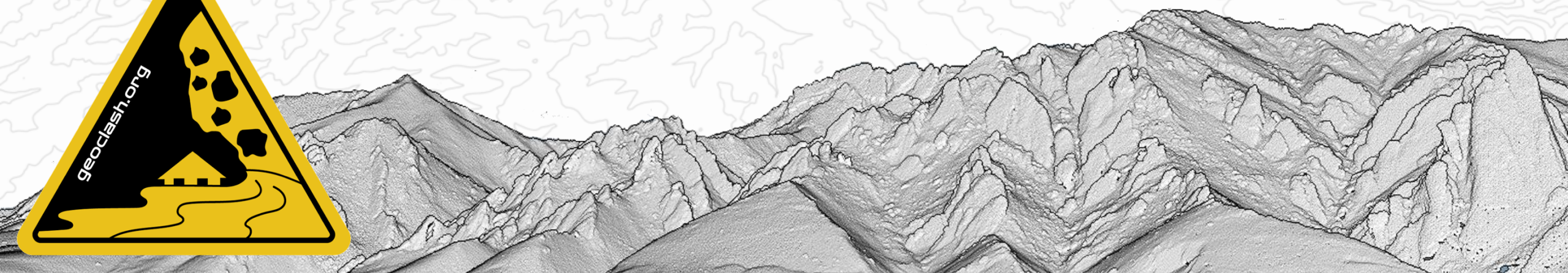
Introduction to OpenTopography & Topographic Data Refresher

Christopher J. Crosby (EarthScope)

2026 NSF Center for Land Surface Hazards (CLaSH) Workshop | Sept. 23, 2026

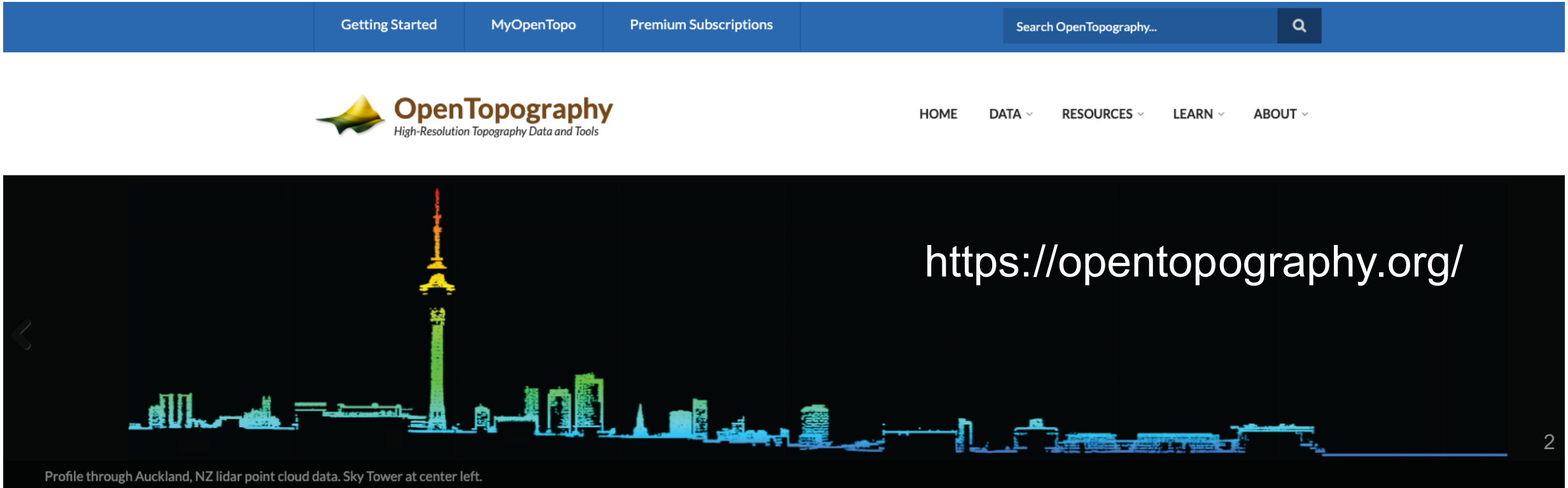


What is OpenTopography?

Democratize online access to *high resolution* topography

Data access (lidar, photogrammetry, satellite) and derived data products

Primary emphasis on Earth science research and education



Who We Are








SDSC
SAN DIEGO SUPERCOMPUTER CENTER

EarthScope Consortium

ASU Arizona State University

Founded in 2009

Supported by US National Science Foundation (*EAR Award No. 2410799, 2410800 & 2410801*)

What Do We Do?

Topographic data hosting and distribution

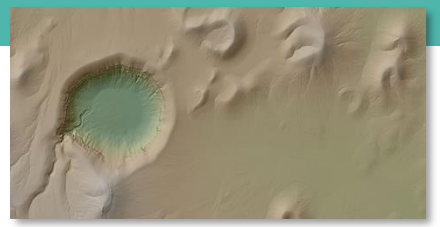
On-demand derived data products and visualizations (DEMs, hillshade, slope, contours, etc.)

