

# Overview of Geospatial Computing at ORNL

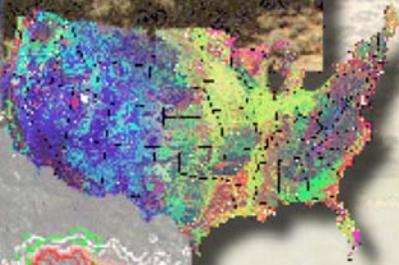
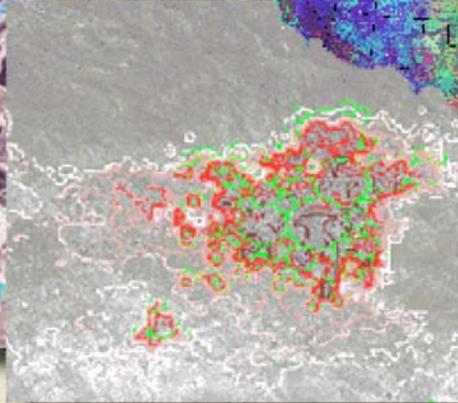
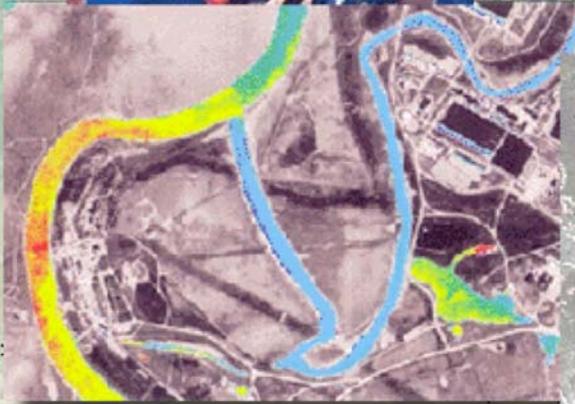
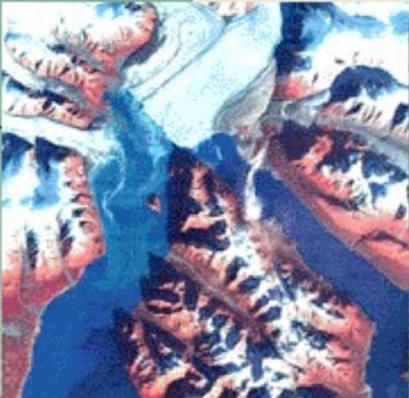


Budhendra Bhaduri

Geographic Information Science & Technology  
Computational Sciences and Engineering Division

OAK RIDGE NATIONAL LABORATORY  
U. S. DEPARTMENT OF ENERGY

# ORNL: A pioneer in Geospatial Science and Technology



**Rich History Spanning  
30 years**

**Defining Geospatial  
Research Agendas**

**Developing New  
Algorithms, Software,  
and Data**

**Conducting Verification  
& Validation Studies**

# Technology Highlights

- **Geospatial Science**
  - ❖ Multi-resolution data analysis
  - ❖ Advanced spatial modeling
  - ❖ Data integration and visualization
  - ❖ Geographic Information Systems (GIS)
  - ❖ Decision Support Systems (DSS)
- **Scientific Data Access**
  - ❖ Collection, Distribution, and Management
  - ❖ Large scale data manipulation

# Strategic Thrusts

- **Spatial-Temporal Population Dynamics**
  - ❖ Identify, characterize, and develop geospatial framework and algorithms for population behavioral models
- **Spatiotemporal Knowledge Discovery**
  - ❖ Develop advanced designs and queries for dynamic spatiotemporal databases
- **HPC in terascale spatial data integration and visualization**
  - ❖ Disparate sensor-based data integration and visualization for time critical mission support



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# Spatial-Temporal Population Dynamics

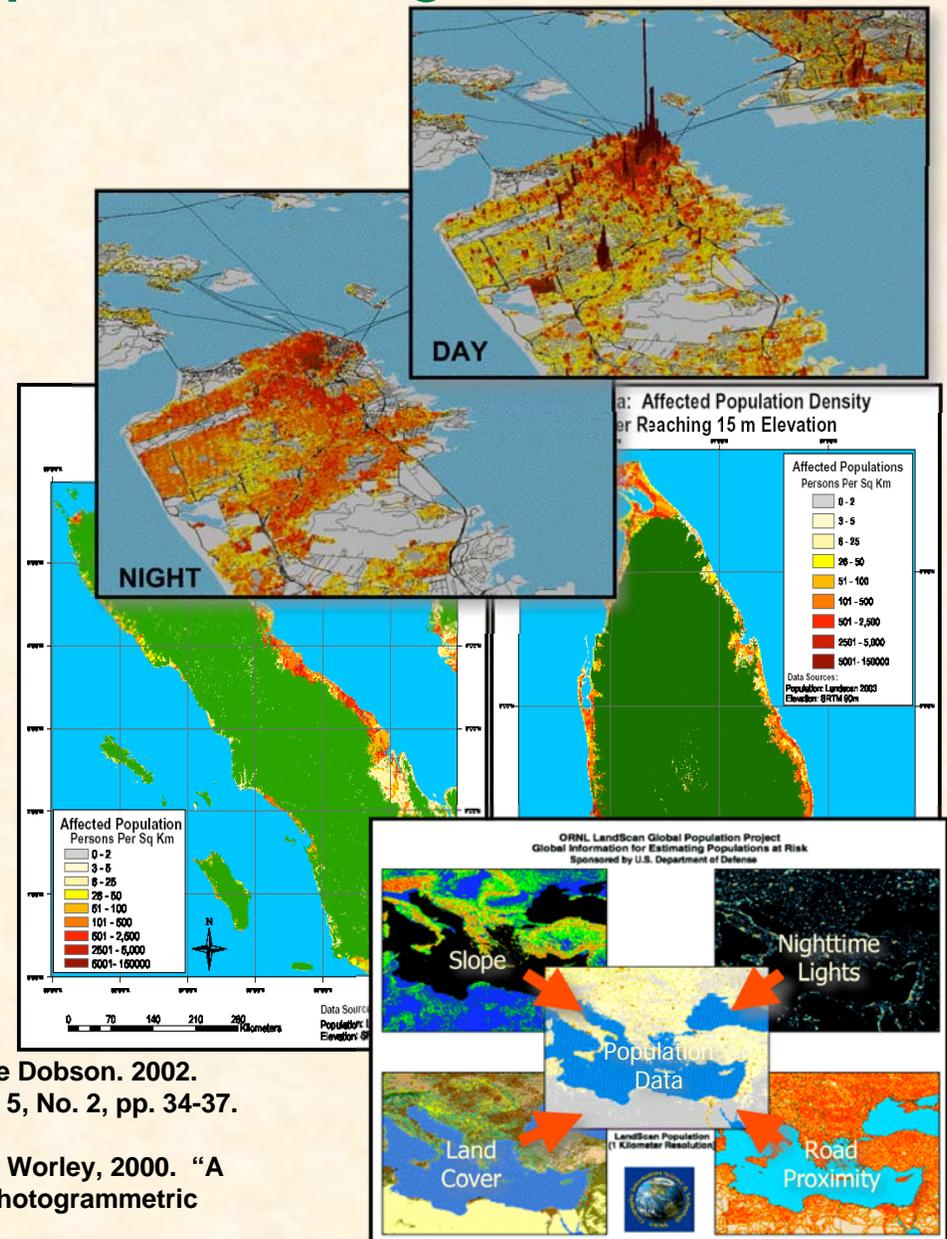
## Projects:

- LandScan Global Population
- LandScan USA
- Population Dynamics Modeling
- Intelligent Consequence Management
- Exposure Assessment within Urban Metropolitan Areas

## Recent Publications:

Bhaduri, Budhendra, Edward Bright, Phillip Coleman, and Jerome Dobson. 2002. LandScan: Locating People is What Matters. *Geoinformatics* Vol. 5, No. 2, pp. 34-37.

Dobson, J.G.E., E. A. Bright, H. R. Coleman, R. C. Durfee, and B. A. Worley, 2000. "A Global Population Database for Estimating Population at Risk." *Photogrammetric Engineering & Remote Sensing* 66(7).



