Visibility analysis for planning landslide alert systems with webcams

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Opportunity: Webcams

https://www.panomax.com/
Content

- Landslide alert vs. early warning
- Technical challenges of a landslide alert system
- Concepts, materials and methods
  - Visibility analysis & visually relevant parameters
  - Study area and data
  - Visibility analysis model
  - Results
- Discussion and conclusion
Landslide alert vs. early warning

- Enables getting informed about a specific landslide location as soon as possible after the event occurred
- Allow fast reaction

- Enables preparation for action when the weather conditions make the occurrence of landslides very likely
- Allow in-time preparation

Complementing systems
Technical challenges of a landslide alert system

- Approach: Analyse the components’ technical feasibility

**Image Information extraction**

- Applying Earth Observation concepts to webcam images

**Achievable webcam coverage**

- Model the coverage of webcam constellations with visibility analysis

**Identify relevant susceptible areas**

- Identify location as susceptible when conditions of known landslides are found

**Step 1: Estimate the viewing capabilities of an installed webcam for targeting landslides**
CONCEPTS, MATERIALS AND METHODS
The look and feel of visibility
Visually relevant webcam parameters

- Webcam field of view determined by:
  - Viewing height \( h \),
  - Vertical view angle \( \alpha \),
  - Horizontal view angles \( \beta \) and \( \beta_2 \) (account for webcam turning capability).
Visually relevant landslide parameters in relation to webcam location

- Landslide size in the webcam’s field of view depends on:
  - Landslide surface area $A$,
  - Its inclination $\gamma$ and orientation $\delta$ to due North,
  - Webcam’s orientation angles $\epsilon$ and $\lambda$ towards the landslide,
  - Distance $d$ between landslide and webcam.
Study areas and data

- **Study area**: Montafon, Vorarlberg, Austria
- **Webcam**: Skiing resort „Silvretta“ at https://silvretta-montafon.panomax.com/nova-stoba
- **Topography data**: DEM (10m; derived from airborne laser scanning)
- **Ancillary**: Worldview-2 (0.5m; 29.08.2015)
Visibility Analysis model

- **Main output:**
  - Ratio-adjusted ground resolution (per 1°-by-1° tile of webcam view)

- **Visualisations:**
  - Map view
  - Augmented reality (AR) view
Results (1/2)

- Background image
- Ground resolution map

AR view

Map view

Greys: 1 - 2 m
Yellows: 2 - 5 m
Reds: 5 - 10 m
Pinks: > 10 m

< 1 m

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Results (2/2)

- Background image
- Ground resolution map

AR view

Map view

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Discussion and Conclusion

- Discussion and Conclusion
  - A webcam’s effective coverage for identifying landslides can be mapped
  - Model needs refinement
    - Address pixels of webcam image and cells of DEM instead of coarse 1°-by-1°-tiles

- Further steps:
  - Information extraction from webcam images
  - Find optimal webcam constellations for susceptible areas
  - …
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