

Storm Data at NCDC

And other severe weather
products and services

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Storm Data – Upper Air – HPD



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National Severe Weather Workshop

Norman, Oklahoma

March 6-8, 2008



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
– WordPerfect V5.0 format	1993 – 1995
– Paradox V7.0 format	1996 – 09/2006
– Windows SQL Server 2003	10/2006 – Current



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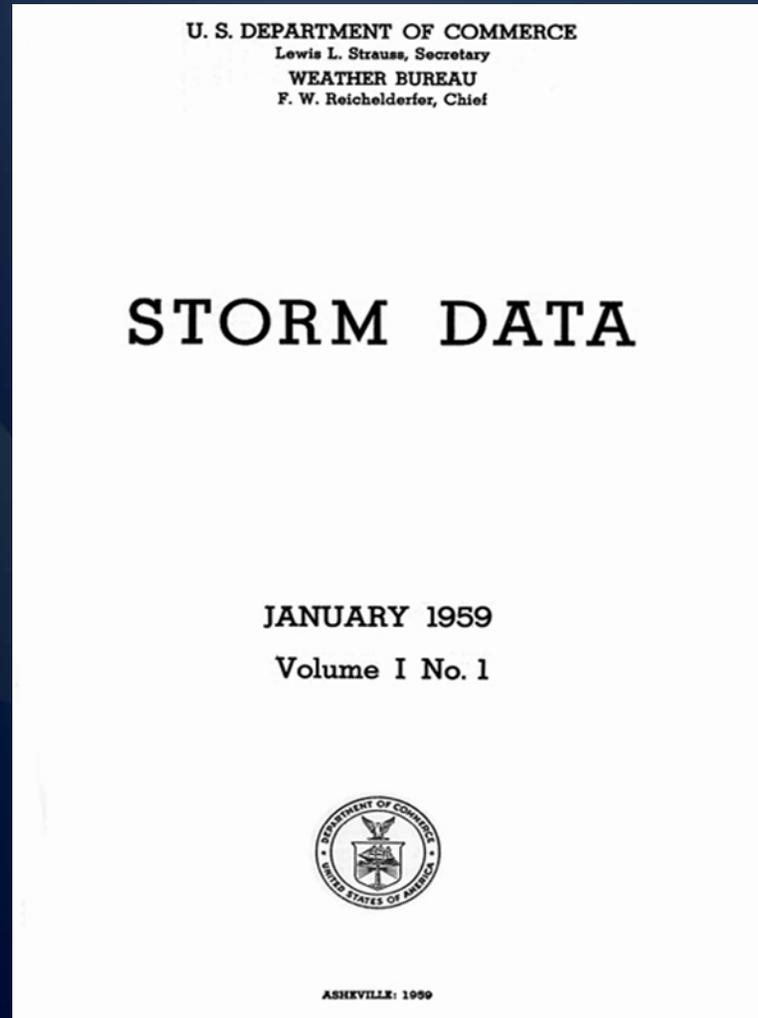
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The Publication

Storm Data began with the January 1959 issue ...



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NWS Form F8

NWS Form F2

WS FORM F-8 (11-81) **STORM DATA AND UNUSUAL WEATHER PHENOMENA** U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE

STATE Puerto Rico NO. _____ MONTH AND YEAR February 1995

PLACE	DATE	TIME	LENGTH OF PATH (MILES)	WIDTH OF PATH (YARDS)	NO. OF PERSONS		ESTIMATED DAMAGE		CHARACTER OF STORM
					KILLED	INJURED	PROPERTY	CROPS	
TYPING EXAMPLE	08	1825CST	27	150	0	0	2	0	Tornado (F2)
40 PUERTO RICO (SJU) February 1995									
Mayaguez	22	1720AST			0	0	0	0	Urban Flood
									Minor flooding of low lying areas was reported in Guanajibo, Valle Hermoso, and along highway 2 near the Mayaguez Mall.
PRZ001	23	0705AST			0	0	0	0	Waterspout Funnel Cloud
									A waterspout was reported by a pilot 5 miles northeast of the Luis Munoz Marin International Airport. The waterspout was moving west northwest. Three funnel clouds were also sighted in the area.
Rio Piedras	23	PM			0	0	0	0	Urban Flood
									Heavy rain fell over the inland sections of the San Juan Metropolitan area producing minor street flooding in Puerto Nuevo. River Rio Piedras reached near overflow stage.
Caguas	25	PM			0	0	0	0	Urban Flood
									Several streets were reported flooded in the town of Caguas.
Canovanas	25	PM			0	0	0	0	Landslide
									Heavy rain caused a mudslide on Highway 186 in Barrio Cubuy which damaged a house and forced the family to abandon it.
Gurabo	25	PM			0	0	0	0	River Flood
									Heavy rains of 3-4 inches in the headwaters of River Gurabo caused the river level to rise nearly 12 feet and to overtop the bridge. River Loiza was also reported out of its banks at the Navarro Road, Santa Barbara sector.

WS FORM F-2 (1-88) **STORM SUMMARY REPORT** U.S. DEPARTMENT OF COMMERCE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION NATIONAL WEATHER SERVICE

PRES. BY WSOM F-42

STATE Kentucky MONTH February YEAR 1996

TYPE OF STORM	NUMBER	DAYS	DEATHS	INJURIES	DAMAGE*	
					PROPERTY	CROPS
TORNADOES	0	0	0	0	0	0
HAIL			0	0	0	0
THUNDERSTORM WINDS			0	0	0	0
HIGH WINDS			0	0	0	0
LIGHTNING			0	0	0	0
FLASH FLOODS			0	0	0	0
FLOODS	1		0	0	0	0
HEAVY SNOWSTORMS AND BLIZZARDS			0	0	0	0
ICE STORMS #			0	0	0	0
HURRICANES & TROPICAL STORMS			0	0	0	0
ALL OTHERS	0	0	0	0	0	0

* Total damage for month, by categories.
Freezing drizzle and freezing rain, commonly known as glaze.

SUPERSEDES WS FORM F-2 WHICH SHOULD BE DESTROYED

U.S. GPO: 1986-554-485



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Outstanding Storms of the Month - July 1981

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Storm Data, which had been slated to end with the June 1981 issue, is given a new lease on life in a revised and expanded format. Coordination among the National Climatic Center, the National Weather Service, and Dr. T. Theodore Fujita, Professor of Meteorology at Chicago University and an acknowledged tornado authority, has made this possible.

