Directions for Plotting Earthquake Beachballs in ArcGIS and Matlab

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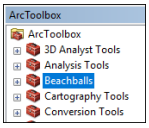
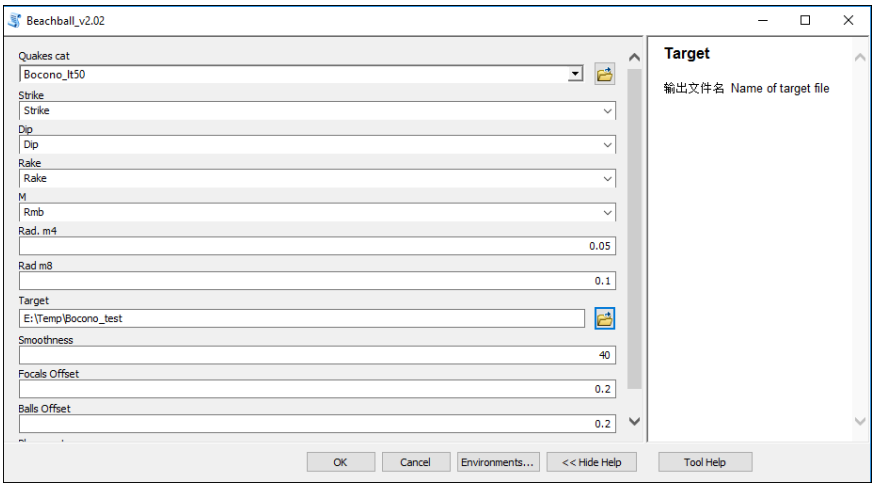
In ArcGIS:

This uses an Arc tool written by Tiesheng Wu, downloaded from the ESRI collection. Copy the directory this readme file is in to your work area. In Arc, go to Geoprocessing and open ArcToolbox. Right click on the word 'ArcToolbox' at the top and go to 'Add Toolbox'. Find your way to where you stored this directory, open the folder 'Beachballs_all' and then click on 'Beach_ball_allv202.tbx'. This will place a toolbox called Beachballs in your ArcToolbox collection:

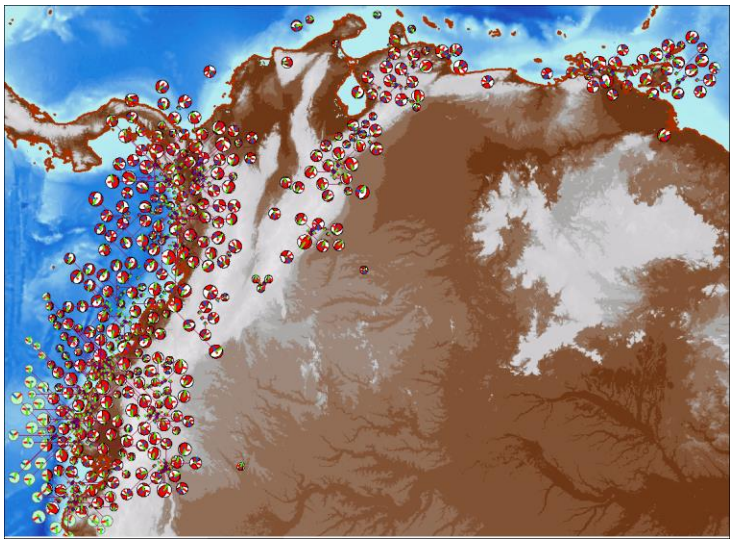


Add the shapefile 'All_CMT_quakes.shp' to your Arc project. This is the global file of CMT solutions, reformatted from the files downloaded from http://www.globalcmt.org/CMTsearch.html. You could in theory plot all of them, but it might take several hours. You will want to filter on area and possibly depth and/or magnitude. An example file is included, Bocono_lt50.shp, which is NW South America less than 50 km depth. Note that there are quakes with depth = 0. I'm not sure if this really is zero or a default value; I think the default value for unknown depth is 33 km but couldn't find confirmation on the web site. Once you have a shapefile of what you want, open the Beachball toolbox and click on Beachballs_v2.02. This will open a menu:

