British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Application of remotely sensed data for landslide hazard assessment: ...a UK perspective

Monitoring and Managing the Earth's Resources - Geological Remote Sensing Group
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David Boon & Stephen Grebby

Claire Dashwood, Hannah Jordan, Pete Hobbs, Lee Jones & Helen Reeves , Catherine Pennington, Katy Freeborough

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Outline

1: Background and current survey methods (Dave)

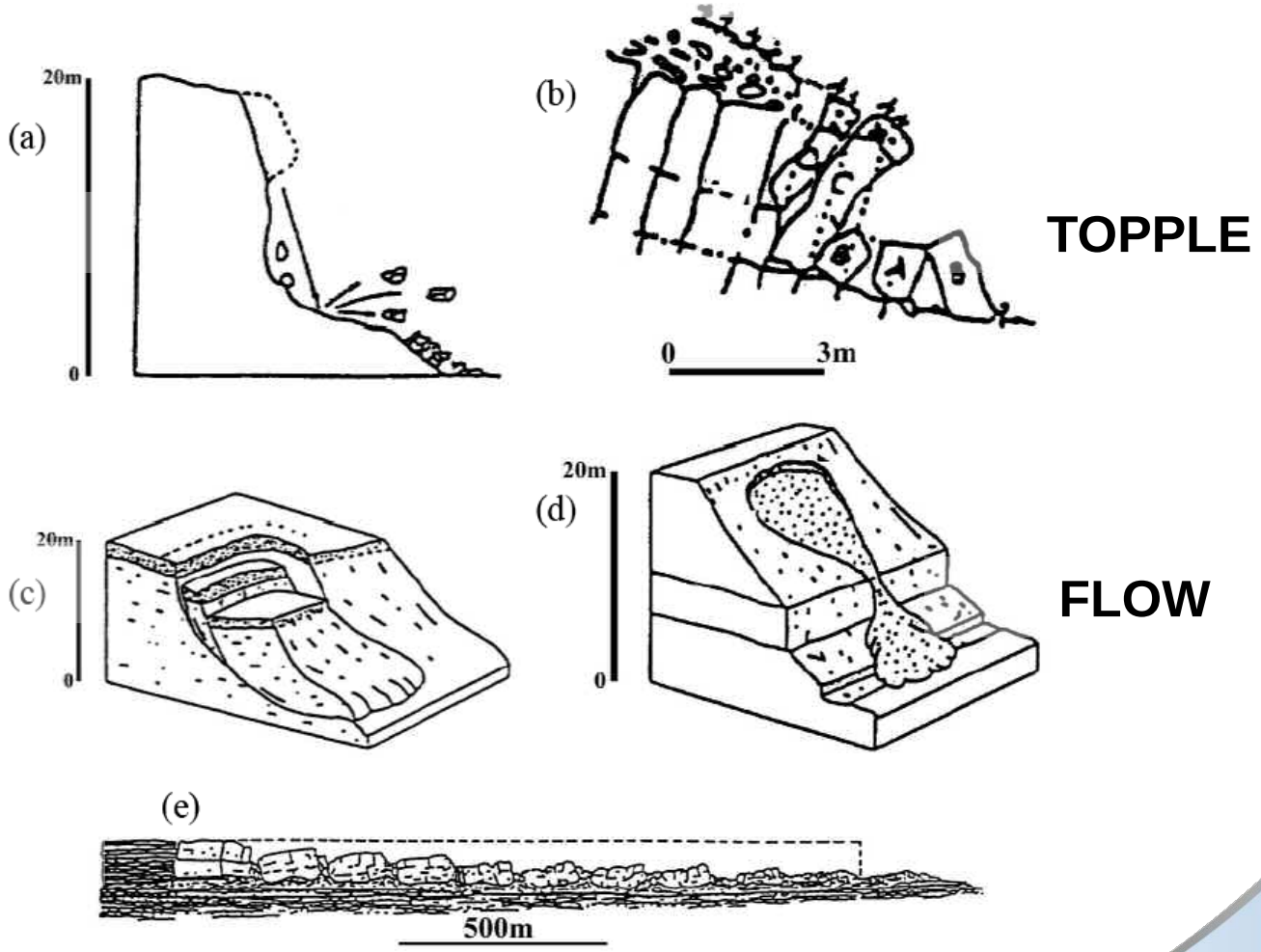
- What causes landslides
- Why and how we survey landslides
- Two ‘Case Studies’ applying RS data

2: Towards enhanced landslide mapping (Stephen)

- Overcoming limitations with current methods
- Quantitative approach to landslide mapping
- Landslide classification in North Yorkshire using LiDAR

1. What is a landslide? Classification

"A downward and outward movement of slope forming materials under the influence of gravity"



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2. What causes landslides?

Pre-conditioning factors

Geology

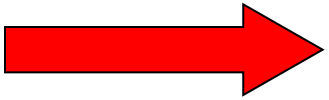
Slope/Topography

Quaternary history

Vegetation change

Tectonic activity

Triggering factors



Climate/Rainfall/Frost

Changes in water table

Loading/Unloading

Earthquake

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3. Impact of landslides in the UK – Ground Risk

