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# Glacier monitoring in the Ala Archa National Park (Tien Shan)

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# Study area

## Ala Archa National Park

74°24' – 74°34' E

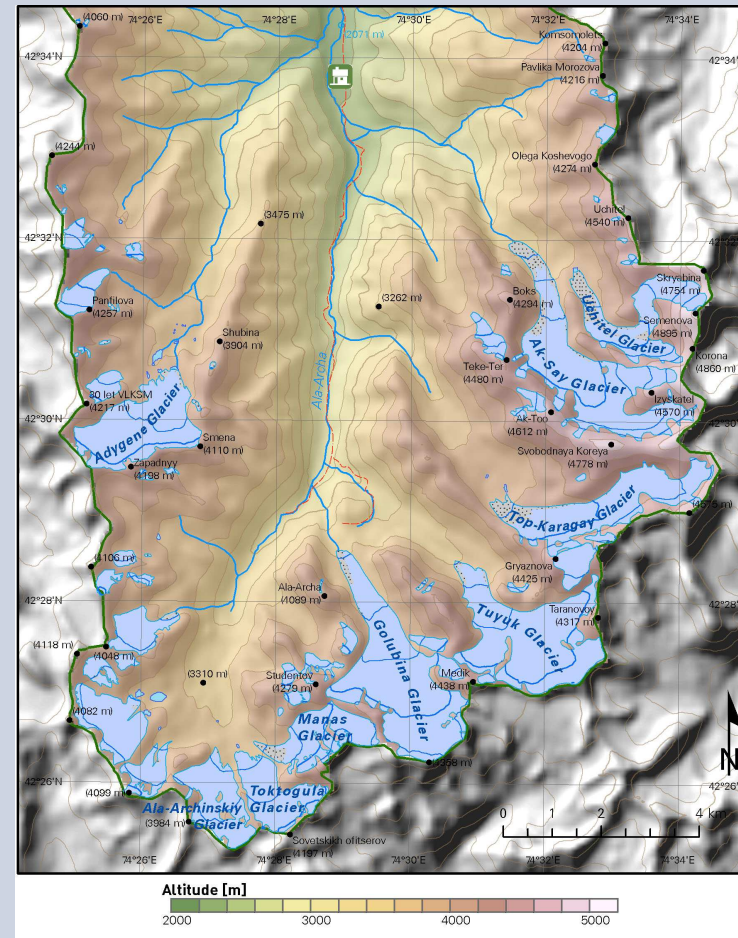
42°24' – 42°36' N

Area: 194 km<sup>2</sup>

Glacierised area: 33 km<sup>2</sup> (~17%)

Mean altitude: 3.550 m

Highest peak: Semenova Pik (4.895 m)

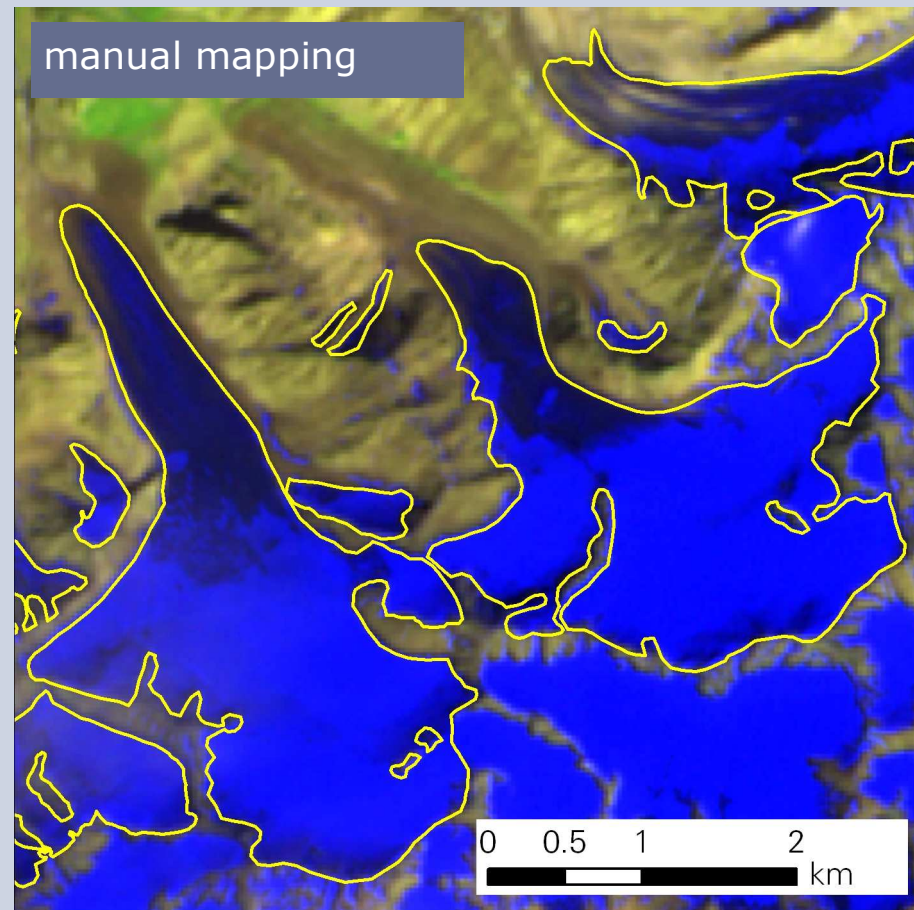


Satellite and sensor	Time period	Resolution
Corona	1964, 1971	5 m
Hexagon	1980	9 m
Landsat TM	1994	30 m
Terra ASTER	2003, 2008	15 m
RapidEye	2010	5 m
SRTM	2000	90 m
Topographische Karten	1960s – 1990s	



