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Weather and anthropogenic [1-20 Hz] seismic noise correlations as an indicator for landslide precursor

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Ambient seismic noise can be acquired by any seismic device, and use to monitor the subsurface properties as long as records are properly synchronized in time, and the background noise structure is stable enough. These conditions have been met on a rapidly evolving landslide over the year 2010 at The Pont Bourquin, Swiss Alps. This landslide is a small but active clayey earthslide-earthflow, which is threatening a national road. Its small dimensions, 250 m in length, 35 m to 65 m wide and about 10 m deep, makes it easy to investigate and to instrument. The landlside has accelerated at the end of the spring of 2010, with displacement rates reaching a few m/month in the feeding zone. An earthflow of a few hundred of m3 was triggered in summer 2010, between the 17^{th} and the 19^{th} of August, after two heavy rainfalls that occurred on the 12^{th} and 15^{th} of August. In order to detect medium changes in the feeding zone, two short-period 3C seismometers were installed in stable ground on both sides of the landslide in January 2010. Those were connected to the same seismic station operated in continuous acquisition mode. Passive seismic data were processed using the cross-correlation technique to evince Rayleigh wave velocity (V_R) variations, which are linked to shear wave velocity changes, in the sliding medium. In the frequency range 10-12 Hz (corresponding to penetration depth of about 10 m), the relative variation of V_R exhibits a slight and continuous increase of about 1% between January and July 2010. After the 23^{rd} of July, V_R values show a significant decrease (7%) to the 17^{th} of August when measurements stopped because of the damage caused by the earthflow. A higher decrease rate in V_R was observed from the 13^{th} of August, 5 days before the earthflow. These results suggest that the evolution of Rayleigh wave velocity (and the shear wave velocity) with time could be a valuable precursor for earthslide events and changes in clay rheology.