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ITC FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION



Geodetic laser scanning technique for characterizing landslides along high-risk road zone: Application and limitations






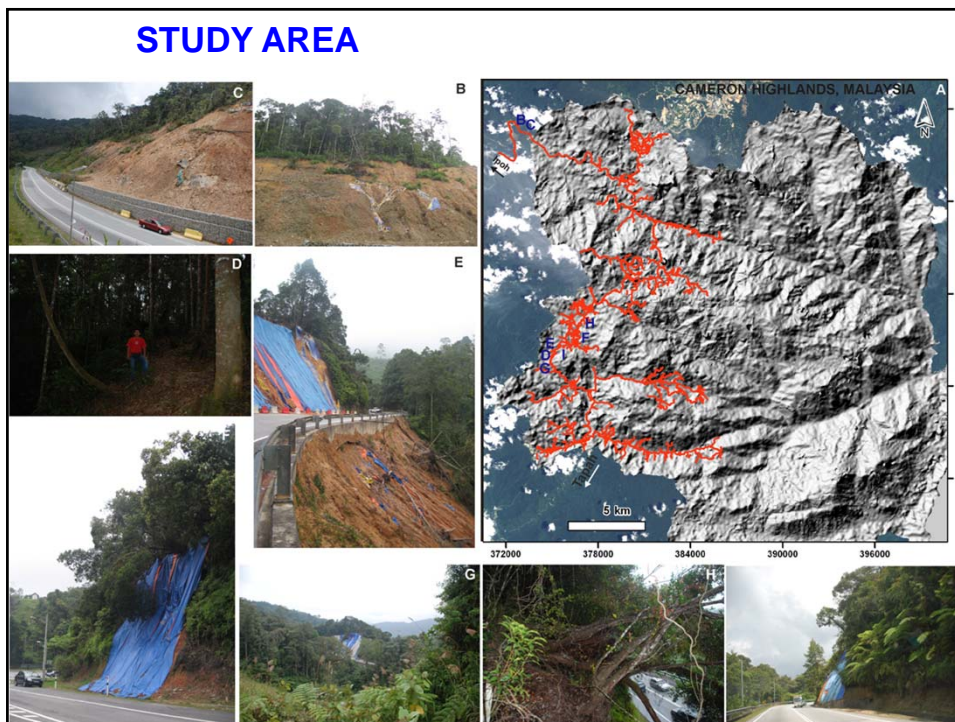
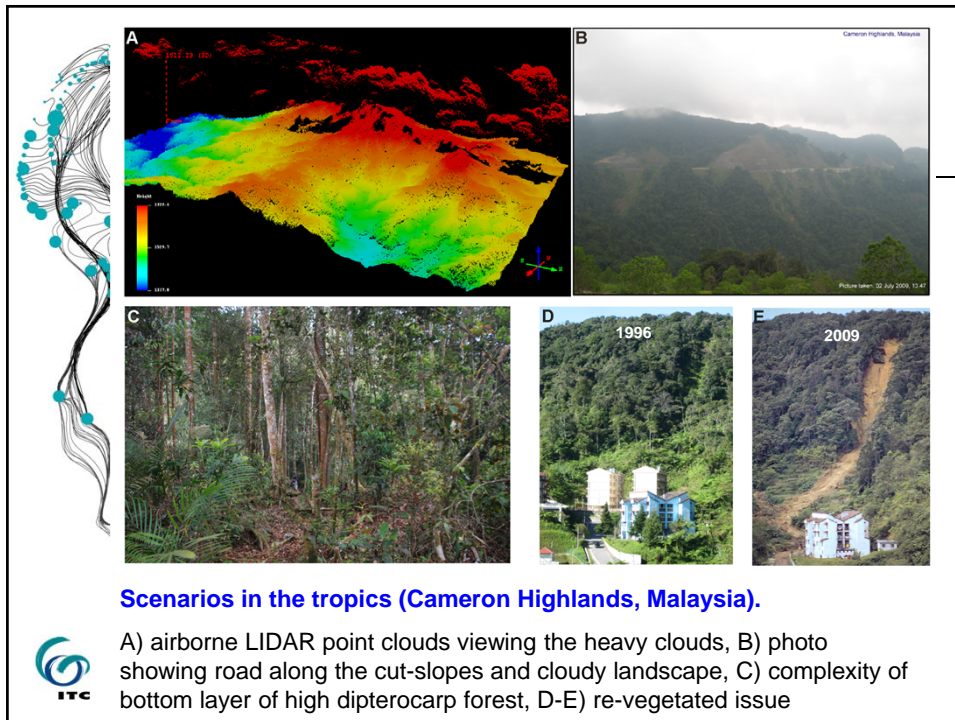
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INTRODUCTION

