



# **Real-Time Estimation of Population Exposure to Weather Hazards**

**Kevin Scharfenberg and Brian Walawender**  
NOAA/National Weather Service

**Kevin Manross and Kiel Ortega**  
NOAA/National Severe Storms Laboratory  
and University of Oklahoma/CIMMS

# Which Storm is “Most Important”?

- **Severe Thunderstorm Warning**  
(2.5" hail, 75 mph winds)
- **Tornado Warning**
- **Severe Thunderstorm Warning**  
(1" hail, 60 mph winds)
- **Severe Thunderstorm Warning**  
(4" hail, 90 mph winds)

# **Now** Which Storm is “Most Important”?

- **Severe Thunderstorm Warning**  
(2.5" hail, 75 mph winds, Population 1,943,852)
- **Tornado Warning**  
(Population 346)
- **Severe Thunderstorm Warning**  
(1" hail, 60 mph winds, Population 41,398)
- **Severe Thunderstorm Warning**  
(4" hail, 90 mph winds Population 2,956)

# USGS “PAGER” Exposure to Shaking

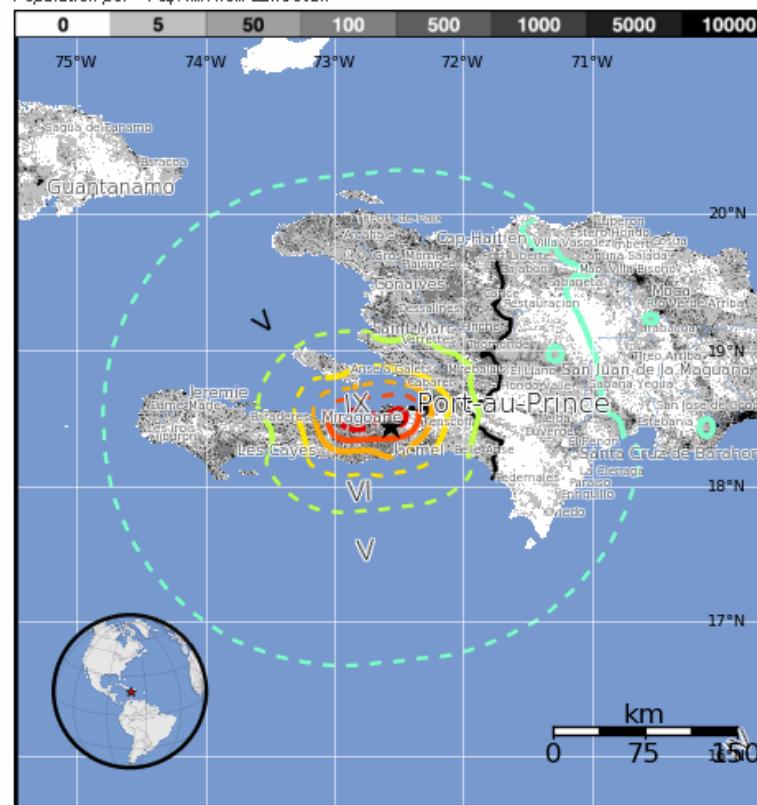
## Estimated Population Exposed to Earthquake Shaking

Estimated Modified Mercalli Intensity	I	II-III	IV	V	VI	VII	VIII	IX	X
Est. Population Exposure	...*	50k*	7,468k*	6,361k	926k	598k	2,030k	908k	118k
Perceived Shaking	Not Felt	Weak	Light	Moderate	Strong	Very Strong	Severe	Violent	Extreme
Potential Structure Damage	Resistant	none	none	none	V. Light	Light	Moderate	Moderate/Heavy	Heavy
	Vulnerable	none	none	none	Light	Moderate	Moderate/Heavy	Heavy	V. Heavy

\*Estimated exposure only includes population within calculated shake map area

## Population Exposure

Population per ~1 sq. km. from LandScan



## Selected Cities Exposed

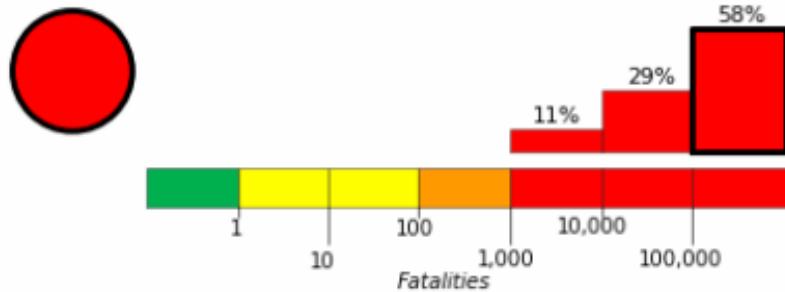
from GeoNames Database of Cities with 1,000 or more residents.

MMI	City	Population
X	Petit Goave	118k
X	Grand Goave	49k
X	Gressier	26k
IX	Leogane	134k
VIII	Port-au-Prince	1,235k
VIII	Carrefour	442k
VIII	Delmas 73	383k
VIII	Miragoâne	89k
V	Verettes	49k
IV	Santo Domingo	2,202k
IV	Santiago de los Caballeros	556k

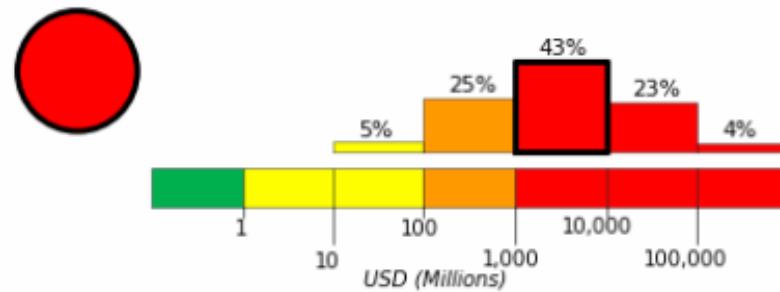
(k = x1,000)

# USGS “PAGER” Estimated Losses

Estimated Fatalities

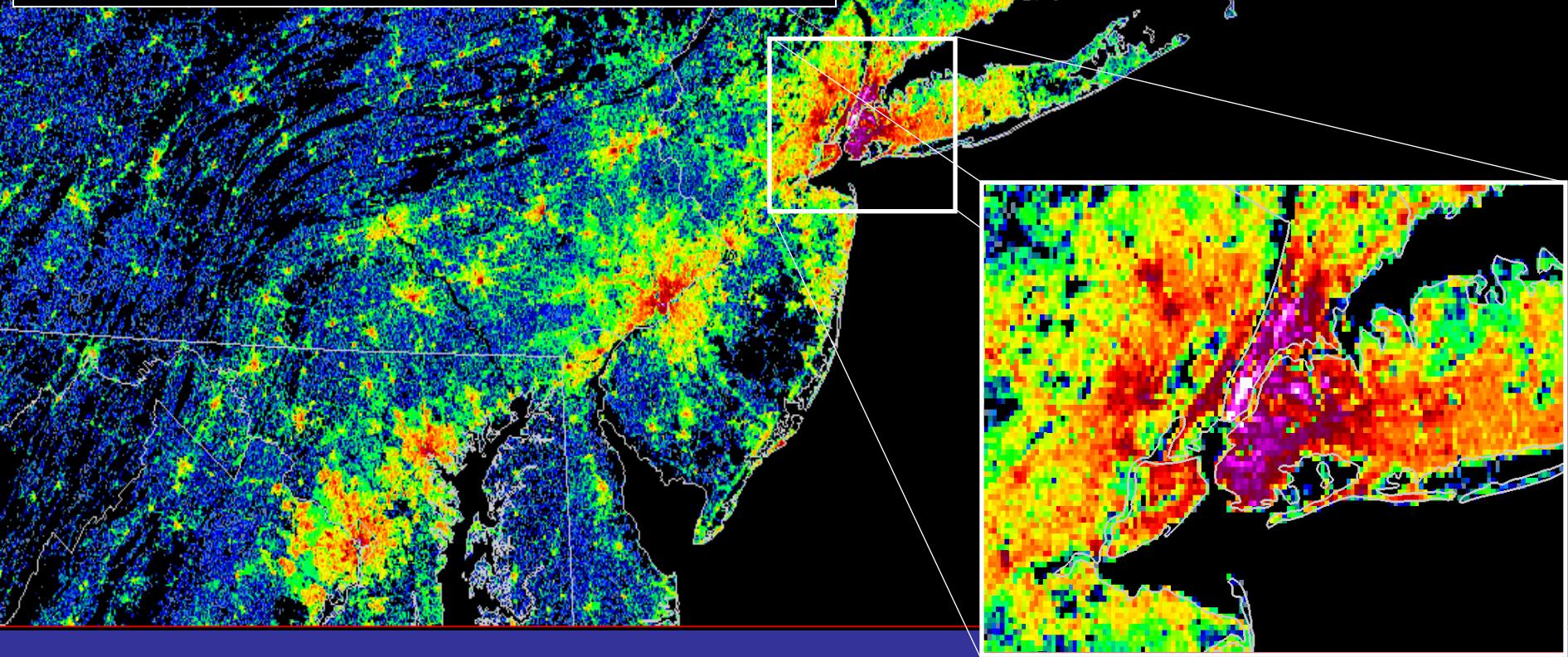
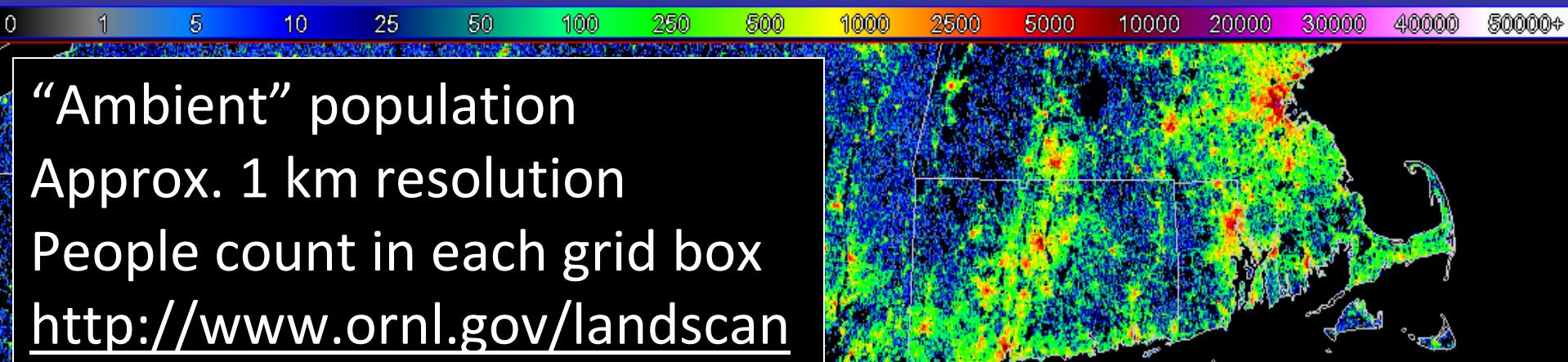


