Review of „Quantifying Long-Term Ground Surface Subsidence in the Lena Delta Induced by Degrading Permafrost Using Sentinel-1 SAR Interferometry “

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This article presents interesting results of ground surface subsidence across the entire Lena river delta. The study uses sequential differential interferometric SAR based on Sentinel-1 SAR data from 6 summer seasons (2016 – 2021). Differential interferograms with an annual temporal baseline are used to bridge snow covered and snow melt periods with low coherence. The authors show with their results that the subsidence rate is highly linked to the different geomorphological units and their respective ground ice content. Validation with limited in situ observations indicates that the approach underestimates the subsidence rate and does not cover the small-scale variability due to the different spatial resolution.

While the manuscript is generally well-written and clearly addressing an important issue (i.e. monitoring ground subsidence in areas with limited in situ data and access), the manuscript could benefit from a few adjustments, which would improve the readability of it for readers not familiar with the investigated area. Besides, the assessment beyond the geomorphological units could be a bit more detailed, particularly with respect to the different vegetation cover types. In the following, some general remarks on the manuscript are provided first, followed by detailed line-specific comments afterwards.

General comments – manuscript:

- **Section 2: Study site**

This section provides a very detailed description of the study site with a particular focus on the three different geomorphological units. This is very interesting but hard to follow as a reader. We would recommend adding a small table that summarizes the differences between the geomorphological units in a concise and structured way, which would support the reader through this section. Besides, it might be useful to move Figure A1 to this part as much information presented here originates from these data sources.

- **Figures 3 & 4**

As a diverging colour ramp is used to visualize positive / negative vertical movement, this should also be reflected in the value range selection: negative values should be highlighted in shades of blue and positive values should be highlighted in shades of red, no movement should have a neutral colour. Currently 0cm movement is indicated in light orange which gives the impression that uplift is much more widespread than it actually is and should, therefore, be adjusted, even though the null point might not reflect true stability, as the authors also mentioned.

- **Section 5.2: Permafrost degradation**

While the investigation of permafrost is very detailed, it lacks a thorough analysis to disentangle the influence of the geomorphological unit and other parameters, for instance, the land cover type. Therefore, the analysis should be more detailed and calculate the histograms provided in Figure 7b and A3 separated by geomorphological unit. That would

provide more insights, whether subsidence rates are rather affected by the landcover class or the geomorphological unit. Of course, the former is also highly dependent on the geomorphological unit but a distinct difference in dynamics of one land cover class for different geomorphological units would strengthen the hypothesis of the authors that the geomorphological unit and their ice content are the key drivers behind different subsidence rates.

Specific comments:

L32-45:
The first paragraph could benefit from a few more references to clarify which statements are based on literature and which statements are by the authors.

L178-180:
"The coherence map of the Lena Delta (Supplementary Figure B2) shows the highest values over the sandy sediments and lowest values – which are, however, still above the thresholds – for the floodplain areas of the youngest geomorphological unit."
Please provide further information about the value range to support your statement (e.g. median, 5^{th}/95^{th} percentile). Consider rephrasing the sentence, as it remains a bit unclear, which thresholds you are referring to.

L183:
Please clarify what your reference region is. Is it a reference point, a certain window or a manually selected aoi? Please also indicate the reference area in one of the maps. Also, the style of the coordinates written is different than further down (L196 – 199), please harmonize that.

L196-199:
Please indicate also these points in one of the maps.

L241-242:
"[…] where red indicates positive (upward) displacement and blue indicates negative (downward) displacement."
This is not true. Please adjust the color scale as mentioned in the general comments.

L242-250:
For a consistent structure of your manuscript, stay with the same order of the geomorphological units across different sections (i.e. study site, results and discussion). Besides, clearly indicate which number the currently discussed geomorphological unit has.

L244-245:
"The youngest geomorphological unit is characterized by heterogeneous rates of motion, depending on the lithology linked to the Holocene river terraces or to the wetland parts of the modern floodplains."
Did you actually test that dependency? If so, please elaborate on that in the discussion. Otherwise consider removing the second part of this sentence.

L249:
"The slight heave apparent in some areas (red in Figure 3) […]"
As mentioned before, this is not true under the current color scale, please adjust it.

L258-259:
Please indicate more clearly that these are four randomly selected exemplary points to highlight the different movement dynamics visible in the time series. Also state clearly that no in situ data is available for these points.

Figure 4:
Please add legend entries to clarify that the white dots indicate in-situ data, and the black dots indicate the location of the exemplary time series.

Figure 5b:
How certain can you be that the difference in displacement between these two islands is a real difference in surface change and not just due to phase unwrapping artefacts, particularly when using interferograms with such long temporal baselines and so small coherence of only about 0.2 (e.g. Figure B1)? Please elaborate that in more detail in the discussion section.

Discussion (L382-421):
Also here: For a consistent structure of your manuscript, stay with the same order of the geomorphological units across different sections (i.e. study site, results and discussion). Besides, clearly indicate which number the currently discussed geomorphological unit has.

L399:
"This is consistent with the long-term deformation values observed here, where […]"
Consider rephrasing: "The long-term deformation values observed here are consistent with this, as […]"

L414-421:
Given the amount of data available, the interpretation of the subsidence dynamics for this geomorphological unit (Holocene terraces and modern floodplains) is too simplistic. Most of the information is just a summary of information already given in the study site section. Instead, please investigate whether surface dynamics vary between the different vegetation cover types. Please also consider the recommendations made in the generic comment.
Besides, you also state that erosion is more extensive near the margins of the island. Is that based on evidence from this study? Or based on previous studies? If the former is the case, please provide some numbers.