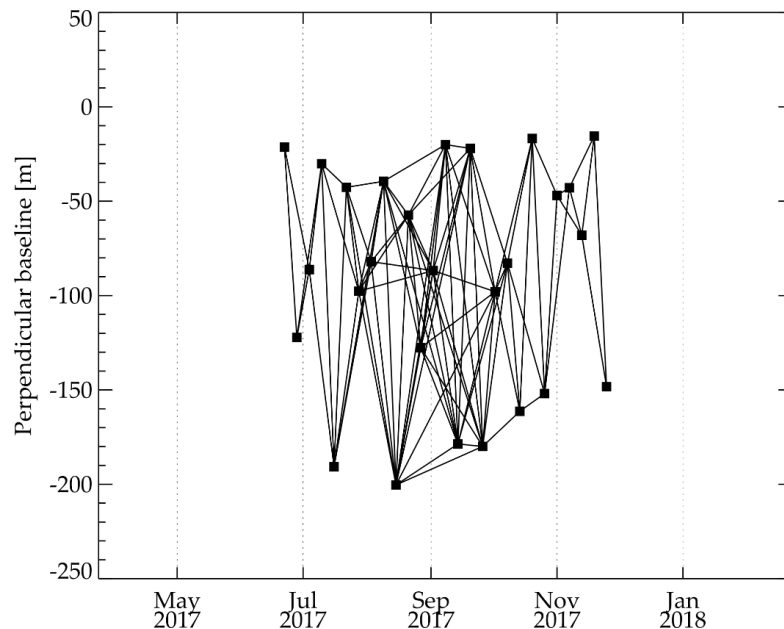


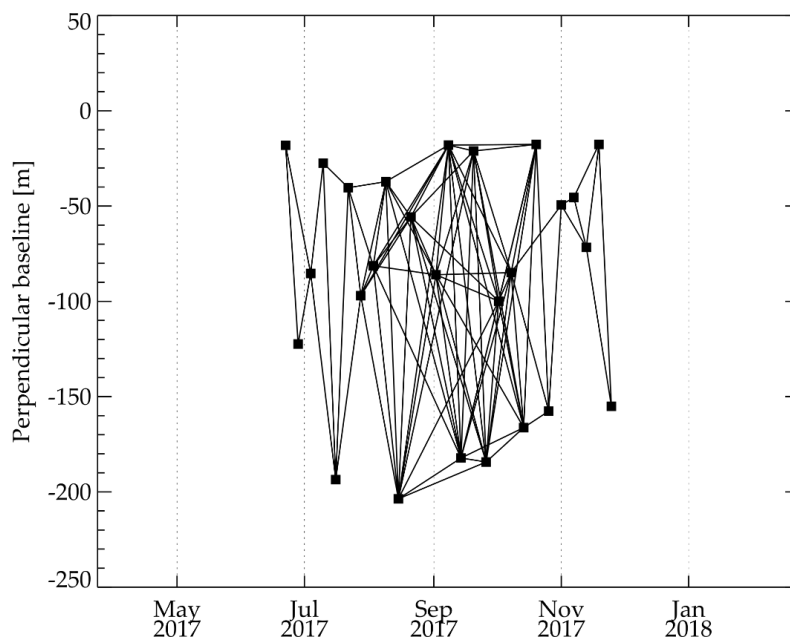
Supplements to:

Seasonal InSAR displacements documenting the active layer freeze and thaw progression in central–western Spitsbergen, Svalbard

