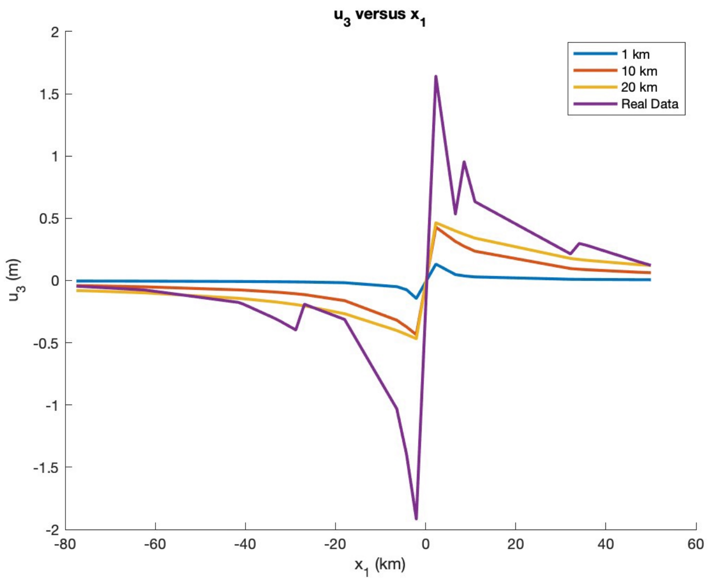
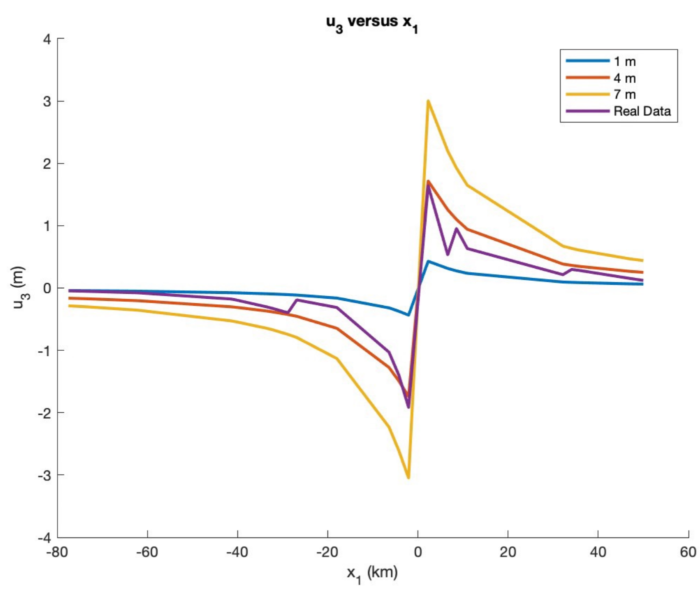
# ERTH 455 Problem Set #5

1. Matlab script attached

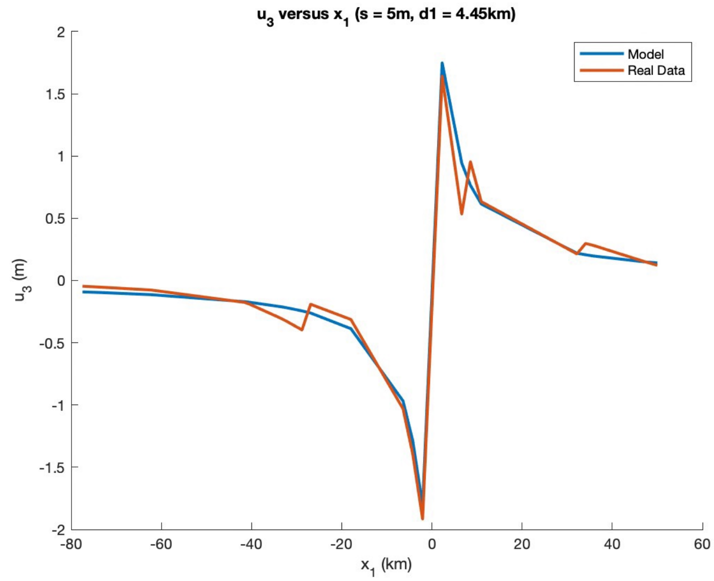
a) As the fault gets deeper, the predicted displacement gets larger.




b) As the slip increases, predicted displacements get larger. Changing the slip seems to have a more dramatic effect than changing the depth.



c) I found that values of $s = 5m$ and $d_1 = 4.45$ km created a model that fit the real data best.




I got these values by calculating values of $u_3$ for 10,000 combinations of $s$ and $d_1$ and picking the one that minimized error between the predictions and the real data.

Our model likely doesn't fit perfectly because of the assumptions we made about boundary conditions. In particular I think the assumption of uniform slip might have a significant impact.

2. a) $u_3 = \frac{-s}{2\pi}\left(\tan^{-1}\left(\frac{x_1}{x_2+d}\right) - \tan^{-1}\left(\frac{x_1}{x_2-d}\right)\right)$

$$\sigma_{13} = 2\mu\epsilon_{13} = \mu\frac{\partial u_3}{\partial x_1} \qquad \epsilon_{13} = \frac{1}{2}\left(\frac{\partial u_1}{\partial x_3} + \frac{\partial u_3}{\partial x_1}\right) = \frac{1}{2}\frac{\partial u_3}{\partial x_1}$$

$$\frac{\partial u_3}{\partial x_1} = \frac{-s}{2\pi}\left(\frac{x_2+d}{(x_2+d)^2+x_1^2} - \frac{x_2-d}{(x_2-d)^2+x_1^2}\right)$$

$$\sigma_{13} = \frac{-s\mu}{2\pi}\left(\frac{x_2+d}{(x_2+d)^2+x_1^2} - \frac{x_2-d}{(x_2-d)+x_1^2}\right)$$

$x_1 = 0$, so:

$$\sigma_{13} = \frac{-s\mu}{2\pi}\left(\frac{x_2+d}{(x_2+d)^2} - \frac{x_2-d}{(x_2-d)^2}\right) = \frac{-s\mu}{2\pi}\left(\frac{1}{x_2+d} - \frac{1}{x_2-d}\right) = \frac{-s\mu}{2\pi}\left(\frac{-2d}{(x_2+d)(x_2-d)}\right)$$

$$= \frac{s\mu d}{\pi(x_2+d)(x_2-d)}$$

b) $\sigma_{13} = \dfrac{s\mu d}{\pi(x_2+d)(x_2-d)}$

At $x_2 = d$ and $x_2 = -d$, the stress goes to $\infty$:

$$\sigma_{13}(x_2 = d) = \frac{s\mu d}{\pi(2d)(0)} = \frac{s\mu d}{0}$$

$$\sigma_{13}(x_2 = -d) = \frac{s\mu d}{\pi(0)(-2d)} = \frac{s\mu d}{0}$$