RECIPE

Reinforcing civil protection capabilities into multi-hazard risk assessment under climate change

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Impacts of climate change (**permafrost degradation** / **deforestation**) on landslide and rockfall risk management – **a DSS prototype**

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20th October, Lissabon

CTFC PAU COSTA FOUNDATION protecció civil FVA Forest Research Institute Baden-Württemberg cima FOUNDATION BFW Austrian Research Centre for Forests INSTITUTO SUPERIOR DE AGRONOMIA ICGC Institut Cartogràfic i Geològic de Catalunya

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Inducement

- the multifactorial issue of natural hazard management becomes even more complex by climate change
- a combination of different natural hazards and/or climate change impacts can significantly increase the hazard potential
- in this context, decision-making and prevention in the field of civil protection are fraught with uncertainty **→ are there DSS that can reduce these uncertainties?**

- "RECIPE" goal: development of recommendations/guidelines/tools as decision-making aids for applied civil protection
- **therefore, a prototype for improved decision-making in the context of rockfall and landslides risk management was developed**

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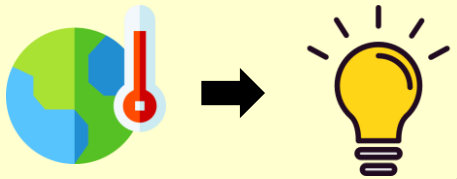
Important steps in advance

identification of potential climate change impacts on risk management for rockfall & landslides



analysis of existing decision making bases for civil protection

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Relevant processes

rockfall < 100 m³

© Liebl

hydrologically driven, spontaneous, shallow landslides

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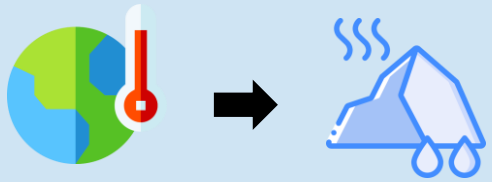
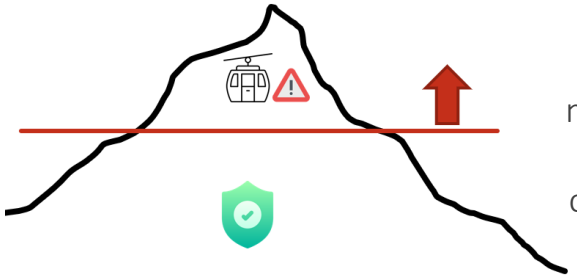
Climate change impacts on rockfall & landslides

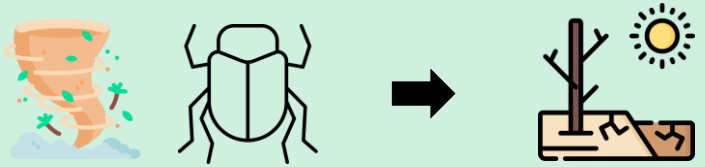
permafrost degradation



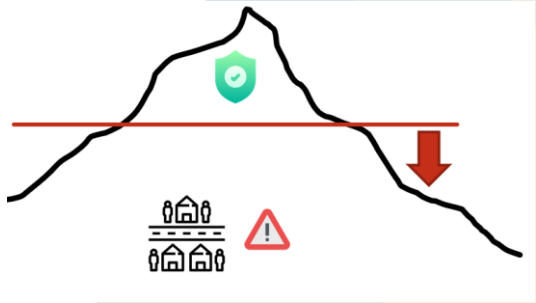


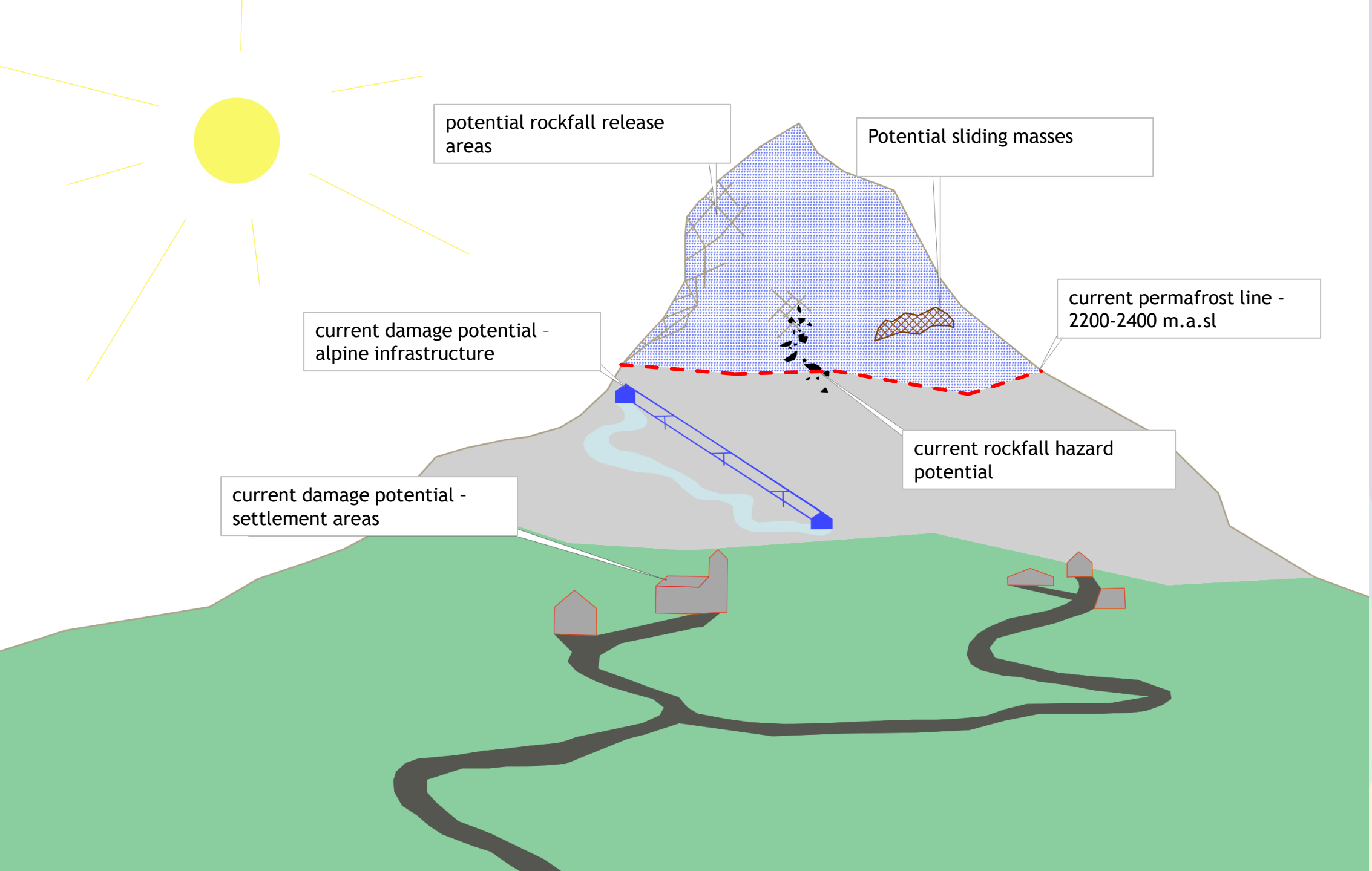
high-alpine areas above 2200 metres are particularly affected; alpine infrastructures such as cable cars, restaurants, hiking & bike trails

