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Insubric Ecosystems Research Group

CH-6500 Bellinzona





Agenda:

- Why historical photos?
- The mono-plotting principle
- Fields of application and examples
- Accuracy estimation: preliminary results of a *crazy* test
- Outlook





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# Oblique photographs display a great potential for historical reconstruction of landscape dynamics

- They go back to the XIX century







# Oblique photographs display a great potential for historical reconstruction of landscape dynamics

- There is a huge amount of images







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- Why historical photos?
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10<sup>th</sup> Swiss Geoscience Meeting, Bern 2012

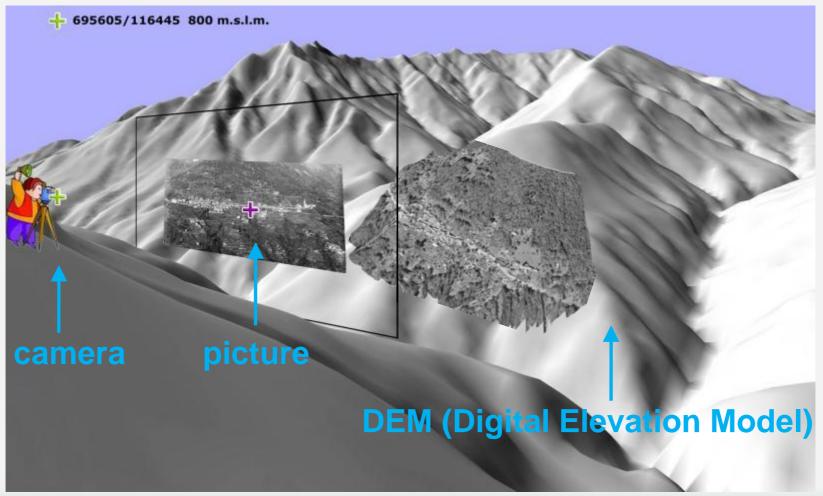
Outlook





The main components of the system are:

the camera, the picture and the DEM (Digital Elevation Model)

