



CHRISTIAN ARNHARDT, VANESSA BANKS, MAJDI MANSOUR, NIKHIL NEDUMPALLILE VASU, AUDREY OUGIER-SIMONIN, KRISHNA PRIYA V K, K. SAJINKUMAR, RAJKUMAR MATHIYALAGHAN

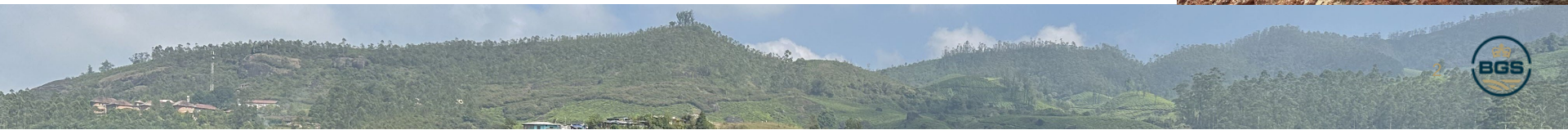
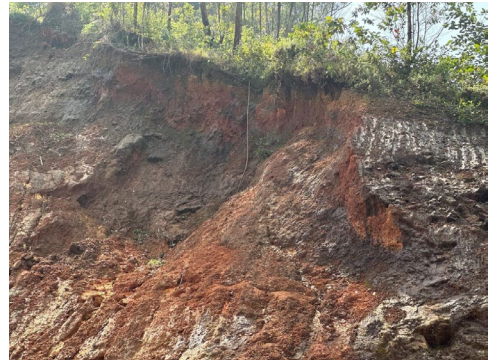
Development of landslide domain maps at regional scale in data poor areas underlain by tropical soils



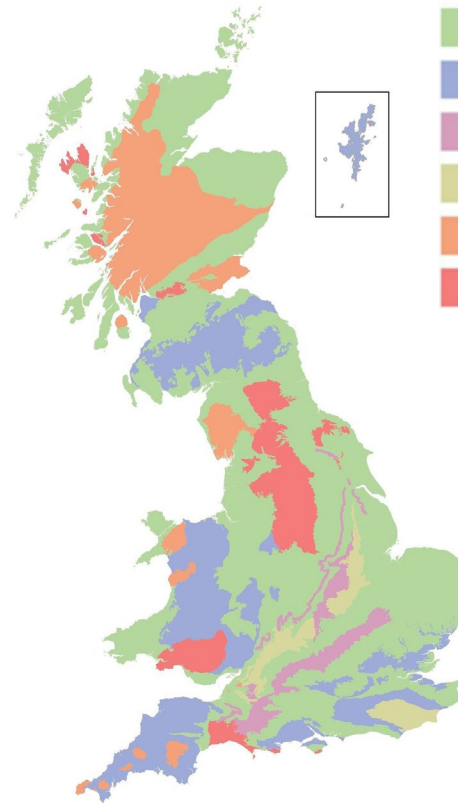
British
Geological
Survey

CONTENT

1. What are landslide domains? An example from the UK
2. The IGRD project “Landslide trigger thresholds for tropical residual soils” - a brief overview
3. Landslide domains in the IGRD project

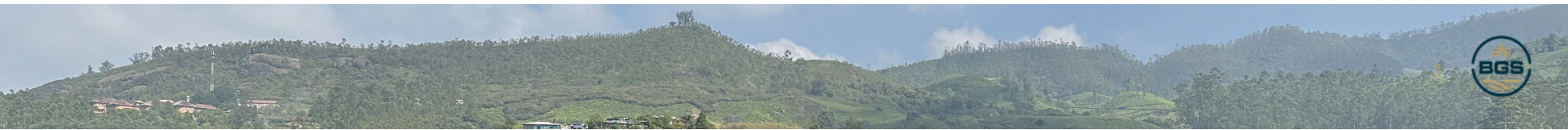


- Great Britain's diverse landscape mirrors a complex geological history shaped by various geomorphological processes and repeated glaciations over millennia
- Diversity of both landscapes and landside processes at different scales → development of a landslide domain map.
- Landslide domain encapsulates key landslide characteristics, organizing them into hierarchical spatial units based on shared physiographical, meteorological, climatic, and geological features that influence the style of landsliding.



