



Methodology of the United States National Weather Service Warning Product Verification

**National Weather Service
Office of Climate, Water, and Weather Services**

Brenton W. MacAloney II
September 17th, 2004



NWS Warning Product Verification Methodology



History

- **1979 – Severe local storm warning verification begins at the National Severe Storms Forecast Center (NSSFC)**
- **1995 – Warning verification program is transferred from NSSFC to National Weather Service Headquarters (WSH)
-- Two contractors are hired at WSH to migrate the program**
- **1996 – Modernized warning verification program is implemented with real-time quality control of warning and event import**
- **1998 – “Stats on Demand” is created for tornado, flash flood, and severe thunderstorm warnings**
- **2001 – Special marine warning verification is added**



NWS Warning Product Verification Methodology



WARNINGS





NWS Warning Product Verification Methodology



Warning Collection Process

```
WGUS53 KLOT 280740
FFWLOT
ILC031-063-093-197-281045-

BULLETIN - EAS ACTIVATION REQUESTED
FLASH FLOOD WARNING
NATIONAL WEATHER SERVICE CHICAGO IL
238 AM CDT SAT AUG 28 2004

THE NATIONAL WEATHER SERVICE IN CHICAGO HAS ISSUED A

* FLASH FLOOD WARNING FOR...
SOUTHERN COOK COUNTY IN NORTHEAST ILLINOIS
GRUNDY COUNTY IN NORTHEAST ILLINOIS
KENDALL COUNTY IN NORTHEAST ILLINOIS
WILL COUNTY IN NORTHEAST ILLINOIS

* UNTIL 545 AM CDT

* AT 238 AM CDT...A TRAINED WEATHER SPOTTER REPORTED FLOODING IN
GRUNDY COUNTY. RAINFALL OF 2.7 INCHES IN AN HOUR WAS REPORTED NEAR
COAL CITY IN GRUNDY COUNTY. A LARGE AREA OF THUNDERSTORMS FROM ABOUT
MORRIS TO JOLIET IS MOVING NORTHEAST AROUND 30 MPH.

* THE TOWNS OF WORTH...WILLOW SPRINGS...TINLEY PARK...ROMEOVILLE AND
POSEN ARE IN THE AREA OF THE FLOODING.

LAT...LON 4182 8759 4131 8777 4135 8857 4157 8848
$$
```

All 123 Weather Forecast Offices (WFOs) participate in the NWS severe weather warning program.

Warning products currently verified:

- Tornado (TOR)
- Severe Thunderstorm (SVR)
- Flash Flood (FFW)
- Special Marine (SMW)



NWS Warning Product Verification Methodology



Warning Collection Process

Warnings are disseminated from the WFOs via several methods including the AWIPS network and are collected on our data servers in Kansas City, MO.



The Kansas City data servers are supported around the clock to ensure little, if any, data loss.



NWS Warning Product Verification Methodology



Warning Collection Process

We immediately download the warnings to WSH and attempt to import them. It is at this point the warnings are subject to quality control created based on National Weather Service Policy Directives written on warning formatting.

Warnings not meeting the import criteria are rejected. Events occurring during the valid time of these erroneous warnings will be counted as unwarned unless a properly issued warning correction is issued.



NWS Warning Product Verification Methodology



Quality Control

```
WUUS51 KWSH 010000 <----- WMO PRODUCT ID
SVRWSH <----- WARNING TYPE and WFO
DCC001-003-005-010200- <----- COUNTY and STATE WARNED
```

```
BULLETIN - EAS ACTIVATION REQUESTED
SEVERE THUNDERSTORM WARNING
NATIONAL WEATHER SERVICE SILVER SPRING MD
700 PM EST WED JAN 1 2001 <----- DATE AND ISSUANCE TIME
```

THE NATIONAL WEATHER SERVICE IN SILVER SPRING HAS ISSUED A

* SEVERE THUNDERSTORM WARNING FOR...
WASHINGTON COUNTY IN THE DISTRICT OF COLUMBIA
JEFFERSON COUNTY IN THE DISTRICT OF COLUMBIA
REAGAN COUNTY IN THE DISTRICT OF COLUMBIA