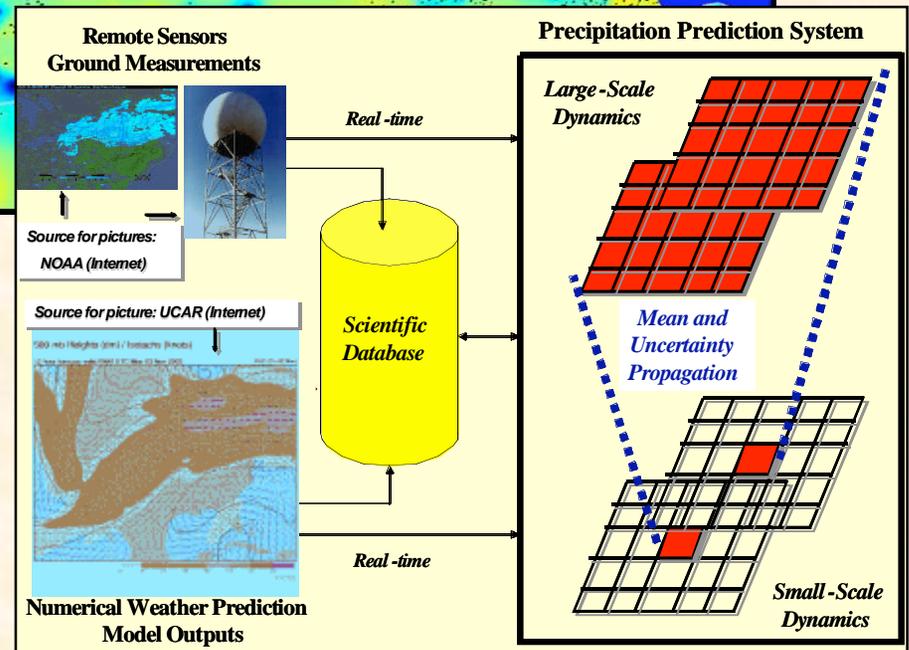
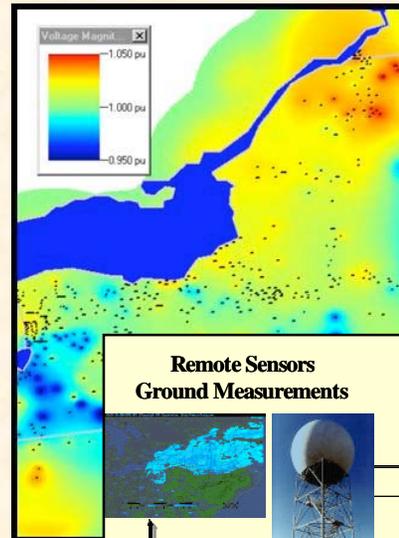
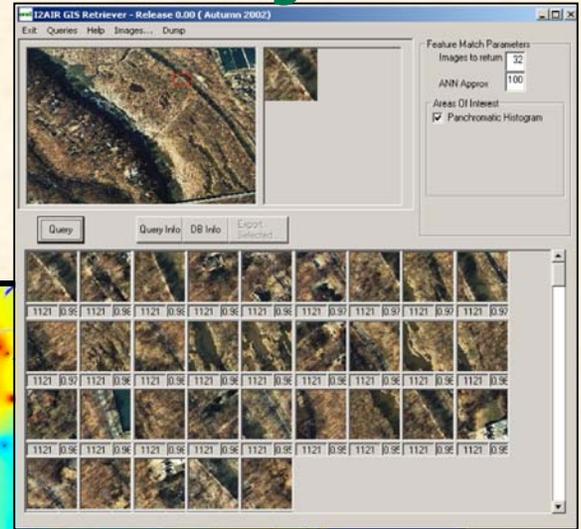
# Spatiotemporal Knowledge Discovery

## Projects:

- Image to Intelligence Archive (I2IA)
- Spatial and spatio-temporal statistics for sensor network applications
- Development of dynamic spatiotemporal database design
- Multivariate dependence and outliers in space and time

## Recent Publications:

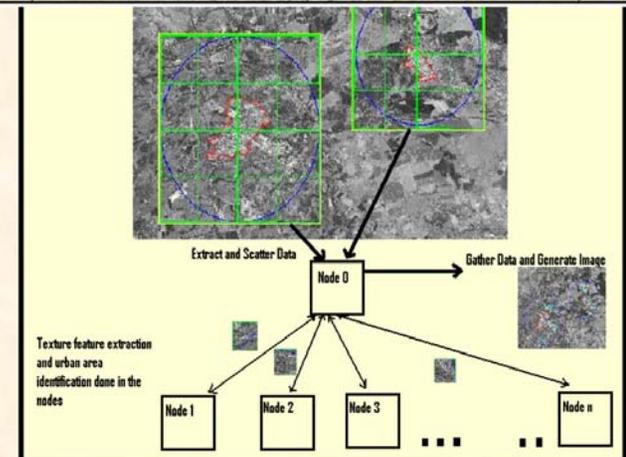
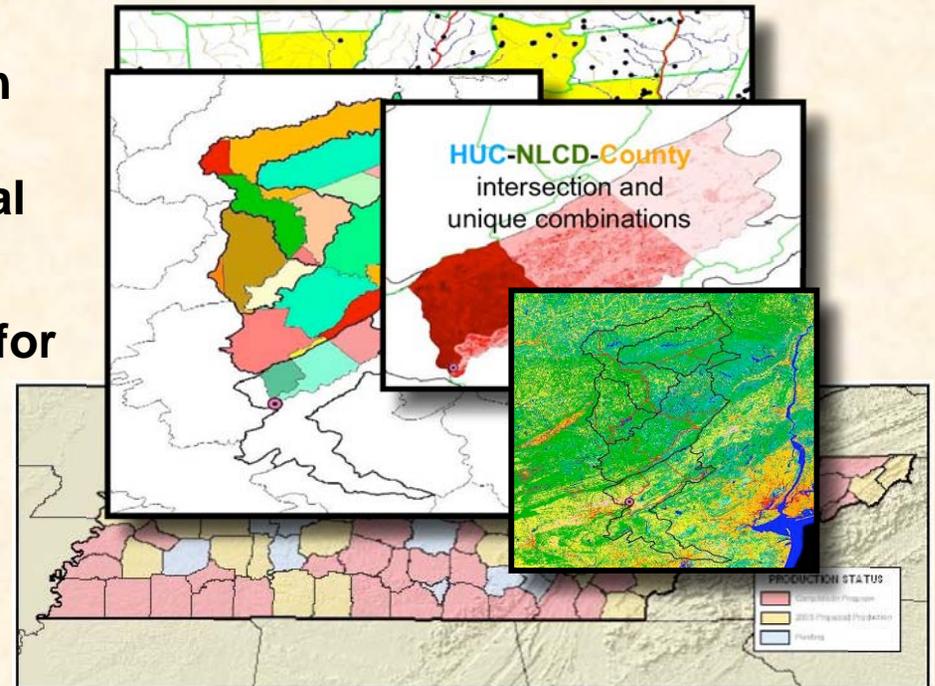
Ganguly, A. R., Khan, S., Erickson III, D. J., Katz, R. W., Ostrouchov, G., Protopopescu, V. A., Bandyopadhyay, S., and Saigal, S., 2005: "Multivariate dependence in complex systems", Invited presentation, 5th Symposium on Understanding Complex Systems, University of Illinois at Urbana-Champaign (this paper has also been invited for submission to the journal Complexity).



