Article

Supplementary Material for: Frequent Glacial Hazards Deformation Detection Based on POT-SBAS InSAR in Sedongpu Basin in Himalayan region

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1. Parameter and coverage of Sentinel-1A SAR data

Table S1 Parameters of Sentinel-1A SAR data

Orbit direction	Azimuth angle(°)	Monitoring time	Image number	Satellite revisit period(d)	Imaging mode	Spacing resolution(m)	Imaging bandwidth(km)
Ascending	-10.5	20141022-20220817	192	12	IW	14×2.3	250
Descending	-169.8	20141029-20220824	167				

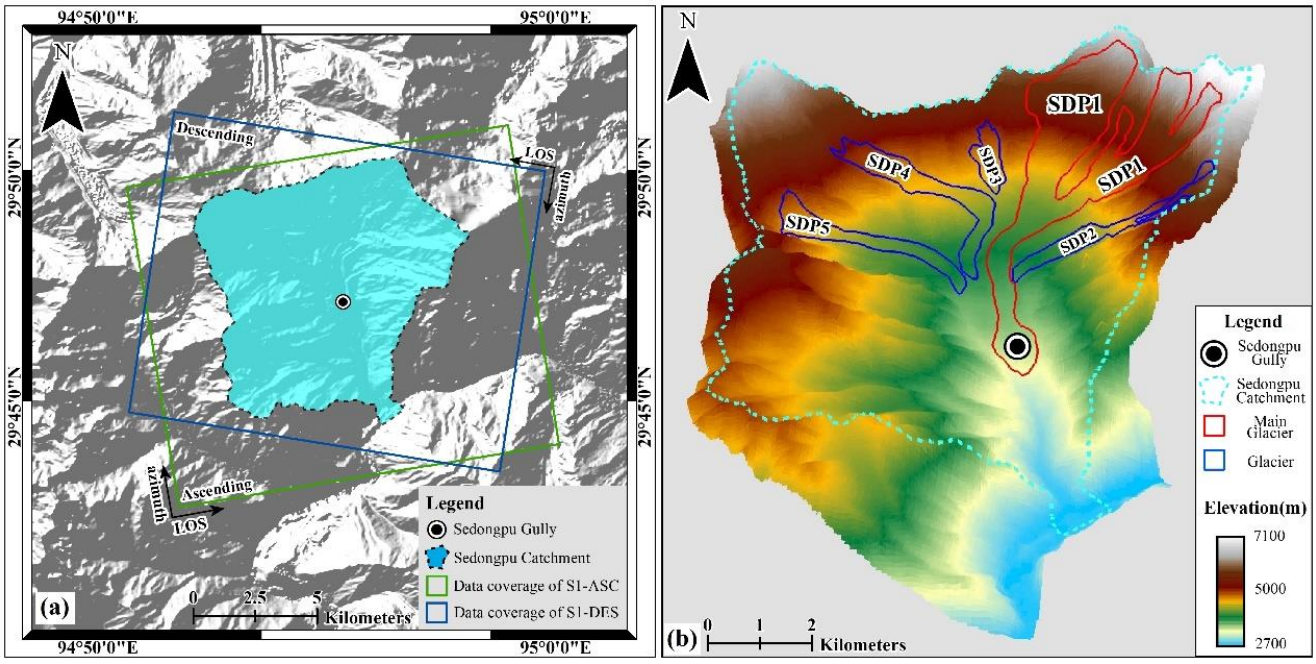


Figure S1 Overview of the Sentinel-1A SAR data. (a) S1-SAR image coverage of ascending and descending; (b) Elevation of Sedongpu basin.

2. Optimization of deformation calculation

Large singular values and deformation calculation errors will introduce into the 3D deformation calculation with using original slope data due to rich texture information of the slope surface. Therefore, the original slope data is processed by the mean filtering method for the detail texture information reduction and the slope characteristics presentation, which shows high reliability of the 3D deformation calculation by using the filtered slope data.

