High-Performance Visualization of Geographic Data

Presented by

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SC07

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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
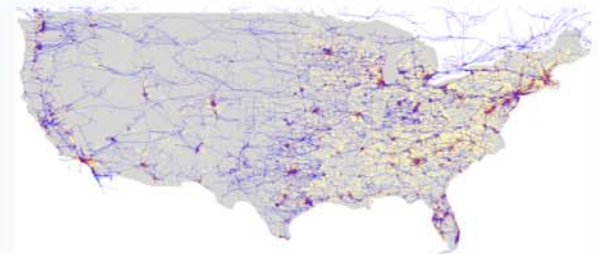 - Environmental management
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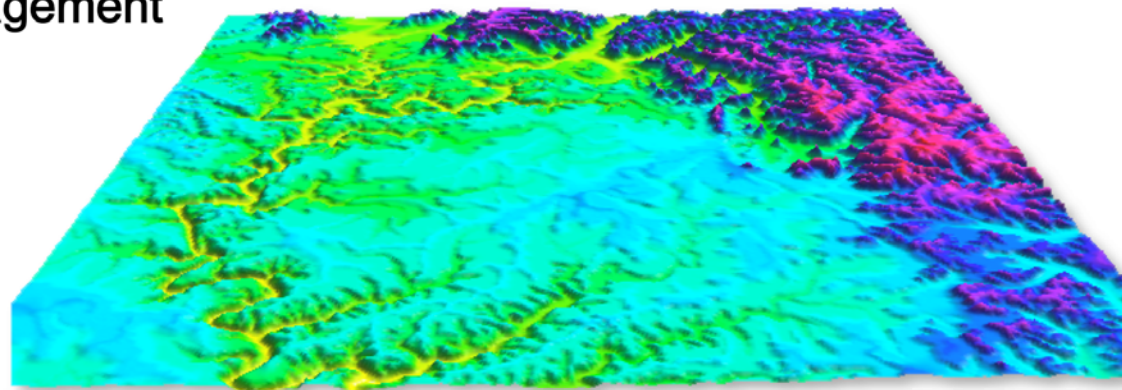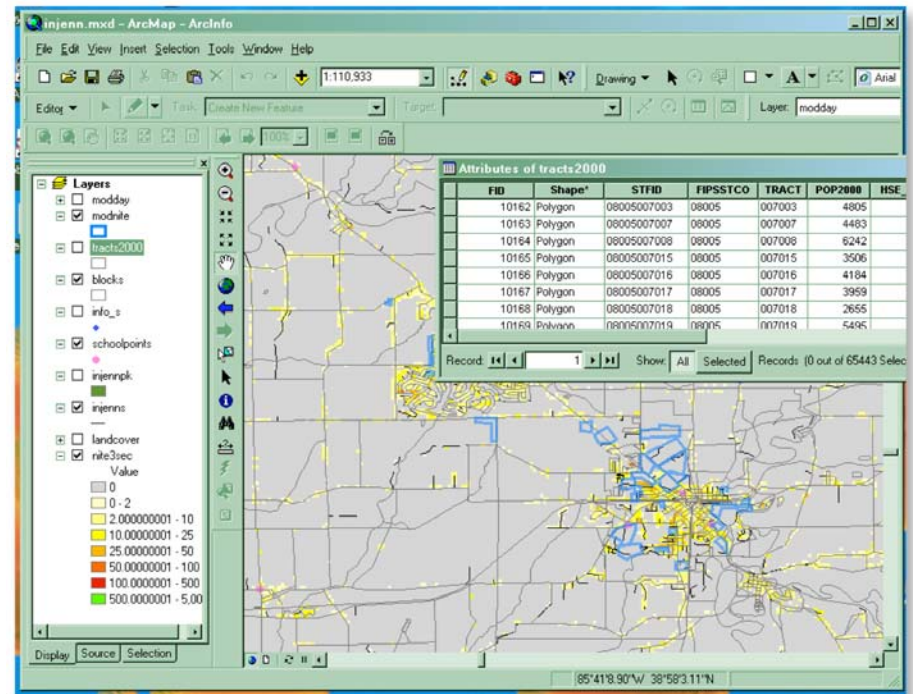
# GIS and high-performance computing: Incentives for convergence

