METADATA TO ZENODO DATASET

Seasonal InSAR thaw subsidence and frost heave time series in central and western Spitsbergen, Svalbard

In relation to a manuscript submitted to *Remote Sensing*:
Manuscript title: Seasonal InSAR displacements documenting the active layer freeze and thaw progression in central–western Spitsbergen, Svalbard
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Brief methodological summary:

We used Synthetic Aperture Radar Interferometry (InSAR) to document the seasonal ground surface displacement progression in the permafrost landscape of Svalbard. We analysed three study areas in central and western Spitsbergen: Adventdalen (ADV), Kapp Linné (KAP) and Ny-Ålesund (NYA). InSAR results are based on snow-free Sentinel-1 SAR images acquired in 2017, with an Interferometric Wide swath mode and an ascending geometry (track 14). We estimated ground displacement time series between June 22 and November 25, 2017 using a Small Baseline Subset (SBAS) method (Berardino et al., 2002), processed with the NORCE GSAR software (Larsen et al., 2005). We included 84 to 90 interferometric image pairs (interferograms) depending on the study area, with a maximal temporal baseline of 48 days. Details on similar InSAR processing strategy, results' properties and limitations when applied to Svalbard environment can be found in Rouyet et al. (2019).

We aimed to develop Sentinel-1 InSAR products documenting the thaw subsidence and frost heave cyclic patterns related to the active layer thawing and freezing. The time series were used to extract the timing of the seasonal thaw subsidence maxima at the regional scale. Several post-processing steps were applied on the initial SBAS results, to filter out irrelevant pixels and focus on unambiguous cyclic time series. We discarded pixels likely to be affected by phase aliasing and decorrelation. We selected only areas with slope angle ≤ 1.5° to focus on flat terrain. We converted all results from radar line-of-sight to vertical displacements as we assume that low-inclined surfaces are not affected by a horizontal component of movement. For each time series, the maximal subsidence value was then identified, and its corresponding Day of Year (DOY) extracted. Pixels with DOY corresponding to the first or the last acquisition of the time series were discarded as they do not document a cyclic process. We finally filtered out the pixels with a maximal subsidence < 10 mm to focus on pixels with an unambiguous transition from subsidence to heave.

The dataset includes .csv files for the three processed regions: Adventdalen (ADV), Kapp Linné (KAP) and Ny-Ålesund (NYA). Each row of the files represents one measurement pixel (ground resolution: approx. 40 m). Each column documents an attribute that is further described thereafter.

Files:

- ADV_InSARfiltered_DOYMAX: 14,547 pixels documenting June–November 2017 InSAR displacement time series, the identified subsidence maxima and their corresponding DOY in the 307 km² ADV area.
- KAP_InSARfiltered_DOYMAX: 21,198 pixels documenting June–November 2017 InSAR displacement time series, the identified subsidence maxima and their corresponding DOY in the 288 km² KAP area.
- NYA_InSARfiltered_DOYMAX: 6,021 pixels documenting June–November 2017 InSAR displacement time series, the identified subsidence maxima and their corresponding DOY in the 121 km² NYA area.

Attributes:

- Attribute "fid": Individual identifier of each documented pixel after filtering.
- Attribute "east": Easting of the pixel center. Coordinate system: WGS 1984 UTM Zone 33N.
- Attribute "north": Northing of the pixel center. Coordinate system: WGS 1984 UTM Zone 33N.
- Attribute "coherence": Mean coherence, a measure of the InSAR signal quality (values between 0 and 1). A low value indicates that the pixel is affected by decorrelation sources reducing the reliability of the displacement estimate.
- Attribute "elevation": Mean elevation of the pixel, in m above the sea level, based on a 20 m Digital Elevation Model (NPI, 2014).
- Attribute "slope": Mean slope angle of the pixel, based on a 20 m Digital Elevation Model (NPI, 2014).
- Attribute "maxdisp": Maximal subsidence value of the InSAR time series, in mm. The value expresses the relative maximum within the documented period. The total seasonal subsidence is likely to be underestimated in areas where the ground started to thaw before June, 22.
- Attribute "doy": Day of Year (DOY) of the identified maximal subsidence value, based on the InSAR time series.
- Attributes "20170622" to "20171125": InSAR displacement time series between June and November 2017. The acquisition dates have a YYYYMMDD format (YYYY = year, MM = month, DD = day). Displacement values are expressed in mm and correspond to vertical variations of the ground surface level. They document subsidence (positive values) or heave (negative values), relatively to the first acquisition date (June 22, 2017). The temporal resolution is 6-day, except in late August in KAP and early October in NYA (12 days), due to discarded images.

References:

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