparency, high portability, high robustness)

# The solution

- The *Generic Mapping Tools* (GMT)
  - “~65 tools for manipulating geographic and Cartesian data sets (including filtering, trend fitting, gridding, projecting, etc.) and producing Encapsulated PostScript File (EPS) illustrations”
  - It has a somewhat steep learning curve, and no graphical user interface
- *i*GMT: a GMT GUI and script generator

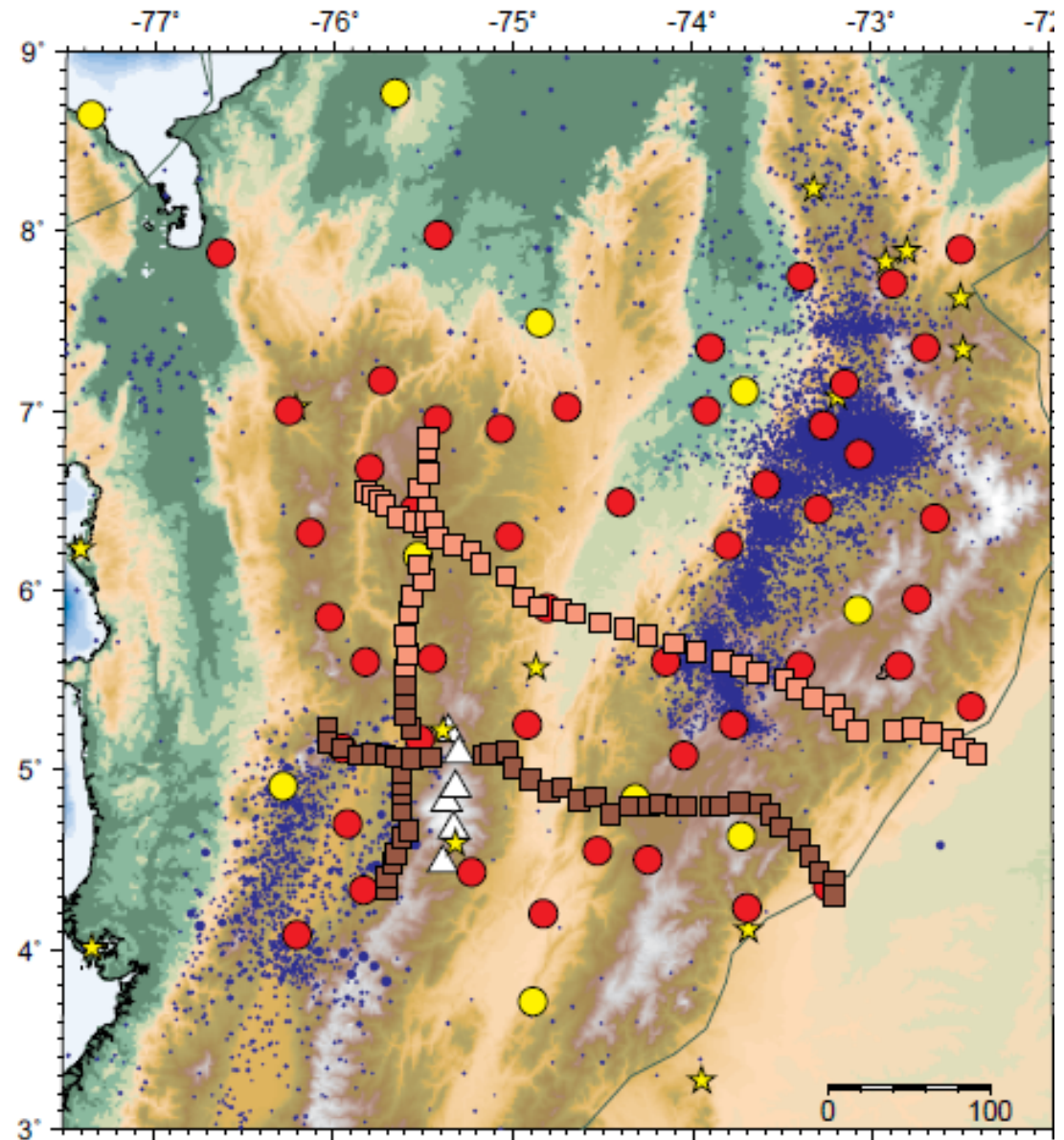
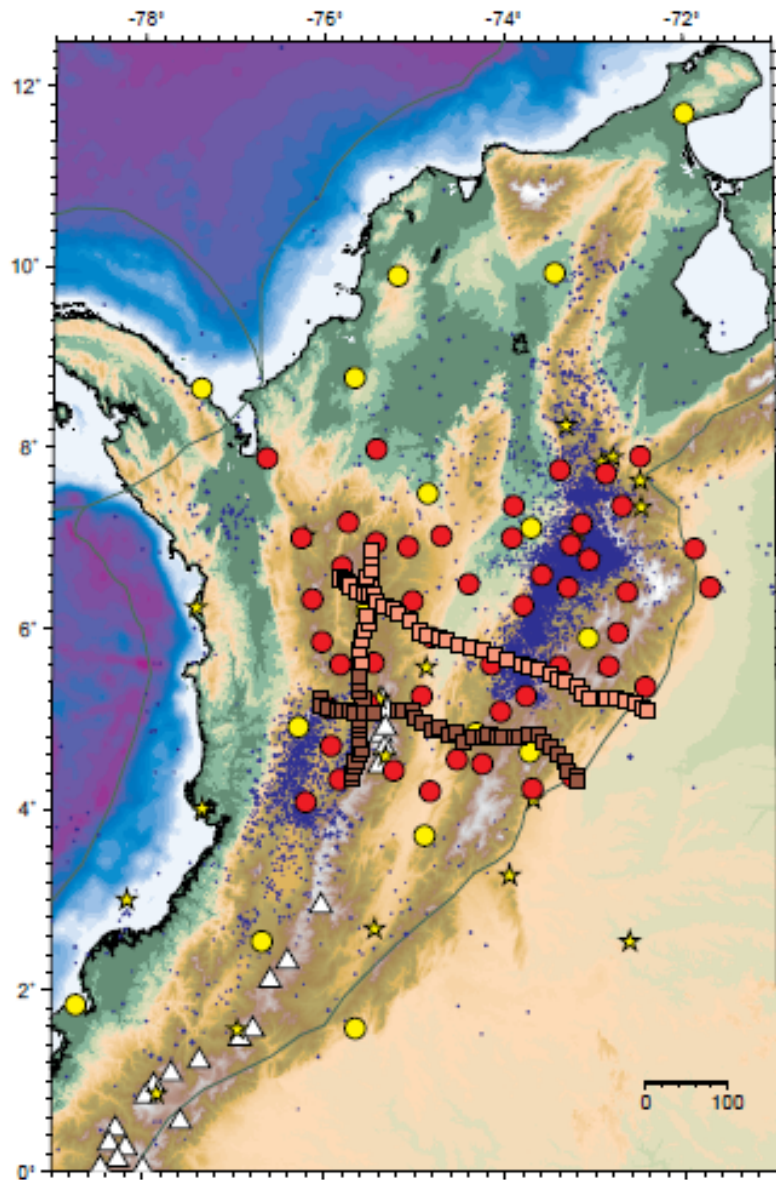


