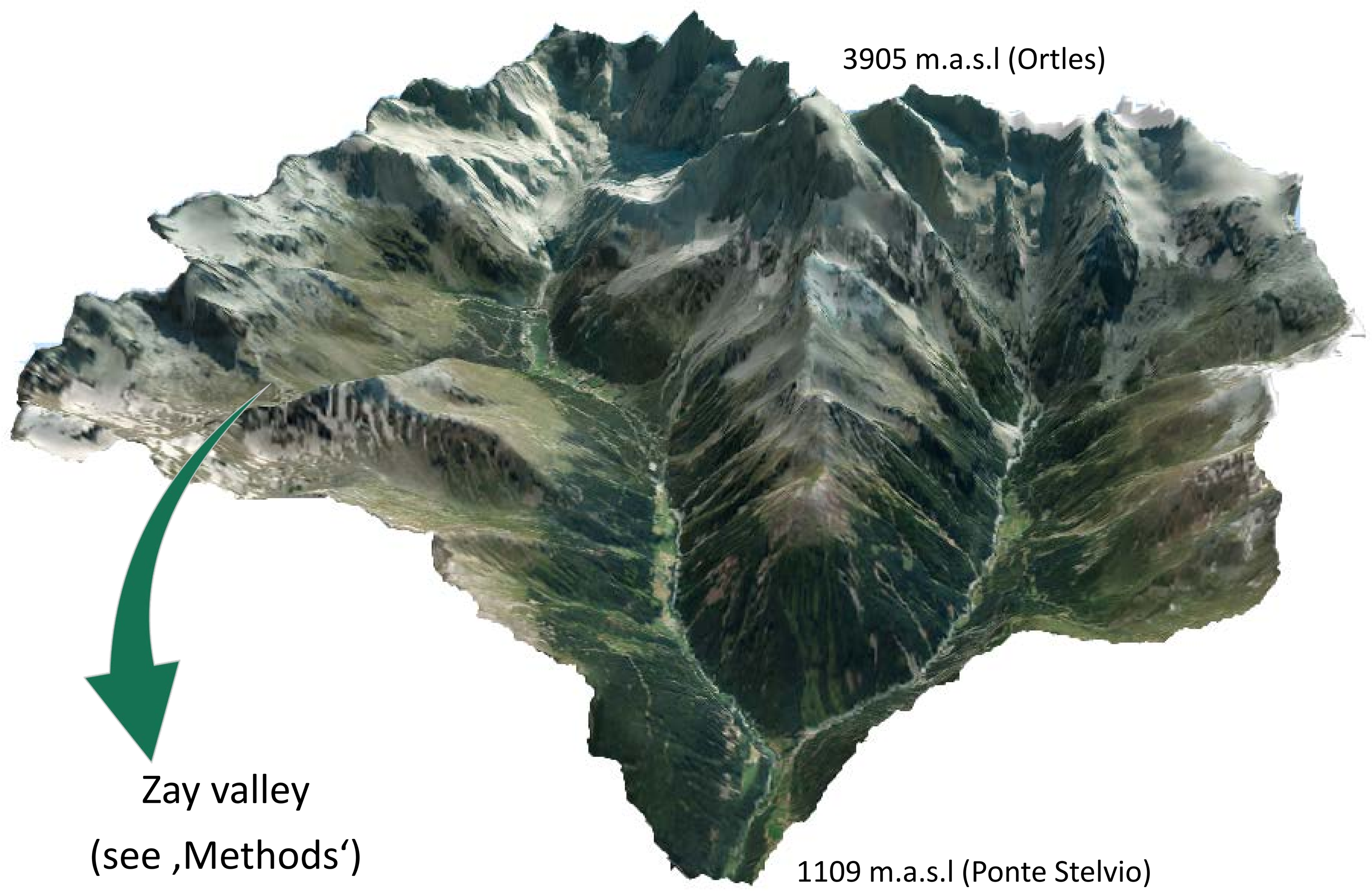
Introduction

High proportions of glacierized and permafrost areas in the Alps are retreating due to the current global warming trend

