TECHNISCHE UNIVERSITÄT DRESDEN
Faculty of Environmental Sciences, Institute of Cartography

Zhadang Glacier

Orthorectification of terrestrial time-lapse camera images for snow line mapping

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Outline

1. Motivation
2. Investigation area – Zhadang Glacier
3. Terrestrial time-lapse camera system
4. Orthorectification – method and workflow
5. Results
6. Conclusion/Outlook

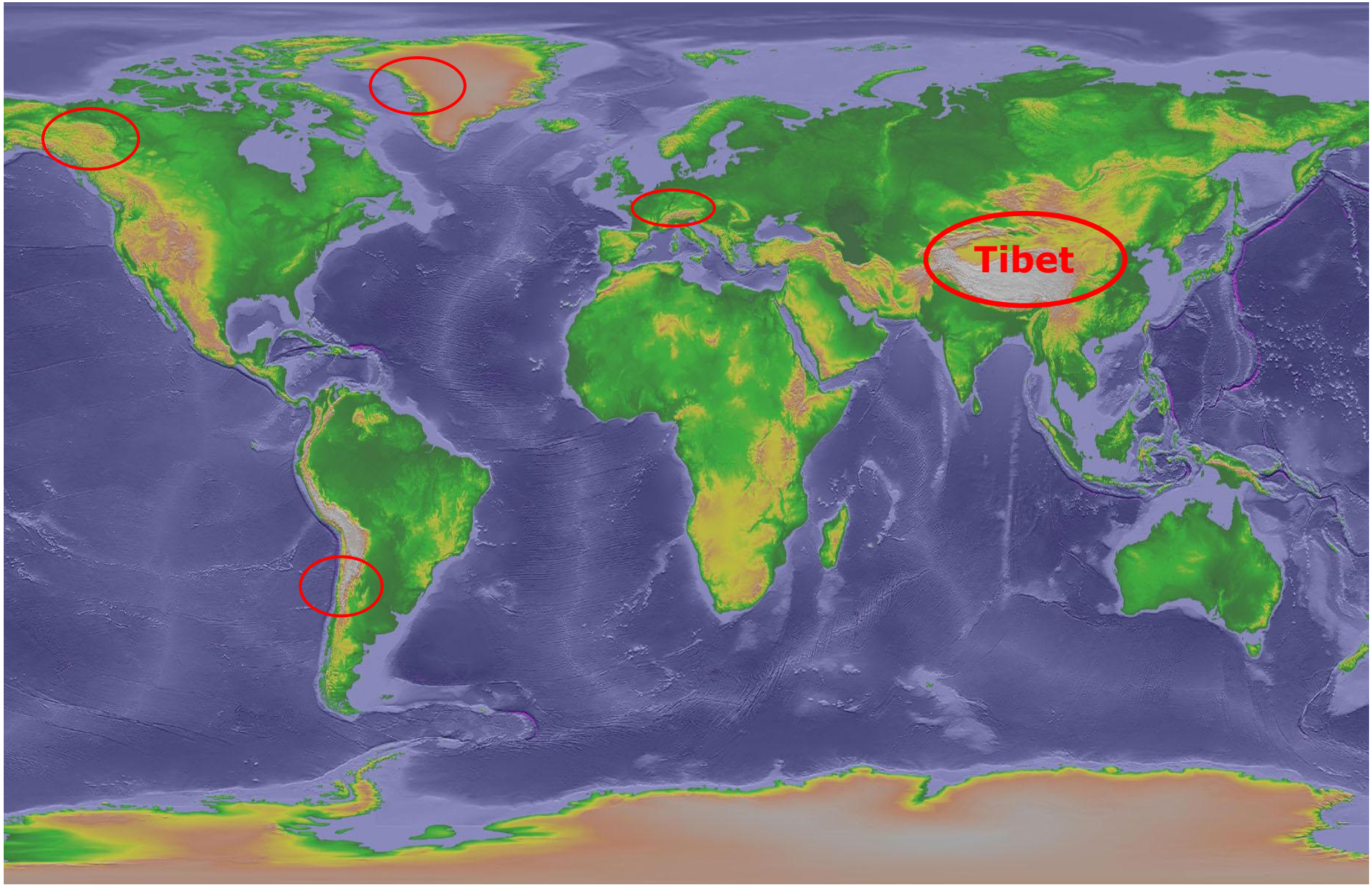
Motivation

