

Glacier and snow avalanche studies in Uzbekistan based on TanDEM-X, TerraSAR-X and PAZ SAR data

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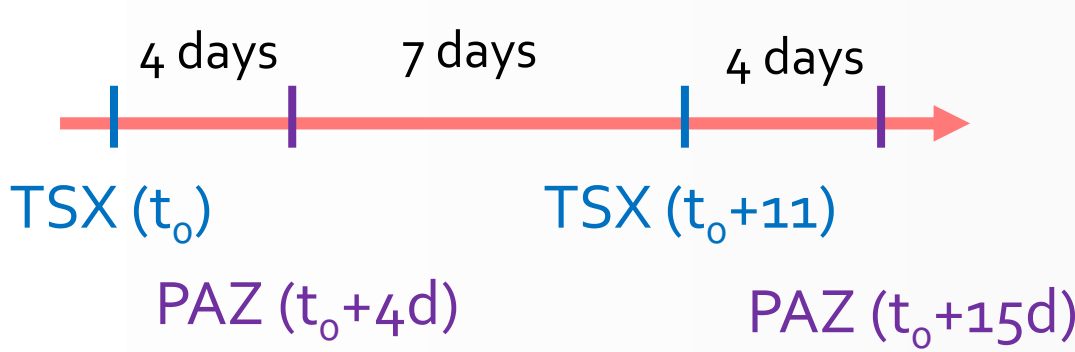
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Background

The mountain and foothill regions of the Republic of Uzbekistan occupy about 12% of the country's territory. They are located in the East and South-East (Western Tien-Shan and Hissar-Alay mountains). Outstanding progress in the republic's economic development predetermines the future active development of Uzbekistan's mountain territories. We assess the possibilities to support these developments with SAR data imagery from the TerraSAR-X, TanDEM-X and PAZ satellite missions in three issues: glaciers dynamics, landslide and avalanche mapping.

SAR data

1. Single pass InSAR TanDEM-X (for DEM generation)
2. Repeat pass InSAR TerraSAR-X/PAZ with 4 days revisit
3. Repeat pass InSAR with $n \times 11$ days

