# Characterizing Types of Rainfall Prone to Sediment Disasters and Their Future Change in the Rokko Mountain

○Ying-Hsin WU, Yukari NAKA, Eiichi NAKAKITA

**Background**

Estimating the future risk of sediment disasters in a changing climate has been one of the essential topics recently. We have attempted to assess the future change of landslide alerts in Japan in a changing climate with the application of the critical line method, abbreviated as CL, a hydrometeorological approach that utilizes a parametric curve comprising hourly precipitation (HR) and soil-water index (SWI). The two parameters represent the effects of short-term rainfall and long-term soil wetness respectively. When considering a rainfall event, the geometric range of the corresponding snake line is significantly influenced by various factors such as rainfall pattern, including duration, peak intensity, time series, and more. Generally, an increase of in rainfall duration corresponds to a larger SWI value SWI, indicating a wider SWI range. On the other hand, intensified rainfall leads to a higher HR value, resulting in a wider range of HR. To quantitatively assess the risk of sediment hazards, one can easily examine the range of snake line composed of HR and SWI. Moreover, for an objective assessment of the change of snake-line range, a reliable and established tool is the method of radial-basis function network, often referred to as RBFN, which has been used for determining critical lines (CL). In our recent study (Wu et al., 2024), we utilized the RBFN method to analyze all rainfall events from climate projections under various scenarios and to generate RBFN curves at various values corresponding to occurrence probability. Subsequently, to reveal the stretching patterns in the directions of SWI and HR, we conducted an examination of the generated RBFN curves by comparing among future and present climate projections. The results show contrasting stretching patterns two climate projections with different spatial resolutions. To comprehend this discrepancy, this study aims to examine the types of all rainfall events and corresponding rainfall features of maximum rainfall rate, duration, and cumulated amount.

**Data and method**

In this study, we analyze two types of datasets, including Radar/Raingauge-Analyzed Precipitation published by JMA, often referred to as Radar-AMeDAS, with a spatial resolution of 1-km, and climate projections simulated by using regional climate models NHRCM at the two spatial resolutions of 2-km and 5-km. The data of Radar-AMeDAS covers a period of 17 years (2006-2022) while the climate projections have 20 years for all members. The climate projections are based on three scenarios, including present climate, RCP2.6, and RCP8.5. For the future climate projections, the member is the ensemble mean of SST, often referred to as c0. In our analysis of rainfall types, we specifically focus on events in which the CL is crossed.

**Analysis results**

The results depicting rainfall types from various datasets are illustrated in **Fig. 1**. In both historical observation and the present climate scenarios, the predominant rainfall type is associated with the events related to typhoon comparing to the other types. Two significant differences are observed. The first notable contrast with Radar-AMeDAS is that cold fronts from NHRCM induce rainfall events in which the CL are crossed. The second is that, from 2-km NHRCM, we can extract CL-crossed rainfall events occurred in a localized area, but there is none of the localized rainfall extracted from NHRCM05. Additionally, according to our definition of rainfall types, approximately one-third of the events occurred in composite weather systems rather than exclusively in a single system. Finally, for a deeper understanding of the discrepancy in rainfall features between the two NHRCM models, a comparison based on rainfall duration and its frequency as well as cumulated amount are illustrated in **Fig. 2**. As a result, it is evident that rainfall events from NHRCM02 exhibit higher intensity in durations shorter than 72 hours, with cumulated amounts less than 400 mm, but feature a higher maximum hourly rain rate. In contrast, NHRCM05 shows generally longer rainfall durations with higher cumulative amounts. These findings offer a clear explanation for the observed discrepancy in the stretching pattern of snake lines and hazard trends between the two NHRCM models with spatial resolutions of 2 km and 5 km.


