School of Computing
FACULTY OF ENGINEERING
UNIVERSITY OF LEEDS

Mobile 3D visualisation techniques in field geology education

Evaluation of current tablet applications

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Supervised by

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Thanks to:

- My supervisors
  - Dr Douglas Paton
  - Dr Roy A Ruddle
- BGS (collaboration)
  - Patrick Bell (Team Leader Web Systems)
  - Wayne Shelly (iGeology iOS developer)
  - Robert C. Pedley (iGeology 3D Android developer)

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Presentation outline

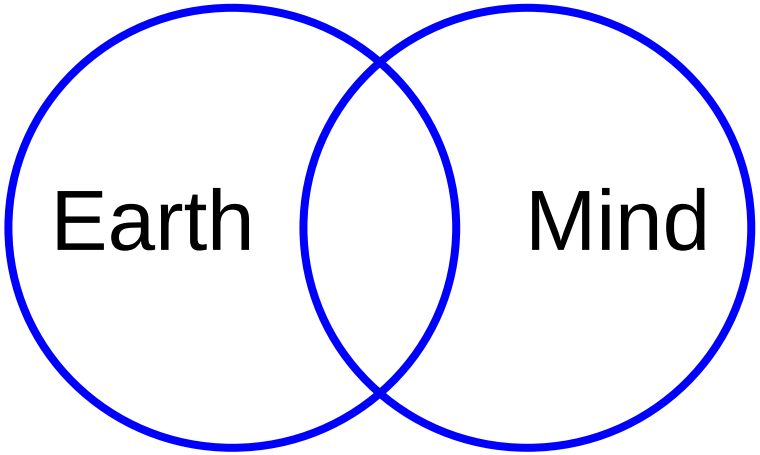
- Research outline
  - Problem & hypothesis
  - Research issues
  - Research case study
- Evaluation
  - Method
  - Results
  - Discussion
- What next?
- Q&A

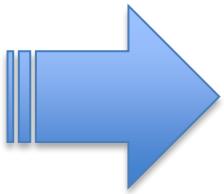
Michael Jones:

"I would say that what makes smartphones smart, in large measure, is their sense of location"

http://m.theatlantic.com/technology/archive/2013/01/googles-michael-jones-on-how-maps-became-personal/266781/

Research outline (1)





Kastens & Ishikawa 2005

iPad Mini image from:
http://www.chipchick.com/2012/10/ipad-mini-what-you-need-to-know.html

Research outline (2)

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- Research:
  - EPSRC PhD in Visualization/Analysis of 3D Geophysical Datasets
  - visualization techniques to aid *student geologists* do fieldwork more effectively.
- Research issues
  - **Extrapolation of 2D features to 3D** Whitmeyer, S., M. Feely, et al. (2009)
  - Apply observation to different scales Whitmeyer, S., M. Feely, et al. (2009)
  - Centuries old techniques Patnode, H. W. and R. Hodgson (1964), K. J. W. McCaffrey, et al. (2005)
    - Geological Maps (2D)
    - Cross sections (2D)
- Nature of data:
  - "**Geological data** is spatial and temporal" K. J. W. McCaffrey, et al. (2005)
- Hypothesis: tablets & smartphones *can help.*

