Geographic Object-Based Image Analysis (GEOBIA) for inventory mapping of forest-covered landslides: a case study (Jena, Germany)

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INTRODUCTION

Motivation

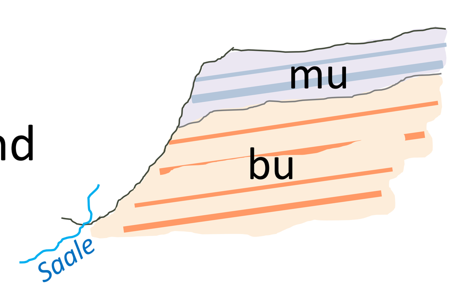
- Reliable landslide inventories are crucial for assessing landslide susceptibility and hazard maps.
- Historic landslides may offer insights into periods of varying landslide activity compared to recent decades.
- Preservation of landslide features under forest cover presents a valuable but challenging source for preparing landslide inventories.

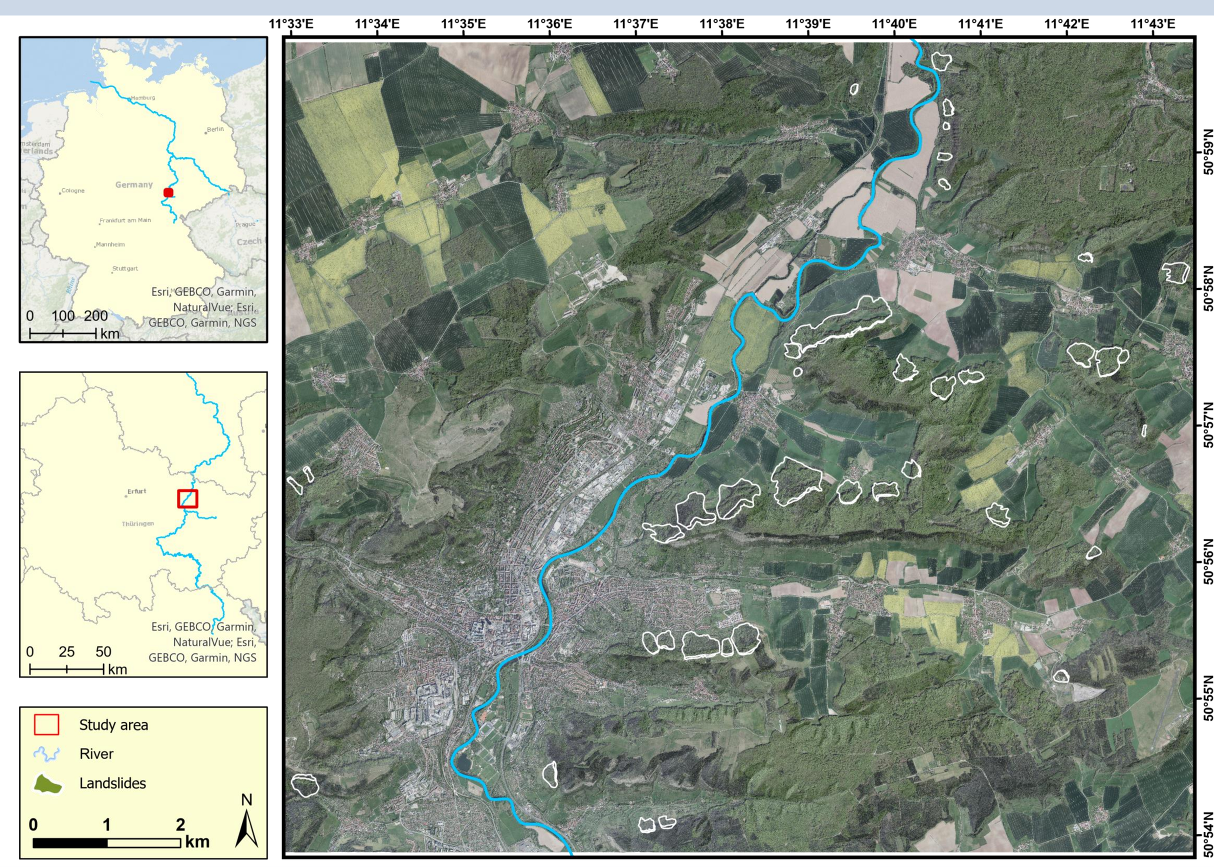
Objectives

- To explore the potential of Geographic Object-Based Image Analysis (GEOBIA) for semi-automatic inventory mapping of forest-covered old landslides in middle-mountain regions.
- To assess the effectiveness of LiDAR data and its derivatives in semi-automated mapping of forest covered landsides.