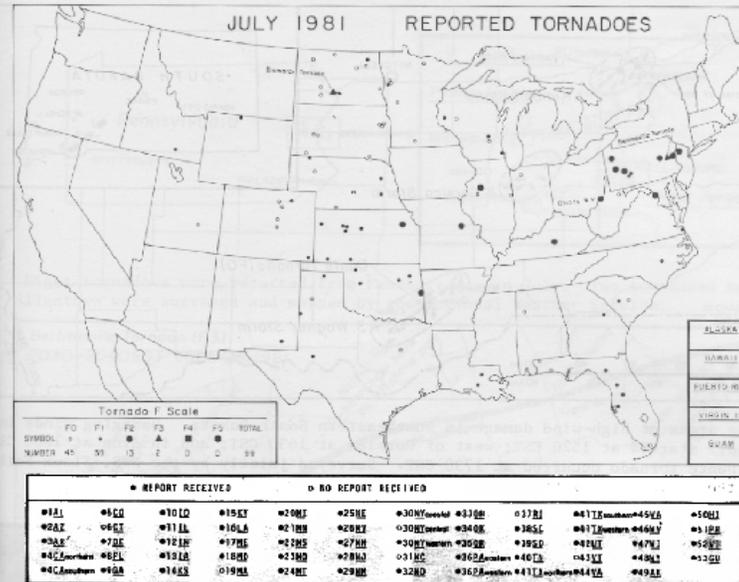
Beginning with the July 1981 issue, Dr. Fujita will review the reports provided by the National Weather Service; assign tornado F scale numbers, and add narratives and pictures on outstanding storms. NWS narratives on tropical storms will also be carried. The National Severe Storm Forecast Center will also participate in the review. Storm Data will be published by the NCC after these reviews, but likely with a slightly longer time lag.

Storm Summary reports that normally appeared in the Climatological Data National Summary are included in the Late Reports and Corrections for January through June 1981. The December issue will include an annual general summary of tornadoes and lightning, hailstorm and wind losses.

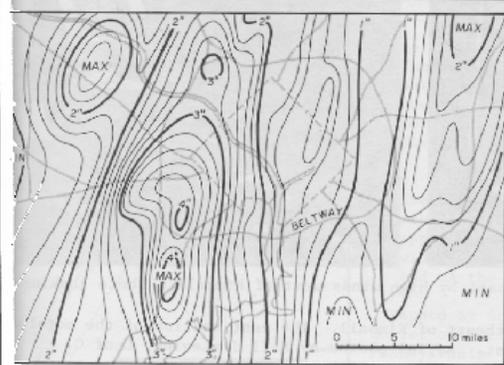
NOTE: This publication contains our best information on storms, but due to the difficulties inherent in collection of this type of data, it is not all-inclusive. Late Reports and Corrections will be carried in the month following receipt of these data.

SEVERE WEATHER - (USPS 363-010) is published monthly by the National Climatic Center, Environmental Data and Information Service, NOAA, Federal Building, Asheville, NC 28801.

OUTSTANDING STORMS OF THE MONTH



RAINSTORM in Washington D.C. and Vicinity on July 3 - 4.



The 4th of July was the fireworks day in Washington D. C. Rain fell intermittently on the 3rd, becoming heavy before dawn of the 4th. Rain ended around noon and skies remained cloudy until early evening. Clearing took place in time for good firework displays in Downtown Washington. The largest rainfall measured was 4.15". One station measured 1.20" in 25 min between 0635 and 0700 EST. (data from Metropolitan Climatological Summaries, National Capital Area - rainfall map plotted by Angela Byers).



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
- January 1, 1996
 - Started with Storm Data in Paradox format, exported to FoxPro.
 - 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
- 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” version using Windows SQL Server 2003



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Web Access

- Very heavily used
- A few problems
 - Limited functionality
 - Lat/lons
 - 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

Continue

Search the NCDC Storm Event database to find various types of storms recorded in your county or use 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 6/93 - 7/93, 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 1950-1992
Thunderstorm Winds 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 queries 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 date instead of by county name.

[List of NWS Forecast Zones by State](#)

[List of NWS Forecast Zones Maps](#)

The Storm Events Database is updated when the data becomes available to NCDC. The data is updated on a monthly basis and is usually 90-120 days behind the current month

Please read the [Storm Events Database FAQ](#) page for more information. The State and County FIPS numbers associated with the maps are located here: [State and County FIPS](#) 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 [Stuart Hinson](#).

Note To Webmaster: [Link directly to Events Database](#)



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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)

- Easy access to data in NCDC Archive
- Inventory for Severe Weather Data
- Derive climatology products
- Geospatial Database solution
- Modular! Scalable!
- Unique spatial dataset relationship
- Services! (web services based, not web page based)
- SOA! (service oriented architecture)



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Data

Current Datasets:

- NEXRAD Level-III Storm Attributes
- Preliminary Local Storm Reports

Coming soon:

- Storm Events Database
 - NWS Warnings
 - National Lightning Detection Network
- Framework for other datasets



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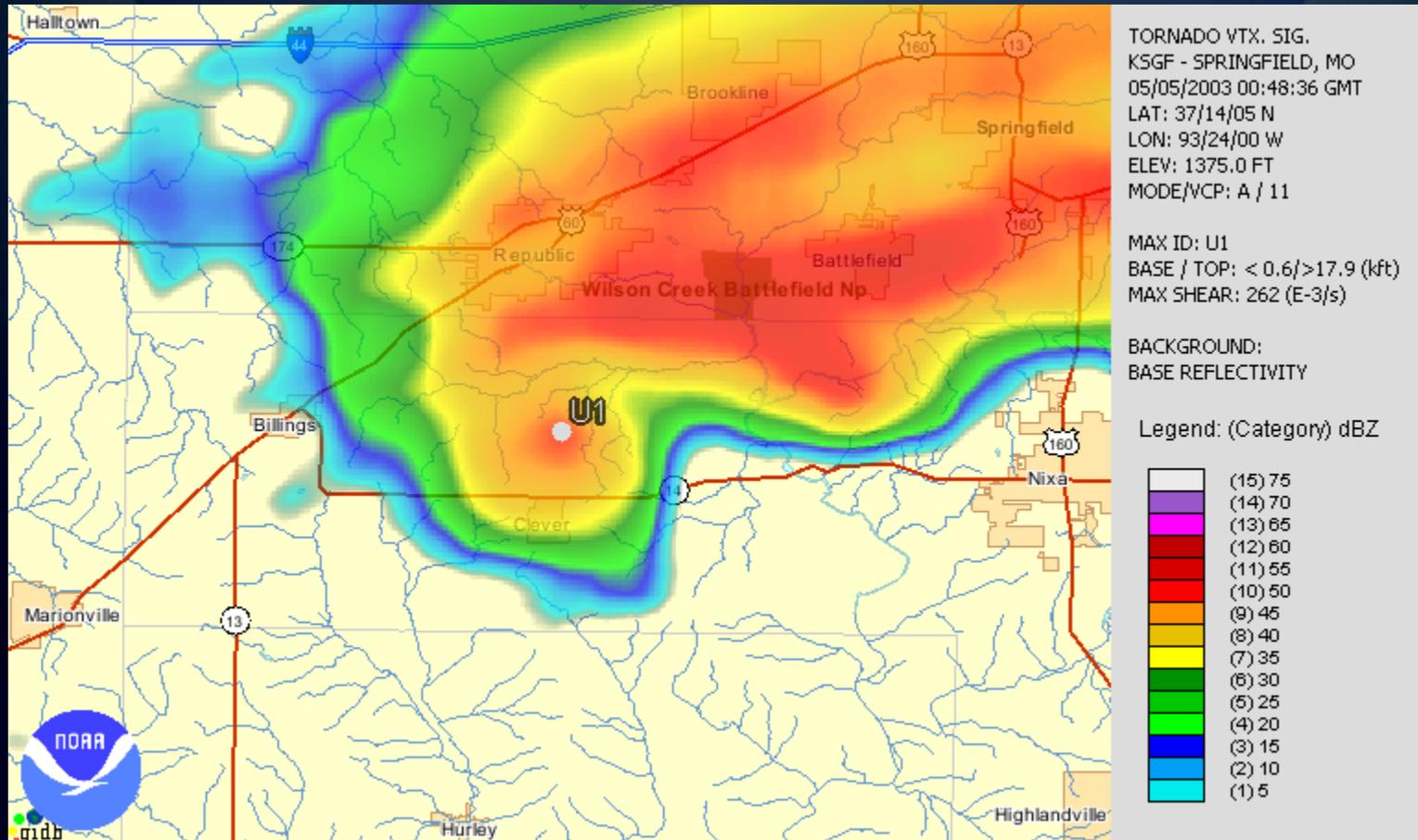
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Data

