

HSC024-04

Room:201A

Time:May 24 09:30-09:45

Estimation of slope failures area induced by the Mid Niigata Prefecture Earthquake by analysis on geomorphic quantities

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The Mid Niigata Prefecture Earthquake in 2004 caused various scales many slope failures in the Chuetsu area. The distribution of them was interpreted by aerial photographs, and the disaster condition maps of the earthquake were published by the Geospatial Information Authority of Japan. In this study, we investigate the common geomorphic quantity on the landslides induced by the earthquake at the study area, and discuss the mean of it.

For analysis on geomorphic quantity, polygon data of existing landslides before the earthquake in the disaster condition maps and elevation data of 10m-mesh digital elevation model in the fundamental geospatial data were used. The large scale slope failures indexed by polygon data in the disaster condition maps are considered landslides caused by the earthquake. We analyzed the coordinates of the centroid, maximum elevation, average elevation and minimum elevation on scarps and landslide masses of the existing landslides before the earthquake by GIS. From the each elevation data associated with the centroid, we calculated the surface models based on the scarps and the landslide masses by using the kriging method, and made elevation difference maps between the two surface models. In addition, we made an elevation map, a slope gradient map, a relief map based on the elevation difference between summit level and streamline surface at the study area. We discussed the characteristics of geomorphic quantity of the area induced landslides by the earthquake considering their maps overlaid the large scale slope failures and the mean of the GIS analysis based on the landform units of the landslides.

The large scale slope failures are located at the various elevations. It is difficult for us to clarify the relationships between the slope failures and slope gradient, and the former and the relief because of the area scales for analysis. It is clarified that the distribution of the large scale slope failures overlaps well with the area indexed the large difference value between the two elevation differences, the first is the elevation difference between the two surfaces based on the maximum elevation of the scarp and minimum elevation of the landslide mass, and the second is the elevation difference between the two surfaces based on the average elevation of the scarp and average elevation of the landslide mass. In this study, following seven interpretations are applied to the GIS analysis based on the landform units of the landslides. 1) The average elevation of the scarp is correlative with the elevation of the landform unit uplifted by crustal movement. 2) The average elevation of the landslide mass is correlative with the elevation of the present landform unit. 3) The difference elevation between 1) the scarp and 2) the land slide mass is correlative with the amount of loss on landslide vulnerability to return to the surface before the crustal movement. 4) The maximum elevation of the scarp is correlative with the elevation of initial form. 5) The minimum elevation of the landslide mass is correlative with the elevation of the base level of erosion. 6) The difference elevation between 4) the scarp and 5) the land slide mass is correlative with the amount of stock on erosion probability to deepen to the base level of erosion. 7) The difference value between 3) the amount of loss on landslide vulnerability and 6) the amount of stock on erosion probability is correlative with the instability of present landform for earthquake motion.

Consequently, we think that the landform analysis from the view point of geography can estimate the landslide area caused by the earthquake more accurately than it from the view point of topography.

Keywords: Landslide, Slope failure, DEM, The Mid Niigata Prefecture Earthquake in 2004