Estimated Economic Losses

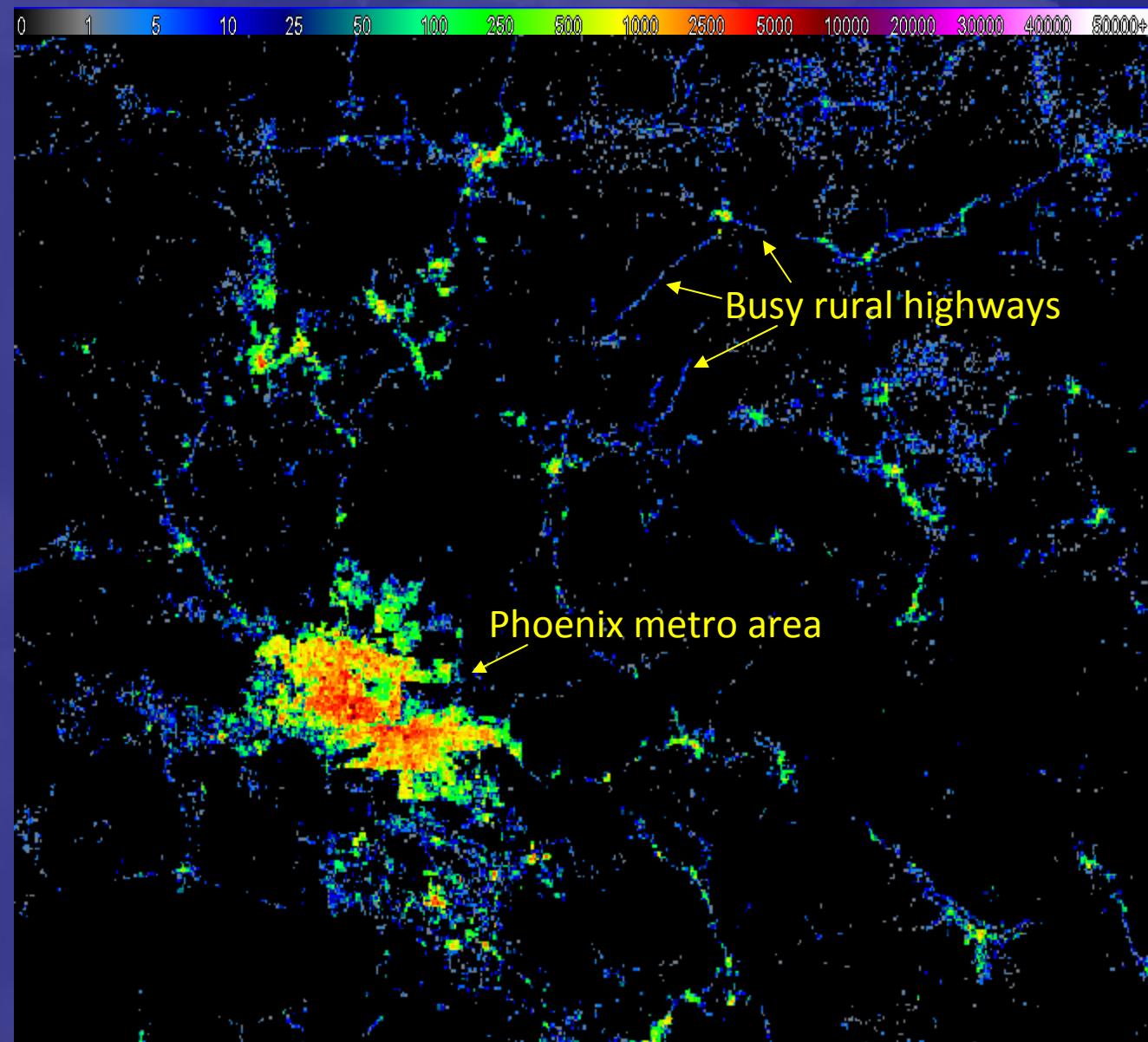


- **Results available:** Within 30 minutes of the earthquake
- **Haiti example:** High-level US officials were alerted of catastrophe within one hour

# High-Resolution Population Grid



# High-Resolution Population Grid



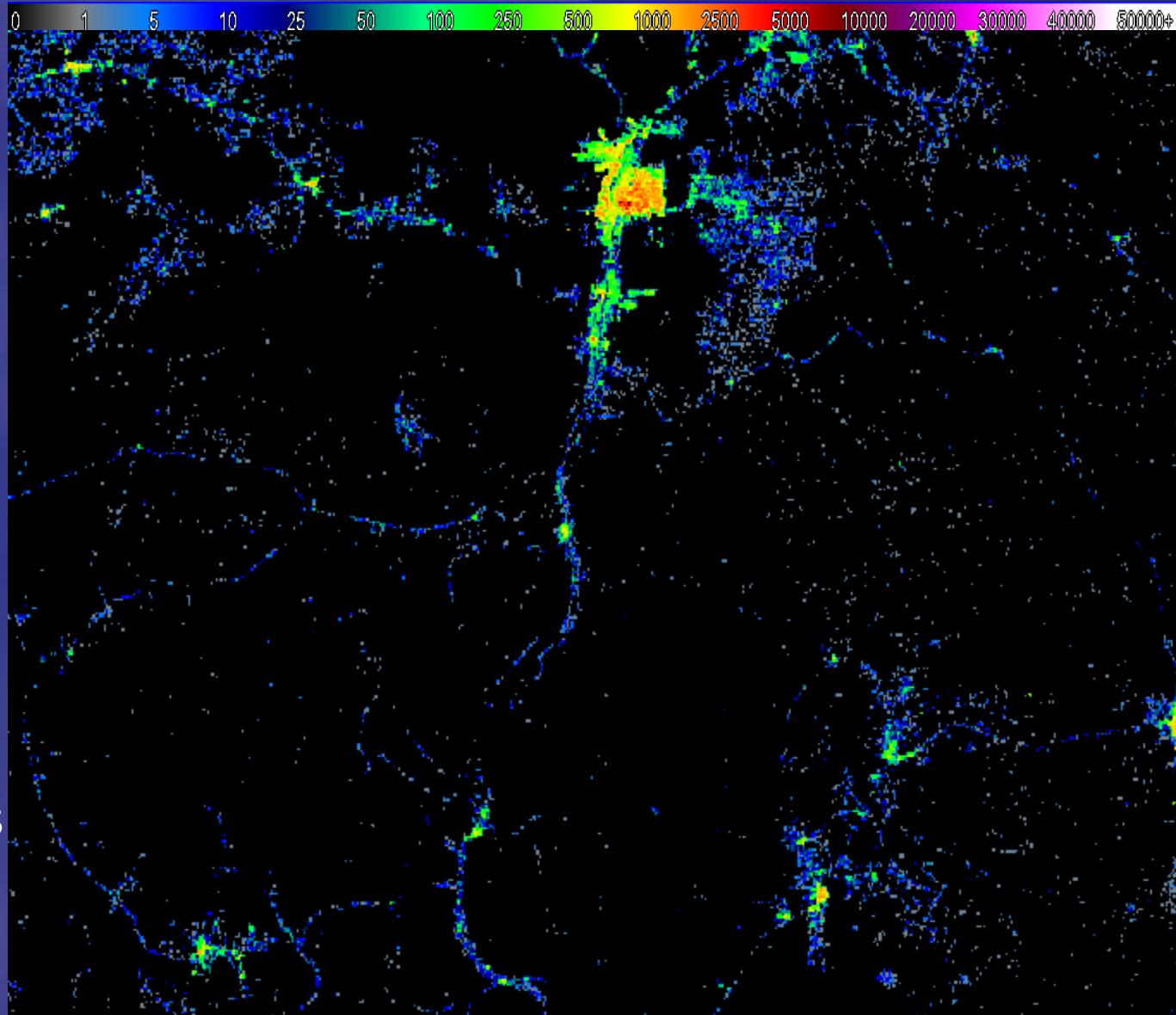
**Large venues  
& institutions  
often appear  
as “point  
targets”**