- Loss of englacial and subglacial storage and increasing instability of permafrost zones
- Sustained high-flows in summer due to increased glacier melting
- A higher frequency of meteorological "extreme" events are expected in the next decades

- Strong impacts on sediment cascades in mountainous glacierized catchments

- Integrated comprehension of geomorphological connectivity fundamental to outline sediment transport hotspots spatially and temporally



Study area

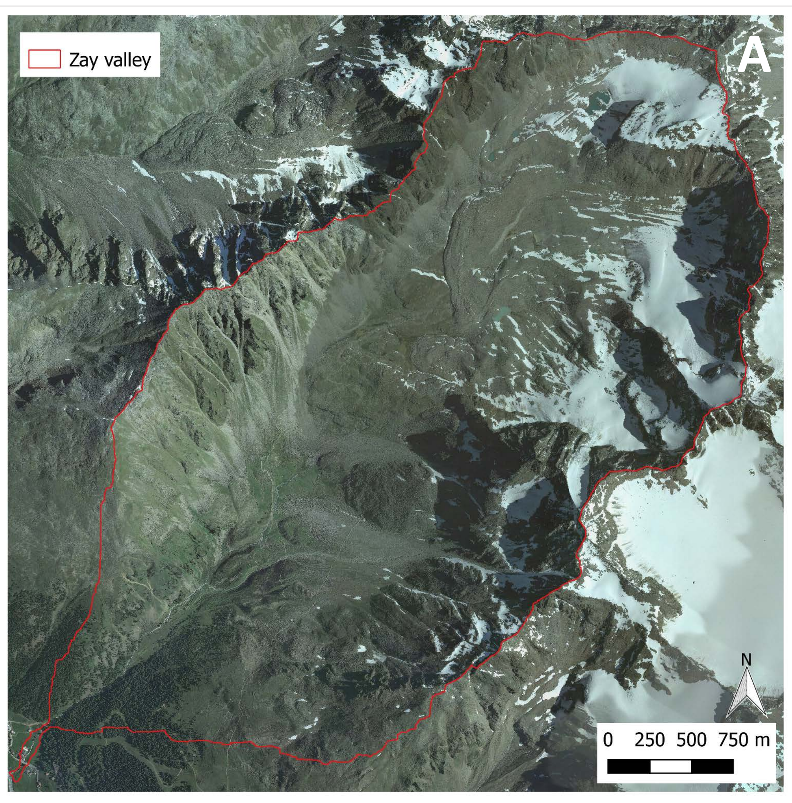
- Sulden, South Tyrol N-W Italian Alps
- ~130 km²
- ~18 km² glacierized
- Debris covered & clean ice glaciers
- Dolomitic & Metamorphic geological units
- ~860 mm/a precipitation

