

EGU2020-5104

<https://doi.org/10.5194/egusphere-egu2020-5104>

EGU General Assembly 2020

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## The use of Frequency Domain Electro-magnetometry for the characterization of permafrost active layers: case studies in the Swiss Alps

Jacopo Boaga<sup>1</sup>, Marcia Phillips<sup>2</sup>, Jeannette Noetzli<sup>2</sup>, Anna haberkorn<sup>2</sup>, Robert Kenner<sup>2</sup>, and Alexander Bast<sup>2</sup>

<sup>1</sup>University of Padova, Department of Geoscience, Department of Geoscience, Padova, Italy (jacopo.boaga@unipd.it)

<sup>2</sup>WSL Institute for Snow and Avalanche Research SLF, Davos, Switzerland

The characterization of the active layer (AL) in mountain permafrost is an important part of monitoring climate change effects in periglacial environments and may help to determine potential slope instability. Permafrost affects 25% of the Northern Hemisphere and 17% of the entire Earth. It has been studied for decades both in the polar regions and – starting a few decades later – in high mountain environments. Typical point information from permafrost boreholes can be extended to wider areas by geophysical prospecting and provide information that cannot be detected by thermal observations alone.

During Summer 2019 we performed several geophysical surveys at permafrost borehole sites in the Swiss Alps. We focused on electrical resistivity tomography (ERT) and Frequency Domain Electro-magnetic techniques (FDEM) to compare the methods and test the applicability of FDEM for active layer characterization, i.e., its thickness and lateral continuity. ERT provides an electrical image of the subsoil and can discern active layer thickness, changes in ground ice and geological features of the subsoil. From a logistic point of view a contactless method such as FDEM would be preferable : i) it can provide electrical properties of the subsoil with no need of physical electrical contact with the soil; ii) it can cover a wider area of exploration compared to ERT, iii) it is faster and data collection is simpler than with ERT due to lighter instruments and less preparation time needed.

Based on the FDEM surveys at the Swiss permafrost sites we were able to detect the frozen/unfrozen boundary and to achieve results that were in agreement with those obtained from classical ERT and borehole temperature data. The results were promising for future active layer monitoring with the contactless FDEM method.