Qualitative analysis of the impact of mass movements on the alpine hiking infrastructure

NH9.8 Natural hazard impacts on technological systems and infrastructures

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QUALITATIVE ANALYSIS OF THE IMPACT OF MASS MOVEMENTS ON THE ALPINE HIKING INFRASTRUCTURE

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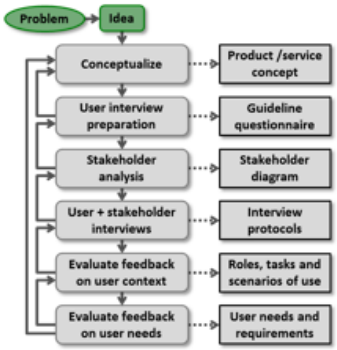
Problem context

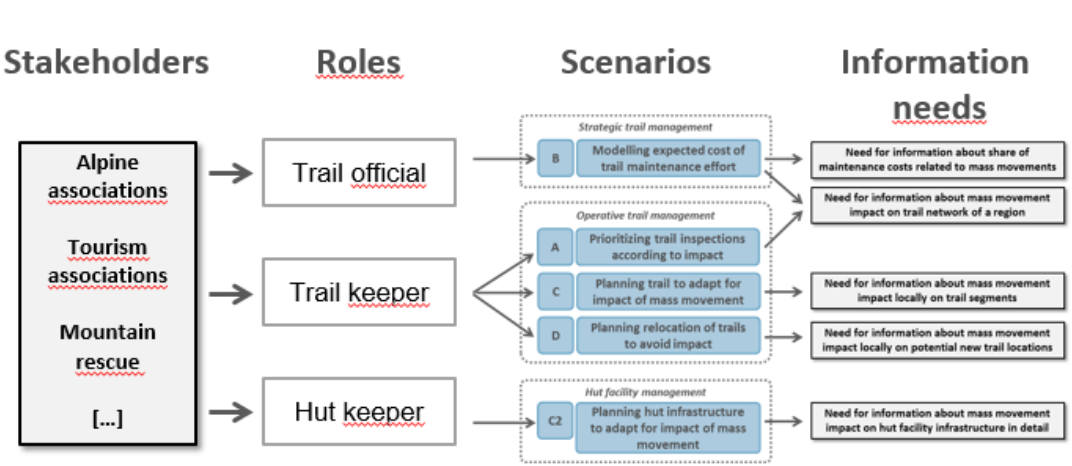
Mass movements like rockfall and landslides cause damage to hiking infrastructure.

Therefore, alpine associations need information about these natural hazards to better manage their infrastructure.

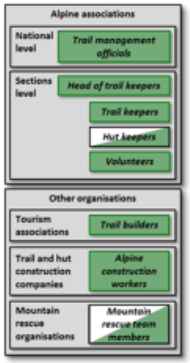
Methods

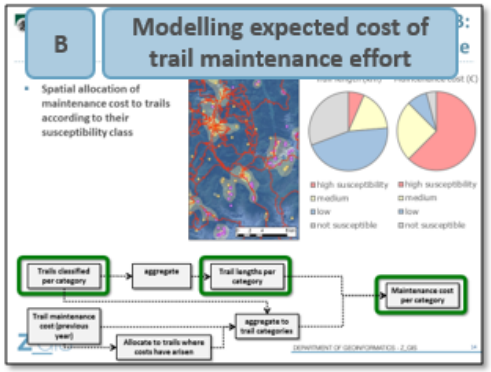
Analyse user requirements





Hiking trail affected by a mass movement in the Austrian Alps. Photo: D. Hölbling, 2015





Requirements related to need #2

Need for information about impact on trail network of a region

ID	Name	Description	Success criteria
1	Area of Interest (AOI)	Polygon encompassing trail network	Trails completely covered
2	Mass movement impact layer	Raster with impact values in 5 classes from weak to strong	Resolution 10m 80 % accurate
3	Impact per trail segment	Impact value as attribute of trail segment	80 % accurate
4	Cost per trail segment	Cost value in relation to impact value and trail segment length	80% accurate
5	Cost uncertainty per trial segment	Cost uncertainty value	
[...]			

Acknowledgements

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MontEO partners

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Content

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- **Methods for analysing user requirements**
- **Results**
  - Stakeholders and their tasks about mass movements
  - Scenarios how to make use of mass movement information
  - Information needs

CONTEXT OF ALPINE INFRASTRUCTURE MANAGEMENT

Heavy rainfall event on 05./06.08.2017: Blocked hiking trails in Großarl Valley, Salzburg, Austria

Foto: F. Albrecht 2017

According to information of the trail keeper of Section Hüttschlag of the Austrian Alpine Association (ÖAV):
A landslide tore away the trail on a width of 10 meters. Several days of reconstruction enabled re-opening the trail. The severity of the rainfall event caused many more blocked trails in the region of responsibility of Section Hüttschlag. The remaining summer season was not enough time to make all trails accessible again.