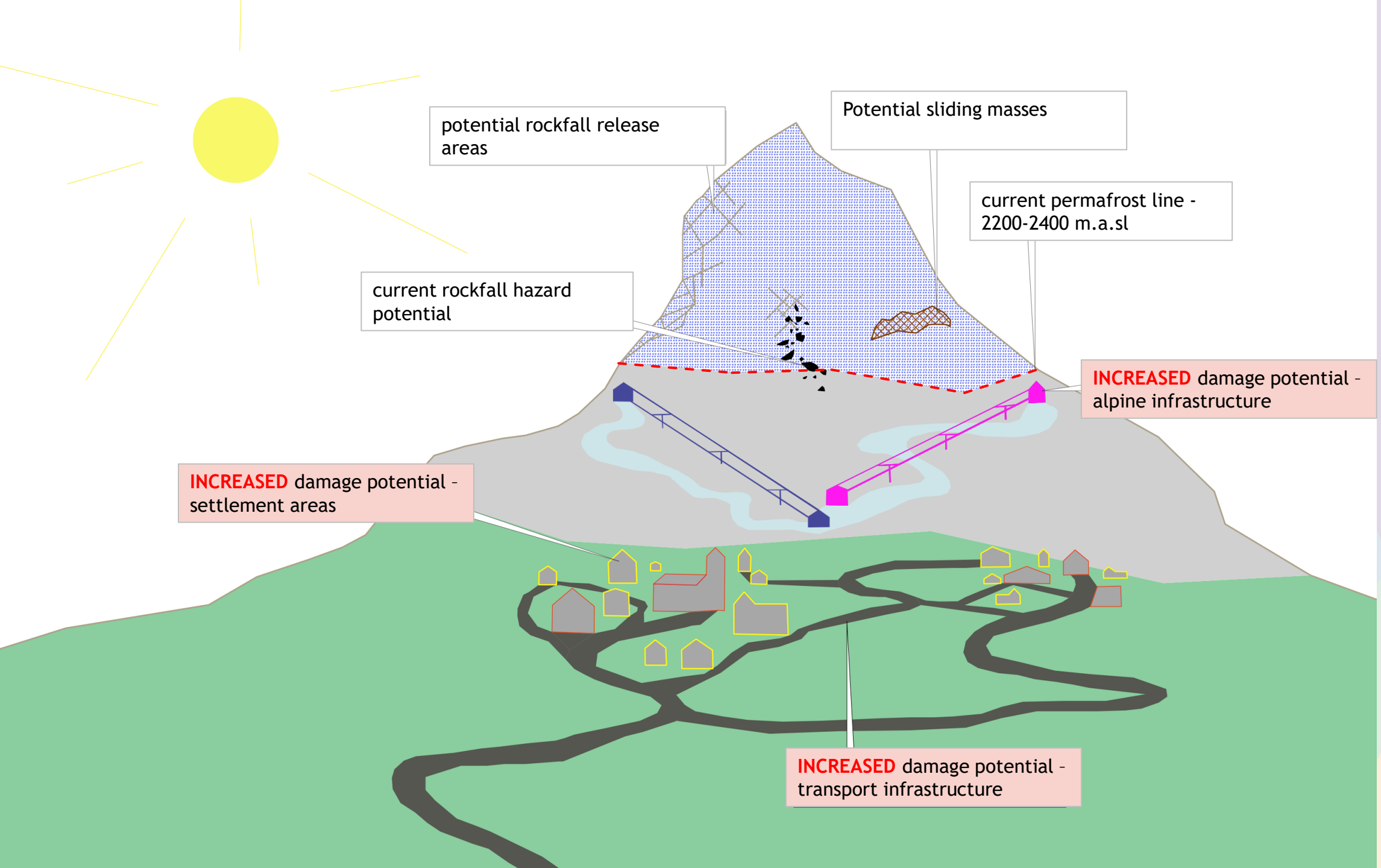
deforestation

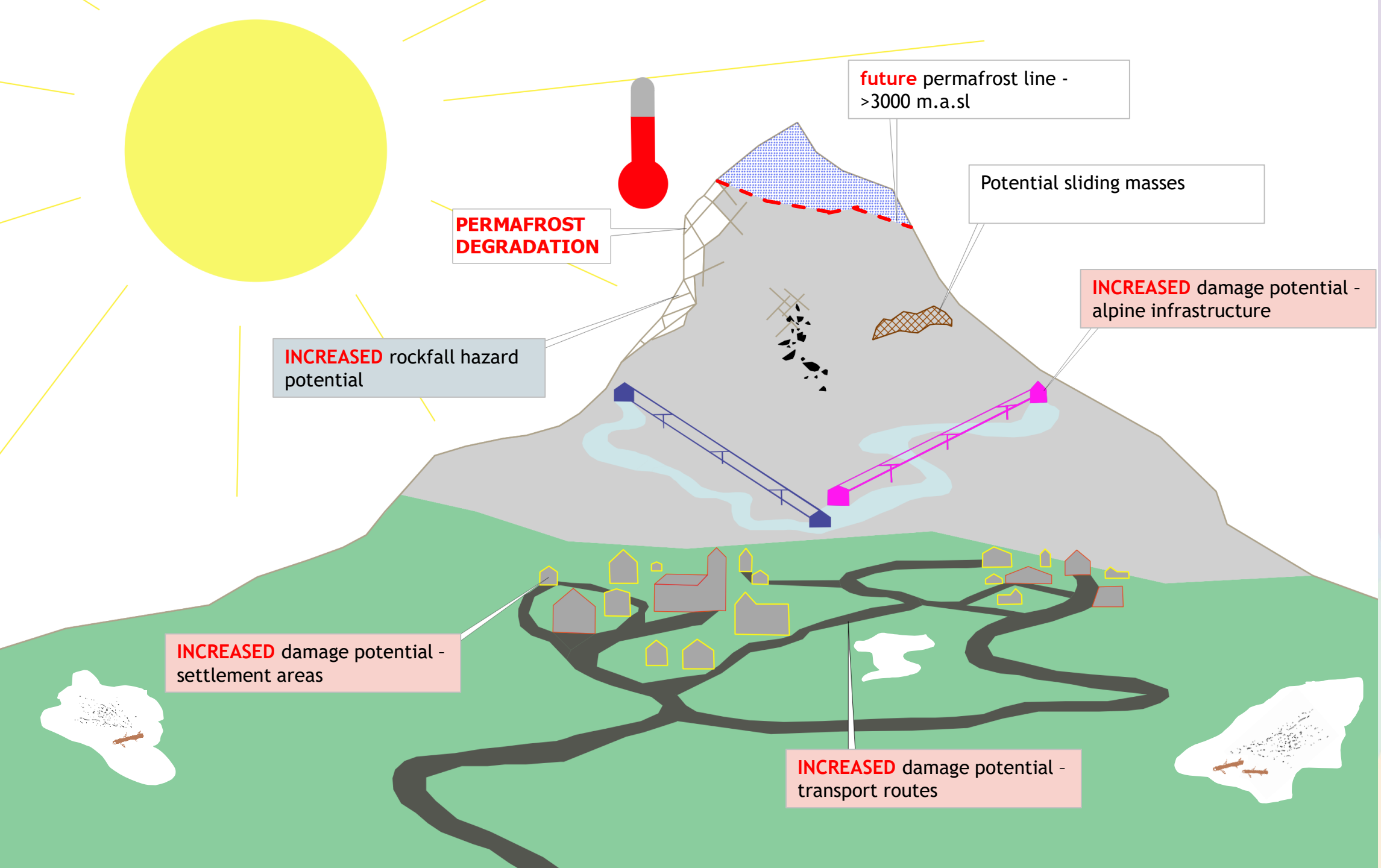


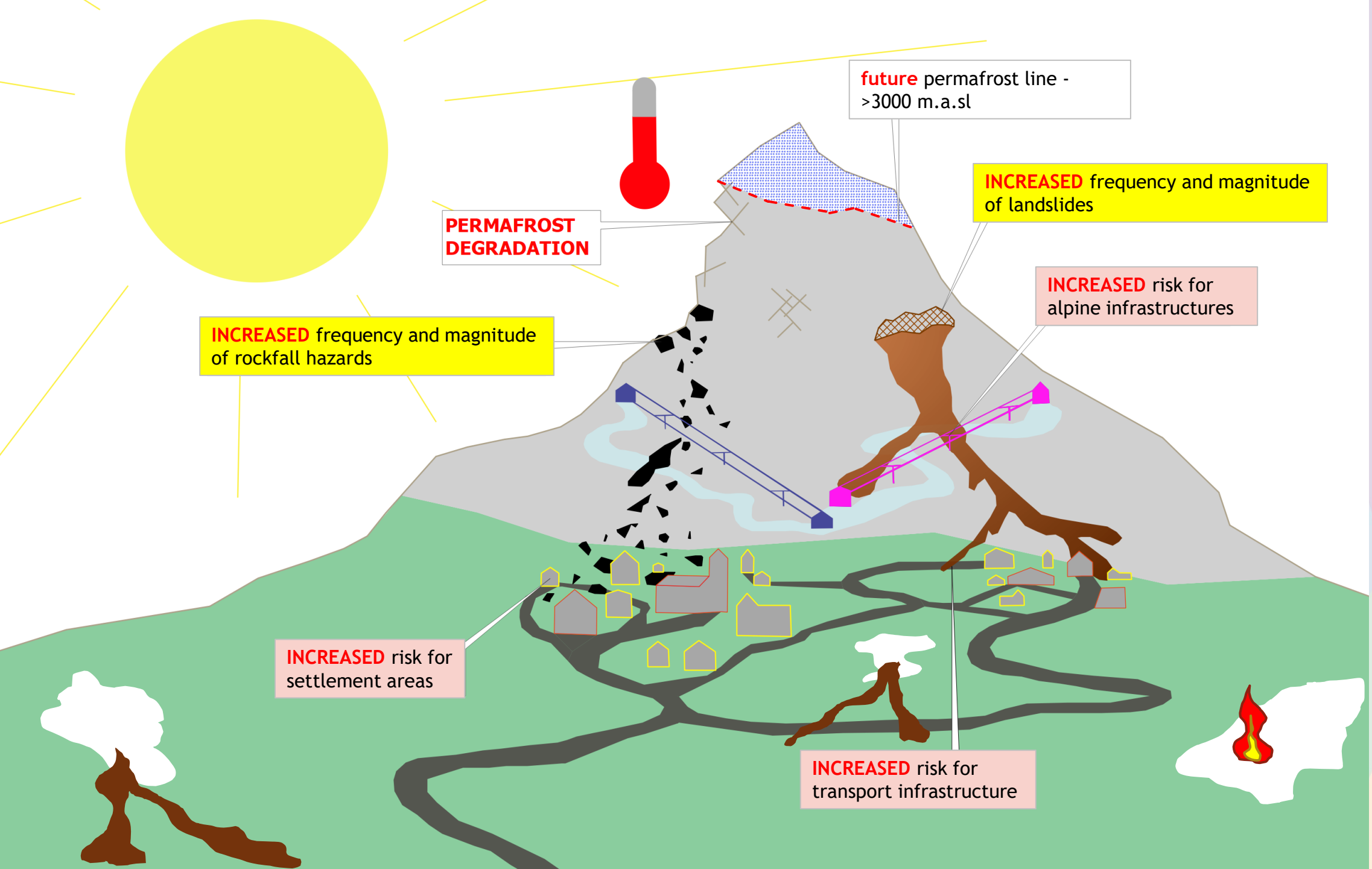
settlement areas below protection forest sites are particularly affected




potential rockfall release areas
Potential sliding masses
current permafrost line - 2200-2400 m.a.sl
current damage potential - alpine infrastructure
current rockfall hazard potential
current damage potential - settlement areas


potential rockfall release areas
Potential sliding masses
current permafrost line - 2200-2400 m.a.sl
current rockfall hazard potential
INCREASED damage potential – alpine infrastructure
INCREASED damage potential – settlement areas
INCREASED damage potential – transport infrastructure


future permafrost line - >3000 m.a.sl
Potential sliding masses
PERMAFROST DEGRADATION
INCREASED damage potential - alpine infrastructure
INCREASED rockfall hazard potential
INCREASED damage potential - settlement areas
INCREASED damage potential - transport routes


future permafrost line - >3000 m.a.sl
PERMAFROST DEGRADATION
INCREASED frequency and magnitude of landslides
INCREASED risk for alpine infrastructures
INCREASED frequency and magnitude of rockfall hazards
INCREASED risk for settlement areas
INCREASED risk for transport infrastructure

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Existing decision making bases for civil protection

- in AUT, for example, responsibilities are very fragmented
- risk management: distinction between local, regional and national levels in terms of planning bases and responsibilities
- in AUT (and other EU countries), municipalities and their bodies have a very central role

- thus, DSS prototypes are primarily addressed to them
- existing planning bases are often unknown
- in Austria, there are no standardised, risk-based planning principles, but there are regional e. g. spatial mappings of hazard processes and the elements of damage potential

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There is a number of existing planning bases which, however, do not take into account climate change and its impacts!