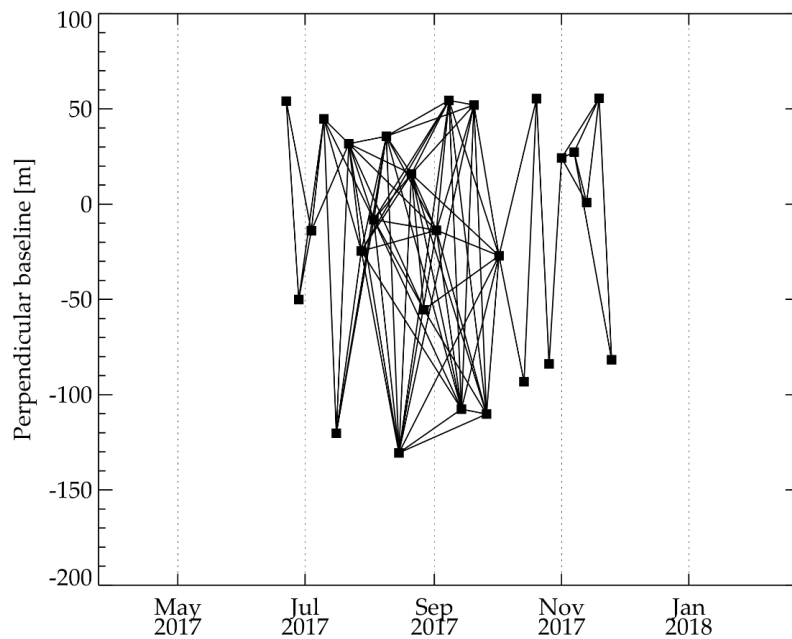
Rouyet, L., Liu, L., Strand, S.M., Christiansen, H.H., Lauknes, T.R., Larsen, Y.



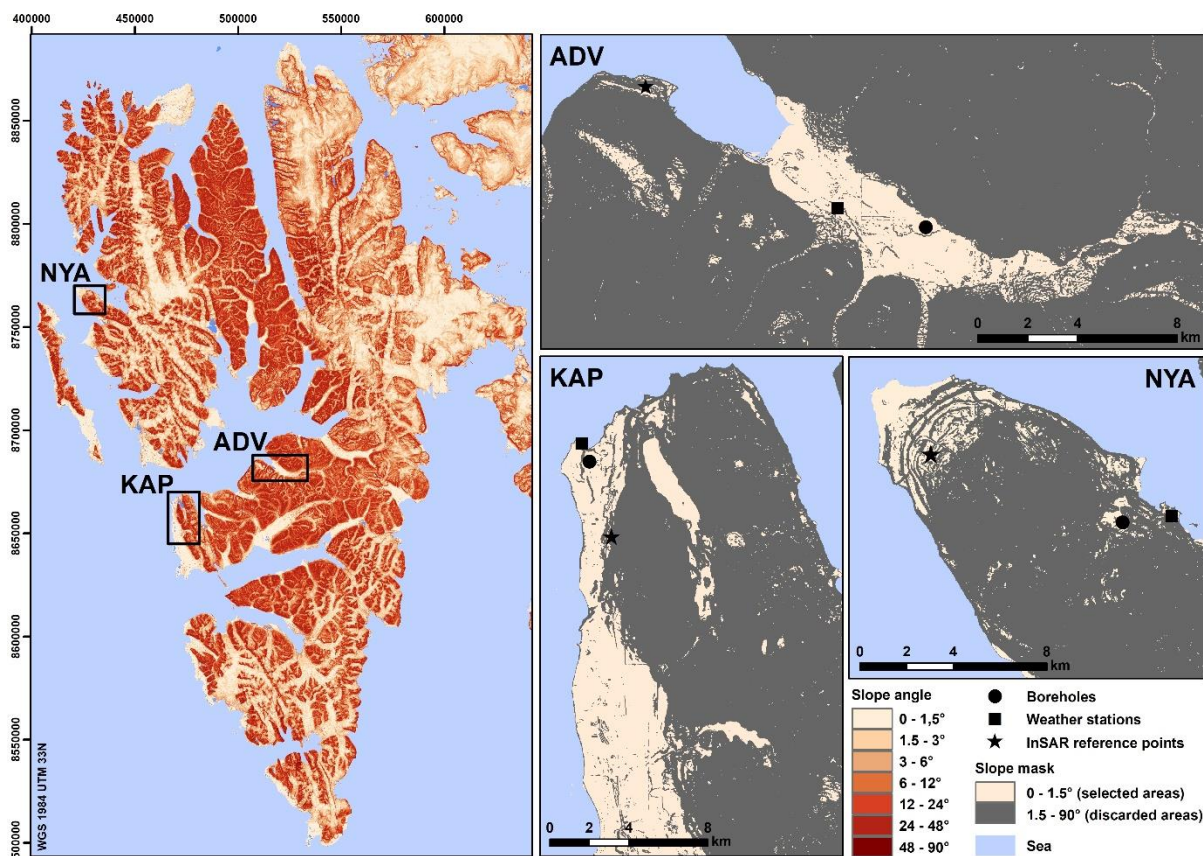
Supplement S1. Baseline plot of the Sentinel-1 interferometric pairs used in Adventdalen (ADV). Black squares: 27 SAR acquisitions (6-day sampling between 22.06.2017 and 25.11.2017). Black lines: 90 interferograms.



