

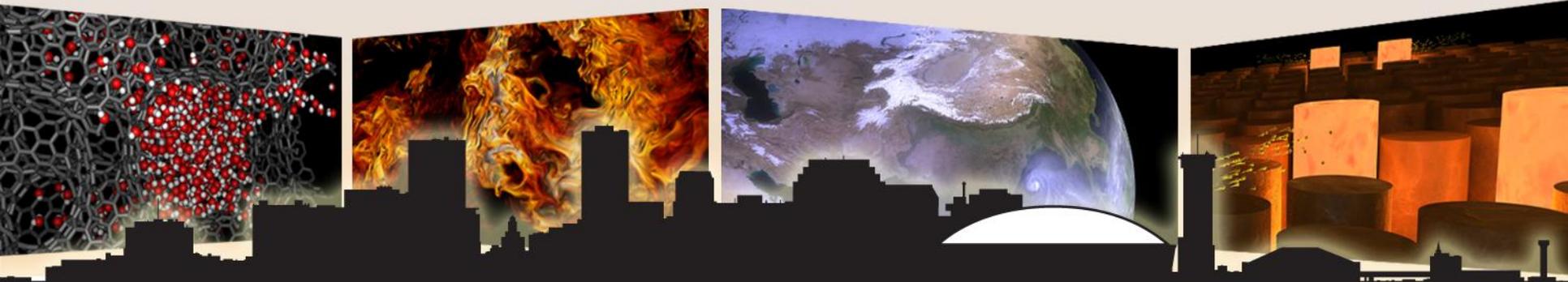
High-Performance Visualization of Geographic Data



Presented by

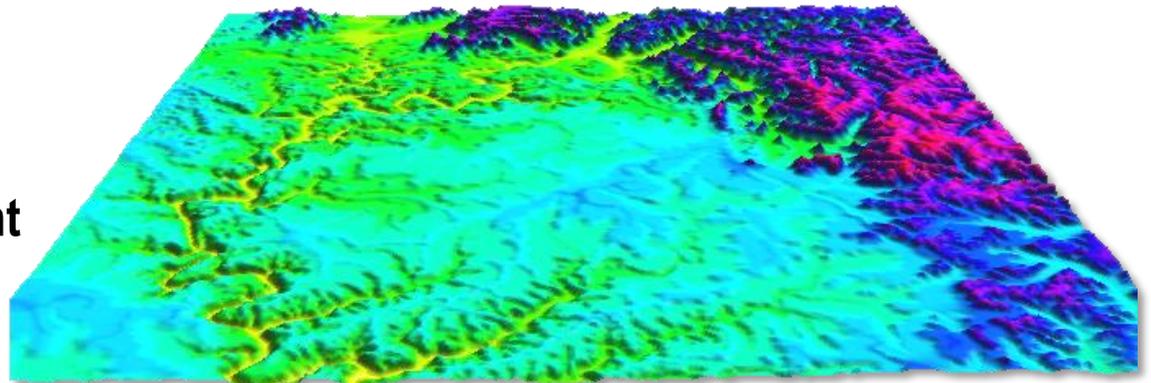
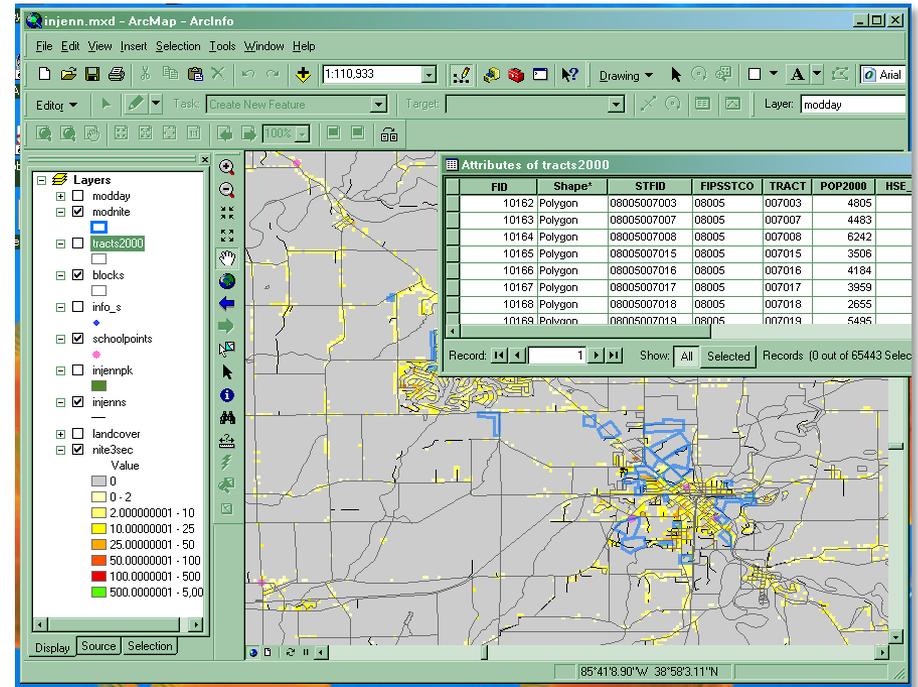
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Geographic Information Science
and Technology
Computational Sciences and Engineering