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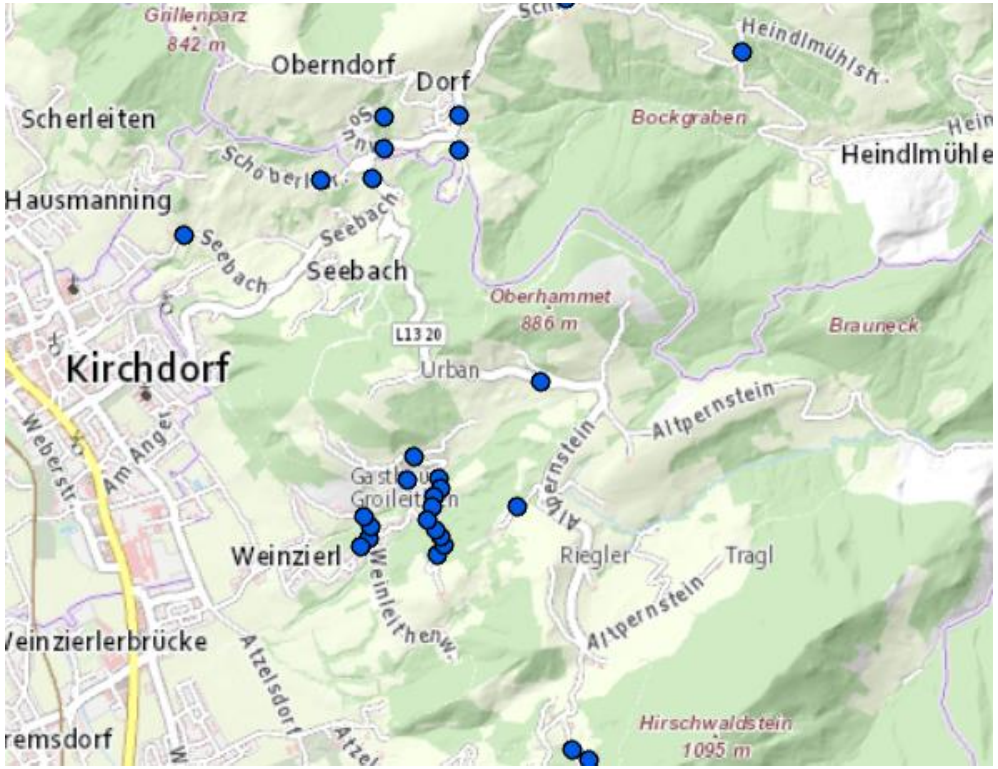
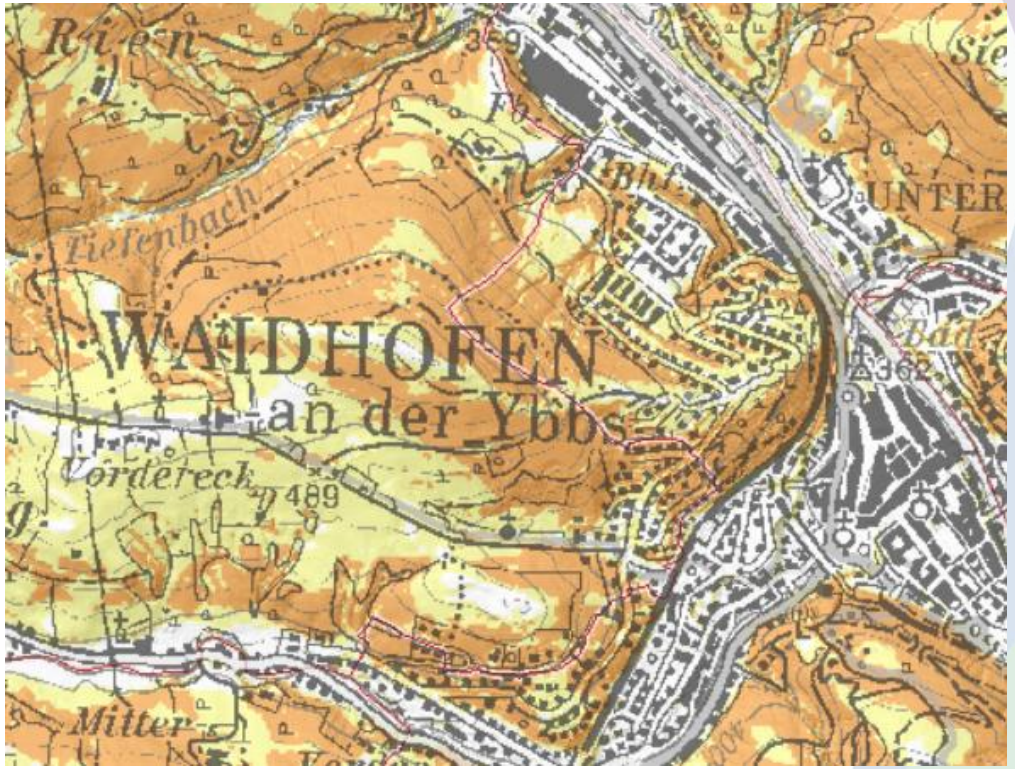
Some examples of existing bases (not areawide!)



event cadastres (© DORIS)



hazard information map (Land NÖ)

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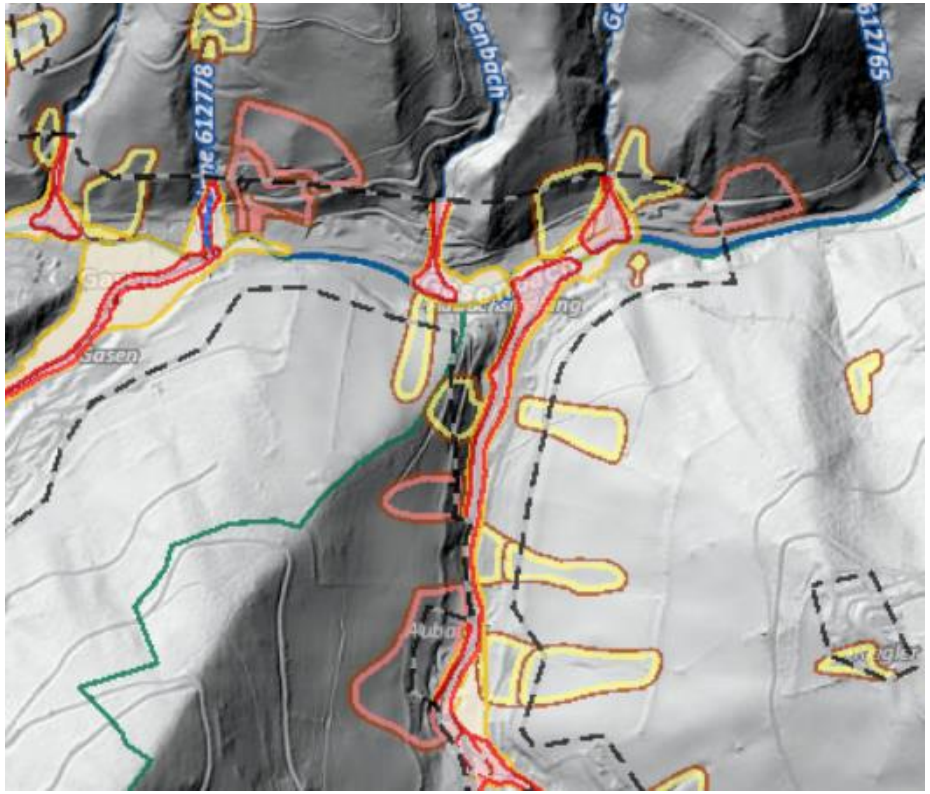
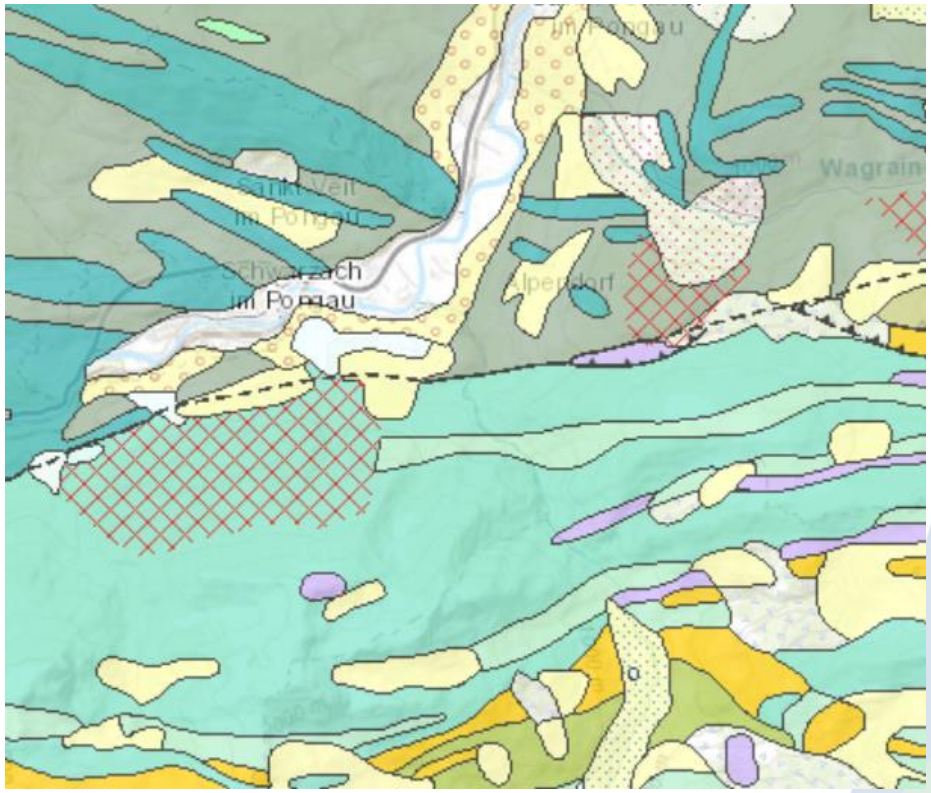
Some examples of existing bases (not areawide!)



danger zone plans (© WLV)

(barely for rockfall and landslides)



geological maps (© GBA)

