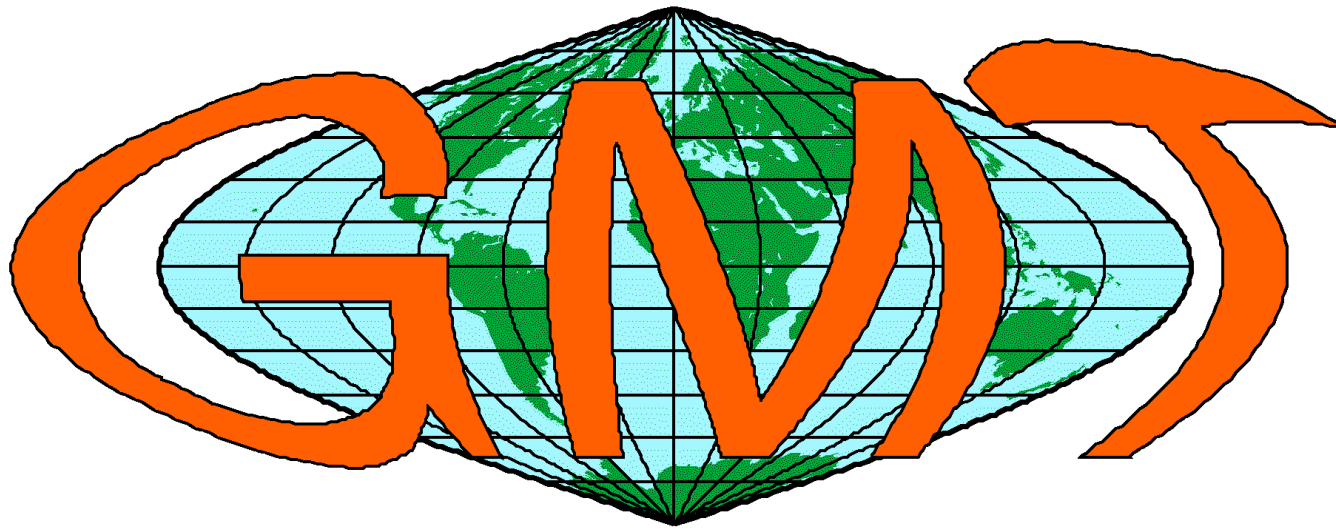
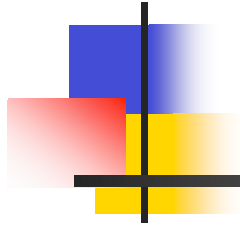


GMT: The Generic Mapping Tools

Paul Wessel, Walter H.F. Smith
and the GMT team

gmt.soest.hawaii.edu



Generic Mapping Tools Graphics



What is GMT?

- GMT is an abbreviation for the **Generic Mapping Tools**
- GMT is jointly developed by Paul Wessel (UH) and Walter H. F. Smith (NOAA), with voluntary community support from around the world
- GMT was initiated in 1987 and has been supported by the US NSF since 1993. GMT 5 is funded for 2005–2010.
- GMT is used by >10,000 scientists worldwide
- GMT is **open source** and **platform independent**
- GMT does **data processing** and *PostScript* **visualization**
- GMT consists of 60+ individual programs with several supplemental packages





GMT Design Philosophy

- **Small** modules focused on **specific** tasks
- Modules can be **combined** in a variety of ways to achieve **complex** results
- Seamless integration with **UNIX-like** tools and environments (GMT are UNIX tools)
- Written in **POSIX C**, thus extremely **portable** and easy to maintain
- **Command-line** interface (others may add GUIs, i.e. iGMT, Web-portals)

