

Determining archaeological potential in high altitude passes and trails in the Pennine Alps

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9th SWISS
GEOSCIENCE
MEETING
2011 ZURICH

Introduction

- Main goals
 - To understand, from a historical perspective, how people travelled through the Alps
 - Want to find the 'best' sites for the conservation of historic artefacts and archaeological material in high altitude locations
 - Create an Archaeological Potential Model using GIS tools
- Purpose
 - To protect and conserve precious artefacts that can act as indicators of pre-historic or historic climate and culture
- Research Directions
 - Historical perspective – archival text analysis
 - Geographic perspective – GIS approach

SNF Project Collaborators

University of Fribourg: Geography

- Claude Collet - Geomatics
- Reynald Delaloye - Geomorphology
- Martin Hoelzle - Glaciology
- Matthias Huss - Glaciology
- Ralph Lugon - Project Manager
- Stephanie Rogers - Geomatics (PhD student)

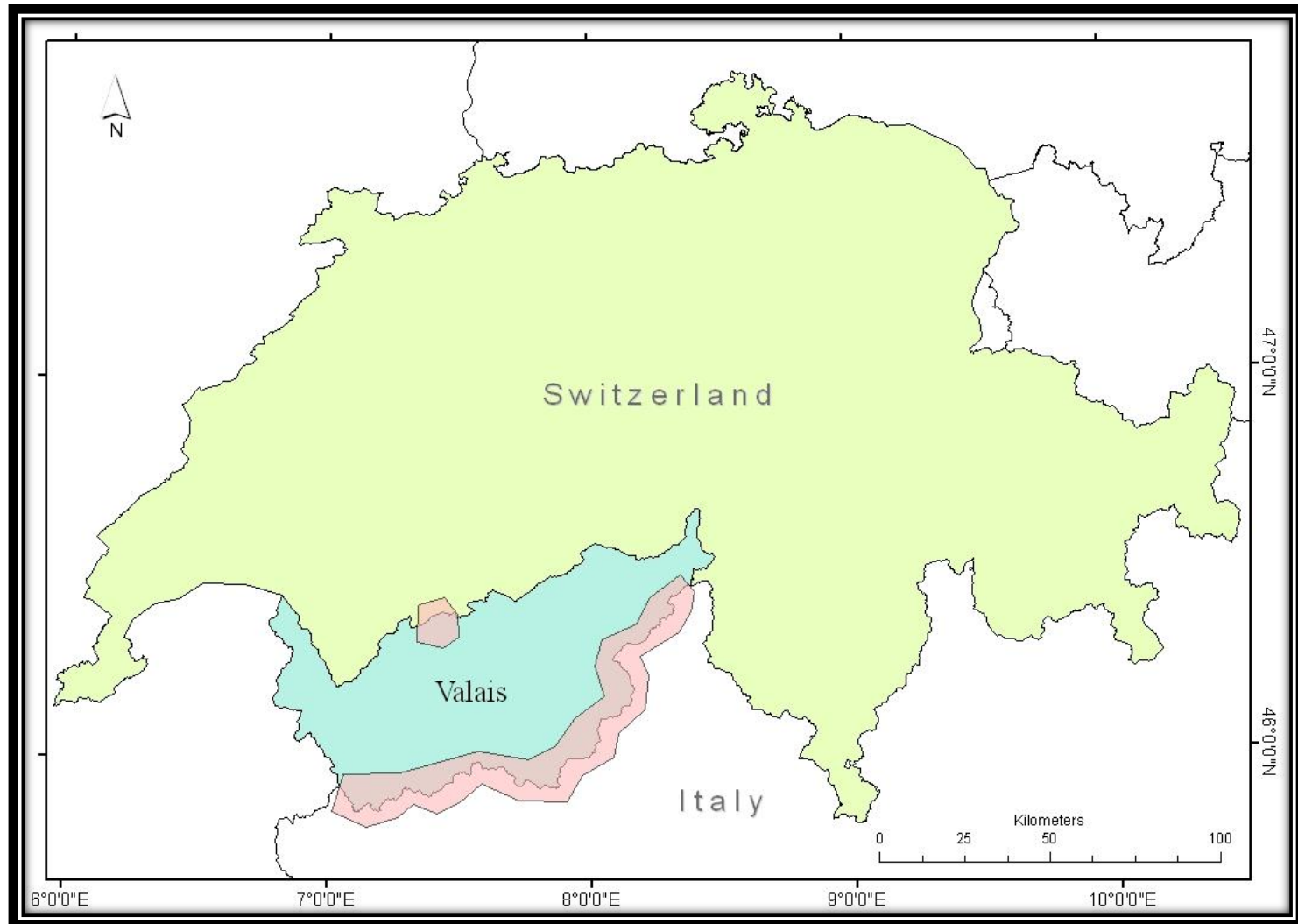
University of Lausanne: History

- Pierre Dubuis
- Muriel Eschmann-Richon

