Using close -to-daily snowline observations from multi -sensor satellite images to derive glacier melt water contribution to total river runoff

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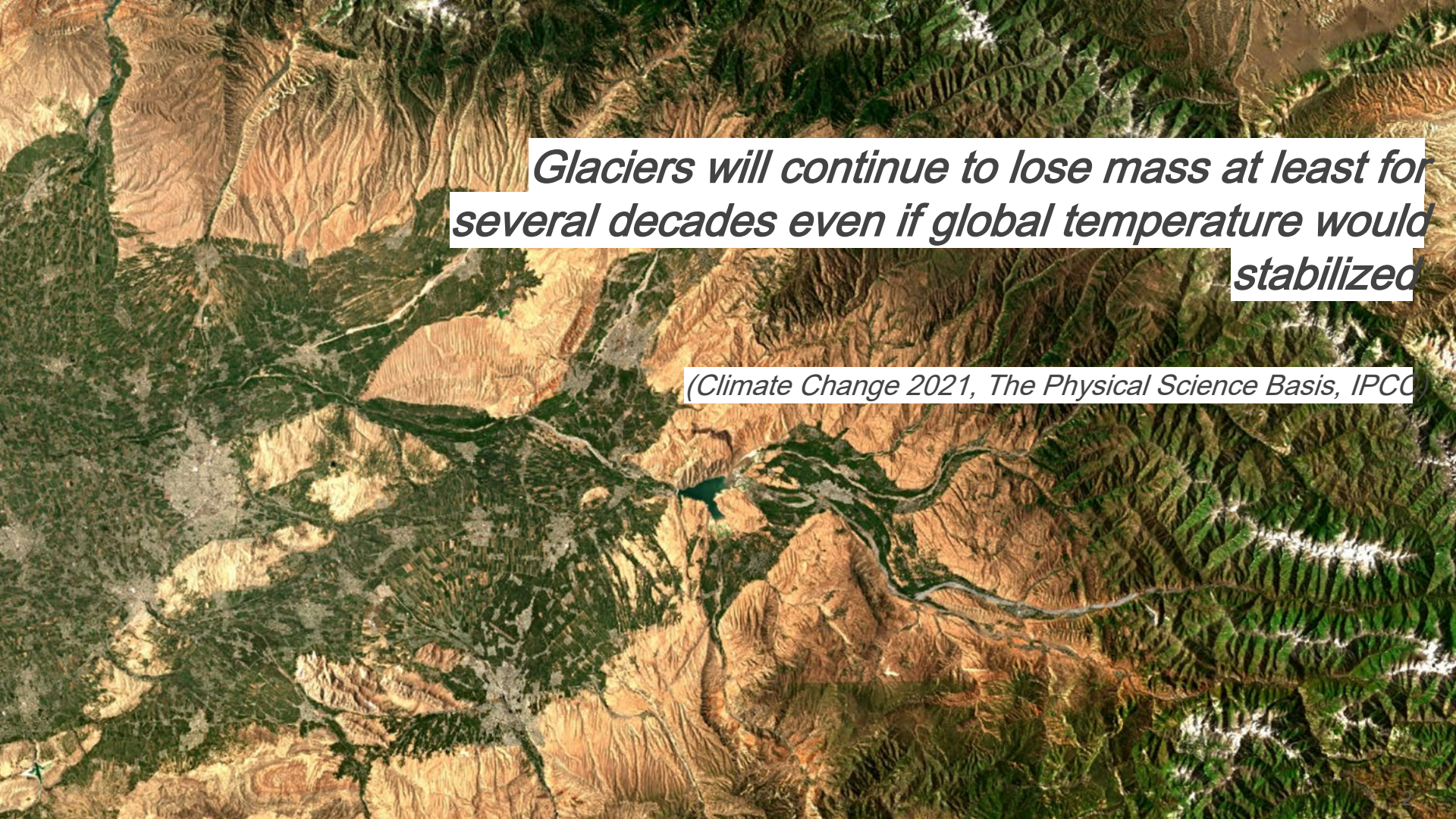
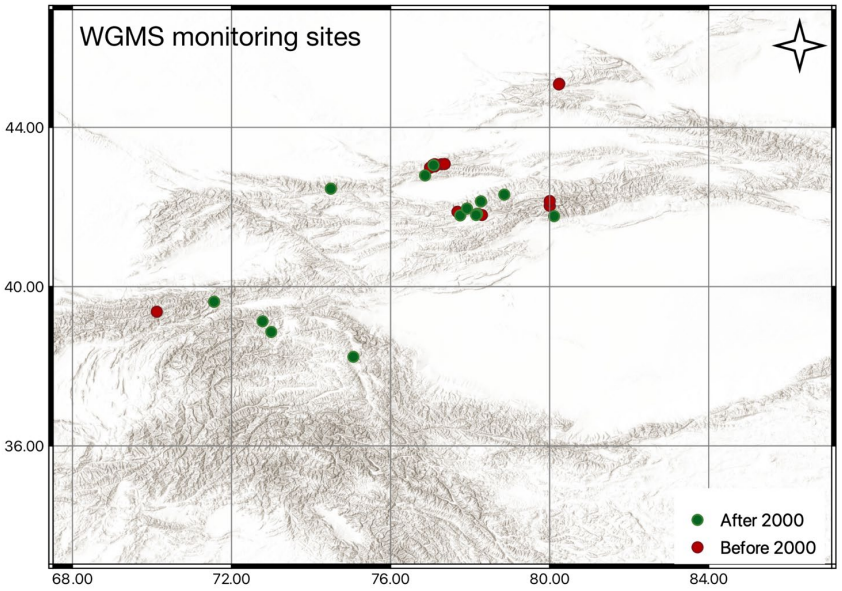
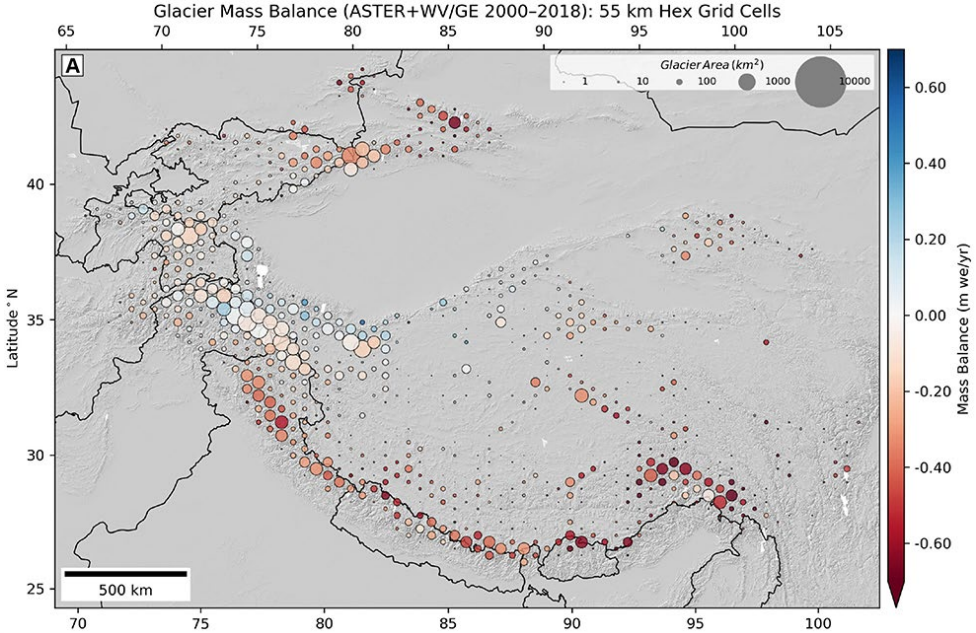
3) Bavarian Academy of Sciences and Humanities, Germany
4) Department of Remote Sensing, University of Würzburg, Germany