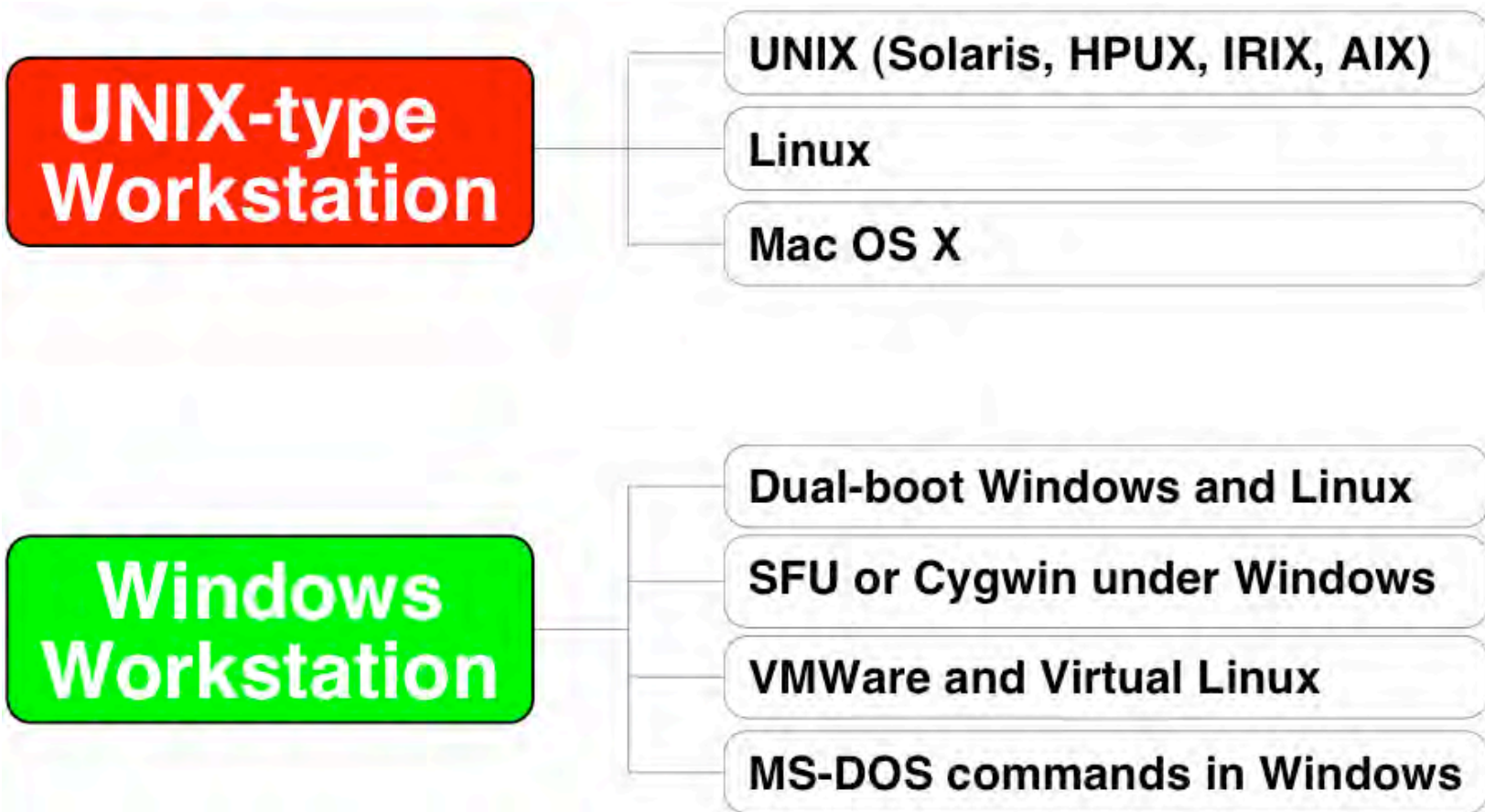


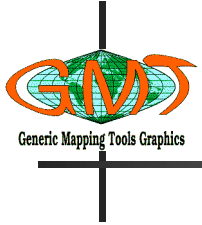
Why is GMT popular?

- **Price** is right!
- Easy to install and runs on **all** platforms
- **Low technical threshold** for using it
- **Architecture-independent, open** file formats
- **Quality** *PostScript* output
- Very **flexible** and **extensible**
- Developers are both **scientists** and **users**, so new features added are needed to do real work and are never gimmicks



GMT Platform Support





What can GMT do?

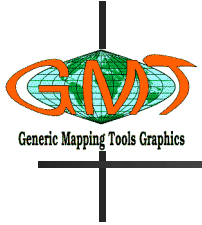
- Data Processing and Manipulation
 - Relies on UNIX tools for basic tasks
 - *sort, grep, awk, perl, sed*
 - Combine tools for complex processing
- *PostScript* Plot Generation
 - Make Regular or Encapsulated *PostScript*
 - Make thumbnail plots or huge posters
 - Other tools can convert *PostScript* to raster images

GMT is not a GIS or an image processing package



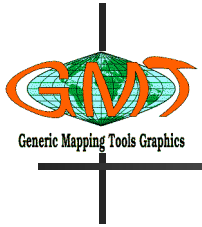
Data Processing and Manipulation

- Filter time series
- Filter 2-D data
- Trend fitting
- Gridding *xyz* data
- Resampling
- Arbitrary math ops
- Cut/paste grids
- Blend grids
- Directional derivatives
- Grid masking
- Data projections
- Optimal triangulations
- Subset extraction
- Spectral estimation
- RGB from *z* grids

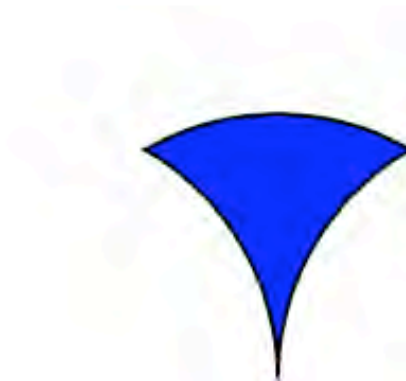
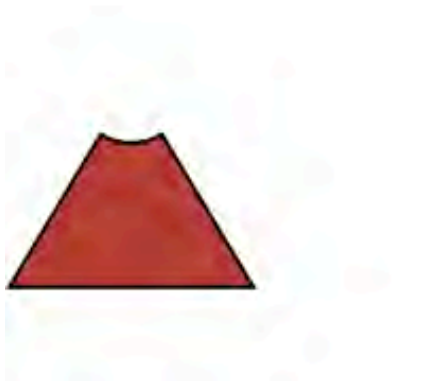
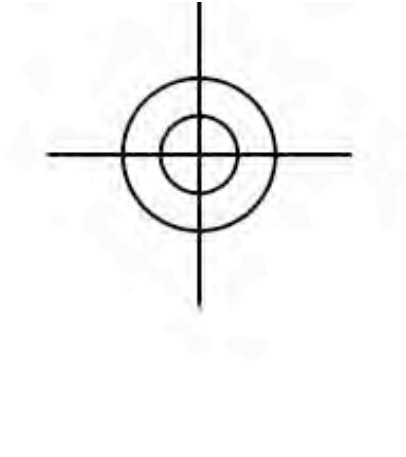
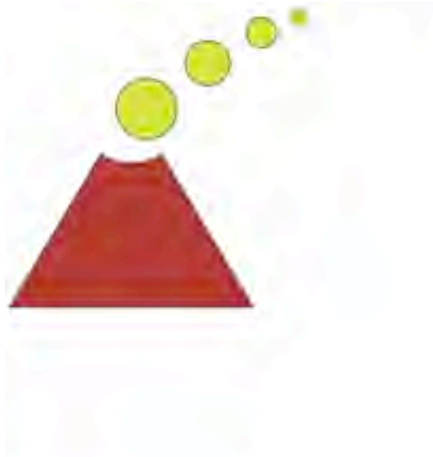


PostScript plot Generation

- Plots of points, lines, and polygons
- Text, labels, and legend placement
- Rectangular or polar histograms
- Base maps with coastlines, rivers, and borders
- Contour maps with contour-aligned labels
- Color images from gridded or raw *xyz* data
- Perspective 2.5-D views with illumination
- Vector fields