# GMT

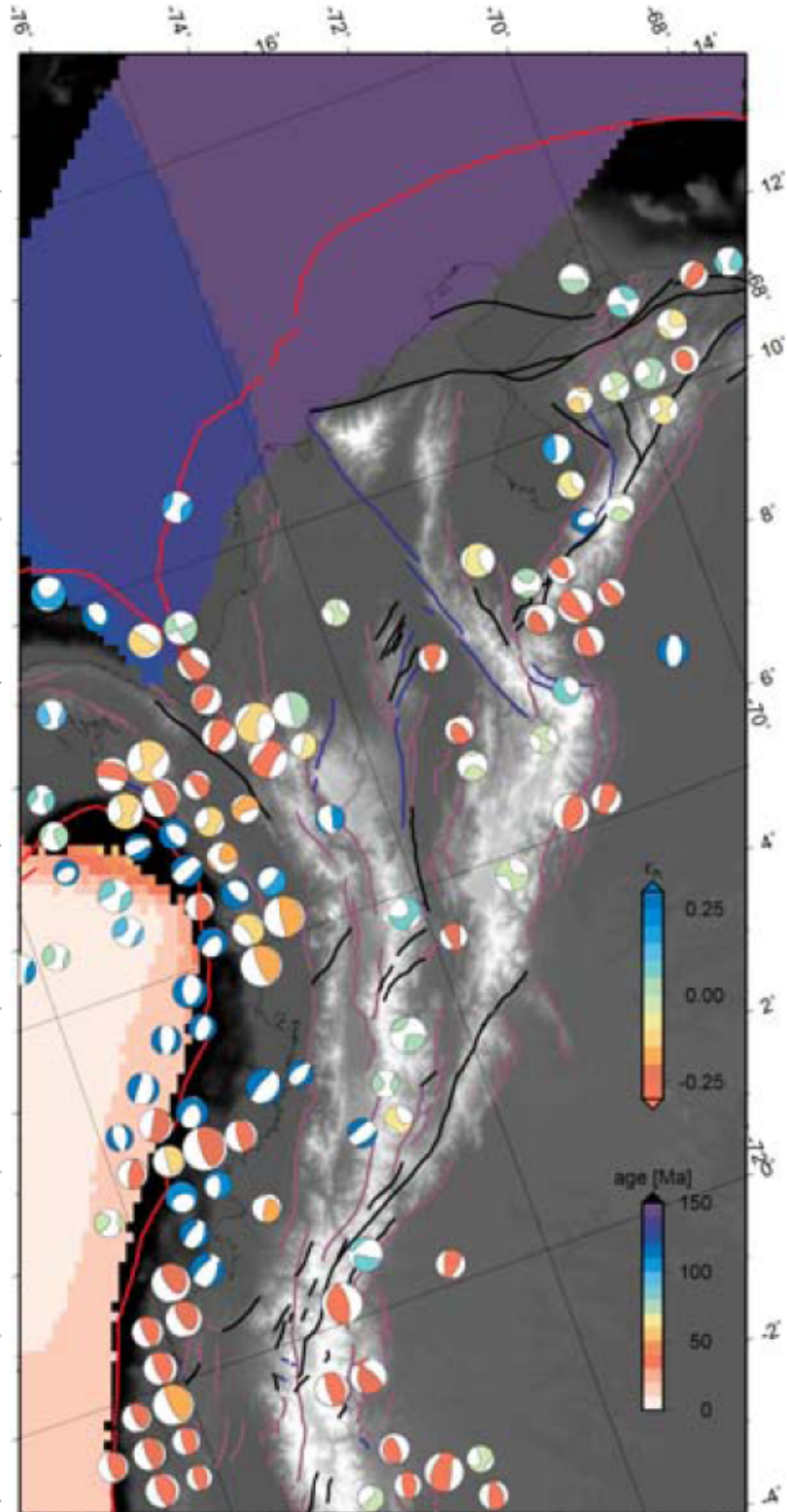
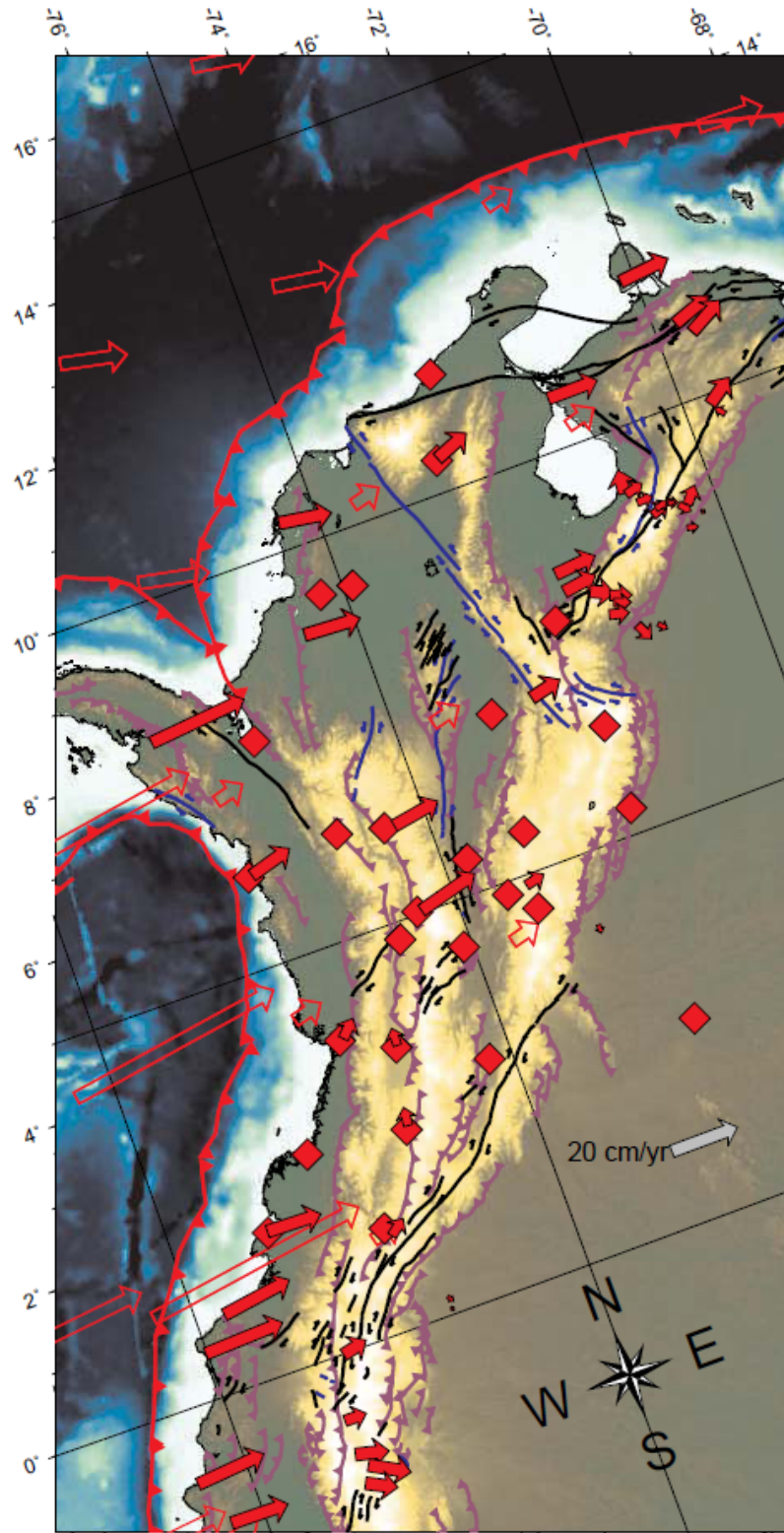