Research issues in 3D

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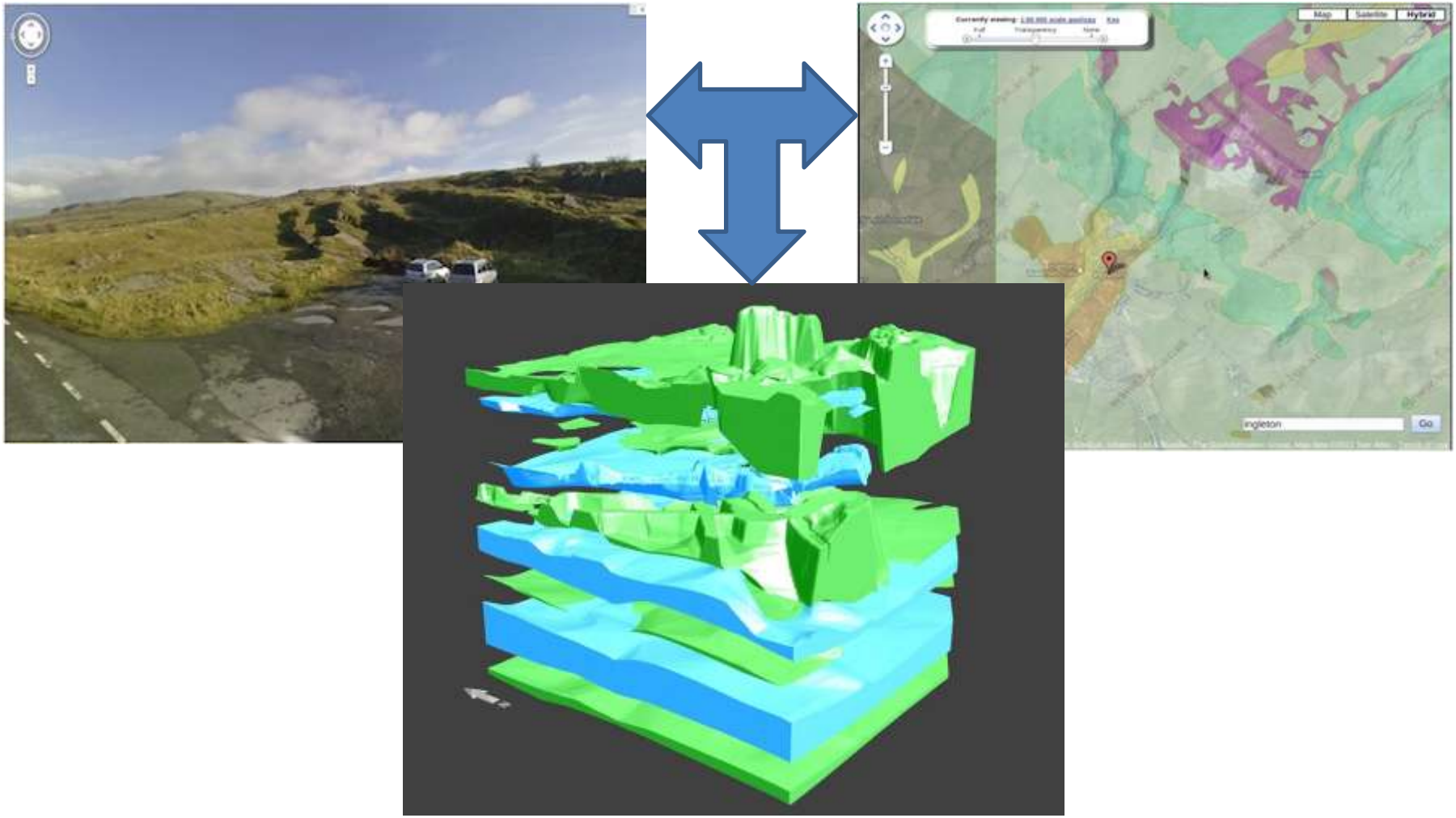

Image: Martin-Luther University Halle-Wittenberg. Bitterfeld, Germany 3D PDF Model Available at: http://www.3d-geology.de/interactive/?lang=en [Accessed 25 Jan 2012].

Ingleton case outline:

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- Tasks
  - Regional geology overview (MSc only)
  - Locate yourself
  - Observations
    - Locate feature
    - Identify rock
    - Sketch
    - Putting rock into context
  - How immediate location fits into area
  - Making assumptions progressively