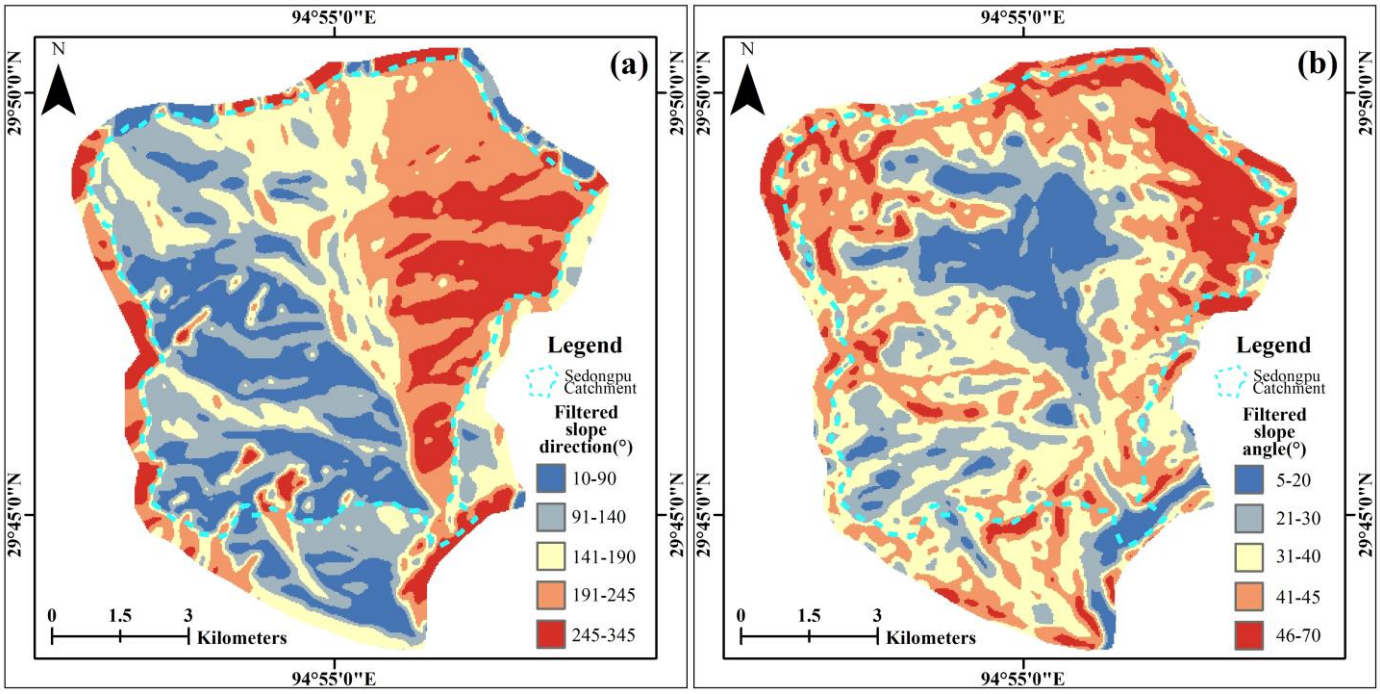


Figure S2 Slope direction and slope angle of Sedongpu Basin. (a) Filtered slope direction. (b) Filtered slope angle.

It is worth noting that the POT deformation result of ascending and descending orbits need to be resampled into a common grid (Figure S3c) for the 3D deformation calculation due to the different of decorrelation, shadow, and distortion regions between ascending and descending tracks POT data (Figure S3a-b).