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## References


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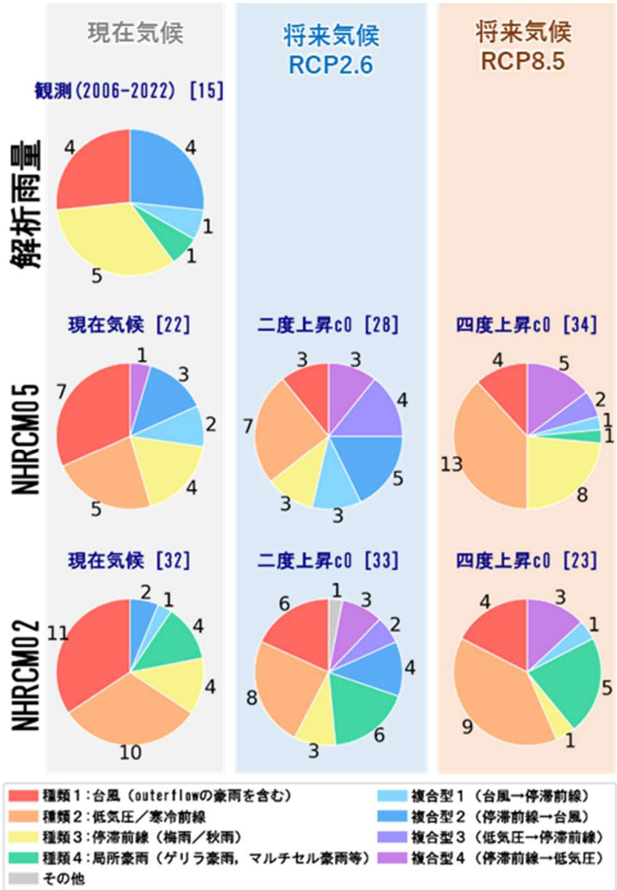


Fig. 1 Pie charts depicting types of rainfall events in which the critical lines are crossed. These events are extracted from Radar-AMeDAS and the scenarios of SPA, RCP2.6, and RCP8.5 from NHRCM05, and NHRCM02.

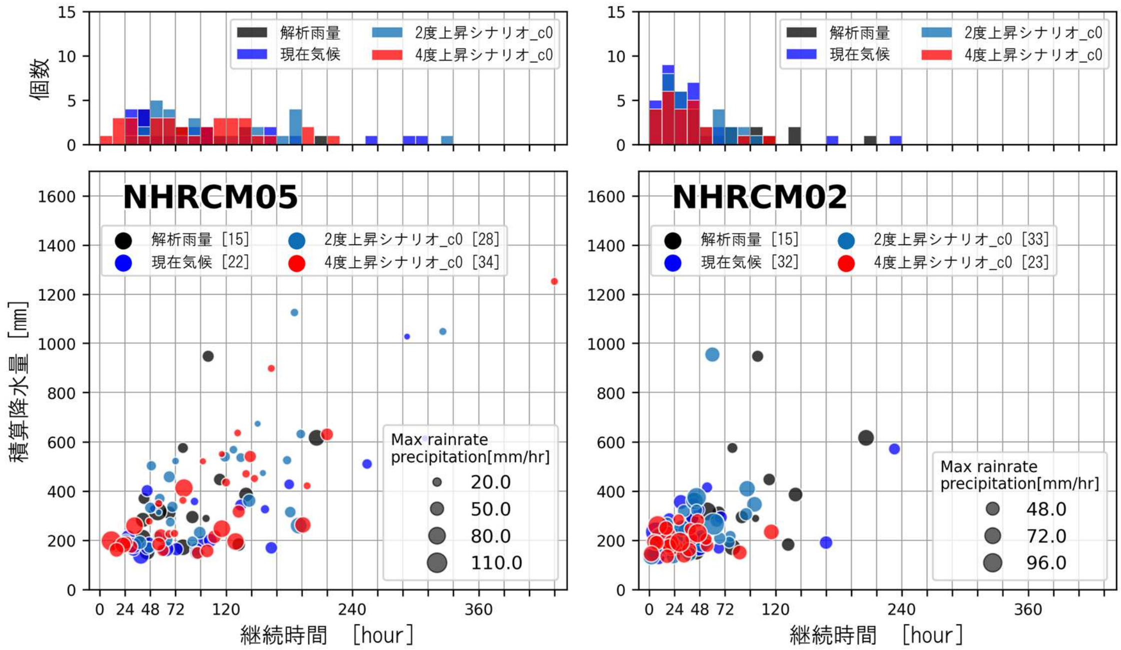


Fig. 2 Comparison of rainfall duration and its relative frequency, as well as cumulated amount among Radar-AMeDAS and the scenarios of SPA, RCP2.6, and RCP8.5 of NHRCM02 and NHRCM05