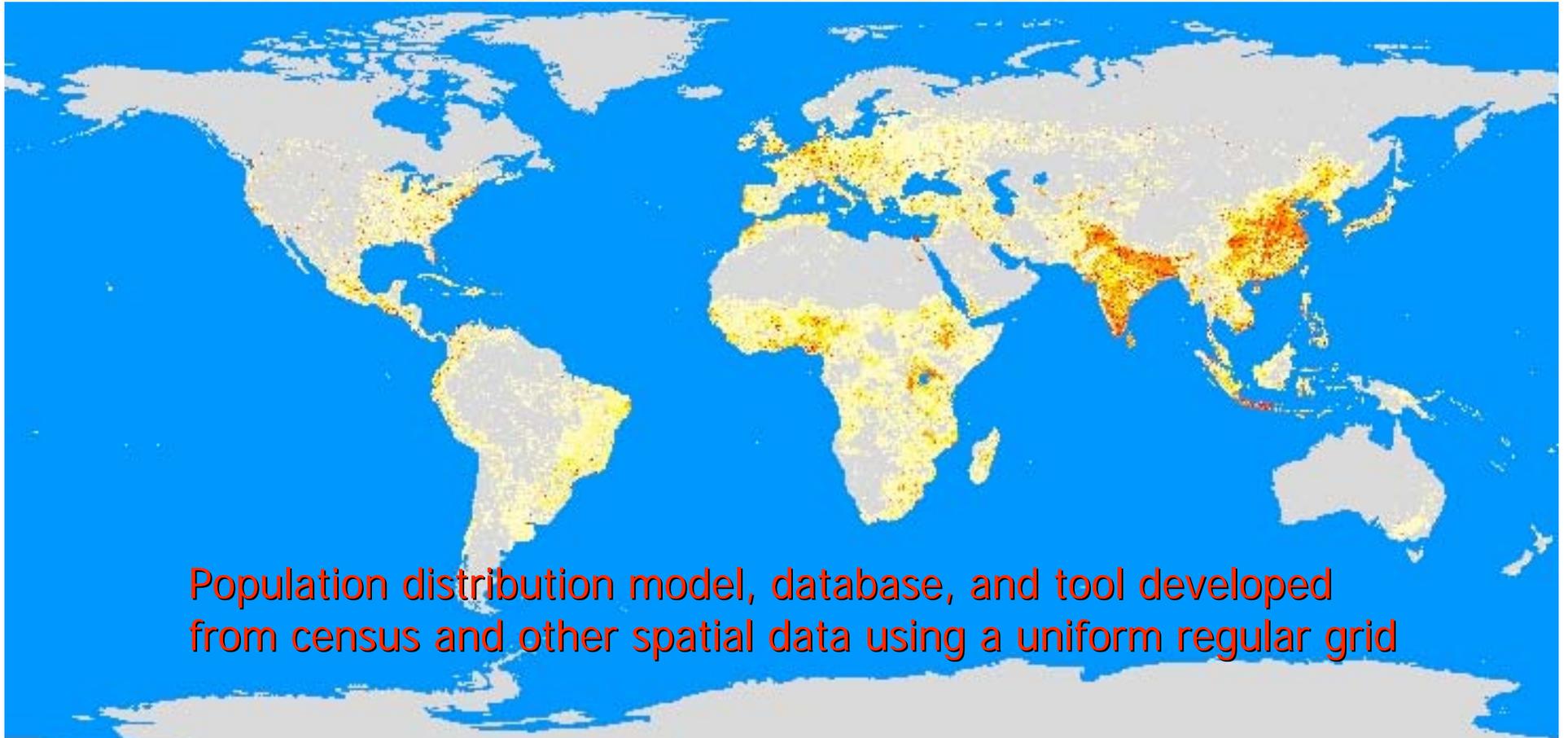
# HPC In Terascale Spatial Data Integration And Visualization

## Projects:

- **Optimal Data Access and Integration Strategies for Terascale Spatial Databases – TNBMP and the National Map**
- **Dynamic Electric Grid Visualization for Tiled Displays**
- **On Demand Intelligence Generation for Global Transportation Planning and Logistics**
- **Watershed Characterization – Hydrology in Response to Human Activities**
- **HPC/Parallel Processing for Large Image Exploitation**



# What is LandScan?

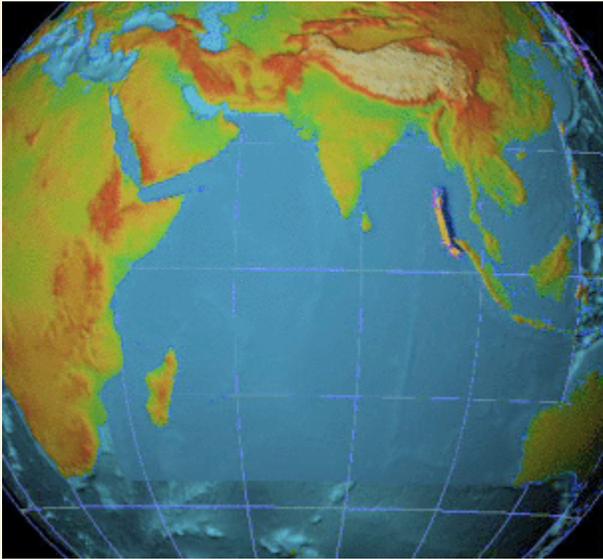


Population distribution model, database, and tool developed from census and other spatial data using a uniform regular grid

Improving knowledge of where people are located.

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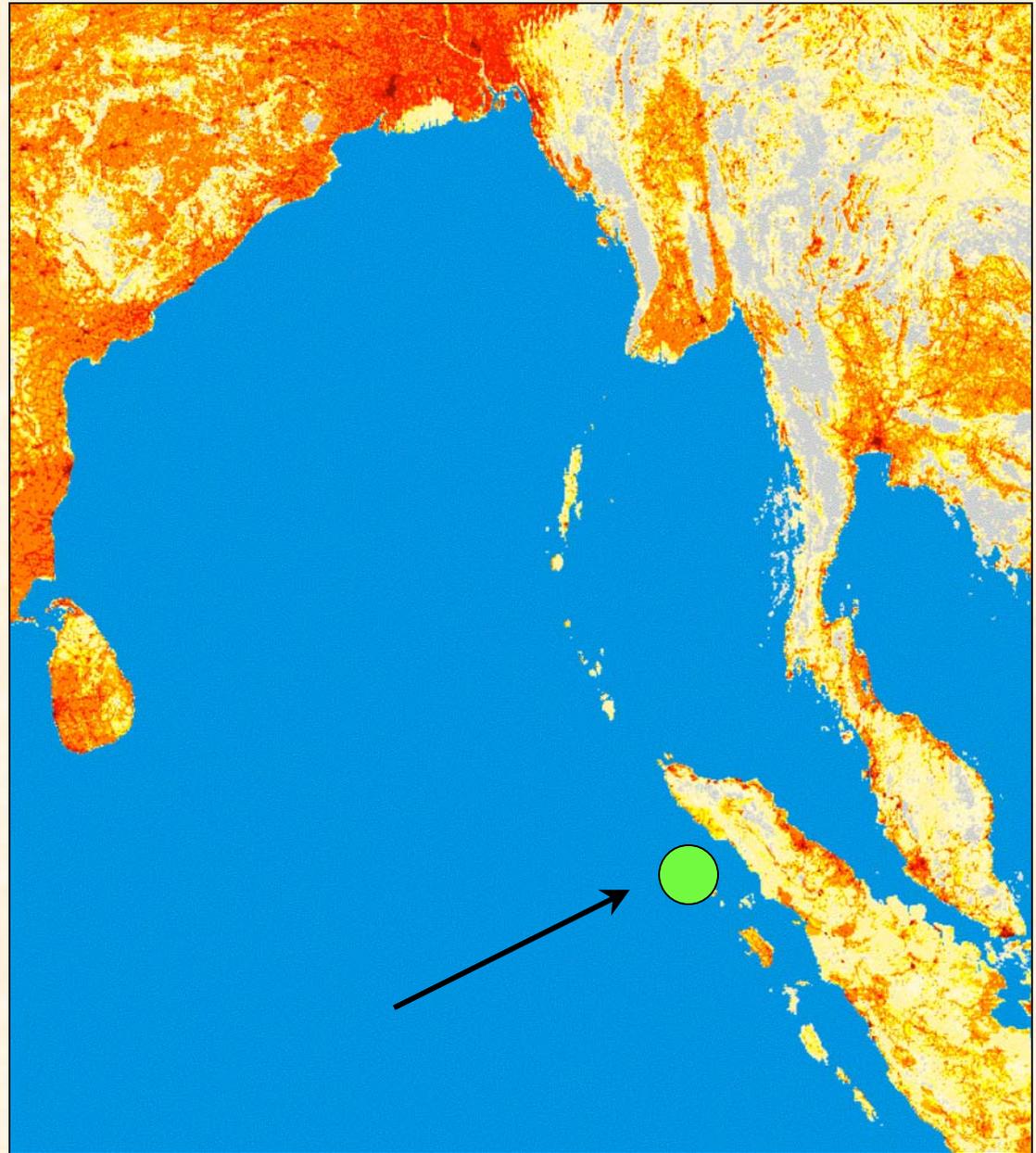




