OSGeo Sample Data Set for research, development and education

Helena Mitasova, North Carolina State University
Markus Neteler, FBK-irst

GRASS GIS

OSGeo.org
The Open Source Geospatial Foundation

Motivation

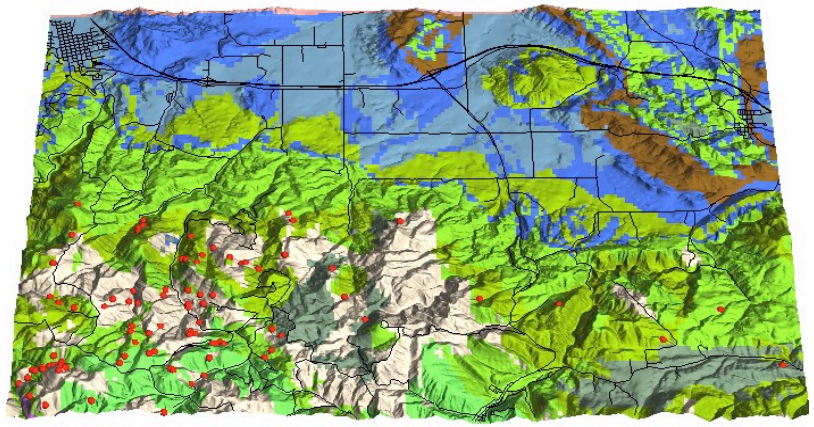
Replacement for 15 year old Spearfish Data

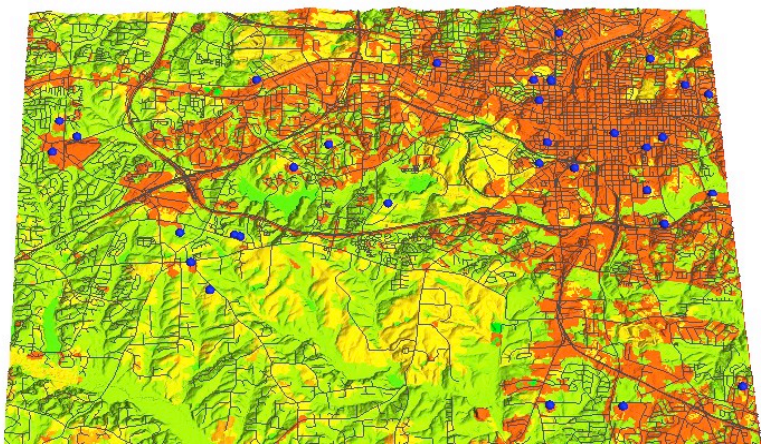
Software testing and development

- compare algorithms accuracy and performance,
- testing new tools, bug fixing

Education and training

- examples for manual pages
- tutorials, courses and workshops
- used in the 3rd edition GRASSBook

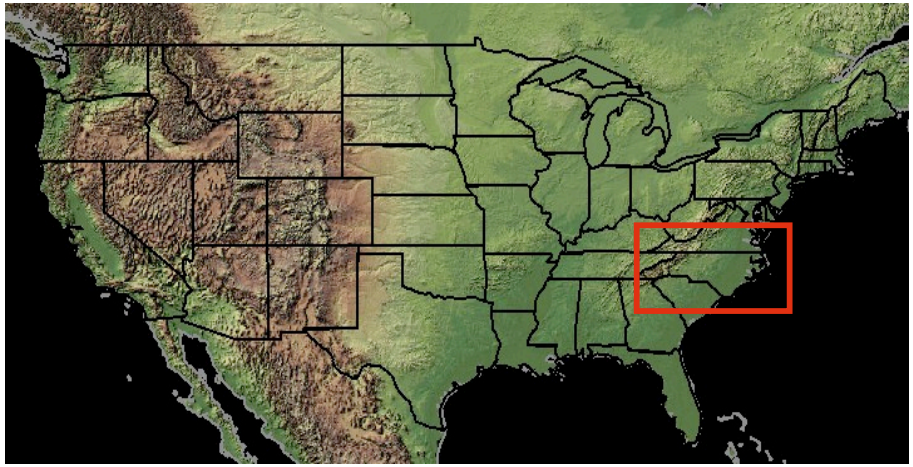


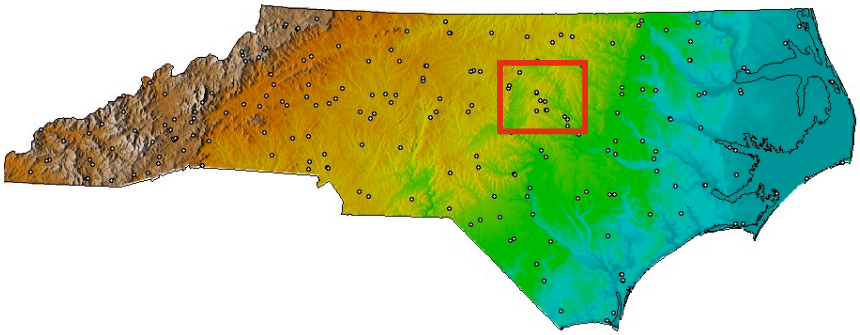


Why North Carolina

State has rapid population growth and strong environmental leadership : both stimulate robust mapping programs

- modern, state-of-the-art official data available for free
- FGDC metadata included
- great support from agencies, local - state - federal
- NC One map, WMS compliant web sites
- varied landscape : ocean to mountains, rural and cities
- local presence: better access and knowledge of data

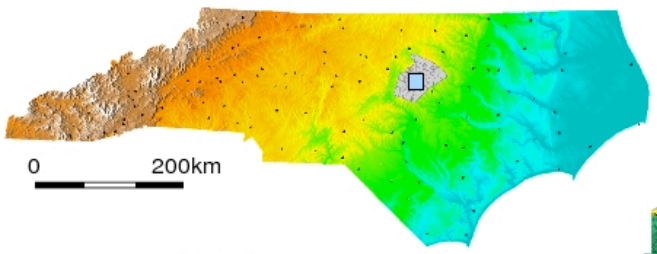


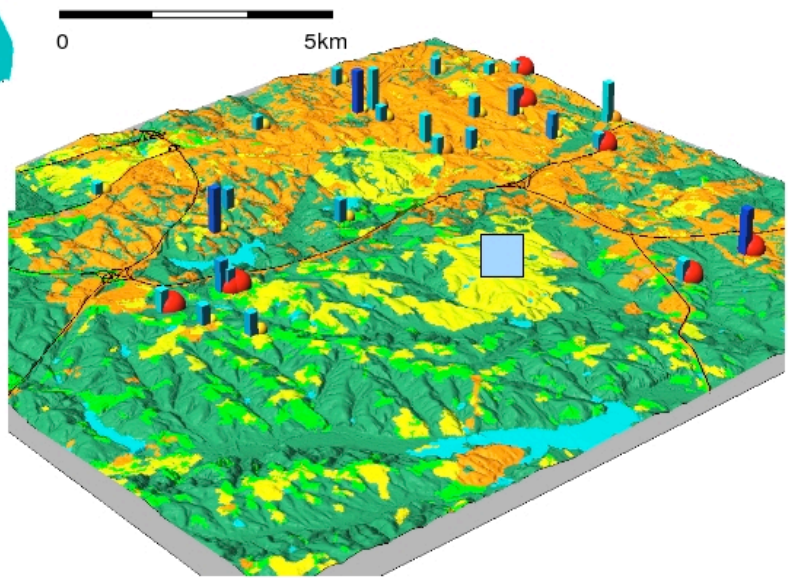


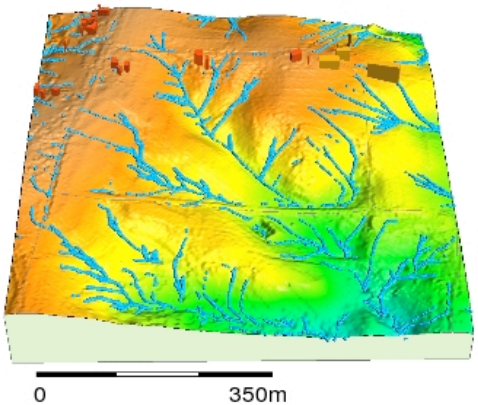
Multiple scales

Hierarchy of scales: State->County->Field/City

State: 800x600km region, 500m resolution raster
County: 20x30 km region, 30-10m resolution raster, most data, scale comparable to Spearfish
Field/city/campus: 800x800m, 1-3m resolution raster







Structure of the data set

Terabytes of data available - creating small and useful data set(s) has been a major challenge

GRASS LOCATION : vector and raster maps in GRASS format, State Plane NAD83 (EPSG 3358)

Data in external formats : original GDAL/OGR supported formats and coordinate systems (geographic, UTM, State Plane, meters and feet) - teach and test format conversions and coordinate transformations

Links to web sites, NC One map : newer and/or higher resolution data, complete spatial extent

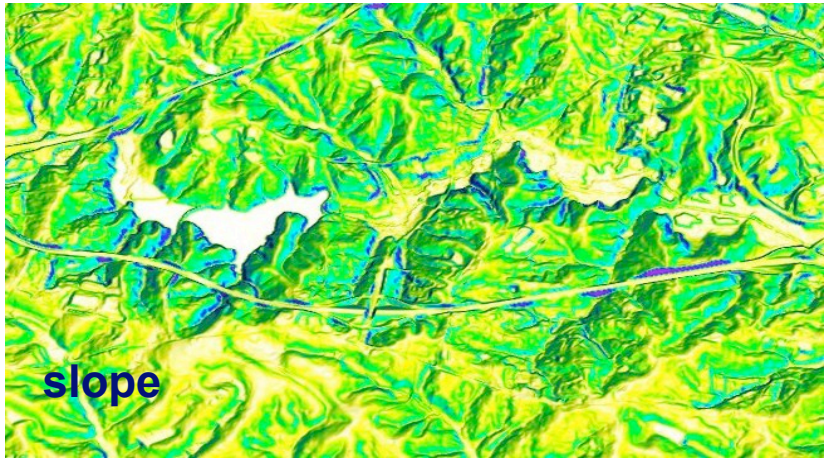
Provide the data integrated in GRASS LOCATION in a different format and coordinate system?
If yes, which format(s) suit the best for OSGeo community?