STUDY AREA

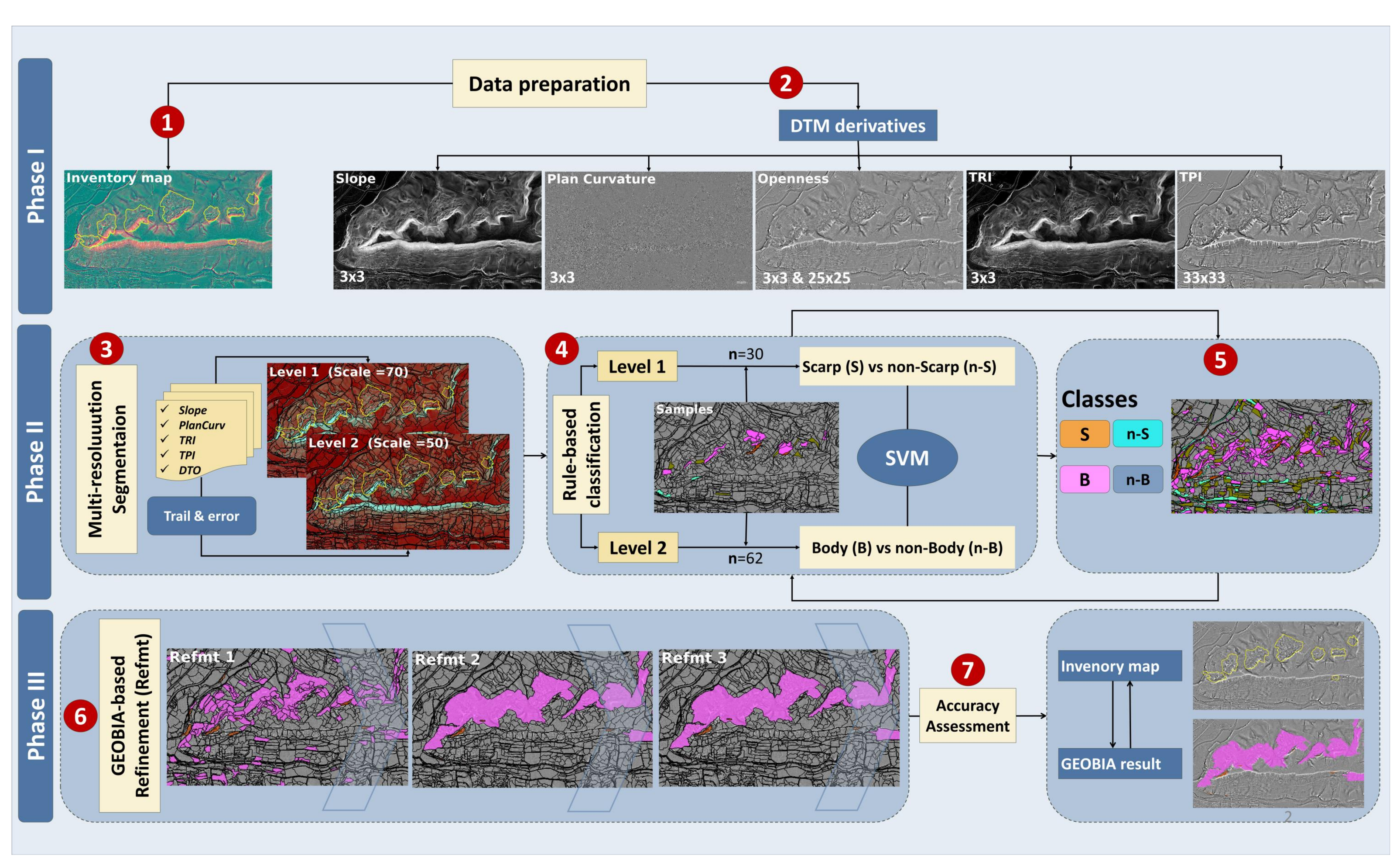
- **Location:**
  - Jena region, Germany (**150 km²**)
  - located within the **Thuringia basin**
- **Geology**:
  - Muschelkalk (mu): limestone
  - Buntsandstein(bu): marls, claystone, and sandstone
- **Landslides:**
  - Mainly, historic large landslides are obscured by dense forest cover



