Science motivations and introductory remarks

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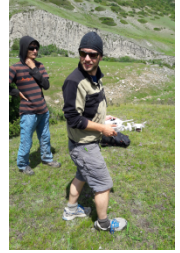
OpenTopography

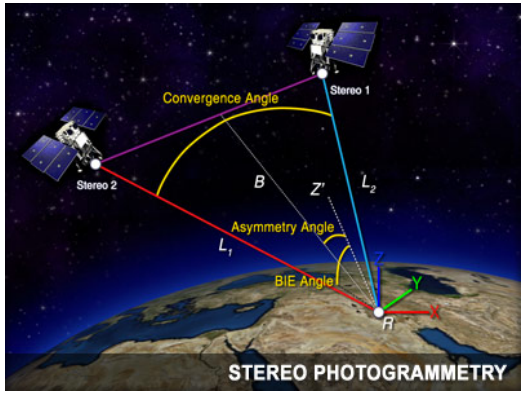
High-Resolution Topography Data and Tools

3D IMAGING WITH CAMERAS & LASERS



Meters to centimeters spatial sampling

Space-based



DigitalGlobe

planet.

polar geospatial center

PLÉIADES CONSTELLATION

A Airborne LiDAR

onboard GPS and IMU constrain position and orientation of aircraft

distance between scanner and ground return determined from delay between outgoing pulse and reflected return

laser pulse

C Structure from Motion

motion of camera provides depth information

sequence of photographs

scene **structure** refers to both camera positions and orientations *and* the topography

line of sight

features matched in multiple photographs

shadow zone

laser pulse

B Terrestrial LiDAR

lines show track of scan across ground
circles show actual ground return footprints

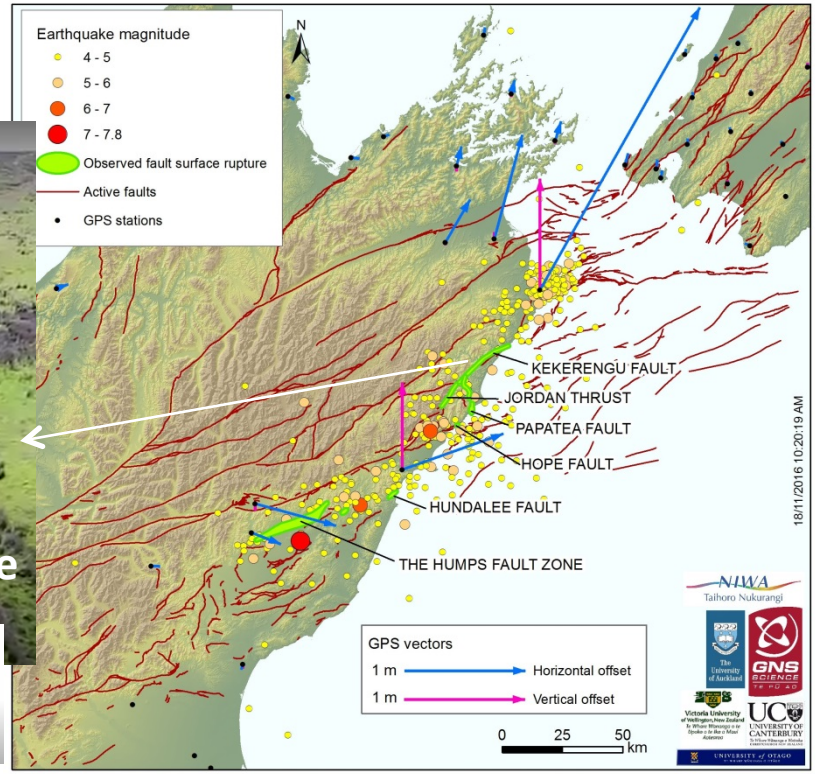
Johnson et al., Geosphere, 2014

Need ~<meter-scale sampling to cover critical scale breaks and temporal repeat to address log(t) response of some phenomena

Science requirements

- Need topography data with sufficient spatial extent and resolution to capture phenomena of interest
- Need topography data with sufficient temporal repeat to capture changes of interest

