

The Severe Weather Data Inventory (SWDI):

A Geospatial Database and Climatology
of Severe Weather Data

Steve Ansari, Stephen Del Greco (NOAA / NCDC)
Mark Phillips (UNC-Asheville / NEMAC)



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



2

NOAA's National Climatic Data Center



Data

Current Datasets:

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

Coming soon:

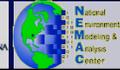
- NWS Warnings, Storm Events Database, Hurricane Tracks, Drought Monitor

Framework for other datasets



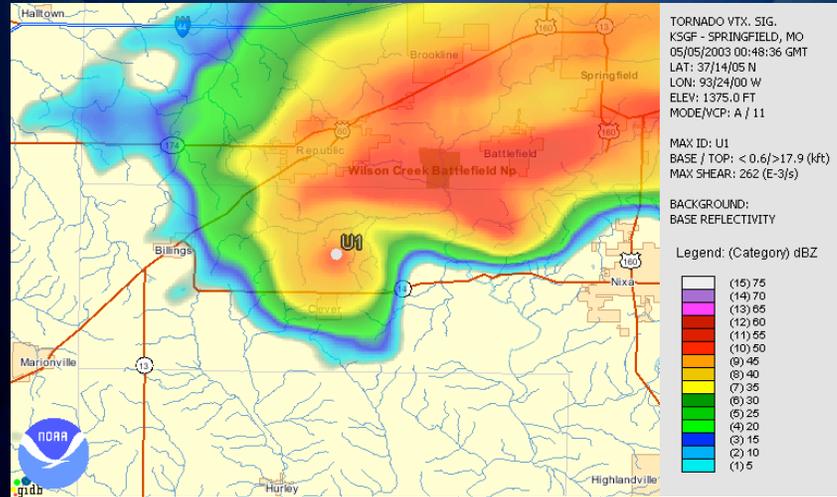
3

NOAA's National Climatic Data Center



Data

NEXRAD Level-III TVS Product (w/ Reflectivity)

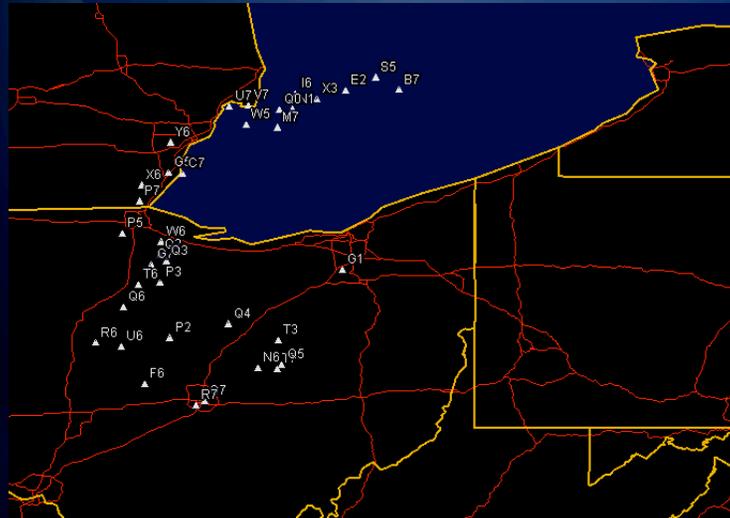


4 NOAA's National Climatic Data Center



Data

NEXRAD Level-III Hail Product



HAIL INDEX
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: P2
PROB: 100%
MAX SIZE: 3.00 in