1. Glaciers are key indicators for the ongoing climate change

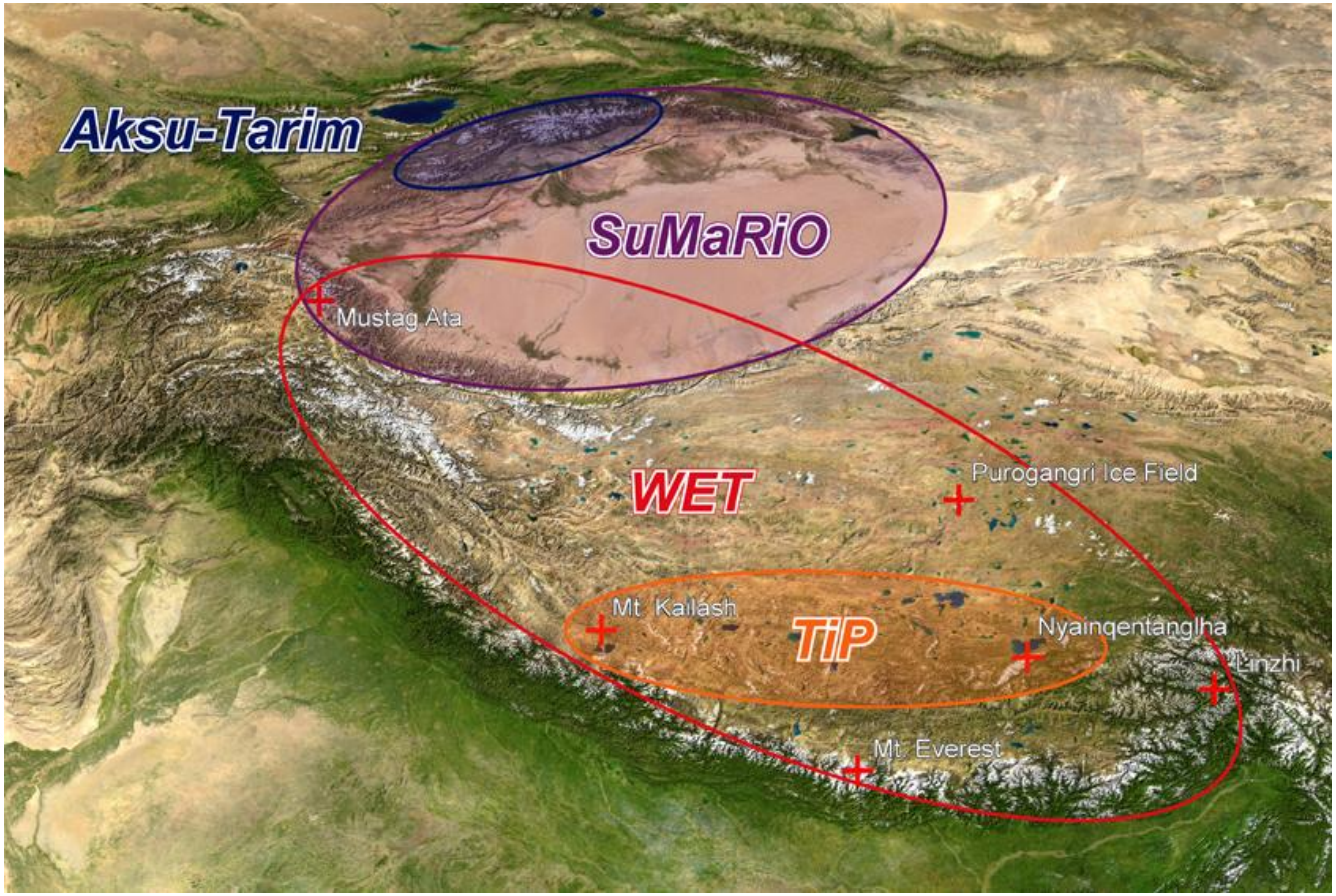
2. The covering snowpack considerably affects the glacier-ice surface temperature and thus the meltdown of the glaciers

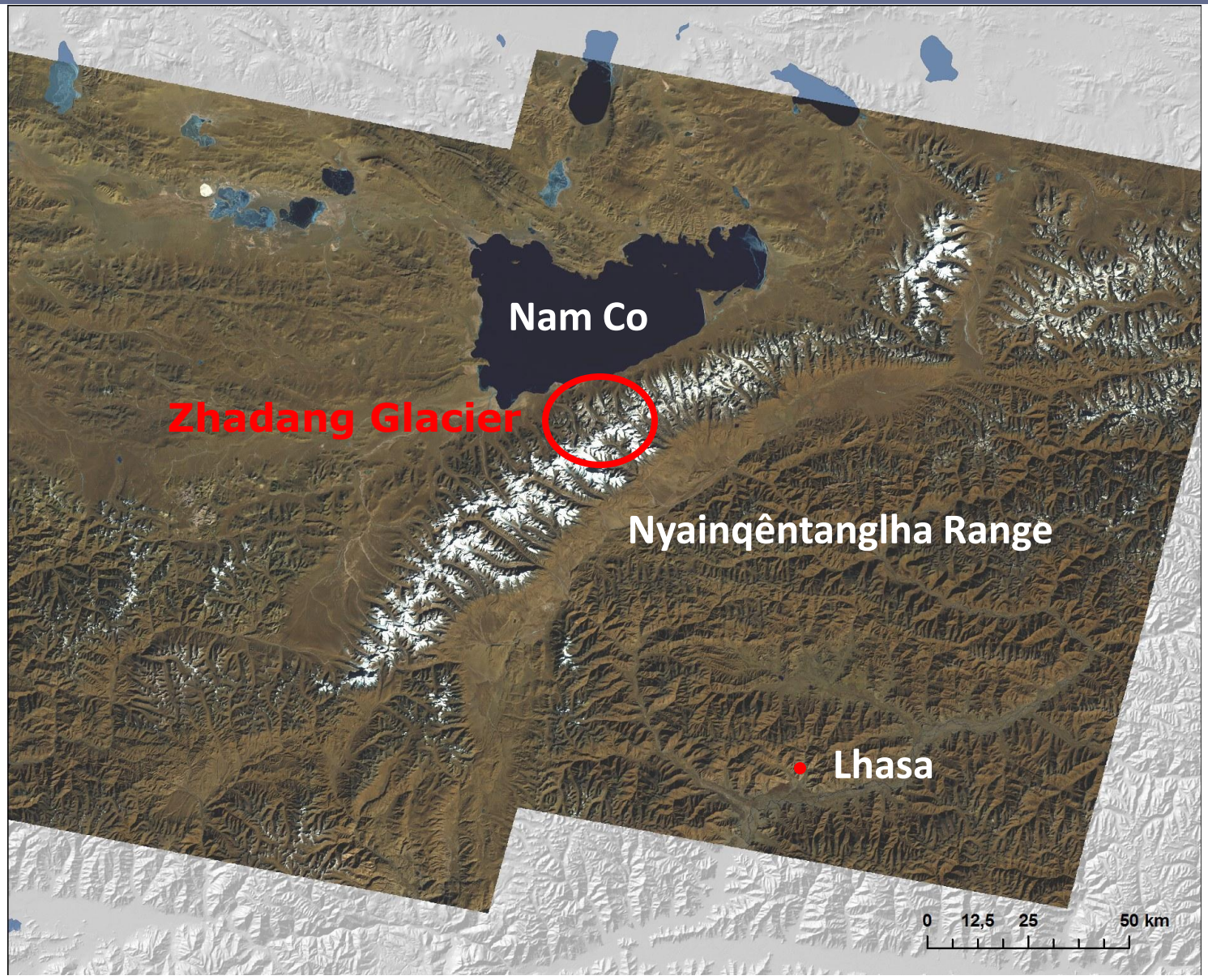
3. The detailed investigation as well as the accurate delineation of the actual snow line – **here defined as the fluctuating lower altitudinal boundary of the snow-covered area** – are of high importance

