

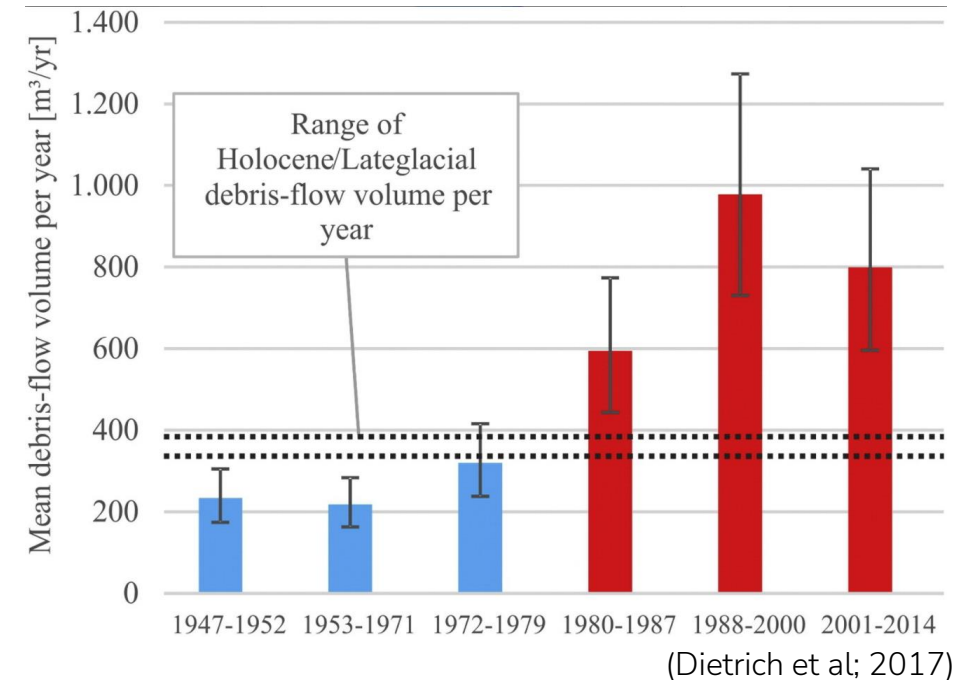
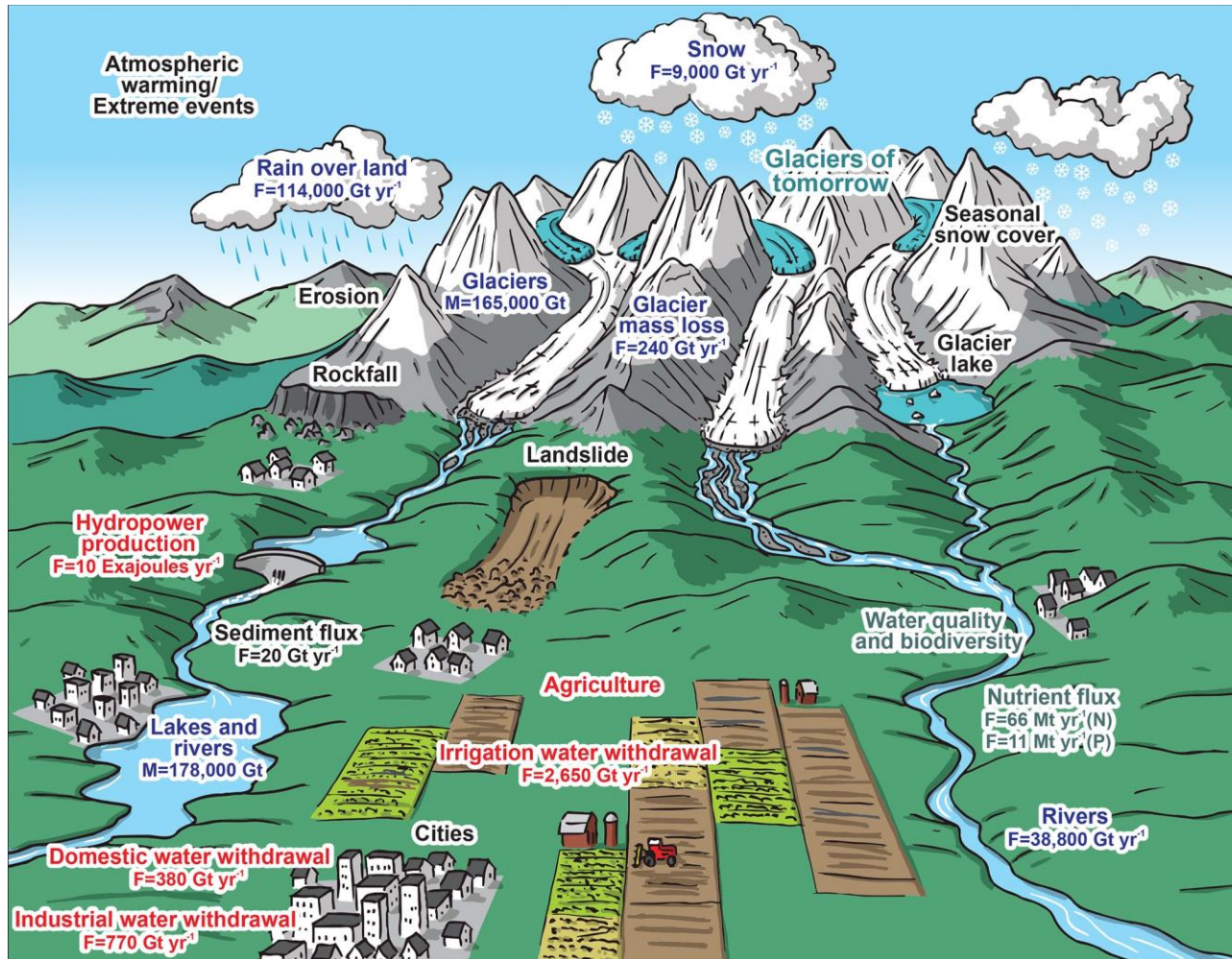
Monitoring rockfalls on alpine peaks. A trade-off between spatial extent and resolution.

