Monitoring of the Reissenschuh landslide (Tyrol, Austria) using remote sensing techniques since 2016 – results and lessons learned

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OPERANDUM

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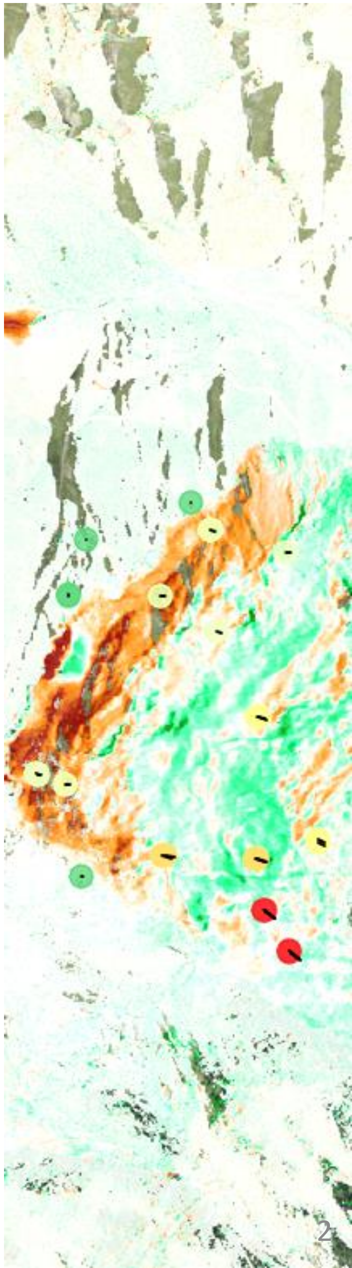


1) Introduction and goals

Primary research question:

How can we efficiently measure a landslide‘s movement in space and time?

Landslide monitoring techniques

→ At points, along lines or area-wide

→ Temporal vs. spatial resolution

→ Each technique goes along with limitations…

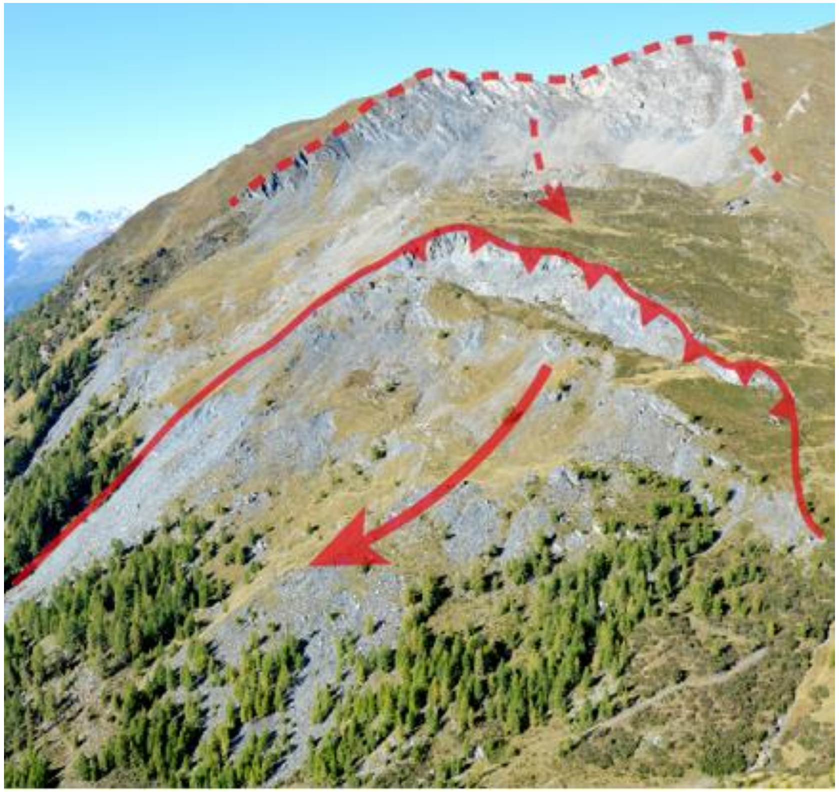
Ideally: Combination of different monitoring techniques

