The Severe Weather Data Inventory (SWDI):

A Geospatial Database and Climatology of Severe Weather Data

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NOAA's National Climatic Data Center

Goals

- Easy access to data in NCDC Archive
- Inventory for Severe Weather Data
- Derive climatology products
- Historical context for events
- Geospatial Database solution
- Web Services – automated access

Data

Current Datasets:

- NEXRAD Level-III Storm Attributes
- Preliminary Local Storm Reports
- National Lightning Detection Network

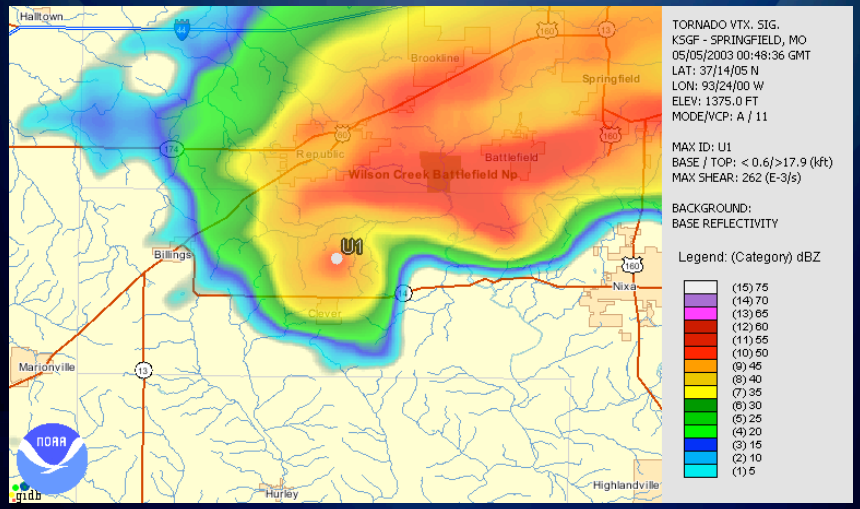
Coming soon:

- NWS Warnings, Storm Events Database, Hurricane Tracks, Drought Monitor

Framework for other datasets

Data

NEXRAD Level-III TVS Product (w/ Reflectivity)



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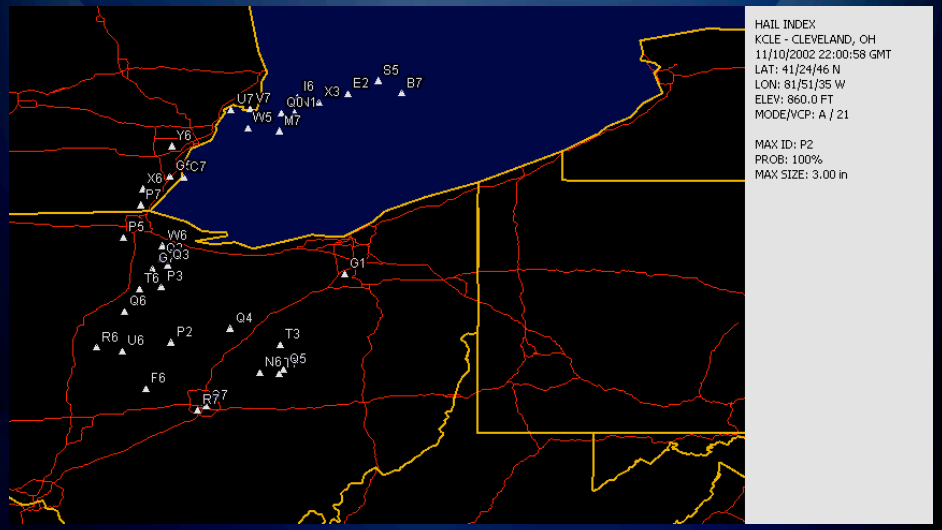
Data