AlpSenseRely: Alpine remote sensing of climate-induced natural hazards



NATALIE BARBOSA, JUILSON JUBANSKI, ULRICH MÜNZER, FLORIAN SIEGERT.

Natural hazards in the alpine region



(Huss et al; 2017)



Rockslide-rockfalls

Debris flows

Bondo

2011

Rock avalanche of 1.5 – 1.7
million m^3

(Baer et al; 2017)

2017

Rockslide-rockfall 3 million m^3

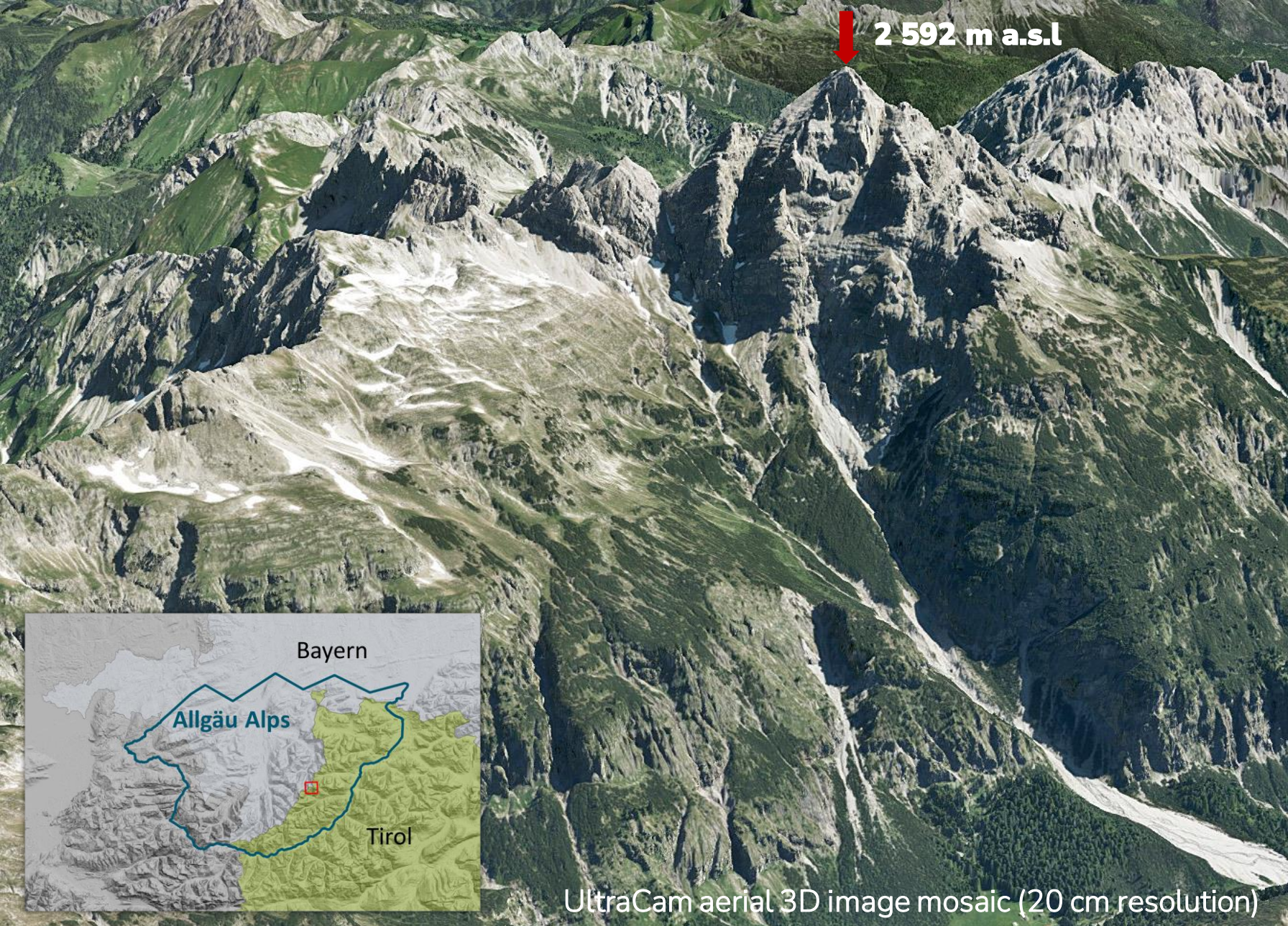
(Mergili et al; 2017)