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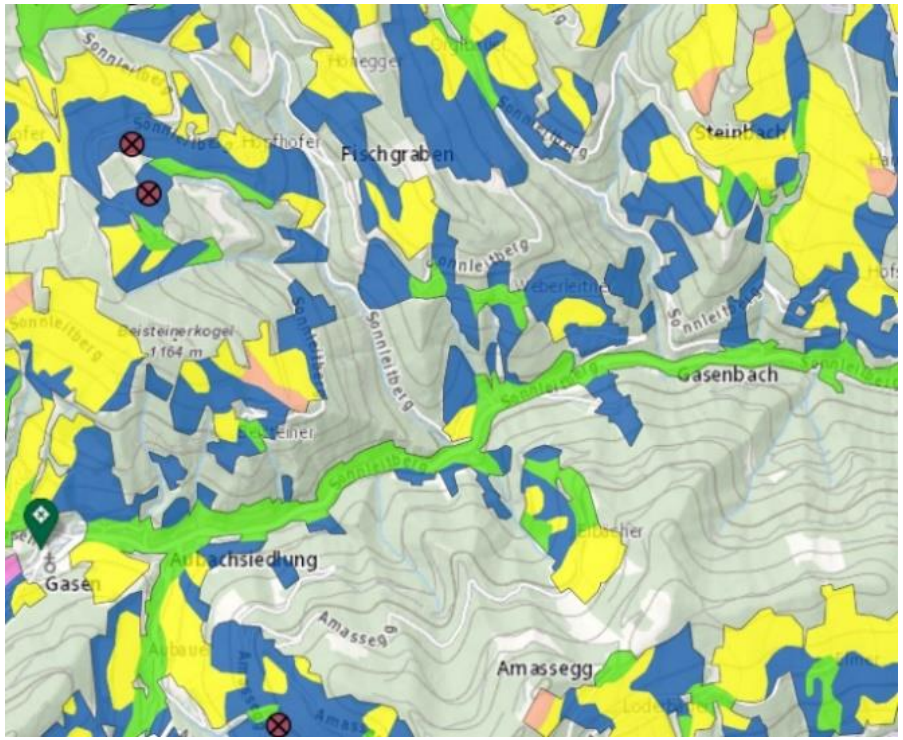
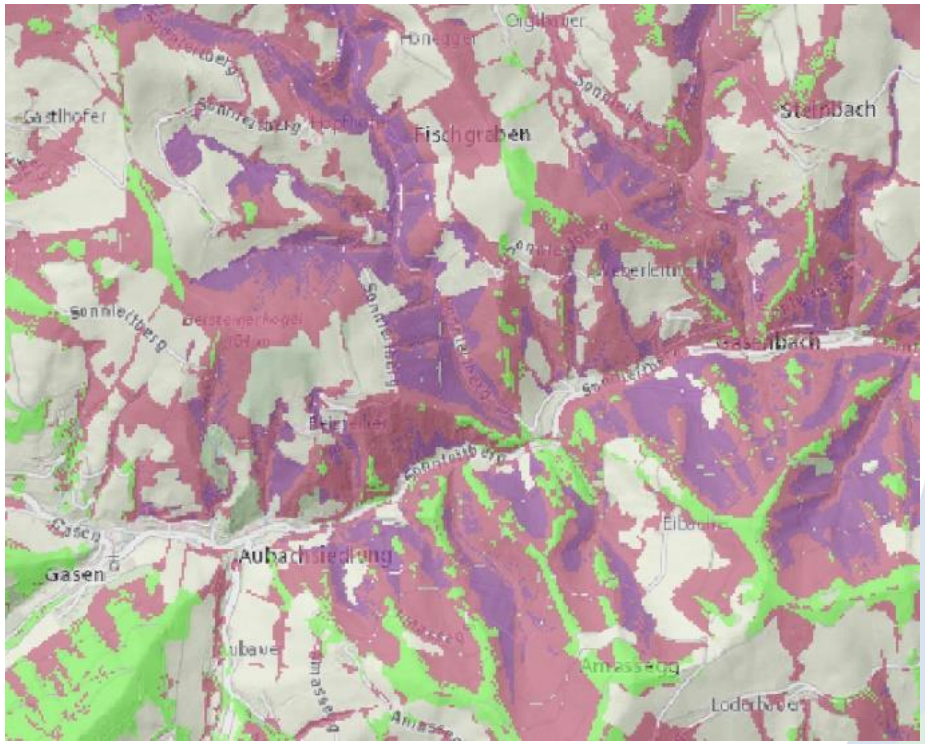
Some examples of existing bases (not areawide!)



soil maps (© BFW)



forest maps (© Amt d. Steiermärkischen Landesregierung)

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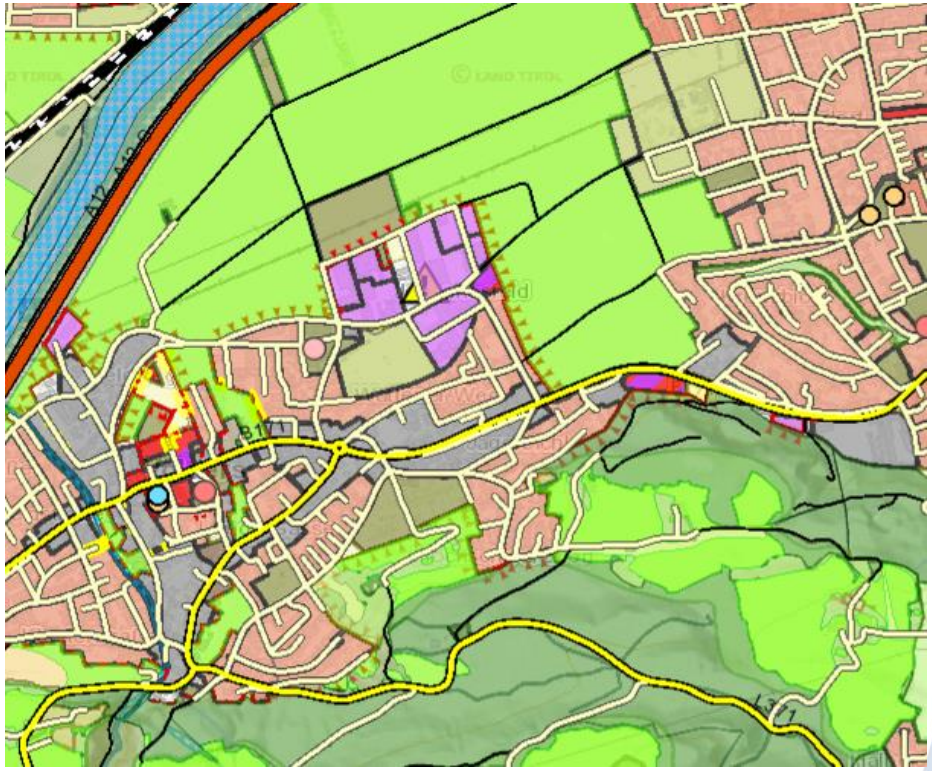
Some examples of existing bases (areawide)

infrastructure maps (© Land Tirol - TIRIS)



land use plans (© Land Tirol - TIRIS)

(© Land Tirol - TIRIS)

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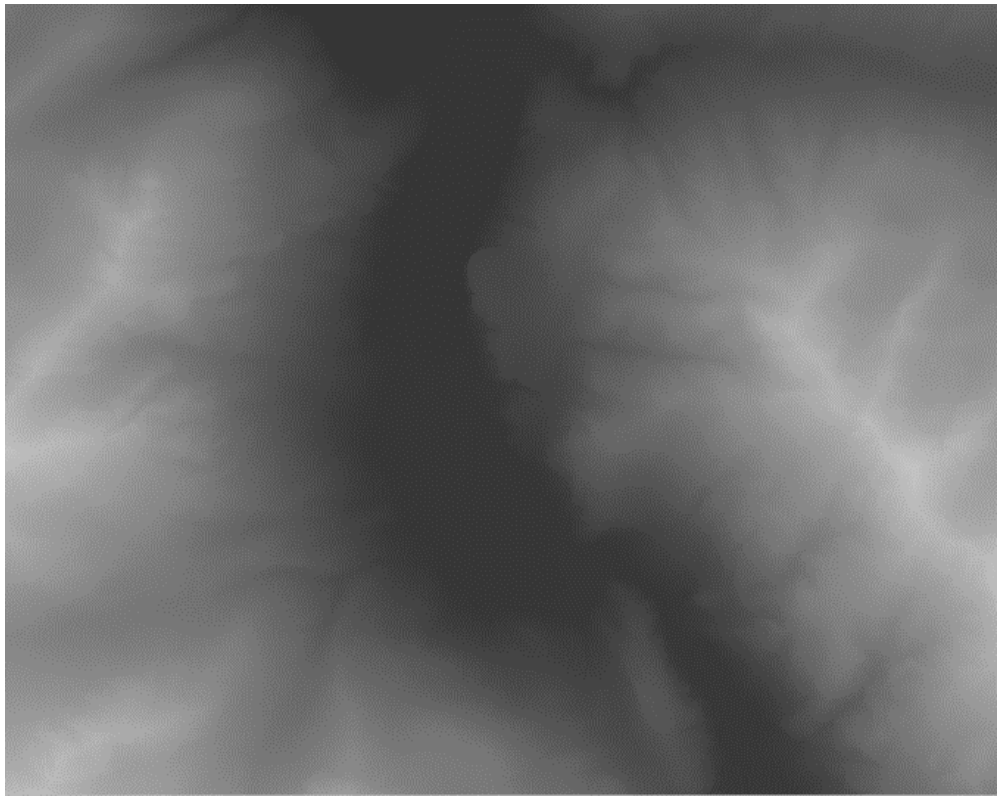
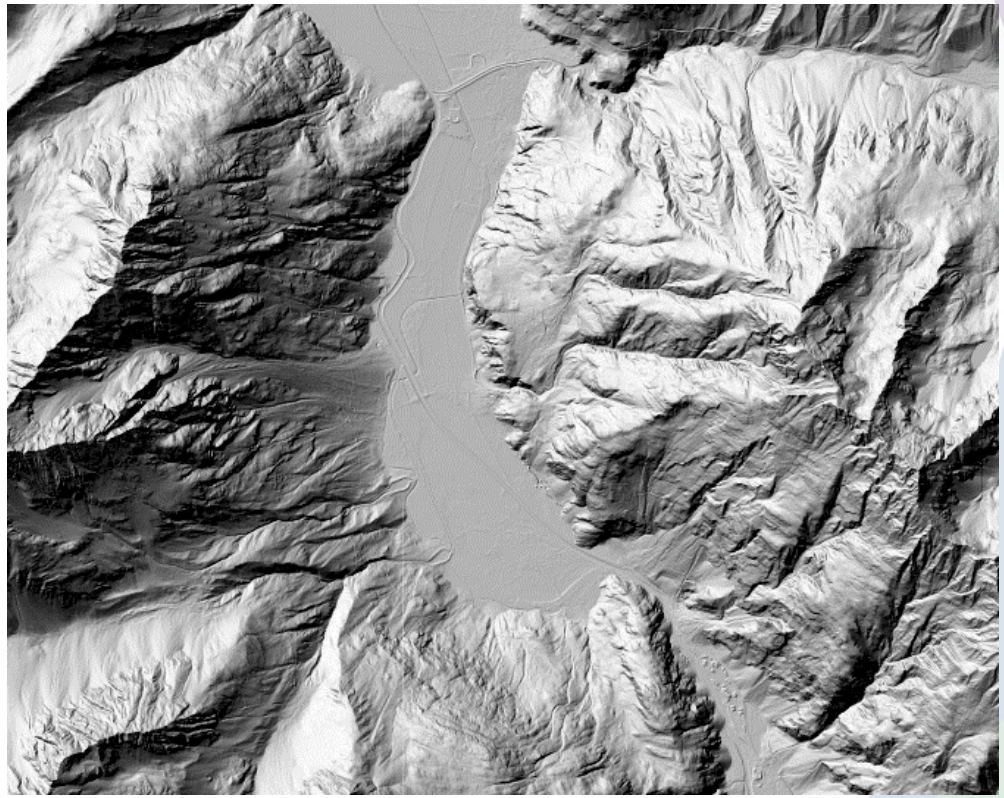
Some examples of existing bases (areawide)