NEXRAD Level-III Hail Product



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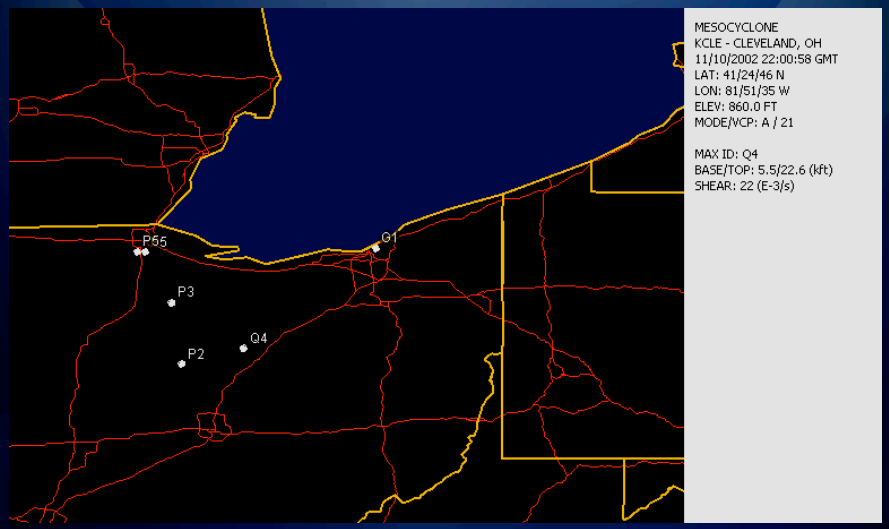
Data

NEXRAD Level-III Mesocyclone Product



MESOCYCLONE
KCLE - CLEVELAND, OH
11/10/2002 22:00:58 GMT
LAT: 41/24/46 N
LON: 81/51/35 W
ELEV: 860.0 FT
MODE/VCP: A / 21

MAX ID: Q4
BASE/TOP: 5.5/22.6 (kft)
SHEAR: 22 (E-3/s)

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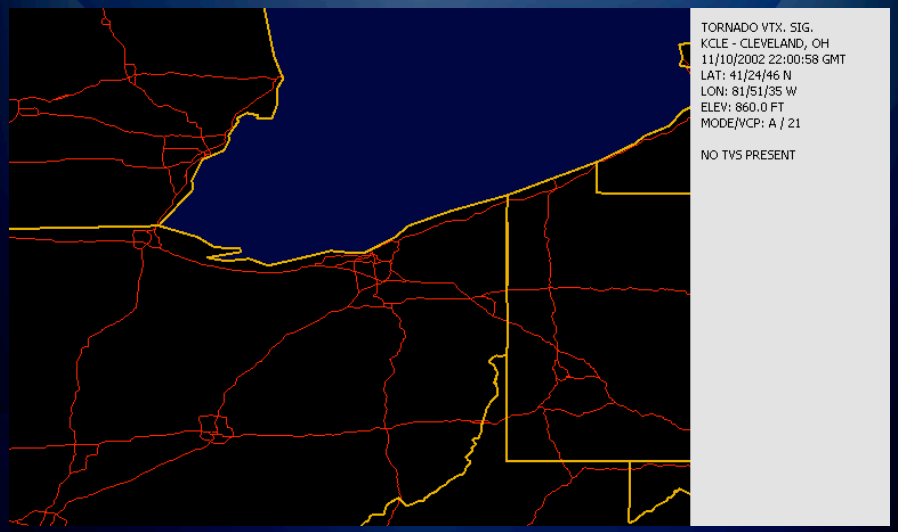
Data

NEXRAD Level-III Tornado Product



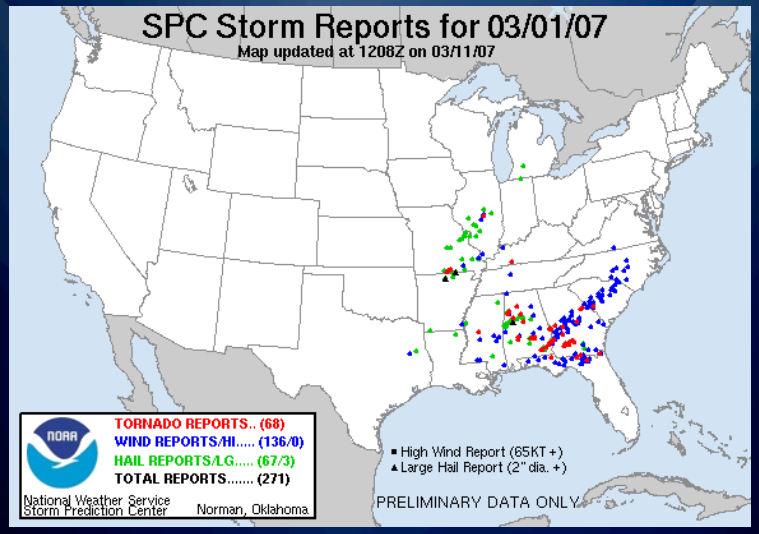
Data

Preliminary Local Storm Reports

- Preliminary reports from Storm Spotters, Emergency Mgmt., etc…
- Tornado, Hail, Flash Flood, Wind, etc…
- Transmitted in real-time – nightly load into SWDI