- 1 Isolated landslide events
- 2 Small scale shallow rotational, translational landslides and debris flows
- 3 Shallow rotation landslides and flows occurring predominantly on escarpment slopes
- 4 Cambering and rotational landslides
- 5 Rock falls, slides and debris flows predominantly in upland areas
- 6 Compound or complex landslides in plateau and valley environments

Dashwood, C., Pennington, C., Bee, E., Freeborough, K., Dijkstra, T. (2017). Creation of a National Landslide Domain Map to Aid Susceptibility Mapping in Great Britain. In: Mikos, M., Tiwari, B., Yin, Y., Sassa, K. (eds) *Advancing Culture of Living with Landslides*. WLF 2017. Springer, Cham.
https://doi.org/10.1007/978-3-319-53498-5_110



Aim

Enhance the reliability of landslide forecasting in tropical environments with limited landslide inventory

Objective

Develop a trigger threshold approach for shallow landslides (debris flows) applicable to large areas by integrating ground information



Geological Survey of India



University of Kerala
(BUFI PhD student)



College of Engineering
Goa



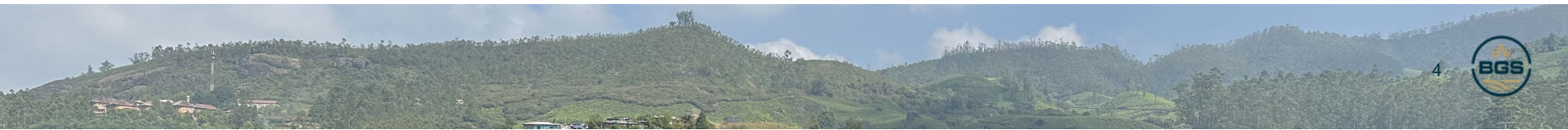
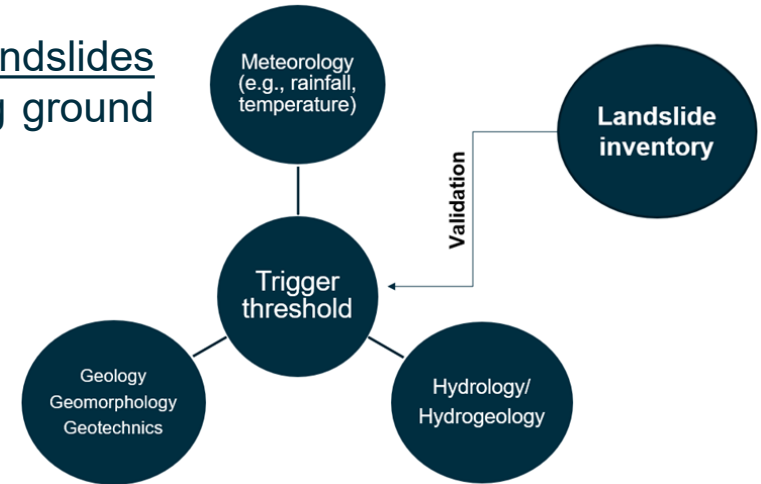
Indian Institute of
Technology Palakkad



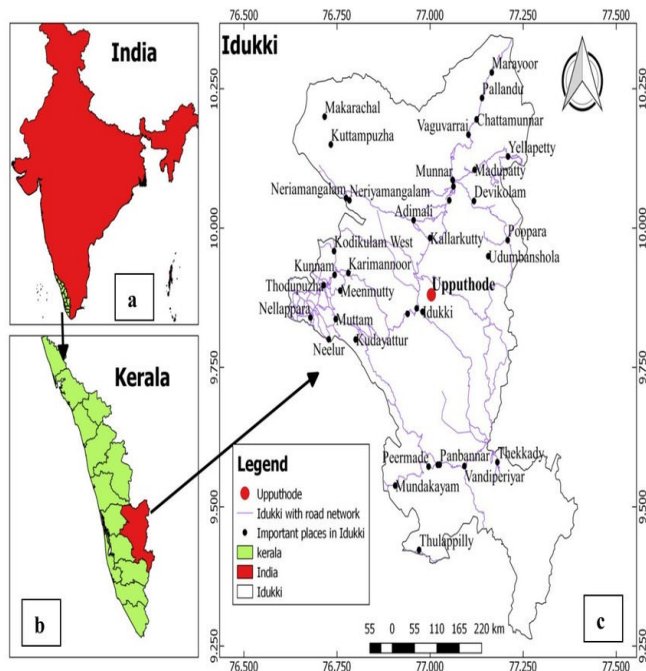
CNR, Italy
Consiglio Nazionale delle Ricerche



