



Summer Weather Dangers

Hurricane Katrina

Water Vapor Image

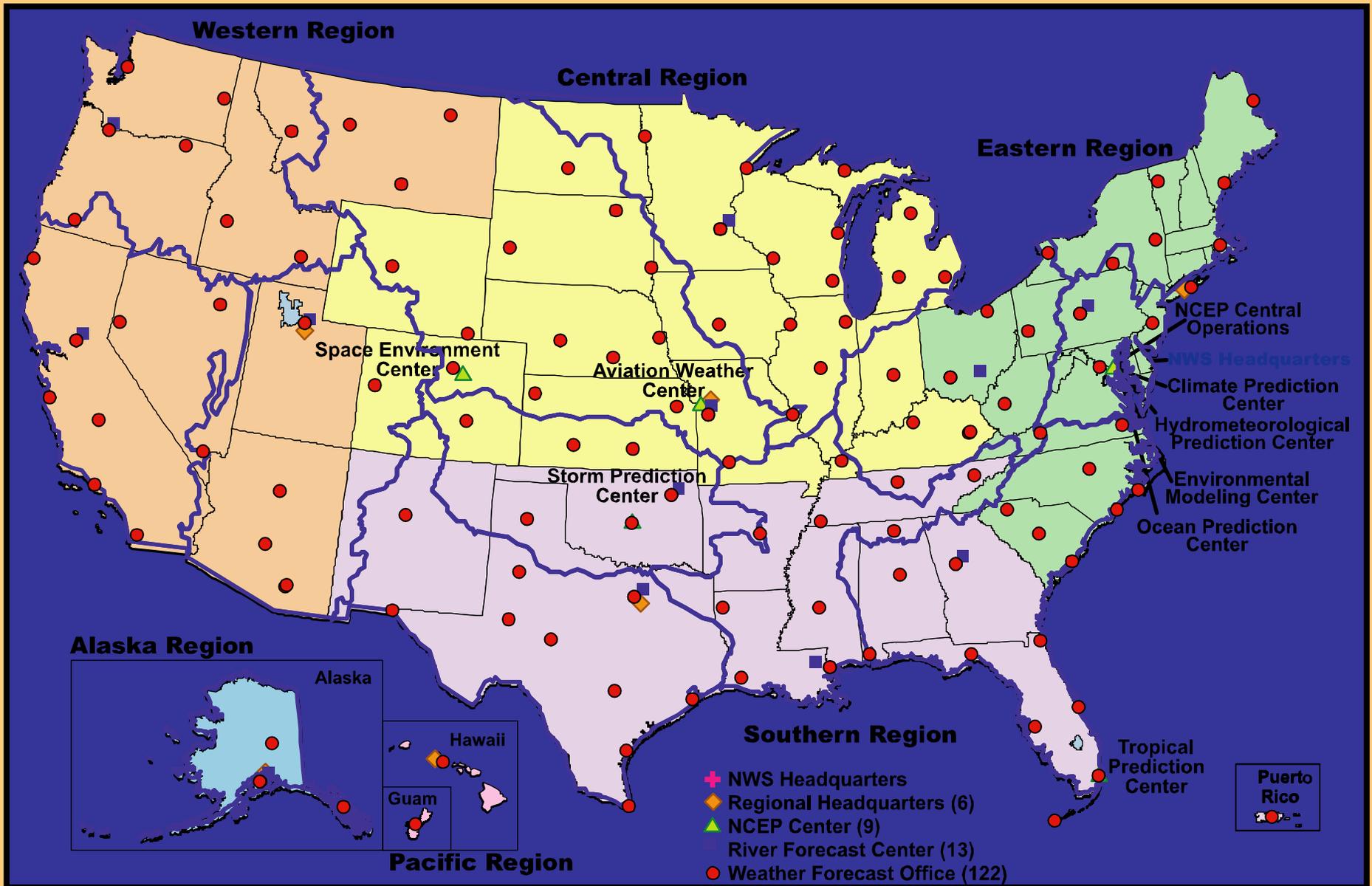
28 August 2005 1815z

90W

National Weather Service
Baltimore-Washington Forecast Office



NWS Service Delivery *Facilities*





Tropical Cyclone Development

Ingredients needed:

- Water Temperature 80+ °F
- Light Winds through all levels of the Troposphere – Little shear
- A Disturbance that initiates the thunderstorm activity



Tropical Cyclone Development

Stages	Sustained Winds
Tropical Wave	No organized winds
Tropical Depression	20 to 38 mph
Tropical Storm	39 to 73 mph
Hurricane/Typhoon	74 mph or higher



Saffir Simpson Scale

Cat	Winds (mph)	Pressure	Damage
1	74 to 95	28.94	Minimal
2	96 to 110	28.50 - 28.91	Moderate
3	111 to 130	27.91 - 28.47	Extensive
4	131 to 155	27.17 - 27.88	Extreme
5	156 +	27.16 or less	Catastrophic