## Glacier area

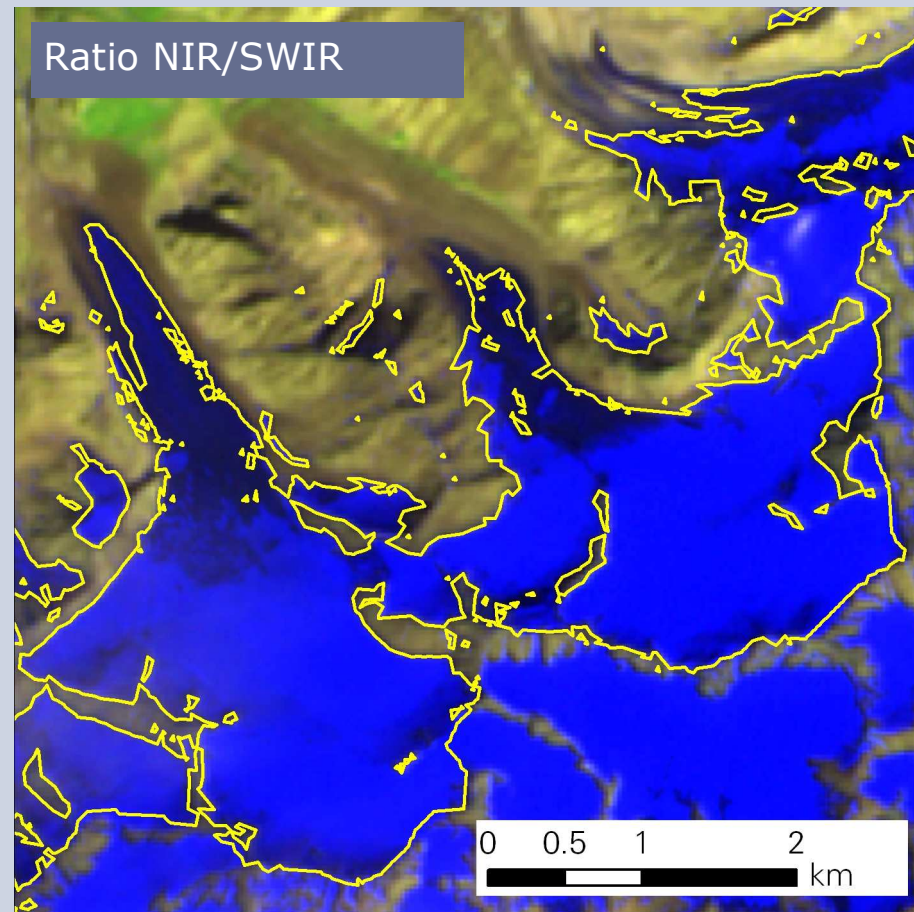
- identification of snow and ice using ratio images (NIR and SWIR band)
- manual mapping for panchromatic data, also as post-processing step





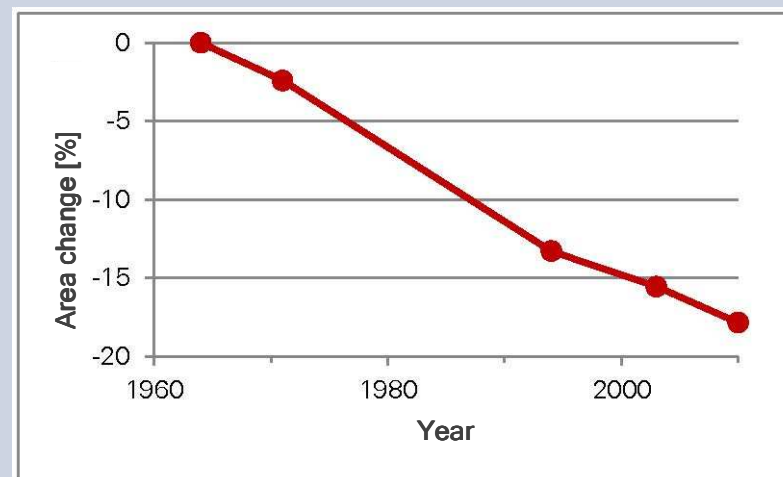
## Glacier area

- identification of snow and ice using ratio images (NIR and SWIR band)
- manual mapping for panchromatic data, also as post-processing step



## Glacier area

- multitemporal analysis of glacier areas shows overall recession
- glacier area changes since 1964: -17,9%



