A Novel Mathematical Model To Predict Wastewater Induced Earthquakes

Kang, Wesley (School: James Madison High School)

Wastewater Injection is the practice of injecting leftover wastewater from industrial practices such as fracking and liquid and gas extraction operations underground. With the rise of these alternative energy sources, the amount and frequency in which the United States has injected wastewater has increased exponentially in the past twenty years. With that, so has wastewater induced earthquakes. To date, there has not been a substantive study on what specific aspect of wastewater injection actually induces earthquakes, and regulation has been vague and not scientifically backed up. This study aims to change that and help both mitigate and predict the potential impacts of such injection wells in communities. A random sample of fifty earthquakes were taken from Oklahoma and Kansas, and the epicenter of the earthquakes were cross-referenced to wastewater injection wells within ten kilometers. Five variables relating to the injection wells were studied and data was collected from each state's relevant agencies. The goal is to mitigate and minimize the impact and create a predictive model. Linear regression tests confirmed each variable's significance in relation to the magnitude of the earthquakes. All variables yielded data significance (p - value < 0.01) . A multivariate linear regression test yielded a final formula that can predict the magnitude of wastewater induced earthquakes. Statistical tests proved additional significance of variables in relation to one another (p - value < 0.01 , satisfactory f-values). The formula can be utilized as a resource for oil companies to help guide their decisions when injecting wastewater underground but also to help influence state regulation to minimize the negative impact on communities.