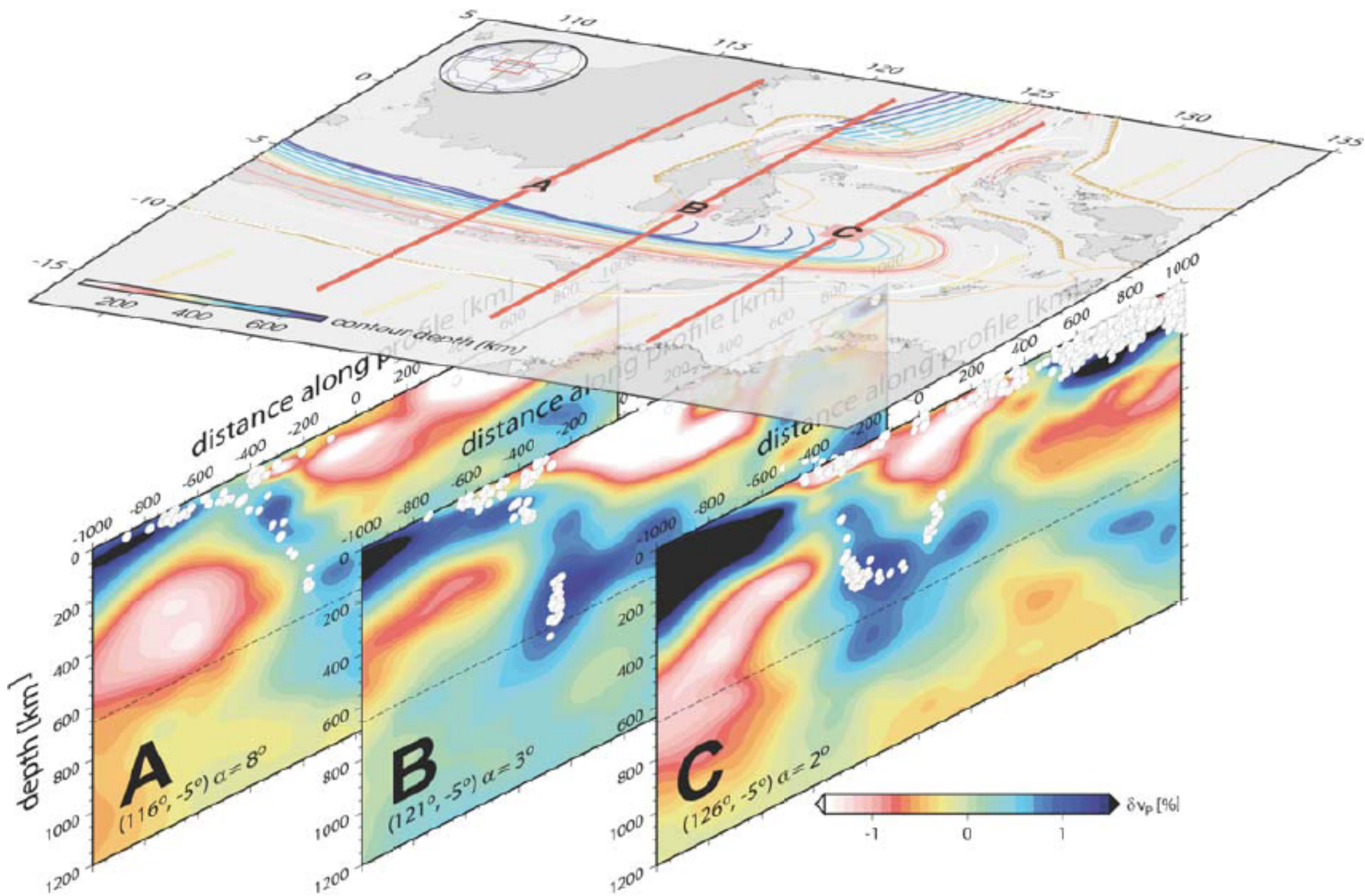
- Written by Paul Wessel and Walter Smith
- Version 4 is at 4.5.7, version 5 is beta (under development) (as of 04/2012)
- UNIX based, C language, command line tool, GPLed
- ASCII, NetCDF data input is projected, and produces a PS
- Data processing, plotting, projections, etc.
- Flexible, powerful, complicated
- <http://gmt.soest.hawaii.edu/>