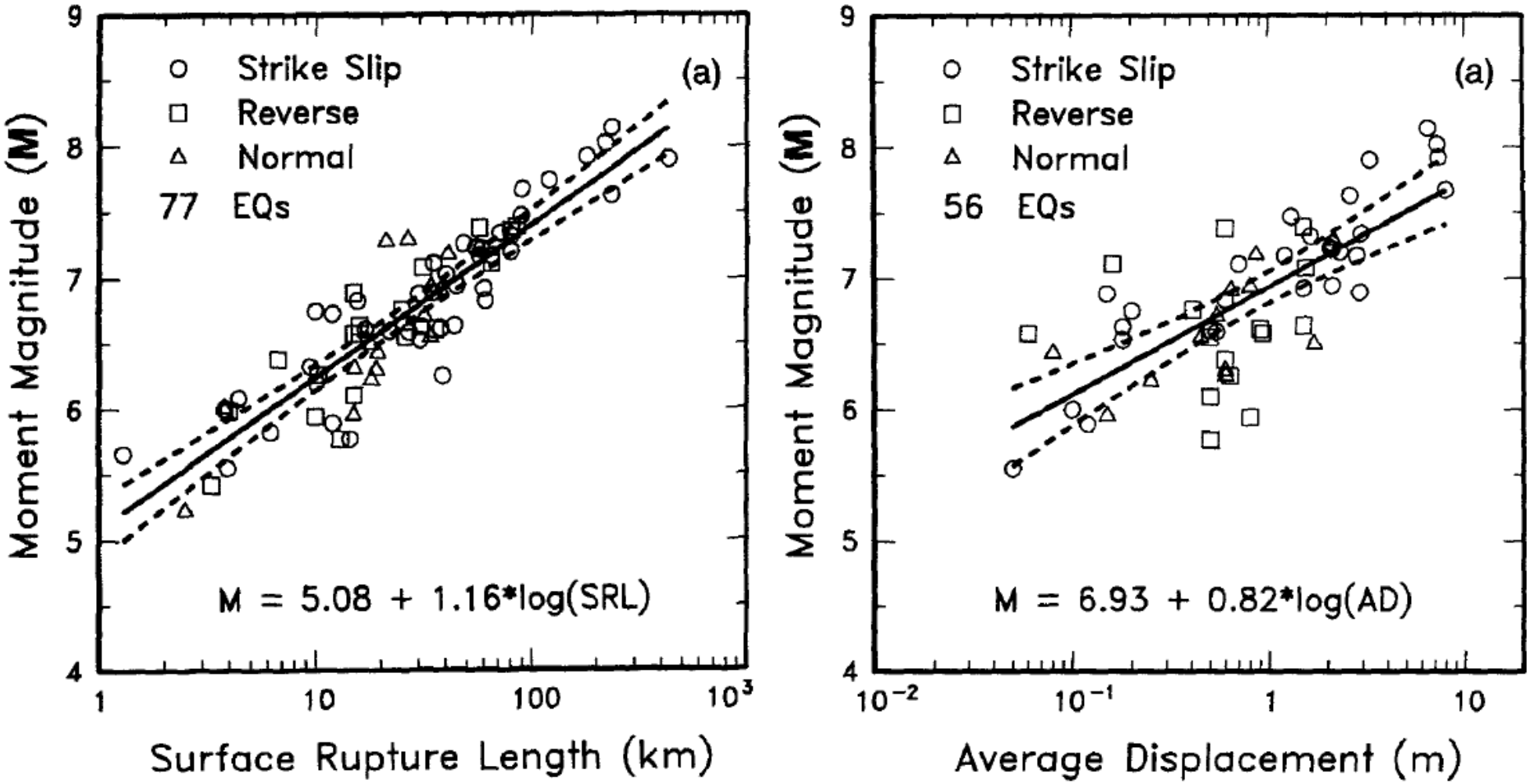
https://www.youtube.com/watch?v=U3H8wlzXGYE&feature=youtu.be



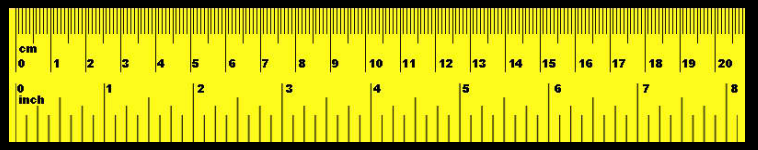
Kekerengu alone is 30+ km of this intricate ground rupture

Length scales >10^5m and <1 m

Wells and Coppersmith, 1994



“Seeing” at the appropriate scale means measuring at the right scale



Surface processes act to change elevation through erosion and deposition while tectonic processes depress or elevate the surface directly— their record is best characterized with the right fine scale.

