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Detecting the impact of short-lived extreme meteorological events on soil horizon using an A-ERT system, Deception Island, Antarctica

Fernando A. Monteiro Santos (1), Mohammad Farzamian (1), Gonçalo Vieira (2), Borhan Yaghoobi (3), Christian Hauck (4), Catarina Paz (1), Ivo Bernando (1), Miguel Ramos (5), and Miguel Angel de Pablo (5)

(1) Universidade de Lisboa, Dom-luis, Geophysics , Portugal (mohammadfarzamian@gmail.com), (2) Centre for Geographical Studies, IGOT, Universidade de Lisboa, Portugal, (3) School of Mining, Petroleum and Geophysics, Shahrood University of Technology, Iran, (4) Department of Geosciences, University of Fribourg, Switzerland, (5) Universidad de Alcalá de Henares, Spain

The Antarctic Peninsula is one of Earth's regions with strongest air temperature increase, at least since the 1950's. However, the climate signal is more complex than previously accounted and recent studies report a cooling in the northwest of the Antarctic Peninsula since 2000 and even a small thinning of the active layer.
An automated ERT (A-ERT) system with a solar panel-driven battery and multi-electrode configuration was installed at Deception Island, Antarctica, associated to the Crater Lake site of the Circumpolar Active Layer Monitoring Network (CALM-S) and close to Global Terrestrial Network for Permafrost (GTN-P boreholes) in order to investigate the potential of the remote automated set-up system in active layer monitoring. The site includes monitoring of air and surface temperatures, permafrost and active layer temperatures in boreholes, snow thickness and once per year, thaw depth is measured manually by mechanical probing during the summer.
Measurements were repeated at 6-hour intervals during a full year to further increase the temporal resolution, in order to detect the impact of the short-lived extreme meteorological events. These events are rarely addressed in permafrost studies but they induce phase-change and potentially are generators of geomorphic activity, such as cryoturbation, or even small debris- flows in sloping terrains. Being able to identify them in the A-ERT data allows for a better characterization of the links between soil thermal regimes and geomorphic dynamics.
Our analysis of the combined geophysical and thermal monitoring approach confirm its applicability in detecting active layer freezing and thawing processes on both seasonal and short-lived meteorological events in a very remote area without maintenance. Our study clearly shows that without automatic and quasi-continuous measurements, short-time active layer freezing and thawing, as well as the infiltrating water from the melting snow cover to the ground during such extreme meteorological events, could not be investigated.

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