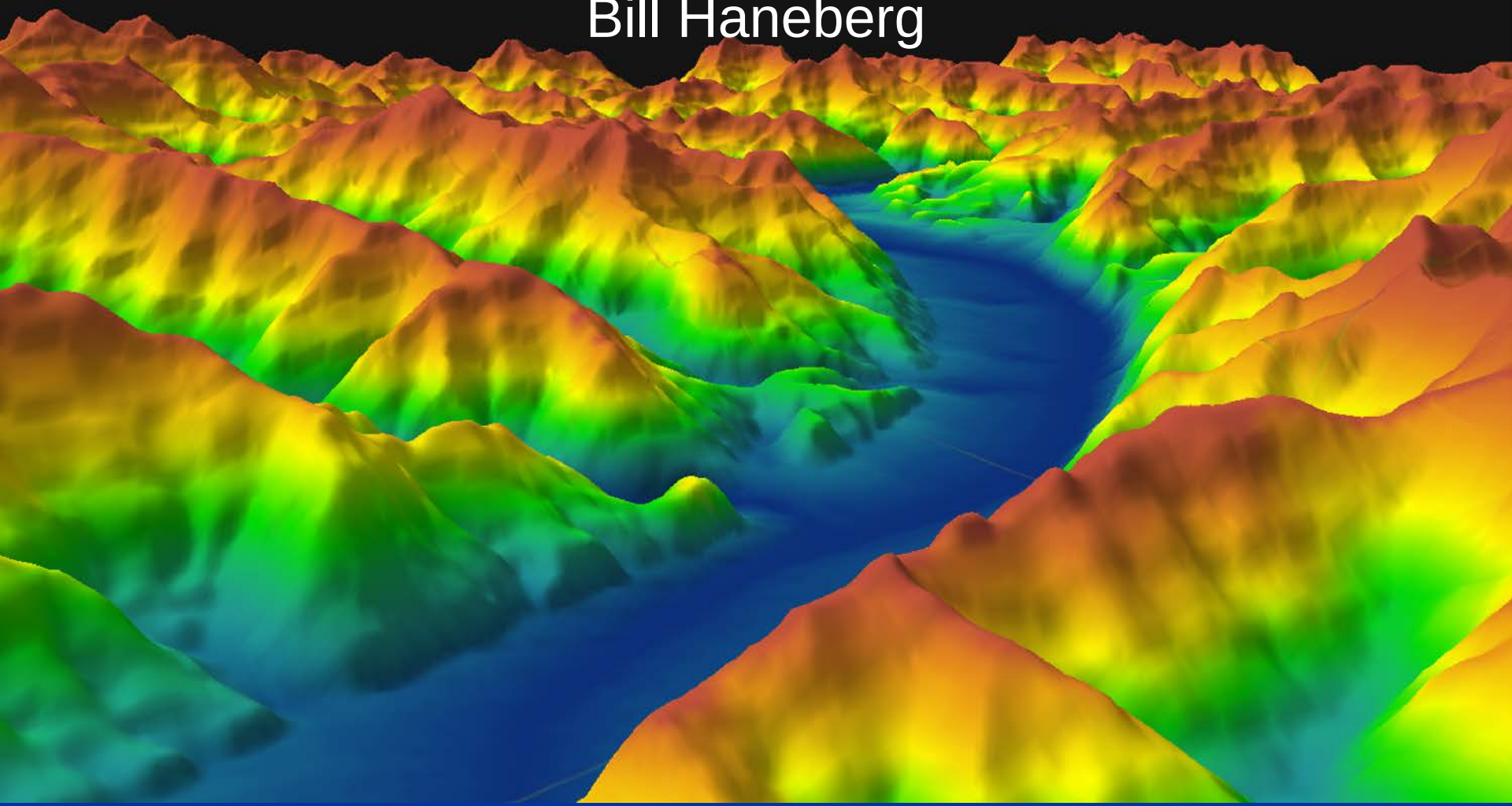
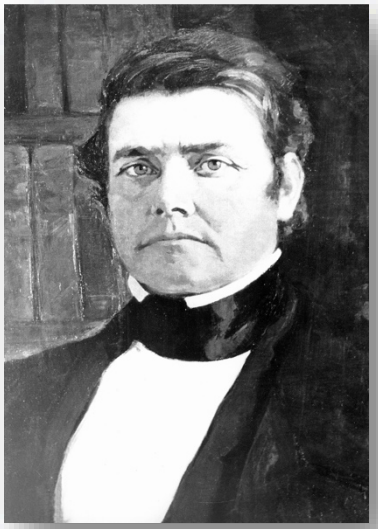
KGS Geospatial

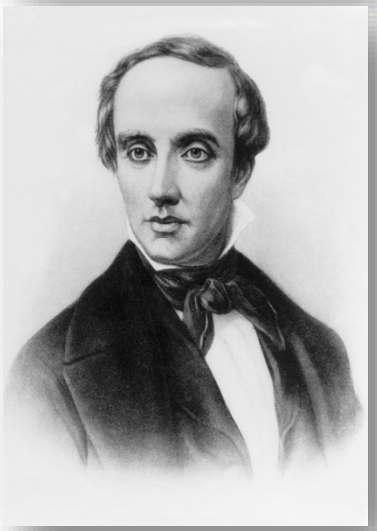
Bill Haneberg



KGS roots go back to 1838

- 1815 William Smith publishes his geological map of England…the map that changed the world.
- 1830-1833 Charles Lyell publishes *Principles of Geology* in three volumes
- **1838-1839 William Williams Mather conducts the first geological survey of Kentucky**
- **1854 David Dale Owen becomes the first State Geologist of Kentucky**
- 1859 Darwin publishes *The Origin of Species*
- **1948 KGS joins the University of Kentucky by virtue of Kentucky Acts Ch. 224, Sec. 3**
- **2016 The 13th geological survey of Kentucky begins**





From the 2017 KGS strategic plan

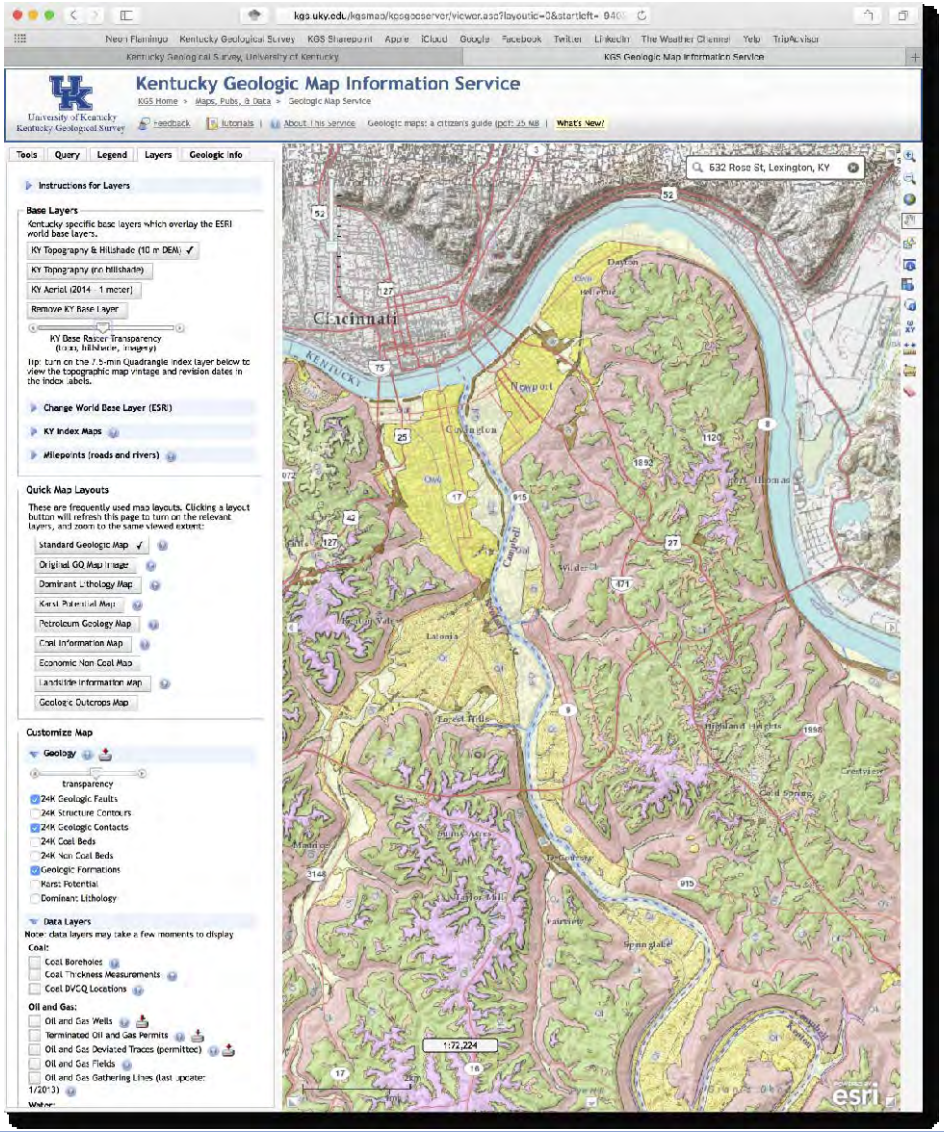
- …**significantly strengthen or develop new KGS expertise** in fields such as quantitative spatial analysis, geostatistics, machine learning, cloud computing, public health, natural resource and environmental economics, mathematical modeling of geologic processes, and remote sensing.

- ….become the **recognized center of expertise for the application and integration of airborne laser scanner (LiDAR) data** in support of geologic, engineering, and environmental projects in Kentucky.

- …become a nationally and internationally **recognized leader in the development and distribution of 3D and 4D geologic data and maps** at a variety of scales and relevant to topics of societal and economic benefit to Kentucky.