Data

Preliminary Local Storm Reports



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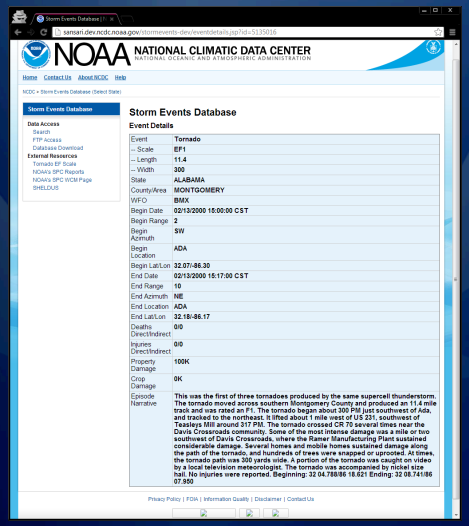
Data

NCDC Storm Events Database

- Verified text reports from NWS and Storm Prediction Center.
- Data from 1950 – Present
- Tornado, Hail, Lightning, Wind, etc…
- Fatalities, Injuries, Crop/Property Damage
- Loaded into SWDI ~3 months after end of each month

Data

NCDC Storm Events Database



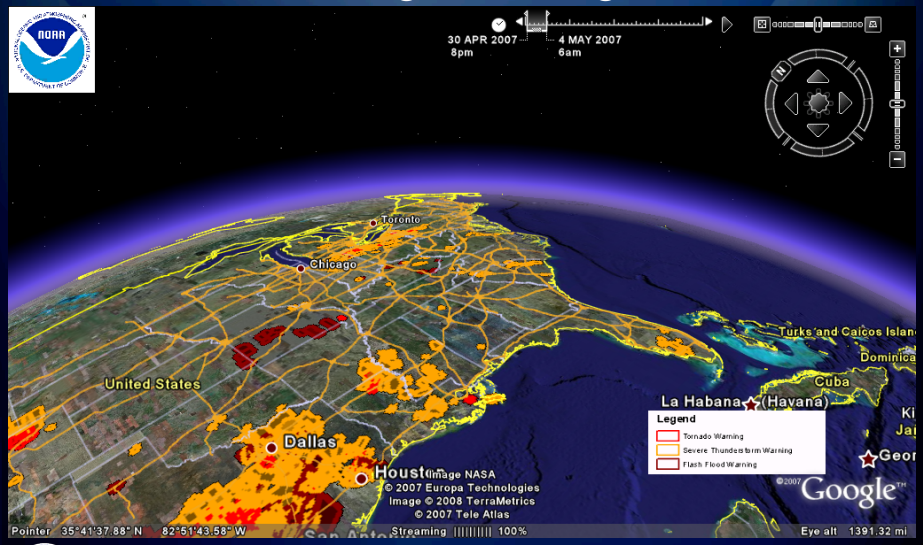
Data

NWS Warnings (polygon and county-based)

- Severe Thunderstorm
- Tornado
- Flash Flood
- Marine

Data

NWS Warnings in Google Earth



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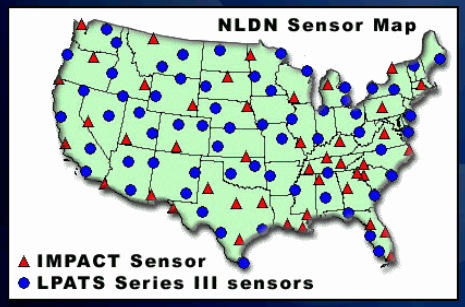
Data