Glaciers will continue to lose mass at least for several decades even if global temperature would stabilized
(Climate Change 2021, The Physical Science Basis, IPCC)

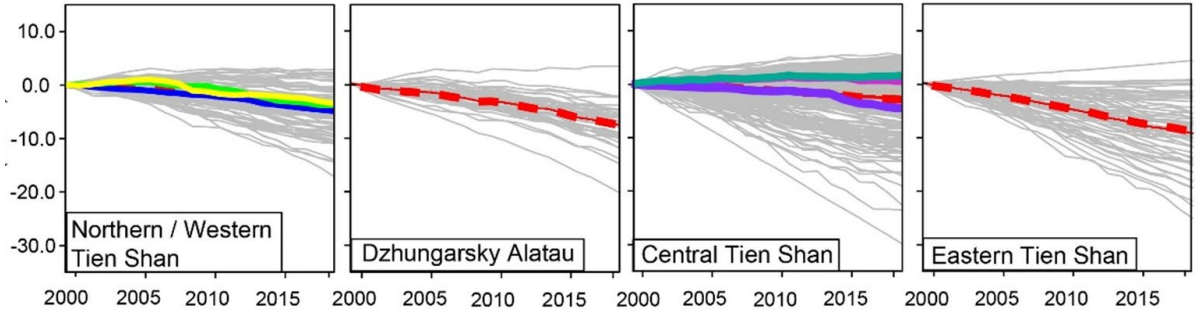
Glaciological & geodetic measurements

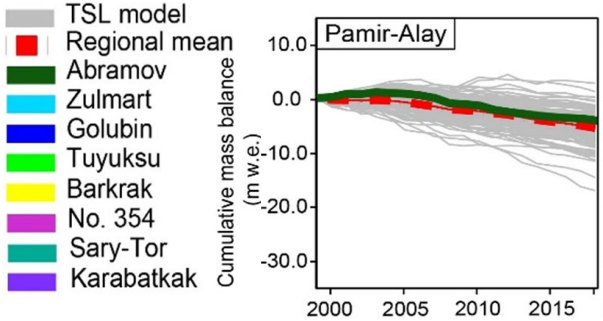


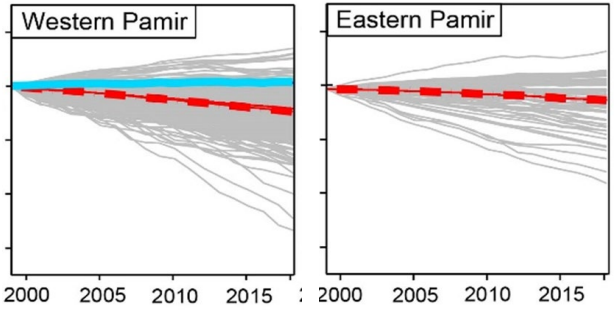


Shean et al. 2020

Representativeness

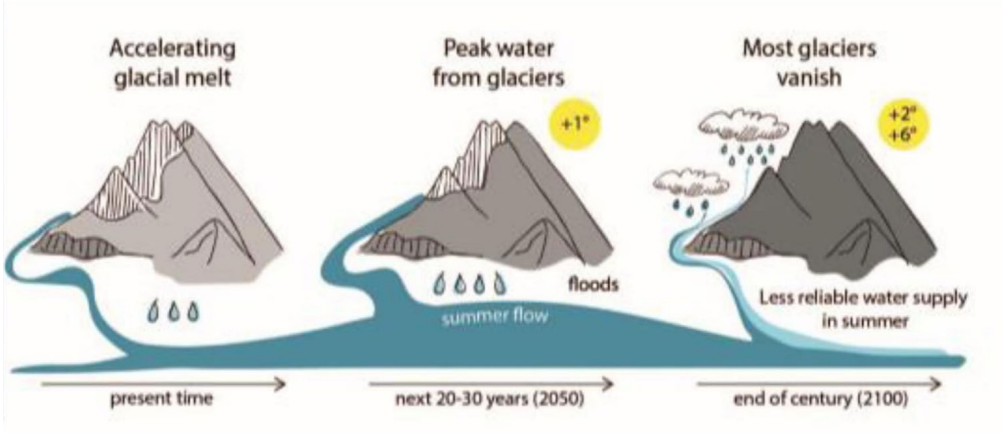


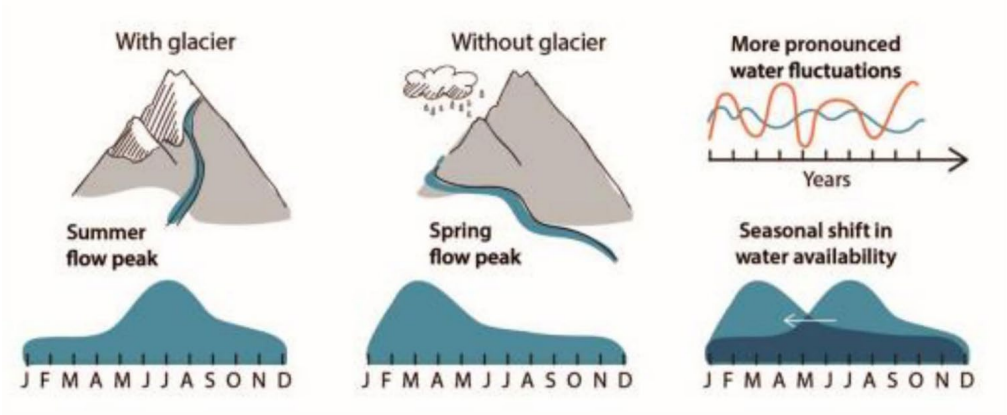




Barandun et al. 2021

Toward sub -seasonal estimates