Geospatial data types I

Raster:

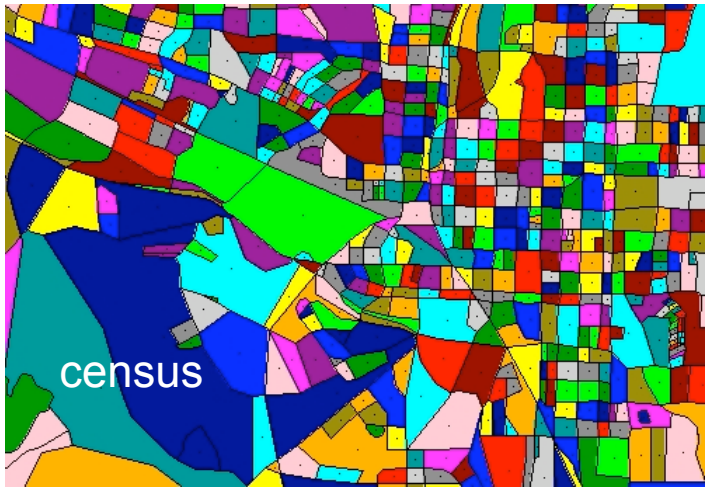
discrete: basins, geology

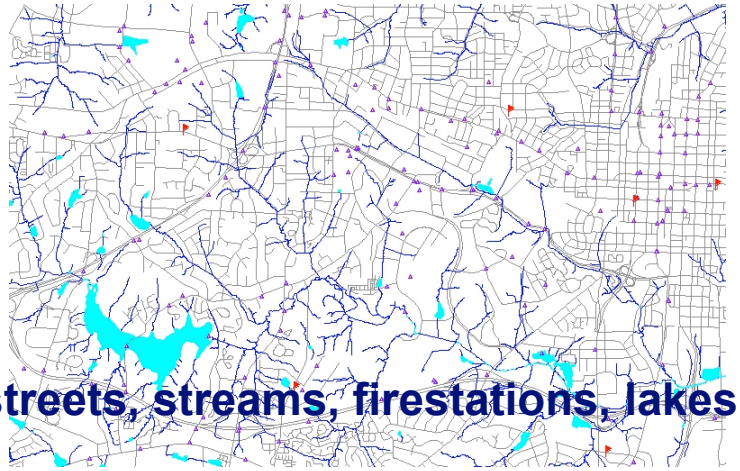
continuous: DEMs,slope



Vector:

polygons, lines, points with attributes





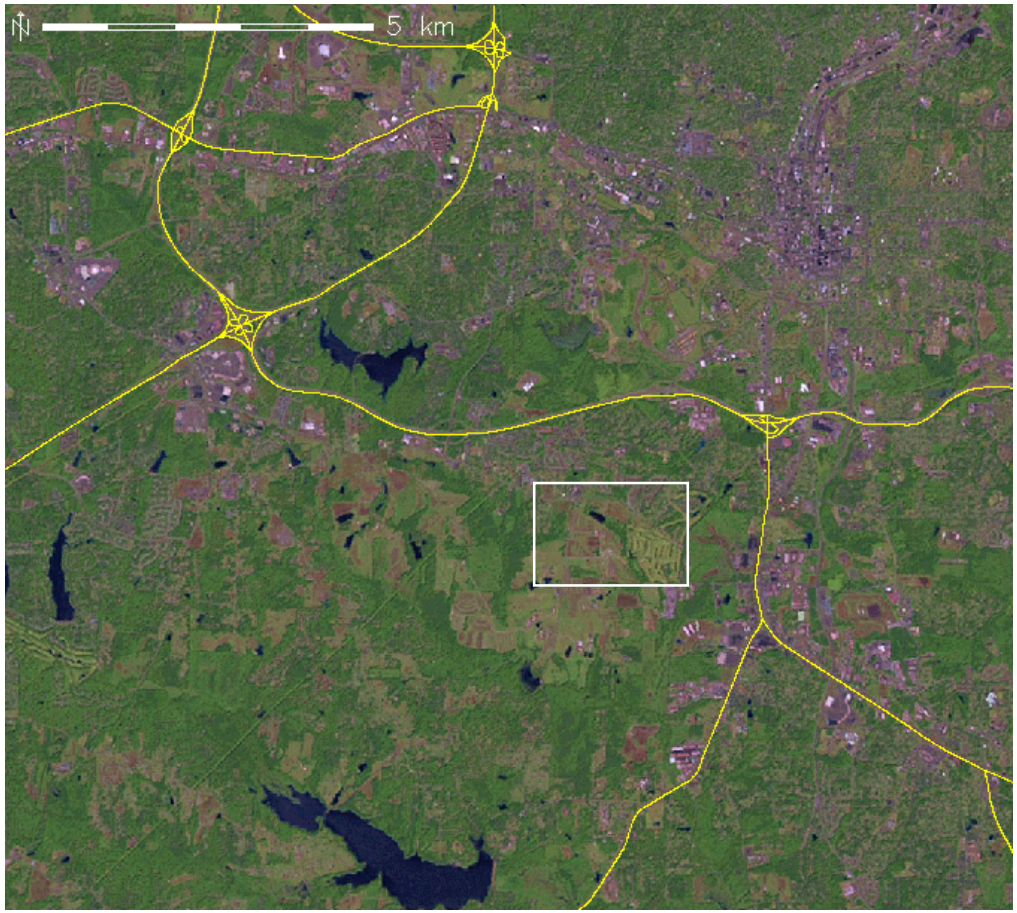
GRASS GIS

Open Source Geospatial Foundation

Geospatial data types II

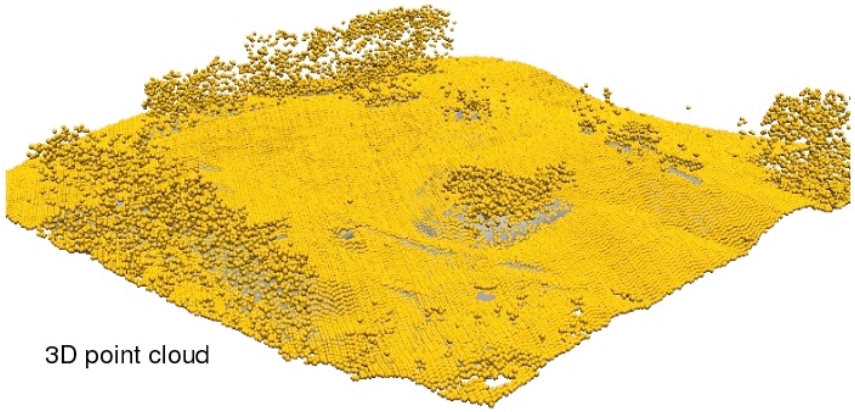
Imagery: LANDSAT, MODIS, orthophoto

Vector: point clouds



2002 LANDSAT

2001 Orthophoto



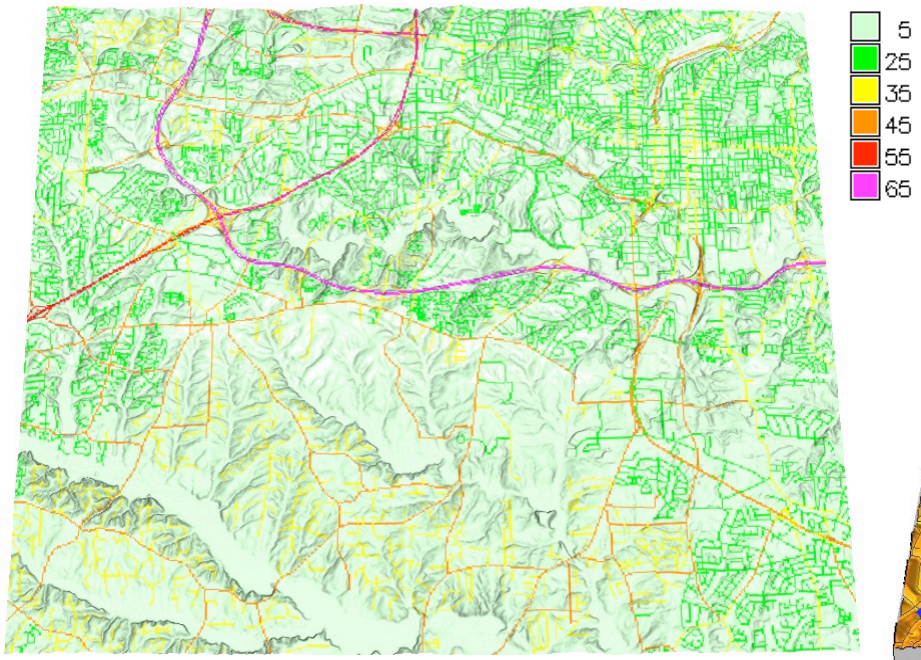
Examples

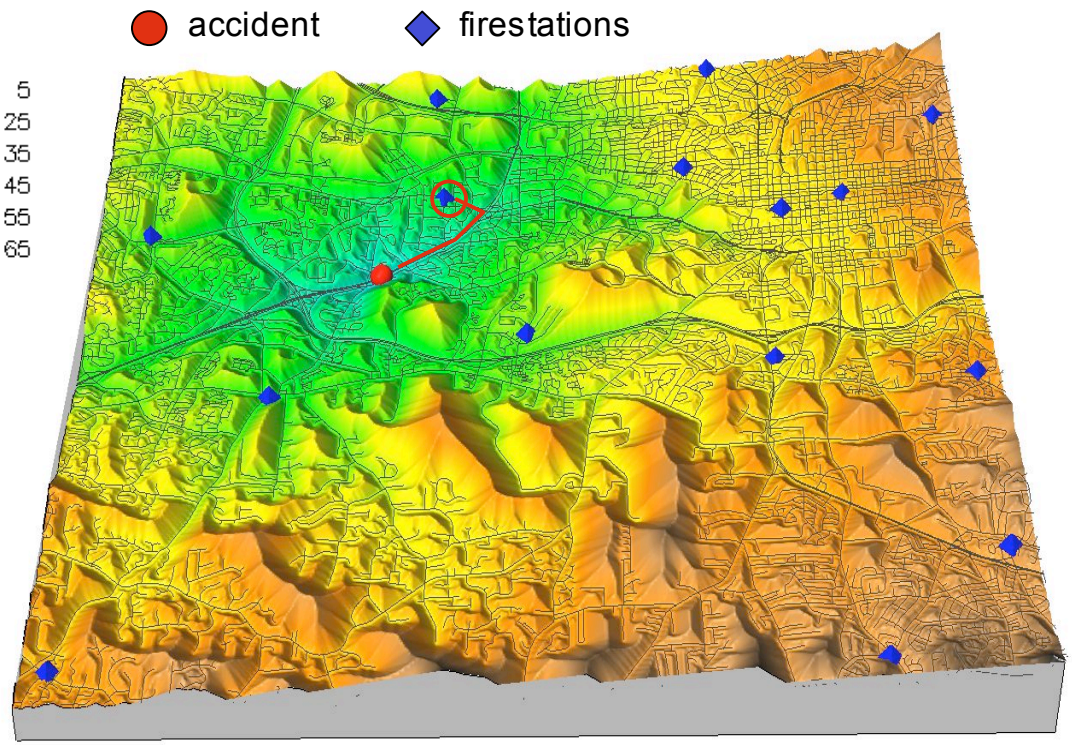
Hundreds of derived maps can be created from the data set using geospatial analysis and modeling tools