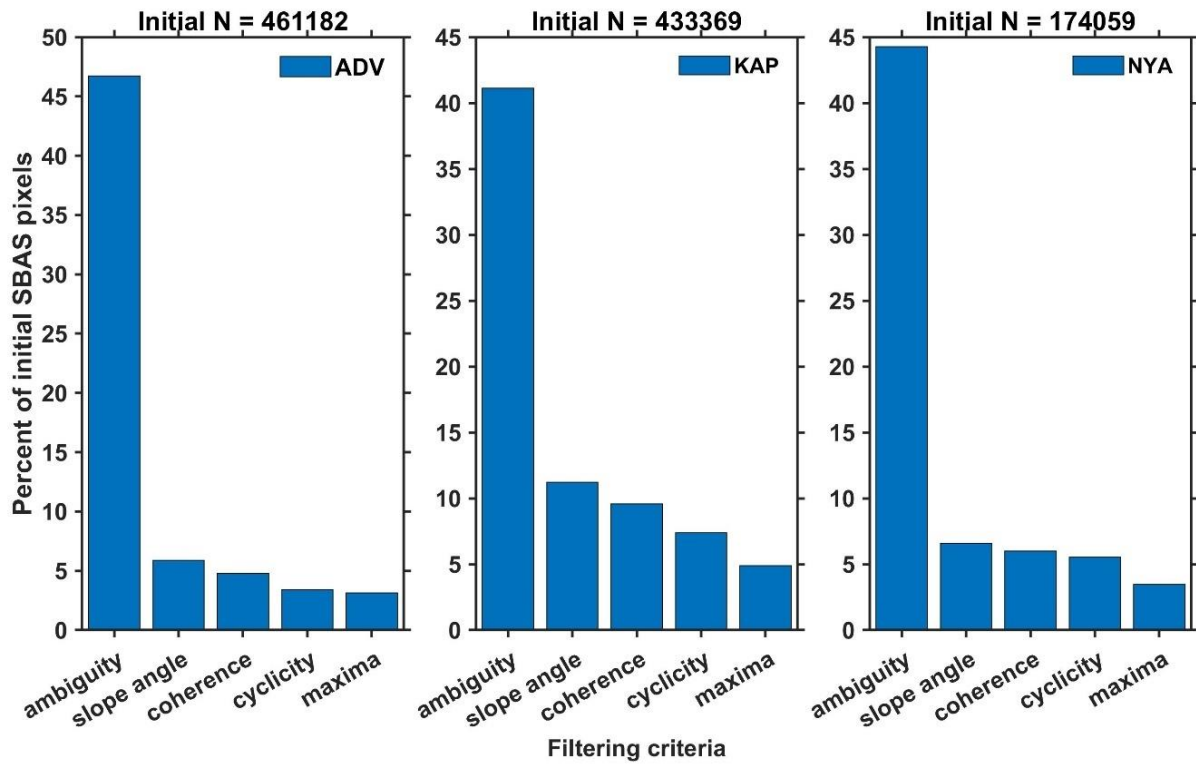
Supplement S2. Baseline plot of the Sentinel-1 interferometric pairs used in Kapp Linné (KAP). Black squares: 26 SAR acquisitions (6-day sampling between 22.06.2017 and 25.11.2017, except 27.08.2017 that has been discarded due to major ionospheric effect). Black lines: 88 interferograms.



