

Geospatial assessment of pre- and post-earthquake landslide susceptibility in Atsuma region, Hokkaido, Japan

(北海道厚真地域における地震前後の地すべりの発生しやすさの地理空間的評価)

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Abstract

The 2018 Hokkaido Eastern Iburi Earthquake (HEIE) caused devastating landslides on the hillslopes in Atsuma, Abira, and Mukawa regions in Hokkaido, northern Japan. The landscape in this region is not extremely steep, but the co-seismic landslides dominated likely due to the lack of cohesion in the surface tephra layers. This research provides geospatial insights and interpretation of the pre- and post-earthquake landslide susceptibility environment in the Atsuma region. Firstly, the author conducted an attribute analysis to explore contributing factors to landslide formation. It is identified that earthquake characteristics, slope gradient, elevation, and geological and tectonic settings played a significant role in their development. This information was used in zonal statistics to explain three major locations where landslides did not occur in Atsuma and to optimize the analysis. Subsequently, the author generated pre- and post-earthquake landslide susceptibility statistics using machine learning and identified that the Random Forest, compared to Logistic Regression, had higher overall performance after validation. Following that, pre- and post-earthquake landslide susceptibility maps based on the Random Forest algorithm were generated. The pre-earthquake susceptibility analysis utilizes seismic attributes, while the post-earthquake susceptibility analysis does not utilize them. The pre-earthquake model then showed greater clarity, in identifying the susceptible regions that followed closely to the HEIE 2018 landslide events in its results. However, the post-earthquake model could not identify susceptible regions clearly, likely because of the lack of such seismic parameters. Therefore, it is deduced that seismic activities plays a primary role in large-scale landslide development in Atsuma.

Keywords: Co-seismic landslides, susceptibility, machine learning, Atsuma, geospatial interpretation