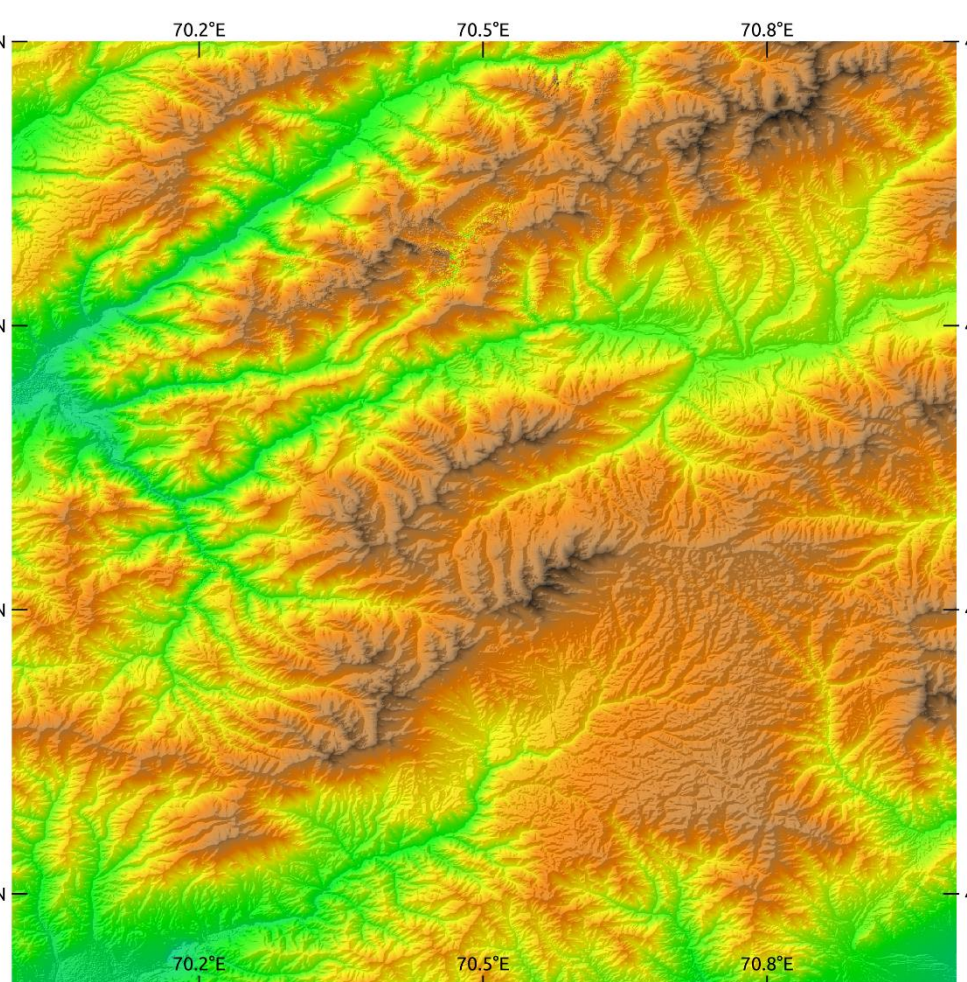
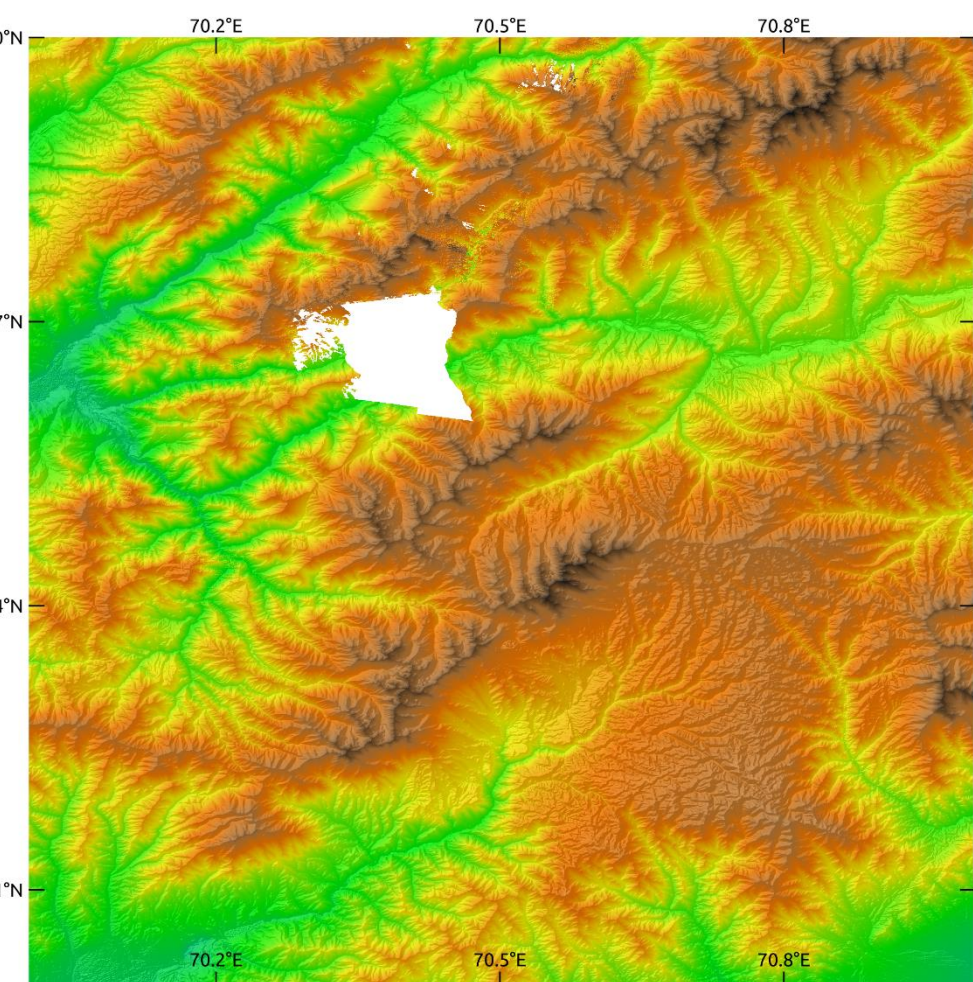


TanDEM-X global DEM gap filling



Original TanDEM-X DEM tile

Gap filled TanDEM-X DEM tile



Additional experimental DEMs from single dates: 13.06.2019 & 26.09.2021. On overlap areas elevations (h_i) are weighted with their Height Error Map (σ_{HEM_i})