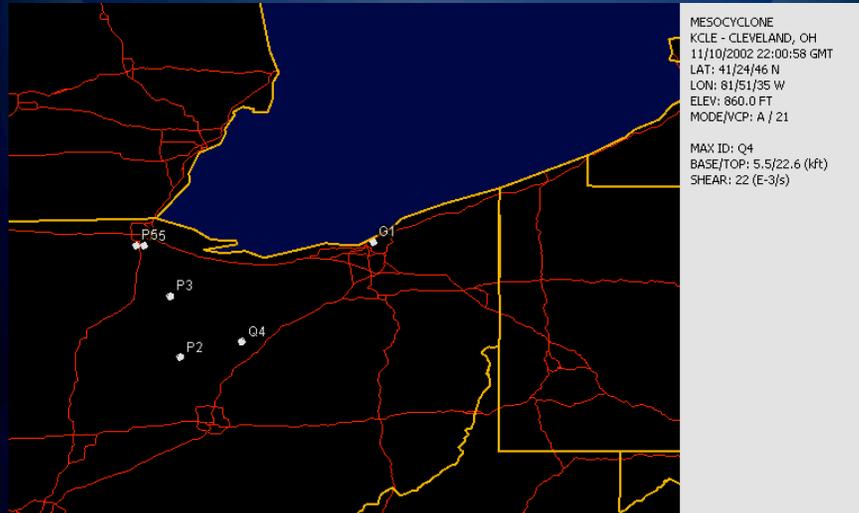


5 NOAA's National Climatic Data Center



Data

NEXRAD Level-III Mesocyclone Product



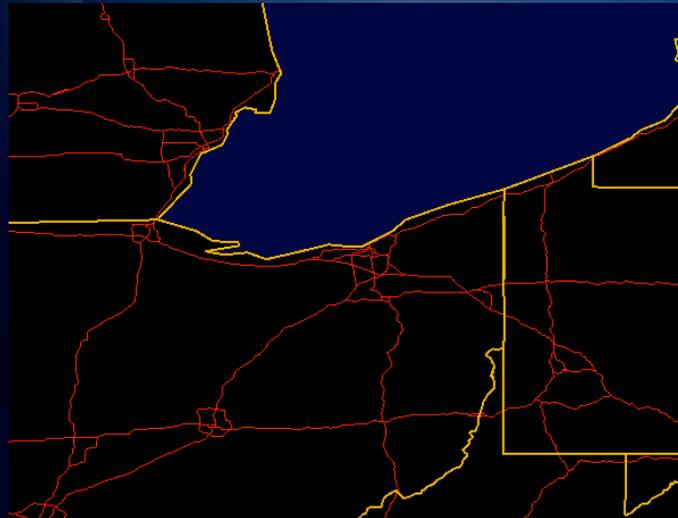
6

NOAA's National Climatic Data Center



Data

NEXRAD Level-III Tornado Product



TORNADO VTX, SIG.
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

NO TVS PRESENT



7 NOAA's National Climatic Data Center



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



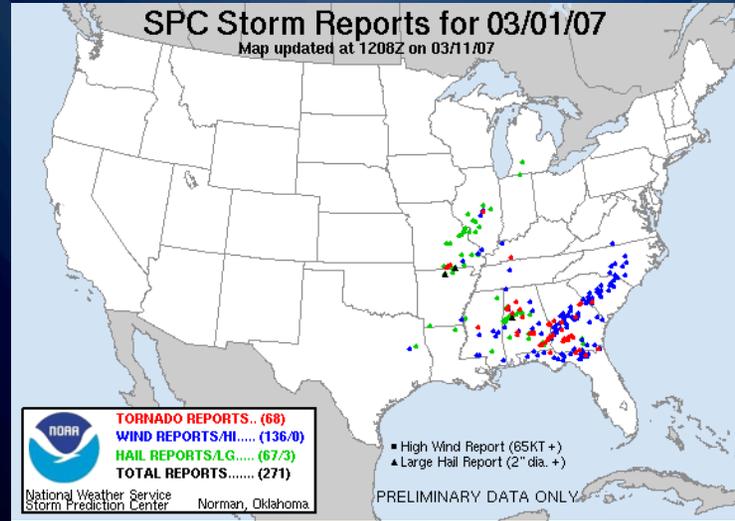
8

NOAA's National Climatic Data Center



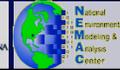
Data

Preliminary Local Storm Reports



9

NOAA's National Climatic Data Center



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



10

NOAA's National Climatic Data Center



Data

NCDC Storm Events Database

The screenshot displays the NOAA National Climatic Data Center website interface for the Storm Events Database. The page title is "Storm Events Database" and the event details are as follows:

Event	Tornado
Scale	EF1
Length	11.4
Width	300
State	ALABAMA
County/Area	MONTGOMERY
WFO	BMX
Begin Date	02/19/2000 19:00:00 CST
Begin Range	2
Begin Azimuth	SW
Begin Location	ADA
Begin Lat/Lon	32.07-86.30
End Date	02/19/2000 16:17:00 CST
End Range	16
End Azimuth	NE
End Location	ADA
End Lat/Lon	32.18-86.17
Deaths	00
Direct/Indirect	
Injuries	00
Property	100K
Damage	
Crop	0K
Episode	
Narrative	

This was the first of three tornadoes produced by the same supercell thunderstorm. The tornado moved across southern Montgomery County and produced an 11.4 mile track and was rated an EF1. The tornado began about 300 feet southwest of Ada and tracked to the northeast. It traveled about 11 miles east of US 291, southwest of Teasley Mill around 3:17 PM. The tornado crossed CR 70 several times near the Davis Crossroads community. Some of the most intense damage was a mile or two southwest of Davis Crossroads, where the Ramer Manufacturing Plant sustained considerable damage. Several homes and mobile homes sustained damage along the path of the tornado, and hundreds of trees were snapped or uprooted. At times, the tornado path was 300 yards wide. A portion of the tornado was caught on video by a local television meteorologist. The tornado was accompanied by heavy rain. No injuries were reported. Beginning: 02 04 78856 16.021 Ending: 02 08 74186 07.800



11

NOAA's National Climatic Data Center



Data

NWS Warnings (polygon and county-based)

- Severe Thunderstorm
- Tornado
- Flash Flood
- Marine



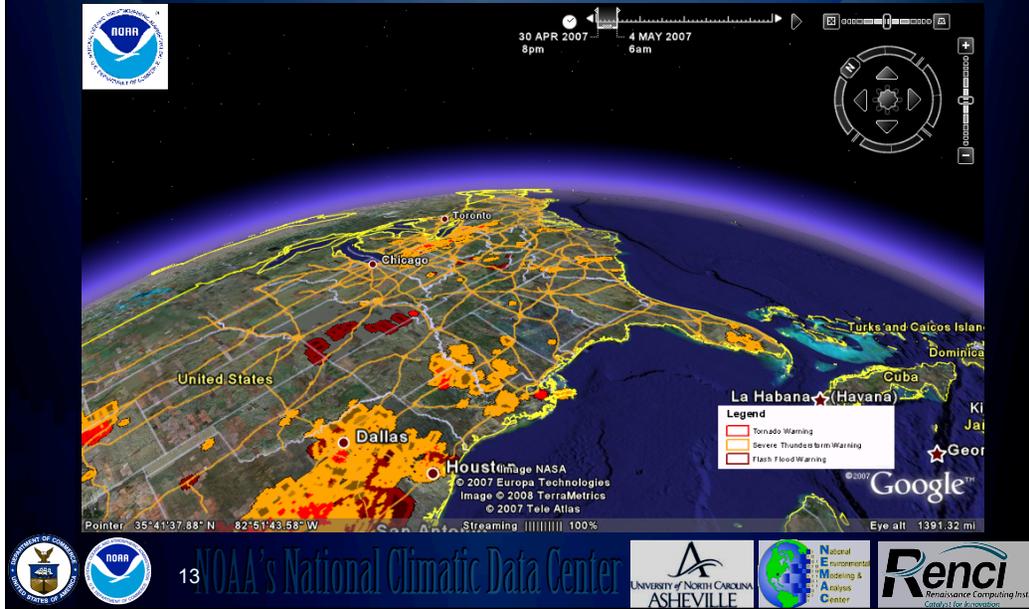
12

NOAA's National Climatic Data Center



Data

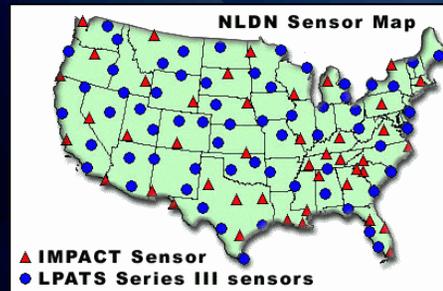
NWS Warnings in Google Earth



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>)