Alpine infrastrcture management in the Austrian Alps

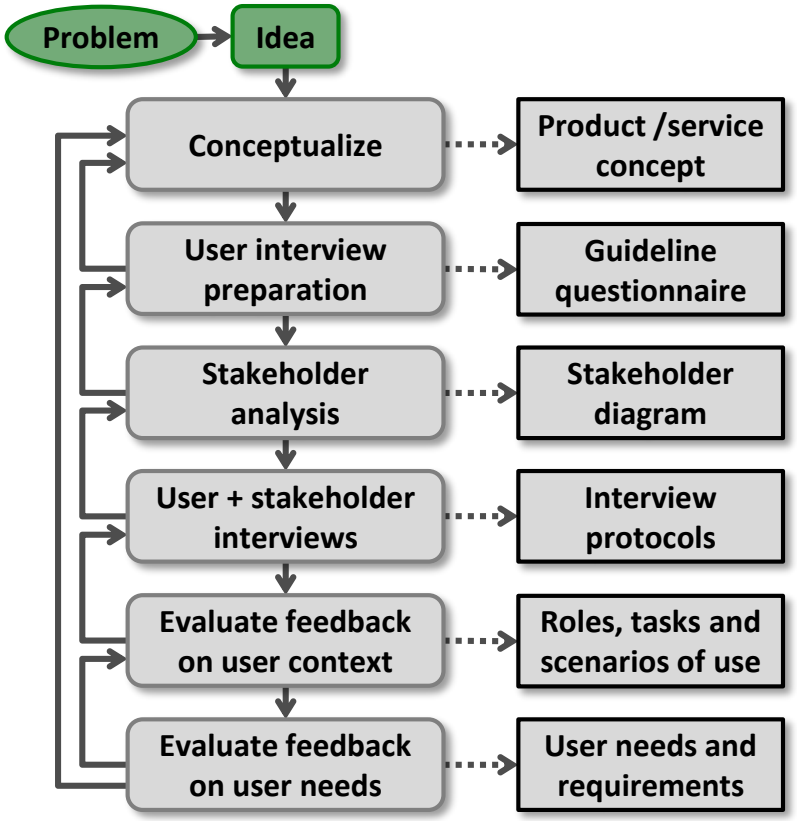
- **The hiking infrastructure of trails and huts is a strong asset for summer tourism in the Austrian Alps**
  - 2.5 Mio. Austrians mention hiking as one of their recreational activities (DAV & ÖAV, 2011)
  - 2.5 Mio. hiking tourists visit Austria per year (WKO, 2018)
- **Challenge:**
  - Mass movements like rainfall-induced shallow landslides debris flows and rockfall cause damage to the hiking infrastructure
  - Resulting in blocked access to mountain huts and hiking routes and need for expensive restoration and trail relocation
- **Objective:**
  - Support alpine infrastructure management and maintenance with innovative Earth observation-based information about mass movements and their impact

Hiking trail affected by a mass movement in the Austrian Alps. Photo: D. Hölbling, 2015