- Hospitals
- Casinos
- Prisons
- Outlet malls

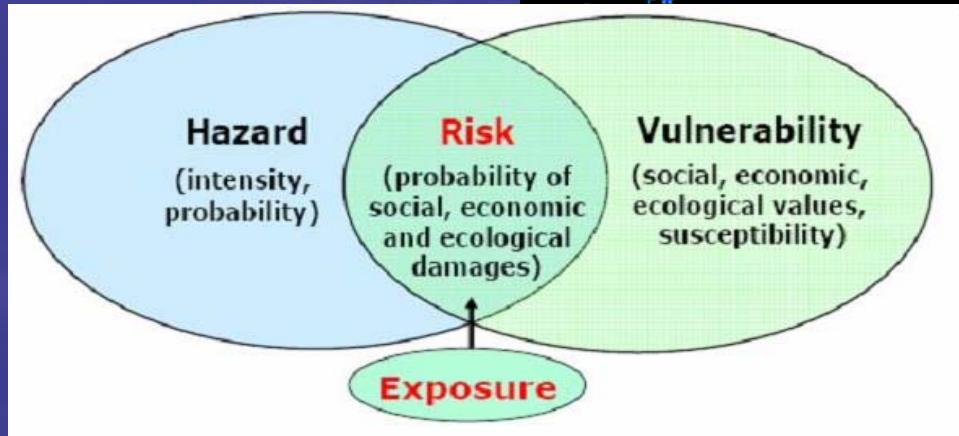
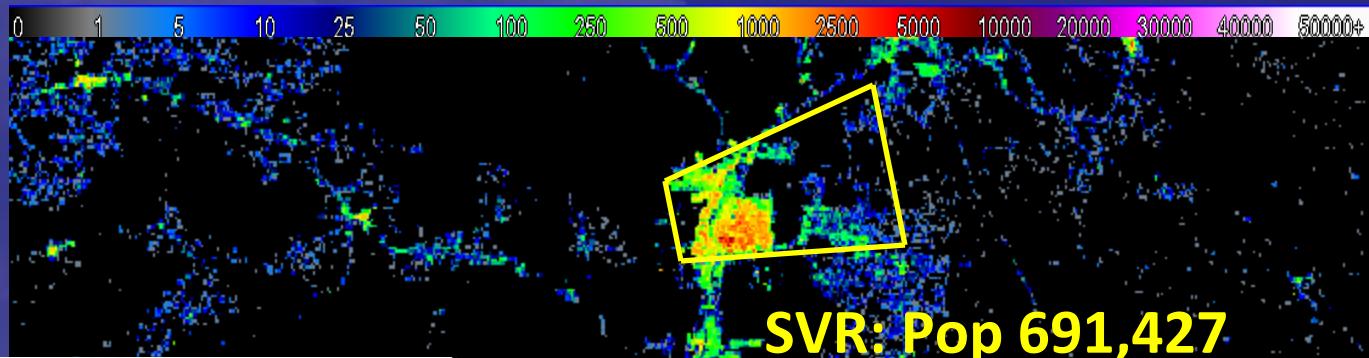
# High-Resolution Population Grid