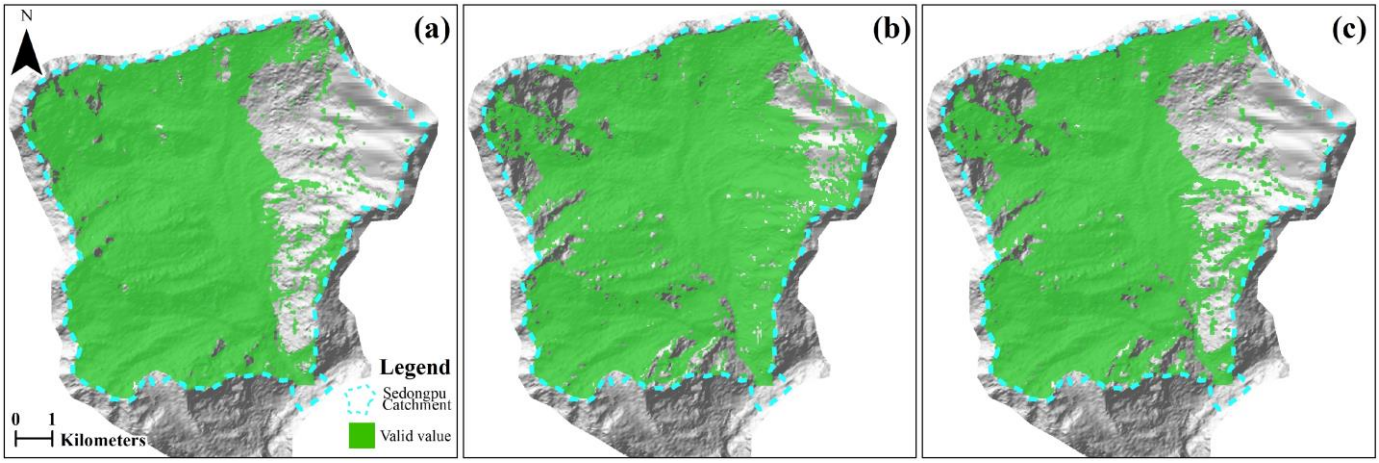


Figure S3 Valid values of POT deformation. (a) Ascending valid value. (b) Descending valid value. (c) combination valid value of ascending and descending.

3. Temporal cumulative displacement of POT

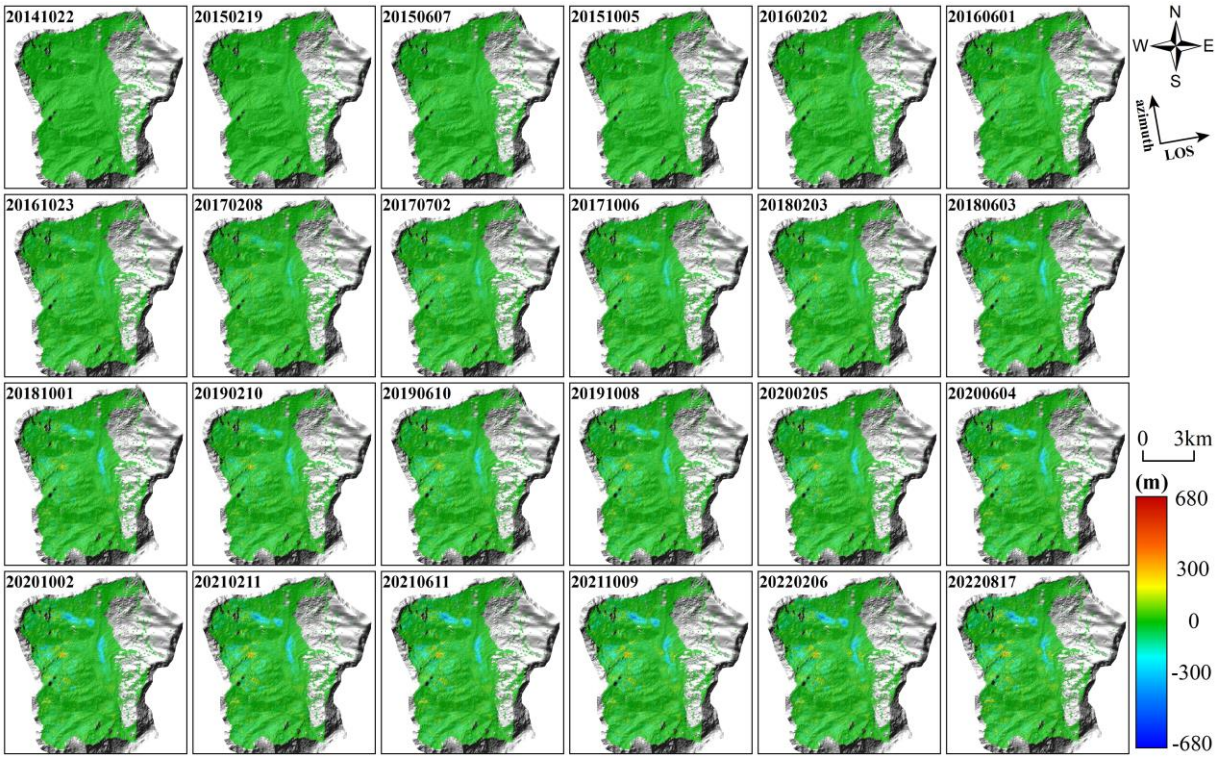


Figure S4 Ascending cumulative displacement in the azimuth direction. Red represents the motion against the flight direction, blue represents the motion along the satellite flight direction. The deformation interval is -652—473m, the deformation is positive along the direction of satellite flight. The deformation results of SDP4 and SDP5 glaciers show a continuous accumulation state and the motion is relatively stable.