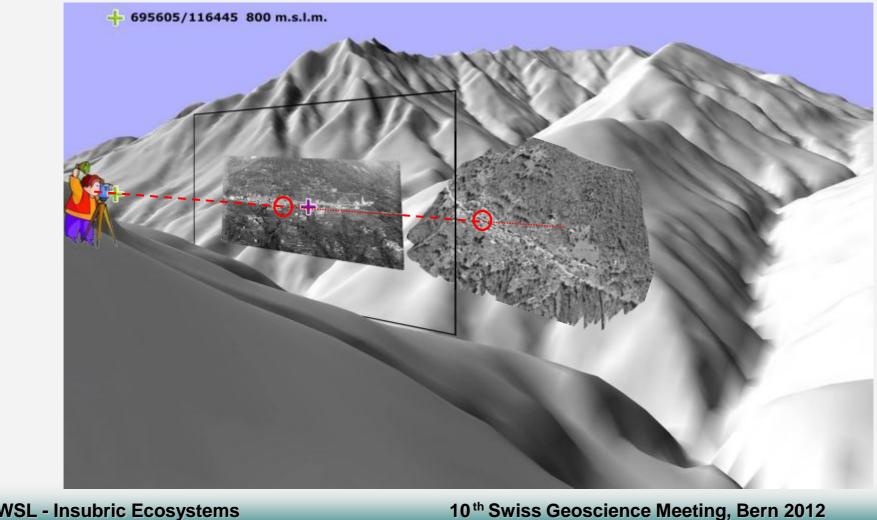




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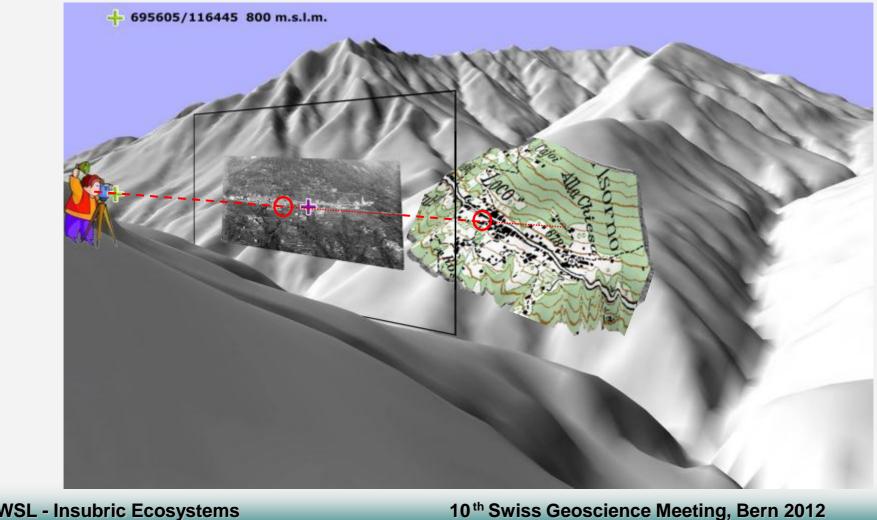
Camera and picture have to be placed in the world space so that:

a ray from the camera through a point on the picture will intersect the DEM at the corresponding real point



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a ray from the camera through a point on the picture will intersect the DEM at the corresponding real point



The accuracy of the system is influenced by:

- camera: accuracy of camera calibration
- picture: resolution
- **DEM:** accuracy

correspondence between DEM and relief at the time of the picture



# **The WSL Monoplotting Tool**

# "A tool for inserting and managing oblique photographs in the corresponding 3D-space"

Main requirements:

- assuring the correspondence of each pixel of the picture with the corresponding xyz coordinates in the real space
- enabling digitization or measure of specific features in the picture
- importing and exporting digitized features from the picture to the standard GIS systems
  - self-intuitive, user-friendly handling



# The WSL Monoplotting Tool: state of the art

- 0 GIS-Suite - WSL Monoplotting-Tool - [Bedretto - 24\_013\_12-05-1986\_12-55\_1A+B - 2012.07.26 - claudio.gis] File Edit Insert View Tools Window Help . # x 🖸 😂 🖶 🗏 📥 🖨 🖨 🔂 🖬 🔂 Project Photo Camera Points Polygons Polylines Maps/dems Maps Dems Photo Bedretto - 24\_013\_12-05-1986\_12-55\_1A+8.jpg Browse Save. Control points Import... Export. Idx Name Photo position World posit Dem (683357.82, 151513.56, 1354.8 0.04 (2994.21, 966.11) 7 0.03 (2874.24, 1035.58) (683272.32, 151545.31, 1359.4 1 0.04 (1199.59, 983.47) (682396.33, 151046.02, 1391.6 7 ( 2023.78, 997.98) (682819.36, 151287.00, 1370.1 0.08 R (682352.38, 152386.89, 2114.7 0.22 (2067.04, 2842.09) 되 0.26 (2296.30, 2635.72) (682535.68, 152380.36, 1987.5 (683383.58, 151894.12, 1432.3 0.08 ( 3208.62, 1377.87) 5 0.02 (2970.95, 1253.64) (683274.04, 151733.95, 1405.4 514 y X 3407.80 Y 896,60 X 300 < 1 Select all Unselect all Toggle selection Select checked + Check all Uncheck all Toggle check Show all Hide all Show selection C Cear all Insert., 下位。 Test 1 Test 2 Test 3 Project. Center and origin Edt.. Center (2269.50, 2238.00) (683454.94, 150668.19, 3000.53) Edt. Origin Work area Left Top Edit. Right Bottom 300 X 3407.60 Y 896.60 E 663595.59 N 151595.58 H 1320.46 × 514 Y

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# The WSL Monoplotting Tool: state of the art

GS-Sutte - WSL Monoplotting-Tool - [Bedrette - 24 013 12-05-1986 12-55 14+B - 2012.07.26 - claudio.gts] File Edit Insert Wess Tools Window Hills 0 - E = 0 = 0 = 0 m × Project Photo Camera Points Polygons Polylines Maps/dems Maps Dems Cameras Save.. Kind Name Matrix camera calibration Name mil Camera parameters Name Value Fix Error Position 684224.3031 🔲 😭 Ox 0.0000 Oy 148078.4203 🔲 🎇 0.0000 Ô2 3800.8667 0.0000 67.289 0 1.174421 0.0000 -Rx 10.0 19.576 0 🔲 💥 0.341667 0.0000 Ry Focal Length Rotation 9,7100 0.169471 0.0000 R2 2334.9578 🔲 📝 G 0.0000 CV. 2645.0162 0.0000 \* 6914.3391 0.0000 D x 513 Y 301 X 3406.19 V 895.00 1.00.0 100.0 mm RF -1 🔶 mage center Compute Nr. iterations 20 💆 Computed values 1 (-0.929, -0.370, -0.028) A rot -1.727 (0.159, -0.328, -0.931) (-0.335, 0.869, -0.364) 10,00 pix Errors min max mean 0.400 1.479 0.888 pixel 0.003 0.012 0.007 angle 0.563 radius 0.251 0.864 Details... Apply Errors min mean max word (2d) 0.251 1.179 0.583 word (3d) 0.252 1.200 0.598 Cancel