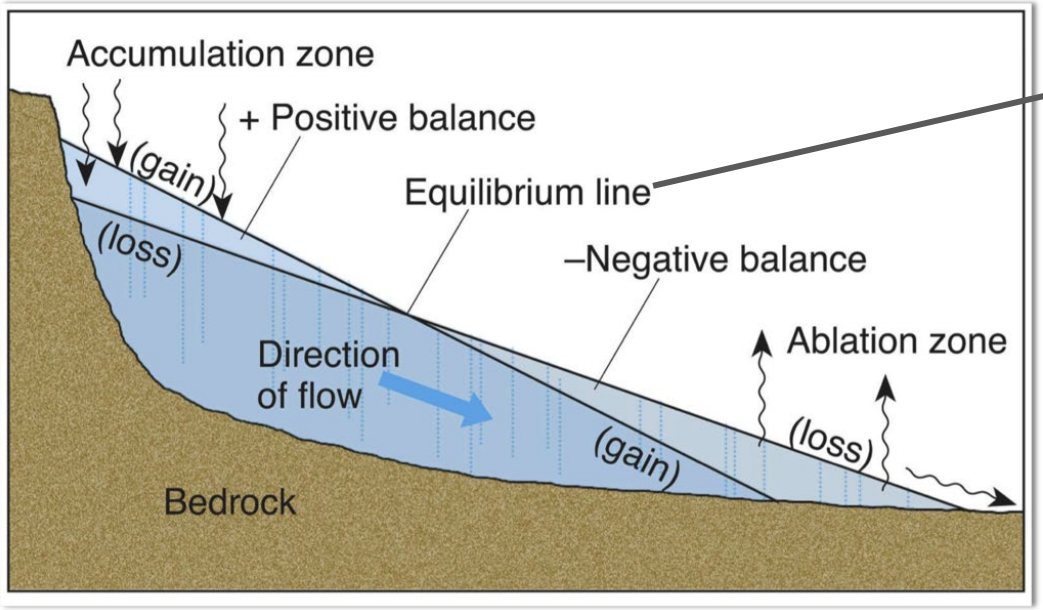


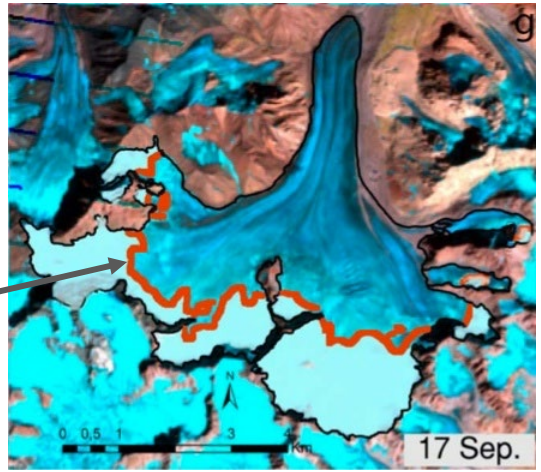


Credits: Zoï Environment Network, Geneva

Transient snowline as a proxy for mass balance

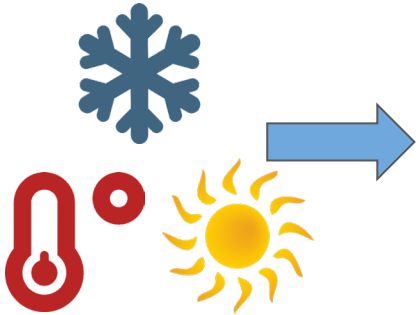
Østrem, 1973; Dyurgerov et al., 1994; Hock, 2007

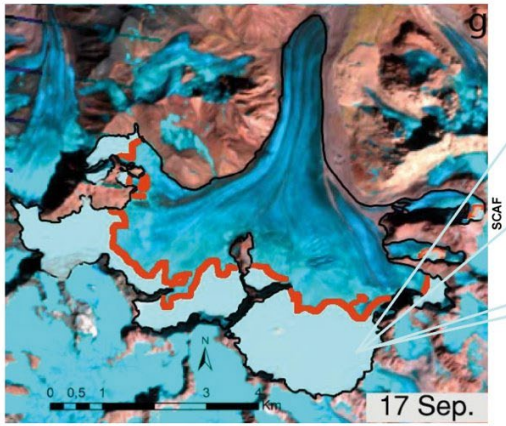


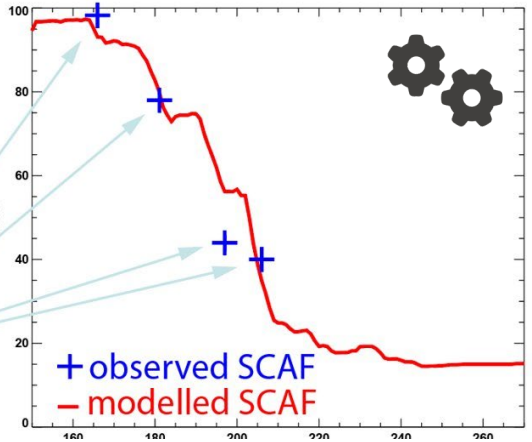


openAmundsen constrained by TSL

eurac research

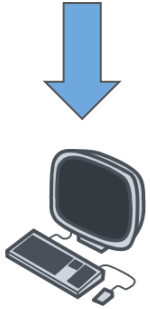






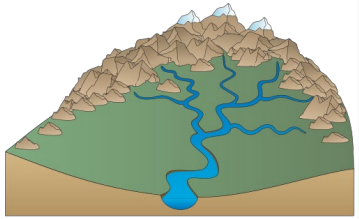
Calibration after Barandun et al. 2018 & 2021

