We thank the reviewer for these valuable comments that improve this manuscript. Please see our responses to each comment below in blue.

General comments

This is a great study. We need regular altimetry validation studies that use observations from kinematic GNSS, and this study which uses a unique dataset that samples surface height change in winter and in summer fills an observational gap. I think the manuscript should be accepted with minor revisions. I also have mostly general comments that the authors can take or leave.

My main criticism is that I think the manuscript could go into more detail about the surface elevation trend that you observe at Summit. Do we see an increase or decrease in mean surface height over the 2-year period you have observations? The density of your observations in space and time provide a unique constraint that I think could be used to describe in more detail the subtle surface elevation change signals that are propagating into the interior from more well documented change from the margins. Could you add in the conclusion or the discussion a short subsection that describes these elevation changes and speaks to the significance of this observation in the context of Greenland/Summit accumulation derived from reanalysis and your observations? Consider adding a section in the discussion:

Interior surface-height change detected by the OGRE network

Beyond bias characterization, the OGRE time series document a net rise in the interior surface of the Greenland ice sheet during 2022-2024..”

We grappled with whether to include information about elevation change in this manuscript as studying not only absolute biases but also the ability of ICESat-2 to correctly capture elevation trends through time is important. Furthermore, understanding the processes that contribute to elevation change in interior Greenland are important for many glaciological and climate applications.

In fact, we have a manuscript in preparation that examines these points on elevation change. We feel this belongs in a separate manuscript because the processes that contribute to elevation change are complex. We must take into account firn thickening/thinning, ice thickening/thinning, in addition to surface processes such as accumulation, thus requiring multiple additional datasets and analyses that we feel would distract from the scope of this manuscript.

It might be outside the scope of this study, but in the future, could you consider using dual frequency GNSS from ground-based radar surveys and UNAVCO kinematic GNSS data to increase the number of GNSS/IS2 crossover points? Much of this data exists and is fully processed on UNVACO/CReSIS servers already, and though most of this data was collected without monitoring sinking from sleds, the sled design/geometry is well constrained and photos from different seasons could be used to calculate the sinking term and augment the year-round surveying described here for summer months over different

regions of Antarctica and Greenland for environments where the surface conditions are more rough near the coast.

This is a good suggestion: we have examined several existing on-ice GNSS studies, including the SMM3 UNAVCO/Earthscope station at Summit and the GLISN stations in south Greenland. These static stations can use reflectometry to derive the surface elevation. However, they were not deployed underneath ICESat-2 overpass lines and therefore required additional corrections for slope that make them too imprecise for this study. These sites, in addition to other kinematic surveys, would be very suitable for radar altimetry comparisons, given the larger footprint.

One other question I have is connected to the methodology and processing of the kinematic GNSS data and -IR data. I think with a base station at summit and the network in Greenland maintained by UNAVCO, it should be possible to process the kinematic GNSS using TRACK relative to base station solutions using software like GAMIT/GLOBK (or public solutions from repositories that host GNET and summit data). In the case of the OGRE, processing with GAMIT/GLOBK as part of a larger solution for Greenland may improve the relative surface height estimates and could be worth considering in the future. If you need help setting this up for future studies, we can connect after the review period (I don't think it affects any of your main conclusions here).

Any suggestions to make the data more useful in future studies are appreciated and we would happily explore this suggestion further.

The only other delicate suggestion I have is to perhaps make less strong claims about the originality of the autonomy of these systems. For instance, someone likely from unavco or pascal is raising these sensors to make it possible to do GNSS-IR over multiple seasons. This is a lot of work, and it's been done for quite a while at Summit, but also more remote sites. For instance, take the second paragraph of the conclusion:

"We also present an autonomous method of retrieving ground-based surface elevation estimates using GNSS interferometric reflectometry with a standard GNSS receiver, mounted on a mast in the snow."

This language makes it seem as though this is the first use of GNSS-IR for monitoring surface height change of ice sheets when most of the methods you've described are well established (and I think still require people to service the instruments?). I think these sentences could be modified to emphasize the novel application (surface tracking/altimetry validation) using an established method. I don't think This was intentional, and my suggestion is just to make this more clear.

We appreciate this suggestion. Indeed, several papers have made use of UNAVCO on-ice infrastructure for reflectometry (e.g., Larson, M MacFerrin, T Nylen 2020), who first suggest the applicability of their methods to altimetry validation. We will adjust our language accordingly in the introduction and elsewhere, while maintaining the novel aspect here: that these stations were designed and deployed specifically for this purpose (e.g., geolocated along ICESat-2 paths with appropriate antenna heights).