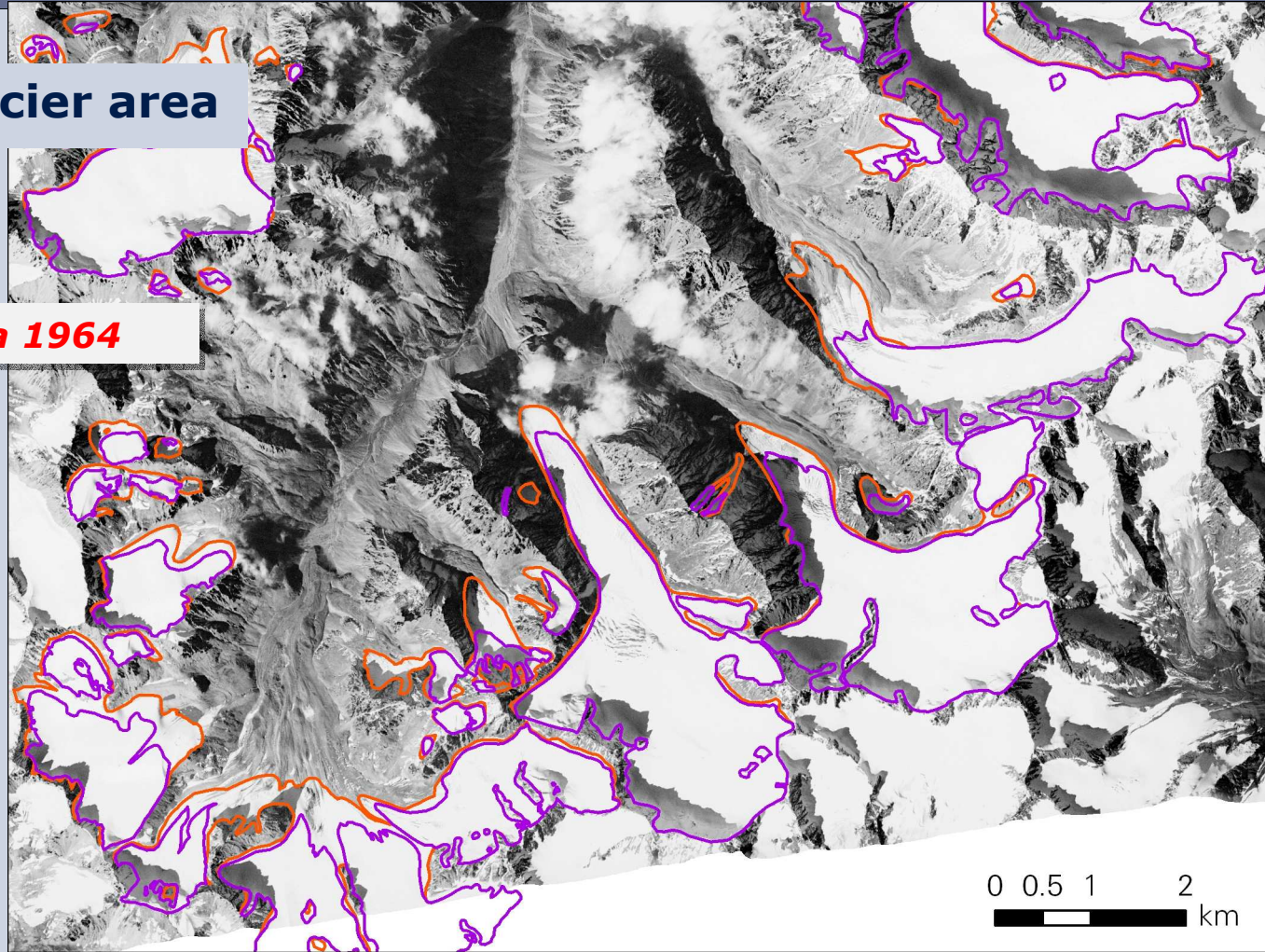
Glacierised area in Ala Archa National Park