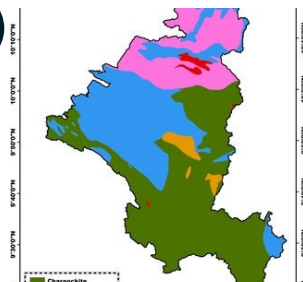
Andhra University



Study site- Idukki district

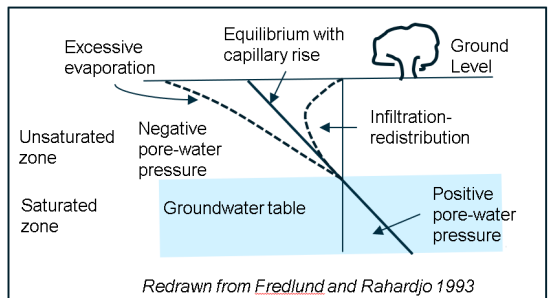


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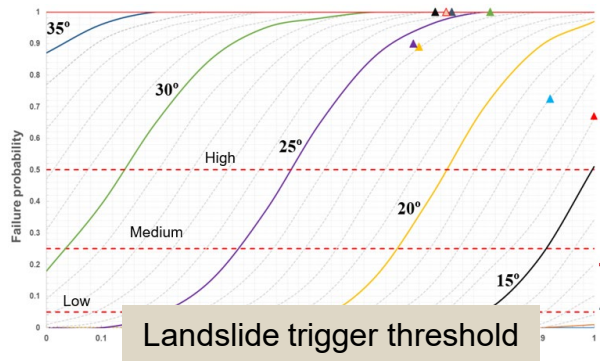
1. Development of domains
2. Hydrological and geotechnical testing

2

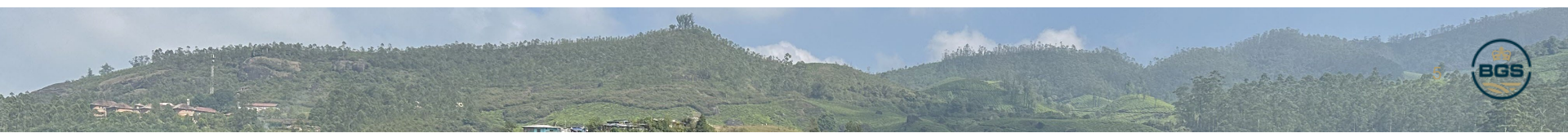


Hydrological and monte-carlo based slope stability modelling

3



Landslide trigger threshold



2. THE IGRD PROJECT “LANDSLIDE TRIGGER THRESHOLDS FOR TROPICAL RESIDUAL SOILS” - A BRIEF OVERVIEW

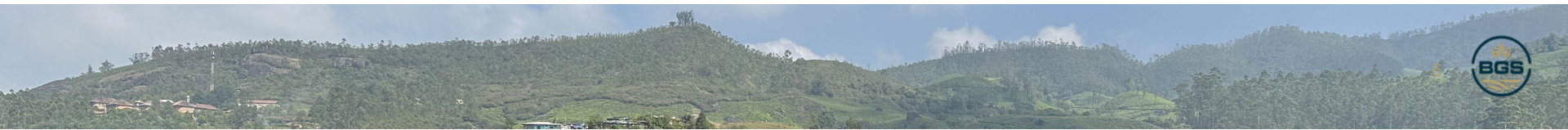
- Kerala and especially Idukki is prone to landsliding with numerous landslides during the 2018 event
- Tropical soils are widely distributed across Idukki.
- Idukki has been extensively studied for landslides.
- Various susceptibility analyses and hazard maps integrate diverse factors using different methods.
- A comprehensive landslide inventory is available, containing thousands of point data information.
- A few approaches for developing landslide trigger thresholds are documented, e.g., Sajinkumar K.S., 2019.

