The occurrence of Landslides in Guarumales, Ecuador

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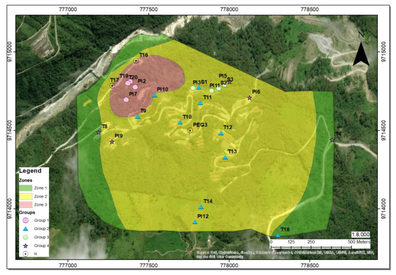
1. Introduction

- Guarumales landslide is located in the Paute river basin, south-east Ecuadorian Andes, where Hidropaute hydro-electric complex holds 3 hydropower plants with 1746 MW installed. They provide approximately 30% of the energy of the country

- Along 2 reservoirs, 21 landslides have been identified[1] being Guarumales one of them.

- Previous work has resulted in mitigation measures and a susceptibility map[1].



The map indicates how the landslide moves by dividing it into 3 zones: Slow (green), intermediate (yellow) and fast (red).

All sorts of data including hydrological and geological have been collected.

2. Objectives

Determine the mechanisms behind the occurrence of the Guarumales landslide.

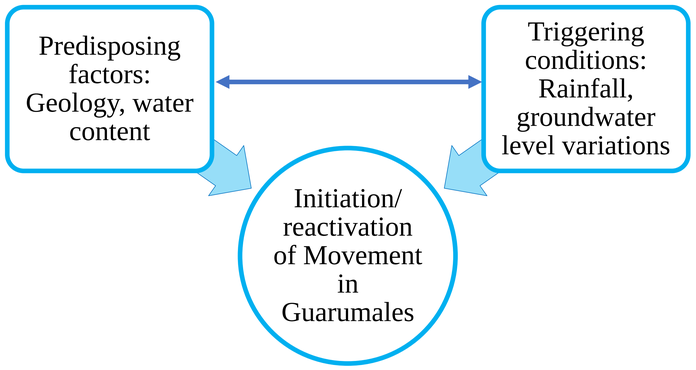
- Identify relevant parameters in landslide initiation-reactivation.
- Determine and quantify predisposing conditions and triggering factors in Guarumales.

3. Methodology

- Detailed geological information from 12 cores reaching up to 100 m.

- Rainfall, evapotranspiration, groundwater levels, and surficial displacements, used for coupled interpretations with geology.

Proposed Approach



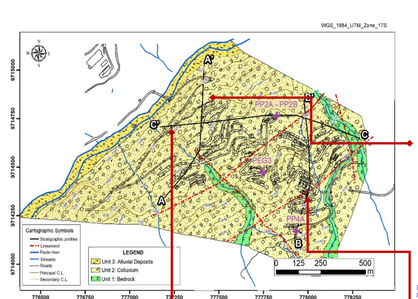
5. Conclusions

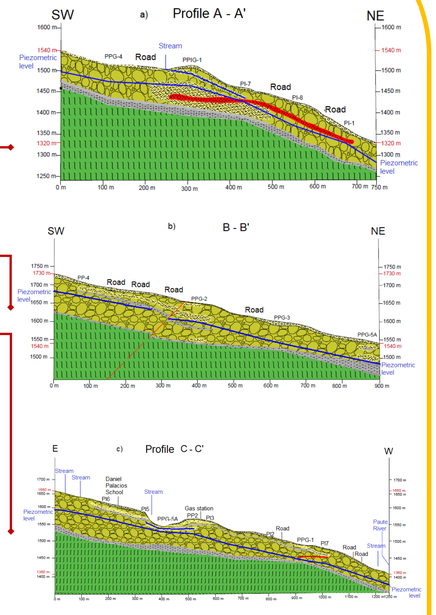
- Rainfall and groundwater act as mechanisms of landslide occurrence. Geology setting enhances the deformation process.

- More shallow groundwater levels are observed where surficial movement is intermediate-fast, influencing deformation.

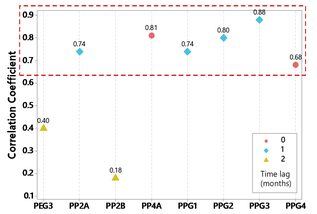
- Geodetical data indicate a continuous movement over 18 years. Relationship with hydrology could not be established due to low time resolution and accuracy of measurements. Monitoring strategies could be improved.

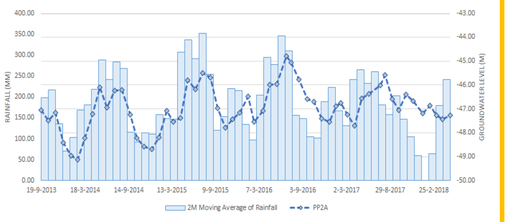
4. Preliminary results





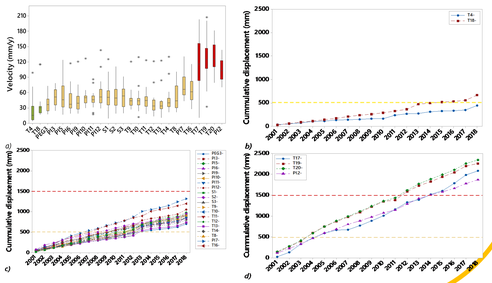
- Composed by a schist bedrock and a clayey fault breccia, underlying a colluvium deposit. 2 groundwater levels found, 1 deep in fractured colluvium and another sub-superficial in sandy loam lenses.





- A relationship between antecedent conditions of effective rainfall and lagged groundwater responses (2-3 months) was established.

- Geodetical measurements indicate a movement rate of 5 to 25 mm/year. in 18 years of data.



[1] X. Robles and P. Guzmán, "Informe de Análisis de Susceptibilidad de zonas inestables para prospección e implementación de instrumentación," CELEC-EP, Cuenca, 2017.