Geologica Belgica Luxemburga International Meeting 2024

Celebrating the 150th Anniversary of the
"Société Géologique de Belgique"

11-13 September 2024

LIÈGE université

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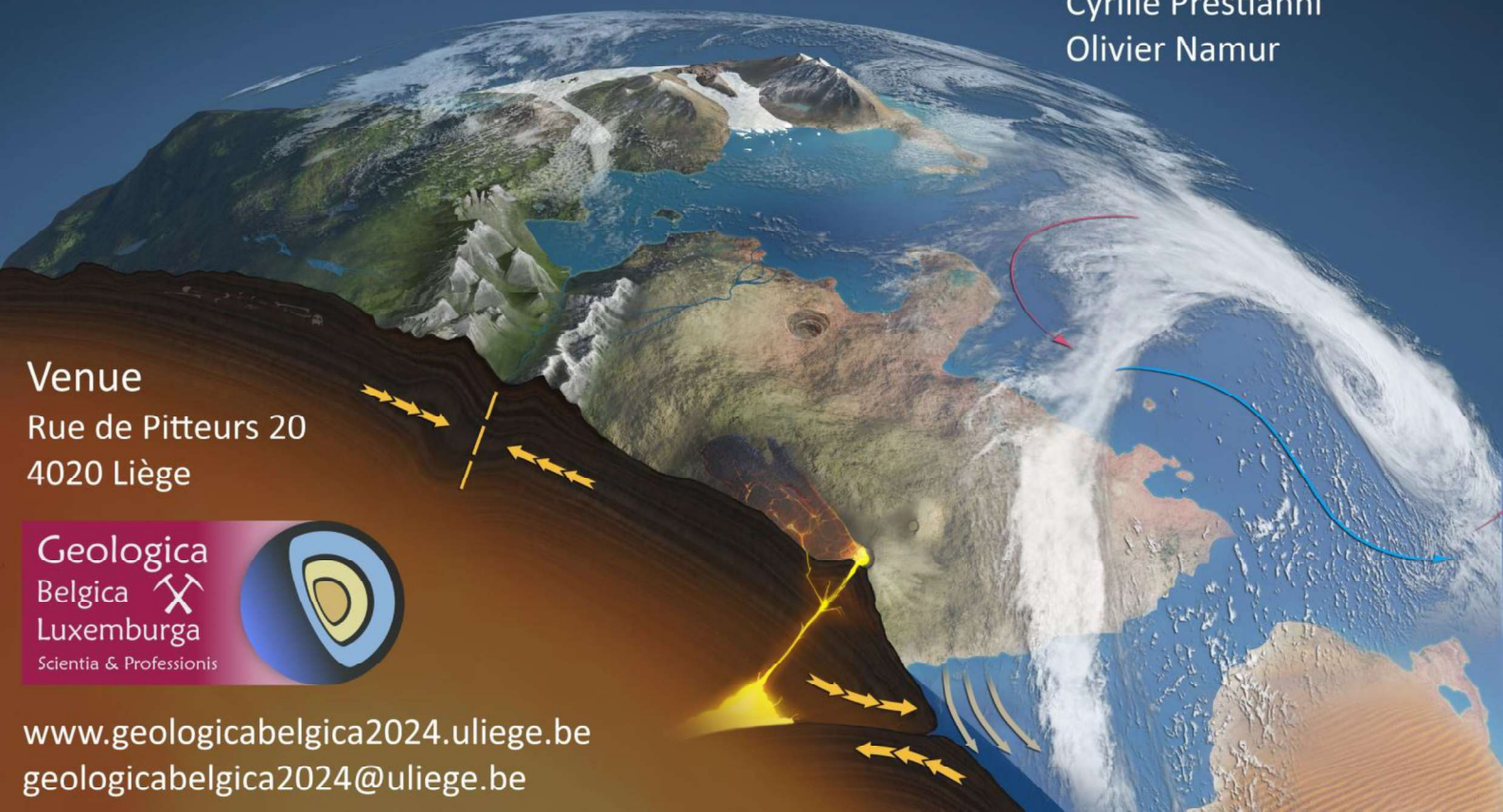

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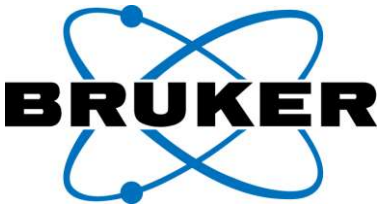

Invited Speaker

Geophysical surveys to improve landslides characterization: examples from around the world

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Characterize a landslide means try to answer some questions like: 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. Moreover, to model the landslide behavior an efficient landslide stability analysis is needed, that means reliable geotechnical parameters have to be assigned to the identified layers. However, it is not always possible to determine the geotechnical parameters from direct tests. Since the '70s, the international community has begun to employ, together with other techniques, active and passive geophysical methods. Both the associated advantages and limitations have been highlighted over the years, and even geophysical techniques are usually defined time- and cost-effective, some drawbacks are still open (Pazzi et al 2019). This work presents different case studies from around the world (Italy, Bolivia, and Belgium) where geophysical techniques have been successfully employed to characterize landslides.

The Italian case study (Innocenti et al 2023) shows how geophysical methods (ERT, SRT, HV, MASW, and GPR) allow to identify the landslide stratigraphy and the shear wave velocity (Vs) values can be used in empirical equation to reliable estimate the friction angle values used in the stability analysis. Although, this indirect estimation is subject to a higher level of error, it could be very useful in the early stages of an emergency, when direct data are not available, and a preliminary forward and backward stability analysis could be performed to assess landslide evolution and civil protection actions.

Seismic noise measurements, integrated with InSAR observations and geotechnical data, were employed in the Bolivian case study to determine the depth of the failure surface and to assess the ground surface deformation (Song et al 2021). The seismic noise measurements (more than one hundred spread over the whole landslide), analysed according to the HV technique, calibrated and validated by means of the geotechnical data derived by boreholes and soil samples, allowed to identify shallow and deep slip surfaces and thus define the different dynamic characteristics of the landslide sub-blocks. The landslides caused damage to the buildings, probably mainly caused by the shallow slip interface (located at a mean depth of 5 m). In the town centre a deeper failure surfaces, approximatively with depth between 15 m and 75 m, can be identified which may be responsible for its different direction and acceleration magnitude of sliding (inferred by InSAR) compared to the other parts of the landslides.

ERT, SRT, and HV data have been integrated in the Belgium case study to reconstruct the stratigraphy and to create a 3D landslide geological model. The three geophysical methods agree in identifying the presence of two main layers: a superficial one of loose material overlying an intact conglomerate one. The contact between the two media would probably be attributable to the sliding surface because of the accumulation of water following significant rainfall events.

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