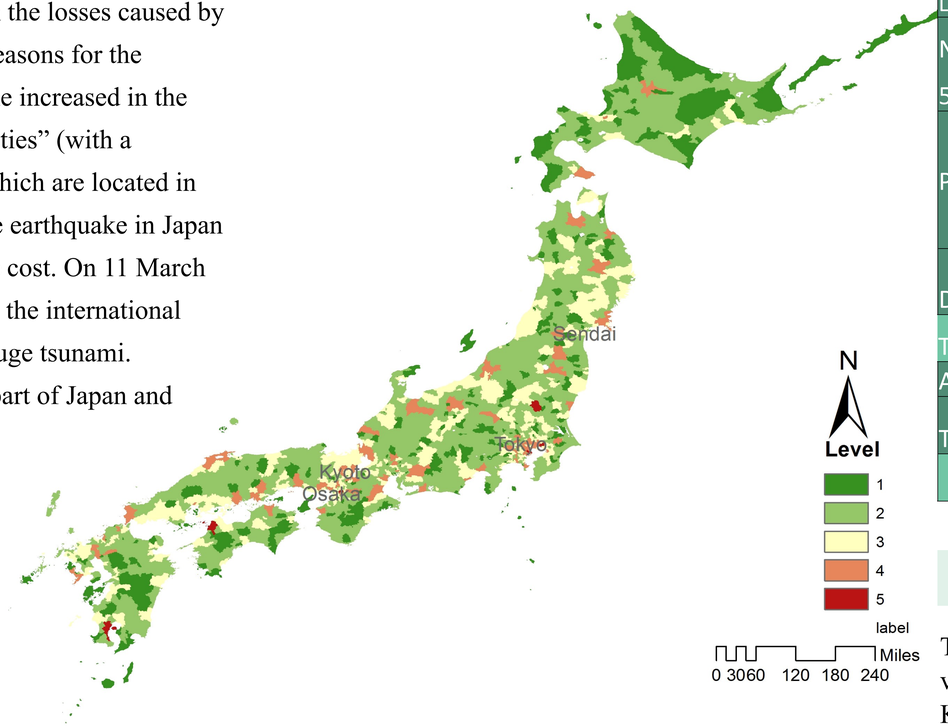
Assessing Earthquake Risk and Vulnerability in Japan

Introduction

In the last few decades, a dramatic increase in the losses caused by earthquakes has been observed worldwide. Reasons for the increased losses are multifarious, including the increased in the population, the development of new “super-cities” (with a population greater than 2 million), many of which are located in zones of high seismic hazard. The 1995 Kobe earthquake in Japan produced US$150 billion absolute earthquake cost. On 11 March 2011, a magnitude 9.0 earthquake occurred in the international waters of the western Pacific and induced a huge tsunami. Earthquake and tsunami hit the northeastern part of Japan and caused mass losses and a nuclear leakage.

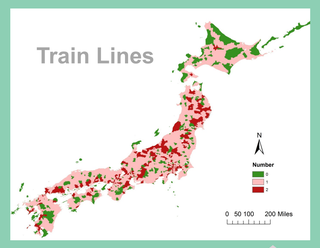
In this project, the primary goal is to analyze seismicity and vulnerability of counties in Japan and find the most vulnerable areas. Four dimensions as will be considered in this Project. Those are past strong earthquake numbers, population, transportation, and the distance to a nuclear plant.