Applies in particular to statistical self similarity

http://en.wikipedia.org/wiki/How_Long_Is_the_Coast_of_Britain%3F_Statistical_Self-Similarity_and_Fractional_Dimension

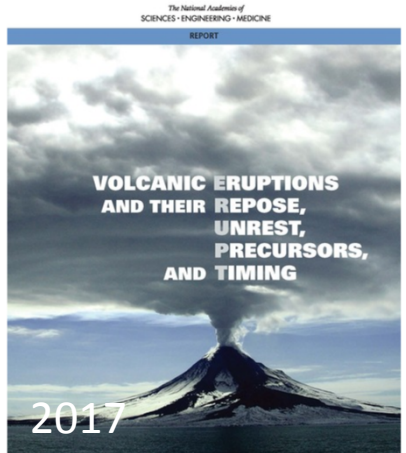
How long is the coast of Britain?
Statistical self-similarity and fractional dimension
Science: 156, 1967, 636-638

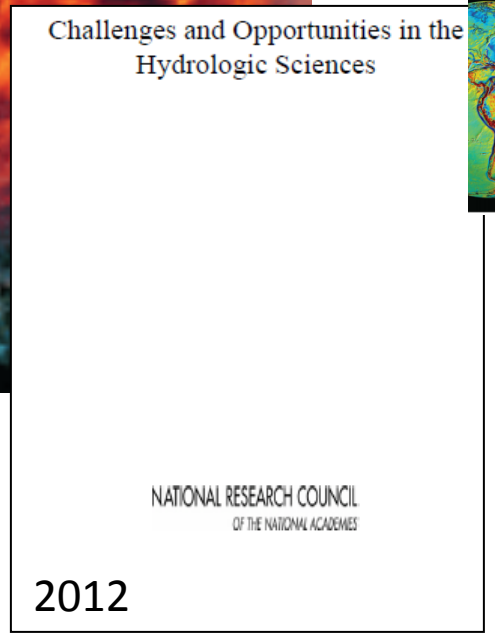
B. B. Mandelbrot

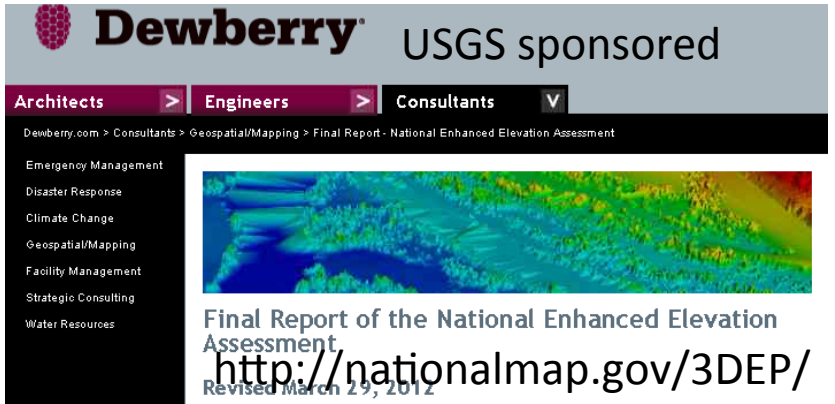
Major US community studies recognize the scientific value of high resolution topography