4. Evaluation and validation of a glacier mass balance model developed at RWTH Aachen


Tibet

Framework within research projects: TiP and WET

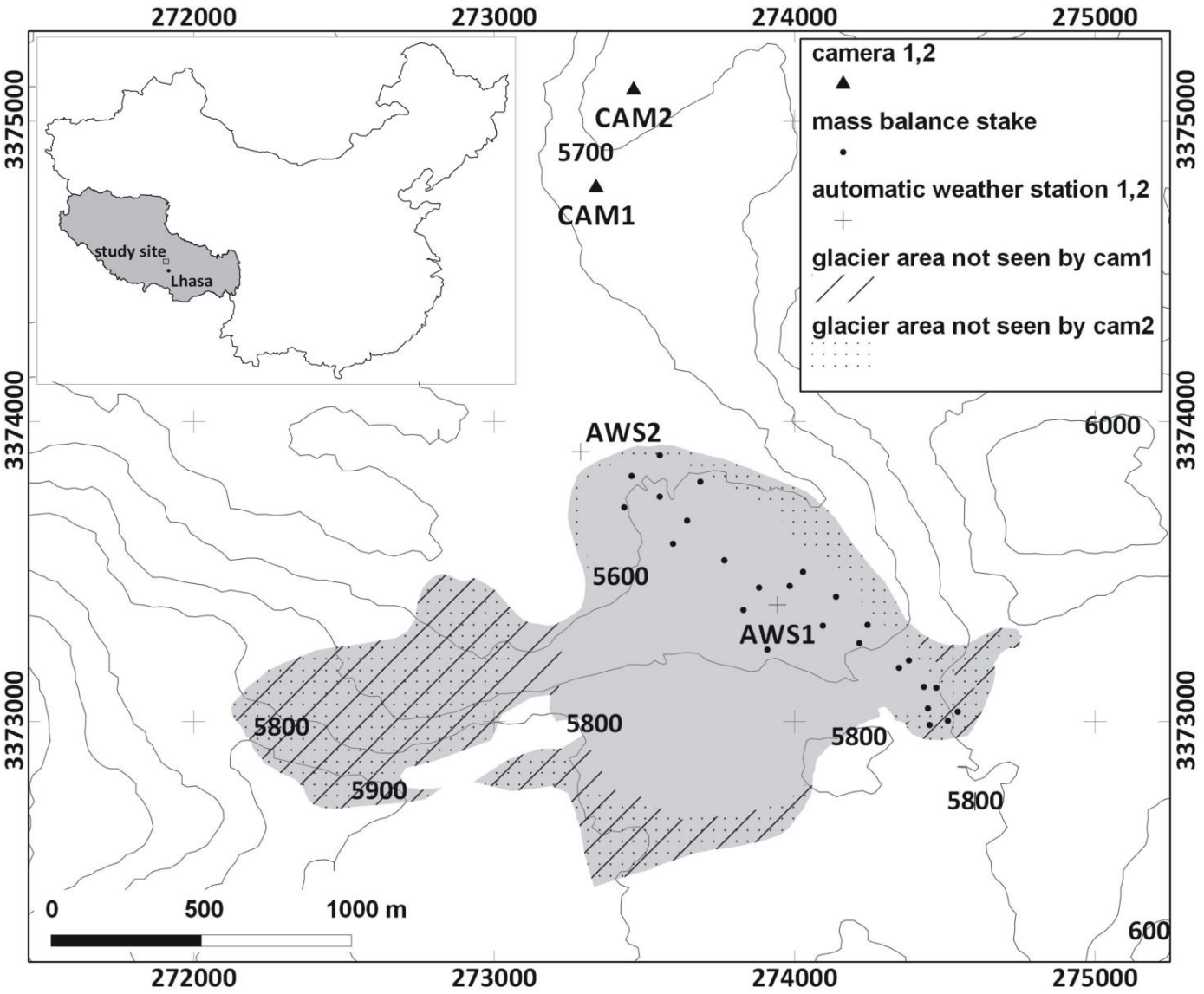



Nam Co
Zhadang Glacier
Nyainqêntanglha Range
Lhasa
0 12,5 25 50 km


Zhadang Glacier (5,515 – 6,090 m a.s.l., 2 km²)
Photo: T. Pieczonka (2009)