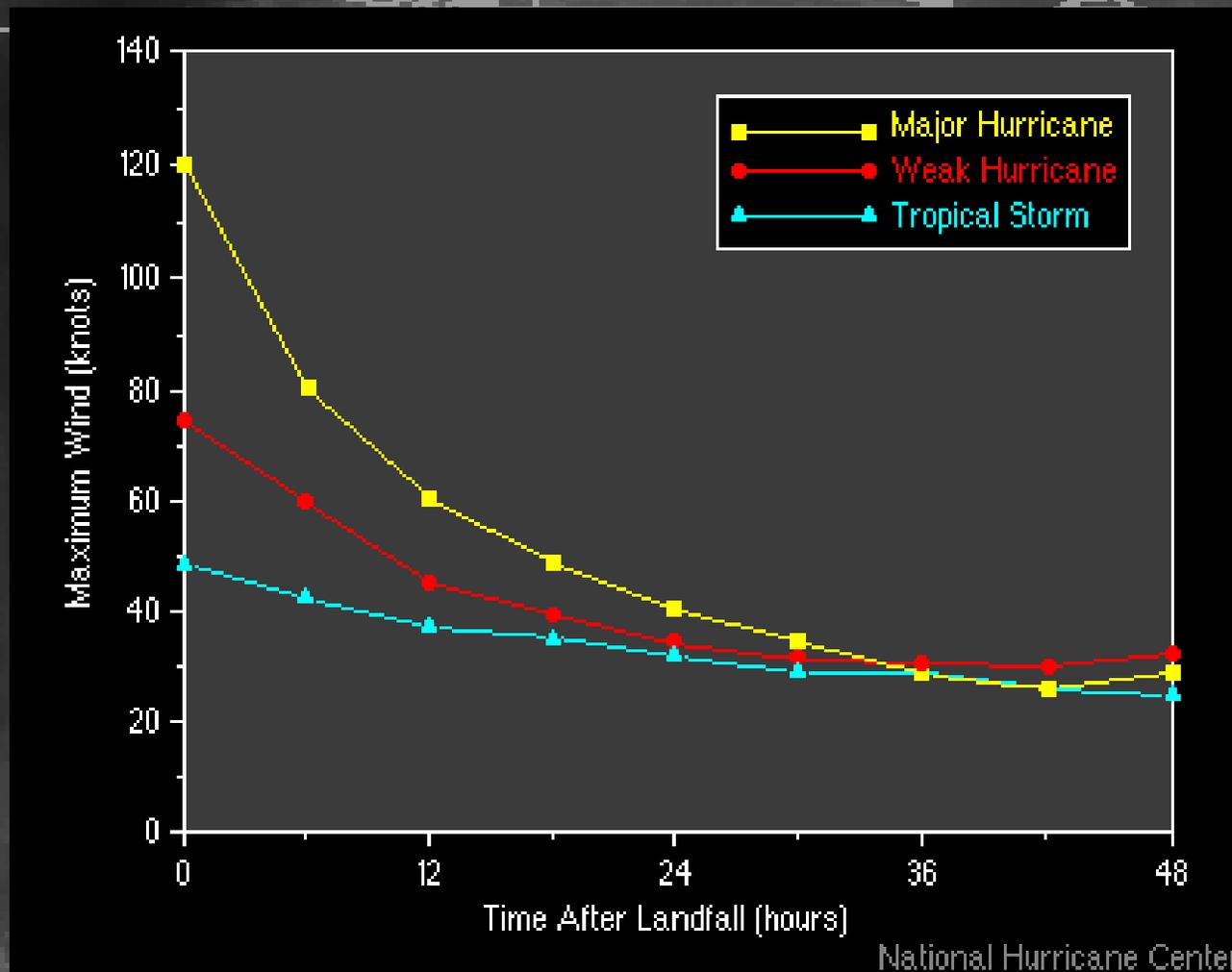


What Kills a Hurricane?

- **Water temperatures below 80°F**
- **Strong winds aloft**
 - Jet stream
 - Wind shear
- **Interaction with Land**



Weakening Upon Landfall



2008 Hurricane Names

Arthur

Bertha

Cristobal

Dolly

Edouard

Fay

Gustav

Hanna

Ike

Josephine

Kyle

Laura

Marco

Nana

Omar

Paloma

Rene

Sally

Teddy

Vicky

Wilfred

Hurricane Hazards

- **Coastal Storm Surge**
- **Inland Flooding**
- **High Winds**
- **Tornadoes**



Storm Surge



DEFINITION - The ABNORMAL rise in water level caused by wind and pressure forces in a hurricane.

Storm surge is the greatest threat to life and property along the coast.



