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Geoscientific Instrumentation Methods and Data Systems Discussions

Interactive comment on "A monitoring system for spatiotemporal electrical self-potential measurements in cryospheric environments" *by* Maximilian Weigand et al.

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As an actual SP user to study hydrological processes in the critical zone, I also think that there is a growing need to provide a state of the art equipment for "long-term, year round, unsupervised operation [which] must be ensured to minimize human intervention" (and, from my point of view, not restricted to permafrost regions). In general, I think that the proposed system is carefully designed and well-though for optimal long-term measurements, using state-of-the-art knowledge about both electrode, electronics, and SP theory. I particularly like that a good care is taken for monitoring the temperature exactly where electrodes are in contact with the ground and the careful

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Discussion paper

study of this crucial effect in such extreme environment.

I went through this nice manuscript in open discussion and I have some questions/comments below. That said, I really like this manuscript and the really nice system that you designed. I'm also quite eager to read the process-based study/paper that will follow this publication.

Best,

Damien Jougnot

CNRS scientist, Sorbonne University

Page 3 lines 18-23: It seems that HS equation is working fine for any kind of geometry (it was also demonstrated around large enough spheres, i.e. in colloid sciences) as long as the surface conductivity can be neglected. We try to discuss and highlight this in our recent paper Jougnot et al. (2019).

P.4 lines 8-20: one can note that Doussan et al. (2002) did perform some long-term monitorings of vertical flow and Voytek et al. (2019) vertical and horizontal close to a tree.

P.8 line 3: "vertical" could be misleading as it could be understood as at various depths.

P.9 line 10: why is fig. 6 called before fig. 4 ?

P.9 lines 11-16: It is good to make measurements with respect to a single reference (i.e., total field instead of dipoles) and having a duplicate of that seems like a good idea, but I am a bit confused by this paragraph. Could the author elaborate on the electrical circuit wiring they propose to be able to measure it with respect to two different references ? is it at the same time ? alternatively ?

P.13 Fig. 7: This experiment is really interesting and changes are bigger than I would have expected. What about between standing electrodes ? And did the authors check between both pairs of buried vs. standing or only one ?

P.14 Section 5.1.2: Given the dynamic of processes sensed by SP signal, is 1h rolling-mean a good choice ? In Jougnot et al. (2015) and Hu et al. (2020) we used 5 min windows and probably missed/were affected by higher frequency SP signal.

P.23 section 6.1: Something which is often done when conducting a SP mapping/profile (and I think should be done), is to remove the reference used for the measurement and re-reference the signal. Could be interesting to show/discuss this point.

P.23 section 6.2: I strongly encourage the author to include dielectric permittivity and local electrical conductivity measurements to their system.

P.24 line 23: I don't think G should be in italics.

References:

Doussan, C., Jouniaux, L., & Thony, J. L. (2002). Variations of self-potential and unsaturated water flow with time in sandy loam and clay loam soils. Journal of Hydrology, 267(3-4), 173-185. Jougnot, D., Mendieta, A., Leroy, P., & Maineult, A. (2019). Exploring the effect of the pore size distribution on the streaming potential generation in saturated porous media, insight from pore network simulations. Journal of Geophysical Research: Solid Earth, 124(6), 5315-5335. Jougnot, D., Linde, N., Haarder, E. B., & Looms, M. C. (2015). Monitoring of saline tracer movement with vertically distributed self-potential measurements at the HOBE agricultural test site, Voulund, Denmark. Journal of Hydrology, 521, 314-327. Voytek, E. B., Barnard, H. R., Jougnot, D., & Singha, K. (2019). TranspirationâĂŘand precipitationâĂŘinduced subsurface water flow observed using the selfâĂŘpotential method. Hydrological Processes, 33(13), 1784-1801.

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