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Continuous monitoring of shear wave velocity at the Montevecchio earthflow (Forlì-Cesena Province, Northern Apennines)

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The Montevecchio landslide is located about 20 km to the south - west of Cesena (Northern Italy). The landslide has a length of nearly 700 m, a maximum width of 50 m in the accumulation zone and the depth of the slip surface is around 10 m. This landslide was triggered several times in the last few years. At first on the 1th of February 2014 and at the end of February 2014 some remedial works started. From February to May 2014, the velocity of the landslide was around meters/day. At the end of May 2014, two monitoring systems were installed in the main track of the earthflow channel. The System 1 consists of a rain gauge, a pressure sensor at the depth of 1 meter, a time-lapse camera Brinno (taking photos every 30 minutes), a laser system and four geophones at 4.5Hz with a spacing of 2 meters. The System 2 consists of three GPS rover placed in the earthflow channel and the master station outside the landslide. During the 2015, the Montevecchio earth flow reactivated three times. The last reactivation was during the night between the 24th and the 25th of May. Analyzing the data acquired from the geophones, the trend of the shear wave velocity over time was detected. The data correspond to an acquisition of the ambient seismic noise (passive mode) with a sampling frequency of 300 Hz for 2min every hours and all them are collected in a Flash Memory Drive. A drop in Vs is found from the 21th-22th of May, in correspondence with a rainfall event. The video collected by the time-lapse camera shows that the landslide started to move downslope with a velocity of about 10 cm/d. Before this rainfall, the landslide was moving at a very low speed (less than 1 cm/day) and shear wave velocities were relatively high. The displacement rate increased on the 27th of May after the second rainfall event (30 mm/d) and reached the value of 10 m/day. The velocity remained apparently constant for several days, but we should consider that the data collected from the 27th of May to the 1th of June are not significant because the geophones were buried and moved downslope of about 50 meters. On the 1st of June the monitoring system was retrieved e reinstalled in its original position. From the first week of June to the 25th of July, the landslide slowed down and reached a velocity of 1 cm/d and accordingly, the Vs shows an increasing trend, except for the drop on the 22th-23th of June. Observing the video, the landslide did not accelerate; maybe the drop in shear wave velocity is a direct consequence of a rainfall event that occurred on the 22th, but we are still working on this aspect. A preliminary interpretation of the observed relationship between the displacement rate of the landslide and the shear wave velocity of the moving mass relies on the changes in the consistence of the material. During the phase of fast moving, the soil probably increases the void ratio and loses its stiffness, so Vs are low. At the contrary, during the phase of slow moving, the void ratio is relatively low and Vs are higher.