* UNTIL 900 PM EST <----- EXPIRATION TIME

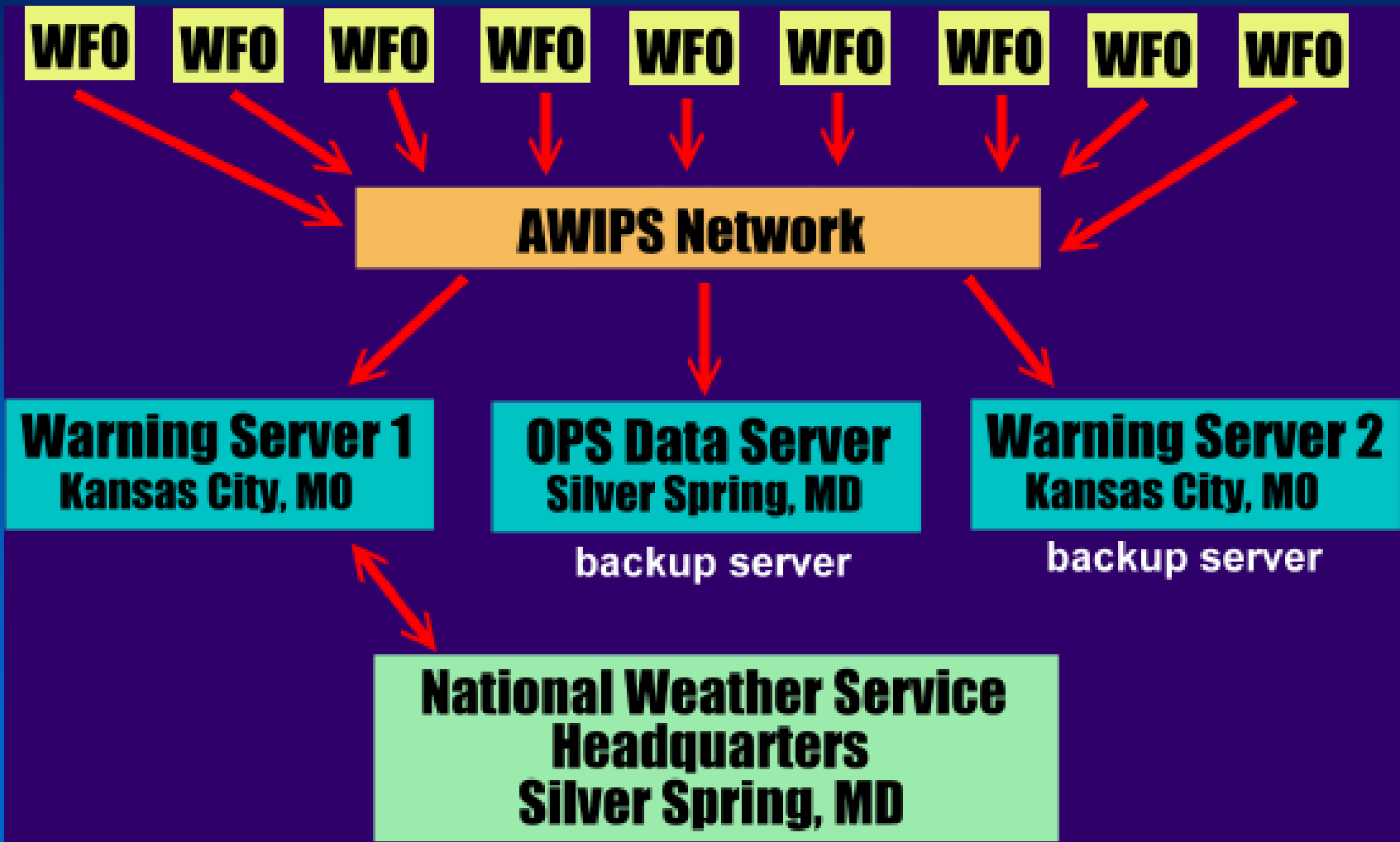
* AT 700 PM CST...SILVER SPRING DOPPLER RADAR INDICATED A SEVERE THUNDERSTORM 2 MILES WEST OF ADAMS MORGAN...MOVING EAST AT 15 MPH.