Does NOT  
capture  
recreation  
patterns &  
infrequently-  
used venues

- Boaters
- Hikers/campers
- Sporting venues
- Spotters/chasers



# Public Risk Assessment



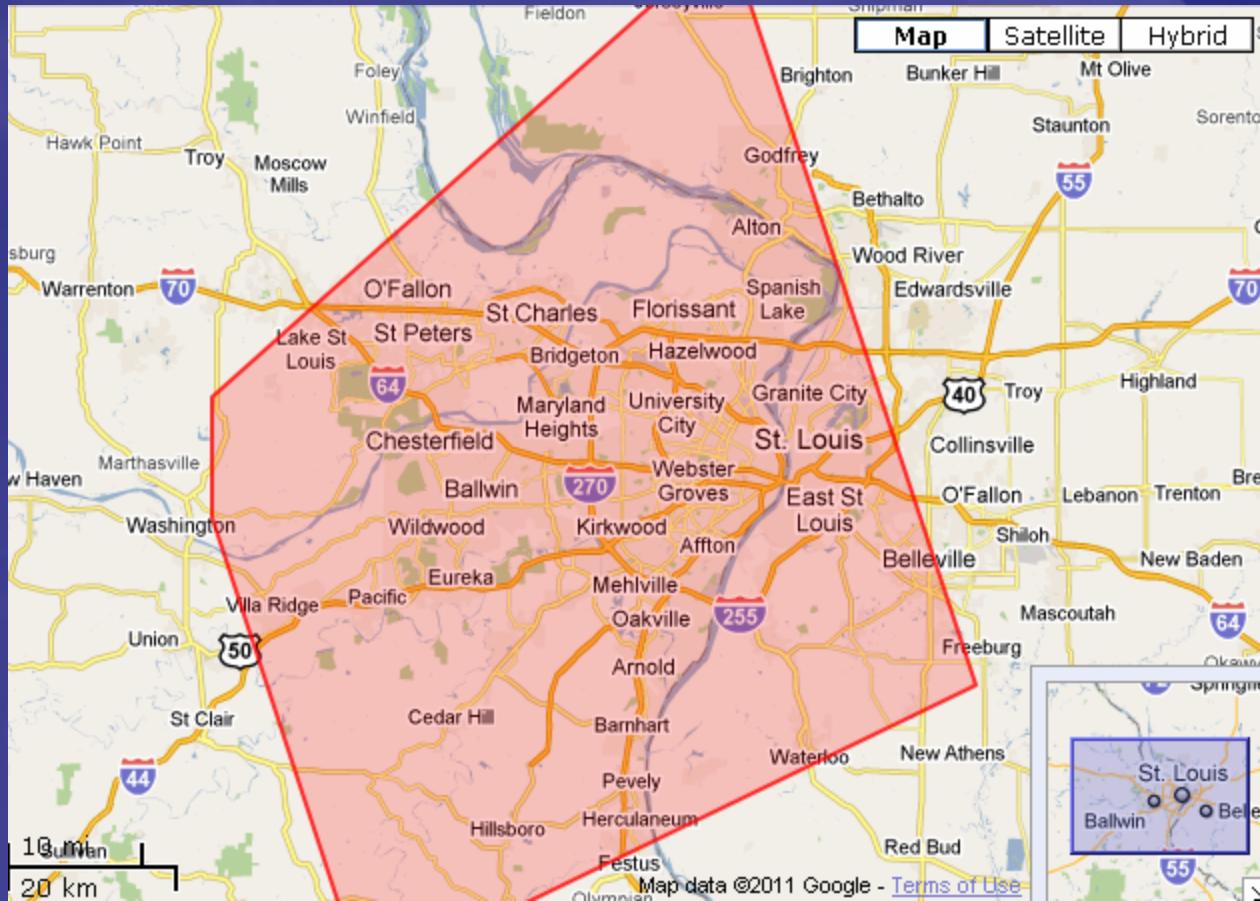
# Public Risk Assessment

**Tornado Warning (0086.2010)**

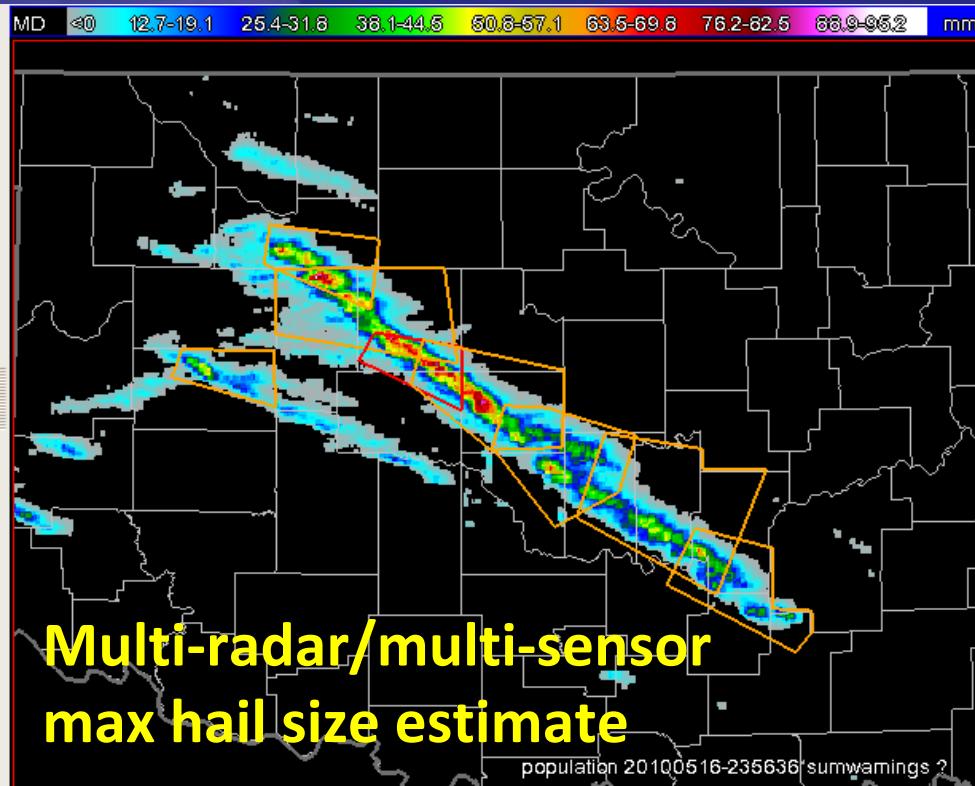
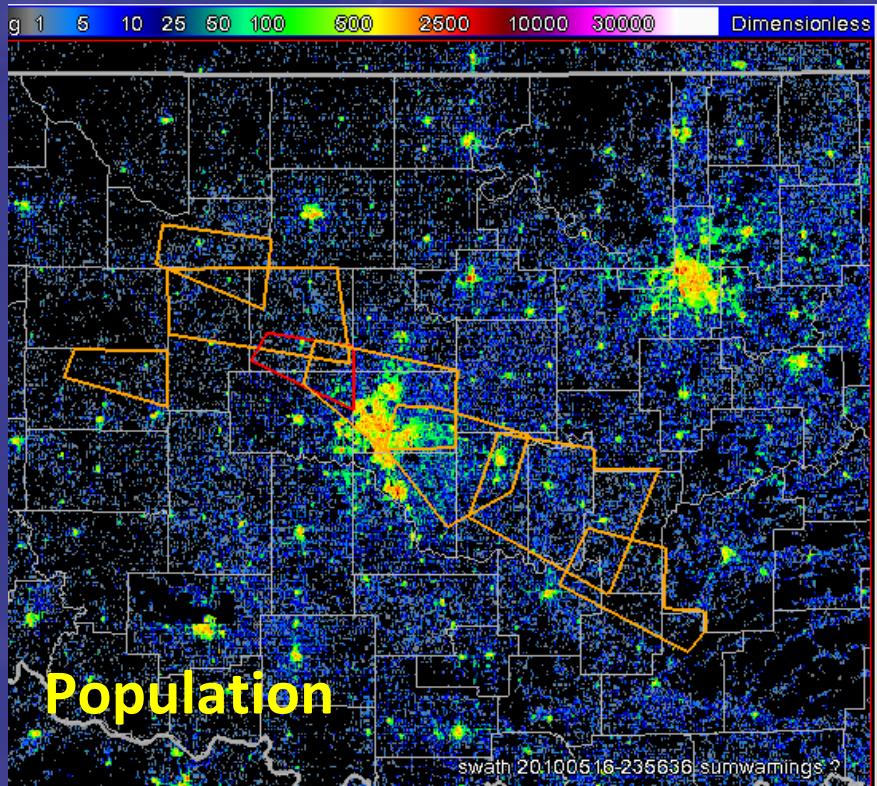
National Weather Service St. Louis, MO

Issued 11:22 am December 31, 2010

**Ambient Population: 3,464,160**



# Event Impact Assessment



**Tornado Warnings**  
Population 25,786

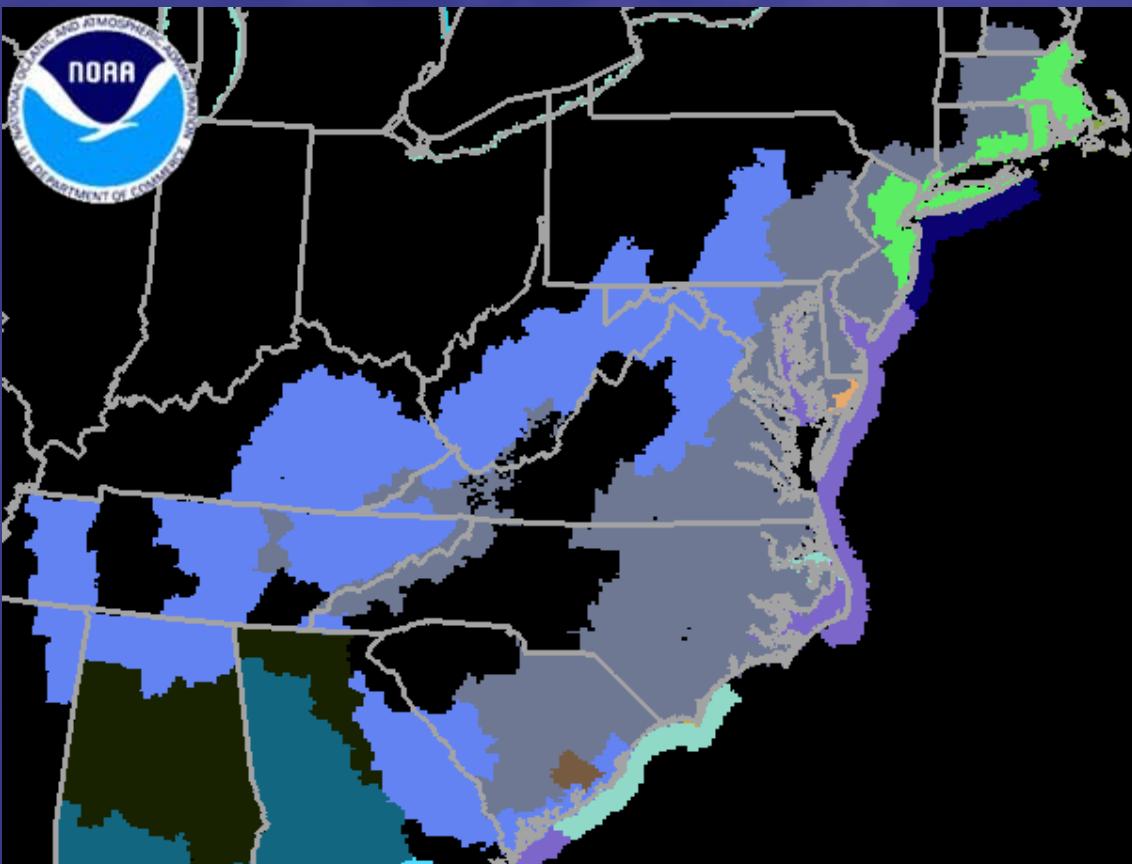
**Severe T'storm Warnings**  
Population 1,542,431\*  
\* Some overlapping population between multiple warnings

**Likely impacted by any hail**  
Population 436,991

**...by “severe” hail**  
Population 318,125

# Public Exposure Assessment

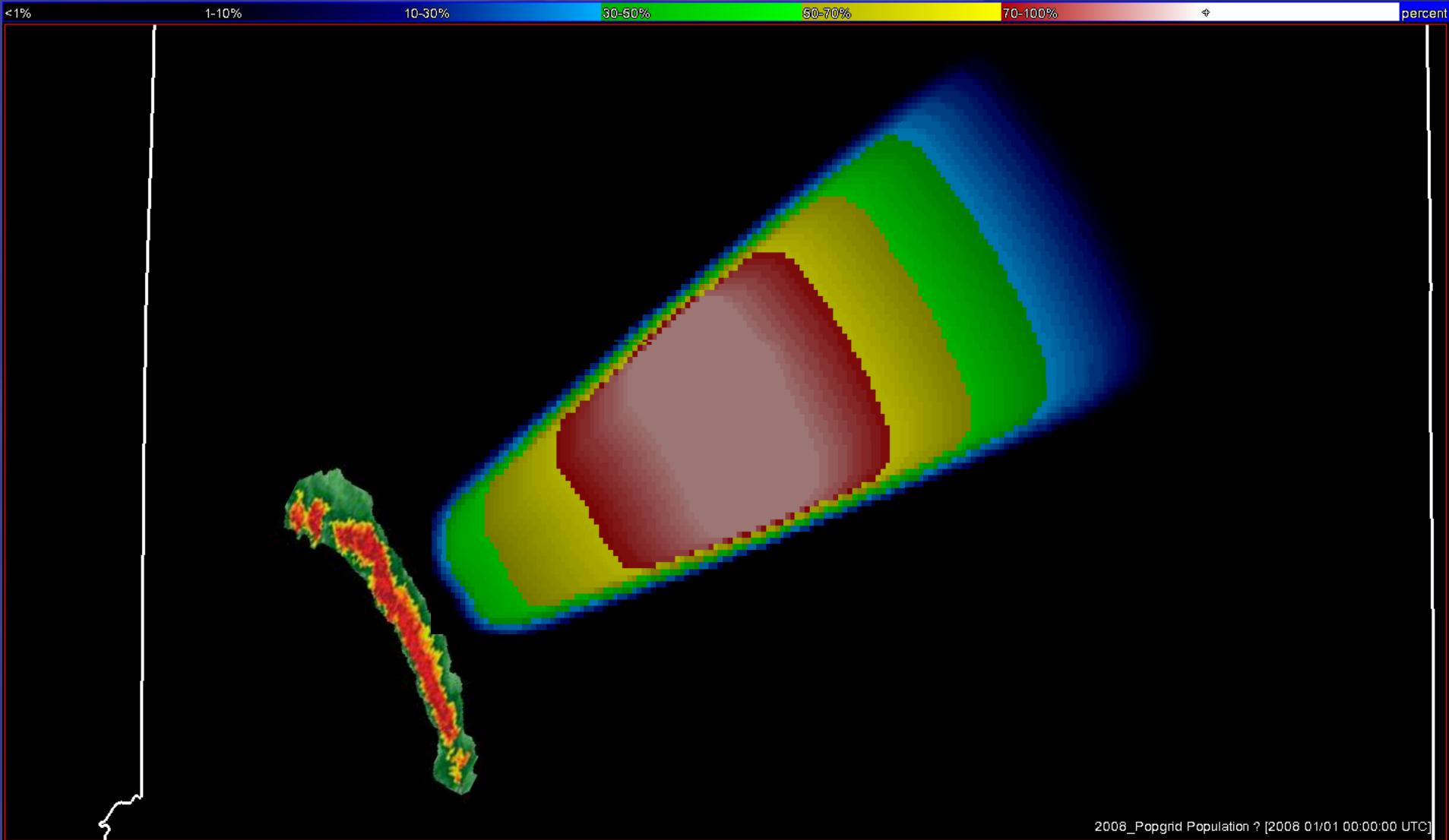
**National Watch/warning/advisory grid  
12 noon EST December 26, 2010**