Portal, APIs, cloud native data, notebooks, open source code

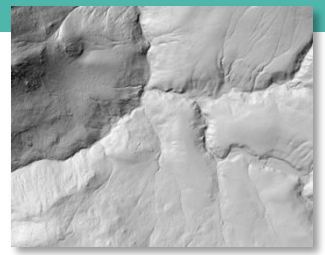
Education and training in use of high-resolution topography

Data Services

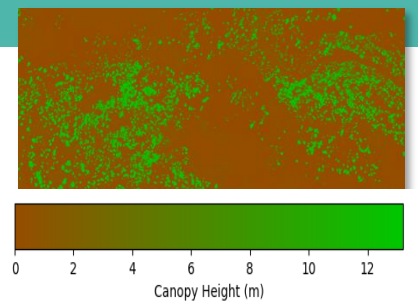
Digital Elevation Models TIN / Local Gridding



Topographic Hillshades

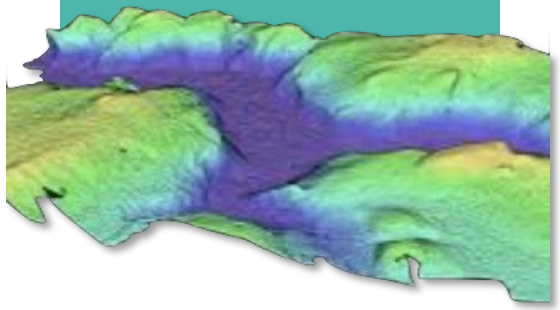


Canopy Height Model



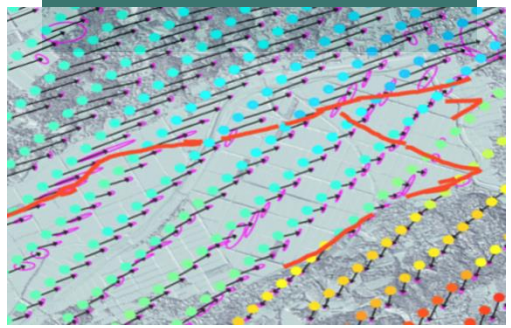
Contour Lines

3D Visualization

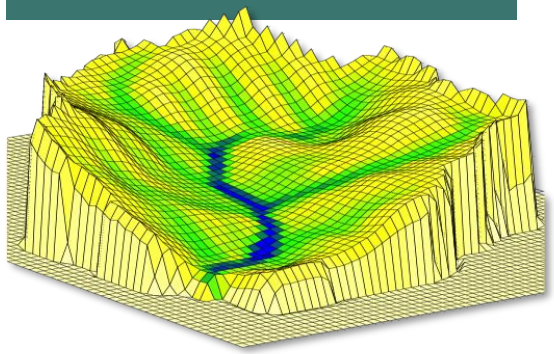


Vertical Differencing

3D Differencing

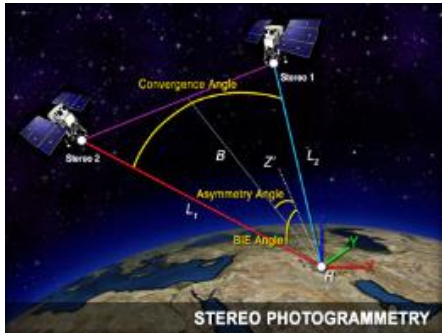


Hydrology Tools



3D Imaging with Cameras & Lasers

Space-based

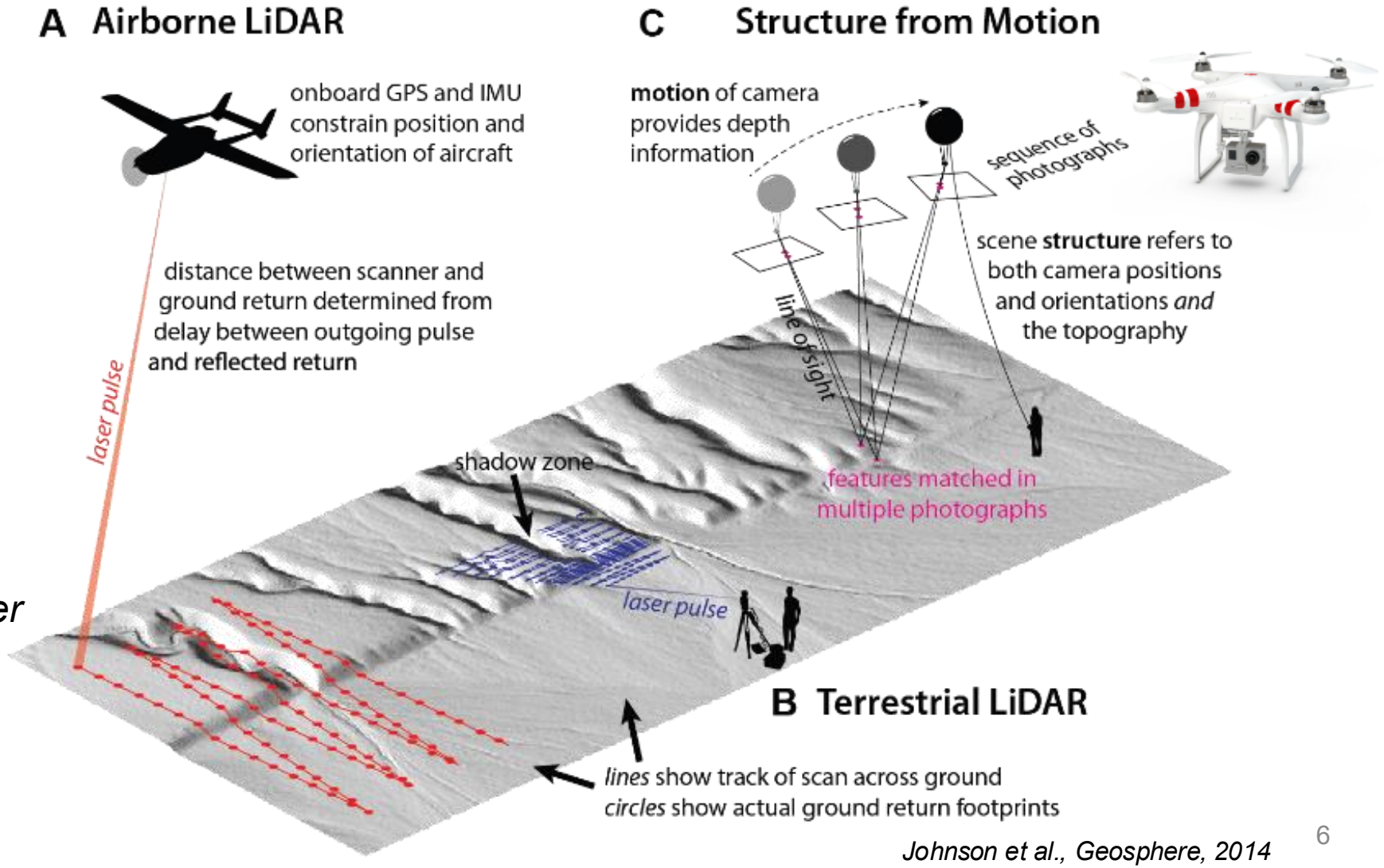


planet.