METHODS FOR ANALYSING USER REQUIREMENTS

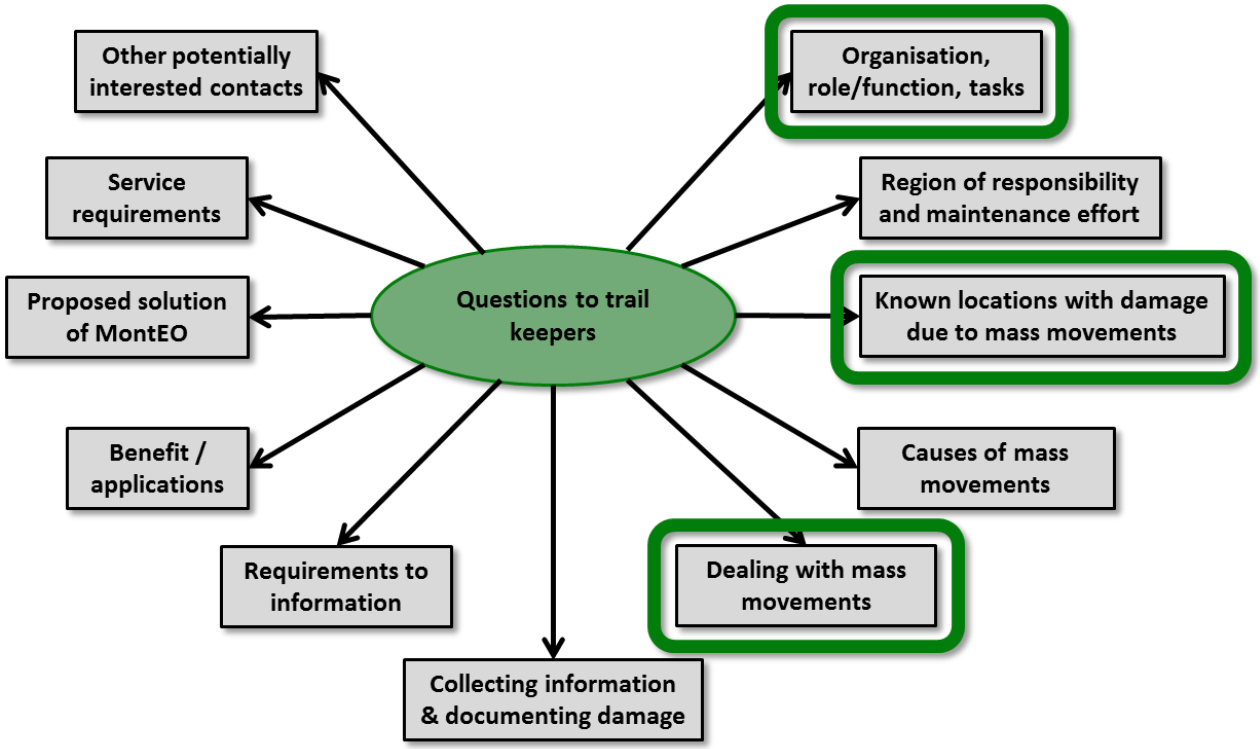
Analysing user requirements

- We performed a user requirements analysis that identified relevant stakeholders and pinpointed both user needs and requirements for information about mass movement impact on alpine infrastructure.



Questionnaire for semi-structured interviews

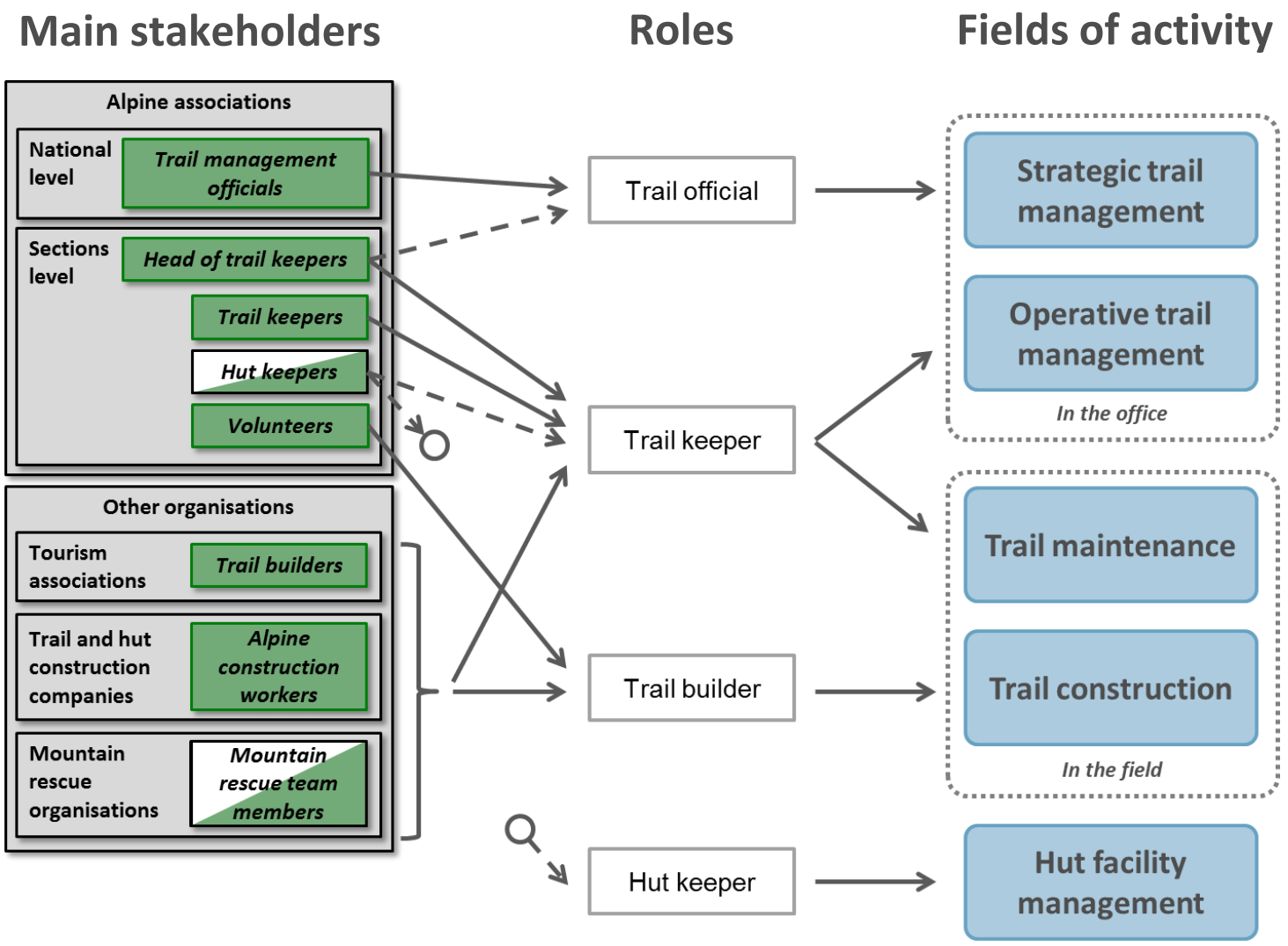
- Interviews were perforemed with 17 interview partners. They are trail keepers, trail builders, hut keepers and officials of the alpine associations of DAV, ÖAV and ÖTK.