# GMT produced examples

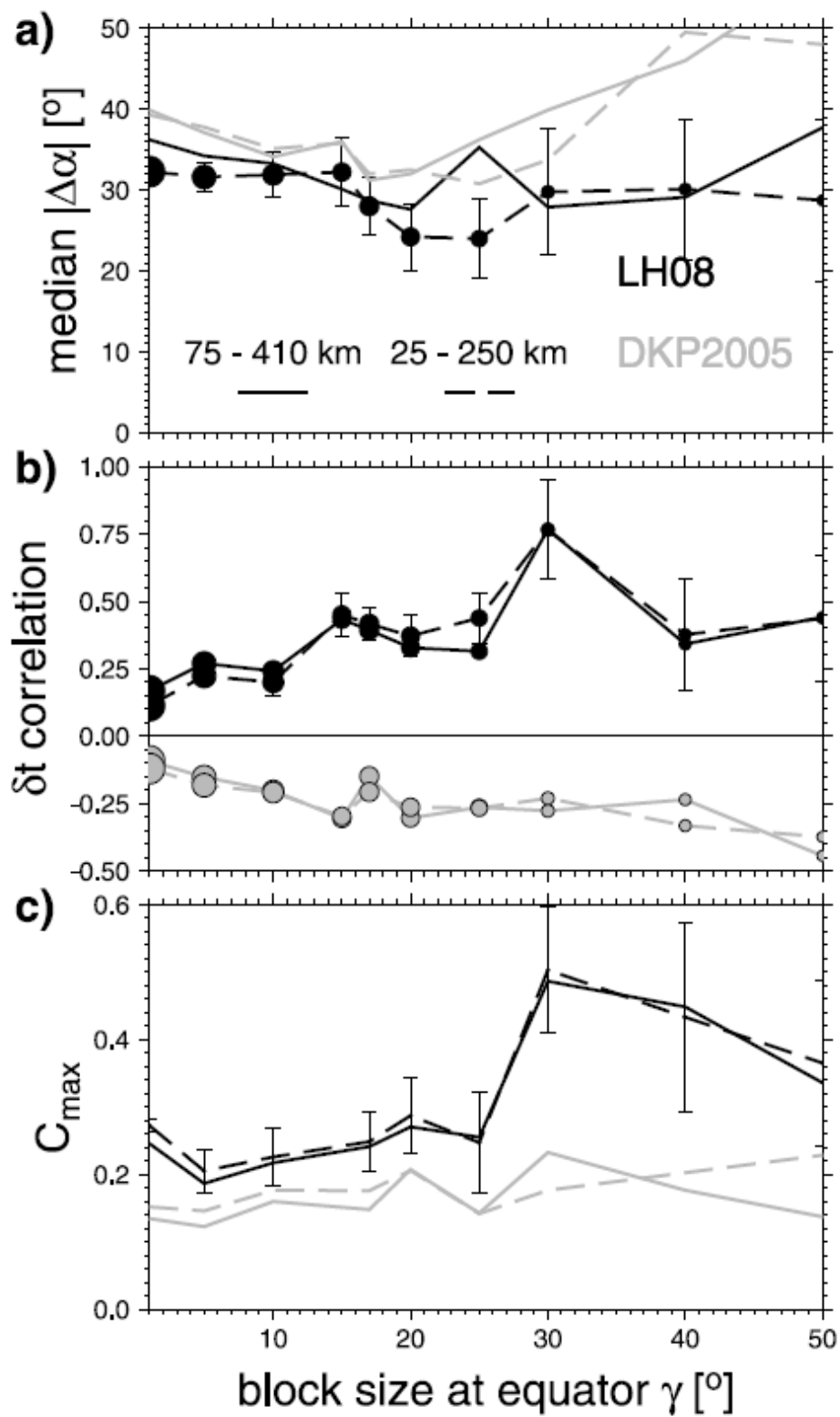




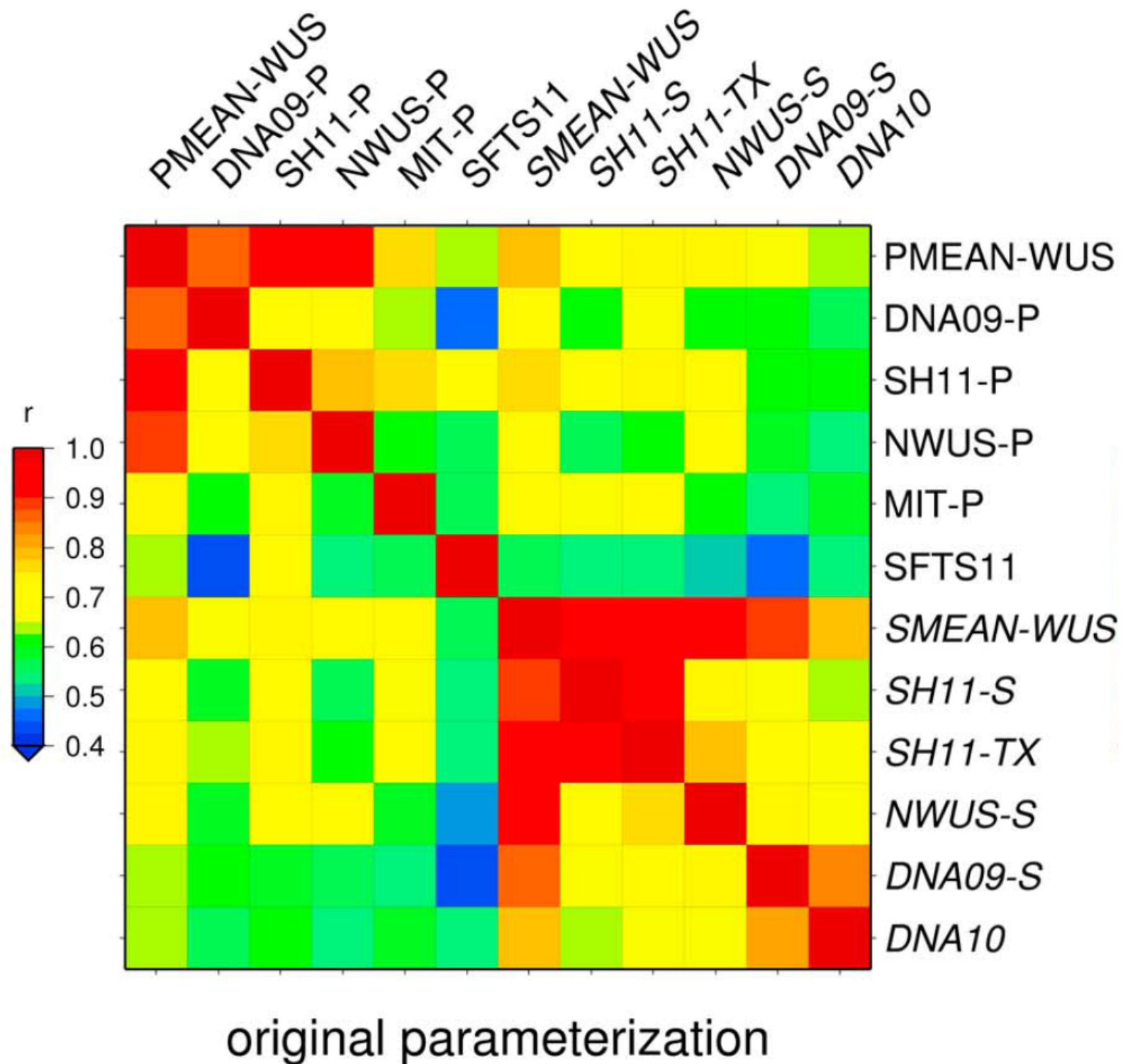








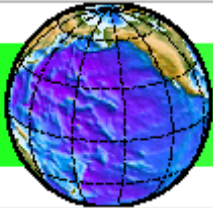





# How to get it?

- Download from GMT web page and install
  - <http://gmt.soest.hawaii.edu/>
  - Requires Linux or OS-X
  - prerequisites such as NetCDF
- Install via package manager (yum, fink)
- Install the USC Geodynamics Earth Science Computing Environment at
  - <http://geodynamics.usc.edu/~becker/ugesce.html>

# GMT documentation



## THE GENERIC MAPPING TOOLS



- HOME
- EXAMPLES
- FAQ
- DOWNLOAD
- DOCS**
- MAILINGLISTS
