

Interactive comment on “Three-in-one: GPS-IR measurements of ground surface elevation changes, soil moisture, and snow depth at a permafrost site in the northeastern Qinghai-Tibet Plateau” by Jiahua Zhang et al.

Anonymous Referee #1

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General comments: This paper presents a modified GPS-IR algorithm for soil moisture retrieval in permafrost regions. The authors find that the modified algorithm performs slightly better than the default method, which can be seasonally-biased due to surface deformation changes resulting from the thawing active layer. The authors find a significant bias between their GPS-IR snow depth retrievals and in situ observations near the antenna.

Overall, I found the paper to be well written with clear objectives. Since the results presented in this paper are only from one GPS antenna with a limited time series, they

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are preliminary, and it is difficult to know if the methodology will be successful at other GPS monuments. However, it makes for a good initial study in this topic.

Specific comments: Figure 2: I think the antenna anchoring position should be drawn not in the permafrost, but in the active layer, since that is where your antenna monument is anchored.

Line 160: Why do you only use 5-15 degrees in this study, when other GPS-IR studies more commonly use 5-30 degrees?

Line 167: Reflector height does have a dependence on soil moisture, though it is not as linear as the dependence of phase on soil moisture. How do you know that your summertime reflector height variations are due to ground surface elevation changes and not due to soil moisture?

Line 323: You say that one reason for the difference between in situ snow depth observations and snow depths derived from GPS-IR is the difference in sampling areas. Couldn't you check this by excluding the SNR observations that lie outside the manual probing positions?

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