NEXRAD Level-III TVS Product (w/ Reflectivity)



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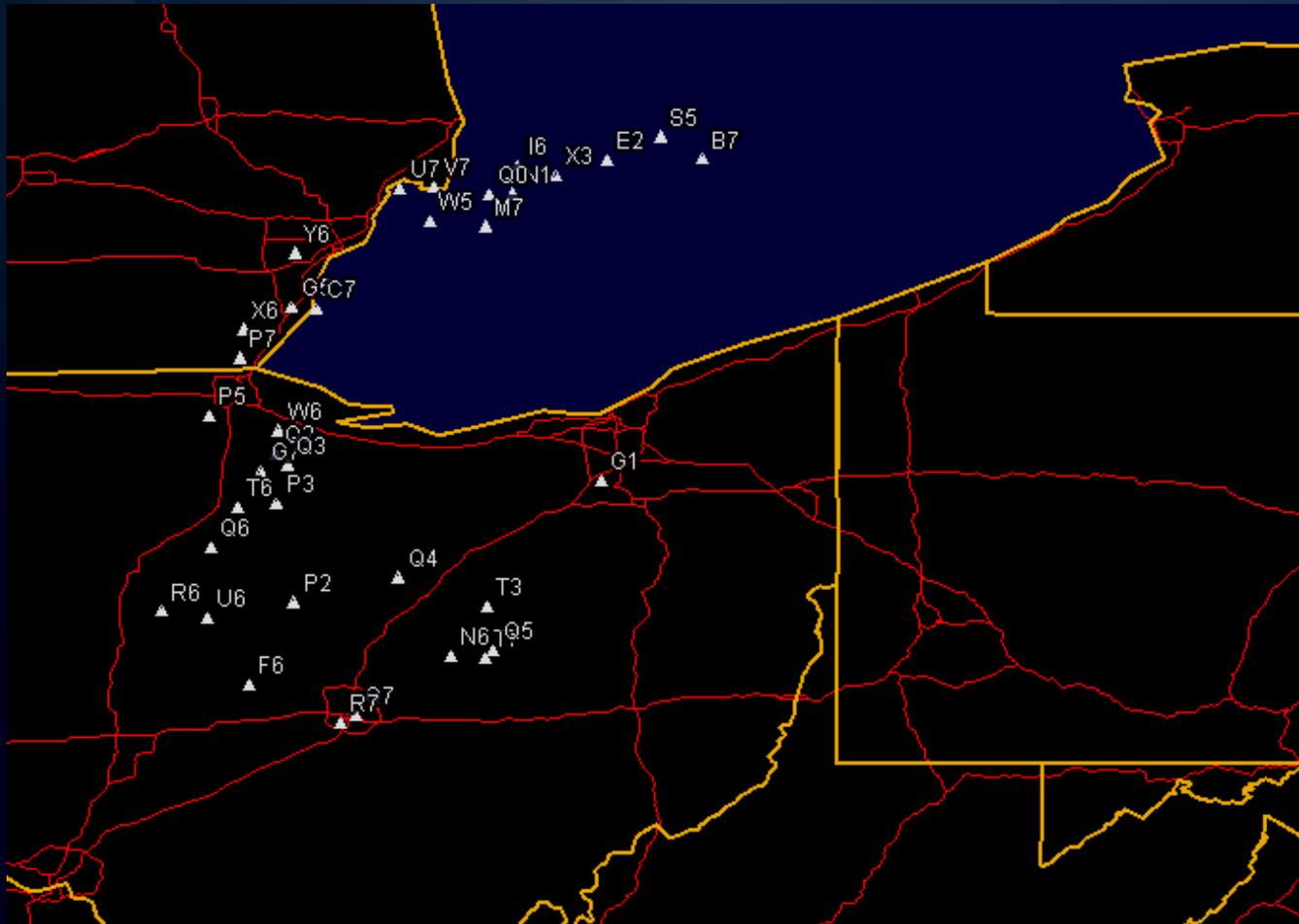
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Data

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



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 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



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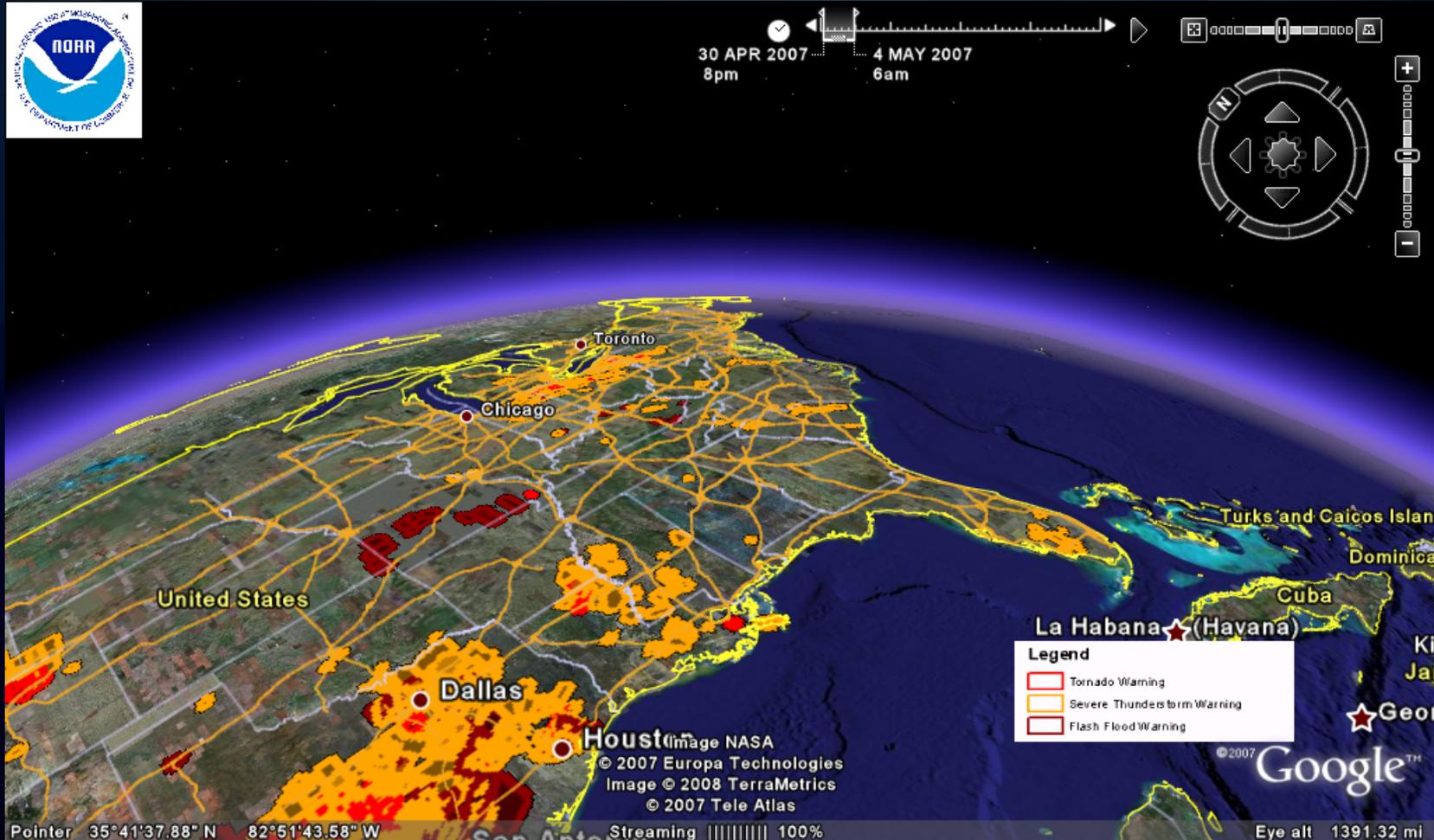
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Data