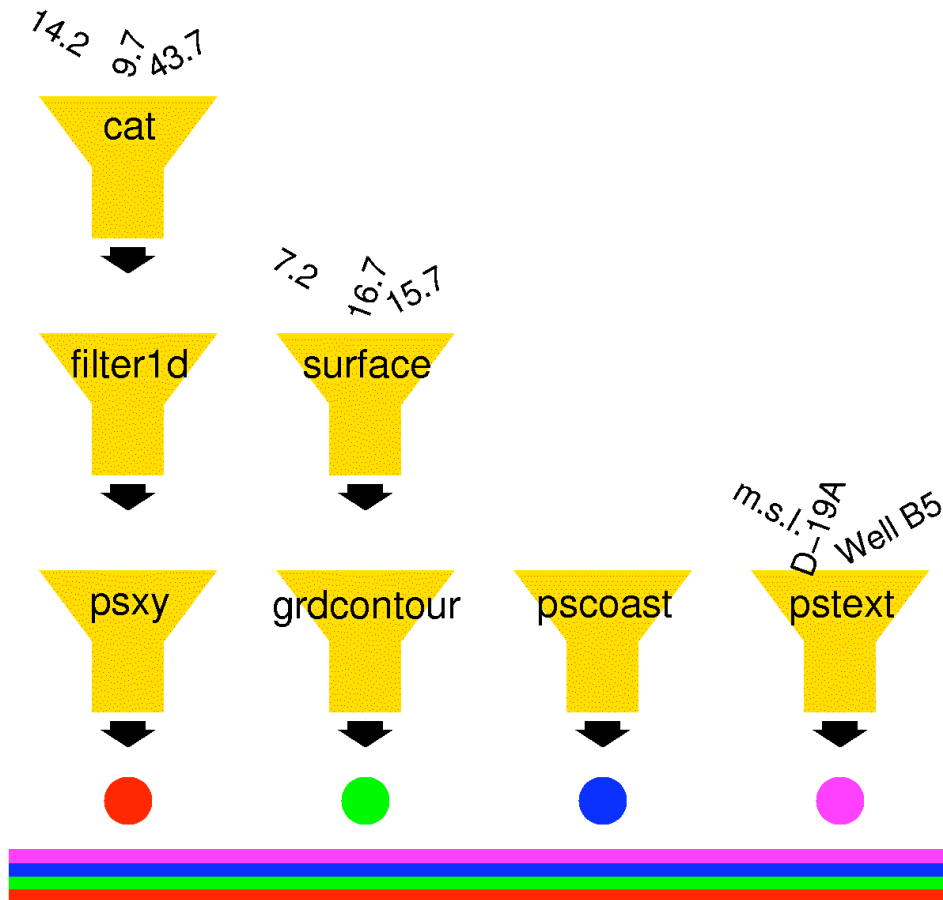
GMT allows for custom symbols

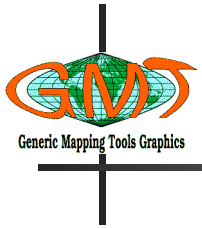




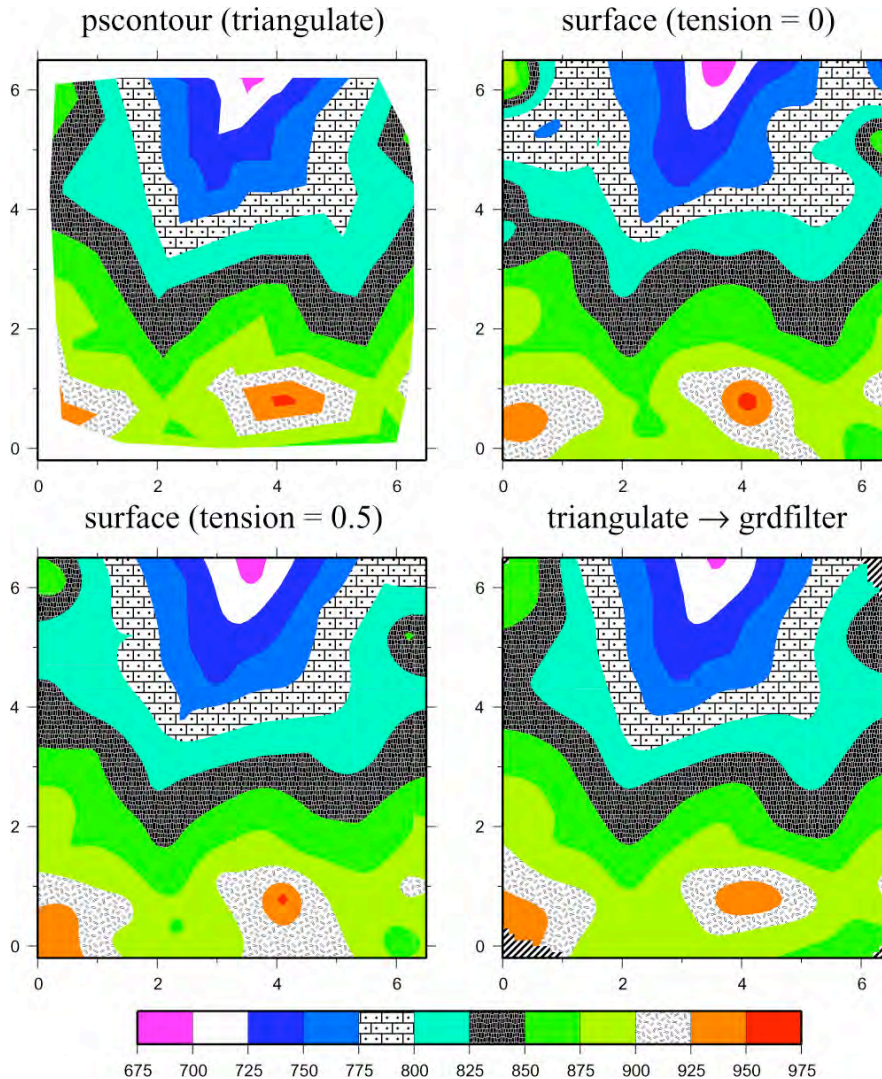
All GMT tools work together

The GMT Cake Bake

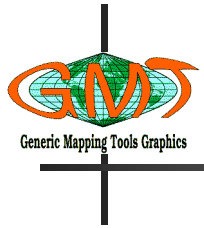