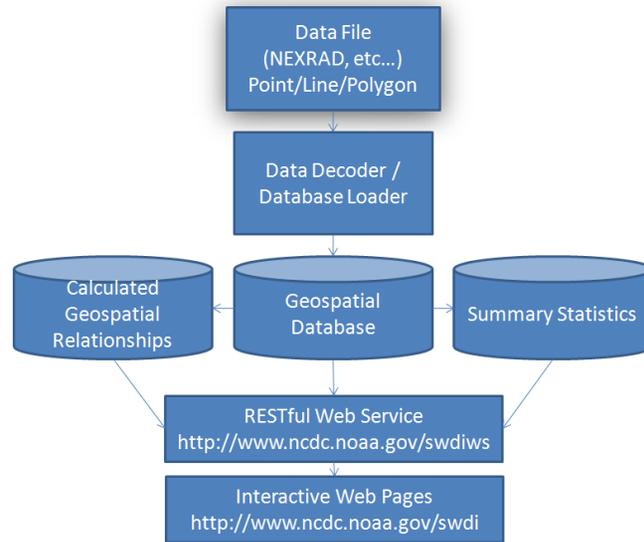


14

NOAA's National Climatic Data Center



Process



15

NOAA's National Climatic Data Center



Access

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

DATE TIME(UTC)	RADAR ID	CELL ID	RAN (mm)	AZ (nmi)	VIL	DBZ	LATITUDE
Sep 24, 2009 23:49:24	KAKQ	Q1	26	39	28	59	
Sep 24, 2009 23:54:13	KAKQ	Q1	26	40	28	58	
Sep 24, 2009 23:30:07	KAKQ	Q1	26	35	26	57	
Sep 24, 2009 23:44:35	KAKQ	Q1	26	38	25	56	
Sep 24, 2009 23:34:57	KAKQ	Q1	26	36	24	58	
Sep 24, 2009 23:15:40	KAKQ	Q1	25	31	23	57	
Sep 24, 2009 23:25:18	KAKQ	Q1	26	33	22	57	
Sep 24, 2009 23:51:53	KLWX	I0	106	159	22	53	



16

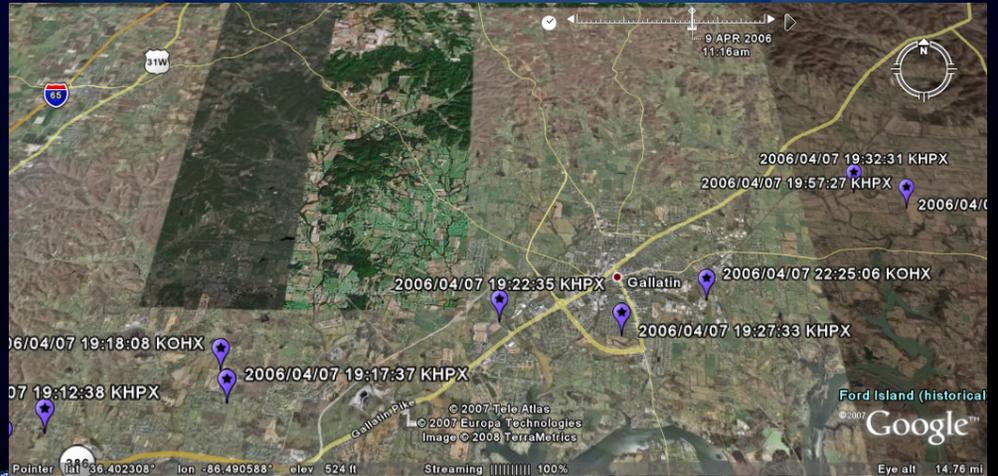
NOAA's National Climatic Data Center



Access

Data Download (Shapefile, KMZ, Text File)