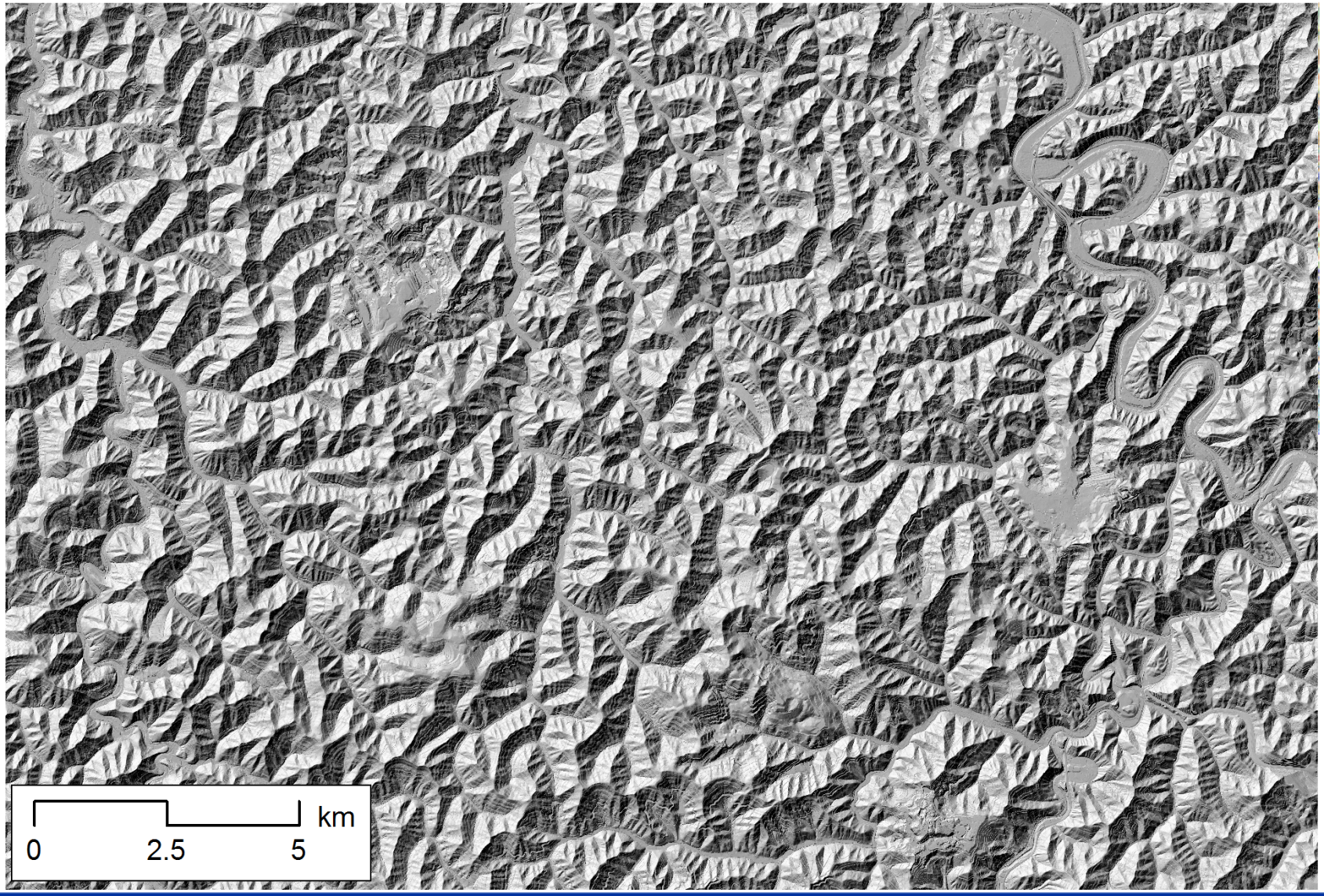
Kentucky is rich in geo-data and geo-knowledge

- Complete digital 1:24,000 geologic quadrangle coverage
- Many thematic map layers
  - Dominant lithology
  - Karst potential
  - Oil and gas information
  - Coal information
  - Non-coal economic geology
  - Landslide locations
  - Faults and structure contours
  - Soil survey coverage (SSURGO)
- Borehole, outcrop, seismic, water data
- **Nearly complete airborne LiDAR coverage**
- **HOW DO WE PULL IT TOGETHER?**

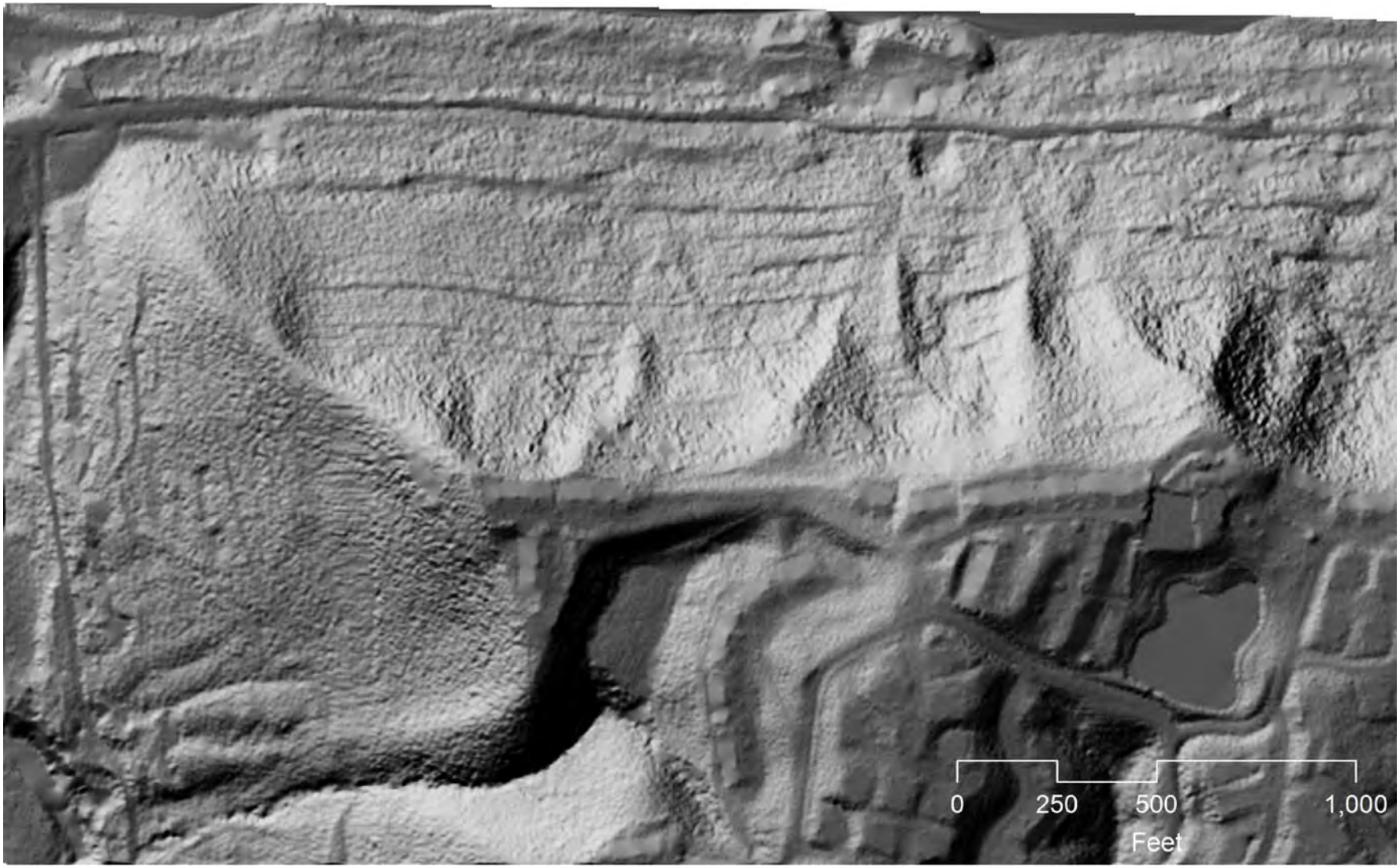


Airborne LiDAR—much more than contours!

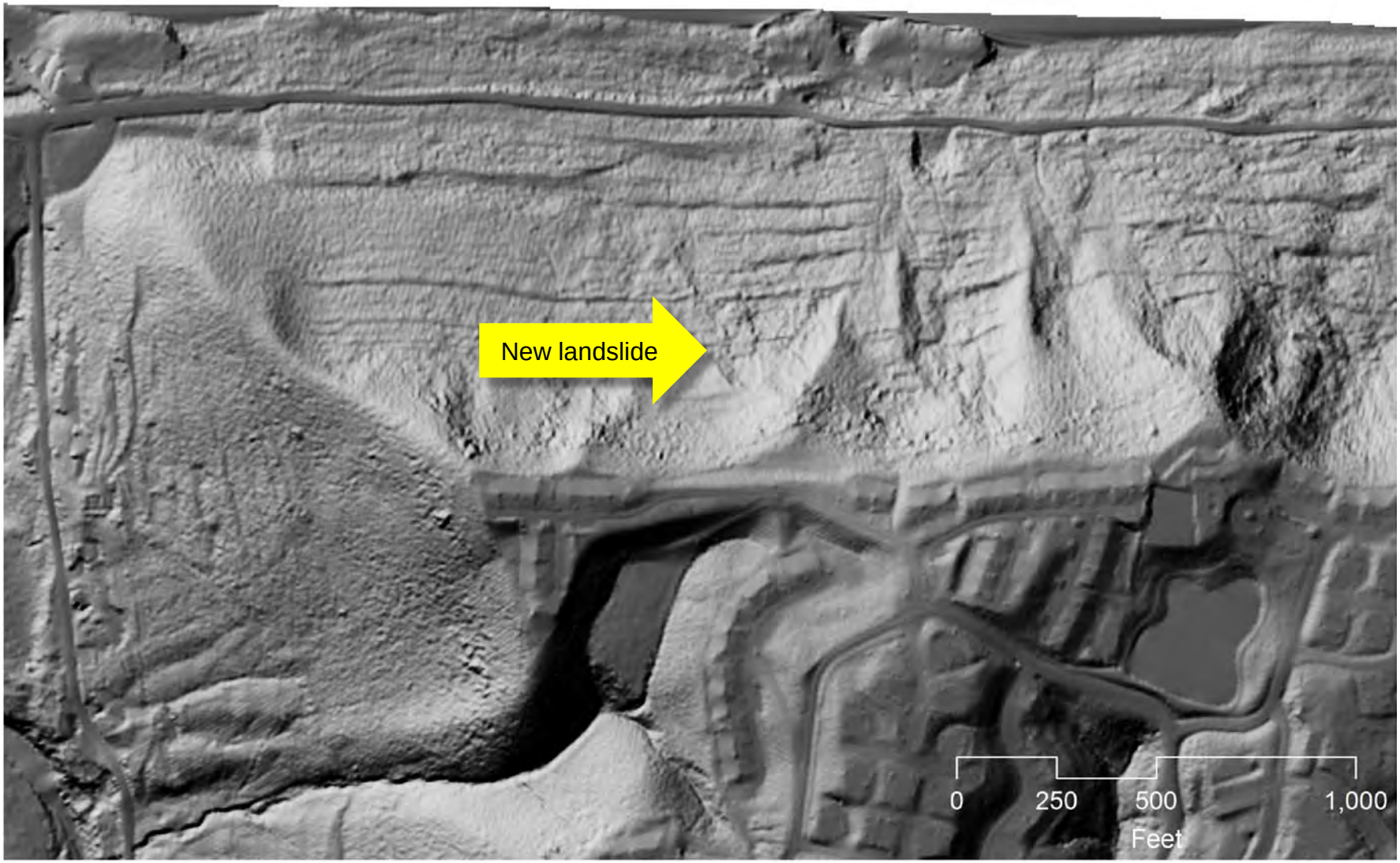
LiDAR to visualize and understand landscapes



