Geophysical Research Abstracts
Vol. 21, EGU2019-8678, 2019
EGU General Assembly 2019

Combined effect of precipitations and earthquakes on slow moving landslide kinematic, a case study with in-situ measurements in the Colca Valley, Peru.

Noélie Bontemps (1), Eric Larose (2), Pascal Lacroix (3), Jorge Jara (4), and Edu Taipe (5)

(1) ISTerre, Univ. Grenoble Alpes, Grenoble, France (noelie.bontemps@univ-grenoble-alpes.fr), (2) ISTerre, CNRS, Univ. Grenoble Alpes, Grenoble, France., (3) ISTerre, IRD, Univ. Grenoble Alpes, Grenoble, France,, (4) PSL Research University,CNRS, École Normale Supérieure, Paris, France, (5) OVI-INGEMMET, Peru

In areas where both earthquakes and precipitations can influence the kinematic of landslides, a combination of these two forcings, enhancing the impact that each one of them would have had separately, has already been observed[1,2]. However, we are still missing quantitative observation with in-situ measurements in order to better understand the mechanisms at the origin of this combined effect. In order to fill this lack, we monitored for almost three years the activity of a slow-moving landslide, Maca, located in the Colca Valley, Peru[3]. This landslide is very interesting for its location, being subject to both seasonal precipitation - with rainfall only between December and April - and earthquakes with magnitude ranging from 3 to 8. The monitoring of the landslide, based on GPS measurements and soil rigidity variations, thanks to the ambient seismic noise correlation method[4,5], allows us to go further in the understanding of the mechanisms impacting the landslide kinematic.

Observations show that (1) there is a clear precipitation-earthquake combination impacting the kinematic of the Maca landslide in 2016. Indeed, at a similar distance from the landslide, an Ml 5.2 event occurring at the beginning of the wet season 2016 generated 6 times more displacement in the following months than an Ml 5.3 that happened during the dry season 2016. (2) From the surface wave velocity variation measurements (dV/V), we associate this combined effect to a decrease of the rigidity of the landslide material, hence easing the infiltration of rainfall into the ground. (3) Once the landslide is in a critical state, i.e. in movement, small seismic events ($Ml<4$) combined with precipitation maintain the landslide in this critical state. We believe that even small shaking events can prevent the landslide material to enter into a healing phase where its rigidity would increase by re-generating bonds between grains.

1. Marc, O., Hovius, N., Meunier, P., Uchida, T. & Hayashi, S.-I. Transient changes of landslide rates after earthquakes. *Geology* (2015). doi:10.1130/G36961.1

2. Lin, G.-W., Chen, H., Chen, Y.-H. & Horng, M.-J. Influence of typhoons and earthquakes on rainfall-induced landslides and suspended sediments discharge. *Engineering Geology* **97**, 32–41 (2008).

3. Bontemps, N., Lacroix, P., Larose, E., Jara, J. & Taipe, E. Rainfall and small earthquakes can maintain a slow moving landslide in critical state. *in prep* (2019).

4. Larose, E. *et al.* Environmental seismology: What can we learn on earth surface processes with ambient noise? *Journal of Applied Geophysics* **116**, 62–74 (2015).

5. Mainsant, G. *et al.* Ambient seismic noise monitoring of a clay landslide: Toward failure prediction: SEISMIC NOISE MONITORING OF A LANDSLIDE. *Journal of Geophysical Research: Earth Surface* **117** (2012).