- REGISTRATION
- MIRRORS
- RESOURCES
- BUGS
- ARRRGHH!
- RELEASES

GMT Pages maintained  
by:  
*Paul Wessel*

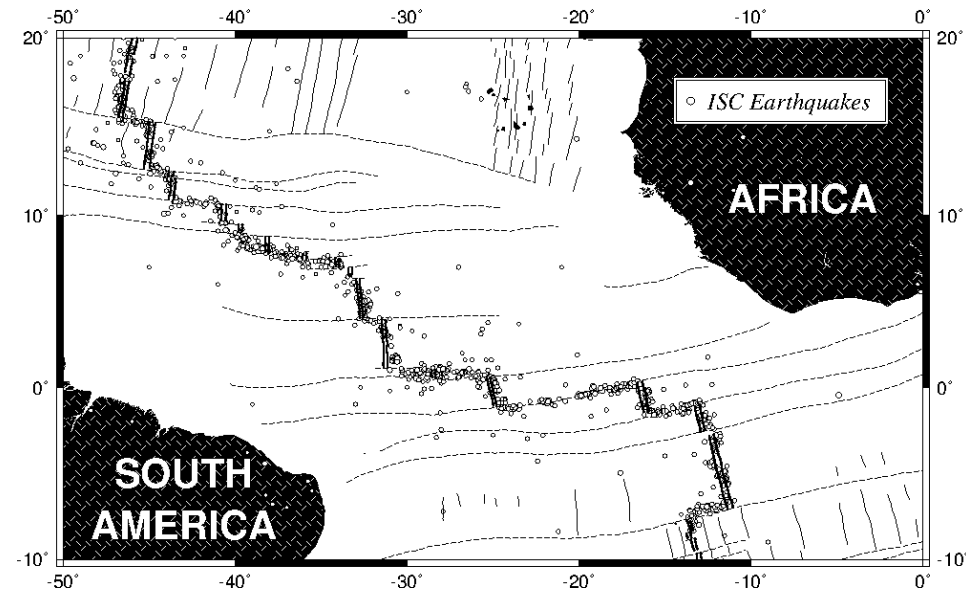
### GMT 4 Online Services

GMT Online Services gives access to four sets of documentation:

1. GMT Technical Reference and Cookbook.
  - [HTML Format](#)
  - [Portable Document Format \(PDF\)](#)
2. GMT Tutorial.
  - [HTML Format](#)
  - [Portable Document Format \(PDF\)](#)
3. GMT Manual Pages.
  - [HTML Format](#)
  - [Portable Document Format \(PDF\)](#)
4. GMT Supplemental Manual Pages.
  - [HTML Format](#)
  - [Portable Document Format \(PDF\)](#)