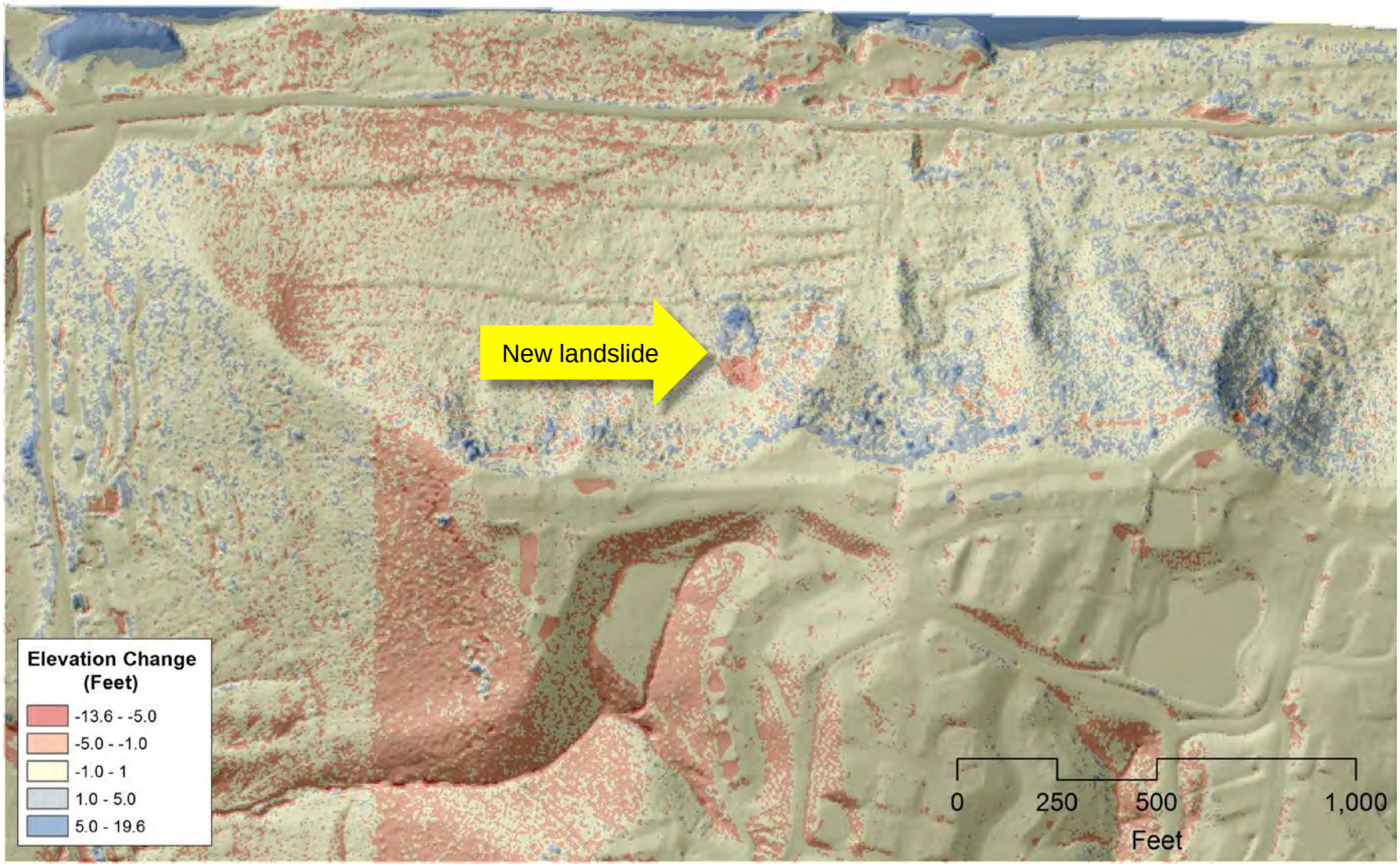
LiDAR landslide detection (2007 data)



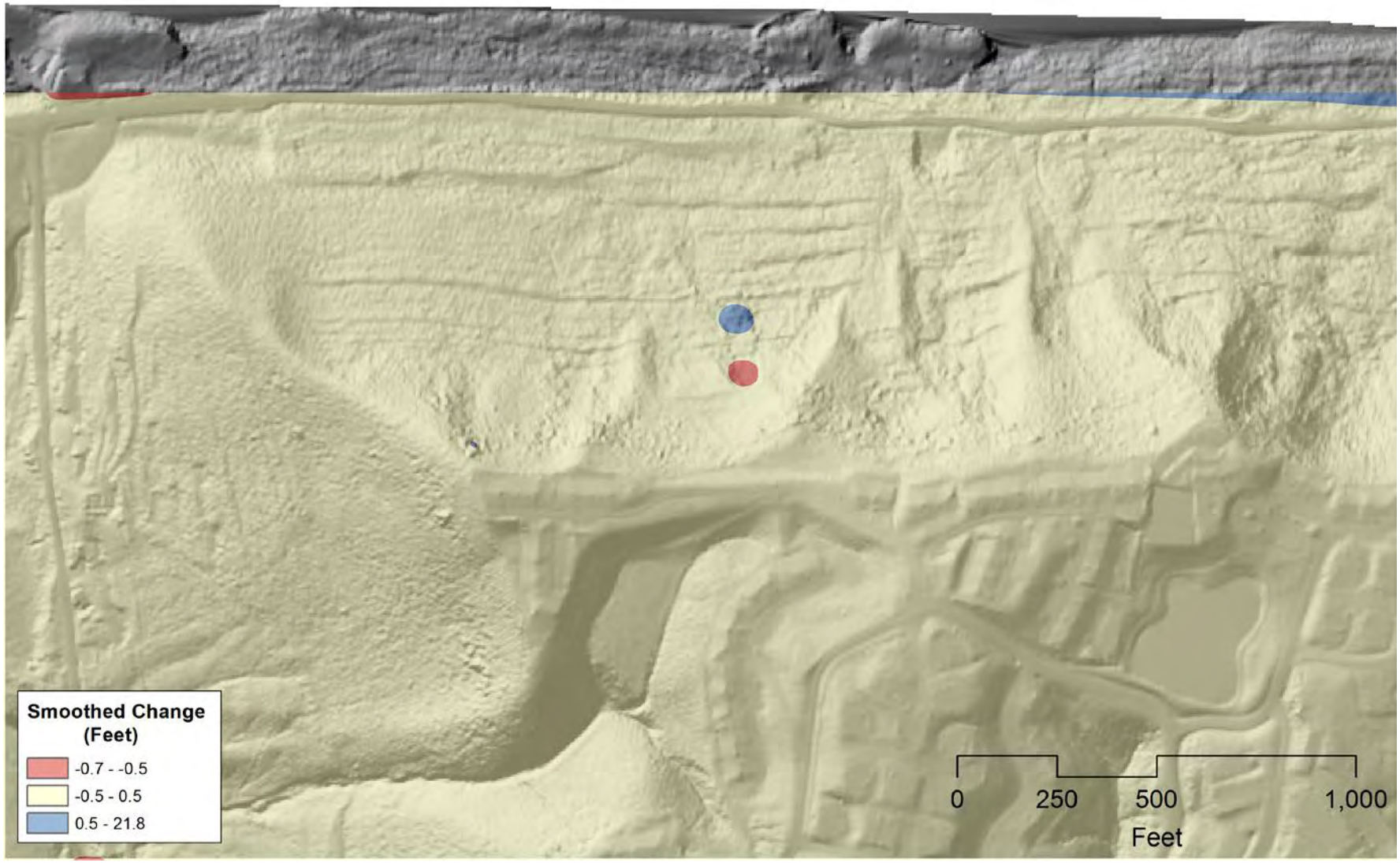
LiDAR landslide detection (2012 data)