DEM (© Land Tirol)



HS (© Land Tirol)

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Current opportunities

- free download of most data
- intersection of “hazard information maps” and maps of infrastructures for identification of potential “danger hotspots”
- but: spatial planning and hazard zone planning do not yet take into account the impacts of climate change and the associated intensification of natural hazards

- **STATIC approach**

…. for modern risk management and civil protection - considering climate change - there is an urgent need of …

- **DYNAMIC approach**

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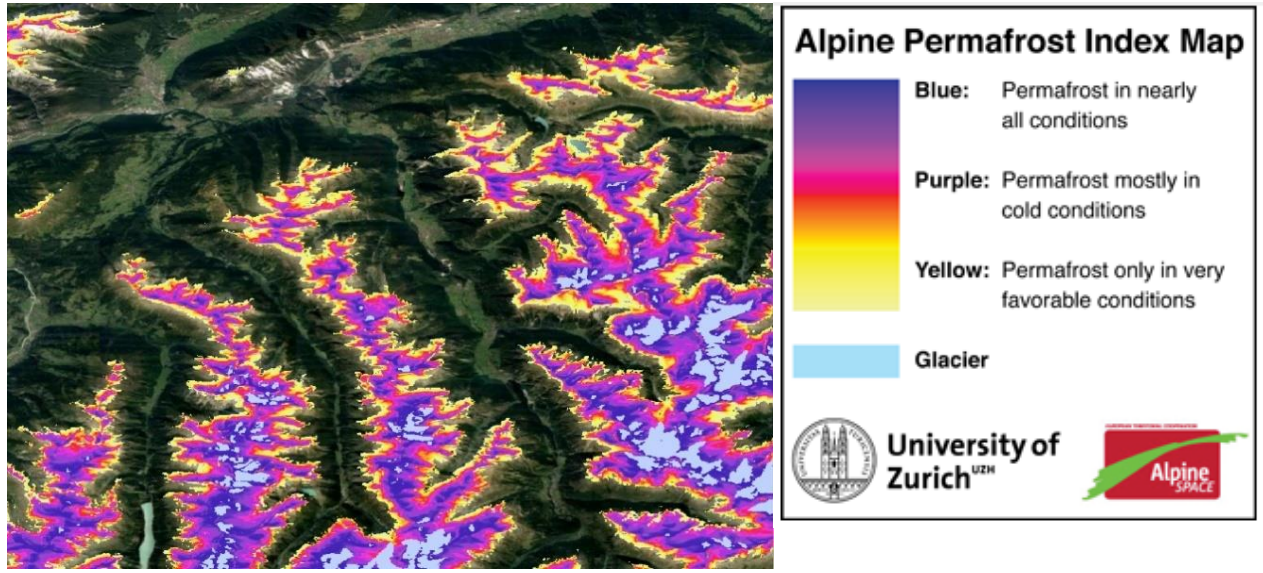
New applications / combination methods

Based on direct consequences of climate change (temperature rise)….

→ consideration → implementation → application of rockfall and landslides relevant:

„Alpine Permafrost Index Map“



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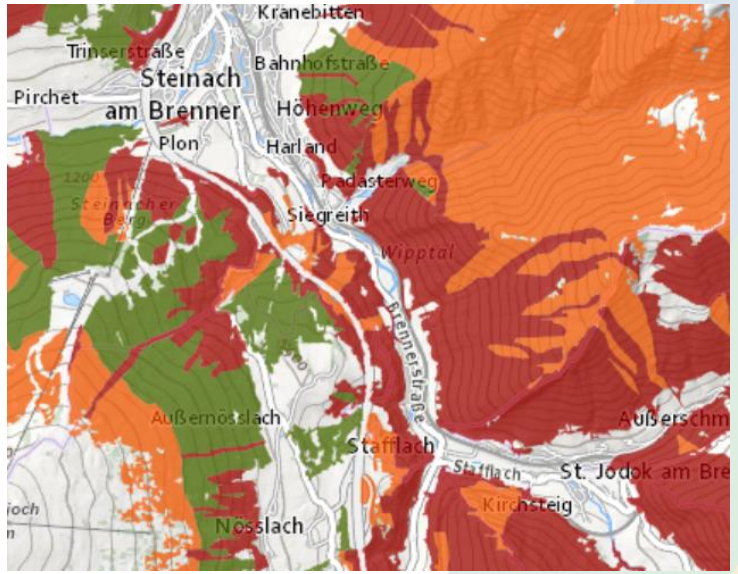
Maps of specific silvicultural information



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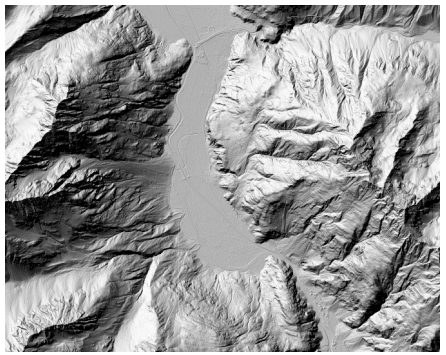
Illustrative example: (considering climate change impacts)

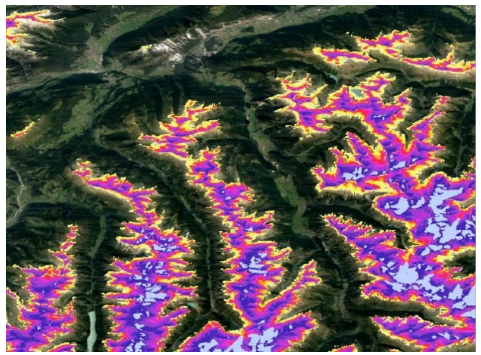
Existing data

DTM



layer of infrastructure

cc influenced layers (APIM)



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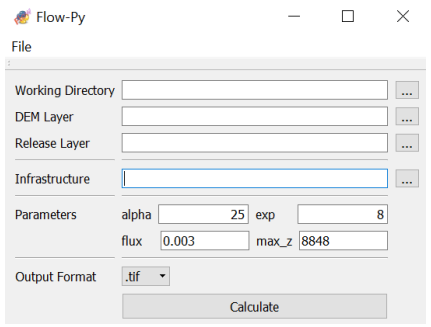
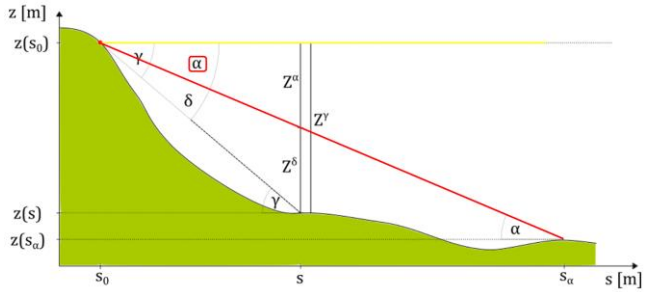
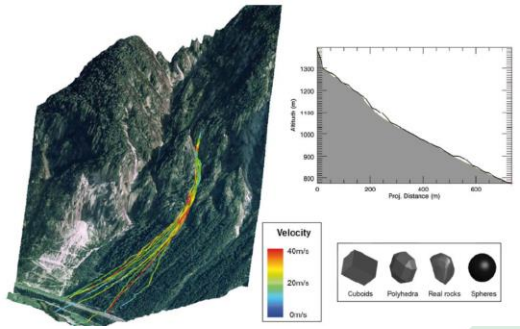
Existing tools:

models & simulation software







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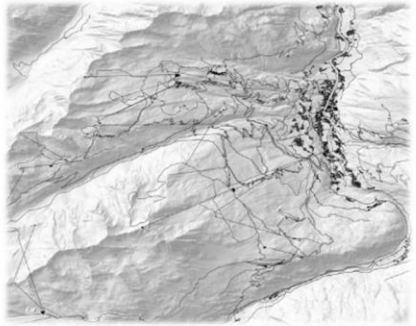
Illustrative example: (considering climate change impacts)

layer of infrastructure



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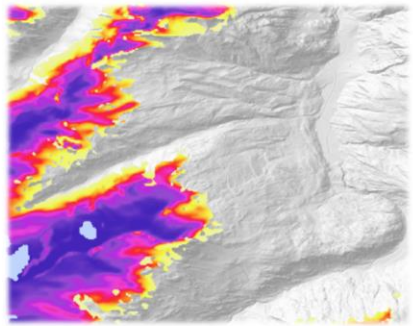
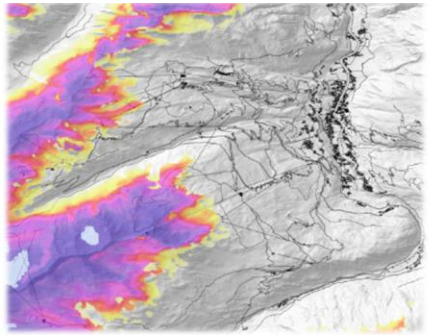
layer of climate change influenced permafrost