Vantor

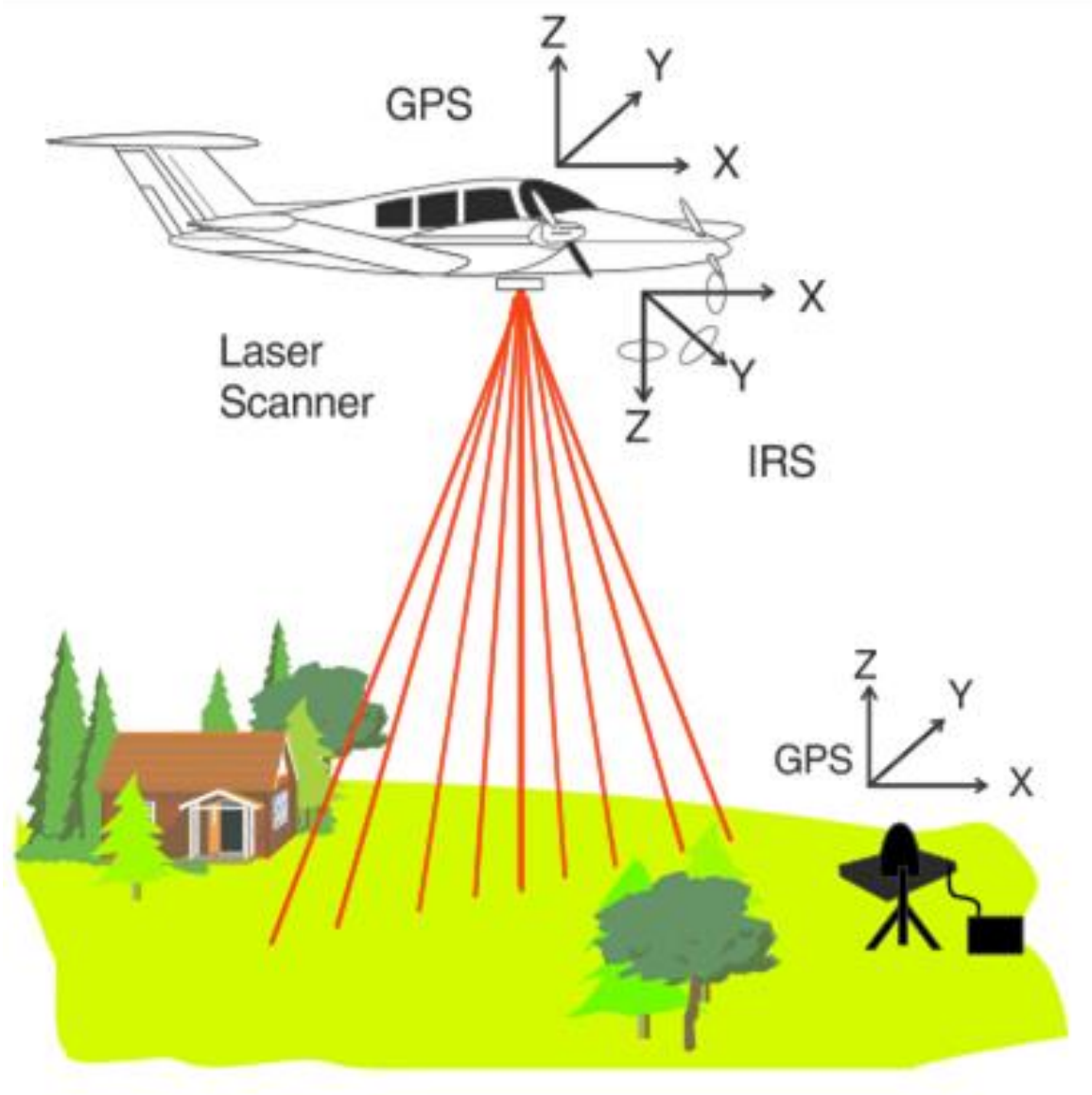
PLÉIADES CONSTELLATION

Need <meter-scale sampling to cover critical scale breaks and high temporal repeat to address landscape response to some phenomena.