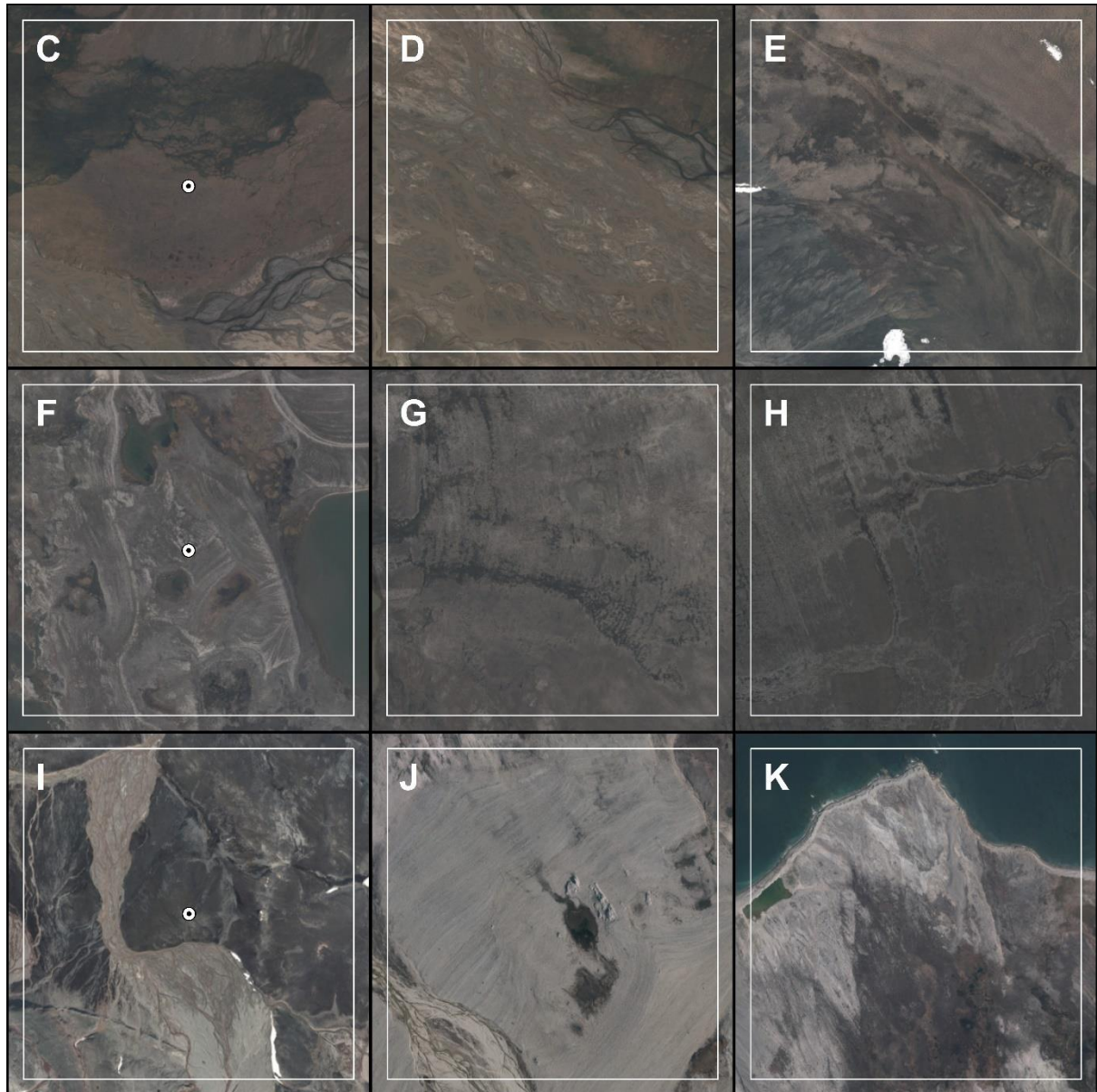
Supplement S3. Baseline plots of the Sentinel-1 interferometric pairs used for Ny-Ålesund (NYA). Black squares: 26 SAR acquisitions (6-day sampling between 22.06.2017 and 25.11.2017, except 08.10.2017 that has been discarded due to snow). Black lines: 84 interferograms.