# Glacier monitoring

Glacier area

**Corona 1964**

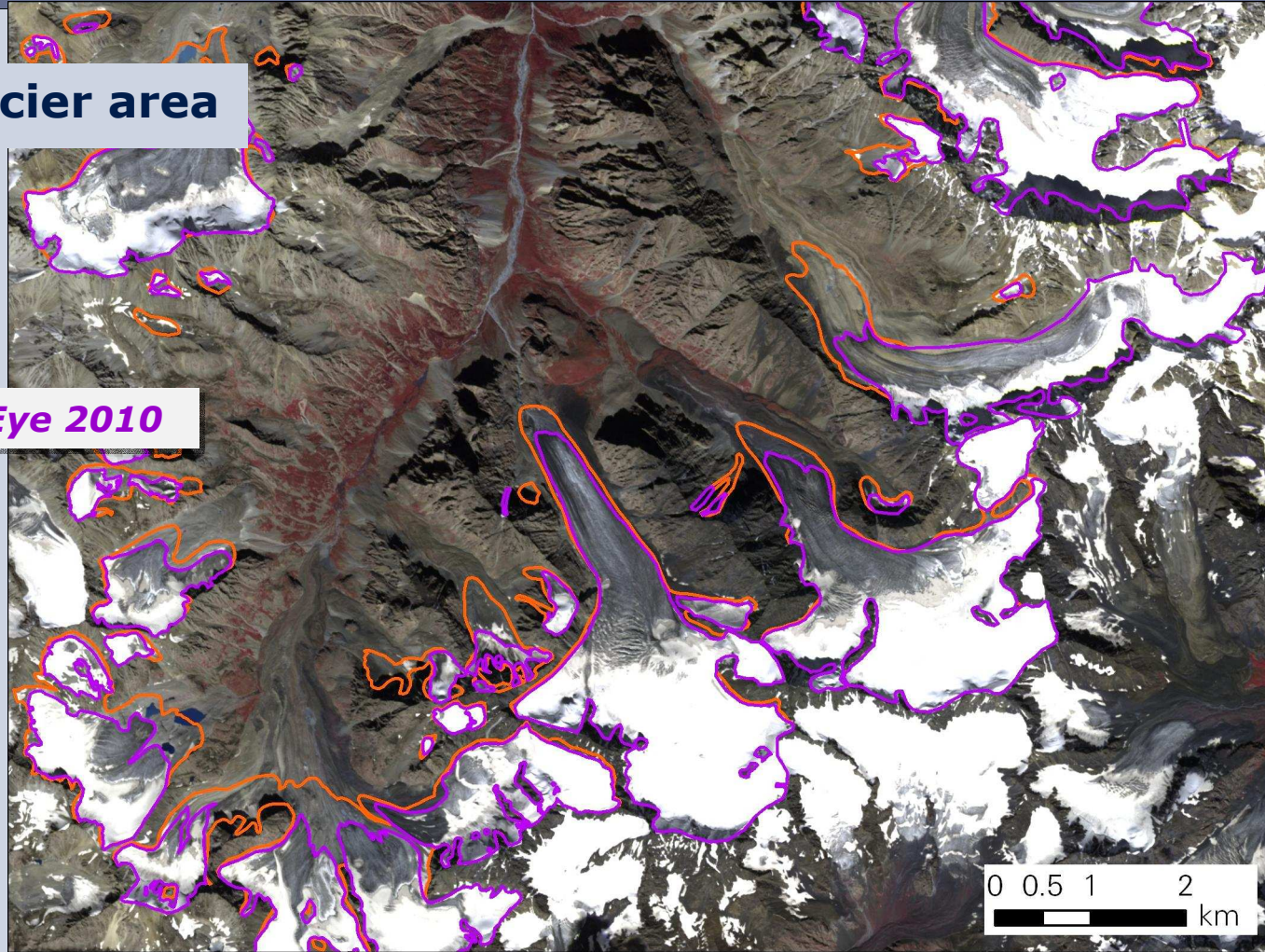




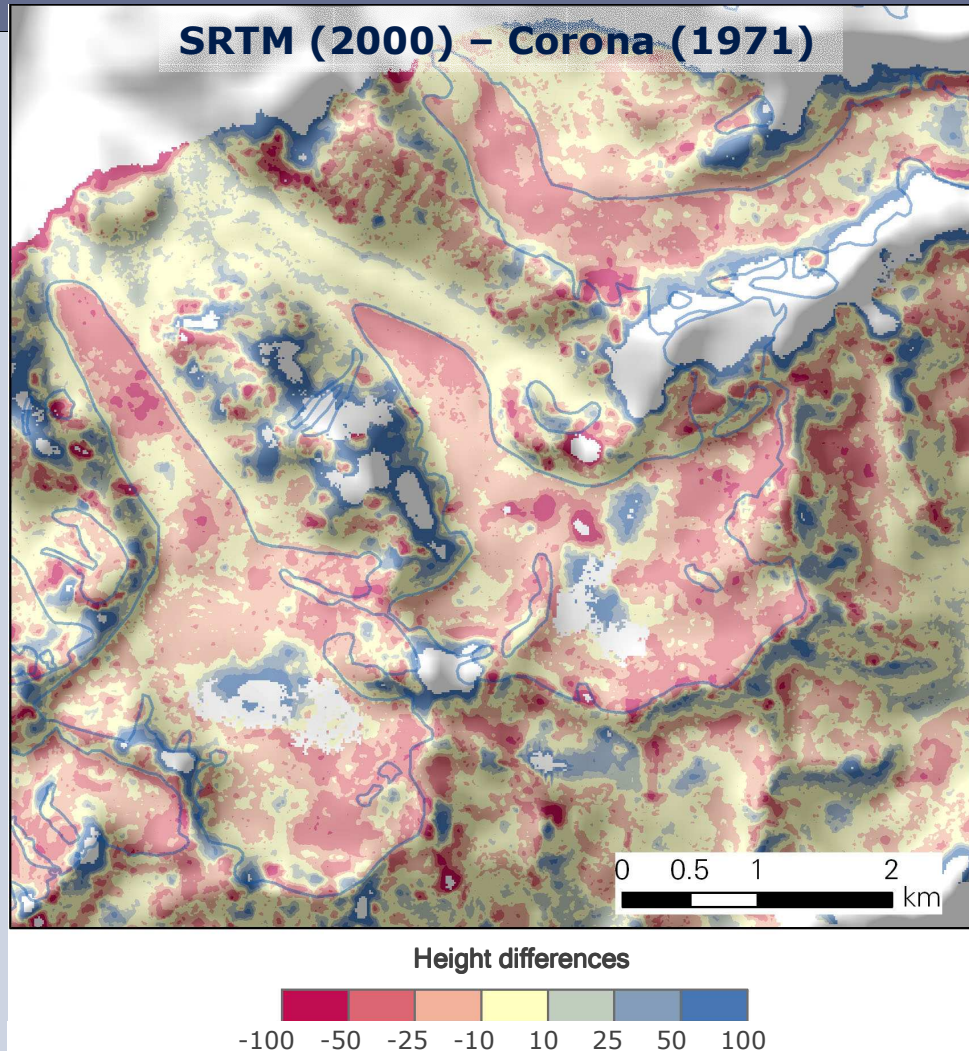
# Glacier monitoring

**Glacier area**

*RapidEye 2010*







## Mass balance

- mass balance = accumulation – ablation
- geodetic method for estimation:
  - comparison of glacier heights
  - ice density:  $\rho_{\text{ice}} = 900 \text{ kg/m}^3$