- cost surface /shortest path example
- noise impact
- visibility analysis
- linear reference system
- network analysis
- generalization
- temperature analysis based on MODIS
- lidar terrain modeling and analysis
- watershed analysis and flow pattern
- precipitation modeling

Cost surface: accident

Speed map

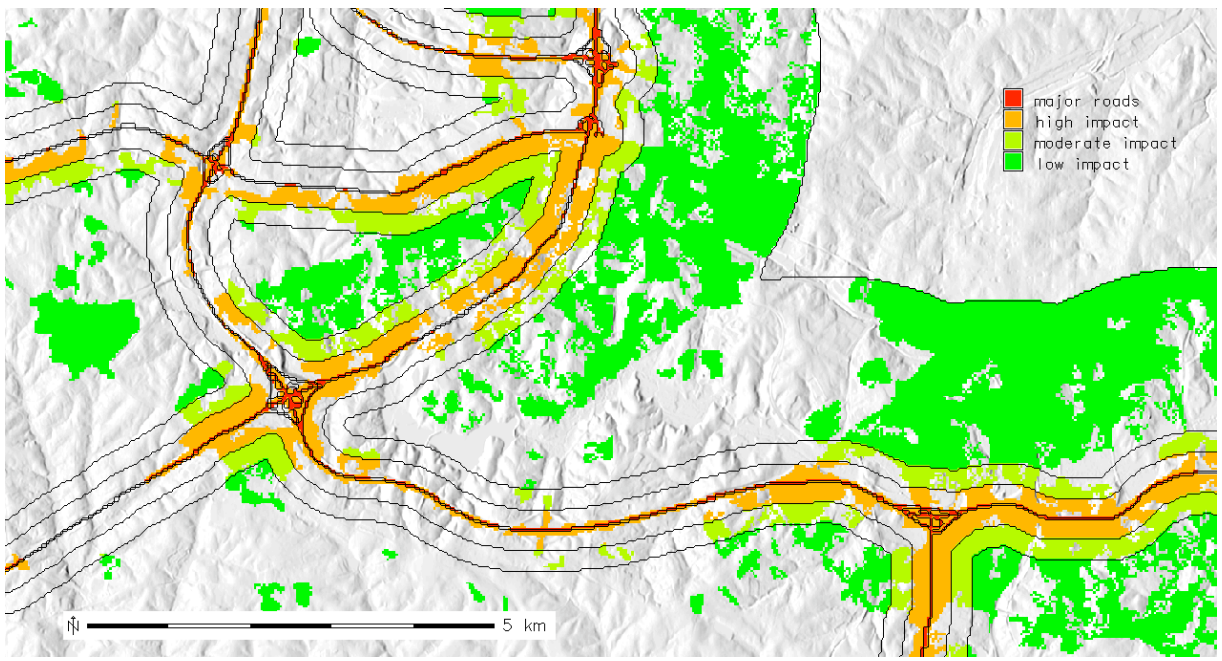




- convert street speed limit data into time (use 5km/hr for off-street areas) ,
- compute cost surface to reach site of an accident from any point in the area,
- find closest fire station, compute shortest path from it

Can be solved both with raster tools and vector network analysis tools

Noise impact analysis

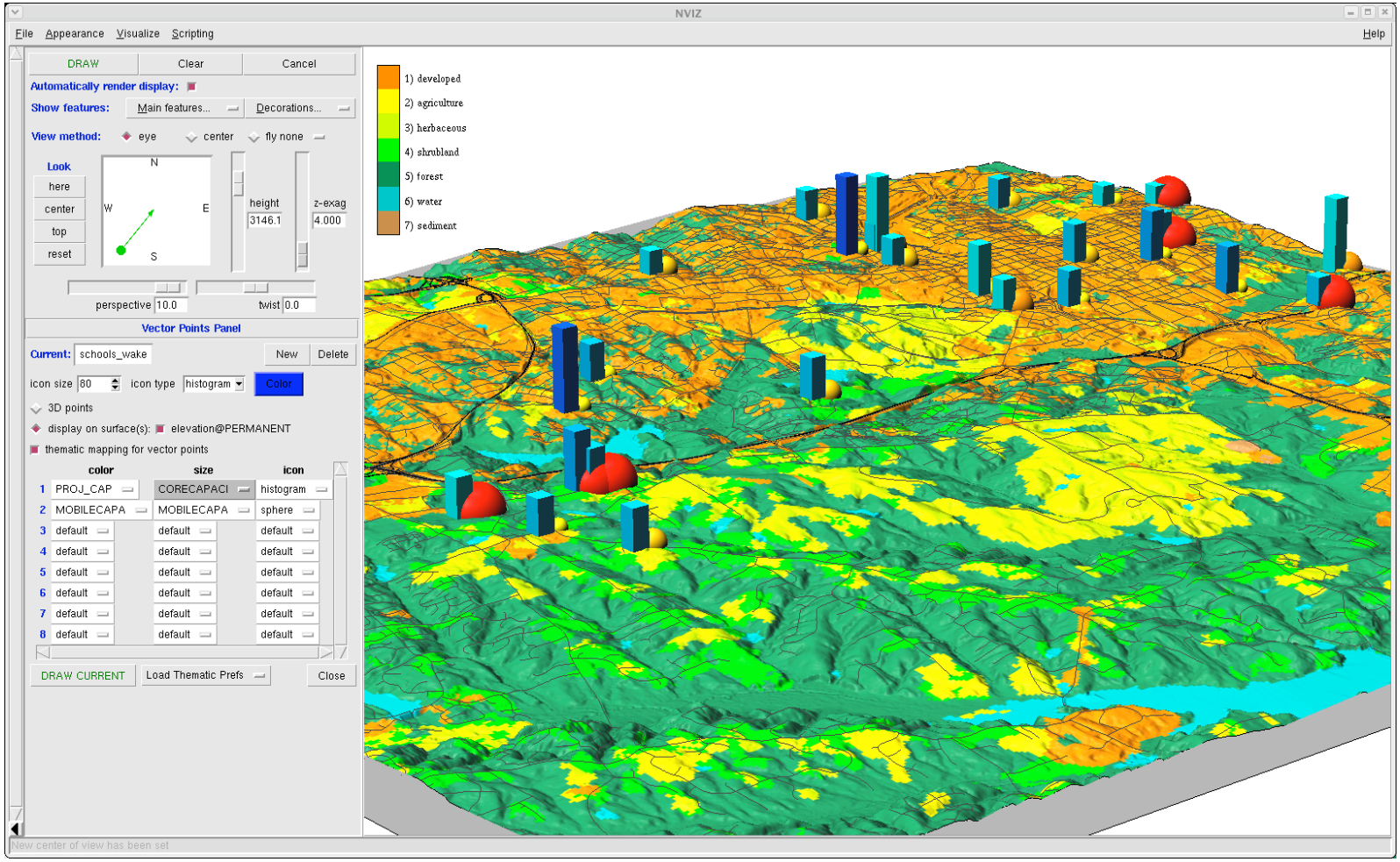


Noise impact:

overlay highway buffers with developed areas

find schools and number of students impacted by noise

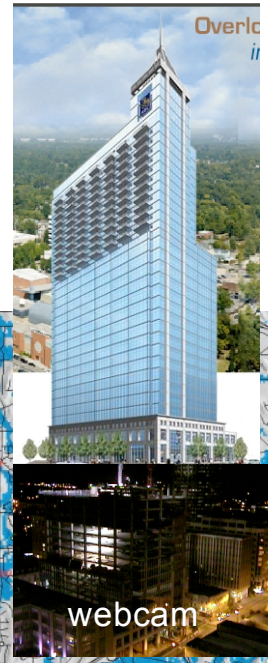
Point data with attributes



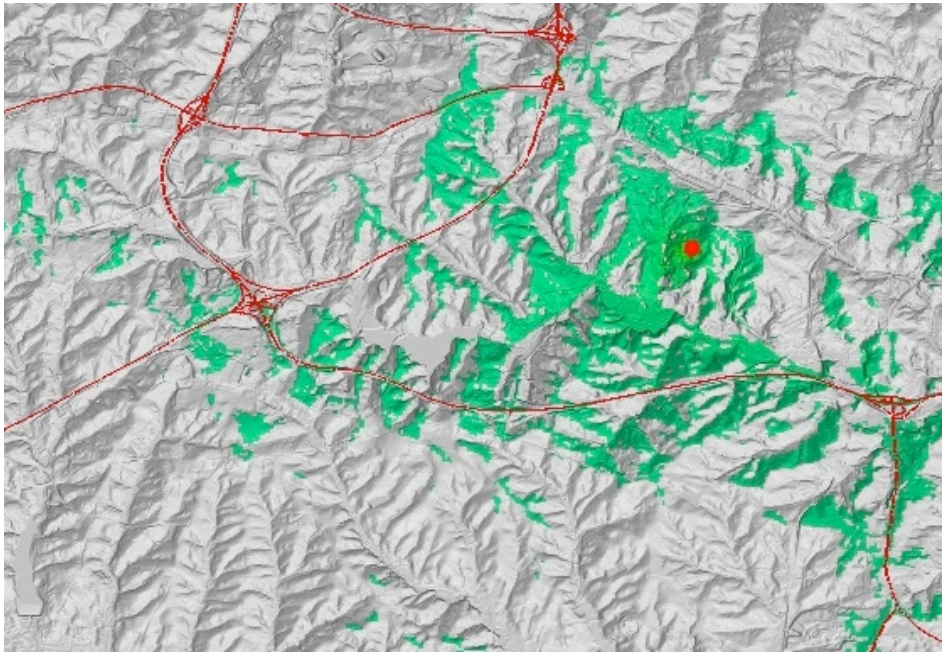
Schools: capacity (blue symbols),
number of mobile units (yellow-red balls)