Johnson et al., Geosphere, 2014

Data Collection

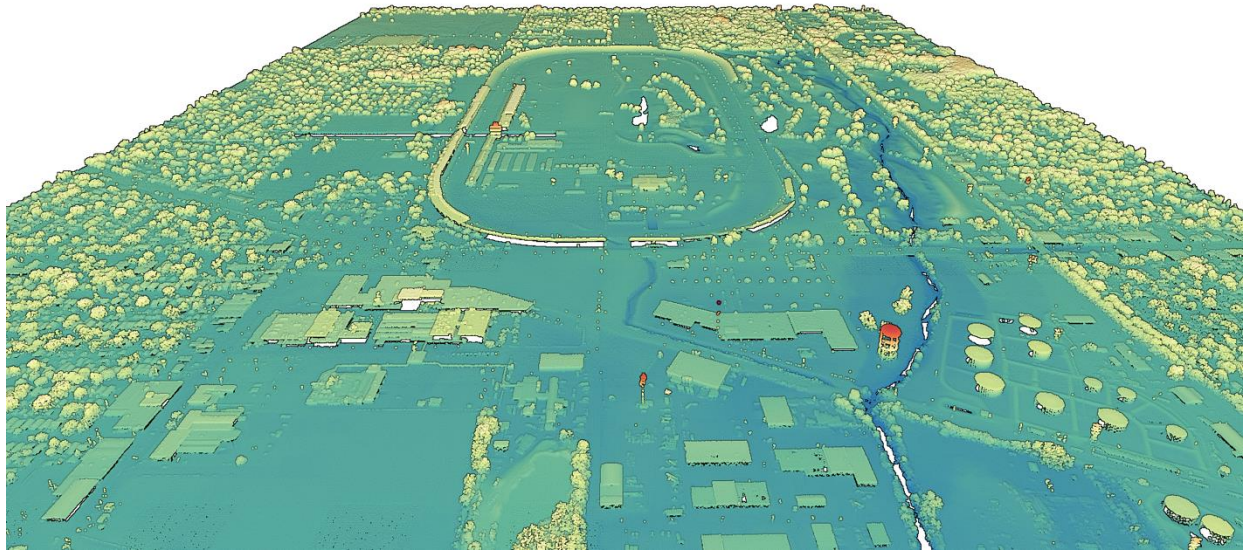


Three main components to provide a georeferenced elevation measurement:

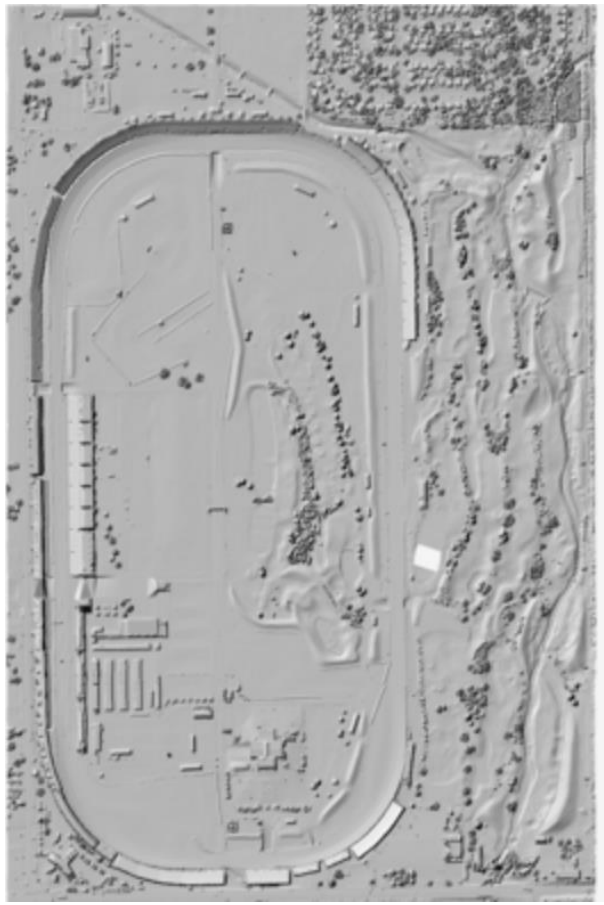
- Laser & Sensor
- Inertial Measurement Unit (IMU). Records roll, pitch, yaw of platform.
- GPS (RTK, DGPS, PPP)