## Earthquake Location and Tsunami Region

With

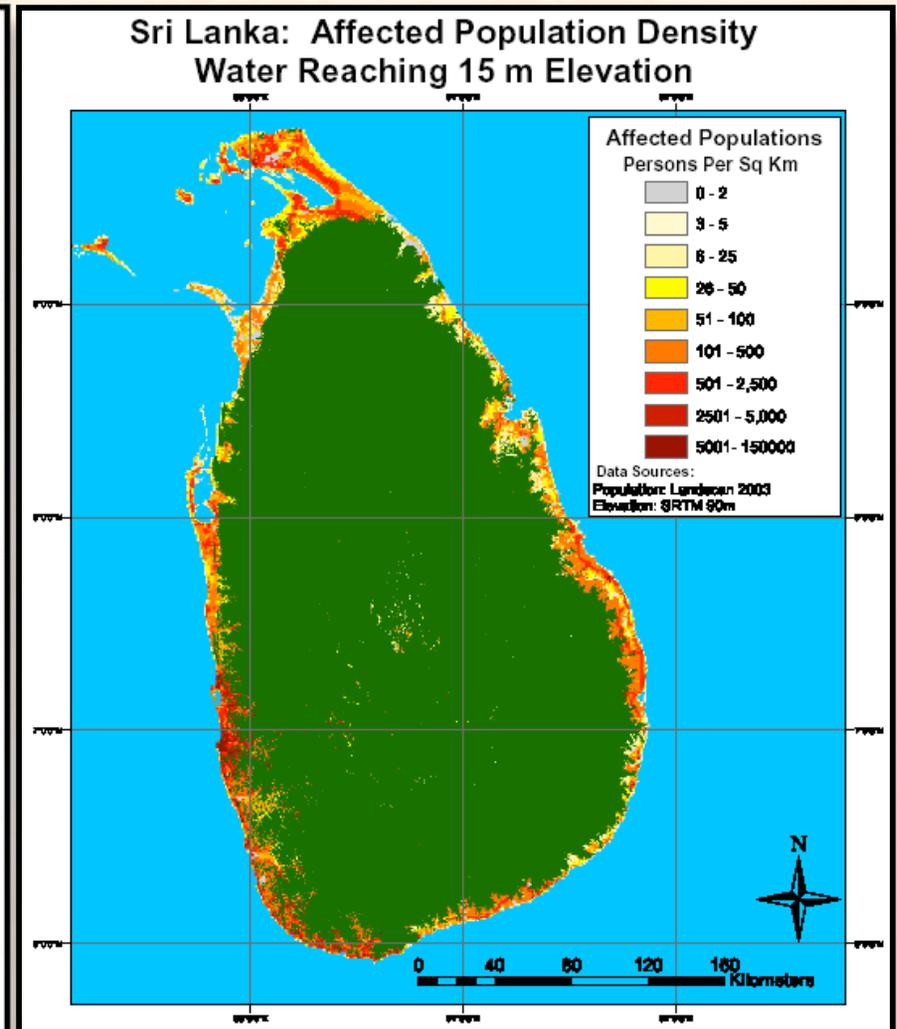
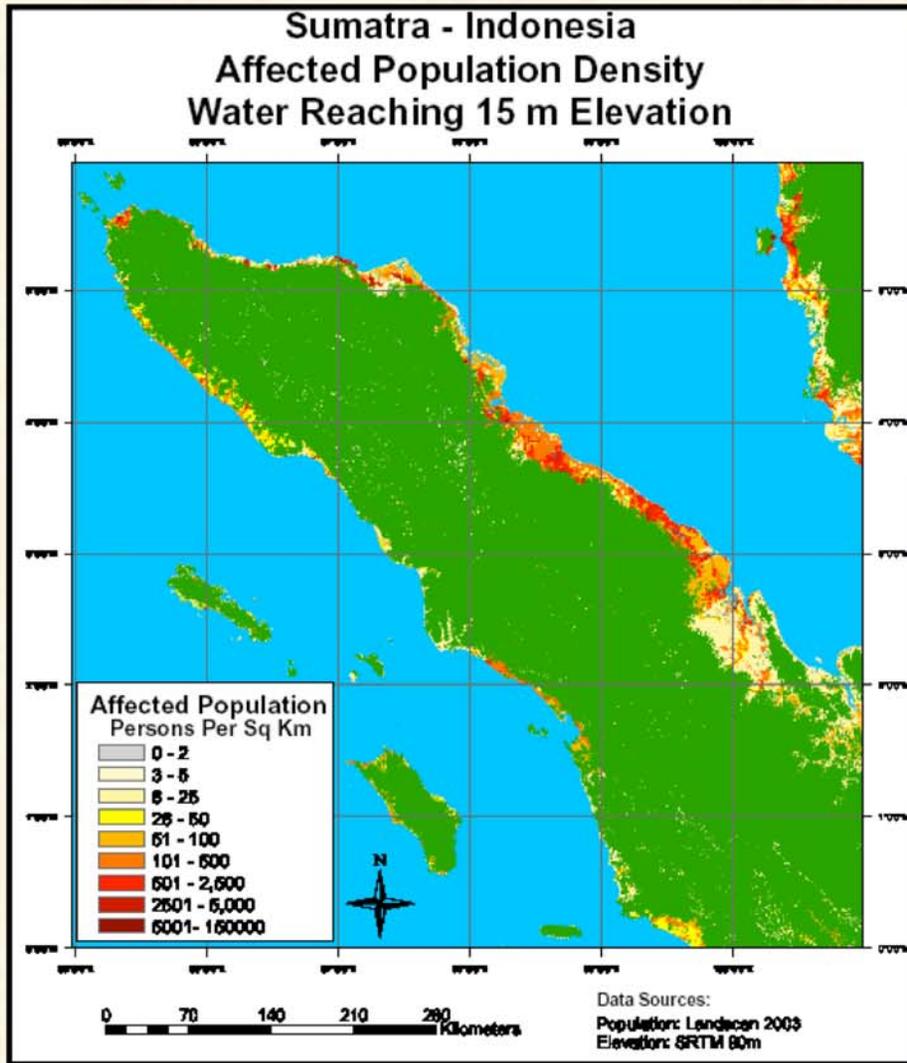
LandScan Population