intersection of infrastructure & permafrost



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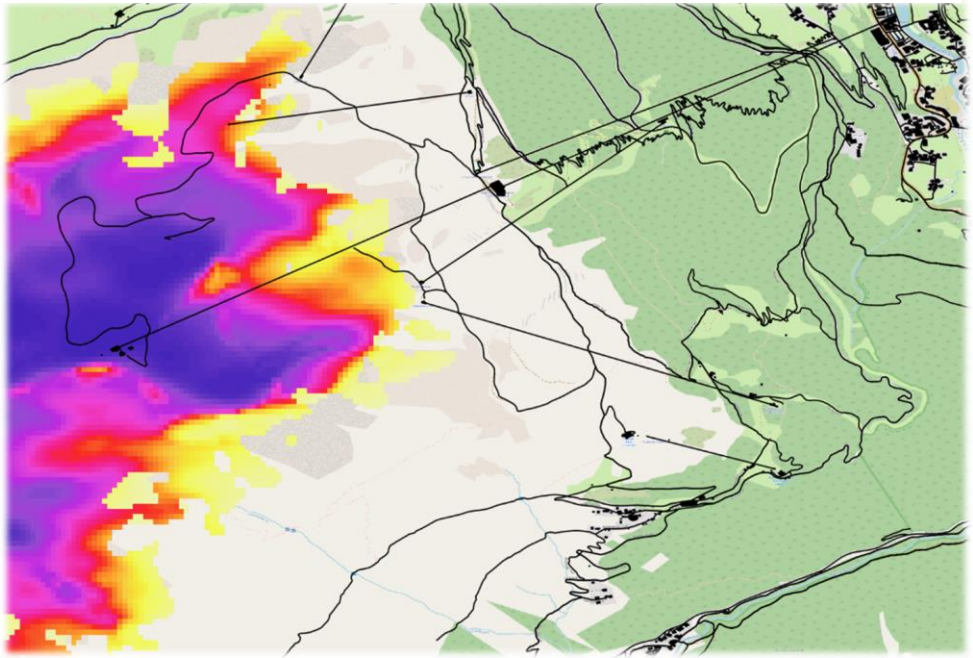
Illustrative example: (considering climate change impacts)

intersection of infrastructure & permafrost



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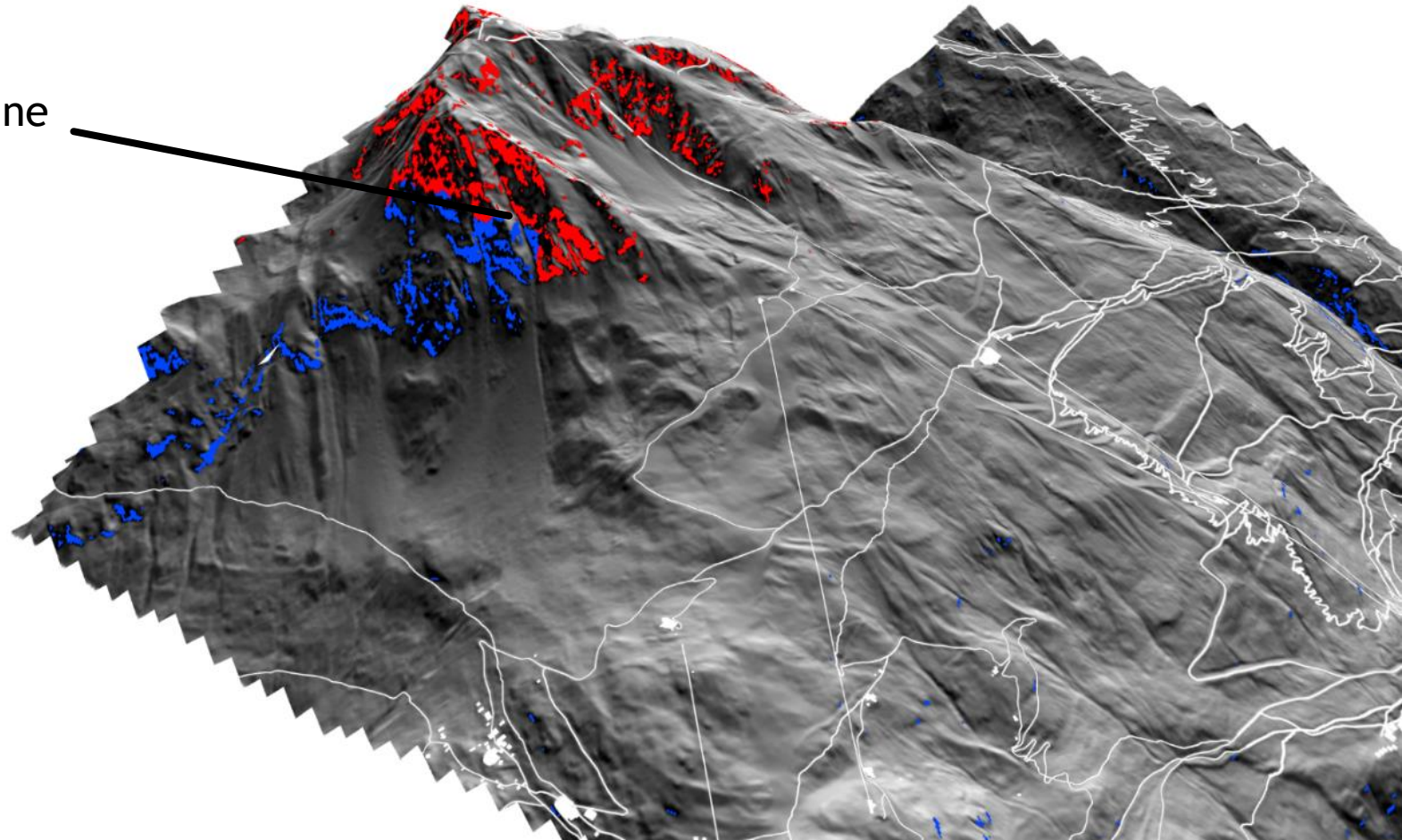
Illustrative example: rockfall release areas with / without permafrost degradation

red: rockfall release areas with further permafrost degradation

current permafrost line

blue: rockfall release areas without further permafrost degradation



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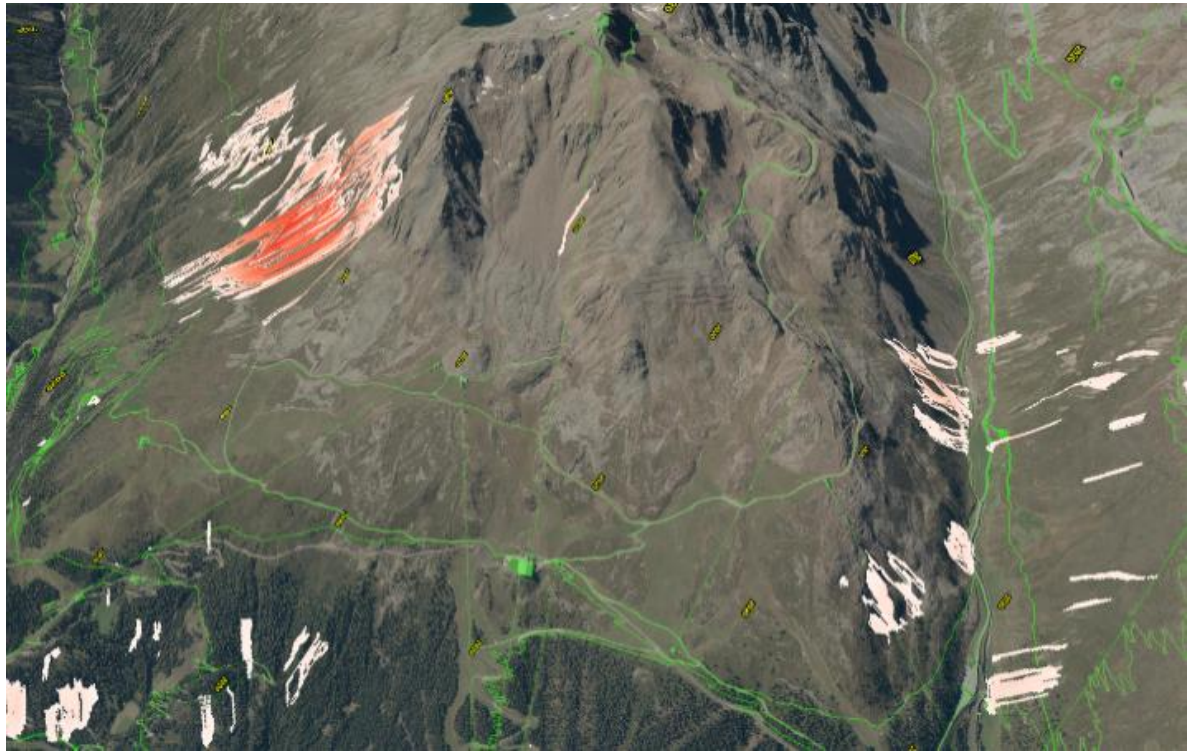
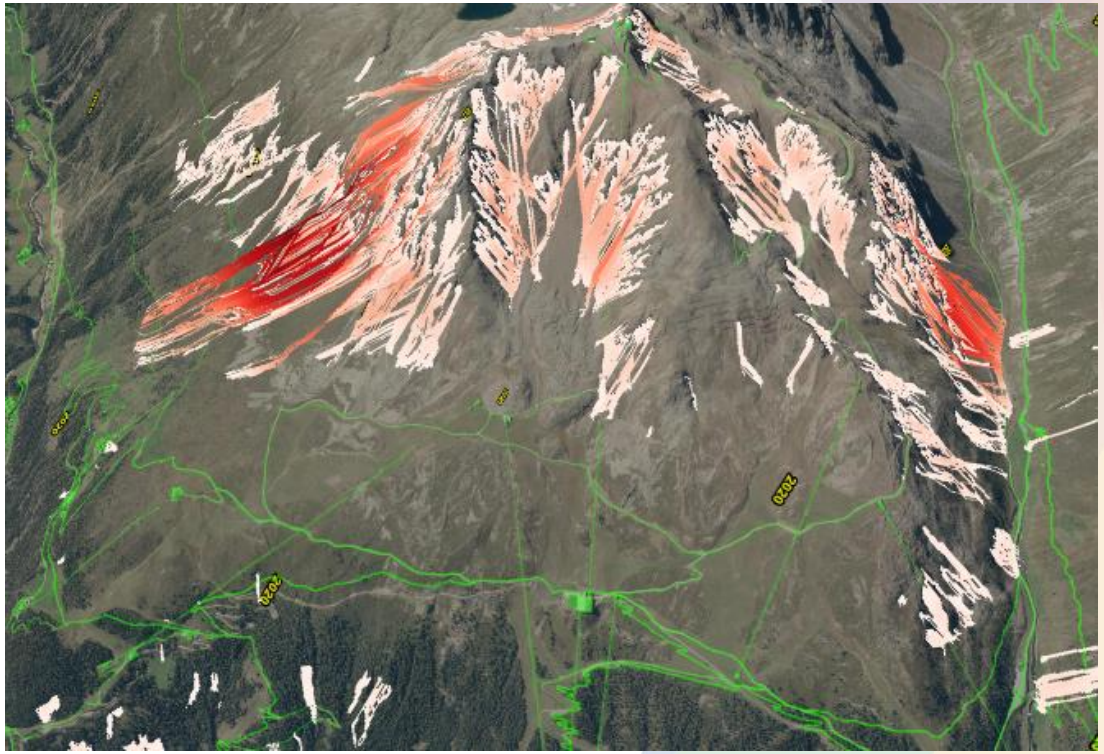
Illustrative example: rockfall simulation with / without permafrost degradation

