

# Storm Data at NCDC

## And other severe weather products and services

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UNCA - Severe Weather Workshop  
Asheville, NC April 17, 2010

# National Climatic Data Center

- Mission:**  
NCDC's mission is to manage the Nation's resource of global climatological *in-situ* and remotely sensed data and information to promote global environmental stewardship; to describe, monitor and assess the climate; and to support efforts to predict changes in the Earth's environment. This effort requires the acquisition, quality control, processing, summarization, dissemination, and preservation of a vast array of climatological data generated by the national and international meteorological services.

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# Storm Data

- History of the Data
- Severe weather data has been gathered since 1826 when observations were recorded in several texts. Some of these sources are listed below:
  - Meteorological Register 1826 – 1860
  - Results of Meteorological Observations 1843 – 1859
  - Report to the Chief Signal Officer 1870 – 1891
  - Monthly Weather Review 1872 – 1892
  - Reports to the Chief of the Weather Bureau 1893 – 1935
  - US Meteorological Yearbook 1935 – 1945
  - Climatological Daily National Summary 1950 – 1980
  - Storm Data 1959 – Current
    - F8 Printed format 1959 – 1992
    - WordPerfectV5.0 format 1993 – 1995
    - Paradox V7.0 format 1996 – 09/2006
    - Windows SQL Server 2003 10/2006 – Current

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# The Publication

Storm Data began with the January 1959 issue ...

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### NWS Form F8

STATE	PLACED	DATE	TIME	CHARACTER OF STORM	NO. OF PERSONS INJURED	ESTIMATED DAMAGE	NO. OF PERSONS KILLED	NO. OF PERSONS MISSING	NO. OF PERSONS HELD	NO. OF PERSONS RESCUED	NO. OF PERSONS SAVED	NO. OF PERSONS UNK.	NO. OF PERSONS UNK.	NO. OF PERSONS UNK.	NO. OF PERSONS UNK.	NO. OF PERSONS UNK.	NO. OF PERSONS UNK.	NO. OF PERSONS UNK.	NO. OF PERSONS UNK.
ARIZONA	PHOENIX	22	172000Z	Urban Flood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARIZONA	PHOENIX	22	172000Z	Urban Flood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ARIZONA	PHOENIX	22	172000Z	Urban Flood	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

### NWS Form F2

STATE	MONTH	YEAR	TYPE OF STORM	NUMBER	DEATHS	INJURIES	PROPERTY DAMAGE	CROPS
ARIZONA	JANUARY	1959	TORNADOES	0	0	0	0	0
ARIZONA	JANUARY	1959	HURRICANES & TROPICAL STORMS	0	0	0	0	0
ARIZONA	JANUARY	1959	ICE STORMS	0	0	0	0	0
ARIZONA	JANUARY	1959	FLASH FLOODS	1	0	0	0	0
ARIZONA	JANUARY	1959	THUNDERSTORM WINDS	0	0	0	0	0
ARIZONA	JANUARY	1959	HIGH WINDS	0	0	0	0	0
ARIZONA	JANUARY	1959	LIGHTNING	0	0	0	0	0
ARIZONA	JANUARY	1959	ALL OTHERS	0	0	0	0	0

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# Outstanding Storms of the Month - July 1981

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## The Current Storm Events Database

- Began as a project to be able to compare radar images with aftermath
- Once online, became one of the most popular websites at NCDC
- Written in cgi scripts using Visual FoxPro 3.0 in 1996
  - Started with Storm Data in Paradox format, exported to FoxPro. (1996-2006)
  - Added the 1993-1995 data from the WordPerfect disks received at NCDC
  - Added the Tornado Archive DSI-9617 (1950-1992)
  - Added SPC Thunderstorm Wind and Hail data (1955-1992)
  - Added NWS Storm Data in Windows SQL Server 2003 (2006-Current)
- Also use the database to produce the Storm Data Archive DSI-3910, the Lightning Archive DSI-9417 and the Tornado Archive DSI-9617
- The National Weather Service Performance Branch developed a new, web-based version of Storm Data using Windows SQL Server 2003 (10/2006)

## Web Access

- Very heavily used
- A few problems
  - Limited functionality
  - Latitude/Longitude
  - Limited search
  - Missing data
  - County based events vs. Zone based events
  - Forecast zone changes
  - Damage amounts
  - Event types

**Storm Events**

Select State

Select Desired State or "All"

State: [All] [v]

Submit

Search the NCDC Storm Event database to find various types of storms recorded in your county or any other selection criteria as desired. The database currently contains:

The Storm Events Database contains data from the following sources:

All Weather Events from 1993 - 1995, as entered into Storm Data. (Except 693 - 703, which is missing) (NO Latitude-Longitude)

All Weather Events from 1996 - Current, as entered into Storm Data. (Including Latitude-Longitude)

Plus additional data from the Storm Prediction Center; including:

Tornadoes: 1908-1992  
Thunderstorms: Wind: 1955-1992  
Hail: 1955-1992

The Storm Events database does not search by National Weather Service Forecast Zone number. However, if the name of the county is contained in the zone name, then you will get results for greater of large scale events by county name. This is not the case for states with very large forecast zones, such as Alaska, Arizona, California, Colorado, Idaho, Montana, New Mexico, Nevada, Utah, Washington and Wyoming. For large scale events in those states, such as flooding, winter storms, hurricanes and extreme temperatures, it is easier to search by state and/or data instead of by county name.

List of NWS Forecast Zones by State

List of NWS Forecast Zone Maps

Please read the Storm Events Database FAQ page for more information. The State and County FTP numbers associated with the maps are located here. State and County: Click the link for more information. Please do not contact NCDC with requests for information about specific weather events. All of the data is received from the National Weather Service and is made available as soon as possible. If you cannot locate a particular event 120 days after the end of the month of occurrence, contact Storm Hints.

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## The Future of Storm Events Database

- It's up to the users (feedback - input)
- Higher quality data
  - Verified reports
  - Multi-layer consistency checks
  - QC using radar, satellite, lightning products
  - Multi-point tornado tracks (or even polygons?)
- Higher resolution (both spatial and temporal)
  - Possible collaboration and data exchange with international communities
    - Canada, Mexico, others?

## U.S. Storm Events Database

Location

From Date: [Aug 22] [2007]

To Date: [Aug 22] [2007]

State: [Alabama]

Submit Query

County Based Event Types

County: [All]

Tornado: EF: [0] to EF: [0]

Tstm Winds: MPH: [0] to MPH: [0]

Hail: In: [0] to In: [0]

Flash Floods

Funnel Clouds

Zone Based Event Types

Zone: [All]

Hurricanes and Tropical Storms

Temperature Extremes

Winter Weather

Drought

Snow & Ice

Wild Fires & Forest Fires

High Winds (non-convective)

Floods

Precipitation

Fog

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## The Future of Storm Events Database

- Can we improved data entry consistency?
  - Starts at the point of entry - the NWSFO...
- Can we improve the timeliness?
  - Possible ingest from NWS in near real-time
- Can we improved data dissemination?
  - GIS-based
  - Web Map services
  - Multiple data export formats

## Conclusion

- An increase in new technology will allow for a much more robust, user-friendly system
- Understand the importance of the need for recording high quality data.
- Consistency is the key
  - In-depth training
  - Damage estimation
- Multiple Product Generation requires consistency
  - Storm Data Publication
  - Storm Events Database
  - Storm Data Archive (DSIs 3910/9714/9617)
  - Storm Data Users - Database on CD-ROM
  - Property damage amounts *should* be used if at all possible

## 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)

## Goals

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

## Data

Current Datasets:

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

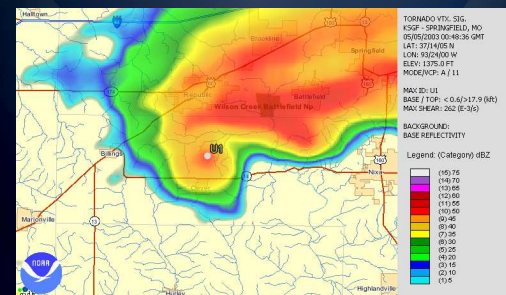
Coming soon:

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

Framework for other datasets

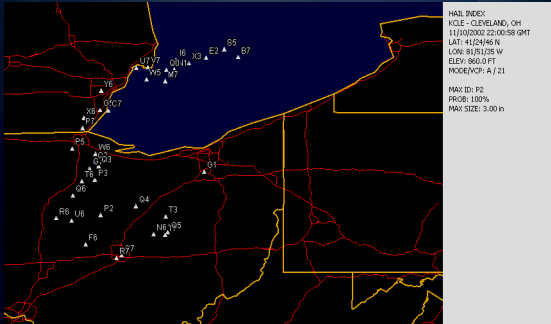
## Data

NEXRAD Level-III TVS Product (w/ Reflectivity)