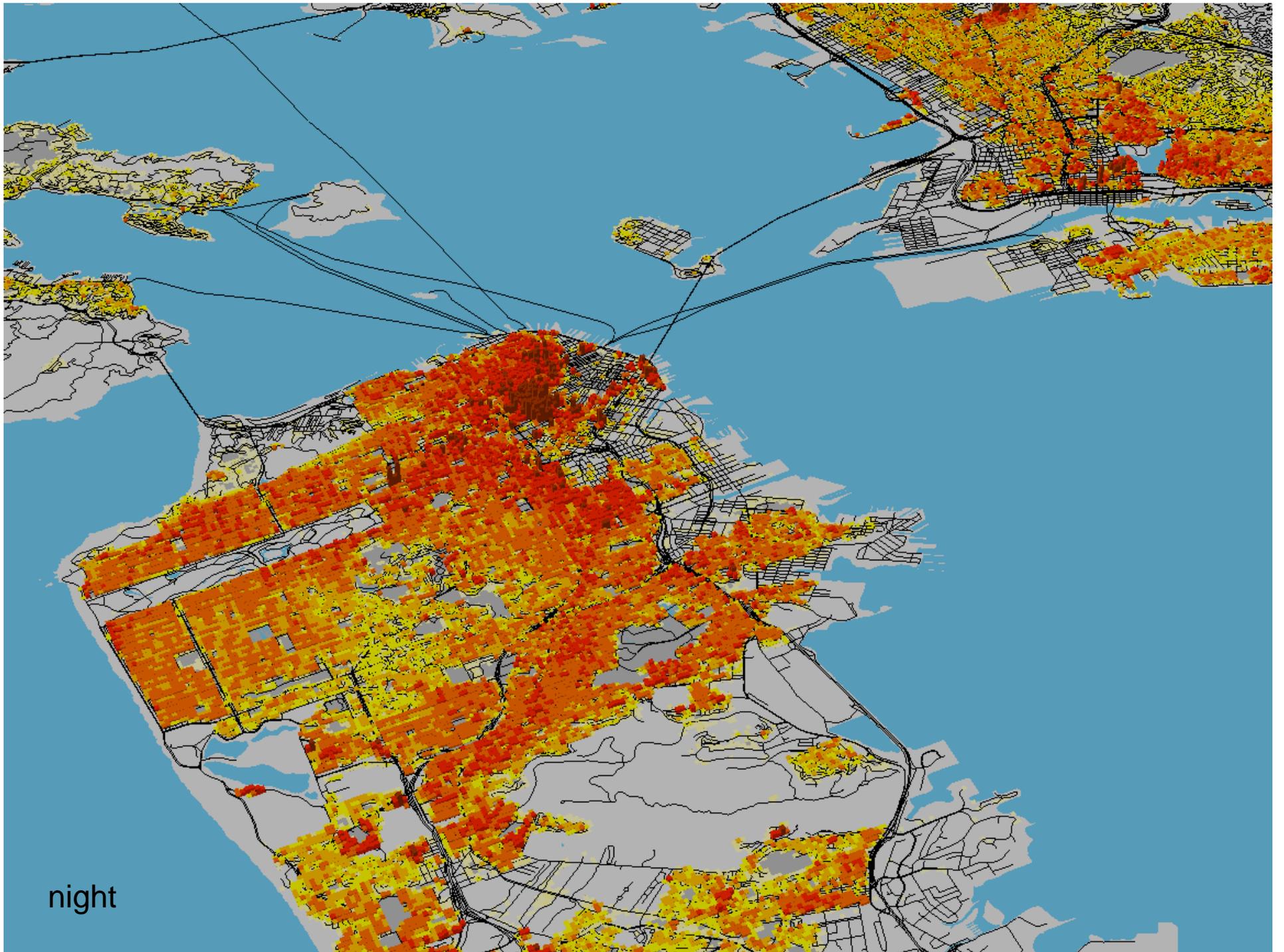


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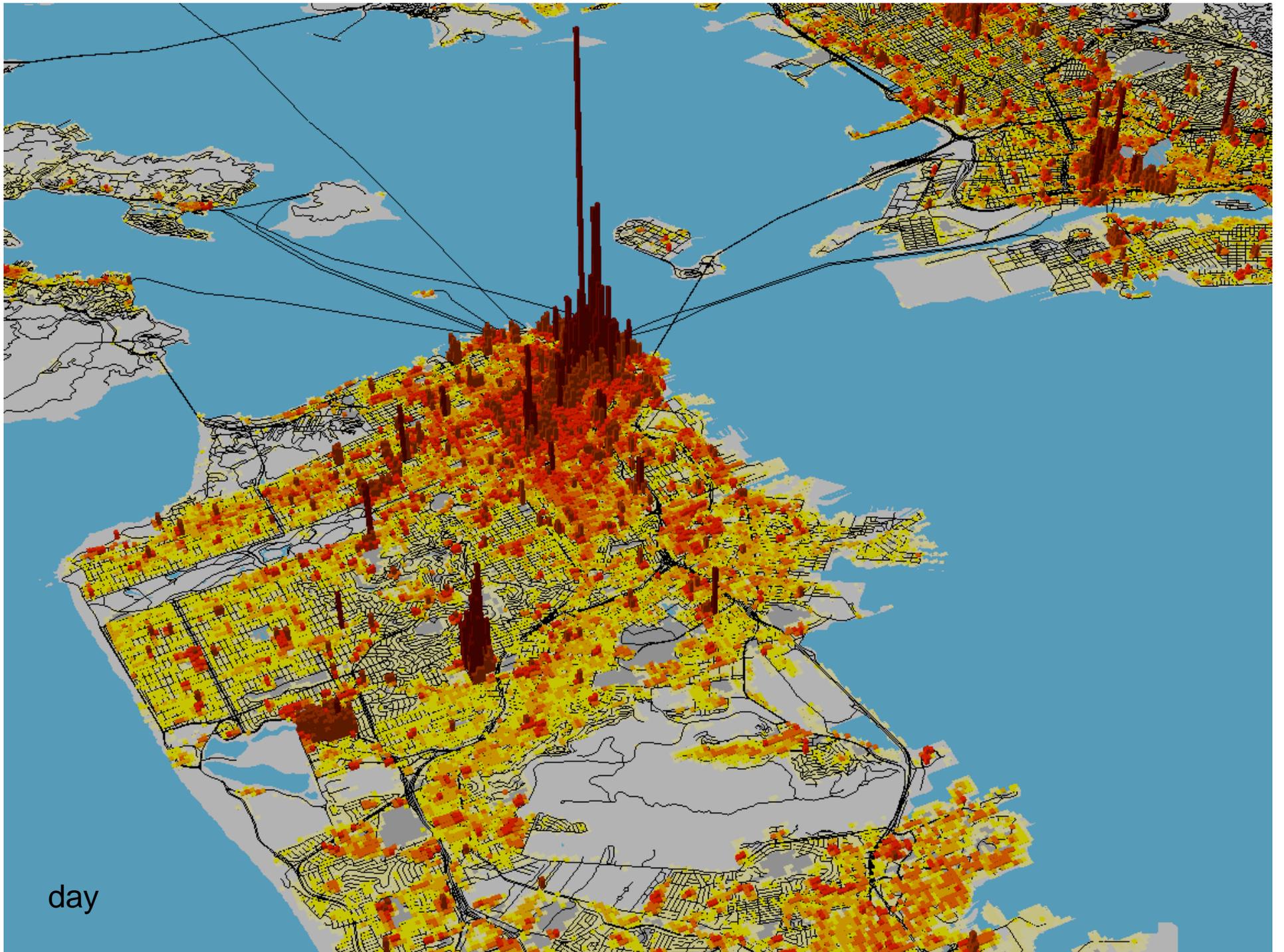