Lead geologist and student interviews

Case study location: Ingleton, North Yorkshire, UK

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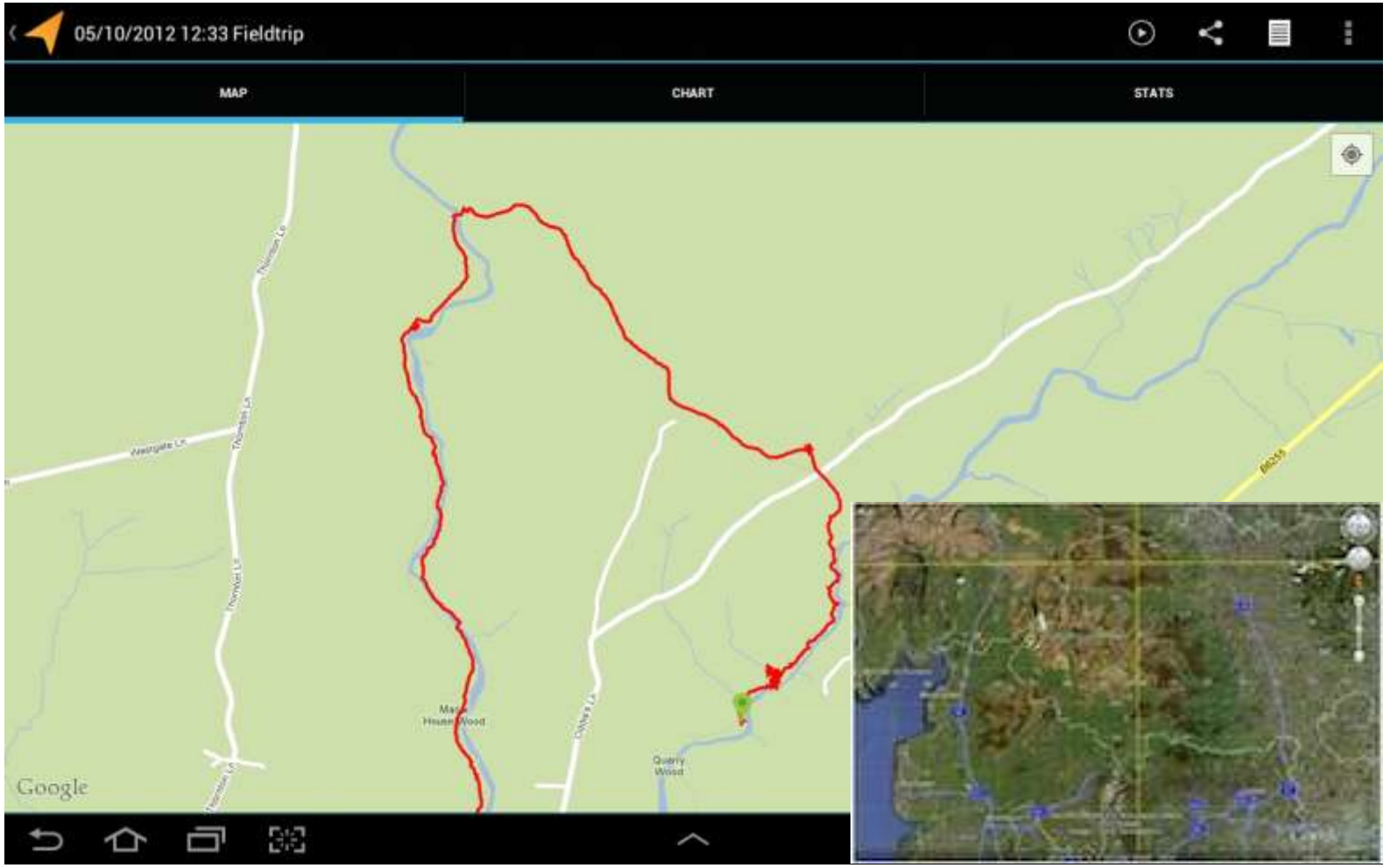
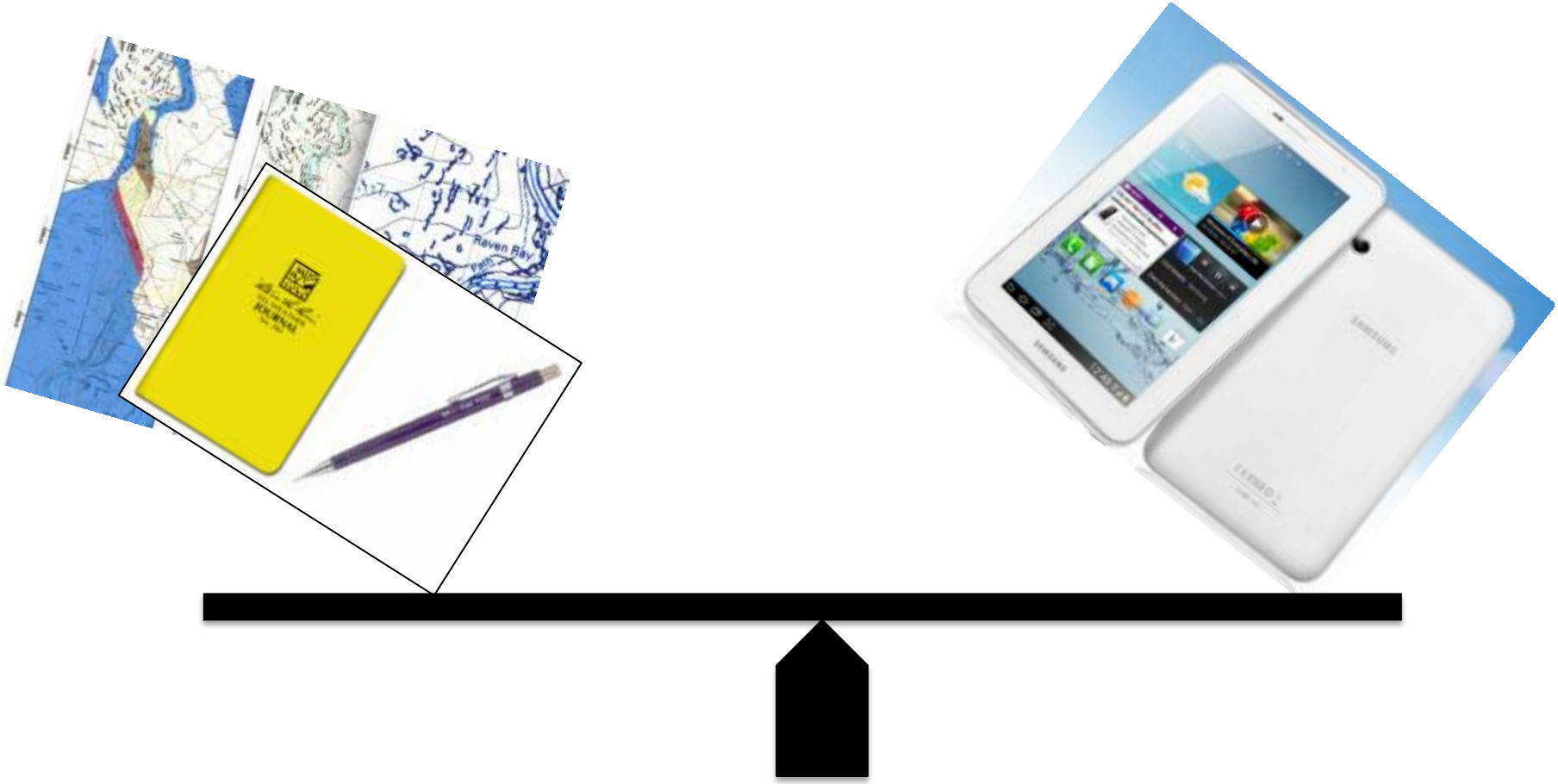