NWS Warnings in Google Earth



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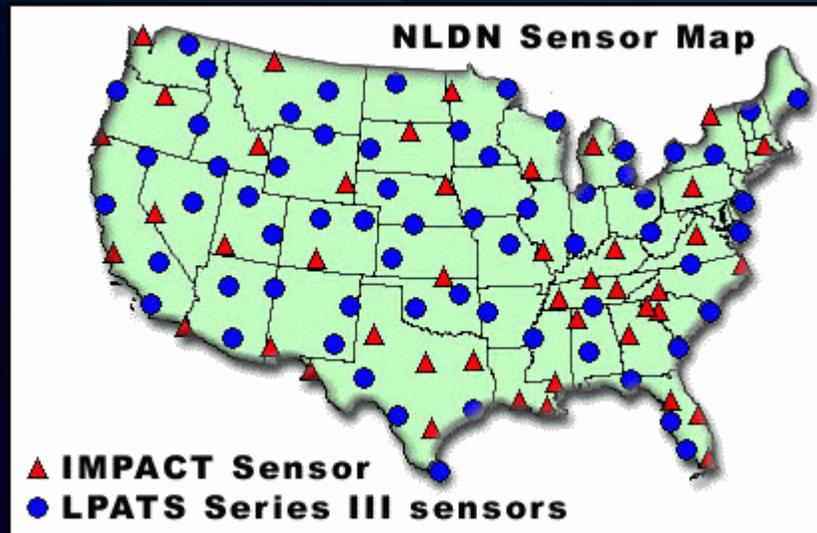
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Data

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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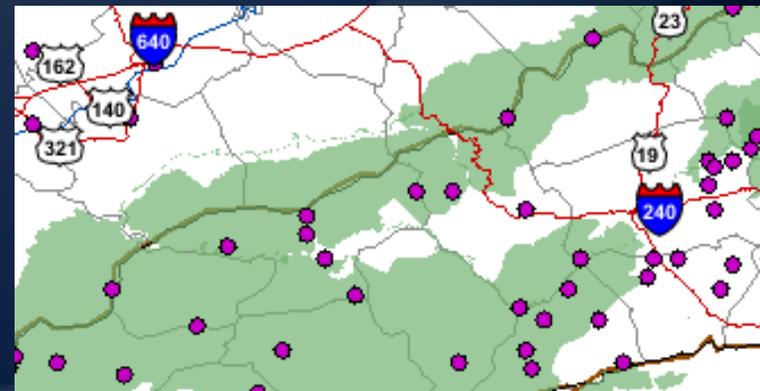
Geospatial Database

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

RECID	BASENAME
15746309	KFDX20041005.tar.Z

RECID	PDATE	VCP
15746309	10/5/04	121
15746309	10/5/04	121
15746309	10/5/04	121
15746309	10/5/04	121

+



*“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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Access

- Web Pages <http://www.ncdc.noaa.gov/swdi>
- Please have BETA testing requests sent to: swdi.ncdc@noaa.gov

The screenshot shows the NOAA Satellite and Information Service (NESDIS) website. The page title is "Severe Weather Data Inventory". It features a search field and a "Search NCDC" button. Below the search field, there are instructions on how to use the search function. The search criteria section includes fields for "Enter latitude & longitude, or an address, and a search radius:", "Select time period:", and "Select product types:". The "Select product types:" section has a list of options: Hail Index, Mesocyclone, Storm Structure, Tornado Vortex Signature, and Preliminary Local Storm Reports. A "Search" button is located at the bottom of the search criteria section.

The screenshot shows the results of a search for Hail Index data. The page title is "Severe Weather Data Inventory". It displays "Hail Index results 1 through 4 of 4:" followed by a table of results. The table has columns for ZTIME, WSR_ID, CELL_ID, PROB, SEVPROB, MAXSIZE, LAT, LON, and DISTANCE_MILES. Below the table, there is a "Close Window" link.