Topographic Data Types

Indianapolis Motor Speedway, IN, USA



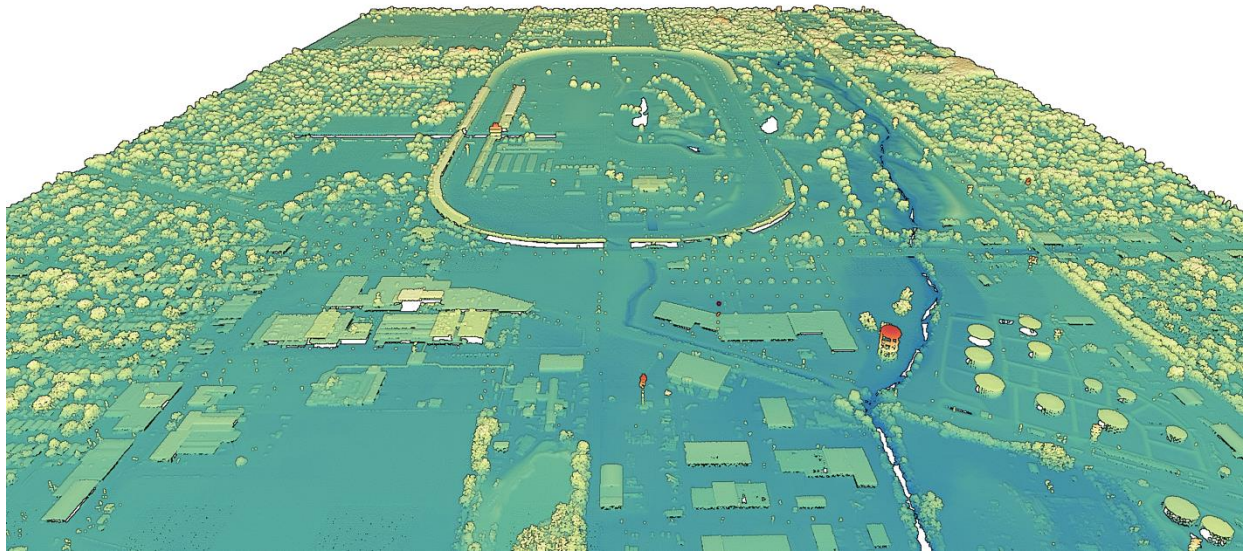
Point cloud



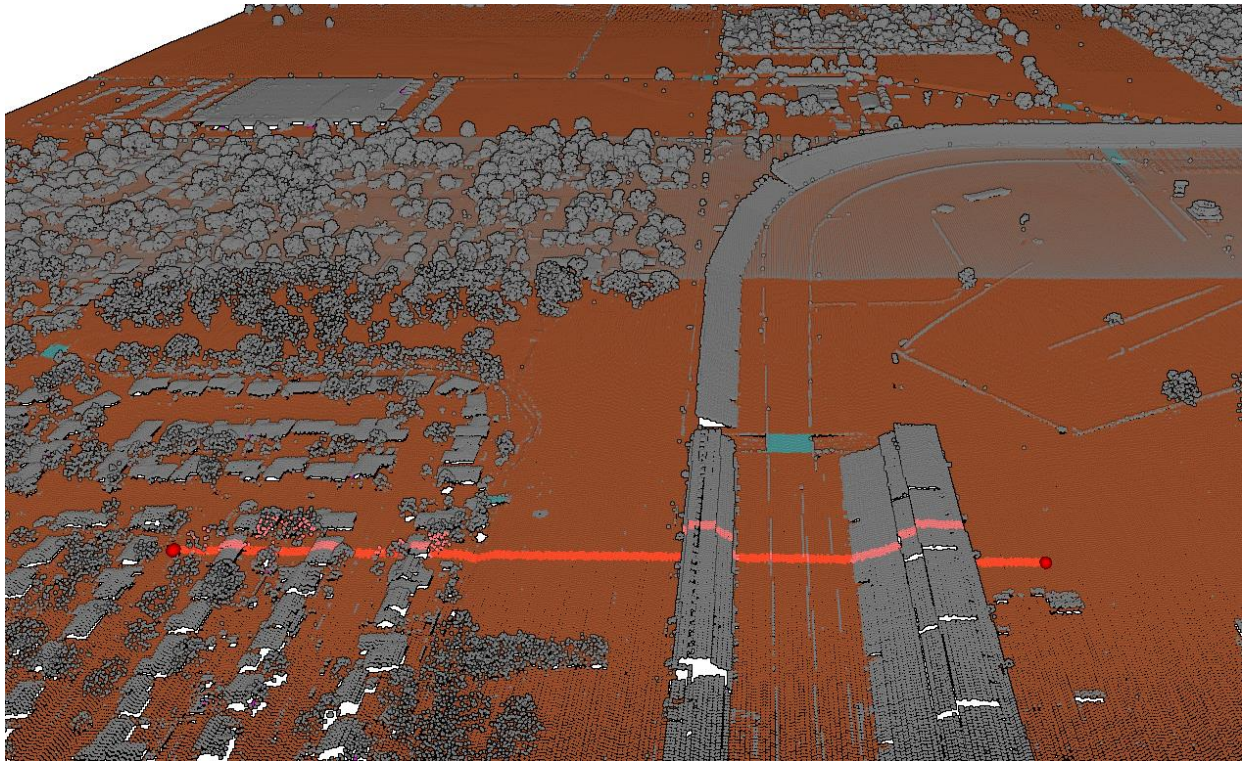
Raster: digital elevation models (DEMs)

Vector: Contours

Point Cloud Data



Point cloud colored by elevation



Point cloud colored by classification

Point cloud profile

Raster Basics

- Digital representation of topography / terrain
  - "Raster" format – a grid of squares or "pixels"
  - Continuous surface where Z (elevation) is estimated on a regular X,Y grid
  - Not True 3D - "2.5D" (e.g. trees, overhangs)
- Grid resolution is defined by the size in the horizontal dimension of the pixel
  - 1 meter DEM has pixels 1 m x 1m assigned a single elevation value.

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	0
0	50	100	100	100	100	100	100	100	100	100	100	100	100	100	50	0
0	50	100	150	150	150	150	150	150	150	150	150	150	150	100	50	0
0	50	100	150	200	200	200	200	200	200	200	200	200	150	100	50	0
0	50	100	150	200	250	250	250	250	250	250	250	200	150	100	50	0
0	50	100	150	200	250	300	300	300	300	300	250	200	150	100	50	0
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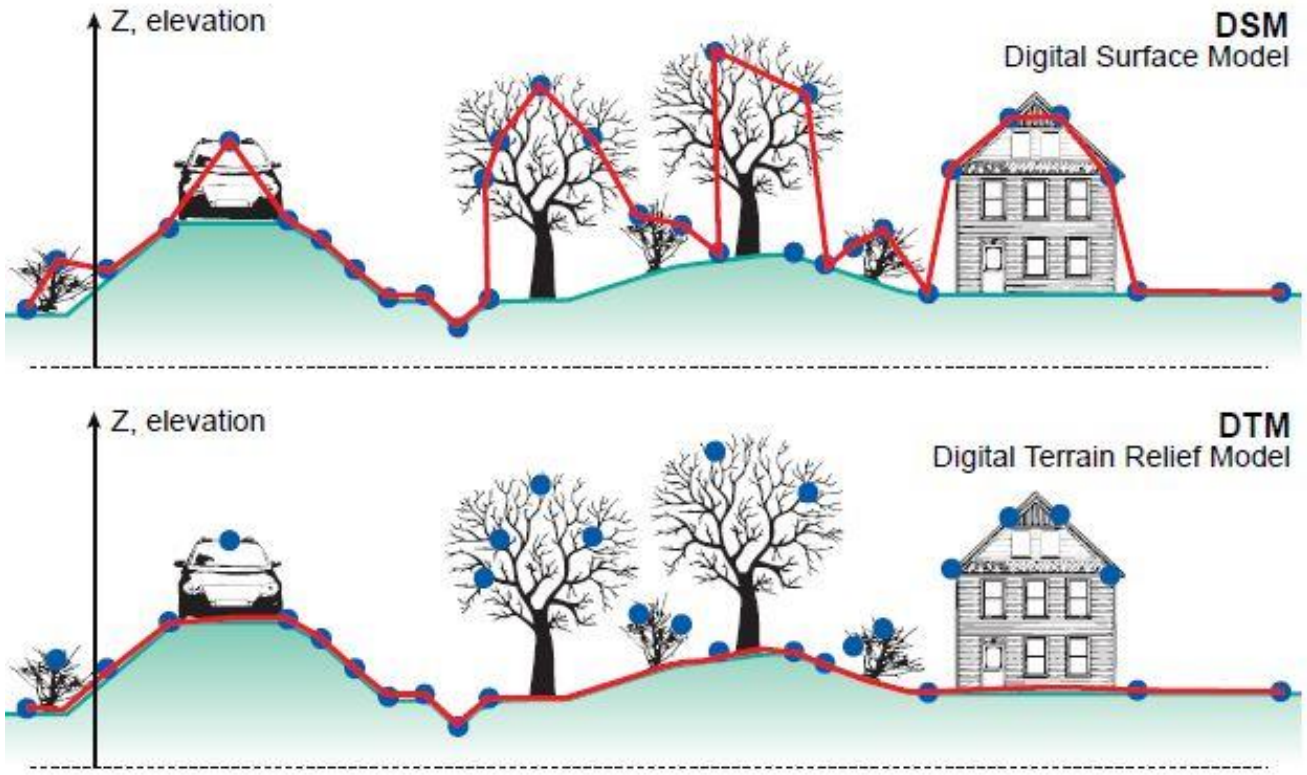
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: http://www.ncgia.ucsb.edu/giscc/extra/e001/e001.html