Terrestrial camera system, Zhadang Glacier

Photo: T. Pieczonka (2009)



Map: E. Huintjes (2013)

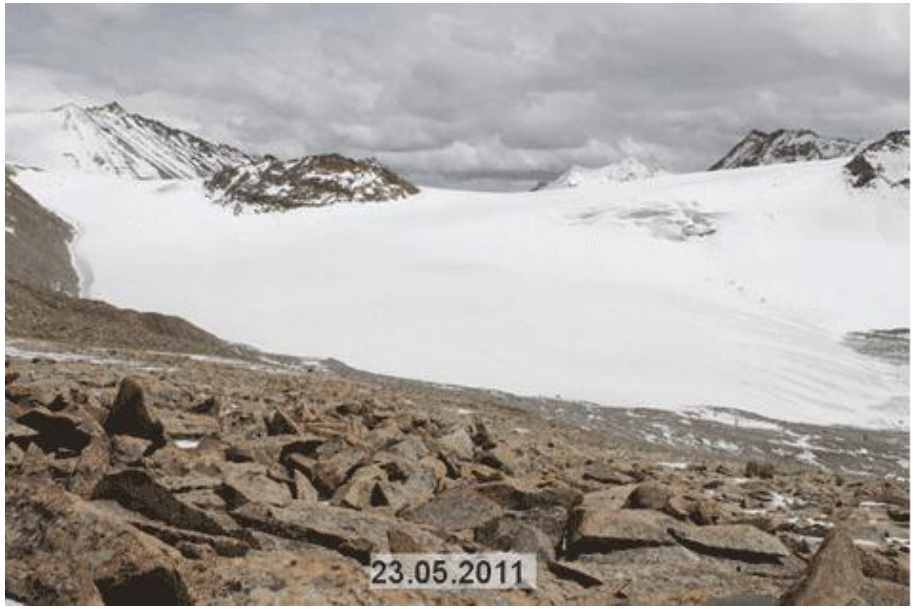
Terrestrial camera system, Zhadang Glacier 2010/2011

picture series from 2010

picture series from 2011

2 cameras, each 6 pictures/day = 6,225 images between May 2010 and September 2012

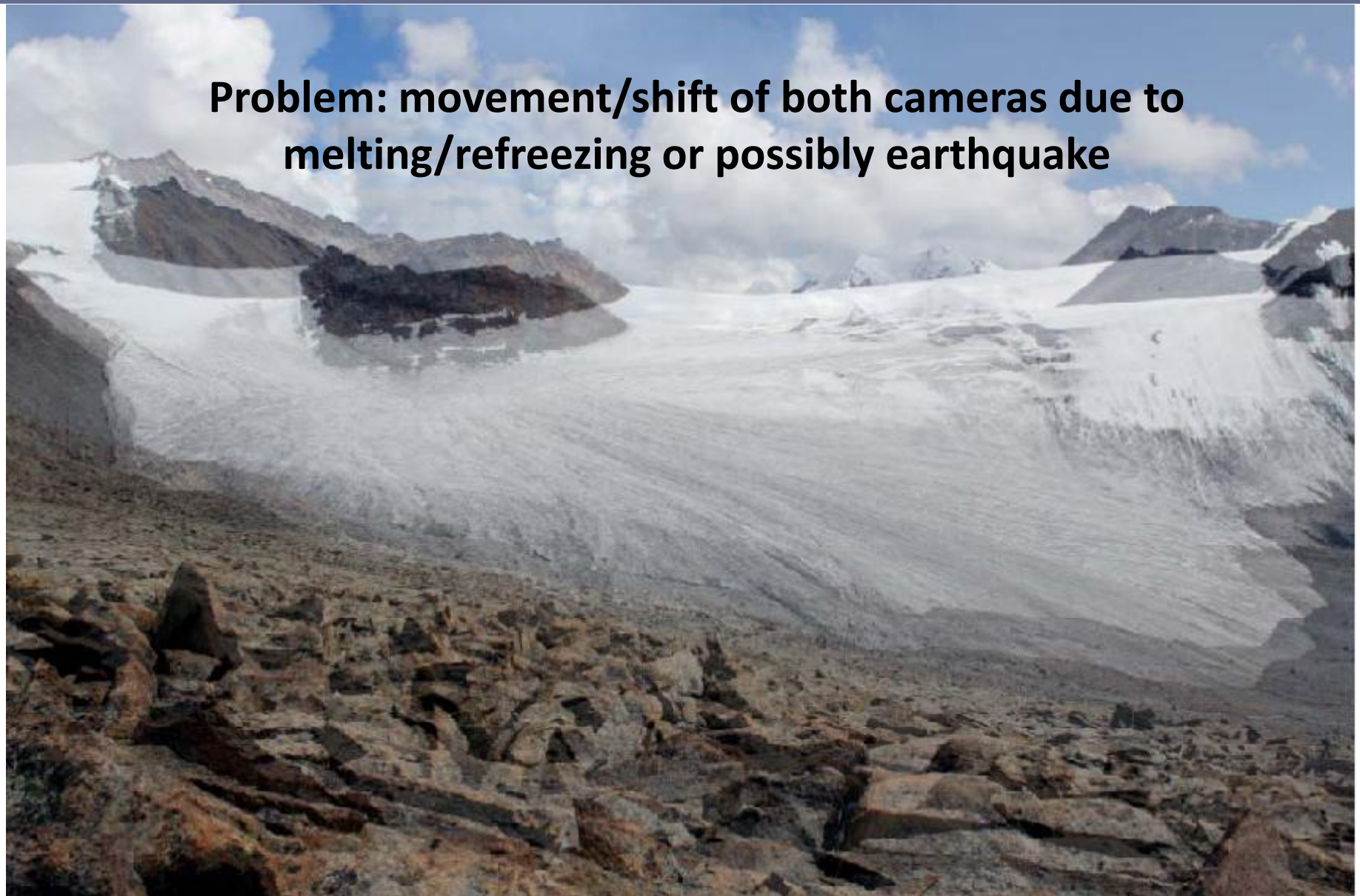
Terrestrial camera system, Zhadang Glacier Cam1/Cam2



picture series 2011 from Cam 1

picture series 2011 from Cam 2

2 cameras, each 6 pictures/day = 6,225 images between May 2010 and September 2012