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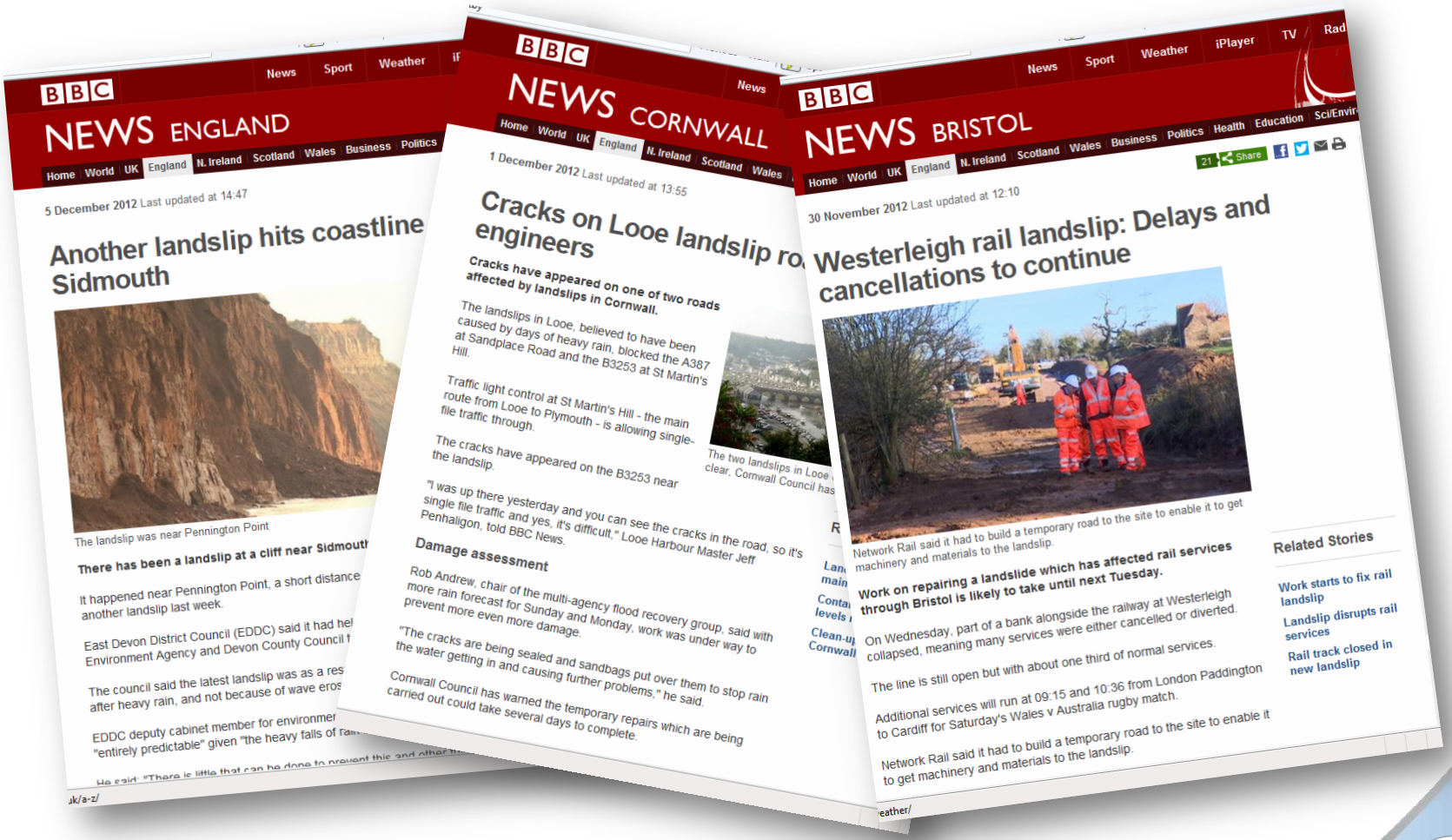
4. The UK landslide hazard is continually evolving...

..So we are continually collecting data. What do the figures tell us?



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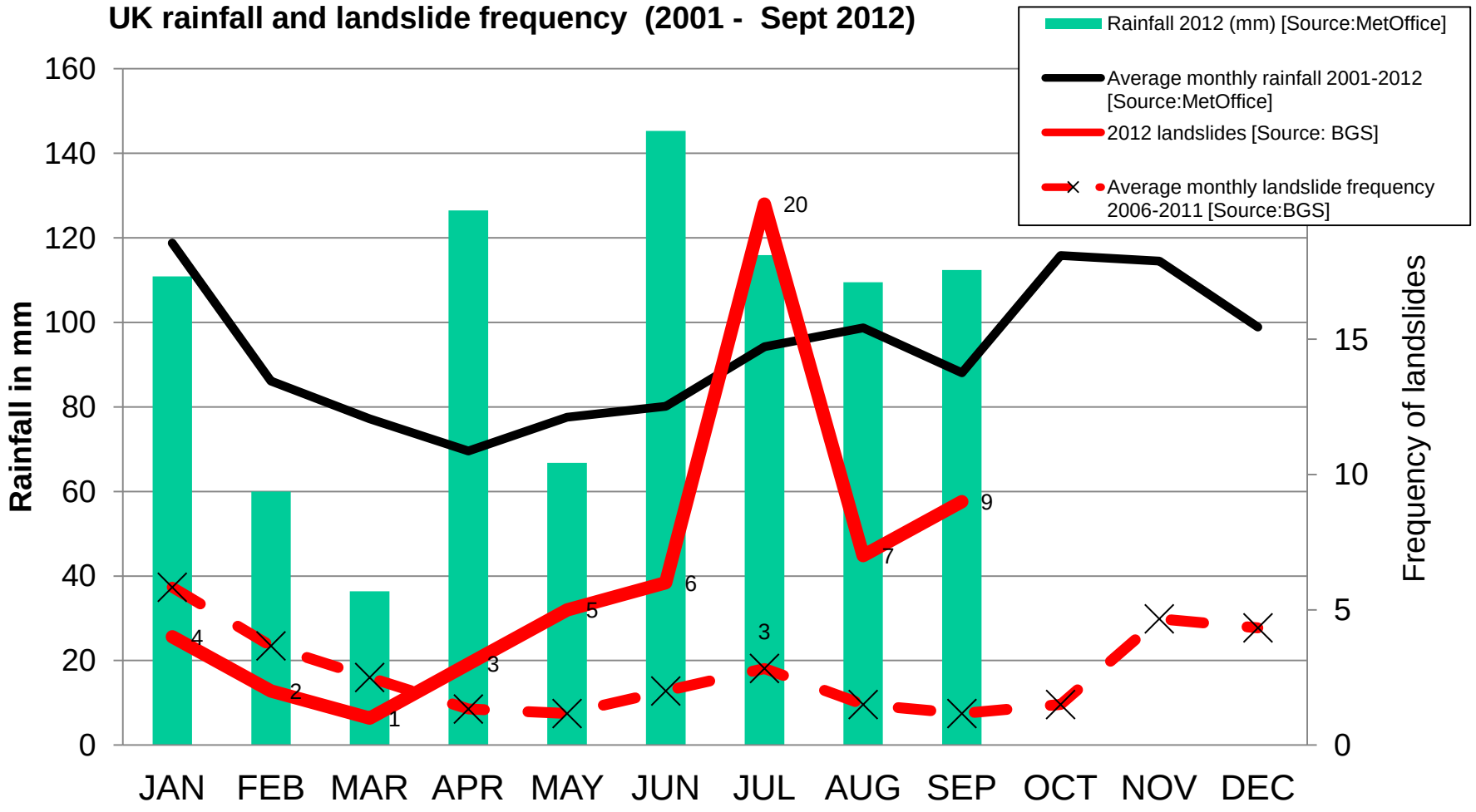