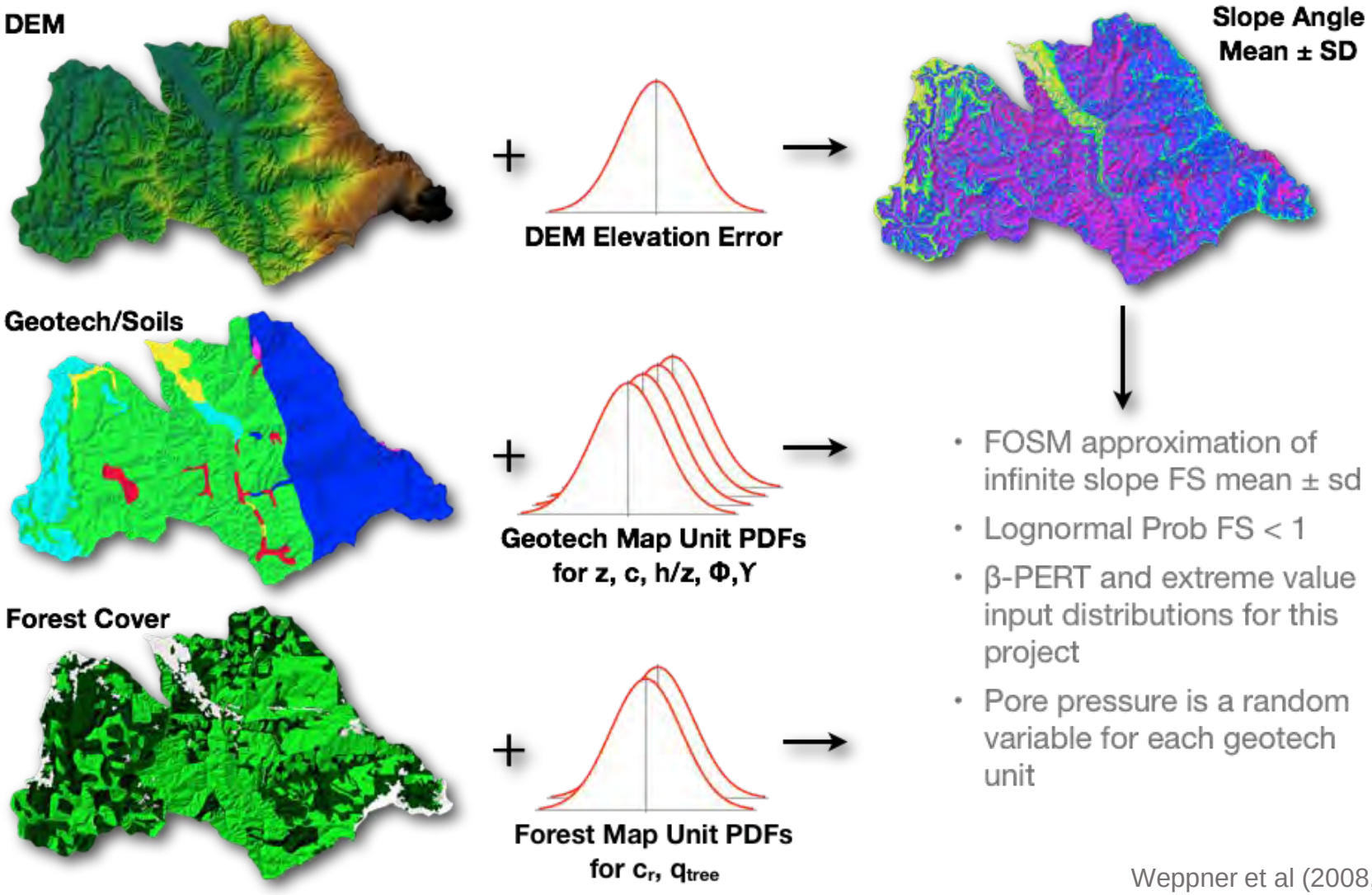
2012-2007 LiDAR land surface difference



Double Gaussian bias and noise reduction

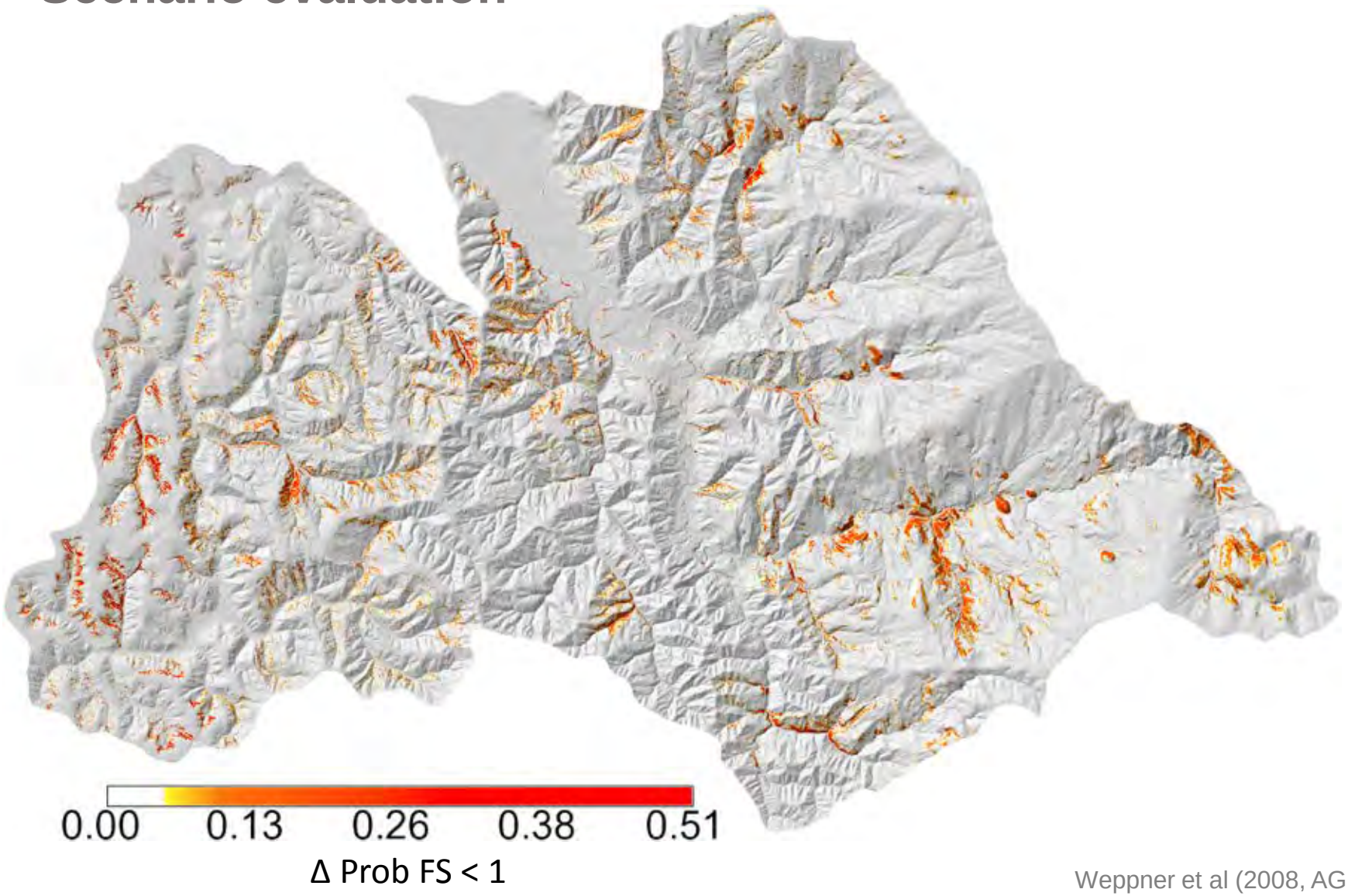


Physics based hazard assessment with LiDAR DEMs



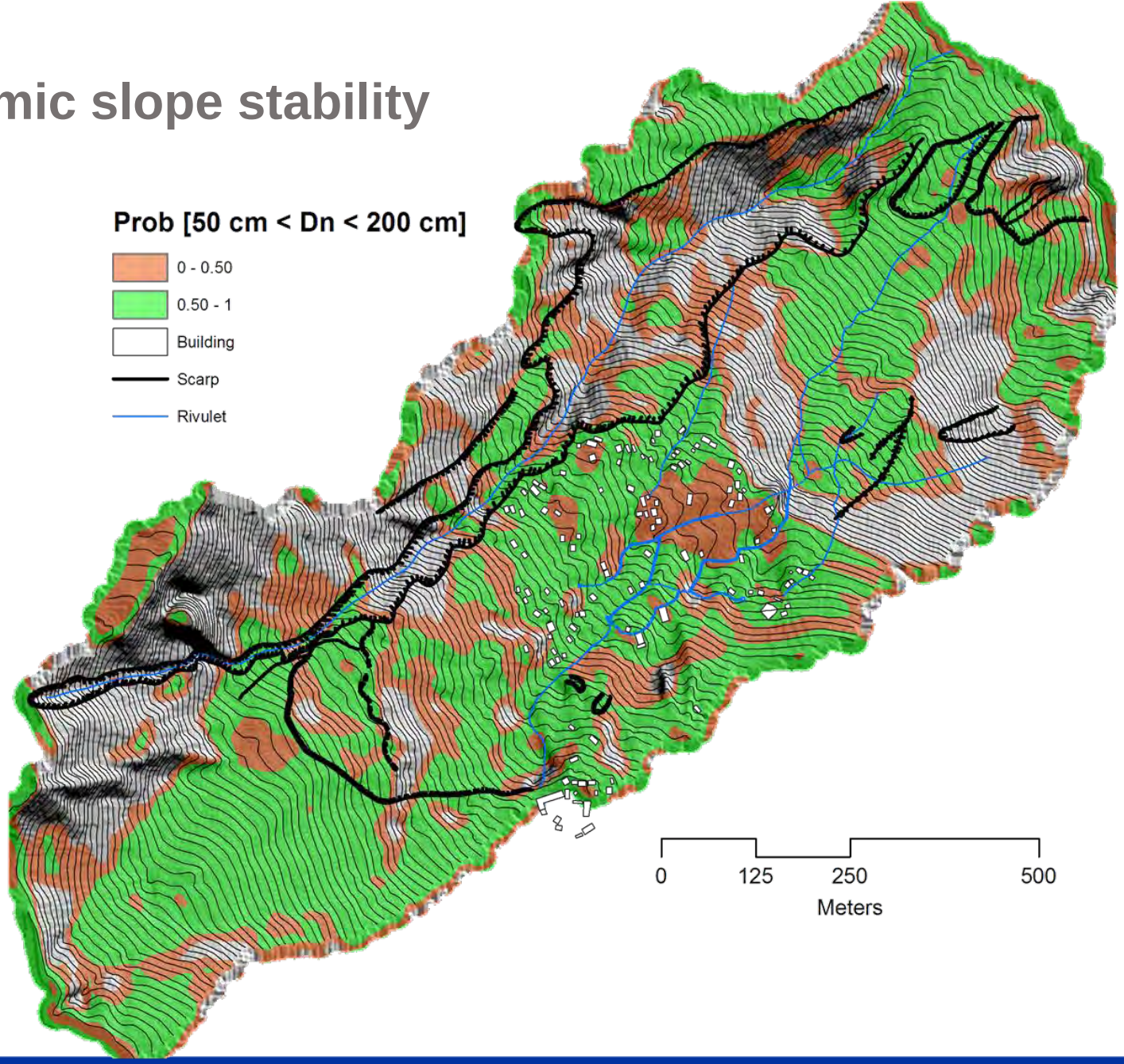
Weppner et al (2008, AGU)