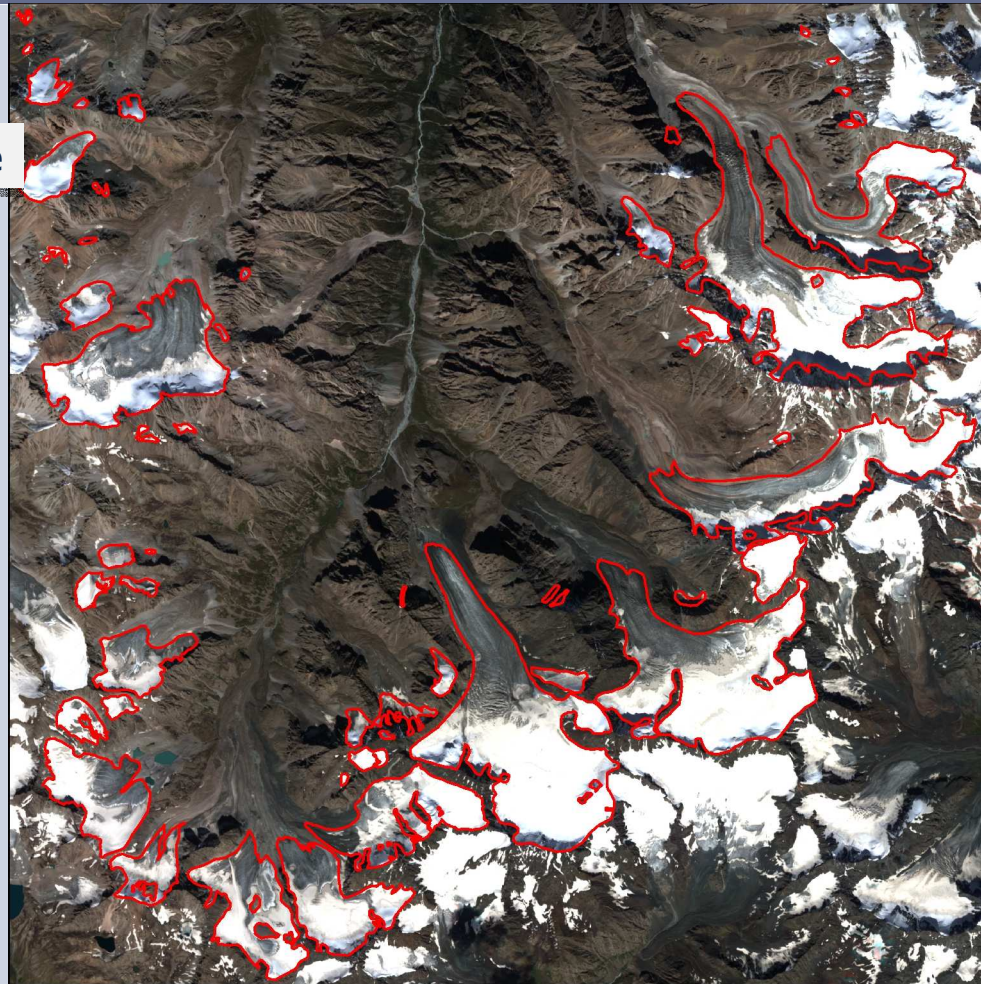


## Glacier volume

- Linsbauer model (2008) based on Shallow Ice Approximation (SIA)
- calculation of ice thickness at points along glacier flow lines
- interpolation of glacier bed topography

# Glacier monitoring

RapidEye



08/12/2011

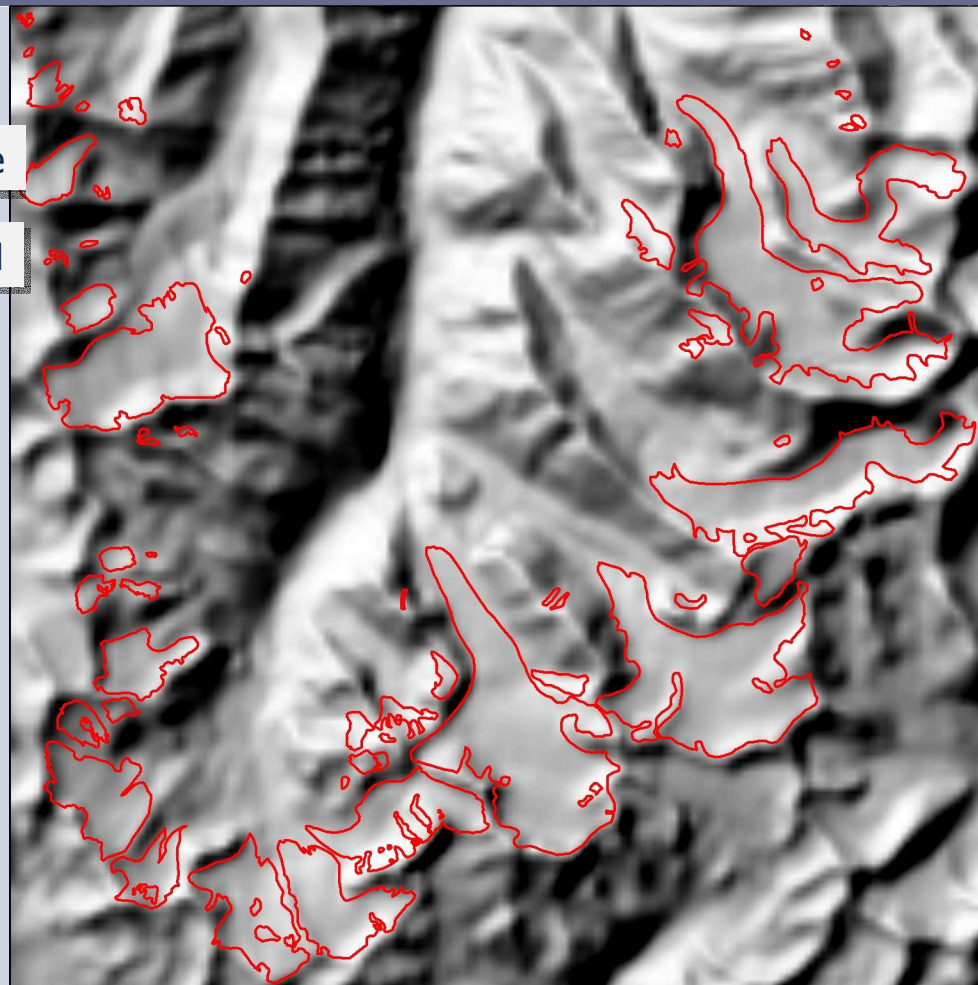
Glacier monitoring in the Ala Archa National  
Park (Tien Shan)