NWS Warning Product Verification Methodology



Warning Import Process Overview





NWS Warning Product Verification Methodology





NWS Warning Product Verification Methodology



Event Collection Process

- Each of the 123 WFOs is responsible for collecting verifiable severe weather events. They collect these reports via:
 - Official NWS storm surveys
 - Emergency managers
 - Official NWS observations
 - Amateur radio operators
 - Newspaper clippings
 - Other sources
- Events are logged in the StormDat program which creates a database called “storm data”
- Storm data is sent to WSH up to 60 days after the end of each month
- WSH uses storm data entries as the verifying events in its verification program.



NWS Warning Product Verification Methodology



StormDat Program Screen Capture

Paradee Runtime - [StormDat Windows 2000]

Menu Episode Edit Data Transfer Web Sites

an event type from the drop-down box... You can narrow down your selection by typing the first letter(s) of the event ty

EVENT TYPE	EVENT SOURCE	STATE	COUNTY OR ZONE NAME	CITY/ZONE #
FLASH FLOOD	NEWSPAPER	OK	BECKHAM	009
TORNADO	BROADCAST MEDIA	OK	GRADY	051
TORNADO	BROADCAST MEDIA	OK	GRADY	051
TSTM WIND	LAW ENFORCEMENT	OK	COMANCHE	031
TSTM WIND	LAW ENFORCEMENT	OK	COMANCHE	031

DATE (MM/DD/YY)	TIME (MM)	TIME ZONE	RANGE	AZI	BEGIN LOCATION	END DATE (MM/DD/YY)	END TIME (MM)	END RANGE	END AZI	END LOCATION
05/04/01	17:00	CST			ELK CITY	05/04/01	17:00			ELK CITY
05/04/01	18:20	CST	2.0	NNE	AMBER	05/04/01	18:24	3.0	N	AMBER
05/04/01	18:05	CST	0.5	E	CHICKASHA	05/04/01	18:08	0.5	E	CHICKASHA
05/04/01	18:48	CST	7.0	ENE	GERONIMO	05/04/01	18:48	7.0	ENE	GERONIMO
05/04/01	18:38	CST	4.0	ENE	GERONIMO	05/04/01	18:38	4.0	ENE	GERONIMO

PATH LENGTH	PATH WIDTH	MAG	DM C/S	F	INJURIES	PROPERTY DAMAGE	PROPERTY DAMAGE EXP	CROP DAMAGE	CROP DAMAGE EXP	EVENT NARRATIVE
0.7	50				1	30.0	K			Several cars stalled in high water,
					0	0.0				This tornado was observed by two
0.2	25				0	0.0				This tornado was observed by two
						2.0	K			A barn was blown over, and minor
						5.0	K			A 200-gallon propane storage tank

Numerous thunderstorms formed across southwest Oklahoma the afternoon of the 4th and spread northeastward. Three tornadoes were confirmed, along with many reports of severe winds.