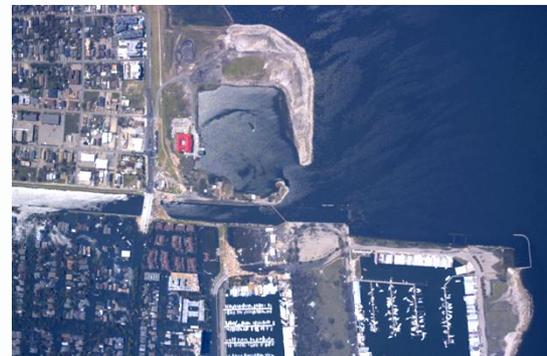
Geographic information systems: A short introduction

- **GIS = geographic information system**
 - Information system to manage geographic data
- **Uses**
 - Data integration, analysis, modeling, and visualization
- **Example applications**
 - Government
 - Homeland security
 - Resource management
 - Environmental management
 - ...

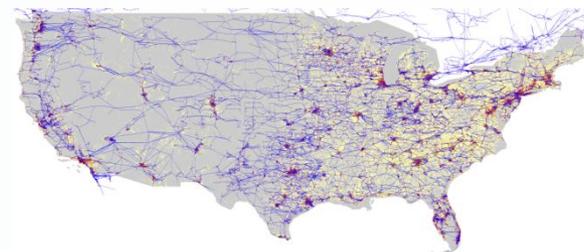


GIS and high-performance computing: Incentives for convergence

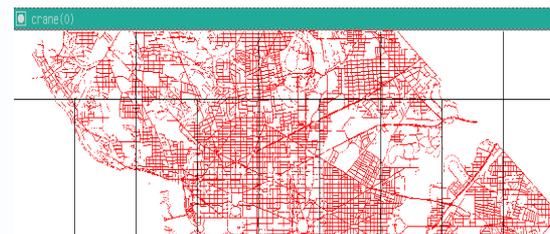
- Growing size of geographic databases (TB per day)
 - Hi-res satellite imagery
 - Sensor networks
 - LIDAR, SAR, MODIS, and other sensor platforms



- Integration of multiple data sources
 - In Internet applications
 - Using OpenGIS standards



- New technologies for scientific computing
 - Dynamic data analysis
 - Data mining and visual exploratory methods
 - Simulation models



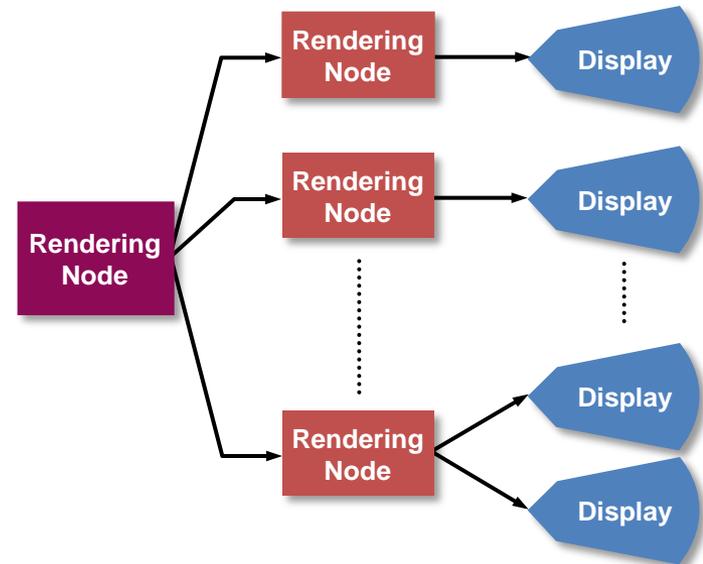
High-performance visualization architecture for GIS

- **EVEREST visualization cluster**

- 30 × 8 foot viewing area
- 11,530 × 3,072 pixel array (35 MP)
- 27 digital light projectors
- 15 rendering nodes

- **Software**

- OS Scientific Linux
- Xdmx distributed X server
- GRASS graphic information system