Folie 12



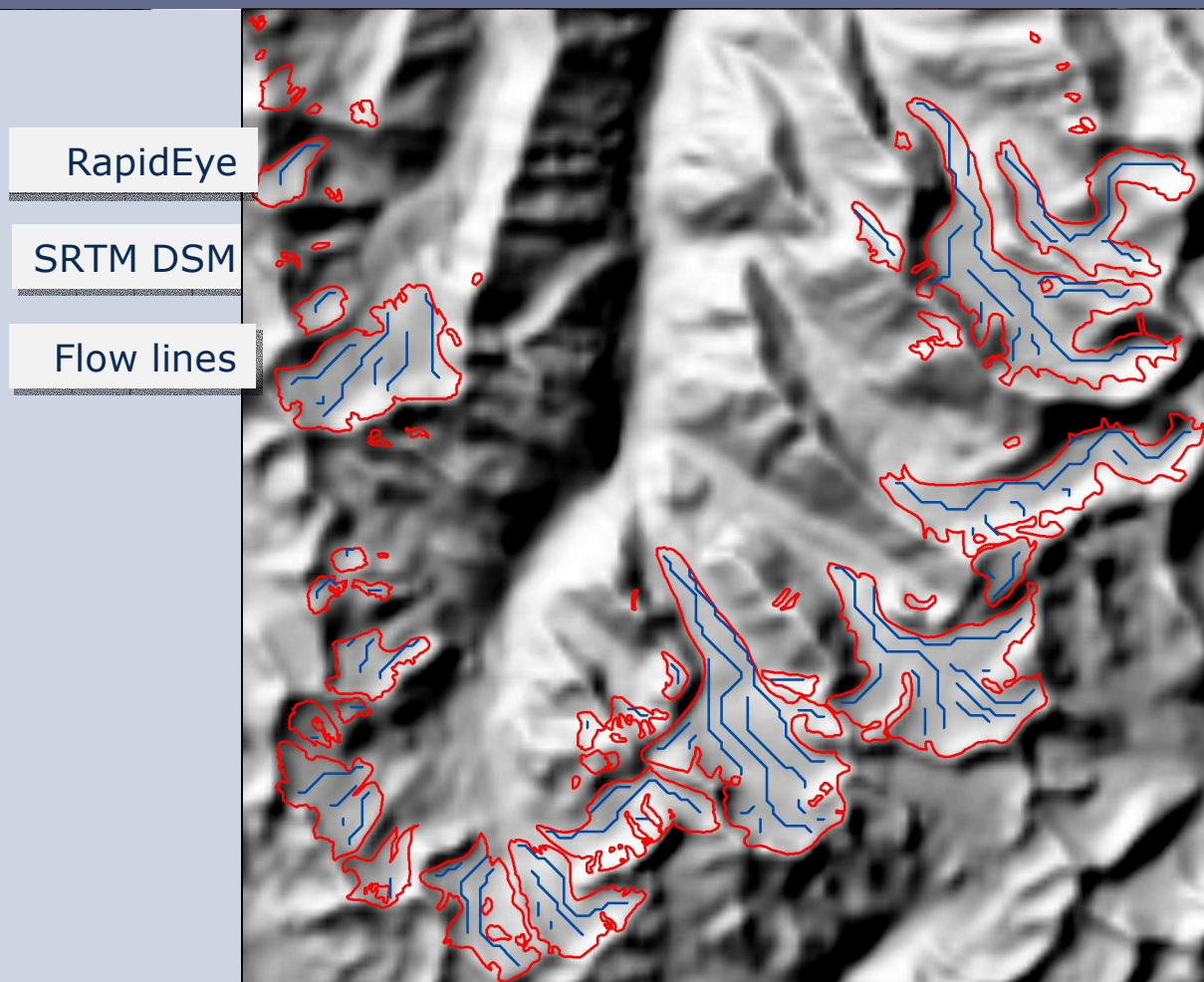
# Glacier monitoring

RapidEye  
SRTM DSM



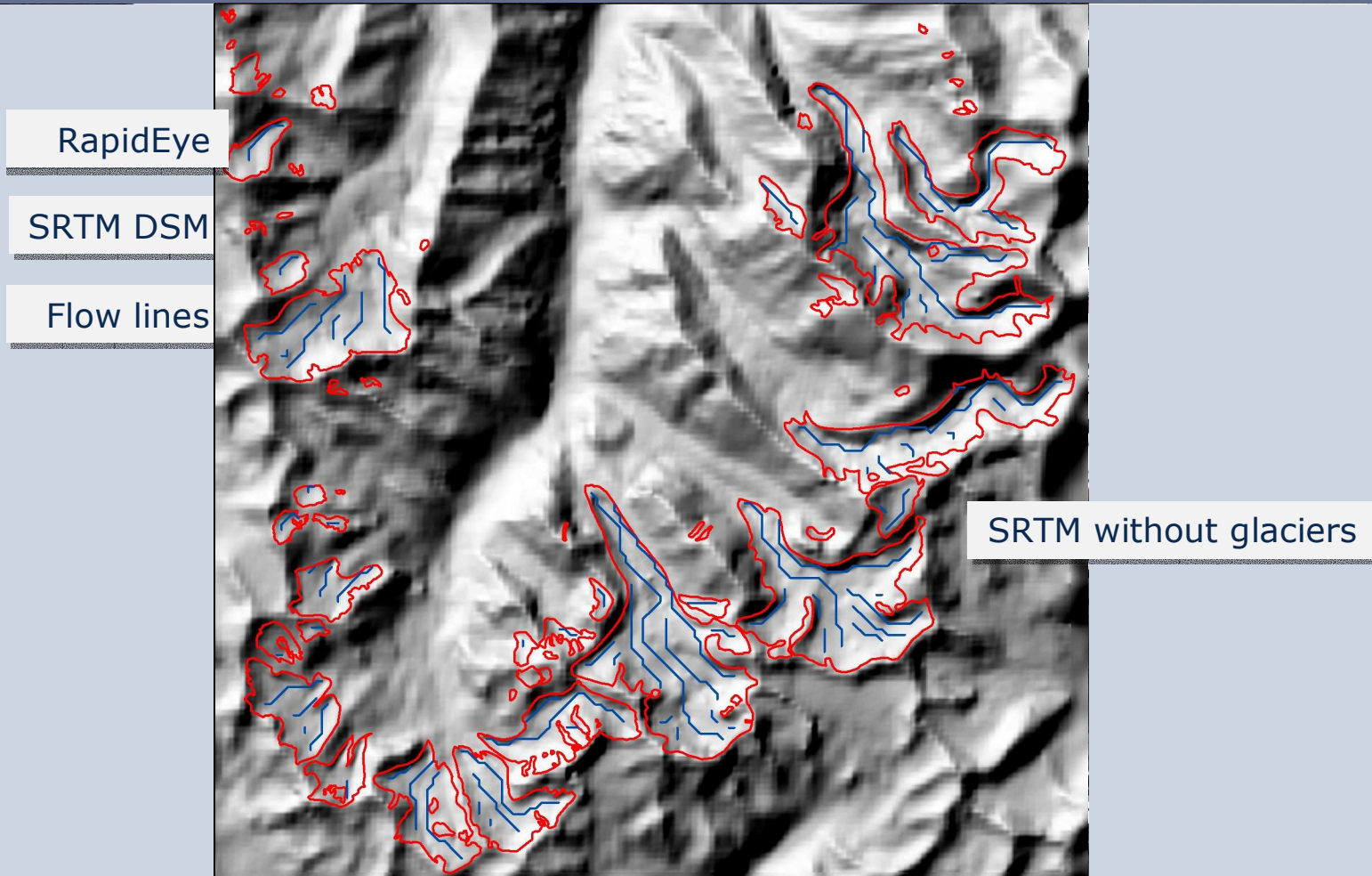


# Glacier monitoring



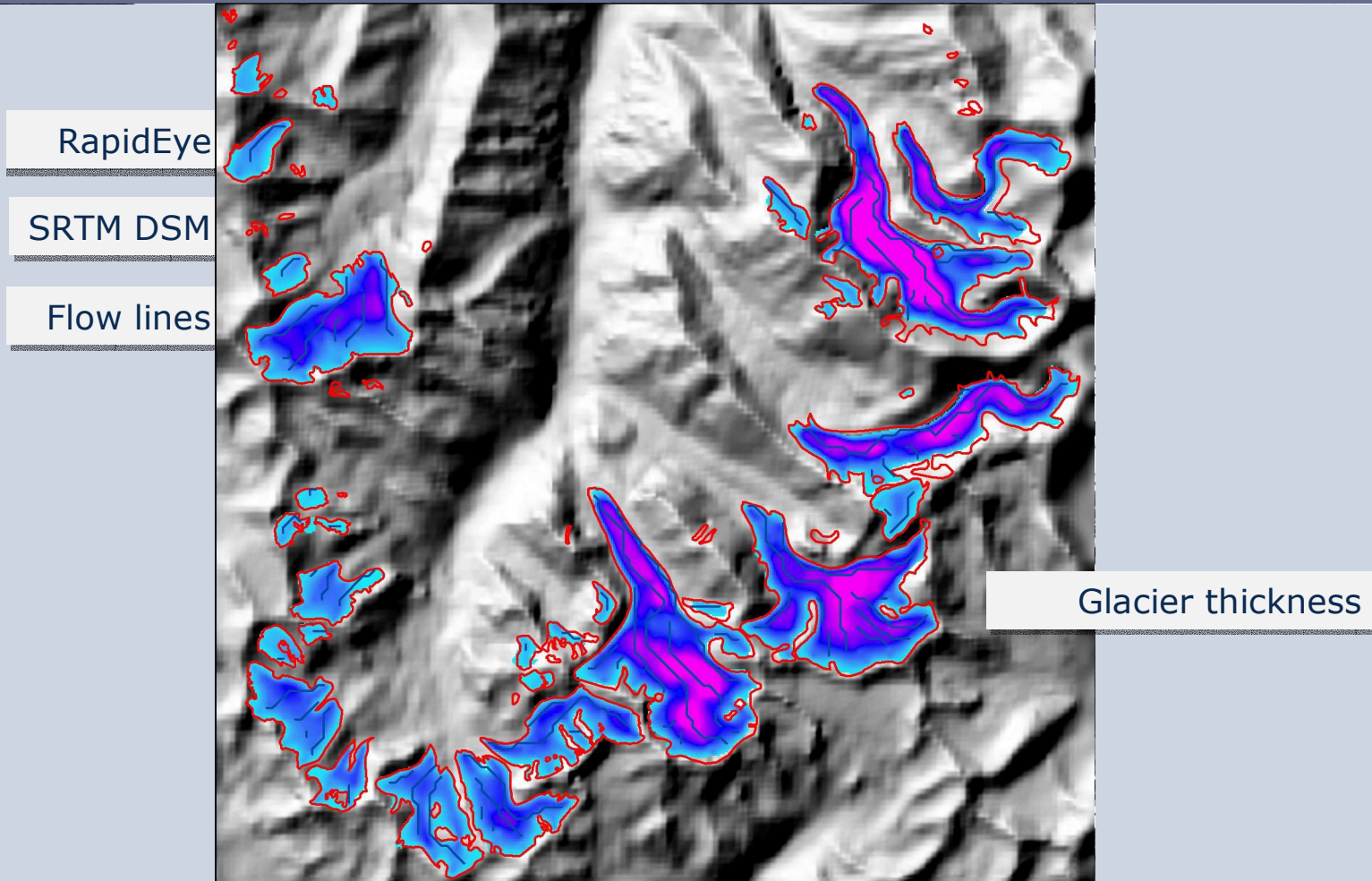


# Glacier monitoring





# Glacier monitoring



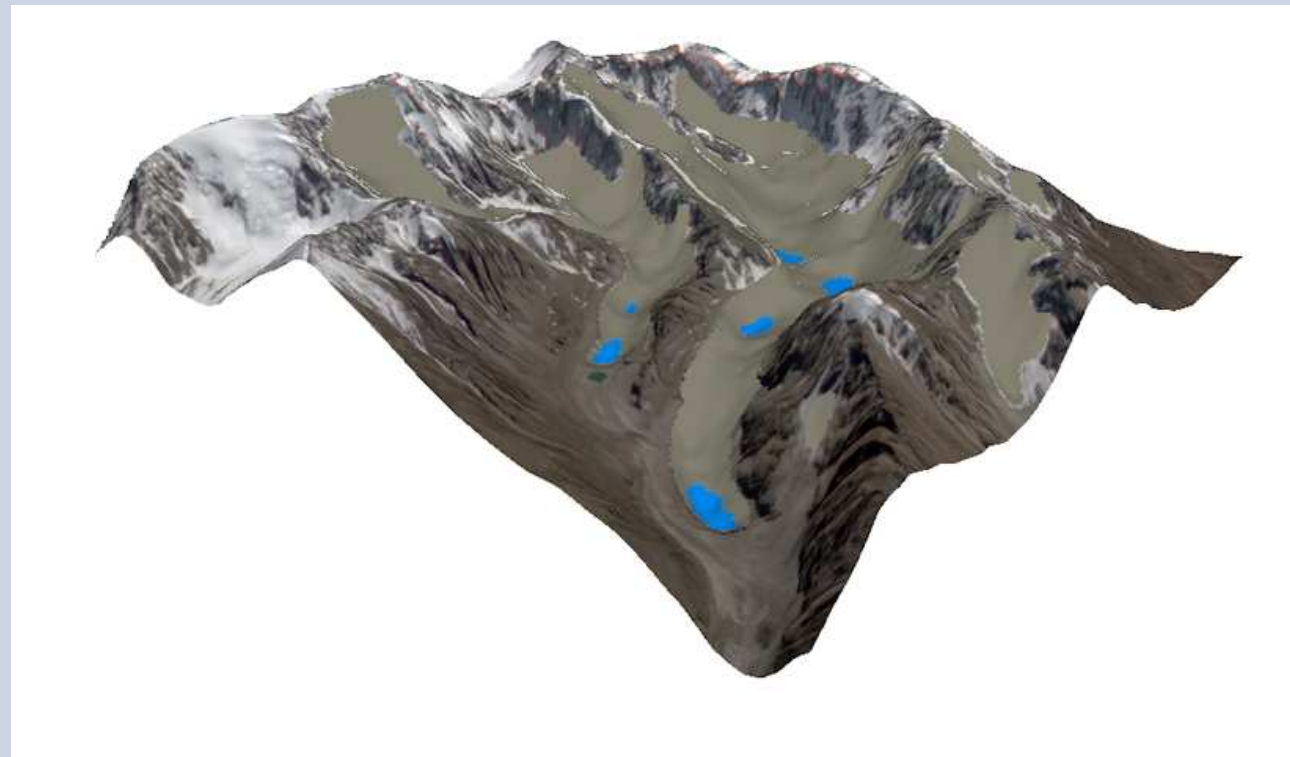


## Glaciers Ak-Say and Uchitel





## Glaciers Ak-Say and Uchitel





# Conclusion

- glacier monitoring with multi-temporal remote sensing data revealed decrease of glacierised area over long period (since 1960s)
- DTM comparison quantitatively shows decline of glacier heights since 1970s
- model for glacier bed topography and volume estimation
- outlook:
  - verification for glacier volume modelling
  - filling of temporal data gaps to complete time series





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**Thank you for your attention.**

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