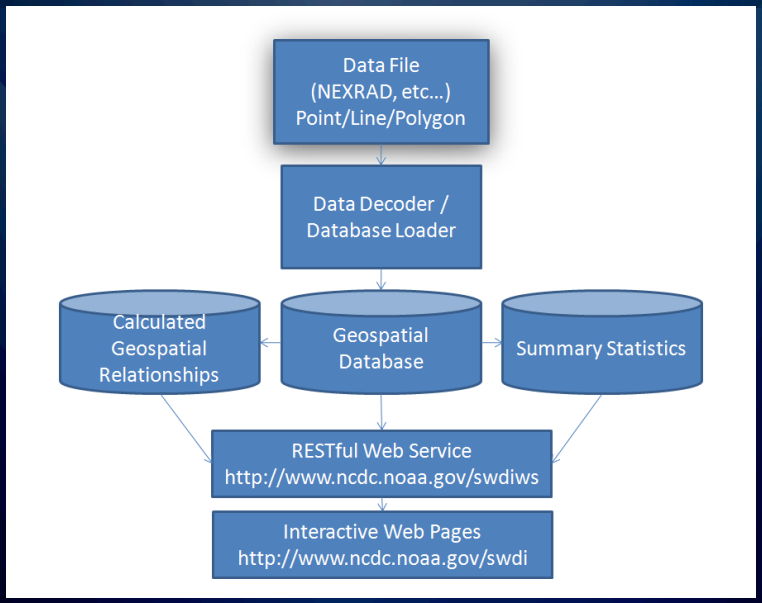
Vaisala's National Lightning Detection Network (NLDN)

- 130 Sensors Nationwide, 1987 – Present
- Raw data: .gov/.mil ONLY



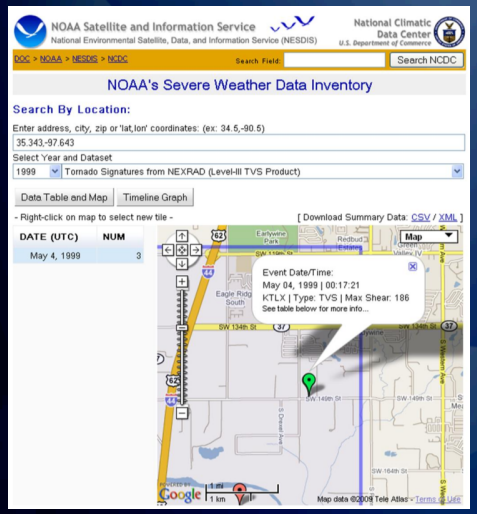
Images courtesy of NASA (http://thunder.msfc.nasa.gov/primer/primer3.html)

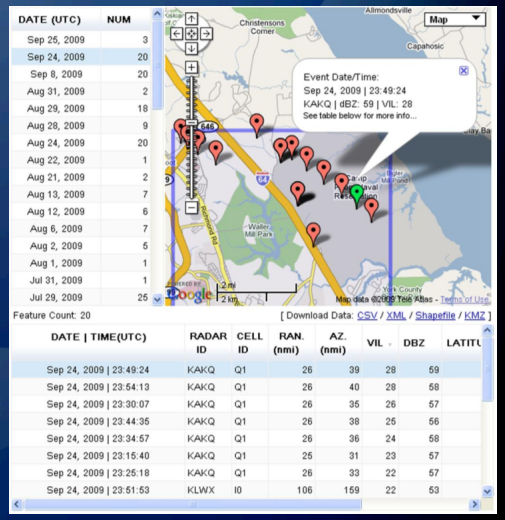
Process


Data File
(NEXRAD, etc…)
Point/Line/Polygon
Data Decoder /
Database Loader
Calculated
Geospatial
Relationships
Geospatial
Database
Summary Statistics
RESTful Web Service
http://www.ncdc.noaa.gov/swdiws
Interactive Web Pages
http://www.ncdc.noaa.gov/swdi

Access

Web Pages (http://www.ncdc.noaa.gov/swdi)