Landslides around Munnar from the 2018 event, Google Earth



| District | Source | | | | Total / % |
|--------------------|--------|-----|------------|-----|------------|
| | NRSC | GSI | GSI + NRSC | New | |
| Idukki | 607 | 685 | 256 | 675 | 2223/47.02 |
| Pathanamthitta | 66 | 24 | 7 | 9 | 106/2.24 |
| Kottayam | 43 | 18 | 13 | 2 | 76/1.61 |
| Thrissur | 206 | 33 | 17 | | 256/5.41 |
| Ernakulam | 94 | 10 | 3 | | 107/2.26 |
| Palakkad | 649 | 54 | 36 | 54 | 793/16.77 |
| Kozhikode | 97 | 23 | 18 | 90 | 228/4.82 |
| Malappuram | 312 | 59 | 36 | 22 | 429/9.07 |
| Wayanad | 250 | 53 | 26 | 2 | 331/7.00 |
| Kannur | 116 | 14 | 10 | 1 | 141/3.00 |
| Kasaragod | 24 | | | | 24/0.51 |
| Kollam | 10 | | | | 10/0.21 |
| Thiruvananthapuram | 3 | | | 1 | 4/ 0.09 |
| Total | 2477 | 973 | 422 | 856 | 4728 |

Landslides from the 2018 event, after L. Hao et al., 2020

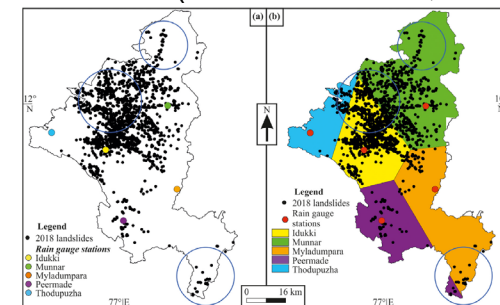




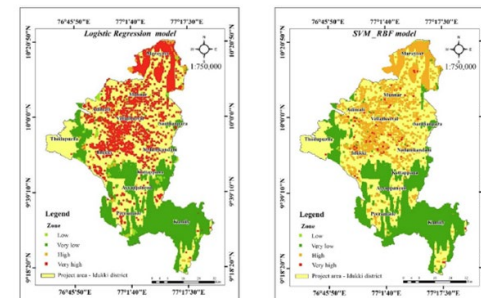
Further analyses are needed for the trigger threshold analysis because:

- current inventory mainly focuses on the 2018 event, lacking comprehensive area-wide information for other periods.
- Most landslides in the inventory are near settlements, roads, and infrastructure, indicating anthropogenic influence.
- Existing data sets for conditional factors like lithology and land use vary in scale and granularity.
- Current landslide analyses are often general and lack differentiation between different types, with few emphasizing debris flows.
- Rainfall threshold analyses typically use classical statistics, relying on limited rainfall information and gauge stations.
- The major challenge is the absence of consistent soil and soil thickness data, often using a coarse geology map as a proxy.

Rain gauge locations and landslide distribution (C.L. Vishnu et al., 2022)

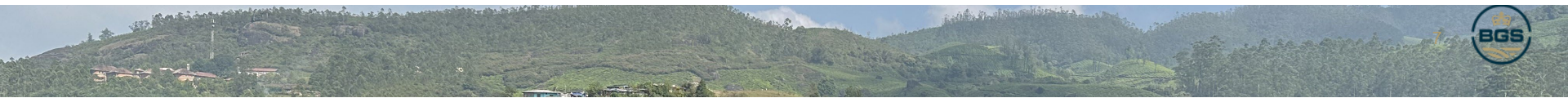


Different landslide susceptibility maps (Shameem Ansar et al., 2022)