Problem: movement/shift of both cameras due to melting/refreezing or possibly earthquake

Orthorectification of the camera images with software RSG (Remote Sensing Software Graz)

1. Manual orthorectification (1 image/week/camera), detection of the image coordinates of the GCPs (change because of camera movement)

2. Renaming of all images (scheme cam1_20110716_14)

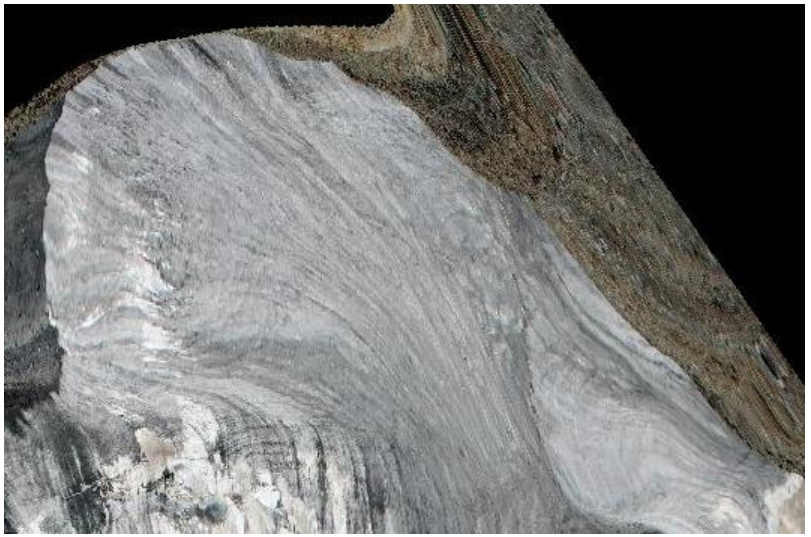
3. Interpolation of image coordinates of the GCPs and generation of a .cl (column-line) file for every image (same file name like corresponding image)

4. Selection of „good“ GCPs with lowest residuals (cam 1: 6 GCPs, cam 2: 5 GCPs)

5. Batch-processing (reference is SRTM – resampled to 1 m, image and interpolated image coordinates of the GCPs are connected by the file names)


7 GCPs that can be identified in every picture
(repeatedly measured in the field)

Orthorectified area of Zhadang Glacier
(Image distortion due to very gentle rise of the upper part of the glacier)



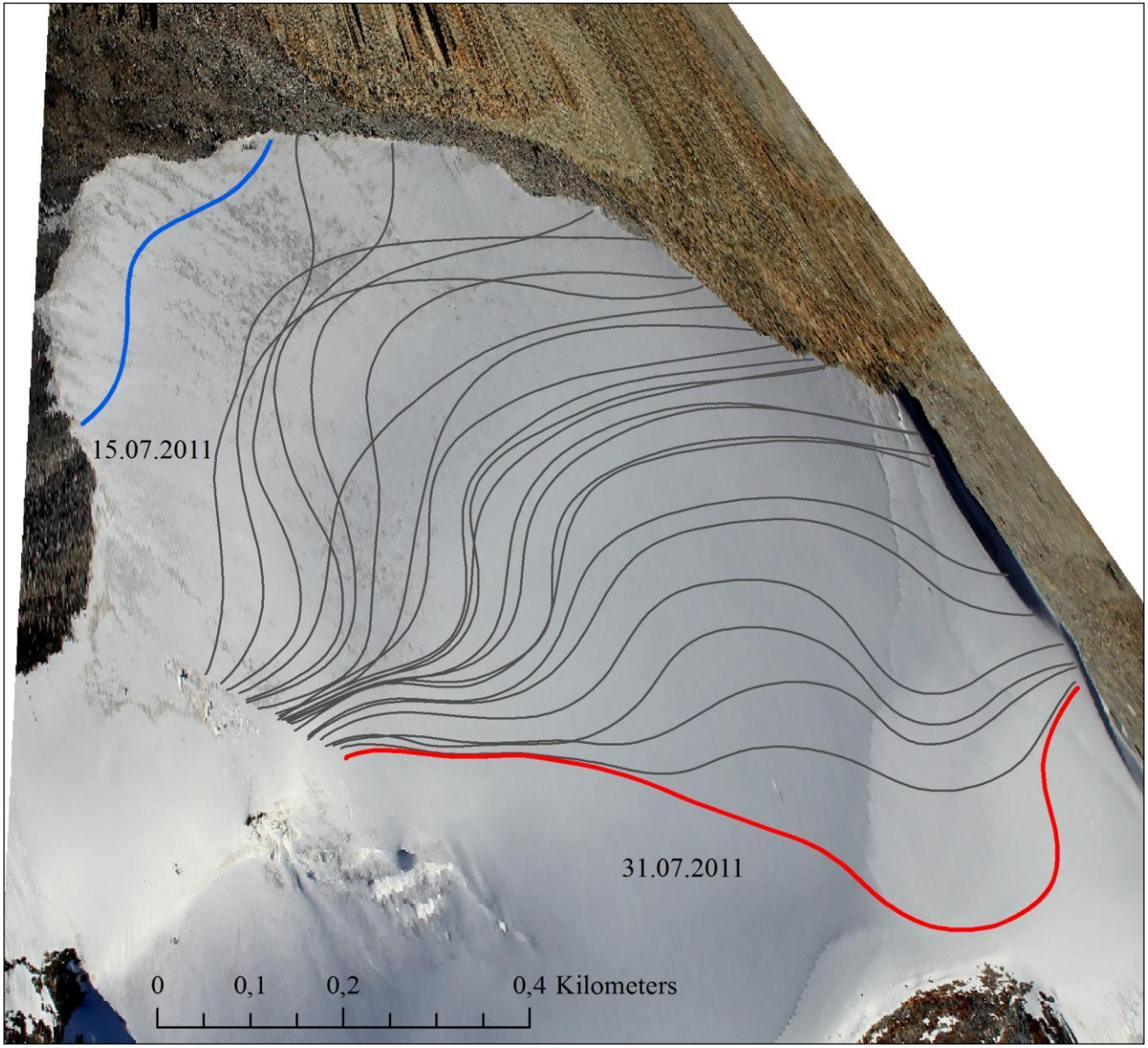
Example of workflow image to ortho-image with snowline