For latest figures see: http://www.bgs.ac.uk/science/landUseAndDevelopment/landslides/November2012.html

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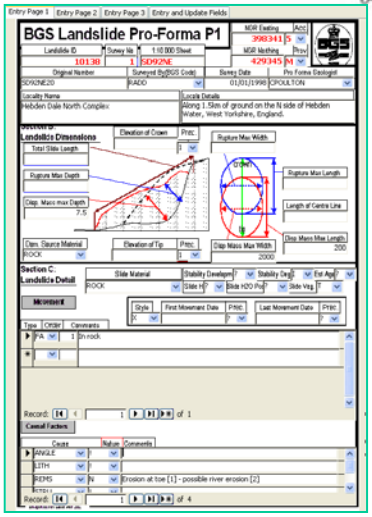
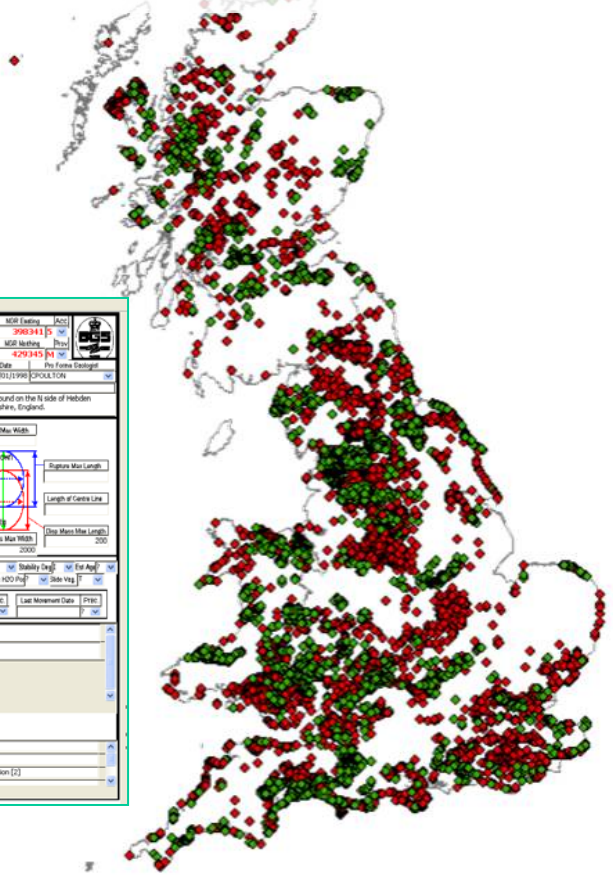
5. RS data for landslide hazard mapping

1. Office 2D/3D Aerial Photo Interpretation (SocetSet/**GeoVisionary**/ARC)

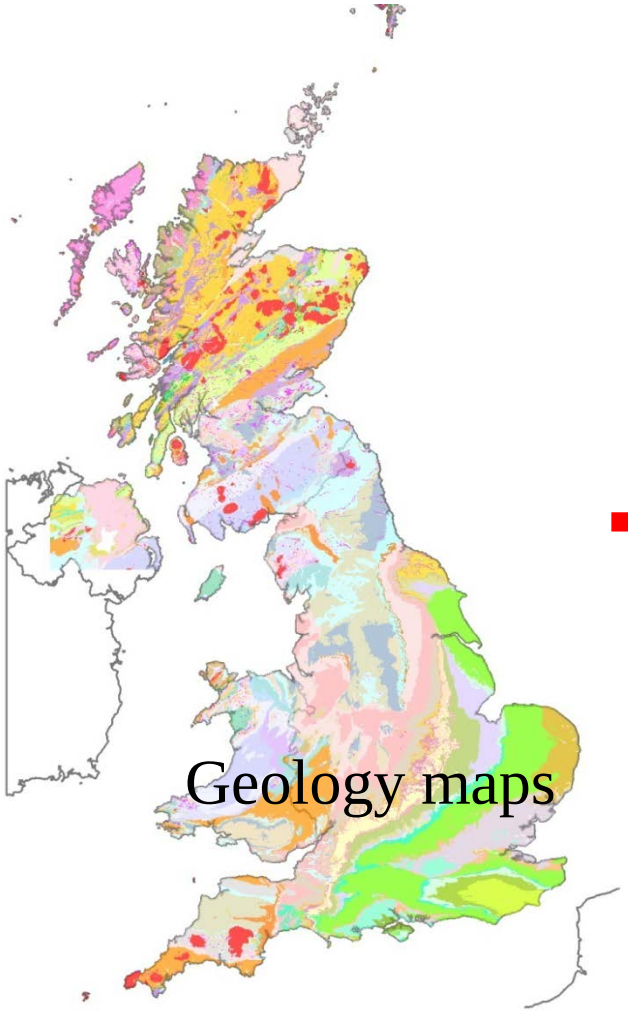
2. Field checking with AP and DTMs

3. Update UK Landslide Inventory and maps
(National Landslide Database
Contains over 14,000 records)





7. National-scale landslide hazard maps for planning



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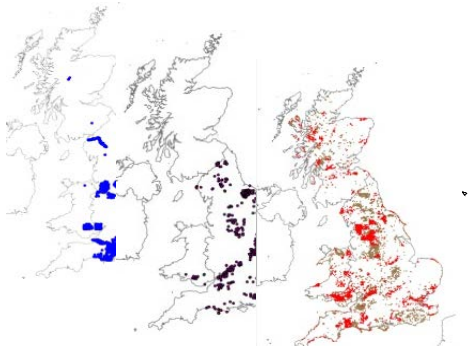