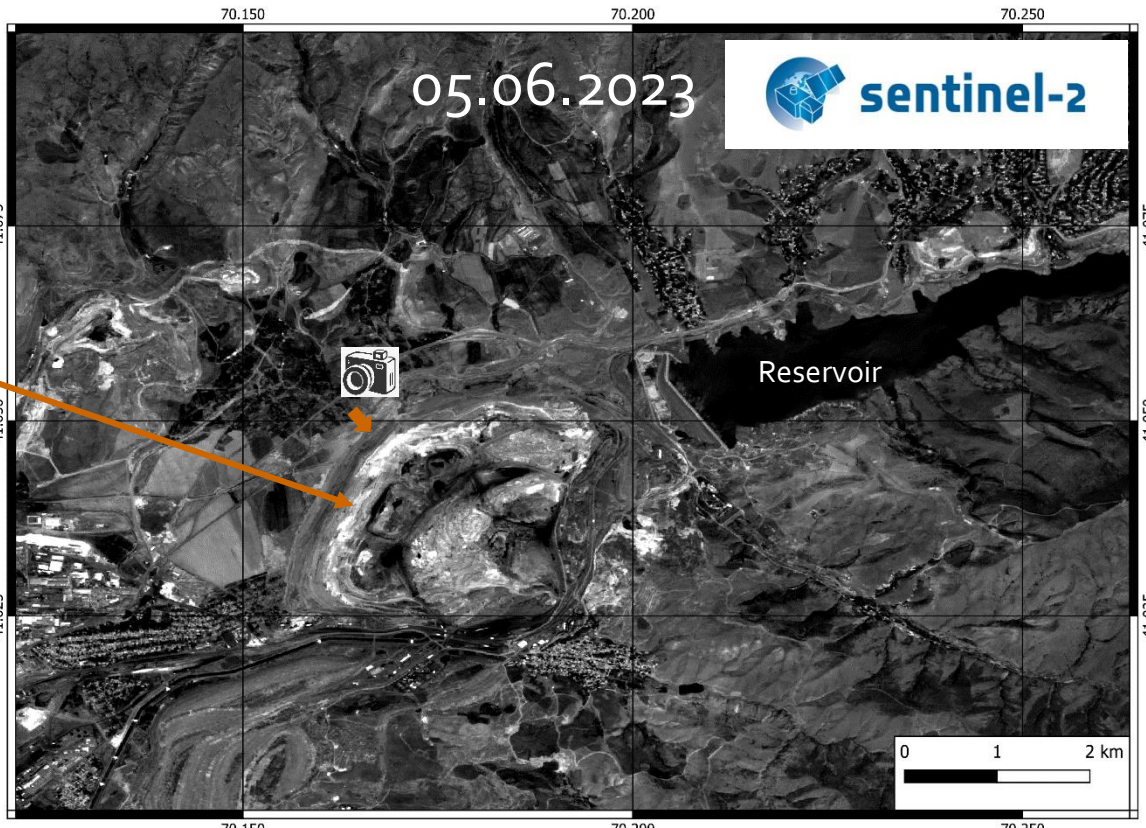
$$h_{mosaic} = \frac{\sum_{i=1}^N \frac{h_i}{\sigma_{HEM_i}}}{\sum_{i=1}^N \frac{1}{\sigma_{HEM_i}}}$$