Basin area: 21 km^2



Bondo

aerial imagery: ©swisstopo



UltraCam aerial 3D image mosaic (20 cm resolution)

Multi-scale monitoring concept

Integral observation of slope changes



Instrumentation and photogrammetric mm deformation measurements since 2018 crack (details on Leinauer et al, 2020).



Yearly upper slope monitoring since 2017 up to 2.5 cm

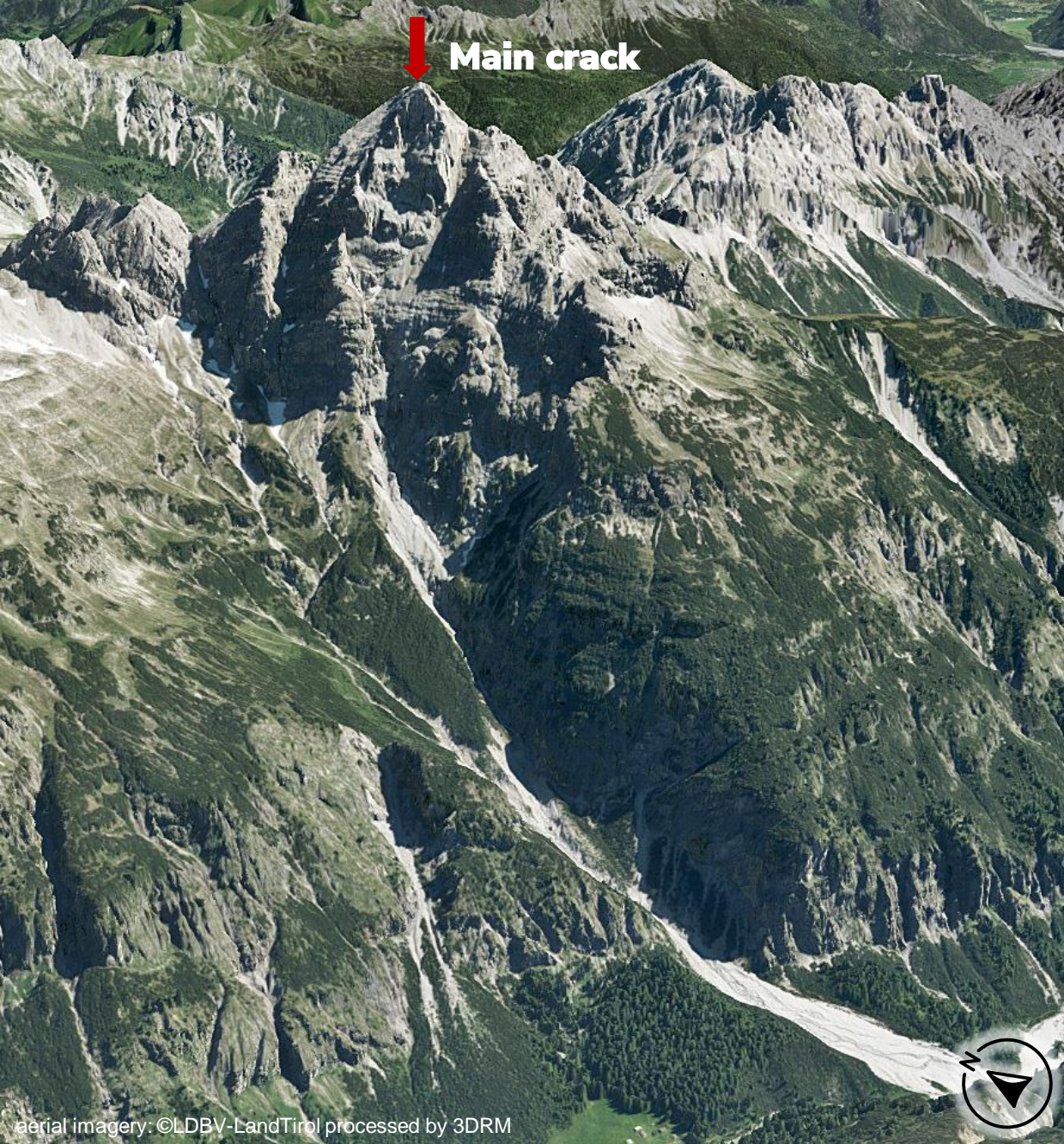


Yearly basin monitoring with a multi-sensor camera system since 2021 (up to 5 cm)