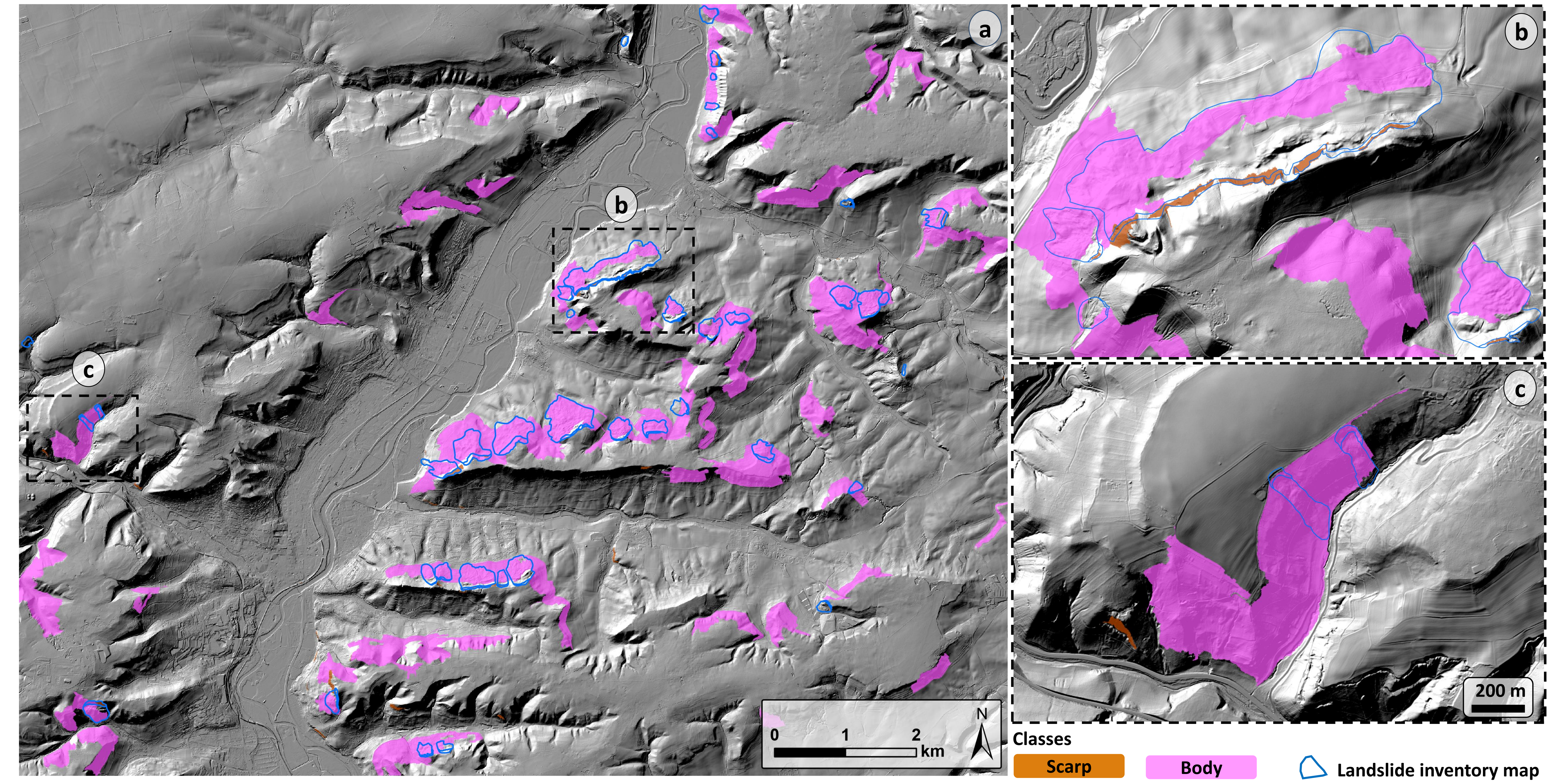


METHODOLOGY

- **Phase I:** A manual inventory map is generated for the purpose of module training and validation. LiDAR derivatives (slope, curvature, Terrain Roughness Index (TRI), Terrain Position Index (TPI), and openness) are computed using ***ArcGIS 10.7.1***.
- **Phase II:** Multi-resolution segmentation is employed across two scales to detect landslide scarps and bodies, incorporating SVM algorithm and rule-based classification.
- **Phase III:** GEOBIA-based refinements are conducted in three steps, followed by accuracy assessment.
- Both Phase II and III are executed using ***eCognition 10.3***.



PRELIMINARY RESULTS



(a) illustrates the classification result over the entire study area, with black dashed polygons marking insets **(b)** and **(c)**. These insets reveal areas where misclassifications occur, resembling true positives due to shared characteristics such as fluvial incisions, valley heads, high roughness, and infrastructure like roads and built-up areas.

CONCLUSIONS & OUTLOOK

- The accuracy achieved in landslide mapping **in this study is >80% (**in comparison to the inventory map**)**. However, **false positive objects still need to be decreased.**
- The module is capable of detecting and mapping historical forestry covered landslides. **However, it only recognizes and maps large and medium-sized landslides** (excluding small sized ones [**area < 0,5 ha**]).
- To enhance this study further, incorporating thematic data like geological maps and land use alongside high-resolution lidar data is recommended.
- The transferability of **this module should be evaluated in other regions.** However, we anticipate that globally, landslides with clear geomorphological signatures in high-resolution DTM data can be identified using this approach.
- In the **next step**, we adopt the methodology suggested by ***Sîrbu et al.(2019)*** to determine the **optimal window size** for each land surface variables **(LSVs)** for detecting landslides, aiming to improve the accuracy and reduce false positives.

THANKS

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REFERENCES

- Sîrbu, F., Drăguț, L., Oguchi, T., Hayakawa, Y., & Micu, M. (2019). Scaling land-surface variables for landslide detection. *Progress in Earth and Planetary Science*, *6*(44), 1–13.