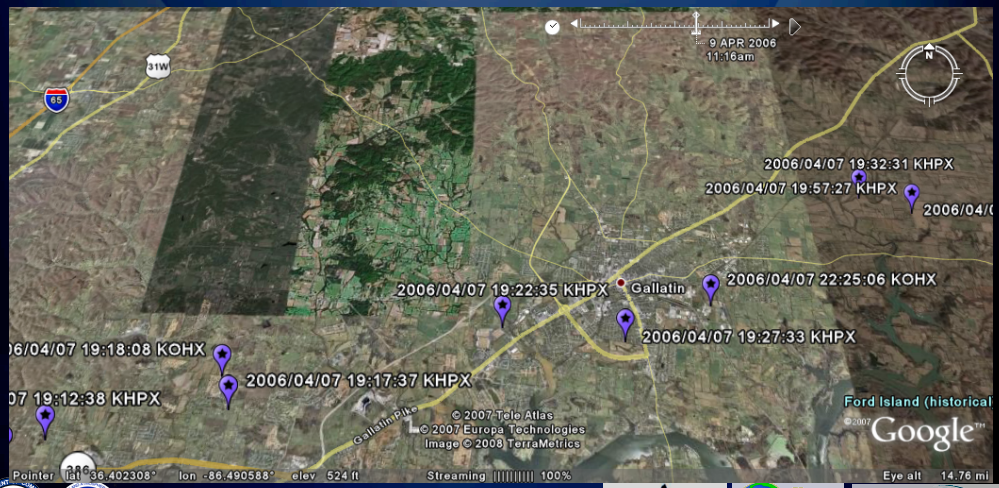




Access

Data Download (Shapefile, KMZ, Text File)

- NEXRAD Tornado Vortex Signatures in Google Earth



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University of North Carolina Asheville

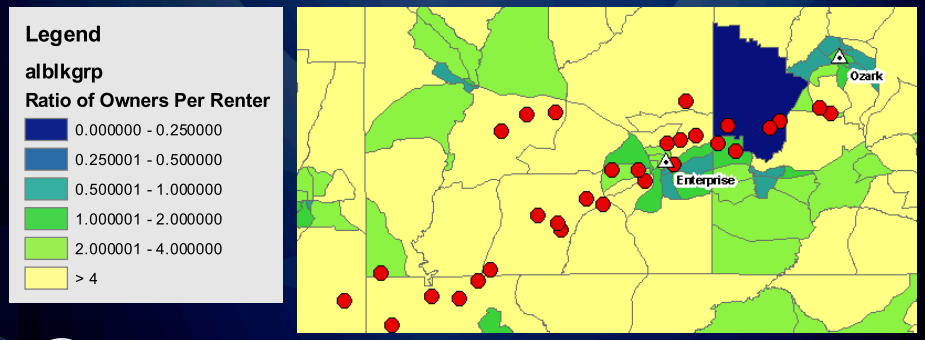
National Environmental Modeling & Analysis Center

Renci Renaissance Computing Institute

Access

Data Download (Shapefile, KMZ, CSV, XML)

- Example GIS analysis with NEXRAD TVS and census data:



Access

FTP: CSV Text files of all SWDI Data

ftp://ftp.ncdc.noaa.gov/pub/data/swdi

REST Web Services

- Each URL defines a unique resource
- Easy programmatic access to data
- Allows integration into custom applications
- System and language independent

