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Interactive comment on "In situ measurement of meltwater percolation flux in seasonal alpine snowpack using self potential and capillary pressure sensors" *by* Wilson S. Clayton

Anonymous Referee #1

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The manuscript "In situ measurement of meltwater percolation flux in seasonal alpine snowpack using self potential and capillary pressure sensors" by Clayton presents a case study with new instrumentation to determine melt and liquid water within seasonal snow. The author describes a self-constructed, transportable instrumentation applicable for conventional fieldwork without transportation support. Measurements with the described system are destructive, which in consequence have a number of limitations and are prone to certain errors. The presented manuscript is well written, it presents a novel approach and might contribute to validation of simulation outputs. However, apart from the assembling and combination of the applied measurements, the presented data are limited to a time period from a single day to maximum two weeks. It

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remains a bit unclear, how this work contributes/ improves our knowledge, while being compared with already existing methods such as capacity plate sensors (Denothmeter) or TDR sensors, the usage of lysimeters for capturing outflow or the cited work on self-potential signatures.

Before publication, I recommend to clearly state the purpose of this work and describe the benefit for the scientific community in comparison to previously published approaches/ data sets. Right now, it is just a feasibility study, which produced deviations to conventionally measured data of almost up to 50%. The current status of this manuscript does not rectify publication within The Cryosphere. In addition, the presented data must be compared with long-term observations of liquid water content behavior, outflow and diurnal changes thereof in seasonal snow presented by Heilig et al. (2015 – doi: 10.1002/2015JF003593). Such measurements were conducted over several months for four consecutive years at three different locations and in a non-destructive manner. Hence, stratigraphy remained undisturbed by measurements and instrumentations. Since you did not present a single data set on snow density/ porosity, it is very difficult to compare the presented results on diurnal changes and saturation with previously published data. Furthermore, you certainly should include work published by F. Avenzi and colleagues about model assessments and measurements of liquid water in seasonal snow. The reference of Samimi and Marshall is just the most recent one for TDR but for introduction of such methodology you rather have to cite Sihvola and Tiuri (1986) and Schneebeli et al. (1998). Avenzi clearly demonstrated that such probes (which you are using in a similar way) can be affected by melt out, heat conduction via cables and air voids surrounding the sensors. For a long-term monitoring this is a strong limitation. The spatial support of your measurements are very limited to just the placements of the sensors. A comparison with snow pillows and ultrasonic transducers being located in a distance of 30 m is a least questionable (i.e. think about heterogeneous percolation). Please include into discussion how much the zeta potential can vary, any literature data, measurements you conducted? This will actually allow for determination of error ranges.

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Some minor points that need to be revised:

P2 L29 give units for the area (m2)

Don't use a point for the abbreviation of meter P5 L7

Please state how far apart from each other all three measurements were conducted (P5 L12ff)

P6 L13 please present data on density determinations

P8 L12 well, it is actually the full energy balance at the location that drives snow melt. Air temp. might be a result from the radiation budget or might be laterally transported by sensible heat, released as latent heat etc. Please be precise.

P9 L9ff it might be more appropriate to use 6am for determination of diurnal changes since at that time usually daily minimum in temperature is reached. (see Heilig et al., 2015)

Sihvola, A.; Tiuri, M. Snow fork for field determination of the density and wetness profiles of a snow pack. IEEE Trans. Geosci. Remote Sens. 1986, 5, 717–721. Schneebeli, M.; Coléou, C.; Touvier, F.; Lesaffre, B. Measurement of density and wetness in snow using time-domain reflectometry. Ann. Glaciol. 1998, 26, 69–72.

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