Valley Morphological Control of Drifted Wood and Debris –the 2017 mass-movements and floods in Kyushu

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In July 2017, the Northern end of Kyushu Island was battered by heavy rainfalls reaching locally 129.5 mm/hour, 400 mm/3 hours, eventually resulting into local excesses of 1000 mm of rainfall over 24 hours. This heavy rain episode due to an abnormally warm sea surface impacted an area that is traditionally relatively dry, due to its position in the shadow of other mountains.

In consequences, the slopes notably in Asakura-City, Hita-City have been hardly hit by landslides, debris flows and floods, all carrying important timber loads. From traditional forestry practices and a recent decrease of rural population in Japan, mountain slopes are mostly covered by “Sugi” and “Hinoki”. Those trees develop shallow root systems in eroded granite, and often above layers of clay that are parallel to the slope surface, further reducing the shear strength of the soil.

Instead of investigating the event itself, the present research use it to understand the local geomorphology and put to the forth the discontinuities that exist in the landscape and that are traditionally “hidden”. This contribution therefore asks the question of how the transport of the wood load and debris is being controlled by the geomorphology from a multiscale perspective (from the single reach to the valley scale). This question is then used to investigate characteristics of the landscape, such as the presence of more resistant rock, potential position of faults, etc.

The methodology relies on a GIS extraction of the data from the aerial photographs collected by the GSI and UAV-based aerial photographs collected by the author, which were built together using the SfM method. The dataset was then pre-processed in QGIS to extract indicators of slope, valley width before and after the flood event, the position of the drifted wood, and measure the number and volume of timber mobilized from the slope.

The data was then processed in ArcGIS using a geostatistical approach as well as a multiscale decomposition based on either a Discrete Meyer wavelet (for features that can be thought of as symmetric) and using a Haar wavelet (for features that are close to a square mother wavelet, such as topographical steps for instance).

The result show that the floodplain size of the valleys is commensurate with the flood event, but that localized variation such as what has been interpreted as fault lines and previous landslides is modifying locally the geometry of the valley, in turn controlling the distribution of drifted wood in the affected valleys. Adding to reach-scale variations of the valley geometry, valley-scale characteristics such as the width have also shown to influence the remobilization pattern of mobilized wood debris.

From the evidenced pattern, one should therefore learn to adapt management strategies to existing valley conditions and potentially use those natural irregularities as tools.

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