## Data

NEXRAD Level-III Hail Product



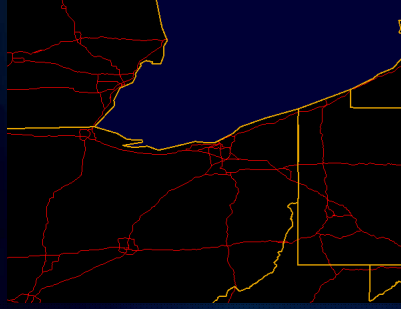
## Data

NEXRAD Level-III Mesocyclone Product





## Data

### NEXRAD Level-III Tornado Product



TORNADO VTL SIG  
KCLE - CLEVELAND, OH  
11/10/2002 22:00:58 GMT  
LAT: 41.24194 N  
LON: 81.51395 W  
ELEV: 560.0 FT  
MODE/VOP: A / Z1  
NO TVS PRESENT






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## Data

### Preliminary Local Storm Reports

- Preliminary reports from Storm Spotters, Emergency Management, General Public, Law Enforcement, etc...
- Tornado, Hail, Flash Flood, Wind, etc...
- Transmitted in real-time – nightly load into SWDI






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## Data

### NCDC Storm Events Database

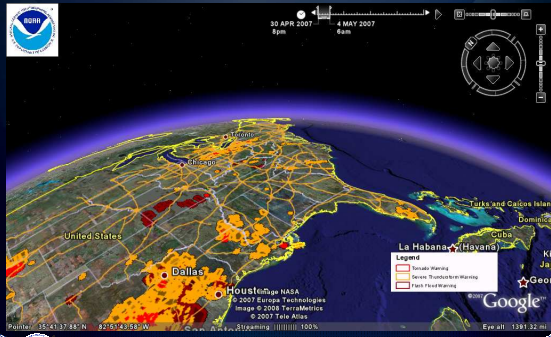
- Verified storm reports from NWS Storm Data since 1996
- Thunderstorm winds and hail data from Storm Prediction Center from 1950 – 1992
- Tornado, Hail, Lightning, Wind, etc...
- Fatalities, Injuries, Crop/Property Damage
- Loaded into SWDI ~3 months after end of each month






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## Data

### NWS Warnings in Google Earth



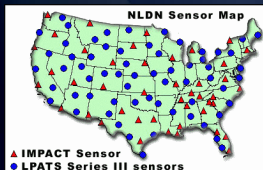




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## Data

### Vaisala's National Lightning Detection Network (NLDN)

- 130 Sensors Nationwide
- 1995 – Present

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

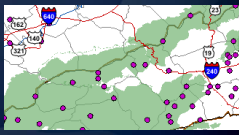



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## Geospatial Database



- Oracle Spatial Extension
- Adds GIS functionality to Oracle database
- Links all spatial datasets together

RECID	BASENAME
15748309	KFDX20041005.tar.Z

+


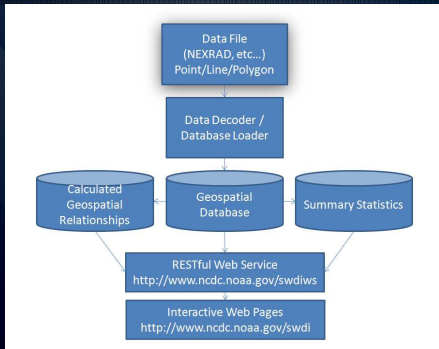
"Select all TVS within 50 miles of ATL between 20050819 18:00Z and 20050819 22:00Z"

"Select all Hail > 1 inch within Fulton County"

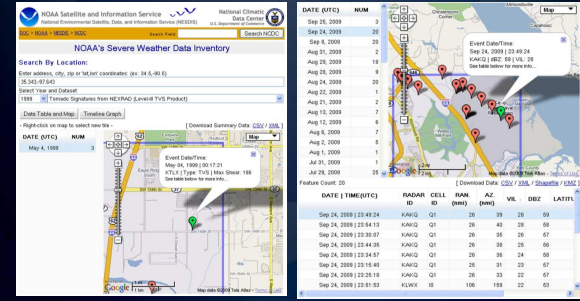
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## Process



## Access

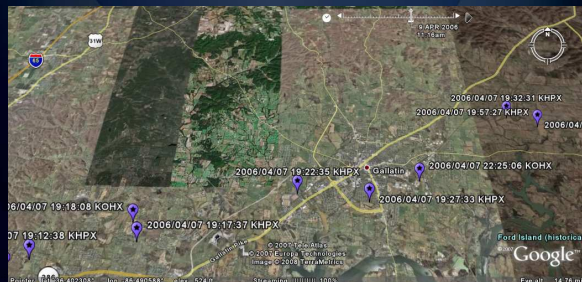
Web Pages ( <http://www.ncdc.noaa.gov/swdi> )



## Access

Data Download (Shapefile, KMZ, Text File)