- The acquisition of precise terrain information has been of utmost importance for a better understanding of natural disasters.
- Geodetic Laser Scanning (GLS) for landslide investigations - more interesting with highly accurate 3D terrain observed in short time.
- To date, there has been little effort to utilize the GLS for landslide investigation along the transportation route in the tropics



METHODS

Space-based geodetic measurement

- establishing several control stations in order to register the 3D models of scanned data into a local coordinate system.
- Utilizing a set of Topcon HiPer Pro Wireless Long-Range Integrated GPS and receiver.



GPS dual frequency Topcon Hiper Pro



Total station Nikon DTM-352



METHODS

Geodetic laser scanning (GLS) measurement

- Use of Topcon GLS-1000 : the occupation and back-sight observation yield a better data acquisition over the tropical rainforest
- A traversing scheme makes this dual-axis tilt instrument suitable for complex scanning areas.
- Registration: tie points, georeferencing, and occupation/back-sight



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METHODS

Characterization of tropical landslides along high-risk road zones

- analyzing the local topographic roughness and slope-based data
- hypothesis - the surface of most landslides is rougher than neighbouring unfailed slopes
- calculating the slope unit features in local scales and also provides understanding on local hill-slope processes driving landslide movement
- slope angle as an important role for driving force of landsliding, particularly the shallow landslides which associated to slope steepness that mainly influenced by the soil strength.



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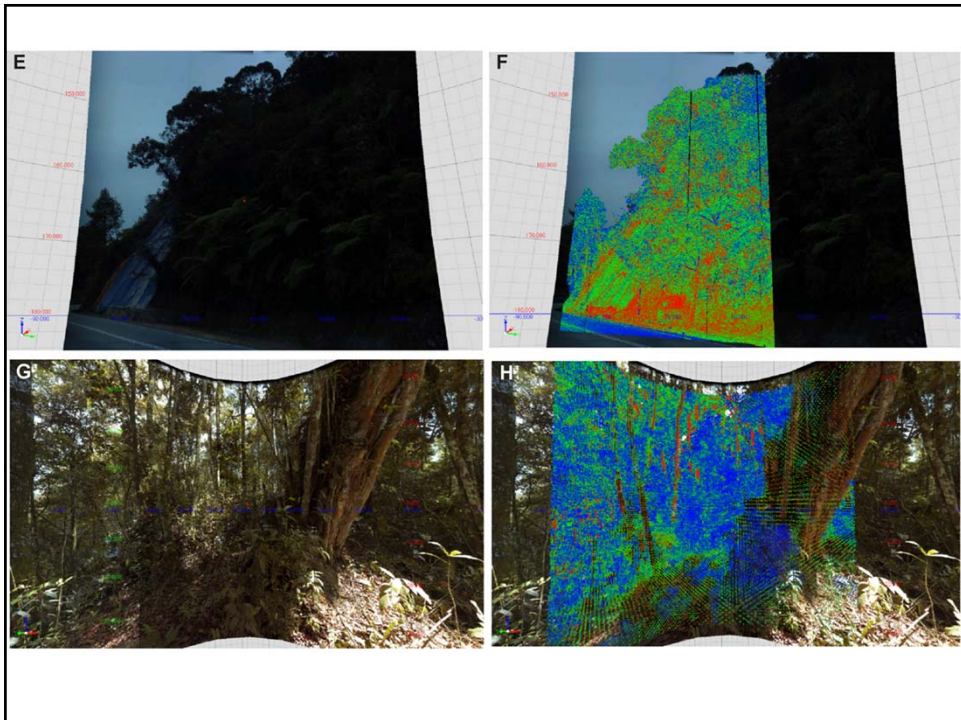
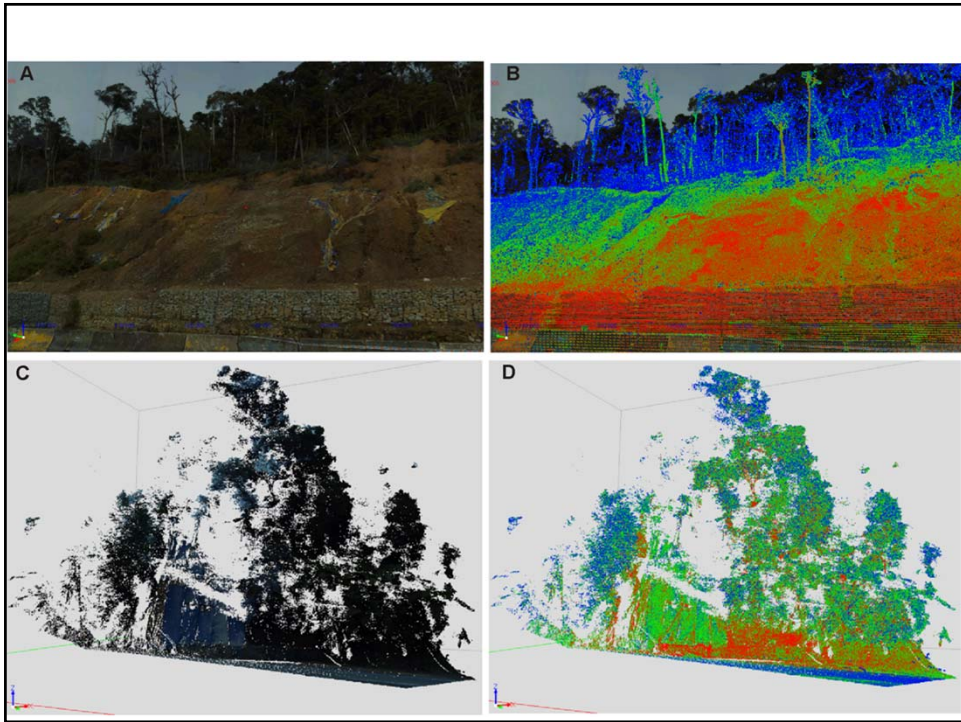