pre climate change rockfall scenery



post climate change rockfall scenery



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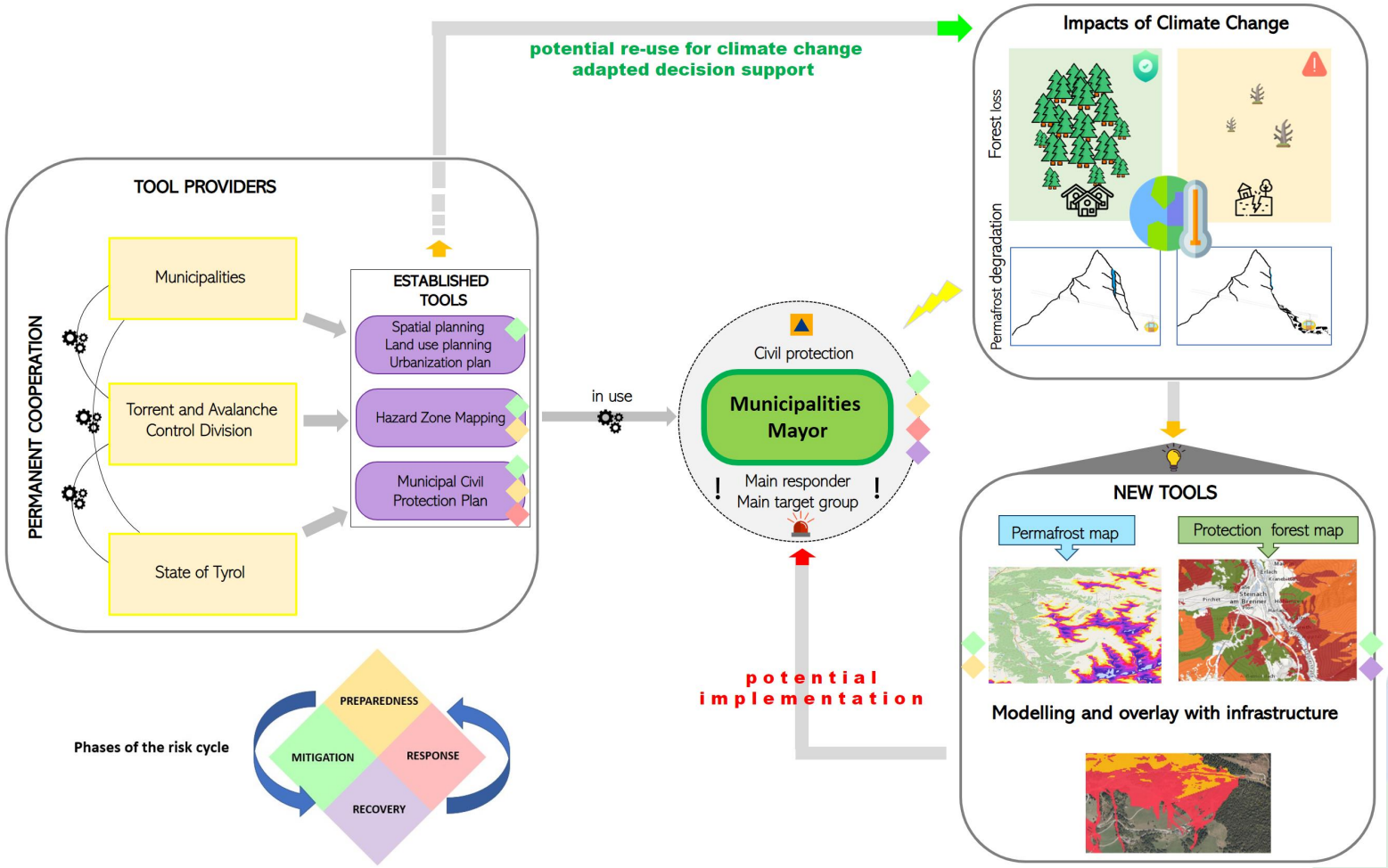
How does a sketch of the DSS prototype look like?



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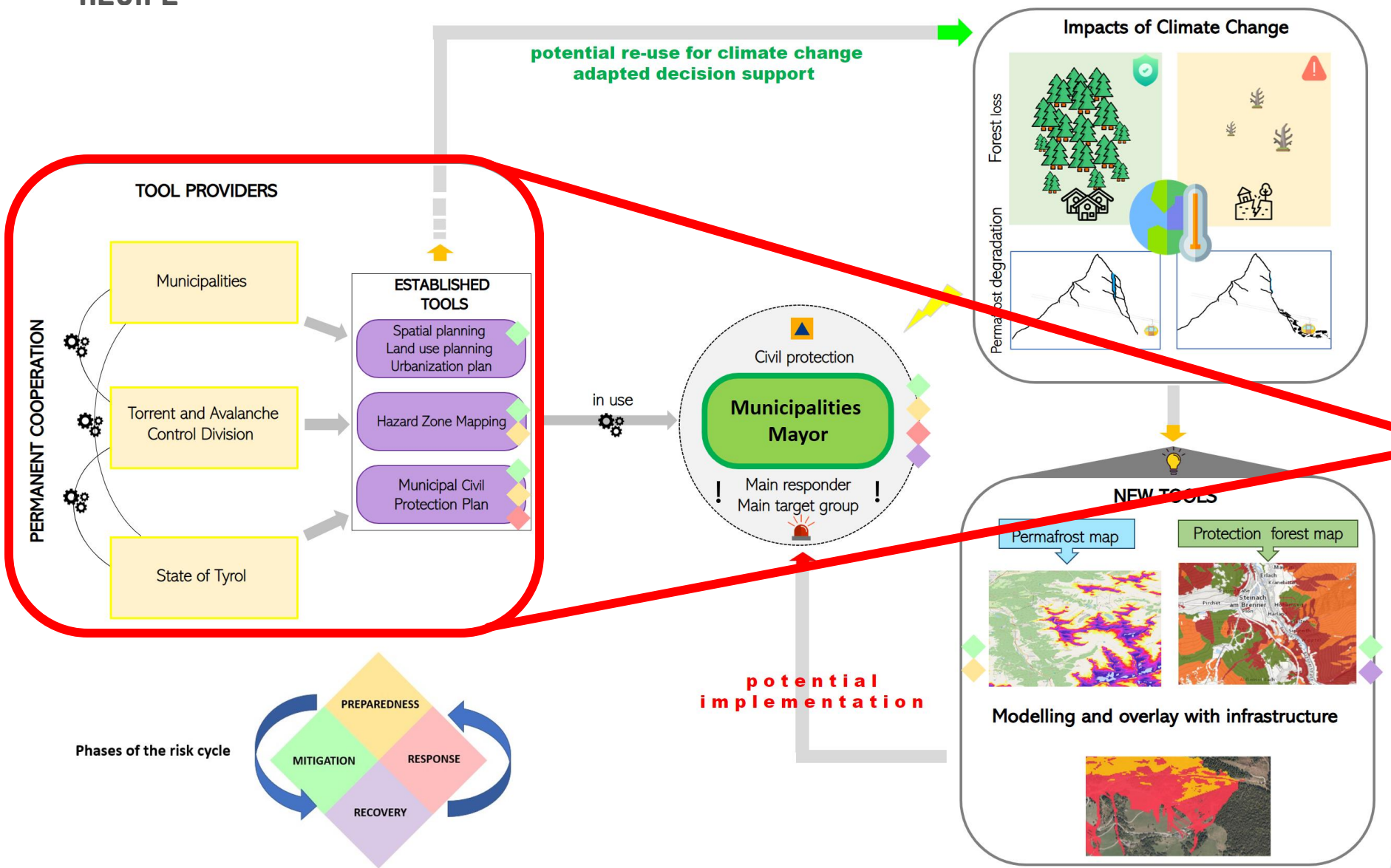