SCAF = Snow Covered Area Fraction



daily SMB

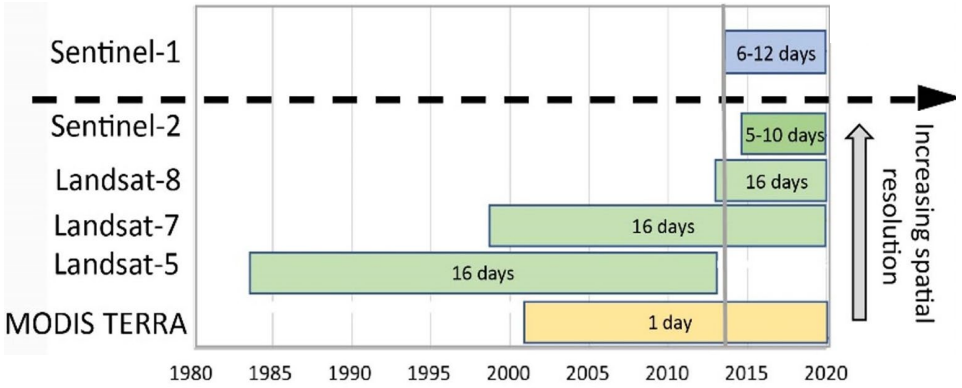
daily glacier meltwater release

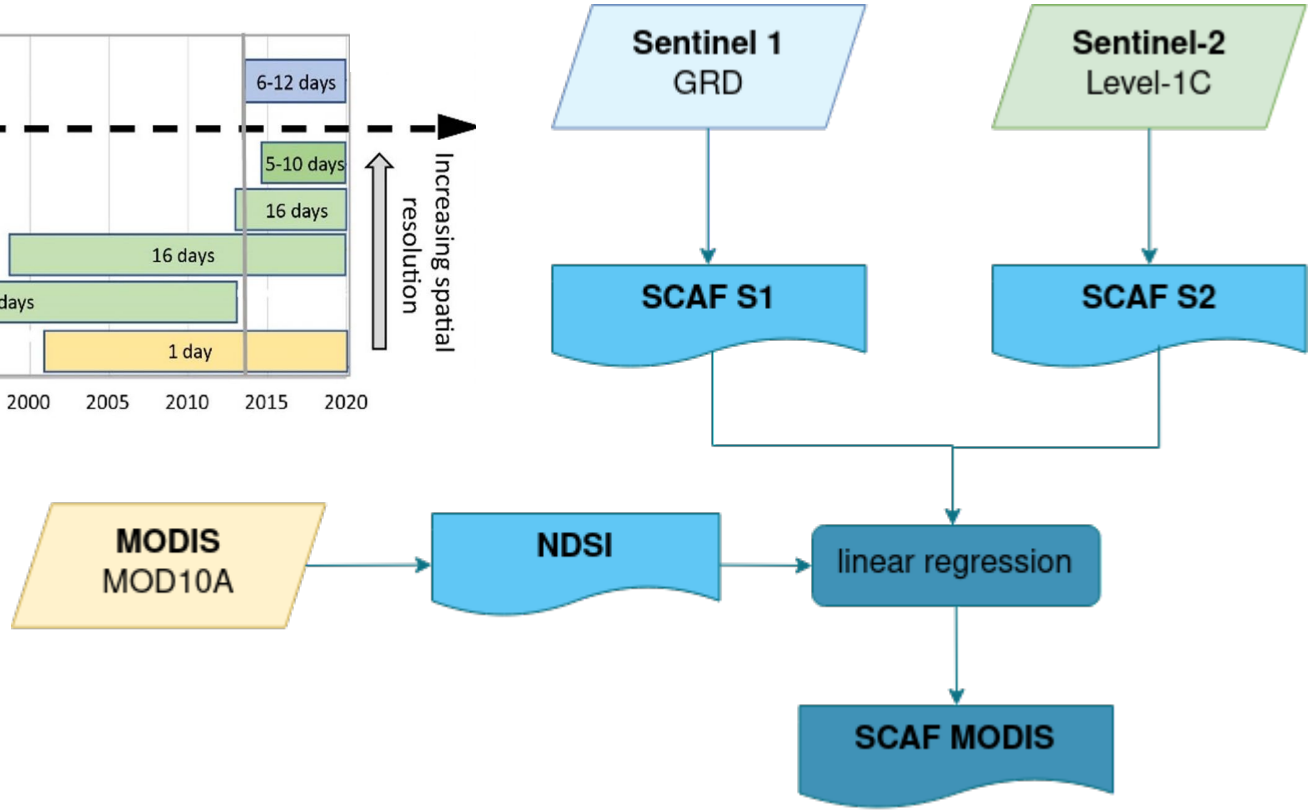


source:pypi.org/project/openamundsen/

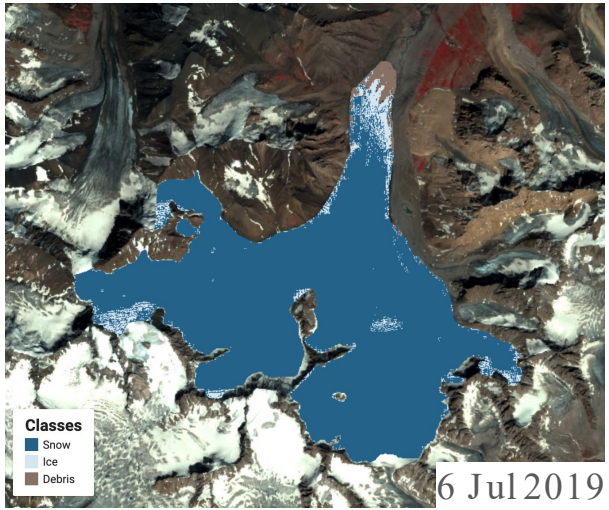
Methodology

eurac research

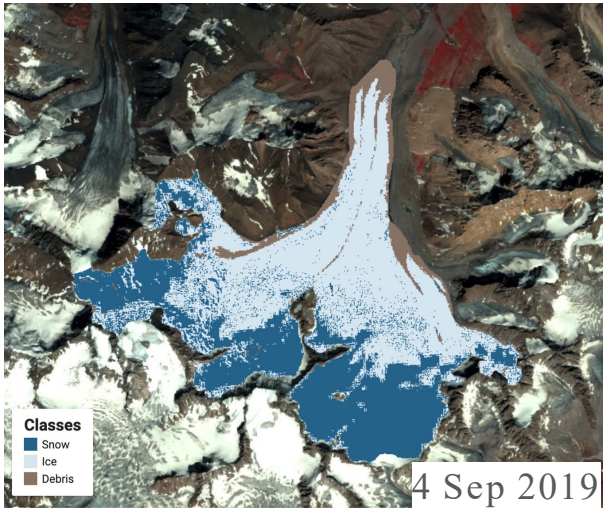




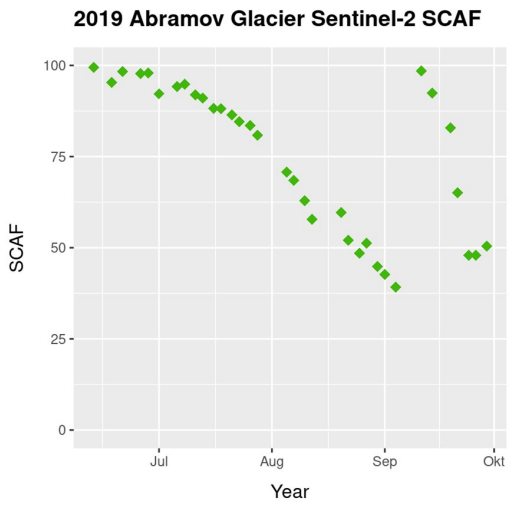
