Estimating the thickness and volume of landslides by relying on surface deformation data

Project Framework

Ground deformation is measured with different techniques at unstable slopes, including in-situ based and remote sensing instruments. However, surface data is not sufficient to constrain the volumes of the mobilized mass, which is an important parameter for landslide hazard assessments. In order to identify the depth of a landslide process, direct site investigations such as (i) drilling deep boreholes and/or (ii) using geophysical methods can be applied. In case (i), logistics as well as budget issues hinder the realization of a number of investigation points suitable. In case (ii) spatial and temporal resolution are intrinsically limited, and thus may provide incomplete results difficult to interpret. Recently, several authors have proposed the possibility to use surface deformation data only to extract information on thickness and basal geometry of landslides (Aryal et al., 2015; Booth et al., 2013; Delbridge et al., 2016; Nikolaeva et al., 2014). These approaches are applied to different types of landslides, and assuming different boundary conditions, mechanical properties, and/or rheologies of the moving mass.

Figure 1: A) Great Aletsch glacier. B) Moosfluh Landslide. C) Surface deformation in the lower portions of the Moosfluh rock slope instability as measured from spaceborne DInSAR. White points are locations of targets monitored hourly with 2 robotized total stations.
Objectives and Methods

The main goal of this thesis project is to investigate the different modelling approaches proposed, and to understand their potential application in a more general framework. The student will first perform a detailed review of literature available for the topic “landslide thickness and volume estimations”, and for the identification of the most suitable models and key parameters for different landslide scenario. Secondly, available surface displacement monitoring data (both in-situ and remote sensing) for different landslides will be analyzed. The student will test previously proposed approaches, as well as a newly developed inverse kinematics model. Modeling results, i.e. landslide thickness and volumes, will be compared with geophysical and/or borehole surveys to estimate the performance. The interpretation of these results will be important to understand the reliability of these approaches and if can be used not only at local slope scale but also at larger scales to better assess regional landslide hazard. The student will have the opportunity to visit the Aletsch Glacier region (Fig 1 A and B) to observe surface deformation features in the field.

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References


