講演要旨

過去の斜面崩壊分布と高分解能 DEM に基づく斜面ハザードマップ構築の試み

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An attempt to construct slope hazard maps based on digitized distribution data of past slope failures and high resolution DEM

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1. Introduction

In general, it is difficult to construct slope hazard maps expressing the susceptibility to slope failures, because it is rather impossible to investigate individual small slopes and predict their frequent occurrence of failures. However, frequent occurrence means that distribution data recorded in the past can give valuable information on location of future occurrence. Then, if the distribution of past slope failures was obtained in a restricted area, and it was combined with detailed DEM and geologic data, the relations will be available for statistical prediction of future occurrences. As one attempt, we analyzed slope failure data of the 1983 San'in heavy rainfall disaster in western Shimane Pref., Japan (Fig.1).

2. Relation between the occurrence of slope failures and slope angles.

The topography and distribution of slope failures (Fig.2) of a small domain (6.3 km²) indicated as *A* in Fig.1, were digitized as 15-m mesh raster data. Fig. 3 shows the relation between the area (numbers of cells) and slope angle obtained in the domain *A*. In Fig.3 (a), the number of cells *t* in each slope angle increases with θ between 0° and 20°, and it decreases in steeper zones. Moreover, the relation that the number of cells *f*, where slope failures were recognized, shows also a similar tendency with θ (Fig.3(b)). The ratio f/t is not constant, and it tends to increase gradually with slope angle θ between 0° and 30° (Fig.3(c)). This ratio means the probability of the occurrence of failures in each slope angle. Based on this, the relation between the ratio f/t and slope angle θ is expressed as

$$f/t = a\theta + b \quad (1)$$

where *a* is 0.0014 and *b* is 0.013 in this area. The relation (1) is also mechanically supported by the model where the weathered portion of the rock mass controls the occurrence of shallow failures. Although the instability may be higher in steeper zones, the low ratio in steeper zones (Fig.3 (c)) is interpreted as slope failures in

steeper zones occur frequently but their volume is small.

3. Relation between the susceptibility and lithofacies

Although the tendency is not distinct, this relation is also recognized in 50-mesh data of domain *B* (Fig.1). Slopes in this domain are composed of three major lithofacies roughly. Then, expressing the relation (1) for each lithofacies (Fig.4), we can obtain the coefficients *a* (0.0022 for schistose rocks, 0.0012 for granitic rocks, and 0.0022 for volcanic rocks) and *b* (0.089 for schistose rocks, 0.070 for granitic rocks, and 0.011 for volcanic rocks). Coefficient *a* means the dependency of the probability on slope angle, and *b* means the susceptibility of each lithofacies to rainfall intensity.

Considering that the ratio f/t means the probability of the occurrence in each slope angle with each lithofacies, we can construct a slope hazard map using this relation as a function of slope angle and lithofacies based on high resolution DEM and lithofacies map. The flowchart to construct such hazard map is shown in Fig.5.

4. Conclusions

(1) The occurrence of slope failures in this area strongly depends on slope angle. This is mechanically supported by the model where the weathered material controls the occurrence of failures.

(2) The high resolution of 15-m mesh DEM is effective in these analyses. Although the tendency is not distinct, 50-m mesh DEM is also available for these analyses.

(3) Using the probability as a function of slope angle and lithofacies, it will be possible to construct a slope hazard map based on high resolution DEM and lithofacies map.

(4) Consequently, this approach is effective in the construction of slope hazard maps in the domains where distribution of past failures is recorded.

Fig. 1. Distribution of slope failures of the 1983 San'in heavy rainfall disaster in western Shimane obtained from 1/8,000 air photos.

Fig. 2. Topography and distribution of the occurrence of failures in the domain A (Fig. 1).

Fig. 3. Relation between occurrence of slope failures and slope angle θ in the domain A.

- (a) Area (number of cells; t) and slope angle θ .
 (b) Area of failures (number of cells; f) and slope angle θ .
 (c) Ratio f/t and slope angle θ .

Fig. 4. Lithological dependency of the ratio f/t in the whole area (domain B). (a) Schistose rocks (b) Granitic rocks (c) Volcanic rocks.

Fig. 5. A flowchart to construct hazard maps the authors used.