Storm Surge

A hurricane over the open sea



As hurricane nears land





Power of the Storm Surge

**Katrina
2005**

September 1998



August 31, 2005





More Representative for the Bay and Potomac



Annapolis

Baltimore





Inland Flooding

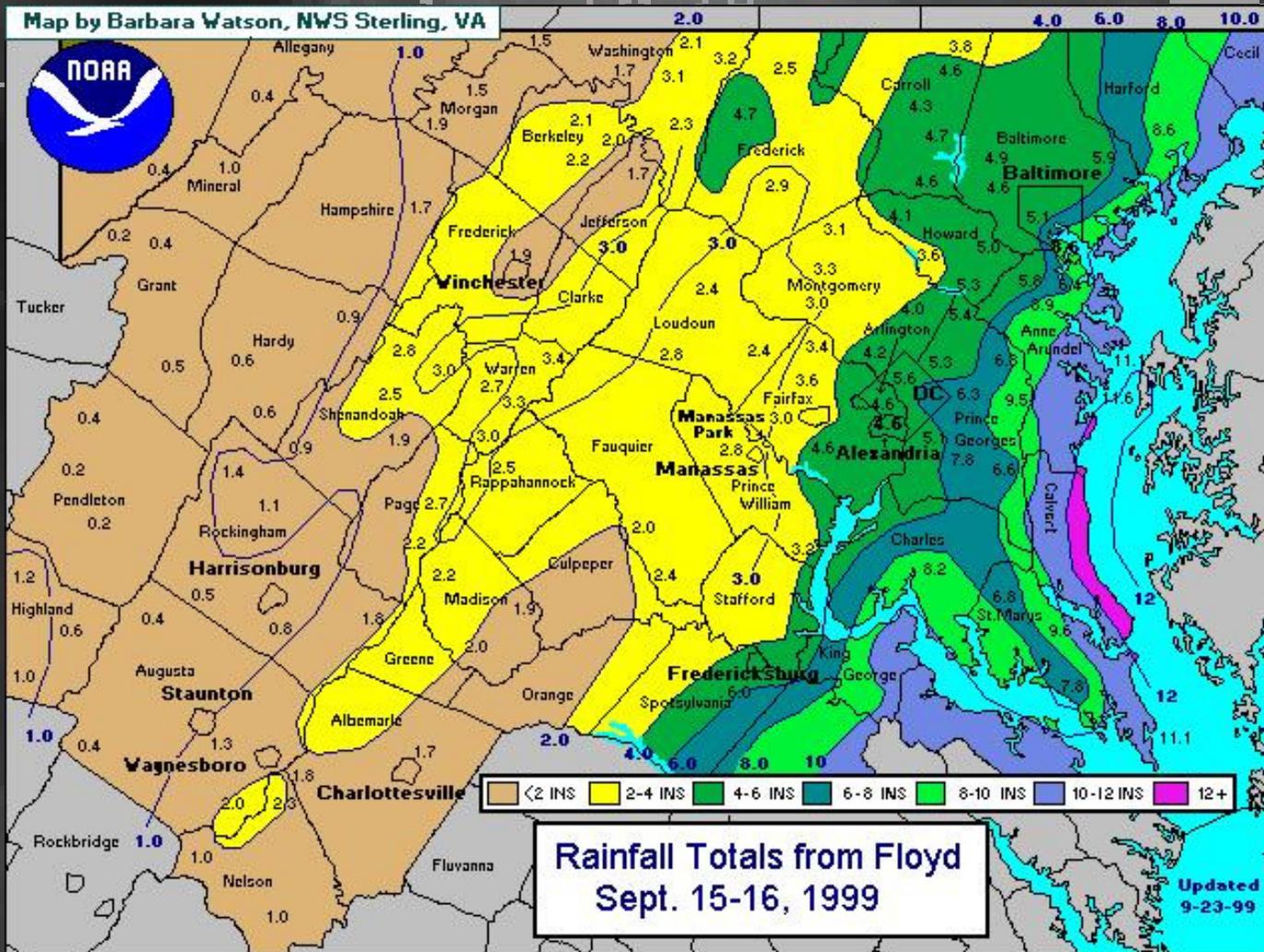
Widespread torrential rains, often in excess of a foot, can produce deadly and destructive flooding that lasts well after the hurricane winds have diminished.

Flooding is the greatest threat to life and property over inland areas.

Hurricane Agnes, only a category one storm, produced record rainfall over the NE U.S. killing 122 people and causing 6.4 billion dollars in damage.



Tropical Storm Floyd





Flash Flooding

- 5 inches of rain can fall in one hour
- Small streams and street-side drains are quickly overwhelmed
- **50% of Flash Flood deaths are people who attempt to drive through water flowing across a road**



Rockville 1975



Photos by Steve Eisen



High Winds

Hurricane force winds, 74 mph or higher can destroy poorly constructed buildings and mobile homes. Debris such as signs, roofing material, siding and small items left outside, become flying missiles in hurricanes.

Fast moving hurricanes maintain strength farther inland. In 1989, Hurricane Hugo battered Charlotte, NC with gusts to 100 mph causing massive damage.



High Winds

- **Hurricane Floyd 1999**

- Thousands of trees fell in Western Shore Counties
- Caused widespread power outages, blocked roads, and damaged buildings
- Overturned tractor-trailer on Chesapeake Bay Bridge early in storm's intensification stopping traffic on the bridge during peak wind gusts (70 to 80 mph)



Tornadoes

As a tropical cyclone makes landfall and begins to decay, the winds at the surface die off quicker than the winds just above the surface. This produces vertical wind shear, especially on the tropical cyclone's right side (left side in the southern hemisphere). This vertical wind shear can result in tornadoes.