Camera 1: view towards south

Nadir view, northened

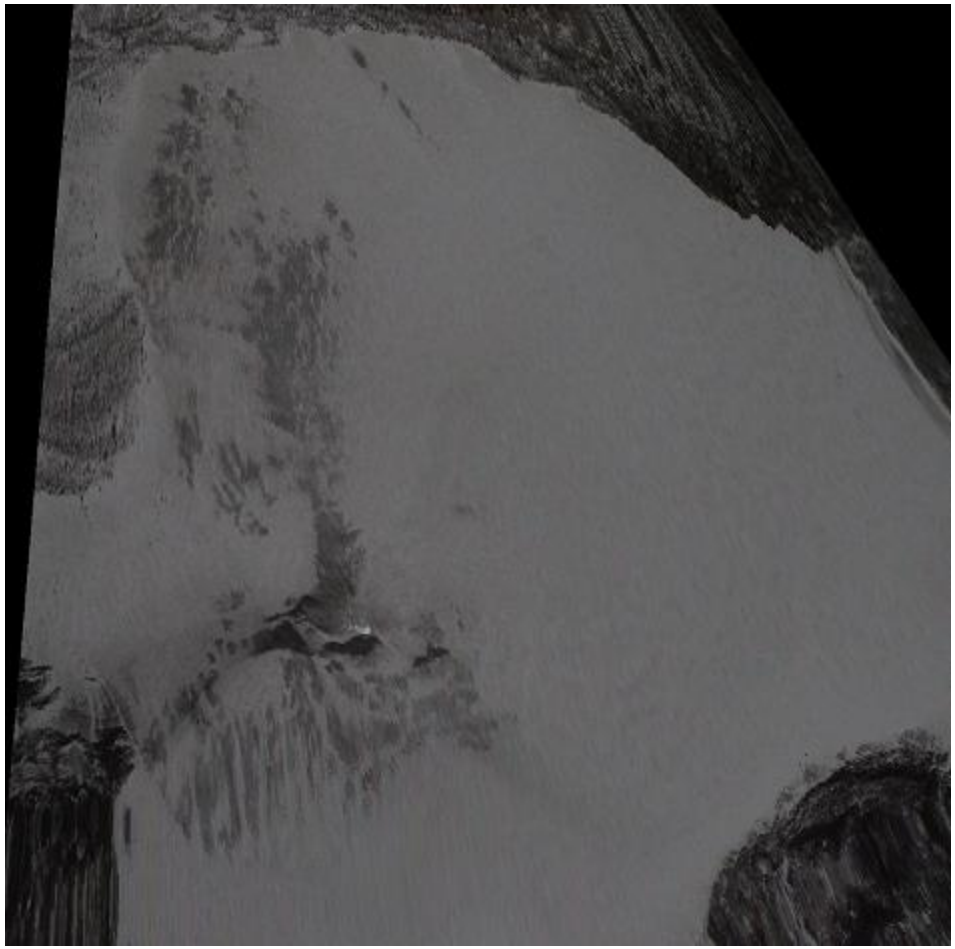

Snowline on nadir view


20/07/2011 18:00


15.07.2011
31.07.2011
0
0,1
0,2
0,4 Kilometers

- A remarkable result is the proof of the existence of ablation due to **heavy snow drift** and **sublimation** on the glacier during the winter months (DJFM)