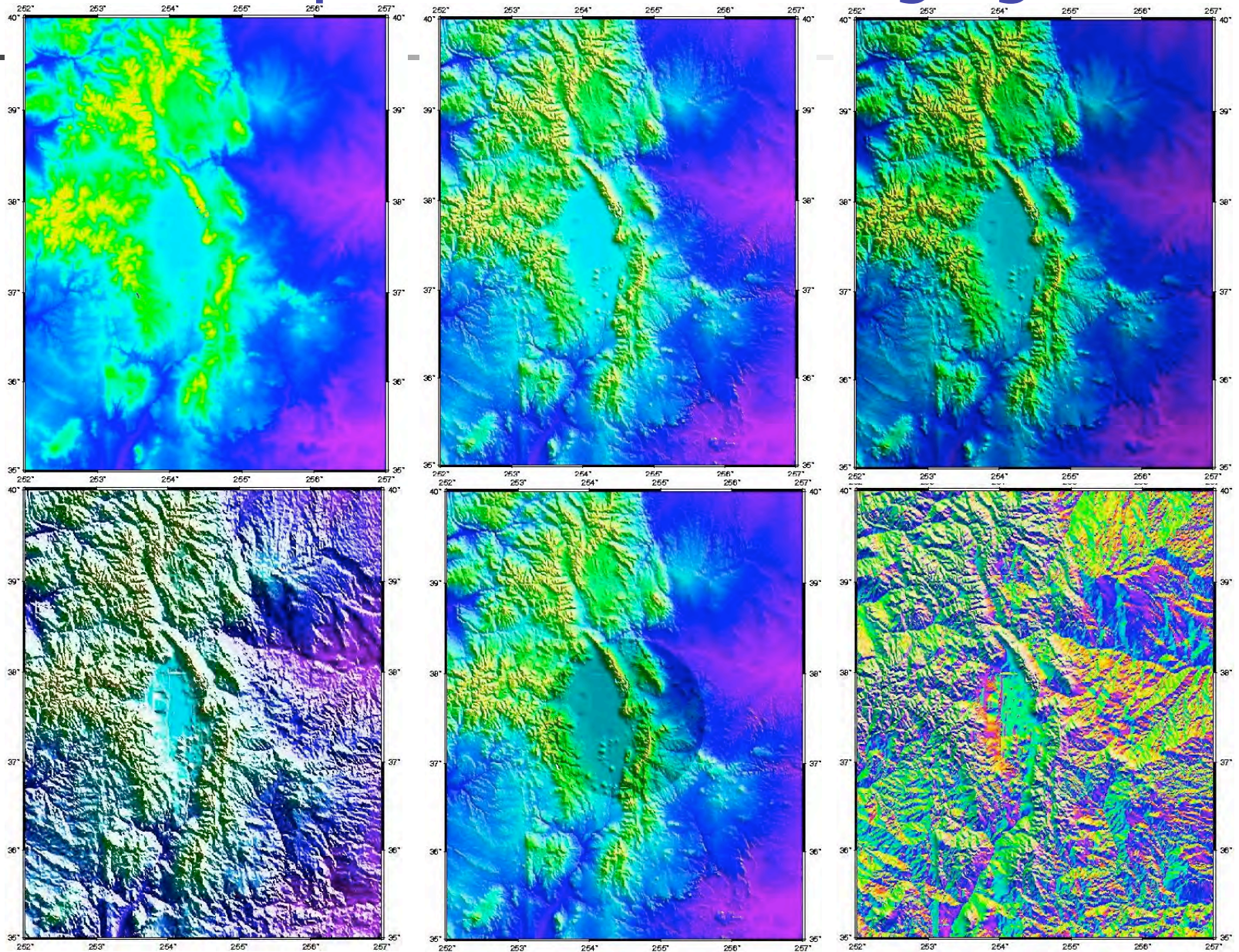
GMT Gridding Algorithms

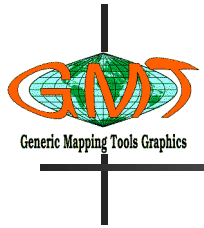


- Triangulation
 - Direct contouring
 - Direct imaging
 - Planar gridding
- Nearest Neighbor
- Surface Splines
 - Minimum curvature
 - Splines in tension