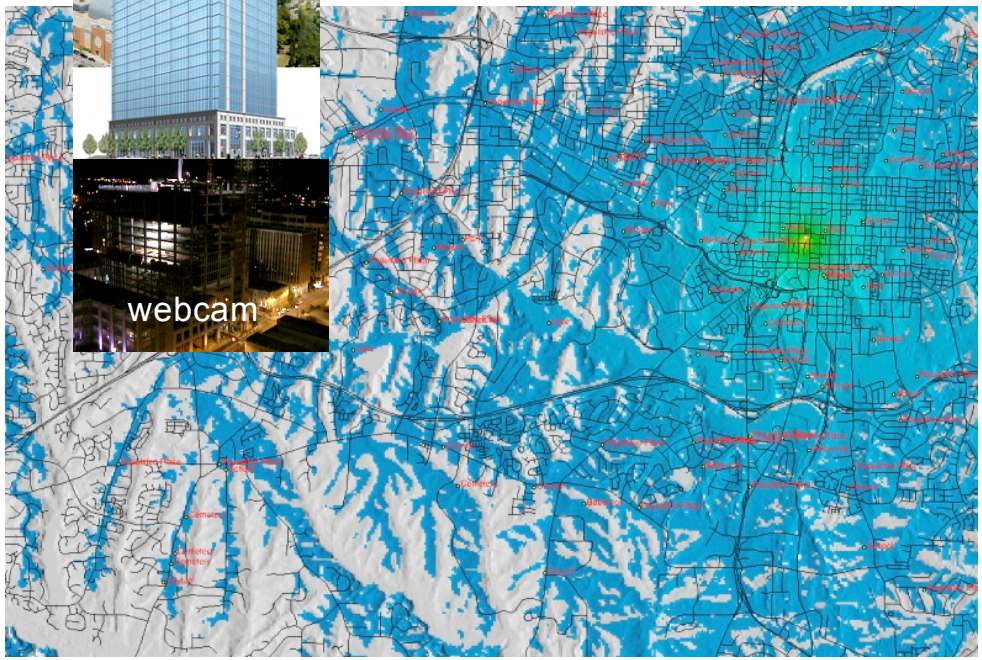
Viewshed analysis

From RedHat headquarters



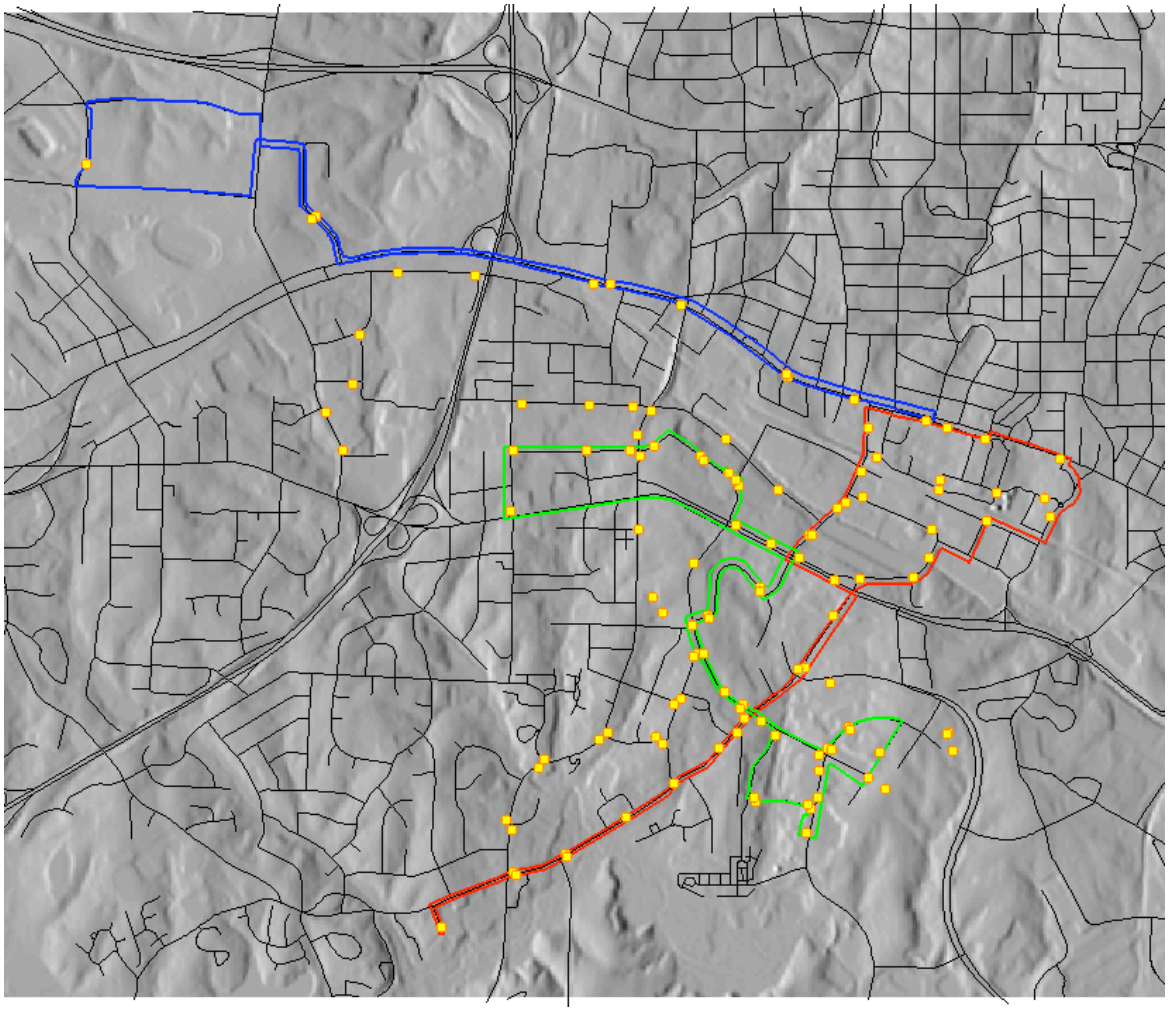
From Royal Bank of Canada headquarters





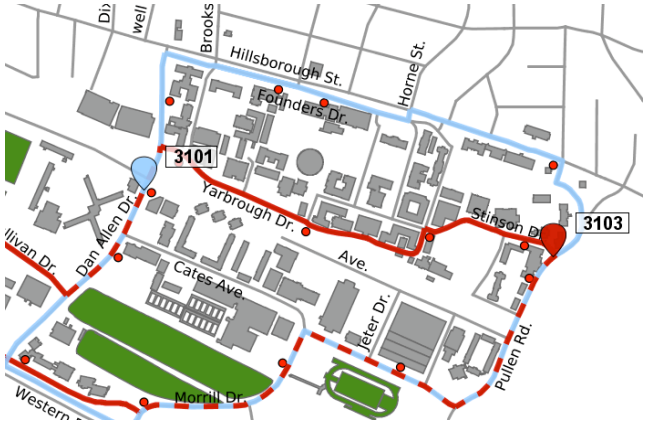
- computed from bare ground lidar based elevation model, 30m resolution
- can be compared with the results from SRTM, higher resolution DEM and DSM
- can be overlayed with Points of Interest map

LRS: Linear Referencing System



Build LRS:
linear referencing system for bus lines

Tasks:
- bus stop relocation
- distance to stop along the route

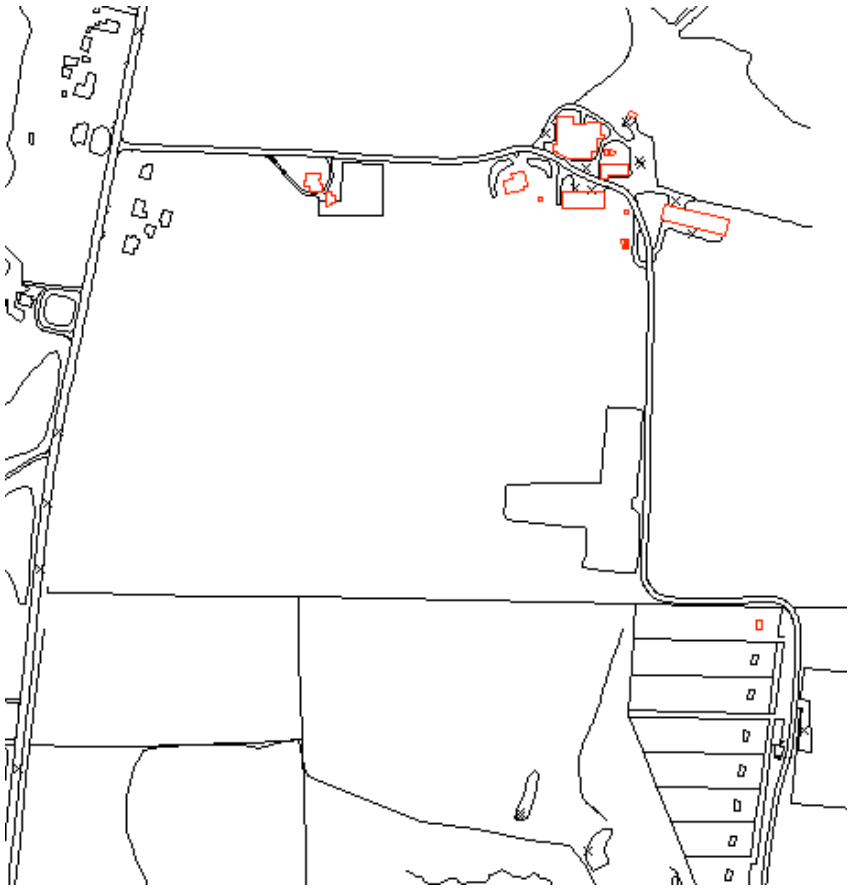


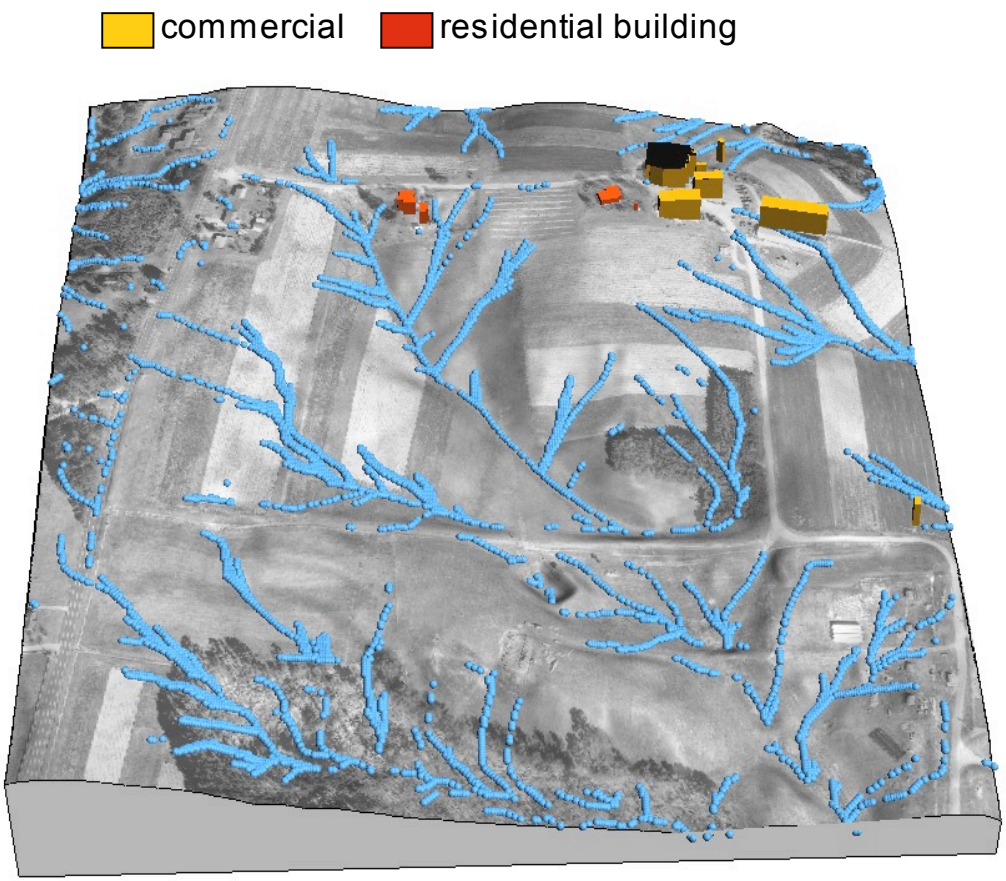
See real-time location of buses at: http://ncsu.transloc-inc.com/

