Review: Rapid mass loss and climate-driven dynamics of the Juvfonne ice patch, Norway (2010–2025), Andreassen et al, 2026

General comments

The authors present an overview of ~15 years of monitoring activity at the Juvfonne ice patch, describing glaciological changes as well as atmospheric conditions, with an interesting and nice-to-read discussion of how wind influences accumulation at the site and what this means for the potential future evolution of the ice patch. The manuscript presents clear results and is generally well written and structured. I would mainly ask the authors to include some more detail regarding certain parts of the methods. Other than that I have various comments on technicalities and phrasing. These are fairly numerous but mostly very small. This will make a nice contribution to TC after some (I think) relatively minor adjustments.

Methods:

Getis-Ord Gi method: Please provide a bit more context, specifically on the concept of the hotspots (Fig 8). I know this is an established method and we don't need a huge level of detail, but it would be good to give enough explanation to follow your reasoning for applying this method and to allow a general interpretation of the hotspot figure for readers not familiar with the method.

Albedo/webcam analysis: I struggled to follow the explanation of this (Section 3.6) and did not fully understand what was done or what, specifically, the purpose of this was. I think this is mainly a matter of expanding and perhaps restructuring the description in the methods section.

Uncertainties: Various uncertainty estimates are provided but it is not always explained how these were obtained (e.g., glacier area, point mass balance). Can uncertainty of surface elevation change be estimated and added to the results?

See also specific comments on the above issues in the list below.

Specific comments

L87 *Two tunnels have been excavated by hand with specially designed ice axes in the Juvfonne ice patch* —> a short explanation on why this was done would be helpful to readers unfamiliar with the location.

L121-124 *Spatial patterns in snow accumulation pattern were analysed using the "Getis-Ord Gi*" method (Getis and Ord, 1992; Ord and Getis 1995). Snow depth values were normalised as deviation from annual mean, and the analysis was conducted using a fixed bandwidth of 300 m. False discovery rate corrections were not applied.*

Can some additional context be provided here? Are deviations of single measurement dates computed as deviations from the annual mean of that year, or does this refer to a multiyear mean or some other approach? Does "fixed bandwidth of 300m" refer to elevation bands? What are false discovery rates in this context? Briefly explain the concept of the Getis Ord method and what the output of this is.

L128 *Measurements represent the outermost continuous boundary of snow or ice.*

How do you exclude seasonal snow? (Or is it included?)

L139 *accuracy assessment showed that the vertical accuracy of the surface elevations was generally better than ±0.1 m*

How was accuracy assessed?

L151 *The accuracy of the 2023 and 2025 surveys is estimated to be within 0.1 m, with the 2016 survey suffering from some doming and have lower accuracy*

As above, how was accuracy assessed? Check grammar in the second part of this sentence

Section 3. 4 Ice thickness

Can you clarify if the two independent surveys were conducted to cross-check the two sensors and the airborne vs walking approach, or if both were combined to improve coverage? This is not clear to me from the text. Similarly, are the "overlapping measurements" used to assess uncertainty always from the two separate campaigns, or was there overlap within the individual campaigns? Consider referring to Fig 7 in this section to indicate the profile lines. Was the airborne survey intentionally conducted in the shape of a star? If so, why?