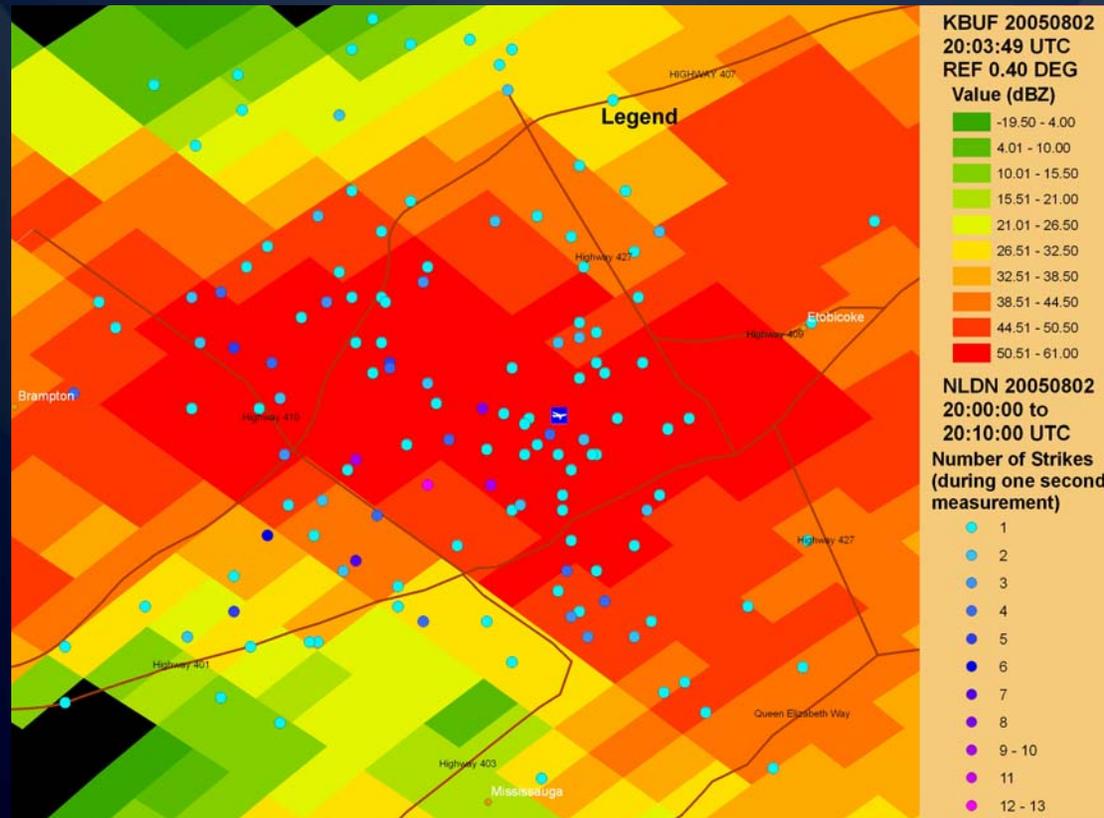
ZTIME	WSR_ID	CELL_ID	PROB	SEVPROB	MAXSIZE	LAT	LON	DISTANCE_MILES
2007/08/24 19:13:30	KGSP	V4	100	60	2	35.601	-82.489	3.88390095470025
2007/08/24 19:09:18	KGSP	V4	100	30	1	35.601	-82.489	3.88390095470025
2007/08/24 19:11:51	KMRX	O3	100	30	1	35.602	-82.488	3.95481355691882
2007/08/24 19:16:05	KMRX	O3	100	10	1	35.592	-82.472	4.8297444793198



Access

Data Download (Shapefile, KMZ, Text File)

- NLDN exported as Shapefile in ArcGIS



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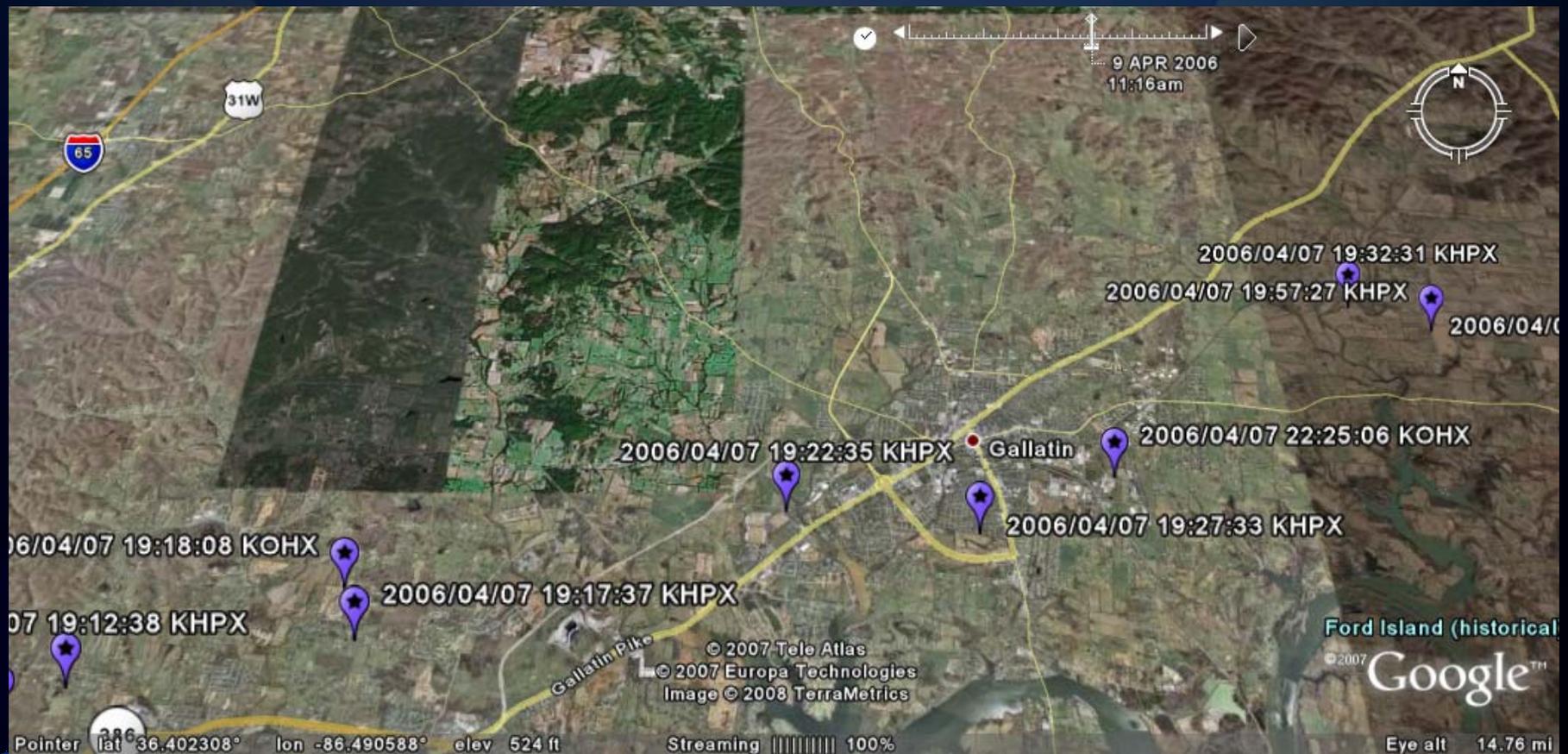
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Access

Data Download (Shapefile, KMZ, Text File)