Network analysis

Find shortest path between two hospitals based on cost (1/speed) and distance

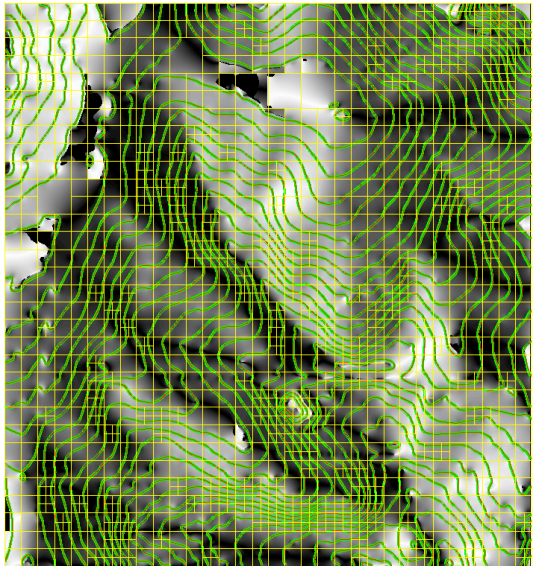
Planimetry with attributes

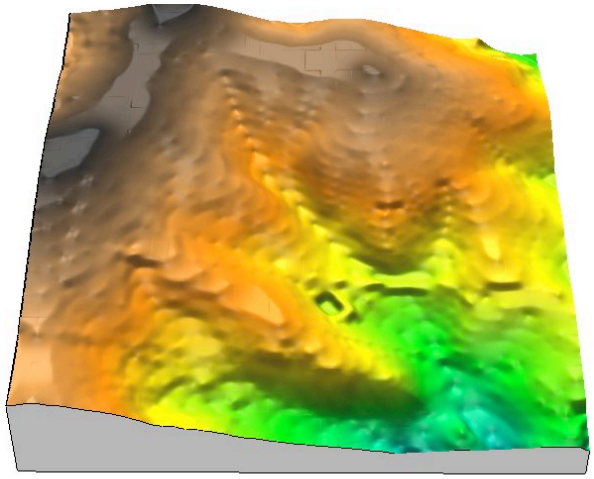




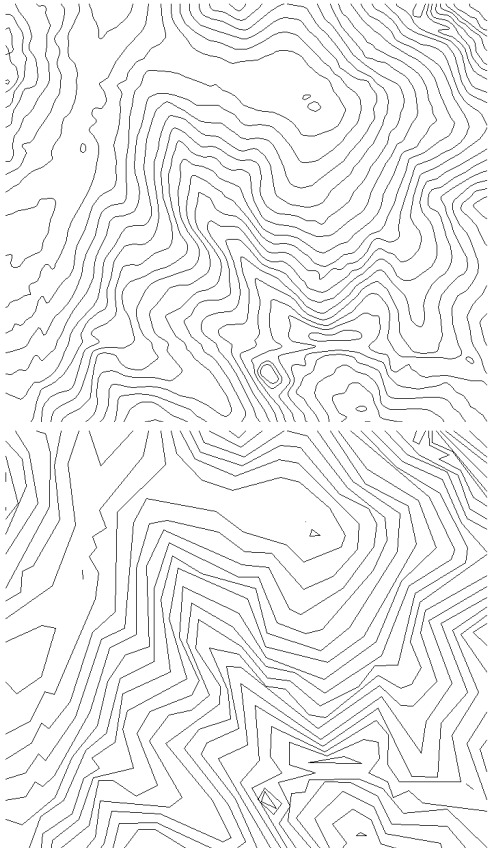
Planimetry combines many layers: buildings, parking lots, fences, roads, …
Features can be extracted using SQL and represented using 3D vectors.

Google SOC project testing

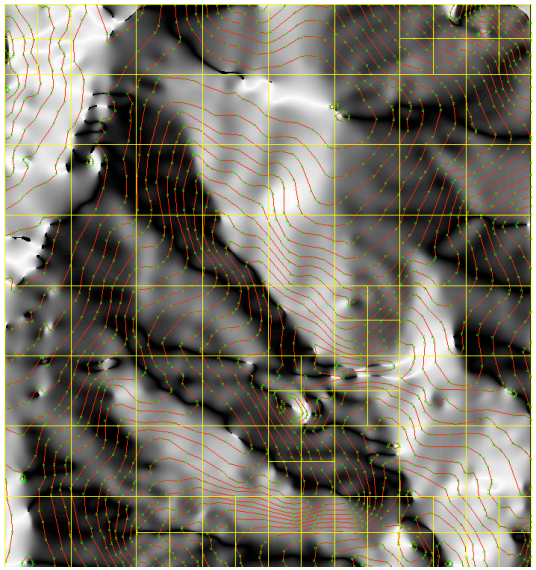


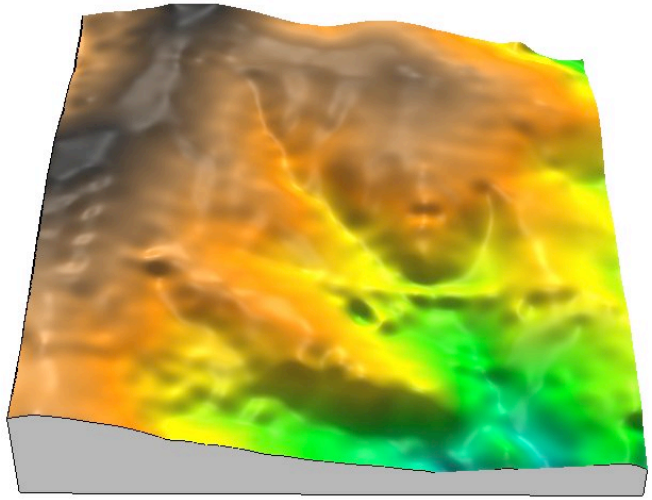


Generalization :
contours (thin the points to improve interpolation), streams, polygons
Daniel Bundala, student
Wolf Bergenheim, mentor