Landslide



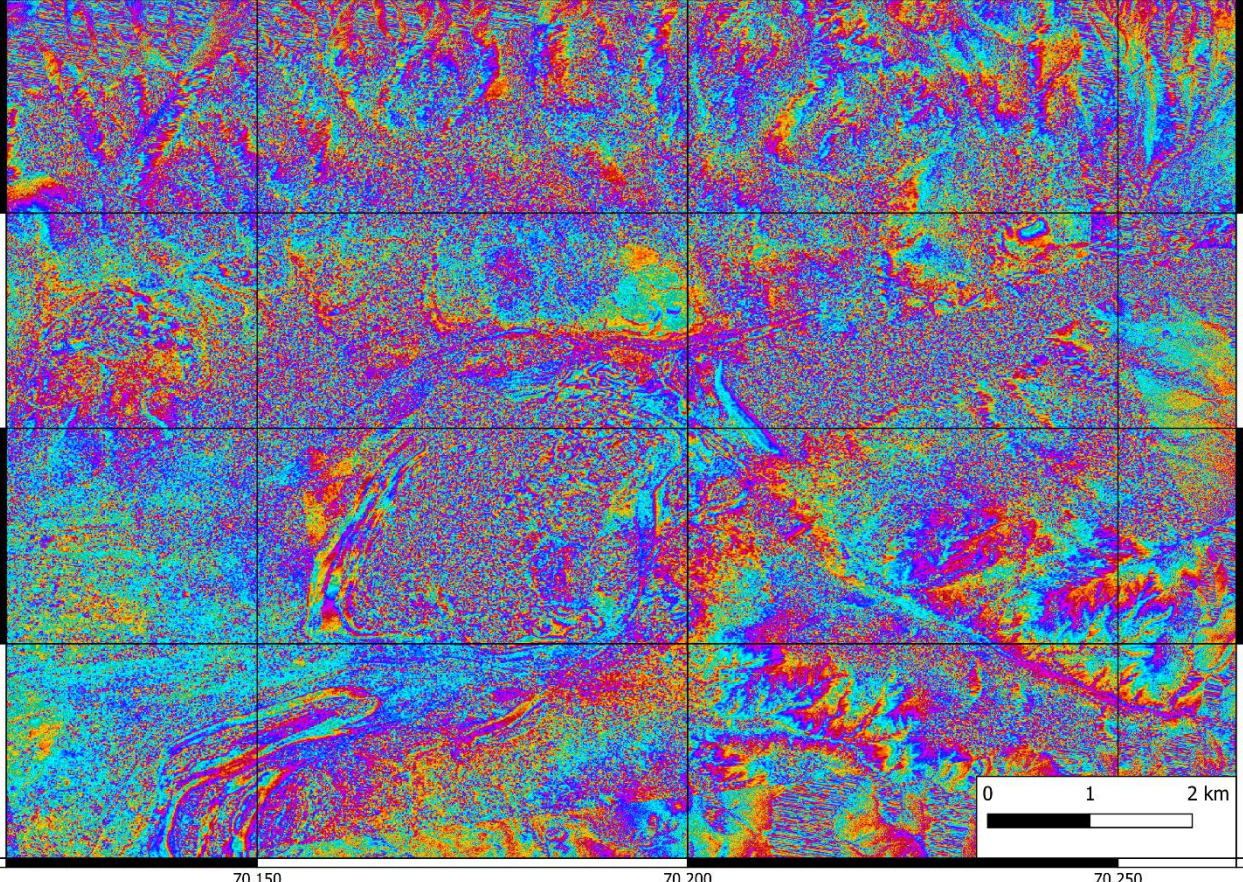
Angren (Tashkent) coal mine

Open pit



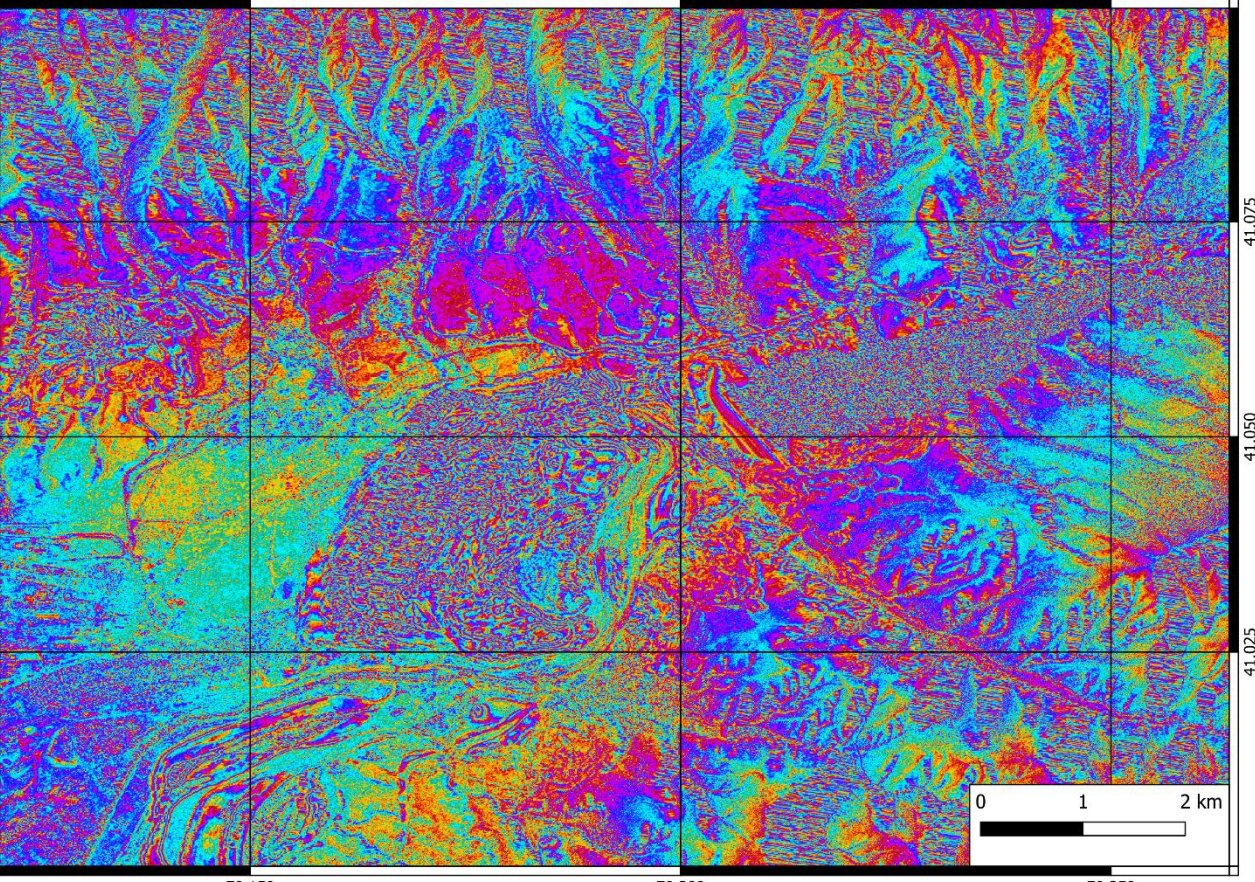
InSAR (Spotlight)