- NEXRAD Tornado Vortex Signatures in Google Earth



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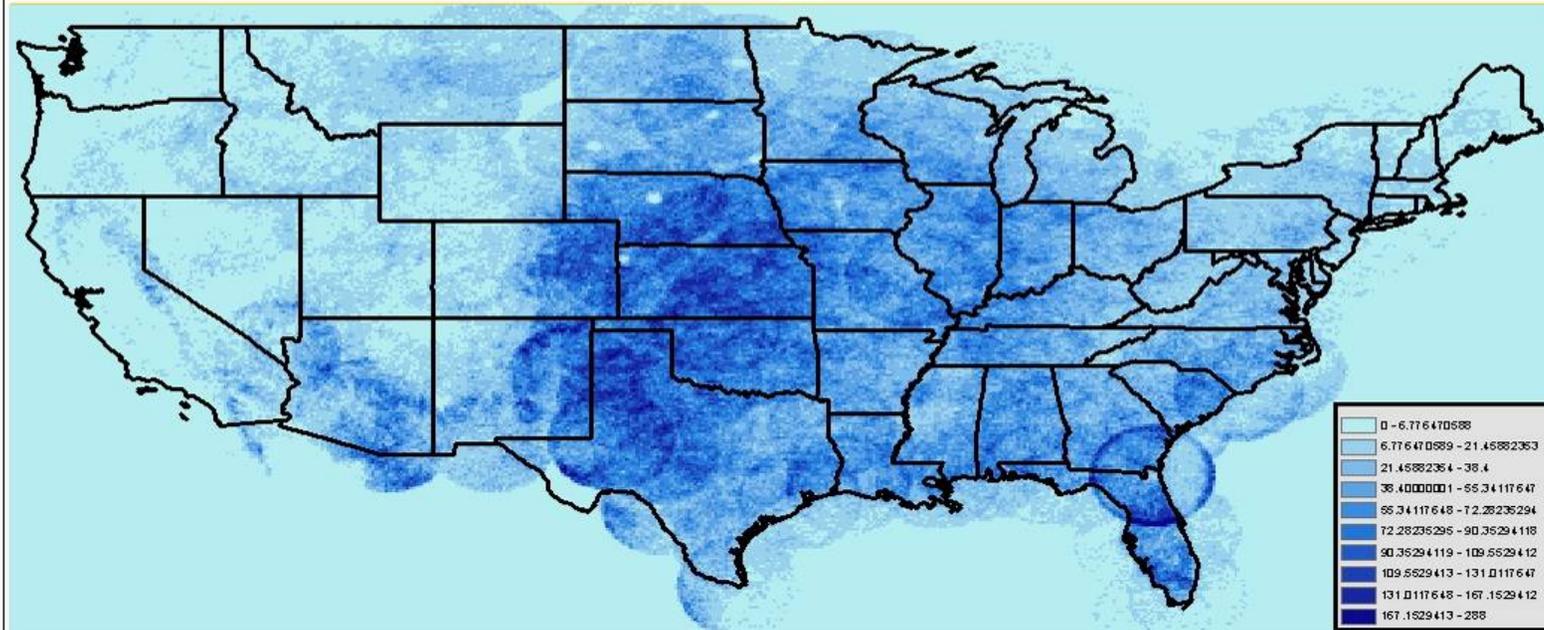
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Analysis

- 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



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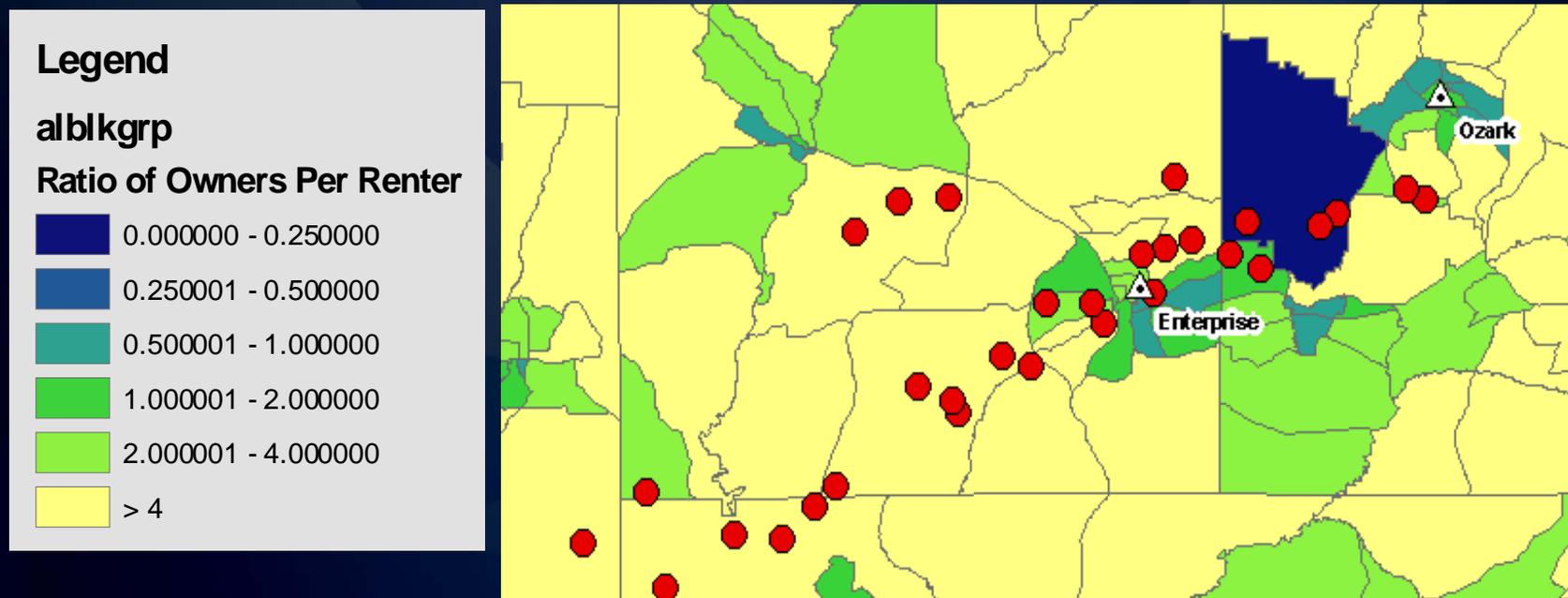
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Storm Risk Assessment Project

- 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)



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Conclusion

The Severe Weather Data Inventory:

- Allows easier access to the NCDC Archive
- Joint project with NEMAC, UNCA, RENC I
- 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



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Archived Severe Weather Warnings For Virtual Globe Applications

Chad Hutchins
STG Incorporated

Steve Ansari
NOAA / NCDC

- A New and Innovative Way To View Severe Weather Warnings
 - Better access and visualization to the customer
- Sub-project of NOAA's Severe Weather Data Inventory
- Provide Interactive Access and Visualization
 - Process archived and near real-time severe weather warnings
 - Exporting in Keyhole Markup Language (KML)
 - GIS Programs



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Typical Warning

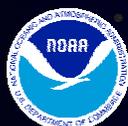
Issued by NWSFO

Tornado Warnings

Severe Thunderstorm
Warnings

Flash Flood Warnings

```
WFUS53 KTOP 050827
TORTOP
KSC157-201-050915-
/O.NEW.KTOP.TO.W.0018.070505T0826Z-070505T0915Z/
BULLETIN - EAS ACTIVATION REQUESTED
TORNADO WARNING
NATIONAL WEATHER SERVICE TOPEKA KS
326 AM CDT SAT MAY 5 2007
THE NATIONAL WEATHER SERVICE IN TOPEKA HAS ISSUED A
* TORNADO WARNING FOR...
  SOUTHEASTERN REPUBLIC COUNTY IN NORTH CENTRAL KANSAS...
  WESTERN WASHINGTON COUNTY IN NORTH CENTRAL KANSAS...
* UNTIL 415 AM CDT
* AT 325 AM CDT...NATIONAL WEATHER SERVICE DOPPLER RADAR INDICATED A
  SEVERE THUNDERSTORM CAPABLE OF PRODUCING A TORNADO 4 MILES SOUTH OF
  AGENDA...OR ABOUT 14 MILES EAST OF CONCORDIA...MOVING NORTHEAST AT
  20 MPH.
* LOCATIONS IMPACTED INCLUDE...
  AGENDA...
  BRANTFORD...
  HADDAM...
  MORROWVILLE...
  WASHINGTON...
IF A TORNADO APPROACHES...GO TO A BASEMENT OR SEEK SHELTER IN A
HALLWAY OR CLOSET ON THE LOWEST FLOOR OF THE BUILDING. USE BLANKETS
OR PILLOWS TO COVER YOUR HEAD AND ALWAYS STAY AWAY FROM WINDOWS.
STAY TUNED TO WEATHER RADIO OR LOCAL MEDIA OUTLETS FOR THE LATEST
SEVERE WEATHER INFORMATION.
LAT...LON 3965 9749 3964 9731 3982 9703 3999 9735
$$|
```