# Running GMT

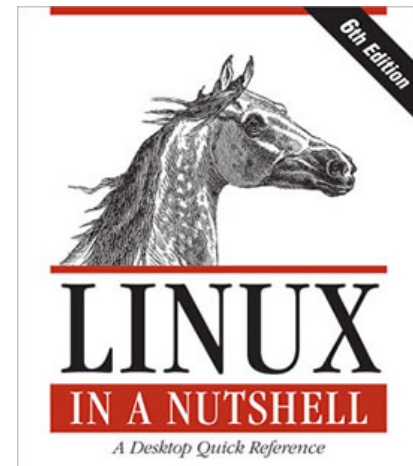
```
#!/bin/bash
#      GMT EXAMPLE 07
#
# Purpose:   Make a basemap with earthquakes and isochrons etc
# GMT progs: pscoast, ptext, psxy
# Unix progs: $AWK, echo, rm
#
ps=../example_07.ps
pscoast -R-50/0/-10/20 -JM9i -K -GP300/26 -DI -Wthinnest -B10 -U~Example 7 in Cookbook~ > $ps
psxy -R -J -O -K -m fz.xy -Wthinner,- >> $ps
$AWK '{print $1-360.0, $2, $3*0.01}' quakes.xym | psxy -R -J -O -K -H1 -Sci -Gwhite -Wthinnest >> $ps
psxy -R -J -O -K -m isochron.xy -Wthin >> $ps
psxy -R -J -O -K -m ridge.xy -Wthicker >> $ps
psxy -R -J -O -K -Gwhite -Wthick -A >> $ps << END
-14.5 15.2
-2 15.2
-2 17.8
-14.5 17.8
END
psxy -R -J -O -K -Gwhite -Wthinner -A >> $ps << END
-14.35 15.35
-2.15 15.35
-2.15 17.65
-14.35 17.65
END
echo ~13.5 16.5~ | psxy -R -J -O -K -Sc0.08i -Gwhite -Wthinner >> $ps
echo ~12.5 16.5 18 0 6 LM ISC Earthquakes~ | ptext -R -J -O -K >> $ps
ptext -R -J -O -Sthin -Gwhite >> $ps << END
-43 -5 30 0 1 CM SOUTH
-43 -8 30 0 1 CM AMERICA
-7 11 30 0 1 CM AFRICA
END
rm -f .gmt*
```





# WTF is happening here?

- UNIX uses shell/shell script interactions with the OS system, traditionally
- This is a good thing, but can take some time to get used to
- Check out some UNIX introduction, e.g.
  - <http://geodynamics.usc.edu/~becker/teaching/unix/lecture1.pdf>
  - <http://geodynamics.usc.edu/~becker/teaching/unix/lecture2.pdf>



# Getting data into GMT

- `cat data_file.xy |  
psxy -Rw/e/s/n -Jxw/yh -Sa0.1 -P > tmp.ps`
- Binary via NetCDF grd files
- Tools for import/export/handling
  - `grdinfo, grdmath`
  - `xyz2grd, grd2xyz`
  - `surface, nearneighbor`
  - Converters: `km12ascii, etc.`

# Some GMT things

- Region:
  - `-R125/130/20/30`
- Projection:
  - `-JM7i`
  - `-JH127.5/6c`
- Line styles:
  - `-W2,45/50/50`
  - `-Wthick,black,-`
- Boundary annotation:
  - `-Ba10f1`
  - `-Ba5f.5g1:"x":/a10f1:"y":.."plot title":WeSn`





# GMT problems and solutions

- K-O
  - 1) Some-GMT-command -K > tmp.ps
  - 2) Some-other-command -O -K >> tmp.ps
  - 3) Yet-another-command -O -K >> tmp.ps
  - 4) Some-last-command -O >> map.ps
- RTFM, the cookbook, or the tutorial
- Join the GMT help list (and google if someone has experienced the same problem before)
- Get a working script and modify
- *i*GMT

# Some nitty gritty stuff that matters

- PS bounding box can be off – modifybb
- PDF is more portable (but sometimes Illustrator chokes nonetheless) -
  - epstopdf
  - ps2pdf
  - eps2eps (...)
- PNG is sometimes more useful (but cannot edit anymore)
  - `convert -density 150 file.ps file.png`

# Some GMT caveats

- There are bugs, sometimes (e.g. supp packages)
- Not necessarily spherical (`surface` vs. `sphtriangulate`)
- Hidden parameters in `.gmtdefaults` file
- Wrong scaling (`-Jx100`) will kill your machine
- Non interactive, not fully 3D
- However, it's the best and there's a large user community




# 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/>





[iGMT home](#)

[Software](#)

[Version history](#)

[Documentation](#)

[Examples](#)

[Data Sets](#)

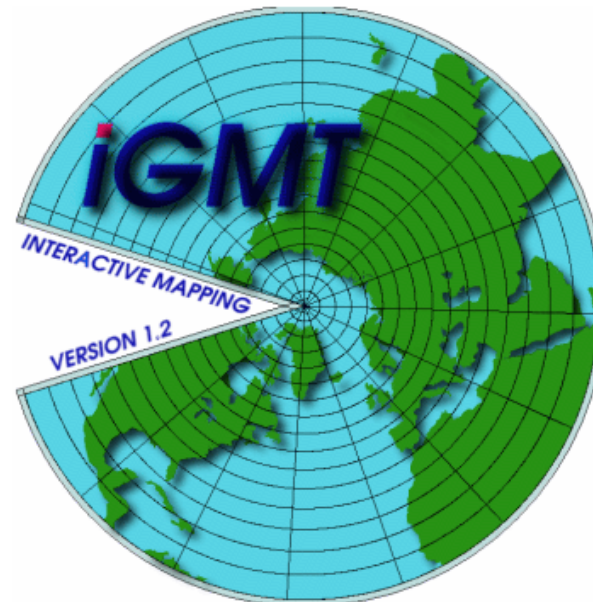
[User Distribution](#)

[Reference, Authors and Copyright](#)