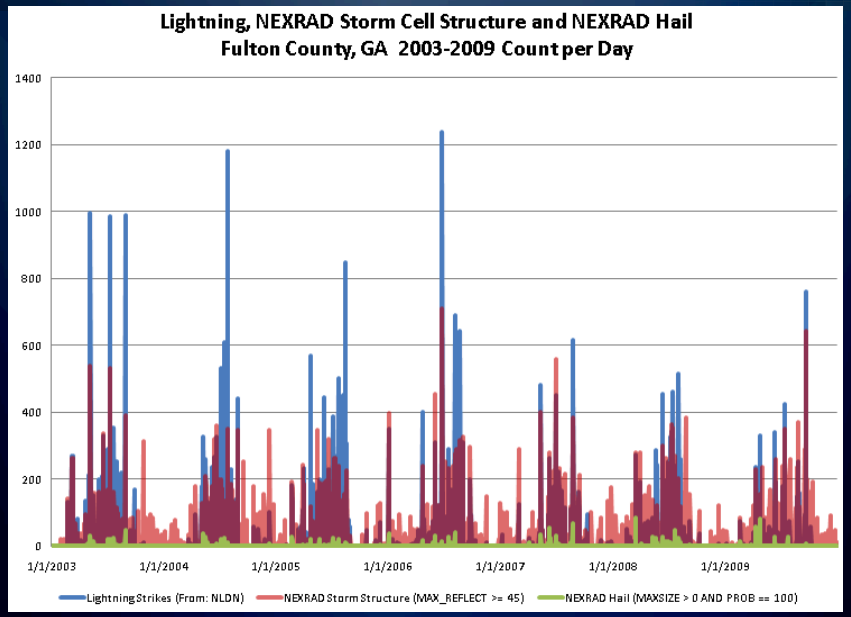
Reports

- Counts by Day per county.
- BETA version for Lightning, NEXRAD Storm Cells, NEXRAD Hail, TVS:
  - ftp://ftp.ncdc.noaa.gov/pub/data/swdi/reports

2003-2009 Fulton County, GA Top 5 Daily Totals

day (UTC)	Lightning Strikes (From: NLDN)	NEXRAD Storm Structure (MAX_REFLECT >= 45)	NEXRAD Hail (MAXSIZE > 0 AND PROB = 100)
6/25/2006	1238	710	2
7/26/2004	1182	352	10
5/6/2003	995	540	30
8/28/2003	989	390	48
7/10/2003	987	534	21

Reports


Lightning, NEXRAD Storm Cell Structure and NEXRAD Hail
Fulton County, GA 2003-2009 Count per Day
1400
1200
1000
800
600
400
200
0
1/1/2003
1/1/2004
1/1/2005
1/1/2006
1/1/2007
1/1/2008
1/1/2009
Lightning Strikes (From: NLDN)
NEXRAD Storm Structure (MAX_REFLECT >= 45)
NEXRAD Hail (MAXSIZE > 0 AND PROB == 100)

Analysis

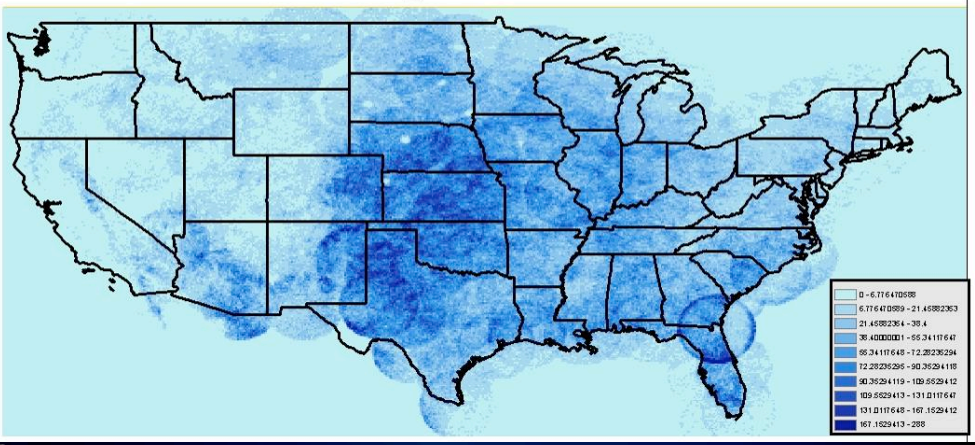
- Comparison between datasets
  - Possible Bias Detection, QC, etc…

"Select all TVS that are NOT within 10 miles and 15 minutes of a Severe Thunderstorm or Tornado Warning"

"Select all Thunderstorm Warnings that do not contain a Local Storm Report"

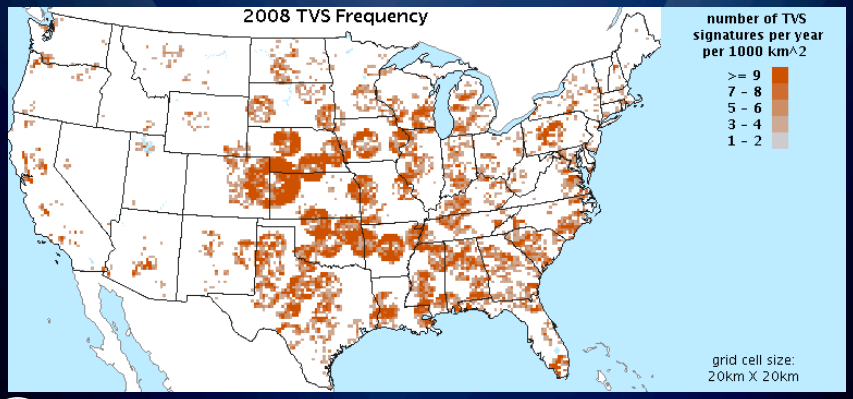
Analysis

NEXRAD Level-III Hail Signatures (2000-2007 - 47 Million records)
Estimated Probability = 100%
Count of Unique Events within 15 minute period
1/10 Degree Resolution Grid