- NEXRAD Tornado Vortex Signatures in Google Earth



17

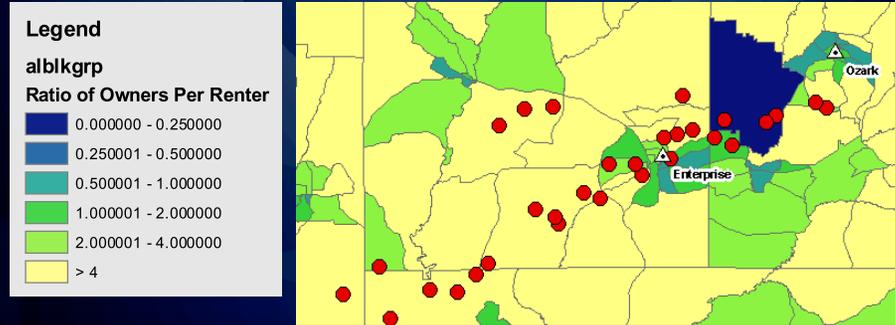
NOAA's National Climatic Data Center



Access

Data Download (Shapefile, KMZ, CSV, XML)

- Example GIS analysis with NEXRAD TVS and census data:



18

NOAA's National Climatic Data Center



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



19

NOAA's National Climatic Data Center



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



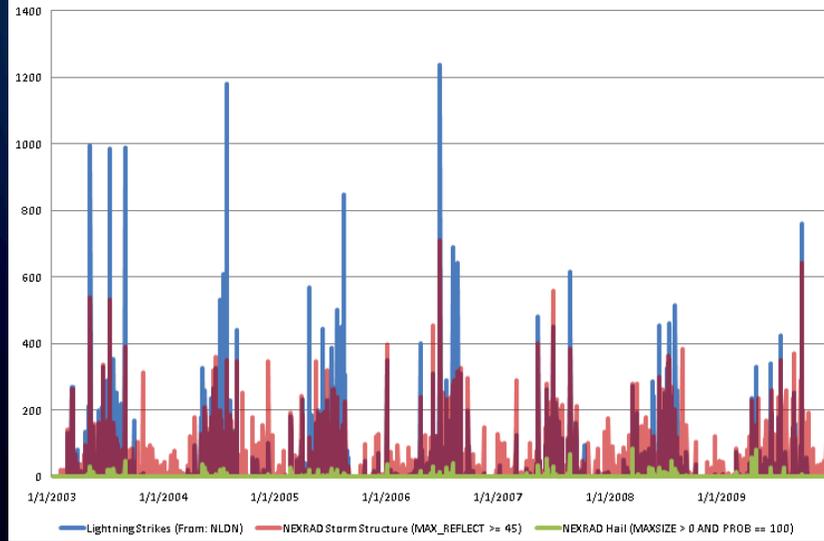
20

NOAA's National Climatic Data Center



Reports

Lightning, NEXRAD Storm Cell Structure and NEXRAD Hail
Fulton County, GA 2003-2009 Count per Day



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”