RESULTS AND DISCUSSION

- The standard deviation of each control stations was measured up to 0.006m (in average of longitude - 4mm, latitude - 3mm, height - 5 mm).
- Several laser scanning plots covering:-
 - Different landslide mechanisms
 - Different local topographic
 - Different environment
 - One aim

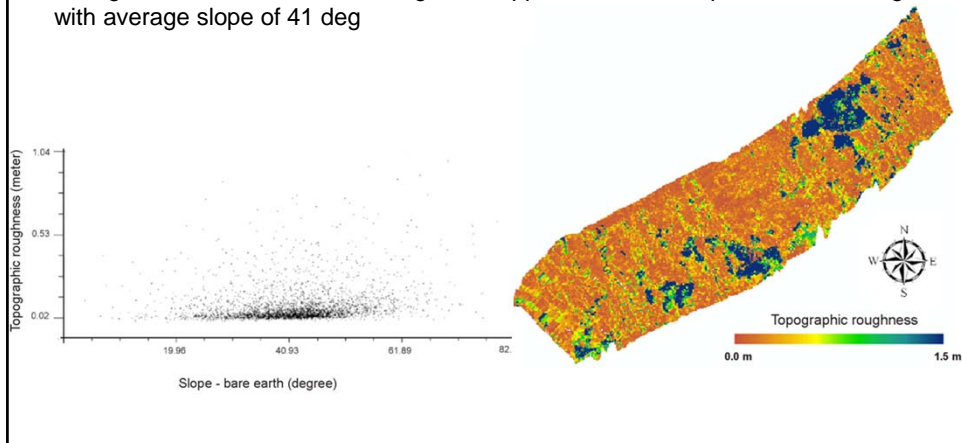


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RESULTS AND DISCUSSION

- A local topographic roughness and slope maps reveals the local changes of topographic roughness and local slopes.
- The topographic roughness of four landslide zones ranging between 0.1 and 1.5 m.
- A higher concentration of the roughness appeared on the slope of 20 to 60 deg, with average slope of 41 deg



RESULTS AND DISCUSSION

- We observed that active landslide components have high topographic variability and undergoes high degrees of deformation.
- The continuous observation could lead to a better understanding of spatiotemporal of tropical landslides.
- In the near future, the utilization of the mobile terrestrial laser scanning for characterizing and monitoring landslides along the roads is much needed.
- Use of higher density of point clouds of airborne laser scanning acquired using a handheld laser scanner could be a better option for mapping landslides over a larger forested terrain