- 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
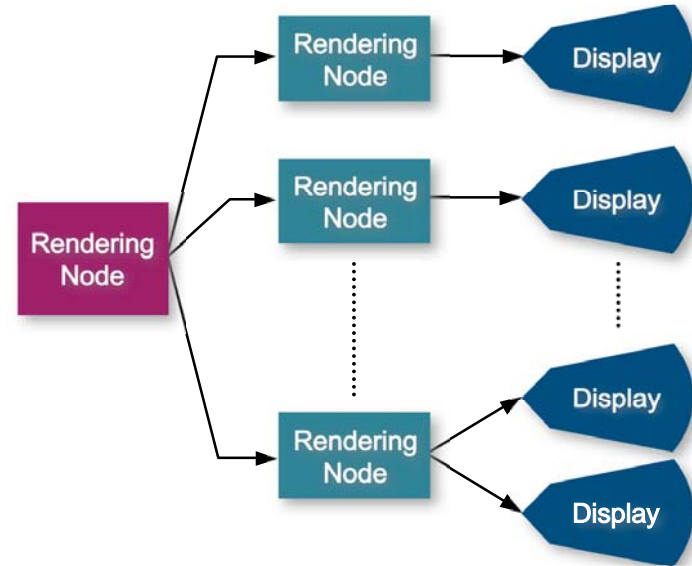 - Simulation models

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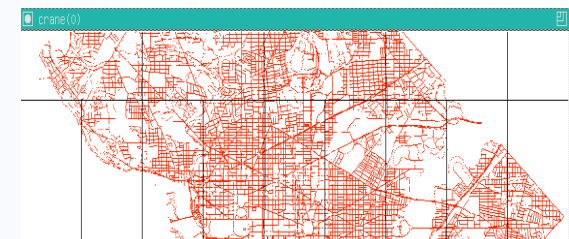
High-performance visualization architecture for GIS

- EVEREST visualization cluster
  - 30x8 foot viewing area
  - 11,530×3,072 pixel array (35 MP)
  - 27 digital light projectors
  - 15 rendering nodes

- Software
  - OS SUSE Linux
  - Xdmx distributed X server
  - GRASS GIS
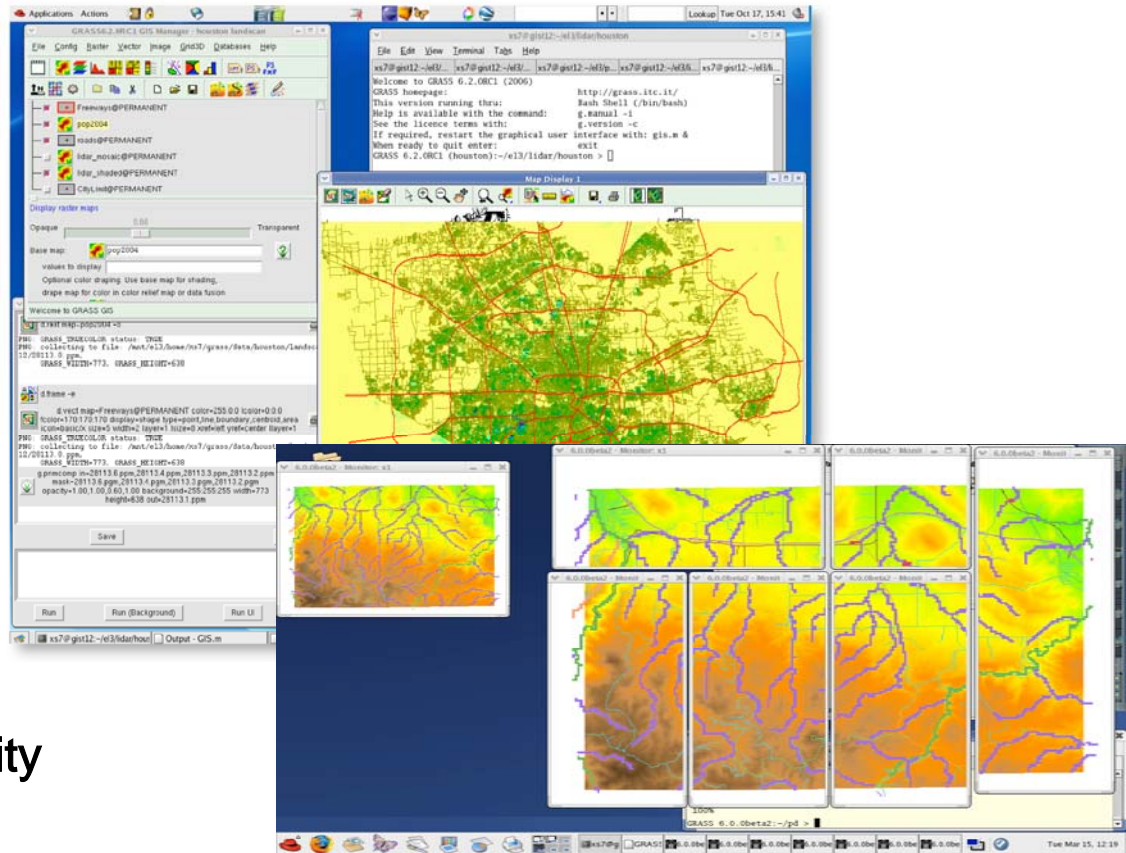
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pd-GRASS: Parallel display for GRASS GIS