Evaluation: convention V tablets



Evaluation outline

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- Participants: student field trips
  - MSc: 9 (Structural geology)
  - Undergrads: 10 (Geophysicists)
- Method:
  - Within participants
  - Normal field trip tasks
  - Baseline: traditional task carried out with & without tablet
- Expert review
  - Comments & review of data (Dr Douglas Paton & Dr Graham McLeod)
- Mostly qualitative
  - Quality of sketch, details and data captured (unquantifiable)
  - Locate yourself (accuracy of location ~meters)

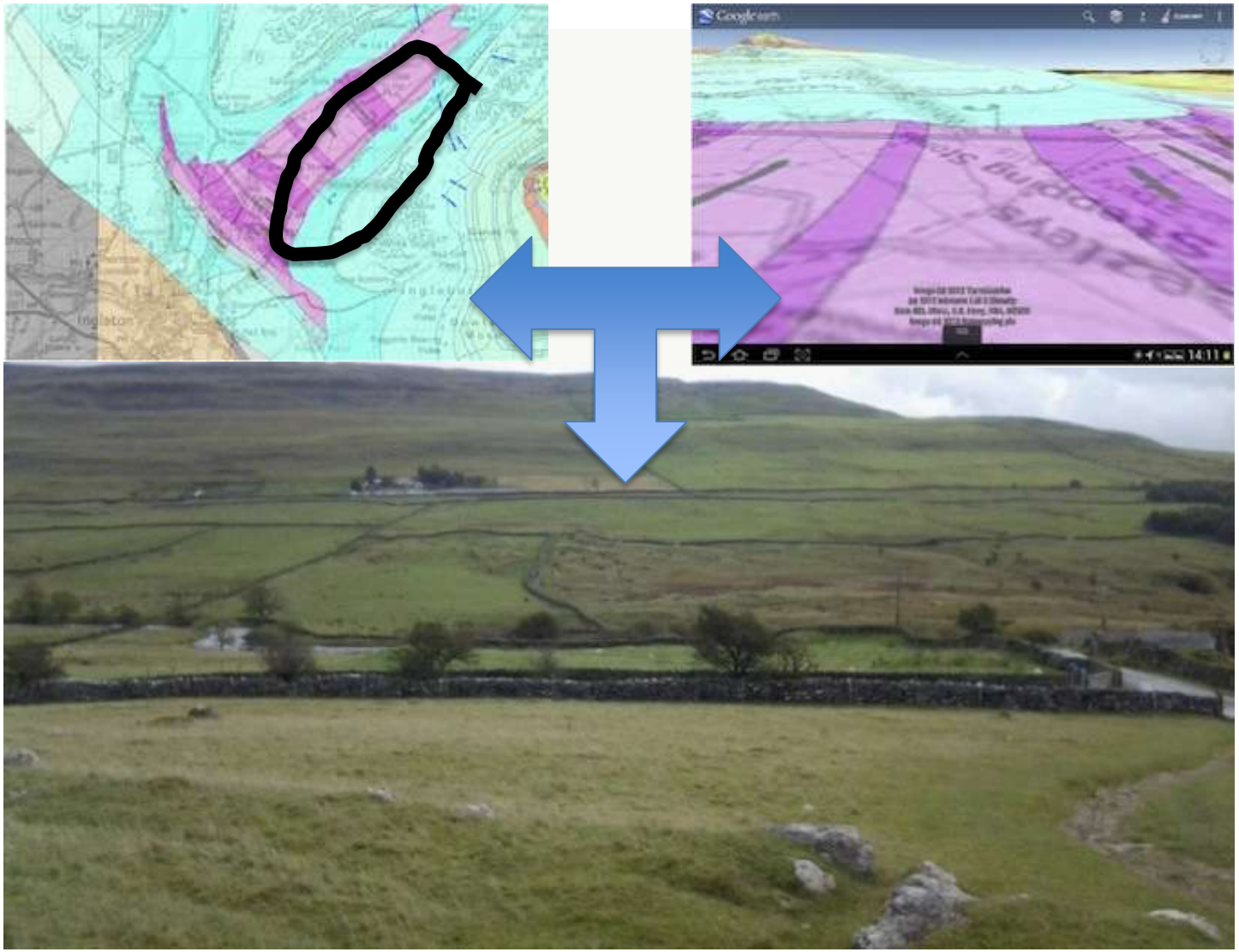
Material

- DEM & satellite imagery
  - Google Earth
- Augmented Reality
  - BGS iGeology3D: geological data over camera view
- Other apps
  - BGS iGeology: 2D geological map + GPS data
  - Polaris Office & PicsArt (35 million downloads): sketching
  - GeoCam (GPS stamp)/SayCheese: picture with GPS stamp
- Conventional
  - Data: printed maps (topographic, geological)
  - Tools: compass clinometers
  - Data collection: notebook and pencil