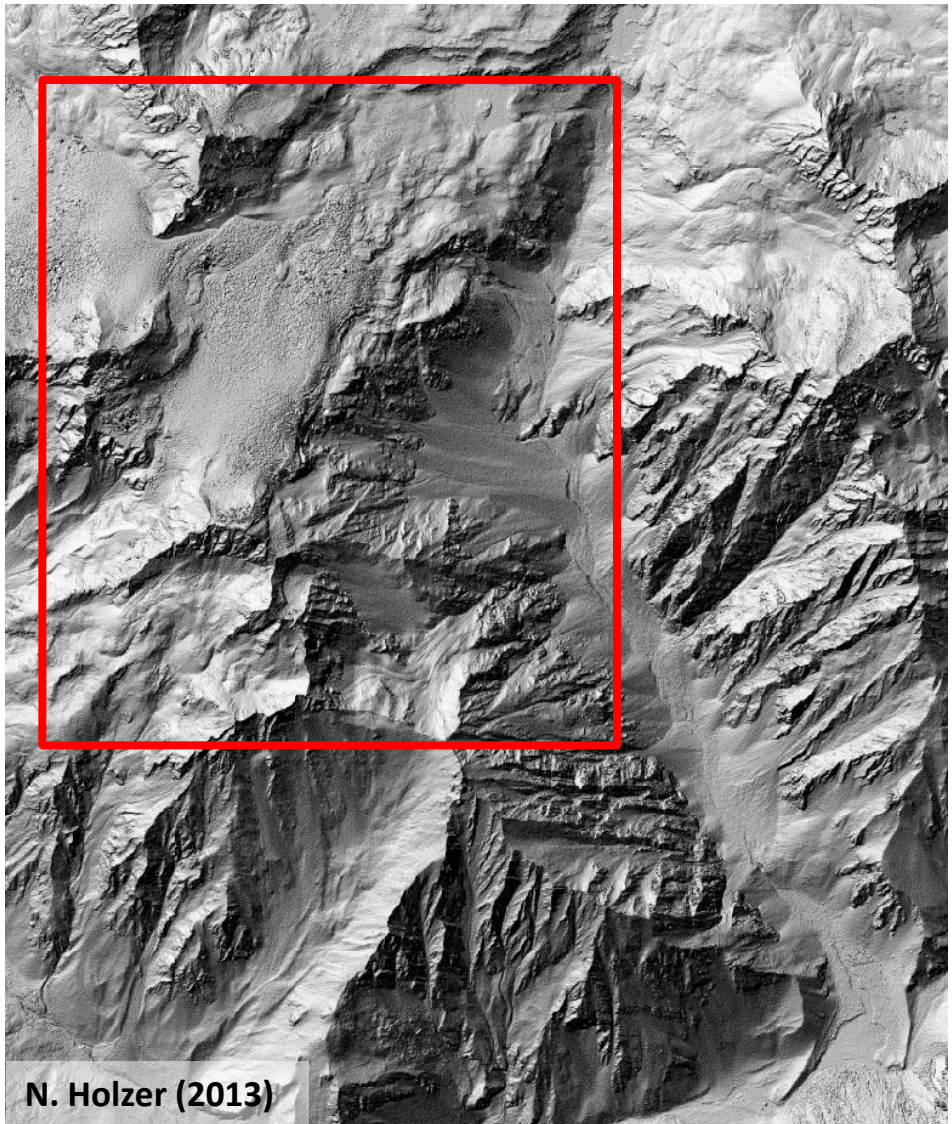
Image from **February** 6 2012 at 22:00



Conclusions/Outlook

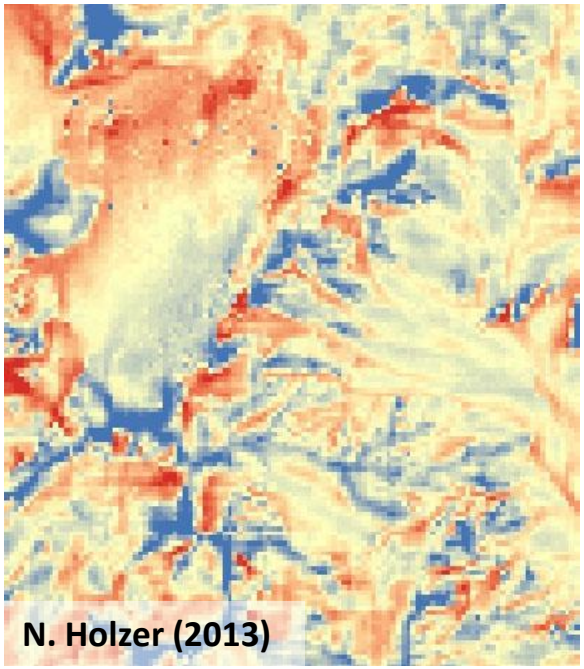
1. Considerable variability and fluctuation of the snow lines
2. Proof of snow drift and sublimation
3. Automatization of the process
4. GLOF monitoring in Halji, Nepal