# Preliminary Maps made by USGS using LandScan

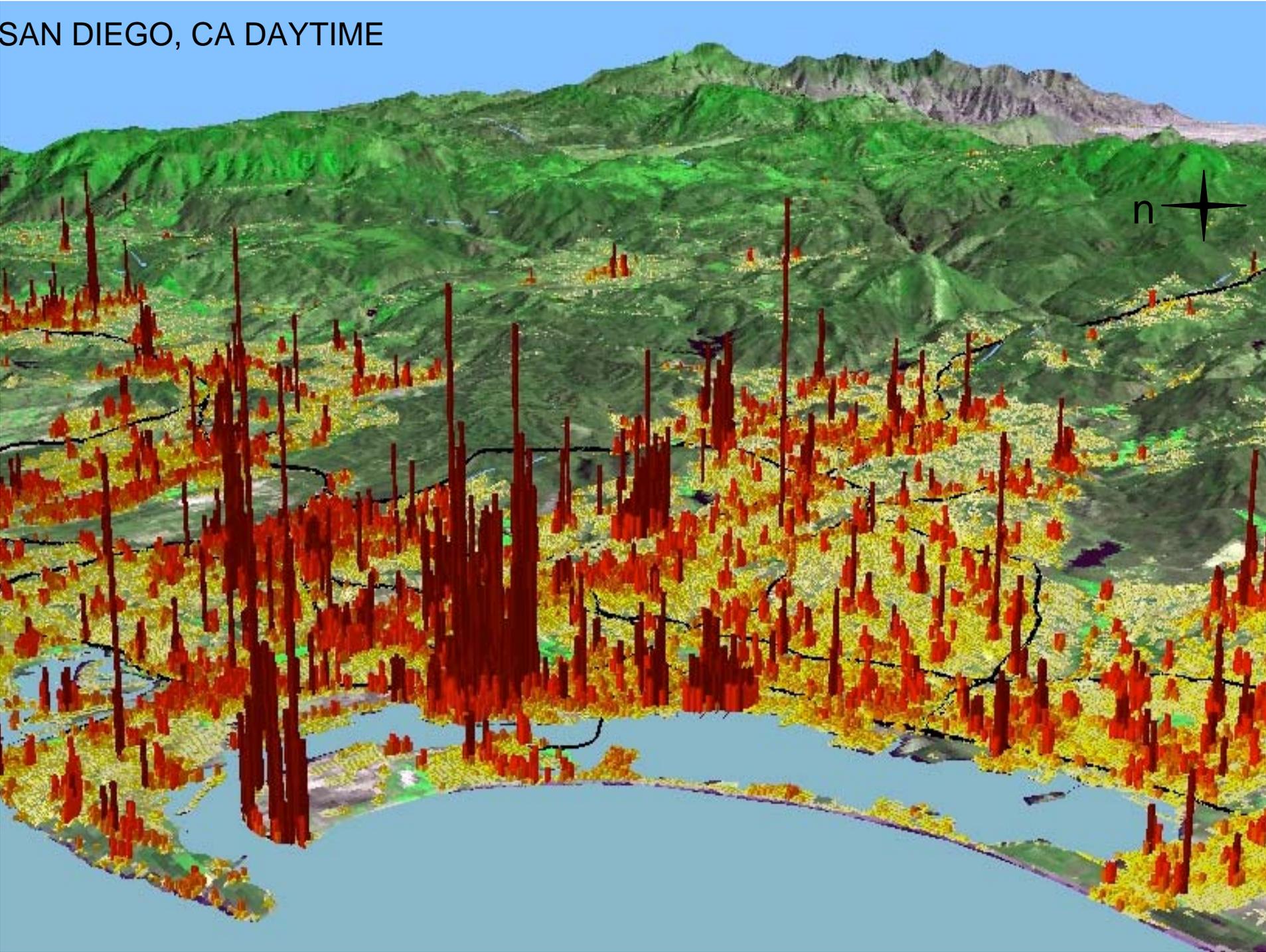




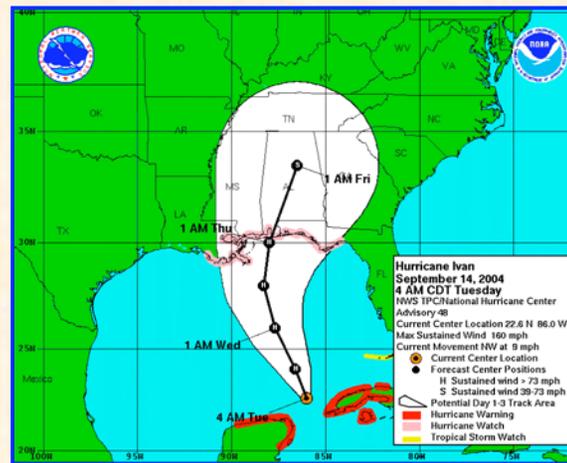
night



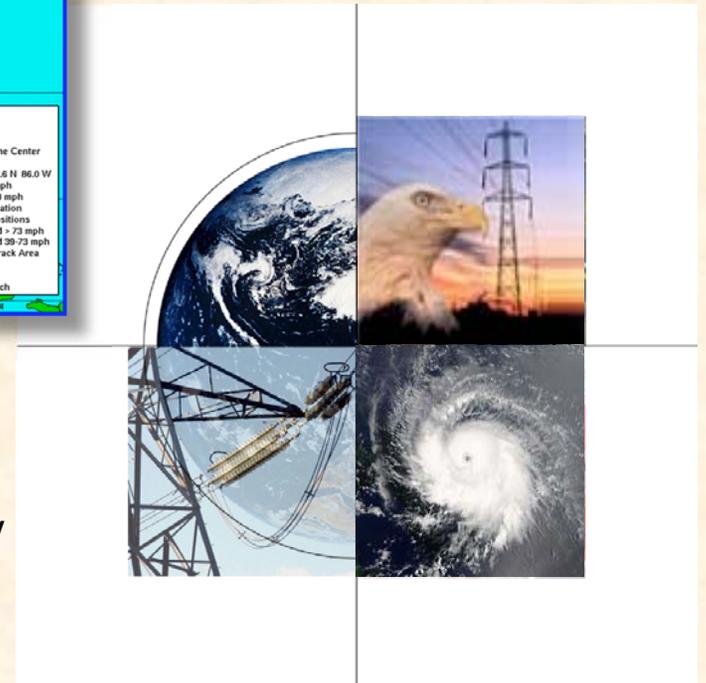
SAN DIEGO, CA DAYTIME



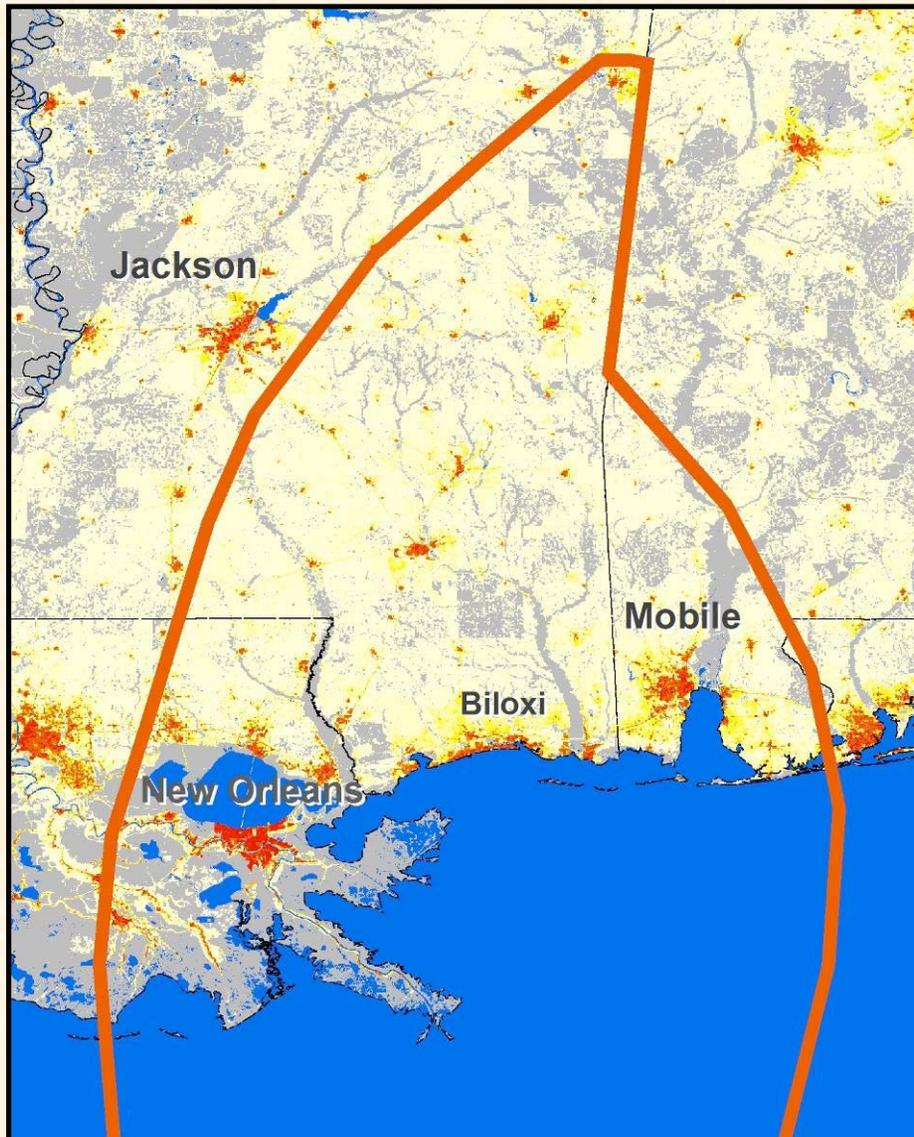
# Visualization & Modeling Working Group Analyses Report Based on NOAA Track #49: *Hurricane Ivan*



