Ground Motion Prediction of Mineral Earthquake

Introduction:

Over the past decades, researchers have been trying to come up with a way to predict the ground motions in sites with different distances away from the earthquake location. There have been different models developed based on the historic data obtained by seismometers for past earthquakes. Acceleration is one of the components of ground motion and it is more common to be used by the researchers for explaining the effect of earthquake on different sites. Seismometers also measure the acceleration to show the earthquake effects on a site. Most of the prediction models created, predict the Peak Ground Acceleration (PGA) of a site due to the earthquake. There are different parameters that influence the prediction of earthquake such as: source to site distance, earthquake magnitude and parameters related to the properties of the soil on a specific site.

Purpose:

In this project GIS is used to represent and compare the predicted PGA to the actual PGA (calculated by seismometers) of different sites which have different distances away from the earthquake. The Mineral, Virginia earthquake (Magnitude 5.8) is being used in this study. For sites, the PGA in New England and Virginia area is being considered.

Methodology:

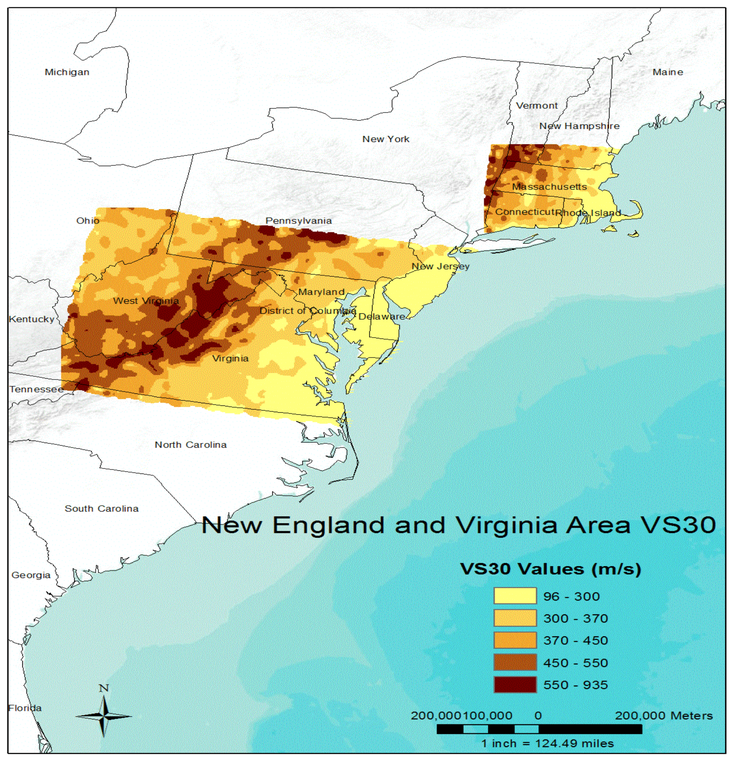
1. Locating the Earthquake location in GIS with its magnitude.
2. Locating the seismometers in GIS with their measurement of PGA and its distance to the earthquake location.
3. Getting data for Vs30 (Soil property parameter) in the desired region which PGA is being predicted.
4. Use the following model created by Boore and Fumal (1997) for Reverse-slip fault to predict the PGA:

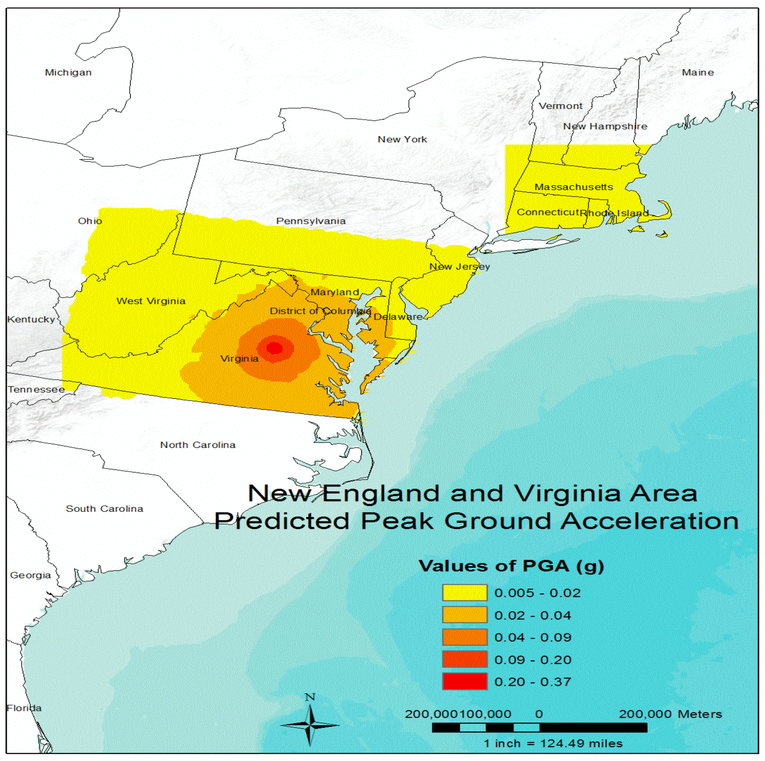
   $Ln(PGA) = -0.117+0.527 (M-6) - 0.778 Ln(r) - 0.371 Ln (Vs30/1396)$

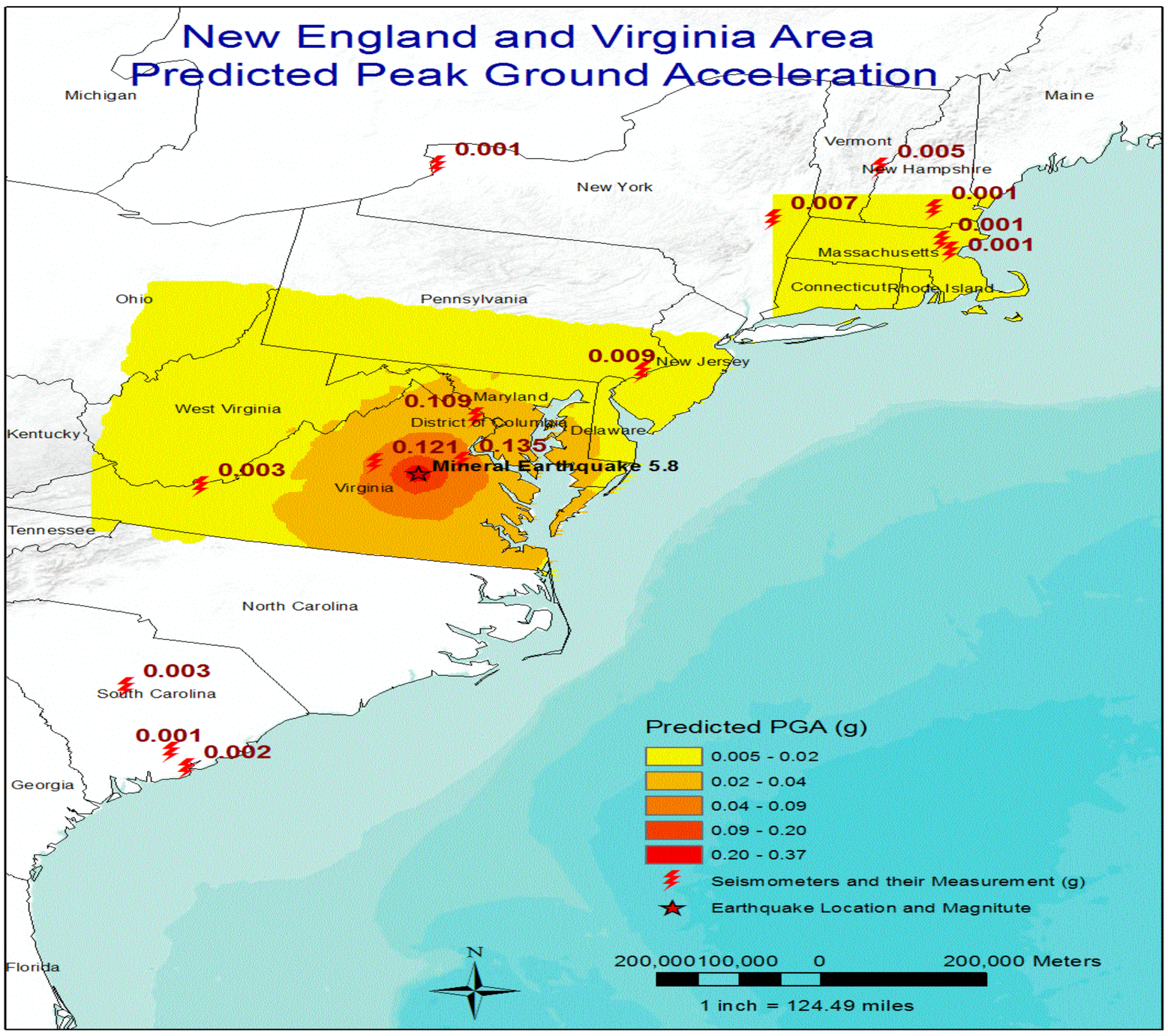
   where M is the moment magnitude of the earthquake, r is the distance in km of the site location to the earthquake location and Vs30 (m/s) is a soil property which is defined as the speed of earthquake wave in 30 m depth from the site surface.
5. compare the results