DELETE EVENT / CURRENT RECORD ADD/REMOVE PICTURE TO CURRENT EVENT CLEAR SCREEN TO ENTER NEW EPISODE

HELP ? DELETE EPISODE X LOOKUP ✓ EXIT REPORTS FATALITIES SAVE ✓

1 of 20 [PRINT&LS;PRINT&M;DE] Edit



Quality Control Features of StormDat

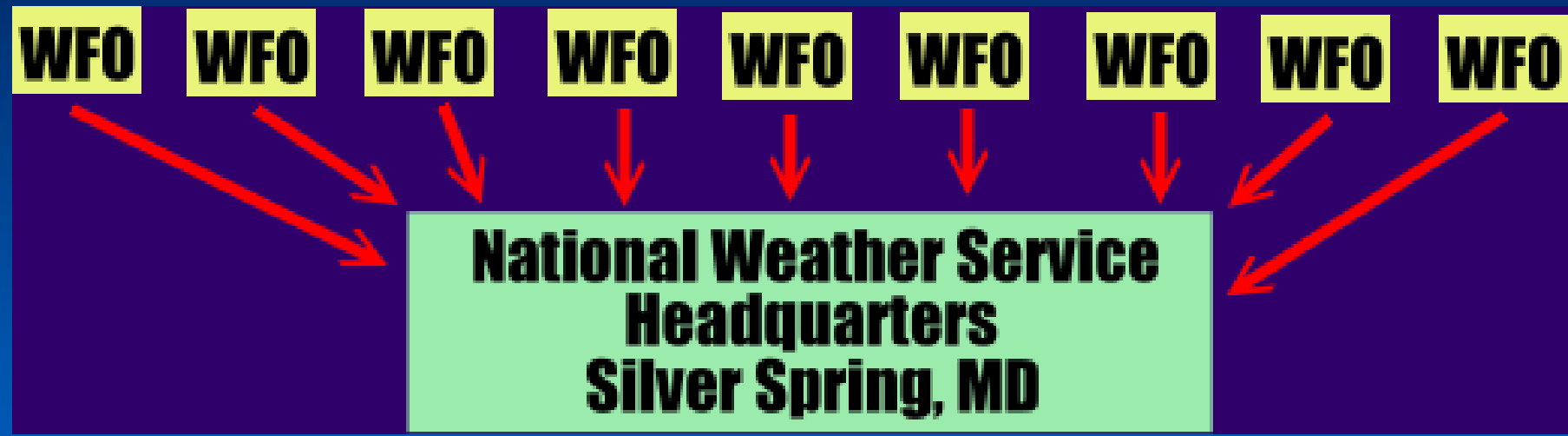
- Finite list of severe and unusual weather events
- The StormDat program has an extensive quality control check when events are saved
- The StormDat program also runs a database integrity check on startup
- Event tracking numbers are used so events may be amended and/or deleted from the database