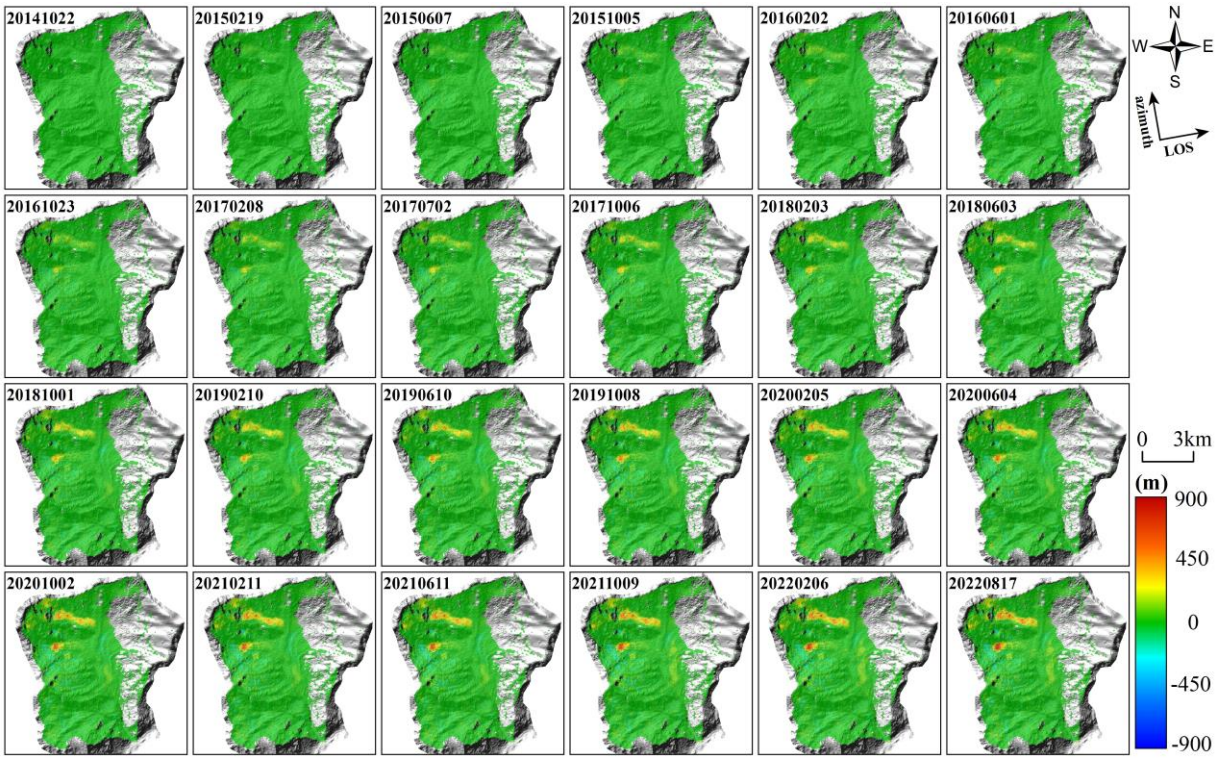


Figure S5 Ascending cumulative displacement in the range direction. The red in the range-direction deformation map represents movement along the line of sight of the satellite; the Blue is moving closer to the satellite. The deformation interval is -457-887m, the deformation is positive along the range direction of the satellite.