[Feedback](#)

Feb 2001, alexander braun

## iGMT: Interactive Mapping of Geoscientific Datasets



[download iGMT here](#)

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 world wide 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 produced maps



iGMT home

Software

Version history

Documentation

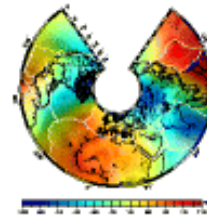
Examples

Data Sets

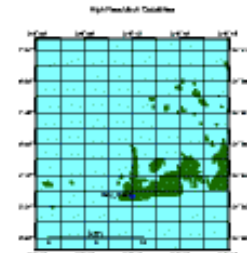
User  
Distribution

Reference,  
Authors and  
Copyright

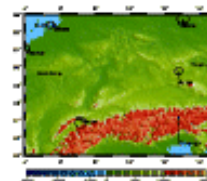
Feedback



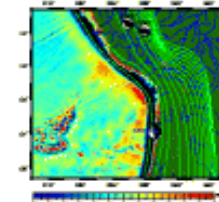
1 - Geoid height and  
Plate boundaries  
[example1.ps.gz](#) 171.1  
KB



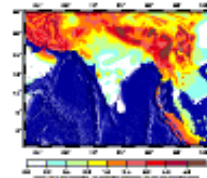
2 - High resolution  
coastlines  
[example2.ps.gz](#) 5.1 KB



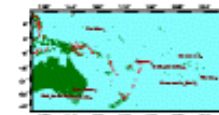
3 - Cities - GPS  
vectors -  
Topography  
[example3.ps.gz](#) 264.9  
KB



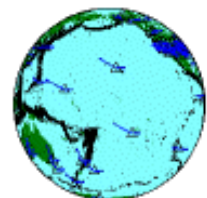
4 - Gravity - Slab  
boundaries - CMT  
solutions  
[example4.ps.gz](#) 710.3  
KB



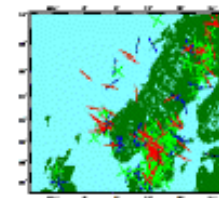
5 - Seismic hazard  
map (GSHAP)  
[example5.ps.gz](#) 195.1  
KB



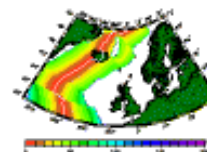
6 - Volcanos and  
Hotspots  
[example6.ps.gz](#) 20.3 KB



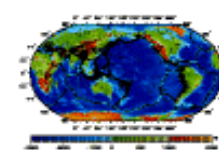
7 - Earthquakes and  
GPS vectors  
[example7.ps.gz](#) 218.3  
KB



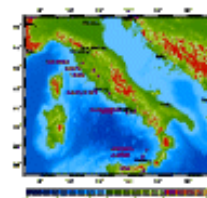
8 - World stress map  
data  
[example8.ps.gz](#) 24.3 KB



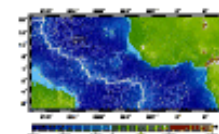
9 - Sea floor age  
[example9.ps.gz](#) 80.2  
KB



10 - Global  
Topography and  
Earthquakes  
[example10.ps.gz](#) 1135.6  
KB



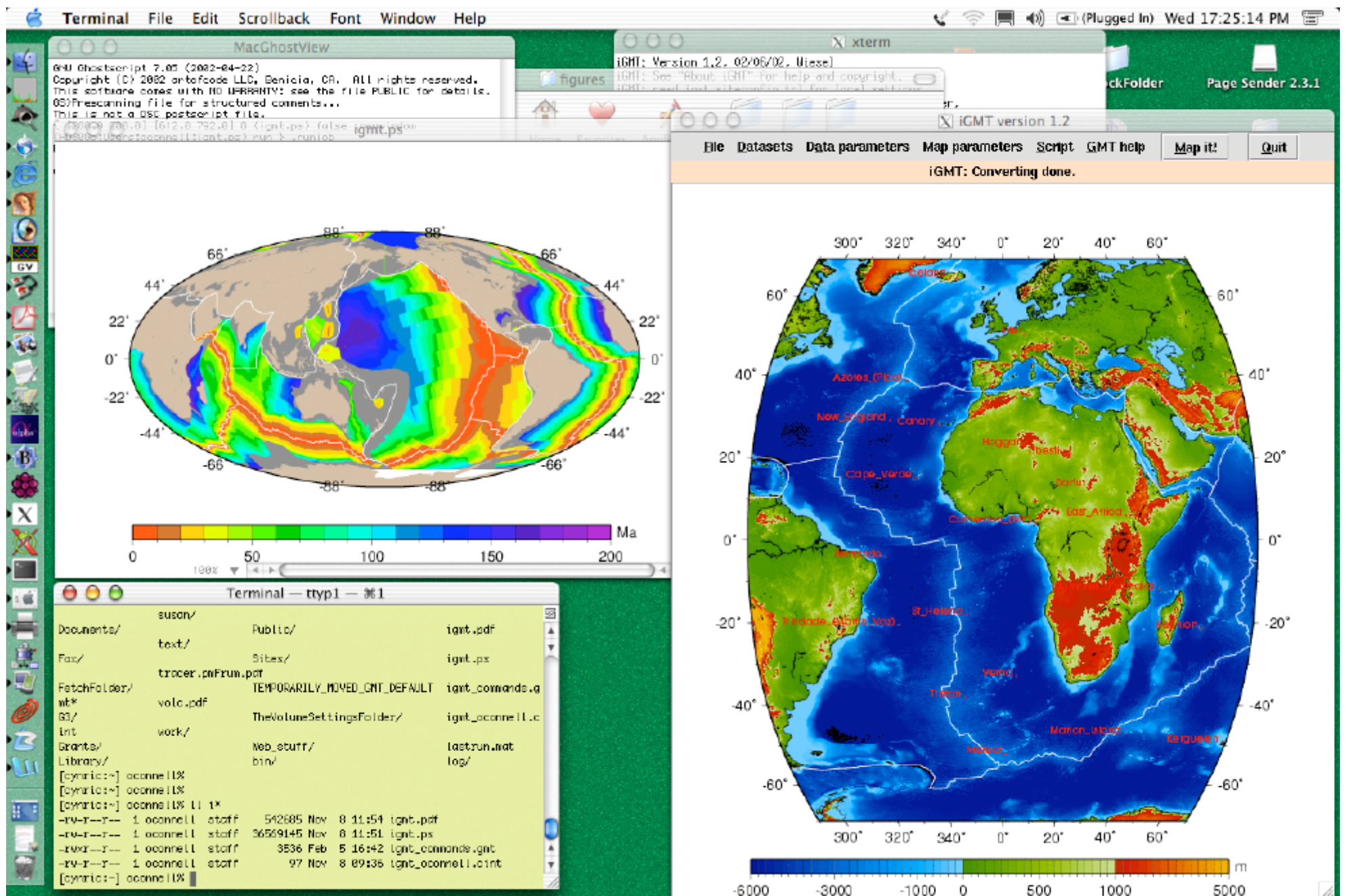
11 - Topography -  
Cities - Volcanos  
[example11.ps.gz](#) 75.2  
KB