NWS Warning Product Verification Methodology



Event Collection Process Overview





WARNING VERIFICATION

NATIONAL WEATHER SERVICE
VERIFICATION / STORM DATA
VERIFICATION - SEVERE WEATHER - STATS ON DEMAND

NATIONAL WEATHER SERVICE SEVERE WEATHER STATISTICS

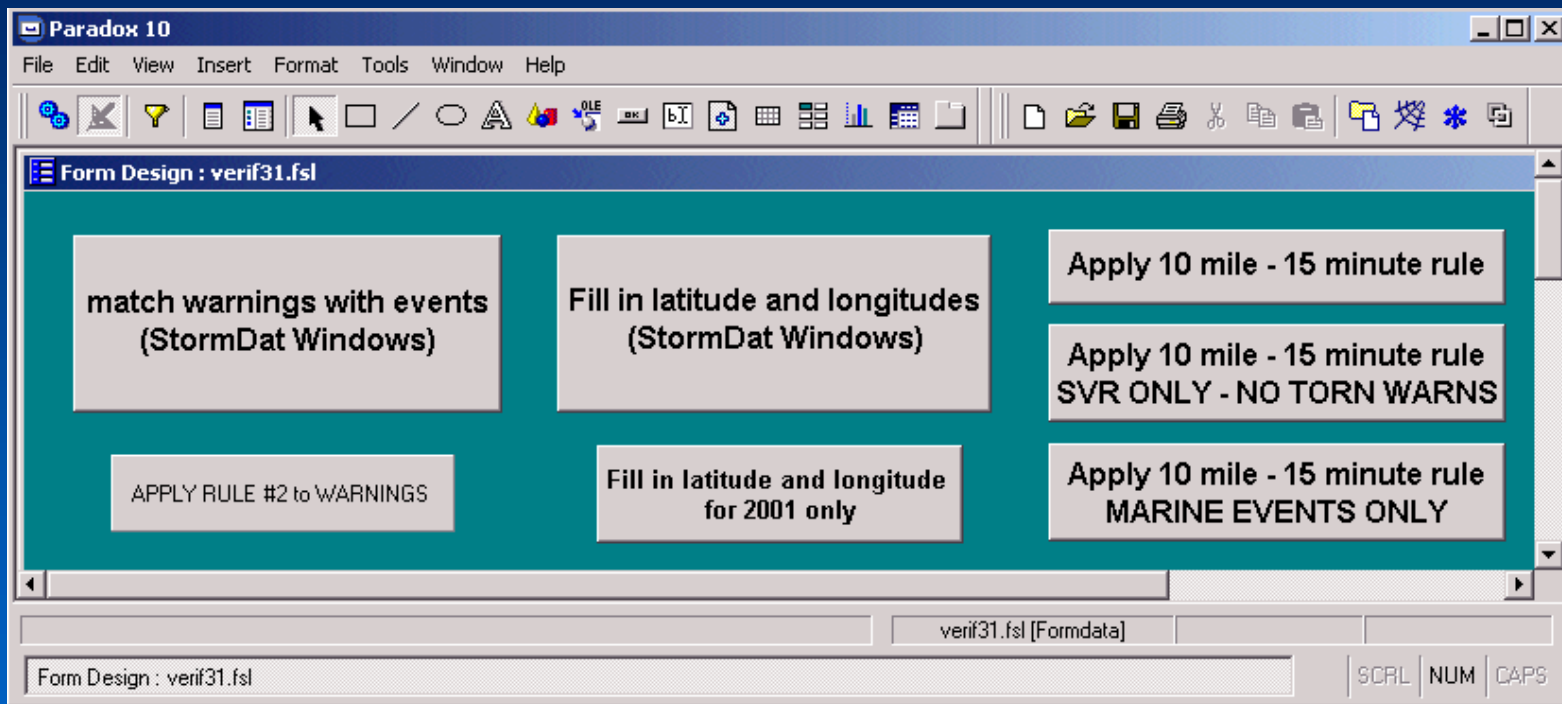
Period: 1/1/03 - 12/31/03

Summaries:

<u>TORNADO WARNINGS ONLY</u>		<u>TORNADO EVENTS ONLY</u>	
TORNADOS ONLY		TORNADOS ONLY	
Tornado warnings issued	: 4023	Tornado events	: 1531
Tornado warnings verified	: 1014	Tornado events warned	: 1212
Tornado warnings not verified	: 3009	Tornado events unwarned	: 319
False Alarm Rate (FAR)	: .748	Average leadtime	: 13.5
		Percent of events w/lead time > 0	: 71.7
		Probability of Detection (POD)	: .792
		Critical Success Index (CSI)	: .236