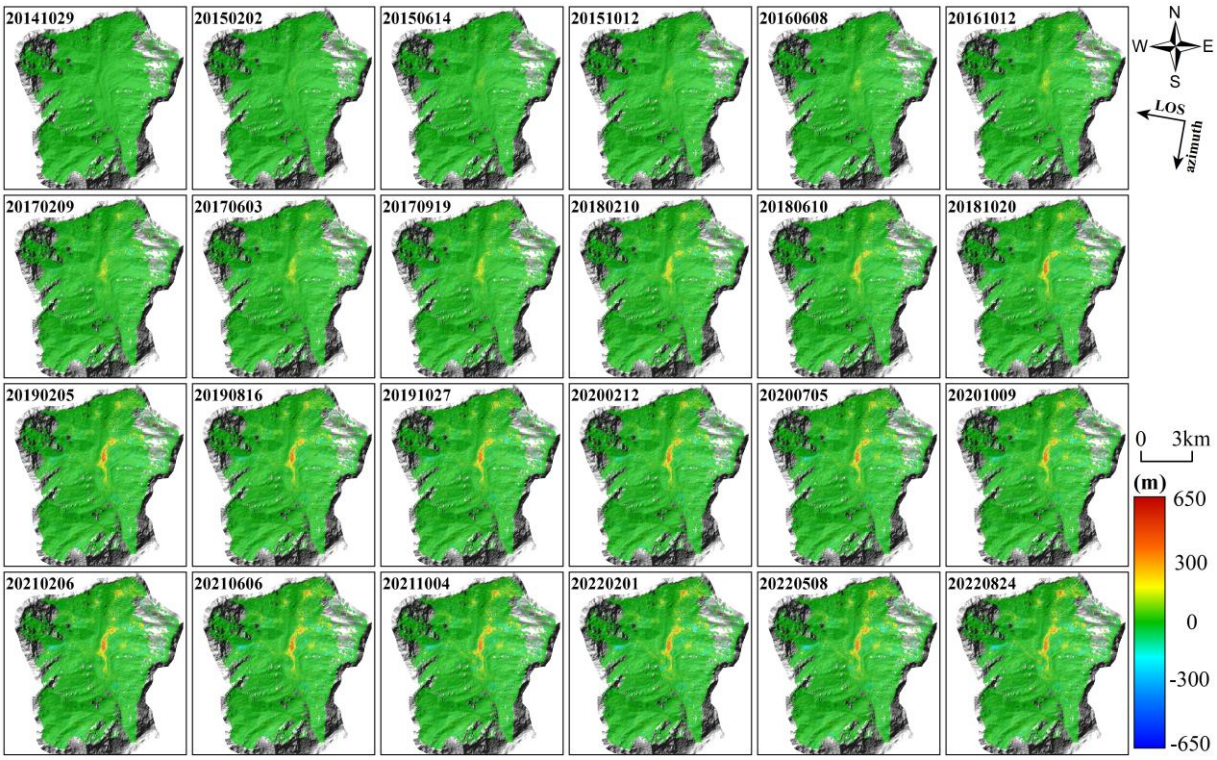


Figure S6 Descending cumulative displacement in the azimuth direction. Red represents the motion along the direction of a satellite flight, while blue represents the motion along the direction of a satellite flight. The deformation interval is -610-610m, the deformation is positive along the direction of satellite flight. The descending deformation results show that the deformation rate of the SDP1 glacier increased after 2017, and gradually recovered to a stable state after 2019.