x 513 y 301 X 3406.19 Y 895.00 E 683594.98 N 151594.11 H 1320.09



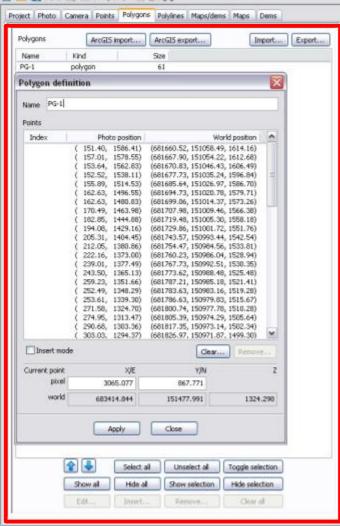
5

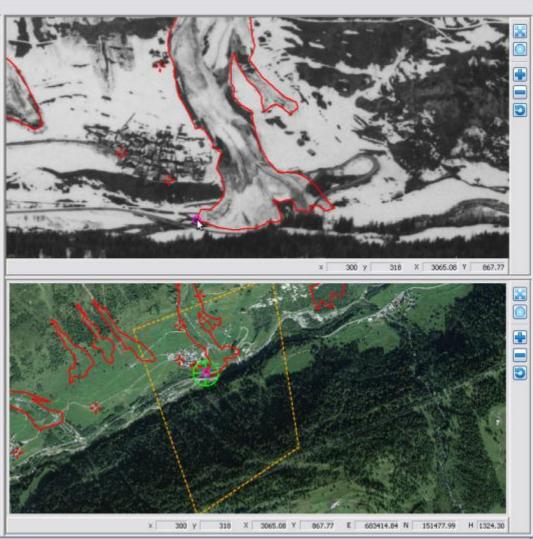
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GIS-Suite - WSL Monoplotting-Tool - [Bedretto - 24\_013\_12-05-1986\_12-55\_14+B - 2012.07.26 - claudio.gis]









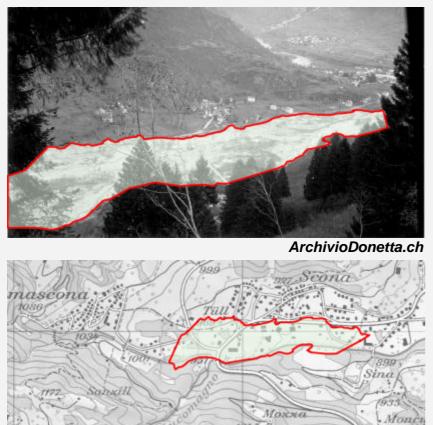
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Reconstruction of natural events: flood of 1927



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Pianexxa di Larescia

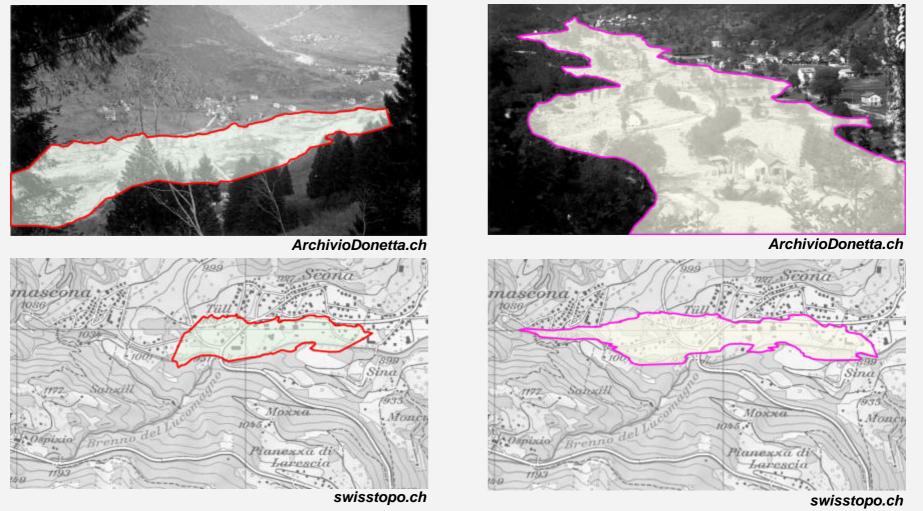
Office for Natural Hazards (TI) – Olivone 1927: boundary of the alluvial material