Canton of Valais: Archaeology

- Philippe Curdy
- François Wibl 

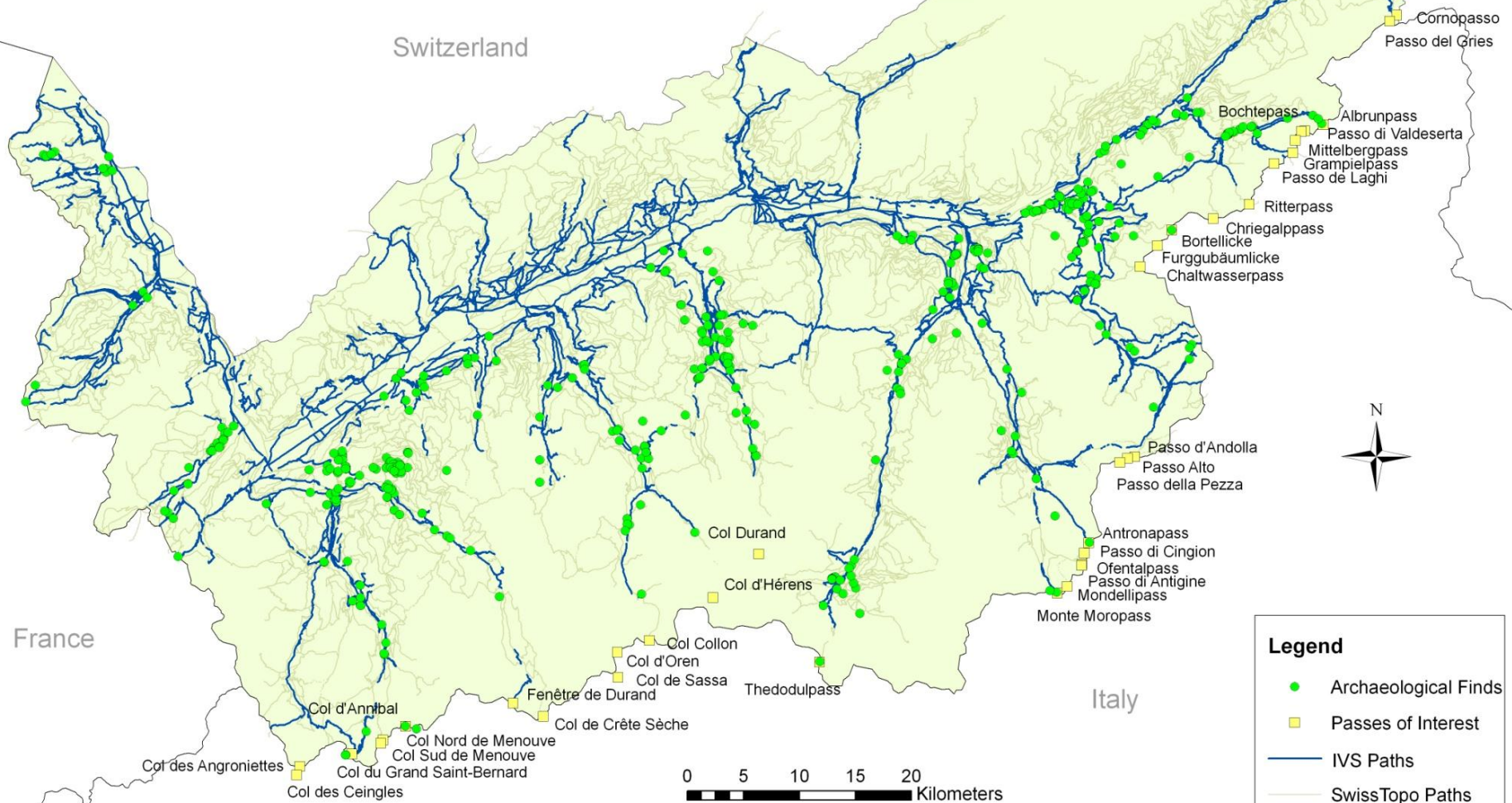
Study area



Historical Perspective

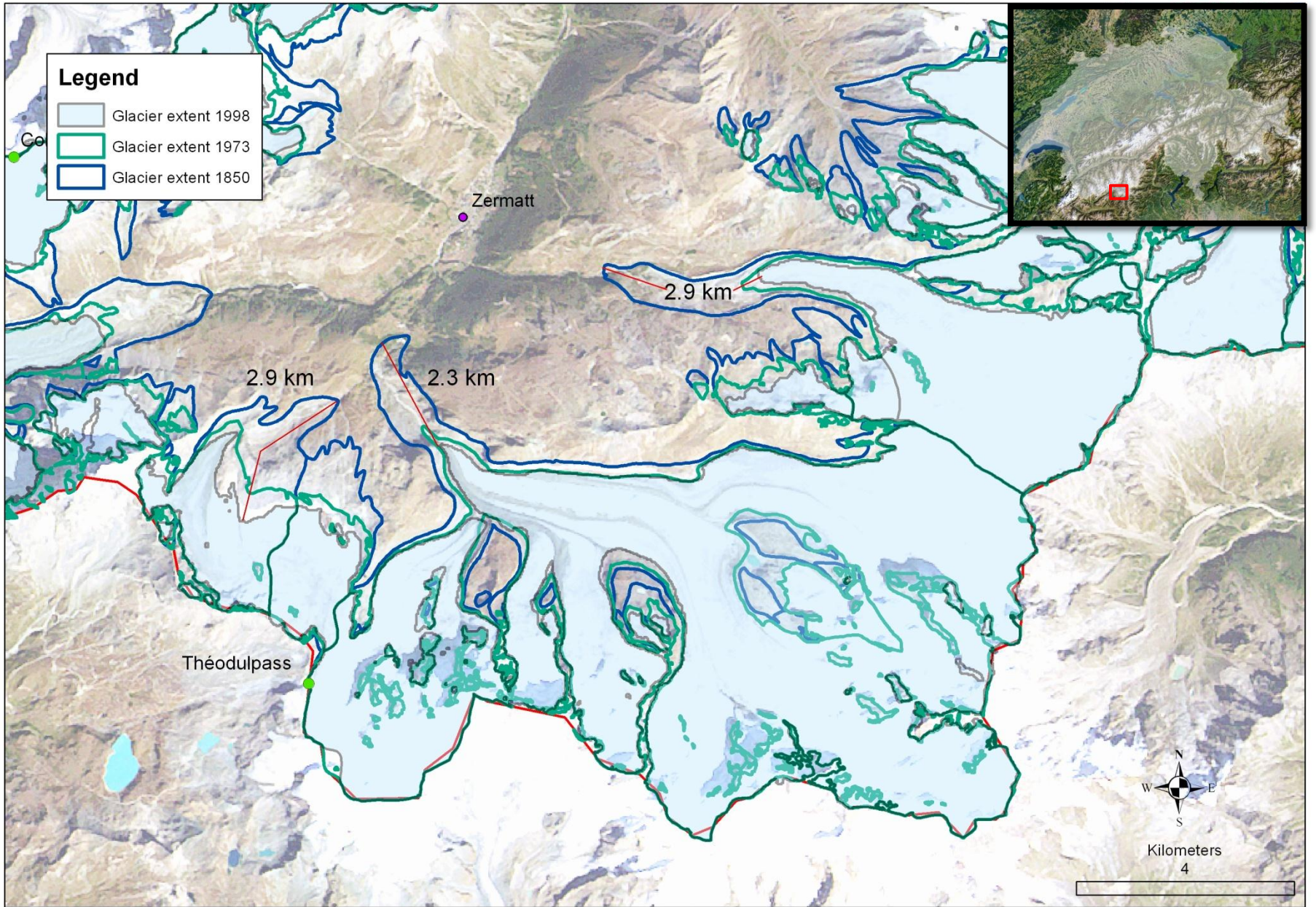
- High altitude passes used as trade and travel routes for thousands of years
- Alpine areas were first thought to be marginal and uninhabitable by humans
- Recent archaeological findings have proven these areas have been used intensively in the past

Archaeological Finds and Potential Passes of Interest in the Pennine Alps



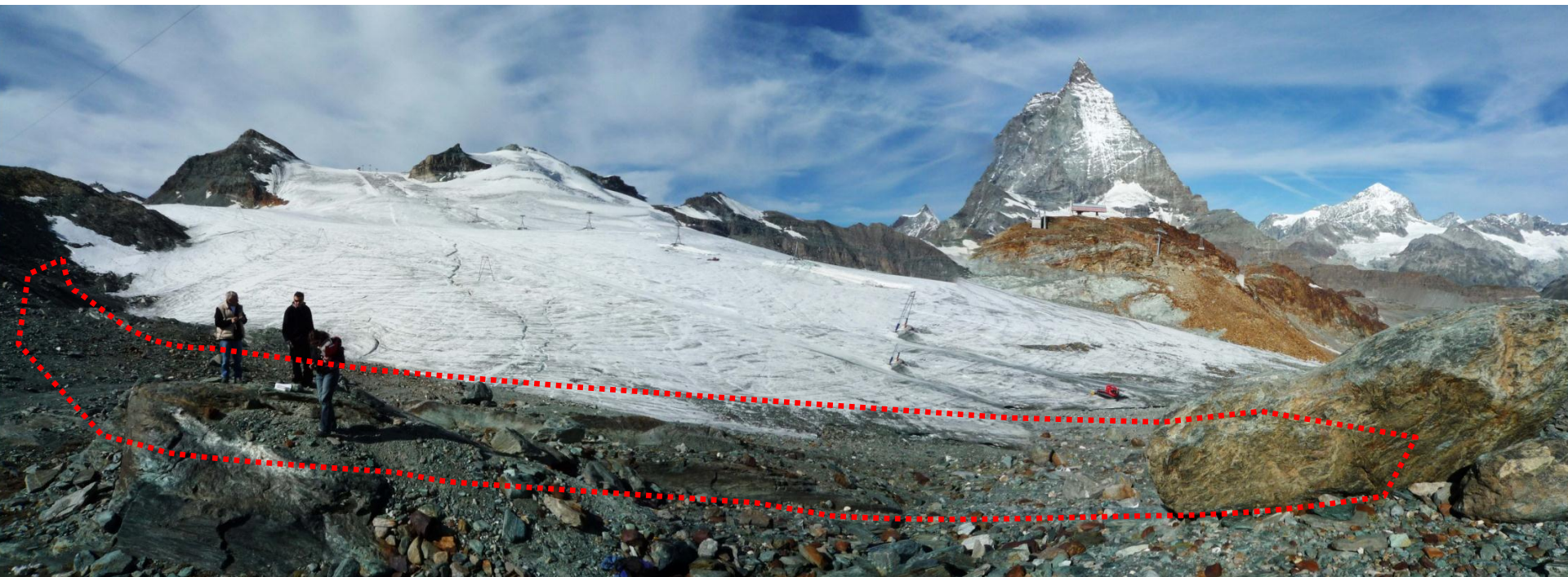
Geographic Perspective

- Current warming period is causing glaciers to retreat
- Glaciers have been thinning and retreating since the mid-19th century
 - Switzerland's have declined a third in volume since 1860 (Krajick, 2002)



Glacial archaeology

- There have been many examples of relics found in high altitude environments all over the world
 - Including the Théodulpas between Switzerland and Italy



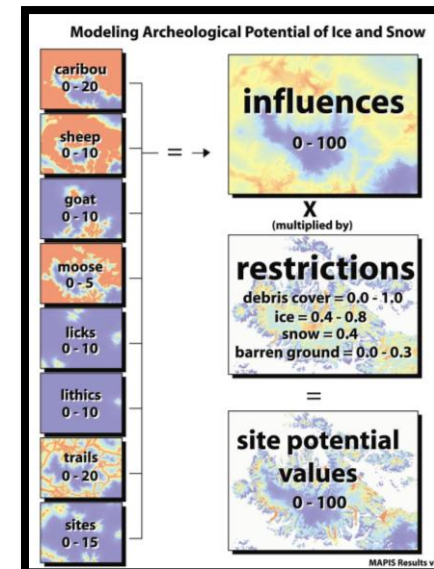
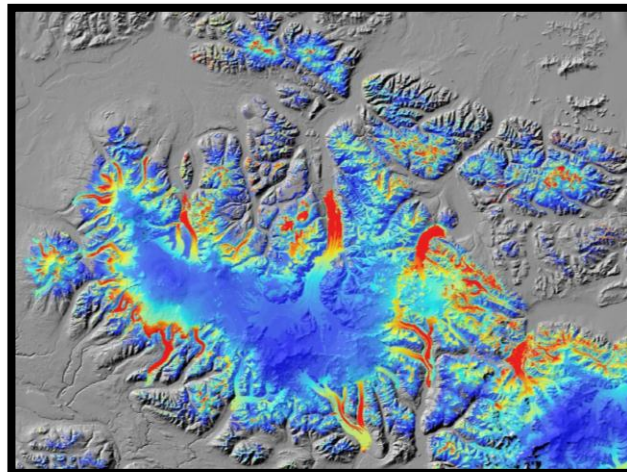
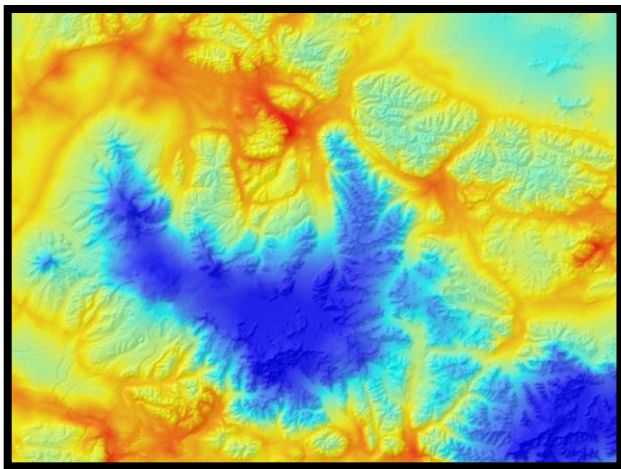
Mountainous Archaeological Findings