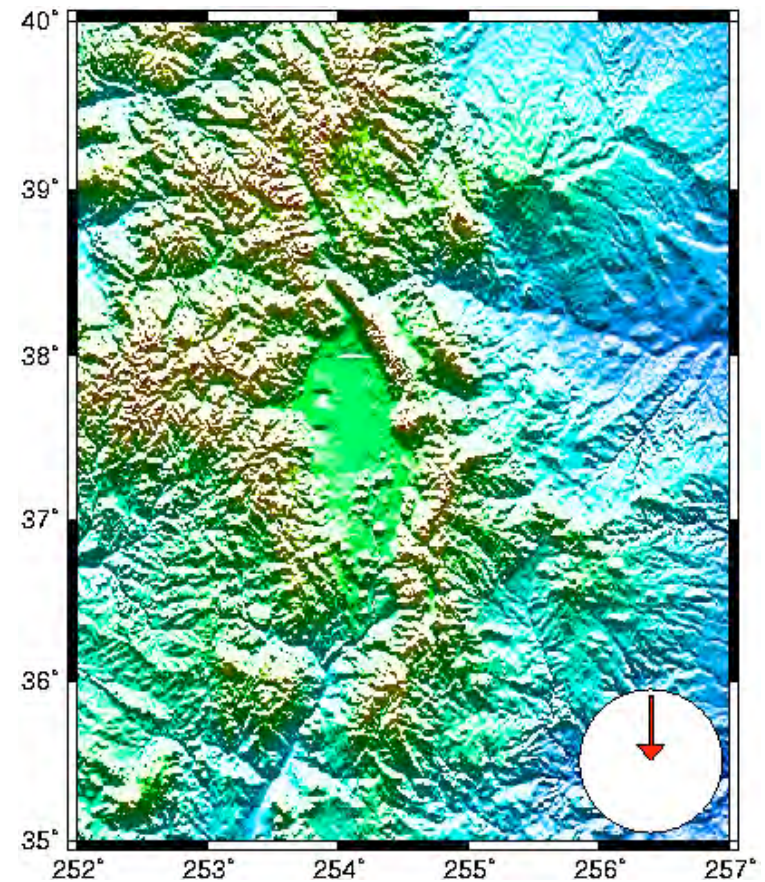
Data Exploration and Imaging

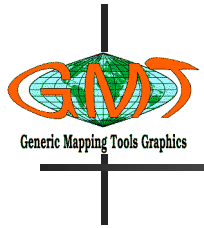




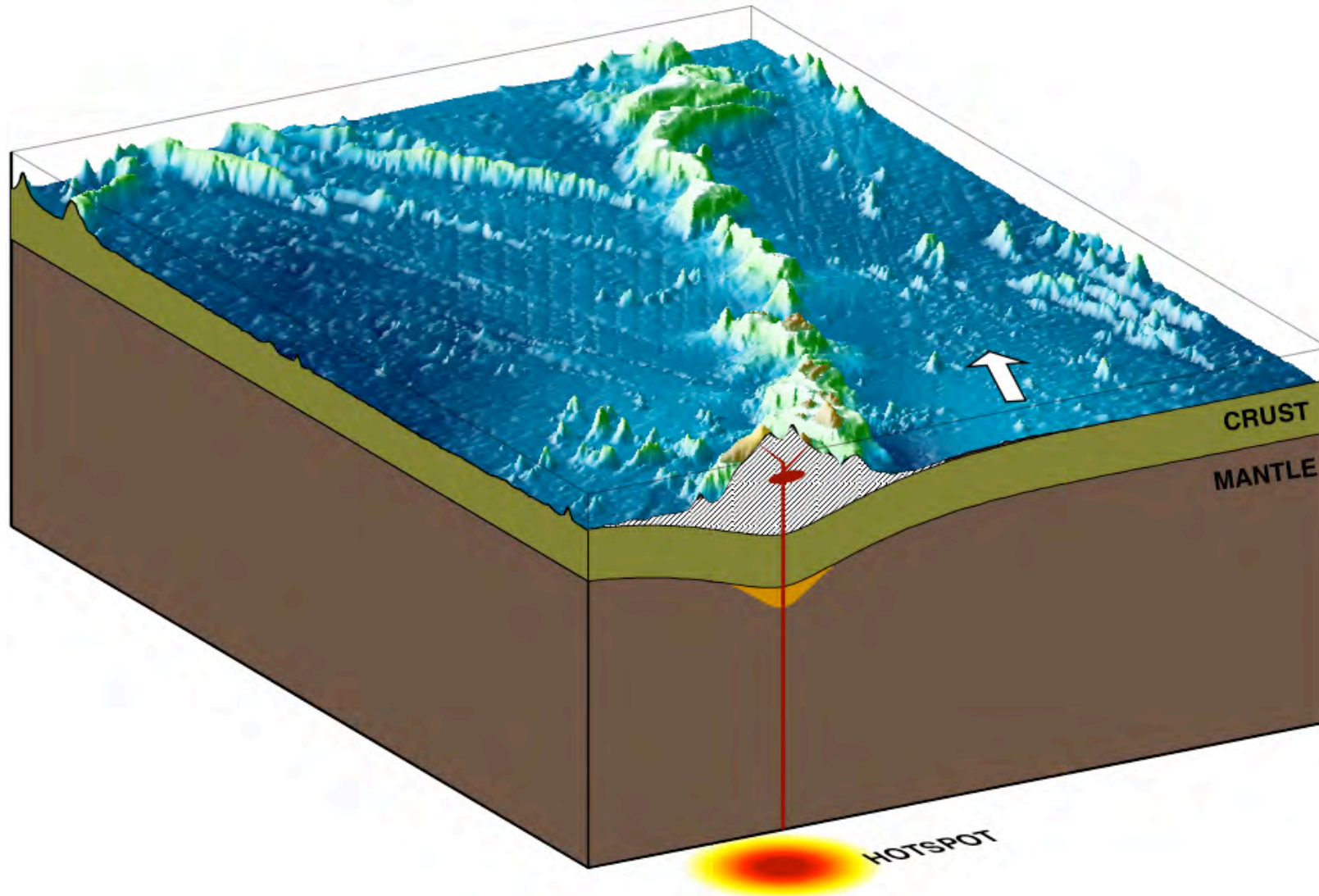
Exploring data

- Adding illumination from different directions can highlight different structures in the grid
 - Morphology trends
 - Data errors



