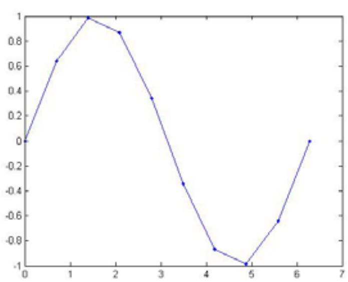
Computational Geosciences
Week 05 – *Plotting and image display in Matlab*

<u>Homework</u>
You will email me script files (.m) showing the code you used to answer these questions. I will simply cut and paste your code into my Matlab command window to see what your answers are. **So your code must work!!!** Be sure to include concise comments to identify *each* question in the script. Remember to comment: name, date, homework description, variables, units, and descriptions of individual steps.

1) **A straightforward plotting exercise:** On the course website there is a dataset called 'fuego.mat', which contains information on heat flux and lava flow length at Fuego volcano, in Guatemala, during 2000-2006. The measurements were derived from data from NASA's MODIS satellite. The dataset consists of four vectors: a) Alldist, which is the distance of lava flows from the central summit vent in km, b) Distday, which is the date vector corresponding to Alldist, in Matlab date number format, b) TotalQ, which is the radiant heat output from the volcano in megawatts (MW) and c) Totald, which is the date vector corresponding to TotalQ. The radiant heat flux is controlled by the surface area of lava exposed on the volcano (more lava=more heat).

Make two plots (i.e. subplots):

- The top plot will show radiant heat flux for the volcano versus time. Make the y-axis a **log scale** from 10 to 10,000 MW. Make the x-axis span from Jan 1, 2000 to Jan 1, 2007 (hint: use *datenum* to convert from strings to numbers for the function *axis*)
- The bottom plot will show distance versus time. The y-axis should span from 0 to 5 km, with the same x-axis range as the top plot.
- Use *datetick* to ensure that both plots have only the year shown as tick labels on the x-axis.
- In both cases, label the axes appropriately, make the plot lines 1 pt, the fontsizes all 12 pt, and the plot box line 1 pt.
- In both cases, make the plot line consist of a solid line connecting the points, with each data point being a small dot. That is, make the line style look like that in the following figure:



- In both cases, use the command *pbaspect* to make the width:height ratio equal 1.5.
- Now load 'arenal.mat' and do the same steps as above for Arenal volcano, in Central America. Plot the Arenal values on the same plots, but in red (so Fuego=blue, Arenal=red). Keep the same plot properties, and ensure that the

Arenal lines have the same properties as Fuego (with the exception of color, obviously). Obviously you can copy and modify much of your Fuego code.

- Put a legend in the upper left of the top plot showing which line color corresponds to which volcano.
- Use *ginput* to graphically estimate the maximum heat flux and the maximum distance of lava flows from the vent, along with the corresponding dates, for each volcano.
- **Please submit answers to the following questions in a PDF document:**
  - What are your graphical (*ginput*) estimates of maximum heat flux and distance (and corresponding dates) for each volcano?
  - Look at the graphs you just made. In qualitative terms, discuss how well correlated the radiant heat flux values are to lava flow distance. Are there specific instances of better correlation? Why would or wouldn't these two parameters be correlated?

2) **Measurements from images:** On the course website there is also a dataset called 'Ice.mat', which contains an ASTER satellite image of sea ice off the South Sandwich Islands, near Antarctica, on August 17, 2001. Each pixel in the image is 15 m in dimension. Display the image using a gray colormap.

- Use *ginput* to measure the approximate dimensions (major+minor axes) of the three largest ice pieces which are contained completely within the image. Remember that distance=sqrt($\Delta x^2+\Delta y^2$). Record these distances in meters or kilometers, whichever is more appropriate.
- Use *ginput* together with the function *polyarea* to measure the area of these three ice pieces (*ginput* lets you get the coordinates of numerous points along the edge of the ice piece, and *polyarea* uses these points to calculate area enclosed by the points). Try to be reasonably precise in your area measurement (more points along the edge, more precision).
- Use *hold on* and *plot* to place red asterisks in the image at the approximate centers of the ice pieces which you measured (so I know which ones you measured).
- **Please submit a short summary (using a small table would be a good idea) of your measurements (dimensions and area) in the same PDF document as in question 2**.

3) **Histograms:** On the course website there is a dataset called 'AmazonFires.mat', which should be familiar. It is a Matlab file containing the dates of the thermal anomalies detected in satellite imagery over the Amazon in 2006, from the same dataset as the Excel file in Week 2. These thermal anomalies reflect brush fires from slash-and-burn agricultural practices. The columns go like this: 1) year 2) month 3) day 4) hour and 5) minute. Use the *histc* and *bar* functions to make a histogram with bins for each month to show the monthly distribution of thermal anomalies (and, hence, brush fires) in the Amazon. Use the command *axis* to make sure the plot box fits snugly around the histogram bars – i.e. there shouldn't be empty space to the left or right edge of the bars. Label the axes appropriately, make the plot lines 1 pt, the fontsizes all 12 pt, and the plot box line 1 pt. Use *pbaspect* to make the width:height ratio of the plotting box equal 1.5.

What to hand in: Email me **three (3) scripts**, one for each question above. In each one, they should load in the appropriate Matlab file (I will modify the working directory for my own computer when test running your code). Also email me a **PDF report** with the information requested in questions 1 and 2.