- Ötzi the 'Iceman'
 - Italian/Austrian border, 1991
 - Approx. 5,300 years old



Previous Research in Modelling Alpine Archaeology

- Dixon et al, 2005
 - Used a GIS based model 'MAPIS' (Modelling Archaeological Potential of Ice and Snow)
 - Combined biologic, geologic and cultural datasets
 - Alaska's Wrangell-St. Elias National Park and Preserve



Theory for an Archaeological Potential Model in the Pennine Alps

- Develop a method to predict sites with highest probability of archaeological remains
 - Based on:
 - Past archaeological find locations and historic trails

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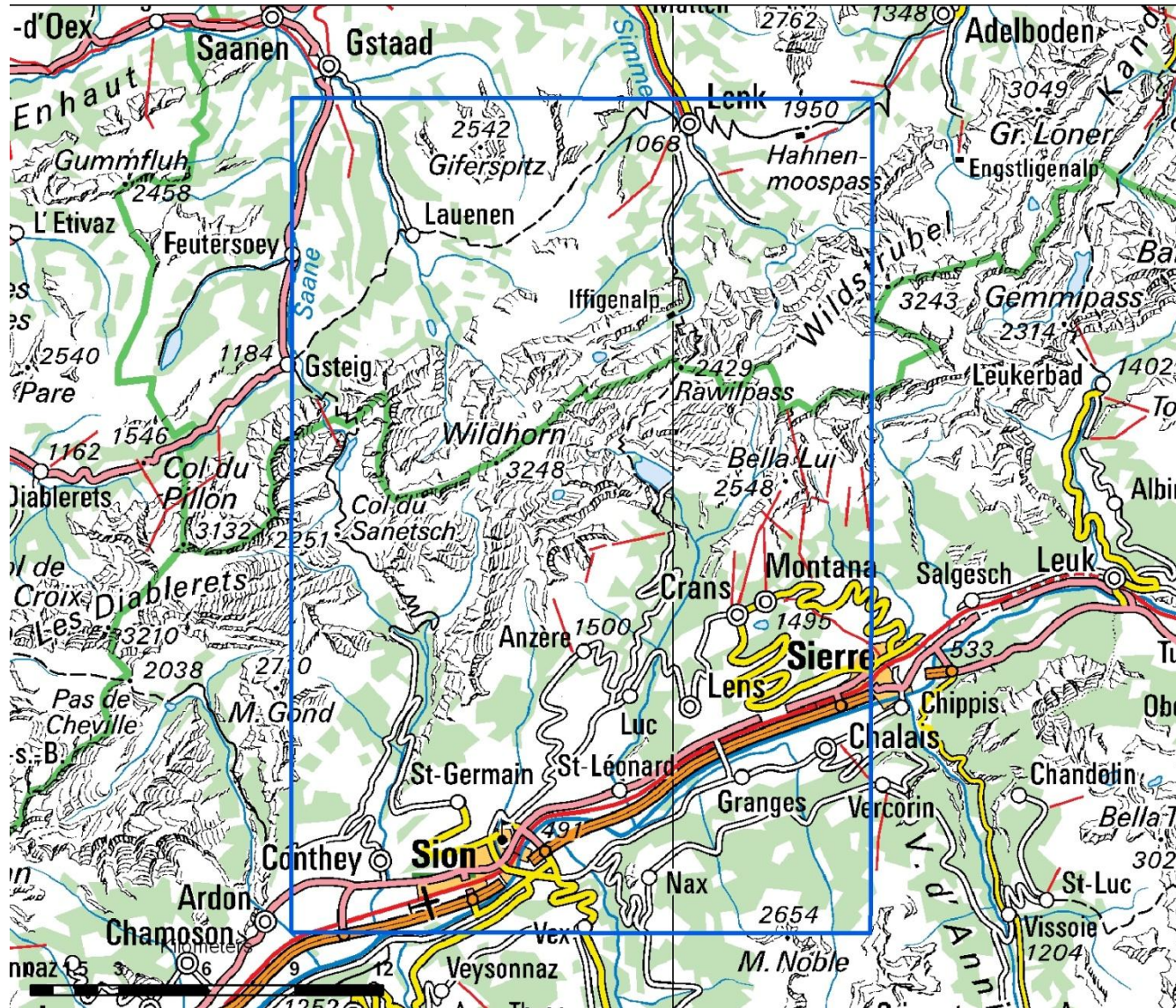
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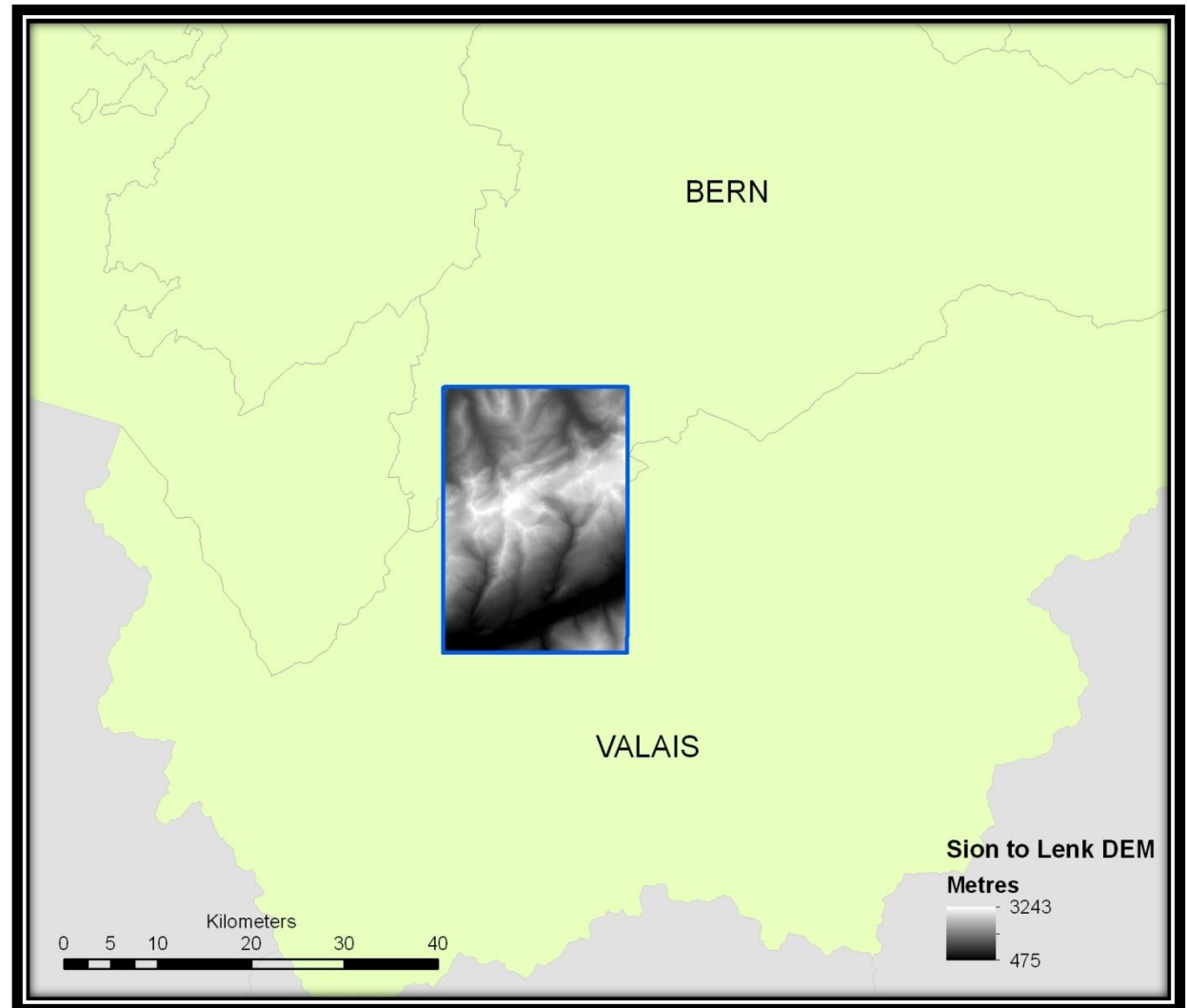
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 - Results from analysis with GIS tools
 - Quantifying terrain landforms
 - Study area: Sion to Lenk