PAZ: 4.05.2022 PAZ 06.06.2022 HoA= 24 m

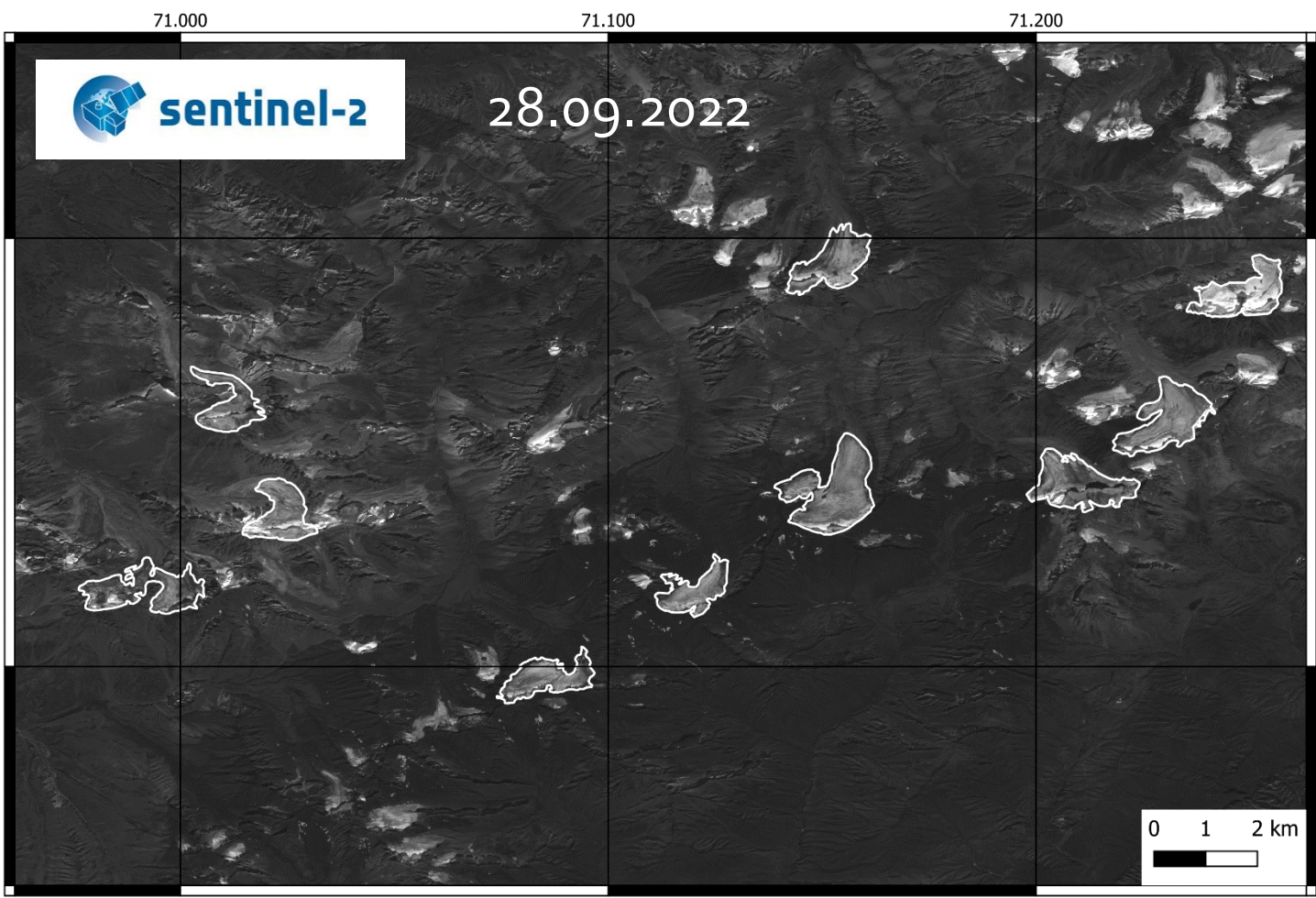


InSAR (Stripmap)