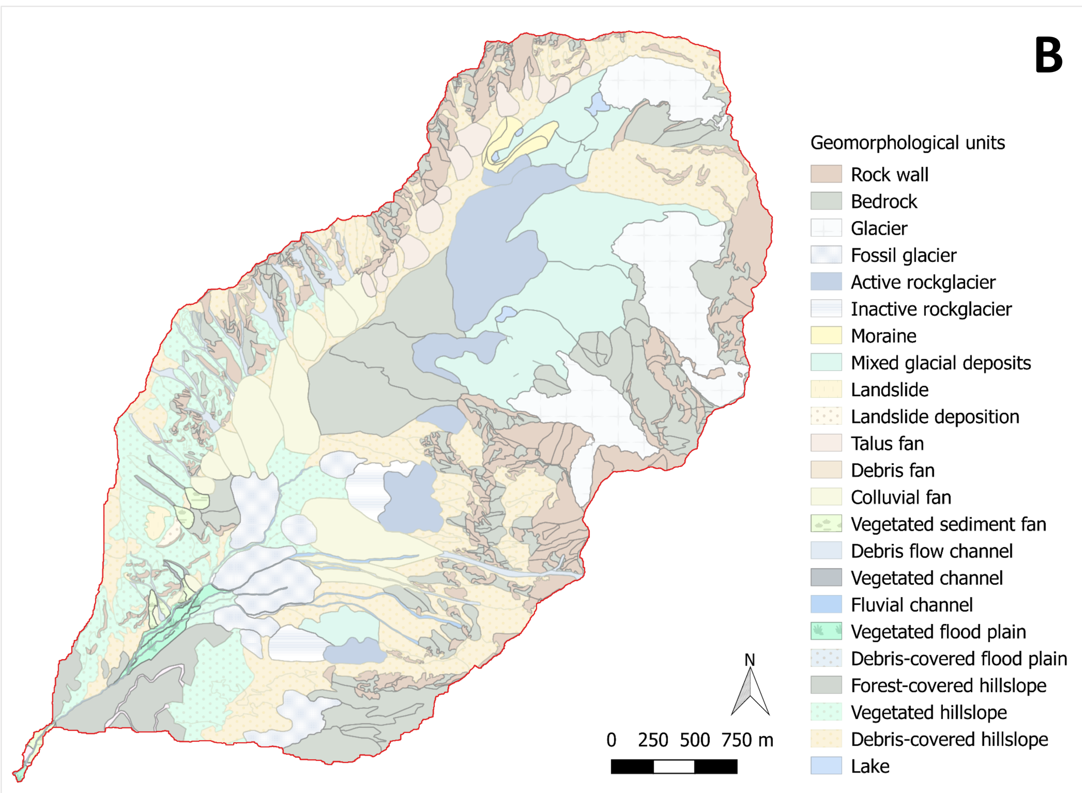
Aim

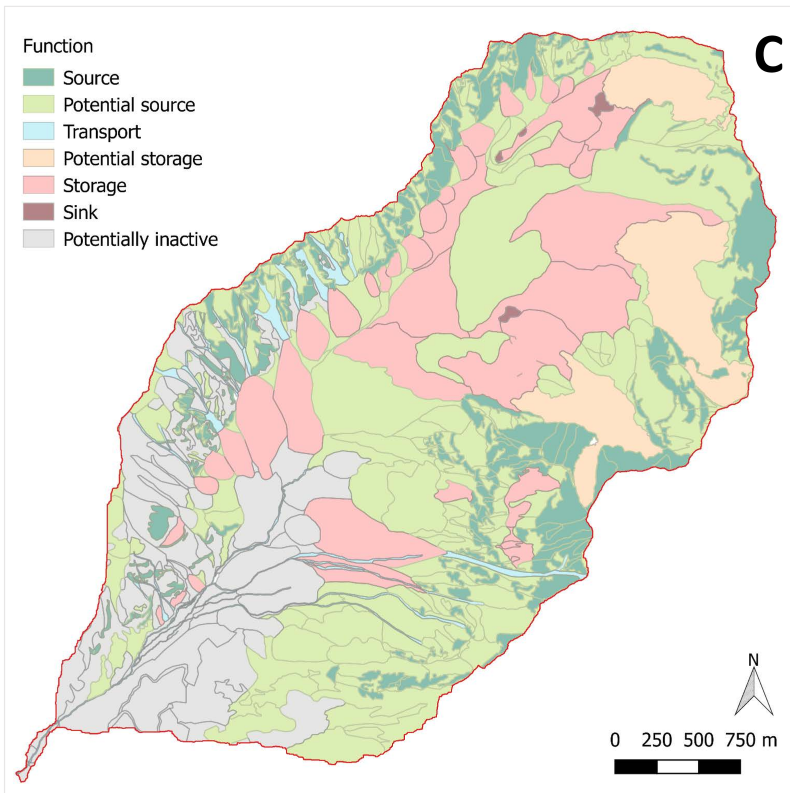
Define

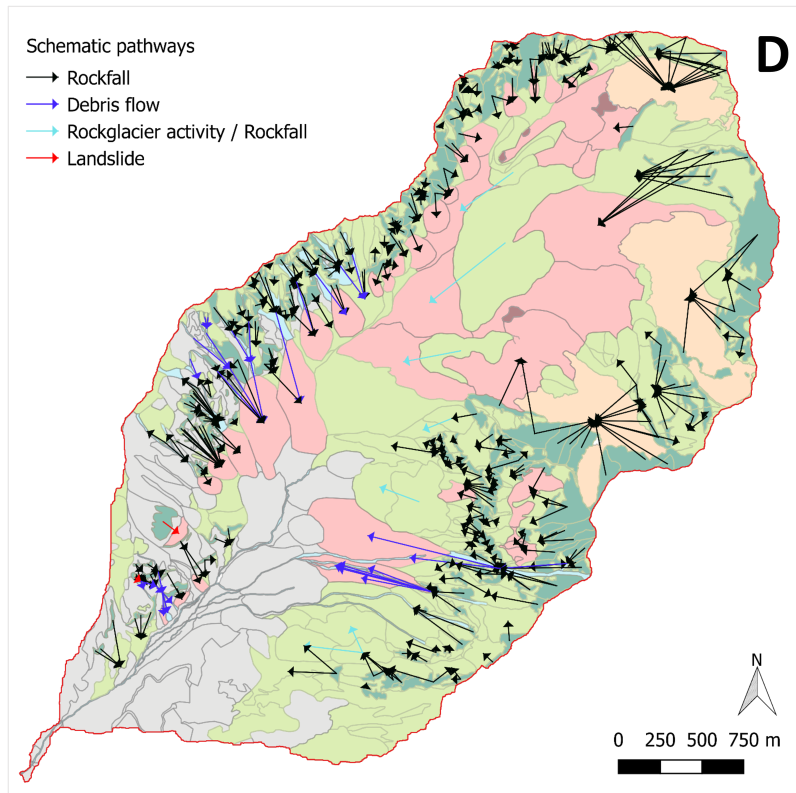
- The spatial distribution of sediment sources, pathways, storage and sinks of different geomorphic processes
- Their corresponding linkage to form effective sediment cascades