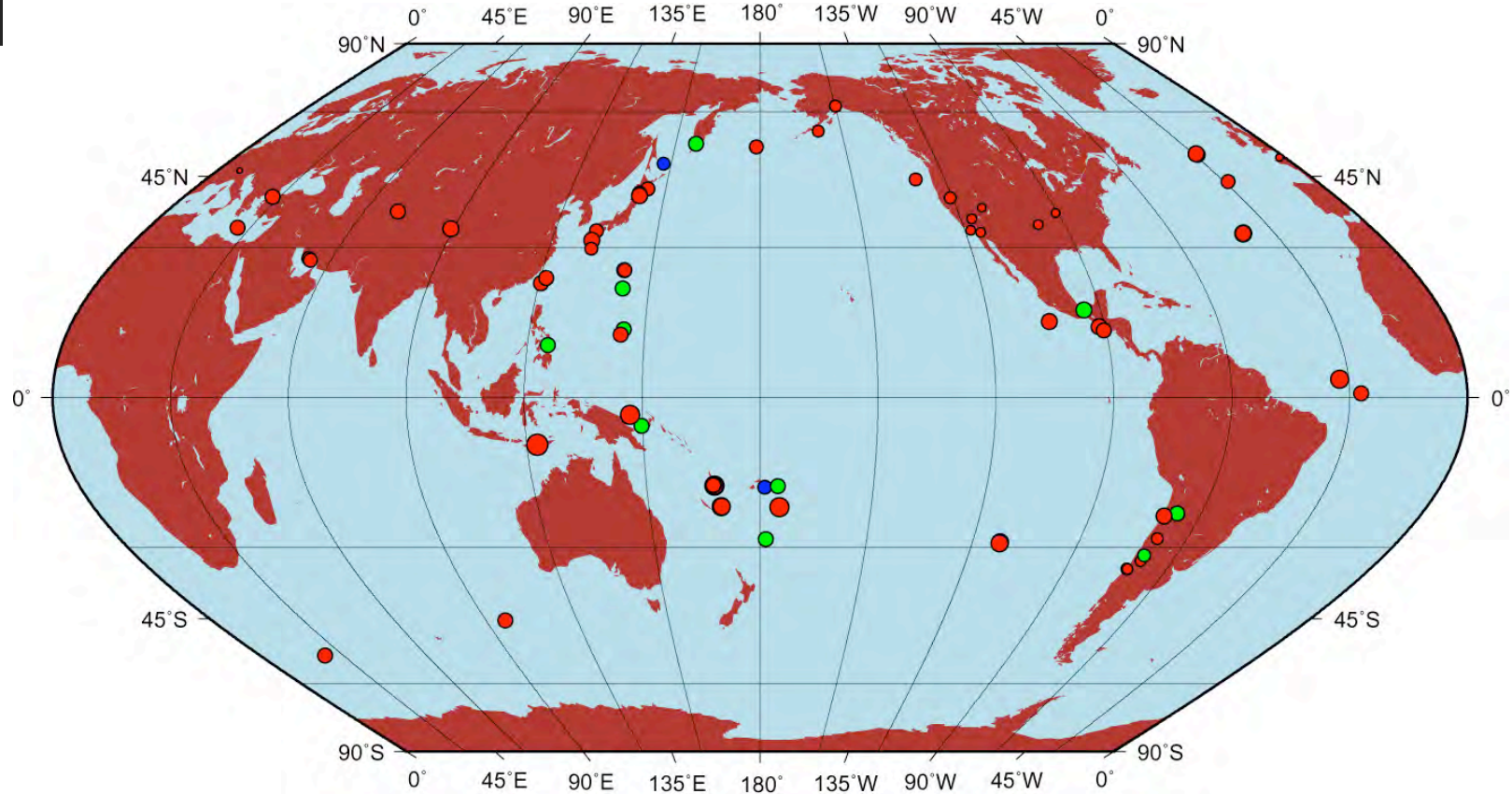


Mixing data, models, and sketches



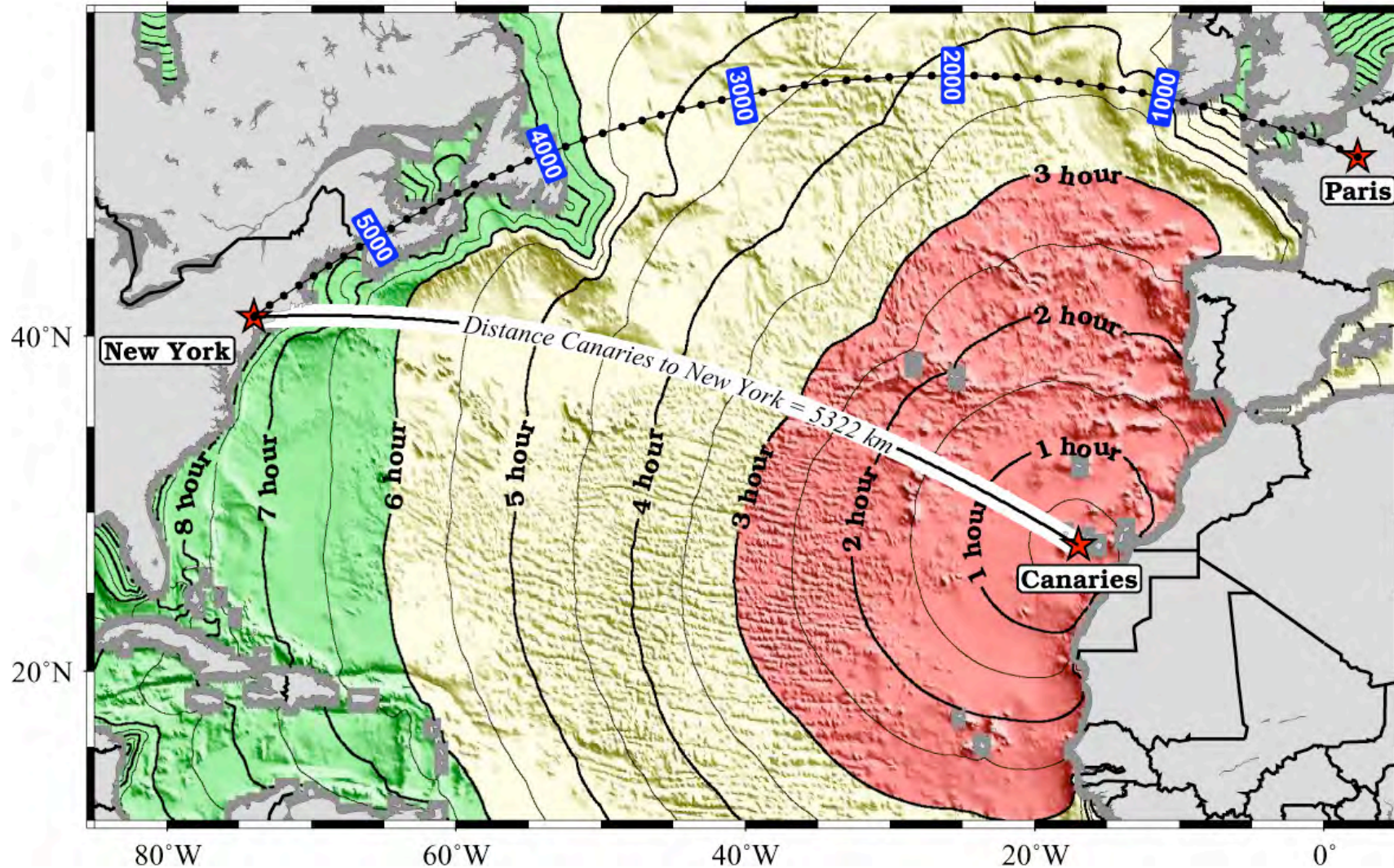


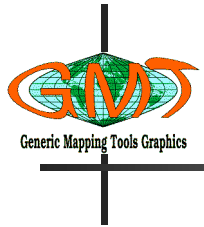
Global maps with legends



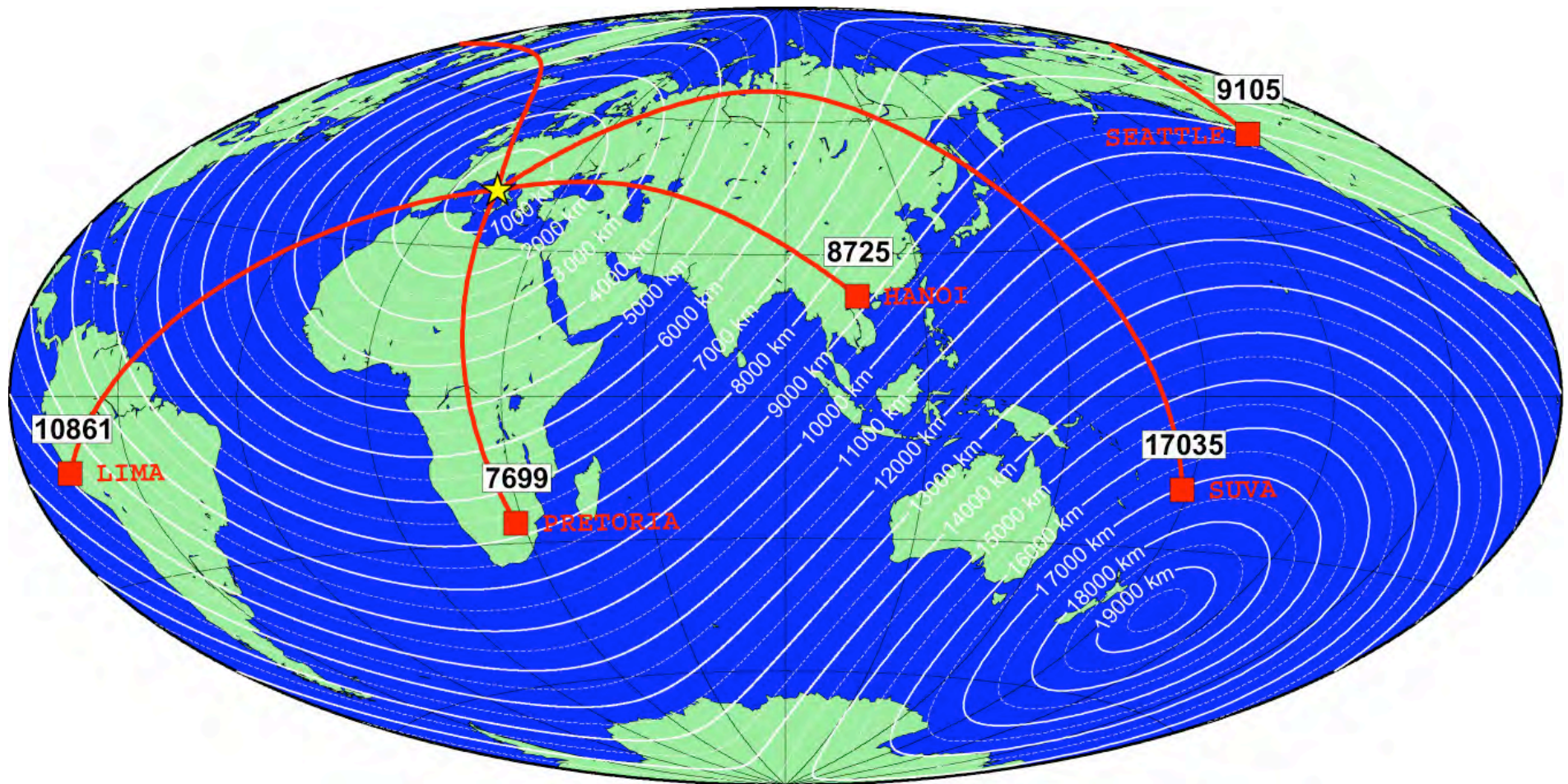
77 events during 04/04/19 00:04:33 to 04/04/25 11:11:33						
● Shallow depth (0-100 km)		● Intermediate depth (100-300 km)		● Very deep (> 300 km)		
○ M 3	○ M 4	○ M 5	○ M 6	○ M 7	○ M 8	○ M 9
USGS/NEIS most recent earthquakes for the last seven days. The data were obtained automatically from the USGS Earthquake Hazards Program page at http://neic/usgs.gov . Interested users may also receive email alerts from the USGS. This script can be called daily to update the latest information.						
GMT guru @ GMTbox						

