

**Teaching Using Software Applications**  
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### Summary

Common software utilities used in the geosciences (e.g. Matlab, ArcGIS, GMT, GeoMapApp) are incorporated into three main classes: 1) Introduction to Geophysics (junior/senior undergraduates); 2) Scientific Computing (undergrad/grad); and 3) Multi-channel seismic processing (graduate). The latter two classes are taught in a computer lab and are project based. There is minimal lecturing. Learning is centered around numerous small projects aimed at applying software utilities to a particular problem in the geosciences.

### Goals

1. To ensure that students in the geosciences are familiar with key applications that can facilitate their studies and research.
2. To introduce common geoscientific problems (across the disciplines for the Scientific Computing class) and their solutions using common software utilizes.

### Important Note

I make it very clear to the students that they are not being “trained” in how to use a software package. We are using a software package to solve a particular problem in the geosciences.

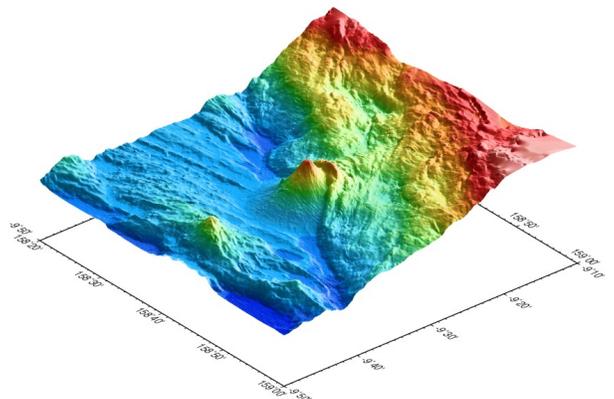
### Examples

Detailed samples of each of the examples below are available for demonstration during the workshop. These are summarized below.

### GMT

GMT is a set of UNIX utilities for manipulating data (plotting, filtering, gridding, projecting, trend-fitting). GMT is one of the harder applications to teach as it is command line based, and thus has a very steep learning curve. The progression in teaching with GMT is as follows:

1. Introduction to UNIX
2. Basic plots (using downhole logging data)
3. Introduction to gawk
4. Filtering
5. Methods for mapping from satellite to seafloor
6. Projections
7. Making maps

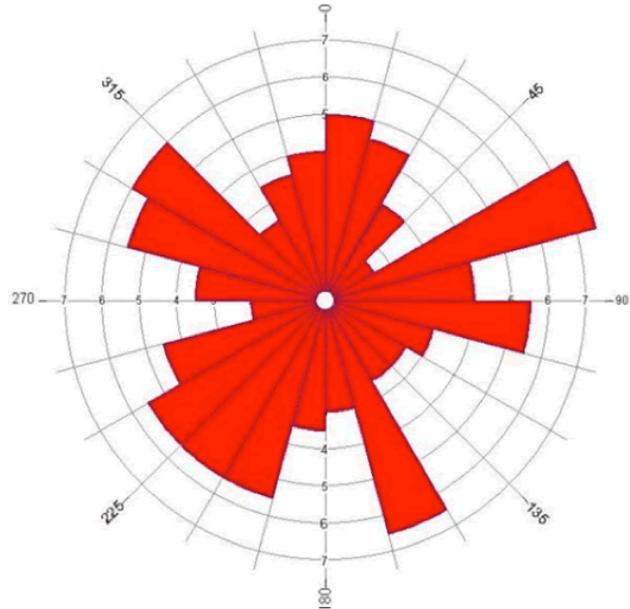


8. Common online sources of map data
9. Trend surface analysis (applied to lithospheric flexure)

### Matlab

Matlab is a tool used commonly in the geosciences and engineering to manipulate data. The learning curve with Matlab is significant, but not as bad as GMT. The progression in teaching with Matlab is as follows:

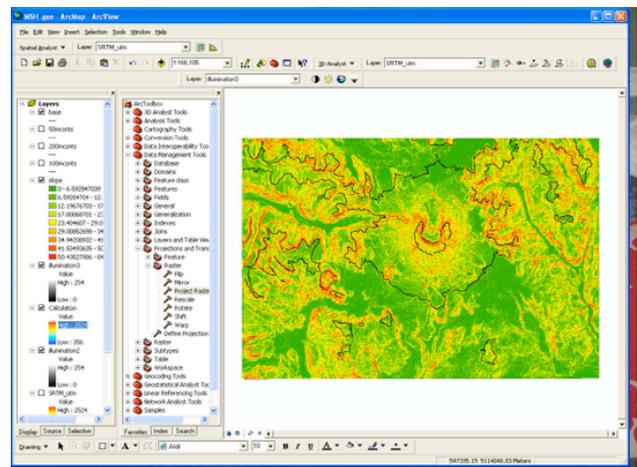
1. Introduction to Matlab, including syntax
2. Making basic plots
3. Plotting earthquake data in 3-D
4. Time series analysis, Fourier transforms, spectral analysis, autocorrelation (applied to ice core data, CO<sub>2</sub> concentration data)
5. Complex plots (e.g. ternary diagrams, stereonets, rose diagrams)
6. M-files and programming in Matlab (applied to making stereonets of strike and dip data)



### ArcGIS

ArcGIS is increasingly used by geoscientists to display and manipulate geoscience data. The learning curve is steep. The progression in teaching with ArcGIS is as follows:

1. Introduction to ArcGIS, including syntax
2. Downloading and displaying Landsat and topographic data (usually SRTM) using ArcMap
3. Reprojection of data, contouring, and hillshading (applied to data from Mount St. Helens)
4. Analyzing map data, including creating slope maps (where would a flow go), and calculating volume
5. Working in subduction zones, including plotting bathymetry, sidescan, volcano, and earthquake data (applied to the Mariana system)
6. Working with and analyzing databases
7. Designing 3-D immersive GeoWall demonstrations



## GeoMapApp and the Marine Geoscience Data System

A single class is commonly designated to tools created by the Interdisciplinary Earth Data Alliance (IEDA). This usually includes GeoMapApp and the Marine Science Data System. Do note that tools such as PetDB also sit under this umbrella. The learning curve for these tools is very easy. Students are always amazed by the amount of data that can be easily accessed. There are many lessons hosted on the SERC website that make use of GeoMapApp (<http://www.geomapapp.org/education/index.html>).



**IEDA**  
INTERDISCIPLINARY  
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**GMRT MapTool**  
Create your own custom maps & grids!  
GMRT MapTool provides instant access to our GMRT Synthesis, a global multi-resolutional data set which includes seafloor bathymetry data to 100-m resolution where data are available.

## ProMAX

ProMAX is a very specific example. It is used as the primary software utility in my multi-channel seismic processing class. The various steps in seismic processing are taught through examples using a data set from Papua New Guinea. These data and supporting materials are available on the IRIS website at [https://www.iris.edu/hq/resource/msp\\_promax](https://www.iris.edu/hq/resource/msp_promax).

