

# Spatio-temporal Analysis of Tsunami Damage based on Dynamic Inundation Prediction Map: A Case Study of Hamamatsu Coastal Area

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Japanese officials are expecting that a huge earthquake will occur in the eastern Japan, with Nankai Trough as the epicenter. The measures concerning the earthquake are based on lessons learned from 2011 off the Pacific Coast of Tohoku Earthquake, and it is assumed that the largest scale earthquake will occur. Therefore, the estimated population in inundation area will increase and scientific evacuation measures are more necessary.

The purpose of this study is to create the dynamic inundation prediction map, to estimate the tsunami damage, and to simulate evacuation possibility based on it. The study area is coastal areas in Hamamatsu City where the huge damage is expected by the great earthquake of Nankai trough.

The research method is as follows. The first is to develop an inundation rate estimation model for calculating the damage of inundation. The second is to apply the model to Hamamatsu coastal area using GIS. The third is to do the spatio-temporal analysis of the human and socio-economic damage after the tsunami uphill(Figs.1 and 2), and examine factors for the change in the tsunami inundation rate. Finally, this study simulates evacuation possibility(Figs.2 and 3).

Using GIS, tsunami inundation rate was calculated for every 10m gridded area. The spatial pattern of the inundation rate was almost depended on the inundation depth. However, there were some places that showed different patterns. For example, in the coastal areas where the embankments and the dense building areas exist, the inundation rate was reduced.

Also, it was found that the tsunami inundation limit does not remain parallel to the coastline, and it enters in a curved condition. Because buildings prevented the inundation and at the same time agricultural fields and rivers promoted inundation(Fig.1). As a result, the area where the tsunami enters from the unexpected direction, not from the coast, was revealed. It seems that such area where the building and agricultural lands are associated is highly dangerous.

As a result of estimating human and socio-economic damage every elapsed time, it was found that the people who need evacuation have increased rapidly after 5 minutes, then gradually increased, and almost converged after 17 minutes with the tsunami uphill(Fig.3). Both the building and agricultural lands were found to have convergence of the damage expansion after 13 minutes.

As a result of simulating evacuation possibility, it was found that incomplete evacuation population has increased in the range of 1 to 4 minutes and 6 to 15 minutes after the tsunami uphill(Fig.3). According to the above information, from 1 to 4 minutes is not sufficient for the evacuation due to the lack of time hence, it has more increase of incomplete evacuation population. From 5 to 15 minutes, it is more increasing due to the lack of evacuation facilities.

Keywords: Tsunami, Inundation, Evacuation, GIS, Hamamatsu City

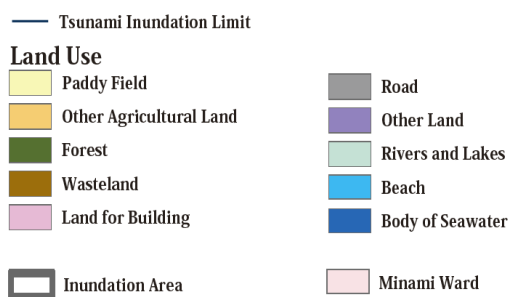
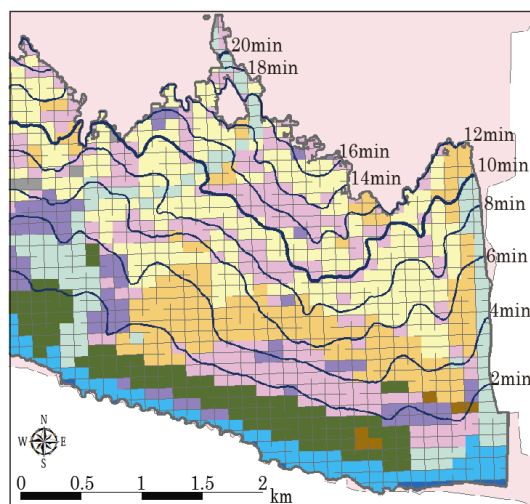


Fig.1 Overlay of land use and tsunami inundation limit.

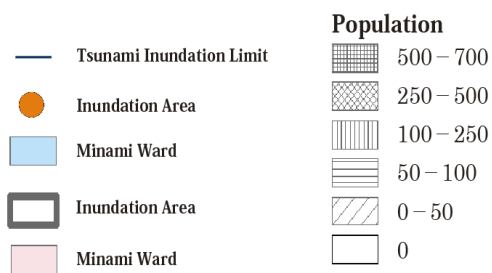
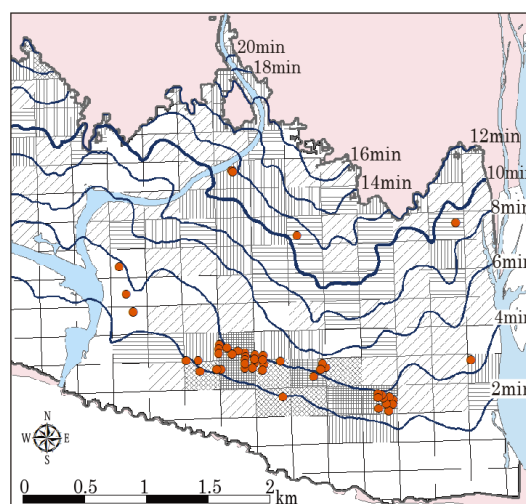


Fig.2 Overlay of population distribution, evacuation facility and inundation limit.

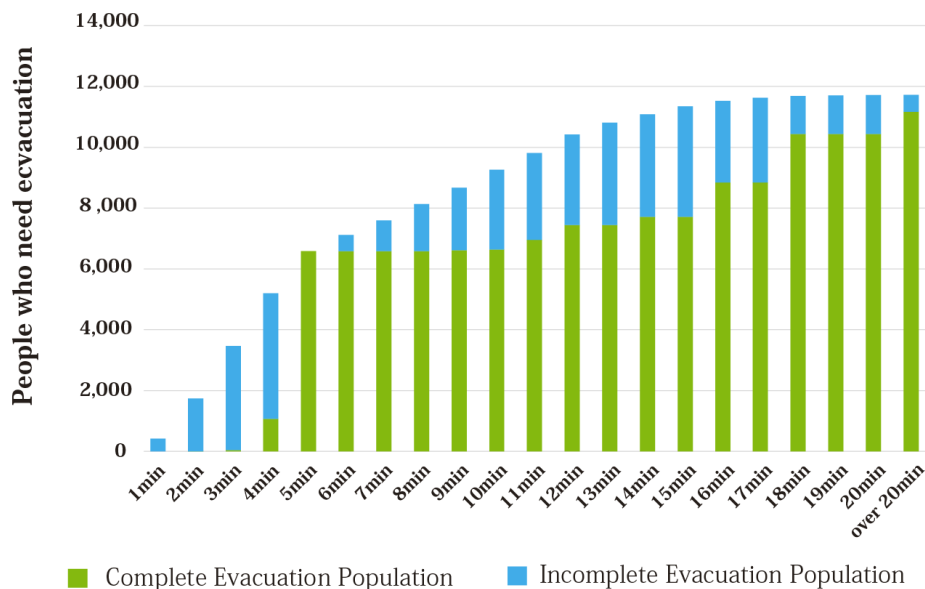


Fig.3 Temporal changes in complete / incomplete evacuation population every elapsed time.