Data Quality

- Climatology grids produced for each product.
- Artifacts, bias and other issues apparent.



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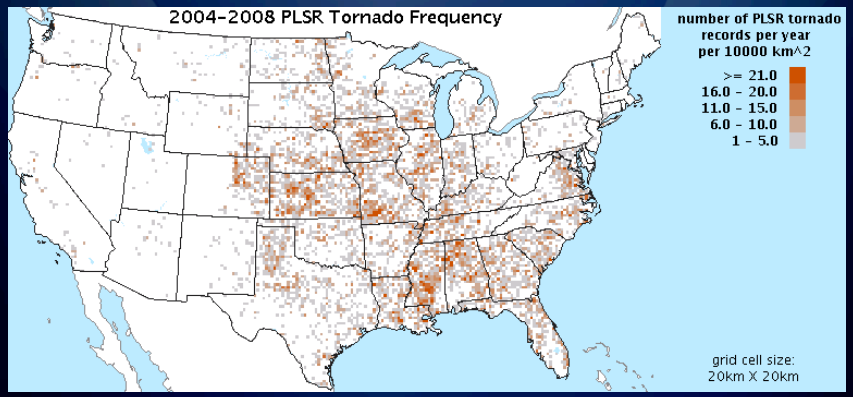

Conclusion

The Severe Weather Data Inventory:

- Allows easier access to the NCDC Archive
- Joint project with NEMAC, UNCA, RENCI
- Modular GIS spatial database approach
- Datasets remain independent
- Multiple user access methods
- Improve disaster response, recovery and mitigation
- Many possibilities of application
- Not real-time at NCDC – updated nightly

Questions for You

- What additional datasets would be most useful?
  - Index of model and satellite data?
  - Inclusion of extremes detected at stations?

- Advice on conveying caveats of data to decision makers?

Contact

Thank you! Questions?

SWDI Website: http://www.ncdc.noaa.gov/swdi

Contact:

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University of North Carolina
ASHEVILLE
National Environmental Modeling & Analysis Center
Renci
Renaissance Computing Institute
Catalyst for Innovation

Extra Slides

Analysis

- Disaster Mitigation

- Example:

Compare 1 Hour of NLDN to Population Grid

Data:

NLDN 08/02/2005 20:00 – 21:00 UTC

Gridded Population of the World - SEDAC (Socioeconomic Data and Applications Center at Columbia University)

http://sedac.ciesin.columbia.edu/gpw

Analysis

- Example:

Compare 1 Hour of NLDN to Population Grid

Process:

1. Download 2000 Population Grid at ~4 km resolution.
2. Convert cell centroids to points
3. Subset data for Florida
4. Spatial Join to closest NLDN data
5. Examine matching population grid cells