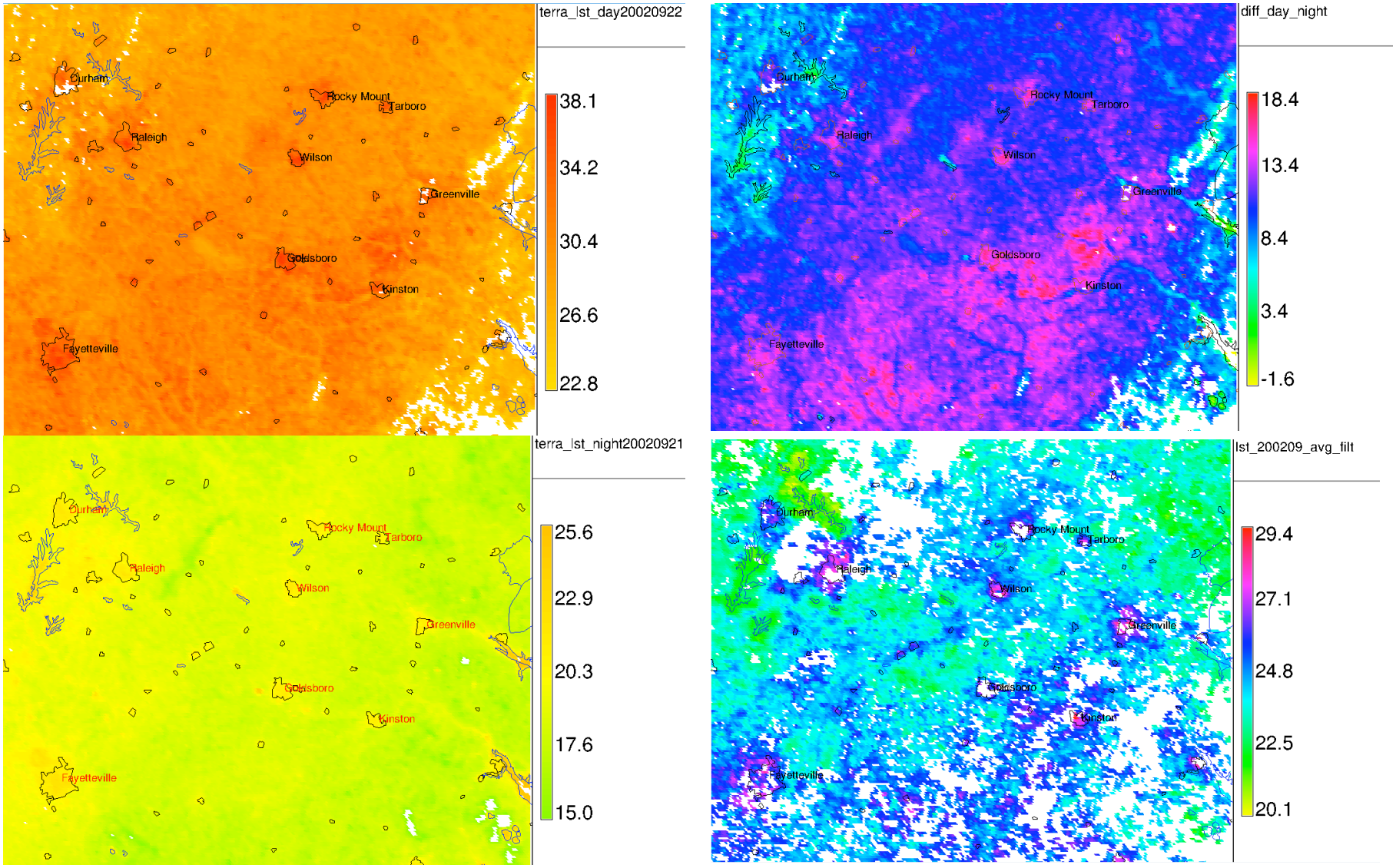


Reduce points from 40,000 to 3,000 interpolate 8-times faster, without artifacts





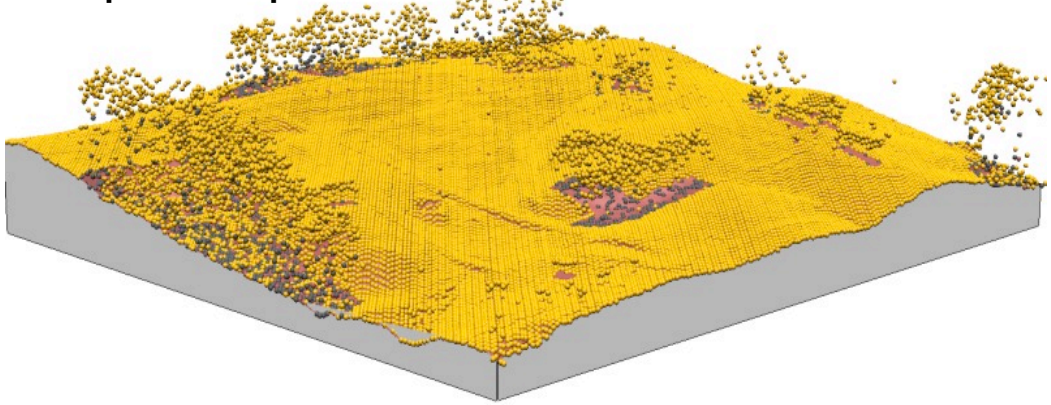
MODIS analysis: temperature



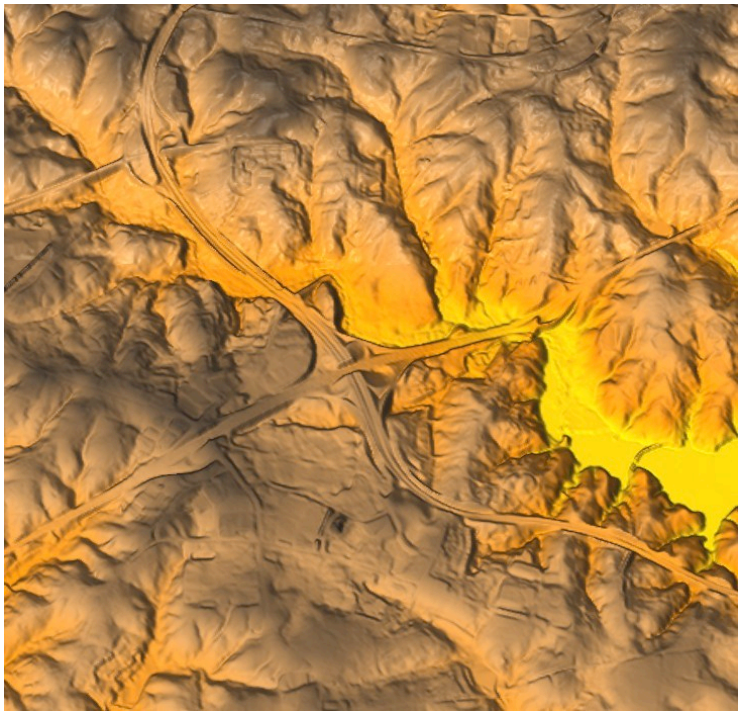
MODIS time series data analysis, 400 MB of data - one year, twice a day

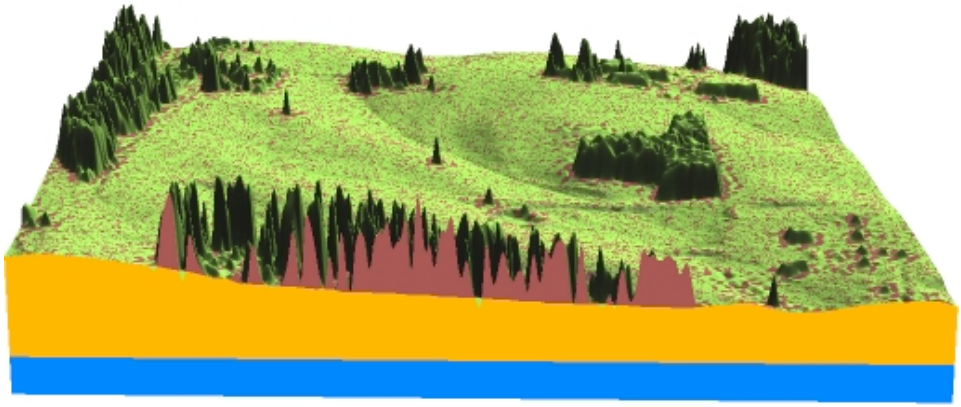
Lidar:point clouds, DEMs, DSMs

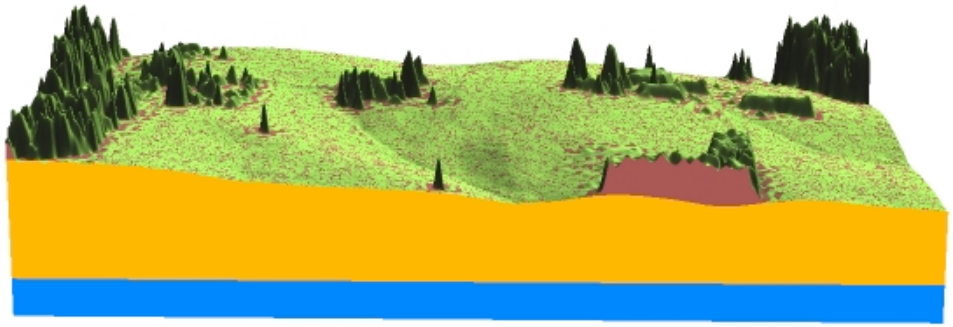
Multiple return point cloud



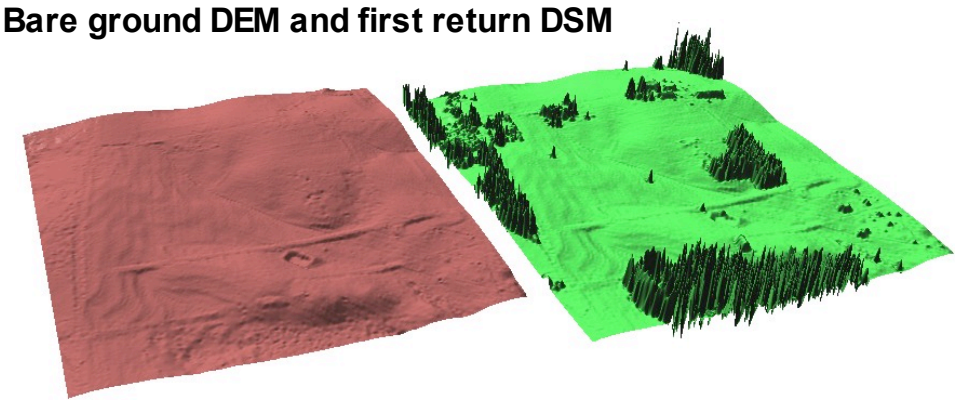
10m DEM derived from lidar



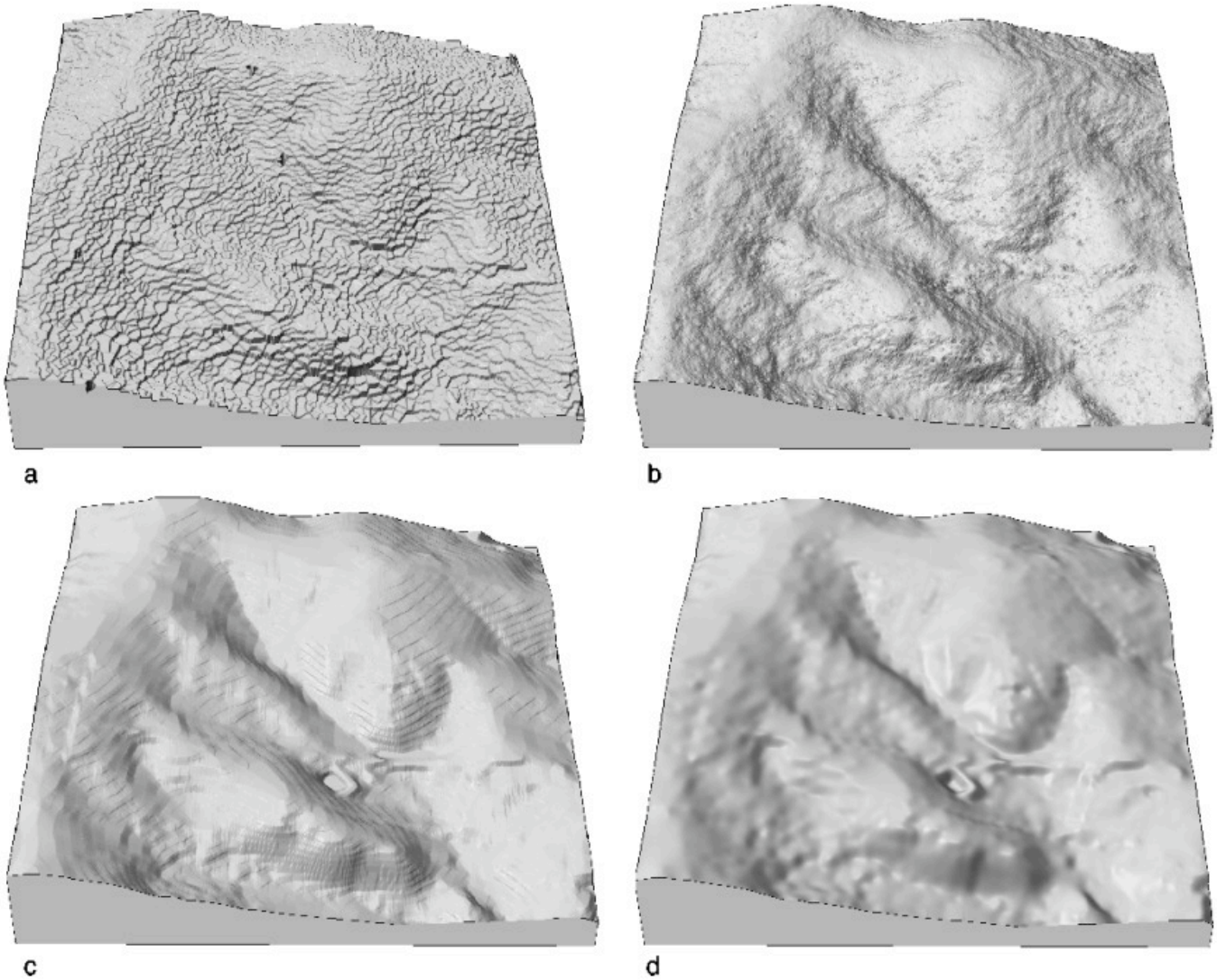




Bare ground DEM and first return DSM



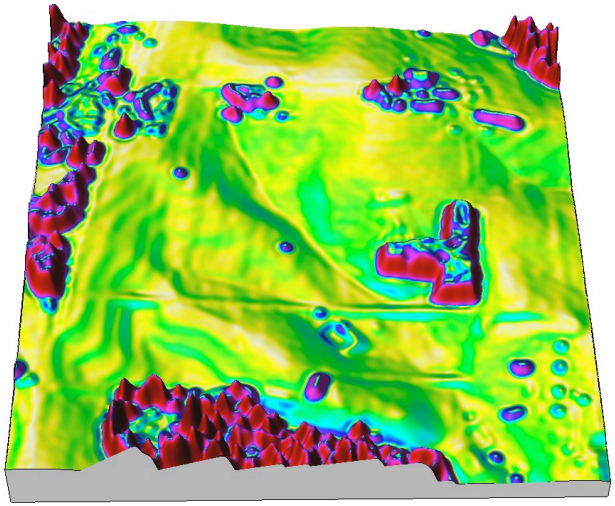
Point elevation data for interpolation



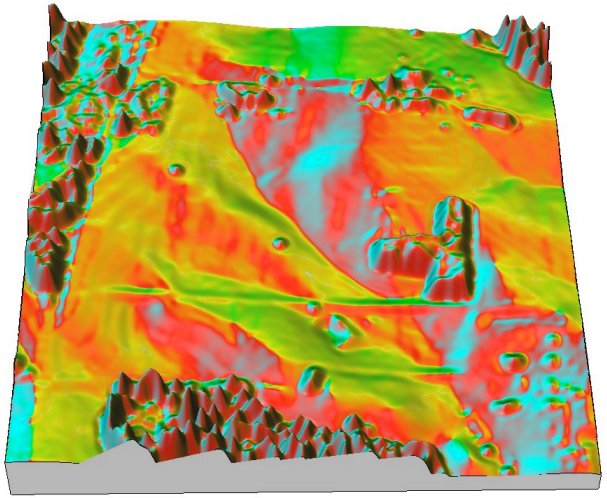
Point data for interpolation:
- random elevations
- lidar-based profiles
- contour points