L224-228 *We compared the imagery with albedo at the Juvvasshøe weather station, defined as the ratio of incoming to outgoing shortwave radiation, to distinguish between bare ground and snow-covered conditions around the glacier. Based on this comparison, we used an albedo of 0.10 as an approximate threshold for bare ground and 0.15 as a threshold for snow cover exceeding 50% of the surface. The higher threshold was used because albedo is highly sensitive to small amounts of snow on bare rock.*
Not sure I understand what was done here. Was this a visual comparison of webcam imagery with albedo at the weather station? Is the station included in the webcam images? If not, how was it compared? When you say "50% of the surface", which surface are you referring to?
Section 4.1 Mass balance data. How were the uncertainty values determined? Consider also providing them for cumulative values.
Fig. 4, Table S1: How was the uncertainty of the extent determined? I don't think this is explained anywhere.
L278 *indicating the effect of the geotextile installed in 2016*
Would this be better in the discussion? I think this should be either omitted or explained in a bit more more detail (how does the textile cause reduced melt/mass gain?)
L288 *This artificial effect locally reduces the observed thinning relative to the surrounding areas*
Similar to above comment. Maybe better as part of the discussion? Arguably it is not an "artificial effect" since the effect on surface elevation is real. Consider rephrasing.
Fig. 8. Getis-Ord Gi method: please provide at least enough background on this method so that readers unfamiliar with it can understand the general message of this figure. What are "hot spots" in this context? Hot implies temperature but is related to snow accumulation here. Briefly explain the general concept in the methods.
L342 *The warm front also brings a small decrease in snow depth.*
Technically, it is not really the warm front as such that brings this but, presumably, settling due to temperatures, wind, etc. Consider rephrasing.
L367 *Additionally, the erosion or deposition of blowing snow can have influenced this result, because blowing snow only takes place during strong wind and often during precipitation. Most likely, erosion due to blowing snow is the key reason why the overall snowfall values are low.*
Consider moving to discussion.
L409 *significant melt days* —> I believe this has not been introduced, consider defining this term in the methods section
Paragraph starting in L496: I suggest moving this to the discussion.
L548 *It should be noted that CPDD does not account for nighttime refreezing, crucial for possible refreezing of melt water.*
Do you assume this to play a significant role here? If so, I suggest stating that.
L573 C*onsequently, the suppression of subsurface melting significantly enhances the longevity of ice patches* —> all ice patches or just those above permafrost?
L581 *Thus, a feedback loop exists: the underlying permafrost delays the degradation of the ice patch, while the ice patch concurrently prevents the degradation of permafrost in its immediate vicinity during periods of climate change.*
As above, not clear form the text if you mean that this is true of all ice patches (i.e., are all of them on permafrost?) or if you are speaking specifically of Juvfonne here?
From L585 onwards, section on LIA extent: This mixes methods and results that have not been introduced yet. Consider restructuring somewhat and mentioning this earlier.

Technical corrections

L46 *with numerous signs from hunting and travelling*
Consider rephrasing for clarity - what kinds of "signs" or these? Archaeological artefacts?
L74 repetition from L58, is this needed again or can redundancies be removed?
L77 *recent inventories* —> specify "glacier inventories" if that is what they are. Why was it not included in the earlier inventories?
Fig1: why are there two "front" markers? Do they indicate the position of the front at different times?
L136 and other instances: ensure all abbreviations are explained (lidar, UAV, RTK,…)
L155 *except for Kjelen and Juvfonne that were digitised orthophotos acquired on 26 August 2019* —> "…, for which outlines digitised from orthophotos acquired on …. were available"? (If this what you mean? otherwise, what are "digitised orthophotos"?)

L168 Global Navigation Satellite System (GNSS)
Introduce abbreviation where it first occurs.
L187 *Model data were also included* —> which model data and for what? (I suggest removing this here since you explain it in the next paragraph).
L234 *Mass balance for the entire ice patch was not calculated for all years, but only for the first year of measurements (2009/2010), when more stakes were available.*
This was already stated in the methods, no need to repeat here unless you include the glacier wide MB from that year.
Fig. 4: the black and blue lines are hard to see. Consider using brighter colours.
L301 *volume of 20 m3 and an estimated volume of 73 m3 in 2011*
Is this meant to be the entire volume of the ice patch (??) Check the units.
L312 bw —> winter mass balance? Was this abbreviation defined?
Fig 9 caption: “around before and after a cold front” rephrase for clarity (omit around?)
Paragraph starting in L 334: check tenses and homogenise them (should probably be past tense throughout)
Fig S5: Unclear from the caption and legend what “3 . Snow depth” is and how it differs from the dark blue snow depth. Please clarify.
Windrose plots (Figs 10, S6) can the scale of the y axis (%) be homogenised across the subplots? It is hard to compare them if the scales differ.
L376 aligning —> aligns?
L377 *Precipitation obtained from seNorge_2018 and observed at nearby Bøverdal station is evenly distributed throughout the year, with the lowest amounts in April and May, and the highest in January and November.*
The second part of the sentence seems to contradict the first.
Fig S7: What is the difference between the solid black line and the dotted line? Explain in caption.
L393 *The annual variations in air temperature is illustrated* —> are illustrated
L408 *Over this 16-year observation period, the exhibits a consistent positive trend* —> incomplete sentence?
L418 *leading to the largest summer balance recorded of nearby Storbreen* —> consider rephrasing for clarity to something like “..leading to the most negative summer balance recorded at nearby Storbreen..”
L472 *To assess how the changes of Juvfonne are compared to other ice bodies in the region, we assessed the repeat lidar surveys covering Juvfonne and the Galdhøpiggen massif over the period 2011-2020*
To assess we assessed — consider rephrasing
Table 1: what are the bold values in the last line? I assume sums and averages, but it should be stated somewhere (caption)
L555 missing ‘ symbol to end the quote
L573 remove extra period after the parentheses