

# Block glacier monitoring Simplon Pass

## Deformation analysis from high-resolution drone data



In the Swiss Alps, more and more block glaciers and permafrost areas are thawing, leading to increased landslides, debris flows, and rockfalls that threaten infrastructure and settlements. Combined with increasingly frequent heavy precipitation, this is resulting in debris flows in locations and on a scale that were previously unexpected.

Periodic drone flights using the **TEDAMOS DroneCam** solution are ideal for monitoring the extent and flow velocities of thawing block glaciers and permafrost areas.

In June 2024, heavy rainfall on the southern side of the Simplon Pass led to a massive debris flow. Debris from the Hübshhorn block glacier broke loose and buried the pass road within the Engi gallery for several meters. Within a few weeks, a comprehensive monitoring system with two objectives was developed: a **warning system** for long-term monitoring of the Hübshhorn block glacier and an **alarm system** for immediate response to short-term hazards such as rockfalls or debris flows.

As part of the long-term **warning system**, a total of five high-resolution drone flights were carried out in 2024 over the entire slope (from 1,600 to 3,000 meters above sea level). Using the resulting orthophotos and high-resolution terrain models, the geologists commissioned by geoforner were able to analyze the movements of the block glacier and debris flow channel in detail.

Multiple flights with our area drone allow us to cover perimeters of several square kilometers and altitude differences of well over 1,000 m in a single day under good flight conditions. The high-resolution aerial images with a ground pixel size of 2 cm allow us to generate detailed orthophotos and very accurate surface models, which can be used to determine volume changes after debris flows, for example.

Using cleverly programmed comparative analyses of the high-resolution terrain models at different points in time, hundreds of measurement points with movement and speed vectors can be derived. The results are available to natural hazard specialists in TEDAMOS Web for interactive deformation analysis to display terrain shifts, material deposits and removals, or volume changes color-coded and/or with measured values.

- 📍 Hübshhorn/Simplonpass
- 👤 ASTRA, Federal Roads Office
- 🕒 2024 - 2026

### Services

- ◆ Flight planning for challenging drone flights in high mountains
- ◆ Conducting periodic drone flights in challenging, high alpine terrain and difficult weather conditions (wind, etc.)
- ◆ Evaluation of a high-resolution orthophoto (GSD 2 cm) and elevation model
- ◆ 3D representation of selected perimeters
- ◆ Deformation analysis based on 3D deformation and velocity vectors

All recorded data is documented in TEDAMOS Web, our password-protected customer portal with 24/7 access.

### Technologies

- ◆ Flight with WingtraOne GEN II
- ◆ TEDAMOS DroneCam

**Analysetools**

Punkt | Linie | Polylinien | Flächen

**Höhenvergleich**

25.06.2024, 06 U...

**Bezugskoordinatensystem**

WGS84 | CH1903+ / LV95

**Eigenschaften**

09.07.2024, 07 Uhr

Kein Tag gesetzt

Orthophoto

Höhenmodell


Hillshade

Relativ

2.2 m

0.1 m

Herunterladen



RMSE Georeferenzierung (4891 Pt.) 3.2 cm | 0.4 pixel | Anzahl Kameras: | Anzahl Bilder: 5016

Map: 3.9 m

**Datenverwaltung**

**Epochen**

- 18.09.2024, 12 Uhr
- 20.08.2024, 12 Uhr
- 09.07.2024, 07 Uhr**
- 25.06.2024, 06 Uhr

**Plandaten**

- Permafrosthinweiskarte
- Dominante Rutschgebl...

**Eigene Layers**

**Messpunkte**

- Deformation

**Hintergrund**

- Hintergrund aus
- OpenStreetMap
- Landeskarte
- Swissimage
- ESRI World Imagery

**Analysetools**

Punkt Linie Polylinien Flächen

**Höhenvergleich**

Basis:  Epochen  Plandaten  Benutzer

Vergleich:  Epochen  Plandaten  Benutzer

09.07.2024, 07 Uhr

20.08.2024, 12 Uhr

WGS84

CH1903+

Aktiv

**Eigenschaften**

09.07.2024, 07 Uhr

Orthophoto

Hillshade

20.08.2024, 12 Uhr

Orthophoto

**Höhendifferenz**  
(Vergleich - Basis)

meter

0.3

0.20

0.10

0.00

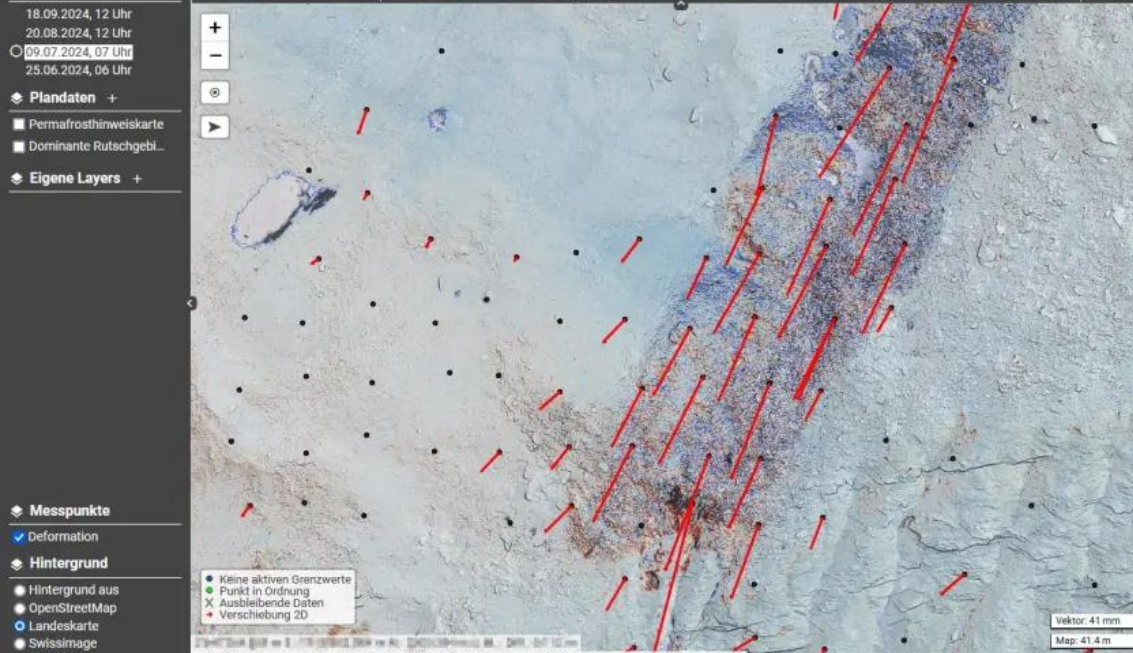
-0.10

-0.20

-0.3

Genauigkeit

Höhenvergleich (2  $\sigma$ ): 6.36 cm



RMSE Georeferenzierung (4891 Pt.) 3.2 cm | 0.4 pixel | Anzahl Kameras: 7 | Anzahl Bilder: 5016

Vektor: 41 mm

Map: 41.4 m