a: Voronoi polygons
b: IDW
c: linear contour-based
d: spline (RST)

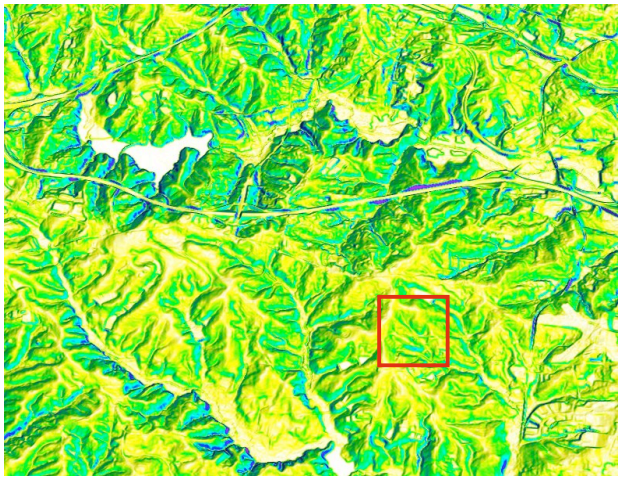
Topographic analysis



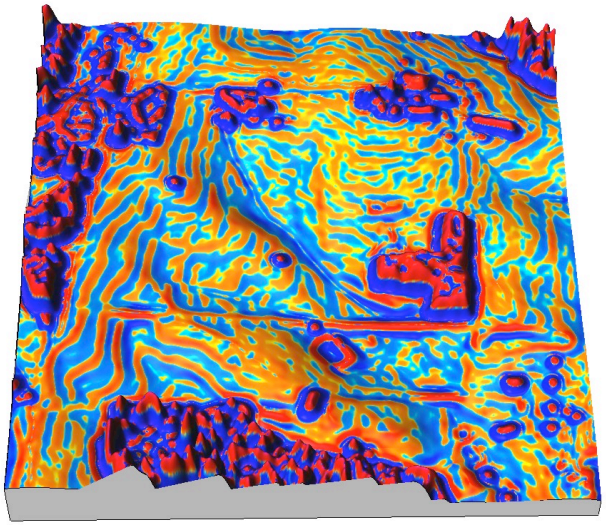
slope



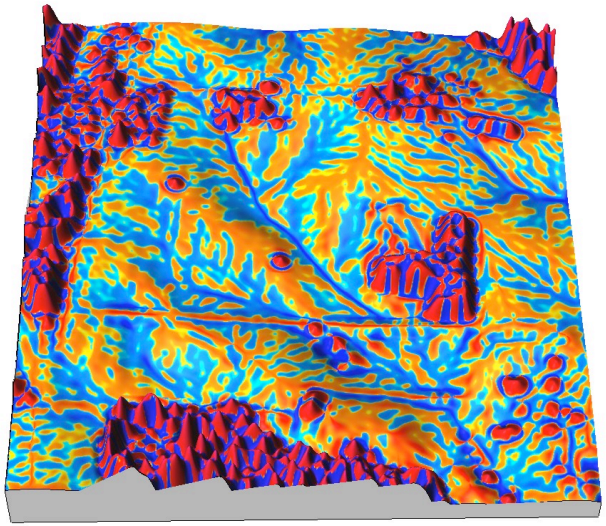
aspect



slope at 10m res., bare ground



profile curvature

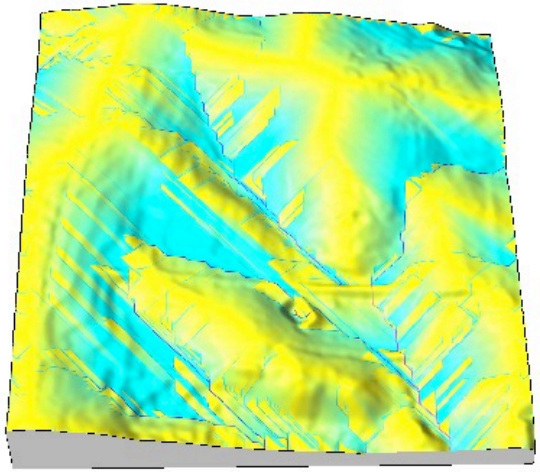


tangential curvature

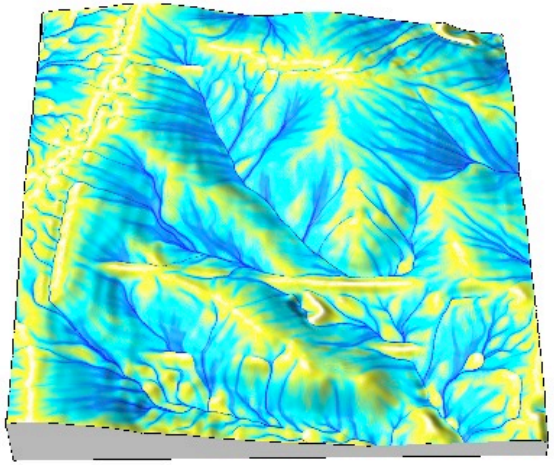
Topographic analysis from different DEMs and DSMs:

- 1m res. lidar DSM
- 10m res. lidar DEM
- 30m SRTM
- 500m DEM

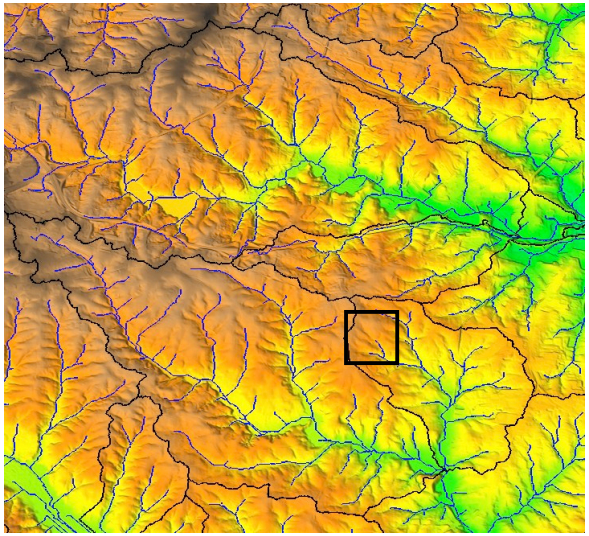
Flow analysis



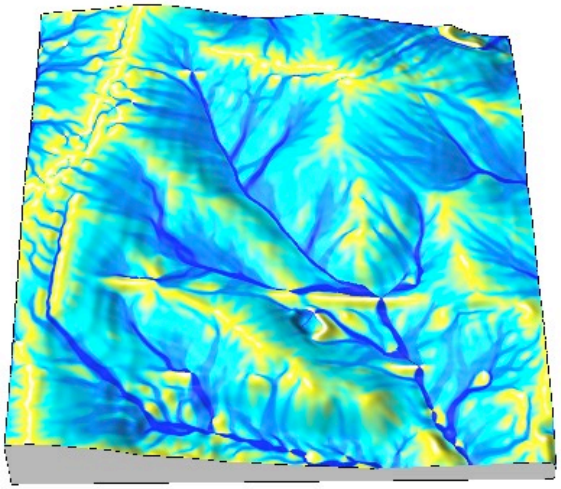
a Single flow direction D8



b Dinf

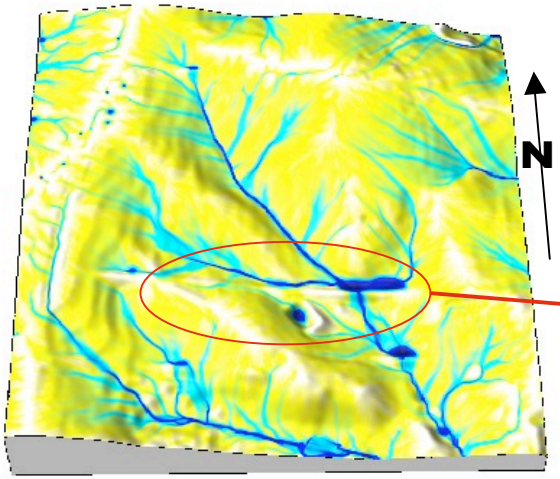


SFD D8: extracted streams, watersheds



c

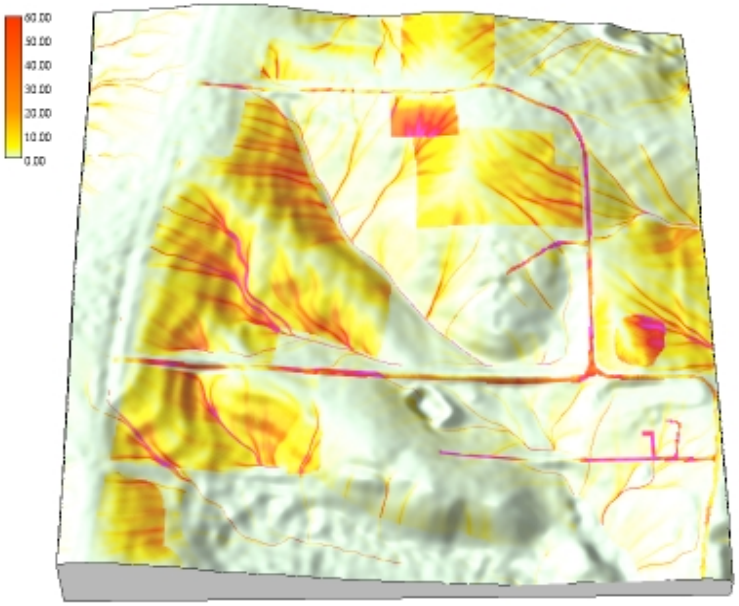
Multiple flow direction D8

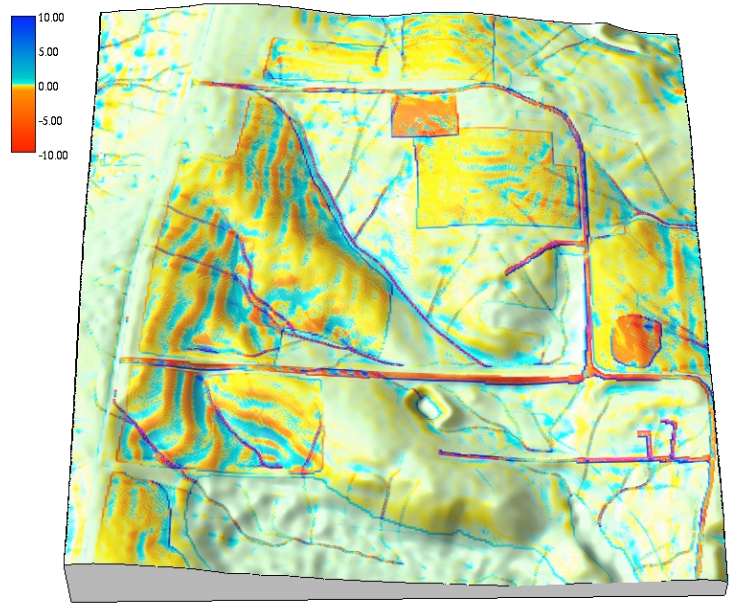


d

Bivariate continuity equation

Sediment transport modeling

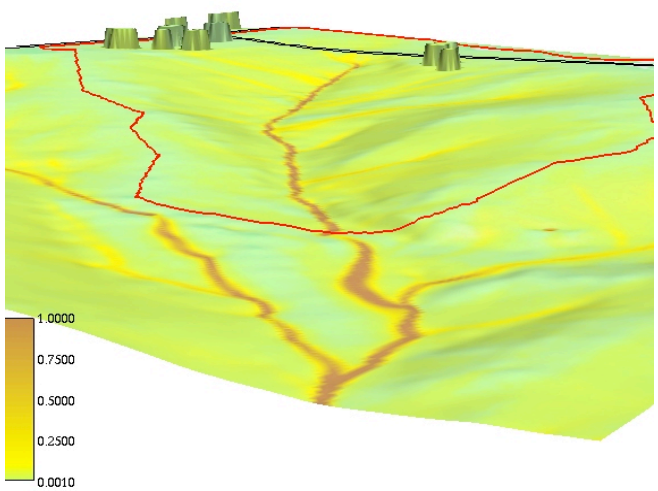




High resolution DEM, soils and land cover data:

process-based simulations

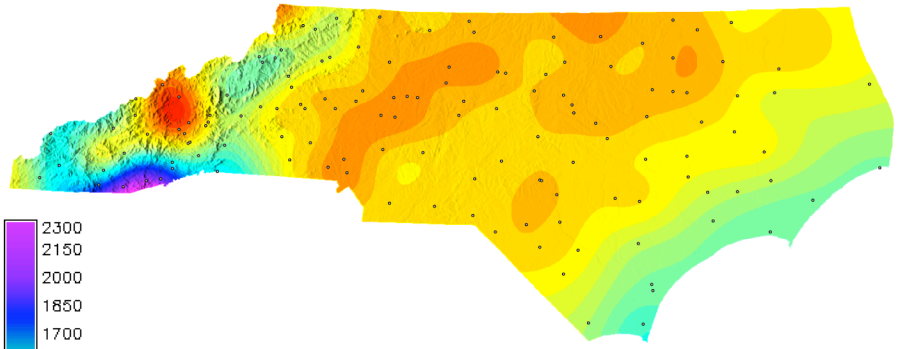
soil detachment
sediment flow
net erosion and deposition

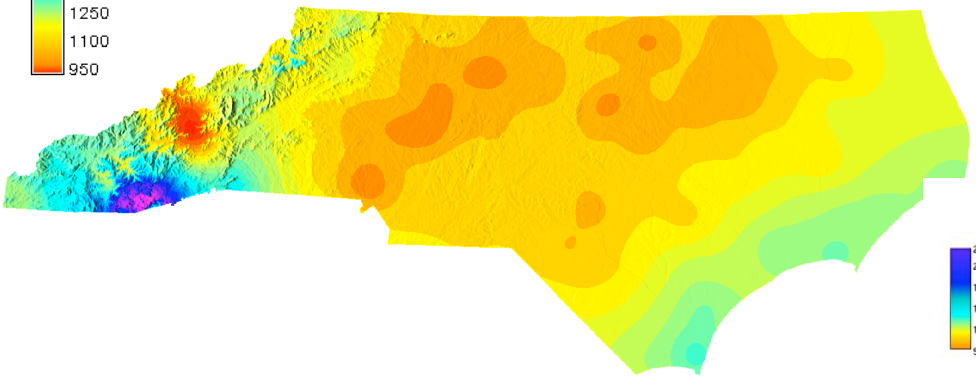


GRASS GIS

Open Source Geospatial Foundation

Precipitation interpolation

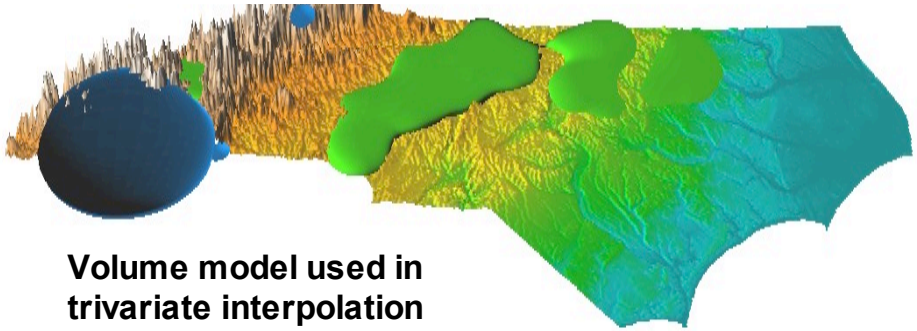




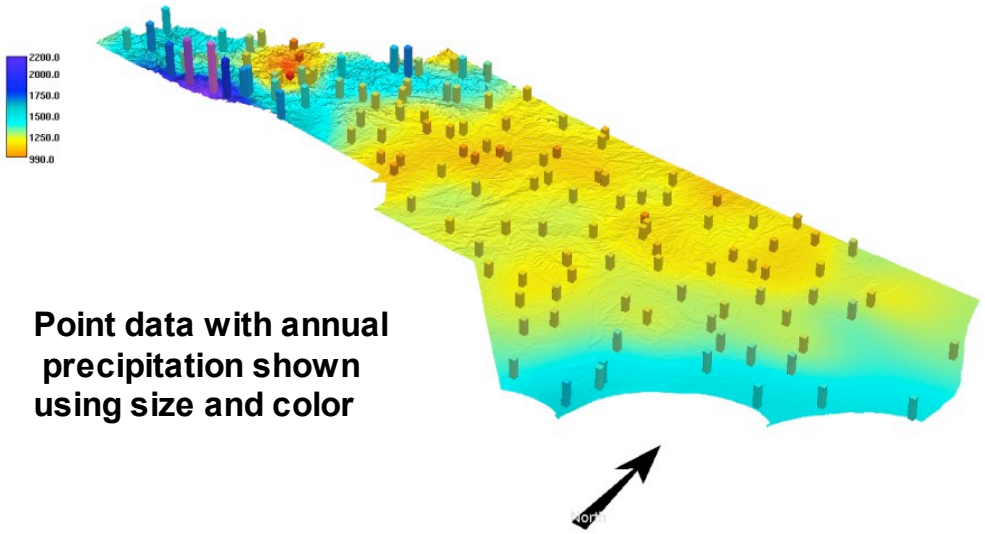
Annual and monthly precipitation normals for 137 stations

Statewide 500m DEM

Bivariate RST interpolation
Trivariate RST interpolation adds impact of elevation



Volume model used in trivariate interpolation



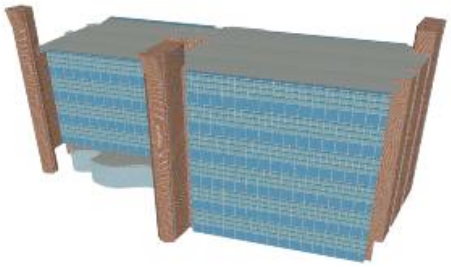
Point data with annual precipitation shown using size and color

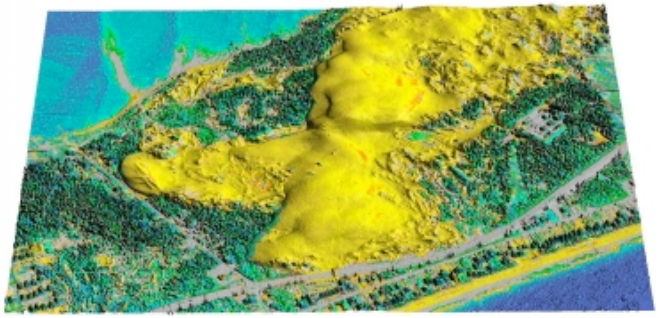
Future plans

Data set will evolve both in terms of its organization and data

- thematic mapsets will be added:
3D urban (NCSU campus, Raleigh, Charlotte)
3D multitemporal coast data,
imagery,
real time data: point and webcam (meteorology, bus locations, traffic, construction, monitoring)
- online browsing and analysis through pyWPS
- examples in the book, tutorials, manual pages, courses

Thanks to Julia Harrell, Doug Newcomb, and Silvia Terziotti for their continuing help with the OSGeo sample dataset





Download

Download web site
http://www.grassbook.org/data_menu3rd.php

Data set license:
Creative Commons Attribution-ShareAlike (CC-BY-SA)

OSGeo wiki web site - needs update

Summary list:

Vector data: administrative boundaries, census data, zip codes, fire stations, hospitals, roads and railroads, public schools and colleges, bus routes, points of interest, precipitation, hydrography maps, geodetic points, soils and geological maps, bare earth and multiple-return lidar.

Raster data: elevation (NED 3arc-sec, SRTM-V1 30m, lidar derived DEMs at 1m and 6m), slope, aspect, watershed basins, geology, and land use. The resolution of raster maps is 500m, 30m, 10m, and 1m.

Imagery data: 1m resolution orthophoto, several LANDSAT-TM5/7 scenes and a MODIS daily Land Surface Temperature (LST) time series.