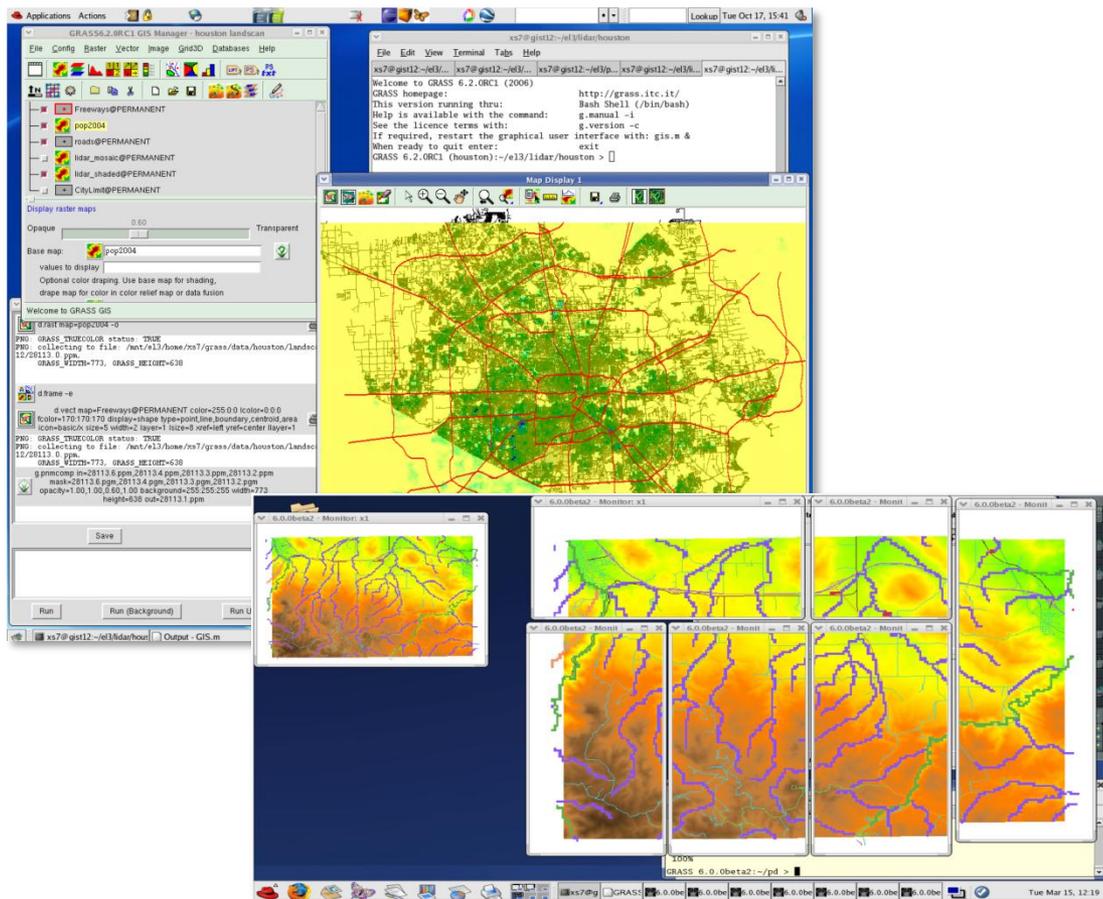
pd-GRASS: Parallel display for GRASS GIS