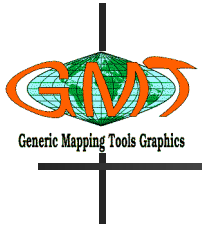
Contours of tsunami travel times



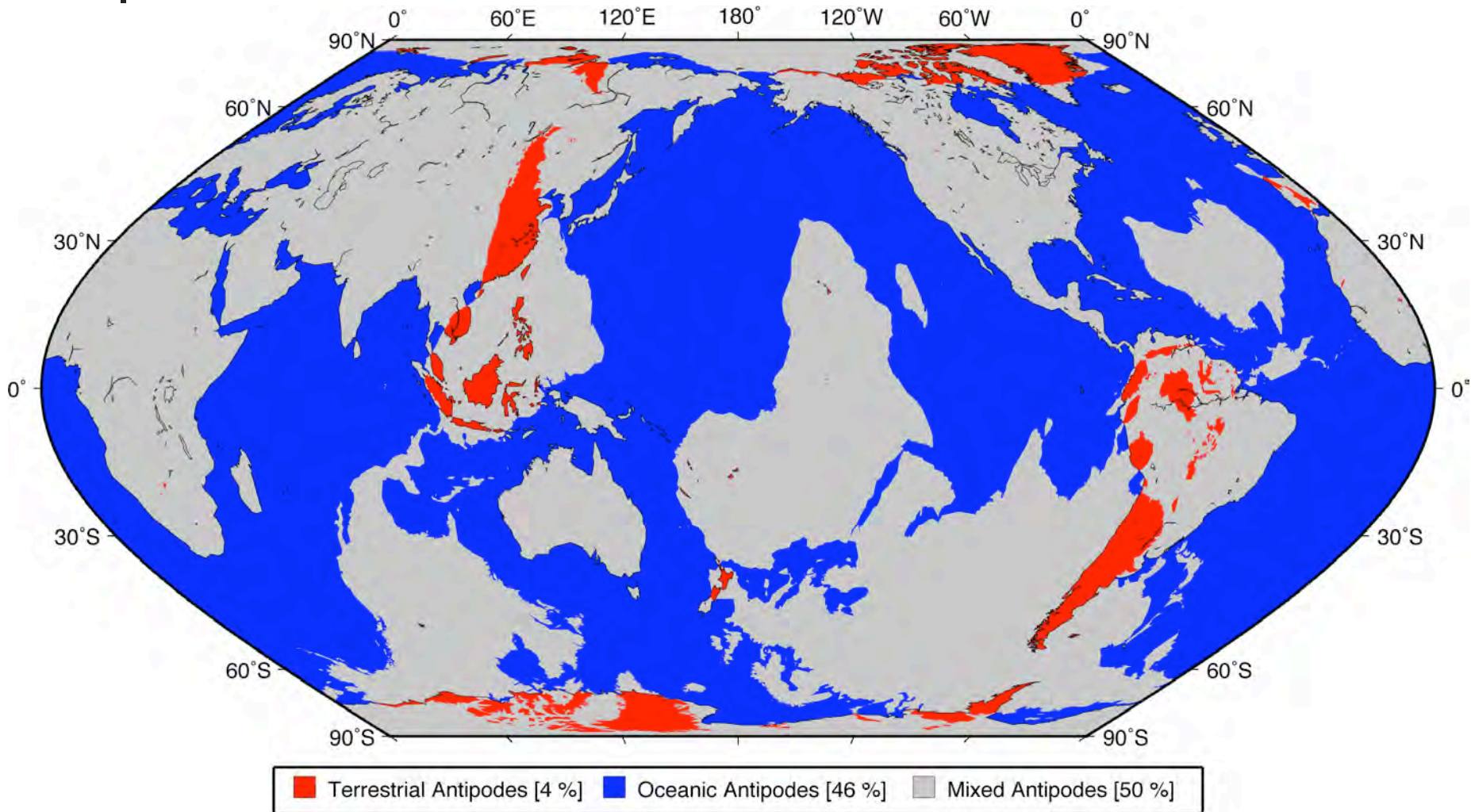


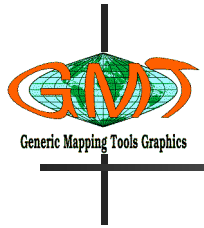
Spherical distances to Rome



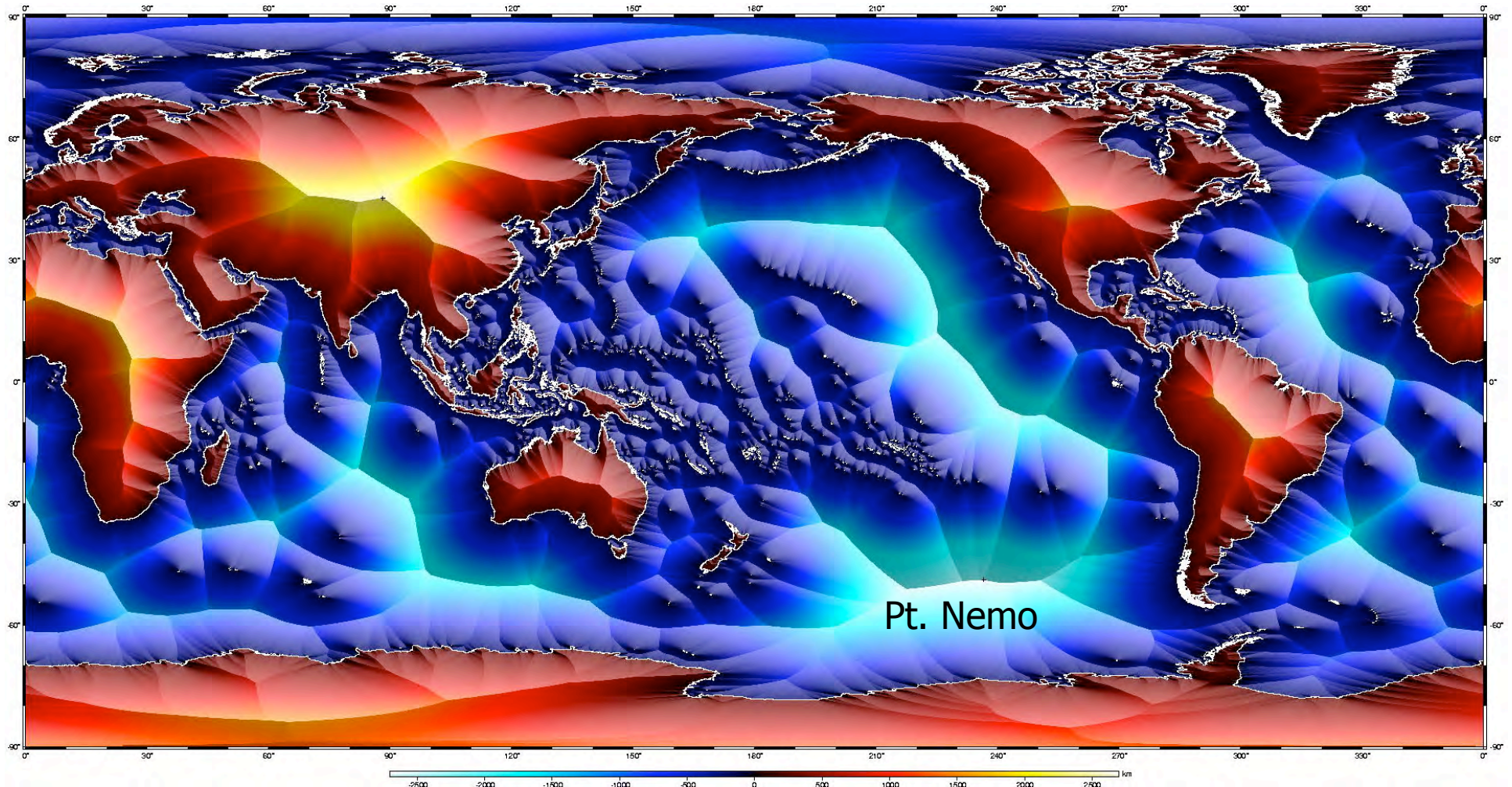


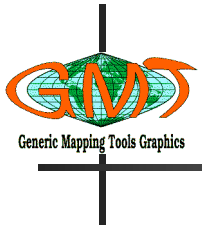
Distribution of antipodes





Distances to nearest coastline





Making movies with GMT

- Write scripts that **loop over time** and use GMT tools to generate individual frames saved as EPS files
- Convert all frames to PPM or JPG files
- Assemble frames to make Animated GIF, a QuickTime movie, or create a DVD



Scenes from "Halloween III"



Exchange of scientific knowledge

- Insights can be shared and scientific knowledge communicated fast when...
 - Software used are **affordable** or **freely available** and can run on **any platform**
 - Data sets used are **freely available** in well-documented, **non-proprietary** formats
 - Publications contain everything needed to **reproduce** and extend results

AGU is a worldwide scientific community that advances, **through unselfish cooperation in research**, the understanding of Earth and space for the benefit of humanity.



CPS = Low-tech exchange

I have proposed the **C**omplete **P**ost**S**cript (**CPS**) format which provides an **application-** and **OS-independent** low-tech solution:

- **Everything** needed to reproduce an illustration (e.g., data, scripts, programs, documentation) are added as compressed *PostScript* comments with **cpsencode** at the end of an EPS illustration
- Recipients of CPS file simply run **cpsdecode** to recover all embedded items