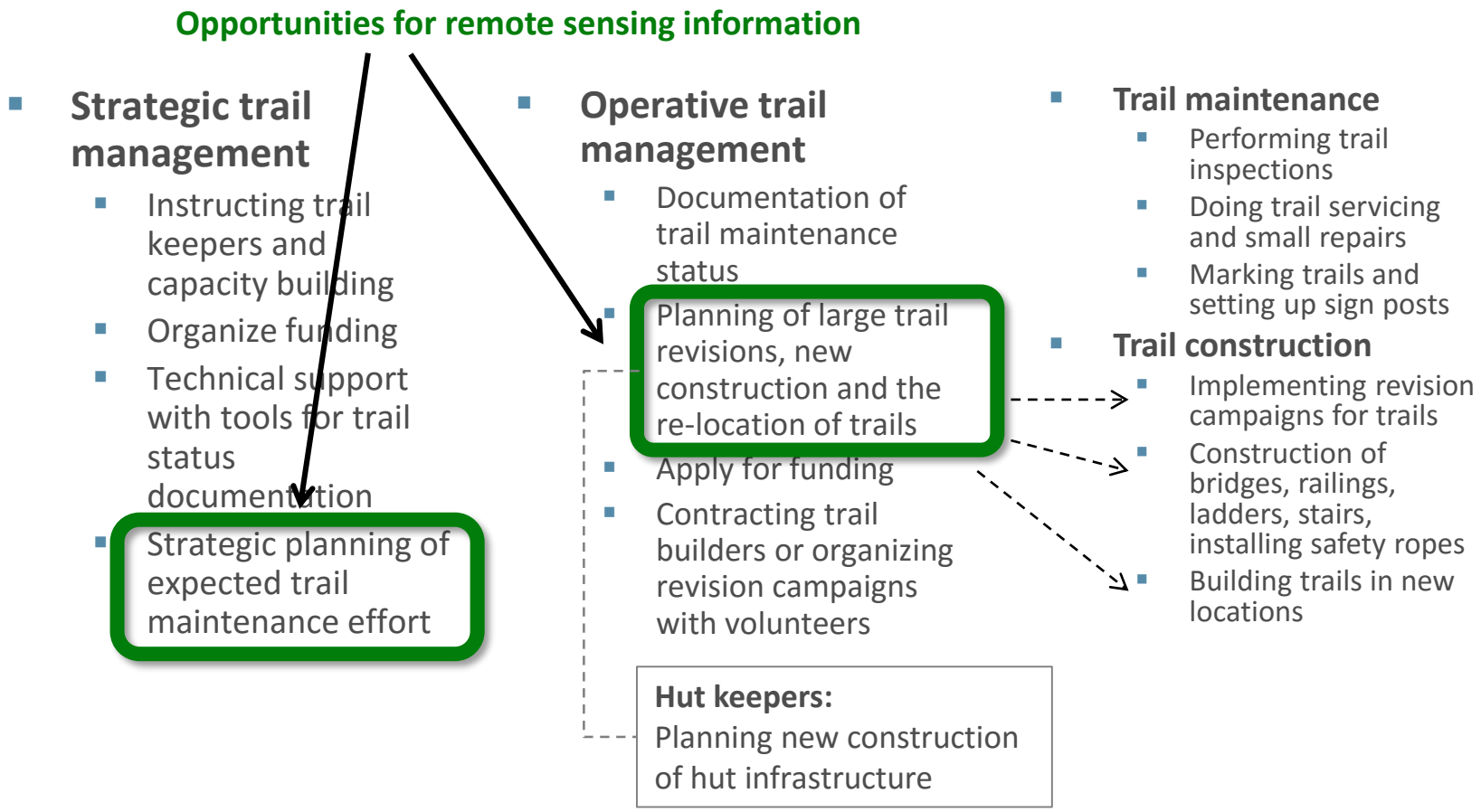
- Stakeholders and their tasks about mass movements
- Scenarios how to make use of mass movement information
- Information needs