Evaluation: Procedure

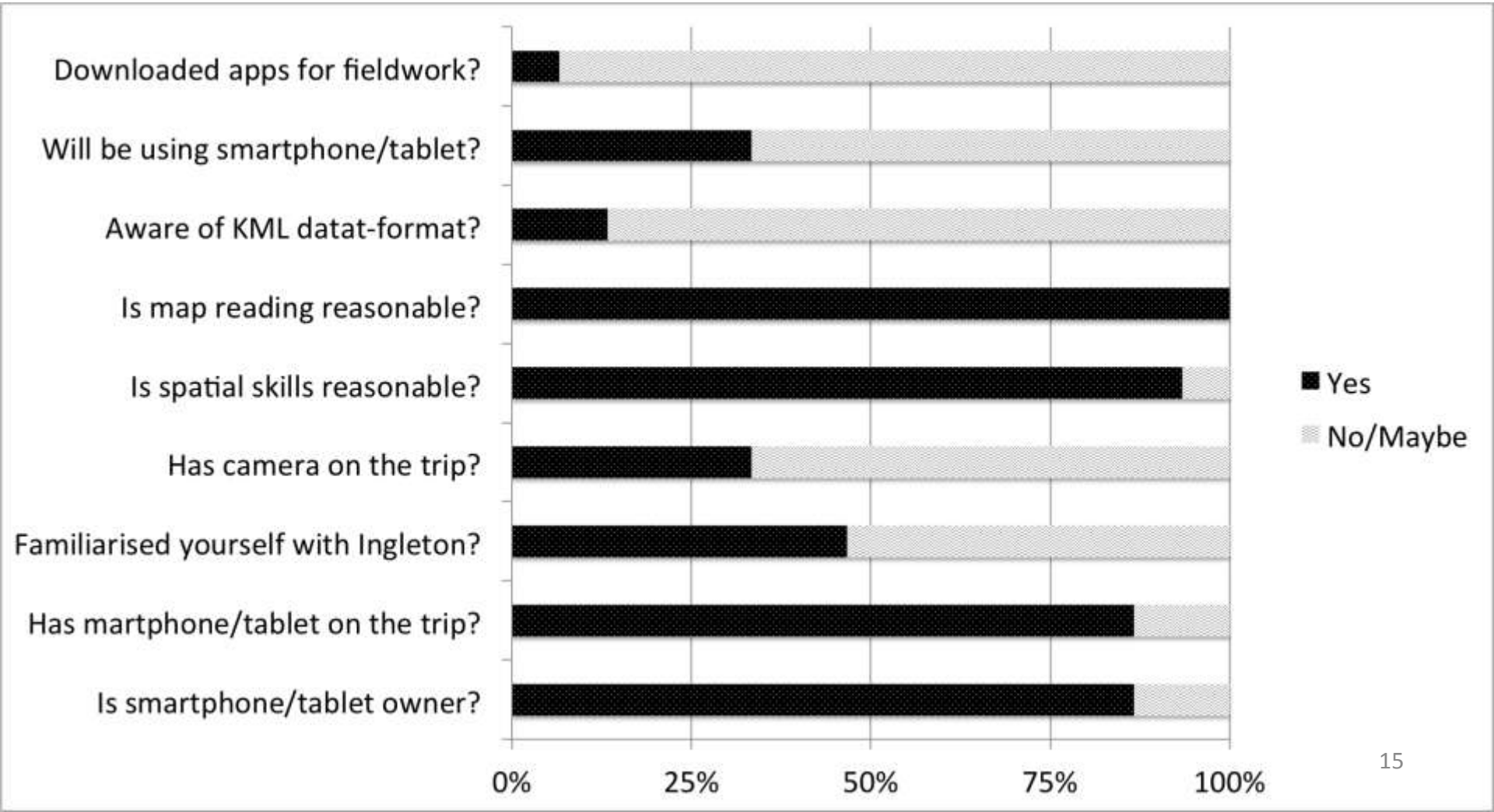
- Participant tasks:
  1. Locate yourself
  2. Routine sketch
  3. **Extrapolate feature: participants interpret a geological feature by drawing a sketch of the real view**
     1. **Assisted by printed maps on a notebook**
     2. **Assisted by tablet applications on a tablet application**
  4. Cross section
- Questionnaire
  - Smartphone ownership
  - Smartphone use in the field
  - Spatial and “map reading” skills