Quantifying Terrain Landforms



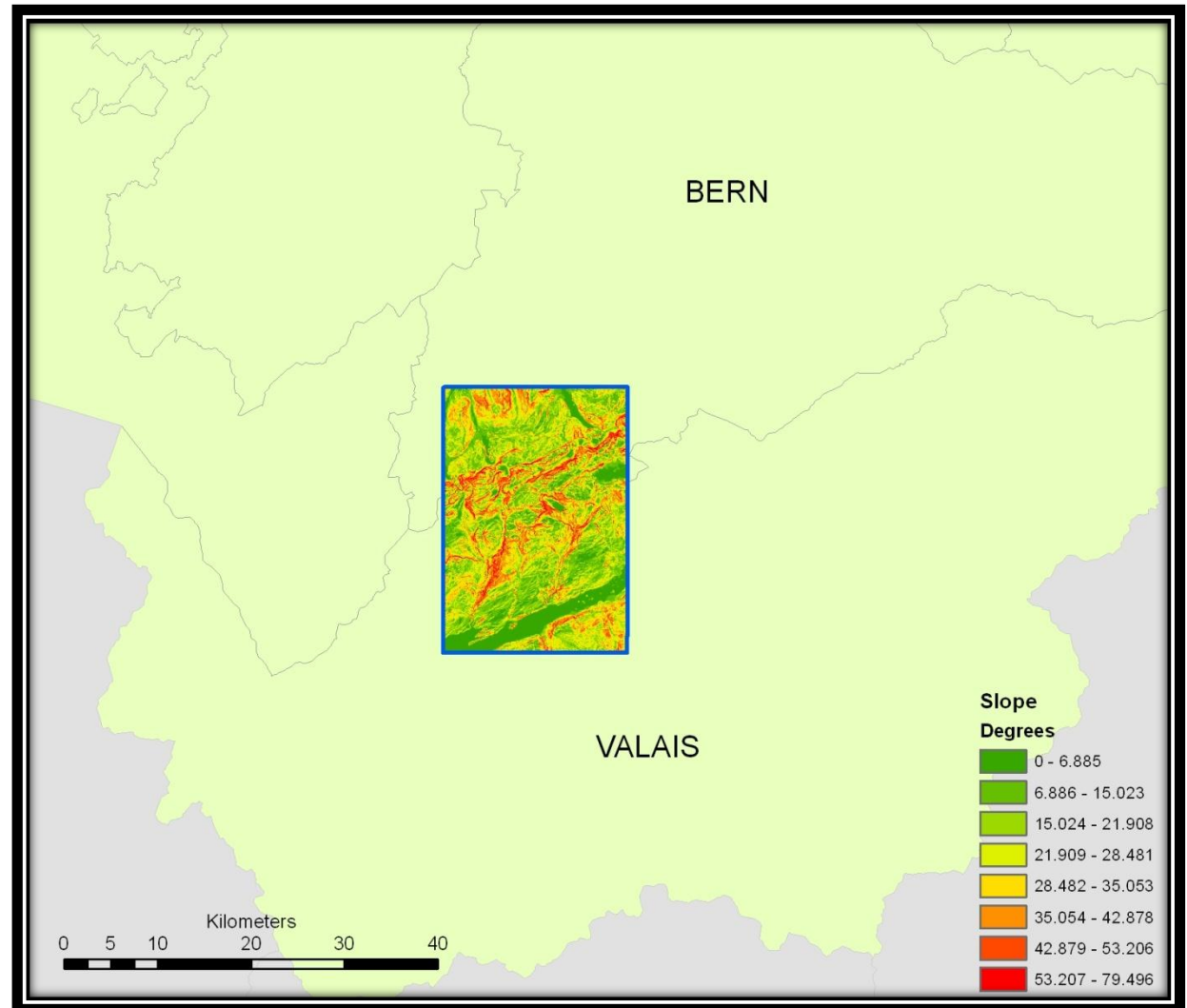
Quantifying Terrain Landforms: 25m DEM

**Derive new surfaces
from the DEM that
aren't originally
apparent**



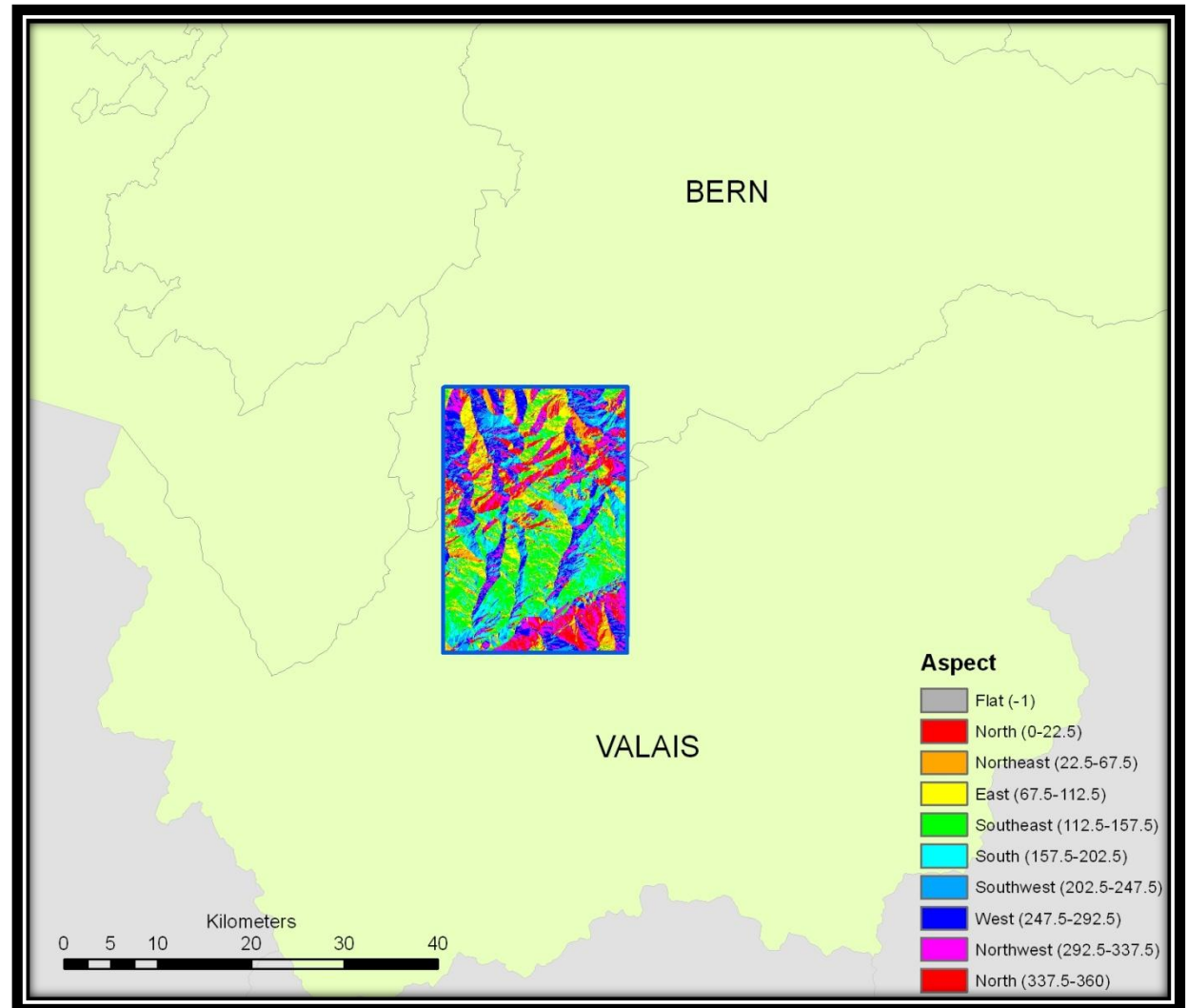
Quantifying Terrain Landforms: Slope

Steep slopes are a deterrent for people travelling through high mountain regions so this tool can indicate which areas to avoid