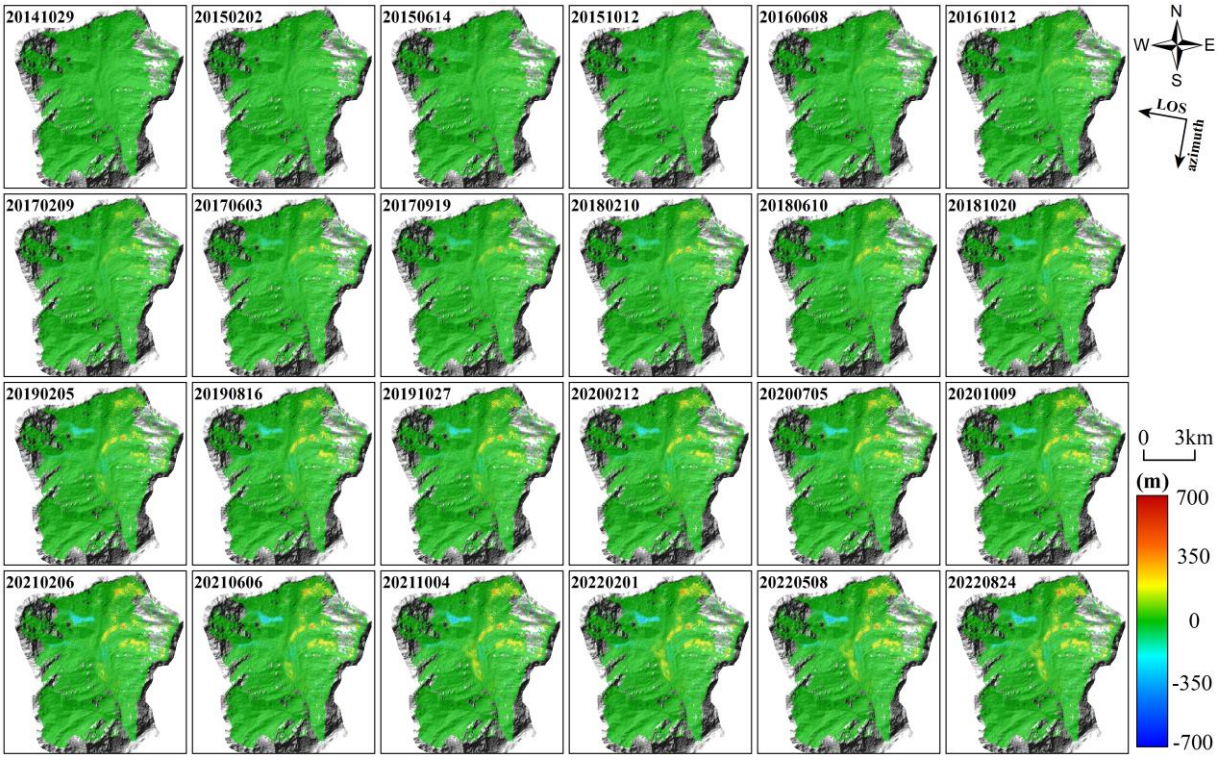


Figure S7 Descending cumulative displacement in the range direction. The red in the range-direction deformation map represents movement along the line of sight of the satellite; the Blue is moving closer to the satellite. The deformation interval is -515—698m, the deformation is positive along the range direction of the satellite.