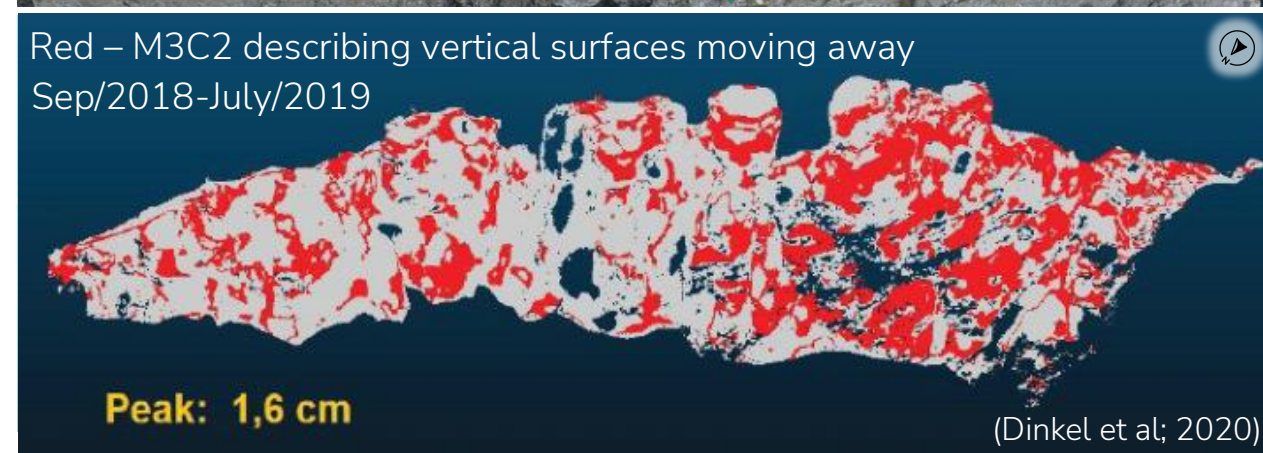
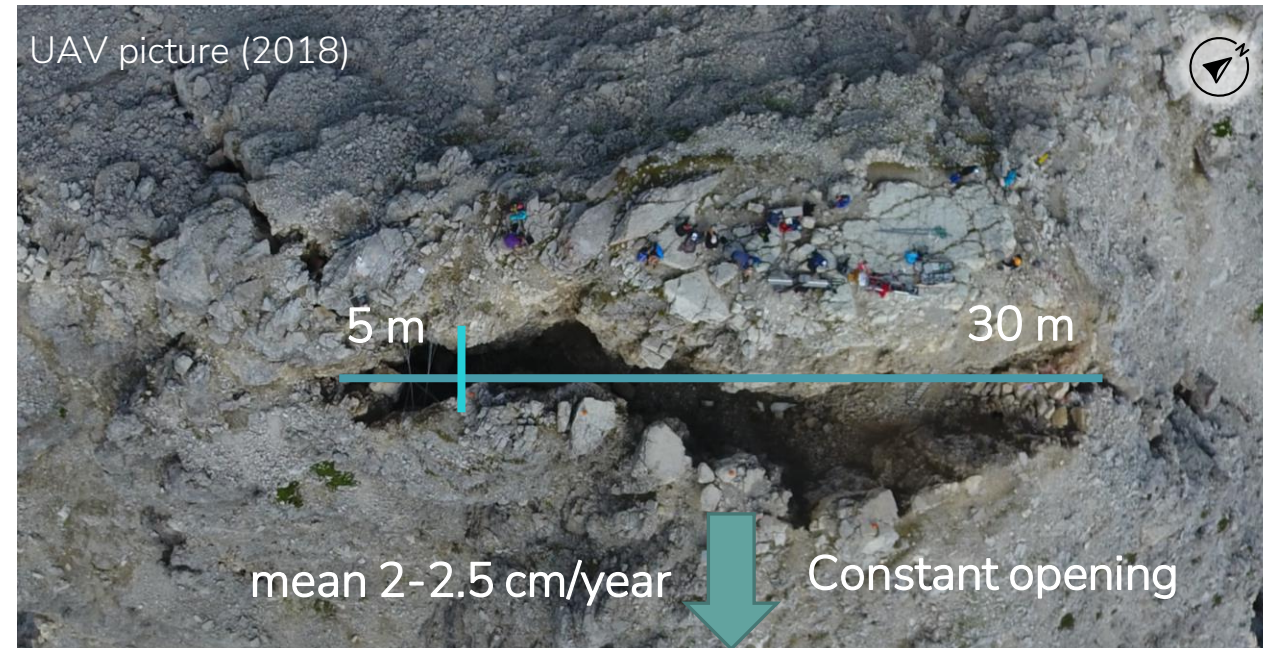