Ispixia

Brenno

### Reconstruction of natural events: flood of 1927

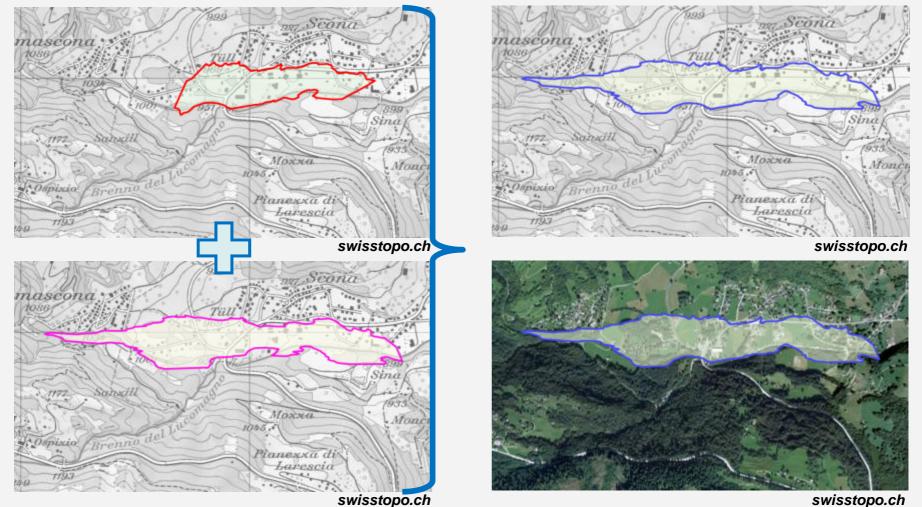


Office for Natural Hazards (TI) – Olivone 1927: boundary of the alluvial material



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Reconstruction of natural events: flood of 1927

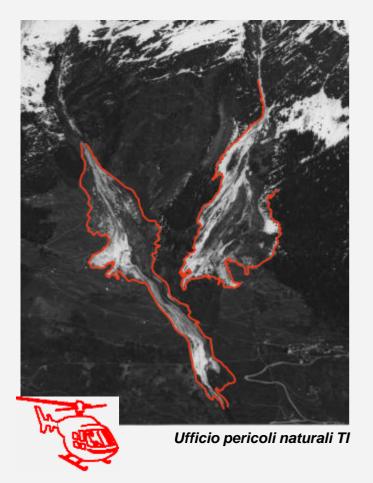


Office for Natural Hazards (TI) – Olivone 1927: boundary of the alluvial material



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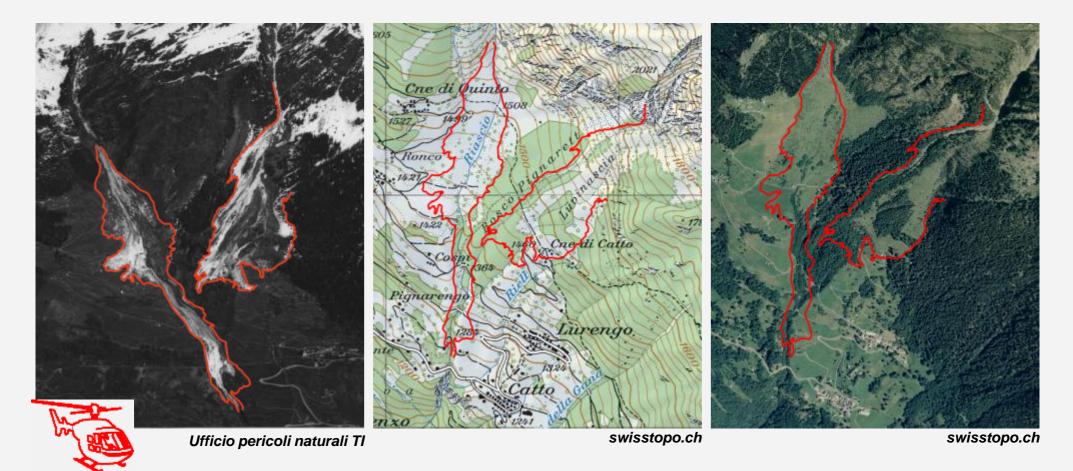
Reconstruction of natural events: avalanche of 1986