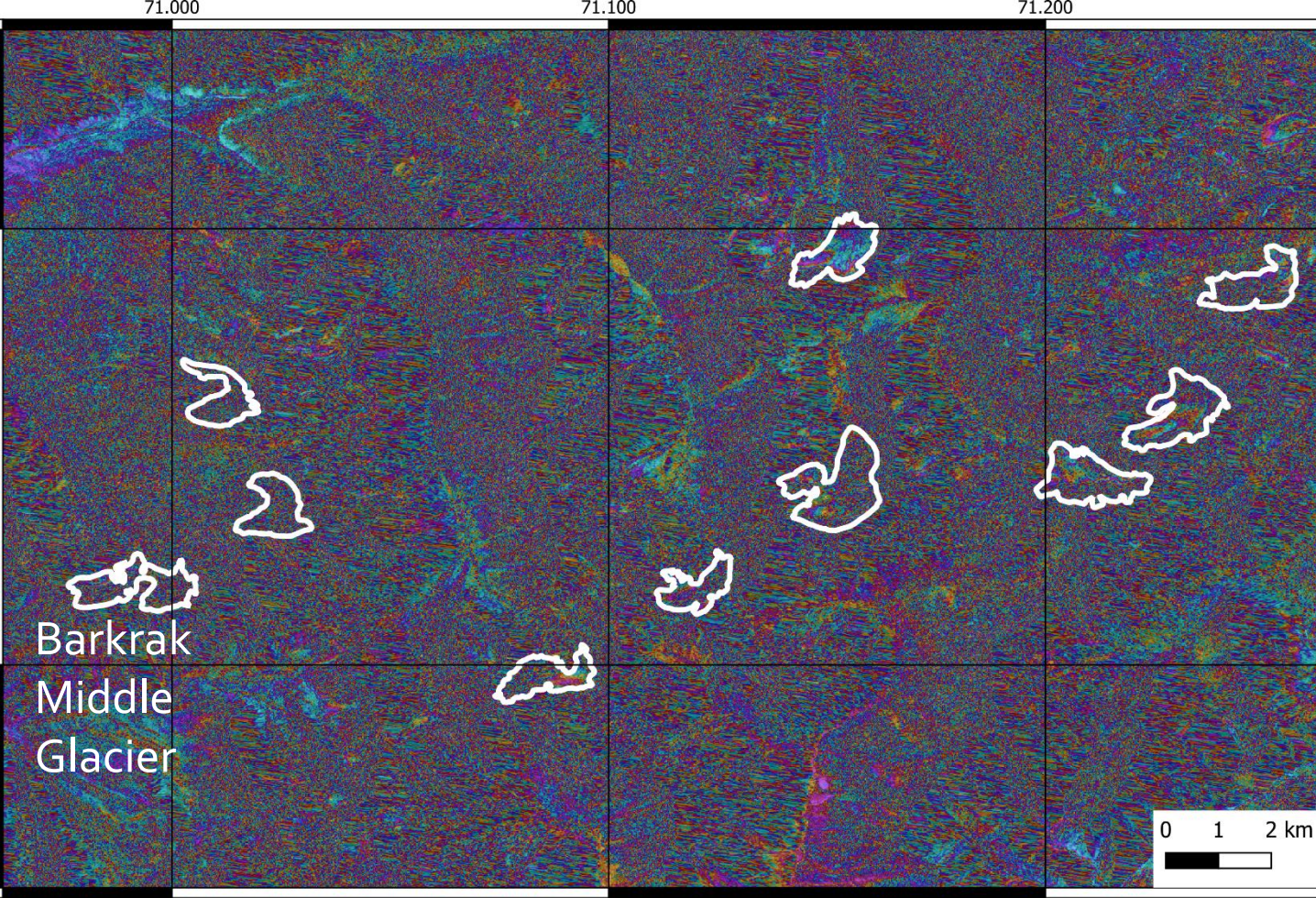
TSX: 6.04.2022 PAZ 10.04.2022 HoA= 8.5 m



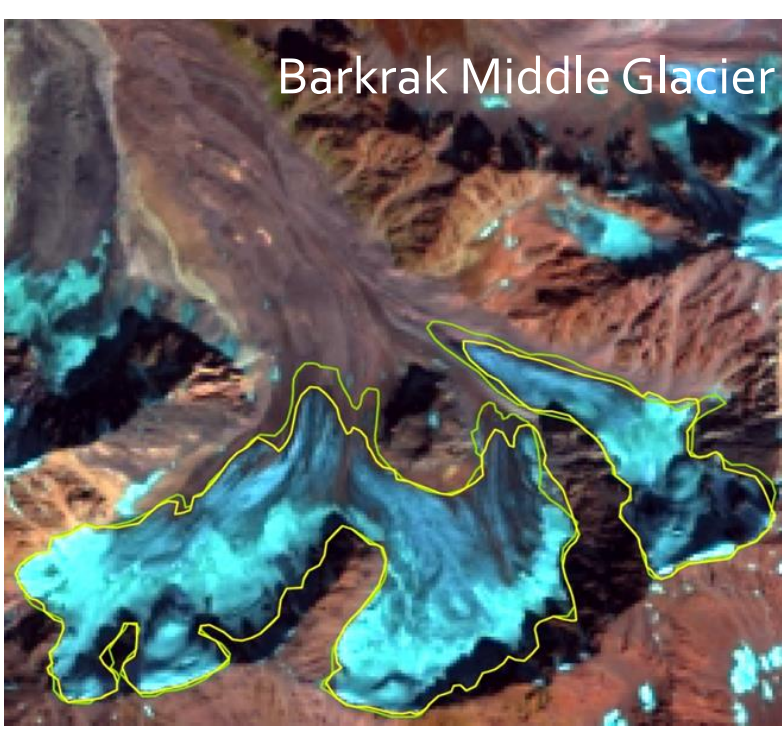
Glaciers



Glaciers in Pskem Basin
Elevation range: 3600-4200 m
Size: 0.1-0.5 km²
Total: 66 km² (2010) in Uzbekistan