RESULTS

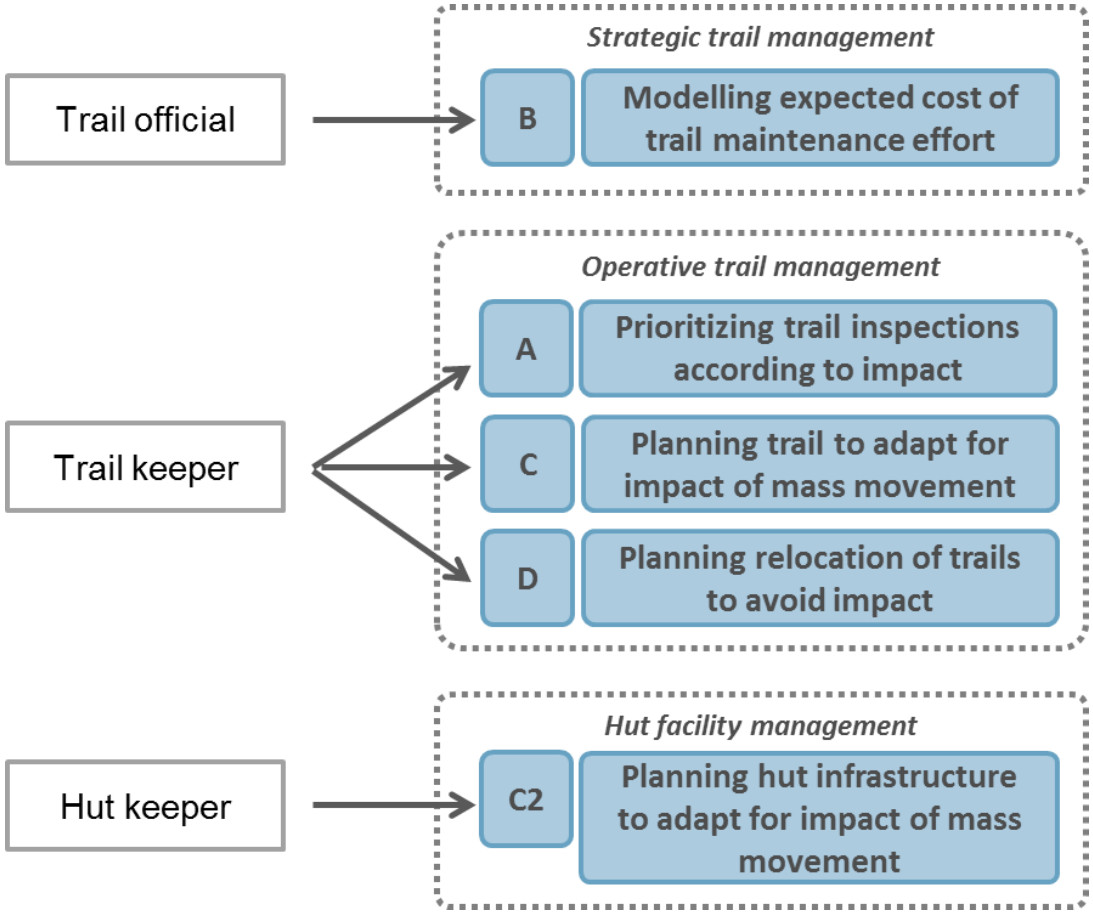
People with trail/hut keeping duty and their fields of activity



Tasks in fields of activity

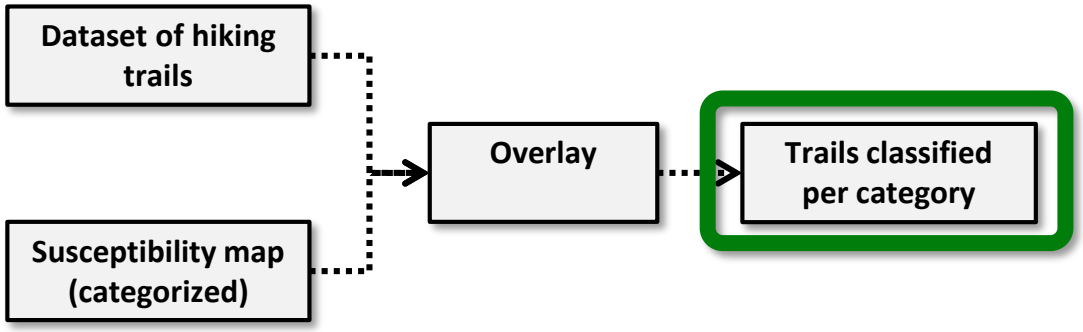


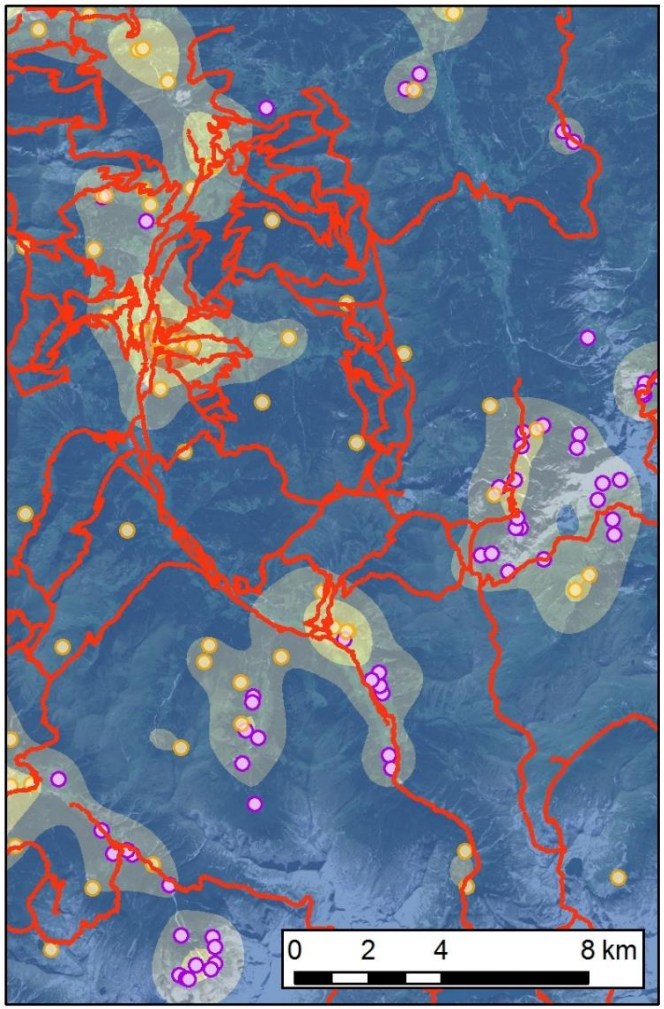
Scenarios for using mass movement information



