GE110 Fall 2008 - Lab 10

November 20, 2008

Velocity Vectors & Focal Mechanisms

Working Directory D:\GE110\Lab_10

∇ Velocity Vectors – relative motion, how GPS stations move relative to a second position

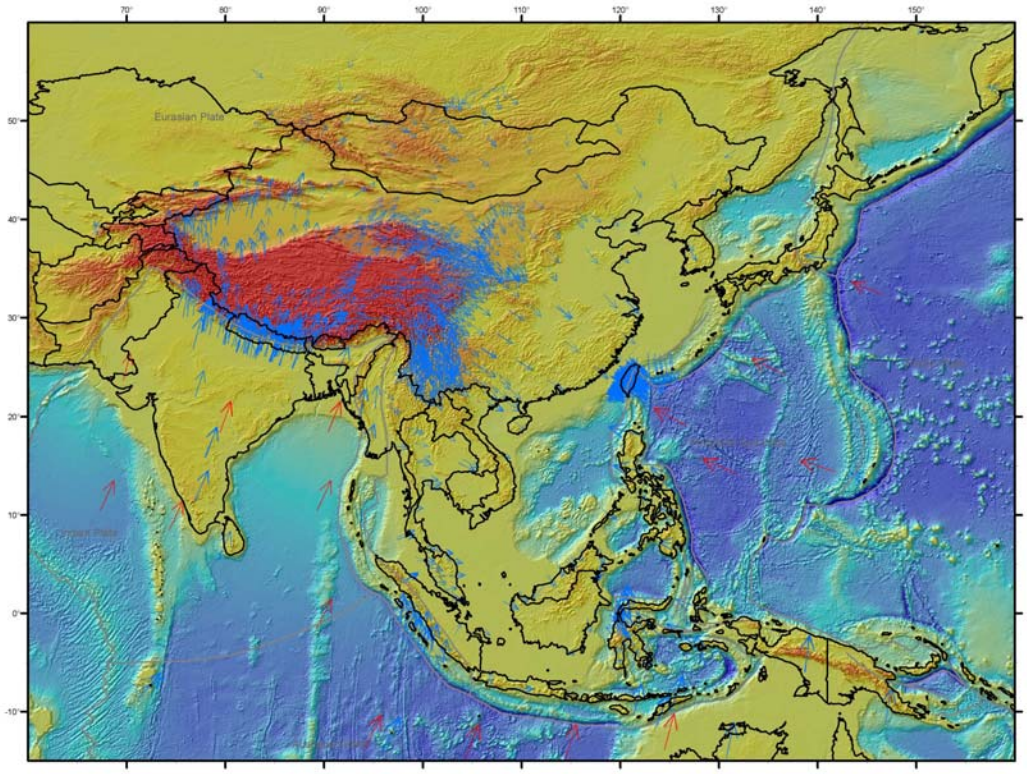
Calculation:

ROT = IF((Ve<>0),(90-(DEGREES((ATAN2(Ve,Vn))))),0)

Distance = =SQRT((Vn^2)+(Ve^2))

	STN	Long	Lat	Vn	Ve	Sn	Se
2	KUNG	102.79	25.03	-48.2581	-11.0634	1.2	1.4
3	MIND	93.9	21.38	-10.5628	-10.6897	1.26	1.96
4	CAMP	107.31	21	-40.65	-9.60834	0.72	0.99
5	TAUN	97.09	20.75	-38.3754	-13.3623	1.23	1.81
6	CHMI	98.97	18.77	-37.3681	-11.571	0.31	0.44
7	LAOA	120.6	18.52	-15.6925	-95.64	0.71	0.95
8	OTRI	99.37	18.34	-36.6577	-12.1894	0.25	0.42
9	NNKI	102.75	17.87	-39.6375	-11.5288	0.96	1.53
10	LAUN	94.54	17.69	-6.41501	-4.47404	1.49	2.04
11	SISM	99.86	17.16	-37.3371	-11.2345	0.89	1.16
12	HPAA	97.72	16.94	-35.5195	-11.6945	1.24	1.67
13	NONN	108.26	16	-39.123	-12.2339	0.79	1.17
14	NAKH	100.12	15.67	-33.7128	-11.545	1.04	1.7
15	UTHA	100.01	15.38	-38.2059	-9.97727	0.32	0.43
16	UBRT	104.87	15.25	-39.2585	-11.503	0.64	0.87
17	SRIS	104.42	14.9	-39.0921	-11.5026	0.32	0.45