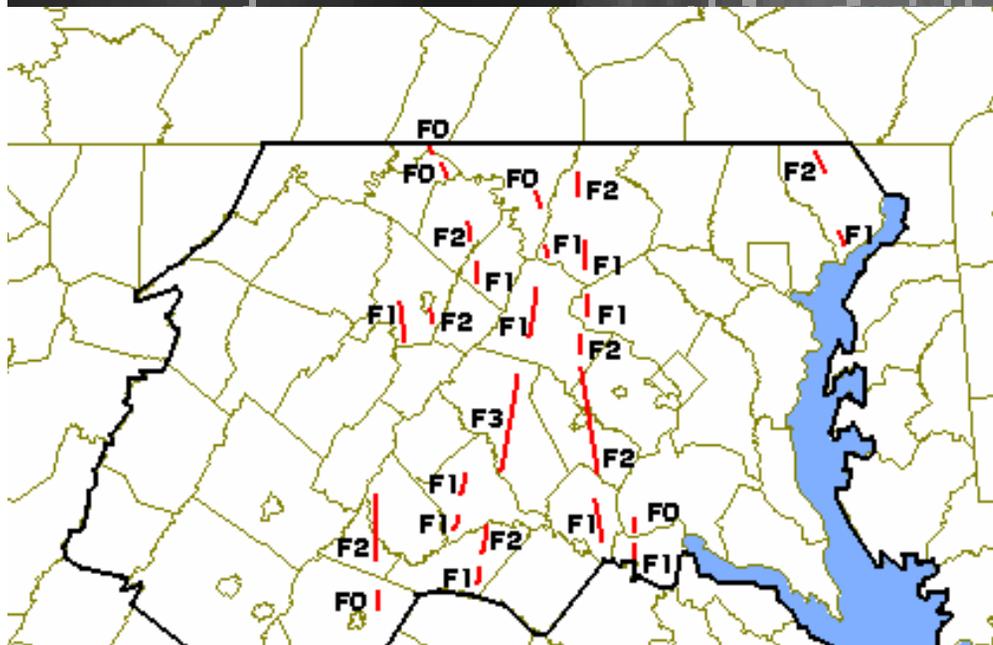


The Virginia/Maryland region is more prone to tornadoes spawned from hurricanes and their remnants than anywhere else in the country.



Tornadoes from Ivan 2004

Worst local tornado outbreak in recent history

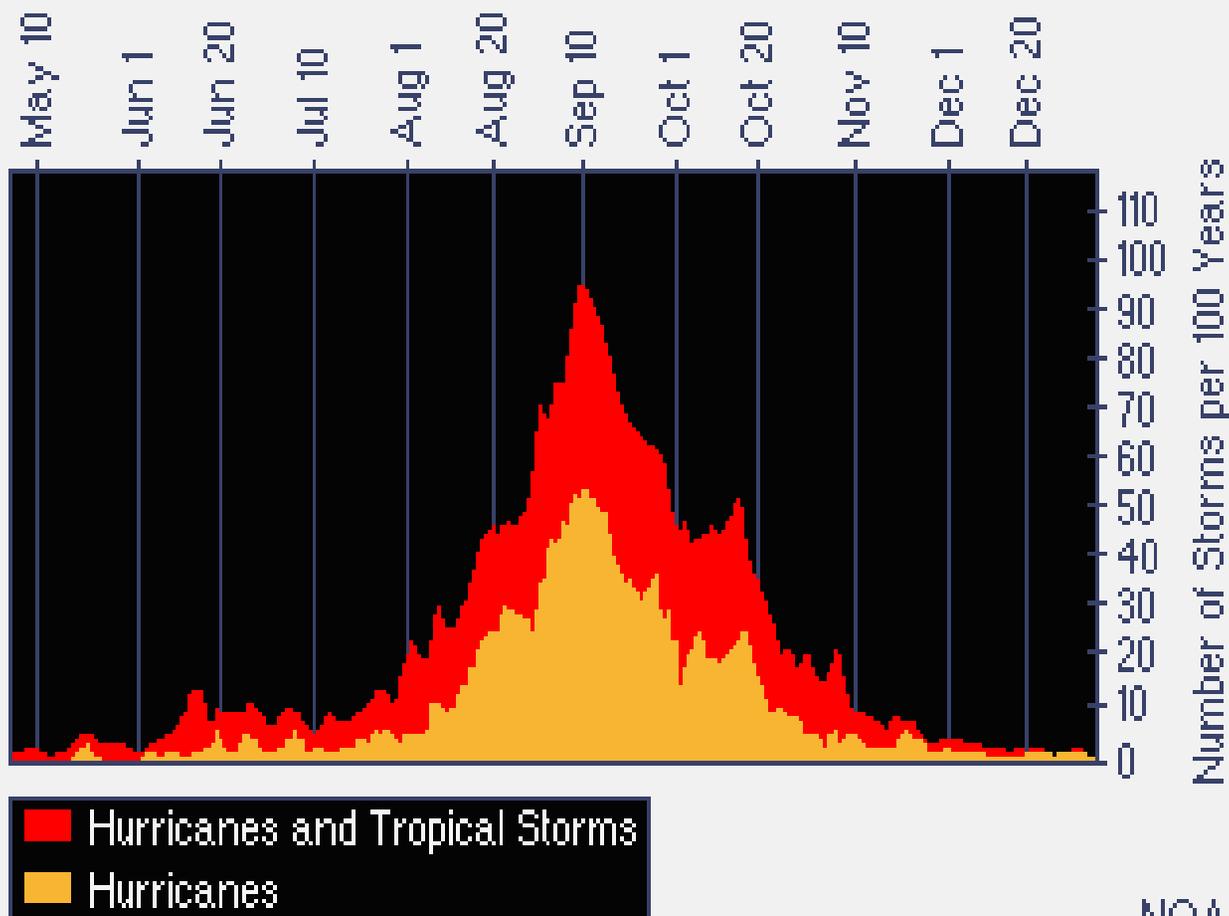


Peak intensity of each tornado is intermittent damage. Paths are su





Peak Season = Aug – Oct.



