Open Access | https://doi.org/10.62329/PFXY3579

AGROGEO

Assessing the suitability of ground-penetrating radar for peat imaging

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Abstract

Peatland conservation and restoration are prominent in slowing global warming. A thorough comprehension of peat inventory, especially the thickness, bulk density, water table levels, and geological setting, is necessary to plan and initiate rewetting strategies and to calculate emission savings. The conventional mapping methods involving push probes and boreholes are not only cost- and labor-intensive, but they also provide only localized measurements. Among the geophysical sensors, while electromagnetic induction (EMI) and gamma-ray spectrometry have proven to be suitable for mapping specific attributes, ground penetrating radar (GPR) is seen as the industry's standard recommendation. However, the success rate can be highly variable in reality depending on the peatland type, and ignoring this can lead to the waste of numerous resources.

To demonstrate this, in this study, we compare GPR survey transects performed on two different peatland types (a bog vs. a fen) with two different antenna center frequencies (i.e., 160 MHz and 450 MHz). Electrical resistivity tomography was also performed along the same transects to complement and guide our interpretation. Our results suggest that while GPR surveys are suitable in rain-fed oligotrophic bogs, less to no success rate can be anticipated in minerotrophic fens. Forward modeling using gprMax is also shown to substantiate these findings. Thus, knowledge of the peatland type constitutes crucial information for sensor selection. If in doubt, we recommend performing on-the-go EMI surveys before initiating GPR surveys, as electrical conductivity might be sufficient on its own for peatland characterization. Moreover, EMI is also useful for predicting GPR performances.

Keywords GPR, ERT, peat, mapping, thickness, bulk density, water table, modelling, field experiment

Conference Talk

Published Feb 01, 2024

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