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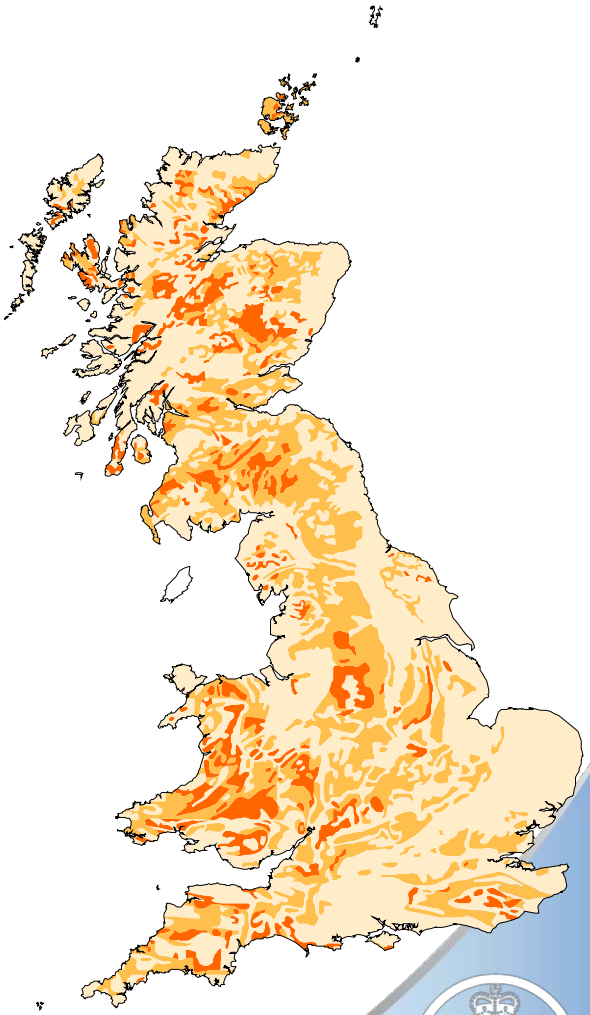

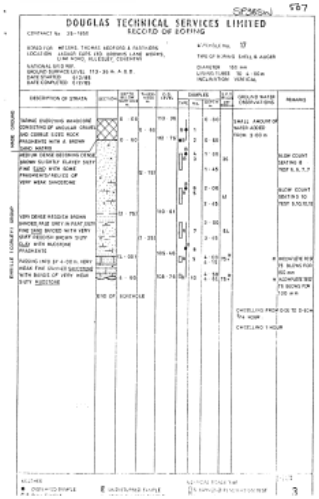

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10. Improving landslide hazard mapping

Geological information

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Landslide inventory

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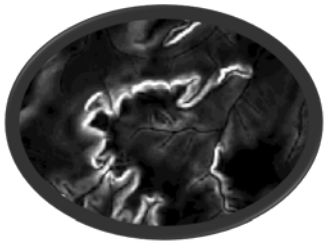

Slope processes information

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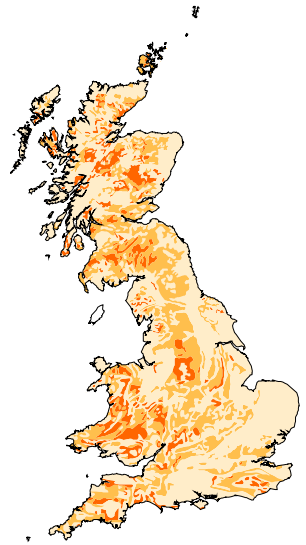

Landslide susceptibility

Knowledge and data!

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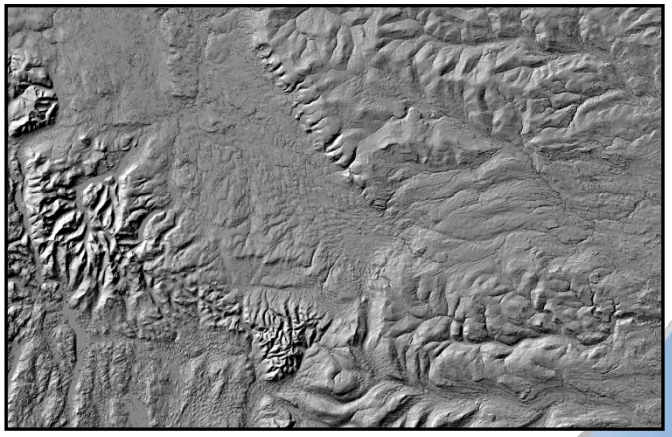
11. Primary limitations of current landslide mapping