Mockup for Scenario A: Prioritizing trail inspections

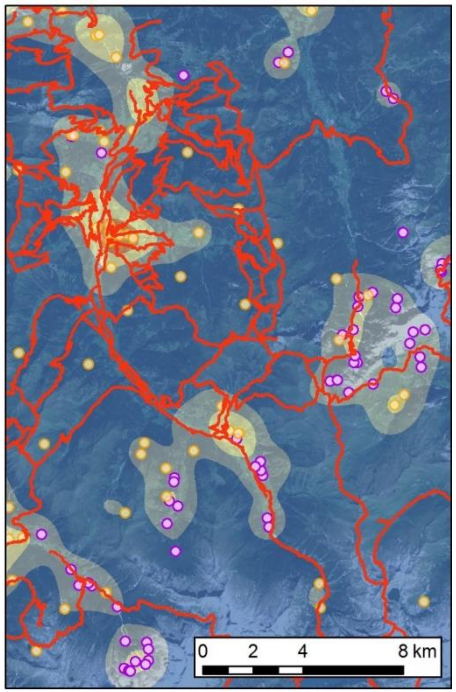
- **Overlaying mass movement information with trails allows to distinguish between**
  - Strongly impacted trails (more damage to be expected)
  - Lightly impacted trails (less damage to be expected)
- **Trail keepers can adapt their seasonal planning of trail inspection campaigns (number and duration) by aligning the frequency of coverage to the impact of mass movements**
- **They use their time more efficiently**

