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Landslides –mudflows – flood inundation multihazard observed in the July 2017 Northern Kyushu heavy rainstorm disaster, Japan

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In the afternoon of 5th July 2017, extreme rainstorm attacked northern Kyushu Island, southwestern Japan, and caused uncountable number of landslides and debris flows in two prefectures, Fukuoka and Oita. Those induced numerous debris flows, mudflows as well as floods that which inundated the downstream communities. The distribution of cumulative rainfall shows the peak of about 250 mm in and around the Asakura city. This disaster claimed 37 lives, although the area had experienced another large-scale extreme rainstorm in 2012, when most of the debris flow took place in Aso volcano caldera rim. This landslide disaster had following characteristics.

1) Spatial distribution: Most of the landslides took place in a narrow rectangle area of about 10 km x 3 km. It reflects the cumulative rainfall distribution, induced by the meteorological back-building phenomena along the Sefuri mountain range. However, the range was as high as 500 m, and meteorologist pointed out that it was unusually low for those phenomena. Almost all of the landslides are shallow, and the density of the landslides are not affected by the geology nor vegetation. It showed the

2) Initiation mechanism: Soil samples were collected from the source area of shallow landslides in heavily weathered granite and andesite zones. Constant-volume direct shear tests and ring shear tests show that the specimens are highly likely to generate excess pore pressure and potentials of sliding surface liquefaction which can explain the mechanism of fluidization and higher mobility. Observed sediments deposited in the downstream community is still under estimate but apparently exceeded the amount of total landslide source volume nor torrent deposits before the disaster. Erosion of torrent / river bank ground may have contributed to the large-scale debris- / mud-flows and sediment transfer by the associated flood which caused the wide area inundation.

3) Landslides – debris-/mud- flows – inundation multi-hazards
Floods and inundation occurred in the rather smaller scale rivers in the rather urbanized areas. Widths of those rivers were widened up to 10 times by erosion and deposition of transported sediments, that which apparently implies the generation of severe meandering during the floods were taking place. Through indoor flume tests of sediment transfer, it was confirmed that depending on the increase in sediment supply rate from mountains, the planar shape of river channel varies, and meandering is generated. It was reproduced in numerical simulation, too. This process contributes even to the larger area of inundation.