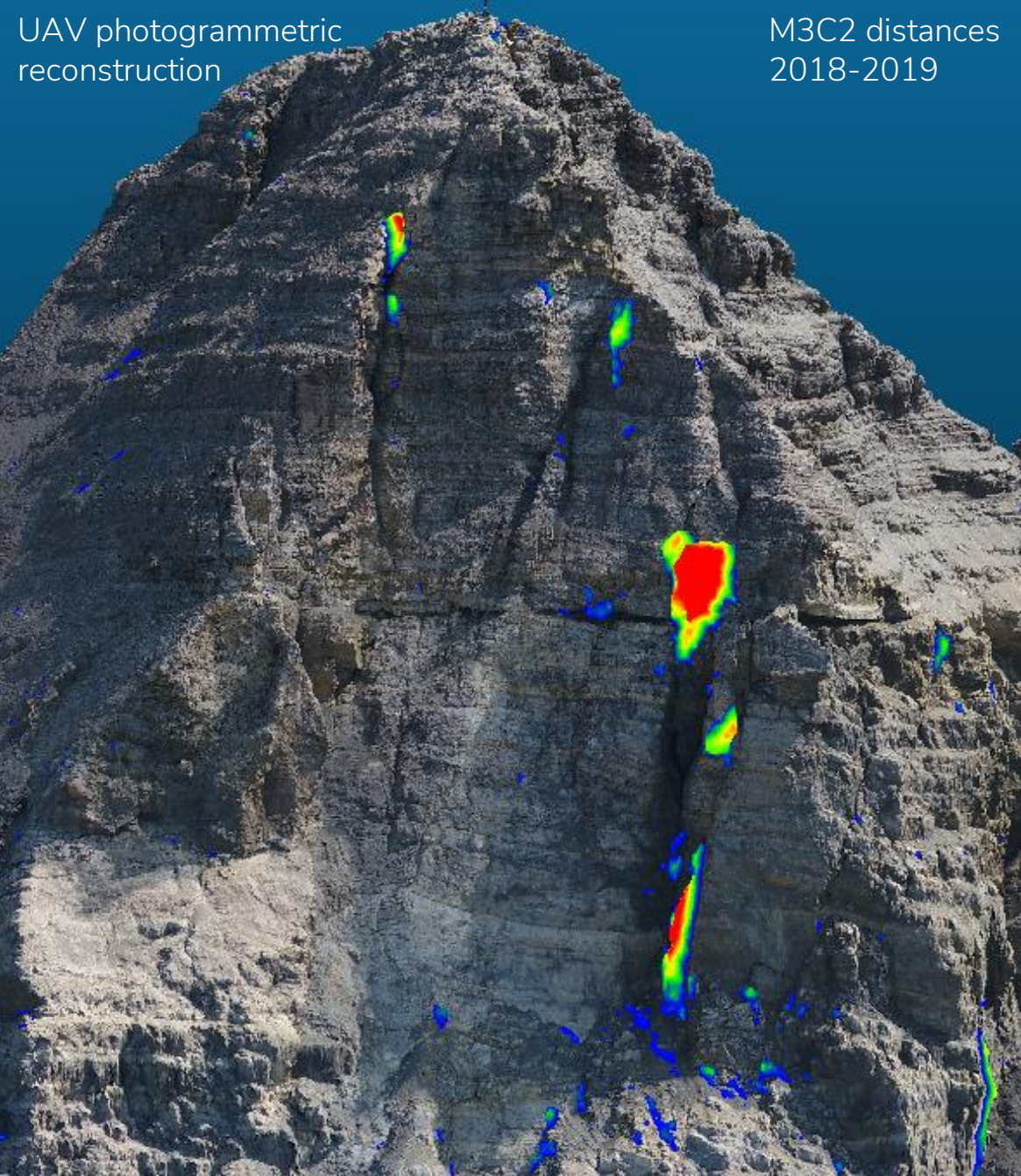
Decadal aerial imagery with a temporal resolution of 2 to 3 year (up to 20 cm) since 2010