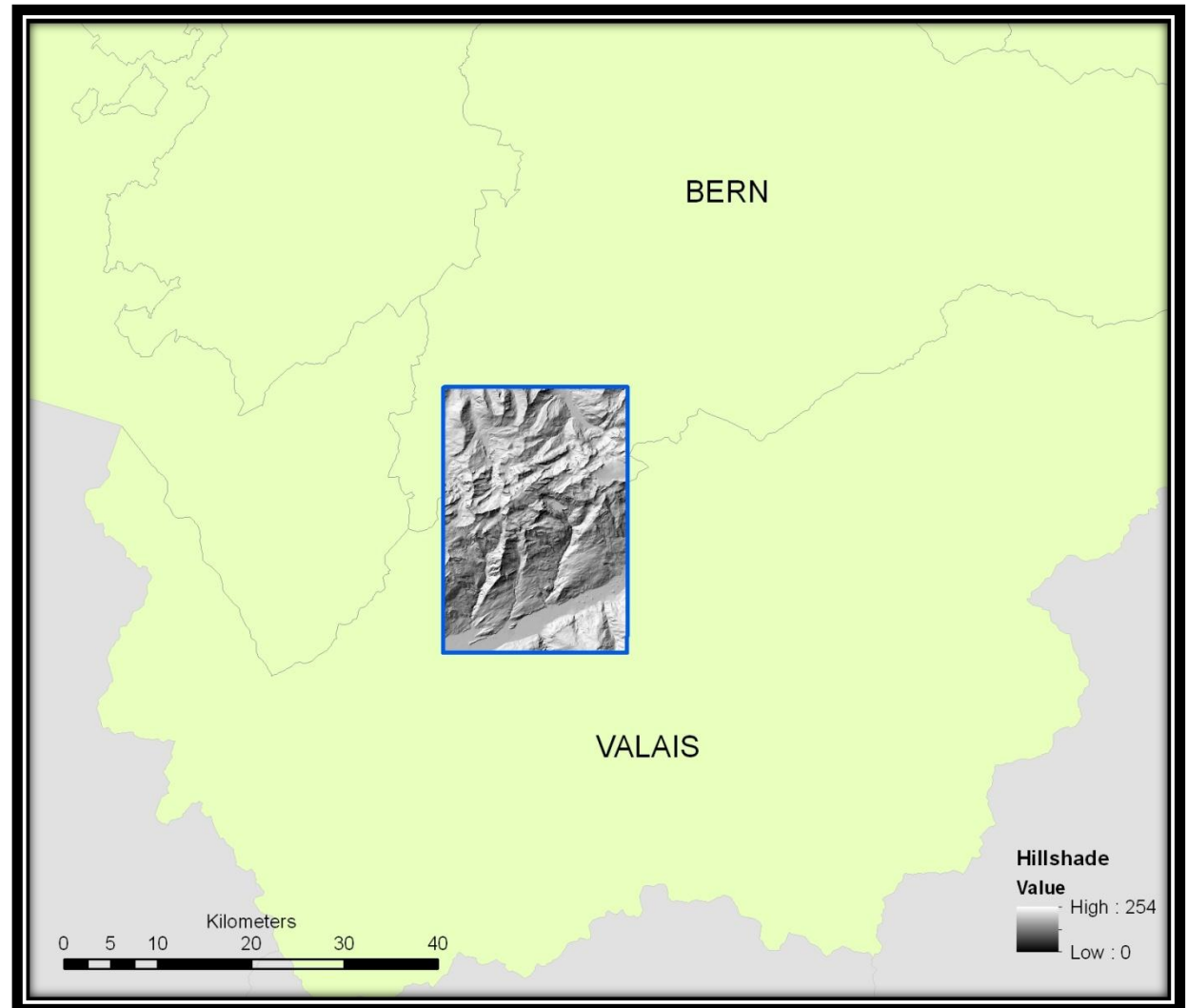
Quantifying Terrain Landforms: Aspect

North facing slopes are more likely to have snow or ice cover compared to south facing ones due to solar radiation levels



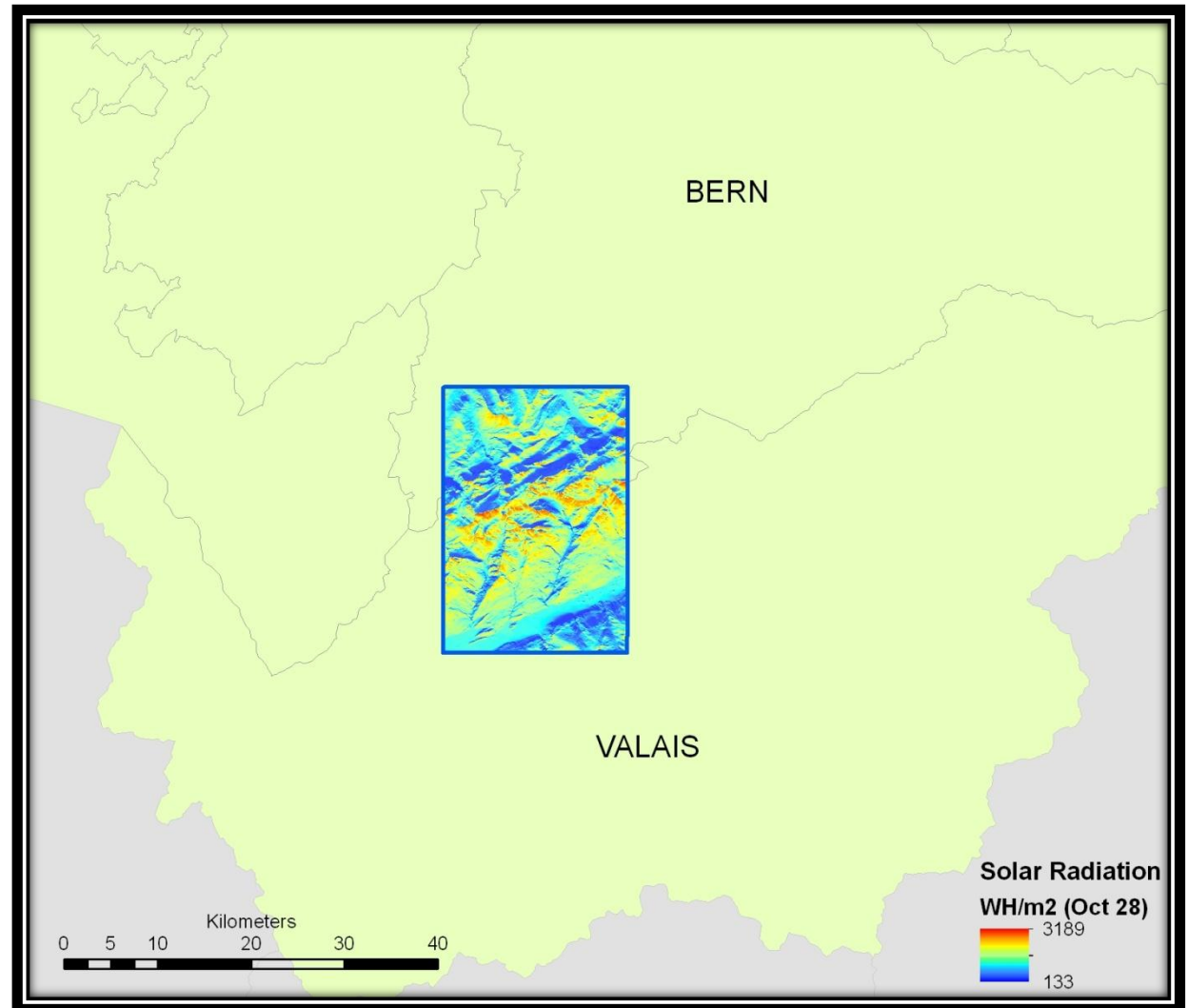
Quantifying Terrain Landforms: Hillshade

**Creates a shaded relief model of the study area.
The angle and illumination of the sun can be altered to model different time periods**