4 Surface feature variation of different glaciers in Sedongpu catchment

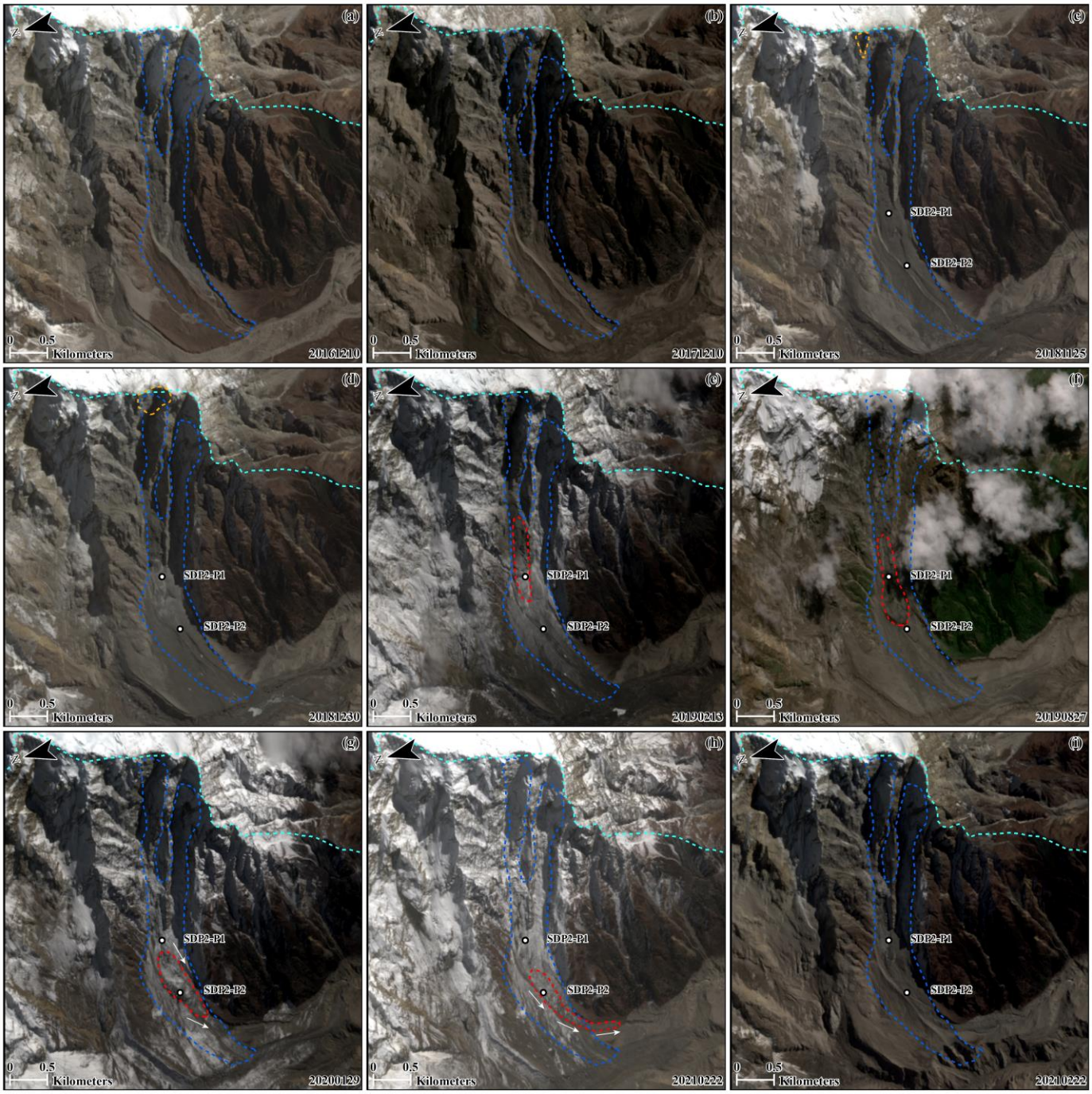


Figure S8 Historical optical images of glacier SDP2. The light blue dashed line is the boundary of the Sedongpu catchment; the dark blue dashed line is the boundary of the glacier SDP2, the yellow dashed line is the location of the ice avalanche, in the red dotted line is the moraine that started to move due to the backside ice avalanche event, the white point is the selected time-series deformation feature point, the white arrows represent the direction of the moraine motion.