Financial and practical constraints with fieldwork

Increasing dependency on remotely sensed data



National-scale Nextmap 5-m DTM

Data

Approach

Visual identification/mapping can be inefficient and subjective

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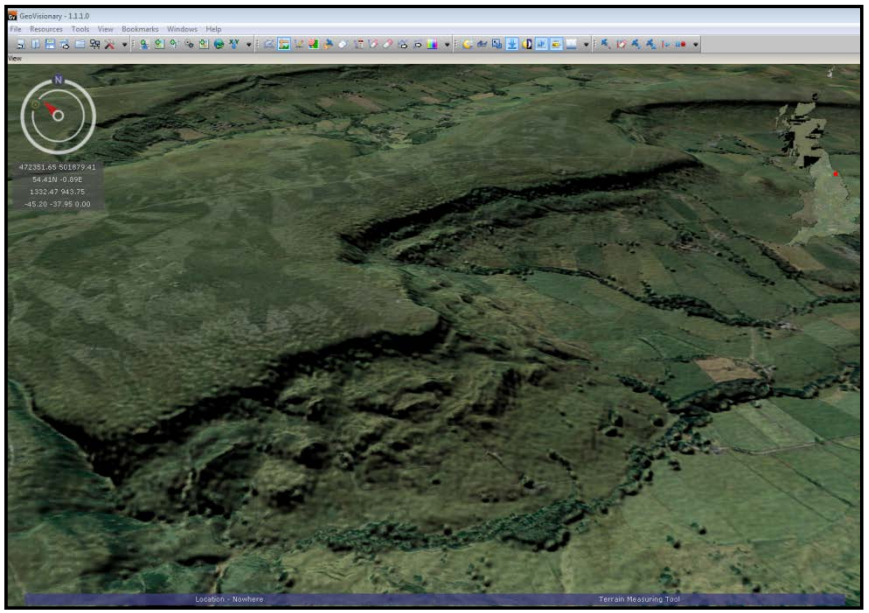
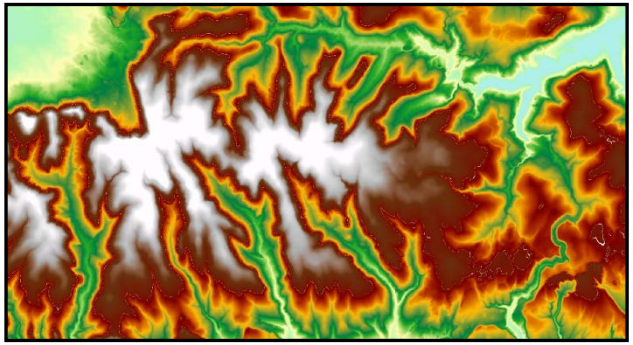
11. Quantitative approach to landslide mapping

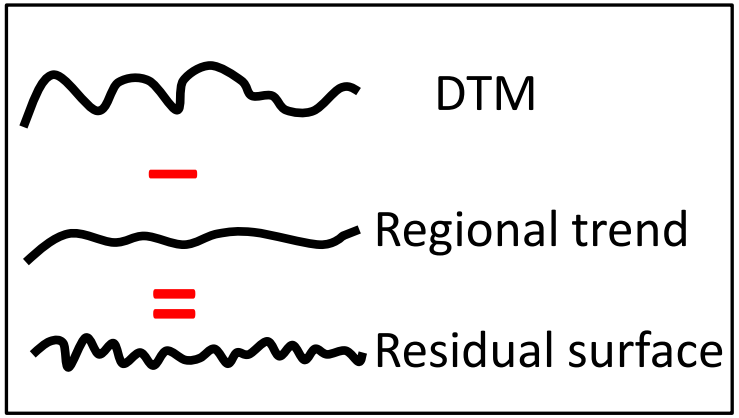


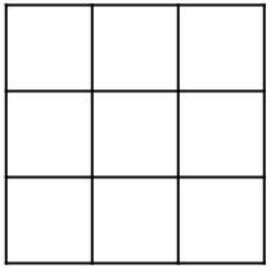
Landslides typically have a distinct topographic expression:

- Non-slipped terrain is smooth
- Slipped terrain is relatively rough and hummocky