Raster Data



Terminology:

Digital Elevation Model (***DEM***) – Generic term

Digital Terrain Model (***DTM***) – “Bare Earth”

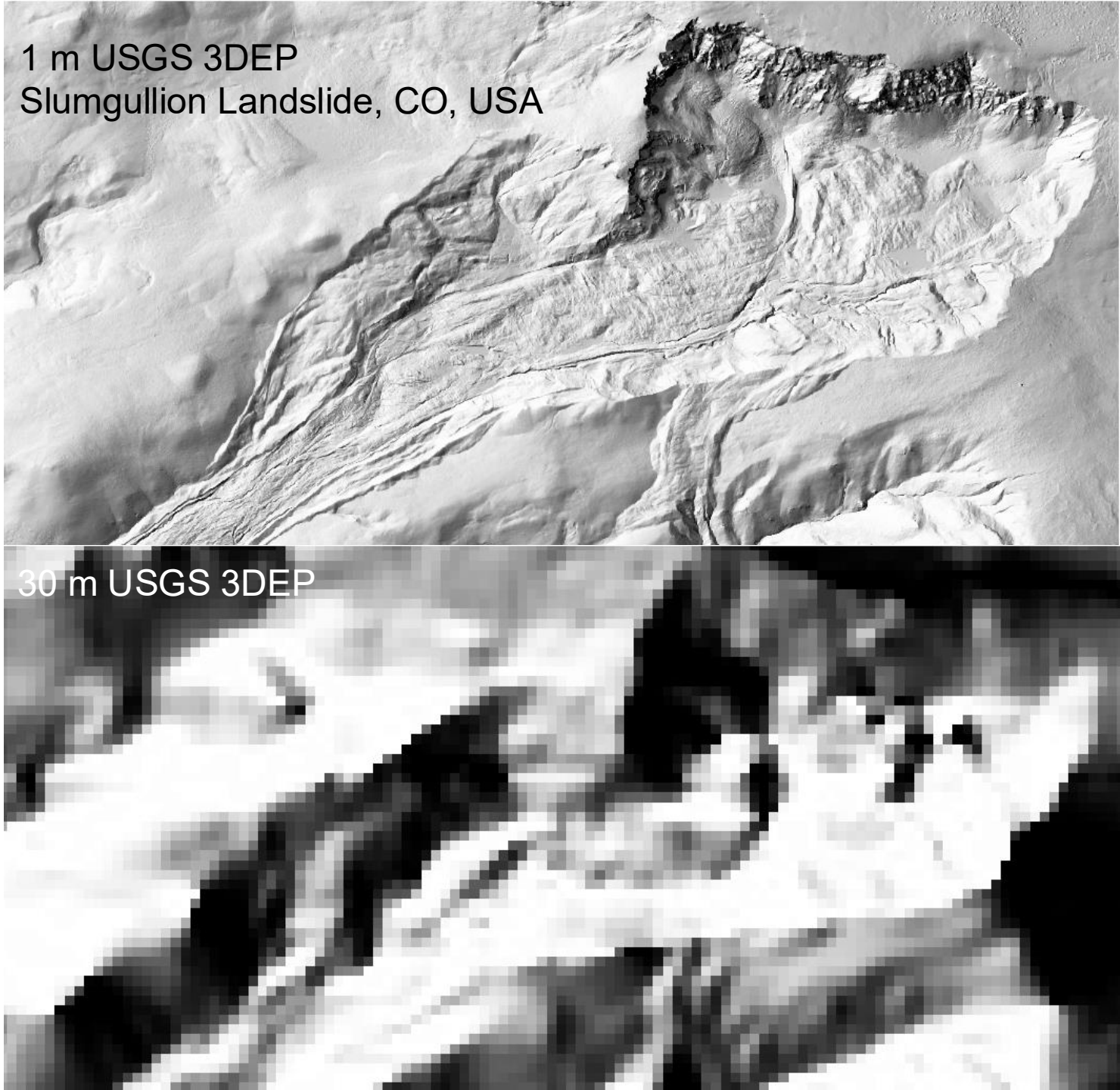
Digital Surface Model (***DSM***) – “Highest Hit”