12 - Bathymetry and  
Plate boundaries  
[example12.ps.gz](#) 4460.2  
KB




# iGMT on desktop



# Solid Earth Research and Teaching Environment (SEATREE)

geosys.usc.edu/projects/seatree/wiki

☆ G seatree



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## Solid Earth Teaching and Research Environment

↳ [A software product by USC Geodynamics](#)

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. (↳ [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.

[Screenshots](#) Illustrations of the softwares capabilities and design concepts.

[Download and installation](#) Instructions on how to obtain and install the whole package. (Release: version 2.0, as of Sep, 2011)

[User Documentation](#) User-level documentation of SEATREE and the modules.

[Developer Documentation](#) Start here if you want to extend SEATREE and/or add modules.

### Solid Earth Teaching and Research ...

#### Modules

[Geodynamics](#)

[Seismology](#)

[Visualization](#)

#### Contributors

[SEATREE design and coding](#)

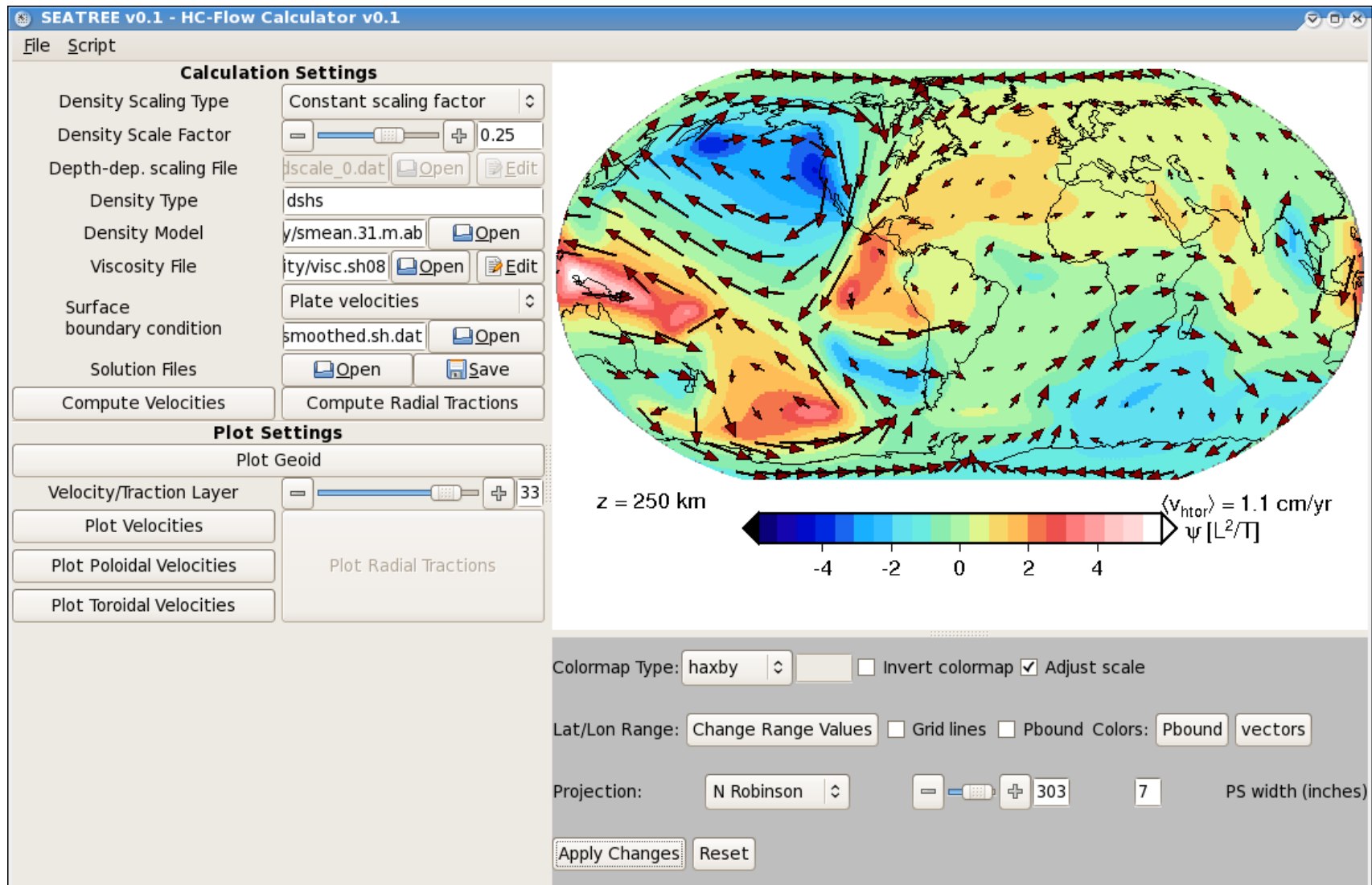
[Module contributors](#)

[Publications and presentations on SEATREE](#)

[Bug reports, feedback, and release history](#)



# Python interface for GMT plots



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