(a) Logistic Regression

(b) Support Vector Machine

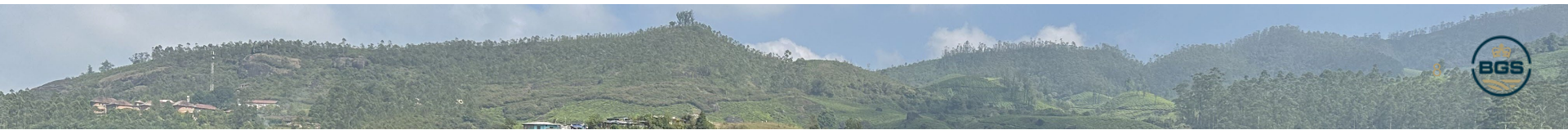
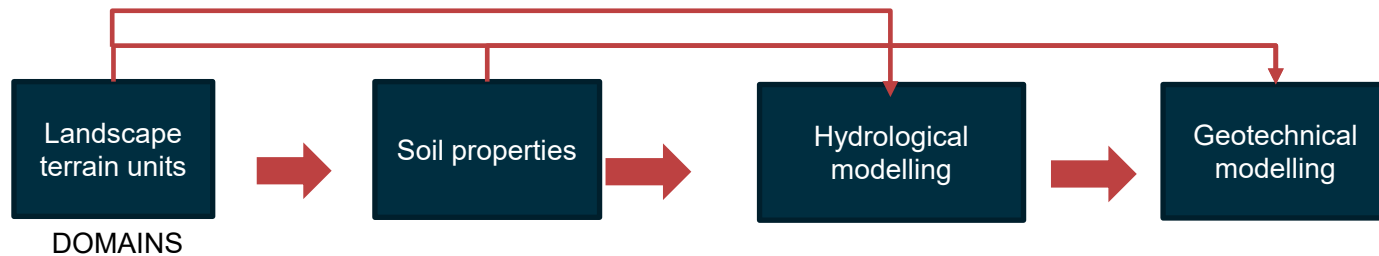


3. LANDSLIDE DOMAINS IN THE IGRD PROJECT

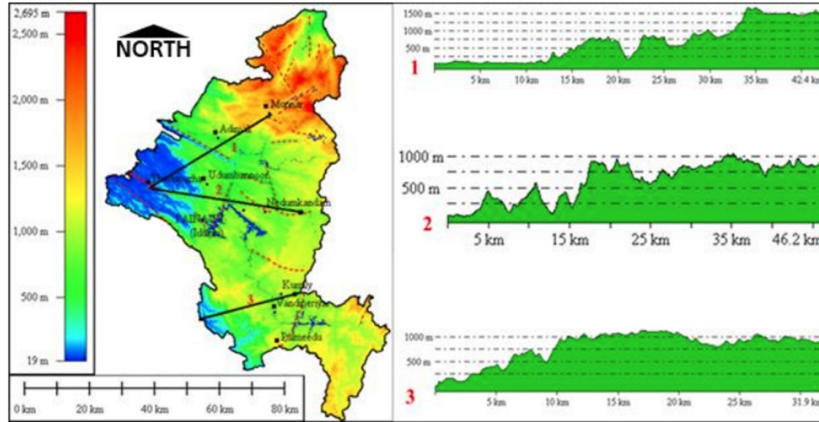
In the frame of this project domain maps should help:

- For understanding the terrain and landscape conditions better and thus the main landslide types and processes
- Define focus areas for sampling and threshold modelling
- Reduce the computations processing size

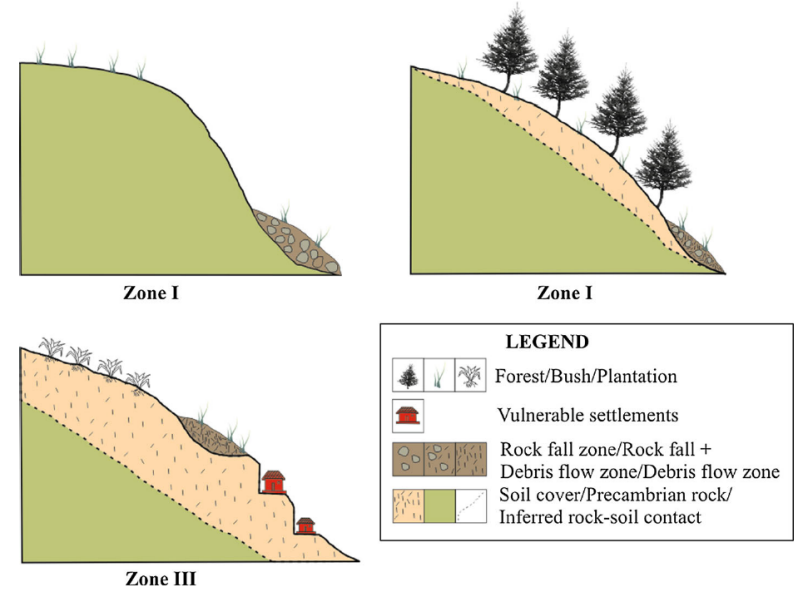
Project Workplan:



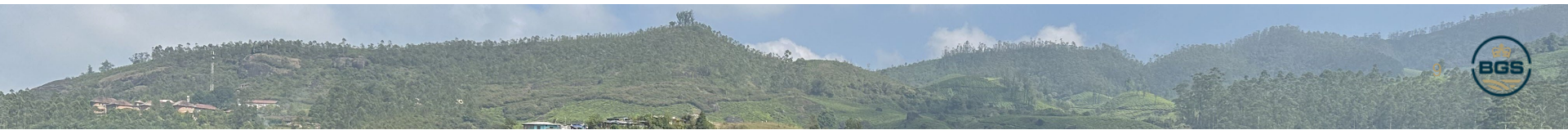
Generalisations of different terrain conditions and corresponding landslide types



Different crosssections through Idukki showing different landforms (Vijesh, CGWB report 2022)

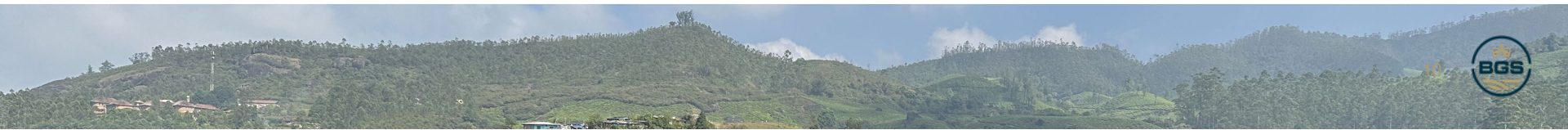
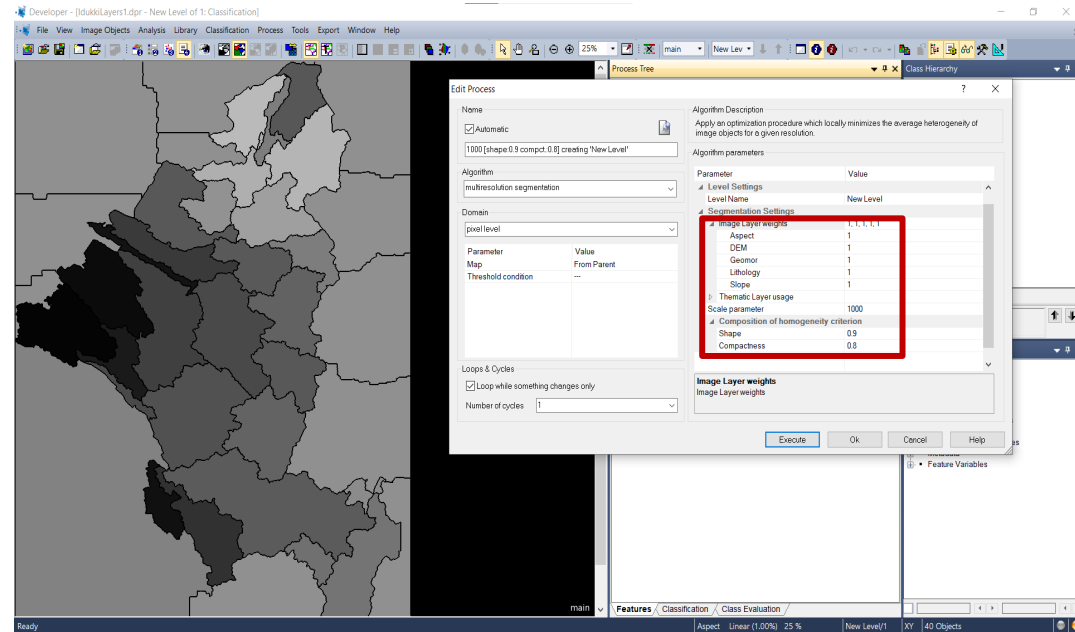


A schematic sketch classifying the study area into different zones on the basis of landslide occurrences and terrain conditions, (K. S. Sajinkumar, S. Anbazhagan, 2015).