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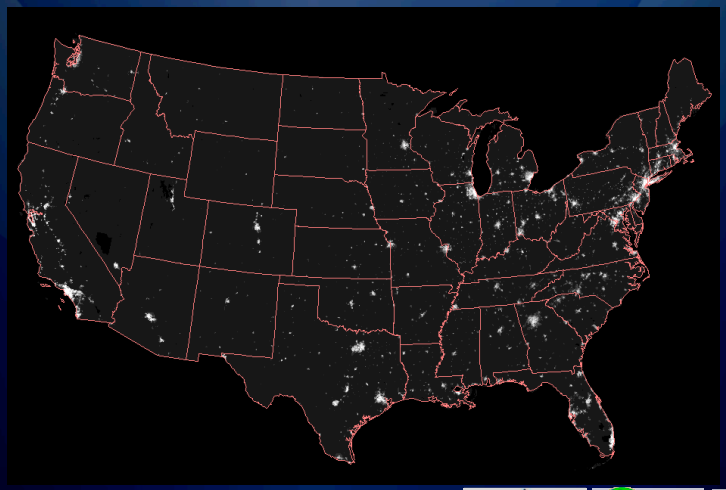
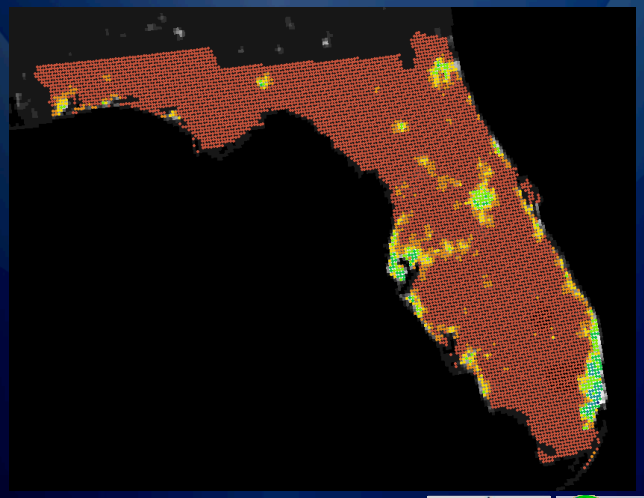
Example Analysis

- Process: Download 2000 Population Grid (~12 km resolution).



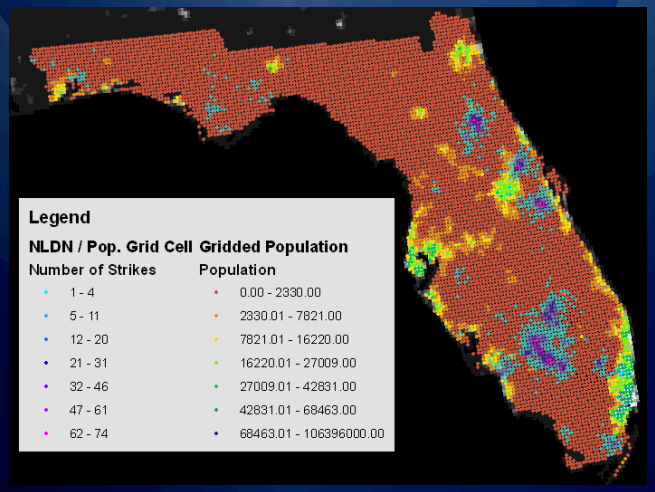
Example Analysis

- Process: Convert cell centroids to points, subset for Florida.



Example Analysis

- Process: Spatially join to NLDN data based on distance.



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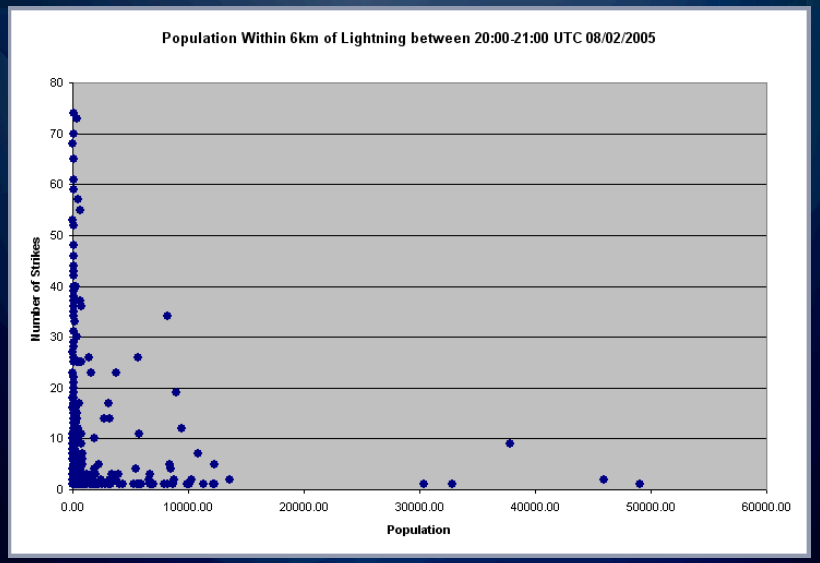
Example Analysis



Total Population Affected = 696,179 --- 5 Strikes or More = 166,346

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