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

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

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pd-GRASS visualization example: Beyond desktop capabilities

Shuttle radar Topography mission (SRTM) dataset

- 90m cell size

- About 3×10^9 pixel

- Approximately 7 GB

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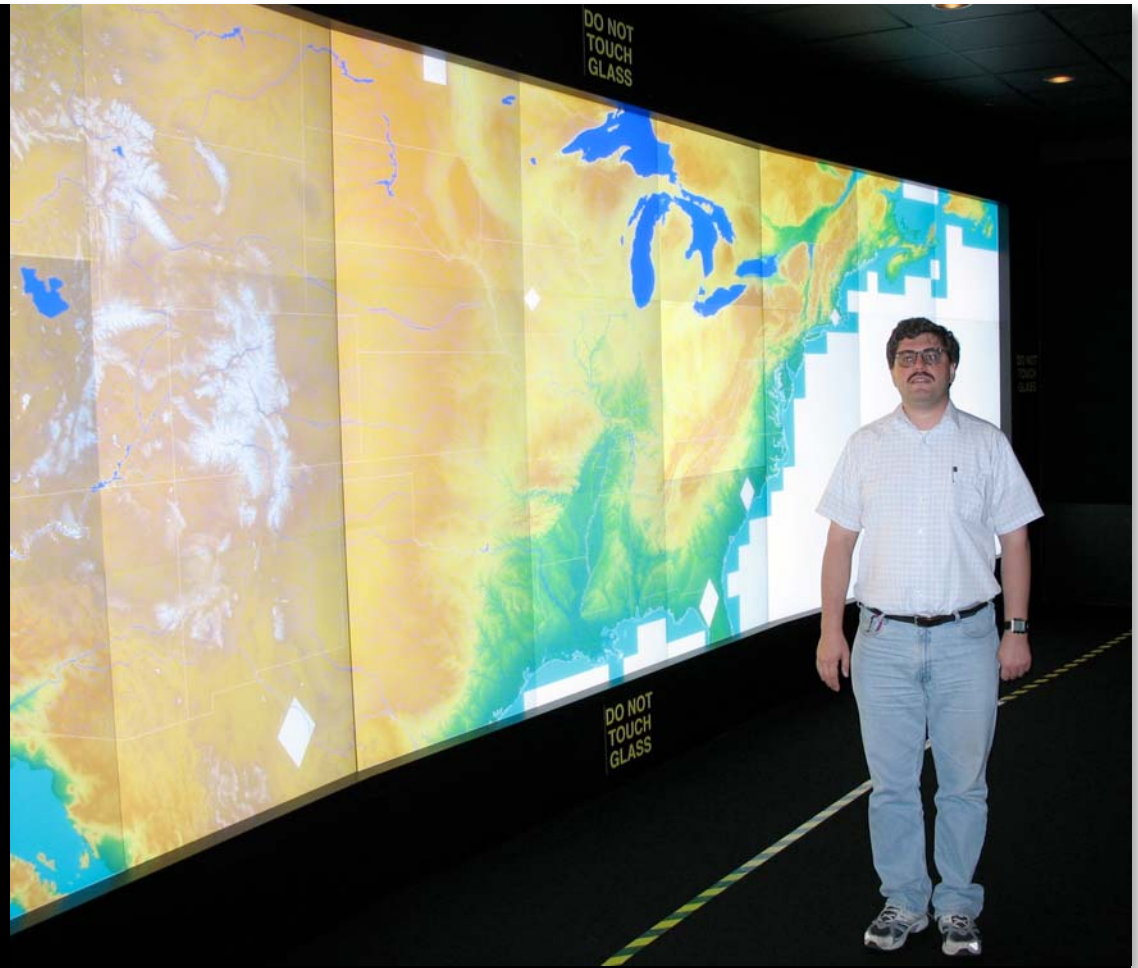
High-resolution 3-D View of LIDAR data: Beyond desktop capabilities