Scenario evaluation

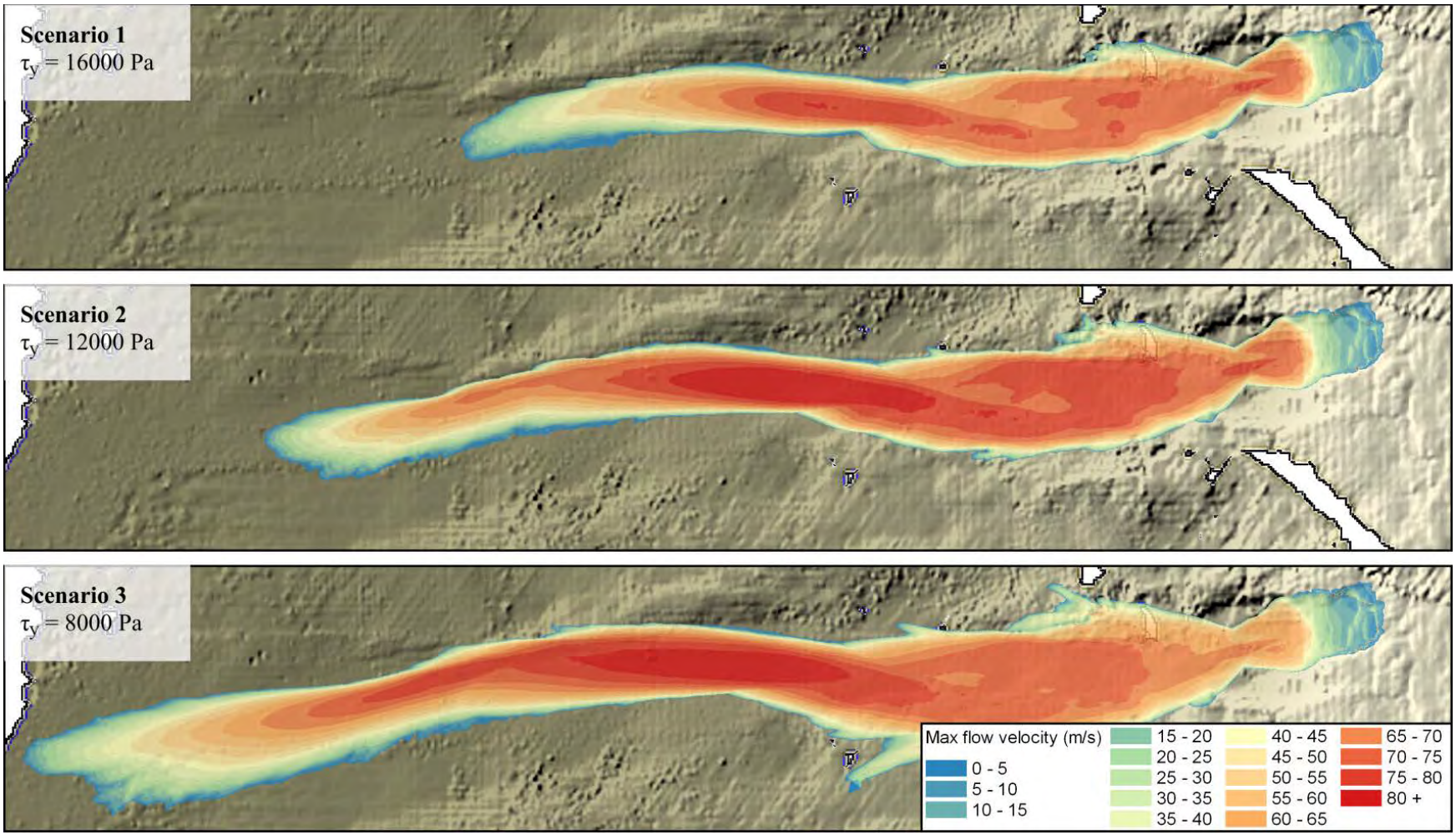


Weppner et al (2008, AGU)

