1. Wir haben in der Vorlesung das Konzept der Spannung besprochen. Spannung ist Kraft pro Fläche und hat die Einheiten N/m^2. Bei typischen Erdbeben ist der Spannungsabfall ca. 5 MPa (1 Pa=1 N/m^2). Nehmen wir mal eine Fläche von 1 m^2 an. Wie groß müsste eine Masse sein, die man von einer solchen Fläche hebt, um einen solchen Spannungsabfall zu erzielen? Wie groß müsste ein Granitblock sein, der diese Masse hat (die Dichte von Granit ist 2600 kg/m^3)?

2. The stress at the core-mantle boundary is 135 GPa. What is the hight of a $1m^2$ x granite body (density 2500 kg/m^3) assuming constant acceleration that produces such stress value?

3. Traction and faults

Assume that the horizontal components of the 2-D stress tensor are

$$\boldsymbol{\tau} = \begin{bmatrix} \tau_{xx} & \tau_{xy} \\ \tau_{yx} & \tau_{yy} \end{bmatrix} = \begin{bmatrix} -30 & -20 \\ -20 & -40 \end{bmatrix} \text{ MPa}$$

(a) Compute the normal and shear stresses on a fault that strikes 10° east of north.

(b) Compute the principal stresses, and give the azimuths (in degrees east of north) of the maximum and minimum compressional stress axes.

4. Find values for the PREM model in Shearer or in the internet:

Using values from the PREM model (Appendix A), compute values for the bulk modulus on both sides of (a) the core–mantle boundary (CMB) and (b) the inner-core boundary (ICB). Express your answers in pascals.

5. (From Shearer: Seismology). The University of California is running an observatory that is measuring deformations:

a) at 5km depth the seismic velocities are v_p=6km/s, v_s=3.5km/s and the density is 2700kg/m^3. Calculate the values of the Lamé parameters in Pascal.

b) After the Landers earthquake 1992 (M7.3) the following deformations were measured 80km to the north of the observatory: e_{11}=-0.26x10^{-6}, e_{12}=-0.69x10^{-6}, e_{22}=0.92x10^{-6}. Indices 1 and 2 correspond to East and North, resp. Calculate – assuming that these values are also true at depth – the changes in stress at 5km depth with the results from (a). Treat this is a 2D problem and neglect stress in vertical direction.

c) Calculate the dominant stress directions (horizontal as azimuth over North). Remember this is an eigenvalue problem.

d) The yearly deformation rates were measured as: e_{11}=0.101x10^{-6}, e_{12}=0.005x10^{-6}, e_{22}=-0.02x10^{-6}. Assume that this deformation continues for 1000 years. Calculate the stress change at 5km depth using results from a).

e) A farmer owns 1km^2 near the observatory. How much land does he win or loose every year? How much land did he win or loose with the Landers earthquake?

Write a Jupyter notebook that helps you solving these problems .