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Spatial relationship between extreme rainfall anomalies and density of the triggered landslides

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Precipitation extremes affect the landscape differently and often drive numerous landslides widespread with disparate densities and features. Revealing the factors that govern this spatial variability is critical for understanding landslide susceptibility and developing prediction models. To this end, examining the peculiarities of the triggering rainfall event at spatial and temporal scales emerges as a promising method. Here, we relied on radar gauge-analyzed (R/A) rainfall estimates (period > 30 years, spatial resolution ≈ 5 km) and a landslide inventory for studying the spatial relationship between rainfall anomalies and triggered landslide density. The landslide inventory counts more than 7,600 shallow landslides distributed in about 550 km^2 and triggered by an extreme rainfall event that hit the Kyushu area in southern Japan in July 2017. A total of 23 R/A cells with different landslide densities were identified from the landslide inventory. A standard period of 72 h (P_{std}), where the cumulative rainfall during the triggering event is maximum, was used to evaluate the spatial rainfall peculiarities at short (1 – 24 h) and long (48 – 72) timescales. Subsequently, rainfall anomalies were discussed by plotting the mean intensities computed at multiple timescales within the P_{std} in the intensity duration frequency (IDF) curves developed for each R/A cell. The spatial density of triggered landslides was strongly influenced by the rainfall intensities that exceeded the 100-years return levels at disparate timescales and demonstrated anomalies. More than 65 % of the triggered landslides were located in only three R/A cells. In these cells, rainfall intensities of the triggering event exceeded the 100-years return level at the various timescales (from short to long) within the P_{std}, favoring numerous landslides of different geometric features. Rainfall intensities in cells with low landslide density reached the 100-years return levels at short timescales (3 – 24 h). However, this was not necessarily achieved in all low landslide density R/A cells. These preliminary results highlighted the spatial impacts of rainfall anomalies computed at multiple timescales on landslide densities and features and motivated further analysis.