- GRASS GIS

- Free GIS package
- No license fees
- Works on Linux

- pd-GRASS

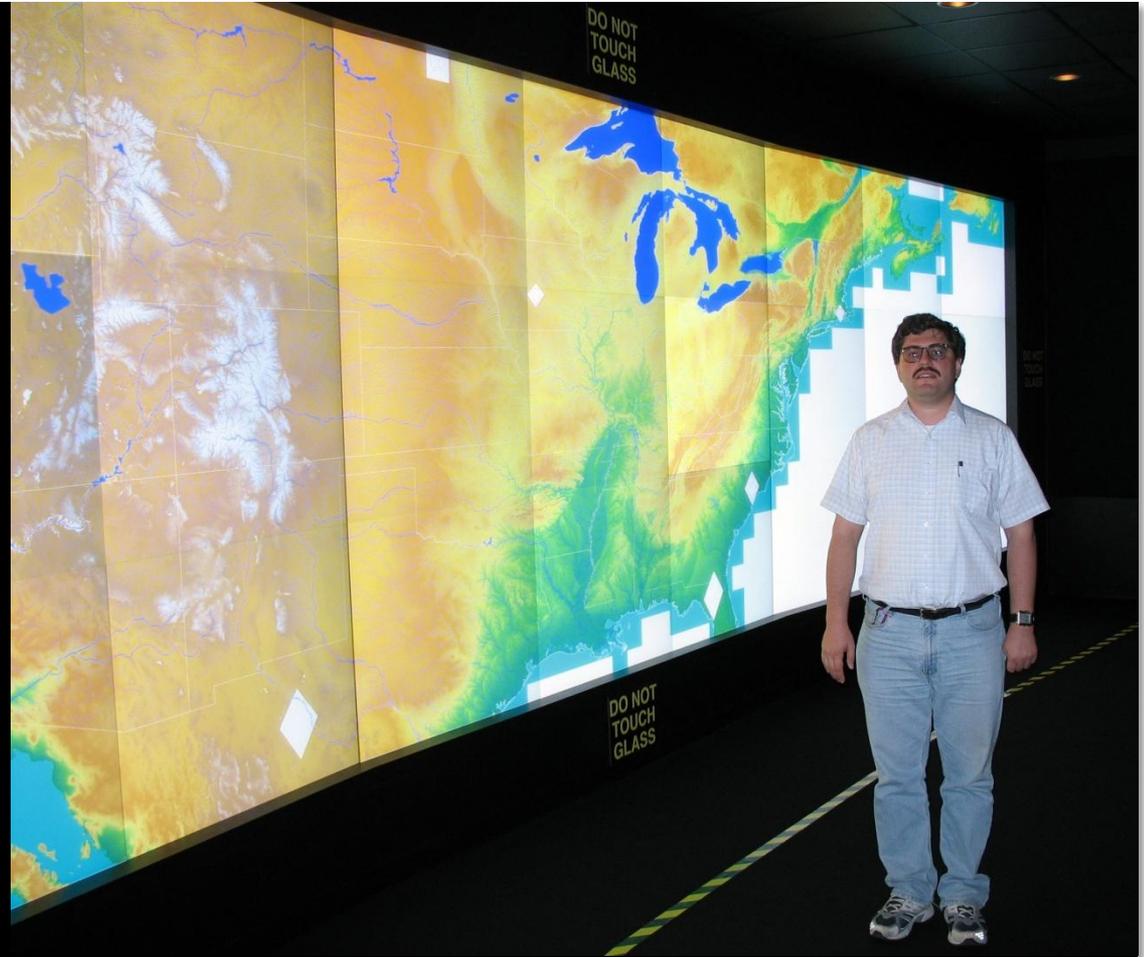
- GRASS module for parallel visualization
- Full parallelization
- Tested with data sets of up to 40 GB
- Full GRASS GIS functionality
- Available under GPL from <http://www.ornl.gov/gist/software/grass/>



pd-GRASS visualization example: Beyond desktop capabilities

Shuttle Radar Topography Mission (SRTM) dataset

- 90 m cell size
- About 3×10^9 pixel
- Approximately 7 GB



High-resolution 3D view of LIDAR data: Beyond desktop capabilities

LIDAR data set for the city of Houston

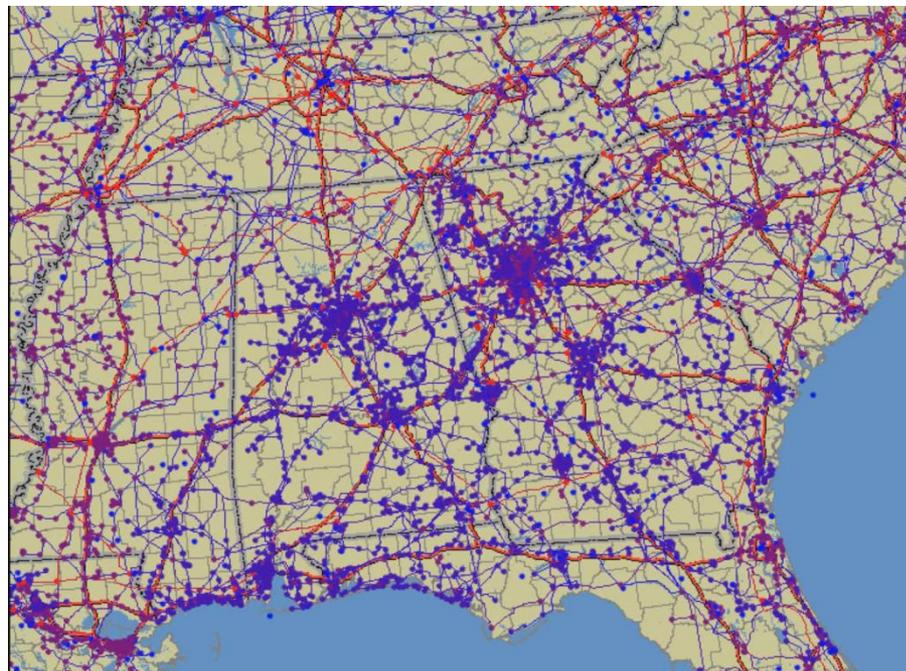
- Resolution: 3 cm horizontal, 1 cm vertical
- 10^8 cells
- Approximately 4 GB