Office for Natural Hazards (TI) – Quinto 1986: avalanche tracks and outlets



Reconstruction of natural events: avalanche of 1986



Office for Natural Hazards (TI) – Quinto 1986: avalanche tracks and outlets



Landscape changes due to a rockslide: Airolo 28.12.1898



Before the event

Ufficio pericoli naturali TI



Just after the event

Ufficio pericoli naturali TI

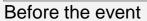
Office for Natural Hazards (TI) – Airolo 1898: rockslide



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Landscape changes due to a rockslide: Airolo 28.12.1898





Ufficio pericoli naturali Tl



Just after the event

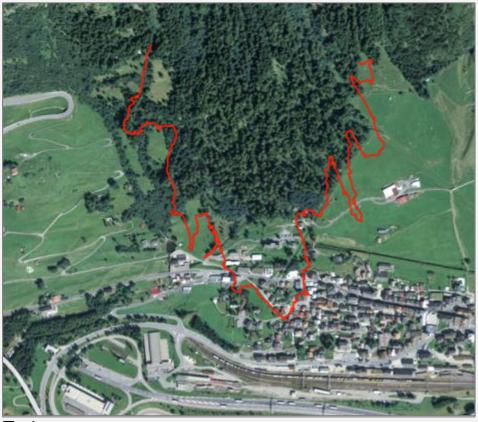
Ufficio pericoli naturali Tl

Office for Natural Hazards (TI) – Airolo 1898: rockslide





Landscape changes due to a rockslide: Airolo 28.12.1898





Today

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Just after the event

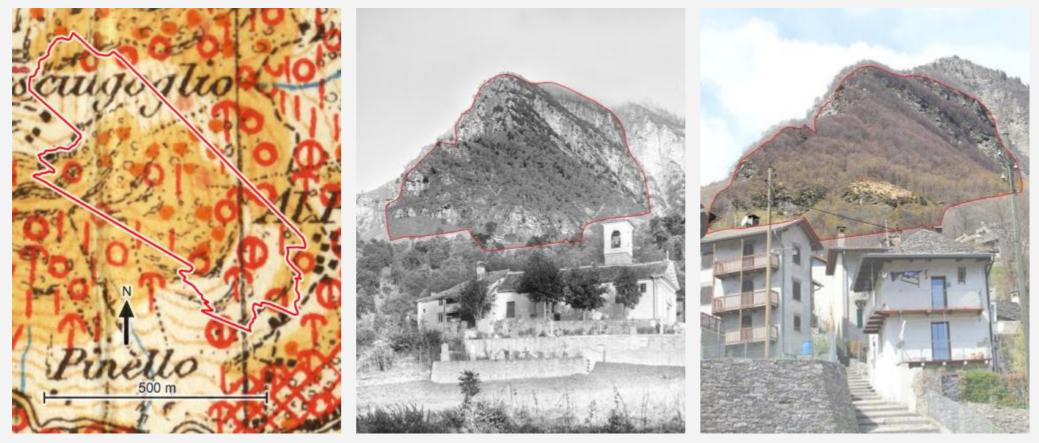
Ufficio pericoli naturali TI

Office for Natural Hazards (TI) – Airolo 1898: rockslide