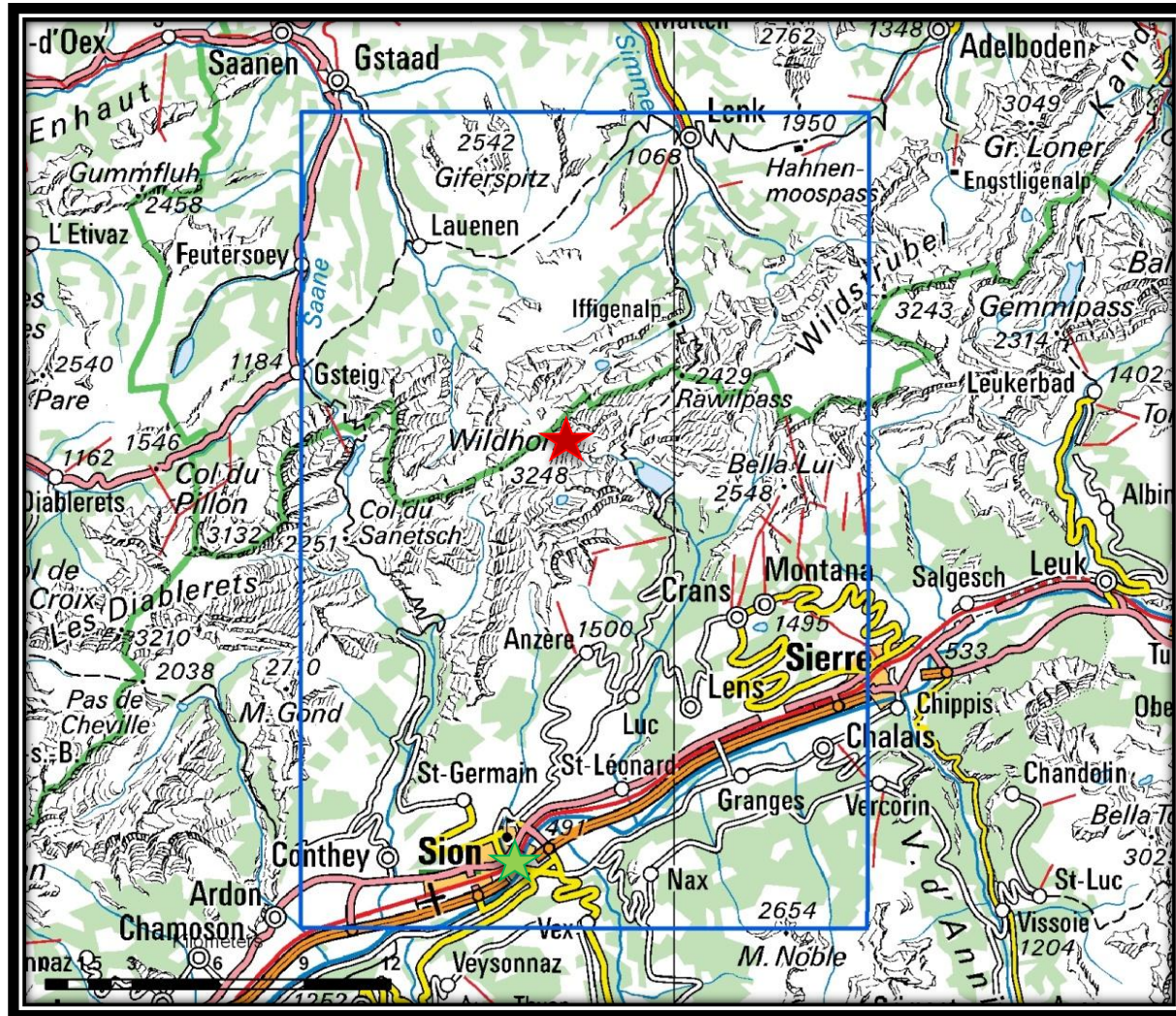
Solar Radiation tools

Areas of lower solar radiation are more likely to contain ice or snow and thus, have a higher archaeological potential



Least Cost Path analysis

Determining potential historic travel routes

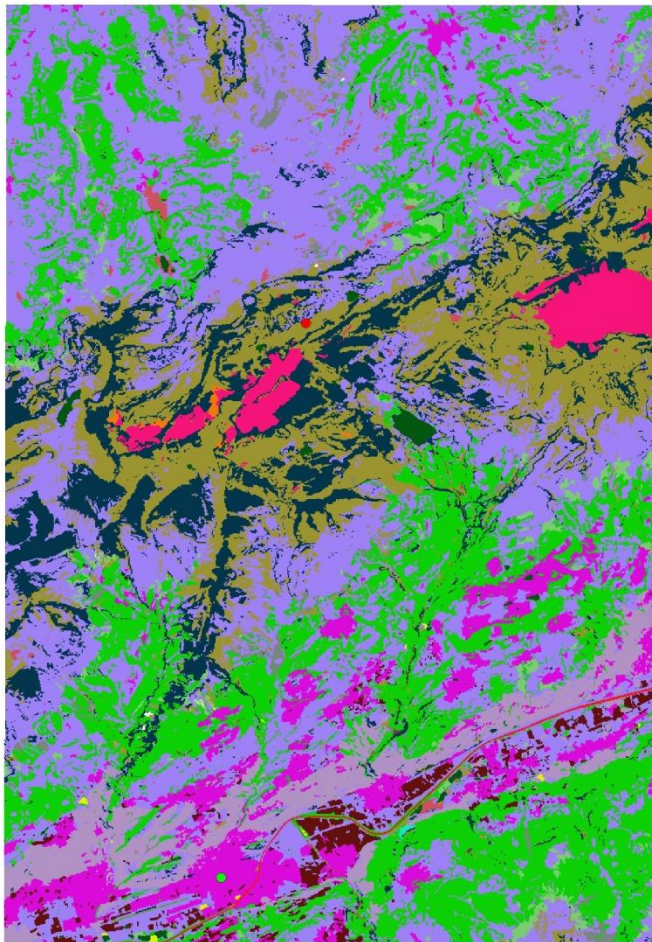


Least Cost Path analysis

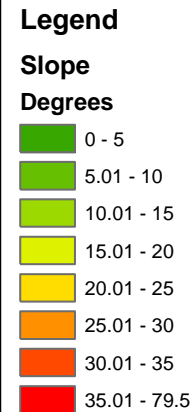
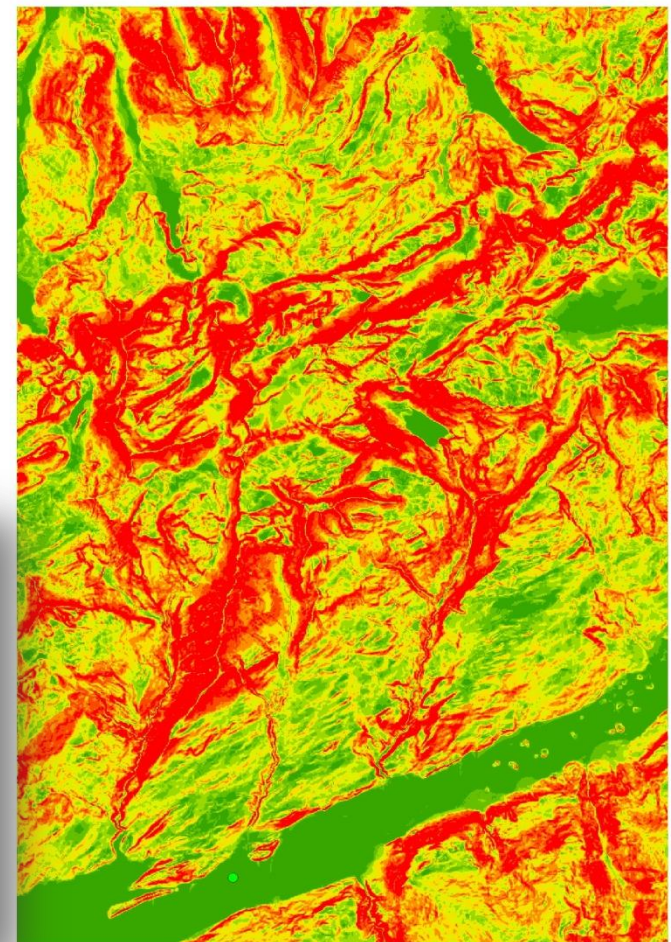
- To determine the paths that require the least amount of energy for people walking through the mountains
- Determining factors:
 - Landcover
 - Slope
- Reclassify and weight factors