identified providers of existing tools / potential receivers of new DSS

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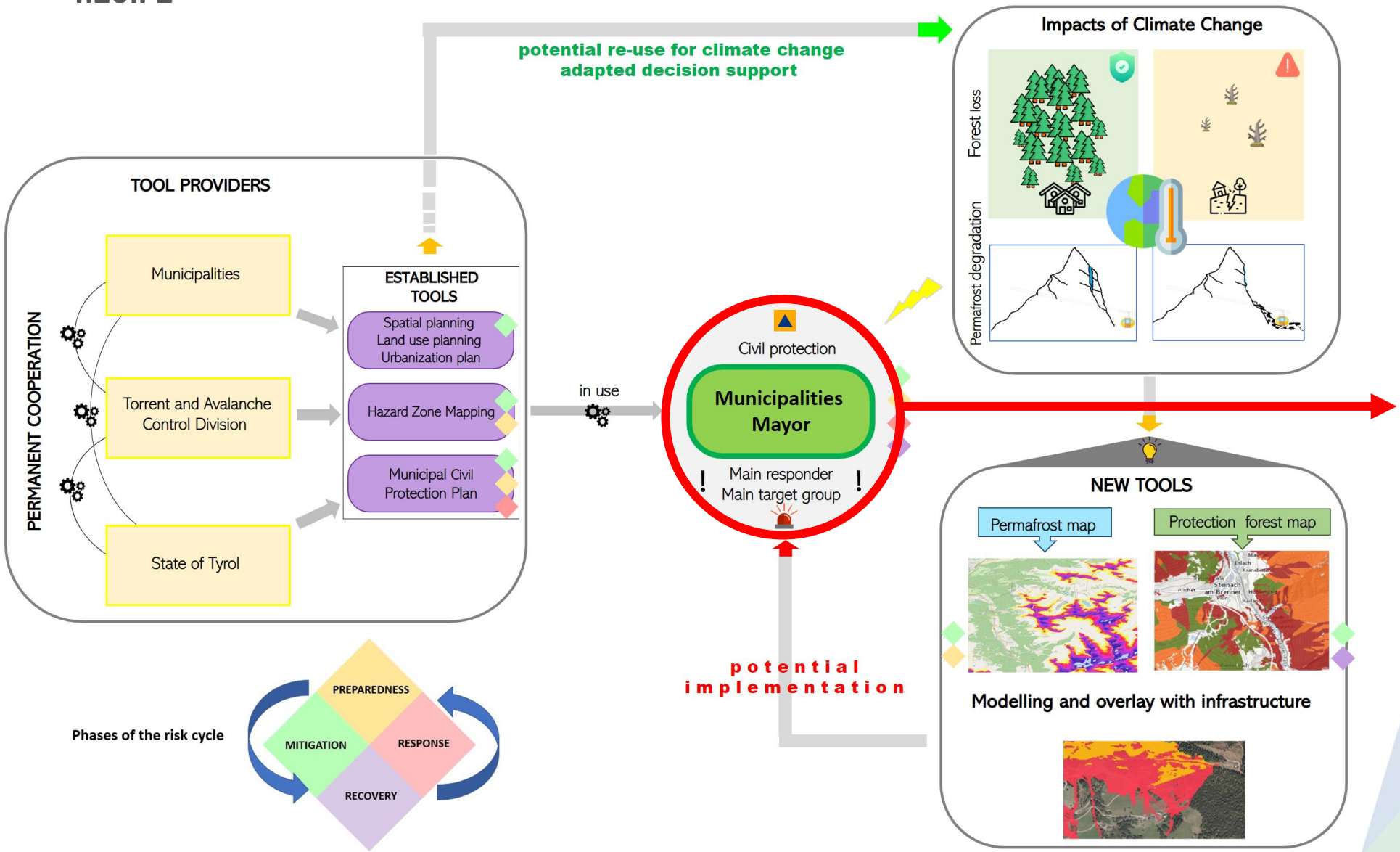

identified main responsible & potential receivers of new DSS

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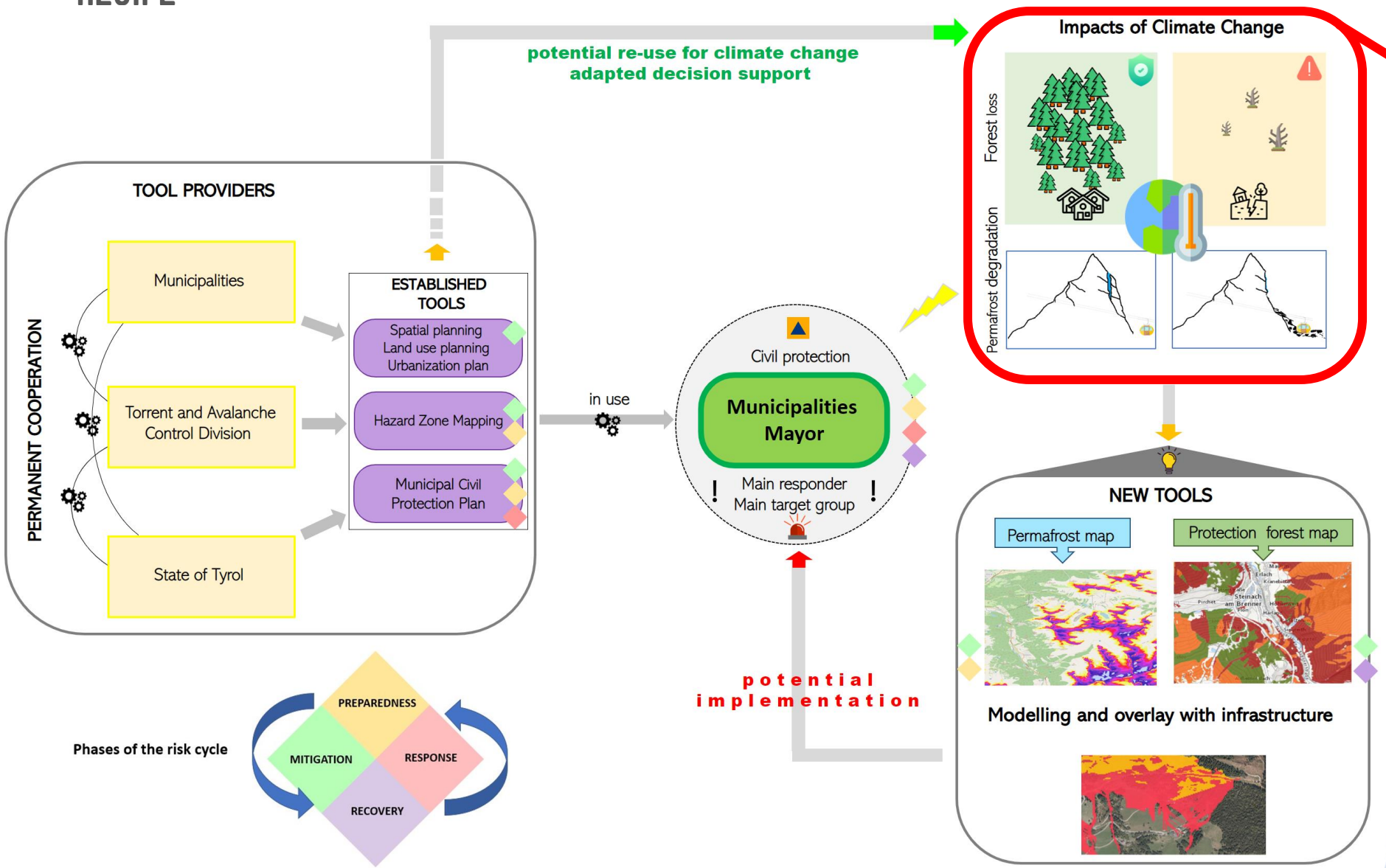

identified climate change induced changes of environment (permafrost degradation & deforestation)

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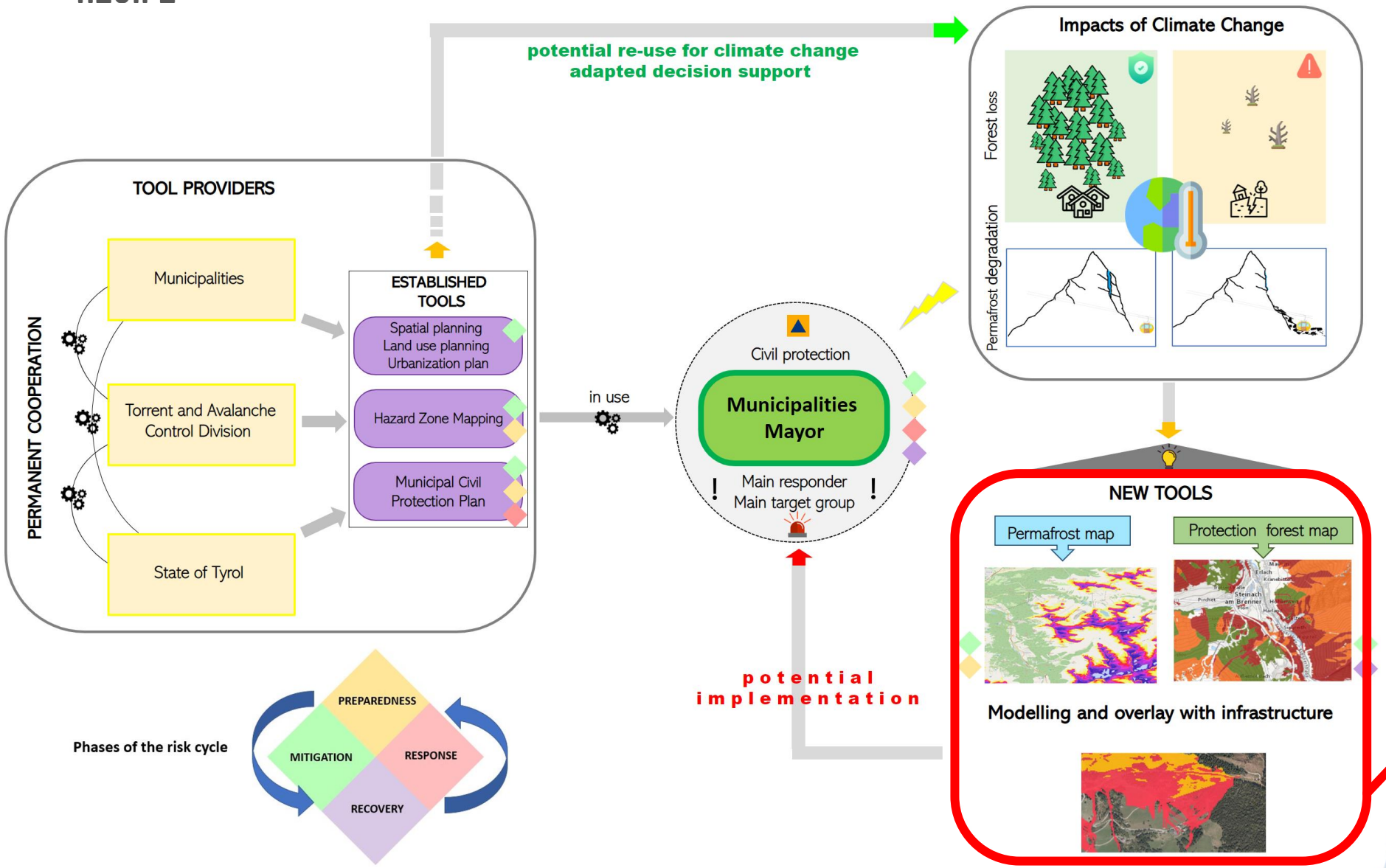

application of existing knowledge, development of new tool combinations

RECIPE

REINFORCING CIVIL PROTECTION CAPABILITIES INTO MULTI-HAZARD RISK ASSESSMENT UNDER CLIMATE CHANGE

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Thanks for your attention

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