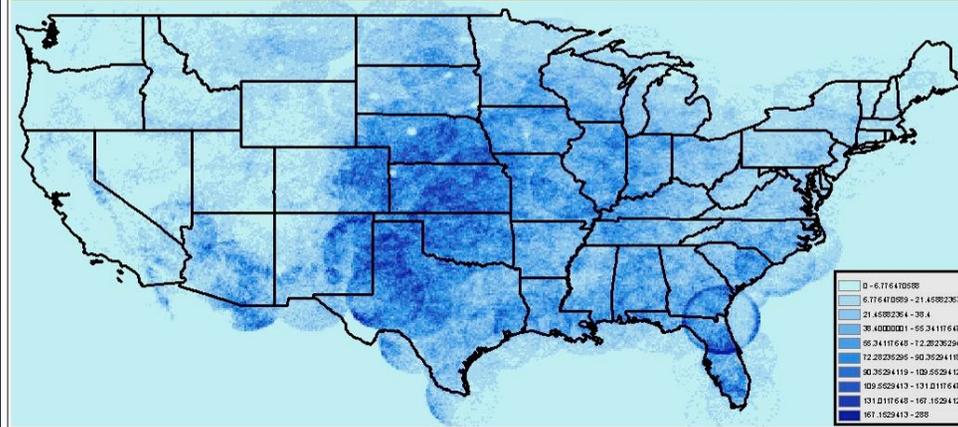
22

NOAA's National Climatic Data Center



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



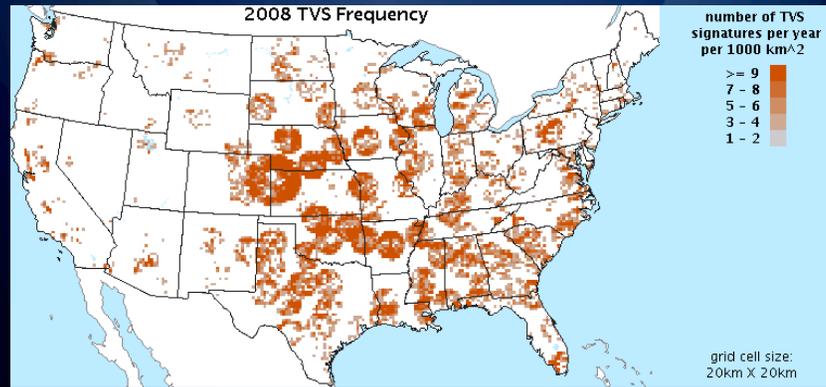
23

NOAA's National Climatic Data Center



Data Quality

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



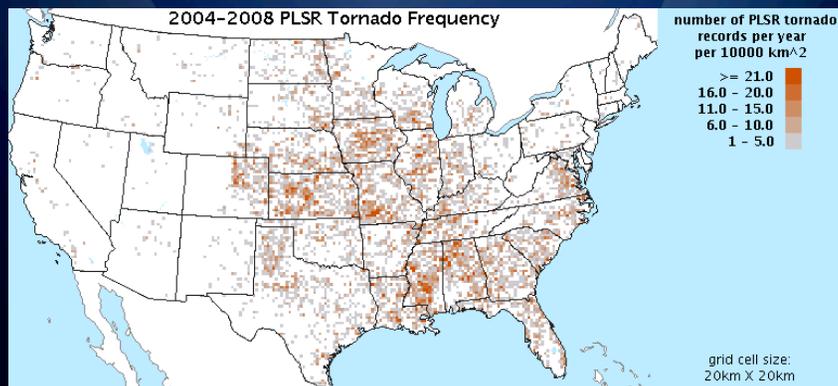
24

NOAA's National Climatic Data Center



Data Quality

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



25

NOAA's National Climatic Data Center



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



26

NOAA's National Climatic Data Center



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?



27

NOAA's National Climatic Data Center



Contact

Thank you! Questions?

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

Contact:

Steve.Ansari@noaa.gov

(828) 271-4611

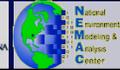
151 Patton Ave.