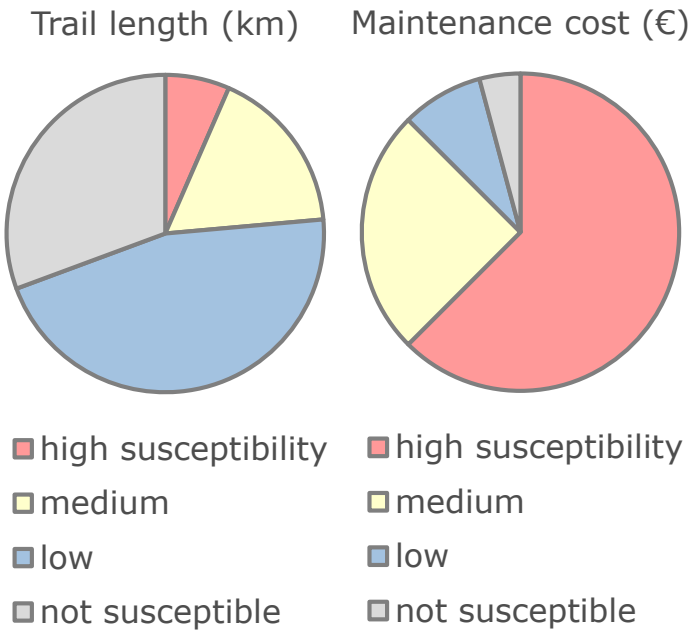


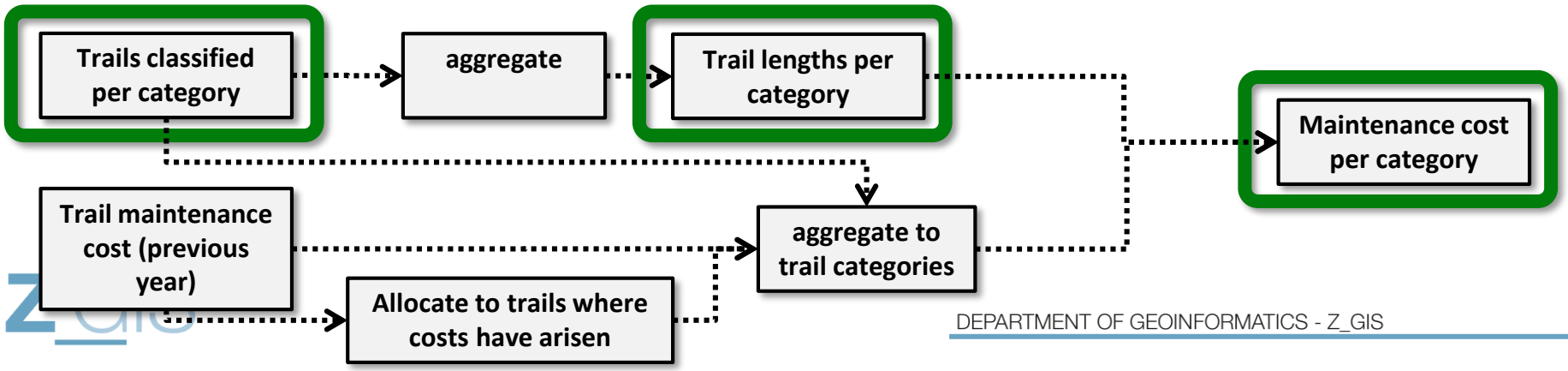


Mockup for Scenario B: Modelling expected cost of maintenance

- Spatial allocation of maintenance cost to trails according to their susceptibility class
- Trail officials gain a better understanding how the spatial distribution of mass movements impacts their expenses for trail maintenance





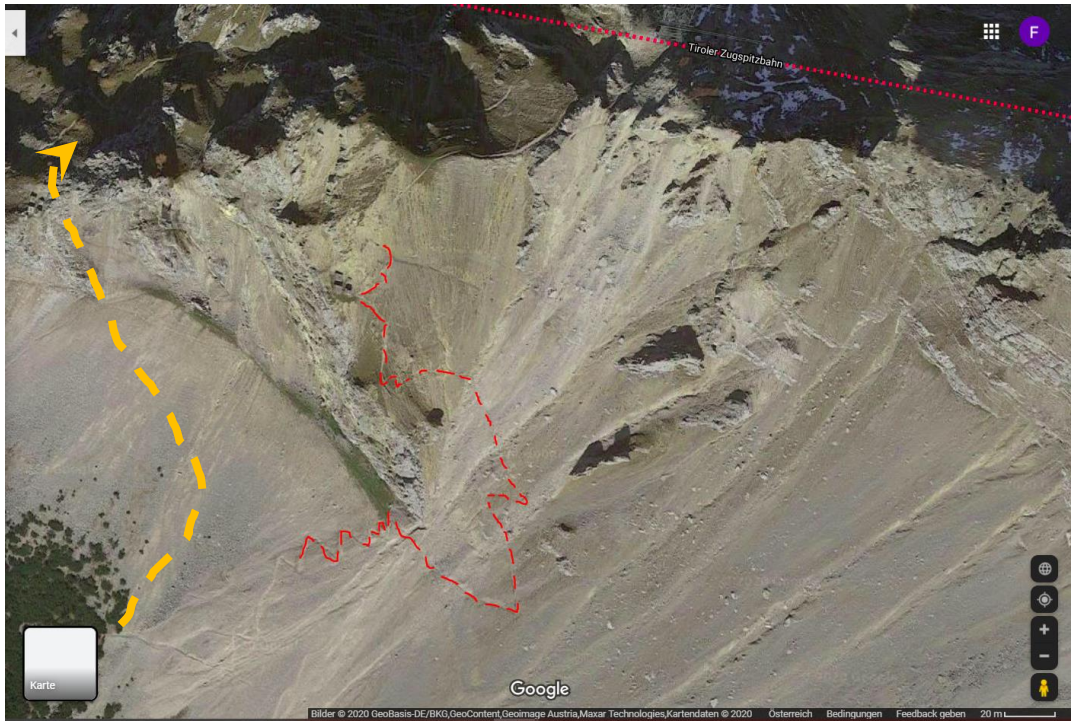


Scenario C/C2: Adapting trail/hut infrastructure to mass movement impact

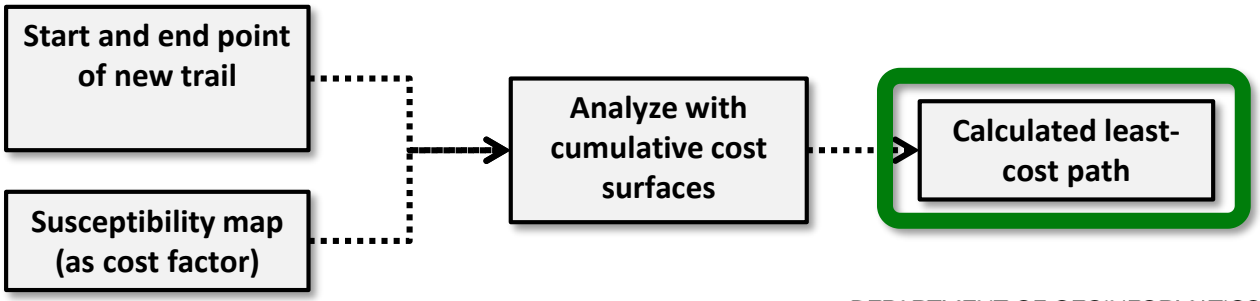
- **Perform planning that is aware of mass movement impact**