- Symbolize by Value = Distance
- Advanced > Rotation = ROT



India-Asia Collision Zone:
Blue - velocities relative to Eurasia
Red – plate velocities

∇ Focal Mechanisms - USGS created a tool, 3D Focal Mechanisms (3DFM), for viewing earthquake focal mechanism symbols three dimensionally. This tool operates within ArcScene® 9.x. The program requires as input a GIS point dataset of earthquake locations containing strike, dip, and rake values for a nodal plane of each earthquake

Mimimum Input Requirements
STRIKE – Positive values ranging from 0 to 360 degrees
DIP – Positive values ranging from 1 to 90 degrees
RAKE – Positive or negative values ranging from -180 to 180 degrees
Data Source
http://neic.usgs.gov/neis/sopar/

- ✓ C:\3DFocalMech\3DFocalMech.sxd
- ✓ Add data - D:\GE110\Lab_10\CMT_focal_mechanism_UTM.shp
- ✓ Calculate Strike = [STRIKE] + 180
- ✓ Add Tien_Shan_UTM.tif - DEM - D:\GE110\Lab_10\SRTM_V4
- ✓ Set Base Heights to DEM > custom 10
- ✓ Add new field – Magnitude > Double > 16 > 2
- ✓ Calculate – Magnitude = [Mw]

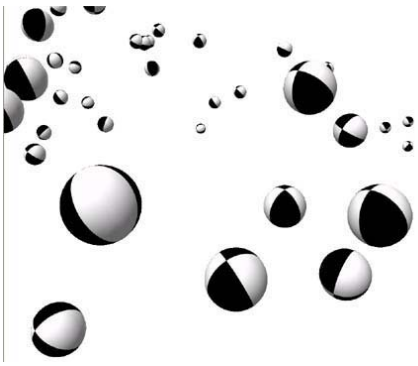
The input point locations must be viewed in a coordinate system whose linear units are meters.

There are three main divisions of symbols that can be created :

1. focal spheres
2. nodal planes
3. principal stress axes

Each of these options can be used independently of the other or they can be used together to create more complex symbols. However, "**Focal Spheres**" and "**Principal Stress Axes**" can not be used together because the axes would be hidden by the spheres if they were drawn simultaneously.

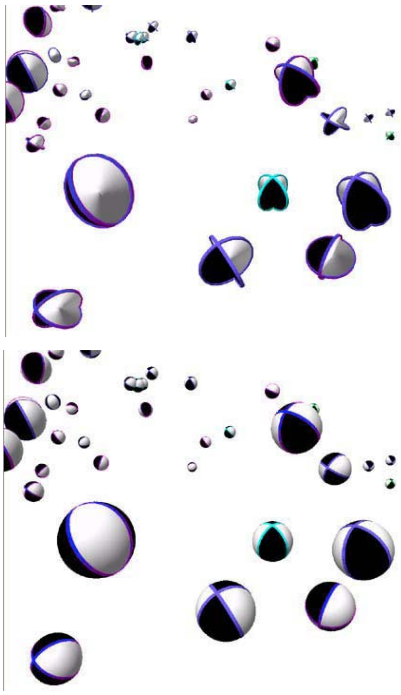
✓ **Focal Spheres** - This is the default setting. It will create black and white three-dimensional focal mechanism spheres around each point



- Click on the beach ball
- Input Earthquake Data – CMT_Focal_mechanism_UTM
- Check Focal Spheres
- Symbol Diameter: 50 KM
- Check Symbol Count
- Draw

✓ **Nodal Planes -** An optional setting that, when used independent of the "**Focal Spheres**" option, displays the focal mechanism symbols as two-dimensional planes

- Input Earthquake Data – CMT_Focal_mechanism_UTM
- Un-Check Focal Spheres
- Check Nodal Planes
- Symbol Diameter: 50 KM
- Draw