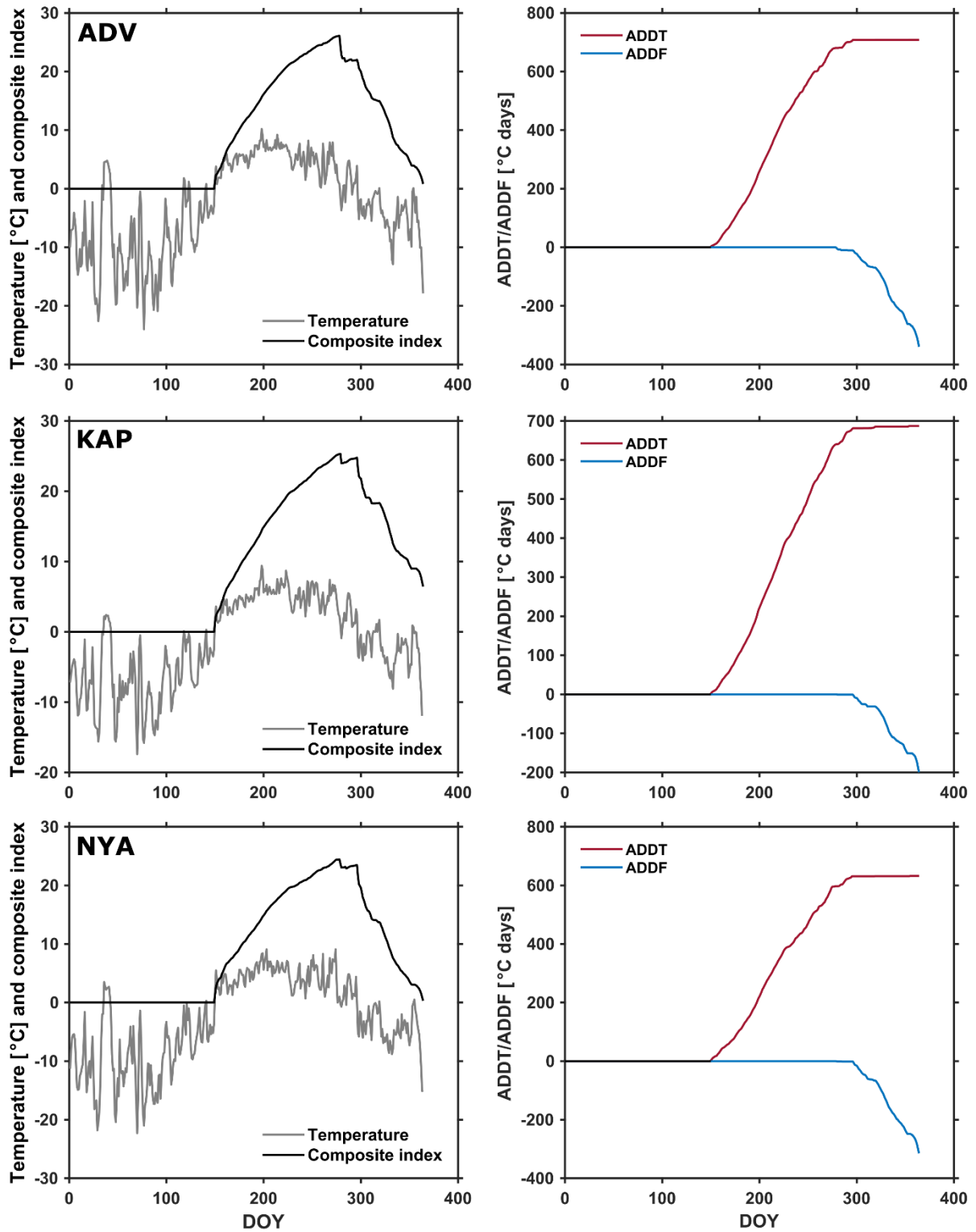
Supplement S4. Left: Spatial distribution of the slope angle in central and western Spitsbergen, Svalbard, based on a 20 m DEM from the Norwegian Polar Institute (2014) [35]. Right: mask of the filtering criterion 2 “Slope angle” discarding all InSAR pixels located on slopes $> 1.5^\circ$ in the three study areas: Adventdalen (ADV), Kapp Linné (KAP) and Ny-Ålesund (NYA).