Sentinel -2 snowline SVM classification



6 Jul 2019



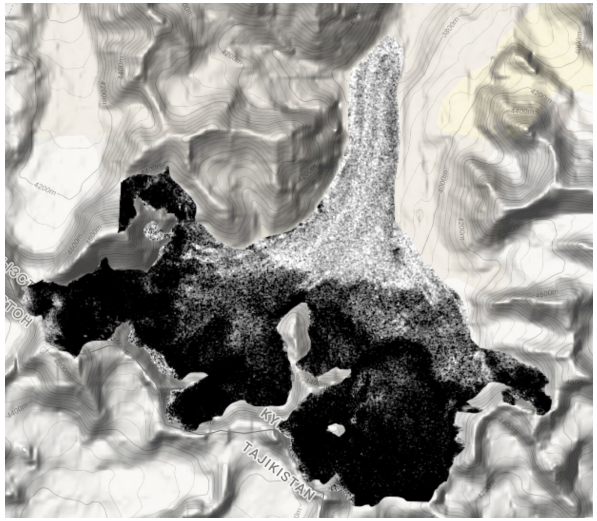
4 Sep 2019

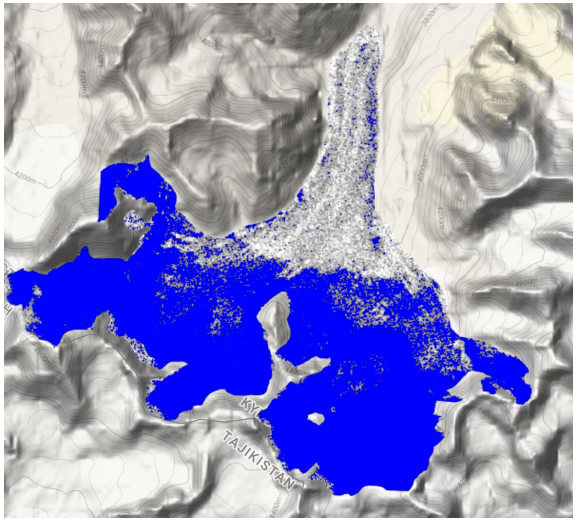


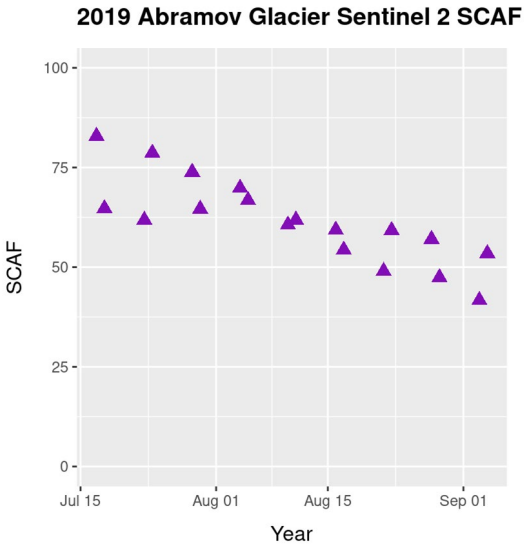
Clouds were filtered with S2_CLOUD_PROBABILITY product

All B2 - B12 were used as an input to SVM

SAR wet snow classification







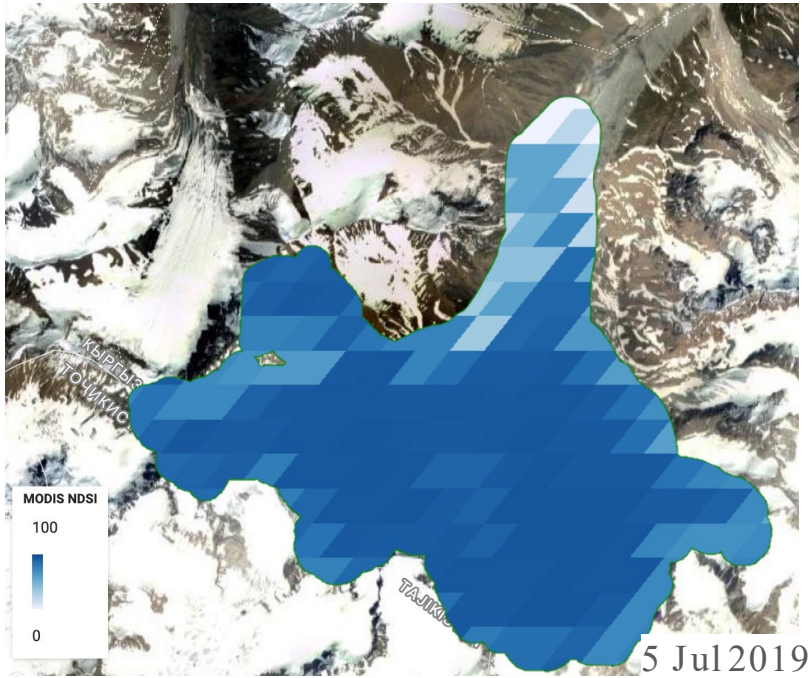
Nagler's Method:

$R_{VV} = \sigma^0_{snow\ VV} - \sigma^0_{ref\ VV}$

$R_{VH} = \sigma^0_{snow\ VH} - \sigma^0_{ref\ VH}$

$R = (R_{VV} + R_{VH})/2$

MODIS mean NDSI

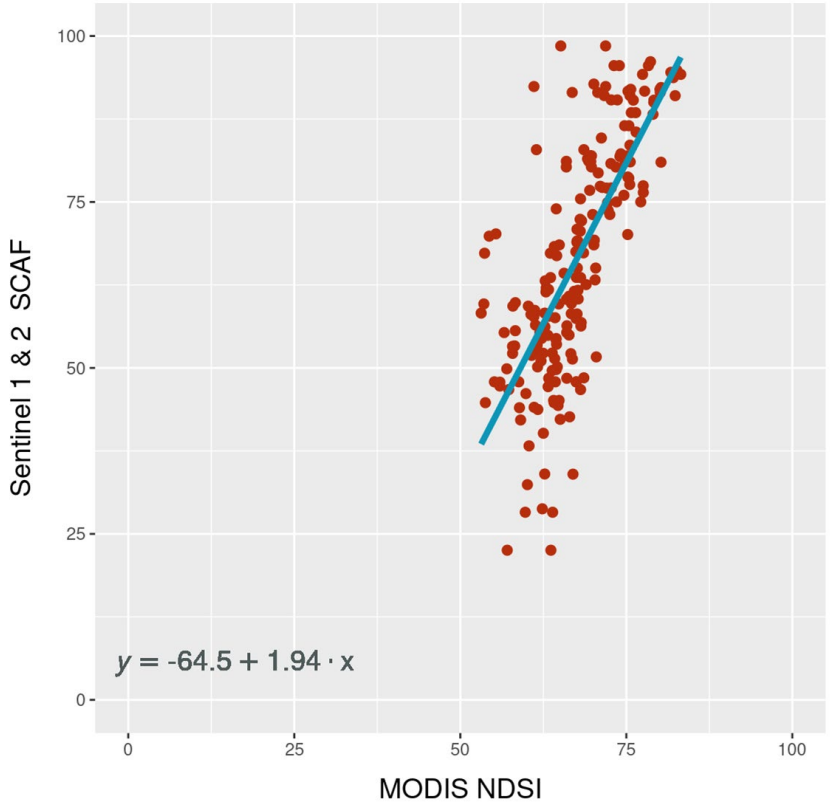


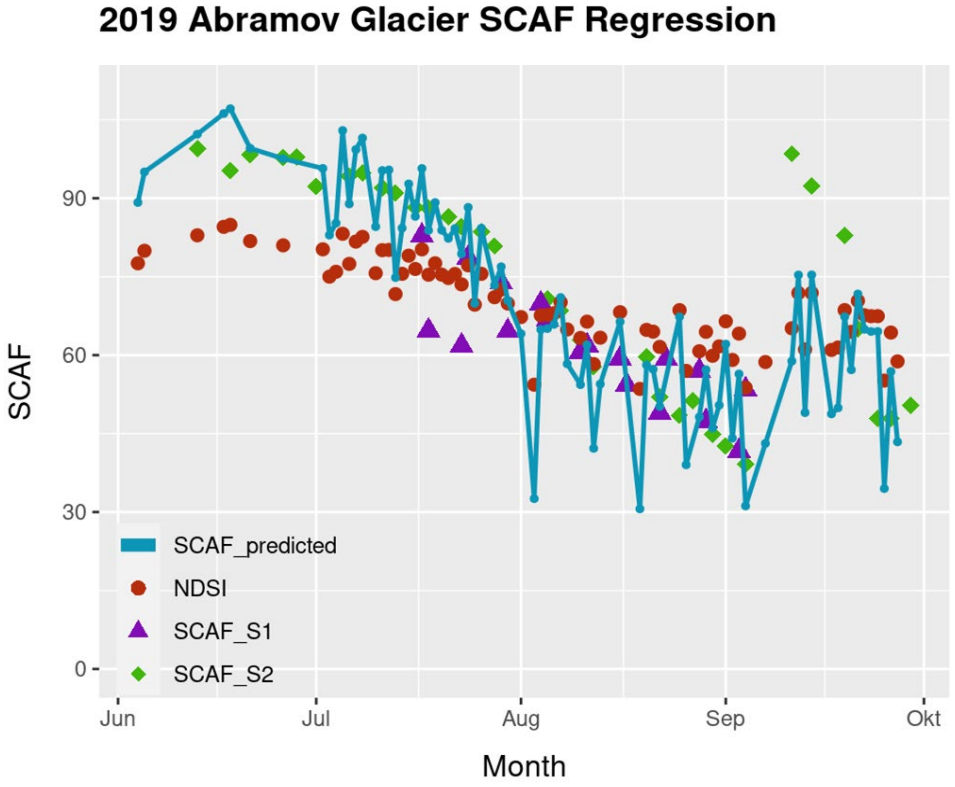
MOD10A NDSI Snow Cover

NDSI = (B4-B6)/(B4+B6)