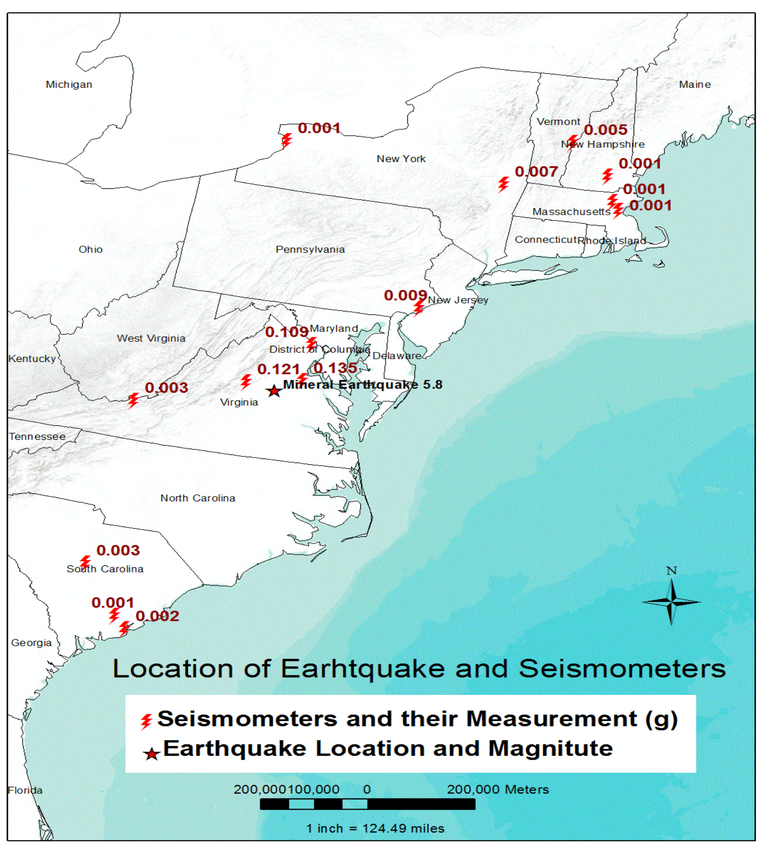
Results:

As it is shown in the final result figure in the middle, the observed PGA from seismometers were within the range of the predicted PGA results. But as it is shown in the table below, by looking at each station and comparing it to the exact value of PGA predicted in that point, it shows that the model did not provide an accurate result for prediction of earthquake in most of the locations. One of the reasons for that could be the fact that the model might be effective for earthquake prone areas like west coast and not east coast. For improvements other models should be looked at for mineral earthquake.









Location	Predicted PGA (g)	Observed PGA (g)	Percent Difference %
VA Charlottesville	0.05	0.121	58.68
VA Corbin (Fredricksberg Obs)	0.07	0.135	48.15
VA Reston Fire Station 25	0.03	0.109	72.48
VA Pearisburg - Giles County CH	0.001	0.003	66.67
PA Philadelphia - Drexel Univ	0.01	0.009	11.11
MA Boston - Jamaica Plains	0.007	0.001	more than 100
MA Bedford - VA Hospital	0.007	0.001	more than 100
Manchester - VA Medical Center	0.007	0.001	more than 100
NY Albany - VA Med	0.007	0.007	0

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