# Fields of application and examples Landscape evolution: Crana 1910 - 1933 - 2012



Bär: vegetation map of 1910

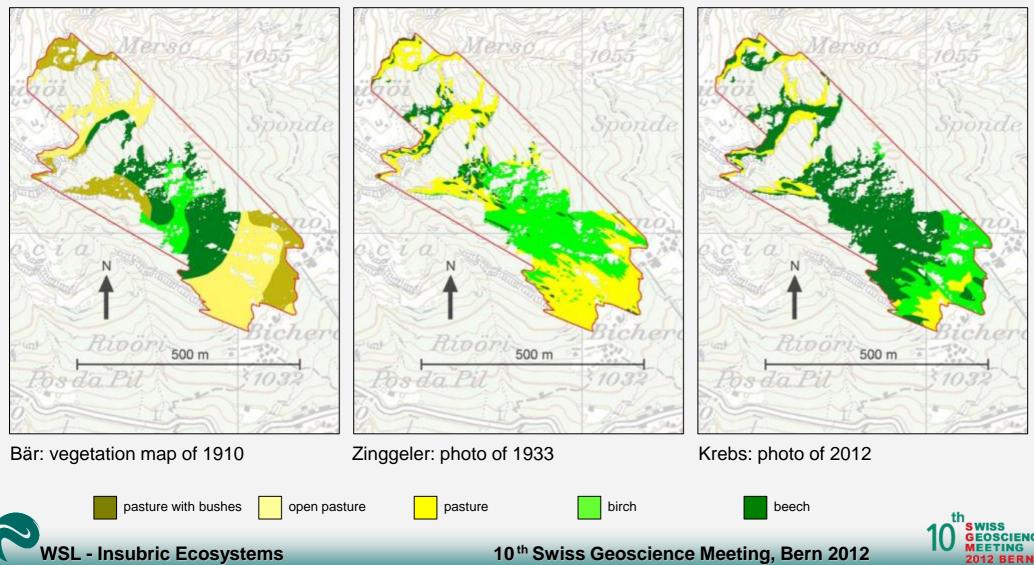
Zinggeler: photo of 1933

Krebs: photo of 2012





# **Fields of application and examples** Landscape evolution: Crana 1910 - 1933 - 2012



Landscape evolution:

- reconstruction of forest boundary and stand age
- glacier's dynamics
- land-use changes (i.e. urbanization)

### Archaeology and history:

- roads and trails
- channels for water and material transport
- disappeared or no longer recognizable elements

#### Reconstruction of natural events:

- floods
- landslides
- avalanches

### Monitoring of current processes:

- surface of glacier melt water
- snowmelt
- wind erosion



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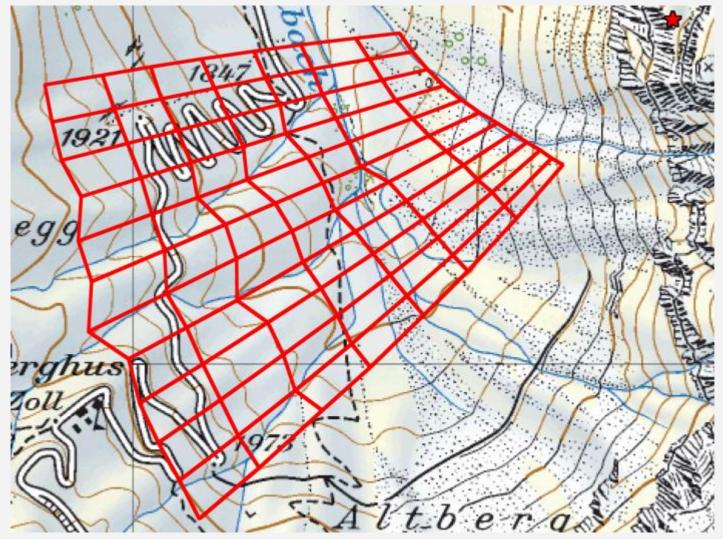
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Splügenpass, Grisons, Switzerland: day 1





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Splügenpass, Grisons, Switzerland: day 1







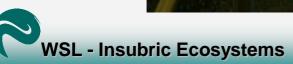
Splügenpass, Grisons, Switzerland: day 2