Task 3: Extrapolate feature

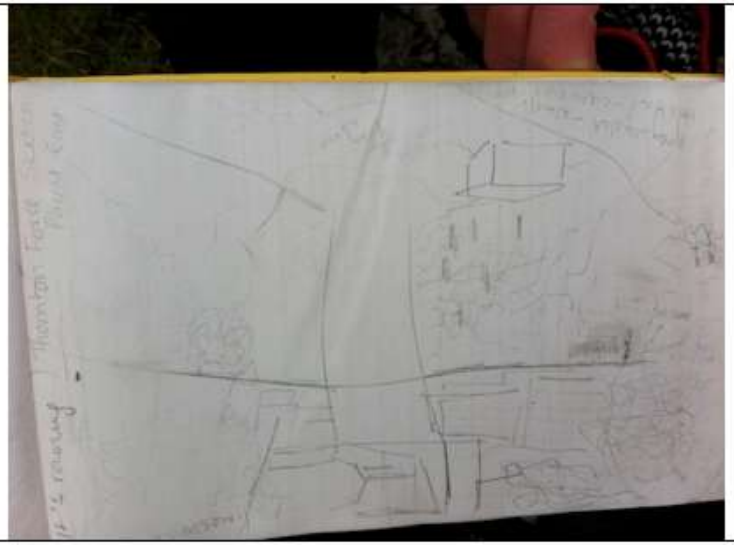


Results (1): Questionnaire

- Most owned smartphones & had them on the day
- Most don't user smartphones for fieldwork



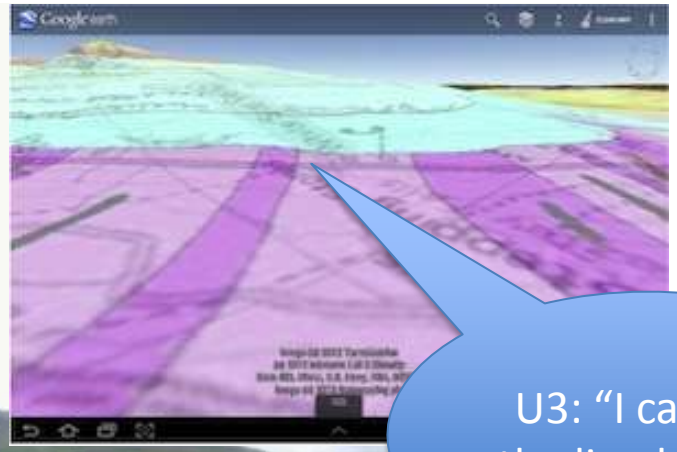
Results (2): Extrapolate feature

	Conventional	Tablet aided
U1		
U2		

"Not easy to write"

Results (3): Extrapolate feature

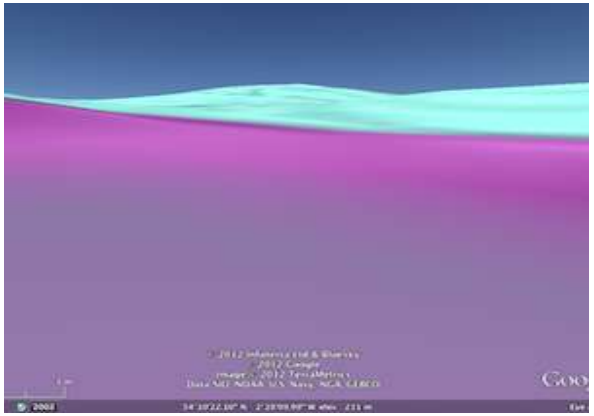
- DEM & data res.
  - OK or good for hillsides
- Much easier to interpret feature

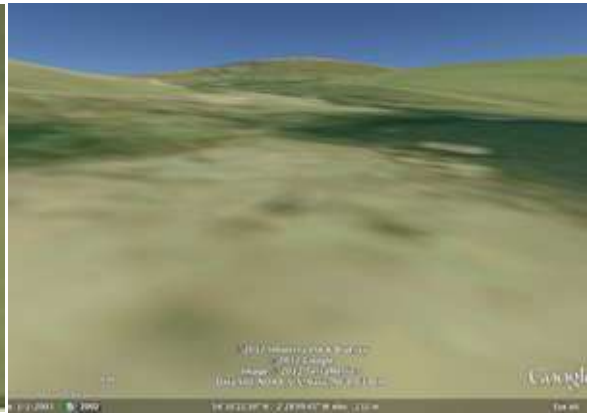


U3: “I can see the line better”