NOAA



Maryland Tropical Cyclones

- **Remnant of a weakened Tropical System 1 to 2 on average per year**
- **Tropical Storm passing near Baltimore every 5 years**
- **Hurricane passing near Baltimore every 50 years**



Time of Year Storm

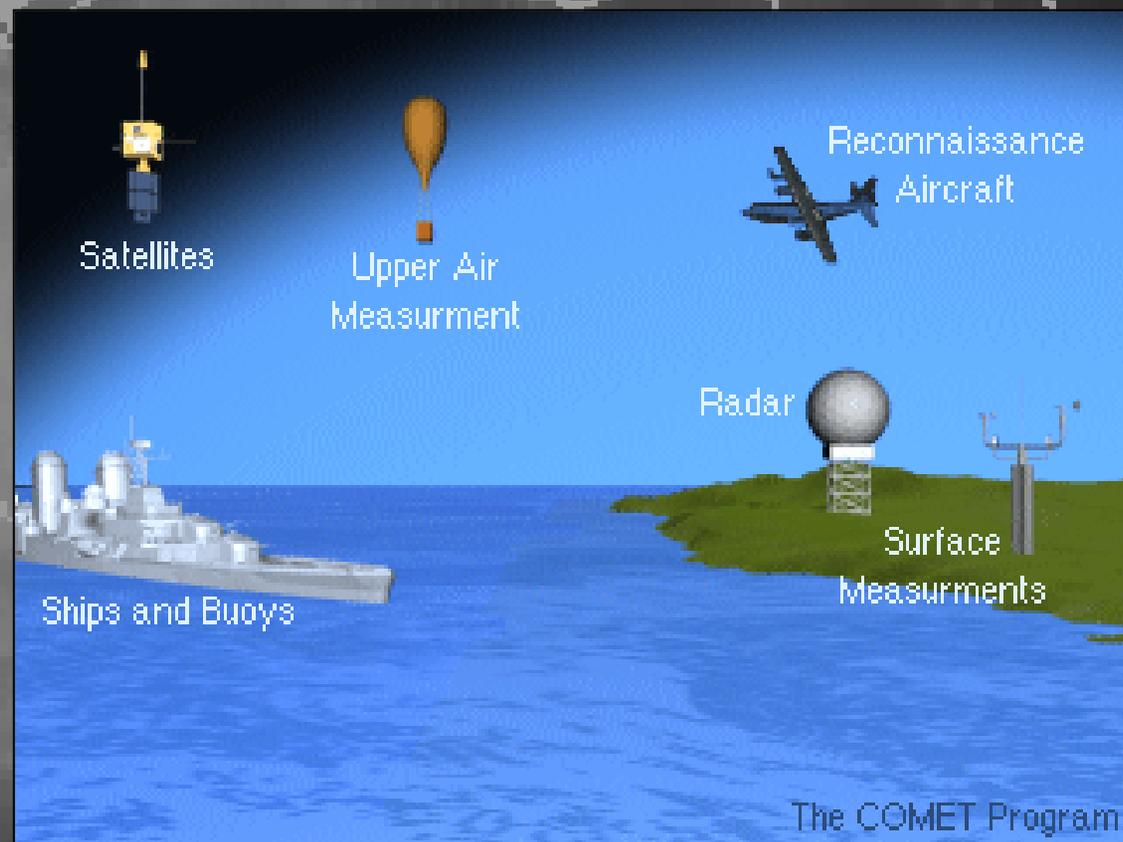
For storm affecting the Maryland/Virginia Area

Month	Occurrence	Month	Occurrence
May	1.6 %	September	33.9 %
June	10.6 %	October	19.5 %
July	9.8 %	November	0.8 %
August	23.0 %	December	0.8 %



Methods of Detection

- Satellite
- Surface Observations
- Aircraft Reconnaissance
- Radar



NWS Terminology



Watch versus Warning

- **WARNING** means that the threat is imminent or occurring in the warning area. Action needed!
- **WATCH** means KEEP A WATCH OUT. Conditions are favorable for the potential hazard to occur. Stay tuned for updates. Action may be needed soon.
- **OUTLOOK** possible concerns in the next several days.



Advisories are low-end WARNINGS
Winter Wx Adv, Coastal Flood Adv, etc.

NWS Terminology



Watch versus Warning

- **WARNING** means that the Hurricane or Tropical Storm threat is less than 24 hours away and is likely to hit your area. Action needed!
- **WATCH** means KEEP A WATCH OUT. The Hurricane or Tropical Storm threat is 1 to 2 days away. It may hit your area. Stay tuned for updates. Action may be needed soon.





Quickly on heat...