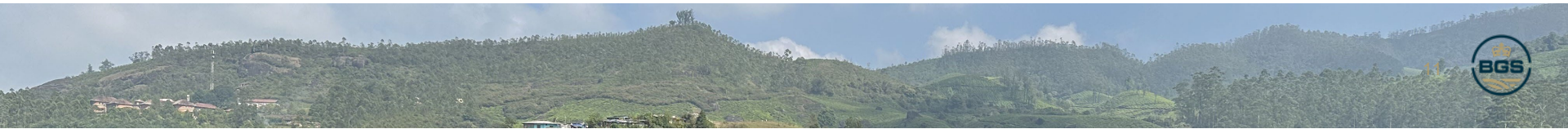
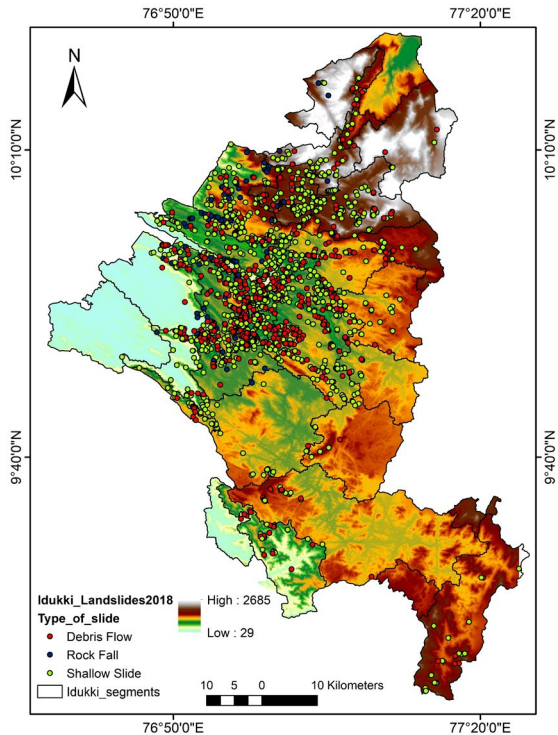
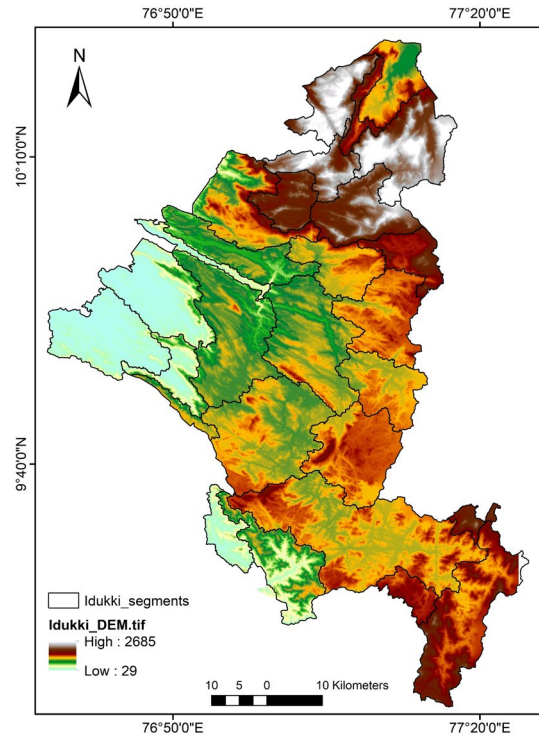
Multiresolution segmentation using eCognition Developer 64 software

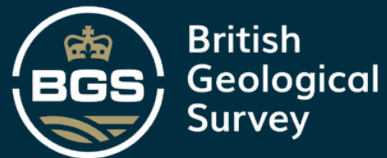
- Software for object-based image analysis (OBIA)
- Segmentation of the Idukki district with respect to DEM, Slope, Aspect, Lithology, and Geomorphology.
- Different parameter settings (scale, shape criterion ratio, compactness) to influence the segmentation process



3. LANDSLIDE DOMAINS IN THE IGRD PROJECT

- First preliminary maps are created
- But, work in progress:
- Further analysis are needed
- Field check in January 2024





THANK YOU

Any questions?