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Raw Data

- Archived
 - Surface Record Retention System (SRRS)
 - Contains data from 2001 to present
- Present Data
 - NCDC Real-time Feed
 - Retrieved from GTS (Global Telecommunications System)



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Java Processing

- Suite of Programs Developed at NCDC That Utilize Open Source GIS Code
 - GeoTools
 - Java Topology Suite
- Process Each Warning in a file into individual “bulletin” Objects
 - Each object is made up of several parts



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Geometry

Obtained Two Ways

1. Polygon Warning: "LAT...LON"
 - Included in most warnings
 - Generated by the forecaster who issued the warnings at the NWS
2. County-Based Warning: FIPS Codes
 - Included in all warnings
 - County geometry is created by using these codes and referencing a shape file
 - Adjoining counties are used to reduce file size and warning area aspect



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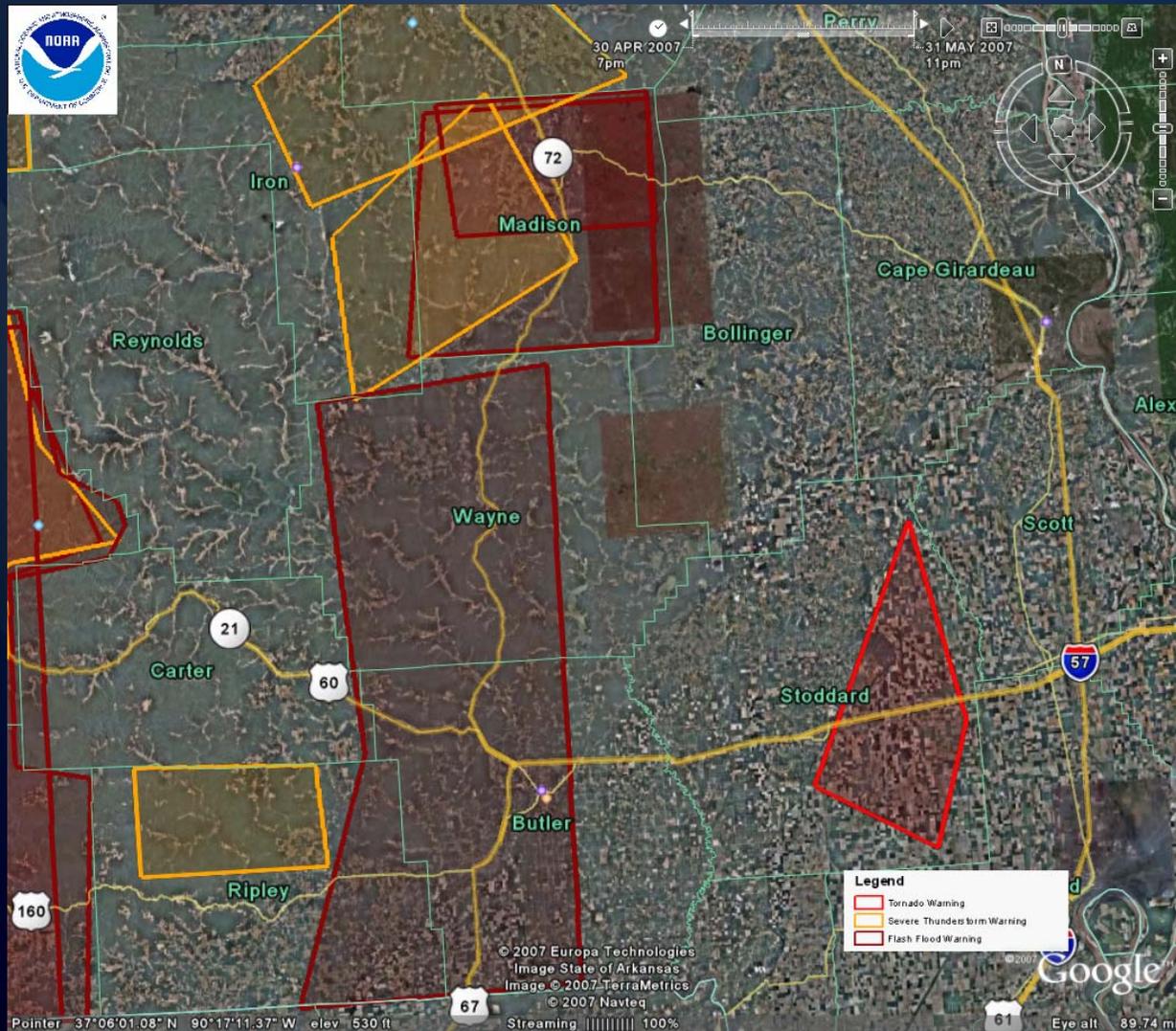
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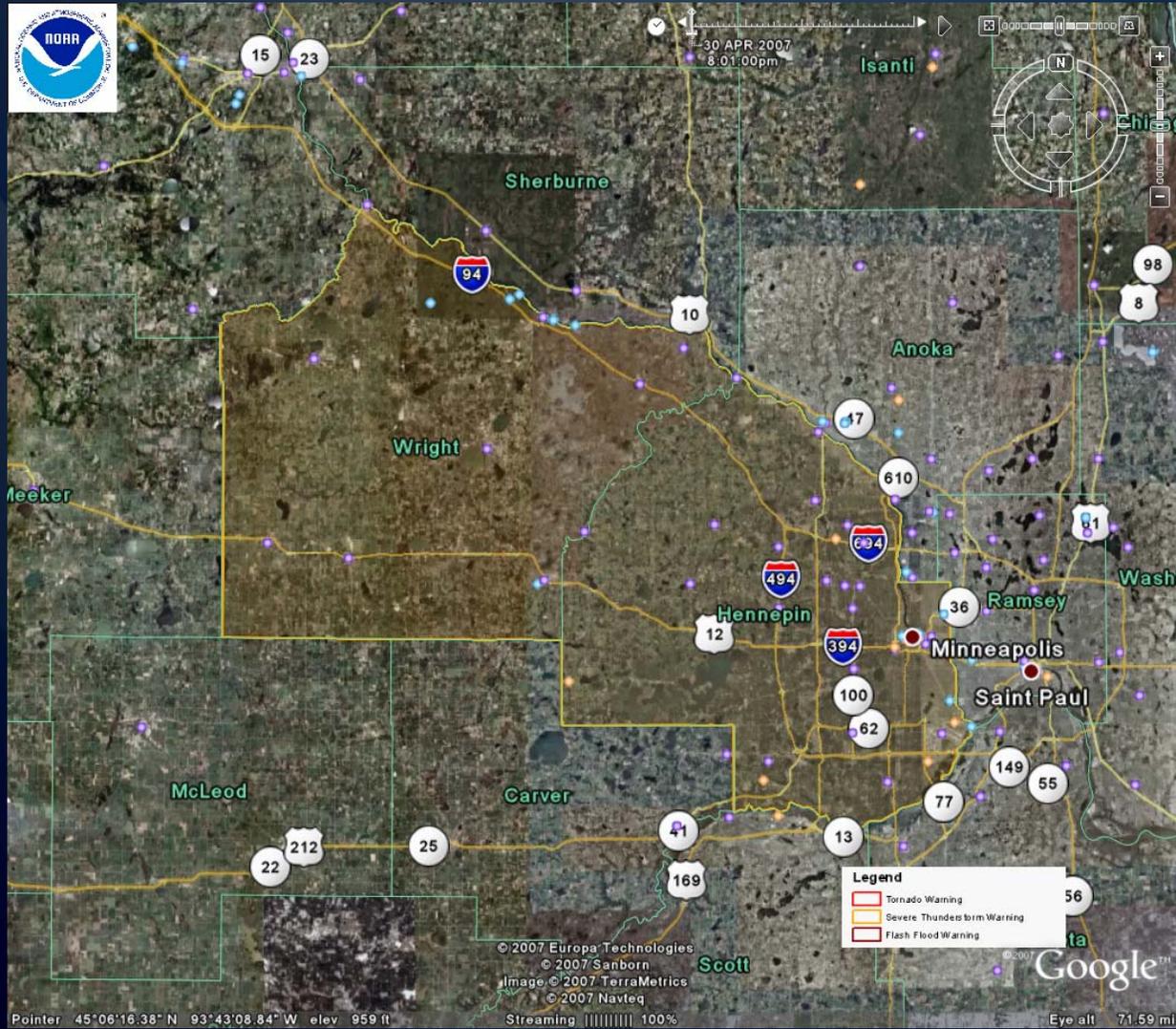
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Geometry