In potential high heat/humidity situations, the goal of NWS Sterling is to give emergency officials and the public as much as lead time as possible to prepare and prevent heat injuries and fatalities. Our products/criteria are:

<u>HEAT</u> <u>Criteria</u>	
Heat Outlook	If there is a 30% chance or greater of exceeding criteria the next 48 hours to 7 days
Excessive Heat Watch	Watch - 50% or greater chance of indices exceeding Heat Warning criteria in next 12-48 hours
Excessive Heat Warning	Warning > 110 degrees F for two hours or greater
Heat Advisory	105-109°F

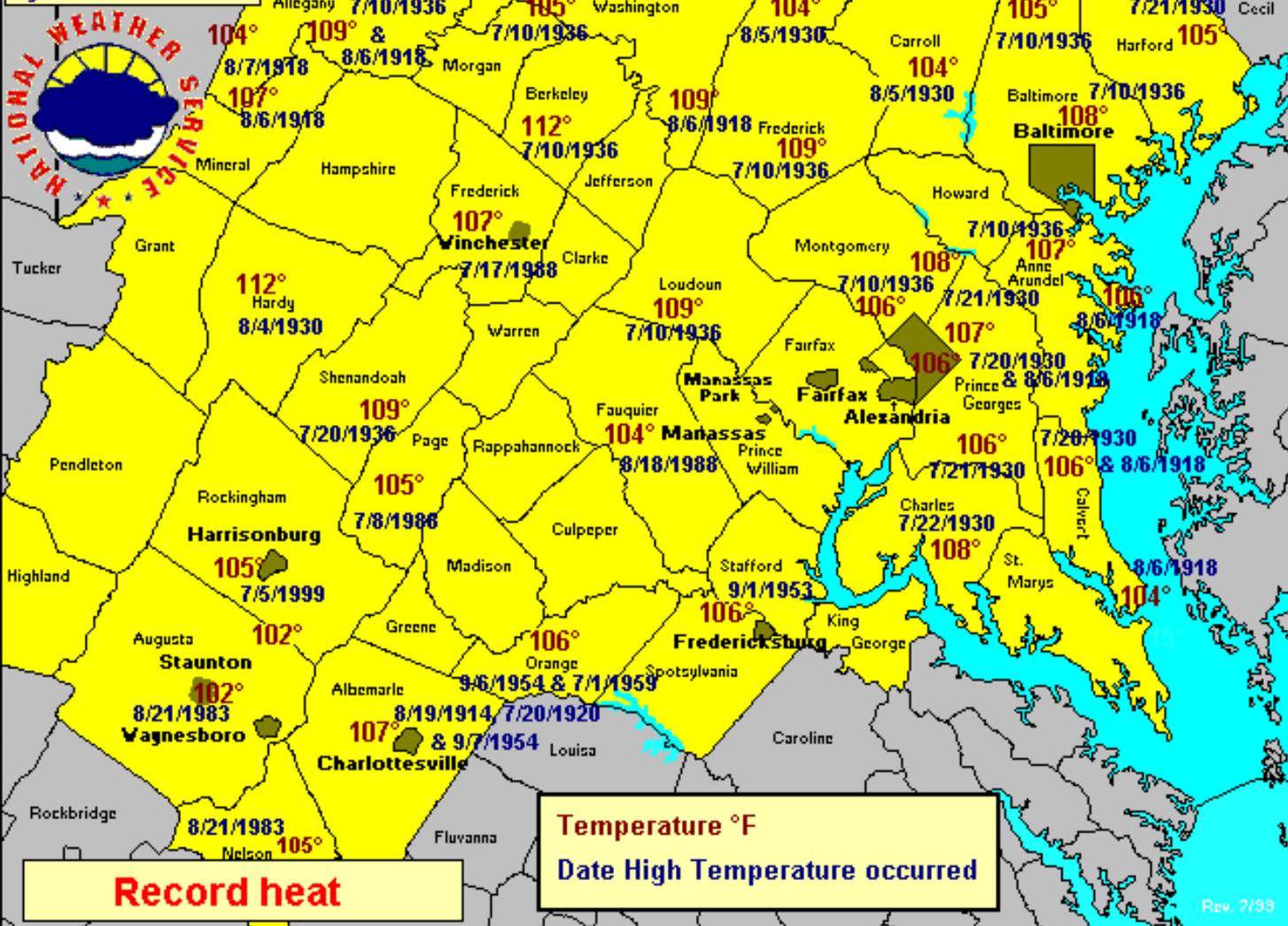




Hottest ever

(straight temperature – no HI)

By Barbara Watson



NWS Data Used:
Length of Record

- Tye River - 1948
- Staunton - 1948
- Charlottesville - 1948
- Dale Enterprise - 1948
- Orange - 1948
- Fredericksburg - 1930
- Luray - 1948
- Warrenton - 1951
- Woodstock - 1930
- Winchester - 1948
- Lincoln - 1930
- Moorefield - 1930
- Martinsburg - 1930
- Washington, DC - 1870
- Baltimore - 1870

Maryland data -
Cooperative sites
Checked known
heat waves back to
1918.