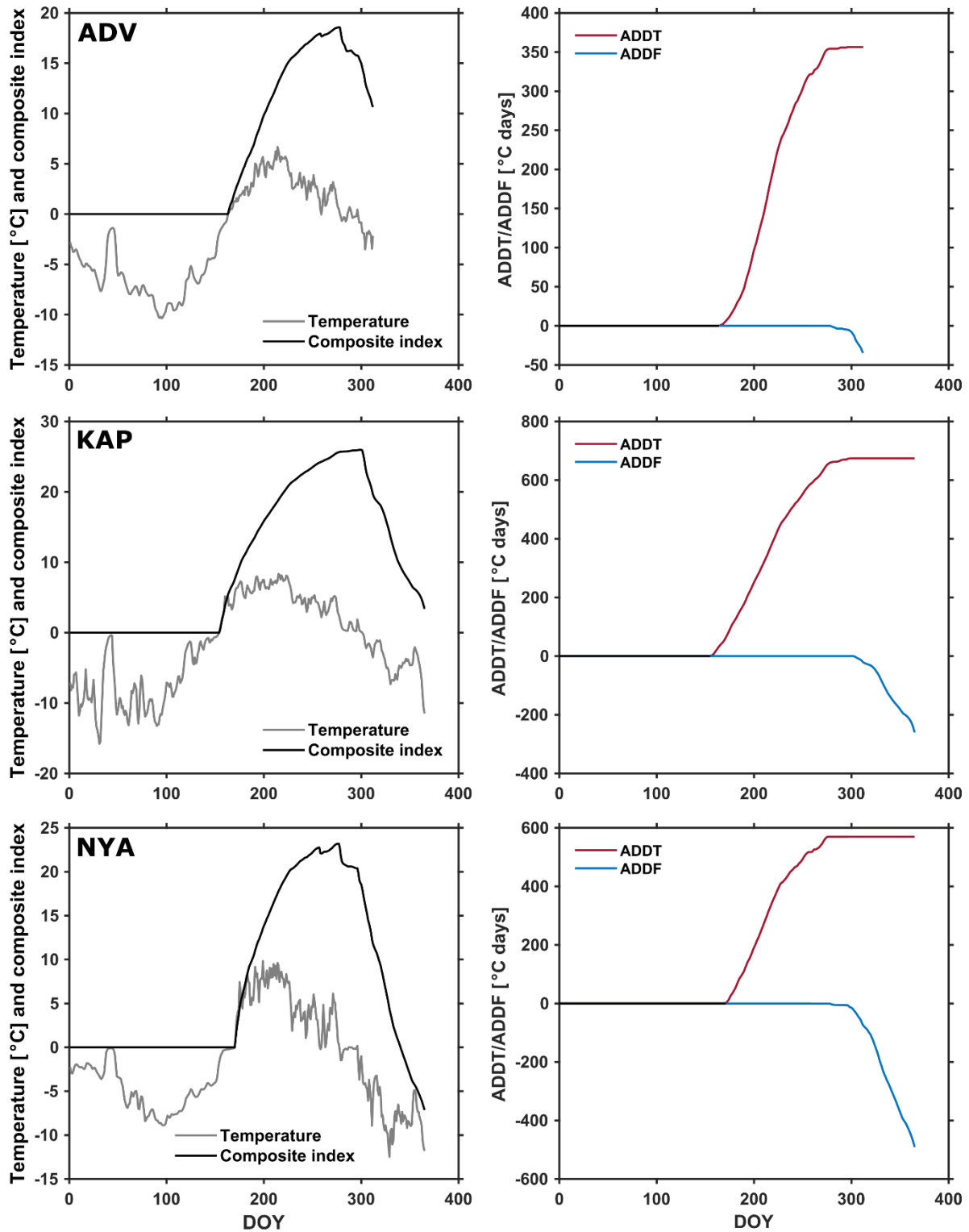
Supplement S5. Percent of documented pixels after the five steps of filtering. Initial N are the numbers of pixels after SBAS processing (Section 3.1). The results have been filtered according to five criteria to remove unreliable and irrelevant information when focusing on the cyclic thaw subsidence and frost heave patterns (Section 3.2).



Supplement S6. Orthophoto imagery of the 1 km² areas (white squares) selected for the discussion of InSAR results' variability within the three regions. **C–D:** Selected areas in Adventdalen. **C** shows the loess-covered ice wedge polygons where ADV borehole is located (white circle). **D** shows the braided river plain and its fluvial sediments. **E** shows a blockfield plateau above Longyearbyen. **F–H:** Selected areas in the Kapp Linné strandflat dominated by beach ridges. **F** is centred around the KAP borehole (white circle). **I–K:** Selected areas in Ny-Ålesund. **I** shows the Bayeleva meltwater plain and the morainic hill where the NYA borehole is located (white circle). **J** shows beach ridges on the strandflat. **K** shows alluvial fans in the outer part of Brøggerhalvøya. Location maps are shown in Figures 3–5. Averaged InSAR time series for each km² subarea are shown in Figure 6. Orthophoto imagery is from the Norwegian Polar Institute (2021) [73], also available in the *toposvalbard.npolar.no* map viewer.