InSAR (Stripmap)
TSX 16.10.2022
PAZ 20.10.2022



Avalanche

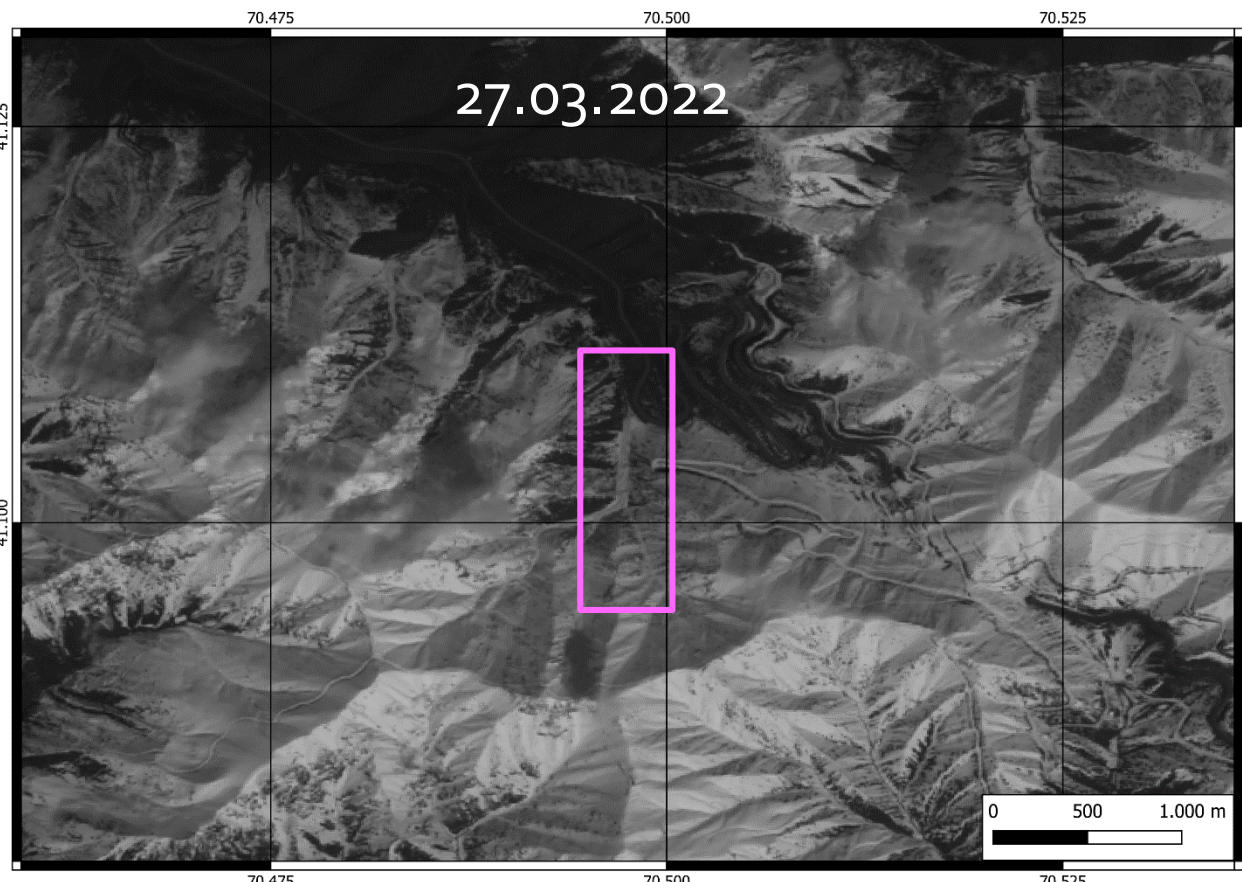
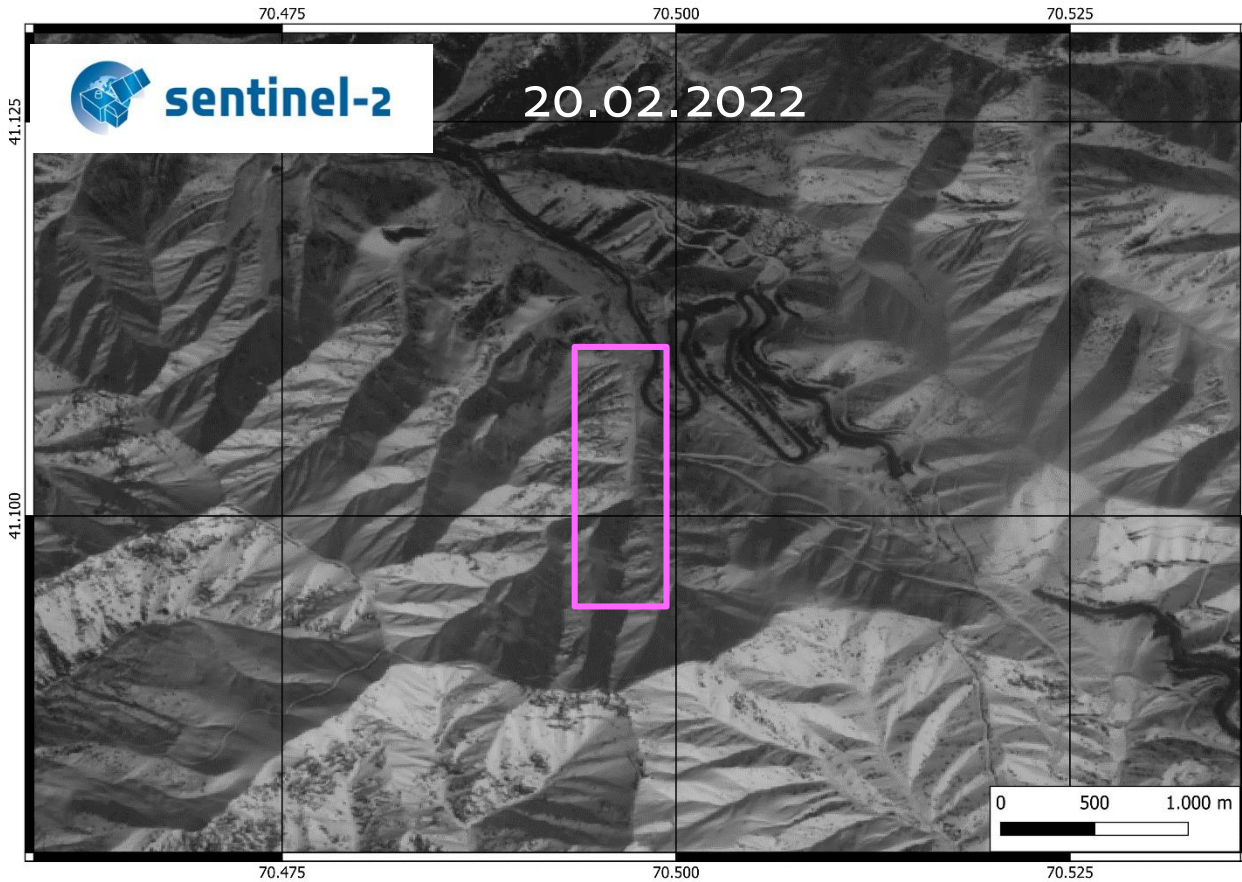
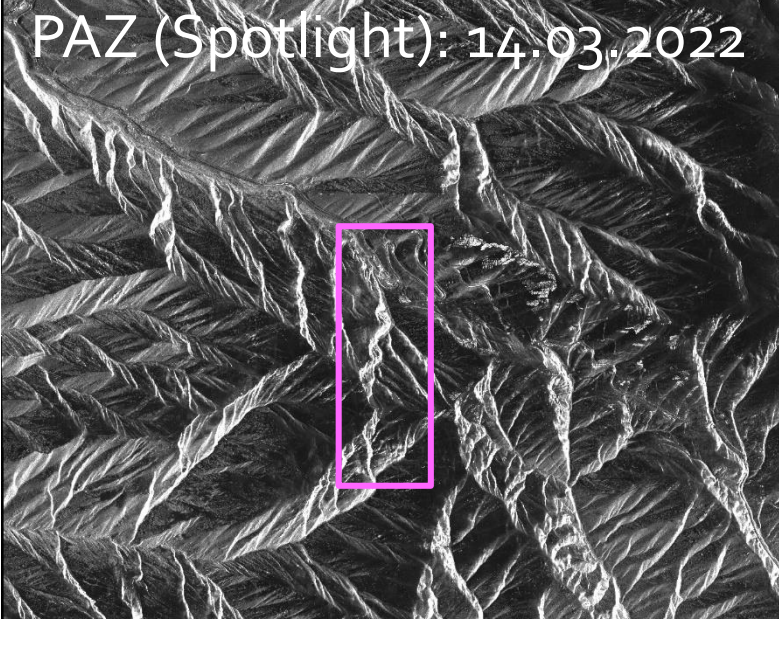


Kamchik Pass (2268 m a.s.l.) road is exposed to avalanche hazards



SL beam spot_046
 $\langle \theta \rangle \sim 38$ deg

Location of the avalanche occurred on 12.03.2022



Deutsches Zentrum für Luft- und Raumfahrt e.V.
in der Helmholtz-Gemeinschaft



TerraSAR-X / Tandem-X Science Team Meeting
18-20 October 2023
German Aerospace Center (DLR)



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