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Development of a Reliability-Based Shallow Landslide Early-Warning Framework during Rainstorm Event

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This study developed a framework to construct the rainfall threshold curves for shallow landslide under stipulated forecast reliability. We used the global sensitivity analysis to determine the effects of the uncertainties of hydrologic and soil properties on the landslide simulation. The results indicate that the hydraulic conductivity, friction angle, cohesion, and initial groundwater level have great influences on the landslide forecasting. To incorporate the uncertainties from rainfall and the four parameters mentioned above into landslide forecasting, we developed the regression error analysis and the optimization methods to construct the rainfall threshold curves for stipulated lead time and forecast reliability. The Mei-Liao Road located in Alishan Township, Chiayi County, Taiwan was the study site. We generated 49 hyetographs among which 35 hyetographs were used to construct the threshold curve. The results showed that the regression error analysis method is preferred owing to its high computation efficiency. We used the remaining 14 hyetographs to validate the accuracy of the rainfall threshold curves. The forecast reliabilities for the 14 hyetographs are very close to the stipulated reliabilities which indicates that the framework proposed is applicable. To improve the efficiency of landslide forecasting operation, we also developed an automatic operational platform based on the FEWS system. This platform enables the automatic landslide forecasting for selected slopes based on pre-specified schedules. Moreover, it can incorporate other natural disaster forecast models.