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.

RC1: 'Comment on egusphere-2026-2189', Anonymous Referee #1, 26 May 2026

The InSAR Svalbard initiative represents a significant milestone for Arctic research. The manuscript presents its background and relevance in a clear and functional manner. Overall, I believe the paper is suitable for publication, pending minor revisions.

I would suggest that the handling editor consider elevating the manuscript to a Research Article, given the uniqueness and potential impact of the service proposed to users. In its current form, the paper gives the impression that additional technical detail could have been included, and that the reliance on external documentation is driven more by space constraints than by a deliberate stylistic choice.

For instance, a more detailed discussion of InSAR limitations in Chapter 3 would be valuable for technical readers, particularly in relation to the motion characteristics of the Svalbard archipelago. Similarly, the solutions adopted for the data viewer, currently only briefly described in Chapter 4, would likely be of interest to InSAR service providers and practitioners, and could be expanded.

We thank the reviewer for the positive feedback. We understand the comment regarding the format. We initially submitted the manuscript as a longer and more comprehensive Research Article. However, the editor asked us to convert the manuscript to a Brief Communication due to the lack of extensive discussion of the results at this stage of the project. This request required a significant change of structure, during which we decided to take out all technical details and compile them in an online user manual (see reference at l.245-246). We believe that it is an elegant way to promote the service, while allowing interested users to read the details of the service and data in a dedicated manual. Considering the recent release of the datasets, no comprehensive data exploitation has been performed at this stage. So far, the focus has been placed on the service design, data processing and product dissemination. The article mostly aims to increase the visibility of the service and make the open data known to a larger audience. In the future, we hope several users will take advantage of the data to perform novel research that might lead to the publication of advanced scientific papers.

Specific comments:

- Please clarify why the short-term observation periods differ between the two orbits.

  Over Svalbard, Sentinel-1 IW images were unavailable before 2018 in the descending geometry.

  We'll add this information in Section 3.

- Please define what is meant by a "season." In particular, specify how the "average" snow-free season is determined and characterized (e.g. using external models or RS data).

  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).

  We'll add this information in Section 3.

- If, due to article-type constraints, a more extensive description of limitations (ref. line 78) and WebGIS functionalities (ref. line 126) cannot be included, I recommend providing at least a concise list of key elements that users should focus on when consulting the external documentation.

  While trying to remain as concise as possible, we'll add the following information in Sections 3 and 4, incl. examples about the content of the user manual and references to the relevant Chapters:

  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). Details about the processing settings. product properties and related limitations are available in the InSAR Svalbard user manual (Bredal et al., 2026b; see Chapters 2, 3 and 5).

  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).

  Regarding the Seasonal Results (4.1), l. 100-101 can be extended as follows: All WebGIS functions, e.g. tools to average and plot time series, are described in the InSAR Svalbard user manual (Bredal et al., 2026b; Chapter 4). Advice for

interpretation, e.g. explanations on the spatio-temporal variability in the data coverage and quality, are also provided (Bredal et al., 2026b; Chapter 5).

Regarding the Interannual Results (4.2), l.126-127 can be extended as follows:
All WebGIS functions, e.g. tools to select and compare time series at several locations, are described in the InSAR Svalbard user manual (Bredal et al., 2026b; Chapter 4). Advice for interpretation, e.g. explanations on the key differences with the seasonal products, are also provided (Bredal et al., 2026b; Chapter 5).

- Does Svalbard have a pre-existing database of slow-moving processes? Clarifying this would help highlight the added value of the project (e.g., whether it provides an update or constitutes a first systematic mapping).

  The background of InSAR research and the relevance of the GMS are provided at l.30-40. We will complement it with the following information:
  Svalbard has a long history of geoscientific and geoengineering research (Humlum et al., 2003). However, surface movement and periglacial landforms have not been consistently mapped across the archipelago. Satellite remote sensing has the potential to fill this gap thanks to operational missions with large spatial coverage and regular image acquisition.

- With reference to line 179: the project clearly illustrates the operational burden and challenges associated with extending a continental-scale Ground Motion Service (GMS) to the Arctic environment. This can be commented.

  This point is partly covered in the introduction (l.27-29). We complemented it with the following sentence:
  The cold climate and the perennially frozen ground (permafrost) lead to challenging surficial conditions to process InSAR (snow, wetness), and heterogenous and nonlinear deformation patterns, which require alternative processing strategies compared to the temperate mainland.

  The last paragraph (l.179-183) will be modified as follows:
  InSAR Svalbard provides a robust foundation for long-term ground motion observations in the archipelago. As new Sentinel-1 images get available and other satellite missions become operational, the platform might evolve into a flexible, service-oriented system supporting research, hazard assessment, and sustainable land-use planning in Svalbard. On the way further, we hope InSAR Svalbard may contribute to setting a baseline for the development of similar InSAR services tailored for polar conditions and permafrost terrain (Duchossois et al., 2024). Developing a pan-Arctic GMS especially designed for cold-climate conditions could complement the existing continental services less suited for such challenging environments.