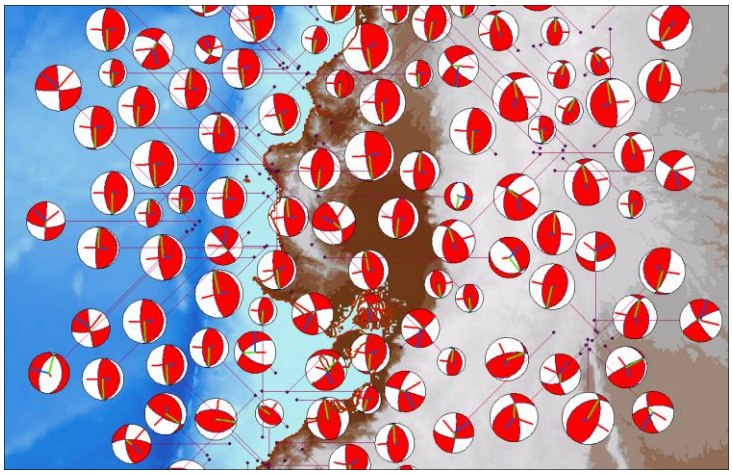


The program needs to know what file you want to use, plus the internal values of strike, dip, rake and magnitude M (the quake file uses Rmb for magnitude) - it plots beachball size as a function of magnitude. Some of the quakes in the original file had magnitude zero, those I made 3.49. Rad.m4 is the beachball radius for Rmb=4, Rad.m8 is for Rmb=8. Default values are 0.05 and 0.1 – for this scale change these to 0.15 and 0.3. I don't know what these units are, so some trial and error needed for your particular area. The other variables Smoothness and so on I haven't messed with. The program is clever enough to avoid overlaps, it will move each plot so that overlap on other plots is minimized. 'Target' is the name to be used for the shapefiles that the program generates, obviously needs to be in an area where you have write permission. Shapefiles generated by this test are Bocono_test_index,

Bocono_test_pie, Bocono_test_PT, Bocono_test_faults and Bocono_test. Here is what this plot looks like:



You can see things get a bit messy in the southwest part of the area, but zooming in it works out:

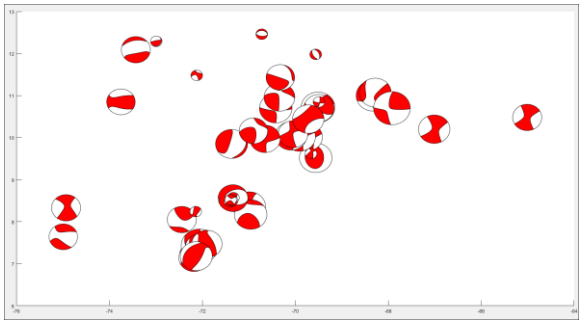


Matlab version

The ArcGIS tool plots fault plane solutions using the double-couple equivalent of the centroid moment tensor (CMT) solution. This is usually a good approximation but it does assume that the earthquake was generated on a perfectly planar fault with no volume change. There is a way to plot the CMT solution that tries to show more variables. It's not perfect and can be somewhat confusing. There doesn't seem to be a version available for ArcGIS, but there is one for MatLab. This is available from

https://www.mathworks.com/matlabcentral/fileexchange/61227-focalmech-fm--centerx--centery--diam--varargin-?s_tid=gn_loc_drop

The folder Matlab_CMT has the two MatLAb files Beachball_tensor.m and focalmech.m. The first is a front end that calls focalmech.m. This program reads the data file CMT_reform_tensor_alldata.txt which is the same data as the Arc program uses. Here is an example of output:



It plots the figures with size a (nonlinear) function of magnitude and location effectively uses a decimal degree projection. It is not clever enough to avoid overlaps.