LIDAR dataset 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

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Parallel geospatial computing

- Uses
  - Processing of large datasets
  - Visual analytics of dynamic data
  - Rendering of scientific animations
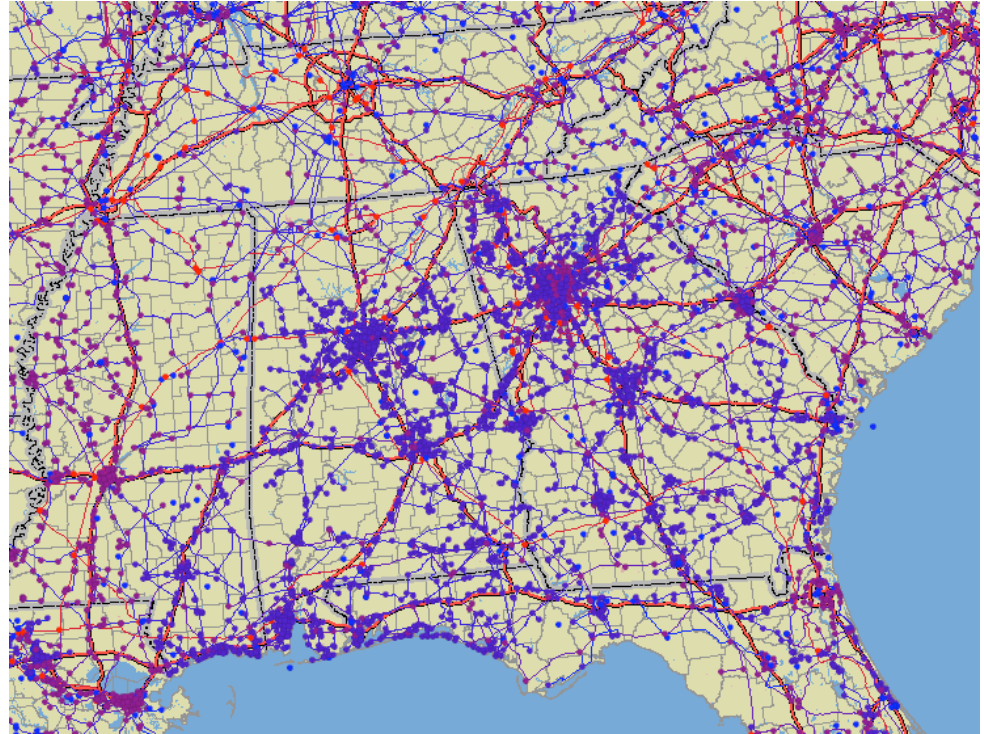
- Tools
  - GRASS+SLURM
    - GRASS=Free Linux-based GIS
    - SLURM=Simple Linux Utility for Resource Management