Science communities

2016



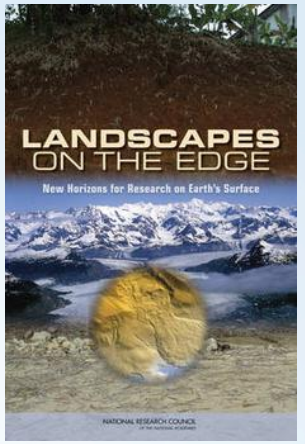




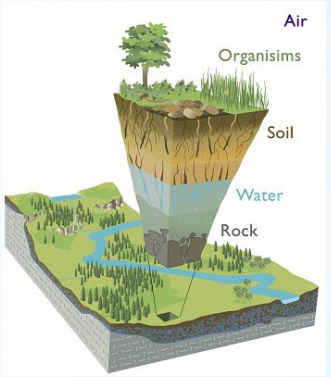
http://nationalmap.gov/3DEP/

Example scientific motivations

- How do geopatterns on the Earth's surface arise and what do they tell us about processes?
- How do landscapes influence and record climate and tectonics?
- What are the transport laws that govern the evolution of the Earth's surface?

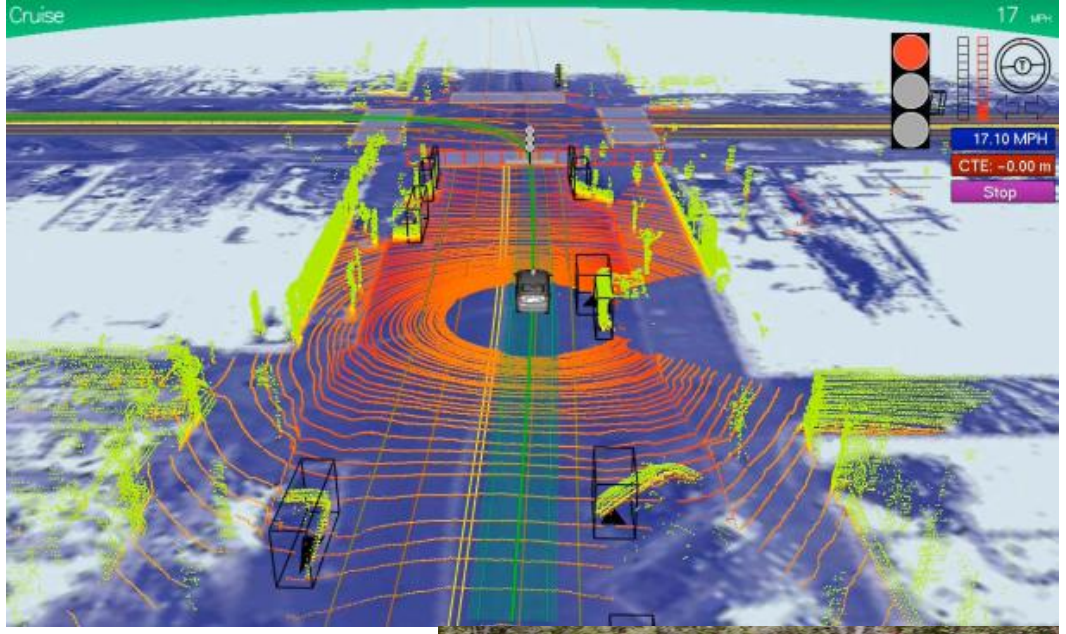


- How do faults rupture and slip throughout multiple earthquake cycles and what are the implications for earthquake hazard?

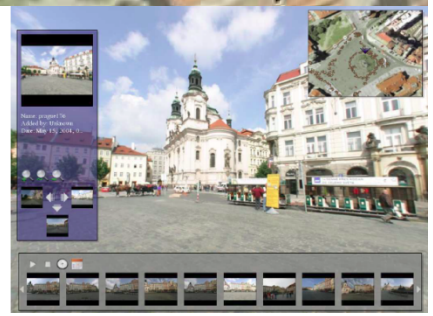


- Landscape and ecosystem dynamics

- Volcano form and process
- Changes in volume of domes, edifice, flows



Google car: Gb/ sec high accuracy navigation data



Modeling the World from Internet Photo Collections (Snavely, et al., Int J Comput Vis , 2007)

Ubiquitous point clouds + 3D models: **coordinated (mapping and monitoring) and haphazard (autonomous navigation, individual photo collections, etc.)**

-Need open access and cyberinfrastructure to support archive, and rapid query, data handling, preprocessing, and differencing