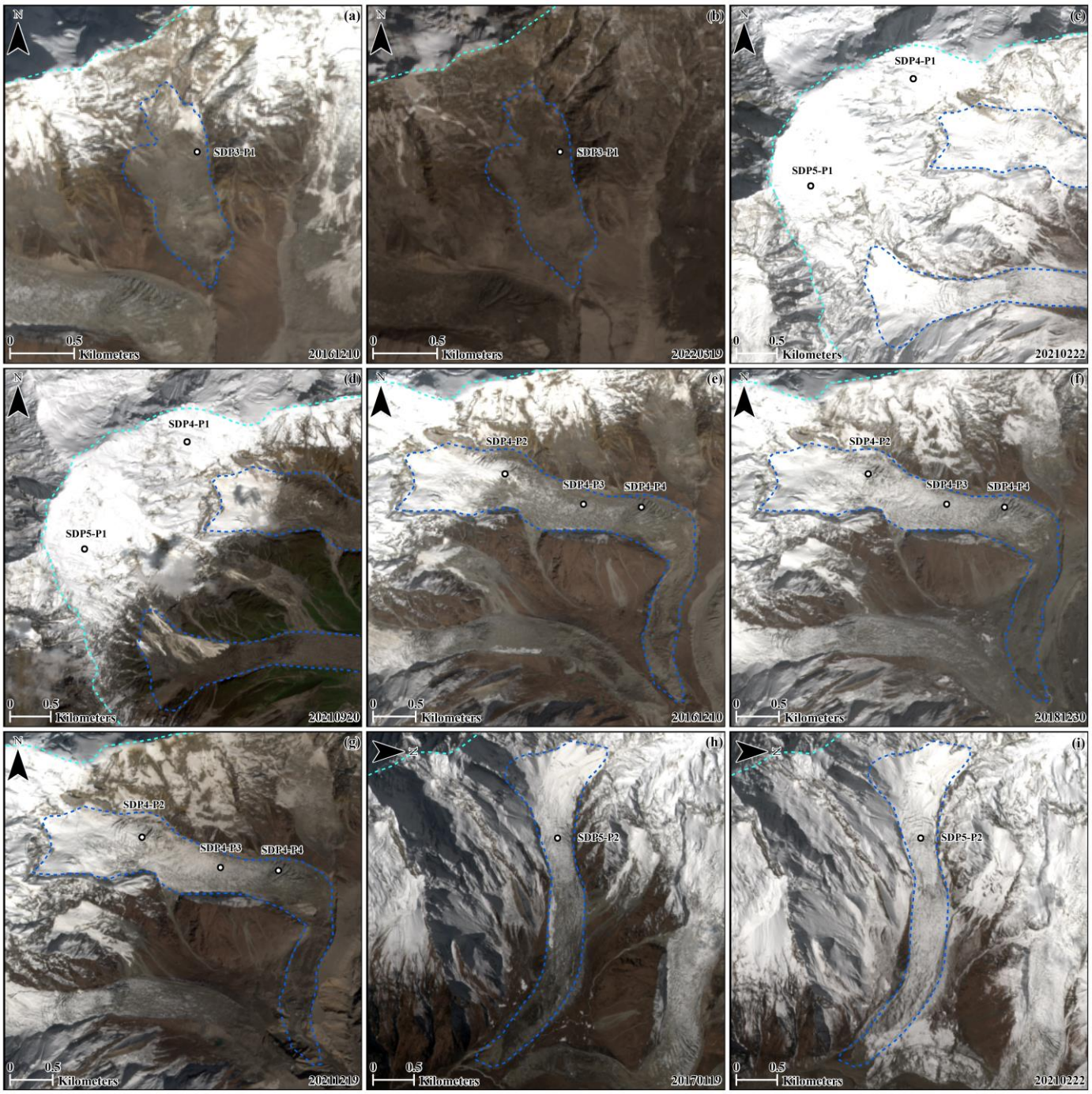


Figure S9 Historical optical images of glaciers SDP3, SDP4, and SDP5. The light blue dashed line is the boundary of the Sedongpu catchment, the dark blue dashed line is the boundary of the glacier SDP3, SDP4, and SDP5, the white point is the selected time-series deformation feature point.

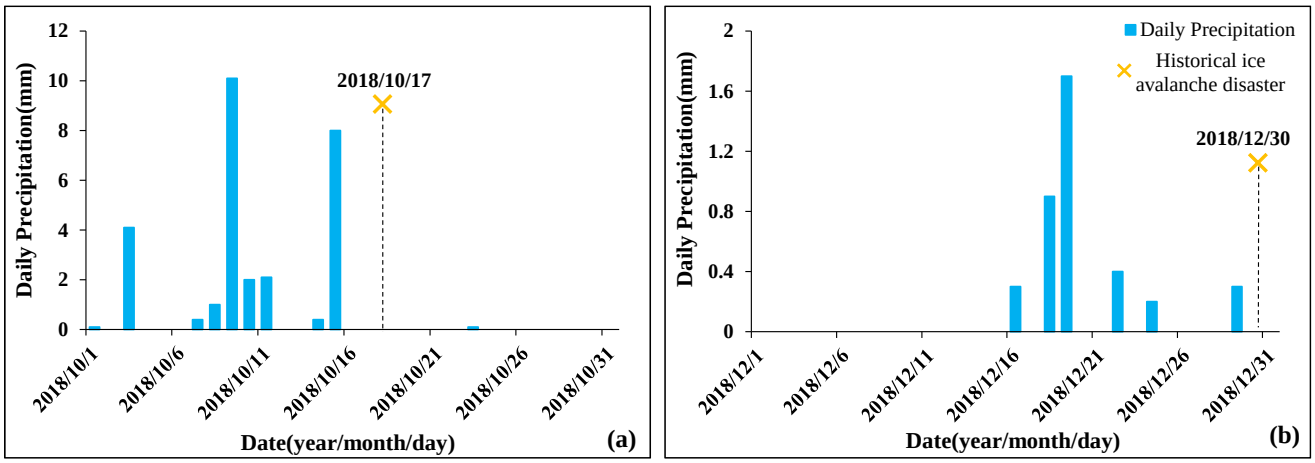


Figure S10 Daily precipitation changes around Sedongpu Basin in 2018. (a) Daily Precipitation data in Oct. 2018. (b) Daily Precipitation data in Dec. 2018.