Pléiades DEM (2013), 1 m resolution

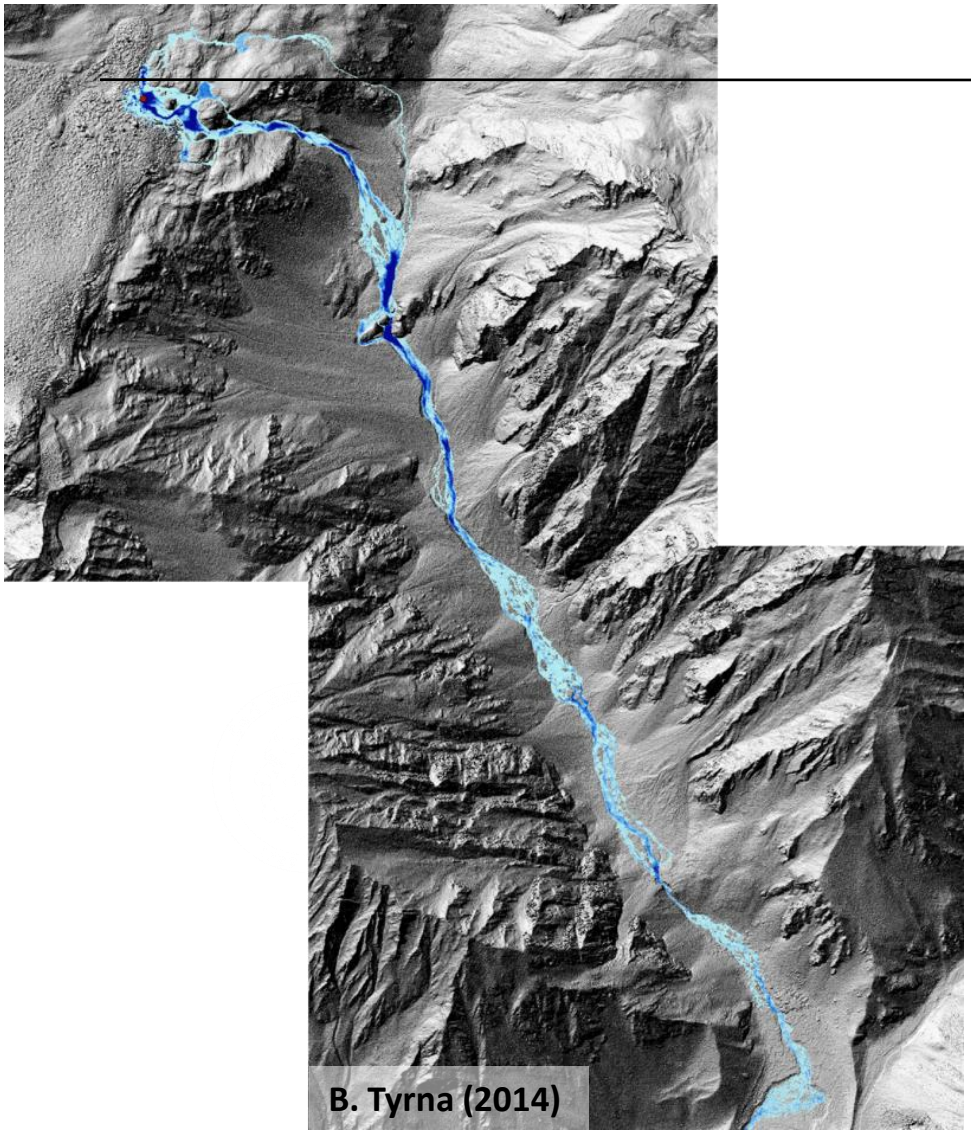


Halji-Glacier

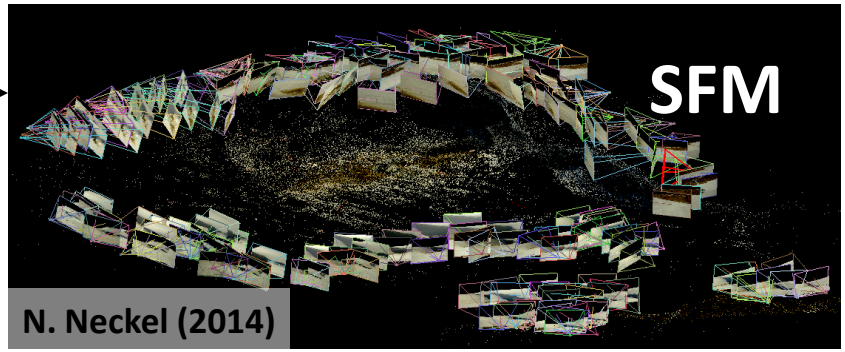
Pléiades DEM (2013)
to SRTM-3 (2000)

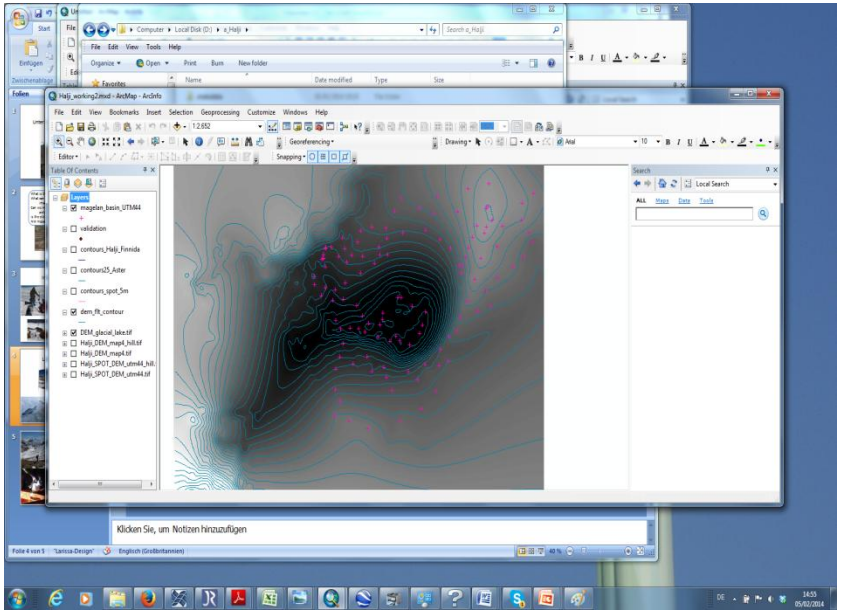


First GLOF modeling results



Morphometry of the lake basin





DEM based on fusion of SFM and DGPS measurements

Automatic Weather Station

Terrestrial Camera

Photos: B. Schröter (2014)

Thank you very much for your attention!

Thanks to: Nicolai Holzer: TU Dresden
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Niklas Neckel: Eberhard Karls Universität Tübingen

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