Mockup for Scenario D: Modelling a replacement route

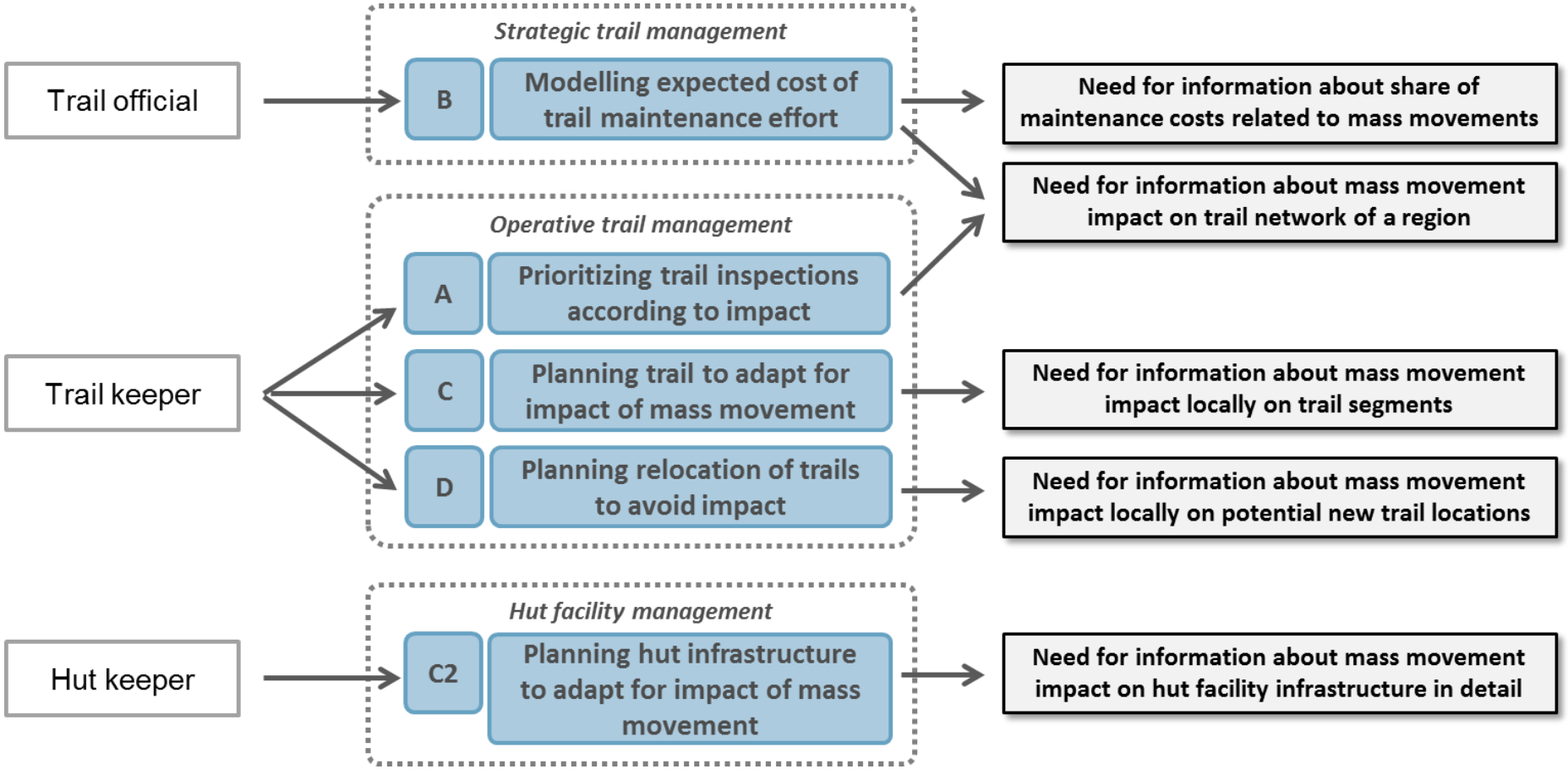
- **Example ÖTK (at the alpine hut "Wiener Neustädter Hütte"):**
  Trail section "Gamskar" of the trail Georg-Jäger-Steig, Zugspitze, Tyrol, Austria
  - Increased activity of mass movements in recent years
  - Trail repairs became necessary much more often
  - A trail relocation is envisaged



- **Mass movement information allows trail keepers to identify and build less impacted trails**
- **Thereby, they can provide a better-maintained trail network that requires less maintenance effort**



Identified information needs



Associated requirements

- **Clear description of required information products and their content**
  - Requirements related to Need #2

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Conclusion

- **Mass movements have an impact on alpine infrastructure that is reflected in the trail management and maintenance tasks**

- **Next steps:**
  - Produce Earth observation based mass movement maps that meet the identified requirements
  - Validate their suitability by discussing scenarios of use with trail keepers and other stakeholders

MontEO – The impact of mass movements on alpine trails and huts assessed by EO data

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