Geometry



Sample of Generated KML Warning in Google Earth



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The Future of Storm Events Database

- It's up to us (and other users)
- 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?



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The Future of Storm Events Database

- Improved data entry?
 - NWSFO resources...
- More timely data?
 - Ingest from NWS in near real-time
- Improved data dissemination
 - GIS-based
 - Web Map services
 - Multiple data export formats



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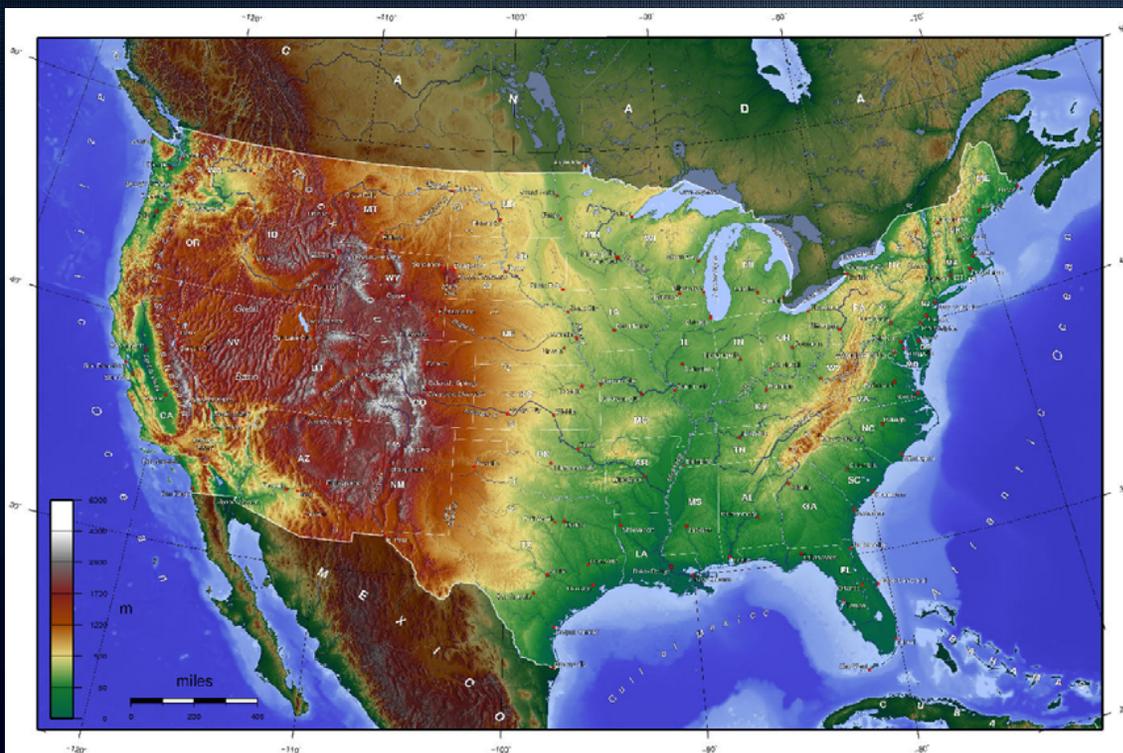
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U.S. Storm Events Database



Layers

Location

- US
- AK
- HI
- PR
- VI
- PAC

Begin Date

Aug 22 2007

End 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
- Winter Weather Snow & Ice
- Wild Fires & Forest Fires
- Temperature Extremes
- Drought
- High Winds (non-convective)
- Floods
- Precipitation
- Fog



Conclusion

- Continue this Annual Storm Summit
 - Invite more interested parties
 - Use available technological improvements
 - 10-1605 rewrite
 - WCM conference
 - Importance of Storm Data
 - In-depth training
 - Damage estimation
- Multiple Product Generation requires consistency
 - Storm Data Publication
 - Storm Events Database
 - Storm Data Archive (DSI-3910)
 - Storm Data Users - Database on WWW and CD-ROM
- Data quality issues
 - Data entry
 - Warning Coordination Meteorologist, Storm Data Focal Point, Office Secretary
 - These data must be entered consistently by the NWSFO
 - Systematic training should be required
 - A National Storm Data Summit with all WCMs should be held to facilitate in the understanding and importance of Storm Data
 - Property damage amounts *should* be used if at all possible



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Thanks!

- Contact Information

- Stuart Hinson – Storm Data

- <http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms>
 - Stuart.Hinson@noaa.gov
 - 828-271-4437

- Steve Ansari – SWDI

- <http://www.ncdc.noaa.gov/swdi>
 - Steve.Ansari@noaa.gov
 - 828-271-4611

- Chad Hutchins – KML Warning Archive

- <http://www.ncdc.noaa.gov/oa/kml/>
 - Chad.Hutchins@noaa.gov
 - 828-271-4592



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