aerial imagery: ©LDBV-LandTirol processed by 3DRM

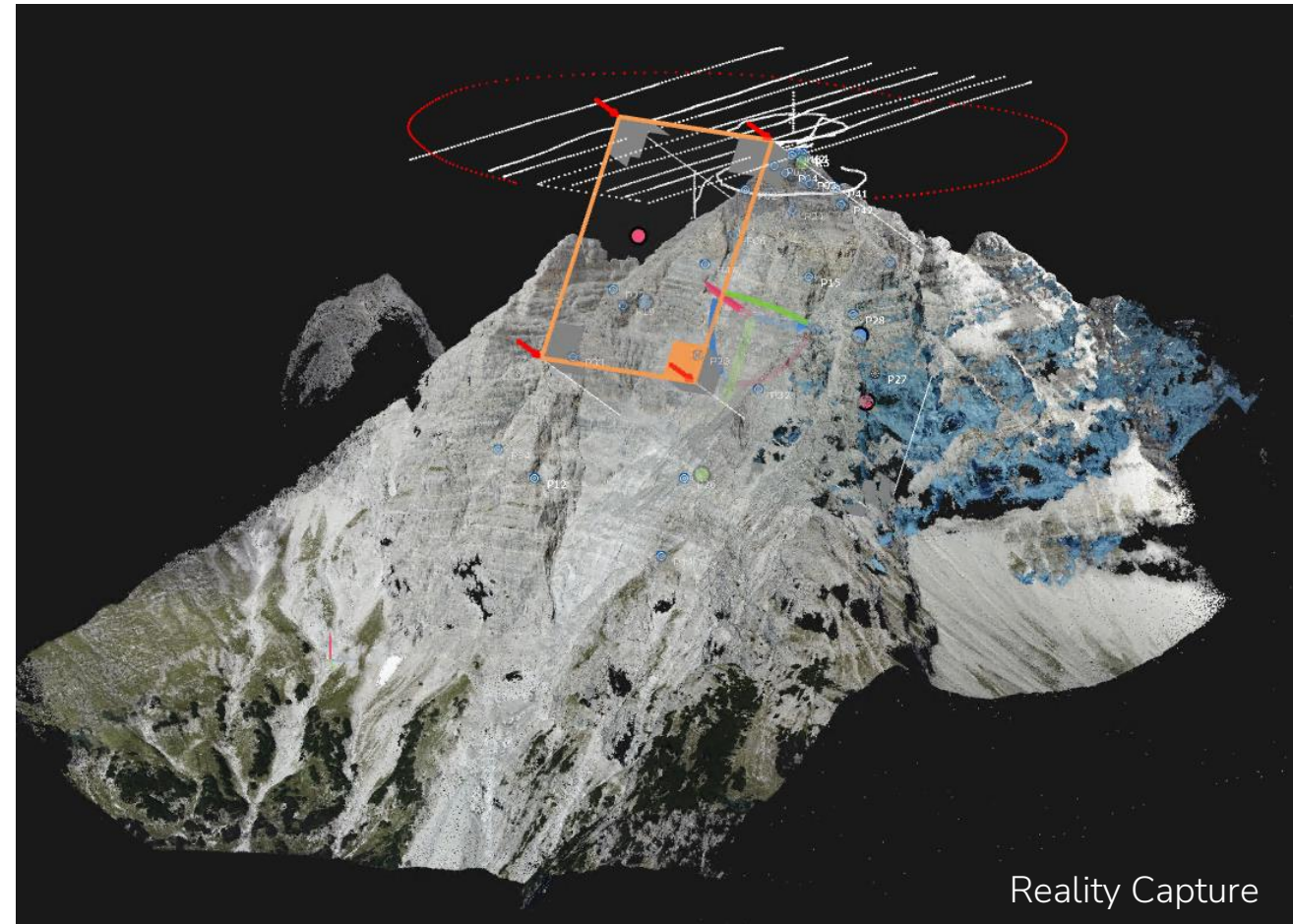


mm deformation measurements - redundancy of instruments (Leinauer et al, 2020).