Seismic slope stability



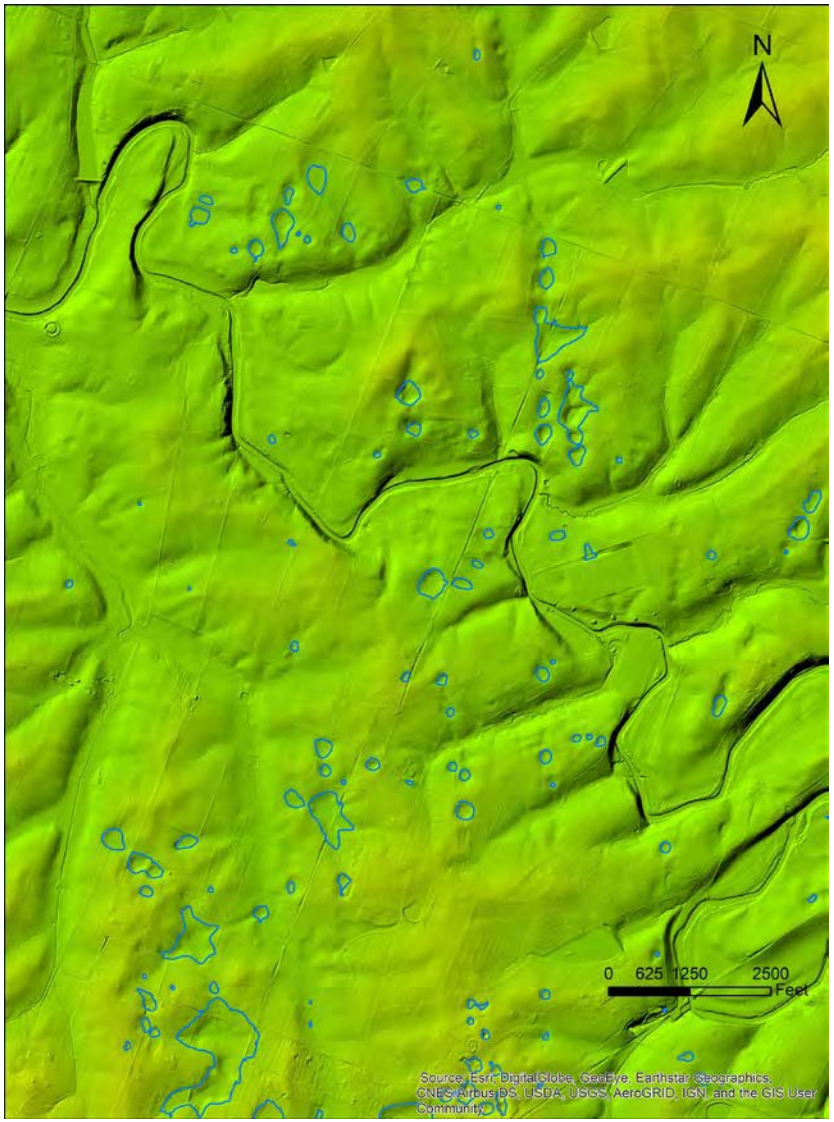
Debris flow modeling

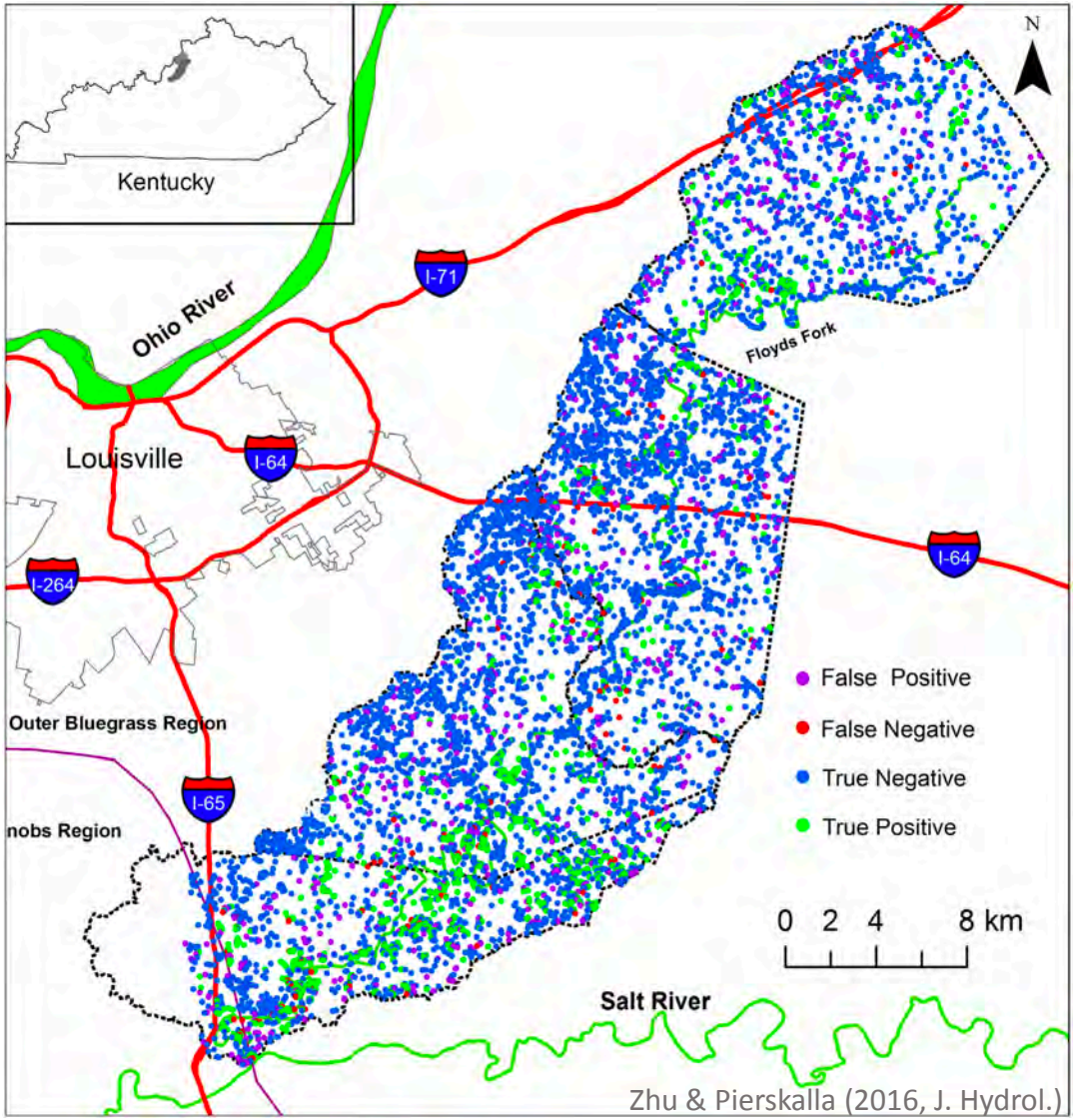


Earthquake scenario modeling

LiDAR based karst terrain and sinkhole mapping

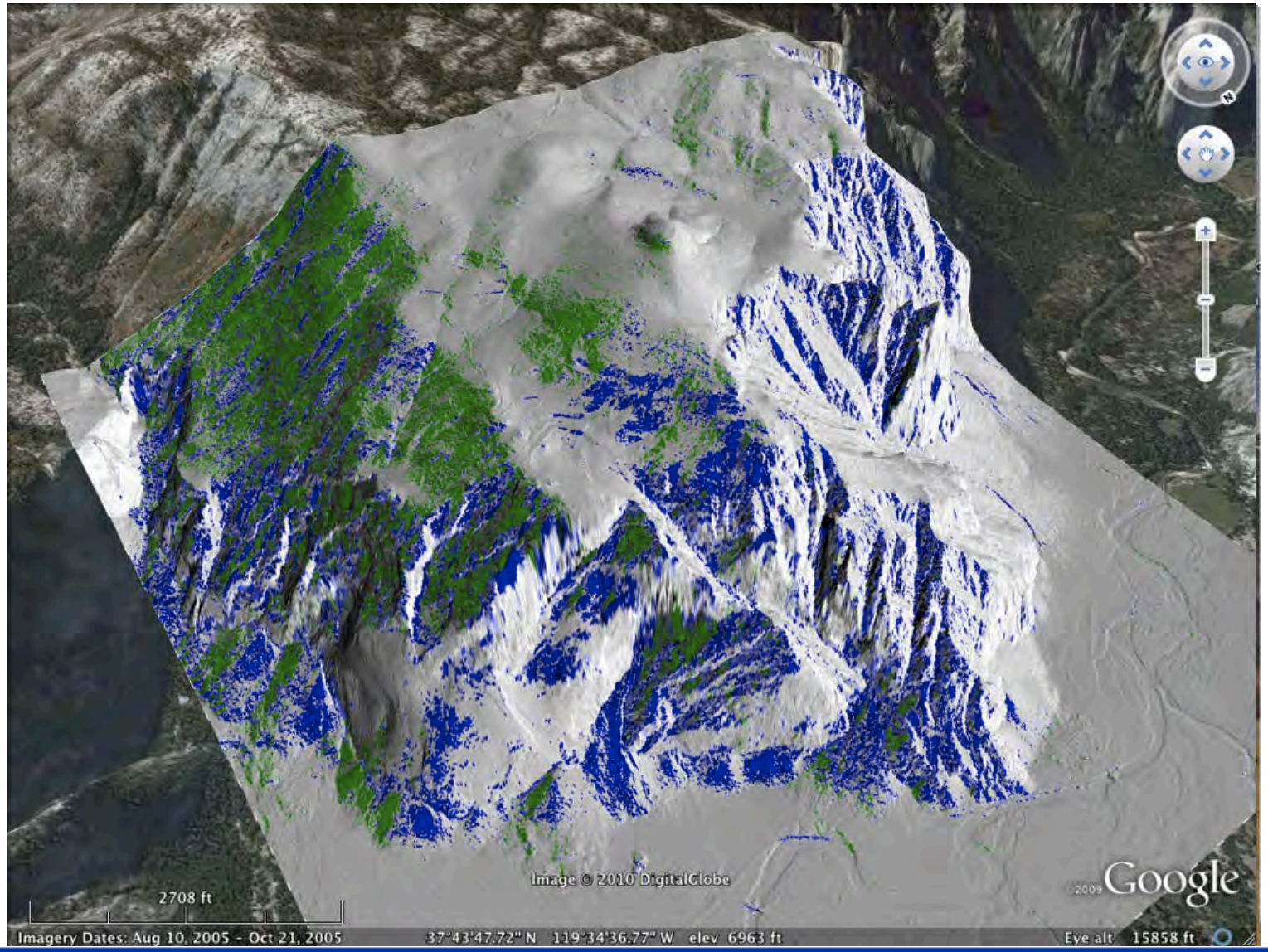
LiDAR and machine learning for sinkhole mapping



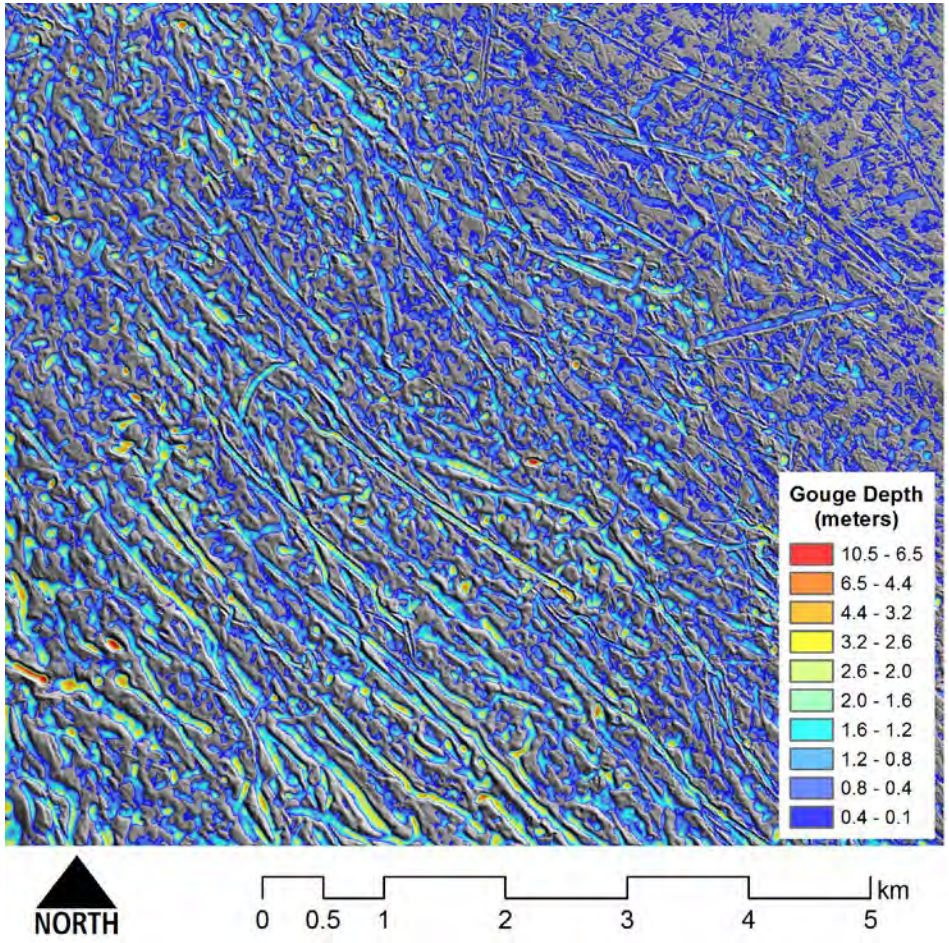


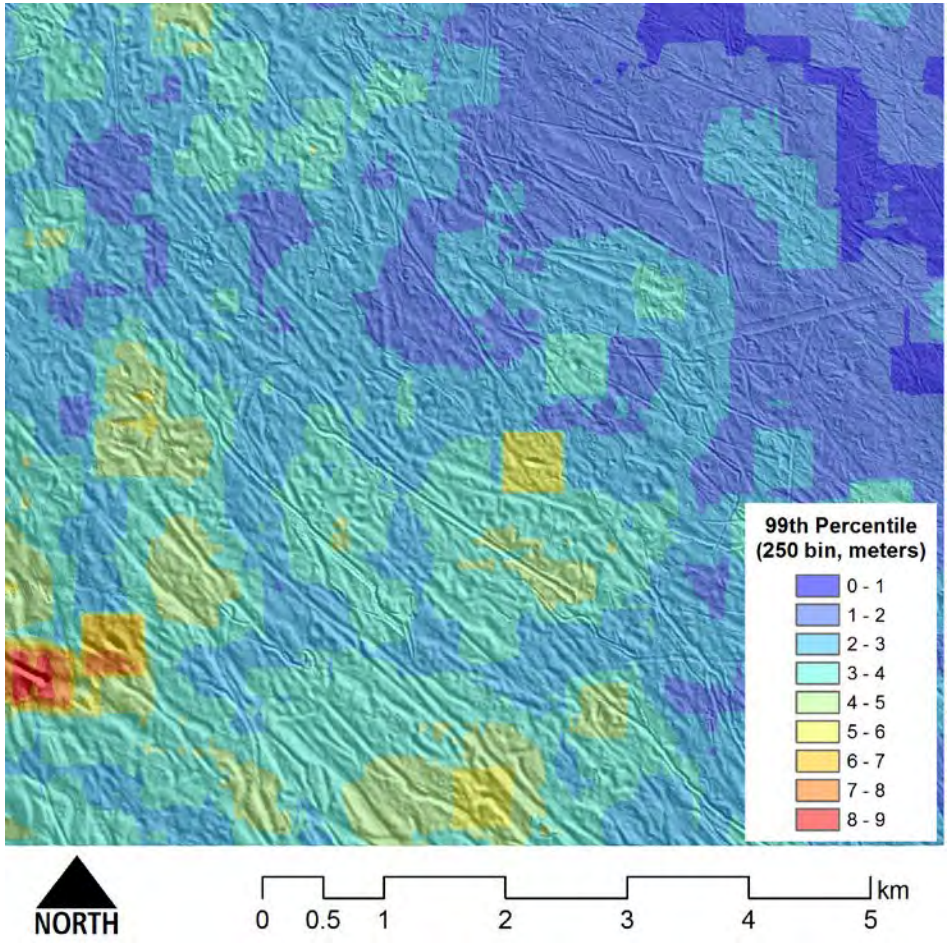
Zhu & Pierskalla (2016, J. Hydrol.)