Data courtesy of Center for Space Research, UT–Austin

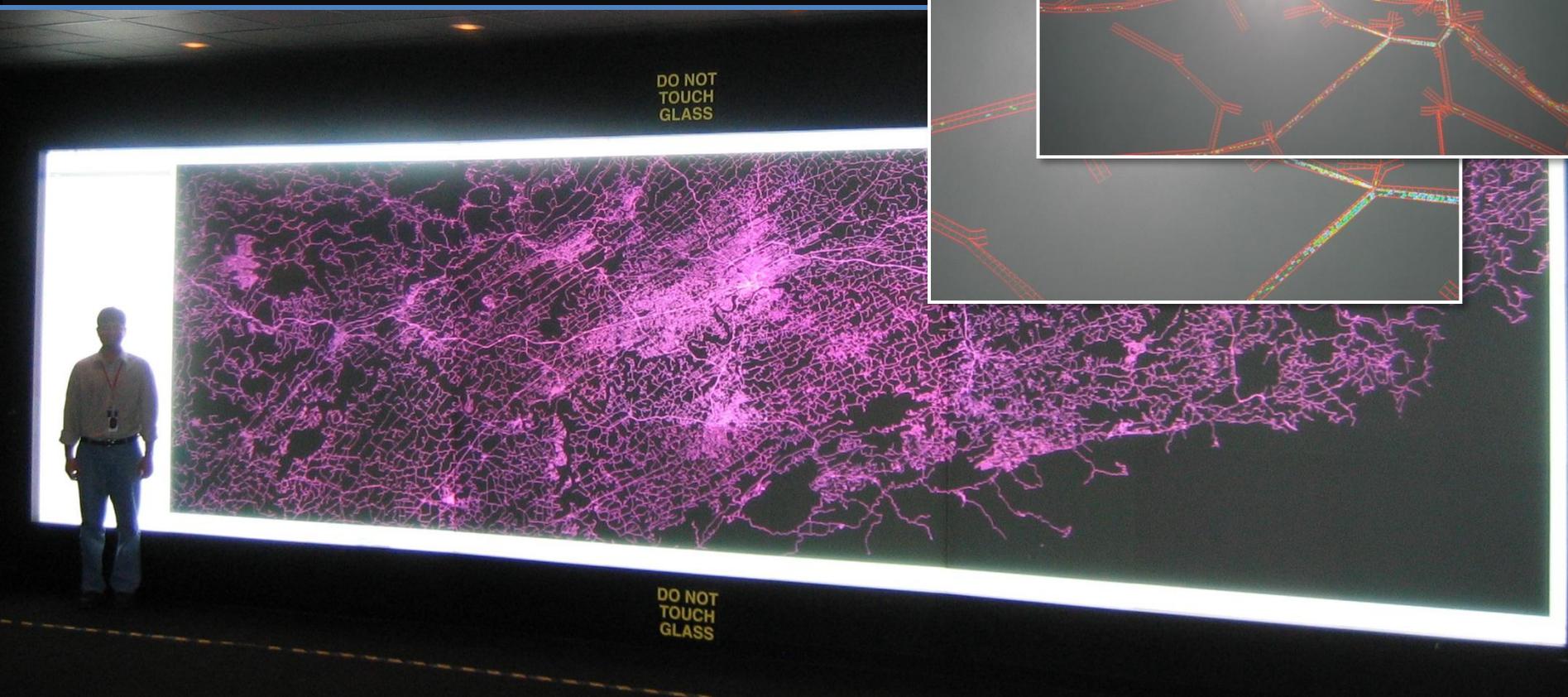
Parallel geospatial computing

- **Uses**
 - Processing of large data sets
 - Visual analytics of dynamic data
 - Rendering of scientific animations
- **Tools**
 - **GRASS+SLURM**
 - GRASS = free Linux-based GIS
 - SLURM = Simple Linux Utility for Resource Management (LLNL)
- **Computational domain decomposition**
 - By data layer
 - By function
 - By geographic region
- **Application example**
 - Decluttering of a map of the southeastern United States electric grid



High-performance visualization of agent-based transportation models

- Meso- and macro-scale models
- Testing evacuation scenarios
- Up to a million links