- Blizzard Warning**  
Population 38,468,292
- Winter Storm Warning**  
Population 44,720,620
- Winter Weather Advisory**  
Population 25,855,532
- Total population impact:**  
109,044,444

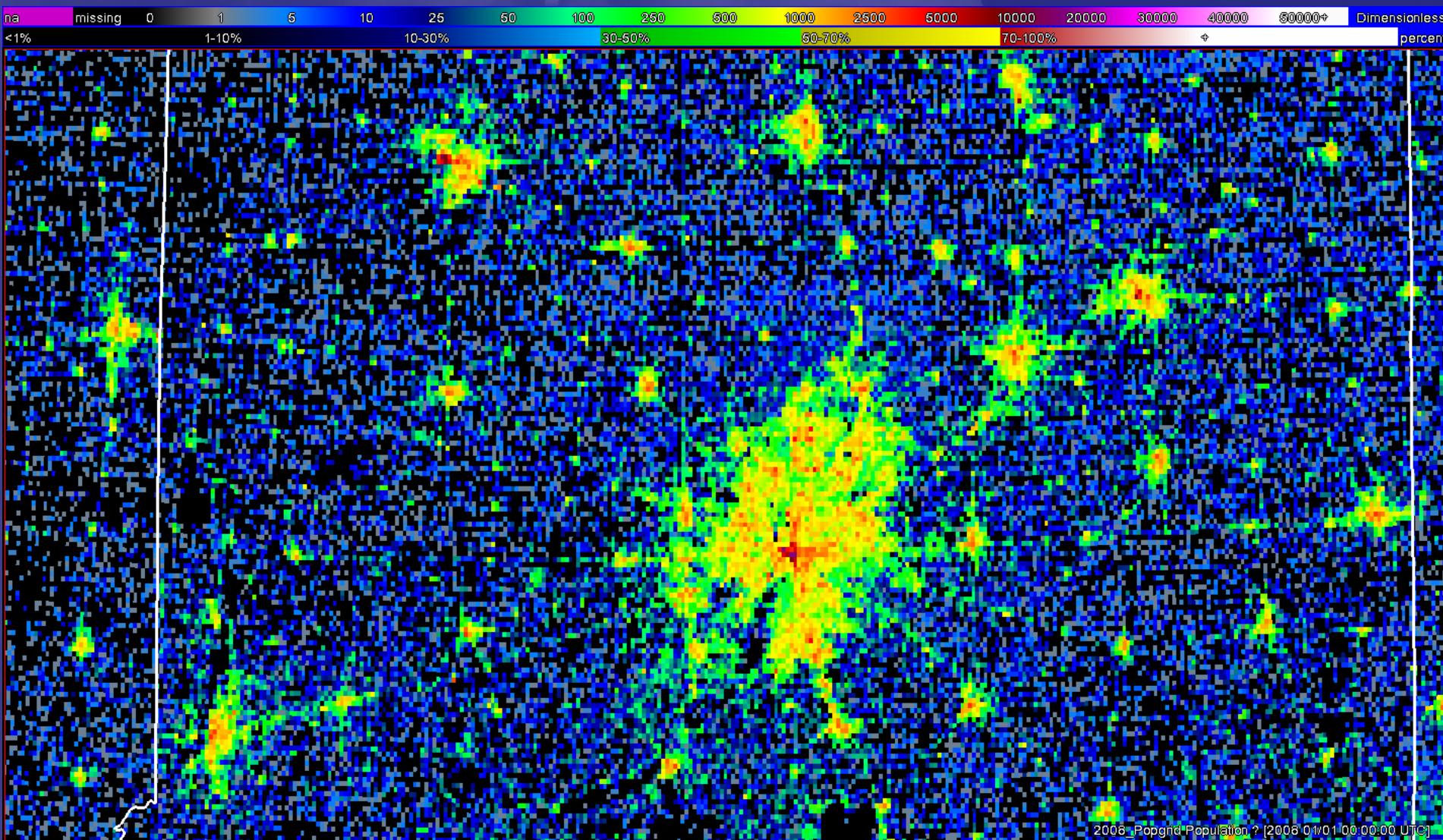
# Probabilistic Hazard Information

Example: Probability of winds over 50 kts (58 mph)



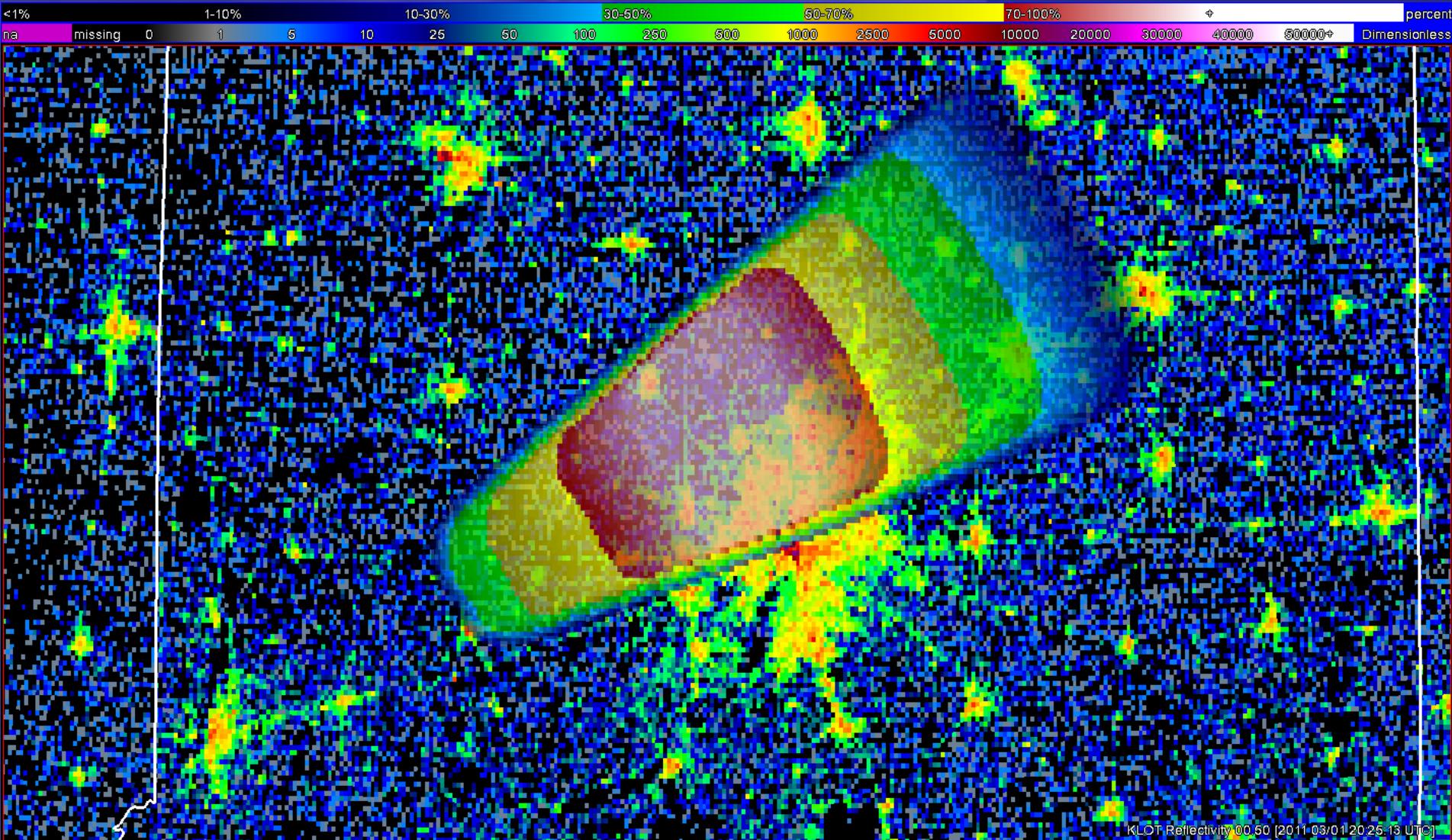
# Probabilistic Hazard Information

Example: Probability of winds over 50 kts (58 mph)