Methods





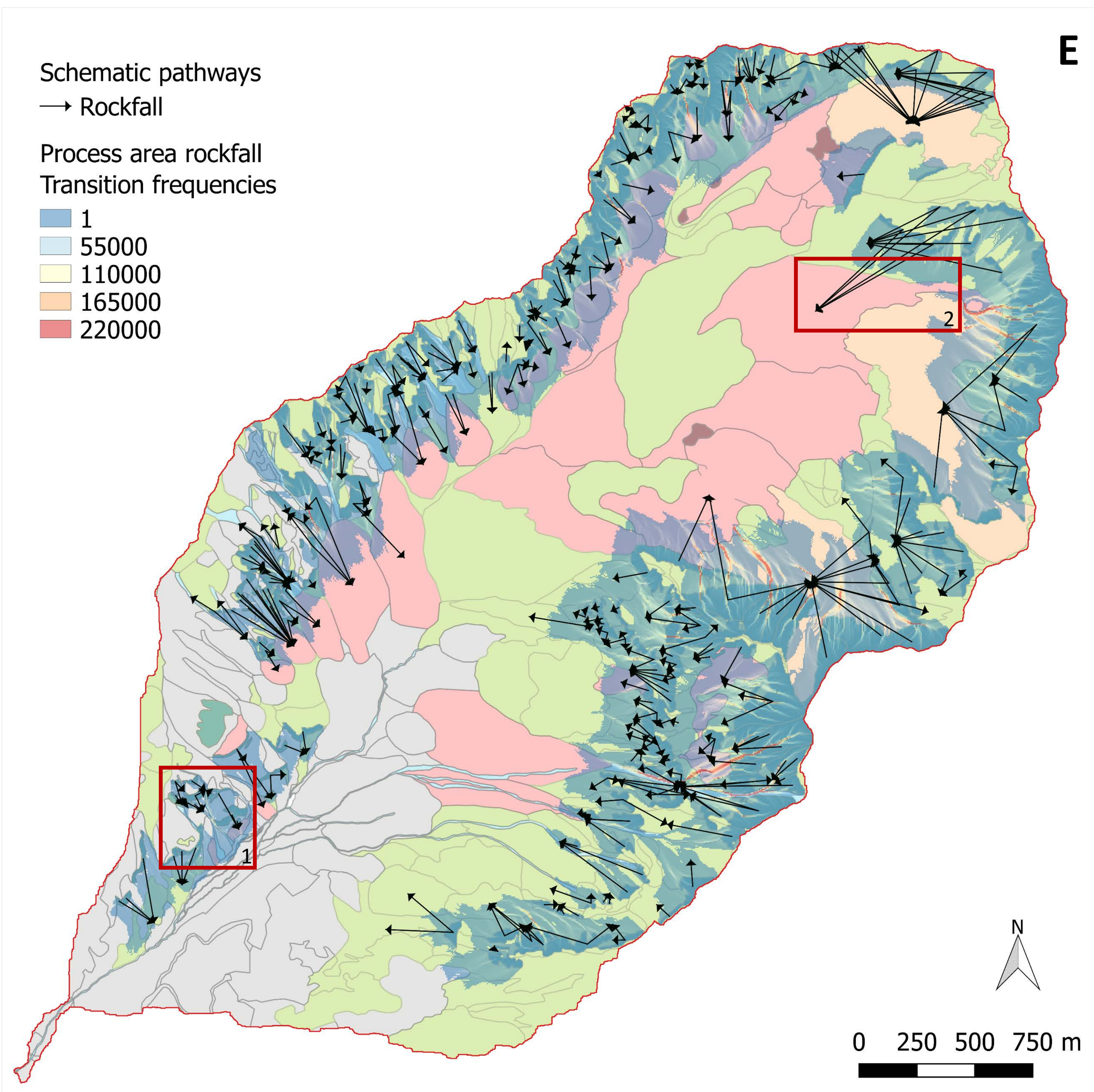




- Development of a geomorphological map based on field trips and remote sensing data analysis (example displayed: sub-basin Zay valley (Fig. B))
- Data sources (provided by the Province of Bolzano):
  - 2 orthophotos (2011, resolution 0.5 m (Fig. A) and 2015, resolution 0.2 m)
  - 1 DEM (2005, resolution 2.5 m)
- Subdivision into single units due to visual interpretation (orthophoto/fieldtrip) plus detailed study of elevation, curvature, slope and aspect data (DEM)
- Study of the functionality of the identified landforms regarding sediment transport processes based on expert knowledge (Fig. C)
- Schematic pathways for different sediment transport processes are drawn based on topographic characteristics and visual evidences (Fig. D) between the central nodes of the geomorphological units
- Comparison between results of a numerical simulation (Gravitational Process Path (Wichmann 2017)) and the drawn pathways (Fig. E)

Preliminary results

- First simulation results for the process 'rockfall' ("Process area rockfall") largely conform with transport regime of the pathways "drawn by hand" (Fig. E)
- Underestimation of run-out length of pathways due to the occurrence of channels (rectangle 1, Fig. E)
- Underestimation of run-out length of simulated rock fall due to change in material (scree/glacier) because of undifferentiated friction coefficient (rectangle 2, Fig. E)
- High proportion of vegetated (potentially inactive) and storage landforms at the valley bottom lead widely to disconnectivity between sediment sources on the slopes and the fluvial network / the valley outlet (Fig. D), which is confirmed by field observations



Outlook

- Next steps:
  - Development of a further elaborated graph network
  - Analysis of frequency and spatial distribution of the transport processes and their initiation, linkage and depositional zones
- Future aspects:
  - Combination of DEMs of Difference (DoDs) and flow routing algorithms to determine sediment pathways and sediment delivery ratios (SDR)
  - Qualitative validation of simulation results and study of temporal dynamics based on results of sediment transport monitoring

References

Wichmann, V., 2017. The Gravitational Process Path (GPP) model (v1.0) – a GIS-based simulation framework for gravitational processes. Geosci. Model Dev. 10, 3309–3327.