EGU2020-5236
https://doi.org/10.5194/egusphere-egu2020-5236
EGU General Assembly 2020
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Landslides and Geophysics: a review of the advantages and limitations on the basis of the last twelve years open access international literature

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Given a landslide, which are the constituent materials? How are the material inhomogeneities distributed? Which are their properties? What are the deformation processes? How large are the boundaries or how depth is/are the slip surface/s? Answering these questions is not a simple goal. Therefore, since the ‘70s, the international community (mainly geophysicists and lower geologists and geological engineers) has begun to employ, together with other techniques, active and passive geophysical methods to characterize and monitor landslides. Both the associated advantages and limitations have been highlighted over the years, but some drawbacks are still open.

On the basis of the more recent landslides classification by Hungr et al. dated 2014, an analysis of about 120 open access papers published in international journals between the 2007 and the 2018 has been carried out. The aim of this review work was to evaluate the geophysical community efforts in overcoming the geophysical technique limitations highlighted in the conclusion section of the review of 2007 by Jongmans and Garambois. These drawback can be summarized ad follow: 1) geophysicists have to make an effort in the presentation of their results; 2) the resolution and the penetration depth of each method are not systematically discussed in an understandable way; 3) the geological interpretation of geophysical data should be more clearly and critically explained; 4) the challenge for geophysicists is to convince geologists and engineers that 3D and 4D geophysical imaging techniques can be valuable tools for investigating and monitoring landslides; and 5) efforts should also be made towards obtaining quantitative information from geophysics in terms of geotechnical parameters and hydrological properties

Moreover, the review work highlighted that the most studied landslides are those of the flow type and fall type for the “soil” and “rock” category, respectively. From the “employed method” point of view, active and passive seismic methods are the most employed in landslide characterization and monitoring. The latest method is also able to remotely detect events that might otherwise go unnoticed for weeks or months, and therefore, it is widely employed. The three more frequently applied techniques to characterize and monitor the slope deformation are electrical resistivity tomography, seismic noise, and seismic refraction. Finally, the main conclusion is that independently of the applied technique/s or the landslide type, a very accurate and high-resolution survey could be performed only on a small landslide portion, as it is costly and time-consuming, even though geophysical techniques are defined as cost and time effective compared

to traditional field methods.