Raster Resolution

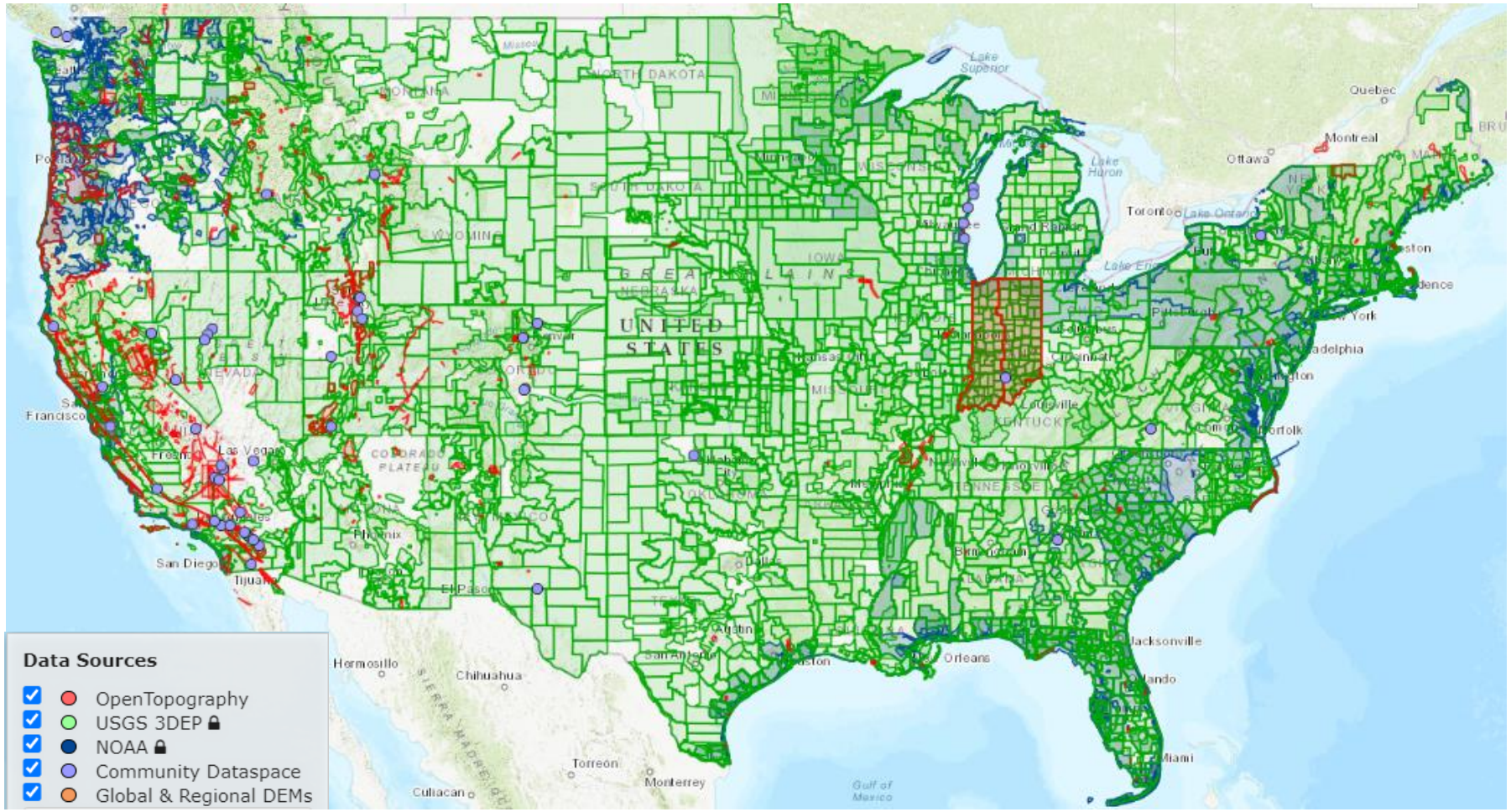
Large differences in resolution & spatial coverage

Best globally available open data are 30 m resolution

High resolution data availability globally are limited but increasing across the developed world.



The Data



95 trillion points from lidar & photogrammetry

17 global & regional topographic datasets (e.g., SRTM, COP30, USGS 3DEP 10m)

High-resolution (0.5 - 2m) DEMs for several countries + Arctic & Antarctic

Global & Regional Topography Data

17 global & regional DEM datasets available.