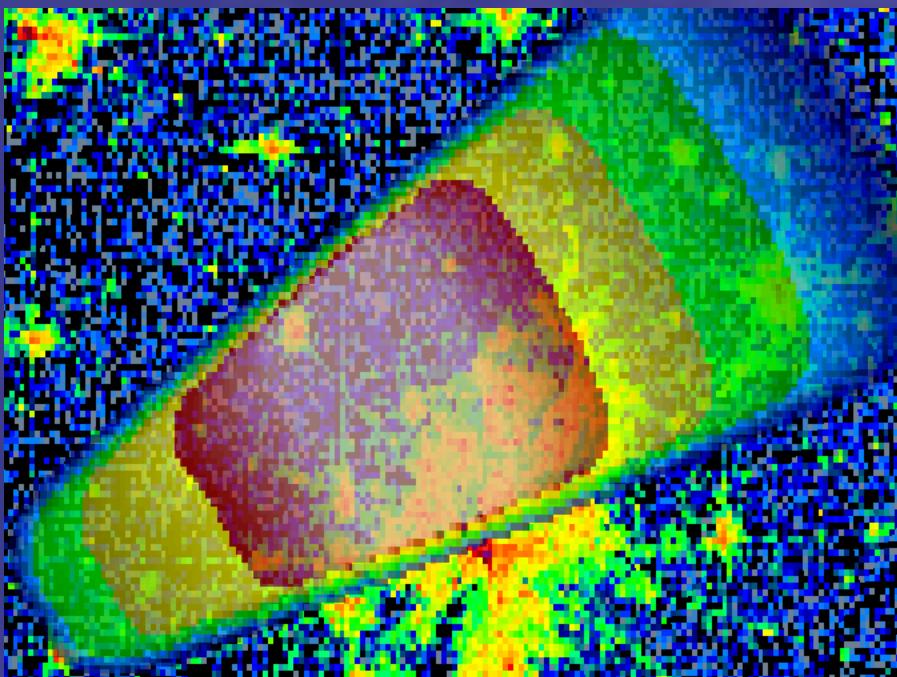
# Probabilistic Hazard Information

Example: Probability of winds over 50 kts (58 mph)



