## Polygon Overlay: Summary of Results

- **Map of population distribution**
- **Map of a region affected by hurricane Sandy**

Where are the safe rescue shelters?

| Input: Given two map layers $A = \{a_1, a_2, \ldots, a_n\}$ and $B = \{b_1, b_2, \ldots, b_m\}$ where $a_i, b_i$ are polygons represented as $(x,y)$ coordinates of vertices and operator $op \in \{\text{Union, Intersect, Diff}\}$ | Output-Sensitive Algorithms:  
1) $O(\log n)$ time polygon clipping algorithm using plane sweep method using $O(n+k+k')$ processors  
2) $O(\log n)$ time algorithm using graph traversal method with $O(n+k)$ processors in PRAM model |
| MPI-GIS: 44X speedup processing 600K polygons in 1) USA Detailed Water Bodies and 2) USA Block Group Boundaries within 20 seconds on a 32-node (8 cores each) IBM iDataPlex cluster |
Hadoop Topology Suite

**Input Polygons**

**Emit (cell id, polygon)**

**Grid-based Shuffle & Exchange**

**R-tree Query**

**HDFS Storage**

**Three versions:**

1. DistributedCache based with Single Map phase
2. Uniform Grid with Map and Reduce phases
3. Chain of two Map and Reduce phases
4. Scalable, 20 fold relative speedup
Hybrid MPI/GPU Polygon Overlay

Developed CUDA kernels

1) Segment intersection filter and Polygon containment filter

2) Multi-threaded CPU implementation with 30-fold speedup on a 64-core AMD node

3) 10-fold speedup on a nVIDIA GeForce GTX 780 GPU paired with a 12-core Intel Xeon CPU