Below are minor suggested changes for style and content:

Figure 1: In panel B, it appears most of the reflections are coming from within this azimuth angle of 5 degrees, but that this zone doesn't overlap in this case with the icesat2 passes. Could similar figures be made for all sites to show how where the measurements you're making are relative to the the icesat-2 tracks.

Given the relative compactness of our network (~30 km east-west), the reflection zones and azimuth angles are mostly consistent from station to station. The fact that the elevation angle window emphasizes the surface area closer to the instrument than the ICESat-2 paths is perhaps our largest source of uncertainty with this method and we will adjust our language accordingly.

LN: 7-11 consider removing autonomy, and defining GNSS, GNSS-IR. Also choose GNSS or GPS (as I think you probably use solutions from all the satellites not just GPS?)

"while reliable, these surveys are resource-intensive. We introduce an alternative, novel validation method using Global Navigation Satellite System (GNSS) Interferometric Reflectometry…"

We will make this language more self-consistent and defined and consult with the editor about acronym definition here. GPS refers to the kinematic survey with the R7 receiver, which is old enough to only track GPS/GLONASS and here only tracks GPS.

L12-16 Consider quoting the bias and standard deviation directly. Revealing mean bias of *** +/- ** cm relative to ICESat-2.

These quantified details for each methodology/technique may be too detailed for these initial sentences but we will examine the appropriateness of this information here or elsewhere in the manuscript.

L23-31: "By contributing a complementary geographic setting to antarctica.."

This is a long and awkward sentence to me -consider revising, and reframing around Summit as a legacy validation site and link to icebridge and icesat-1.

Fixed.

LN 112-118 (Section 3.1): "The median standard deviation of each pseudo-static point..

This was a sentence that I felt could be shortened and combined with the second sentence:

The median standard deviation of the pseudo-static points was 0.8 cm (n=****), consistent with prior Summit estimates (0.9 -1.8 cm).

We will consider this suggestion.

LN 158- 166 (Section 3.4): “We follow the same method described above to compare ICESAT-2…”

Consider changing for clarity to: For ATL06 – ORGE, we apply the same filters (quality.= 0 ; …, but we use a 60 m search radius (beam-pair spacing 45 m) and a linear cross-track interpolation between Spots 3-4 at the OGRE latitude.

Changed.

LN 233- 239 (Section 5): Consider changing “When we segregate…” to “Separating overpasses flagged for blowing snow or clouds does not affect bias or precision.”

Changed.

Appendix A: It looks like there was an idea that was not finished or completed. What was the example the authors intended to include here (e.g. …).

Fixed.

Minor comment (not necessarily for a single section):

Can you include a summary table of the parameters you used in the GNSSrefl code. It would also be great to include figures of the Fresnel zone for each receiver as this shows really explicitly the area that you sample from. Height solutions can be sensitive to fesnel zones and the threshold azimuth angle, and recording all this information in a table could help users who want to replicate this kind of study quickly (a lot of this is already well documented in the code). Also include information about which frequencies (likely both?) and constellations were used in the reflection solution.

We will ensure that the processing parameters are properly detailed for easy replication.

Copy edits:

LN 29: bi-monthly -> bimonthly, and consider rewriting for clarity

Changed to semimonthly.

LN 44: Consider citing Larson & Nievinski (2013), Seigfried et al., (2017), Hoffman et al., (2025), Trine et al., (2024), which have used -IR to measure accumulation. GNSS-IR is a powerful measurement technology that is still underused in the glaciological community. Citing these other studies can bring

awareness to this method and how it can be used in validation studies of surface height change and to understand near surface accumulation and firn densification.

Added these citations.

LN 190: delete temporal

Done.

Figure 4 caption: Clarify -> clarity

Done.

Section 5: snow pack -> snowpack.

Done.

Throughout: Use ~ throughout to approximate value.

Done.

Throughout: Overflight -> overpass .. I'm not sure what the community standard is here. Flight seemed odd to me, but I could be wrong.

Standardized to overpass.

Throughout: Sub daily -> subdaily

Done.

Throughout: Include space before units.

Done.

Throughout: 1-\sigma -> 1\sigma

Done.

Throughout: Consider abbreviating y^-1 to yr throughout and being consistent with abbreviation of s y, and day (d). I defer to the editor on this. I'm not sure what the best practices are for the cryosphere.

We will change to yr and double check with the editor.