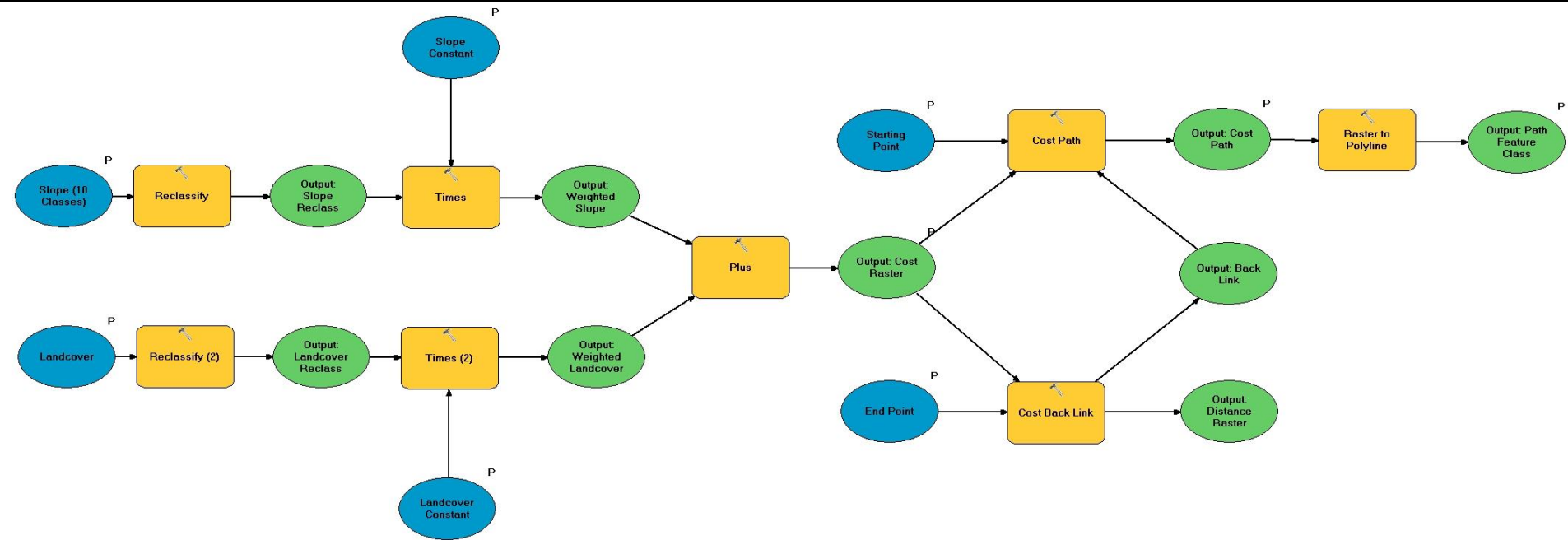
Model Inputs

Landcover



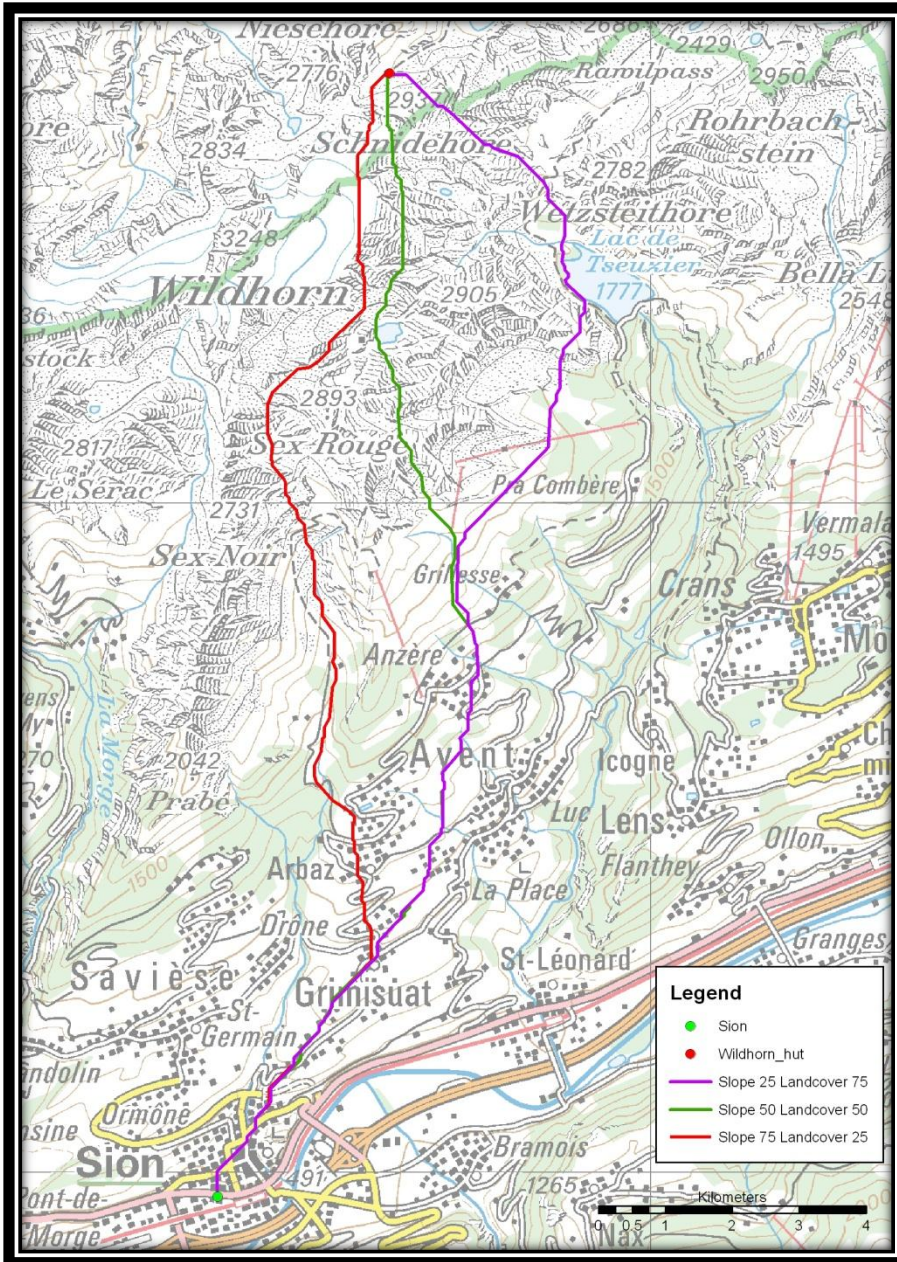
Slope

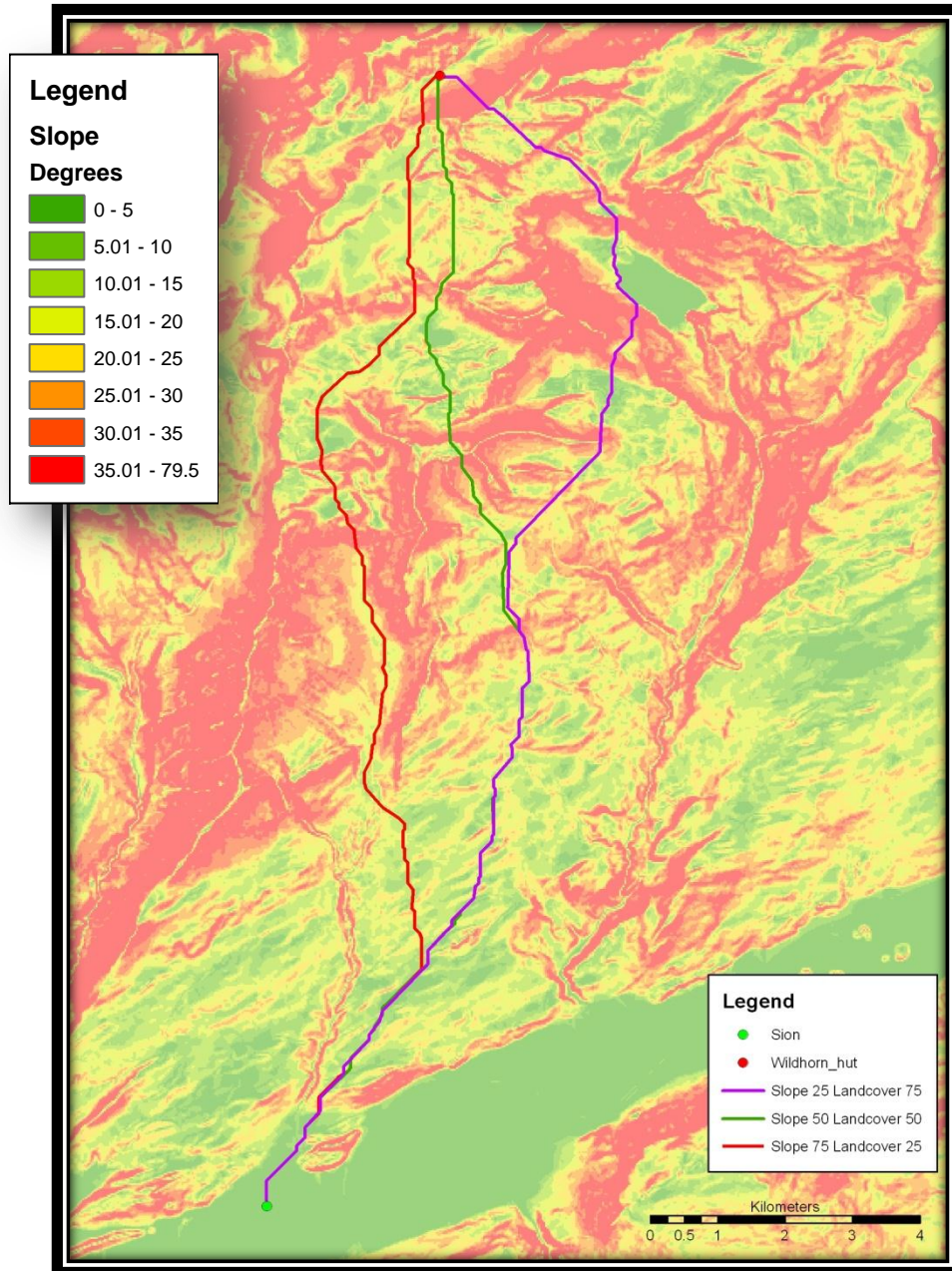




Preliminary results of least-cost paths

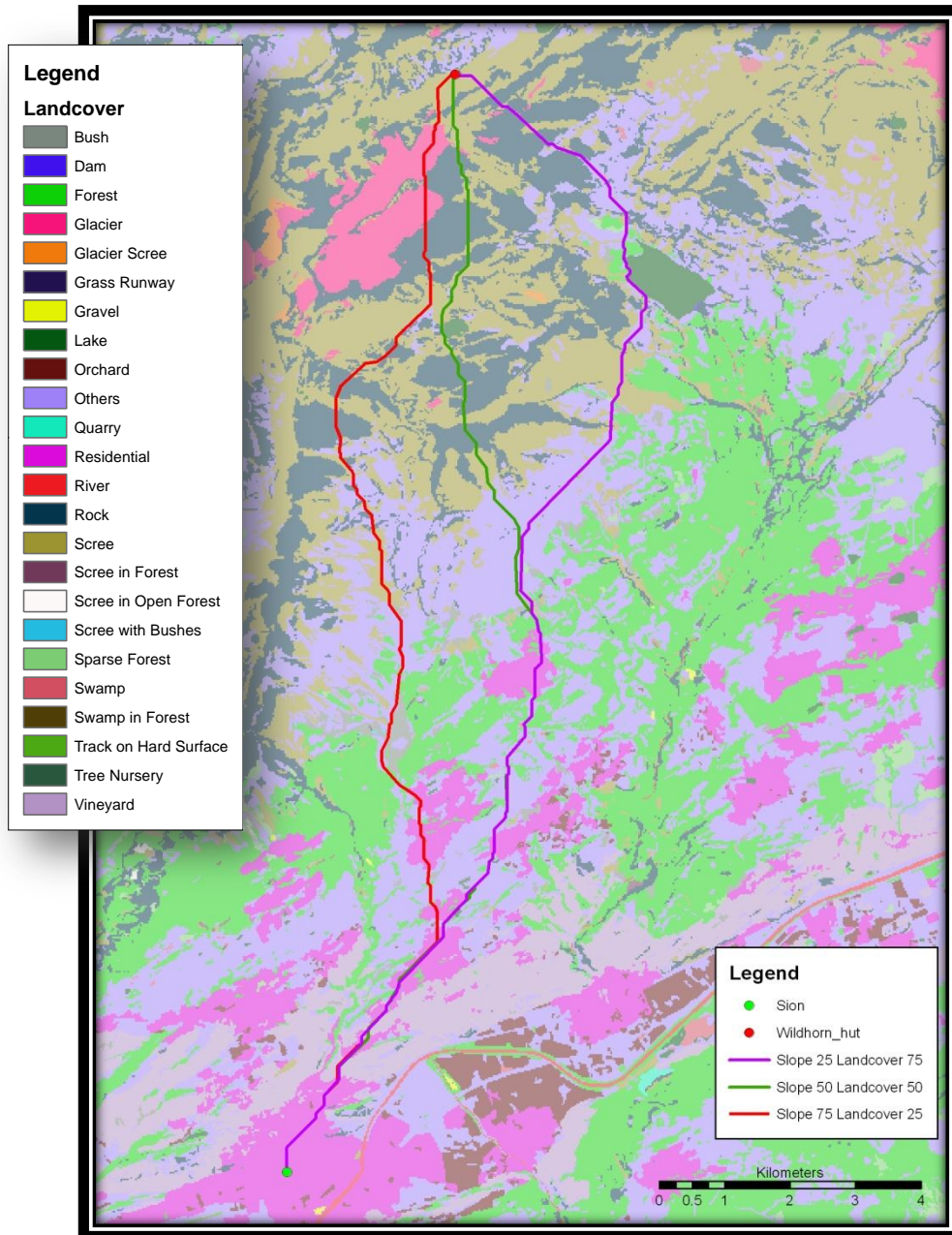
- Red Path:
 - Weighted 75% Landcover, travels along « easier » walking surfaces
- Purple Path:
 - Weighted 75% Slope, travels along less steep slopes
- Green Path:
 - Equal weighting, Median path





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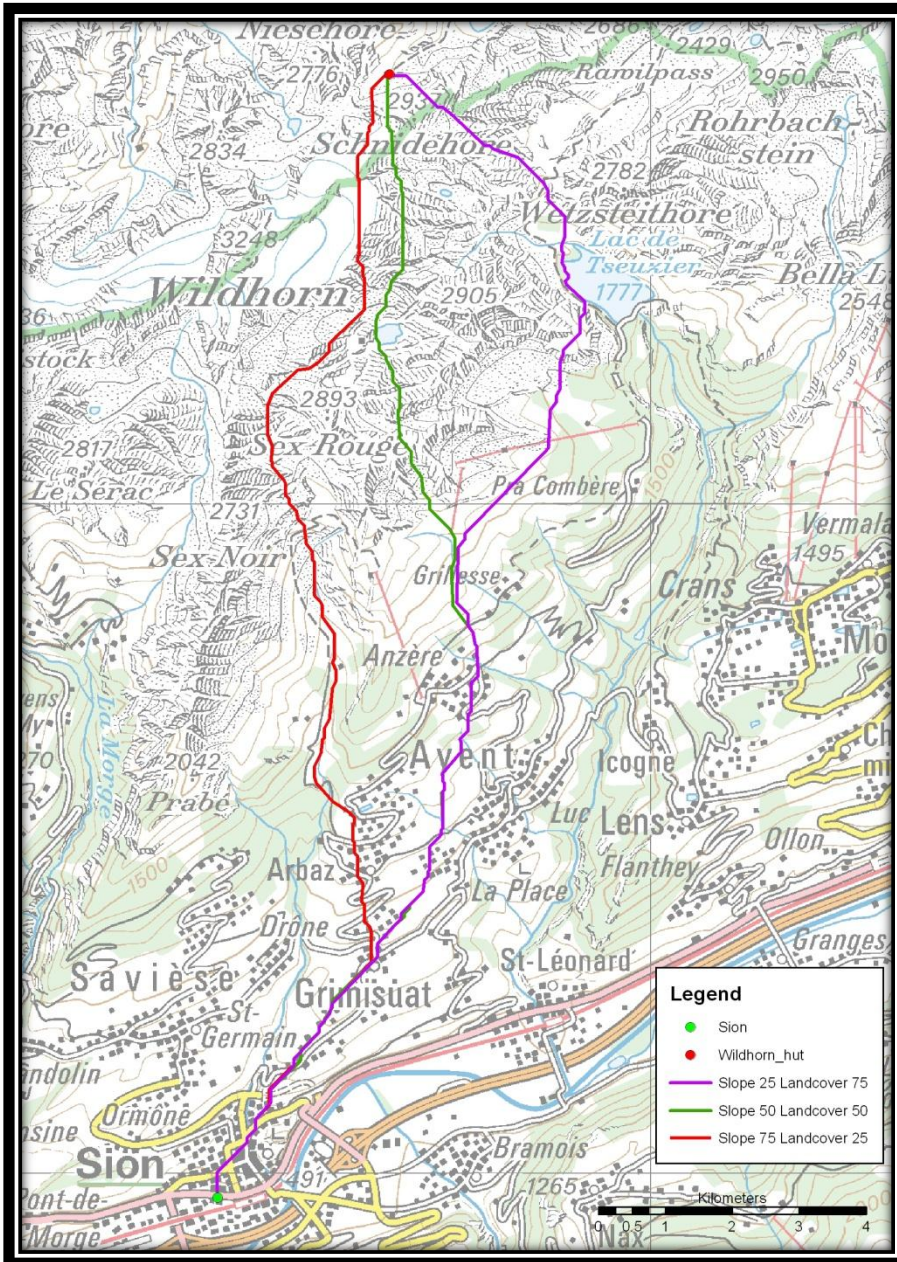
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Future Archaeological Potential Model



- Archaeological find locations
- Historical trails and passes
- Altitude of pass
- Glaciated areas
- North facing slopes
- Results of Least-cost paths
- Bed topography
- Colder than 0° for thousands of years
- Flat passes

- Non-glaciated areas
- Steep slopes
- Rapidly moving ice
- Altitudes lower than 2500m
- Areas of high solar radiation

Thank you!