Structural geology with LiDAR



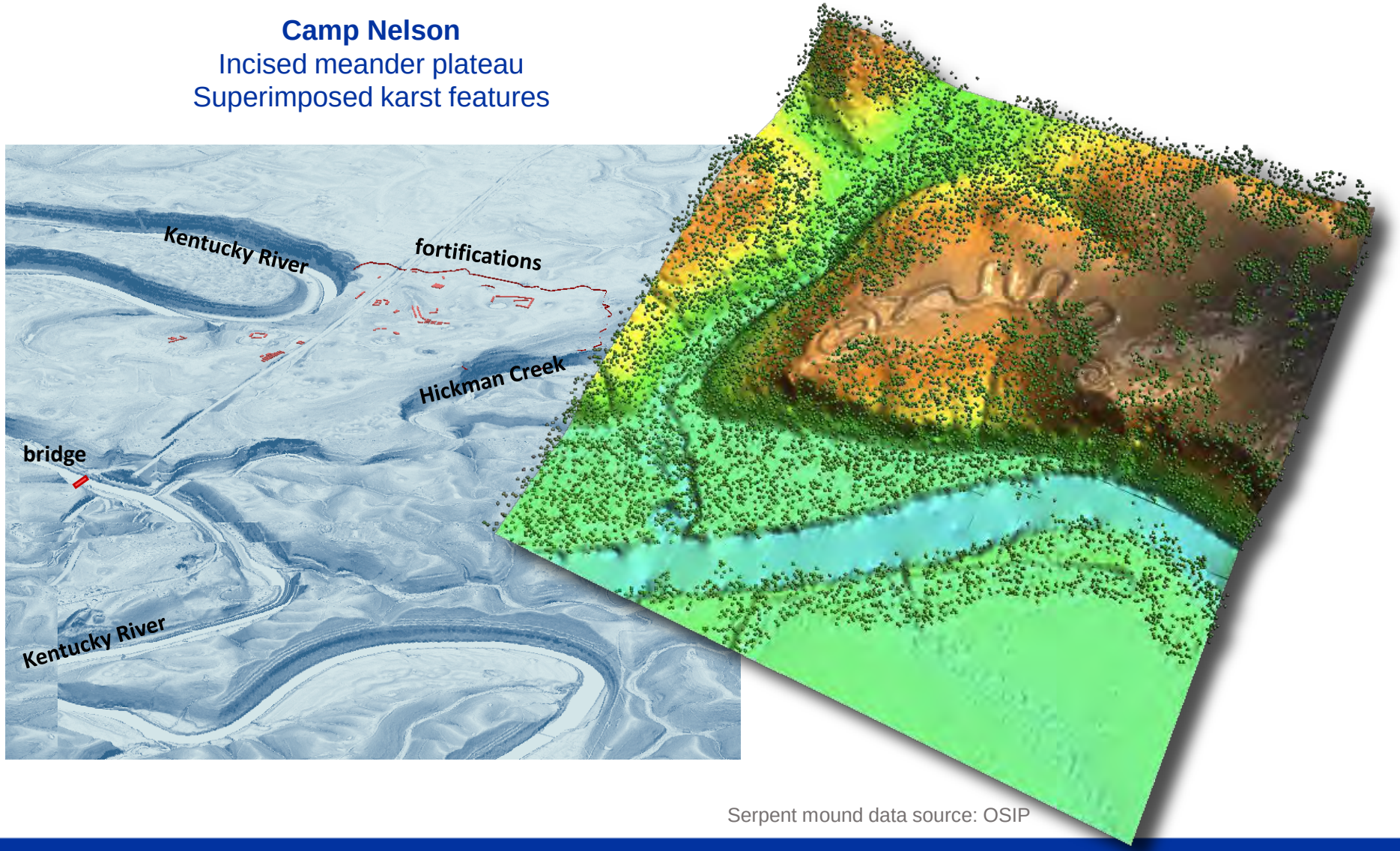
Seafloor ice gouge depth distribution





Applications to other fields: archeology

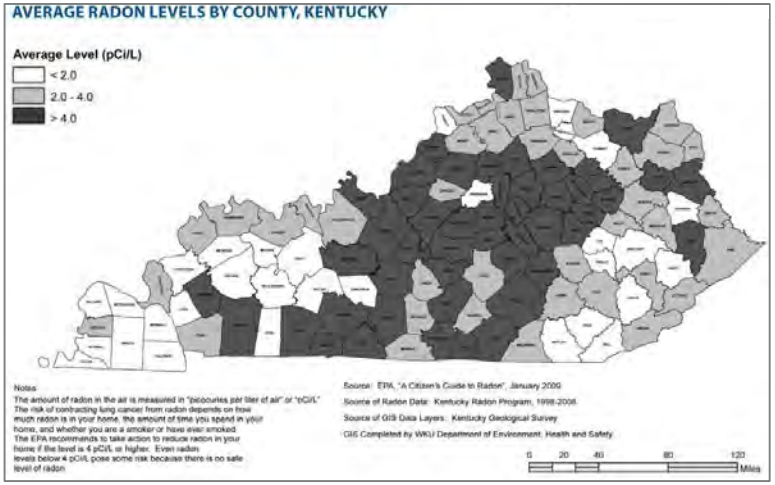
Camp Nelson
Incised meander plateau
Superimposed karst features



Serpent mound data source: OSIP

Applications to other fields: route selection

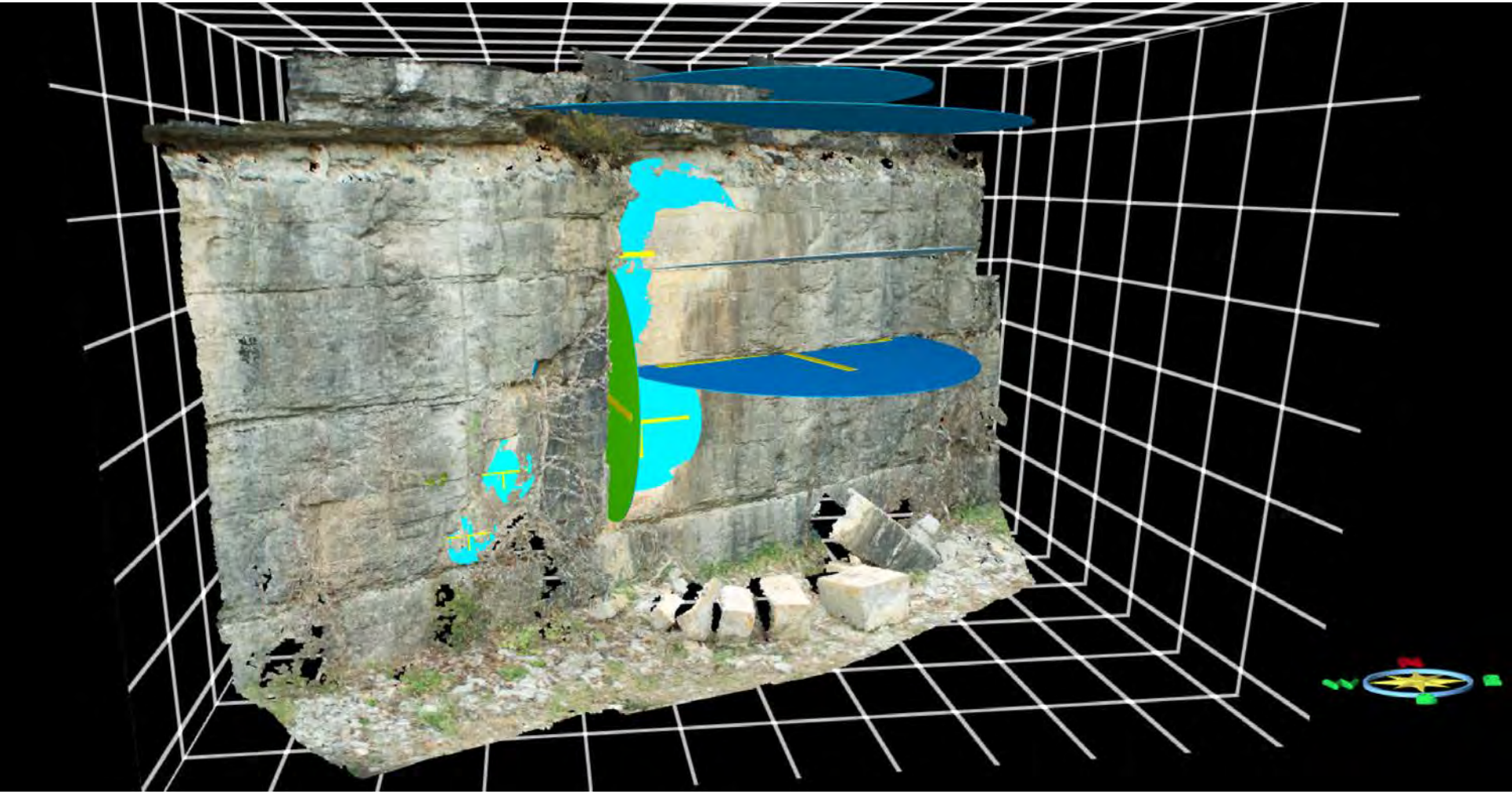
Application to other fields: indoor radon potential