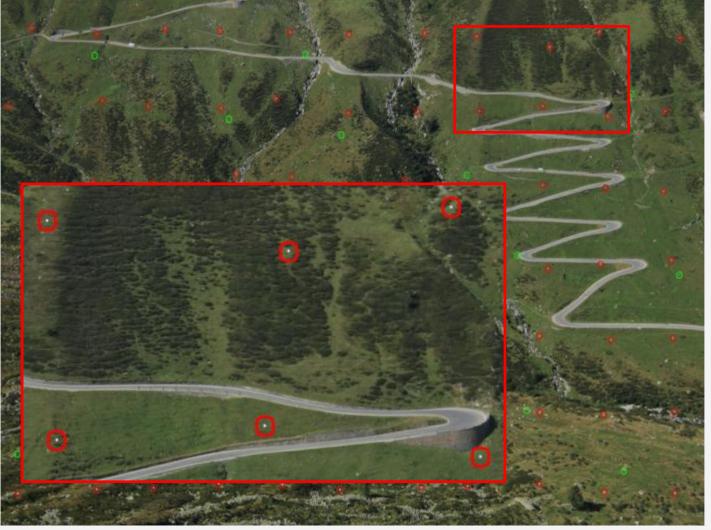


# Accuracy estimation: a crazy test in the real world Splügenpass, Grisons, Switzerland: day 2





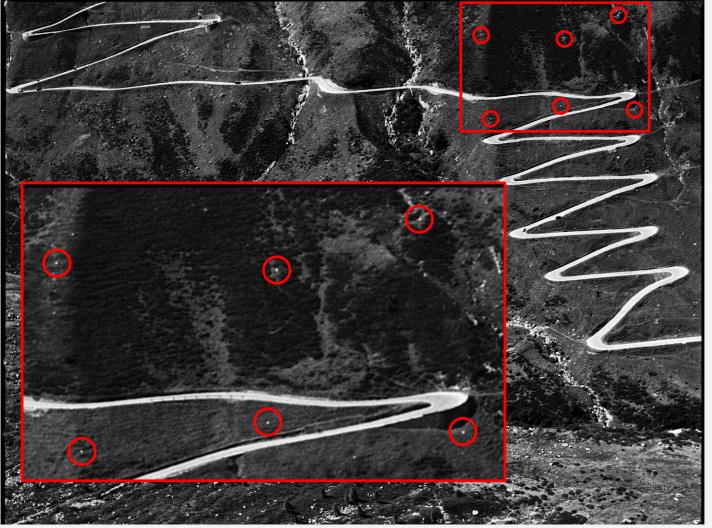
Splügenpass, Grisons, Switzerland: day 2





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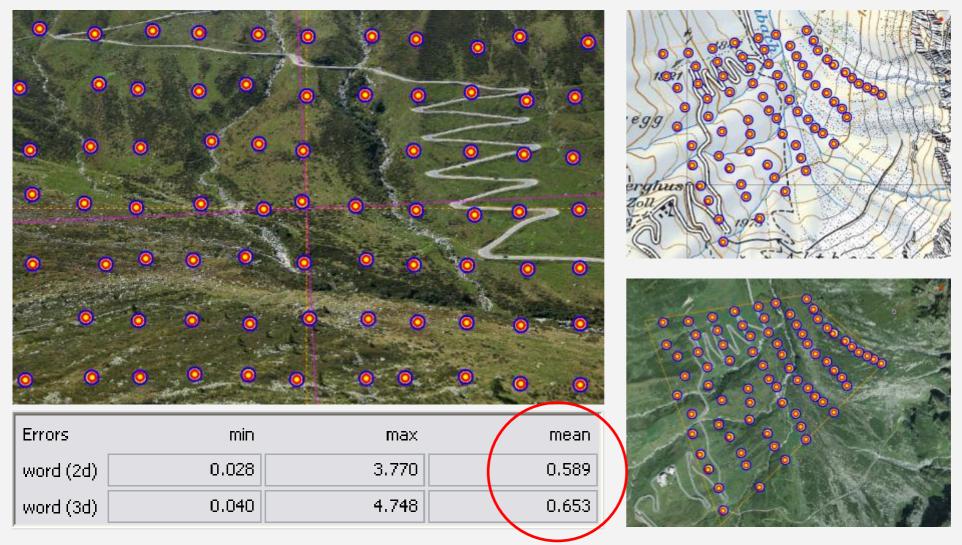
Splügenpass, Grisons, Switzerland: day 2





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Splügenpass, Grisons, Switzerland: very preliminary results





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# **Outlook of the project**

#### Current status:

- user friendly, advanced prototype
- simple data editor (points, polylines, polygons)
- interoperability with GIS system through ASCII files (ArcGIS, Q-GIS)

#### Future plans:

- enhancing integration in ArcGIS
- implementing robust accuracy estimation
- encouraging the usage by research, educational and public institutions



For further information:

- contact me here, for practical demo
- <u>claudio.bozzini@wsl.ch</u>
- Google search: "wsl" and "bozzini"

# Thank you.

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