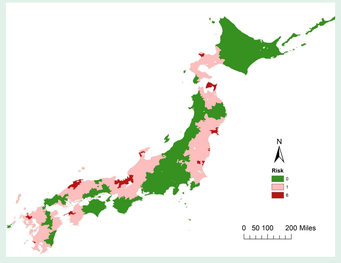
Variable Reclasssifications						
Level	0	1	2	3	4	6
Number of earthquake above 5 magnitude (moderate)	0	1	2	\	\	\
Population	\	0-100000	100000-200000	200000-500000	500000-1000000	\
Distance to a nuclear plant	>100km	10km-100km	\	\	\	0-10km
Transportation=	2*Airports+Train lines					
Airport numbers	0	1	>1	\	\	\
Train lines	0	1-8	8-64	\	\	\
Earthquake Vulnerability=3*earthquake+3*population+nuclear plant+ transportation						

Methods

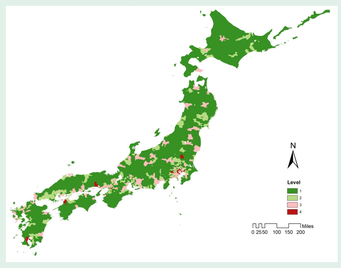
All points or lines categories were first converted to polygons using special join. Then they were converted to raster and reclassified to value them on a settled scale. Next, new weight was given based on the reclassified scale. Finally, each category’s value was summed together to get a final score. Higher scores were associated with a higher risk for earthquake.



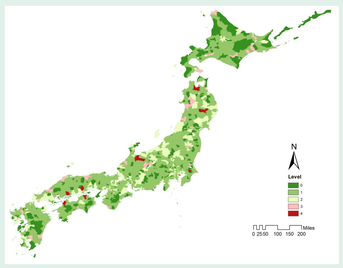
Nuclear Plants



Population



Transportation



Results

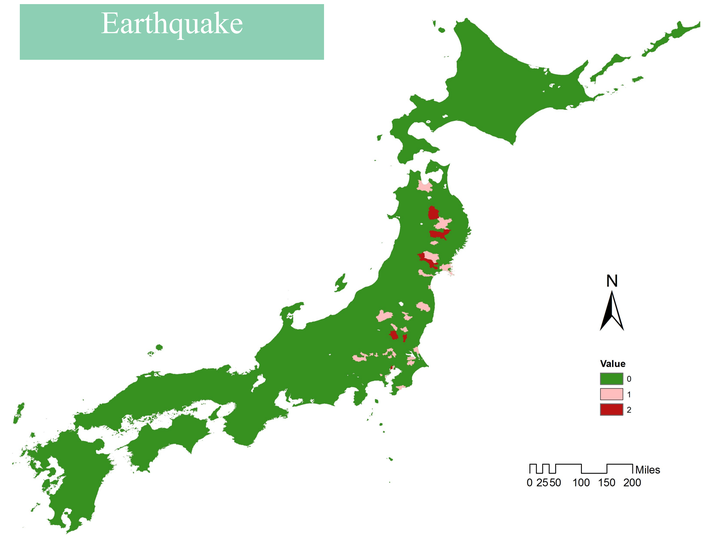
The maps presented show high vulnerability around Tokyo, Kyoto and Osaka.

Tokyo is one of the “super cities”, has the highest population in Japan. The Greater Tokyo Area is the most populous metropolitan area in the world. Several strong earthquakes occurred around Tokyo area from the earthquake intensity data, this may suggest the geologic structure is unstable around Tokyo area. Except no nuclear plant around Tokyo, all variables show high risk of Tokyo.

Kyoto and Osaka all are effect by a nuclear power plant, taking the risk of exposure to nuclear leakage. As Important cities of Japan, they have relatively high population and good transportation, even though there are no past strong earthquake, these two cities have high vulnerability to earthquake.

Cities like Sendai, near by a nuclear plant and has several past strong earthquake, but the population and transportation show this city is not much important as others, so the vulnerability of Sendai is relatively low.

Earthquake



Reference::

G.M. Calvi and R. Pinho. (2006) Development of Seismic Vulnerability Assessment Methodologies over The Past 30 Years. ISET Journal of Earthquake Technology, Paper No. 472, Vol. 43, No. 3, pp. 75-104.

Data Sources:

Geospatial Information Authority of Japan, National Land Numerical Information from National Spatial Planning and Regional Policy Bureau, MILT of Japan.

Projection: Transverse_Mercator

Weiyang Xiao

12/7/2017

Introduction to GIS, CEE187

Tufts University