- Computational domain decomposition
  - By data layer
  - By function
  - By geographic region
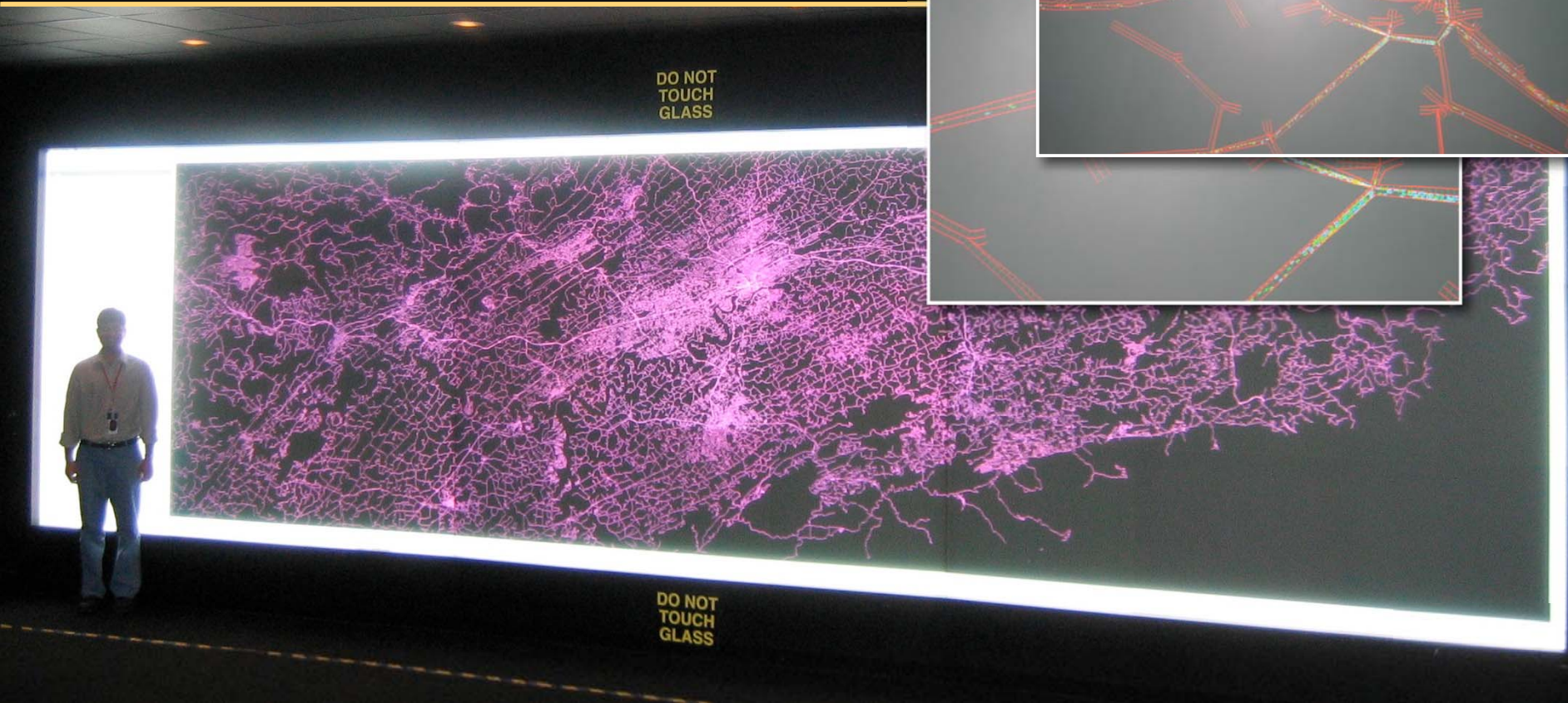
- Application example
  - Animated display decluttering for the Southeastern United States electric grid

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# High-performance visualization of agent-based transportation models

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

Geospatial analytics: Visual exploration and inferencing for dynamic geographic data