Supplement S7. Air temperature measured at three weather stations (Table 2), calculated Accumulated Degrees Days of Thaw and Freeze (ADDT/ADDF) and composite index, here based on a scaling factor α of 1.4. The calculation starts at the thaw onset based on the temperature data (the index therefore remains at zero before initiation).



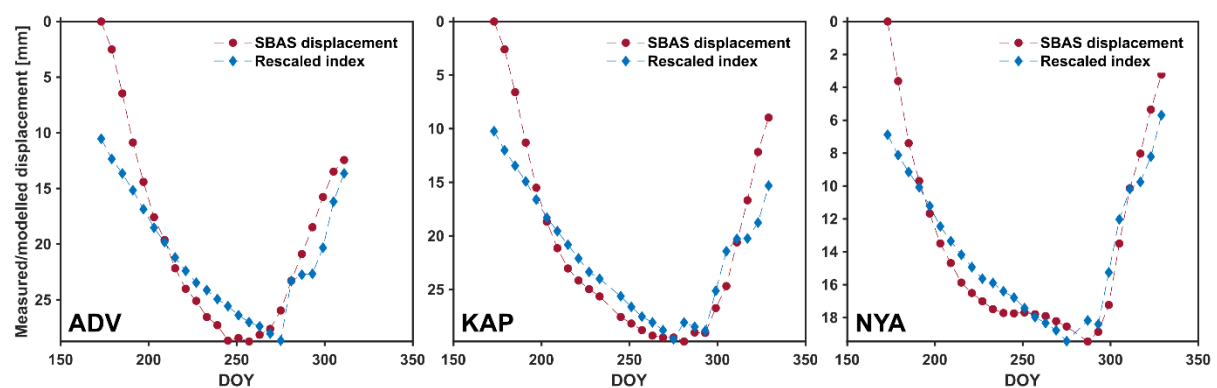
Supplement S8. Ground temperature measured in three boreholes (Table 2), calculated Accumulated Degrees Days of Thaw and Freeze (ADDT/ADDF) and composite index, here based on a scaling factor α of 1.4. The calculation starts at the thaw onset based on temperature data (the index therefore remains at zero before initiation).

Supplement S9. Coefficient of determination R^2 or proportion of the variance of the regional averaged InSAR displacements that is explained by the composite index, based on air and ground temperature. In bold are the results that are kept for visualization (Figures 9 and Supplement S10) after having tested five scaling factors α . Information about temperature data is summarized in Table 2.

	Temperature Series	Scaling factor α				
		1	1.2	1.4	1.6	1.8
Adventdalen (ADV)	Air temperature	0.807	0.858	0.893	0.912	0.914
	Ground temperature	0.796	0.836	0.871	0.899	0.919
Kapp Linné (KAP)	Air temperature	0.813	0.868	0.905	0.922	0.921
	Ground temperature	0.862	0.904	0.931	0.944	0.943
Ny-Ålesund (NYA)	Air temperature	0.807	0.879	0.913	0.915	0.894
	Ground temperature	0.913	0.956	0.966	0.951	0.920

Supplement S10. Coefficient of determination R^2 or proportion of the variance of the InSAR displacement time series (three scales: the single pixels near the boreholes, km² and regional averages) that is explained by the composite index based on ground temperature. In bold are the results that are kept for visualization (Figures 10–12) after having tested five scaling factors α . Information about temperature data is summarized in Table 2.

	InSAR Series	Scaling factor α				
		1	1.2	1.4	1.6	1.8
Adventdalen (ADV)	Near borehole pixel	0.982	0.962	0.935	0.899	0.856
	Km ² average	0.970	0.980	0.981	0.973	0.957
	Regional series	0.796	0.836	0.871	0.899	0.919
Kapp Linné (KAP)	Near borehole pixel	0.924	0.939	0.938	0.924	0.987
	Km ² average	0.950	0.970	0.975	0.964	0.941
	Mean series	0.862	0.904	0.931	0.944	0.943
Ny-Ålesund (NYA)	Near borehole pixel	0.269	0.375	0.473	0.556	0.623
	Km ² average	0.889	0.859	0.807	0.744	0.677
	Regional average	0.913	0.956	0.966	0.951	0.920



Supplement S11. Measured displacements (regionally averaged InSAR series, DOY maxima Q1–Q3, Figure 8B) compared to modelled displacements (rescaled composite index) based on air temperature. Note that the y-axis scale varies for each graph. Information about temperature data is summarized in Table 2.