Record heat

Temperature °F
Date High Temperature occurred

NWS Terminology



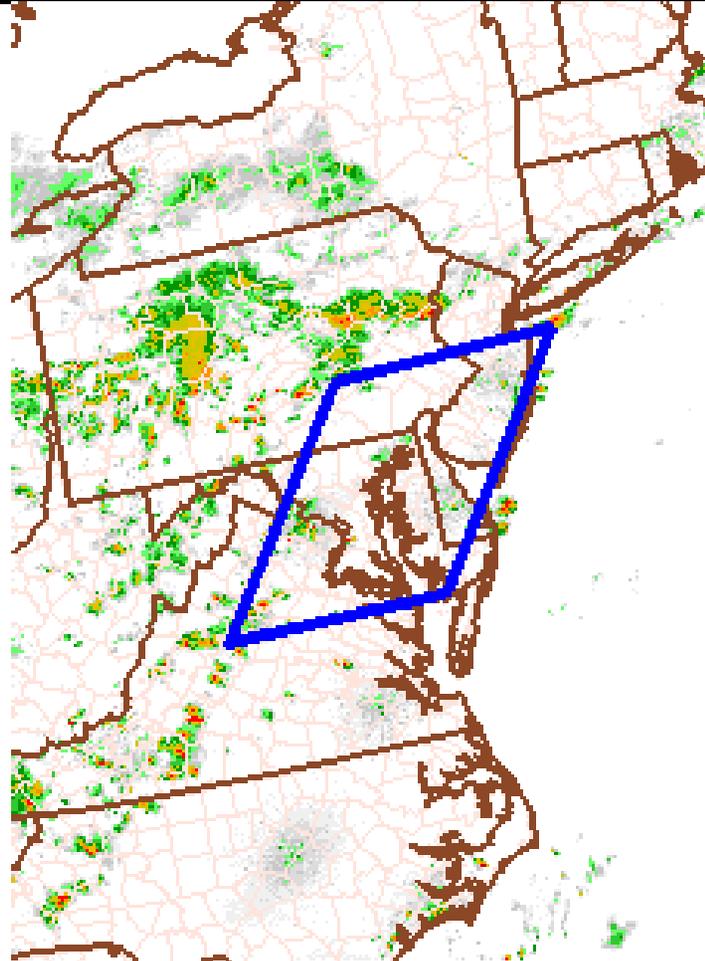
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Advisories are low-end WARNINGS
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Severe Thunderstorm Watch



20040618/1854

SEVERE THUNDERSTORM WATCH # 424
VALID FROM 255 PM UNTIL 800 PM EDT

WUUS51 KLWX 110050
SVRLWX
MDC003-005-027-510-110130-
/O.NEW.KLWX.SV.W.0149.080611T0050Z-080611T0130Z/

BULLETIN - EAS ACTIVATION REQUESTED
SEVERE THUNDERSTORM WARNING
NATIONAL WEATHER SERVICE BALTIMORE MD/WASHINGTON DC
850 PM EDT TUE JUN 10 2008

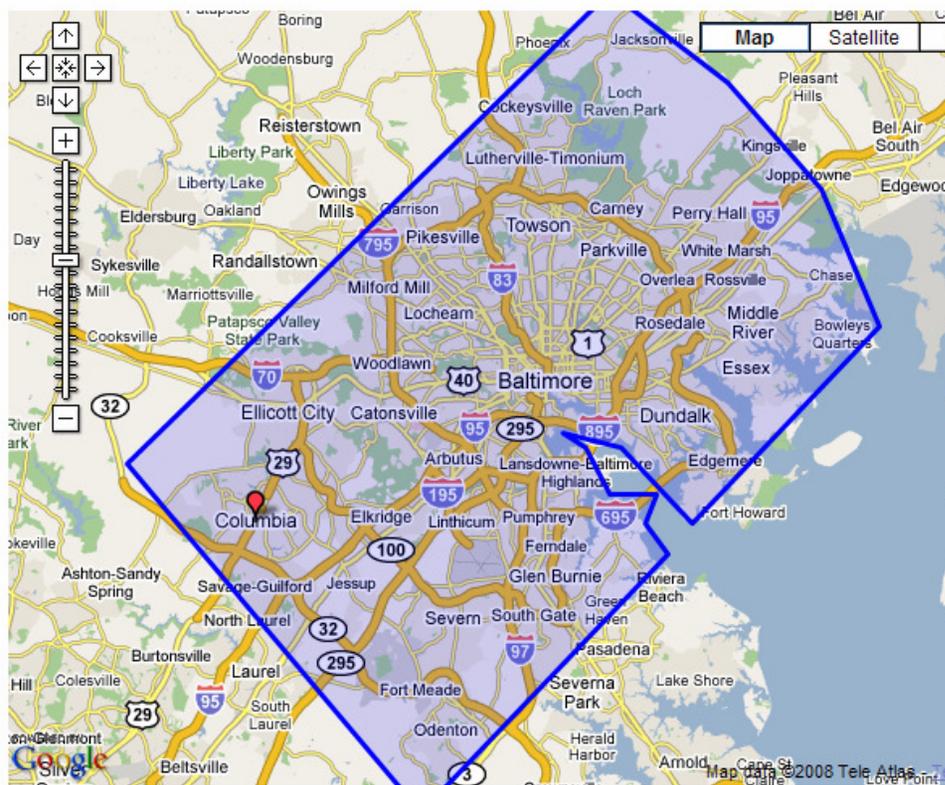
THE NATIONAL WEATHER SERVICE IN STERLING VIRGINIA HAS ISSUED A

- * SEVERE THUNDERSTORM WARNING FOR...
NORTHWESTERN ANNE ARUNDEL COUNTY IN CENTRAL MARYLAND...
EASTERN HOWARD COUNTY IN CENTRAL MARYLAND...
SOUTHERN BALTIMORE COUNTY IN NORTHERN MARYLAND...
BALTIMORE CITY IN NORTHERN MARYLAND...
- * UNTIL 930 PM EDT
- * AT 845 PM EDT...NATIONAL WEATHER SERVICE DOPPLER RADAR INDICATED A SEVERE THUNDERSTORM. THIS STORM WAS LOCATED NEAR COLUMBIA...AND MOVING NORTHEAST AT 38 MPH.
- * LOCATIONS IMPACTED INCLUDE...
CATONSVILLE...
ELKRIDGE...
ARBUTUS...
WOODLAWN...
PUMPHREY...
BROOKLYN PARK...
BALTIMORE...
ROSEDALE...
PARKVILLE...
BWI AIRPORT...
DUNDALK...

