

Problem Set #4 - Dislocations in a half-space.

This exercise will help build your intuition about how the displacement pattern should look given certain kinds of earthquakes or slip events.

Use the MATLAB script called `DislocOkada.m` that is available on the class website to calculate the displacements at the surface given dislocation source parameters. Note that when you get this function off the class page it may call other functions (that are also on the class page), so make sure you get those too. You could also use `OkadaBlock.m`, which is in some ways easier. Consult the 'help' for details about the meaning of variables, etc. In this script your inputs are geographic coordinates of the end points of the surface projection of the fault (which imply its length). In this case assume some coordinates for one end point, and make the appropriate calculations to get the other inputs needed for the script.

For each dislocation calculate the model displacement on a grid of points and plot in MATLAB. The function `MESHGRID` is nice for generating grids, and outputs from this function can be used as inputs into the handy plotting tools e.g. `PCOLOR` and `CONTOUR`.

For each dislocation listed below make a plot that includes:

- 1) The location of the source plane, i.e. its projection at the surface for a 2d plot, OR its 3d position in a 3d plot (which is straightforward in MATLAB).
- 2) The surface displacement vectors using the `QUIVER` function, evaluated on a grid of evenly spaced points at the surface. Choose grid spacing that is appropriate, i.e. is not too dense to see vectors but is dense enough to get a feel for the pattern of displacement.
- 3) The magnitude of (horizontal only) surface displacement with a contour plot. Read MATLAB's doc page on `CONTOUR` to see how to invoke this function.
- 4) `OkadaBlock.m` provides vertical displacement as well. Plot contours of the vertical displacement magnitude using "contour".

Please use `subplot` to put all figures for each dislocation onto a single plot. Somewhere on the plot you should indicate what is the M_w for the event.

Dislocation 1

Strike slip on a *vertical* fault that has slipped in a right lateral sense and has ruptured the surface ($D_{top}=0$). This rectangular fault patch is 10 km long (horizontally) by 5 km wide (along depth direction) and slips 0.5 meters. Orientation (strike) of fault is not important so choose something and go with it.

Does the displacement pattern make sense? What is the magnitude of this earthquake? Remember $M_o = \text{Area} \cdot \text{slip} \cdot \text{shear modulus}$, and $M_w = (2/3) \cdot (7 + \log_{10}(M_o)) - 10.73$

Dislocation 2

1.0 meter of *normal* slip on a 3 km x 3 km patch that dips 30 degrees, with the top of the plane at 2 km depth.

What is M_w ?

Dislocation 3

Tensile opening of a crack of 1.0 meter that is dipping 45 degrees. The TOP of the 1.0 km x 1.0 km plane is at 1.0 km depth.

What is M_w ?

Email your plots and responses to whammond@unr.edu