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Interactive comment on "Ground subsidence and heave over permafrost: hourly time series reveal inter-annual, seasonal and shorter-term movement caused by freezing, thawing and water movement" *by* Stephan Gruber

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Thank you very much for your review and your constructive comments on this manuscript. I hope that the explanation given below, and the changes to the manuscript, will provide an adequate response.

Referee comments are indicated as "RC" and author responses as "AR".

RC: As always when combining new development of technical devices with scientific results, the resulting papers may lack focus. In this case, the description and devel-

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opment of the tilt arm is combined with first tests and results, and the paper focus on the latter in the end. A part of the discussion is again used to discuss the design of the tilt arm. The introduction of the new device would justify a short communication or similar, while the 2 years data of soil heave may not justify a publication in a high-ranked international journal, even the data look reasonable, and Fig. 5 is illustrative. The results obtained are interesting, and discussed against the possibility of hydrological processes being a major driver. However, this aspect is not documented by measurements or models.

AR: Both referees allude to the possibility of making this a short communication and I respectfully disagree with this suggestion: First, the journal guidelines for (2–4 pages, up to 3 figures/tables, up to 20 references) would not permit an adequate level detail. Second, the potential of processes other than phase change in soil to obfuscate analyses of surface movement can be clearly shown, even with this short dataset and in the absence of additional observations of hydrology.

RC: Introduction: Wordy and could by straightened up, and be merged with “Background” chapter.

AR: The introduction has been shortened although it still needs some space to outline the problem to be addressed in the context of relevant previous research. The background, already quite dense, has been retained as a separate section as it puts the proposed innovation into the context of previous work.

RC: Introduction: I miss a key map, and an image over the study area to get an impression how it looks like there.

AR: Both referees asked for an additional image while, at the same time, suggesting shortening the manuscript. As a balance, the revised submission now has an additional figure that shows the character of two field sites (the third being similar to one shown) with overview images and a close-up on the tilt arm showing ground cover. The previous Figure 1 (now Figure 2) has, correspondingly, been shortened by removing the

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first panel. Because the geographic arrangement is inconsequential and coordinates are listed, no additional map has been included.

RC: Material and Methods: Now, the tilt arm is explained and introduced as a new field device, and the error range is presented well. See comment above. L. 113 mentions a drill and a references, better to explain the drill if it is important.

AR: The sentence specifying the type of drill has been removed.

RC: Delete the 4.2. paragraph (just one sentence) or incorporate elsewhere. 4.8. the same, paragraph is not necessary.

AR: incorporated 4.2 into preceding paragraph and deleted 4.8

RC: Fig. 4: What is “density” here?

AR: Density is better explained now in Figure 4 and also, values have been removed from the vertical axis as they do not add relevant information to the interpretation.

RC: Acknowledgements: l. 315: “And who came up with those site names..”. What is this?

AR: deleted

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