Surface Roughness







Standard dev. in n x n pixel kernel

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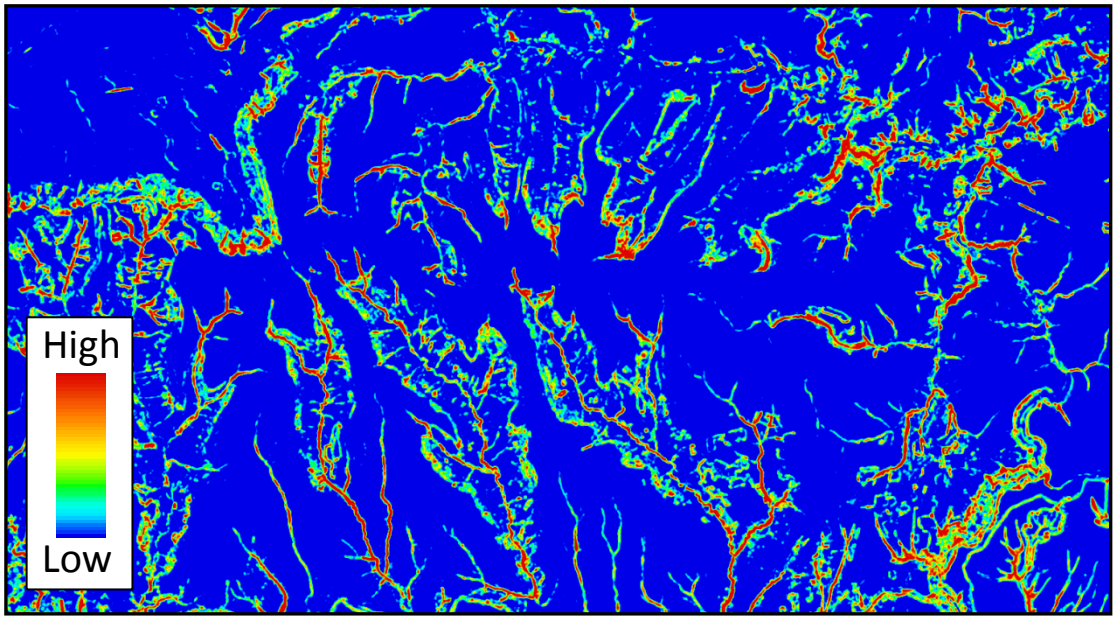
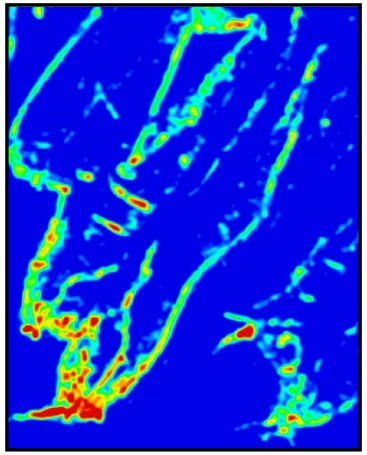
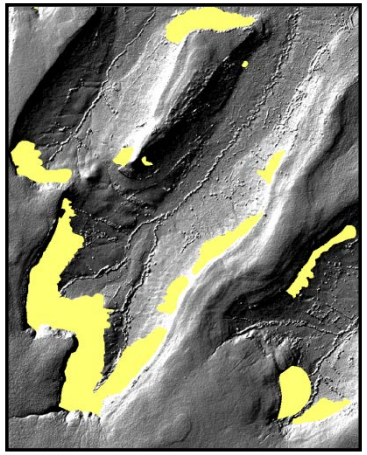
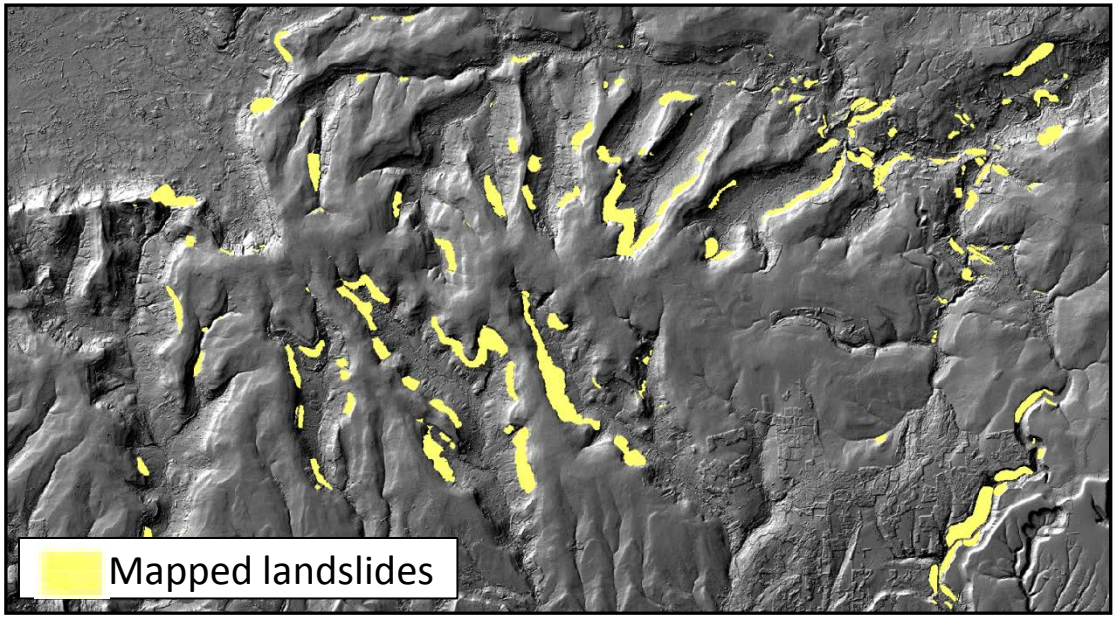
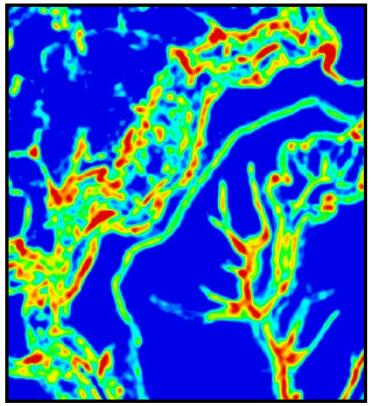
12. Landslide mapping using surface roughness