HAIL TO THE SIZE OF PENNIES AND WIND GUSTS TO 60 MPH CAN BE EXPECTED IN THE WARNED AREA. STAY INDOORS AND AWAY FROM WINDOWS UNTIL THE STORM HAS PASSED.

LAT...LON 3949 7646 3942 7638 3933 7633 3920 7649
3925 7655 3926 7660 3925 7658 3922 7656
3922 7652 3920 7653 3918 7651 3901 7672
3924 7697 3955 7656
TIME...MOT...LOC 0050Z 239DEG 33KT 3922 7680

\$\$
LISTEMAA/STRONG



Key:
TOR SVR FFW FLW SMW

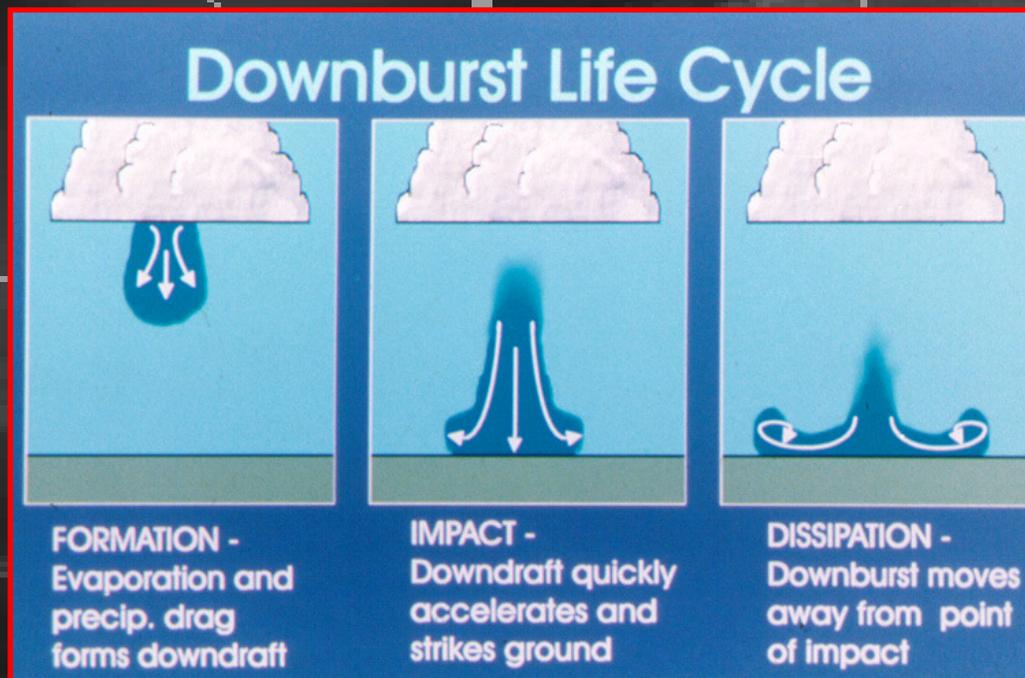


Downbursts





Downburst Characteristics



- Sudden downward rush of air from a thunderstorm
- Wind gusts can reach 150 MPH
- Sometimes referred to as a microburst
- Downburst damage can easily be mistaken for that of a tornado

Downburst damage in Anne Arundel County in August 1999.





Downburst Descending from Storm

1



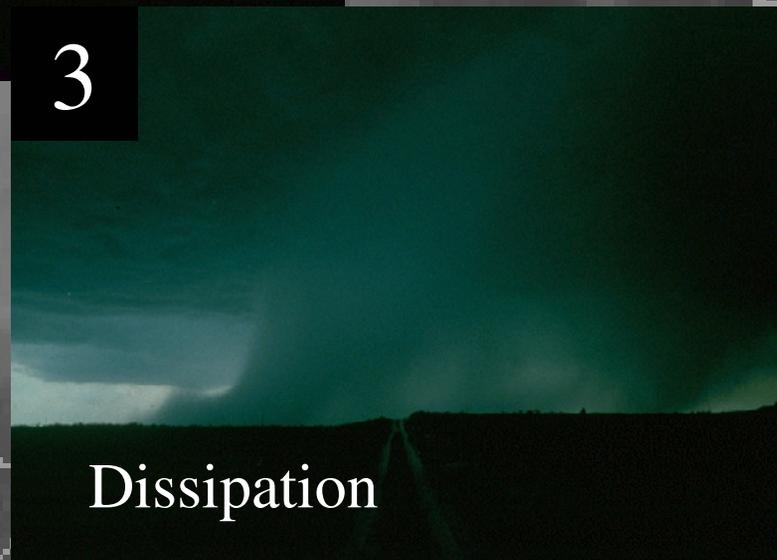
Formation

2



Impact

3



Dissipation



Thank You!

www.weather.gov/baltimore

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National Weather Service
Baltimore-Washington Forecast Office
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