Office of Energy Assurance  
Office of Operations Support  
Argonne National Laboratory  
Los Alamos National Laboratory  
National Energy Technology Laboratory  
Oak Ridge National Laboratory  
Sandia National Laboratory



Detailed Population  
Analysis



Impacted Population:

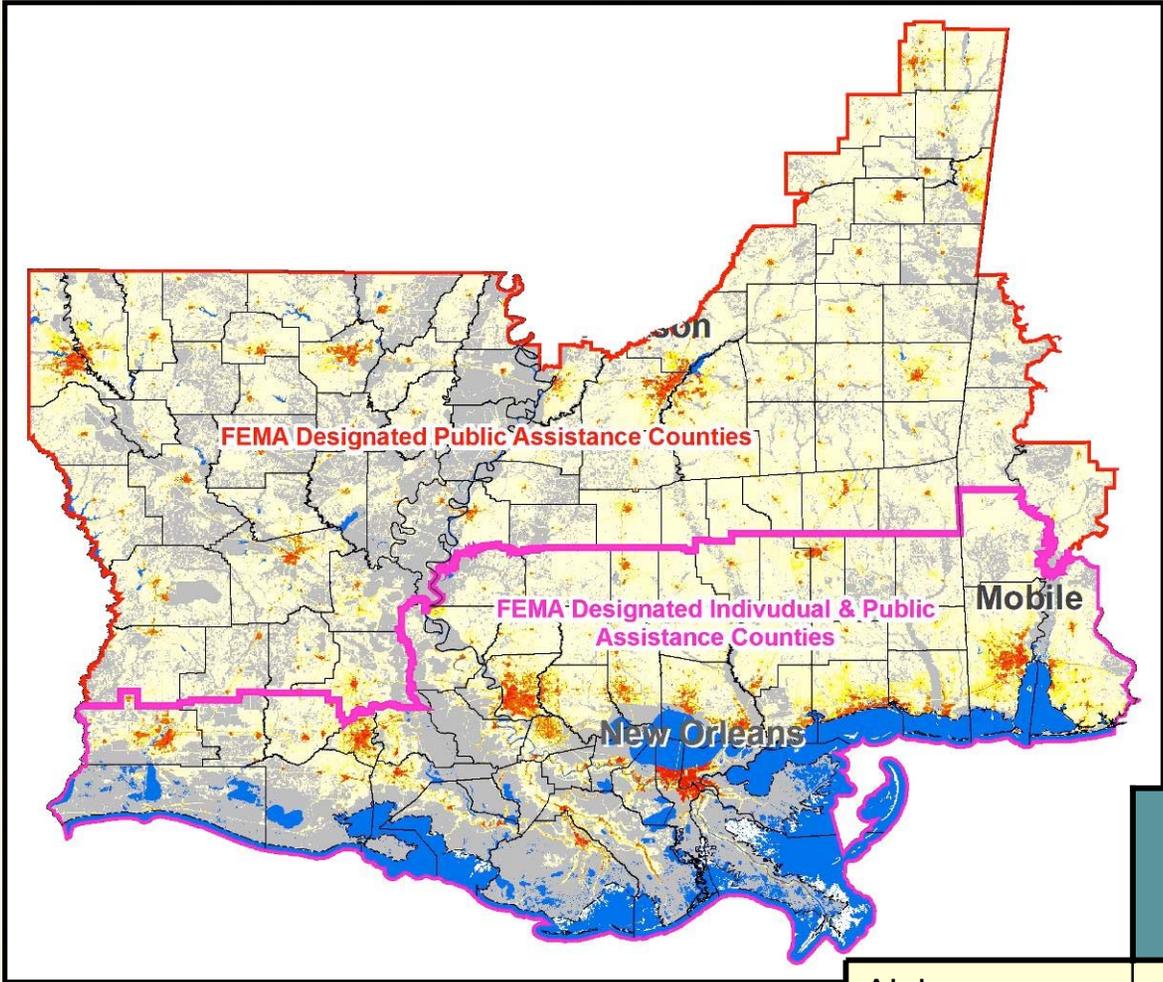
**Hurricane Force  
Winds**

**Total Population:**

**3,348,411**

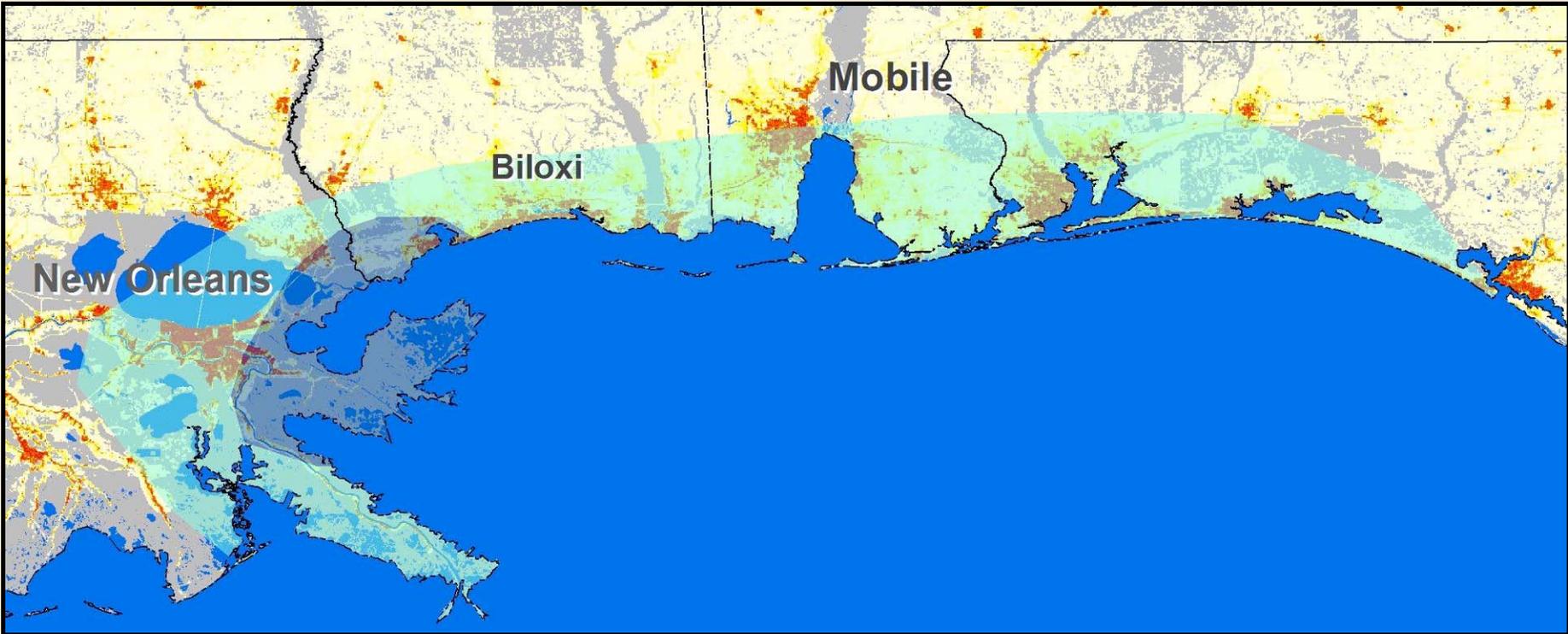
Detailed Population Analysis

Impacted Population:  
**FEMA Designated Assistance Counties**



	Individual & Public Assistance	Public Assistance
Alabama	575,133	56,801
Mississippi	707,506	1,391,233
Louisiana	3,153,293	1,362,477

