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# Calibration of a geophysically based model using soil moisture measurements in mountainous terrains

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The use of geophysical methods in the field of permafrost research is well established and crucial since it is the only way to infer the composition of the subsurface material. Since geophysical measurements are indirect, ambiguities in the interpretation of the results can arise, hence the simultaneous use of several methods (e.g. electrical resistivity tomography and refraction seismics) is often necessary. The so-called four-phase model, 4PM (Hauck et al., 2011) constitutes a further step towards clarification of interpretation from geophysical measurements. It uses two well-known petrophysical relationships, namely Archie's law and an extension of Timur's time-averaged equation for seismic P-wave velocities, to quantitatively estimate the different phase contents (air, water and ice) in the ground from tomographic electric and seismic measurements.

In this study, soil moisture measurements were used to calibrate the 4PM in order to assess the spatial distribution of water, ice and air content in the ground at three high elevation sites with different ground properties and thermal regimes. The datasets used here were collected as part of the SNF-project SOMOMOUNT. Within the framework of this project a network of six entirely automated soil moisture stations was installed in Switzerland along an altitudinal gradient ranging from 1'200 m. a.s.l. to 3'400 m. a.s.l. The standard instrumentation of each station comprises the installation of Frequency Domain Reflectometry (FDR) and Time Domain Reflectometry (TDR) sensors for long term monitoring coupled with repeated Electrical Resistivity Tomography (ERT) and Refraction Seismic Tomography (RST) as well as spatial FDR (S-FDR) measurements.

The use of spatially distributed soil moisture data significantly improved the 4PM calibration process and a semi-automatic calibration scheme was developed. This procedure was then tested at three different locations, yielding satisfactory two dimensional distributions of water-, ice- and air content (Pellet et al., 2016).

REFERENCES

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