Asheville, NC 28801



28

NOAA's National Climatic Data Center





29

NOAA's National Climatic Data Center



Extra Slides



30

NOAA's National Climatic Data Center



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>



31

NOAA's National Climatic Data Center



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



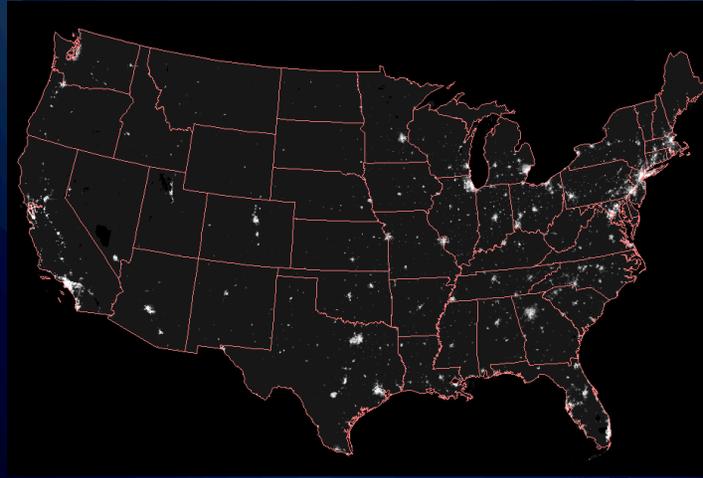
32

NOAA's National Climatic Data Center



Example Analysis

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



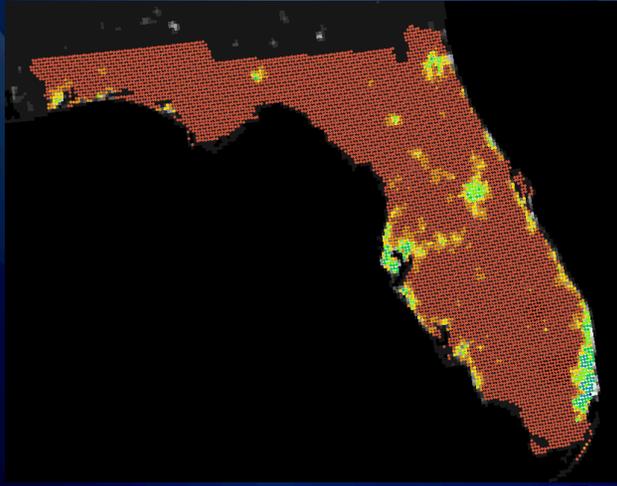
33

NOAA's National Climatic Data Center



Example Analysis

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



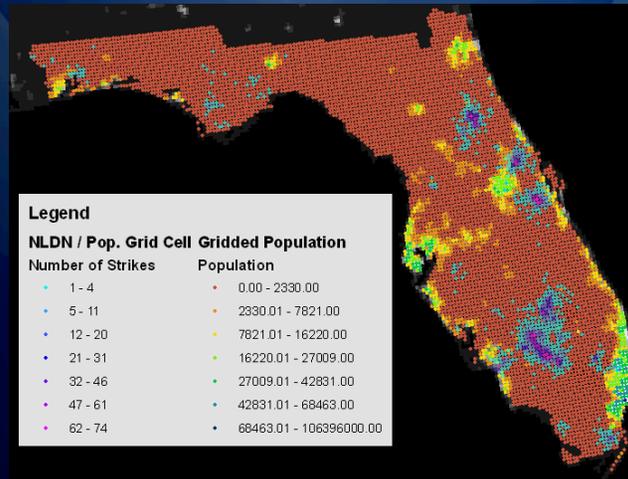
34

NOAA's National Climatic Data Center



Example Analysis

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

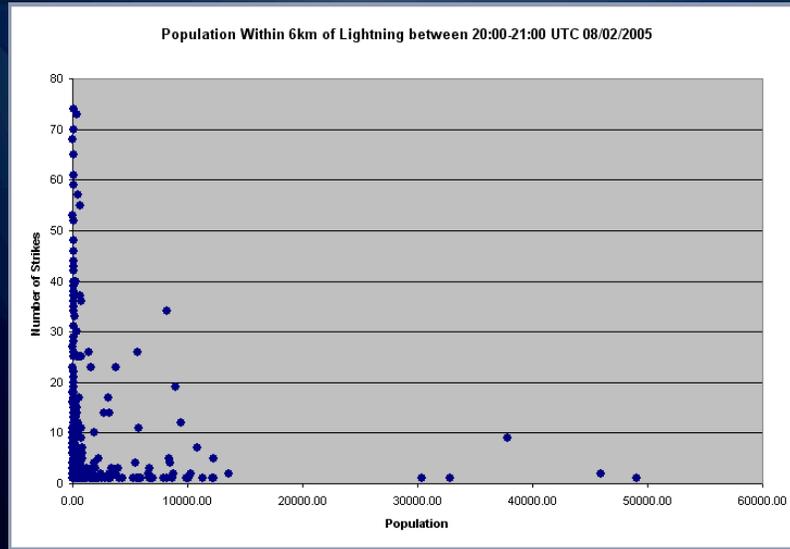


35

NOAA's National Climatic Data Center



Example Analysis



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



36

NOAA's National Climatic Data Center

