Evaluation of the locations of localized heavy rainfall that cause simultaneous sediment disasters

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Tomoyuki Noro, Head
Ikuo Murata, Researcher
Joko Kamiyama, Senior Researcher
Hiroshi Ikeda, Guest Research Engineer
Sabo Risk-Management Division, Sabo Department

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1. Introduction

Many recent sediment disasters that caused tremendous human and property damage, including the one in the city of Hiroshima in 2014, were caused by concentrated heavy rains due to the formation of band-shaped precipitation systems. Compared to heavy rains caused by typhoons and tropical cyclones that can be forecasted a few days in advance, band-shaped heavy rainfall is known to be hard to forecast in advance with long lead times and can cause severe human damage due to sediment disasters because the disaster occurs in an unexpected fashion.[1]

In such situations, it is considered important to develop technologies to predict at an early point the risk of the occurrence of sediment disasters, which are increased by the formation of band-shaped heavy rainfall, in order to issue alerts for a sediment disaster and evacuation. Therefore, the Sabo Risk Management Division is considering a method for evaluating the places with high probability of the formation of band-shaped heavy rainfall in advance with a long lead time.

2. Evaluation of the Occurrence Potential of Localized Heavy Rainfall

In this consideration, heavy rain caused by the formation of band-shaped heavy rainfall was defined as localized heavy rainfall, and five environmental parameters shown in the table below, which were considered to affect this evaluation, were used as indicators. It was found that using these indicators and thresholds could help to determine whether the rain was a case of localized heavy rainfall or a case of short-period heavy rain with low risk of the occurrence of a sediment disaster, such as an evening shower, and they could possibly be utilized as disaster warning information at least approximately 6 hours before the occurrence of a sediment disaster.[1]

Table Environmental parameters and thresholds used for evaluation (Draft)

Environmental parameter	Explanation on indicator	Set threshold/potential
K index (KI)	An indicator of the instability of atmosphere. The larger the value is, the atmosphere is less stable.	KI=35 1 point
Showalter stability index (SSI)	An indicator of the instability of atmosphere. The smaller the value is, the atmosphere is less stable.	SSI=0 1 point
Precipitable water (PW)	An indicator of the amount of rainfall in the case where all water vapor in the atmosphere is condensed and goes into the ground	PW=50 1 point
Storm Relative Environmental Helicity (SREH)	An indicator of whether rotating upward flow emerges in cumulonimbus clouds easily or not when cumulonimbus clouds are formed.	SREH=90 5 points
Convergence of Lower Water Vapor Flux (CFLX)	An indicator of the degree of convergence of lower (From ground to approximately 1,500 m) water vapor which causes the development of cumulonimbus clouds.	CFLX=1000 5 points

In addition, the figure below shows an example of classifying the cases exceeding the threshold of each indicator into levels 1 to 4 in the order of lowest to highest point as the occurrence potential of localized heavy rainfall. Each indicator was calculated using the predicted Meso Scale Model-Grid Point Value for 15 hours in advance. (For disaster prevention, the value for approximately 12 hours in advance is used because it takes approximately 2.5 hours to distribute the data.) In addition, higher points were provided to SREH and CFLX than other indicators because their property of determining the cases of localized heavy rainfall and short-period heavy rain was relatively high. As a result, in the regions where sediment disaster warning information was released, the potential for localized heavy rainfall was approximately level 4, and it was found that localized heavy rainfall that increased the risk of the occurrence of a sediment disaster could be forecasted 9–12 hours before the release of sediment disaster warning information.

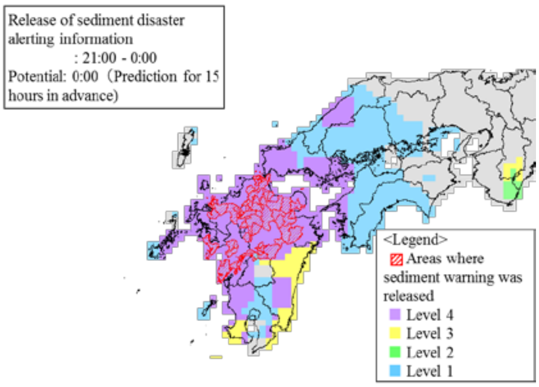

Figure An example of the evaluation of occurrence potential of localized heavy rainfall (June 21, 2016)

3. Conclusion

Since the range of the prediction result of this evaluation method tends to be wider than the range where localized heavy rainfall occurs, we would like to advance the research toward an increase in evaluation accuracy by using numerical predictions with higher spatiotemporal resolutions and reviewing the threshold of each indicator.

☞ For details, refer to the following:

1) Masaru Kunitomo, et al. (2016) Attempt of the evaluation of occurrence potential of localized heavy rainfall toward the increase in accuracy of sediment disaster occurrence prediction, No. 78, pp. B-184-B-185 of the *Journal of the Japan Society of Erosion Control Engineering* of FY 2016.