Warning Collection Process



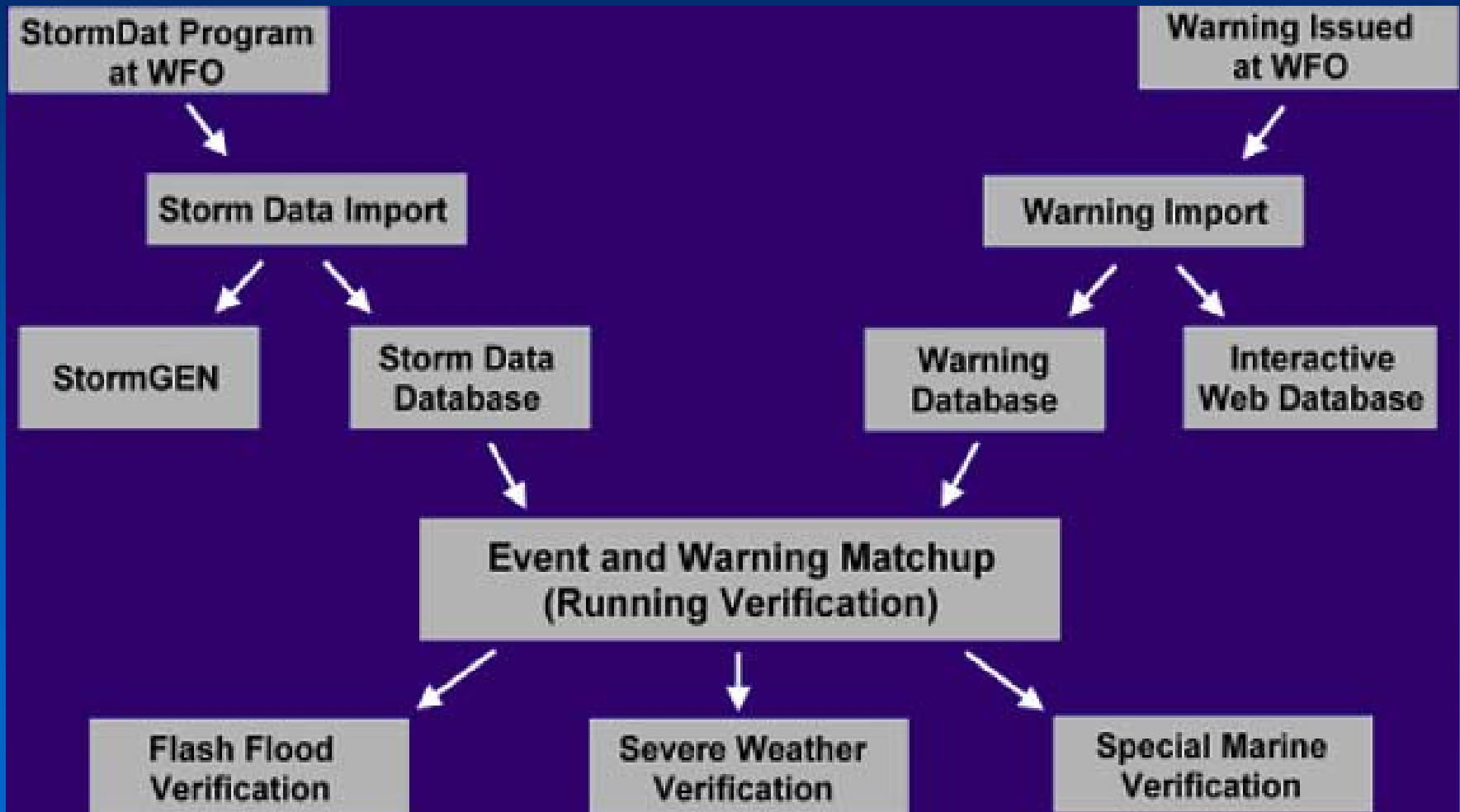
- Matching of events and warnings is done on the first business day of every month.
- The matching process takes approximately 5-7 hours