→ Overcome limitations

→ Exploit synergy effects

2) Study area Reissenschuh landslide

- Schmirn valley, Tyrol (Austria)
- Deep-seated gravitational slope deformation (DSGSD)
- Partly covered by low and high vegetation
- Currently active part:
  - Elevation range: 1750 – 2200 m
  - Area: 0.3 km²
  - Movement in the order of 1 m/a
- Monitored with repeated TLS-, ULS- and DGNSS-measurements since 2016



J. Branke, 05/10/2018

3) Monitoring techniques and results

Multi-temporal terrestrial laser scanning (TLS)

+ High spatial resolution (500 pts/m²)
+ High accuracy (order of ±5 cm)
- Limited coverage (few km²)

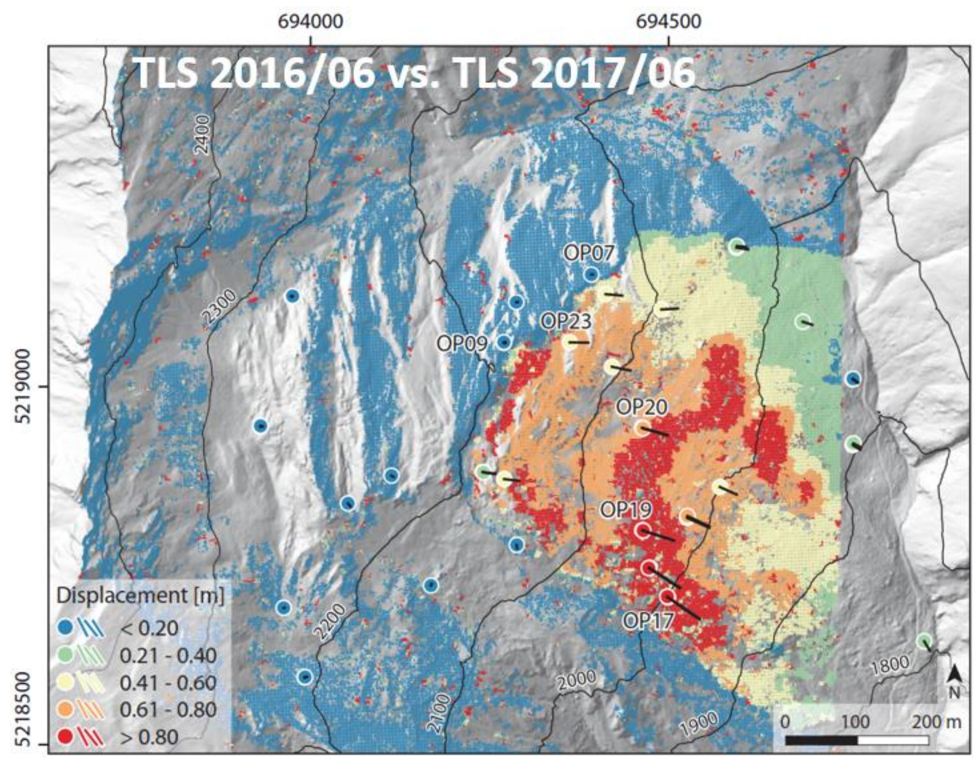
Innovative algorithms:

→ ICP-Matching (Pfeiffer et al. 2018)

→ 3D displacement derived directly from the point clouds

Riegl VZ-6000
Ultra-long range
Terr. laser scanner

J. Pfeiffer, 28/06/2016



Pfeiffer et al. 2018

3) Monitoring techniques and results

Unmanned aerial vehicle laser scanning (ULS)

+ High spatial resolution (1000 pts/m²)
+ High accuracy (order of ±2 cm)
- Limited coverage (1 km²)

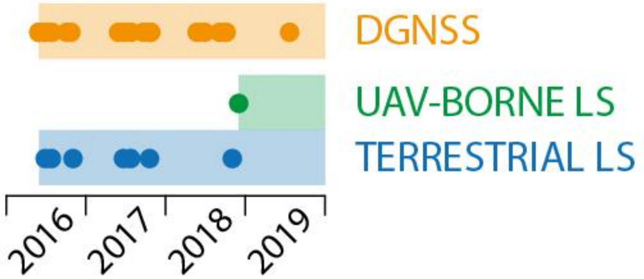
Efficient data processing tools:

→ Handling massive point clouds

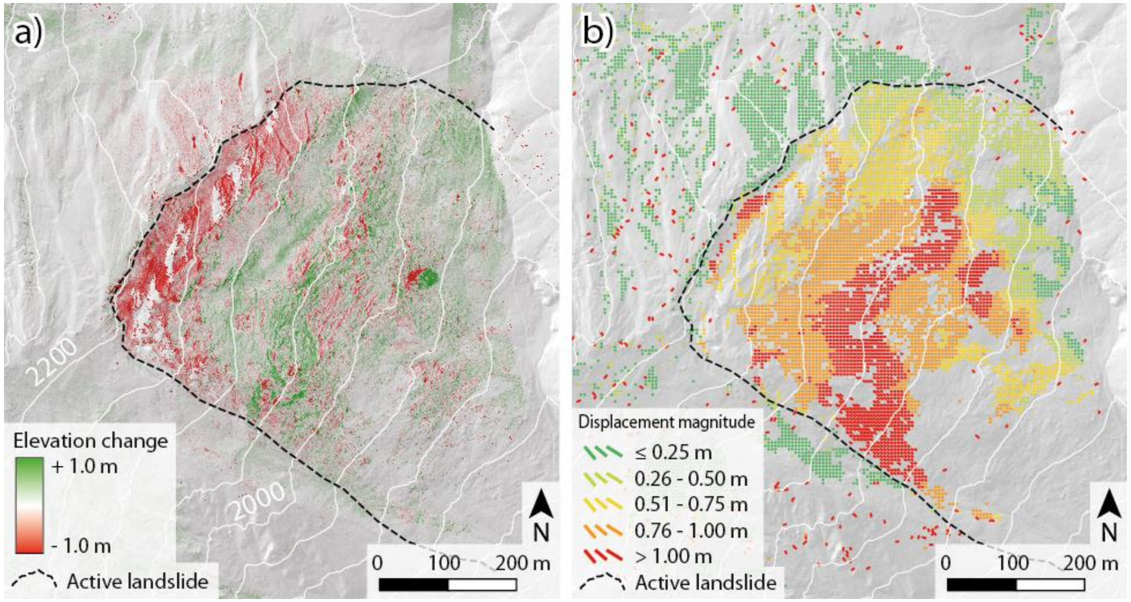
→ Typically 1 billion points

Riegl RiCopter with VUX-1LR laser scanner

T. Zieher, 18/10/2018



TLS 2017/06 vs. ULS 2018/10

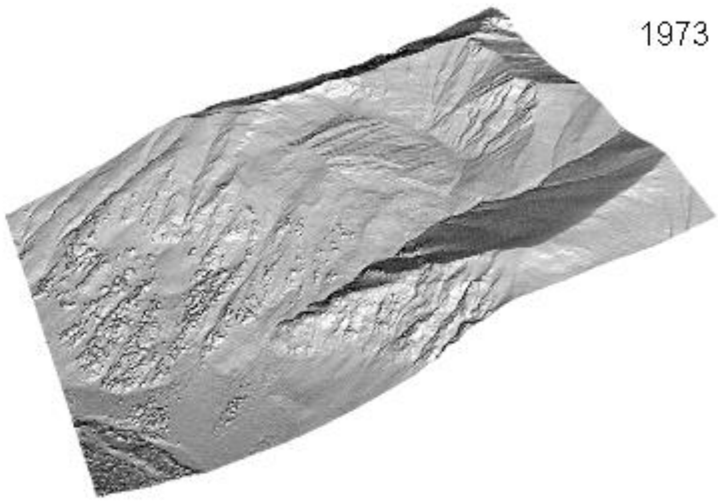


Bremer et al. 2019

3) Monitoring techniques and results

Airborne laser scanning (ALS)

+ Available area-wide (e.g. Tyrol, Austria)
- Lower accuracy (order of dm)
- Lower spatial resolution (2 pts/m²)