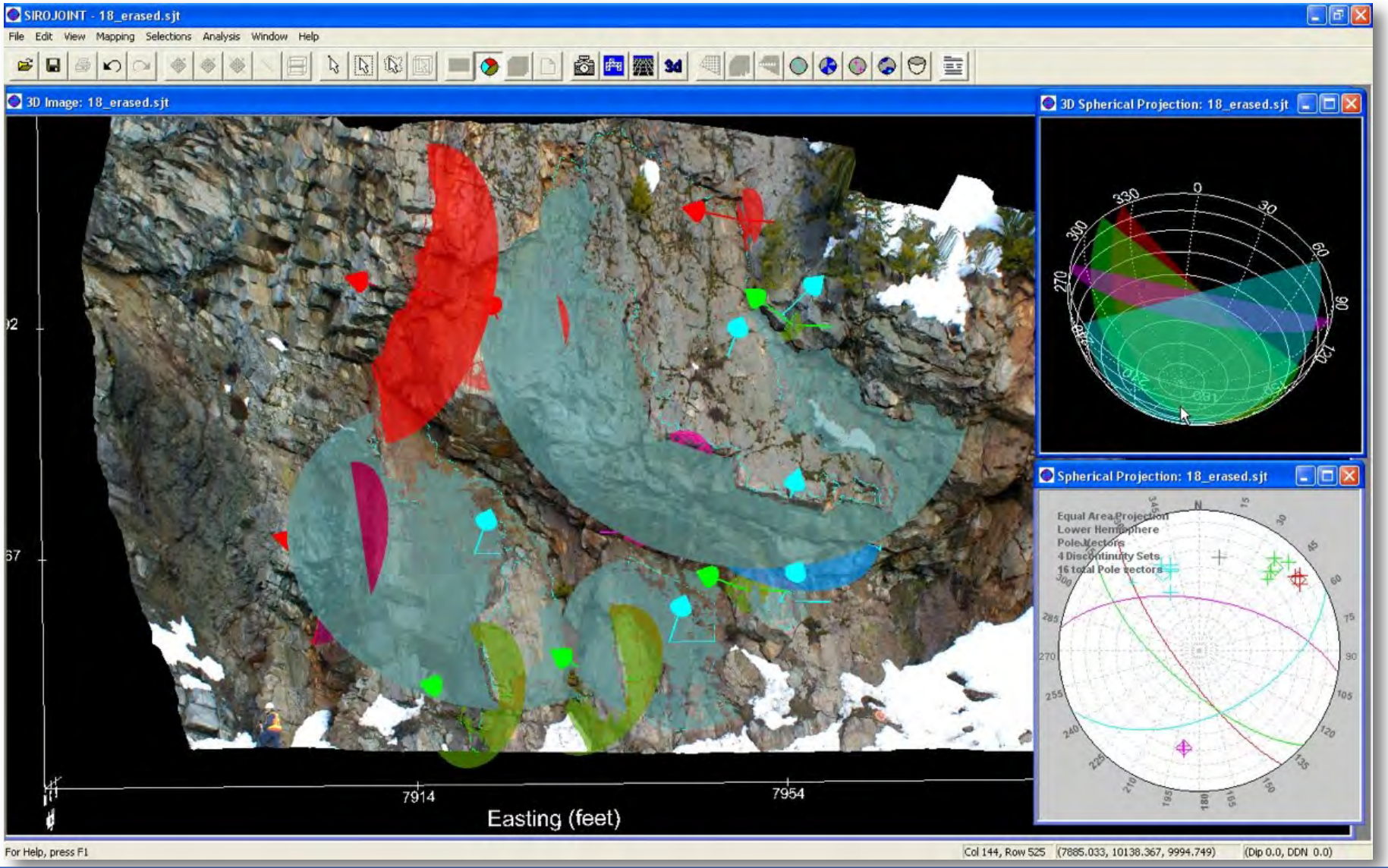
Digital outcrop modeling

Digital outcrop modeling

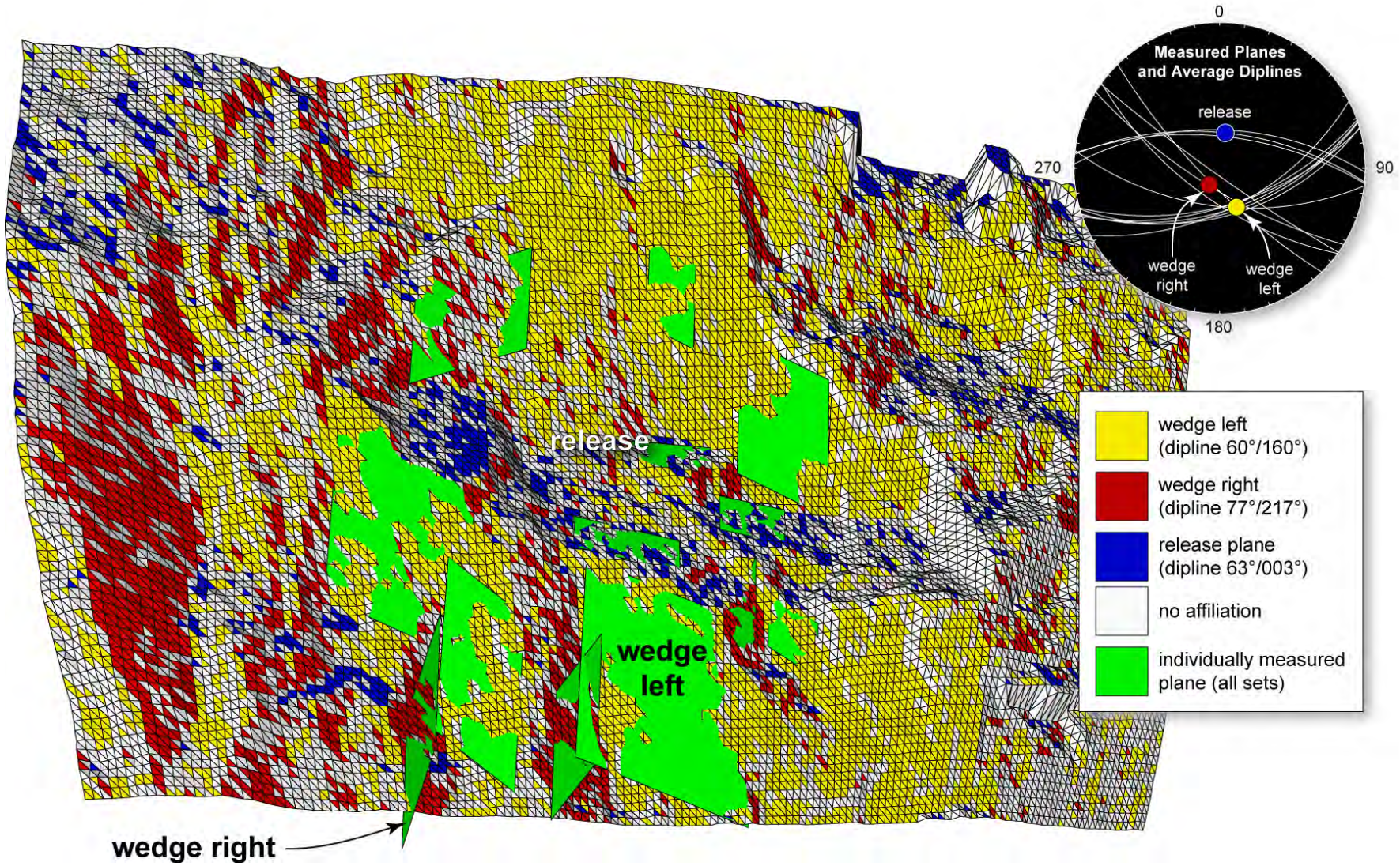
Virtual mapping of individual features



Virtual mapping of individual features



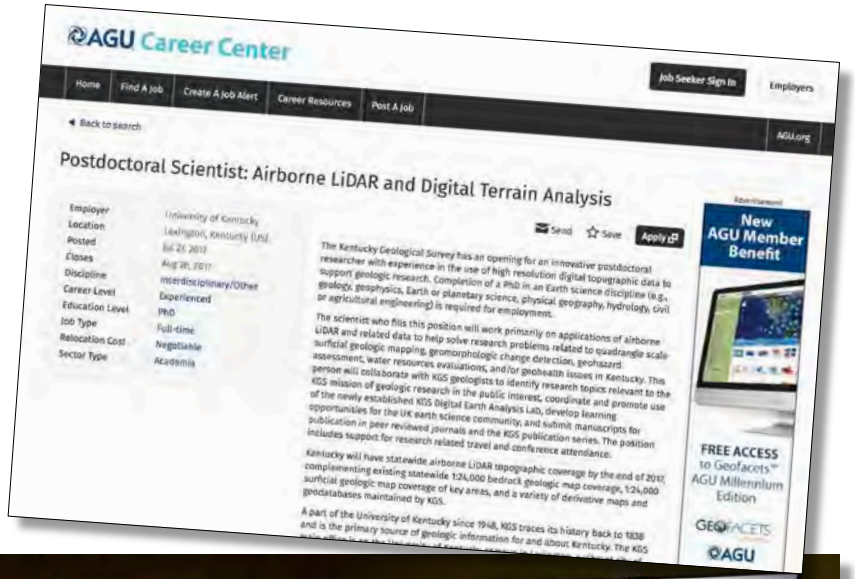
Automated selection based on pre-defined criteria



DEAL

Digital Earth Analysis Lab

Kentucky Geological Survey



- Dedicated mini-tower workstations
- 34” curved 4K displays
- 80” ultra-HD touchscreen display with dedicated server for interactive group work
- Ergonomic work desks and chairs
- MMRB high-speed internet connection
- **Cloud solutions for storage and computing**
  - Terabyte class virtual workstations
- LiDAR point cloud, terrain modeling, remote sensing, digital photogrammetry, virtual mapping, and other advanced software
- **UK-wide collaboration with CSC and others**