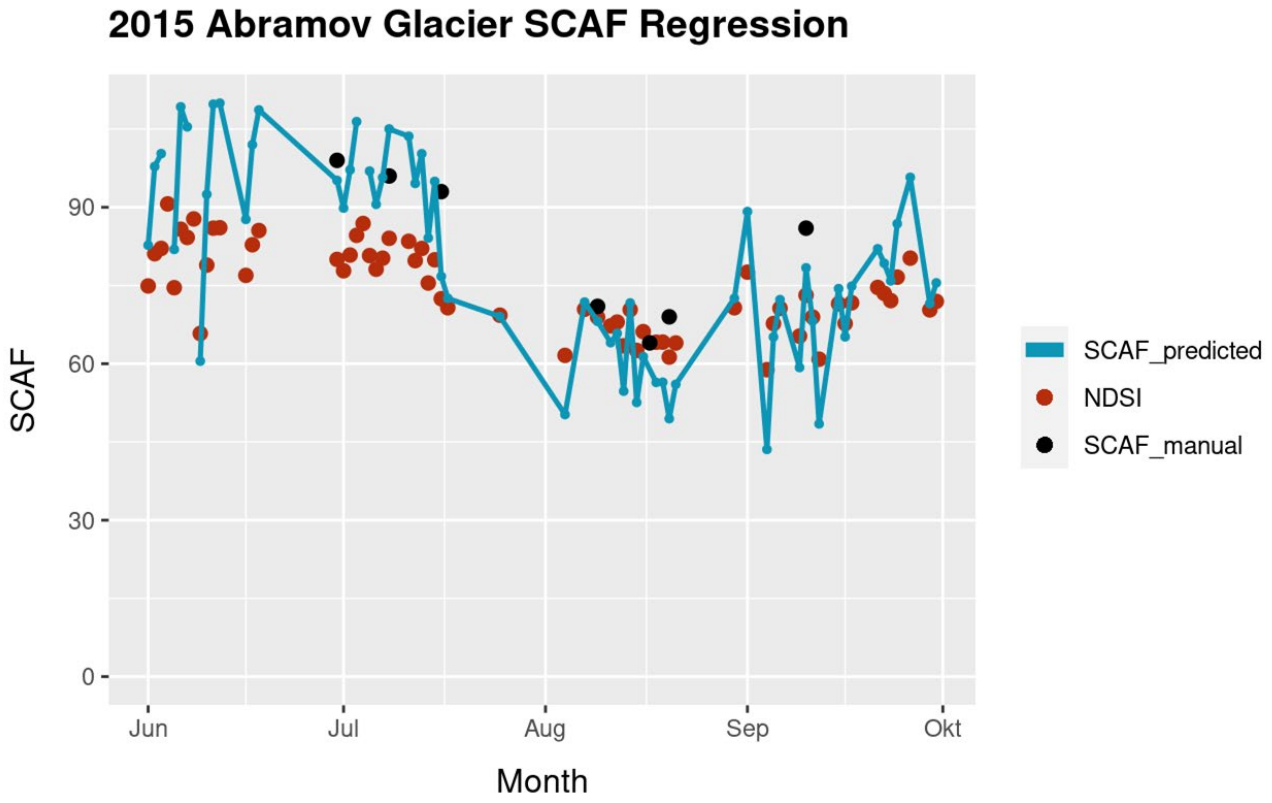
Temporal gap-filling

SCAF correlation & regression result



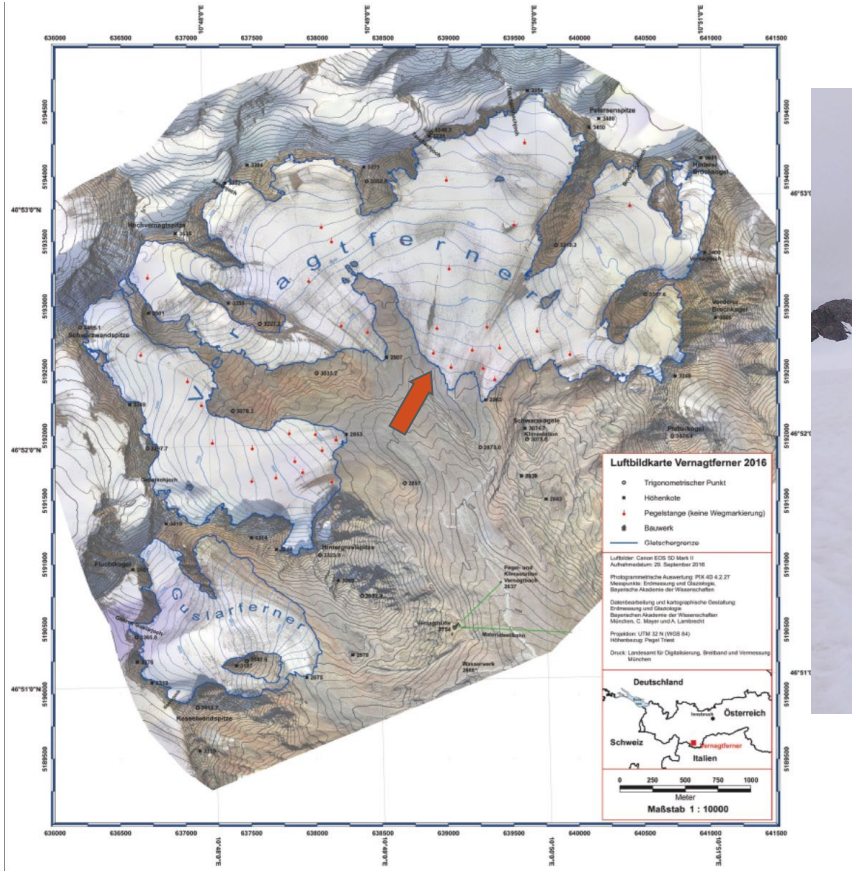


SCAF validation



openAmundsen: calibration & validation

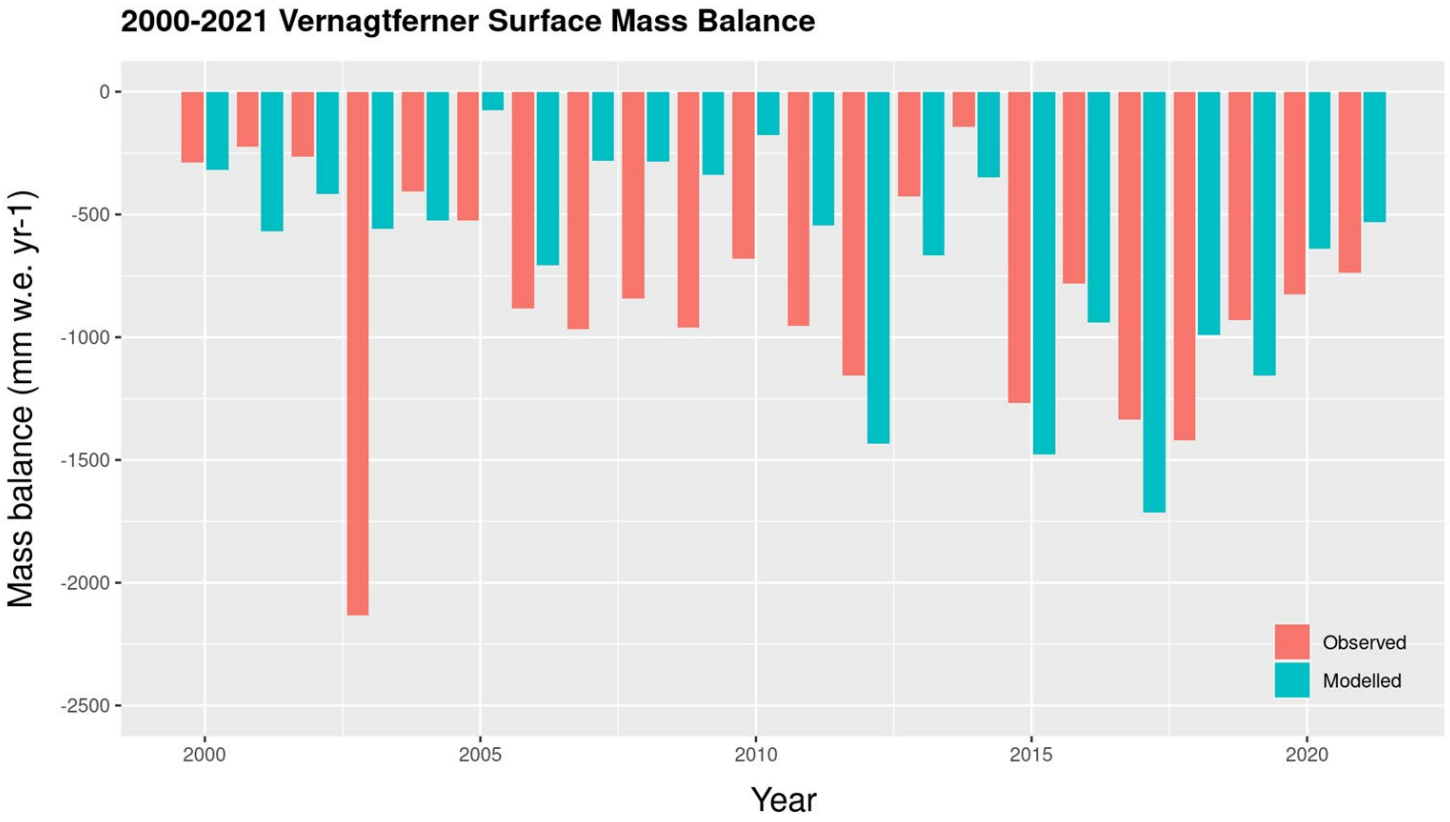
Smart Stake



Electronic Stake

Photo: M. Barandun

Preliminary results