NWS Warning Product Verification Methodology



Verification Process



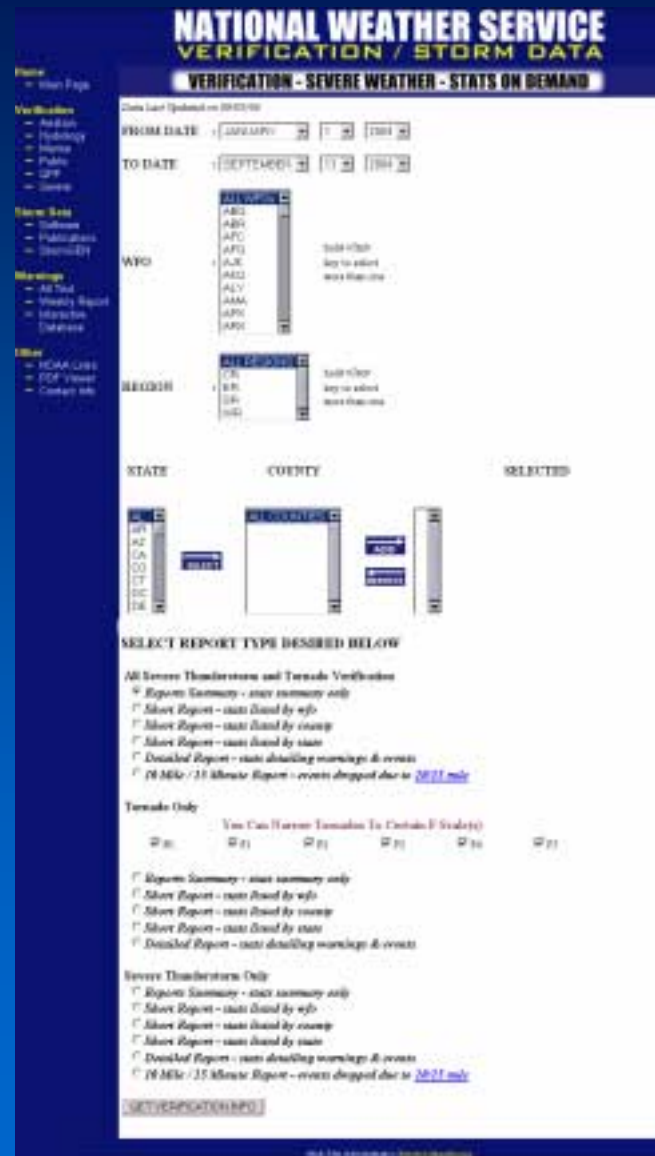


NWS Warning Product Verification Methodology



“Stats on Demand”

- Overview:
 - Web based program
 - Designed for customized verification requests on demand
- Data available:
 - TORNADO: 1986 – 2004
 - SEVERE TSTM: 1986 – 2004
 - FLASH FLOOD: 1986 – 2004
 - SPECIAL MARINE: 2001 – 2004
- Reports available:
 - Report Summary
 - Report by Forecast Office
 - Report by County/Zone
 - Detailed Report (broken out by every event and warning)





“Stats on Demand” Output Example

NATIONAL WEATHER SERVICE VERIFICATION / STORM DATA VERIFICATION - SEVERE WEATHER - STATS ON DEMAND

NATIONAL WEATHER SERVICE SEVERE WEATHER STATISTICS

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TORNADOS ONLY

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NWS Warning Product Verification Methodology



“Stats on Demand” Output Example

NATIONAL WEATHER SERVICE VERIFICATION / STORM DATA

VERIFICATION - SEVERE WEATHER - STATS ON DEMAND

NATIONAL WEATHER SERVICE SEVERE WEATHER STATISTICS

Period: 1/1/02 - 9/13/04

Counties: PRINCE GEORGE'S(MD) - MONTGOMERY(MD)

Severe Local Storms Verification Report for : **LWX - BALTIMORE/WASHINGTON, VA**

TORNADO WARNINGS ONLY

<u>YR</u>	<u>MTH</u>	<u>DAY</u>	<u>ISSUE TIME</u>	<u>EXPIRE TIME</u>	<u>COUNTY</u>	<u>STATE</u>	<u>TYPE BASIS</u>	<u>VERIFICATION</u>
2002	4	28	1702	1745	PRINCE GEORGE'S	MD	TORN-RAD	NOT VERIFIED
2002	5	13	1311	1345	MONTGOMERY	MD	TORN-PUB	NOT VERIFIED
2003	11	5	1421	1500	MONTGOMERY	MD	TORN-RAD	TORNADO
2004	5	25	1828	1930	PRINCE GEORGE'S	MD	TORN-RAD	NOT VERIFIED

TORNADO EVENTS ONLY

<u>YR</u>	<u>MTH</u>	<u>DAY</u>	<u>TIME</u>	<u>COUNTY</u>	<u>STATE</u>	<u>EVENT</u>	<u>WARN TIME</u>	<u>WARN TYPE</u>	<u>LEADTIME</u>
2003	11	5	1408	MONTGOMERY	MD	TORNADO		NOT VERIFIED	0
2003	11	5	1410	MONTGOMERY	MD	TORNADO	1421	TORN-RAD	0



NWS Warning Product Verification Methodology



Future of Warning Verification

A movement is being made within the NWS to stop issuing warnings on a county by county basis, but to move towards a “polygon warning area”.