# Probabilistic Hazard Information

## Example: Probability of winds over 50 kts (58 mph)



**70% or greater chance**

Population 864,395

**50-69% chance**

Population 371,602

**30-49% chance**

Population 342,853

**10-29% chance**

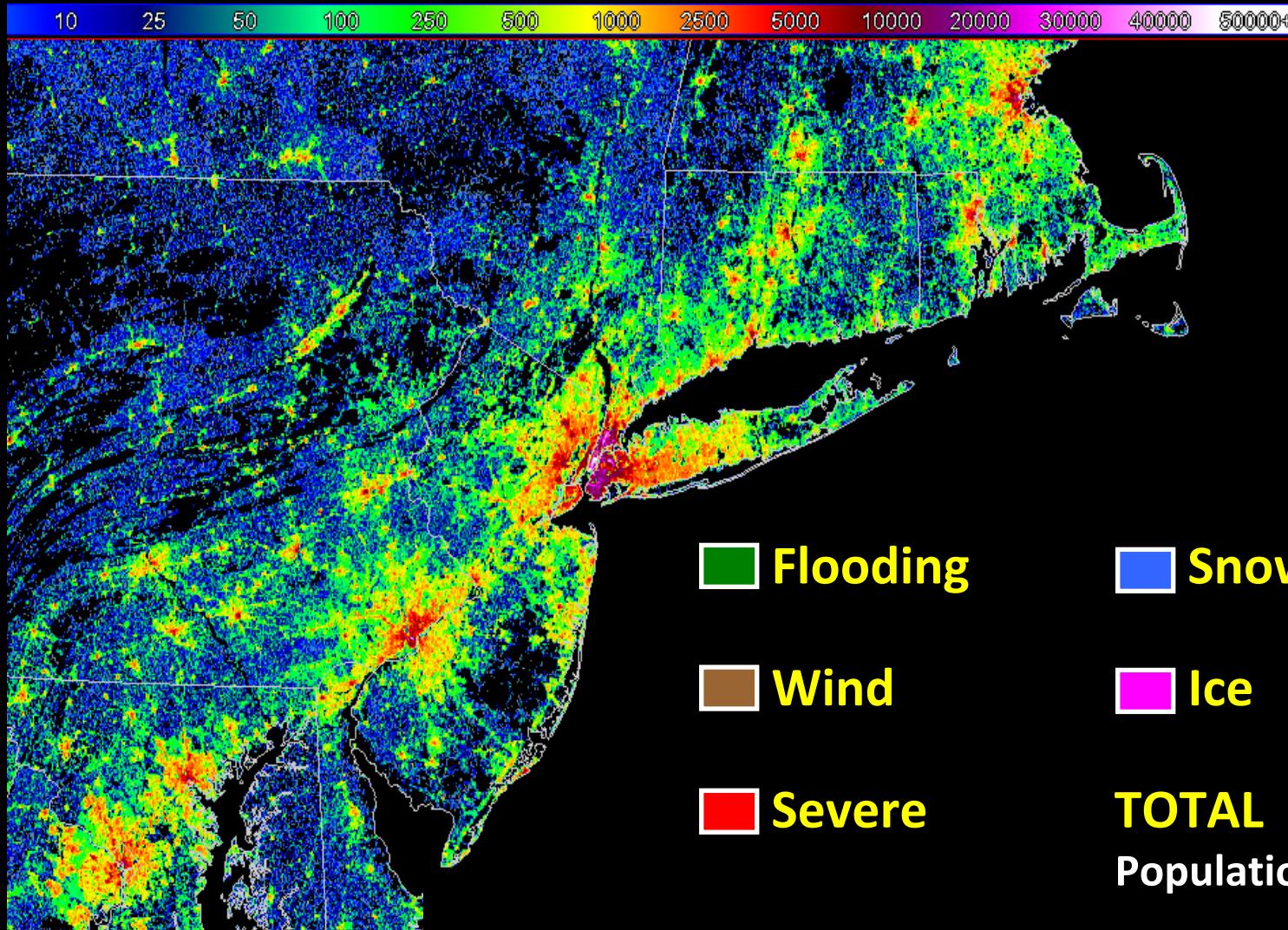
Population 191,253

**10-100% chance total:**

Population 1,769,103

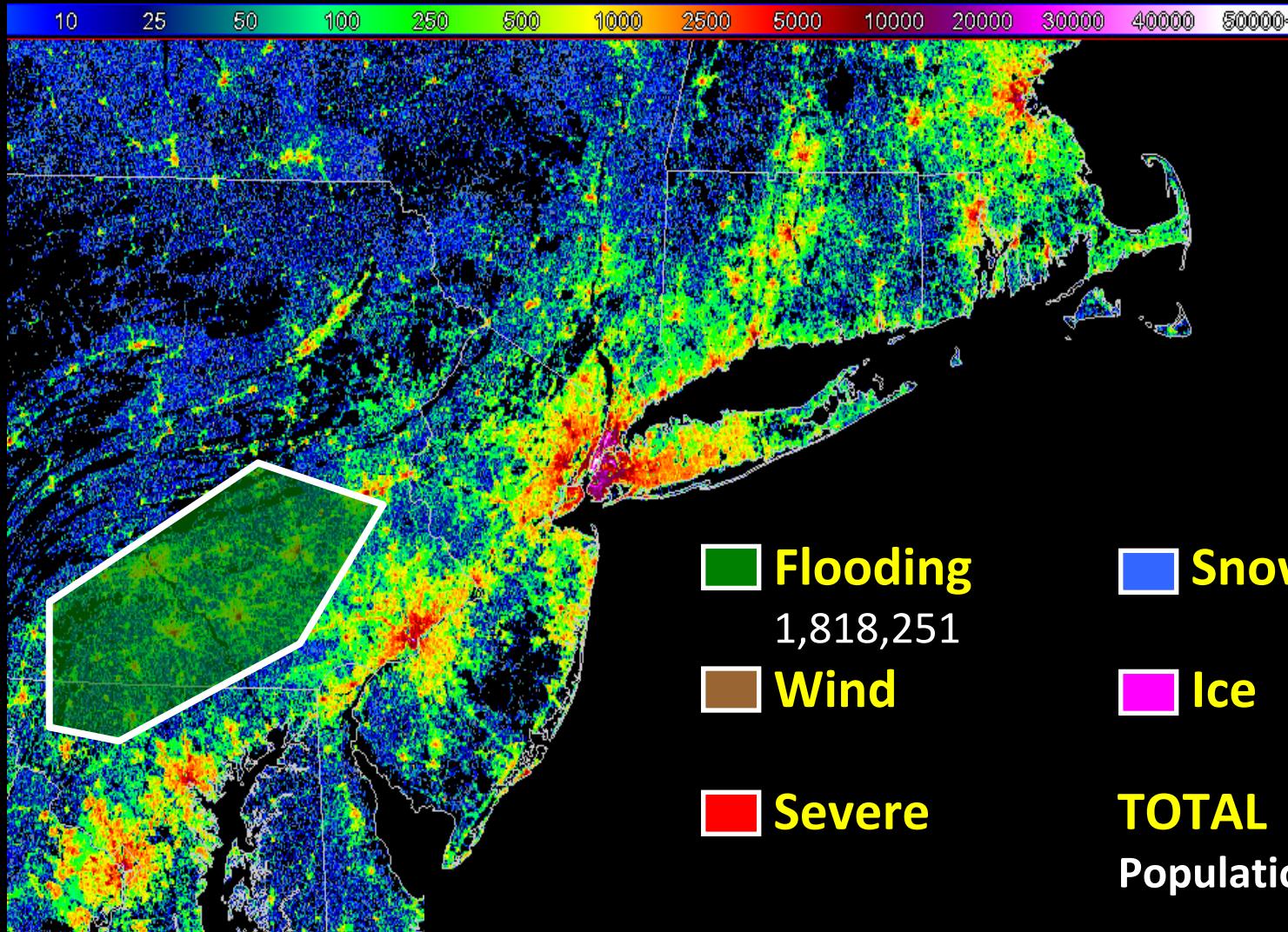
# High-Resolution Population Grid

## HAZARDS IMPACT MONITOR



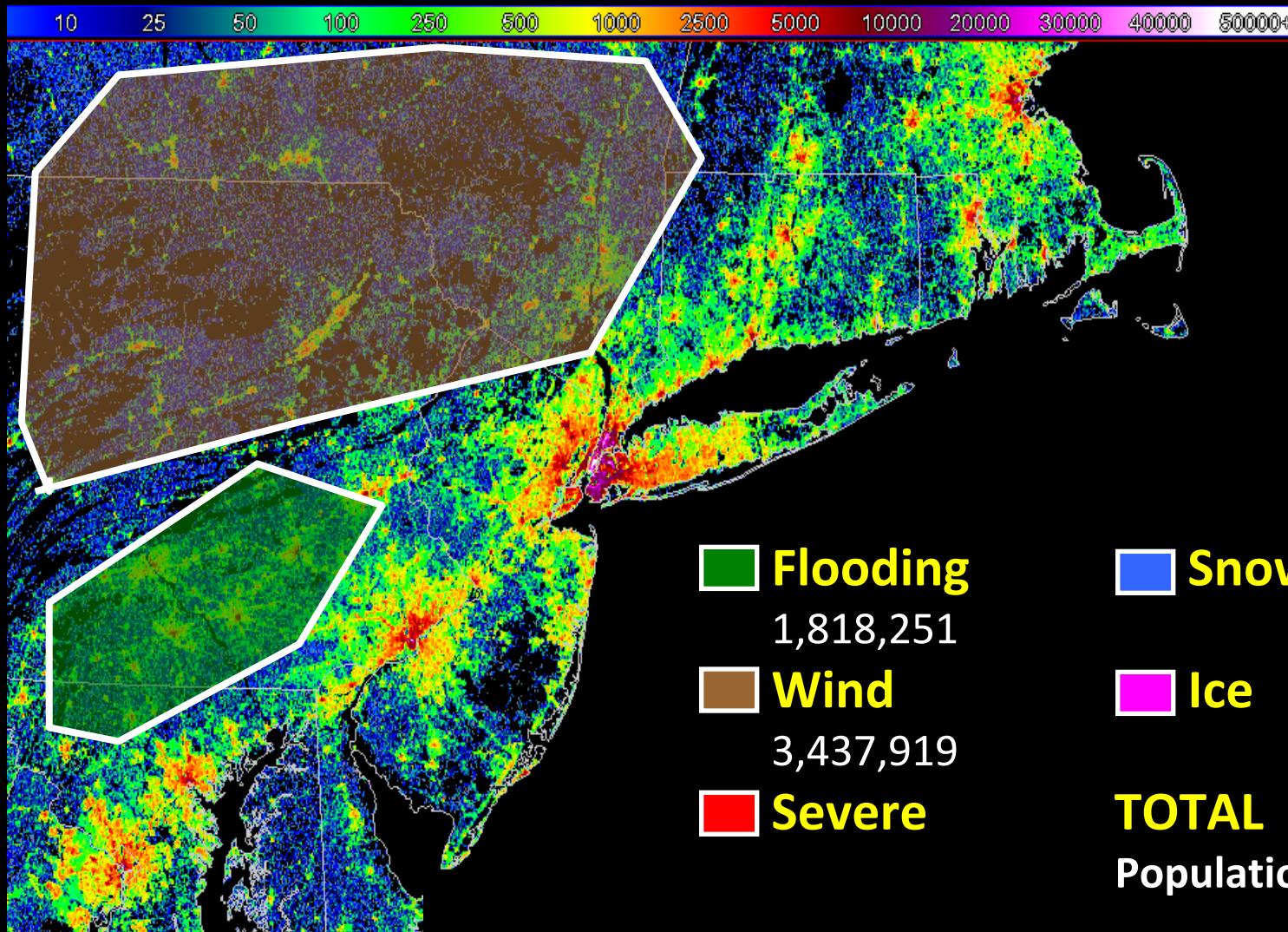
# High-Resolution Population Grid

## HAZARDS IMPACT MONITOR



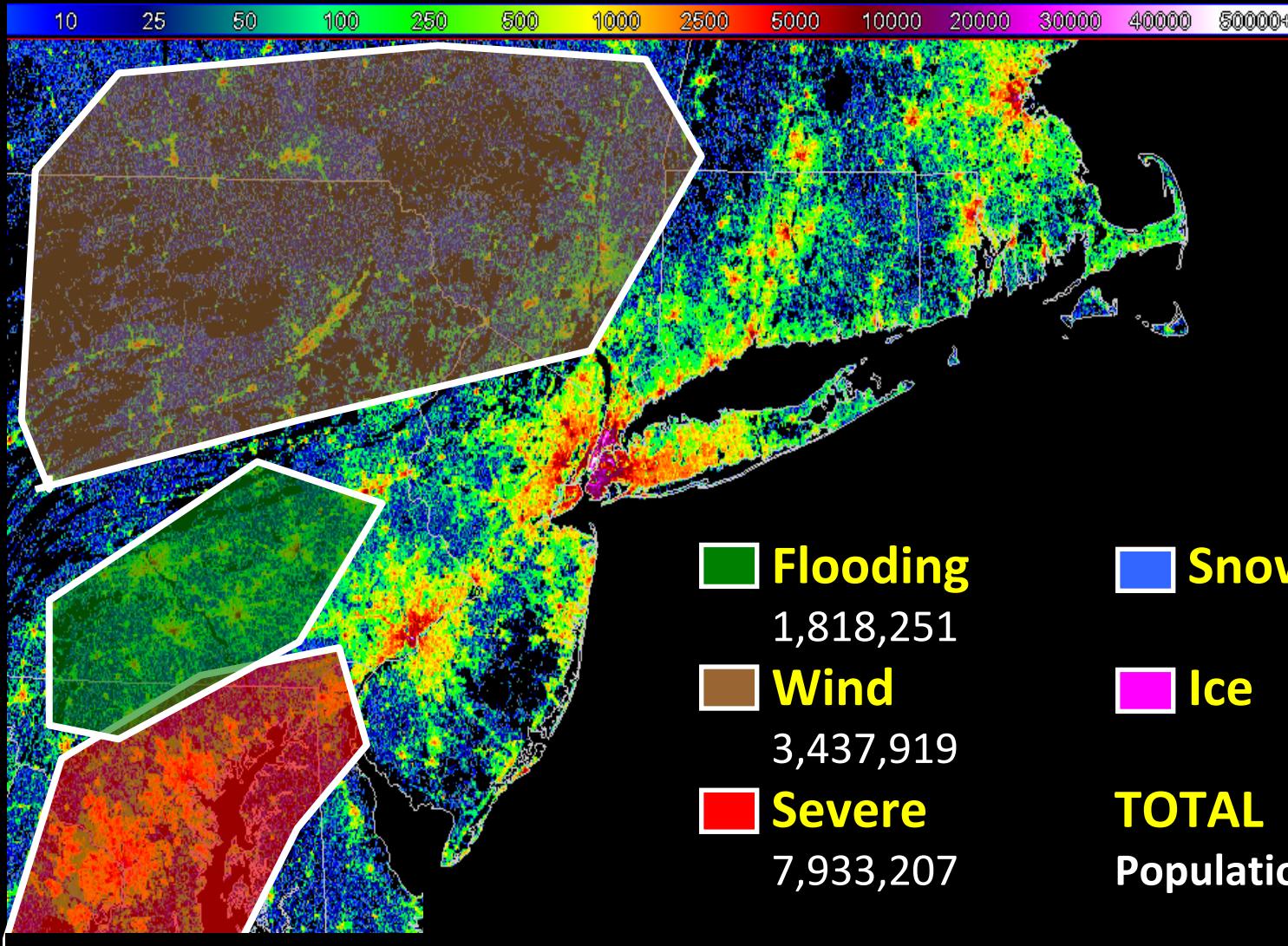