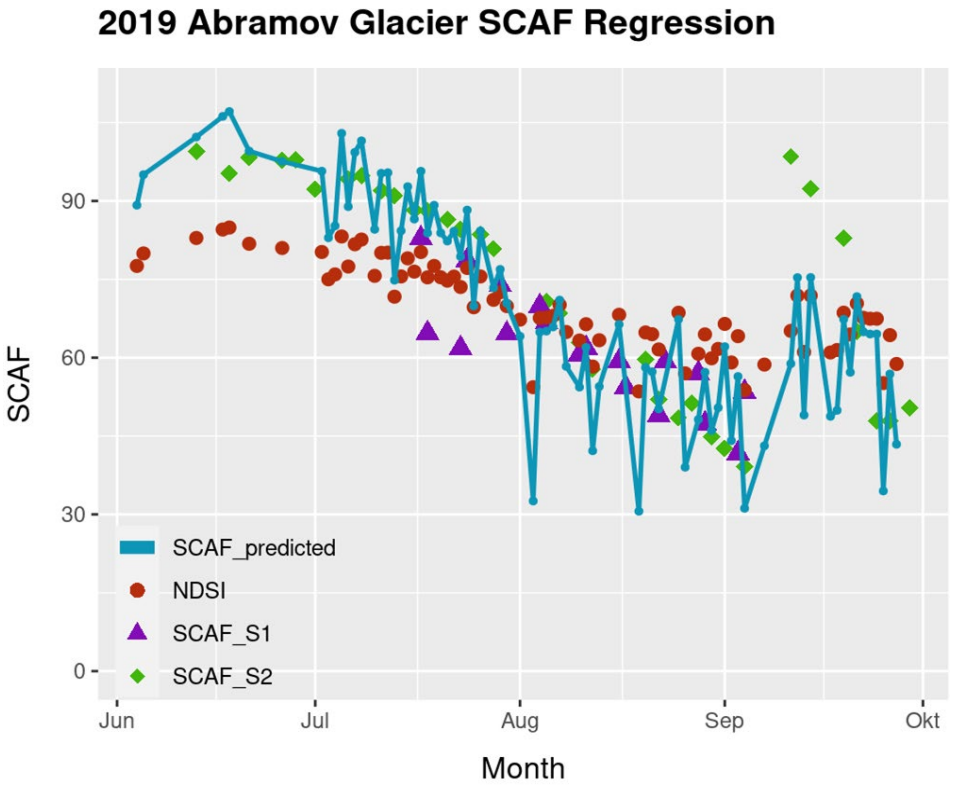


Limitations

- Sentinel-2 SVM classification training dataset
- Sentinel-1 unable to detect the end of ablation season
- Agreement is limited in observed and modelled SMB in earlier years

Conclusion

- Snowline derived from multi-source satellite observations used for mass balance model calibration



Thank you!