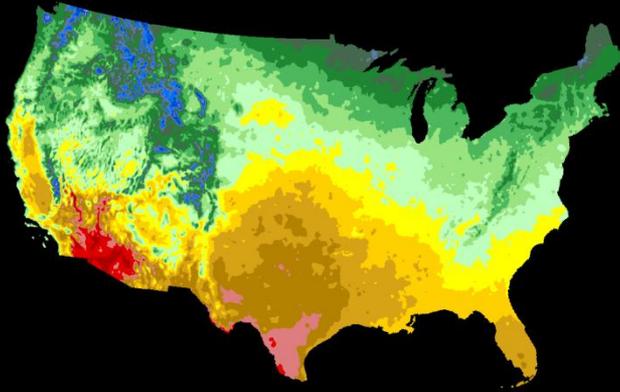


Animations of high-resolution remote sensing data

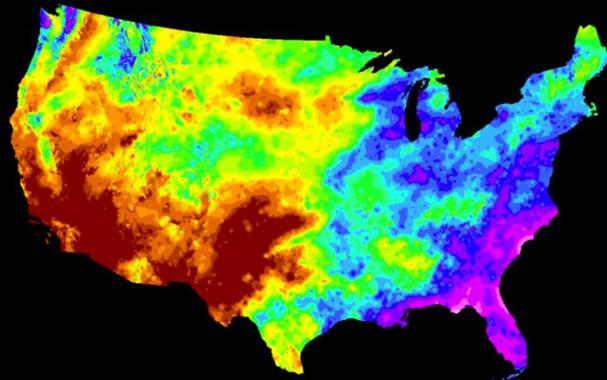
Normalized Difference Vegetation Index (NDVI) calculated from MODIS (Moderate Resolution Imaging Spectroradiometer) imagery shows the condition of the vegetated areas at spatial resolution of 250 m and 16 day time intervals

NDVI can be compared with temperature and precipitation from preceding period to vegetation growth

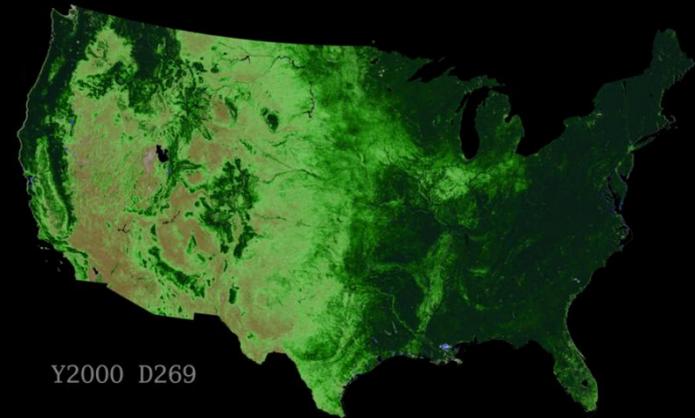
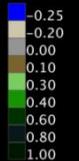
Maximum Monthly Temperature (°C)



Monthly Precipitation (in.)