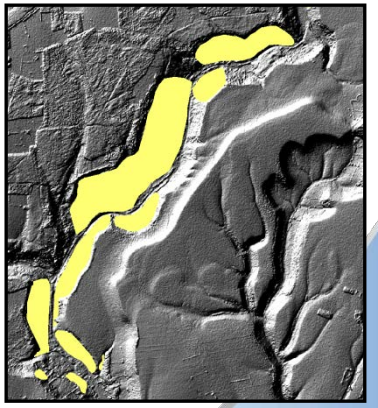




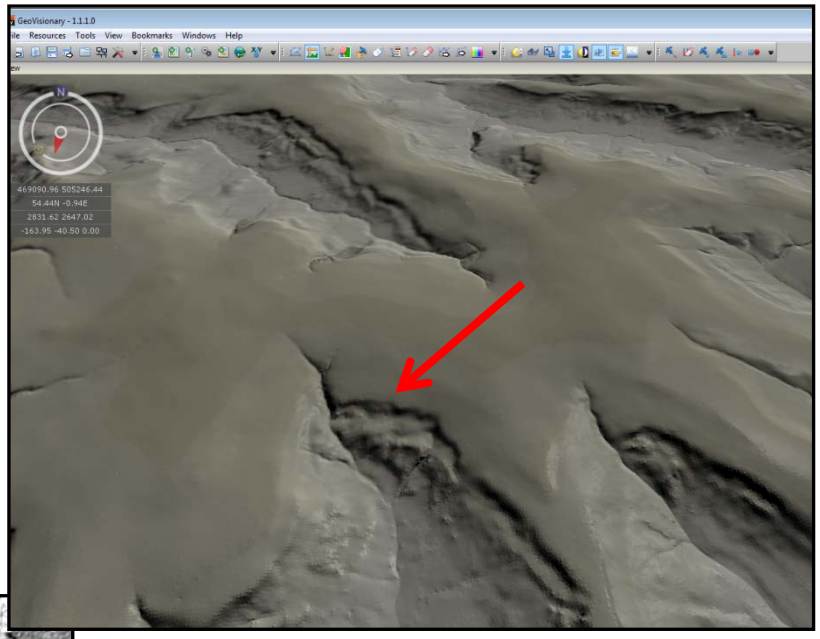


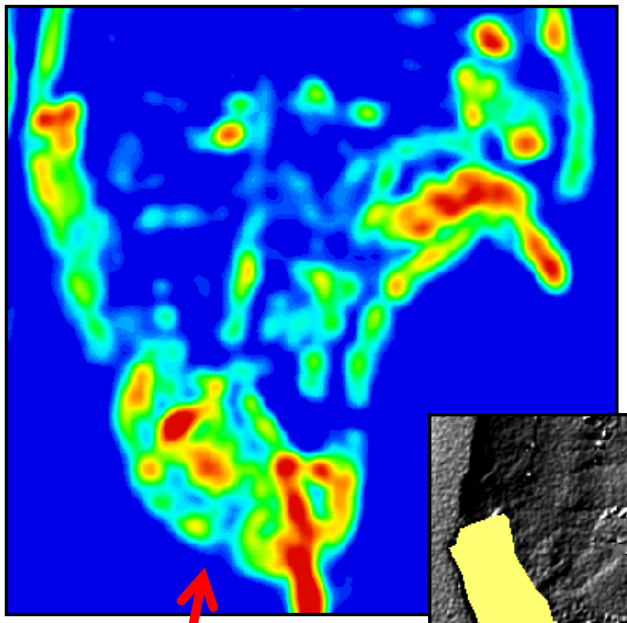


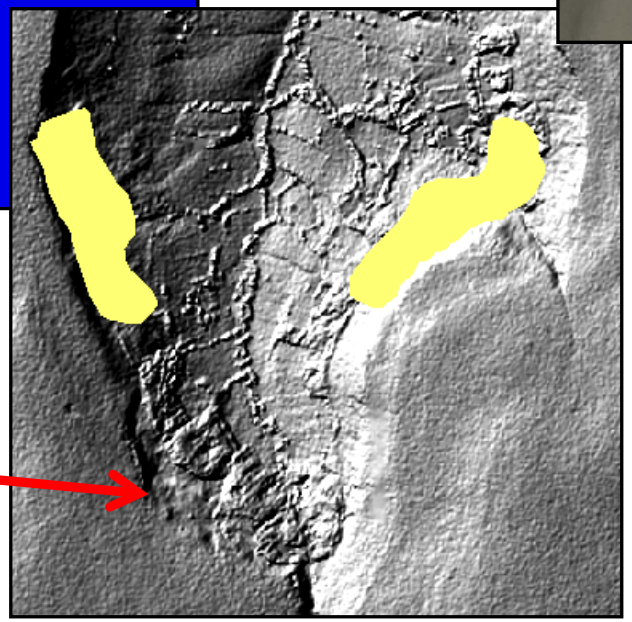




...surface roughness continued







Unmapped landslide?

- 5-m Nextmap DTM can be used to identify deep-seated landslides through roughness
- Not suitable for mapping shallow landslides and coastal hazards

LiDAR – Terrestrial & Airborne

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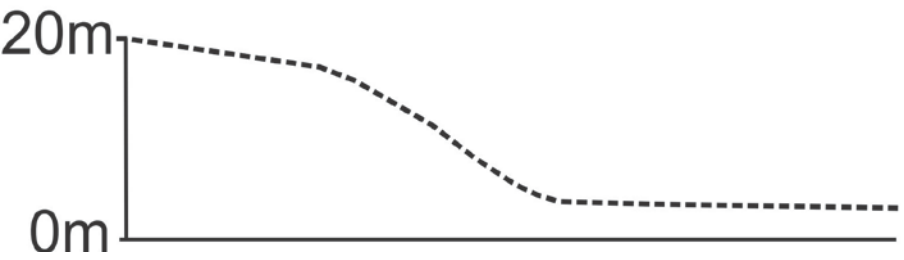
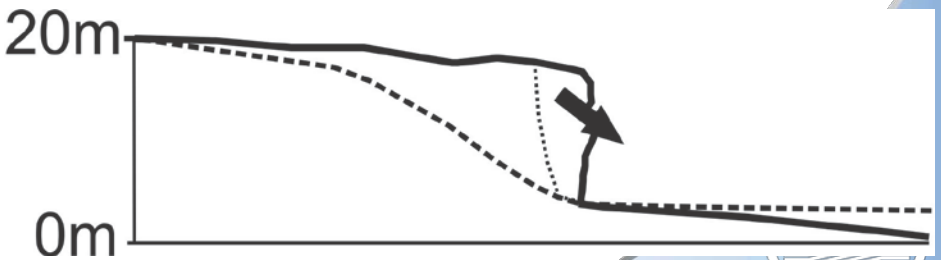
13. Advantages of Terrestrial LiDAR data for cliffs