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WGUS53 KLOT 280740
FFWLOT
ILCO01-063-093-197-201045-

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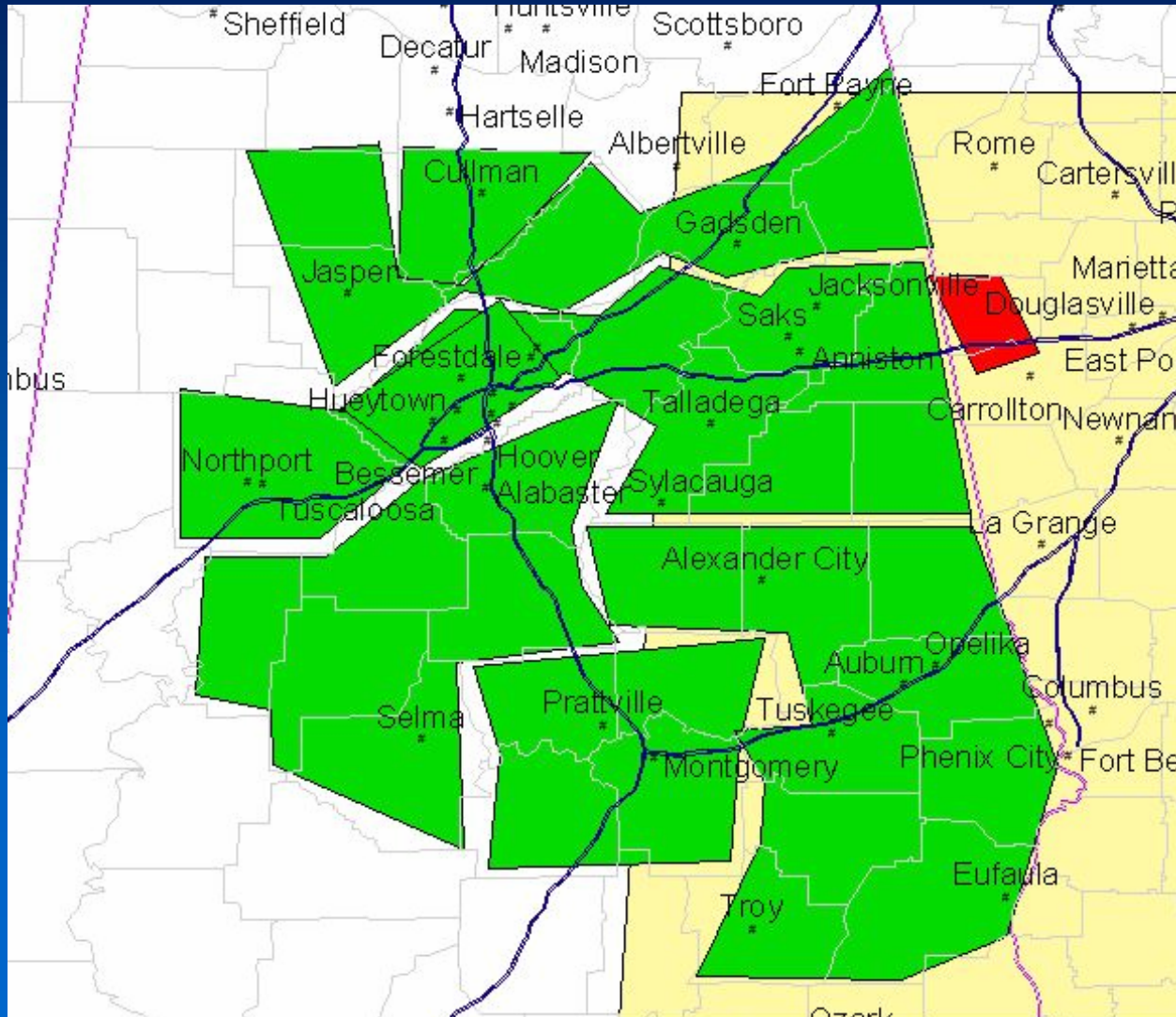
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NWS Warning Product Verification Methodology



Graphical Example of Polygon Warnings





Future of Warning Verification

- A “polygon warning verification” team has been created
 - The team will look into issues dealing with creating verification scores to assess performance
 - Early signs point to the fact that we can not score polygon warnings the same as county warnings
- Also we have plans of verifying these other warning products:
 - Winter Storm Warning
 - High Wind Warning
 - Coastal Flood Warning
 - Areal Flood Warnings



NWS Warning Product Verification Methodology



Contact Information

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Please feel free to grab a business card from me if you would like more information on the National Weather Service Verification Program.