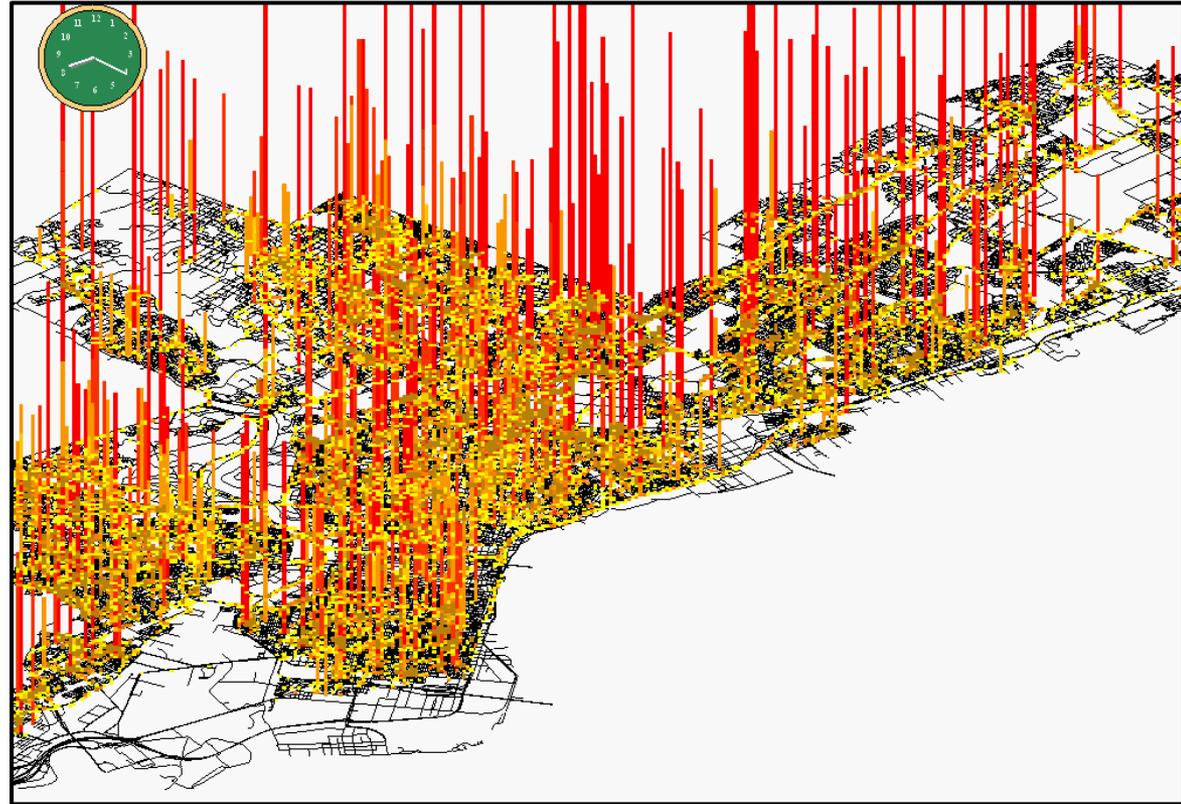


NDVI



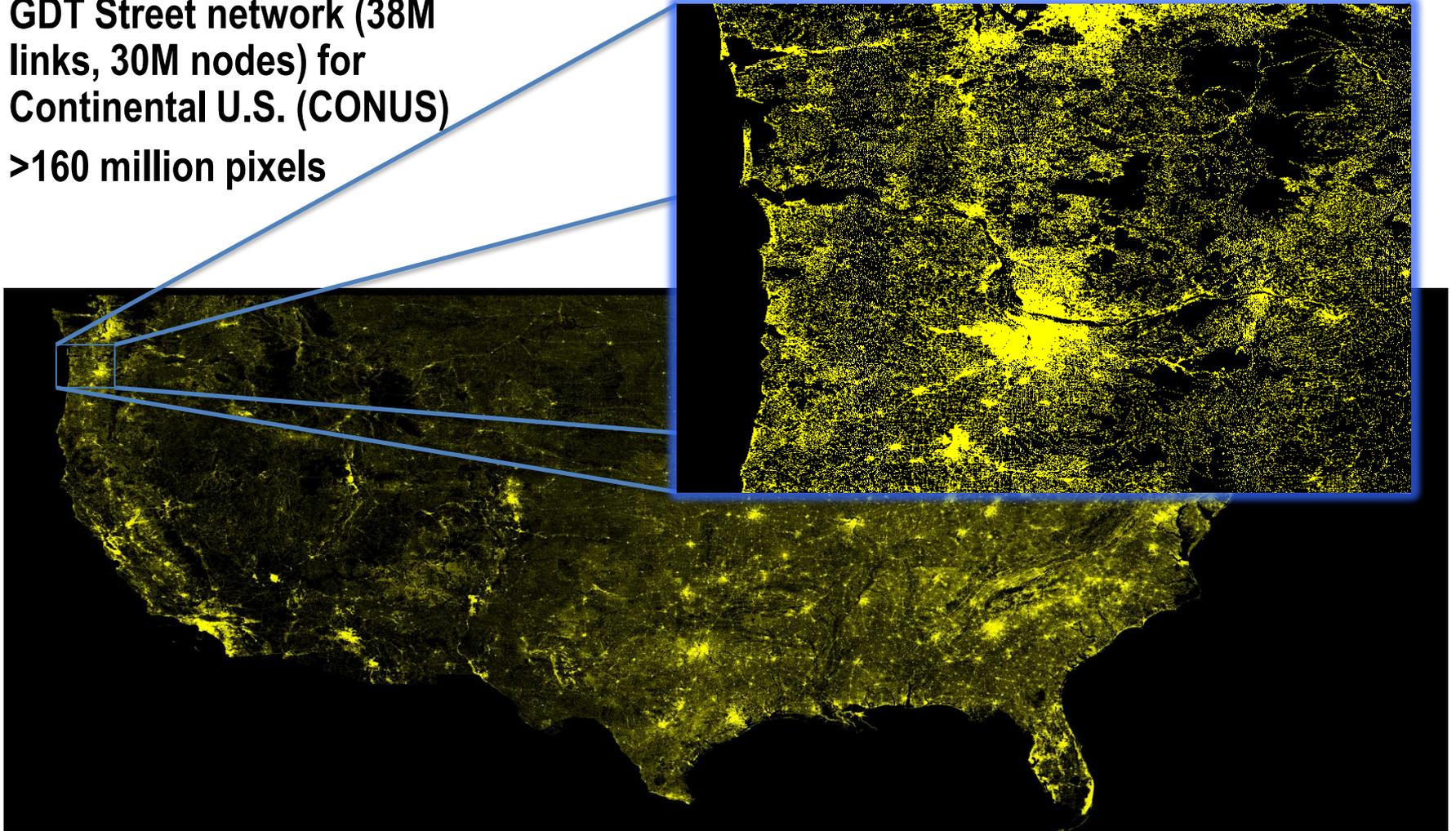
High-performance visualization of transportation models