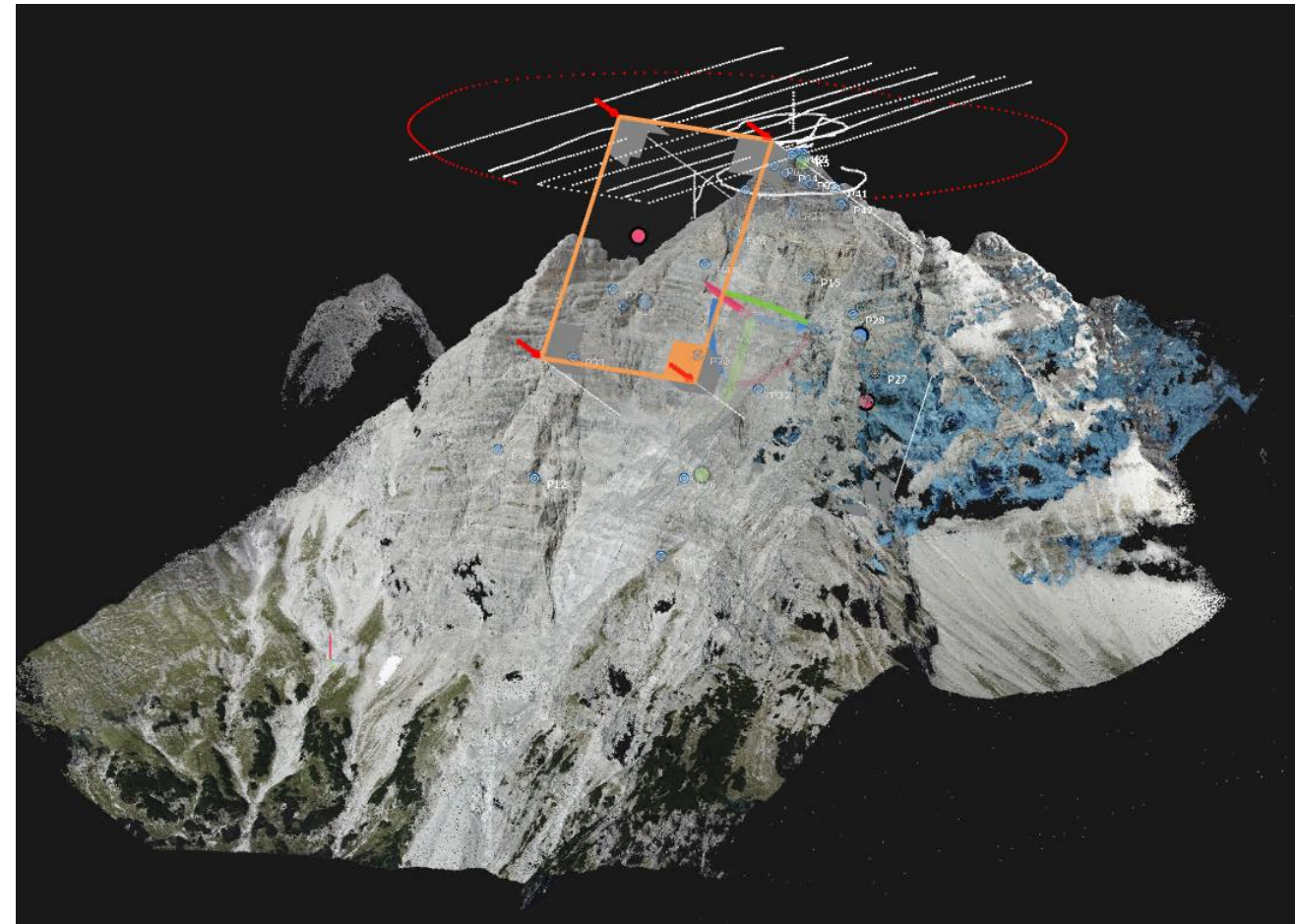
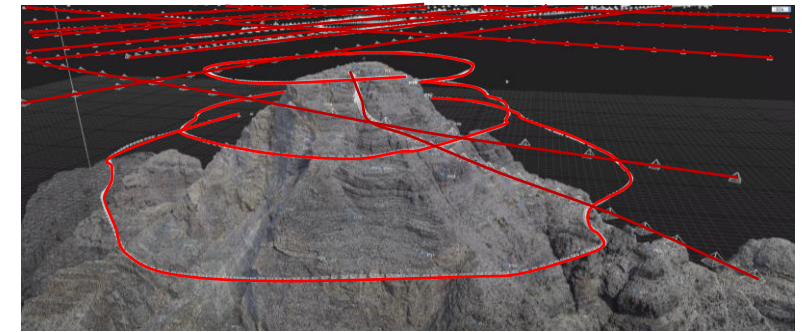
Peak slope monitoring



Reality Capture



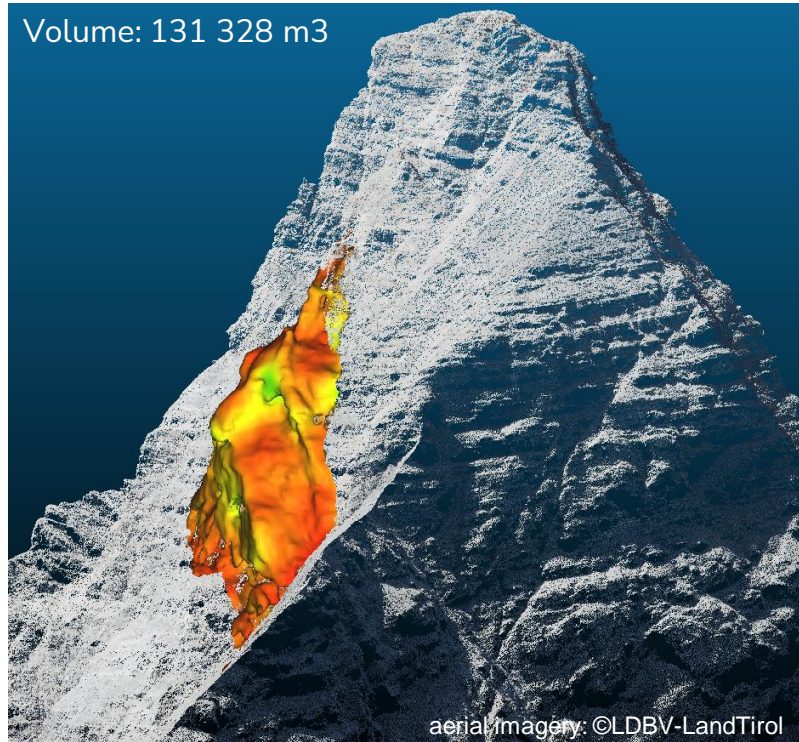
Peak slope
monitoring





Decadal aerial imagery (UltraCam)
with a temporal resolution of 2 to
3 year up to cm