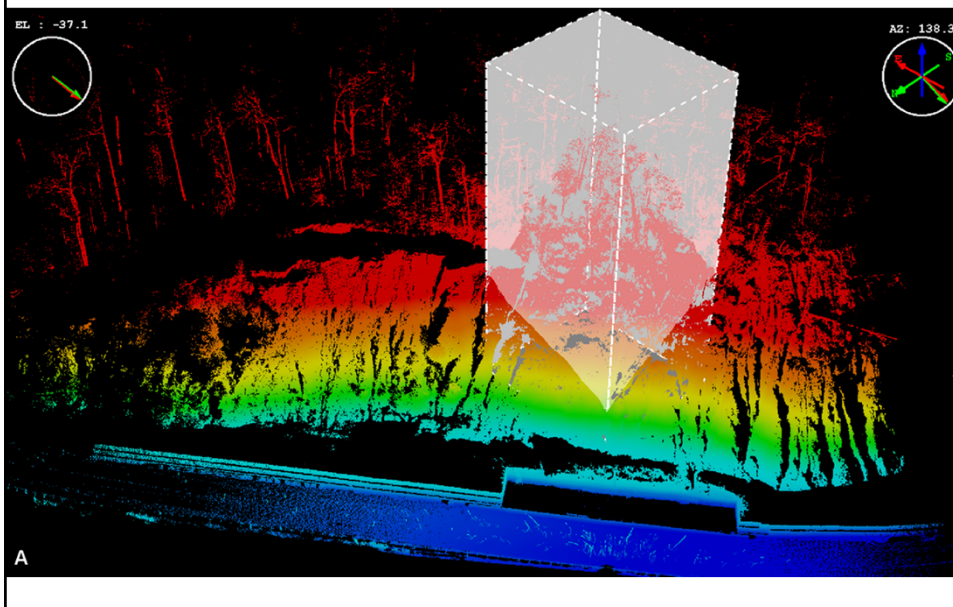


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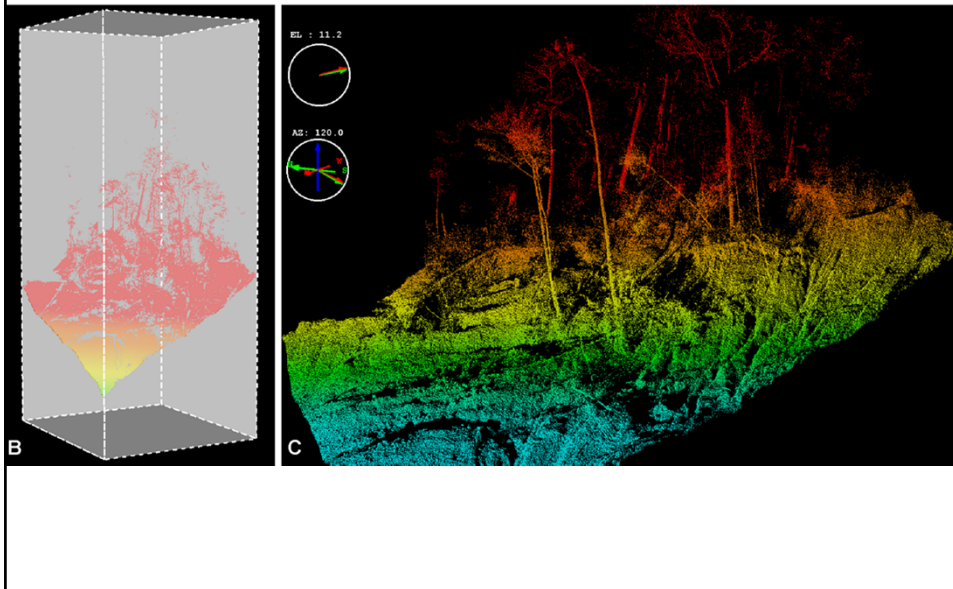
Current research



Current research



Current research



CONCLUSION

- We concluded that GLS is of great interest to supersede the capability of traditional surveying techniques in providing highly accurate and reliable topographic data in equatorial regions.
- As recommended in the National Slope Master Plan 2009-2023, this technique can be an important tool to support for emergency response in the context of disaster management in the tropics, particularly over highlands areas in Malaysia.



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THANK YOU FOR YOUR ATTENTION



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