'Best available' DEM: NextMap (5-m) viewed in GeoVisionary

DEM from Terrestrial LiDAR 10-mm Viewed in GeoVisionary





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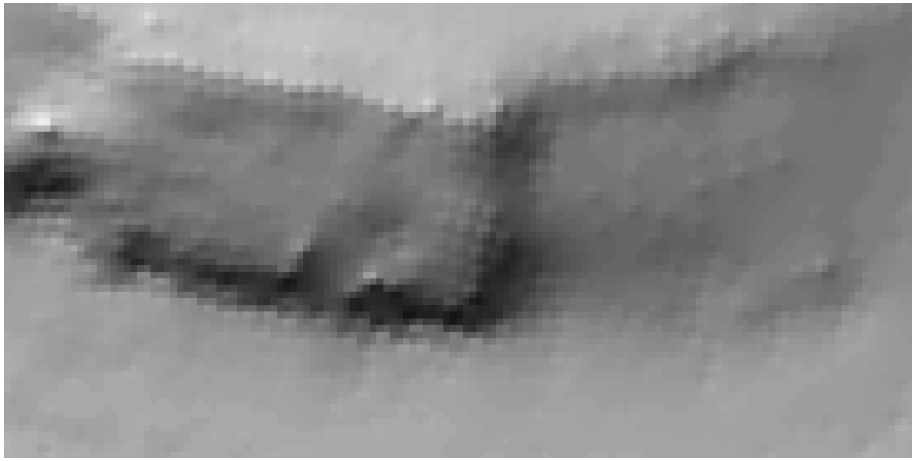
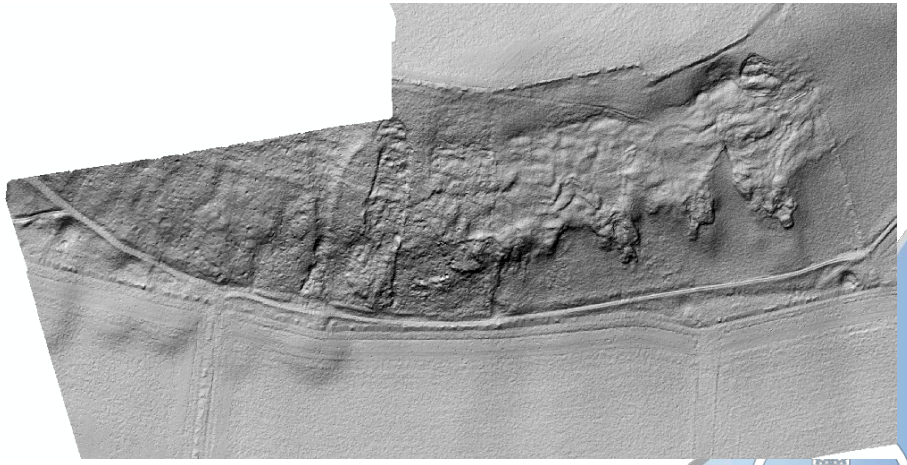
14. Advantages of Airborne LiDAR data

High-resolution DTMs

Identifying shallow landslides



5-m Nextmap DTM



0.25-m LiDAR DTM

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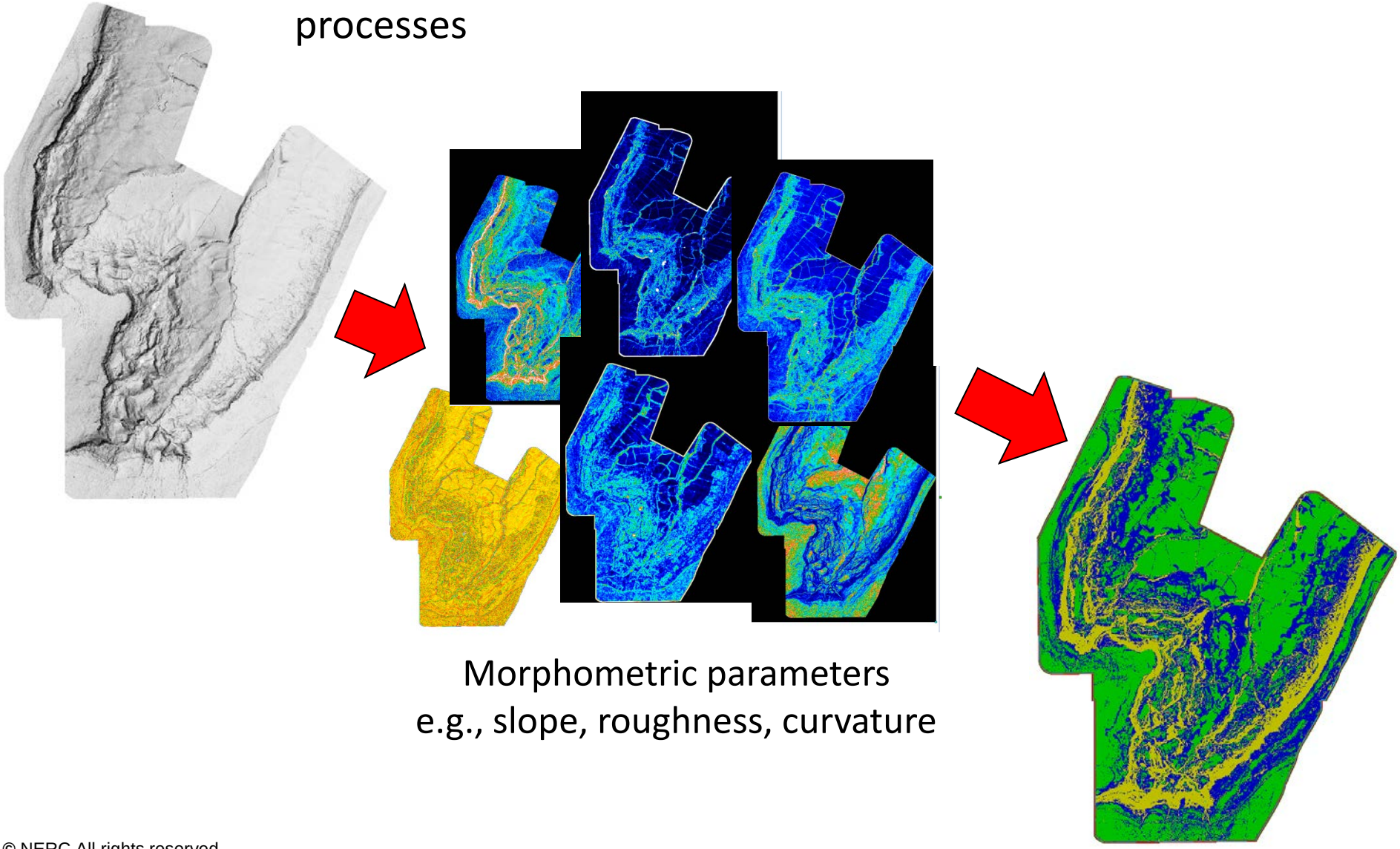
15. Classification of landslide morphology

- Landslide morphology can improve knowledge of slope processes



Morphometric parameters
e.g., slope, roughness, curvature

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Conclusion

- Landslide inventory and slope processes knowledge are essential for landslide hazard mapping
- Remotely sensed data plays an ever increasing role in geohazard studies for engineering and planning
- High-resolution topographic data and quantitative analysis can improve knowledge – inventory and slope processes
- Feed knowledge back into susceptibility mapping
- Integration of quantitative and qualitative techniques has potential to deliver efficiency gains

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