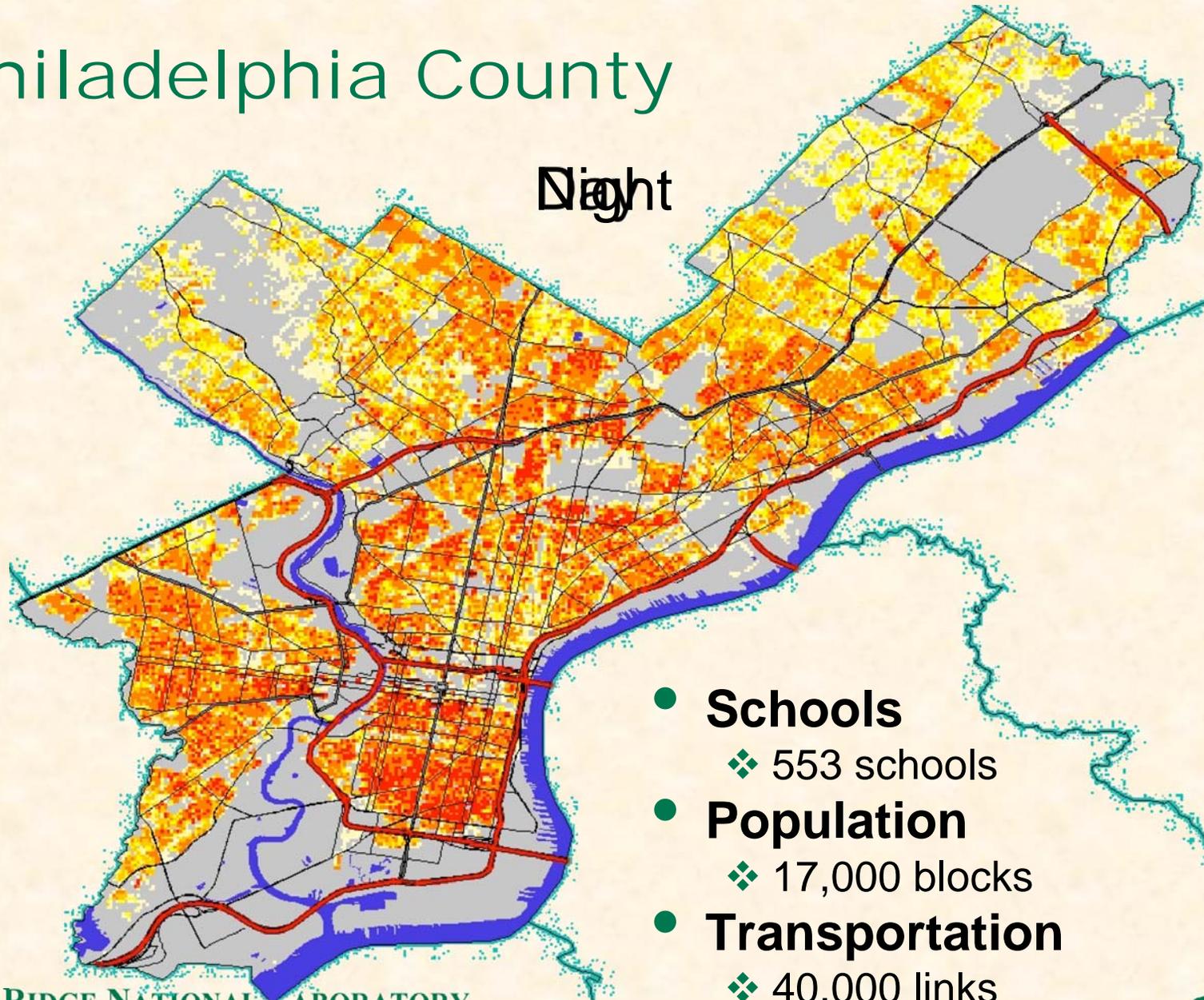
# Impacted Population: Storm Surge Areas



	Total Population	
Significant Damage (< 5 ft. surge)	1,007,676	
Catastrophic Damage (5 - 20 ft. surge)	1,513,871	

# Philadelphia County

Night



- **Schools**
  - ❖ 553 schools
- **Population**
  - ❖ 17,000 blocks
- **Transportation**
  - ❖ 40,000 links

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# Schools Data

	Age	LandScan
<b>KG</b>	5	21,081
<b>Elementary</b>	6-11	106,319
<b>Middle</b>	12-14	63,729
<b>High</b>	15-18	96,676
<b>Total</b>		287,805

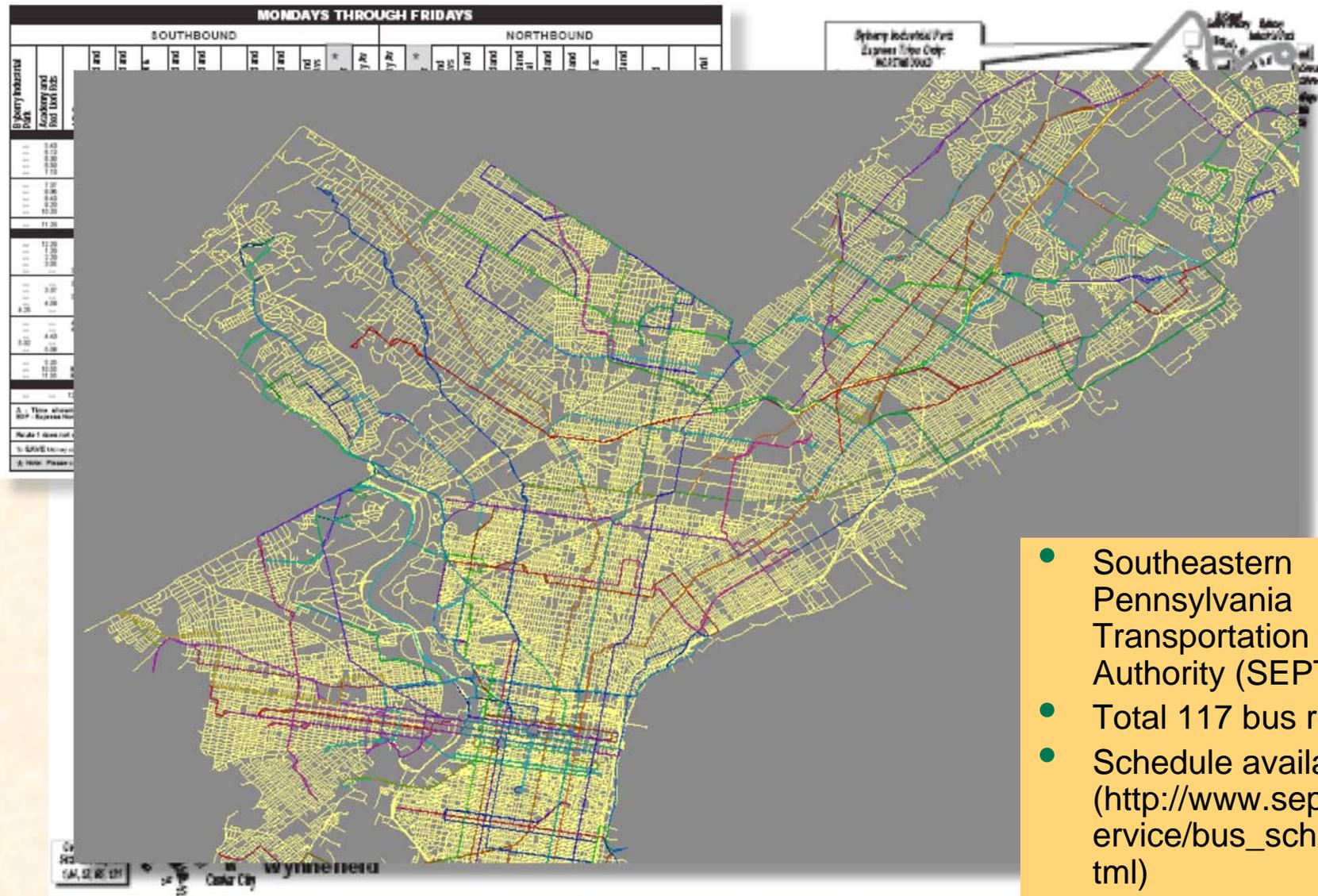


School Type	Number
KG	6
Elementary	269
Middle	30
High	72
Combined	168
Special/New	8

	LandScan	NCES	Enrollment
<b>Public (02-03)</b>	315	307	213,696
<b>Private (01- 02)</b>	238	242	68,482
<b>Total</b>	553	549	282,178

NCES: 1.5% home schooled

# Public Bus Routes



- Southeastern Pennsylvania Transportation Authority (SEPTA)
- Total 117 bus routes
- Schedule available ([http://www.septa.org/service/bus\\_schedules.html](http://www.septa.org/service/bus_schedules.html))

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