# High-Resolution Population Grid

## HAZARDS IMPACT MONITOR



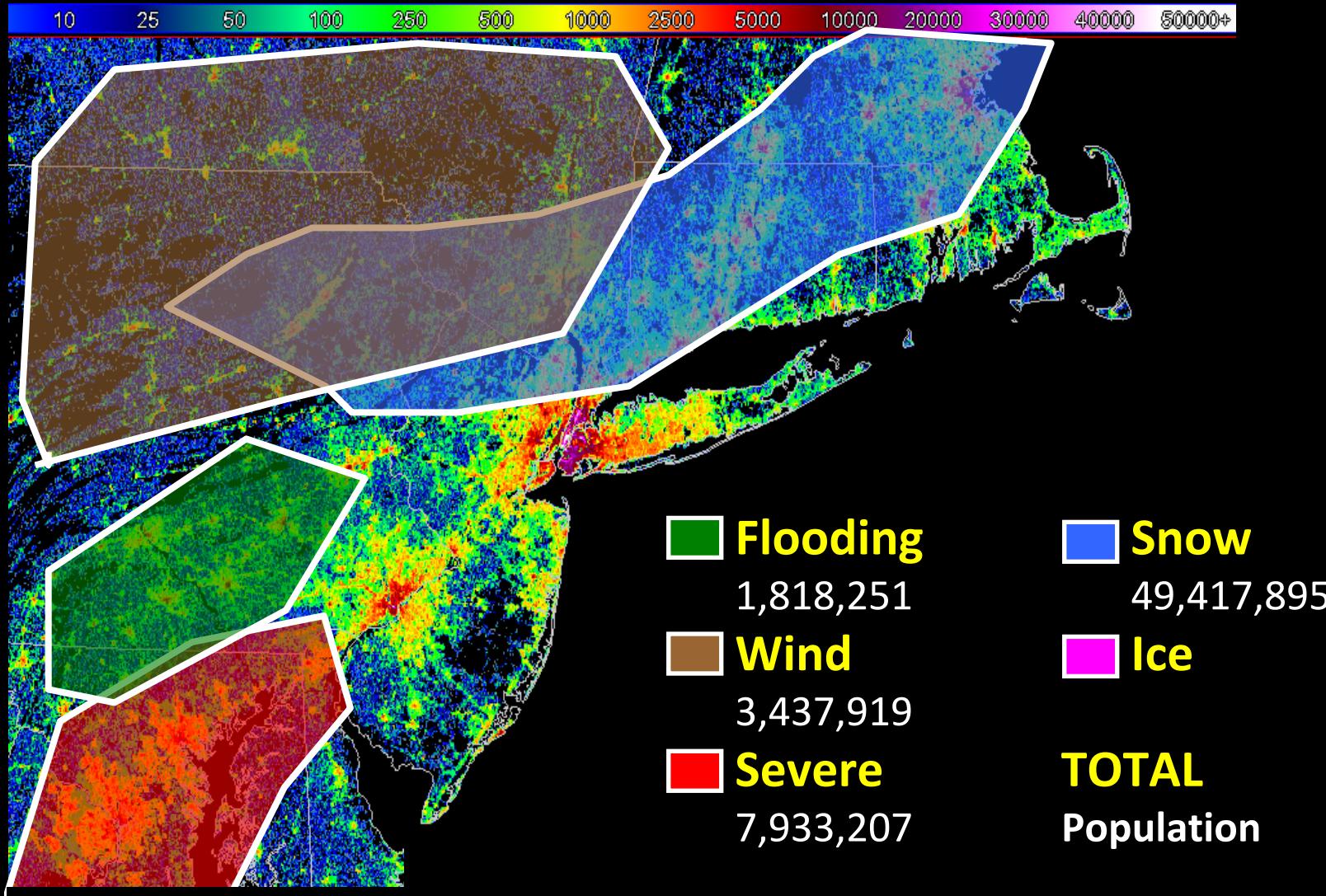
# High-Resolution Population Grid

## HAZARDS IMPACT MONITOR



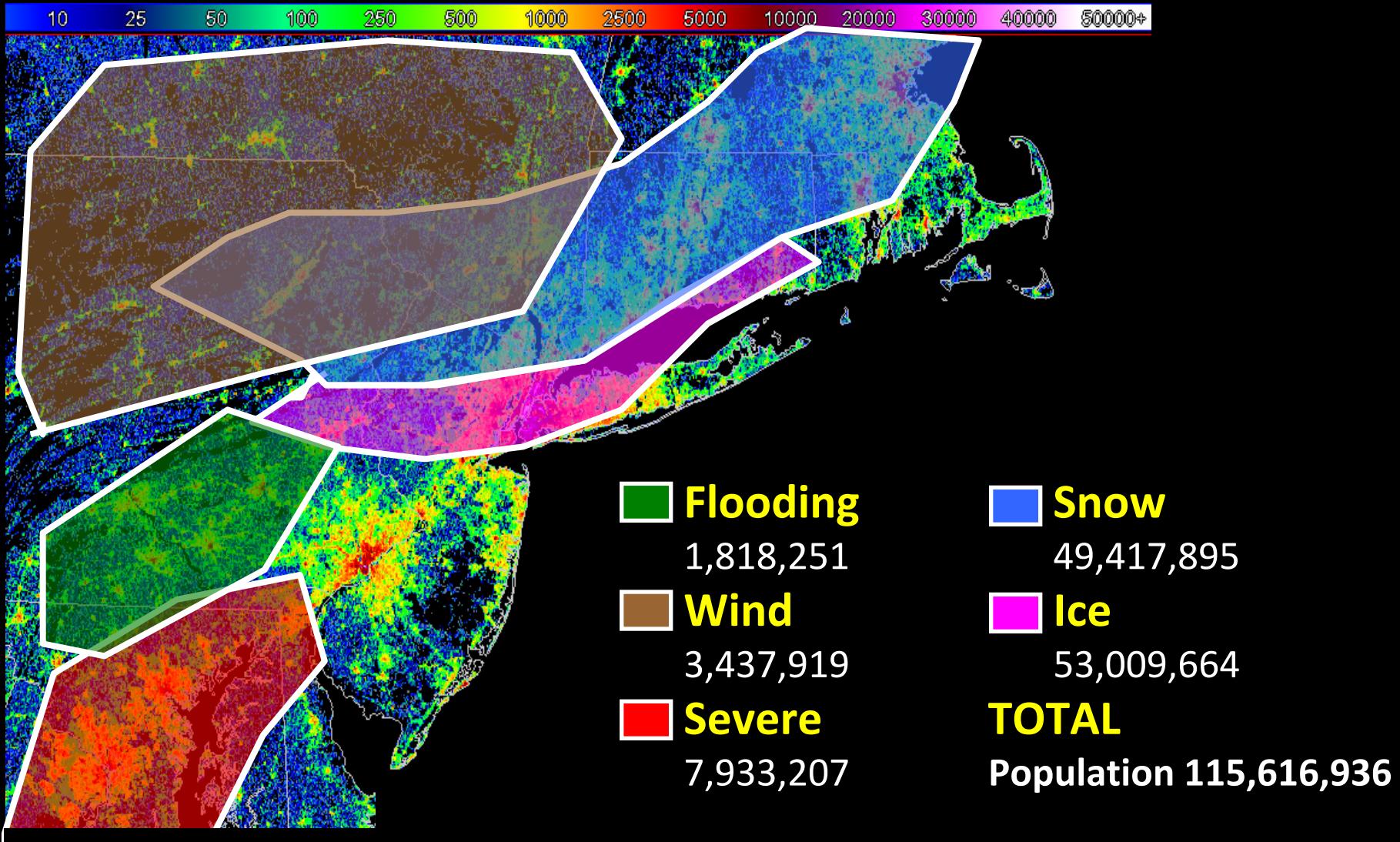
# High-Resolution Population Grid

## HAZARDS IMPACT MONITOR



# High-Resolution Population Grid

## HAZARDS IMPACT MONITOR



# Moving Forward

- **Developing operational computer code**
  - Considering web displays, dissemination plans, etc.
- **Exploring other areas**
  - Northeast snow impact scale (national?)
  - Flood/surge inundation impact
  - Economic impact/casualty models?



[Kevin.Scharfenberg@noaa.gov](mailto:Kevin.Scharfenberg@noaa.gov)