Geographic spread of socio-economic and environmental processes and events

- History of the U.S. electric infrastructure

- Scenarios for development of nuclear power production
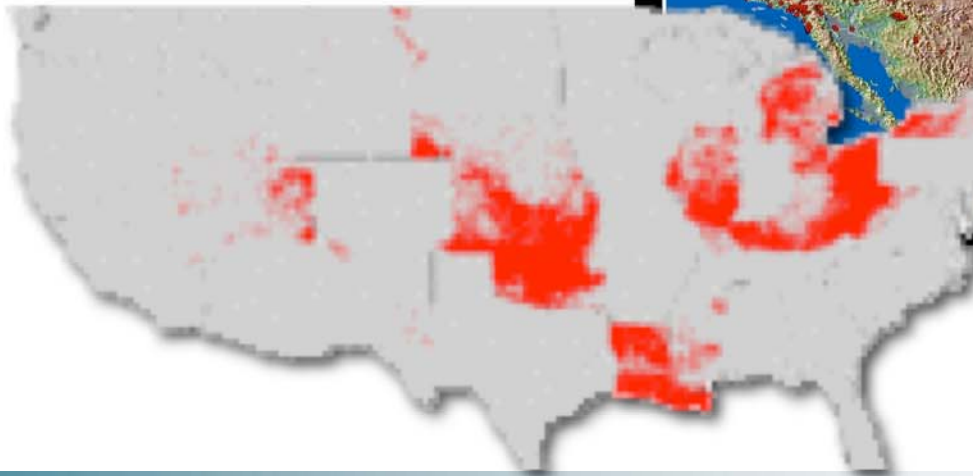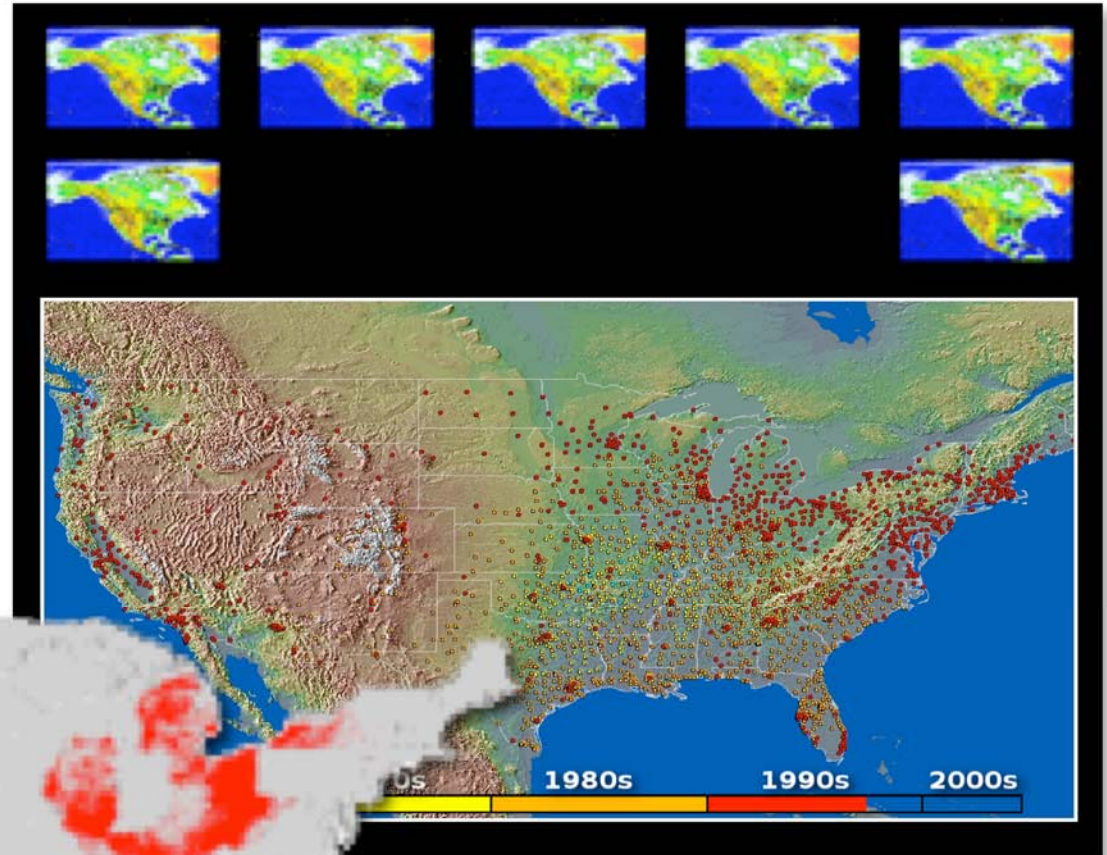
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