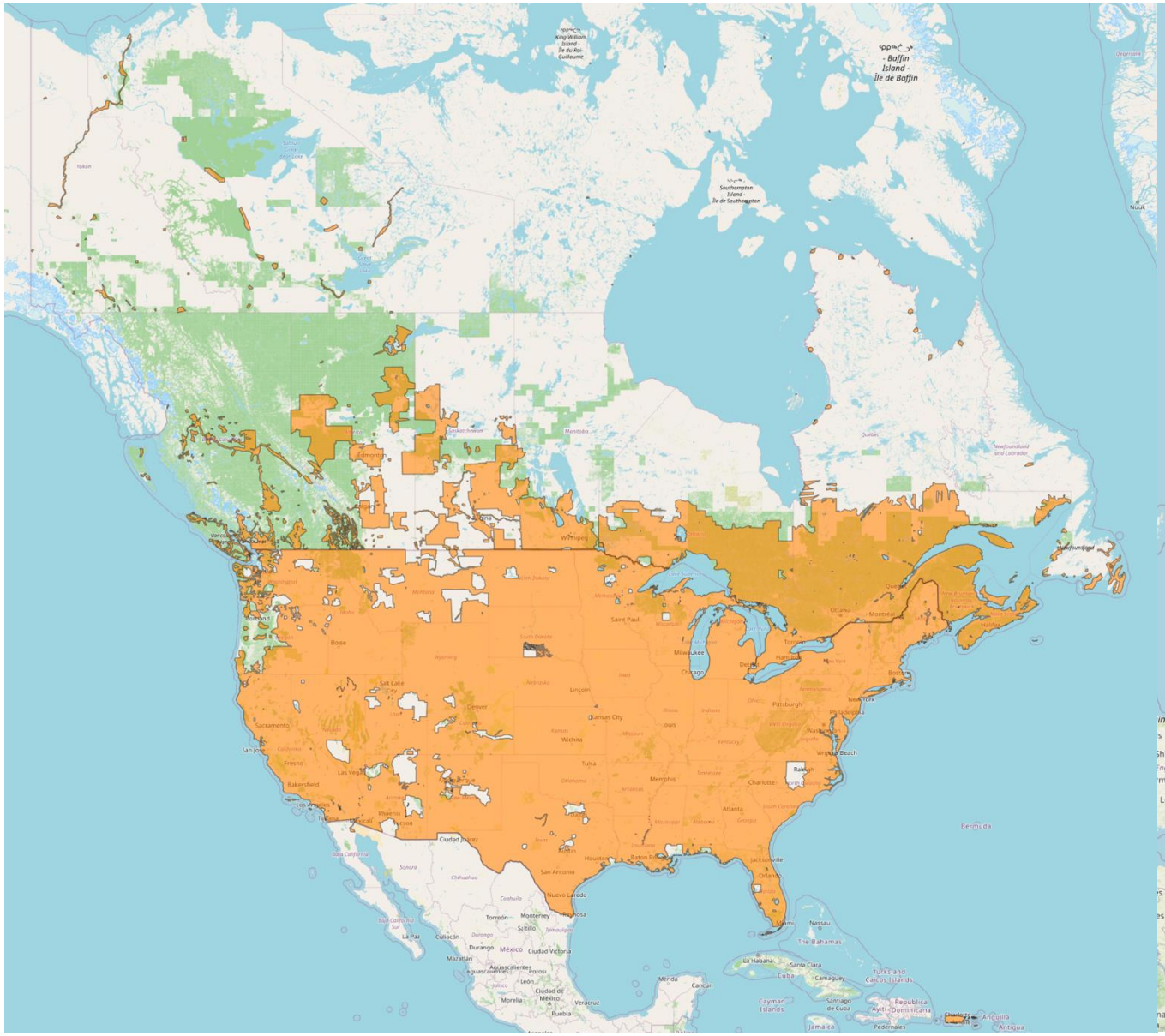
Ranging from 1km to 30 meter resolution. Spatial coverage varies

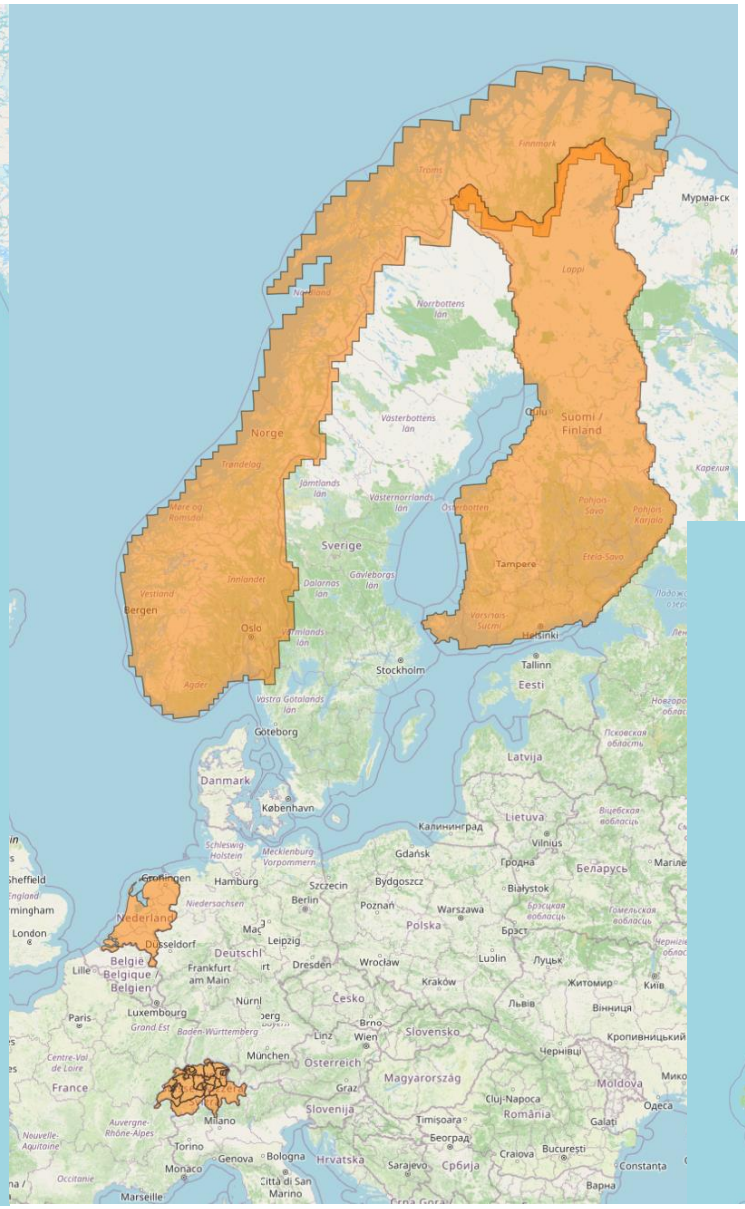
Most datasets accessible via OpenTopography Portal and APIs

SRTM 30 m, 90 m

USGS 10 m

High-resolution DEM availability





50cm to 2m DEM data availability in OT (excludes polar regions).

Focus on increasing access to international datasets

White River, IN

OpenTopography

NSF

Thank you!

www.opentopography.org

Contact: info@opentopography.org

Socials: @OpenTopography

SDSC

EarthScope Consortium

ASU

Demo: OpenTopography data discovery and access