Brief Communication – InSAR Svalbard Ground Motion Service: Observing Surface Displacements in the High Arctic

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We answer the reviewer's comments hereafter in red.
The line numbers refer to the preprint.

RC2: 'Comment on egusphere-2026-2189', Anonymous Referee #2, 08 Jun 2026

The manuscript titled "InSAR Svalbard Ground Motion Service: Observing Surface Displacements in the High Arctic" presents an operational InSAR-based platform for monitoring ground displacement in Svalbard using Sentinel-1 data. The topic is highly relevant for Arctic geohazard and permafrost research, and the development of an open-access InSAR service for Svalbard represents an important contribution to the community. The paper is concise and generally well structured. However, the manuscript currently lacks sufficient methodological detail to fully support several of the scientific interpretations presented. I therefore recommend publication after minor revision.

We thank the reviewer for the positive feedback. Considering the Brief Communication format requiring a concise structure, we could not detail all processing steps and parameters. The contribution must be seen as an introduction/pitching paper, rather than a complete technical report. We ask the readers to refer to the linked user manual for processing details and advice for data interpretation (see reference at l.245-247). See also the answer to reviewer 1. That said, we tried to address the comments below and will complement the manuscript with a few more explanations targeting the specific requests of both reviewers.

Comments:

1. Lines 79 – 94 (Method): the present description of the methodology is insufficiently detailed. The two complementary SBAS processing strategies that were applied to generate two types of InSAR Svalbard products must be described in greater depth, with a full account of the strategies and the type of results obtained.

The processing details are provided in the user manual (see l.77-78). However, we'll add complements directly in the manuscript, while referring to the relevant Chapters of the user manual for more details. The following information will be added to Section 3:

We used Sentinel-1 SAR images acquired in the Interferometric Wide (IW) swath mode from track 14A (ascending geometry) and track 154D (descending geometry). Only images from the snow-free periods were processed, because snow causes decorrelation of the phase signal. There are gaps in winter, and the observation time window varies each year due to variable climatic conditions. The documented season typically spans from June to October (at best, from late May to early December). The images are selected with a data-driven approach based on signal stability metrics (interferometric coherence). To reduce the noise, a spatial multi-looking factor of 8×2 (range × azimuth) was applied to the IW images, resulting in a final ground resolution of ~30 m. The temporal resolution corresponds to the satellite's revisit interval: 6 days during dual-satellite operation (2017–2021); 12 days before fall 2016 and after the Sentinel-1B failure in December 2021.

The processing workflow includes removal of orbital and topographic phase components, filtering to reduce speckle noise and atmospheric effects, phase calibration, interferogram unwrapping, SBAS inversion and geocoding. Overall, it followed the same steps applied to past Svalbard InSAR case studies (Rouyet et al., 2019; Wendt et al., 2026).

The SBAS workflow is similar for both products (seasonal and interannual), but the time intervals used to build the interferometric pairs vary to capture ground dynamics across multiple timescales.

For both products, various filtering techniques have been applied to discard low-quality pixels, irrelevant signals and areas likely to be affected by unwrapping errors and phase ambiguities (Bredal et al., 2026b; Section 2.2).

2. Lines 102 – 112 & 128 – 136 (Results): the authors discuss the interpretation of displacement signals. These signals include thaw subsidence, rock glaciers, solifluction, and permafrost creep. However, the absence of quantitative validation against independent datasets or report is evident.

Due to the Brief Communication format, the section "Results" is only an overview of the products available in the service, with some examples of interpretation. Indeed, at this stage, we do not have performed comprehensive validation, mostly due to the difficulty of finding data directly comparable in Svalbard (generally few in-situ measurements documenting surface movement, and difficulty comparing with InSAR due to different spatiality, temporality and dimensionality). So far, our mandate has focused on the service design, the data processing and the product dissemination. At this stage, the priority is to promote the availability of this new set of data. In the future, we hope this will trigger related research and comparison with other datasets to contribute to validation. We mention it as a prospect: l.175-176.

3. Lines 149 – 158 (Potential applications): the authors discuss the potential of the data to support several operational and research activities. The following list details the relevant applications of the current InSAR Svalbard products: It is recommended that the author provide illustrative examples of research papers on each of these pertinent applications

I can suggest these papers:

- Chen, J., Wu, Y., O'Connor, M., Cardenas, M. B., Schaefer, K., Michaelides, R., & Kling, G. (2020). Active layer freeze-thaw and water storage dynamics in permafrost environments inferred from InSAR. Remote Sensing of Environment, 248, 112007.

- Poggi, F., Nardini, O., Fiaschi, S., Montalti, R., Intrieri, E., & Raspini, F. (2025). Multi-Sensor Satellite Analysis for Landslide Characterization: A Case of Study from Baipaza, Tajikistan. Remote Sensing, 17(12), 2003.

- Cigna, F., Banks, V. J., Donald, A. W., Donohue, S., Graham, C., Hughes, D., ... & Parker, K. (2017). Mapping ground instability in areas of geotechnical infrastructure using satellite InSAR and Small UAV surveying: A case study in Northern Ireland. Geosciences, 7(3), 51.

- Becattini, F., Poggi, F., Tanteri, L., Confuorto, P., Del Soldato, M., Moretti, S., & Raspini, F. (2025). Opensource InSAR data for the characterization of geomorphic processes at different scales. Geografia Fisica e Dinamica Quaternaria, 48(1-2), 103-119.

We understand the comment and agree that all the references above are relevant to the potential applications of the InSAR Svalbard data. However, one requirement of the Brief Communication format is a maximum of 20 references. The current version of the manuscript reaches this limit. In addition to mandatory references (data reference, figure references), we focused on references targeting the Arctic and Svalbard for key background info and examples of interpretation. If you have a concrete suggestion about which reference could be removed and replaced, we can consider it in the next version of the manuscript.

4. Line 146: The designation of chapter “6 Potential applications and future perspectives” should be changed to “5 Potential applications and future perspectives”.

Thanks for spotting this error. It will be corrected.