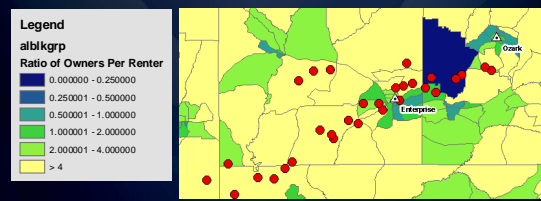
- NEXRAD Tornado Vortex Signatures in Google Earth



## 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

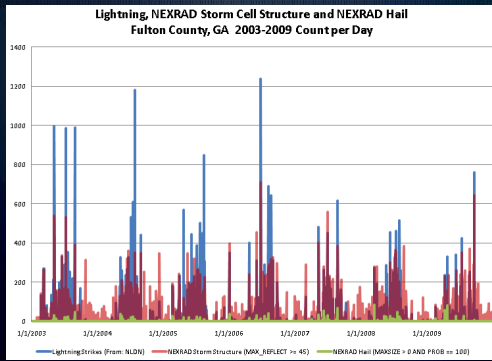
- Each URL defines a unique resource
- Easy programmatic access to data
- Allows integration into custom applications
- System and language independent

## 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



## Analysis

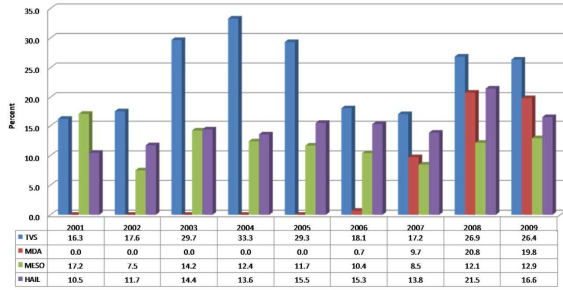
- Comparison between datasets
  - Possible Bias Detection, QC, etc...

*“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

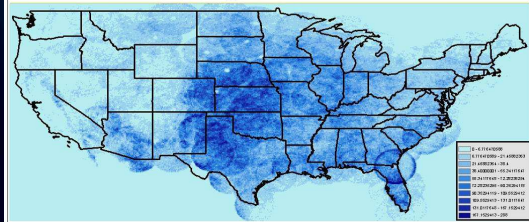
Percent of NEXRAD Level-III Severe Weather Signatures within NWS Severe Thunderstorm or Tornado Warning (+/- 1 hour)



## Analysis

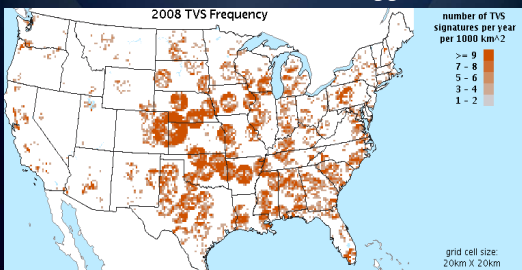
- Comparison between datasets
  - Possible Bias Detection, QC, etc...

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



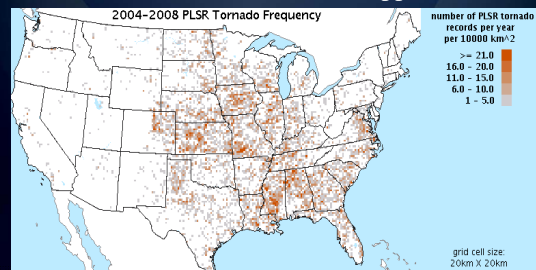
## Data Quality

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



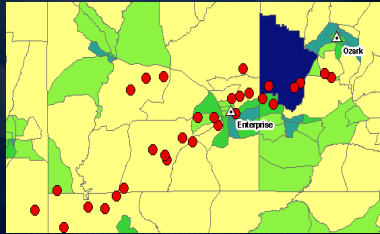
## Data Quality

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



## Storm Risk Assessment Project

- AL Tornado outbreak of 03/01/2007.
  - Who was affected? (using L3 TVS data)
    - 4.2 to 1 Homeowners to Renters in affected Census blocks. (Alabama statewide ratio = 2.6)



## 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

## *Thanks!*

### • Contact Information

- Stuart Hinson – Storm Data
  - <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms>
  - [Stuart.Hinson@noaa.gov](mailto:Stuart.Hinson@noaa.gov)
  - 828-271-4437
- Steve Ansari – SWDI
  - <http://www.ncdc.noaa.gov/swdi>
  - [Steve.Ansari@noaa.gov](mailto:Steve.Ansari@noaa.gov)
  - 828-271-4611