Volume: 131 328 m³

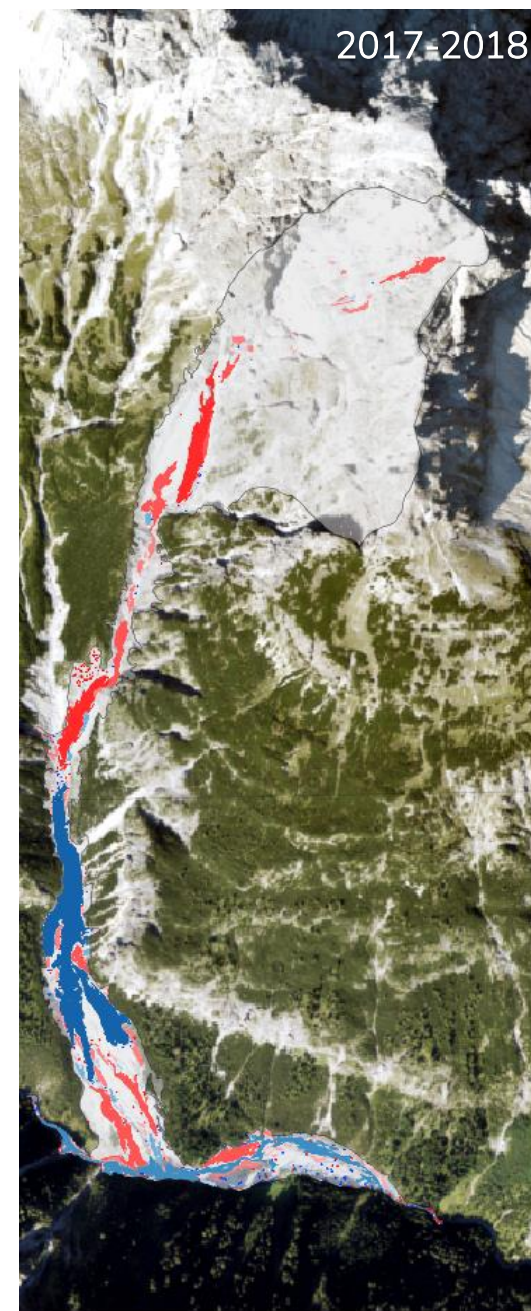


aerial imagery: ©LDBV-LandTirol

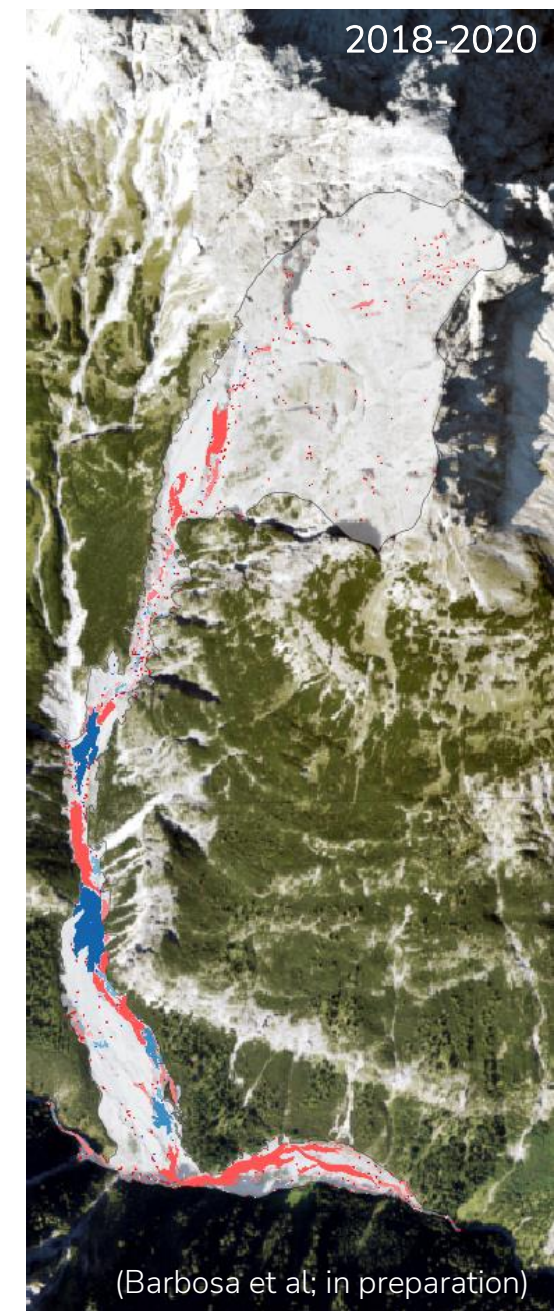
Rockfall, 10. Juli 2016 (Dav, 2016)



2015-2017



2017-2018



2018-2020

(Barbosa et al; in preparation)





Multi-sensor camera system (MSKS)

- 5 Canon EOS5 cameras, one nadir oriented and 4 oblique views to obtain a field of view of 160°.
- 1 MicaSense Altum oriented nadir. RGB, NIR and red edge spectral bands.
- 1 Optris PI 640i thermal sensor.

2019 - UAV



2021 - MSKS





Challenges and opportunities

- The multi-scale monitoring approach allows to observe and quantify rates of change, magnitude of change and predominant geomorphological processes in a basin at different spatial and temporal resolutions.
- The main challenge is the integration of the multi-scale data and observations into the early warning system in order to predict and alert catastrophic events.

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