When used together with the "**Focal Spheres**" option, a sphere with colored rings around the nodal planes will be drawn

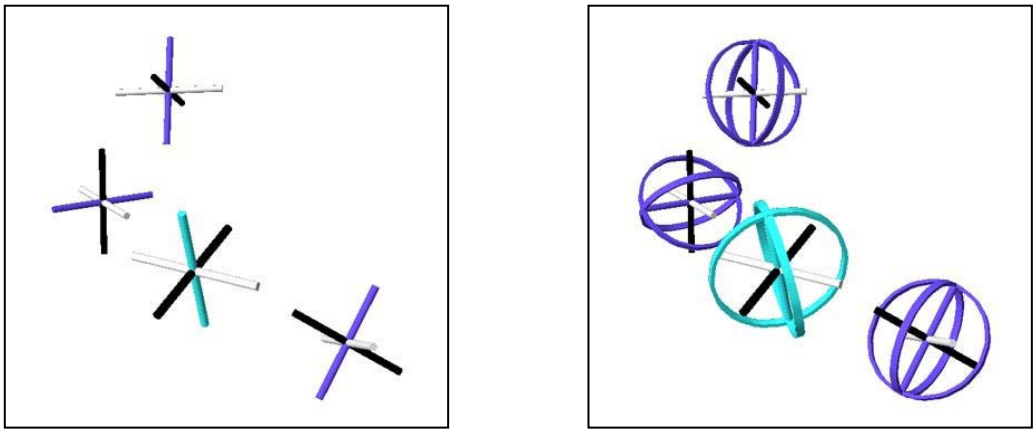
- Repeat above, but leave Focal Spheres Checked

✓ **Magnitude Colors -** This sub-option under the "**Nodal Planes**" option is available only if the dataset contains a MAGNITUDE field and the "**Nodal Planes**" option is selected. Choosing this option will color the nodal plane rings based on the magnitude of the earthquake. Colors are selected based on the following ranges. If magnitude values are not present, or this option is not selected when nodal planes are drawn, then the rings will be shown with a neutral tan color.

Table 1. Magnitude color ranges

MAGNITUDE	COLOR
Less than 3	Dark Blue
3 to 3.99	Light Blue
4 to 4.99	Green
5 to 5.99	Yellow
6 to 6.99	Orange
7 and greater	Red

✓ **Principal Stress Axes -** An optional setting that uses the values in the STRIKE, DIP, and RAKE fields to display the null, pressure, and tension axes of the focal mechanism symbols as colored bars. The pressure and tension axes are oriented at forty-five de-gree angles to the nodal planes, whereas the null axis follows the intersection of the primary and auxiliary planes if faults are optimally oriented to the external stress field.



"Principal Stress Axes" selected as the only symbol option (left), and in combination with the "**Nodal Planes**" option (right).

- ✓ **Scale by Magnitude -** This optional setting will only be available if the dataset contains a MAGNITUDE field. It will add an additional ad-justment to the diameter of the symbols based on magnitude, so that the larger the magnitude the larger the symbol. Symbol sizes will only be increased not decreased.
    - Repeat, checking scale by magnitude
- ✓ **Scale by Rupture Patch Size** - This optional setting will only be available if the dataset contains a MAGNITUDE field. Rupture patch describes the area along a fault were movement has taken place during an earthquake. Generally, the larger the magnitude the larger the rupture patch. Values entered for sym-bol diameter will not be applied when this option is chosen.
    - Repeat, Scale by rupture patch
- ✓ **View Depth -** This optional setting will only be available if the dataset contains a DEPTH field. It allows symbols to be placed at their correct locations beneath the Earth's surface. When present, the depth values will be used by default and the values will be treated as positive kilometers; however, it is also possible to use negative kilometers, positive meters, or negative meters by choosing the correct options from the drop boxes. If this option is not used or unavailable, all symbols will be drawn at the Earth's surface, unless the points in the GIS layer have already converted to 3D before running 3DFM. If this is the case the "**View depth**" option should be turned off.
    - Add Field > Depth > Double > 12 > 1
    - Calculate Depth = [depth_km]
    - Repeat, Check View depth
    - Postive > Kilometers