- Movement of school students in Philadelphia County
- 270,000 high school, middle school, and elementary school students
- 50,000 links on street network

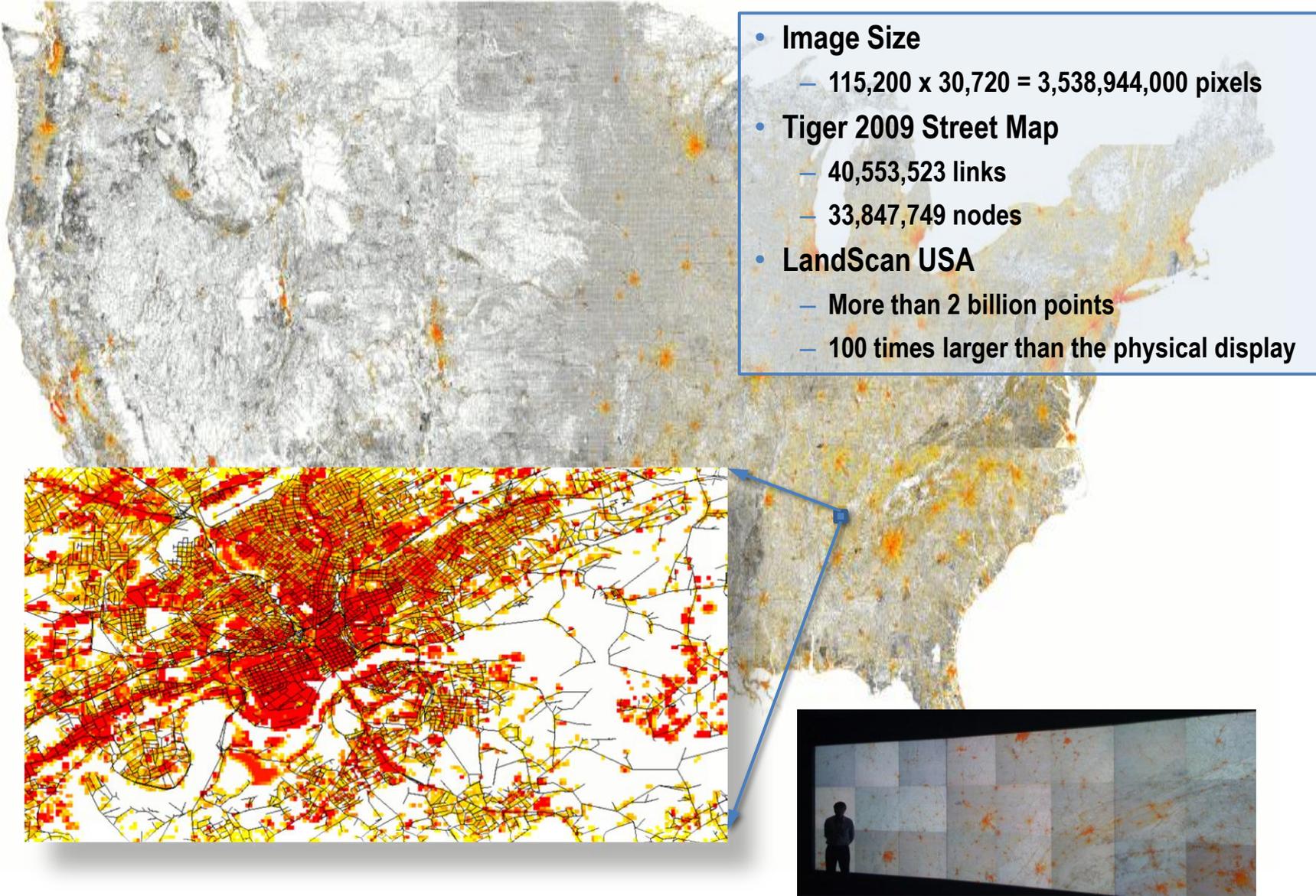


Visualization of nationwide transportation networks

- GDT Street network (38M links, 30M nodes) for Continental U.S. (CONUS)
- >160 million pixels



TIGER 2009 Street Map and LandScan USA



Contacts

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