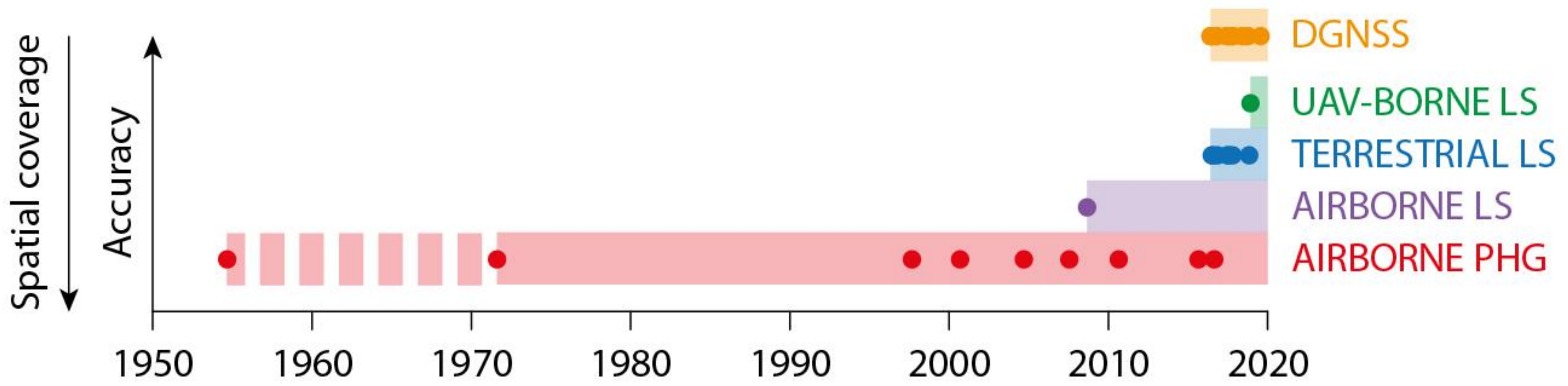


Photogrammetric techniques

→ Processing of historical aerial imagery

+ Archives dating back to the 1950ies
+ Available area-wide (e.g. Tyrol, Austria)
- Lower accuracy and spatial resolution

PHG 1973/09 vs. ALS 2008/08



4) Lessons learned and future challenges

- Integration of various techniques allows to extend the monitoring in space and time
- The Reissenschuh landslide has been active at least for 46 years
- Innovative strategies and tools for data handling and analyses for case study scale developed

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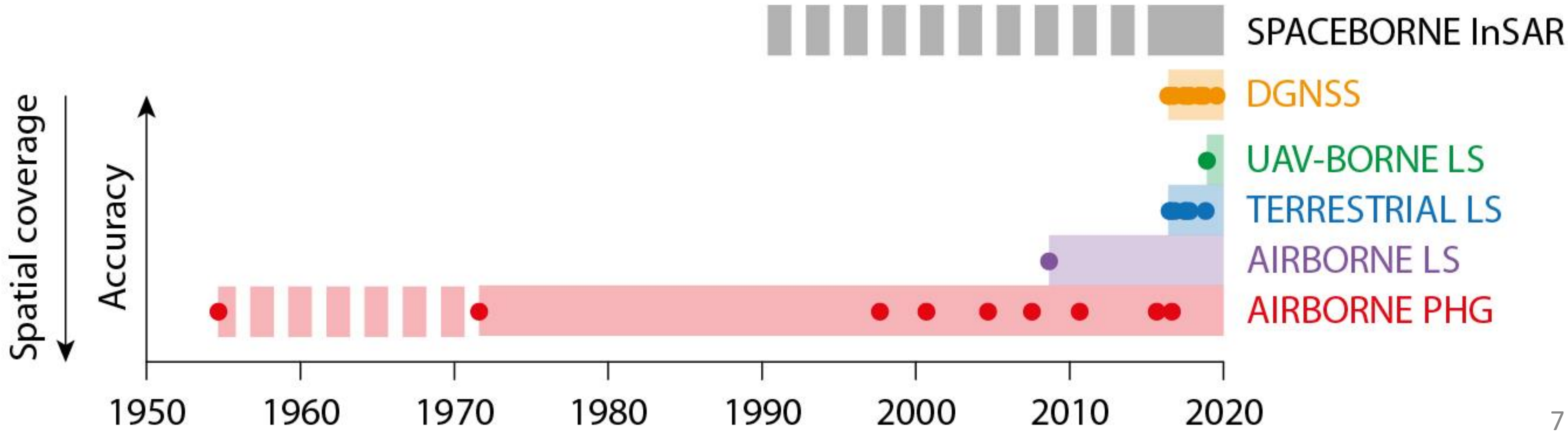
Outlook

- Transfer of the developed tools to other sites/to a regional scale (e.g. Zieher et al. 2019)
- Low-cost DGNSS at selected points to assess the temporal dynamics of the landslide
- Evaluation of spaceborne InSAR for the Reissenschuh landslide



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