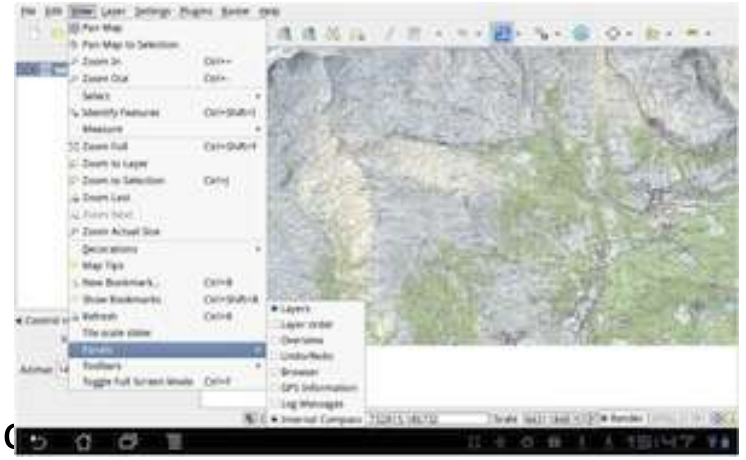
Results (4): Extrapolate feature

- DEM/imagery resolution
  - GE DEM UK (~90m)
  - Useless in <90m outcrops
  - Recognize location
    - Satellite imagery
  - Data shadows (Bellian et al 2005)
    - Steep dipping faces
    - Obscured faces





Discussions

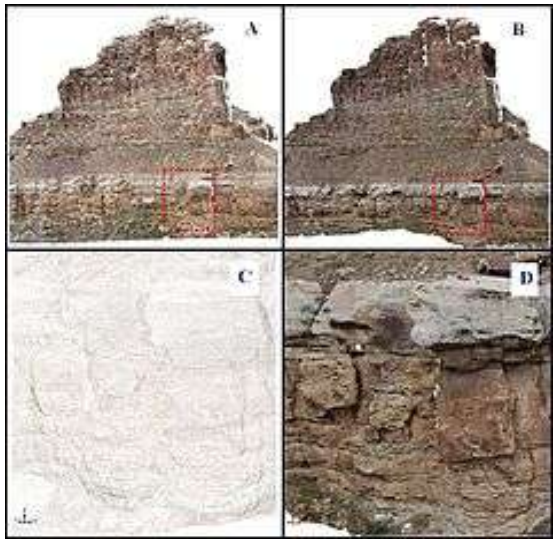


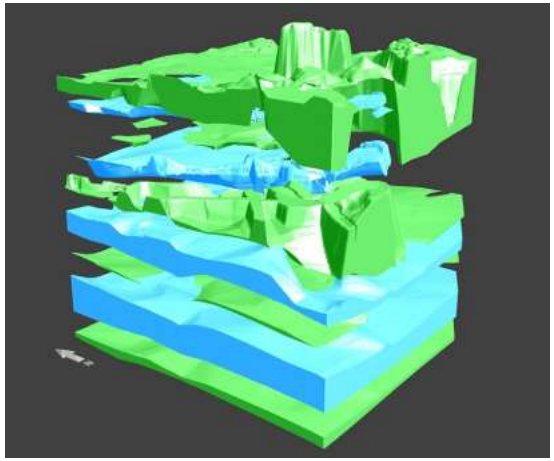
- There isn't an app for that
  - One application solution?
- Revisit the issues
  - Visualize 3D nature
  - Extrapolate feature > apply observatio
- Tasks: Extrapolate feature
  - GE data (DEM + Sat imagery) is suitable for areas bigger than data res.
  - Not suitable fore resolution finer than data res.
- Augmented Reality (BGS iGeology3D)
  - Facilitates recognition.
  - In the same category with GE in terms of data resolution
- Subsurface visualization
  - Add it to virtual globes or AR (iGeology3D)
  - Can visualize OBJ models on iOS using NinevehGL

Image from: Quantum GIS Android. Available from: http://www.opengis.ch/android-gis/ Accessed 9/12/2012

What next?

- Improve data?
  - DEM (30m? or even 2m?)
  - Satellite imagery (0.5m in future)
- Outcrop model
  - LiDAR and images plus other data
  - GIS & smartphone/tablet unfriendly
- The smart edge?
  - Make best use of the available data
  - Hardware goodies
  - Interaction and interface
- 3D Model
  - Subsurface geology?
  - Resolution, again?





Outcrop image from: http://en.wikipedia.org/wiki/Digital_outcrop_models

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Q&A