

***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***

**Anonymous Referee #1**

Received and published: 29 December 2019

The manuscript by Gruber describes a new device developed to measure heave and subsidence with high resolution in environments dominated by freeze-thaw processes. The device is described and tested in three contrasting sites, and the results are compared to a simple empirical model. The vertical movement of the ground is an important process in these environments, with geomorphological and geotechnical significance.

The manuscript is mainly well written and structured, and comes to relevant results, which may be of interest for the scientific community working with frost heave and also interpreting outcomes from remotely-sensed imagery. The results are discussed

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upon relevant other literature, but maybe a bit simplistic against the Stephan solution etc. My impression is somehow positive, however, the authors may think about the following points:

- As always when combining new development of technical devices with scientific results, the resulting papers may lack focus. In this case, the description and development 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.
- Introduction: Wordy and could be straightened up, and be merged with “Background” chapter. I miss a key map, and an image over the study area to get an impression how it looks like there.
- 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.
- Delete the 4.2. paragraph (just one sentence) or incorporate elsewhere. 4.8. the same, paragraph is not necessary.
- Fig. 4: What is “density” here?
- Acknowledgements: l. 315: “And who came up with those site names..”. What is this?

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Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2019-227>, 2019.

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